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NO. 426 ALBANY, N. Y. JULY 1, 1908

New York State Museum

JOHN M. CLARKE, Director

Museum bulletin 120

THE MINING AND QUARRY INDUSTRY OF NEW YORK STATE

REPORT OF OPERATIONS AND PRODUCTION DURING 1907

BY

D. H. NEWLAND

ALBANY

UNIVERSITY OF THE STATE OF NEW YORK

1908

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STATE OF NEW YORK

EDUCATION DEPARTMENT

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JOHN M. CLARKE

Director, Science Division

STATE HALL, ALBANY, N. Y.

New York State Education Department
Science Division, April 16, 1908

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

My dear sir: I have the honor to submit herewith, for publication as a bulletin of the State Museum, the annual report on *The Mining and Quarry Industry of New York State,* prepared by David H. Newland, Assistant State Geologist.

Very respectfully
John M. Clarke
Director

State of New York
Education Department
COMMISSIONER'S ROOM

Approved for publication this 17th day of April 1908

A. S. Draper

Commissioner of Education.

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REPORT OF OPERATIONS AND PRODUCTION DURING 1907

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PREFACE

With the present issue the annual reviews of the mining and quarry industries of the State encompass a period of four years, the first having been published in 1905. The incentive for their continuance is found in the general interest which attaches to this branch of industrial activity, as illustrated by the number of requests received for information relating to all phases of the subject as well as by the rapid progress that is being made in the industries themselves.

The publication of the reports is rendered possible only through the cooperation of the many enterprises engaged in exploitation of the local resources; it is a pleasure to acknowledge the cordial manner with which their assistance has been given.

INTRODUCTION

Substantial progress was made during the past year in many departments of the mineral industry, and though conditions in some lines were not so prosperous as they had been in previous years, the general record may be regarded with satisfaction. The census of production that has been conducted for the present and preceding issues of this report covers over 30 different materials mined or quarried in the State; the total value of the output returned for 1907 amounted to $37,427,405, showing a small advance over the corresponding total for 1906 which was $37,132,832, the largest recorded up to that time. When compared with other years the status of the industry in 1907 appears in even more favorable light, as the value of the production in 1905 was $35,470,987 and in 1904 only $28,812,595. Within the four years for which returns have been collected, there has thus been a gain of 30 per cent in the mineral production of the State.

These valuations, it may be noted, are based on materials in elementary or first marketable form, so that they actually represent only a small part of the aggregates contributed each year by the mineral industry in general. The metallurgical and chemical products classed as mineral are among the largest items of local manufactures.

By comparison of the tables of production included herewith, it will be observed that iron mining has undergone uninterrupted expansion during the past few years. The output for 1907 amounted to 1,018,013 long tons and exceeded that of any previous year since 1890. There were 13 mines under exploitation, or two more than in 1906 when the production was 905,367 tons. Several additional mines have been under development preliminary to active work. The Clinton ore belt has been the center of special interest, and large tracts of land in Wayne and Cayuga counties have been taken over by companies with a view to mining operations. The Fair Haven Iron Co. began shipments from this region for the first time last year. The Adirondack region also has shared in the activity. The Benson mines in St Lawrence county and the Cheever mine near Port Henry have been reopened, while the deposits of titaniferous ores at Lake Sanford received attention and their operation is postponed only for the want of railroad facilities which are planned for the near future. With a return of the iron market to normal conditions, it may be expected that the iron ore production of New York will soon develop beyond all proportions of the past.

The clay materials reported in 1907 represented an aggregate value of $12,688,868. There was a decrease of $1,266,432 from the amount returned for the preceding year, due to the smaller output and market values of the building materials. The combined output of brick, tile, fireproofing and terra cotta used for building purposes was valued at $8,909,392 as compared with $11,063,433 in 1906. The number of bricks made was 1,366,842,000, of which 1,051,907,000 came from the Hudson river region. The decline in the output of building materials was counterbalanced to some degree by the gain in pottery manufactures which were valued at $2,240,895, against a value of $1,795,008 for the preceding year. Of the 61 counties of the State 43 were represented among the reports received last year from the manufacturers of clay products.

The quarries of New York contributed a value of $7,890,327, against $6,504,165 in 1906, showing an increase of about 20 per cent and establishing a new record for these industries. The total was divided according to the various uses into: building stone $2,208,545; monumental stone $162,359; curb and flagstone $1,064,193; crushed stone $2,812,998; other uses $1,642,232. The output of slate, millstones and of limestone used in making hydraulic cement is not included in the totals. The marble industry was specially active last year and the production valued at $1,571,936 has probably never been exceeded in the State. The stone quarries are distributed among all the counties practically, while they yield nearly every kind of material for building, construction or ornamental purposes.

The companies manufacturing hydraulic cement reported an output of 3,245,729 barrels, with a value of $2,971,820. The totals consisted of 2,108,450 barrels of Portland cement valued at $2,214,090 and 1,137,279 barrels of natural rock cement valued at $757,730. In the preceding year there were 4,114,939 barrels produced valued at $3,950,699, so that there was a loss for the year of 869,210 barrels in quantity and $978,879 in value. The poor showing has been due largely to the unfavorable conditions that obtained in the natural cement trade which has shown a steady decline for several years past.

The salt production of the State amounted to 9,657,543 barrels, as compared with 9,013,993 barrels in 1906, thus continuing the progress that has for some time been a feature of the industry. The value of the output was $2,449,178, exceeding that of the previous year by $317,528. There were six counties represented in the returns, with Onondaga county in the lead, though its output consisted mostly of salt used for soda manufacture. Livingston county made the largest quantity of marketable grade, chiefly rock salt.

An aggregate of 323,323 short tons of gypsum was taken from the mines and quarries of the State last year, as compared with 262,486 short tons in 1906. The output has increased by over 100 per cent within the last three years, due to the rapid development of the trade in wall plasters, stucco, etc., and to the use of gypsum in Portland cement manufacture. The value of the different materials was $1,038,355, as compared with $699,-455 in 1906.

The combined value of the petroleum and natural gas produced in the State was $2,536,349, a small increase over the value reported for 1906 which was $2,487,674. The quantity of petroleum taken from the wells, estimated from the receipts of pipe line companies, was 1,052,324 barrels, valued at $1,736,335, or nearly the same as in the preceding year. The natural gas production was valued at $800,014, as compared with $766,579 in 1906; the volume amounting to 3,052,145,000 cubic feet against 3,007,086,000 cubic feet in the preceding year. New discoveries of gas continue to be reported and the additional supplies thus made available have more than sufficed to maintain the rate of production.

The mining of pyrite showed a notable advance during the past year, the output amounting to 49,978 long tons, which compares with 11,798 tons for 1906. The mineral is obtained in St Lawrence county. A large amount of exploratory and development work has been done recently, with results that may lead to a further expansion of the industry. The product finds a ready sale for making sulfurous and sulfuric acids.

The talc mines near Gouverneur contributed a production of 59,000 short tons, or a little less than in 1906. The value of the output was $501,500. The production is governed chiefly by the requirements of the paper trade and shows little tendency to fluctuate from year to year.

Garnet for abrasive uses is obtained from the eastern Adirondacks. An output of 5709 short tons valued at $174,800 was reported in 1907. The returns for the preceding year showed an output of 4729 short tons with a value of $159,298.

The crystalline graphite mined in the Adirondacks amounted to 2,950,000 pounds, against 2,811,582 pounds in 1906. The value of the product was $106,951 as compared with $96,084. Almost the whole quantity was taken from the mine at Graphite, Warren co., though many other enterprises have been inaugurated during the few years.

A somewhat unusual industry not elsewhere represented in this country is that connected with the production of natural carbon dioxid, or carbonic acid gas, as it is generally known. The gas occurs in association with the mineral waters of Saratoga Springs and its collection and storage for use form an interesting, as well as important, industrial development. About 5,000,000 pounds of the gas are sold each year, chiefly to manufacturers of carbonated waters.

Mineral production of New York in 1904

PRODUCT	UNIT OF MEASUREMENT	QUANTITY	VALUE
Portland cement	Barrels	1 377 302	$1 245 778
Natural rock cement	Barrels	1 881 630	1 207 883
Building brick	Thousands	1 293 538	7 473 122
Pottery	....	....	1 438 634
Other clay products	....	....	2 592 948
Crude clay	Short tons	8 959	17 164
Emery	Short tons	1 148	17 220
Feldspar and quartz	Long tons	8 703	28 463
Garnet	Short tons	3 045	104 325
Glass sand	Short tons	11 080	8 484
Graphite	Pounds	3 132 927	119 509
Gypsum	Short tons	151 455	424 975
Iron ore	Long tons	619 103	1 328 894
Millstones	....	....	21 476
Metallic paint	Short tons	4 740	55 768
Slate pigment	Short tons	3 132	23 876
Mineral waters	Gallons	8 000 000	1 000 000
Natural gas	1000 cubic feet	2 399 987	552 197
Petroleum	Barrels	1 036 179	1 709 770
Pyrite	Long tons	5 275	20 820
Salt	Barrels	8 724 768	2 102 748
Roofing slate	Squares	18 090	86 159
Slate manufactures	....	....	7 441
Granite	....	....	221 882
Limestone	....	....	2 104 095
Marble	....	....	478 771
Sandstone	....	....	1 896 697
Trap	....	....	468 496
Talc	Short tons	65 000	455 000
Other materials[a]	....	....	1 600 000
Total value	....	....	$28 812 595

a Includes apatite, carbon dioxid, diatomaceous earth, fullers earth, marl and sand. The value is partly estimated

Mineral production of New York in 1905

PRODUCT	UNIT OF MEASUREMENT	QUANTITY	VALUE
Portland cement	Barrels	2 117 822	$2 046 864
Natural rock cement	Barrels	2 257 698	1 590 689
Building brick	Thousands	1 512 157	10 054 597
Pottery	....	....	1 620 558
Other clay products	....	....	2 603 861
Crude clay	Short tons	6 766	16 616
Emery	Short tons	1 475	12 452
Feldspar and quartz	Long tons	17 000	48 500
Garnet	Short tons	2 700	94 500
Glass sand	Short tons	9 850	7 765
Graphite	Pounds	3 897 616	142 948
Gypsum	Short tons	191 860	551 193
Iron ore	Long tons	827 049	2 576 123
Millstones	....	....	22 944
Metallic paint	Short tons	6 059	70 090
Slate pigment	Short tons	2 929	22 668
Mineral waters	Gallons	8 000 000	1 000 000
Natural gas	1000 cubic feet	2 639 130	607 000
Petroleum	Barrels	949 511	1 566 931
Pyrite	Long tons	10 100	40 465
Salt	Barrels	8 575 649	2 303 067
Roofing slate	Squares	16 460	94 009
Slate manufactures	....	....	1 000
Granite	....	....	253 955
Limestone	....	....	2 411 456
Marble	....	....	774 557
Sandstone	....	....	2 043 960
Trap	....	....	623 219
Talc	Short tons	67 000	469 000
Other materials[a]	....	....	1 800 000
Total value	....	....	$35 470 987

[a] Includes apatite, carbon dioxid, diatomaceous earth, fullers earth, marl, sand and sand lime brick. The value is partly estimated.

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*a*	....	....	1 850 000
Total value	....	....	$37 132 832

a 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	1 038 355
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	1 000 400
Natural gas	1000 cubic feet	3 052 145	800 050
Petroleum	Barrels	1 052 324	1 736 331
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*a*	...	...	1 850 000
Total value	...	...	$37 427 405

a Includes apatite, arsenical ore, carbon dioxid, diatomaceous earth, fullers earth, marl and sand and gravel exclusive of glass sand.

ARSENICAL ORE

The mining of arsenical ore is a new industry in New York State. While arsenical minerals have been produced at different times in the past in connection with the exploitation of pyrite deposits, it does not appear that they were considered of value or employed for the extraction of arsenic. The present enterprise was started in April 1906, by the opening of an old pyrite property situated near Carmel, Kent township, Putnam co. Shipments of crude ore and concentrates were made both in 1906 and 1907, most of the material having been sold to foreign chemical works. The mine is owned by the Putnam County Mining Corporation.

The ore occurrence was described briefly in the preceding issue of this report. It consists of arsenopyrite and subordinate pyrite with a quartz gangue occurring in veins that cut the gneiss country rock in proximity to a basic dike now altered to serpentine. The veins are made up of a number of parallel stringers closely set and forming what is properly called a lode. There are two such lodes of which the one worked has a northerly strike and is from 12 to 20 feet wide while the second lode intersecting at an angle of 60° has been only prospected. The ore body is opened by a vertical shaft bottomed at 100 feet from which a drift has been run along the course of the lode. It is about 12 feet wide in the drift.

During the past year the company has installed a plant for concentrating the low grade material. The process as described by Edward K. Judd,[1] consists in passing the ore through a jaw crusher and rolls and treating on hydraulic jigs of the Joplin type. There are eight jigs run by hand and provided with ¼ inch screens. The arsenopyrite is recovered from the hutch only, the material on the screens being rejected. The jig capacity is 4½ tons of crude ore or 1½ tons of concentrates each per day. The concentrates average 25 per cent arsenic.

A sample of the high grade ore gave the following percentages on analysis:

Silica	2.90
Iron	36.11
Copper	2.17
Sulfur	22.72
Arsenic	36.00
	99.90

Arsenopyrite occurs near Edenville and at other localities in Orange county, and in the town of Lewis, Essex co., 10 miles south of Keeseville. The Edenville deposit carries also leucopyrite, the diarsenid of iron and scorodite, a hydrous arsenate of iron.

CEMENT

There were few changes of note in the hydraulic cement industry during 1907. A fairly active demand existed throughout most of the year, but as in other manufacturing lines a sharp market decline took place in the last three months. Except for

[1] Eng. & Min. Jour. Feb. 8, 1908.

this, prices were on about the same level as in 1906. The conditions in the natural rock cement trade have been less favorable than in the other branch, reflecting influences which are of general nature and have been operative for some time.

There are 10 counties in the State which manufacture hydraulic cement. The crude materials used are found in nearly every section and the development of the industry has been governed more by commercial considerations, such as fuel prices and facilities for shipment of the product to market, than by the distribution of natural resources. Over one half of the annual production of the State is made in the Hudson river region and most of the remainder in the central and western part along the main trunk lines and the Erie canal. Ulster county has long been the center of the natural rock cement industry, while Onondaga and Erie counties furnish smaller quantities of the material. The Portland cement plants are located in Columbia, Greene, Livingston, Onondaga, Schoharie, Steuben, Tompkins, Ulster and Warren counties.

For the past year there were 18 firms which reported a production as compared with 19 firms so reporting in 1906. The combined output of Portland and natural rock cement amounted to 3,245,729 barrels valued at $2,971,820. In 1906 the output was 4,114,939 barrels valued at $3,950,699, so that there was a loss for the year of 869,210 barrels in quantity and of $978,879 in value. The decrease was shared by both branches, but in greater part by the natural rock cement.

The production of Portland cement amounted to 2,108,450 barrels valued at $2,214,090, against 2,423,374 barrels valued at $2,766,488 in 1906. There were 10 companies in operation during the whole or a part of the year. The decrease is accounted for by the fact that one of the larger plants was closed down for repairs and improvements during most of the season. A new plant has been erected by the William M. Hoag Cement Co. at Rosendale, Ulster co., but made only experimental runs in 1907.

Of natural rock cement a production amounting to 1,137,279 barrels valued at $757,730 was reported, as compared with 1,691,565 barrels valued at $1,184,211 in the preceding year. The Rosendale district contributed most of the output as heretofore, its share having been 970,929 barrels valued at $679,650. In 1906 the same district made 1,514,336 barrels valued at $1,107,535. Onondaga county reported a total of 47,350 barrels valued at $22,750 against 63,043 barrels valued at $30,923 in the preceding year. In all there were eight companies active, or one less than in 1906. The plant owned by the New York Cement Co. at Rosendale was burned down in December 1906.

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

CLAY

The manufacture of clay materials holds a prominent place among the industrial activities of the State. Clays suitable for making the common wares are distributed throughout every section. The rapidly growing markets for these products has led to the establishment of numerous manufacturing plants so that there is scarcely a city or community of any size which does not contain one or more of such enterprises. This is particularly true with regard to the manufacture of building materials, such as brick, terra cotta and tile, which are being employed more and more widely as elements of permanent construction. Owing to their cheapness, durability and the convenience with which they can be adapted to meet the varied architectural requirements, the use of clay materials will no doubt continue to find favor for a long time to come.

The production of the finer grades of clay wares has not attained the importance shown by the other lines. In contrast with most of the states along the Atlantic seaboard New York possesses very small resources in the finer varieties of clays and kaolin. This fact has retarded the development of industries in which such materials are employed, but with the present facilities for transport the deficiency has become less formidable to local manufacturers. There are now a number of plants in the State making tableware, electrical supplies, and other porcelain and semiporcelain wares.

Production of clay materials

The tables included herewith give full details as to the production of the different clay materials in the State. They are based on returns received from practically all of the manufacturers in every department.

The value of the products reported for 1907 indicates that the year was a fairly prosperous one for the local industries though comparing somewhat unfavorably with the two preceding years when unusually flourishing conditions obtained throughout the State. There was a smaller demand for clay building materials due to decreased building operations in New York and other large cities. This brought about a severe decline in the prices which had been raised to a high level, and to a curtailment of production. The decrease in output, however, was not so marked as might have been expected owing mainly to the number of new plants that had been placed in operation during the previous year and to the enlargement of facilities in many other plants. Aside from the branches connected with the building trade, there was little change in the industry and the production of most materials was well maintained or even showed a gain.

The aggregate value of the clay manufactures of all kinds in 1907 was $12,688,868. This compared with $13,955,300, the total reported for 1906, shows a falling off of $1,266 432 or about 9 per cent for the year. Of the 61 counties in the State 43 were represented in 1907 as having an output of this class of mineral materials. The number of individual plants in operation was 242, as compared with 265 in the preceding year and 250 in 1905.

The shrinkage in the valuation of the building brick alone was greater than the combined decrease for the entire production. The total reported by the manufacturers of this material amounted to $7,424,294, against a value of $9,688,289 for 1906, or a decrease of $2,263,995. Of the total, common brick accounted for $7,201,525, as compared with $9,302,165 in 1906, and front and fancy brick for $222,769 as compared with $386,124 for the preceding year. The production of vitrified paving brick was valued at $184,306 against $178,011. Fire brick and stove lining amounted to a value of $624,033 against $527,659. The manufactures of drain tile amounted to $162,167 against $166,645; and of sewer pipe to $463,500 against $95,142. The production of terra cotta was valued at $1,224,300, as compared with $1,037,387 in 1906; fireproofing at $45,672 as compared with $120,282; and building tile at $215,126, as compared with $217,475. In addition there were produced miscellaneous materials, including flue lining, fire tile and shapes, conduit pipes, sidewalk brick and acid-proof brick, the collected value of which amounted to $104,575, against $129,402 in 1906. The potteries of the State reported an output valued at $2,240,895, as compared with a value of $1,795,008 in the preceding year.

Production of clay materials

MATERIAL	1905	1906	1907
Common brick	$9 751 753	$9 302 165	$7 201 525
Front brick	302 844	386 124	222 769
Vitrified paving brick	180 004	178 011	184 306
Fire brick and stove lining	498 184	527 659	624 033
Drain tile	146 790	166 645	162 167
Sewer pipe	444 457	95 142	463 500
Terra cotta	874 717	1 037 387	1 224 300
Fireproofing	133 995	120 282	45 672
Building tile	251 600	217 475	215 126
Miscellaneous	75 114	129 402	104 575
Pottery	1 620 558	1 795 008	2 240 895
Total	$14 280 016	$13 955 300	$12 688 868

A distribution of the production according to the counties in which it was made places Onondaga county in the lead as having the largest clay-working industry. The value of its output was $1,331,443, the greater part representing pottery. In 1906 it ranked fourth. Ulster county which was second in the preceding year maintained that position with an output valued at $1,324,476. Rockland county fell from first to third place with a total of $1,258,467. The manufacture of brick is the basis of the industry in these counties. Richmond county advanced from sixth position in 1906, to fourth last year, and contributed $1,121,524; it manufactures most of the terra cotta made in the

State. The other counties that reported a production of over \$100,000 in value in 1907 were: Orange (\$789,297); Erie (\$786,703); Dutchess (\$781,262); Monroe (\$583,664); Kings (\$574,863); Albany (\$540,341); Columbia (\$433,357); Westchester (\$390,773); Ontario (\$342,810); Rensselaer (\$321,016); Saratoga (\$256,275); Greene (\$237,620); Steuben (\$186,124); Suffolk (\$127,610); Chautauqua (\$113,350); Allegany (\$111,751); and Nassau (\$105,000). Queens county should also be included in the foregoing list, but the value is withheld owing to there being but a single producer.

Production of clay materials by counties

COUNTY	1905	1906	1907
Albany	\$624 238	\$675 099	\$540 341
Allegany	118 989	111 683	111 751
Broome	18 000	12 000	8 250
Cattaraugus	a	35 500	41 234
Cayuga	25 920	17 860	14 832
Chautauqua	78 130	99 085	113 350
Chemung	96 000	90 000	88 940
Clinton	5 900	4 800	4 250
Columbia	520 500	489 750	433 357
Dutchess	1 258 937	975 410	781 262
Erie	700 527	804 159	786 703
Fulton	1 700	2 600	2 000
Greene	389 562	399 298	237 620
Jefferson	36 502	36 722	20 352
Kings	565 888	575 973	574 863
Madison	12 000	16 800	32 000
Monroe	644 411	341 870	583 664
Nassau	76 992	163 700	105 000
Niagara	3 372	10 832	16 282
Oneida	133 250	103 263	98 315
Onondaga	932 285	1 094 635	1 331 443
Ontario	345 250	343 040	342 810
Orange	1 011 006	1 170 695	789 297
Rensselaer	263 256	296 762	321 016
Richmond	645 367	896 789	1 121 524
Rockland	2 144 210	1 767 012	1 258 467
Saratoga	362 268	388 450	256 275
Schenectady	a	92 700	83 637
Seneca	3 525	39 525	a
Steuben	164 663	209 052	186 124
Suffolk	113 000	138 500	127 610
Tompkins	15 004	a	7 100
Ulster	1 776 035	1 465 457	1 324 476
Warren	45 712	34 500	25 000
Washington	20 270	22 033	22 990
Westchester	592 705	536 189	390 773
Other countries*b*	406 542	496 886	505 960
Total	\$14 280 016	\$13 955 300	\$12 688 868

a Included under "other counties."

b Includes in 1906: Genesee, Herkimer, Livingston, Montgomery, New York, Queens, St Lawrence, Tioga, Tompkins and Wayne counties. In 1907 the following counties are included: Genesee, Herkimer, Livingston, Montgomery, New York, Queens, St Lawrence and Wayne.

Manufacture of building brick

The output of common building brick in 1907 amounted to 1,351,591,000, valued at $7,201,525. In addition there were made 15,251,000 front and fancy pressed brick valued at $222,769, making an aggregate output of brick for building purposes of 1,366,842,000 valued at $7,424,294. The total number manufactured in the preceding year was 1,600,059,000 valued at $9,688,289, consisting of 1,575,434,000 common brick valued at $9,302,165 and 24,635,000 front and fancy brick valued at $386,124. The manufacture of building brick was carried on in 36 counties by a total of 205 companies or individuals. In 1906 there were 37 counties represented with a total of 213 producers while in 1905 there were 39 counties and 192 producers.

The average price received for common brick was $5.33 a thousand as compared with $5.98 a thousand in 1906 and $6.53 a thousand in 1905. Front and fancy pressed brick averaged $14.61 a thousand against $15.68 a thousand in 1906 and $16.20 a thousand in 1905. The prices are based on sales at the yards.

Production of common building brick

COUNTY	1906		1907	
	Number	Value	Number	Value
Albany	74 083 000	$461 399	60 210 000	$300 141
Broome	2 000 000	12 000	1 500 000	8 250
Cayuga	2 215 000	13 310	1 804 000	10 832
Chautauqua	8 567 000	52 031	7 967 000	49 876
Chemung	15 000 000	90 000	13 289 000	88 940
Clinton	800 000	4 800	650 000	4 250
Columbia	84 500 000	489 750	84 972 000	433 357
Dutchess	167 132 000	975 410	149 130 000	781 262
Erie	56 302 000	319 365	52 282 000	309 697
Greene	64 690 000	390 748	35 876 000	184 620
Jefferson	5 100 000	36 722	2 667 000	20 352
Monroe	26 077 000	158 463	25 198 000	148 462
Nassau	22 000 000	125 000	17 000 000	102 000
Niagara	2 172 000	10 832	2 681 000	16 282
Oneida	20 550 000	100 825	15 126 000	94 560
Onondaga	22 387 000	127 494	22 460 000	146 160
Ontario	3 510 000	21 700	2 600 000	18 200
Orange	189 180 000	1 170 695	154 502 000	789 297
Rensselaer	31 776 000	173 906	15 488 000	78 540
Richmond	34 769 000	172 880	30 205 000	180 509
Rockland	296 145 000	1 767 012	232 018 000	1 258 467

COUNTY	1906		1907	
	Number	Value	Number	Value
St Lawrence.....	a............	a........	800 000	$6 000
Saratoga........	70 509 000	$385 950	50 798 000	254 385
Seneca..........	6 050 000	36 400	a...........	a........
Steuben.........	4 705 000	31 800	3 287 000	29 818
Suffolk.........	21 710 000	137 500	20 130 000	124 610
Tompkins.......	a............	a........	1 100 000	7 100
Ulster..........	252 665 000	1 465 457	260 404 000	1 322 476
Warren.........	a............	a........	5 020 000	25 000
Washington......	3 300 000	18 100	2 750 000	14 300
Westchester.....	70 621 000	458 000	59 307 000	323 553
Other counties*b*..	16 919 000	94 606	11 370 000	70 169
Total......	1 575 434 000	$9 302 165	1 351 591 000	$7 201 525

a Included under "other counties."
b Includes in 1906 the following: Allegany, Cattaraugus, Fulton, Herkimer, Livingston, Montgomery, St Lawrence, Schenectady, Tioga, Tompkins and Warren. In 1907 the following counties are included: Allegany, Cattaraugus, Fulton, Herkimer, Livingston, Montgomery, Schenectady and Seneca.

Hudson river region. The counties situated along the navigable stretch of the Hudson river constitute an exceptional region as regards the clay-working industry and deserve special consideration. No other part of the State, or indeed of the country, supports so extensive a development of brick manufacture. The district supplies practically all of the common grade of brick consumed in the building operations of New York and vicinity in which market it has a decisive advantage owing to the facilities for transport by water. The yards for the most part are placed close to the river so that the brick can be shipped to destination at a minimum of expense. In the nine counties included in the region there are more than 125 yards with a combined capacity of about one and a half billions a year.

Owing to the depressed state of the trade during 1907, there was a notable reduction in the output of the region as compared with that for the two preceding years when conditions were specially prosperous. The production of common brick reported by the 122 plants that were active aggregated 1,051,907,000 valued at $5,471,713. In 1906 the production, the largest on record, amounted to 1,230,692,000 valued at $7,352,377, distributed among 131 plants. There was thus a loss for the year of 178,785,000 in quantity and of $1,880,664 in value. The highest value for any year was reported in 1905 when the output of 1,219,318,000, the second largest ever reported, made by 119 plants, was valued at $8,191,211.

The average number of brick manufactured by each plant in 1907 was 8,622,000 as compared with 9,471,000 in 1906 and 10,246,000 in 1905. The price for the whole region averaged $5.20 a thousand against $5.98 a thousand in 1906 and $6.54 a thousand in 1905, showing a drop of 20 per cent in two years.

With the exception of Columbia and Ulster, all of the counties along the Hudson river reported a reduced output, the loss being proportioned more or less to the magnitude of the industry in each county. Ulster county showed a small gain and its output of 260,404,000 valued at $1,322,476 gave it first place, ahead of Rockland county which held that position in 1906. The latter which contributed 232,018,000 valued at $1,258,467 however, had the greater number of active plants with 31 as compared with 27 for Ulster county. Orange county ranked third in the list with a production of 154,502,000 valued at $789,297 made by nine plants.

Output of common brick in the Hudson river region in 1906

COUNTY	NUMBER OF PLANTS	OUTPUT	VALUE	AVERAGE PRICE PER M
Albany	11	74 083 000	$461 399	$6 23
Columbia	6	84 500 000	489 750	5 80
Dutchess	19	167 132 000	975 410	5 82
Greene	6	64 690 000	390 748	6 04
Orange	12	189 180 000	1 170 695	6 19
Rensselaer	9	31 776 000	173 906	5 48
Rockland	33	296 145 000	1 767 012	5 97
Ulster	26	252 665 000	1 465 457	5 80
Westchester	9	70 621 000	458 000	6 46
Total	131	1 230 692 000	$7 352 377	$5 98

Output of common brick in the Hudson river region in 1907

COUNTY	NUMBER OF PLANTS	OUTPUT	VALUE	AVERAGE PRICE PER M
Albany	10	60 210 000	$300 141	$4 99
Columbia	6	84 972 000	433 357	5 10
Dutchess	19	149 130 000	781 262	5 23
Greene	5	35 876 000	184 620	5 15
Orange	9	154 502 000	789 297	5 11
Rensselaer	7	15 488 000	78 540	5 07
Rockland	31	232 018 000	1 258 467	5 42
Ulster	27	260 404 000	1 322 476	5 08
Westchester	8	59 307 000	322 553	5 46
Total	122	1 051 907 000	$5 471 713	$5 20

The past year was uneventful in respect to the New York market. The large surplus amounting to about 300,000,000 carried over by the plants from the preceding year sufficed to meet the demand in the early months before the season for brickmaking began. Consequently the prices did not reach the high level that obtained in the first part of 1906, while there were no such fluctuations as characterized the market of that year. The range was mostly between $5 and $6 a thousand at the yard, with a tendency toward the lower value for most of the time. Some shipments were marketed for less than $5. With the severe depression that took place in the fall, building operations were curtailed to an extent as to effect a practical cessation of the demand for a time, and the manufacturers were left with an unusually heavy supply of unsold brick at the close of the year. The stocks at the yards along the river are estimated at over 300,000,000. While some improvement in the market conditions is to be expected for the current season, the production will probably show little if any gain.

Other clay materials

The manufacture of paving brick was carried on during 1907 in Greene, Onondaga and Steuben counties. There were four companies engaged in the business and the output was 12,296,000 valued at $184,306. In 1906 there were five companies which reported a production of 11,472,000 valued at $178,011. Chautauqua county which was represented in the list of counties manufacturing this article in 1906 made no output last year.

Fire brick and stove lining were manufactured in Albany, Chautauqua, Erie, Kings, Rensselaer, Richmond, Schenectady, Washington and Westchester counties by a total of 12 companies. The output of fire brick amounted in value to $384,217 and of stove lining to $239,816, a combined value of $624,033. In 1906 the value of the two materials was $527,659 reported by 13 companies. Onondaga county made a small production in 1906 but none last year.

Drain tile and sewer pipe were made in Albany, Cayuga, Erie, Genesee, Madison, Monroe, Oneida, Onondaga, Ontario, Saratoga, Steuben and Washington counties. The output of drain tile was valued at $162,167 against $166,645 in 1906; and sewer pipe at $463,500 against $95,142. The large gain in the production of sewer pipe was due to the restarting of a large plant in Monroe county. There were 19 companies engaged in these industries as compared with 26 in the preceding year. The list of counties in 1906 included Chautauqua, Kings, Seneca and Wayne in addition to those already enumerated.

The output of terra cotta, fireproofing and building tile came from Albany, Allegany, Chautauqua, Genesee, Kings, Monroe, New York, Onondaga, Queens, Rensselaer, Richmond and Ulster counties, with a total of 14 companies, or three less than in 1906. The production of terra cotta was valued at $1,224,300, against $1,037,387 in 1906; fireproofing at $45,672 against $120,282; and building tile at $215,126 against $217,475. Erie and Ontario counties reported no output last year, while Ulster county was represented for the first time.

New manufacturers of clay materials

The following list includes the names of companies or individuals who have erected plants during the past year or have taken over plants from other companies, for the manufacture of clay structural materials. The list is supplementary to the one published in the issue of this report for 1905 and together with the supplementary list contained in the report for 1906 gives the names of operators and location of plants corrected to date.

NAME	LOCATION OF PLANT
Chautauqua co.	
Dunkirk Ice & Fuel Co.	Dunkirk
Dutchess co.	
N. I. Pennock	Arlington
Oneida co.	
Mohawk Valley Brick Co.	Utica
Rensselaer co.	
Lane & Co.	Castleton
Tioga co.	
Tioga Red Brick Co.	Spencer
Tompkins co.	
Cook Brick & Tile Co.	East Ithaca
Ulster co.	
Empire Brick & Supply Co.	Glasco
Lengsholz & Diedling	Malden
Henry Toppin	Ulster Landing

Pottery

The manufacture of pottery has become an important branch of the clay-working industry of the State. Its development, however, has been due rather to the exceptional facilities afforded by the State for manufacturing and marketing the products than to the existence of natural resources of crude materials that are employed in the potteries. With the exception of the deposits of slip clay in Albany county and a limited supply of stoneware clays in Onondaga county, the raw materials are derived entirely from without the State. The kaolin used comes from New Jersey and from England, the feldspar from Canada, and much of the pottery clay from New Jersey.

In the accompanying table is shown the value of the pottery manufactures during the past three years. The total valuation of the product for 1907, as returned by the individual plants, was $2,240,895. The preceding year's output was valued at $1,795,008 and that of 1905 at $1,620,558. The growth of the industry during the period has been brought about by the increased production of the high grade products — porcelain and semiporcelain tablewares and electric and sanitary supplies. The manufacture of stoneware and earthenware has remained almost stationary. The products listed in the table under "Miscellaneous" include yellow and Rockingham wares, clay tobacco pipes, fire clay crucibles and artistic pottery.

There were 22 potteries that reported as active in 1907, the same number as in the two preceding years. They were distributed among the following counties: Albany, Chautauqua, Erie, Kings, Madison, Monroe, Nassau, Onondaga, Ontario, Schenectady, Suffolk, Washington and Wayne. Onondaga holds first place in point of production, with a total for 1907 valued at $1,095,958, as compared with $858,270 in 1906 and $718,985 in 1905. Kings county is the second largest producer, contributing an output valued at $343,121, against $306,105 in the preceding year and $308,443 in 1905.

Value of production of pottery

Ware	1905	1906	1907
Stoneware	$115 890	$84 031	$65 271
Red earthenware	30 740	30 234	28 296
*a*Porcelain and semiporcelain	800 000	835 000	1 181 162
Electric and sanitary supplies	600 325	768 236	869 378
Miscellaneous	73 603	77 507	96 788
Total	$1 620 558	$1 795 008	$2 240 895

a Includes china tableware.

Crude clay

In the foregoing tables relating to clay products no account has been taken of the crude clay entering into their manufacture. There are a few producers in the State who do not utilize the crude clay themselves, but ship their output to others for manufacture. Some of the material, like the Albany slip clay for example, is even forwarded to points without the State. In 1907 returns were received from four producers in this branch of the industry whose total shipments amounted to 3927 short tons valued at $6163. The corresponding total for 1906 was 5477 short tons valued at $9125 and for 1905 it was 6766 short tons with a value of $16,616.

DIATOMACEOUS EARTH

The production of diatomaceous or infusorial earth is carried on to a small extent in New York State. The deposits occur on the bottoms of the small Adirondack lakes, those in Herkimer county being best known, and are formed by the accumulation of the minute silicious skeletons of organisms inhabiting the waters. They attain a thickness up to 30 feet in White Lead lake from which the present supply is obtained. The material is excavated and purified by washing and settling in vats, after which it is compressed into cakes for shipment. According to an analysis published in the report for 1905 it contains about 86 per cent silica, 2 per cent or less of iron oxid, alumina and lime, and about 12 per cent water.

The earth is employed as an abrasive, particularly for polishing of metal surfaces, as a substitute for quartz in the manufacture of wood filler, and for various other purposes. The production reported in 1907 was made by George W. Searles of Herkimer.

EMERY

The source of the small quantity of emery produced in the State is near Peekskill, Westchester co. The material in crude state is a rock, made up of corundum, spinel and magnetite chiefly, and represents a phase of the basic igneous intrusions of that vicinity which are known as the Cortlandt series. The emery occurs as lenses and bands grading off at the edges into the country rock which is usually norite. The material was originally worked as an iron ore, but unsuccessfully owing to its refractory nature from the presence of so much alumina. In their geological relations the bodies resemble the titaniferous magnetites of the Adirondacks, a similarity that is strengthened by the fact that the analyses of the emery show a small percentage of titanium.

The production of emery in 1907 amounted to 1223 short tons, valued at $13,057. This is a little less than the production for the preceding year which totaled 1307 short tons valued at $13,870. In 1905 the output was 1475 short tons valued at $12,452 and in 1904, 1148 tons valued at $17,220. The valuation is based on the material at the quarries, where it undergoes only hand sorting and cobbing preparatory to shipment to outside points for grinding and manufacture into emery wheels, stones, cloth, etc.

The list of producers in 1907 includes the following: Blue Corundum Mining Co., Easton, Pa., Keystone Emery Mills, Frankford, Pa., Tanite Co., Stroudsburg, Pa., J. R. Lancaster, Peekskill, and J. H. Bugby, Peekskill. With the exception of J. R. Lancaster and J. H. Bugby, the companies mine the emery for their own use in connection with manufacturing plants.

FELDSPAR

The output of this mineral is won from occurrences of pegmatite that are found in the Adirondacks and in the southeastern section of the State. The quarries near Bedford, Westchester co., have supplied in recent years most of the feldspar suitable for pottery uses, while the Adirondack quarries have furnished material for roofing purposes, poultry grit and to a limited extent for pottery. Quartz is always associated with the feldspar and it is sometimes utilized as well.

The combined production of feldspar and quartz in 1907 amounted to 8723 long tons valued at $36,230. The total compares with 13,660 long tons valued at $44,350 in the preceding year. The value of the feldspar sold to pottery makers ranges from about $3 per ton for the crude to $7 per ton for the ground product, at the quarries or mills. The quantity sold for other purposes has not been included in the totals.

The quarries near Bedford, owned by P. H. Kinkel's Sons, have been the most important producers of pottery feldspar. A part of their output is ground before shipment. The quartz is sold to the Bridgeport Wood Finishing Co. for manufacture into wood filler. The Hobby quarry, in the town of Northcastle, opened by Otto Buresch, was also worked in 1907 by P. H. Kinkel's Sons. The feldspar occurs here in very large massive crystals, with little tendency toward the usual intergrowth with quartz, a feature of considerable importance in quarry work.

In the Adirondack region, the Claspka Mining Co. and the International Mineral Co. have been active during the past year. The quarry owned by the former company is situated near Batchellerville, Saratoga co., and the output is shipped to potteries. The International Mineral Co. has a quarry and mill near Rock pond, Essex co., west of Ticonderoga. The pegmatite is crushed and shipped unsorted for roofing material, for which purpose it takes the place of common gravel, but is considered superior to the latter owing to the fact that the feldspar with its smooth cleavage planes has greater adhesive properties when applied to tarred surfaces. The smaller sizes made in crushing the pegmatite are sold for poultry grit.

A new enterprise that began production in the early part of the present year is the Crown Point Spar Co., with a quarry near Crown Point, Essex co. The pegmatite occurs in the midst of gneissoid granite and apparently is a coarse phase of the granitic magma crystallized in place, since it shows little resemblance in form to a dike cutting the gneiss intrusively or to a vein occupying a fissure. It constitutes a mass that is traceable for several hundred feet along the strike and across the dip of the gneiss, and is as yet only partially explored. The quarry is situated near the eastern face of the ridge known as Breed's hill, 1½ miles south of Crown Point and ⅓ mile west of the Delaware & Hudson Railroad. A large mill has been erected close to the railroad, where the rock is conveyed by a cableway. The mill equipment is very complete and will enable the company to supply feldspar in any of the forms in which it is marketed. The pegmatite is an intergrowth of potash feldspar and quartz with a little mica and tourmalin. The separation of the minerals is effected entirely by mechanical means after crushing, whereas in other quarries the removal of the quartz and iron-bearing impurities is performed by hand cobbing. The feldspar belongs to the variety known as microcline, which has the same chemical composition as orthoclase, but differs in its crystallization.

GARNET

The abrasive garnet industry in the Adirondacks continued to progress during 1907, as shown by the output which exceeded all previous records, having been about 20 per cent larger than that for the preceding year. There were no new discoveries, and mining has been restricted to the usual localities.

The North River Garnet Co., owning property at Thirteenth lake, Warren co., is the largest operator in the region. The company has an unlimited supply of garnet rock which is obtained by open quarry work. The rock face now exposed measures 142 feet in hight, while there is known to be an extensive body below the level of the present workings. The material is crushed and concentrated mechanically by a process specially planned for the purpose by Mr F. C. Hooper. By the addition of another unit to the mill, the productive capacity has been raised to about 8000 or 9000 tons annually, which is considerably in excess of the present market requirements of the country.

The Gore mountain and Garnet peak properties near North River are worked during the open season, the former by H. H. Barton & Sons Co., and the latter by the American Glue Co. The garnet occurs in both places as large crystal masses in a hornblende gneiss. It is separated by hand cobbing.

On the slopes of Mt Bigelow in northern Essex co., about

5 miles south of Keeseville, there is a large body of nearly pure garnet that has been described in the issue of this report for 1905. In regard to geological features, the garnet shows a good deal of contrast to the other occurrences. Much of the material has a massive appearance, consisting of granular particles loosely bound together, though in places a tendency toward crystal structure may be observed. Exploratory operations have been conducted during the last two years by G. W. Smith of Keeseville, and a considerable quantity of the garnet was shipped in 1907 to American and foreign consumers.

The Adirondack localities furnished a total of 5709 short tons in 1907, valued at $174,800, as compared with 4729 short tons ($159,298) in the preceding year. The output during the first six months of the year was proportionately larger than in the latter half when the market fell off in sympathy with the general business depression.

GRAPHITE

The production of crystalline graphite during the past year has been attended by few developments of special interest. As heretofore, the American mine near Hague, Warren co., supplied most of the output. This mine, owned by the Joseph Dixon Crucible Co., has been operated steadily for many years and may be said to represent the only firmly established enterprise in the Adirondacks. Stimulated by its success, several other mines have been opened in the surrounding region, but in most cases without commensurate results.

The total reported by the companies in 1907 was 2,950,000 pounds, having a valuation of $106,951. The production in the preceding year was 2,811,582 pounds valued at $96,084, while in 1905 it was 3,897,616 pounds valued at $142,948. The average value of the graphite per pound was 3.6 cents in 1907, 3.4 cents in 1906 and 3.7 cents in 1905. There has thus been a shrinkage in the prices, as well as in the production since 1905, though a slight gain in both is shown for the last year over the corresponding figures for 1906.

The Crown Point Graphite Co. discontinued operations at the mine near Penfield pond, Essex co. A deposit near Eagle lake will be worked during the coming season, in preparation for which the present plant has been enlarged.

The Glens Falls Graphite Co. has erected a mill at the mine situated near Conklingville, 8 miles west of Hadley, Saratoga co. Only experimental runs have been made thus far. The deposit is reported to be extensive. It belongs to the sedimentary type, the graphite being distributed along the bedding or cleavage planes of a quartzite.

The Empire Graphite Co. has a property near Greenfield, Saratoga co., and began active work in the early part of 1908.

In St Lawrence county some attention has been given to a deposit occurring on the Indian river about 3 miles from Rossie village. The graphite forms the principal constituent of a schist, through the body of which it is distributed richly in very small scaly particles. It is a crystalline graphite, but too fine in size to be easily separated. Trial shipments of the crude material were reported to have given satisfactory results when used for foundry purposes.

The wide distribution of graphite in the Adirondack region undoubtedly makes it a promising field for prospecting and mining, but there are strict limitations surrounding the industry, the neglect of which on the part of the mining companies has led to many failures. The amount of capital expended in the erection of new milling plants and mine equipment during the last five years aggregates several hundred thousand dollars, and in many cases there has been little or no return for the outlay.

The separation and refining of graphite under the conditions presented by the Adirondack occurrences involve unusual difficulties. As described in previous reports, the deposits that have been the main sources of supply consist of disseminated flakes in a gangue that ranges from quartzite to a feldspar-quartz schist with a considerable percentage of dark silicates. While the graphite has a specific gravity somewhat below that of the accompanying minerals, the difference is not sufficient to make a separation by gravity methods alone practicable, and in fact is of less importance than the scaly habit of the mineral. The first separation is carried out by shaking tables, buddles or by the pneumatic jig, and the product secured, corresponding to the tailings in the concentration of metallic ores, contains a certain amount of slimes or dust and any other scaly minerals, as well as the graphite. The elimination of the granular impurities can be effected satisfactorily, if the graphite is relatively coarse, by the pneumatic or flotation methods of refining, but scaly silicates like mica are not readily removed.

Biotite and phlogopite are the varieties of mica commonly found in the graphite rock. Owing to their scaly habit and disseminated distribution they are somewhat difficult to distinguish from the graphite flakes in hand specimen, though under the microscope they are readily revealed by their transparency. A considerable percentage of mica will be discovered oftentimes in this way when microscopic examination fails to reveal its presence.

The size of the graphite flakes is another feature that must be taken into consideration. A rock carrying a coarse crystal, other things being equal, is the more desirable, since the economy and perfection of the separation process increase in direct relation to the size of the graphite. The coarse sizes also command higher prices in the market than the fine flake, under equal conditions of purity.

There is considerable variation in the crystallization of the graphite depending upon the character of the gangue. The schists and quartzites of the Adirondacks represent ancient sediments of the nature of sandstones and sandy shales which have been transformed under the influences of heat and pressure while they were deeply buried in the earth. The graphite is traceable to the carbonaceous constituents of plants or animals included in the sediments at the time of their deposition, and its formation which involves a distillation of the organic compounds with loss of the volatile parts was an accompaniment of the general metamorphism. It is to be expected that the graphite would show a more perfect crystal development in rocks that have been profoundly changed, and this is, in fact, the case. The schists of the eastern and interior parts of the Adirondacks carry a much coarser flake than the rocks on the western side which have been less metamorphosed. In the deposits of St Lawrence county, on the west, the flake is very fine, at times showing an approach to amorphous graphite. This is, of course, only true with respect to the deposits of organic nature in the sedimentary rocks. The graphite found in veins and dikes is quite uniform throughout the whole region, but such occurrences have little importance from an industrial standpoint.

GYPSUM

The production of gypsum is made in the central and western parts of the State, in Madison, Onondaga, Cayuga, Monroe, Genesee and Erie counties. The gypsum is associated with the Salina formation which carries the rock salt beds and is quarried or mined along the outcrop from Madison county westward. The Salina formation can be traced to the east into Albany county but with such diminishing thickness as to preclude the occurrence of workable gypsum deposits in that section.

Most of the workings are situated near the southern edge of the belt occupied by the Salina beds. The gypsum occurs below the Bertie waterlime which marks the top of the formation and above the salt horizon. Its beds are regularly disposed with respect to the inclosing rocks, dipping with them at a very low angle to the south. They afford a practically inexhaustible supply. Their greatest thickness along the outcrop is in Onondaga county where as much as 60 feet have been found, divided into several layers. In the western part of the State the beds range from 4 to 8 feet thick. Many of the borings for salt have encountered gypsum, showing its continuation for long distances to the south along the dip of the strata.

The present extensive utilization of gypsum in New York has been due to the establishment of plants for the manufacture of plaster of paris, stucco, wall plasters, etc., a branch of the industry that has grown to large proportions in the last decade. Formerly the principal outlet for the mineral was in agriculture which still affords a small market for the ground product. Another use that has become quite important is in the Portland cement trade; a considerable proportion of the gypsum listed in the accompanying table as sold in crude state is shipped to points in Pennsylvania and elsewhere for admixture with Portland cement.

The gypsum rock as found in New York has a gray or drab color. It contains a varying amount of impurities in the form of lime and magnesia carbonates, clay and silica or quartz, besides a small proportion of organic matter which is the principal coloring agent. In calcination the organic substances are broken up or driven off. The impurities on the average amount to from 5 to 15 per cent of the total.

The manufacture of calcined plasters is carried on in Syracuse and vicinity, at Wheatland and Garbutt, Monroe co., and at Oakfield, Genesee co.

Production and trade. With the exception of the last three months of the year, the demand for gypsum and gypsum materials was active, stimulating a largely increased output. The quantity of gypsum mined or quarried during the year was

323,323 short tons, as compared with 262,486 short tons in 1906; 191,860 short tons in 1905 and 151,445 short tons in 1904. The output has thus more than doubled within the last three years. It is to be expected from the present general conditions of business that there will be little if any advance made during the current year.

Of the total quantity of crude rock reported for 1907, about 70 per cent was calcined for plaster. The product of plaster of paris, wall plasters, etc., amounted to 222,502 short tons valued at $820,064, which compares with 163,451 short tons valued at $595,285 in the preceding year. The totals include only the quantities made from gypsum obtained in the State; some crude gypsum is imported each year from Canada and calcined in local plants. The amount of ground gypsum or land plaster made was 15,441 short tons valued at $38,859, against 20,656 short tons valued at $46,094 in 1906. The portion sold in crude state to Portland cement manufacturers and for other purposes amounted to 91,060 short tons valued at $179,432, against 34,626 short tons valued at $58,076 in the preceding year.

Production of gypsum

	1906		1907	
	Short tons	Value	Short tons	Value
Total output, crude	262 486	....	323 323	....
Sold crude	34 626	$58 076	91 060	$179 432
Ground for land plaster	20 656	46 094	15 441	38 859
Wall plaster etc. made	163 451	595 285	222 502	820 064
Total value	....	$699 455	....	$1 038 355

The Akron Gypsum Co. and the American Gypsum Co. made a production for the first time in 1907. Their properties are located near Akron, Erie co., where an excellent quality of rock is found, running as high as 95 per cent gypsum. The former company has a mill and warehouse under construction and will ship its output in manufactured form. The American Gypsum Co. sold the crude rock.

The Victor Gypsum Co. was engaged in the exploration of a property at Victor, Ontario co., but has made as yet no production.

The United States Gypsum Co. has taken over the quarry and mill of the Cayuga Plaster Co., at Union Springs, which has been operated in addition to its properties at Oakfield.

A new quarry has been opened at Jamesville, Onondaga co., by James E. Hubbell of Syracuse. The beds are reported to be 60 feet thick. Analyses furnished by Mr Hubbell show the following percentages:

	1	2
SiO_2	3.34	5.56
Fe_2O_3, Al_2O_3	2.92	1.88
$CaCO_3$	3.32	4.10
$MgCO_3$	2.69	3.32
$CaSO_42H_2O$ (Gypsum)	87.48	85.18
	99.75	100.04

No. 1 is a sample of soft weathered rock and No. 2 of the hard rock.

IRON ORES

The activity in the mining of iron ores during recent years was well maintained throughout most of 1907, as it was only in the last two or three months of the year that the production began to fall off in sympathy with the general business depression. The returns furnished by the mining companies show an advance sufficient to carry the production to a point above that recorded for any year since 1890, the total amounting to over 1,000,000 tons. With the increment supplied by the new enterprises, there would have been, undoubtedly, a still larger gain recorded for the present year if the market had continued favorable, but several mines have now suspended work and will await improved conditions before resuming.

There were 13 companies engaged in mining during the year, besides those carrying on exploratory or other preparatory work. This shows a gain of two over the number for the preceding year.

The accompanying table gives the production of iron ore, distributed according to kinds, for the period 1890–1907 inclusive. The statistics covering the years previous to 1904 are taken from the annual volumes of the *Mineral Resources* published by the

United States Geological Survey, while the figures from 1904 to date have been collected at this office. They represent marketable ores as shipped to the furnace and not the mine output which is considerably larger, since the greater portion of the magnetite ores is concentrated.

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

The total shipments reported by the mines in 1907 amounted to 1,018,013 long tons, valued at $3,750,493. As compared with the preceding year when the shipments were 905,367 tons valued at $3,393,609, there was an increase in output of 112,646 tons or about 12 per cent.

Classified as to variety the shipments consisted of 853,579 tons of magnetite and 164,434 tons of hematite. Of the magnetite 499,895 tons were marketed in the form of concentrates with an approximate content of 65 per cent iron. The 353,684 tons of lump magnetite included in the total are estimated to average 60 per cent iron. The hematite and limonite range from 40 to 60 per cent, with an average probably of 45 per cent.

The 499,895 tons of magnetite concentrates were made from approximately 818,467 tons of crude ore. The mine output or amount of ore hoisted during 1907 was thus 1,336,585 long tons which compares with 1,154,814 long tons in 1906 and 1,109,385 long tons in 1905. Based on the crude ore, the output last year was probably as large as that recorded for any previous year in New York State.

Of the magnetite 801,820 tons were derived from the Adirondacks. The producers in that region included Witherbee, Sherman & Co., and the Port Henry Iron Ore Co., at Mineville; the Chateaugay Ore & Iron Co., at Lyon Mountain; and the Benson Mines Co., at Benson Mines. The Arnold Mining Co. at Arnold was inactive. In southeastern New York, the Hudson Iron Co., operating the Forest of Dean mine and the Sterling Iron & Railway Co., operating the Lake mine were the only ones to report a production.

Of the output of hematite 55,409 tons were reported by the Rossie Iron Ore Co., and the Old Sterling Iron Co., who own mines near Antwerp, St Lawrence co., and 109,025 tons by the producers of oolitic and fossil hematite from the Clinton formation. The latter producers were as follows: Franklin Iron Manufacturing Co., and C. A. Borst, Clinton; Fair Haven Iron Co., Sterling; Furnaceville Iron Ore Co., and Ontario Iron Ore Co., Ontario Center. The Fair Haven Iron Ore Co. and the Ontario Iron Ore Co. made their first shipments in 1907.

Several new developments have been under way during the year. In the Adirondacks, the Cheever mine near Port Henry which has been closed down for the last 15 years, was reopened and equipped with a mill of 300 tons daily capacity. The company expected to begin shipments the present season. The exploration of the titaniferous magnetite deposits at Lake Sanford in the central part of the Adirondacks, mentioned in the preceding issue of this report was prosecuted with energy and surveys have been nearly completed for a railroad to afford access to the locality from Lake Champlain, some 40 miles distant. The results of test borings on the property have been favorable in respect to the continuation of the deposits in depth.

In Wayne county, on the western section of the Clinton deposits, there has been unusual activity and large tracts of land situated along the outcrop of the ore have been taken over by mining companies. The Furnaceville Iron Co. is the pioneer among the latter, while the Wayne Iron Ore Co., the Lake Ontario Iron Ore Co., and the Rochester Iron Ore Co. were organized in 1907. A large amount of exploration has been performed in Wayne and Cayuga counties, and with the restoration of former market conditions, it may be expected that extensive mining operations will be instituted.

Mineville. The output of ore from this locality in 1907 was probably the largest on record, and was considerably in excess of that reported for any recent year. A total of about 750,000 tons was hoisted from the mines of Witherbee, Sherman & Co., and the Port Henry Iron Ore Co. The so called Old Bed mine group which includes the "21," Joker and Bonanza workings furnished the greater part of the output, but the Harmony shafts of Witherbee, Sherman & Co. contributed a considerable share The expansion of mining has been made possible by the addition of the power facilities from the new electric station on the lake side at Port Henry. This plant supplying 800 kw. was placed in operation during the past year.

The Port Henry Iron Ore Co., has been engaged in sinking its new shaft on the "21" property east of the Bonanza shaft. It will have a vertical depth of 500 feet, with crosscuts at intervals of 80 feet extending into the ore body. It is divided into three compartments of which two are for hoisting and will have a capacity of 1500 tons a day. This will more than double the former output of the mine, bringing the total hoisting capacity of the two companies up to fully 1,000,000 tons annually.

Mining is to be resumed on the Barton hill group which has lain idle for several years. The group comprises a number of openings made at intervals along a practically continuous bed that lies to the west of the Old Bed mines and extends 3500 feet in a northerly direction over the shoulder of Barton hill. An adit starting from the Arch pit near the middle of the bed is under construction and will give an outlet to the surface for the ore in the northern section where recent exploration has disclosed the existence of bodies hitherto unworked.

Benson mines. This property belonging to the Magnetic Iron Ore Co. has been taken over by the Benson Mines Co., and was again placed in operation in the fall of 1907 after making improvements in the mining and milling equipment. Altogether about $150,000 was expended in bringing the installation up to date.

The deposits are low grade, averaging about 35 per cent iron, but they rank among the largest in the Adirondacks. In their general character they resemble those at Lyon Mountain; they consist of bands of the country gneiss carrying magnetite in disseminated grains more or less evenly distributed through the mass of the rock. A width of over 200 feet is shown in the old workings, while the ore can be traced by outcrops of magnetic attraction for a distance of over 2 miles along the strike.

The deposits are worked by open-cast or quarry methods. Under the present management some innovations have been made that are superior as regards economy over the ordinary methods in use in the Adirondack region. Instead of percussion drills of small caliber, shot drills capable of boring 4 inch holes to a depth of 50 feet are employed. The holes are heavily loaded with dynamite and break down an enormous quantity of the ore at one time. The large blocks are then broken up by secondary drilling and blasting into sizes within the capacity of the crushers. The ore is loaded by steam shovel on to cars for transport to the mill, where the first crushing is performed by a pair of 6 foot rolls. The ore then passes to smaller rolls which reduce it to the size required in the separation.

The company intends to erect a new mill in the near future, if the results of present operations are satisfactory. The ore bodies have been tested, it is said, to a depth of 600 feet on the dip, without encountering any marked change in their character.

Lake mine. The Sterling Iron & Railway Co. operated this mine during 1907. The ore body is the same one that is tapped by the celebrated Sterling mine which was located in 1750 and furnished ore for a local furnace built the following year. The underground workings approach to within a few feet of the Sterling and extend under Sterling lake. The ore is a non-Bessemer fairly rich magnetite. The following analysis is taken from Putnam's report.

Iron	57.25
Sulfur	.088
Phosphorus	1.205
Manganese	present

MILLSTONES

A small output of millstones is made each year in Ulster county, where the industry has been established for over a century, still furnishing a great part of the domestic millstones used in this country. The product is known in the trade as Esopus stone, from the early name of Kingston which was once the principal point of shipment.

The millstones are quarried from the Shawangunk grit, a light gray quartz conglomerate found along the Shawangunk mountain from near High Falls southwest toward the Pennsylvania border. The Cocalico stone obtained in Lancaster county, Pa., and the Brush mountain stone, found in Montgomery co., Va., are of similar character. In Ulster county the grit rests in unconformable position upon Hudson River shales and is overlain in places by a red shale. It has generally been correlated with the Oneida conglomerate of central New York to which it has some physical resemblance, but recent investigations have shown quite conclusively that it belongs higher up in the stratigraphic series in the horizon of the Salina. Its thickness in Ulster county ranges from 50 to 200 feet.

The grit is composed of quartz pebbles of milky color surrounded by a silicious matrix. The pebbles are of subangular form and vary from a fraction of an inch to 2 inches in diameter. The texture is an important factor in determining the value and particular use of the finished millstones.

The size of the stones marketed ranges from 15 to 90 inches. The greater demand is for the smaller and medium sizes, with diameters of 24, 30, 36, 42 and 48 inches. A pair of 30-inch millstones commonly sells for $15, while $50 may be paid for a single stone 60 inches in diameter. The largest sizes bring from $50 to $100. Besides the common type of millstones, disks are furnished which are employed in a roll type of crusher known as a chaser. The pavement of such crushers is also supplied by the quarrymen, in the form of blocks. Quartz, feldspar and barytes are commonly ground in chasers.

Most of the Ulster county quarries are situated along the northern edge of the Shawangunk mountain. Kyserike, St Josen, Granite and Kerhonkson are the principal centers of the industry while the distributing points include New Paltz and Kingston in addition to those named. The industry is carried on intermittently, many of the producers engaging in other occupations during a part of the year.

The market for millstones has been curtailed of late years by the introduction of rolls, ball mills and other improved forms of grinding machinery. The roller mill process has displaced the old type of cereal mills, particularly in grinding wheat. The small corn mills distributed throughout the southern states, however, still use millstones and furnish one of the important markets for the New York quarries. A part of the product is sold also to cement and talc manufacturers.

Besides the uses that have been enumerated, it would seem probable that the Ulster county grit might be well adapted for the lining of pebble mills, an application which has not been attempted, hitherto, so far as known. Such mills are employed quite extensively for fine grinding of feldspar and other hard materials. They are usually lined with imported French rock which is furnished in small blocks dressed to the required shape. In its general freedom from iron or other coloring agents, the grit fulfils one of the important requisites for such material, but its wearing qualities under the severe conditions can not be determined except by actual test.

The production of millstones in 1907 amounted to a value of $21,806, as compared with $22,442 in 1906 and $22,944 in 1905. The production includes also the blocks and disks quarried and sold for roll crushers. At one time the output of Ulster county was valued at over $100,000 annually.

MINERAL PAINT

The term mineral paint is here used to designate the natural mineral colors obtained by grinding an ore or rock. The materials suitable for this purpose that are found in New York State include iron ore, shale, slate and ocher.

For metallic paint and mortar colors some form of iron ore, generally hematite or limonite, is commonly employed, but only a few localities are known where the ore possesses the requisite qualities of color and durability. The fossil hematite from the Clinton formation is perhaps most widely used in this country. The mines owned by C. A. Borst at Clinton, Oneida co., and those of the Furnaceville Iron Co. at Ontario, Wayne co., supply much of the crude material. The red hematite mined by the Rossie Iron Ore Co. at Rossie, St Lawrence co., also yields a good metallic paint.

Mineral paint made from shale and slate is quite extensively used for wooden structures. When there is a considerable percentage of iron oxids present, the shale and slate may be sold for metallic paint. Their value depends largely upon the depth and durability of their color; but the degree of natural fineness and the amount of oil required in mixing must also be considered in determining their utility. At Randolph, Cattaraugus co., beds of green, brown and bluish shale occur in the Chemung formation. They are worked by the Elko Paint Co. In years past red shale has been obtained in Herkimer county from the Vernon beds at the base of the Salina. A similar material occurring in the Catskill series has been worked at Roxbury, Delaware co. The red slate of Washington county, which belongs in the Cambric, is also ground for paint. The Algonquin Red Slate Co. of Worcester, Mass., and A. J. Hurd of Eagle Bridge produce this material.

A product known as mineral black is made by grinding slate found in the Hudson River series.

The ferruginous clay called ocher occurs quite commonly in the State, but no deposits are exploited at present. A bed occurring on Crane mountain, Washington co., once supplied a considerable quantity.

Sienna, a variety of ocher, occurs near Whitehall. The deposit is a thin stratum in glacial drift and has been worked on a small scale.

In addition to the producers above mentioned, the Clinton Metallic Paint Co., of Clinton, and the William Connors Paint Manufacturing Co., of Troy, are engaged in the manufacture of mineral paints from New York materials.

The production of mineral paints in 1907 was as follows: metallic paint and mortar color, 5269 short tons valued at $59,521; slate pigment, 620 short tons valued at $3700. In the year 1906 the following quantities were reported: metallic paint and mortar color, 2714 short tons valued at $29,140; slate pigment, 2045 short tons valued at $15,960. These quantities include only the output made within the State from local materials. A part of the ore and rock is shipped each year to points outside of the State for manufacture. An output of 9667 long tons valued at $24,185 was reported in 1907 by four firms who sell the crude ore or rock to paint grinders. In the preceding year the corresponding total was 9382 tons valued at $22,949.

MINERAL SPRINGS

The mineral springs of New York afford a variety of waters suited for medicinal and table uses. There are over 200 springs in the State that have been listed and classified according to the nature of their dissolved mineral ingredients, though many have no commercial application, except perhaps for local consumption. Some of the spring localities — like Saratoga Springs, Ballston Springs and Richfield Springs — are popular resorts during the summer season and in this way the waters afford an indirect but very important source of income.

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 this State. The dissolved bases may exist in association with chlorin and carbon dioxid, as is the case with 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 occuring usually in the Trenton limestone. They are accompanied by free carbon dioxid, which together with chlorin, sodium, potassium, calcium and magnesium exists also 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 co., and Massena Springs, St Lawrence co., are among the localities where sulfureted waters occur and are utilized.

The Oak Orchard springs in the town of Byron, Genesee co., 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 co., 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.

A branch of the industry that has recently assumed considerable importance in New York State is the sale of spring waters which can not be classed as mineral in the usual sense of the term, but find wide use as potable waters on account of their freedom from harmful impureties. Such waters are usually shipped in bulk to the principal cities where they are bottled and distributed by wagons among the individual consumers. The Great Bear spring at Fulton and the Deep Rock spring at Oswego are examples of this class of springs.

The following list includes the names of the leading springs in the State which are employed for commercial purposes or have recently been so employed:

NAME	LOCALITY
Baldwin Mineral Spring	Cayuga, Cayuga co.
Chautauqua Lithia Spring	Westfield, Chautauqua co.
Breesport Oxygenated Mineral Spring	Breesport, Chemung co.
Chemung Spring	Chemung, Chemung co.
Magnetic Flint Rock Spring	Elmira, Chemung co.
Rockdale Mineral Spring	Rockdale, Chenango co.
Lebanon Mineral Spring	Lebanon Springs, Columbia co.
Mount View Spring	Poughkeepsie, Dutchess co.
Ayers Amherst Mineral Spring	Williamsville, Erie co.
Avon Sulphur Springs	Avon, Livingston co.
Artesian Natural Mineral Spring	Franklin Springs, Oneida co.
Glacier Spring	Franklin Springs, Oneida co.
Kirkland Spring	Franklin Springs, Oneida co.
Split Rock Spring	Franklin Springs, Oneida co.
Geneva Lithia Mineral Water Spring	Geneva, Ontario co.
Crystal Springs	Oswego, Oswego co.
Deep Rock Spring	Oswego, Oswego co.
Great Bear Spring	Fulton, Oswego co.
White Sulphur Springs	Ritchfield Springs, Otsego co.
Massena Spring	Massena Springs, St Lawrence co.
Artesian Lithia Spring	Ballston Spa, Saratoga co.
Arondack Spring	Saratoga Springs, Saratoga co.
Champion Spring	Saratoga Springs, Saratoga co.
Chief Spring	Saratoga Springs, Saratoga co.
Congress Spring	Saratoga Springs, Saratoga co.
Empire Spring	Saratoga Springs, Saratoga co.
Eureka White Sulphur and Mineral Spring	Saratoga Springs, Saratoga co.
Geyser Spring	Saratoga Springs, Saratoga co.
Hathorn Spring	Saratoga Springs, Saratoga co.
Hides Franklin Spring	Saratoga Springs, Saratoga co.
High Rock Spring	Saratoga Springs, Saratoga co.
Lincoln Spring	Saratoga Springs, Saratoga co.
Patterson Mineral Spring	Saratoga Springs, Saratoga co.
Royal Vichy Spring	Saratoga Springs, Saratoga co.
Saratoga Carlsbad Spring	Saratoga Springs, Saratoga co.
Saratoga Seltzer Spring	Saratoga Springs, Saratoga co.
Saratoga Victoria Spring	Saratoga Springs, Saratoga co.
Star Spring	Saratoga Springs, Saratoga co.
Washington Lithia Spring	Ballston Spa, Saratoga co.
Chalybeate Spring	Sharon Springs, Schoharie co.
Magnesia Spring	Sharon Springs, Schoharie co.
White Sulphur Spring	Sharon Springs, Schoharie co.
Red Jacket Mineral Spring	Seneca Falls, Seneca co.
Pleasant Valley Mineral Spring	Rheims, Steuben co.
Sulphur Spring	Hornby, Steuben co.
Setauket Spring	East Setauket, Suffolk co.
Big Indian Spring	Ellenville, Ulster co.
Elixir Spring	Clintondale, Ulster co.
Vita Spring	Fort Edward, Washington co.
Clyde Mineral Spring	Clyde, Wayne co.

The industry in connection with the production and sale of spring waters has attained to large proportions and promises to show continued growth. The quantity marketed at present may be estimated at fully 8,000,000 gallons a year with a value of about $1,000,000. Approximately one half of the total value is represented by sales of mineral waters from Saratoga co. The figures given are estimates based on a partial canvass of the industry. A more accurate statement of the production is impracticable owing to the many changes that take place in the industry each year. The commercial utilization of many springs is transitory and others are employed only locally for supplying hotels, sanatoriums, etc. It is believed, however, that the estimate is close to the actual production.

NATURAL GAS

The production of natural gas for lighting and heating purposes has been carried on in New York since the first part of the preceding century. It is recorded that the village of Fredonia, Chautauqua co., was illuminated by gas supplied from local wells as early as 1825, an event attracting widespread interest at the time and no doubt a precursor of the extensive exploitation of the natural gas fields in other sections of the country. Following this development came the discoveries of the pools in Cattaraugus county which began about 1865, and later those in Allegany county, a result of explorations conducted for petroleum. Within the last 20 years there has been a great expansion in the industry and gas wells are now scattered over most of the western part of the State, including 15 counties which are active producers.

Geological occurrence. The range of the productive 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.

Though small amounts of gas have been found in sandstones correlated with the Potsdam, the lowest beds which are the source of any considerable flow are the limestones of Trenton age. The wells of Oswego and Onondaga counties now supplying gas are bottomed in the Trenton, though in many instances secondary contributions are derived from the overlying Utica shale. Elsewhere, as in Oneida and Jefferson counties, these limestones have not afforded any durable supply.

The next higher horizon of importance is at the base of the Lower Siluric and includes the Medina sandstone and its eastern representative, the Oswego sandstone. The occurrence of pools in this formation is of recent discovery, but they now yield a very large portion of the production. The principal field, opened since 1890, is in Erie county beginning near Buffalo and extending eastward through the towns of Cheektowaga, Amherst, Lancaster, Clarence, Alden and Newstead. A second field occurs south of Buffalo between that city and Jewettville. The wells at Avon and Caledonia, Livingston co., are said to reach the Medina. In the last two years large pools have been encountered in what is regarded as the white Medina sandstone in northern Chautauqua county, notably at Westfield and Silver Creek. The recent discoveries at Pavilion, Genesee co., are likewise reported to be in that formation.

The remaining formations of the Lower Siluric are made up mostly of shales and limestones. They appear to be relatively poor reservoirs for gas.

In the Devonic system, practically all of the formations represented in western New York have been found to contain gas at one or more localities. The most prolific, undoubtedly, are the upper members, the Portage and Chemung shales and sandstones. They are tapped by numerous wells in Allegany, Cattaraugus and Chautauqua counties. The principal gas supplies are derived from southern Allegany and Cattaraugus counties, from the same fields which yield petroleum. Many of the wells yield both gas and oil, and a part of the gas is consumed locally in operating the oil pumps, while the remainder is run into pipe lines for distribution in the neighboring cities and villages. The original wells put down in the Lake Shore belt of Chautauqua county, at Fredonia, Brocton, Mayville and Ripley seem to have found the gas mainly in the Chemung shales. The deeper wells that were drilled later encountered reservoirs at different horizons below the Chemung, as far down as the Medina. The Marcellus and Onondaga formations of the Devonic are considered by Bishop[1] to be the sources of the gas at Gowanda, in northern Cattaraugus county.

[1]Oil and Gas in Southwestern New York. N. Y. State Geol. 19th An. Rep't. 1901, p. 116.

The geographical limits of the gas fields can only be broadly defined, but it is observable that with one or two exceptions they are situated in the western section of the State in the middle and southern tiers of counties. The wells of Oswego county, near the end of Lake Ontario, represent the most easterly points at which the presence of gas in quantity has been established, and there the pools seem to be confined to small areas. The disturbed condition of the strata has, no doubt, militated against the accumulation of gas in the eastern section of the State.

Production. There are about 850 productive gas wells distributed among the different counties and owned by 150 individuals and companies. Most of the wells in Chautauqua county are operated for private use and their combined output is small. Aside from them, the production is in the control of a relatively few companies who have pipe lines and distribute the gas for general consumption.

The production during the past four years is shown in the accompanying table, which gives the value of the output for the leading counties. The total value in 1907 amounted to $800,014, which is an increase of $33,435 over the value returned for the preceding year.

Production of natural gas

COUNTY	1904	1905	1906	1907
Allegany-Cattaraugus	$183 830	$204 430	$247 208	$250 159
Chautauqua	31 822	26 232	94 345	106 411
Erie	254 899	281 253	317 554	320 199
*a*Livingston	32 451	41 805	52 805	55 780
Onondaga	15 350	16 825	16 385	17 030
Oswego	14 990	13 583	13 182	10 585
*b*Wyoming	18 855	22 872	25 100	39 850
Total	$552 197	$607 000	$766 579	$800 014

a Includes also Seneca, Schuyler, Steuben, Ontario and Yates counties.
b Includes also Niagara and Genesee counties.

The quantity of gas produced in 1907 was approximately 3,052,145,000 cubic feet. In arriving at this total, estimates are included for certain producers who were unable to supply exact figures, but as it is only the smaller operators who do not keep records of their wells, the estimate is very close to the actual production. No account is made, however, of the gas consumed by oil companies for pumping. The quantity of gas yielded by the wells in 1906 was 3,007,086,000 cubic feet, in 1905, 2,639,130,000 cubic feet and in 1904, 2,399,987,000 cubic feet. The average value of the natural gas varies according to locality from a minimum of 18 cents to a maximum of 50 cents a thousand cubic feet. The general average for the whole State in recent years has been about 25 cents.

New developments. There has been an average amount of drilling done during the past year and the additional supplies from new wells have more than sufficed to keep up the production.

In Chautauqua county, the Frost Gas Co. put down another well at Sheridan where it first began producing two years ago The new well is said to have given an indicated flow of 2,500,000 cubic feet a day. The South Shore Gas Co. also opened a successful well at a depth of 2100 feet at Sheridan. At Westfield the Welch Gas Co. drilled its fourth well, which attained a depth of 2340 feet. After shooting, a flow of 350,000 feet a day was registered, apparently from the Medina sandstone. In exploring for oil at Levant, in the southeastern part of the county, a gas reservoir was tapped at 1200 feet depth showing a pressure of 125 pounds. The exploration of a large tract of land near Gerry is in prospect where options have been secured for that purpose by O. M. Burdick and A. L. Shaner of Bolivar.

A well flowing 200,000 cubic feet a day was put down at Elma, Erie co., and others are to be drilled during the current year. It is intended to use the gas at Elma. A successful well has been located at Ebenezer by William Vogel, the reservoir being tapped at 1600 feet.

The Pavilion Natural Gas Co. continued drilling at Pavilion, Genesee co., where important discoveries were made in 1906. The company now has nine producing wells with an indicated capacity of 10,000,000 cubic feet. The gas is supplied to the villages of Leroy and Pavilion. A well drilled on the Charles Kane farm gave an estimated flow of 2,500,000 cubic feet when first opened. The Alden-Batavia Natural Gas Co. has begun exploration at Darien in southwestern Genesee county.

A new development at Naples, Ontario co., is a well located in the valley just west of the village. Gas was found at 1092 feet depth. There are four old wells on the east side of the valley. Plans have been formed for the exploration of a large tract of land near Reed's Corners, east of Canandaigua, by a Pittsburg company.

In Steuben county, the North Side Gas & Oil Co. continued the drilling of a well at Ferenbaugh which was started in 1906. After encountering a small flow at 250 feet, the hole was carried down to 2100 feet and shot, but registered less than 40,000 feet a day. A second well of nearly equal depth gave no results. The Steuben Oil and Gas Co. of Hammondsport will sink a test well near Keuka. Drilling has been started near Canisteo on the farm of James E. Wilson. The exploration of the Troupsberg field has been discontinued for lack of success.

PETROLEUM

The oil pools found in New York State constitute the northern extension of the Appalachian field which reaches its main development in Pennsylvania, Ohio and West Virginia. They underlie small areas in Cattaraugus, Allegany and Steuben counties near the Pennsylvania border. The first well was drilled in Cattaraugus county in 1865, while Allegany county began producing about 1880. The oil is encountered in fine-grained sandstones of dark color belonging to the Chemung formation of the Upper Devonic.

In Cattaraugus county the productive area embraces about 40 square miles, mostly in Olean, Allegany and Carrolton townships. The pools occur at several horizons from 600 to 1800 feet below the surface. The principal ones are the Ricebrook, Chipmunk, Allegany and Flatstone.

The oil field of Allegany county extends across the southern townships of Clarksville, Genesee, Wirt, Bolivar, Alma, Scio and Andover and is divided into several pools that are considered to be more or less independent. The Bolivar, Richburg and Wirt pools have been most productive. The oil is found at depths from 1400 to 1800 feet. The Andover pool lies partly in the town of West Union, Steuben co., and is tapped by wells from 850 to 1000 feet in depth. The discovery of oil in the town of Granger, on the Livingston county border has been in some respects the most noteworthy addition to the productive area of late years, since the pool is much farther north than any heretofore found in the State.

There has been little change in the production of petroleum for several years past, though the drilling of new wells is not so actively prosecuted as formerly; the maintenance of the output at a nearly constant level may be ascribed in a large degree to the relative permanency of the pools. Practically all of the production is obtained by pumping. By using gas engines which are fed by the natural gas that accompanies the petroleum the pumps can be worked at small expense and wells yielding less than a barrel a day are profitable. The product is transported to the refineries by pipe lines. The following companies handle practically all of the output within the State: The Allegany Pipe Line Co., Columbia Pipe Line Co., Union Pipe Line Co., and Fords Brook Pipe Line Co., all of Wellsville; Vacuum Oil Co., of Rochester, and the Tide Water Pipe Co., Limited, of Bradford, Pa.

The output of petroleum in 1907 amounted to 1,052,324 barrels, as compared with 1,043,088 barrels in the preceding year. The following table shows the total for each year since 1891. The statistics subsequent to 1903 have been compiled from the receipts of oil reported by the companies above mentioned, while the others are taken from the annual volumes of the *Mineral Resources*.

*a*Production of petroleum in New York

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

a The statistics for the years 1891–1903 inclusive are taken from the annual volumes of the *Mineral Resources*.

During 1907 the exploration of the newly opened Short Tract or Granger district in northern Allegany county was carried on with vigor and additional discoveries are reported. This district was prospected to some extent five or six years ago, but without definitely establishing the presence of oil. The first of the productive wells is located on the Van Nostrand farm, 5 miles from Fillmore. An area of about 1000 acres in the vicinity has been proved to show good indications. The construction of a pipe to connect the wells with the railroad at Fillmore was begun during the year. The oil is clear and light in color and gravity, closely resembling the product from the Tiona field of Pennsylvania. Some of the wells when first opened flow under natural pressure.

Discoveries of oil were reported from Rexville, and in the town of Wayne, Steuben co., but as yet nothing definite can be stated concerning their importance.

PYRITE

As was anticipated in the preceding issue of this report, the pyrite industry of St Lawrence county experienced a notable advance during the past year. The production amounted to 49,978 long tons, as compared with 11,798 long tons in 1906 and 10,100 long tons in 1905, and was the largest ever recorded in the State. The St Lawrence Pyrite Co. at Stellaville and the American Pyrites Co. at Gouverneur were in active operation, the latter company, however, closing down its plant in July.

The property of the St Lawrence Pyrite Co. is situated 1 mile north of Hermon and includes the old Stella mine, the first to be opened in the district. This is not worked at present. The ore is taken from two new mines, to the southeast of the Stella shaft, developed since 1904 when the present company acquired the property. Most of the output is obtained from the mine adjacent to the mill. The other mine, situated ¼ mile south, is still in the development stage though producing some ore. An average of from 250 to 300 tons daily is mined. The whole mine output goes to the mill where it is concentrated to a product assaying from 47 to 48 per cent sulfur. A preliminary crushing is performed at the mine shafts by means of jaw crushers which discharge directly into cars. The ore passes through a Gates gyratory crusher and rolls at the mills. The first concentration is effected by Hancock jigs, while the middlings from this treatment are recrushed by rolls and reconcentrated on Hartz jigs. The slimes are passed over Overstrom tables. The mill has a nominal capacity of 500 tons crude ore a day.

The ore bodies have much similarity of shape and geological relations to the magnetites of the western Adirondacks. They are of lenticular form with their axes of extension alined parallel to the foliation of the wall rock, but often show a pitch across the dip. They range up to 30 feet thick. They occur in overlapping series sometimes closely set and again separated by varying thicknesses of the wall rock. The country is a dark hornblende-biotite schist belonging to the sedimentary or Grenville series of Adirondack formations.

The pyrite occurs in coarse particles and aggregates which only occasionally show crystal boundaries. The gangue consists mainly of vein quartz. Zinc blende is a common accompaniment, and pyrrhotite is encountered at times in considerable bodies. Though inclosed by sediments the deposits can scarcely be construed as original beds of contemporaneous formation, but their genesis probably has been parallel to that of the magnetites found in the Grenville which are always pyritic and not rarely richly so. There are no well defined walls, for the mineralization extends outward into the schist for some distance beyond the limits of the pay ore. The pyrite seems to have impregnated and replaced the schist to a great extent, at the same time filling small fissures and seams along the bedding planes. Its origin is traceable to iron-bearing solutions which have circulated through the schist when it was probably at considerable depth from the surface and perhaps in a less metamorphosed condition.

The crude ore carries about 30 per cent sulfur. An analysis of Stella ore showed the following percentages:

Silica	32
Iron	32
Sulfur	32
Copper	.04
Gold and silver	traces

The amount credited to silica probably includes the insoluble constituents, such as feldspar, hornblende, biotite and other silicates of the schist as well as quartz. The pyrite is free from arsenic and other deleterious impurities. It is shipped to acid makers in New York and adjoining states.

The National Pyrites Co., who formerly operated the mines at High Falls or Pyrites, has retired from business. The property has been taken over by the Oliver Iron Mining Co., a branch of the United States Steel Corporation. It is now being prospected in a thorough manner by the diamond drill. The ore occurs in lenses that strike northeast and dip northwest at an angle of 15° or so, with a pitch toward the north. The line of outcrop extends across the Grasse river under which there are workings reached from openings made on an island in the river. A striking feature of the deposits is the occurrence of pyrrhotite in segregated masses between the pyrite shoots. The mineral is not intermixed to any extent with the pyrite.

The Cole mine near Gouverneur consists of a large lens that outcrops at the surface and is worked as an open cut. It affords an ore above the average in richness, a part of the product being suitable for shipment in the crude state. The American Pyrites Co. took over the property in 1906, as successor of the Adirondack Pyrite Co. The suspension of operations, it is understood, has not been due to any failure of ore supply or technical difficulty, but to the heavy burden of royalties imposed.

SALT

The continued growth of output is the principal feature of the salt industry in the State recorded during the past year. The gain has been somewhat larger than the average and indicates apparently that the New York product is fully holding its own in the trade. Owing to its command of the large eastern markets, the local industry has been able to maintain the important position which it secured more than a century ago, notwithstanding the recent rapid development of other sources of supply.

All of the different grades of salt known to the trade are produced in the State. The rock salt mines situated in Livingston county supply more than one half of that commodity used in the country. The manufacture of salt by the solar process is carried on extensively on the Onondaga Reservation where it was first started in 1789. The brines used for that purpose are natural, while in the other localities the manufacture of brine salt is based on solutions obtained by driving wells into beds of rock salt and the introduction of water from the surface which is pumped up after becoming saturated. The grades of salt known as common fine, common coarse, table, dairy, packers, agricultural and milling salt are made by artificial evaporation of brines, the quality depending upon the methods employed and the degree to which the refining operations are carried.

In addition to the salt that is marketed as such, a very large proportion of the annual output of the State is converted into soda products by the Solvay Process Co. This company has a plant at Solvay near Syracuse, where the preparation of soda ash, carbonate, bicarbonate, etc., is carried on from brine that is supplied by the company's wells in the town of Tully, 20 miles south of Syracuse. The salt content of the brine thus used is included in the production tables herewith.

Altogether there were 31 companies in the State who reported an output in 1907, or one less than in the preceding year. Of the total number, Onondaga county was represented by 20 companies, while the remaining 11 were distributed among the following counties: Genesee, Livingston, Schuyler, Tompkins and Wyoming. The International Salt Co., the largest manufacturers of brine salt in the State, operated four plants as follows: Ithaca works, Ithaca; Cayuga works, Myers; Glen works, Watkins; and Yorkshire works, Warsaw. The Hawley and Warsaw works, at Warsaw, owned by the company were inactive. No new manufacturers have entered the list of producers during the year.

The total quantity of salt obtained from mines and wells in New York last year amounted to 9,657,543 barrels of 280 pounds, on which a value of $2,449,178 was placed. This shows a gain of 643,550 barrels, or 7 per cent, over the output for 1906 which was 9,013,993 barrels valued at $2,121,650, the largest reported up to that year. Most of the increase was contributed by the mines of rock salt, the output of which is about one third the entire total for the State.

The accompanying tables show the production of salt distributed among the various grades. The output listed under "other grades" is made up principally of rock salt and salt used for soda manufacture which are combined so as not to reveal the figures reported by the individual companies. A small quantity of other kinds not specified in the returns is also included under that item. The valuation placed on the salt thus listed is much smaller proportionately than that of the other grades inasmuch as the salt consumed by the Solvay Process Co. bears only a nominal value.

Production of salt by grades in 1906

GRADE	BARRELS	VALUE	VALUE PER BARREL
Common fine	1 164 064	$413 462	$ .35
Common coarse	182 636	62 758	.34
Table and dairy	1 211 936	603 034	.50
Coarse solar	510 800	191 551	.38
Packers	39 286	14 100	.36
*a*Other grades	5 905 271	846 745	.14
Total	9 013 993	$2 131 650	$ .23

a Includes rock salt, salt in brine used for soda manufacture, and small amounts of brine salt for which the uses were not specified in the returns.

Production of salt by grades in 1907

GRADE	BARRELS	VALUE	VALUE PER BARREL
Common fine	1 214 093	$446 618	$ .37
Common coarse	155 593	64 794	.42
Table and dairy	1 183 643	639 464	.54
Coarse solar	415 971	156 072	.37
Packers	43 614	14 993	.34
*a*Other grades	6 644 629	1 127 237	.17
Total	9 657 543	$2 449 178	$ .25

a Includes 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.

Onondaga county ranks first among the counties of the State in quantity of annual output and has contributed by far the largest total production. Between the years 1797 and 1892 there was made and sold from the Onondaga Salt Springs an aggregate of 71,284,419 barrels, equivalent to 9,979,819 short tons. If the salt utilized for soda manufacture be also included, the production of the county to date can not be much less than 20,000,000 tons. Up to the year 1880, when the beds of rock salt in the western part of the State began to be utilized, Onondaga county supplied the whole output, but since then it has gradually lost its importance in the trade and the greater part of the total now returned for the county represents the salt in brine consumed for soda manufacture.

The relative rank of the counties of the State, according to their output of marketable salt in 1907, was as follows: Livingston, Wyoming, Tompkins, Schuyler, Onondaga and Genesee.

Livingston county furnishes the entire product of rock salt which is mined at Retsof and Cuylerville. The Retsof Mining Co. has worked a deposit at the former locality for many years. The Sterling Salt Co. at Cuylerville began production in the fall of 1906 and the past year was the first one in which the mine was continuously active.

The growth of the salt industry in New York during the past 25 years is illustrated by the accompanying table which covers the output for the period 1883–1907 inclusive. It is noticeable that while the production has increased nearly six times during the period, the value of the annual total has grown at a much smaller rate. The figures for the years previous to 1904 are taken from the annual volumes of the *Mineral Resources.*

Production of salt in New York since 1883

YEAR	BARRELS	VALUE
1883	1 619 486	$680 638
1884	1 788 454	705 978
1885	2 304 787	874 258
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

SAND

The resources of the State in sands adapted for building, metallurgical and other uses are extensive and suffice to meet most of the local requirements for the material. The building and construction trades call for the largest quantity, consuming several millions of tons annually of the common grades which are obtained in great part within the immediate vicinity of the markets. Molding sands, glass sand, furnace sand, fire sand and filtration sands are among the other kinds produced, some of which are shipped to points without the State.

Building sand. The glacial deposits which are found in nearly all sections afford an abundance of sand for building and construction purposes. The deposits may be mixed with gravel, boulders and clay, requiring some preparation of the sand by screening or washing before it can be used. Frequently, however, the materials have been sorted by natural processes so that beds yielding clean and evenly sized sand may be found. The supplies of sand used in building operations in Albany and Rochester are derived from local morainal deposits. Alluvial sand found along the stream valleys is employed in many localities in the interior of the State. Beach sand also enters into the trade; most of the building sand consumed in New York city is obtained from the shores of Long Island, and Buffalo derives its supply from the beaches of Lake Erie principally from the northern or Canadian shore.

The extent of the trade in building sand is indicated by the statistics collected by the United States Geological Survey, according to which the production of New York in 1906 amounted to 3,369,194 short tons valued at $1,045,844. Large as the total is, it perhaps falls short of the actual production, since there is great difficulty in obtaining complete information on the subject. Little capital is represented in the individual enterprises and they are mostly of transitory nature, so that many changes take place each year. The intrinsic value of the product, aside from the costs of labor and transportation, is small.

Glass sand. For the manufacture of glass, pure quartz sand is required. The presence of dark minerals such as magnetite, hornblende, biotite, etc., which carry iron, is particularly objectionable. In the manufacture of window glass and articles of common glass, the iron is kept down to a small fraction of one per cent, while for the finer grades no more than a trace is allowable.

The glass sand produced in New York comes from the vicinity of Oneida lake. The principal localities where it is found are in the towns of Rome, Verona and Vienna, Oneida co., and Constantia, Oswego co. At one time this section supported a large industry in the manufacture of window glass, with factories at Durhamville, Constantia and Cleveland, but the cost of fuel became a serious handicap when competition was encountered with centers of manufacture in the natural gas and soft coal regions. Small quantities of the sand are now shipped to other parts of the State for making bottles and common wares. The shipments in 1907 amounted to 1200 short tons valued at $1380.

Some of the sandstones of New York have been used in the past for glass making. The Shawangunk grit was once quarried near Ellenville, Ulster co., and the output sold to Pennsylvania companies. The Potsdam sandstone has likewise been used for the purpose.

Molding sand. This material is produced largely along the Hudson river valley, in Albany, Columbia and Dutchess counties. The deposits are a part of the water-washed glacial accumulations of the region and are found in the upper section immediately underlying the soil. The valuable portion ranges from a few inches up to several feet thick. The sand contains a little clayey matter which contributes to its firmness and plasticity. The finest grades are used for stove and other castings that require a smooth finish and are shipped to Albany, Troy and more distant points. Sand used for making cores in molding is obtained from Oneida lake, from the same deposits that yield glass sand.

SAND-LIME BRICK

There have been few changes in this industry during the year. The activity shown in the erection of new plants for the manufacture of sand-lime brick was less noticeable than in the preceding year, no doubt due in part to the smaller demand that has been experienced for building materials of all kinds. Reports were received from 12 plants, of which nine were operative during the whole or part of the year, and the production amounted to 16,610,000 valued at $109,677. The seven plants that reported as active in 1906 made an output of 17,080,000 valued at $122,340. The plant of the Rochester Composite Brick Co. was destroyed by fire but is to be replaced. The following is a list of the companies engaged in the industry in the State.

NAME	LOCATION
Buffalo Sandstone Brick Co.	Buffalo
Granite Brick Co.	Glens Falls
Granite Brick Co.	Sandy Hill
Lancaster Sand-Lime Brick Co.	Lancaster
Newburgh Sand-Lime Brick Co.	Newburgh
Paragon Plaster Co.	Syracuse
Rochester Composite Brick Co.	Rochester
Roseton Sand-Lime Brick Co.	Roseton
F. W. Rourke & Co.	Brooklyn
Sand Stone Brick Co.	Schenectady
Schenectady Brick Co.	Schenectady
Watertown Sand Brick Co.	Watertown

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 attained much greater importance in the industry. The slate occurs in several horizons among the metamorphosed Paleozoic strata of the region, but belongs mostly to the Cambric and Lower Siluric systems. 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 New Hamburg.

The slate from Washington county is remarkable for its variety of colors. The red slate which is obtained near Granville and in the Hatch Hill and North Granville sections has no superior for beauty and permanency, while purple, variegated and different shades of green slate occur in the southern section around Middle Granville, Salem and Shushan. Nearly all of the product is sold for roofing purposes. The manufacture of other materials such as mantels, floor tiling, blackboards, billiard tables, etc., is not carried on to any extent in the State.

The production of slate for the past year amounted in value to $53,625. Of this, roofing slate represented $52,450 and mill stock $1175. The number of squares of roofing slate made was 11,686. In 1906 the total production was valued at $61,921 consisting of 16,248 squares of roofing slate valued at $57,771 and mill stock valued at $4150. The average value of roofing slate for the year was $4.60 a square against $3.56 a square in 1906. The increased value was due more to the relatively large quantity of red slate produced than to higher market prices.

STONE

The quarry industries of New York are of large and growing importance. There are few other states that possess such a variety of geological formations with so many different rock members. The resources afford almost every kind of material used for building and construction purposes and many of the ornamental stones. Still the local product falls short of meeting the requirements, specially for building and decorative stones, and large quantities are brought in annually from other states or are imported from foreign countries.

The statistics and notes incorporated in the following pages relate to the different quarry industries of the State, except those of slate and millstones, which are treated under their own titles elsewhere in this report.

Production of stone

The value of the quarry materials produced in 1907 amounted in the aggregate to $7,890,327. The total for the preceding year was $6,504,165, showing a gain of $1,386,162, or about 20 per cent. Nearly one half of the amount consisted of limestones which accounted for a total of $3,182,447 as compared with $2,963,829 in 1906. The sandstone quarried was valued at $1,998,417 against $1,976,829 in the preceding year, the larger part contributed by the companies engaged in the bluestone trade. The marble quarries reported the largest increase for the year, the production having a value of $1,571,936, as compared with $460,-915 in 1906. The output of granite showed a small falling off, with a total value of $195,900 in 1907 and $255,189 in the preceding year.

Classified as to uses, crushed stone was the largest item in the total and represented a value of $2,812,998, an increase of nearly $400,000 for the year. The use of crushed stone in road improvement work and for making concrete has been the chief factor in the development of this branch of the industry which has nearly doubled in importance within the last three years. The quantity of crushed stone made last year was approximately 3,319,706 cubic yards, as compared with 3,132,460 cubic yards in 1906. The quantity reported as used for road metal was

854,720 cubic yards, against 905,750 cubic yards in 1906. This total, however, does not represent the full amount thus used, as some of the firms are unable to classify their product. The value of the building stone, rough and dressed, amounted to $2,208,545, against $1,408,583 in 1906. Curb and flagstone aggregated the sum of $1,064,193 as compared with $999,678, represented largely by bluestone. The monumental stone, principally marble, was valued at $162,359, against $103,219 in 1906. The value of the stone quarried for purposes other than those given, including lime, furnace flux, paving blocks, riprap, rubble, etc., was $1,642,232, as compared with $1,557,192 in 1906.

Production of stone in 1905

VARIETY	BUILDING STONE	MONUMENTAL	CURBING AND FLAGGING	CRUSHED STONE	ALL OTHER	TOTAL VALUE
Granite	$139 414	$10 431	*a*	$69 748	$34 362	$253 955
Limestone	246 300	....	$7 297	1 193 800	964 059	2 411 456
Marble	571 810	177 557	*a*	*a*	25 190	774 557
Sandstone	530 485	....	1 029 913	37 406	446 156	2 043 960
Trap	*a*	....	....	601 669	21 550	623 219
Total	$1 488 009	$187 988	$1 037 210	$1 902 623	$1 491 317	$6 107 147

a Included under "All other."

Production of stone in 1906

VARIETY	BUILDING STONE	MONUMENTAL	CURBING AND FLAGGING	CRUSHED STONE	ALL OTHER	TOTAL VALUE
Granite	$231 190	$4 119	*a*	$13 980	$5 900	$255 189
Limestone	229 479	....	$8 067	1 590 205	1 136 078	2 963 829
Marble	337 365	99 100	*a*	*b*	24 450	460 915
Sandstone	610 549	*a*	991 611	51 205	323 464	1 976 829
Trap	*a*	....	....	780 103	67 300	847 403
Total	$1 408 583	$103 219	$999 678	$2 435 493	$1 557 192	$6 504 165

a Included under "All other." *b* Included under Limestone.

Production of stone in 1907

VARIETY	BUILDING STONE	MONUMENTAL	CURBING AND FLAGGING	CRUSHED STONE	ALL OTHER	TOTAL VALUE
Granite	$84 774	$9 613	*a*	$92 950	$8 563	$195 900
Limestone	189 782	....	$13 123	1 725 203	1 254 339	3 182 447
Marble	1 408 190	152 746	*a*	*b*	11 000	1 571 936
Sandstone	525 799	....	1 051 070	55 818	365 730	1 998 417
Trap	*a*	....	....	939 027	2 600	941 627
Total	$2 208 545	$162 359	$1 064 193	$2 812 998	$1 642 232	$7 890 327

a Included under "All other." *b* Included under Limestone.

Granite

Under the head of granite are grouped by the trade the crystalline rocks in which feldspar and other silicates are the predominant minerals. Besides granite in the strict sense the class comprises syenite, diorite, gabbro and anorthosite, in fact practically all of the igneous rocks, as well as many gneisses and schists, that are adapted for building construction or ornamental purposes. The fine grained crystalline rocks known as trap, however, are usually separated from the class owing to their somewhat special qualities and will be treated here under their own title.

There are two principal areas where these rocks occur in New York, the one being the Adirondack region and the other the lower Hudson valley and the bordering highlands. Both regions afford a variety of both massive and gneissoid types in great abundance, yet the quarries have not been developed as yet on a scale at all commensurate with the local markets. The present output represents but a fraction of the granite actually used each year for building or other purposes; by far the greater part is brought in from other states and some is imported from foreign countries.

The returns received from the quarries for 1907 show an output valued at $195,900, as compared with a value of $255,189 for the preceding year. The value of the building stone quarried was $84,774 against $231,190 in 1906, the decrease being due to the smaller operations in the quarries of Westchester county which supply building stone to New York city. The production of granite for other purposes was as follows: monumental stone, $9613, against $4119 in 1906; crushed stone, $92,950 against $13,980; rubble and riprap, $5600 against $2423; paving blocks, curbing and miscellaneous, $2963, against $3477. The quantity of crushed stone made was approximately 111,150 cubic yards against 16,800 cubic yards in 1906. Westchester county contributed a production valued at $76,820, as compared with $172,845 in the preceding year. The remainder of the production was distributed among the following counties: Clinton, Essex, Fulton, Herkimer, Jefferson, New York and Warren counties. There were 14 quarries operated during the year, or five less than in 1906.

Production of granite

MATERIAL	1905	1906	1907
Building stone	$139 414	$231 190	$84 774
Monumental	10 431	4 119	9 613
Crushed stone	69 748	13 980	92 950
Rubble, riprap	30 125	2 423	5 600
Other kinds	4 237	3 477	2 963
Total	$253 955	$255 189	$195 900

Quarries for furnishing crushed stone have been opened at Little Falls where there is an extensive intrusion of the Adirondack syenite. The crushing plant of the John Pierce Co. on the north side of the Mohawk river is the largest in the State, and produces road metal, railroad ballast and concrete material. Another quarry on the south side of the river has recently been equipped with a plant for making concrete blocks. The quarries are advantageously situated for shipment of their product both by railroad and the canal system of the State and should command a wide market.

The Picton Island Red Granite Co. has been engaged in quarrying on Picton island in the St Lawrence river. The stone is a biotite granite, ranging from medium to fine in texture, and has a very attractive reddish color, verging toward pink in the fine grained variety. Similar granites have been quarried in the vicinity for many years and have gained a wide repute for their beauty and durability. The present quarries have furnished building material chiefly, but the stone is well adapted for monumental and decorative work as well. It has a specific gravity of 2.653 and a crushing strength of 16,500 pounds to the square inch.

The Adirondack anorthosite affords in some places a gray or bluish gray massive stone often showing the very pleasing effect of a porphyry when polished. It has been quarried on a small scale, principally for monumental purposes. The opening of new quarries near Ausable Forks, Clinton co. is contemplated by Mr Ernest Leblond who has also a quarry property in Adirondack syenite in the same vicinity.

Limestone

The limestone quarries are first in importance among the stoneworking industries of the State. Compared with sandstone which ranks second in value of output, limestone is not so generally used as building material, but it finds extensive employment for road metal and concrete. Its wide occurrence in connection with a natural fitness for the purpose, has favored the development of a large crushed stone business that covers nearly every section of the State. The manufacture of lime is also an important industry, requiring a considerable proportion of the quarry output.

The noncrystalline limestones, which are considered under this head, comprise a variety of rocks as regards their geological occurrence and physical and chemical characters. They are distributed among the Cambric, Lower Siluric, Siluric and Devonic systems. In a few localities, the crystalline limestones or marbles of the Precambric are quarried for lime making and such production is reported as limestone. In their chemical composition the limestones of New York show a range from practically pure lime carbonates to magnesian limestones and dolomites and to silicious, aluminous or ferruginous types in which the carbonates play a subordinate rôle. Light colored and white limestones are not abundant, however, in the State, the prevailing colors being grayish or drab, and for this reason considerable quantities of such stone are brought in from other States, principally Ohio and Indiana.

Production of limestone

MATERIAL	1905	1906	1907
Crushed stone	$1 193 800	$1 590 205	$1 725 203
Lime made	702 684	795 348	888 309
Building stone	246 300	229 479	189 782
Furnace flux	198 168	287 816	338 127
Rubble, riprap	40 664	32 975	14 588
Flagging, curbing	7 297	8 067	13 123
Miscellaneous	22 543	19 939	13 135
Total	$2 411 456	$2 963 829	$3 182 447

The total production of the limestone quarries last year amounted in value to $3,182,447. This is exclusive of the stone used in the Portland and natural cement industries, for which no statistics have been collected. Compared with the previous year there was a gain of $218,618 in the valuation or about seven per cent. The product was distributed among 35 counties of the State with a total of 136 active quarries.

Crushed stone for road metal, concrete, etc., represents the largest item in the output. The value of this material was $1,725,203 against $1,590,205 for 1906. The manufacture of lime is second in importance with a product valued at $888,309 in 1907 and $795,348 in 1906. Building stone represented a value of $189,782, as compared with $229,479 in the preceding year. Limestone used as flux in metallurgical processes accounted for $338,127 against $287,816. Other items are: rubble and riprap valued at $14,588 against $32,975; flagging and curbing $13,123 against $8067; and miscellaneous materials, not classified in the returns, valued at $13,315, as compared with $19,939 in the preceding year.

Distributed according to counties in which the limestone was quarried, the largest producer was Erie county which reported an output valued at $516,727, consisting principally of building stone, crushed stone and furnace flux. This county also ranked first in 1906 with a valuation of $525,381. Onondaga county which returned a total of $479,780 was second as in 1906 when its output amounted to $391,457. It manufactures more lime than any other county in the State. The remaining counties which reported a value of over $100,000 each with their respective totals are here given, the figures in parentheses being the corresponding totals for 1906: Dutchess $399,244 ($368,927); Rockland $284,800 ($242,184); Genesee $283,513 ($227,062); Warren $225,262 ($205,832); Westchester $156,957 ($143,168); Albany $129,220 ($106,800); and Clinton $110,560 ($96,925).

Lime. There were 38 firms that reported an output last year of limestone (including marble) for lime burning, either as a main product or in connection with the quarrying of other materials. The greater portion of the limestone was converted by the companies operating the quarries. In all 18 counties participated in the production. The quantity of lime made was 403,114 short tons valued at $888,309. Onondaga county reported a product of 295,293 short tons, or about 73 per cent of the whole amount.

In the preceding year the output amounted to 313,369 short tons valued at $795,348, of which Onondaga county contributed 208,-250 tons. The importance of the industry in this county is to be ascribed to the operations of the Solvay Process Co. which uses the lime as a reagent in the manufacture of soda products.

The production in the other leading counties for 1907 and 1906 respectively was as follows, in short tons: Warren 45,747 (39,-076); Clinton 14,800 (16,400); Washington, 13,600 (12,000); Lewis 11,251 (9500); Jefferson 6482 (10,450); Westchester 6029 (7353).

It will be noted that the value of the production as above given is considerably less than the commercial price; this is due to the fact that a nominal valuation has been placed upon the portion used as a chemical reagent. Disregarding the quantity thus consumed, the value of the lime made for the market averaged $4.47 a short ton in 1907 and $4.58 a short ton in 1906.

Crushed stone. Limestone is more generally employed in New York for crushing than any other kind of stone. The total production in 1907 amounted to 2,211,102 cubic yards valued at $1,725,203, as compared with 2,194,547 cubic yards valued at $1,590,205 in the preceding year. Of the quantities given, 363,-589 cubic yards in 1907 and 486,750 cubic yards in 1906 were returned as having been used for road metal, though the amounts thus employed probably exceeded these totals, since some firms do not keep any records as to the disposal of their product.

The leading counties in the production of crushed stone, with their outputs in cubic yards, are as follows, the figures for 1906 being in parentheses: Dutchess 426,744 (400,177); Rockland 390,368 (373,387); Genesee 344,160 (323,128); Erie 250,720 (289,110); Albany 203,000 (150,000); Westchester 132,566 (105,441); and Onondaga 103,546 (92,950).

Building stone. The use of the local limestones for building purposes shows little or no tendency toward expansion, notwithstanding the important increases in the other materials supplied by the quarries. The value of the building limestone, rough and dressed, produced in 1907 was $189,782 as compared with a value of $229,479 in 1906. Erie county has the largest quarries of building stone, its output amounting in value to $114,351 as compared with $118,806 in the preceding year. The remaining counties are small producers. The output each year is supplemented by large quantities of limestone that are brought in from other states.

Furnace flux. The metallurgical industries of the State consume limestone as a flux in smelting operations. The largest users are the iron blast furnaces located in Buffalo and vicinity. The supply for this district is obtained from the outcrop of the Onondaga limestone in western New York and the adjacent part of the province of Ontario. The principal New York quarries are located at Clarence and Gunnville, Erie co., and at North Leroy, Genesee co. Blast furnace flux for the Adirondack iron furnaces is obtained at West Chazy, Clinton co., and near Port Henry, Essex co. It is also quarried at Oriskany Falls, Oneida co., for the furnace at Franklin Springs. A small output of the Gouverneur marble is shipped to Ohio for flux. The production of limestone classed as flux in the returns amounted to 563,684 long tons in 1907 valued at $338,127. In the preceding year the production was 400,002 long tons valued at $287,816.

Production of limestone by counties in 1906

COUNTY	CRUSHED STONE	LIME MADE	FURNACE FLUX	BUILDING STONE	OTHER USES	TOTAL
Albany	$96 200	$9 600	....	$500	$500	$106 800
Cayuga	23 098	....	$300	11 000	3 000	37 398
Clinton	8 350	61 500	15 900	7 175	4 000	96 925
Dutchess	368 927	....	....	....	....	368 927
Erie	222 384	375	172 550	118 806	11 266	525 381
Fulton	6 963	9 200	....	....	....	16 163
Genesee	142 342	14 000	69 650	1 070	....	227 062
Greene	1 785	....	186	24 500	15 500	41 971
Herkimer	4 000	6 300	....	810	....	11 110
Jefferson	4 875	42 250	....	6 053	499	53 677
Lewis	635	47 000	....	824	1 025	49 484
Madison	20 184	....	....	90	1 320	21 594
Monroe	52 295	....	....	7 564	547	60 406
Montgomery	55 235	....	....	4 116	1 297	60 648
Niagara	2 400	40	....	3 425	10 716	16 581
Oneida	32 000	....	12 600	15 000	....	59 600
Onondaga	63 986	313 500	3 420	8 976	1 575	391 457
Rockland	242 184	....	....	....	....	242 184
St Lawrence	....	9 040	3 311	800	911	14 062
Saratoga	13 000	....	....	3 000	....	16 000
Schoharie	21 073	300	....	10 825	7 875	40 073
Seneca	3 301	800	100	2 025	100	6 326
Warren	13 347	190 665	....	1 370	450	205 832
Washington	36 000	48 000	....	....	400	84 400
Westchester	105 441	36 766	711	250	....	143 168
*a*Other counties	50 200	6 012	9 088	1 300	....	66 600
Total	$1 590 205	$795 348	$287 816	$229 479	$60 981	$2 963 829

a Includes Columbia, Essex, Ontario, Orange, Rensselaer, Schenectady, Ulster, Wayne and Yates counties.

Production of limestone by counties in 1907

COUNTY	CRUSHED STONE	LIME MADE	FURNACE FLUX	BUILDING STONE	OTHER USES	TOTAL
Albany	$126 920	$2 000	....	$300	....	$129 220
Cayuga	32 578	400	$560	7 000	$13 050	53 588
Clinton	25 200	62 000	19 200	3 150	1 010	110 560
Dutchess	399 244	....	....	....	....	399 244
Erie	194 144	300	202 845	114 351	5 087	516 727
Fulton	9 141	11 637	....	....	....	20 778
Genesee	200 150	....	82 863	500	....	283 513
Greene	5 475	350	....	5 500	500	11 825
Herkimer	450	5 750	....	75	....	6 275
Jefferson	422	30 871	....	6 067	4 312	41 672
Lewis	475	55 255	....	604	758	57 092
Madison	45 000	....	5 000	....	....	50 000
Monroe	30 908	....	....	6 410	537	37 855
Montgomery	35 000	....	....	6 677	1 038	42 715
Niagara	30 123	500	....	1 920	8 250	40 793
Oneida	27 213	....	7 980	....	....	35 193
Onondaga	63 885	399 996	895	11 404	3 600	479 780
Ontario	3 433	....	....	808	678	4 919
Rockland	284 800	....	....	....	....	284 800
St Lawrence	....	10 940	9 843	809	154	21 746
Saratoga	10 000	....	....	2 500	....	12 500
Schoharie	12 051	300	....	18 446	....	30 797
Seneca	1 325	200	....	1 750	400	3 675
Warren	11 200	212 539	....	86	1 437	225 262
Washington	40 000	54 400	....	....	....	94 400
Westchester	132 566	24 116	275	....	....	156 957
*a*Other counties	3 500	16 755	8 666	1 425	215	30 561
Total	$1 725 203	$888 309	$338 127	$189 782	$41 026	$3 182 447

a Includes Columbia, Essex, Orange, Orleans, Schenectady, Ulster and Wayne.

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, non-crystalline limestones, 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 monumental marble is obtained principally in the vicinity of Gouverneur, St Lawrence co., where a large quarry and polishing industry has been established for many years. The stone has a coarse crystalline texture, a color varying from white to mottled white and gray, often quite dark gray, and takes a lustrous polish. As only the best of the quarry material can be used for monumental work, the poorer grades are dressed into blocks for building and construction purposes. There are a few quarries that have been worked specially for building marble.

The quarries of southeastern New York are located in the metamorphic belt extending from Columbia county, through Dutchess and Westchester to Manhattan island. White and light gray marbles are the characteristic products and are sold principally for building purposes. The South Dover Marble Co. owns quarries of white marble at South Dover, Dutchess co., which have furnished material for many buildings in New York and other cities. The marble is generally recognized as one of the best of the kind. It is employed also for interior work. The Waverly Marble Co. with quarries at Tuckahoe, Westchester co., has been a large producer of building marble, which has been used in many notable structures. It is white but coarser grained than the South Dover marble. Among other localities in this region where quarries have been worked are Ossining, Dobbs Ferry, White Plains, Oscawana and Pleasantville, Westchester co., and Greenport, Columbia co. Some of the quarries furnish material for lime making.

The production of marble during the past year amounted to a value of $1,571,936 which is much the largest total that has been reported by the New York State quarries. The value was distributed among the different kinds of marble as follows: building marble, rough and dressed, $1,408,190; monumental marble, rough and dressed, $152,746; other kinds, $11,000. The corresponding total for 1906 was $460,915, and was divided into: building marble, $337,365; monumental, $99,100; other kinds, $24,450. The value of the marble quarried last year in southeastern New York aggregated $1,252,000 against $260,350 in 1906. St Lawrence county reported an output valued at $297,936 against $136,835 in the preceding year. A new producer in this county is John J. Sullivan who has worked the Davidson marble quarry, 2 miles southwest of Gouverneur.

Production of marble

VARIETY	1905	1906	1907
Building marble	$571 810	$337 365	$1 408 190
Monumental	177 557	99 100	152 746
Other kinds	25 190	24 450	11 000
Total	$774 557	$460 915	$1 571 936

Sandstone

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

The wide distribution of sandstones in the geologic series of New York State, together with their adaptability to many uses, has given them great economic importance, and in value of the annual output they rank second only to limestone among the quarry materials. Nearly all the formations above the Archean contain sandstones at one or more horizons. The kinds chiefly quarried in New York are the Potsdam, Hudson River, Medina and the Devonic sandstones. A few quarries have been opened also in the Shawangunk conglomerate and the Clinton sandstone.

The fine grained evenly bedded strata that occur in the Devonic are popularly known as bluestone, a term first applied to them in Ulster county where they are distinguished by a bluish gray color. The name, however, no longer has its original significance and is here used generally for the sandstones found within the Devonic belt which stretches across the southern part of the State. Much of the bluestone possesses the property of splitting regularly along planes parallel to the bedding which renders the stone specially serviceable for flagging and curbing.

Production of sandstone

The total value of the sandstone quarried in New York last year was $1,998,417, or a little more than that for 1906 which was $1,976,829. The production was made in 35 counties by over 400 individuals and companies.

Classified as to uses the values for 1907 and 1906 (in parentheses) are divided into: building stone, rough, $220,718 ($343,077); building stone, dressed, $305,081 ($267,472); curbing, $599,053 ($553,085); flagging, $452,017 ($438,526); paving blocks, $320.301 ($282,063); crushed stone for roads, $13,799 ($14,677); crushed stone for other purposes, $42,019 ($36,528); rubble, etc., $24,812 ($11,661); all other kinds, $20,617 ($29,740). There was a small decrease in the value of building stone; the other materials held their own or showed small gains.

The following tables give the value of the production distributed among the leading districts of the State.

Production of sandstone in 1906

DISTRICT	BUILDING STONE	CURBING AND FLAGGING	PAVING BLOCKS	CRUSHED STONE	RUBBLE, RIPRAP	ALL OTHER
Bluestone						
Hudson river...	$70 816	$220 961	$14 228	....	....	....
Delaware river..	110 008	572 470	1 350	$700	$1 188	....
Chenango co...	85 576	41 985	....	....	2 678	....
Wyoming co...	234 280	....	....	550	843	$140
Other districts..	12 658	4 247	....	2 770	....	325
Total bluestone.	$513 338	$839 663	$15 578	$4 020	$4 709	$465
Sandstone						
Orleans county.	$50 845	$147 438	$260 878	$225	$552	$25 000
Other districts..	46 366	4 510	5 607	46 960	6 400	4 275
Total sandstone.	$97 211	$151 948	$266 485	$47 185	$6 952	$29 275
Combined total.	$610 549	$991 611	$282 063	$51 205	$11 661	$29 740

Production of sandstone in 1907

DISTRICT	BUILDING STONE	CURBING AND FLAGGING	PAVING BLOCKS	CRUSHED STONE	RUBBLE, RIPRAP	ALL OTHER
Bluestone						
Hudson river...	$60 613	$219 357	$13 925	....	....	....
Delaware river..	66 627	633 600	873	....	$1 528	$800
Chenango co...	62 302	28 380	175	$500	1 029	14 317
Wyoming co...	195 155	659	....	....	955	....
Other districts..	7 123	1 484	2 400	4 125	....	....
Total bluestone.	$391 820	$883 480	$17 373	$4 625	$3 512	$15 117
Sandstone						
Orleans co.....	$85 750	$139 140	$296 928	$15 500	$800	$4 100
Other districts..	48 229	28 450	6 000	35 693	20 500	1 400
Total sandstone.	$133 979	$167 590	$302 928	$51 193	$21 300	$5 500
Combined total.	$525 799	$1 051 070	$320 301	$55 818	$24 812	$20 617

The value of the bluestone quarried in 1907 was $1,315,927, or approximately 65 per cent of the total output; the value of the other sandstone quarried was $682,490 or 35 per cent of the total. Compared with the preceding year, the returns show a falling off in the bluestone trade, due mainly to the smaller output of building stone, the decrease being distributed over all the different districts. There was little change in the values of the other materials from those reported in 1906. The combined total of sandstone quarried on the other hand showed an increase.

The production of bluestone by districts was as follows, the figures for 1906 being in parentheses: Hudson river $293,895 ($306,005); Delaware river $703,428 ($685,716); Wyoming county $196,769 ($235,813); Chenango county $106,703 ($130,239); other districts $15,132 ($20,000). In the Hudson river district of Albany, Greene and Ulster counties, about 65 per cent of the output in 1907 was sold as flagstone and curbstone and about 21 per cent as building stone. In the Delaware river district including Sullivan, Delaware and Broome counties, the value of the flagstone and curbstone sold amounted to about 88 per cent and the building stone to 11 per cent. In Chenango county about 60 per cent of the entire product was marketed as building stone, while in Wyoming county practically the whole output consisted of that material.

The production of Medina sandstone in Orleans county last year was valued at $542,218, as compared with $484,938, the value of the output in 1906. This stone has come into wide use for street work owing to its durability and even wear, and is also an attractive building material. The quarries at Albion, Medina, Holley, etc., are large and well equipped.

Trap

The term trap is commonly applied to the dark fine grained igneous rocks occurring as dikes or sheetlike intrusions. The variety known as diabase, composed essentially of plagioclase feldspar and pyroxene in small interlocking crystals, is the most common in New York State. The dikes are well distributed throughout the eastern Adirondacks, particularly in Clinton and Essex counties, but they are usually too small to be workable. The dikes near Greenfield, Saratoga co., and at Little Falls, Herkimer co., are exceptional in size for that region, having a thickness of 200 feet or more. By far the largest occurrence in the State is that on the west side of the Hudson river, south of Haverstraw, which forms the remarkable scenic feature known as the Palisades. The southern end of this intrusion is found on Staten Island where it extends southwest from Port Richmond.

The principal use of trap is for crushed stone for roadmaking and concrete. It possesses qualities of strength and durability which place it first among the varieties of stone used for these purposes. The somber color and the difficulty of dressing the stone limits its employment for building work. It is used to some extent for paving blocks.

Rockland county produces most of the trap at the present time. The quarries are at Rockland lake, Mt Joy, Haverstraw and Nyack and are worked in connection with crushing plants. The stone is supplied to the cities and towns along the river, New York affording the largest market. The output of the county had a value of $874,527 in 1907 as compared with $780,703 in the preceding year.

The quarries at Port Richmond, Richmond co., were the only ones worked in the southeastern part of the State, aside from those mentioned.

The remainder of the output came from Greenfield and Northumberland, Saratoga co., and Fort Ann, Washington co.

The aggregate value of the production last year was $941,627, as compared with a value of $847,403 in 1906. Crushed stone was the chief item in the total and amounted to 982,454 cubic yards, valued at $939,027 against 851,293 cubic yards valued at $780,103 in the preceding year. A total of 362,904 cubic yards with a value of $349,485 was reported as sold for road material, but the actual quantity thus used was probably somewhat greater.

Production of trap

MATERIAL	1906		1907	
	Cubic yards	Value	Cubic yards	Value
Crushed stone	851 293	$780 103	982 454	$939 027
Paving blocks, etc	....	67 300	....	2 600
Total	....	$847 403	....	$941 627

TALC

The talc industry of St Lawrence county experienced a prosperous year, with demand and prices above the average for some time past. The production showed a small falling off and amounted to 59,000 short tons valued at $501,500, as compared with 64,200 tons valued at $541,600 in 1906. The figures for both quantity and value of output are based on ground talc in marketable form. The average selling price for the year was $8.50 per ton in carload lots at Gouverneur, which is the usual shipping point for all the mines. The following table gives the annual production and value for the period 1896–1907, the figures previous to 1904 being taken from the *Mineral Resources.*

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

The smaller output in 1907 is traceable to curtailment of milling facilities incurred by the destruction by fire of the Hailesboro mill in the preceding year; the mill, one of the original four belonging to the International Pulp Co., was the largest in the district. The company immediately added to the capacity of the Dodgeville mill which it took over from the United States Talc Co., and also started the construction of a new mill at Hailesboro. The latter is planned for a nominal capacity of 100 tons ground talc a day, or 25 tons more than the capacity of the old mill; it was practically completed at the end of the year.

By acquiring the property of the Union Talc Co., the International Pulp Co. has further strengthened its position as a producer. The former has been the largest of the independent companies since its organization in 1900. It owned three mines and produced a superior grade of talc.

The Ontario Talc Co. increased its mining capacity during the year by opening the Potter mine on the Van Namee farm, 1½ miles below Fullerville, from which 15 tons of talc a day were taken. The company is planning the construction of a new mill to be located at Gouverneur.

A talc deposit in the vicinity of Natural Bridge, Lewis co., has attracted some attention recently, though nothing more than a little exploration has been done thus far at the locality. Specimens of the mineral show an earthy or amorphous texture resembling rather the talc from the southern states than that from St Lawrence county.

The fibrous and foliated talc is marketed mostly among paper manufacturers. The former variety is particularly adapted for filling book and writing papers in which a smooth finish is desirable, and for that purpose is considered superior to kaolin in that it is more readily incorporated with the paper stock and at the same time makes a stronger tissue. The St Lawrence county talc has become a staple article in both the domestic and foreign paper trades. Large quantities are exported to Germany, where it competes with the best German clays. It is also shipped to Austria, Italy, France, Great Britain and other countries. The foliated talc is prepared separately and finds special employment in wall paper manufacture for giving a lustrous finish to the surface, such as was formerly produced by the use of ground mica.

ZINC AND LEAD

The deposits of zinc blende near Edwards and Fowler, St Lawrence co., described in preceding issues of this report, remained idle throughout the past year and as yet no shipments have been made from either locality. Their development so far has given very promising results which will lead, no doubt, to a resumption of operations as soon as the present legal difficulties are removed.

The old lead mines in the towns of Rossie and Macomb, St Lawrence co., have received some attention during the year. The mine near Pierces Corners has been under exploration by O. J. David of Gouverneur. The formation of a company under the title of the St Lawrence Lead Mining & Developing Co. was effected for the purpose of carrying on exploration and mining work in this section.

The mine near Otisville, Orange co., once owned by the Washington Mining Co., has been under development by the Phoenix Lead Co. of Paterson, N. J. The vein is reported to be 6 feet wide. It carries galena and zinc blende. No ore was shipped during 1907.

INDEX

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NO. 428 ALBANY, N. Y. AUGUST 1, 1908

New York State Museum

JOHN M. CLARKE, Director

Museum bulletin 121

FOURTH REPORT OF THE DIRECTOR OF THE SCIENCE DIVISION

INCLUDING THE

61ST REPORT OF THE STATE MUSEUM, THE 27TH REPORT OF THE STATE GEOLOGIST, AND THE REPORT OF THE STATE PALEONTOLOGIST FOR 1907

ALBANY

UNIVERSITY OF THE STATE OF NEW YORK

1908

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STATE OF NEW YORK

EDUCATION DEPARTMENT

npliments of

JOHN M. CLARKE

Director State Museum and
State Geologist

ATE HALL, ALBANY, N. Y.

New York State Education Department

Science Division, January 22, 1908

Hon. Andrew S. Draper LL.D.

Commissioner of Education

SIR: I have the honor to submit herewith my Fourth Annual Report as Director of the Science Division, for publication as the introductory portion of the 61st Annual Report of the State Museum.

Very respectfully

JOHN M. CLARKE

Director

State of New York

Education Department

COMMISSIONER'S ROOM

Approved for publication this 22d day of January 1908

A. S. Draper

Commissioner of Education

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REPORT OF THE DIRECTOR 1907

INTRODUCTION

This report covers all departments of scientific work under the charge of the Education Department and the Regents of the University and concerns the progress made therein during the fiscal year 1906–7. It constitutes the 61st annual report on the State Museum and is introductory to all the scientific memoirs, bulletins and other publications issued from this office during the year mentioned.

Under the action of the Regents of the University (April 26, 1904) the work of the Science Division is "under the immediate supervision of the Commissioner of Education," and the advisory committee of the Board of Regents of the University having the affairs of this division in charge are the Honorables: T. Guilford Smith LL.D., Buffalo; Daniel Beach LL.D., Watkins; Lucian L. Shedden LL.B., Plattsburg.

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

I Condition of the scientific collections

II Report on the Geological Survey, including the work of the State Geologist and Paleontologist, of the Mineralogist and that in Industrial Geology.

III Report of the State Botanist

IV Report of the State Entomologist

V Report on the Zoology section

VI Report on the Archeology section

VII A State Historical Museum

VIII Publications of the year

IX Staff of the Science Division and State Museum

X Accessions to the collections

XI Appendix: New entries on the general locality record of the paleontological collections

XII Appendixes (to be continued in subsequent volumes). All the scientific publications of the year.

I

CONDITION OF THE SCIENTIFIC COLLECTIONS CONSTITUTING THE STATE MUSEUM

The collections of the State Museum, both those exposed for exhibition and the much larger quantity, under stress of circumstances now in storage, remain in essentially the same condition as reported last year. With the present straightened quarters additional display of material, however interesting and instructive, is effectively debarred and as a consequence none of the recent acquisitions in which the past year has been fruitful have been made accessible to the public. The members of the scientific staff are industrious in the acquirement of materials. These materials are in very large degree the basis of investigations and must be temporarily accessible for study. Eventually, however, (and that is, generally, as soon as possible) these scientific specimens, irrespective of the interest attaching to them, or of their excellence, must be packed away in storage to await their resurrection in more adequate quarters.

The distribution of the various collections was stated specifically in the report of last year. It remains unchanged. The materials of the museum now occupy parts of

A Geological Hall
B State Hall
C Capitol
D Storage house, Orange street
E Flint Granite Co., Cemetery Station
F Property of Joseph L. Verstrepen, Delaware street

The offices of the members of the staff are also divided, part in the State Hall, another part in the Geological Hall.

The State Museum is a divided house, but not a house divided against itself. It stands, and there is every reason to believe that its work fortifies it by an uninterrupted progress along lines that are not alone of immediate practical import to the commercial interests of the State, but, of far greater ultimate moment to the community, also to a more adequate conception of the works and processes of nature. In the world's history never has the fact been made clearer than now that the State which most encourages scientific investigations for the purpose alone of determining the relation of its citizenship to the active natural forces on which that citizenship depends is performing its highest duty to the community and insuring its own stability. Though every channel of scientific knowledge seems gorged with details of information which few can digest, yet out of this choked and tangled mass, gradually unravel the guiding lines of knowledge which must give direction to the future progress of the race.

The new museum. In view of the dismembered condition of the State collections and the widely separated divisions of the working force, the advent of new and adequate quarters is hailed as the opening of an era which can not fail to infuse a wholesome spirit and a more definite objective in the labors of this organization.

In the 70 years of its history the scientific departments have had no direct appeal to the people save through the avenue of publication. It has been at no time possible to adequately display the tangible evidence of the State's natural resources. The real educational value of the collections is still untried though not unproven.

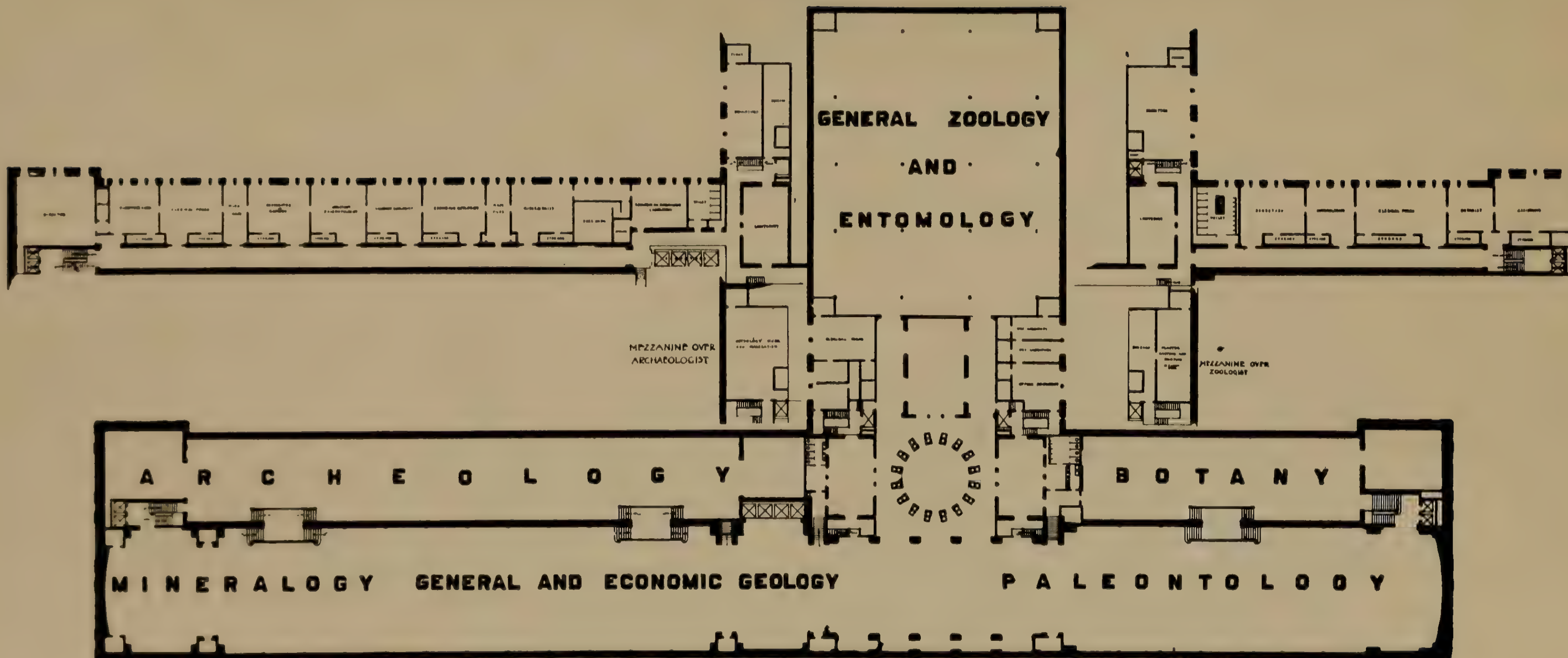
The provision made for museum quarters in the new Education Building on the basis of plans which have now been approved by the commission in charge thereof, will be not only adequate for present needs; it is hoped that provision has been made therein for the progress of another generation. Care has been taken to provide for such emergencies as time may bring and, while it is quite possible that the natural growth of the institution will uncover demands which have not yet presented themselves, experience has taught such vivid lessons in the economy of space that it is altogether likely we shall be equipped for such conditions.

The accompanying plan indicates the general arrangement of space alloted to the Science Division, exhibition rooms and offices. The most notable feature in this arrangement is the great hall extending the full length of the front, 580 feet, with a width of 54 feet. This noteworthy room covering fully 30,000 square feet of floor space is broken only by architectural features extending at intervals partly outward from the walls, sufficient to divide the magnitude of the space into sections adequately adapted to the diversity of the proposed collections without interrupting the vista through the entire space. It is proposed to assign this space to the collections in structural and industrial geology, mineralogy, stratigraphy and paleontology, thus bringing together collections which in this museum have been treated as homogeneous. This fine chamber presents a problem in the treatment for the purposes for which it is designed, as its great length and hight will tend to dwarf its contents unless these are displayed with studied care and with all possible assistance from approved and adequate appliances. From the central architectural feature of the chamber, the inclosed dome, corridors leading on either side into the north wing, open into a large room 131 x 106 feet affording a floor space of 13,886 square feet. This room is not divided except so far as the series of columns affords a basis for partition into communicating sections, should the materials to be installed require such treatment.

It is the present plan to reserve this large apartment to the collections in zoology, both vertebrate and invertebrate, inclusive of the extensive collections in economic and faunal entomology. To the right and left of the corridors leading to the wing are the offices of the Zoologist, equipped with room for necessary clerical force with dry and wet laboratories adjoining, and of the Archeologist. All the rooms thus described and apportioned are on the same level but over the last two chambers mentioned are mezzanines which afford space for storage of zoological material, maceration and plaster casting.

The architectural necessity of introducing trusses on the third floor of the building, crossing the inner subdivision of the main

Plate I


GENERAL ZOOLOGY
AND
ENTOMOLOGY
MEZZANINE OVER
ARCHAEOLOGIST
MEZZANINE OVER
ZOOLOGIST
ARCHEOLOGY
BOTANY
MINERALOGY
GENERAL AND ECONOMIC GEOLOGY
PALEONTOLOGY

or Washington avenue structure has resulted in an apparently very advantageous division of the museum floor into two levels. Thus from the main level described one rises by short flights of steps 5 feet to a higher platform running the entire length of the building on the inner side save where the space is divided by the dome and the corridors into the northern wing. This subdivision affords two long and somewhat narrow but not constrained chambers, one covering about 11,000 square feet, the other 5760 square feet. These rooms have excellent possibilities for the display of the extensive collections of the relics of Iroquois and other Indian cultures on one side, and for the botanical collections on the other.

The space thus available for exhibition purposes is

Hall of Geology	30 000	square feet
Hall of Zoology	13 886	"
Hall of Archeology	11 000	"
Hall of Botany	5 760	"
Total	60 646	"

All this exhibition space is lighted entirely from above; side light is wholly excluded. It is recognized that this mode of illumination will present its own problems in the effective disposition of the exhibits and may call for special construction or adaptations in the form of the cases in order to avoid puzzling or troublesome reflections, but it may prove to have especial advantages in flooding the whole chambers with light from one direction without the interruption or isolation that comes from light entering separate apertures, like a series of windows.

The construction which necessitates the elevation of the inner portion of the main floor also makes provision for a lower level on this inner side of the museum apartments. By a descent of 7 feet the lower level is reached and here, on either side of the main corridor to the wing, are rooms for the offices of the scientific and clerical staff adequately equipped with files, storage and laboratories. This lower floor turns the corner at each angle with the wing and runs beneath the offices of the Archeologist and Zoologist on the level above, providing room for an Insectory on one side and Artists rooms with north light on the other. This entire series of offices is supplied with lateral light and the suites have their own private corridors. The surface area of these offices is about 19,000 square feet. The total available space for all museum purposes is practically 80,000 square feet.

II

REPORT ON THE GEOLOGICAL SURVEY INCLUDING THE WORK OF THE STATE GEOLOGIST AND PALEONTOLOGIST, OF THE MINERALOGIST AND THAT IN INDUSTRIAL GEOLOGY

GEOLOGICAL SURVEY

Areal rock geology

In continuation of operations directed toward the execution of a geological map on the topographic base of 1 mile to the inch progress has been made along lines which have been pursued for several years.

Central and western New York. Since my last report the double map including the Rochester and Ontario Beach quadrangles, embracing the city of Rochester and its environs, has been issued. This report was prepared by Mr Hartnagel. The Geneva-Ovid double north and south sheet and the Portage-Nunda double east and west sheet are printing. The latter contains special maps of Letchworth park at the Portage falls of the Genesee river and a chapter on the postglacial history of the river.

The Auburn-Genoa and the Honeoye-Wayland quadrangles have been completed as separate double maps, while the map of Phelps remains as a single quadrangle. Work has also begun on the Caledonia quadrangle and some preliminary observations made on the Belfast sheet. All this work has been executed by D. D. Luther. Of other quadrangles awaiting publication are the Syracuse sheet by Prof. T. C. Hopkins and the Morrisville sheet by H. O. Whitnall. The field work for the Cazenovia sheet has also been completed and that on the Chittenango sheet begun by Mr Whitnall.

All the quadrangles above referred to cover areas of sedimentary rocks only and the problems arising thereupon are almost exclusively those of refinement of stratigraphy and correlation.

Field work on the Remsen quadrangle has been completed by Prof. W. J. Miller. The northern half of this quadrangle is occupied by crystalline rocks and the rest by the Paleozoic sedimentaries. The crystallines include (*a*) highly altered Grenville sediments, (*b*) syenite gneiss, (*c*) a complex made up chiefly of intermingled Grenville rocks and syenite. The Paleozoic rocks comprise the Trenton series of limestones and the Utica shale.

Northern New York. Since my last report the Long Lake map and accompanying report by Prof. H. P. Cushing have been issued.

Professor Cushing's work in the past season has continued upon the Theresa and Alexandria quadrangles which also involve problems pertaining to both the crystalline and the sedimentary rocks. The mapping of the former was completed last season. In the work on the Paleozoic sediments which required the aid of a paleontologist, Dr Ruedemann assisted with the cooperation by invitation of Mr E. O. Ulrich of the United States Geological Survey. Mr Ulrich's intimate acquaintance with rocks of similar age in other parts of the country rendered his collaboration of much value.

During the previous season the Potsdam sandstone had been studied and was found everywhere to grade upward into a dolomite formation quite like the rocks which elsewhere immediately overlie the Potsdam around the Adirondacks and which have been regarded and mapped as passage beds into the Beekmantown formation above. It was naturally expected that the Beekmantown formation would be present here, to be followed in proper succession by the Lowville, Black River and Trenton limestones. In working downward from the Trenton as the summit rock of the quadrangle, the Black River limestone appeared with a thickness of some 20 feet and with a sharp lithologic boundary separating it from the Lowville beneath.

The upper part of the Lowville proves to be abundantly fossiliferous, but when followed downward these fossiliferous limestones are succeeded by others which carry an abundant ostracode fauna but with little else. These two limestones have a combined thickness of some 75 feet. Just beneath them follows a considerable thickness of whitish, very impure limestones, sometimes shaly, alternating with occasional beds of pure limestone and of dolomitic limestone with again an ostracode fauna. This mass has a thickness of about 80 feet and beneath it lies a 10 foot mass of pure blackish limestone with many fossils, mainly gastropods but with some cephalopods and trilobites. There is some mixture of Lowville forms in this fauna but in the main it consists of forms which do not pass up into that formation. The fauna appears to be one not before noted in New York, and according to Mr Ulrich seems comparable with the fauna of the upper Stones River formation of other regions. Its close association with the Lowville, both stratigraphically and paleontologically, seems to preclude its reference to the Beekmantown formation and its fauna is wholly different. The name *Pamelia formation* is suggested by Professor Cushing for this series. The invasion of the sea during this stage was from the west, and this district marks the easternmost edge of its extent. Here alone in the State is the formation well exposed. A name for the New York expression of the series seems therefore called for. It overlapped an old land surface, thins rapidly eastward and thickens to the west, and its presence furnishes for the first time an adequate explanation of the great thickness of limestone reported by the drill in the deep wells of northwestern New York.

On reaching the base of the Pamelia formation it was found to rest everywhere on the beds which had been referred to as passage beds during the work of the previous season, and to rest on them with the most prominent unconformity noted among the sedimentaries in northern New York. The basal beds of the Pamelia formation are weak and therefore seldom exposed but when seen show everywhere a thin basal conglomerate and sandstone. The underlying formation had suffered considerable erosion as evinced by its varying thickness and the varying thickness of the beds of the Pamelia formation beneath the heavy fossiliferous limestone bed, as shown in numerous sections in small areas. The time interval in this unconformity seems to represent the whole, or the major part of Beekmantown and Chazy time. Nothing that can be correlated with the Beekmantown formation is represented in the section.

For the so called passage beds beneath, the name *Theresa formation* is proposed, their entire thickness being well exposed in the township of that name. This formation seems also to hold a fauna not before noted in the State.

The absence of the Beekmantown limestone, the great unconformity between the Theresa and Pamelia formations, and the close connection of the former with the Potsdam into which it grades, and of the latter with the Lowville, seems to add weight to the view previously urged, that the Potsdam-Beekmantown passage beds of northern New York, with possibly a portion of the Beekmantown, are so closely connected with the Potsdam that they must of necessity be classed with them, and that, since the normal fauna of the middle and upper Beekmantown is plainly a Lower Siluric fauna, the line of division between the two great rock groups is to be found somewhere within the limits of what has heretofore been considered as Beekmantown. In this connection the discovery of an unconformity between Brainerd and Seely's group A and group B of the Beekmantown, made by Messrs Ruedemann and Ulrich in the Ticonderoga region the past summer, comes to have large significance.

Both the Potsdam and the Theresa formations have large representation on the Alexandria quadrangle, but the chief interest attaches to the Precambric rocks. The main rock of the Thousand Island region is a granite gneiss, a bathylith of probable Laurentian age. Near its edges it holds abundant inclusions of schists, and passes by increase of these into a belt of schists cut by granite, these dikes diminishing as one recedes from the main granite mass. There is much in these schists to suggest that they are impure limestones transformed by the contact action of the granite gneiss. This Alexandria bathylith seems to have been much richer in mineralizing agents than was the similar Antwerp bathylith of the Theresa quadrangle. A coarse granite is also present which seems of later date.

Eastern Adirondacks. For a number of years, Prof. James F. Kemp, who has excellently served the State work in geology, has continued his investigations in the eastern Adirondacks. Under the auspices of the United States Geological Survey Professor Kemp has long devoted close attention to the intricate problems presented by the crystalline rock region of the Elizabethtown, Ausable, Mt Marcy and Lake Placid quadrangles. By an arrangement entered into with Professor Kemp, the Director of the United States Geological Survey and the Director of the New York State Survey, this work is now transferred to the supervision of this office with full assent to the eventual publication here of all the results acquired whenever the work shall have been completed. Under this understanding, Professor Kemp has reviewed and continued his work on these quadrangles. Some problems which seemed determined in the past have been of necessity reopened, for it was inevitable that there should be some gaps in the record and some former determinations requiring corroboration. During the past season Professor Kemp's work has been concentrated upon the Elizabethtown quadrangle, which is not only the most thickly settled of the four mentioned but economically the most important. Since the earlier fieldwork in this area was done, in 1896–97, we have come to recognize the great syenitic series of eruptive rocks which was imperfectly noted under other terms in earlier reports and thus made to accord with a scheme of classification at that time apparently satisfactory. This area, moreover, is on the border between the central anorthosite mass and the outer Grenville sedimentary and other gneisses. There are puzzling intermediate types and on the whole a complicated assemblage of rocks whose relations await determination. In the 10 years past there has also been extensive development of mining and diamond drilling in the great iron ore bodies at Mineville and it has been desirable to bring the records up to date. There lies between the boundary of the Elizabethtown quadrangle and Lake Champlain a comparatively narrow belt of country in the Port Henry quadrangle which it has seemed desirable to treat together with the former, and as the latter includes areas of Paleozoic sedimentaries the assistance of Dr Ruedemann was enlisted in the solution of problems involved in the mapping of these. The season's work, thus, has been largely devoted to (1) reviewing and plotting new data in regard to the Mineville ores, (2) verifying and amplifying observations on the Elizabethtown quadrangle, (3) traversing the Precambric formations of the Port Henry sheet. In general beneath the undoubted sediments of the Grenville and intimately involved with them along the borders there is a great series of rocks usually gneissoid but often massive, of a mineralogy ranging from the granites through the syenites to and into acidic diorites which are probably of intrusive origin and which represent one or more great bathyliths. Though at times decidedly variable in composition this may well be due to the fusing into their substance of the Grenville sediments, which range from quartzites to limestones. The whole aggregate has been extensively faulted. Distinct from this complex are the anorthosites and some related gabbros, but between the anorthosites and the syenites there are intermediate transitions which add to the difficulty of sharply defined mapping.

Valcour island, Lake Champlain. Prof. George H. Hudson is finishing the survey of the eastern shore of Valcour island on the scale of 1:1000 and proposes to reduce the remainder of the island to one of 1:3000.

The chief reason for continuing the survey on this large scale is the fact that the region is one of curiously changing dip and strike. It has been influenced not only by east and west faults together with some compression, but the influence of a great and somewhat distributed north and south fault close to the east edge of the island is very apparent. The southwesterly section has been remeasured and some important corrections made, and the east section of the island worked out with good exactitude. This is the most important section of the island, because its beds present a hundred times the area of the south section.

An interesting result of this investigation is the recognition of the repetition of the coral and stromatoporoid reefs in the Chazy

Plate 2

Cliff on Valcour island, Lake Champlain, showing the undercutting by frozen spray on a weak stratum of thinly laminated limestones overlain by more compact beds

Plate 3

Reef dolomite (base of upper Chazy) Smugglers Harbor, Valcour island, Lake Champlain.

Plate 4

Cystid point, Valcour island, Lake Champlain. The dipping upper Chazy beds at the left and the horizontal beds at the right indicate a syncline between

Plate 5

Paradise bay, northern arm, Valcour island, Lake Champlain Showing undercutting by freezing in joint planes and not by direct wave action

Plate 6

Another view at Paradise bay indicating the agency of frozen spray in undercutting the rock face

Plate 7

Glacial pebble from left bank of Saranac river about 1 mile above Plattsburg. Taken from the till close upon the glaciated bed rock. It shows a series of fine parallel striae made by sand grains lying between it and the bed rock and the usual irregular scratches and incisions caused by rubbing against other blocks in the till.

beds. Only one of these has commonly been recognized by other investigators. At Cystid point a reef is shown and its extinction and the deposit of sediment over it is clearly to be seen. Five meters down from this horizon and 300 meters to the north is another. Twenty-three meters down and 1000 meters to the north comes the more massive one which forms the "dove color" of Tiger point. Reef material is found again from 400 to 500 meters north of this and at a horizon 70 meters below the surface at Cystid point. This reef is as large as the Tiger point reef and in many respects resembles it. The shore is of a deeper blue dove color on the whole, yet this darker dove color may also be found in the Tiger point reef. The rock abounds in cephalopods and the trilobite Glaphurus pustulosus. The rocks of Sloop island (which show a pure dove colored rock as light as that of Tiger point) seem by their position to belong to this reef. One of the reefs noted belongs to the upper Chazy, the other 47 meters below it, is in the middle Chazy.

The fault system of the region is of interest and corrections have been made of the location of the faults mapped by others and also data on new faults acquired. A preliminary map of the intricate fault system of the Plattsburg region has been made and the fact brought forward that the form of Lake Champlain is the outward expression of some of the more extended of these faults. Enough evidence has been acquired to show the presence of two widely different systems and that correlation of the scattered observations is at least in part, possible. The north and south system appears to be the younger, or at least has suffered the most recent additions to its displacements.

A number of interesting observations have been made on the island, bearing on the glacial history of the region and on the striae of the glacial boulders. An enormous amount of the energy of a moving glacial sheet is spent in reducing its ground moraine to powder. The sheet of till in actual contact with the bed rock does not move so rapidly as the sheets lying over this. As a consequence comparatively few stones of the till are found with surfaces ground by contact with bed rock, for such a grinding produces a flat face with hundreds of parallel lines as may be seen in the adjoining photograph; on the contrary curved outlines predominate caused by contact with each other.

Highlands of the Hudson. Geological fieldwork in the Highlands was continued by Dr Charles P. Berkey during a part of the season along the lines developed last year. Although less time than usual was available for this work, considerable additional area was mapped in both the West Point and Carmel quadrangles, some portions of which have been studied in detail.

In the discussion of *Structural and Stratigraphic Features of the Basal Gneisses of the Highlands* published last year in Museum Bulletin 107, the major structural types of the Highlands formations were outlined. As a related problem the chief reasons for doubting the exact equivalence of the Inwood limestone and Manhattan schist to the Wappinger limestone and Hudson River shales were given. A special effort has been made the past season to follow out all of the more promising lines of field evidence bearing upon this question of stratigraphic succession and correlation. This has led to the tracing of the contact lines of the tongues of crystalline limestones and schists that project into the Highlands from the south side. If these formations could be followed entirely through the Highlands to the north side, as the earlier maps indicate, it was believed that some direct relationship between these crystallines of the south side and the better known Cambric strata of the northern border could be determined.

After studying for this special purpose all of the valleys that give such opportunities from the south, it seems necessary to conclude that there is no place in New York where the crystalline schists and limestones characteristic of the southerly areas can be traced through to the northern border. There is always a belt of several miles in width occupied only by the typical gneisses of the Highlands. This line of attack therefore furnishes no conclusive proof.

Observations made on numerous areas of the Cambric strata of the northern border indicate a much more profound metamorphic change in them in passing eastward from the Hudson river to the Connecticut line. Limestones and schists, that seem to be beyond question equivalents of the Wappinger and Hudson River formations, have in that district all the characteristics of the Inwood limestone and Manhattan schist of the vicinity of New York city.

With such results in two of the lines of attack, it seems necessary to make a more minute study of the Stony Point-Peekskill region, the one district where apparently almost typical Cambric formations occur on the southern border of the Highlands.

As the mapping of the ancient gneisses progresses it is evident that traces of interbedded limestones belonging to the oldest series of the region are comparatively common. Several occurrences in addition to those previously enumerated have been mapped. Associated with two of these small limestone belts are graphitic schists of considerable prominence. These types are believed to lend further support to the sedimentary character of certain portions of the series. One of the graphitic outcrops has attracted some local attention looking toward development.

It is clear, however, that the proportion of the igneous members to the sediments in the basal gneiss series varies greatly in different areas. In the eastern part of the Carmel quadrangle those interpreted as igneous types greatly predominate. The prevalence of schists, limestones and quartzose rocks considered sedimentary, is much more marked in the West Point quadrangle and especially in the vicinity of the Hudson river.

Surficial geology

The problems relating to the impounding and drainage of surface waters upon the retreat of the glacial ice, the making and breaking of glacial and postglacial lakes, the molding of the present topography of the country to the change in the level of the marine waters and their former incursion into what are now fresh-water passages, have involved investigation along lines and in areas indicated in my report of last year, by Prof. J. B. Woodworth in the northeastern region, Prof. H. L. Fairchild in the central and western region and Prof. A. P. Brigham in the Mohawk valley.

For the northeastern region Professor Woodworth has practically completed the detailed mapping and report for the Schuylerville quadrangle. The report will give an account of the extensive sand deposits between Saratoga and Fort Edward which are not without economic interest because of the occurrence of molding sands in that district. The remarkable rock basins of Round lake and Saratoga lake are dealt with, but a final report on these features must await the detailed mapping of the topographic sheets in which their southern and western portions lie. These lake depressions notwithstanding their small size are of singular interest. The report will contain a diagnosis of late glacial lake and river changes, adding much in details to the preliminary sketch made in the report on *Ancient Water Levels of the Champlain and Hudson Valleys.* Similar work on the Rouse Point sheet lying directly east of the Mooers sheet already published has progressed and the completion of this map will carry the line of marine deposits from the base of the Adirondacks along the International boundary to Lake Champlain. The customary classification of glacial deposits for the purpose of geologic mapping breaks down in this area by reason of the modification of the deposits through action of sea waves and currents. The problem of how best to map these modified glacial deposits has perhaps not yet been satisfactorily solved. The problem is a particularly difficult one by reason of the varying degree of alteration and rearrangement of the original accumulations. Some parts of the area display a typical glacial topography and underlying structure of the materials; yet other districts show the glacial deposits entirely recomposed in beaches, bars, and offshore sediments. These features are not always clear; there are large tracts in which no distinctive surface characters exist and in which the deposits can only be discriminated on such broad groupings as stratified, gravelly, sandy or clayey. This results in the necessity of coloring large areas as undifferentiated glacial and marine or glacio-marine gravels and sands.

On the Rouse Point quadrangle there is a marked belt of sandy beach deposits about the hills at levels between 180 and 220 feet above sea level. Along the northern border of the area in the vicinity of Champlain village, pocket beaches occur at lower levels. Marine shells have been found in sufficient abundance to give some idea of the fauna. There is a noticeable abundance of Mya arenaria at these lower levels, but it is absent at the higher stands of the sea. Either this mollusk reached the area relatively late or lived only in the deeper offshore stations. Owing to its abundance in shallow surface deposits I am inclined to the view that it migrated into the Champlain area much later than Saxicava rugosa and Macoma greenlandica. If this be true it may be possible to differentiate locally these life zones. Mytilus edulis also appears in abundance and in an excellent state of preservation at these lower levels, as on the Isle la Motte.

The field work indicates pretty clearly that a morainal belt extends southeastward across the Mooers area towards Chazy, indicating a protrusion of the ice front into the Champlain embayment at a late stage, possibly as an ice advance after the sea once got into the area. Unless the unfossiliferous clays about East Beekmantown and near the lake shores in that vicinity and around Alburg can be referred to the lacustrine stage, no deposits are recognized which can be definitely referred to the glacial lake waters which preceded the marine invasion in this field, nor have any Prewisconsin drift deposits been found.

The shores of Lake Champlain about its northern end seem in places to be higher than when the cliffs were cut. The evidence from many parts of the shore is not conclusive for or against changes of level, either a rising or a sinking. Such channels as that from Champlain village suggest a rising of the water level. It is probable that the highly tilted Siluric slates in Vermont are being crowded up and that downward movements have been taking place among the faulted rocks of the New York shore along the International border.

Western, central and northwestern New York. As a result of Professor Fairchild's investigations the story of the succession of glacial waters in western, central and northern New York is approaching completion. Following several introductory and preliminary papers, the glacial waters held in the Lake Erie basin in this State have been described in State Museum bulletin 106. The later waters in central New York down to the Iroquois stage are described in the paper awaiting publication. Lake Iroquois is well known in its general character and history, but there yet remains for description: (1) the local glacial lakes held in the valleys of the western and northern Adirondacks during the Iroquois stage; (2) the extinction of Lake Iroquois; (3) the sea level waters which occupied the Ontario basin subsequent to Lake Iroquois and preceding the present Lake Ontario. The past summer's work has been on these three elements of the history, and is briefly summarized in the following description.

(1) *Local glacial lakes.* All the well defined valleys sloping westward or northward from the Adirondack mass must have held glacial waters while the ice acted as a barrier. The largest and most interesting of these local lakes was the one in the Black river valley, which in all the elements concerned in the functions and relationship of such waters is the most excellent known in the State. The larger part of the summer was used in the study of this lake, and its description will form the subject of a future paper.

(2) *Iroquois extinction.* A broad ridge of Potsdam sandstone extending north from the Adirondacks into Canada forms the divide between the Champlain and Ontario basins and is the critical area in this study. A rapid examination of the divide shows that the Iroquois waters were held up to the Rome outlet until the south edge of the ice body had receded as far north as the International boundary, but that here the waters found lower escape across Covey hill, the north end of the ridge. The outflow here cut the great

ravine locally known as the "Gulf" in the resistant Potsdam sandstone, and the seaward escape of the Ontario basin waters was shifted from the Mohawk-Hudson to the Champlain-St Lawrence. These waters, with level inferior to the Iroquois and with different outlet, require a distinctive name and it is proposed to call them Hypo-Iroquois.

With only a little further recession of the front of the ice sheet on the end or nose of Covey hill the Hypo-Iroquois waters found yet lower escape between the ice and the north-facing land slope, and the outflow carved the slope into a series of irregular benches or terraces. When the waters were lowered between three and four hundred feet below the intake of the Covey gulf the level of the ocean was reached and the waters in the Ontario basin blended with the sea.

The gravel bars of the Iroquois shore have been traced to a point midway between Watertown and Carthage, but eastward and northeastward from here the shoreline is weak and very irregular, passing far up the valleys of the present north-flowing streams. The deltas built at the mouths of these rivers in the Iroquois waters are proofs of the relation of streams to the high-level lake, and they have interesting characters. Excepting the Potsdam quadrangle the long stretch of the Iroquois shore from Carthage to Covey hill is unmapped by the topographic survey and its close study is not at present advisable.

(3) *Gilbert gulf.* The marine beaches on the north slope of Covey hill are remarkable for their strength, number and composition. The upper ones are strong, close set ridges of sandstone boulders. Aneroid measure makes the highest continuous bar about 460 feet A. T. This is 10 feet higher than the figures previously given for the upper reach of the marine waters by Gilbert and Woodworth. It is particularly desirable to determine the precise altitudes for the several Covey hill features and the State should place benches along the International boundary.

Passing down the hill slope from the marine summit bar it is found that 20 distinct bars occur in a descent of only 140 feet, the greatest interval (aneroid measure) being 12 feet. This multiplication of the wave-built ridges agrees with the theoretical expectation, since the vertical spacing was produced by the very slow, and probably uniform, uplifting of the land out of the sea, giving opportunity and time for bar construction at all interior levels.

Professor Woodworth has traced the marine shore westward some distance and Professor Fairchild has located the upper limit at points north of Burke and Malone. Topographic sheets of the region are necessary for the mapping.

The sea level waters in the Ontario basin, called Gilbert gulf have left definite shore features which had been mapped previous to this season as far north as the mouth of Stony creek, 3 miles southwest of Henderson. During the summer the mapping has been carried northeastward to Stone Mills, on the Theresa quadrangle.

The highest Gilbert gulf bars lie at about 262 feet altitude near Texas, northeast of Oswego, where the water plane passes beneath the level of Ontario. The plane rises to the north so that the highest bar is 325 feet at Henderson Harbor; 375 feet at Dexter; 380 to 390 feet at Stone Mills and Depauville; and about 400 feet at Clayton. Along the nearly north and south line of 46 miles between Texas and the Hogback hill, 4 miles southwest of Clayton the average rise is about 3 feet per mile. With the assistance of Mr F. A. Hinds of Watertown the altitude of the highest of the strong Iroquois bars on the Farr place, 3 miles east of Watertown, was determined by precise leveling as 733 feet, a reduction of 7 feet from the previous aneroid figures. Using this corrected altitude we find that the deformation of the Iroquois shore in the stretch between Richland and Farr's is $733-566 \div 30$ miles $= 5.6$ feet per mile. It appears therefore, that the average uplift on the Iroquois shore in this region is nearly twice that of the marine beaches, which fact has an important bearing on the time relations of the two water bodies.

Before the details of the closing stages of the Preontarian waters can be advantageously studied and the dramatic history fully written, the topographic sheets of the areas northwest and north of the Adirondacks must be published. The sheets more specially needed for this study are the four along the State boundary lying between the published Mooers and Massena sheets; also the sheet east of the Carthage sheet.

Aside from these items of Pleistocene history in the regions referred to, a review has been made of contemporary features of the Upper Genesee valley with special reference to the relations of the preglacial drainage and glacial lakes of the river to the production of the gorge and cataracts at Portage.

The region under study by Professor Brigham includes the Broadalbin, Gloversville, Amsterdam and Fonda quadrangles, an area of about 900 square miles, reaching from the southern Adirondack region into the edge of the Appalachian plateau south of the Mohawk river. It does not, however, include any uplands belonging to the Helderberg or Catskill regions, although these are near at hand and conspicuously viewed from the southern boundary of the area. The principal drainage of the area is through the Mohawk river, with several of its affluents, principally the Schoharie, while the Sacandaga controls the drainage of a part of the northern border. The northern limit is nearly marked by the village of Northville, while Duanesburg and Esperance villages are close to the southern border. On the west the area extends just beyond the Big Nose or west of Yosts Station.

Glacial lobes. Perhaps the most salient features brought out by the investigation of the territory are two glacial lobes, one a part of the great Mohawk glacier, which is now demonstrated to have moved westwardly for a short distance up the Mohawk valley and what may be called a *Sacandaga glacier,* moving southerly about the region of Northville, swinging toward the southwest in the neighborhood of Mayfield, filling into affluent westward flow with the Mohawk glacier about Gloversville. The existence of such a westward Mohawk flow was postulated by Chamberlin on the evidence which was at hand many years ago. Further advent of this westward movement has been given by Professor Brigham.

Conspicuous evidence of this movement is found in the glacial striae which are well distributed throughout nearly the entire area. About 60 localities of such striae have been found and recorded. The direction is not on the average greatly variant from westward, but north and south of the Mohawk river in the neighborhood of the Big Nose there are interesting divergences. On the north of the river to the west-northwest and on the south of the river toward the west-southwest, illustrating the axiradiant flow of Chamberlin, a still more interesting and somewhat puzzling divergence is found in the neighborhood of Galway village west and northward where some of the striae point distinctly toward the northwest and even branch toward the north-northwest. As the glacier apparently came around into the Mohawk valley from the Hudson-Champlain depression, this seems a curious condition. What possible effects, if any, of local glaciation in the Berkshires and Catskills may have produced results here, remain to be determined. It may be asked whether this postulated western flow might not have been a flow to the eastward as the striae themselves do not ordinarily give special evidence as to whether the flow was in one direction or the other, but the carriage of erratic material and the relative distribution of the drift in certain localities, leave the westward flow beyond question. A still more striking confirmation is found in connection with the Schoharie valley. On the east side of the lower Schoharie within this district, the drift is a very massive till and outcrops of the bed rock are almost absent. In fact that section of the Schoharie valley from Esperance to Fort Hunter was filled with till to a remarkable extent and the postglacial excavations by the stream have produced a singularly interesting series of topographic forms normal to river action. On the west of the Schoharie on the contrary, outcrops of the bed rock are everywhere present, the drift is very thin, ledges and glaciated benches are frequent and the region gives every evidence of having been powerfully scoured. These conditions as between east and west are exactly what would be expected from a westward moving glacier, passing over the hills in the neighborhood of Minaville, dumping and filling in the valley transverse to its course, and drifting powerfully against the edges of the exposed striae west of the stream, cleaning away the drift and giving to the whole topography a characteristic glacial expression. It should be remembered, however, that these striae and other evidences of a westward flow only determine the last glacial conditions of the area. What earlier flows there may have been and what their directions were, must for the present, and perhaps always, be left to conjecture.

As above indicated, the valleys drained by the Sacandaga distributaries permitted a considerable glacier to flow southward out of the mountain region and the striae, while not so numerous as in the Mohawk region, are sufficient in number and distributed in such a manner as to leave no doubt of the directions already described. Two localities of striae about 4 miles southeast of Batchellerville show gradings of a south-southwest direction, belonging evidently to this Sacandaga or southern Adirondack movement, which was quite at right angles to the northwestward movement already noted in the neighborhood of Galway.

Interlobate moraine. One of the most interesting glacial developments in the entire district is a belt of sand hills extending across the Gloversville and Broadalbin quadrangles from Gloversville westward over Cliff hill and eastward toward Broadalbin, Hagadorn's Mills and Barkersville. This grade moraine is in many parts massive, from 1 to 2 miles wide, hills sometimes low and spreading and other times lofty and massive, more often with constructional moraine forms, sometimes toward the southern edge tending toward the drumlin form, as if that edge of the moraine had been overridden. No doubt some of the smaller present hills are of the nature of dunes as there are localities where the sand is still exposed to the free action of the winds. A considerable part of the city of Gloversville is situated on this moraine, and the more direct road from Gloversville to Broadalbin is about in the center of the moraine and traverses a region which has many of the characteristics of a desert. This grade moraine apparently was accumulated between the two lobes already described where the edges touched or approximated each other. As far as can be judged from limited observations and from the appearance of topographic maps, the moraine belt extends from Barkersville northeastward along the base of the mountains to Corinth. Its western extension if any, has not yet been traced.

Recessional moraines. South of the moraine already described, in the field of the Mohawk glacier, special moraine accumulations are almost absent excepting heavy deposits of till in the Mohawk valley which have been so reshaped as largely to lose their character as moraines. In any case they represent dumping and filling in the immediate Mohawk valley and the work of localized tongues. The region south of the river to the limit of the district is distinctly free of anything which could be called morainic. On the eastern edge of the district from the interlobate moraine southward to the Mohawk river a number of small morainic areas were found, generally of till. It is evident that these extend over in some measure into the Saratoga quadrangles eastward, and further study may develop a distinct belt of such moraine. In that case it would appear to mark the recession of the glacier out of the Mohawk valley to limit the western edge of the Hudson valley glacier at that stage of recession. This would be in harmony with Professor Woodworth's efforts at the determination of the existence of a Hudson valley glacier extending down toward Schenectady and thus preventing the accumulation of the sands of Lake Albany over the region northward from Schenectady. Various accumulations that may be called recessional are found in the Sacandaga region, especially in the neighborhood of Osborne's bridge and northward but more especially in the Sacandaga valley northward from Northville and northward from Edinburg. Here are two great accumulations of constructional hills of sand and gravel which may be regarded as the terminal of the Sacandaga glacier at that stage of its recession.

Distribution of the drift. Some facts have already been given in the description of the glacial lobes. No general estimates of the thickness of the drifts are offered. These it is believed are sure to be delusive. It may be said in a general way that in the Adirondack portion of the area the drift is apt to be thick in the valleys and it is generally thin on the slopes and summits as would be expected. In the Sacandaga basin south of Northville and over the region of the Great Vly the drift is of unknown thickness and outcrops are rare. Naturally the drift is very massive along the belt of the interlobate moraine, and south of this moraine extending from about West Perth eastward for 7 or 8 miles there is a broad flat topped plateaulike mass of till sometimes showing sandy phases. The north edge of this region is near Broadalbin and the south near Perth, the ridge averaging perhaps 3 to 4 miles in width. It is on the high ground between the Mohawk and Sacandaga basins and it is seen as a conspicuous profile from all high points south of the Mohawk river. It is historic in the sense of having carried the ancient highway of Johnstown to Saratoga. It is conjectured that it has been a great overridden moraine of an earlier age but this suggestion is offered doubtfully and with hesitation. South of this region toward the Mohawk river, especially in the region between Galway and Amsterdam the drift is thin. Around Johnstown eastward and westward it is comparatively massive. So is it also at many points in the Mohawk valley. South of the Mohawk it inclines to be thick near the river but averages thin wherever the glacier overrode the higher sandstones which lie south of the black shales. An exception, however, appears several miles about Charleston Fourcorners where the geological map shows almost no outcrops and where the drift must be comparatively massive. An interesting belt of drumlins exists in the vicinity of Gloversville and Johnstown. At Johnstown these drumlins make up a large part of the territory, show altitudes of from 50 to 150 feet and are the most conspicuous elements in the topography. The same is true northward and northwestward of Gloversville to the base of the Adirondacks. A few of these drumlins are peculiarly massive and noble in proportion, making an aggregate of great ellipsoid swells which command the attention of the observer. The same forms are found eastward of Gloversville and along the road from Gloversville to Mayfield and curiously these forms in some cases emerge among the sands of the interlobate moraine. Some of these are seen between Gloversville and Broadalbin, the sands sweeping around the base of the drumlins and in some cases partly up on one side or one end. Many of the drumlins are conspicuous for groups of large boulders turned on their eastern slopes. The axis of the drumlins is in a way east-west but within the field of the Sacandaga glacier some of them tend towards the northeast-southwest direction as do the drumlinoid forms about Mayfield. Thus the drumlins and drumlinoids fall into perfect harmony in direction of trend with the glacial striae. The till of many of these drumlins is comparatively light and sandy but this may be said also of the ground moraine in general in the vicinity of the crystalline rocks. Indeed the ground moraine everywhere in the region follows the usual law of glacial deposits in showing the close kinship to the bed rocks from which it has been so largely derived. This has a conspicuous bearing on the agriculture of the region and it will be found, for example, that the drift around Johnstown partakes especially of the character of the underlying black shales and the soils are consequently rich and the region agriculturally prosperous. A similar belt, productive for the same reason, is found south of the Mohawk river for a width of 4 or 5 miles in the vicinity of Scotch Church, Minaville and Glenville. On the higher sandstone hills the drift, as already indicated, is not only thin but partakes of the poverty of the sandstones so far as its productive capacity is concerned.

Lake deposits. Some of the most interesting accumulations of the district were made in standing water. These include small areas of high level sands, evidently in pools or lakelets sustained by retaining walls of ice. An example of this is found west of Hagadorn's Mills, a tablelike deposit which has been cut in two by the waters of the Kenneatta. Another of these level sand deposits likewise dissected by a stream, is found southwestward from Benedict and another conspicuous example lies just westward from Edinburg. In the eastern part of Gloversville is an area of flat or gentle sloping sands or clays which are doubtfully interpreted as deposits of a lake surrounded by a glacial moraine and waning glacial ice.

Deposits of Lake Sacandaga. This name is given to a body of water which evidently occupied the depression now known as the Great Vly. Its water was apparently held in place by the massive drift in the region of the interlobate moraine and by the receding ice of the Sacandaga in the direction of Batchellerville and Conklinville. The basal deposits of the Vly are undoubtedly sediments of this lake overlain by large accumulations of swamp and vegetable material. The most interesting and distinctly formed delta of the district was built by the issuing waters of the Sacandaga glacier at and south of Northville. Most of Northville village lies upon a flat table which is a remnant of this delta. The delta can be traced for about a mile north of Northville heading against the great recessional moraine to which reference has already been made. South of Northville it has been largely dissected and much of it swept away by the Sacandaga river. Slight remnants are seen on the east of the river but the major parts of it are on the west. Beginning with the flat sandy area on which the resort known as Sacandaga Park is situated and extending southward to a point eastward from Cranberry creek and past Ogden's creek toward Northampton some small areas of till emerge from the silts of the delta near its edge and from Sacandaga Park to Osborne's bridge much of the old delta area is occupied by terraces and flat plains and old channels of the Sacandaga river.

Lake deposits of the Mohawk valley. These include conspicuous deposits of sand, silts, clay and gravel at altitudes varying from 440 to 460 feet, in some cases a little higher. These are found about the Lower Cayadutta and west of Fonda. They extend from Fultonville to the Schoharie creek south of the river. They are found conspicuously along the north side of the river and east and west of Tribes Hill. They also appear at the golf grounds of the Antlers Club and along the river on the north side of Amsterdam, and east and west around Port Jackson. These deposits are conspicuous and they are to be seen at Hoffmans Ferry. In the great delta on the north side there are minor exhibitions of them southeastward to Rotterdam or a little beyond. These silts and sands evidently represent waters at an altitude of from 440 to 460 feet and the determination of a barrier by which such waters should be maintained has been one of the most puzzling questions of the investigation. No entirely satisfactory answer is at hand, but it is the best belief of the writer that the barrier was ice in the vicinity of Schenectady. It is not necessary to believe that the entire strip of the valley from Schenectady westward was in the earlier stage occupied by these waters continuously, for at some points in the vicinity of Amsterdam, for example, there are the accustomed clays containing scratched stones and there are sands and gravels of such irregular character as to lead to the conviction that the waters in which they were deposited were in the immediate presence of ice, which could have been no other than a local remnant ice tongue extending up the valley from the main glacier which still lingered in the region of the middle Hudson. These deposits at similar levels are found to the westward of the area now under consideration, nearly or quite up to Little Falls. It seems very probable that the capacity of stagnant ice to maintain a barrier has been greatly underrated. Such ice is often covered with debris. The streams which would flow over it, proceeding from a recent glaciated region would naturally be so overloaded that they would tend to aggregate rather than to erode. No spillways or water-swept areas at the proper altitude have been found on the hill flats westward from Schenectady although some search has been made for them. The problem demands further study but the evidence is conclusive that lake waters in front of a waning ice tongue occupied a long section of the Mohawk valley at about the altitudes indicated.

There is some evidence that such conspicuous accumulations for example, as the great sand flat " west of Fonda " is not altogether and perhaps is not largely a delta of the Cayadutta creek, for on the very borders of the Mohawk river on the south edge of the lacustrine accumulation is found at least one locality cross-graveled, dipping to the northward, whereas, as further north and toward the head of the supposed delta, the deposits are silts and fine sands. This points to the suggestion that the deposited part at least was made while the immediate valley of the Mohawk was occupied by a remnant glacier from which these gravels were derived.

Deposits of Lake Albany age. The waters of Lake Albany extended up the Mohawk valley. The writer is not aware that this fact has been sufficiently recognized, but by consulting the contour maps of the valley it will be seen that the waters of Lake Albany at an altitude of 340 or more feet would extend far up the present course of the river. This also carries with it the interesting conclusion that the Iroquois drainage which swept down the Mohawk valley and is believed to have deposited as a delta the Schenectady and Albany sands, must have been a drainage following the belt of still water through a long stretch of the Mohawk valley. A number of deposits of coarse gravels have been identified in the area as probably belonging to the Lake Albany stage. It could not have any reference to the present or recent work of the river and they do not seem to belong to the earlier 440 to 460 foot stage already described. Such deposits of coarse gravels occur down at Yosts where they have been largely excavated by the New York Central Railroad. They form a stone ridge east of Randall, south of which ridge is an interesting old channel of the river waters. They occur again in the hill about 40 feet in hight which extends northeastward from Fort Hunter and they are found conspicuously developed as appears by the map, from Hoffmans Ferry toward Schenectady. Doubtless these deposits were much more extensive than they are at present, having been largely swept away by the waters of the river after Lake Albany subsided. Reference has been made to the heavy tills of the Mohawk valley. These are basal and massive on both sides of the river. At certain points as already described, they are capped by the lacustrine silts and sands of the higher level, but in many cases these sands, which must have sloped down to the flood plain level originally, and amassed tills, have been swept away along the lower slopes so that in cross-section we should have massive tills sloping from the upland down to the river. At certain points, as east of Fultonville and along all the lower parts of the city of Amsterdam, are belts of water-swept till. Along these lower grounds of the city of Amsterdam till is very thin, bed rock near at hand, and east of the city are fields of boulders which apparently are remnants of tills of which great Iroquois currents have removed finer materials. For many miles along the Mohawk river the deposits of the drift are exceedingly steep. They are almost cliffs and there is an entire absence of morainic contours. These forms could not have been constructional in the glacial sense. When these tills were dumped into the Mohawk valley they must have been purely morainic forms resulting from a melting down of the ice tongues which occupied the valley. It would seem that these slopes of till with their occasional covers of the customary silts have been powerfully undercut by Iroquois waters, giving the steep slopes of the present, but it must also be recognized that that undercutting could not effectively take place until there was some subsidence of Lake Albany waters allowing effective current action by the grade stream carrying the drainage of the glacial Great Lakes. These facts and suppositions involve a problem concerning the Iroquois drainage and the waters of Lake Albany which deserves further and more final investigation. An interesting remnant of the Lake Albany silts is found near South Schenectady along the waters of the Normans kill. Here, near the region of the Amsterdam quadrangle is a small embayment of Lake Albany waters and therefore a reentrant area of sands which joined with the greater area that appears in the Schenectady quadrangle.

Schoharie lake. An interesting development of lacustrine sands and clays is found along the Schoharie river from Esperance up stream for some miles. In looking for a cause of these lacustrine accumulations it was discovered that by the dumping and filling process already described a great till barrier had been formed across the Schoharie valley just south of the small village of Burtonsville. That till barrier raised the waters of the Schoharie above that point to a hight of about 100 feet greater than at present. The till has been cut away down leaving cliffs largely of till but also in part, on the concave side of the bend, cliffs of bed rock. It would appear that this raising of the waters must have extended about 20 miles up the Schoharie from Esperance and that the lake was maintained there in the immediate postglacial times until the barrier could be cut away. There is apparently a well marked delta belonging to this lake above Central Bridge and along the valley towards Cobleskill. The conditions of this lake above Schoharie village need further study for their full elucidation.

Areas of marsh and obstructed drainage. It was not practicable to distinguish in the mapping between areas of existing marsh and areas of soft meadow which represent recent or comparatively recent lake filling. These areas, however, serve in an interesting way to show the obstruction of drainage caused by glacial deposits and a moment's inspection of the map would show that where the deposits are conspicuously massive, as along the belt of interlobate moraine, the areas of marsh and lake fillings are conspicuous. It is quite possible that many small areas apparently due to recent lake filling, may have been areas also occupied by small lakes of glacial age. This, however, can not be determined unless there are chances for suitable excavation or exposure of the materials. Thus along Auries creek about 2 miles southwest of Glen is a flat ground about a mile in length which would naturally be taken as a combination of lake filling and flood plain but a chance section made by the stream shows massive lacustrine clays containing glaciated stones and therefore demonstrably representing a lake of glacial age.

Summary. The field investigations for these four quadrangles, Broadalbin, Gloversville, Amsterdam and Fonda, are practically completed and seem to show conclusively the presence of the two great glacial lobes already described with a massive interlobate moraine with scant evidences of any recessional moraine in the case of the Mohawk glacier, but at least one conspicuous belt of recessional moraine in the case of the Sacandaga glacier. The retreat of the ice is marked by the presence of glacial waters, notably small high level sand plains of the Sacandaga delta, the high level lacustrine silts and sands of the Mohawk valley, the gravels and sands of the Lake Albany and Iroquois stage, and the lacustrine clays of Lake Schenectady. Postglacial modifications of the glacial deposits are conspicuous along the valleys of the Mohawk and the Schoharie. Curiously along the Mohawk there is nothing that can be called ordinarily alluvial terrace. Meanders are practically absent while along the Schoharie terraces meanders and abundant oxbow channels are typical and conspicuous. These differences point to radical differences in the history of the major valley as compared with that of its tributary, and these differences have to do, it would seem, with the marked lacustrine conditions and great lake outflow that belonged to the Mohawk valley. As already intimated the conclusions here announced by Professor Brigham and the hypothesis suggested need explanation and confirmation by close study of surrounding areas. It is desirable to know the westward and southern limits of the Mohawk lobe. From the general appearance of the topography it would seem that the powerful glaciation of the Mohawk region must have ceased not far south of the boundary of the present area. The map of the Berne quadrangle south of the Amsterdam quadrangle seems to show interesting conditions which it has not been possible to study in the field. Near the middle of the quadrangle there is a conspicuous bifurcation in the trends of the drumlinoid or linear forms of topography, indicating apparently a push to the west as a part of the flow of the Mohawk glacier already described, and a push to the south along the lines of the Hudson valley. It is conjectured that a study of this area in the field will show corresponding directions of the glacial striae and that here may perhaps be found a point of conspicuous divergence between the Mohawk and Hudson river lobes of the glacier at a certain stage of their activity.

Industrial geology

Mines and quarries. The third of the series of annual bulletins reviewing the progress of the mineral industries in the State was published in July of the current year. There is a steady demand for information relating to the mineral resources, such as is given in these publications, and the continuance of their issue seems advisable.

The statistics collected for publication in the report indicate a material growth in the importance of the mining and quarry industries during recent years. The total output of all materials reported by the individual producers was valued in 1906 at $37,118,430, the valuation being based on the crude or first marketable form of the products. The corresponding total for 1905 was $35,470,987 and for 1904 it was $28,812,595. The varied character of the industries is shown by the fact that there are some 35 different materials produced in commercial quantities. Among the more notable developments recorded in the last report are those relating to the iron ore, gypsum and salt industries, all of which have possibilities for expansion greatly beyond present proportions.

These mineral statistics are gathered and tabulated with ultimate care. It is believed that they present the most accurate analysis given to the public of the condition of mineral production in this State. They are published with promptitude and as early as possible after the close of the calendar year.

Iron ores. The description of the iron ore resources of the State has been an urgent need for some time. The previous reports of Emmons, Putnam and Smock are out of print and besides are wanting in many particulars to make them representative of present conditions in the technical and scientific branches of the subject. Field work preliminary to a new investigation was started in 1905 by the Assistant State Geologist and has been continued as opportunity offered during subsequent seasons. Owing to the size of the territory that has to be covered by field work it has been deemed advisable to issue a separate report on each of the larger districts, whereby an earlier publication of the results will be assured. The Adirondack magnetites will be described in the first report, the preparation of which is now practically completed. In this part of the work the cooperation of Prof. J. F. Kemp has been secured. He has kindly undertaken to prepare a description of the Mineville district which he has recently mapped in connection with the survey of the Adirondacks now being carried out under the direction of the State Geologist.

The investigation of the Adirondack magnetites has brought out much that is new concerning their geology. The important problems bearing upon the character of the rock associates and origin of the so called nontitaniferous magnetites have been studied with care, and while they are extremely puzzling, it is believed that progress has been made in their elucidation. The walls inclosing this class of ores belong to the feldspathic gneiss series which it has been found includes both igneous and sedimentary derivatives. There may be distinguished, thus, two main varieties under which all of the occurrences probably are included, though in a few cases the evidence is insufficient at present to place the magnetites definitely with either. The igneous rocks which carry the ore belong to several types, ranging from acid granites on the one hand to granites poor in quartz, syenites and even more basic phases that approach the gabbro-anorthosite group which contains the titaniferous ores. It appears very probable that there is a close relation in the geological occurrence of both classes of ores found in the igneous rocks, since the latter show the most intimate connection in their fundamental characters. Like the titaniferous class, the low-titanium ores (they are not strictly nontitaniferous) are native to the wall rocks and have formed in their present place by some process incident to the cooling and consolidation of the latter. Magmatic segregation has perhaps been influential in some instances, as has already been pointed out by Cushing, but the mineral associations of most of the magnetites point to gaseous or gas-aqueous agencies as the more important factor in the process of formation. The ore bodies originated previous to the dynamic stresses which have affected the whole region and thus have been drawn out and alined parallel to the general foliation. The magnetites found in the sedimentary gneisses differ from the others in several respects. They are always pyritic and have, as associated minerals, garnet, scapolite, sillimanite and usually much hornblende. Their origin is doubtful as the evidence bearing upon it is subject to different interpretations. They may be ancient beds interstratified with the wall rocks or later introductions due to ground waters or insulations set up by the igneous invasions. They are frequently cut by granitic masses and they are possibly an older series than the other magnetites.

The mining industry of the Adirondacks has grown considerably in the last two or three years. The outlook for its future seems quite promising. Not only are the low-titanium ores being developed on a larger scale than previously, but there is a good prospect that the titaniferous deposits will soon be worked on a commercial scale. The new enterprise at Lake Sanford, mentioned in the issue of this report for 1906, has been active during the current year in carrying on investigations; productive operations only await the construction of a railroad to the locality which is in a now inaccessible part of the Adirondacks.

In accordance with the recommendation made in my report of last year the Legislature granted a specific appropriation for the exploitation of the Clinton hematite ores of central New York. It was therein pointed out that a large body of these ores lies almost wholly undeveloped along a belt of country more than 100 miles in length, east and west between Clinton and Wolcott, that it was of first importance to the iron industry in this State to determine probabilities of variation in the volume of this ore body in its dip and local variations in the quality of the ore.

To ascertain these facts borings are necessary at various points south of the observed or buried line of outcrop. The more numerous such borings are the more accurate the deductions will be. It would be well if series of such holes could be put down at points from half a mile to 2 miles back of the outcrop at alternating intervals of about 5 miles, but the present provision will not cover the cost of so much drilling. We are therefore now engaged in putting in with diamond core drill a single series of holes which will have an approximate average depth of 175 to 200 feet and which have thus far been located about 2 miles south of known surface outcrops. The outcome of this undertaking will have to be deferred to the next report.

Oil shales. An undeveloped source of eventual wealth to the State lies in its vast deposits of densely black, bituminous shales which reek with the components of natural gas and petroleum. These beds of black shale lie in the Devonic system of western and southwestern New York, particularly in the Genesee and Portage divisions of the Upper Devonic and are to be found in outcrop quite freely from Canandaigua lake westward to Lake Erie. Preliminary efforts have been made this year to ascertain the available hydrocarbon content of these shales for the purpose of instituting comparisons between them and similar shales like those of Scotland which are today distilled for the commercial production of petroleum, paraffin and ammonia sulfate. The method of treatment of the Scotch shales and the products resulting may be thus briefly stated. The oil is distilled at a temperature of about 900° F. The spent shale is then heated to about 1300° F. to increase the yield of ammonia and permanent gases from the shale. The Scotch shales yield on an average 25 gallons of *crude oil* and 45 pounds of *ammonia sulfate* per ton.

The first distillation of the crude oil yields:

1 *Green naphtha.* This is treated with sulfuric acid and caustic soda yielding "shale spirit" or naphtha.

2 *Still coke;* a valuable smokeless fuel, the production of which has now become an extensively capitalized industry.

3 *Green oil;* the source of paraffin.

The oil is tested with sulfuric acid and caustic soda and is then ready for the second distillation, by which it is fractionated into *light* and *heavy* oils, the latter containing solid paraffin. The light oils are used in making four grades of burning oils. The *paraffin* is obtained from the heavy oil by cooling below 32° F. and straining out by means of filter presses. The paraffin is then subjected to further treatment producing paraffin wax.

The value of the products of the Scotch shale industry is upward of £2,000,000 annually, and is rapidly increasing. The results derived from the analyses made of the New York shales are too incomplete to afford adequate basis of comparison as the method of distillation employed seems not that best adapted to the problem. The indicated proportions of fixed carbon and volatile hydrocarbons are apparently less than in the Scotch shales, but it is not certain that a more exact treatment with care to prevent volatilization of the hydrocarbons would not give a different result. At all events the results obtained are sufficiently encouraging to justify further pursuit of the inquiry.

SEISMOLOGICAL STATION

The seismological station of the State Museum has rendered efficient service throughout the year. Except for occasional stoppages of short duration — usually less than an hour each — due to the necessity of making readjustments from time to time, it has been operative continuously since March 10, 1906, when the instruments were first installed.

One of the chief objects of the records is to secure information relative to the character and frequency of earth tremors in the vicinity of Albany, which are set up by distant shocks. This line of investigation has never before been carried on anywhere within a radius of several hundred miles from the station. The results thus far obtained have shown the locality to be well adapted for receiving records and have already thrown considerable light on the subject. With the present equipment the larger earthquakes throughout the world are registered within a few minutes of their occurrence. It is hoped also that the observations may afford information as to possible earth movements of local nature. These have not been detected as yet, though it is considered more than probable that there are slow oscillations going on within the neighboring region which in the course of time will manifest cumulative effects of sensible magnitude. The observations must be continued over a considerable period to form a basis for the study of these movements.

The importance of seismological investigations is rapidly gaining recognition in this country; stations are now planned or under installation at Cambridge, Mass., New Haven, Conn., and Ann Arbor, Mich., as part of the scientific equipment of the several universities at those places. In the near future there will thus be a series of stations covering the northeastern section of the country quite completely, as observations are now made also at Cheltenham and Baltimore, Md., and Washington, D. C. It may be suggested that the work might be materially advanced by coordination of the different observing points, and it is hoped that some arrangement of the kind will be effected. In this manner the detection of the small local movements which are apt to be confused with the feebler tremors of distant origin would be specially facilitated.

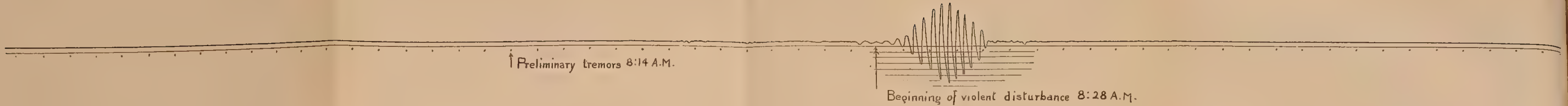
The Albany station has been called upon frequently to supply information regarding earthquake occurrences, both for the press and for scientific purposes. Records have been available some times long before the arrival of telegraphic dispatches from the centers of disturbance. It has also been possible to demonstrate the nonexistence of many reported shocks in the neighboring region. The observations relating to the San Francisco and Valparaiso earthquakes have been supplied to the California Earthquake Commission and the International Seismological Association for use in the preparation of their reports.

The year just ended was the first for which a complete series of records has been obtained. In all, 19 disturbances, large and small, were registered. A tabulation of the data is given herewith, accompanied by notes explanatory of the individual occurrences. Similar information covering the period March 10 to October 1, 1906, was included in the report for that year.

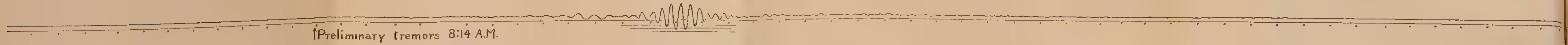
The character of the records traced by the instruments differs in each case, and it is not possible to give all the elements for every disturbance. Some of the more remote shocks which are apparently of relatively small proportion cause only feeble vibrations indicated by a slightly wavy line as traced on the recording cylinder. The record of larger earthquakes, on the other hand, is usually resolvable into several portions of distinctive character from which deductions may be made, according to well known principles, as to the distance traveled by the waves, and the direction and relative magnitude of the disturbance.

SEISMOGRAMS

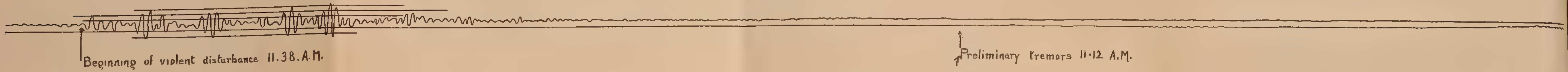
July 1, 1907
North-south vibrations



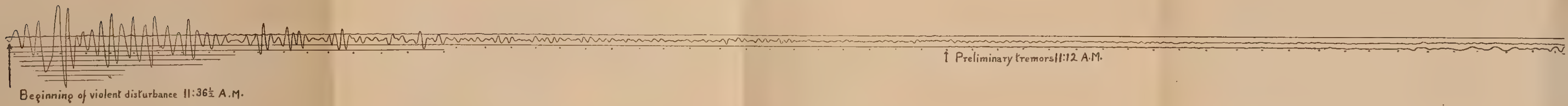
July 1, 1907
East-west vibrations



September 2, 1907
North-south vibrations



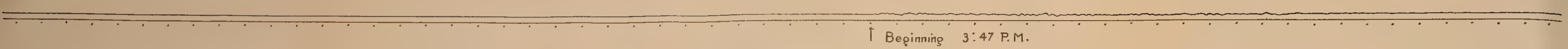
September 2, 1907
East-west vibrations



SESIMOGRAMS

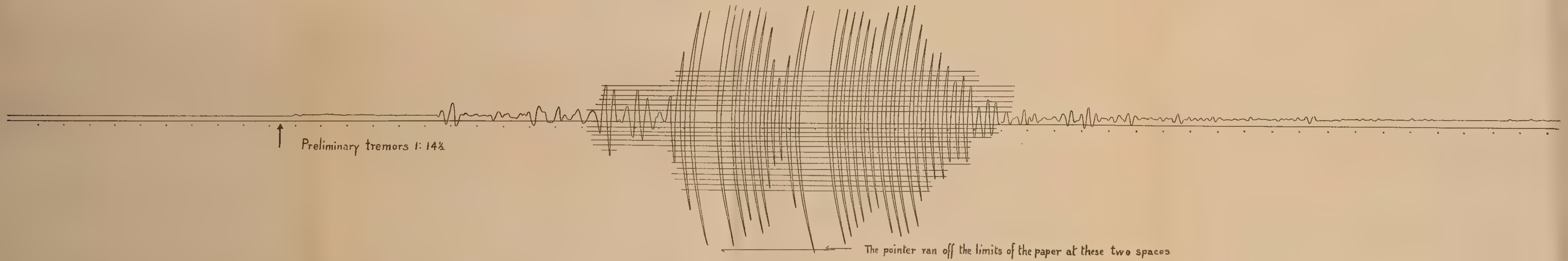
Kingston earthquake

January 14, 1907
East-west vibrations

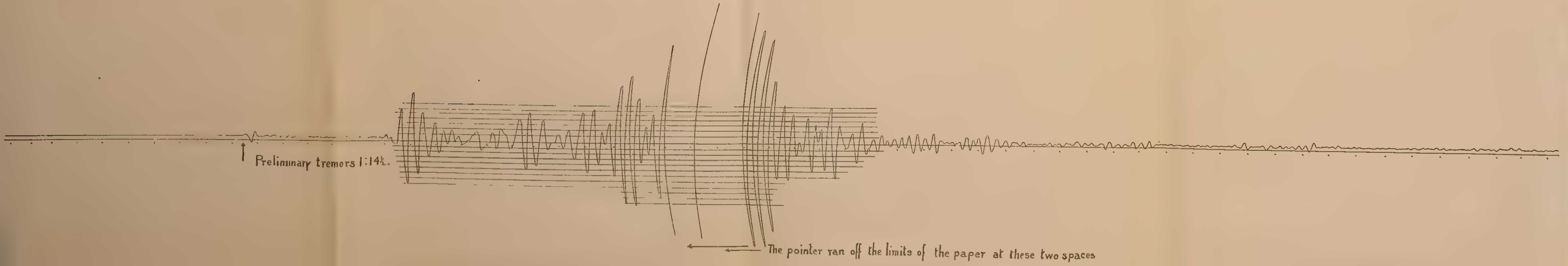


Mexican earthquake

April 15, 1907
North-south vibrations



April 15, 1907
East-west vibrations



A description of the instruments in use at the station has been given in a previous report. The important constants applicable to the interpretation of the records are as follows: Latitude, n. 42° 39′ 6″; longitude, w. 73° 45′ 18″. Weight of each pendulum, including arm, 11.283 kilograms. Distance of center of gravity from rotating axis 84.6 centimeters. The period of the pendulum (time required for a complete swing) averages 30 seconds, with variations of two or three seconds from the mean. The recording arm has a multiplying ratio of 10. The base of the instruments is approximately 85 feet above sea level.

RECORD OF EARTHQUAKES AT ALBANY STATION OCTOBER 1, 1906 TO OCTOBER 1, 1907

Standard Time

Da e	Beginning preliminaries			Beginning principal part		Maximum		End		Max. amplitude
1906	h.	m.		h.	m.	h.	m.	h.	m.	mm
Oct. 1	9	28	p. m.	..	..	..	..	10	30	1
Nov. 14	1	34	p. m.	..	..	..	..	1	41	7
Dec. 3	5	03	p. m.	..	..	..	..	5	30	....
Dec. 22	1	39	p. m.	2	03	2	15	3	0	10
Dec. 23	12	39	p. m.	12	52	12	52	1	34	5
1907										
Jan. 2	7	53	a. m.	7	55	7	56	8	24	8
Jan. 4	12	43	a. m.	1	25	1	26	2	17	6
Jan. 14	3	47	p. m.	..	..	..	..	4	12	1.5
Mar. 31	5	16	p. m.	..	..	..	..	5	47	....
Apr. 15	1	14½	a. m.	1	19½	1	33	3	0	*a*
May 28	10	00	a. m.	..	..	..	..	..	..	....
May 31	8	02	a. m.	..	..	8	12	9	00	....
June 1	3	55	a. m.	..	..	..	..	4	38	....
June 4	10	31	p. m.	..	..	..	..	11	53	2
June 28	1	25	p. m.	..	..	..	..	2	12	....
July 1	8	14	a. m.	8	23	8	28½	9	15	50
Aug. 17	11	40	a. m.	..	..	..	..	12	15 p. m.	....
Sept. 2	11	12	a. m.	11	36½	11	38	3	00 p. m.	50
Sept. 23	4	46	p. m.	..	..	..	..	5	37	....

a Amplitude over 150mm maximum exceeding the limit of registry.

October 1. A slight movement lasting a little over an hour and registered only on the north-south pendulum, showing the direction to be nearly at right angles. The same disturbance was noticed at the stations at Washington, Isle of Wight and Perth, Australia. Its origin was not definitely fixed, so far as has been learned, but it was probably in the southern Pacific or Indian ocean.

November 14. A small disturbance, probably centered within 2000 miles of Albany. Slight shocks were reported in New Mexico and Kingston, Jamaica.

December 3. A series of minute vibrations producing a wavy line. Disturbance was of West Indian origin.

December 22. A very characteristic record of a macroseism. The east-west component was the larger with a maximum amplitude of 10 millimeters as compared with 6 millimeters for the north-south component. The duration of the preliminary tremors indicated a source from 6000 to 10,000 miles distant. A heavy earthquake was reported in Russian Turkestan in the vicinity of Lake Balkash at 11.20 p. m., and when due allowance is made for time difference and transmission of the waves, the relation between the record and this disturbance becomes apparent.

December 23. Registered mainly on the east-west machine, with an indicated distance of 4500 miles from Albany. A distinct occurrence from the preceding, perhaps originating in the Cordilleran region of Mexico or South America.

January 2. The same disturbance was recorded at Laibach, Austria, a little later than at Albany. Its center was somewhere in the Pacific.

January 4. A distant shock of unknown source.

January 14. The earthquake which destroyed Kingston and had its focus in the vicinity of that city. The record of the waves was scarcely proportional to the reported intensity of the shock, showing only vibrations of small compass without any distinct division into preliminary and main portions. The first waves to arrive were apparently the main ones, as the destructive shock occurred at 3.35 p. m., according to press dispatches, or 12 minutes before the beginning of the record. This would indicate a velocity of about 3 kilometers per second which is the average rate of travel of the larger waves.

March 31. Faint vibrations of undoubted seismic character. An earthquake was reported in Turkish Armenia on this date, but the accounts are so vague that no connection can be established certainly with the Albany tracing.

April 15. Remarkable for the magnitude and duration of the main tremors. The indicated intensity of the shock exceeds that of any recorded before or since by the seismograph. The two components have nearly the same amplitude in their principal parts, though the east-west machine shows a longer absolute period of disturbance, the north-south pendulum ceasing to vibrate at 2.20 a. m. The pointers of both pendulums swung completely off the cylinder. The earthquake seems to have been centered south of Mexico City in a sparsely inhabited region, which accounts for the small damage and loss of life that ensued.

May 28. Slight trembling indicated on the north-south pendulum, continuing at intervals until 5 p. m.

May 31. Faint tremors of seismic nature.

June 1. Small disturbance, coincident with a slight shock in Ecuador.

June 4. A distant earthquake traced for over an hour on the north-south pendulum.

June 28. Small tremors.

July 1. This disturbance would seem to have been a severe one, and perhaps 5000 miles distant in a southerly direction. The Havana station reported its passage at 7.43 a. m. It was probably submarine.

August 17. A thickening of the line traced by the north-south instrument, breaking into minute waves 20 minutes after the beginning

September 2. A very distant shock, as shown by the long duration of the preliminary tremors and by the continuance of the record for an interval of nearly four hours. Vibrations much more pronounced on the north-south machine. The Isle of Wright station reported its passage later than American stations so that it undoubtedly came from the Pacific.

September 23. Vibrations of small amplitude throughout.

September 24. North-south pendulum showed a condition of slight instability, due to a small earthquake. Disturbance recorded at Washington.

MINERALOGY

In the section of mineralogy, the research work has included an investigation of the crystal forms of the calcite from Rossie, St Lawrence co., a study of the crystal forms and twinning habit of the new occurrence of calcite from Sterlingbush, Lewis co., and a study of the minerals from Newcomb, Essex co. The work on the Rossie calcite which yielded two forms new to the species and 12 which are new to the occurrence, has amply demonstrated the value of detailed crystallographic study on a large number of specimens from localities even as well known as this one. The work on the Newcomb minerals, which is still in progress, has already yielded a new form for arsenopyrite and three new forms for wernerite as well as a ratio for the axial elements of the latter mineral very close to that determined by vom Rath.[1] The tourmalin crystals

[1] Pogg. Ann. 1863. p. 119–254, 262.

from Newcomb have also proved of interest as showing several rare crystal forms.

A case containing a few examples of the large and unique calcite crystals from Sterlingbush has been installed in the corridor of the fourth floor of the Capitol where the fine pink and purple colors of these specimens show to excellent effect.

The packing for storage of the large collection of New York minerals was completed and a system of labeling for the boxes has been devised by which newly collected material can be readily sorted into its place when the entire collection is reassembled.

A collection illustrating the recent work of the museum in mineralogy was exhibited at the last annual reception of the New York Academy of Science at the American Museum of Natural History in December.

The mineral collections have been enriched through the gift of Mrs J. V. L. Pruyn of a collection illustrating the minerals from the vicinity of Mount Vesuvius, and by the gift of Mr H. H. Hindshaw of a large collection of minerals from Lyon Mountain, Clinton co., N. Y., which latter amply supplements the material previously acquired by the museum from this interesting locality. A beautiful series of minerals from foreign localities was obtained from Dr F. Krantz of Bonn.

The field work of this section has resulted in the collection of a number of handsome specimens from the graphite mines in the vicinity of Crown Point and Ticonderoga, Essex co., of a series of over 50 specimens of tremolite from a new locality near Gouverneur, St Lawrence co., and of a large number of specimens of calcite for exhibition and study from the limestone quarries at Smith's Basin, Alsen and West Camp.

An important addition to the series of gem minerals from New York, comprises 26 crystals of diopside from the well known locality at DeKalb, St Lawrence co. These average 15 millimeters in diameter, the largest measuring 35 millimeters across the basal section. They are, for the most part, transparent and of a fine emerald green color. They were obtained by the Assistant State Geologist from Mr Calvin Mitchell of DeKalb Junction.

PALEONTOLOGY

Early Devonic faunas. In all of my recent reports reference has been made to the progress of investigations and correlation studies of the New York early Devonic faunas and those of the

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The hexactinellid sponge Hydnoceras bathense Hall & Clarke. 1/6 natural size. This and the following plate show a series of slabs recently put on exhibition. About 250 sponges have been made visible by careful preparation and others lie buried in the rock. The blocks represent a small portion of a great sponge plantation, in the Chemung rocks at Bath, N. Y.

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Plate 9

Fossil sponges
Hydnoceras bathense. Hall & Clarke
1/6 natural size

St Lawrence gulf region. The work has progressed more slowly than could have been anticipated largely because of the great difficulties involved in executing the plates in accordance with the accepted standard of our lithography. The first volume of this memoir covering especially the geology and paleontology of the Gaspé region of Canada has stood complete in type for a year awaiting the production of these plates. The illustrative matter is now finished and it will be possible to distribute this part of the work within a short time. Meanwhile the second part has gone to press. This second volume is concerned with these faunas in their development in New Brunswick and Maine and particularly recounts the aspects and character of the faunas in New York. During the past year a very significant addition to the Oriskany faunas in this State has been made by the discovery in Orange county along the eastern limb of the Skunnemunk mountain syncline of a considerable development of this horizon in which the preservation of the fossils is instructive and the species full of interest, as many have been seen for the first time, others mark the first appearance in this State of forms recorded from more eastern localities.

When Professor Hall was elaborating the paleontology of the Helderberg and Oriskany formations the development of these rocks in the Appalachian region of New York south of the Helderberg mountains did not contribute materially to his stores. The outcrops in this region had been delineated with approximate accuracy by Mather but in all his paleontological work in New York, Hall seldom got far away from the undisturbed rocks of the central and western districts of the State to which he was early wedded. Work was later done in this Appalachian region by N. H. Darton of the United States Geological Survey (which can not be regarded as making any advance in accuracy upon that done 50 years before by Lieutenant Mather) and by Dr Heinrich Ries, who constucted a map and report of Orange county recording interesting data in regard to details of stratigraphy without attempting close analyses on the basis of paleontology. In the instructive but involved sections entangled in Appalachian folding the arenaceous deposits of the Lower Devonic have generally passed as "Oriskany" and the calcareous beds beneath as "Lower Helderberg," a discrimination which is no longer accurate or adequate. In late years the regions have been given careful study at certain points and the succession of the faunas closely analyzed. Perhaps the first of these efforts was that made by the writer to portray the character of the Oriskany fauna of Becraft mountain, the sole outlier of this stage on the east of the Hudson river. This was followed in the year 1903 by two important contributions, one by Stuart Weller on the Paleozoic rocks and faunas of New Jersey, in which he discussed the sections at the entrance of the western or Port Jervis-Otisville branch of the divided Paleozoics of eastern New York and those further south in his own state; another by Gilbert van Ingen and P. E. Clark on the "Disturbed Rocks in the Vicinity of Rondout, N. Y." [Mus. Bul. 69] in which all the precise determinations were made by Mr van Ingen.

In 1905 Prof. H. W. Shimer published the paleontology of the section at Port Jervis known as Trilobite mountain [Upper Siluric and Lower Devonic Faunas of Trilobite Mountain, Orange County, N. Y., Mus. Bul. 80].

Prof. George H. Chadwick has recently brought together some results of further examinations made for the State Museum, of the sections at Rondout and southward into Greene county, with the special aim of elucidating the composition of the Port Ewen fauna. Though these results have not been put in final form the author's determinations are of very considerable interest.

The Port Ewen beds, to rehearse briefly the history of this stratigraphic unit, are a series of thin limestones and gray lime shales, which, in the Appalachian region of New York and New Jersey lie immediately below the Oriskany silicious limestone and upon the Becraft limestone, bear the lithic character of the New Scotland lime shales and carry a large percentage of Helderberg fossils. It is a division not recognized by the early geologists in their partition of the "Lower Helderberg" and it is entirely absent from the succession west of Schoharie. Its earliest recognition as a definite unit was by Prof. W. M. Davis in 1882 who termed these rocks whose position he determined as above the Becraft limestone, the "Upper shaly beds" contrasting them in this designation with the "Catskill or Delthyris shaly limestone" below. Professor Davis did not attempt to delimit these beds and did actually, according to Professor Chadwick, include in his division some part of the "Upper Pentamerus limestone." The writer in a joint publication with Professor Schuchert [Science, Dec. 15, 1899], recognizing the distinct unit character of these strata termed them the "Kingston beds," later substituting for this term, which proved to have been employed by the Canadian geologists for a quite different formation, the name *Port Ewen beds* from their exposure near Port Ewen station on the West Shore Railroad. The character of the fauna of these Port Ewen beds has not been well understood and it was this problem that carried Professor Chadwick into the field. Through the efforts of Mr Chadwick and Mr Shimer we have now a fairly adequate idea of the composition of the fauna of these beds.

Though, as already stated, the preponderance in the census of the species so far as known, is Helderbergian there is a noteworthy percentage of species that may be regarded as normal or at least usual to the calcareous Oriskany above. Various others have been recognized as passing upward from the Helderbergian into this Oriskany and Mr Chadwick in his closest analyses of the assemblage has pointed out its generally decadent condition as a Helderberg fauna.

There are also other species of very first import which have and probably must continue to be regarded as index fossils of the Oriskany formation. Chadwick determines Megalanteris ovalis, Beachia suessana, Leptocoelia flabellites, Leptostrophia oriskania, Brachyprion majus and B. schuchertanum. He indicates also the possible occurrence of Spirifer arenosus. Professor Shimer determines Spirifer murchisoni and Meristella lata.

It becomes now a question for very careful consideration whether a fauna lying beneath the normal position of the Oriskany beds and carrying such fossils as these, can with propriety be regarded a Helderbergian fauna notwithstanding its preponderance of Helderberg species. Upon this line of inquiry the recently discovered Oriskany fauna already referred to will throw additional light but the evident earlier immigration into the eastern New York region of Oriskany species than had before been noted is not in anywise out of harmony with the evidence of their association in the Gaspé basin at the northeast.

Monograph of the Eurypterida. It has long been the writer's purpose to prepare a revision of these remarkable crustaceans which occur in a variety and abundance in the rocks of New York unequaled elsewhere in the world. The Bertie waterlime outcrops in Erie, Cayuga and Herkimer counties and the Salina (Pittsford) shales in Monroe and Orange counties have now afforded a really extraordinary manifestation of the profusion of these creatures. Fifty years ago James E. De Kay and Professor Hall had described the commoner forms of these crustaceans Eurypterus and Pterygotus from the Bertie waterlimes, and Messrs Grote and Pitt some years since published in the bulletins of the Buffalo Society of Natural Sciences accounts of supposed additional species occurring in these rocks at Buffalo. With the exception of the latter practically all accounts of these fossils in this State have been published in the reports of this institution; some notices in the *Palaeontology of New York,* volume 7; Mr Clifton J. Sarle described the remarkably interesting species from the Salina beds of Pittsford in Museum bulletin 69 and the writer the extraordinary fauna from the Otisville shales in bulletin 107. The collections of the museum representing these genera: Eurypterus, Pterygotus, Eusarcus, Hughmilleria, Stylonurus etc. are very extensive. All of the material described by Mr Sarle and the writer is here and recent additions to the specimens from these localities run up into hundreds of examples. Large collections have also been made by us in recent years from the localities in Herkimer county. The museum of the Buffalo Society of Natural Sciences is the possessor of most commanding collections of eurypteroids from the Bertie waterlimes in that city, which have been greatly enlarged of late by the enthusiastic interest of Mr Lewis J. Bennett, president of the Buffalo Cement Co. from whose quarries nearly all the specimens of these Bertie waterlime crustaceans scattered through the museums of the world, have come. In later years Mr Bennett has provided that all specimens taken from his quarries go into the museum of the Buffalo Society with the result that these collections have become fairly stupendous and vastly illuminating. The courtesy of a formal vote of the trustees of the Buffalo Society of Natural Sciences has enabled me to feel confident that this fine material will be subject to my use. It is my hope soon to reach a time when these investigations may be taken up for uninterrupted pursuit. Meanwhile progress is made as occasion affords.

Mastodons. In my report for 1903 I gave a summary of records of discoveries of mastodon remains in this State since the date of the first finding of the bones of the Mastodon americanus a short distance below Albany in 1705. The list there given afforded evidence of about 60 distinct occurrences of these skeletons. Last year I supplemented this record with four items. During the past season another discovery has been made. A brief notice of this follows and thereafter some notes of interest on other remains.

1907. *Perkinsville, Steuben co.* This skeleton was found in August last by John Morsch on his farm near the west end of

Perkinsville swamp and ¾ mile north of the railroad station of Portway. This swamp is a nearly equilateral triangle about 1½ miles on the side. It occupies a shallow depression in a mass of morainic drift of unknown depth at the head of the Cohocton valley and is adjacent to the west side of a low ridge that separates the drainage area of the Cohocton river from that of the Canaseraga creek. It has an altitude of 1360 A. T. The surface layer of the swamp is black muck to a depth of 6″ — 1′, beneath which is a bed of nearly white marl 6″ — 6′ in thickness. The bones were found about 26 rods from the highway and 4 or 5 rods from the north edge of the black soil or border of the swamp. In digging about a small boulder Mr Morsch came upon one of the larger leg bones and proceeded to take out the remains of the skeleton. These bones lay largely in their natural position and while perhaps the numerical two thirds of the skeleton were preserved, the more conspicuous bones were fragmentary or wanting. At the conclusion of the excavation it was found that all four legs and feet, a large number of ribs and vertebrae, parts of the shoulder girdle and one ramus of the lower jaw with teeth had been recovered. The skull with tusks, greater parts of pelvis and scapulae were gone. It would seem that the animal in sinking into the mire had been left with the more protuberant portions of the body, the head probably thrown up and back, exposed to the air and inviting the attack of rodents. The absence of these parts when all the other bones had so compactly kept together, left little likelihood of their being found in any other part of the swamp. The preservation of the bones recovered was excellent for mounting and it is to be regretted that the specimen just missed being a desirable acquisition to a scientific museum.

1876. *Pike, Wyoming co.* [See Report Paleontologist, 1903 p. 932]. I append here some additional data concerning the Pike skull taken from a recently published account [Guide to the Genesee Valley Museum, Letchworth Park, by Henry R. Howland, 1907, p. 5].

These remains of a mastodon were found in the summer of 1876 in cutting a farm land ditch on the farm of Charles Dennis, on the outskirts of the village of Pike, which is about 7 miles from Glen Iris, and through which flows the Wiscoy creek, one of the tributaries of the Genesee river. The tusks were fortunately quite perfect and with them were found a part of the skull, some vertebrae and some foot bones. In order that these remains should be properly preserved they were at once purchased by Mr Letchworth who caused them to be mounted at the natural history establishment of Prof. Henry A. Ward in Rochester, N. Y. The prompt action taken in the matter resulted in the preservation of this valuable relic which was returned to Pike and allowed to remain on exhibition at the Pike Seminary until the completion of the Genesee Valley Museum Building in 1898. In 1904 the seminary building was destroyed by fire. The measurements of the Pike mastodon are as follows:

Length of skull, measured in a straight line from back to front..	43½ inches
Length of tusks, measured along lower curve	96½ inches
Greatest circumference of the tusks.....	23 inches

I append here some historically interesting observations on the occurrence of mastodon bones in America made by Dr Johann David Schoepf in his *Reise durch einige der mittlern und südlichen vereinigten nordamerikanischen Staaten, nach Ost-Florida und den Bahama-Inseln, unternommen in den Jahren 1783 und 1784,* volume 1, pages 408–15, 1788. This is a work of extraordinary interest which has been quite overlooked by students of American history. Its author was a surgeon in the Hessian forces sent over by George III and remained after the consummation of peace to travel through the country and collect scientific materials. The narrative gives a lively, anecdotal picture of the domestic and community life of the times interspersed with interesting reflections on the new government. Dr Schoepf was the author of other more technical works arising from his American experiences. He wrote a treatise on American Materia Medica, on the Reptiles of the country and was the first man of science to produce a special treatise on the geology of North America. His *Beyträge zur Mineralogischen Kenntnisse der Ostlichen Theils von Nordamerika und seiner Gebürge* published in 1787 is characterized by acute observation and keen interpretations of geological phenomena. It was 50 years in advance of the times and wholly ignored by the first American workers in the same field. Of these books only his Materia Medica was translated into English. German was unpopular, it was the language of the hated Hessians and of the Hanoverian house. So these very illuminating and interesting volumes have been buried as deep as Captain Kidd's treasure.

Among the natural rarities of the Kentucky regions, the many large teeth and bones belonging to an animal no longer existing in all America have long excited the wonder of all travelers. The place where they were first discovered in great heaps is a low hill, on the east side of the Ohio, 2–3 miles from its banks and about 584 miles below Fort Pitt, measured along the course of the river. At the sources of a little brook where there are extensive salt licks, the heavy tread of the buffalo herds which gather there, with help of wind and weather, have uncovered these bone heaps which are buried only a little way beneath the surface. The mass of bones is said to be very considerable; to judge only from what lies bare or projects from the surface, some estimate that there must be the ribs of at least 12–15 animals. How many more yet may not be buried under the earth? It was perhaps a numerous herd of beasts that here found their common grave. As to the former owners of these bones, the native Americans have just as little knowledge as the opinions of the most learned students of nature have imparted. On account of the immense size of the bones and of the elephantlike tusks found among them the natural inference has arisen that they are remains of elephants formerly native in this part of the world or by accident brought here and destroyed, and one is all the more justified in the opinion, which has in itself nothing contradictory, as in so many other regions similar elephant bones have been discovered where the race of elephants is as little native as in America.

By exact comparison between these bones from the Ohio and other bones and teeth from living elephants, certain variations have been marked which raise new doubts. Particularly it has been found that the thigh bones on the Ohio are thicker and stouter than those of the well known elephants; that the tusks are often somewhat twisted and especially that the crowns of the molar teeth are furnished with wedge-shaped elevations which the present elephant does not possess. For these, and especially the last reason, the learned Dr Hunter[1] believes himself justified in assuming that these American bones and teeth must have belonged to a flesh-eating animal larger than the known elephant. From their relations to the bones found in Siberia, Norway and other northern lands of the old world, Raspé seeks to make it appear probable that they are the remains of a great animal (elephant or not) which was of a special species and originally was adapted to colder regions, the whole race of which has from unknown causes now become extinct.[2]

With this view Daubenton and other savants agree and Mr Pennant believes that this still undetermined animal may yet be encountered alive somewhere in the interior unknown regions of America, and calls it therefore in his synopsis, the *American elephant.* If now, remains of the hippopotamus have not to some extent on the Ohio been mixed with those of the elephant and hence given rise to errors, this idea needs further elucidation.

In Pittsburg I saw in the possession of an artillery officer a thigh bone, a molar and a tusk which he had himself brought from that region. The thigh bone, though quite dry and here and there with

[1] Philos. Trans. 1768. v. LVIII.

[2] Philos. Trans. 1769. v. LIX. Dissertatio epistolaris de Ossibus & Dentibus Elephantum, aliarumque Belluarum, in America boreali etc. obviis, quae indigenarum belluarum esse ostenditur. *I. C. Raspé*

some of its substance lost, weighed not less than 81 pounds, was 3 feet, 9½ inches long; in the middle where it was comparatively flat its circumference was only 20 inches but on the lower joint 2 feet, 6½ inches. The tusk was 3 feet long, 4 inches in diameter at the end, but it was not entire. I could see no evidence of its being twisted. The molar tooth which I received as a gift, weighed easily 6 pounds and the crown was armed with three wedge-shaped elevated processes.[1]

The first two pieces were given to the library in Philadelphia where I afterward had the opportunity of seeing them. As an incident it may be observed that the officer referred to, in order to fetch these three pieces from their locality a few miles from the boat on the Ohio, paid one of the soldiers a slight pourboir of 1000 paper dollars equivalent in value to 2400 Rhenish florins. Besides the molar referred to I have seen in Philadelphia in the collection of Mr du Sumetière, several others, found in other parts of America. These were all quite similar and some had the elevated processes of the crown particularly sharp, while in others they were low. If this style of tooth only were always found among the elephantlike bones discovered at various separated places in America, then the assumption that they belonged to an ancient race of American elephants would be much strengthened. It has recently become known that the spot on the Ohio is not the only one in North America where similar remains of these animals are found. Teeth have been discovered on the Tar river in North Carolina, near Yorktown in Pennsylvania and in Ulster county in New York. Catesby mentions an elephant tusk dug up in South Carolina; Kalm an entire skeleton in the country of the Illinois and others have been found in South America. The largest collection of the Ohio fossil bones is in the possession of Dr Morgan of Philadelphia. On account of the trackless distance it was formerly very difficult to obtain these remains which had to be brought by a long circuit down to New Orleans and then up to Philadelphia by sea. Now the settlement of Kentucky affords better prospect of an early and more exact knowledge of the remarkable bone deposit. It would be superfluous to repeat the various theories which have been advanced to explain the occurrence of this accumulation of remains of so very strange an animal. Floods, marvelous changes of climate, of the earth's center of gravity and of its axis, have been invoked. The American hunters satisfy themselves with the explanation that these were real elephants killed off by a hard winter which they were not able to withstand and to support their opinions they point out that often an extraordinarily

[1] This molar is now in the very fine scientific collection of Privy Counselor Schmidel of Anspach and both in respect to weight as well as in entire structure entirely different from the elephant's tooth with which the Privy Counselor has compared it. The molar of an elephant which Mr Sparrmann has described, weighed only 4½ pounds.

severe winter kills off other species of animals specially acclimated to this part of the world.[1]

It is easy to see that such a restricted cause could have no effect in accumulating the deposits of these animals in the tropic South America. No one, however, has been happier in his theories upon this problem than the author of the *Essai sur l'origine de la population de l'Amerique,* volume II, page 298, who regards all these bones (whether in jest or earnest, no one knows) as nothing more than the remains of a troop of fallen angels (equipped with six-pound back teeth!) which, according to his notion, were the original inhabitants of the earth in its primitive and glorious state, until, because of their transgressions they were condemned to universal destruction near their own earthly habitation, whereupon the rest of the purified planet was cleaned up for the reception of the present improved race of mankind.

Devonic crinoids of New York. The work on the New York crinoids has shown a fauna of exceptional and unexpected interest. Thus far nearly 40 genera have been recognized, some for the first time in Devonic rocks and the number closely approaches the total genera hitherto known from the Devonic rocks of the world. The group of the Inadunata is well toward completion and many drawings of the species made. These investigations are being made by Mr Edwin Kirk.

Paleozoic corals. Excellent progress has been made by Dr T. Wayland Vaughan on the anaylsis of the genera of the Paleozoic corals. Dr Vaughan labors under the disadvantage of endeavoring to rescue the results of previous attempts made here to define and illustrate these fossils but his efforts give promise of an eventually satisfactory outcome.

Devonic fishes. A monograph of the Devonic Fishes of New York by Dr Charles R. Eastman was issued during the year as Memoir 10. This work affords a comprehensive survey of present knowledge of the fishes obtained from the rocks of this State and though these remains are in many instances in highly incomplete condition, it has laid the foundation of future study of these organisms. Moreover the author's wide acquaintance with his subject has given his general conclusions more than ordinary interest and force. Under the title "Zoological conclusions" problems of the evolution of the fishes are discussed, such as the origin of the cel-

[1] In the severe winter of 1779–80 a great number of roe deer were found dead here and there in the woods in the interior of America and its mountains; often many together near the frozen springs where they were accustomed to drink or to lick salt. A multitude of birds and other animals were also killed that winter.

shaped fishes among races which have not progressed, the origin of the paired fins and the development of the effective fins. The chapter entitled " Geological conclusions " is of special interest as indicating the distribution and migrations of the early fish fauna and may well be reproduced here.

GEOLOGICAL CONCLUSIONS

It will be convenient to include under this head certain topics whose practical bearing is of chief interest to the geologist, although the evidence involved is partly zoological, and in still larger part geographical, or paleogeographical. We refer to such matters as relate to the areal and vertical distribution of Devonic fish life, the dispersion of new types and varieties, migration, succession and occasional recurrence of faunas, and indications furnished by the fossils themselves in regard to climatal and physical conditions, either those of local nature, or others prevailing over wide areas. Thus, by way of illustration, we are able to affirm from the general complexion of ancient faunas, that the climate of arctic regions was notably warmer during the Devonic and late Paleozoic than at subsequent periods. We are in possession, also, of a large fund of evidence regarding migrational movements, and can delineate with great exactitude a number of physical barriers that were interposed to lines of migration. Means are at hand in very many cases for distinguishing between free swimming inhabitants of the open sea and other forms whose structural organization proves them to have been bottom feeders, mud grovelers, or frequenters of estuaries and fresh-water lagoons. Manifestly inferences of this nature are of far-reaching geological significance, besides having a direct practical application. Finally, a knowledge of the relations of successive vertebrate faunas is an important corollary to the information we have concerning fossil invertebrate faunas, the two categories being mutually complementary, and taken altogether are essential to a natural classification of geologic formations.

We may consider first some of the more general conclusions derived from a study of the distribution of Devonic fishes, having special reference to those of New York State. In the first place it is necessary to bear in mind that the Devonic faunas of the interior of North America announce themselves as belonging to two distinct types, one being more or less confined to the eastern, and the other to the west central United States and Canada. Or, to put it differently, it is possible to recognize within the interior of our continent two more or less distinct geological provinces of the Devonic, differing from each other and from the more remote areas lying to the westward (Cordilleran and continued border provinces) in their respective faunal characteristics. The eastern interior province, which has received the name of Appalachian, is typically represented in New York State, but extends westward into Ontario and Michigan, and southwestward into the Ohio valley region, forming circumscribed areas known as the Cumberland and Indiana basins. The western interior province is represented typically in Iowa, and was more or less effectively separated from the eastern during early and Middle Devonic time. Its limits are coextensive with the so called Dakota sea, which was open to the northwest during the mid-Devonic through Manitoba, the Mackenzie Basin, and across Behring straits into Siberia, but was probably closed to the northeast. The suggestion has been made, and indeed been received with some favor, that intercommunication existed during the mid-Devonic between the typical Iowan and Eurasian faunas by means of a northeasterly passageway through Manitoba, Hudson and James bays, Greenland, Spitzbergen and circumpolar regions. More recently, however, weighty objections have been opposed to this theory, and it has been asserted very emphatically by Professor Schuchert that there is not the slightest reason to connect the Hudson and James Bay Devonic with that of the Dakota sea (or western intercontinental province). It is further denied by the same author that this latter province was in connection with a southern ocean, extending into Brazil, until Hamilton time. On the other hand students are agreed that communication was maintained between the Appalachian province and that of the southern hemisphere during the mid-Devonic. Concerning the pathways that were open between the Appalachian and Eurasian provinces during the Middle and later Devonic there are still some differences of opinion.

It will be observed accordingly, that the Devonic in this country was preeminently an era of provincial development of marine faunas. Furthermore it appears that diversity in this respect is more strongly marked in the Appalachian region, where there were varying conditions of sedimentary deposition, than in the Cordilleran and continental border regions, where these conditions were more uniform. Thus, in the eastern province, as Professor Williams has pointed out, diversity and alternation of deposits are accompanied by numerous successive and distinct faunas; in the extreme western regions, uniformity of prevailing calcareous sedimentation for long periods is characterized by the abnormally long continuance of many Devonic species; and the central continental province, midway between the two, is marked by the unmistakable recurrence of Devonic species well along into the Carbonic. Another noteworthy feature of the Devonic which has been developed very fully and clearly by the painstaking investigation of Dr Clarke is that faunal changes within the ancient Appalachian sea are sometimes so precisely indicated that it is possible, as in the case of the Portage group, to trace the boundaries not only of local provinces, but of local subprovinces characterizing the stage in question. Thus, the Genesee province of the Portage is divided into Chautauquan and Naples subprovinces on the basis of differences in their faunal facies; and an interesting peculiarity of the Naples subprovince is that, as stated by Dr Clarke "with contemporaneous faunas of the Appalachian gulf" its fauna "has in its purity no organic relation, direct or sequential."

It is very necessary to understand this matter of the provincial character of Devonic faunas in North America. Also, in tabulating the facts of distribution, one must keep in mind the inferred lines of intercommunication between those provinces that were connected, as well as the position of barriers between others that are known to have been separated. The data upon which our information in regard to these matters reposes have been brought together chiefly by workers in invertebrate paleontology, and as the evidence at their disposal is enormous as compared with that obtained from a study of the vertebrates alone, no deductions drawn from the latter are likely to prejudice the results depending upon a different class of remains. In point of fact, no discoveries of fossil fishes have yet been made which tend to contradict or discredit conclusions already established on the basis of fossil invertebrate evidence. The known distribution of the former is in all respects consonant with, and one is tempted to add, confirmatory of the principles that have been formulated from a study of the latter. We find simply that the more mobile free-swimming contingent of Devonic faunas followed the same routes and penetrated, probably with greater facility, into the same areas as the slower moving invertebrate associates of the original fauna, wherever we are able to trace its migrations.

Nevertheless, some facts relating to the distribution of Devonic vertebrates stand out with such distinctness as to attract particular attention. The earlier Devonic horizons in New York State are singularly deficient in fish remains, and the faunas that appear successively in the Meso- and Neodevonic are introduced with little or no foreshadowing, save that the members of the Hamilton fish fauna are largely a residuum or evolution product of the preceding Onondaga congeries. Clearly, however, the Mesodevonic fish faunas are not indigenous in the Appalachian basin for we meet with practically the same assemblage in rocks of equivalent age elsewhere, as for instance, in the Eifel district (Calceola beds) and Bohemia (étages F^2 and G^1–G^3) ; and besides, the Oriskanian fauna contains no elements, so far as known, out of which the Onondaga might have developed. The vertebrate portion of the latter is, therefore, quite unmistakably an immigrant fauna. That it did not come in from the northeast may be asserted with equal confidence, for none of its members are represented in the maritime provinces of eastern North America, nor indeed, in the Lower Old Red sandstone of North Britain, Greenland or Spitzbergen. As in the case of the majority of invertebrates, the Onondaga fish fauna came in from the west, and in course of time very probably withdrew westward, many of its characteristics persisting into the Hamilton of the western interior province. The Hamilton piscine fauna is so obviously the descendant of the preceding Onondaga, and these two together have so much in common with the Eifelian, Bohemian and Russian Mesodevonic, as to confirm in the strongest possible manner the contention of Professors Clarke and Schuchert that the Ulsterian and Erian should be recognized as divisions of the Middle Devonic.

Attention has been called by Professor Schuchert to the similarity between the Middle Devonic fauna of the Hudson Bay region, and that of the Mississippian Onondaga. A number of considerations are proffered to show that while each of these faunas has its individual facies, yet both are of that type which characterizes the American, in contradistinction to the Eurasian province; and moreover, they differ both in horizon and facies from the Stringocephalus zone of western and northwestern Canada. It is inferred, accordingly, that the Hudson Bay Devonic area was entirely shut off from communication with the Dakota sea, but on the other hand it is thought probable that intermittent connection existed between the former basin and the Mississippian sea. An opening is also posited by the same writer, lasting throughout the Devonic, between the Appalachian and Eurasian provinces, the route leading through the so called Connecticut straits, thence along the Gulf of St Lawrence and across the Atlantic. Having established what seems to him a reasonable basis for the propositions just stated, Professor Schuchert sums up his conclusions in regard to Middle Devonic faunal distribution in the following paragraph:

"The Onondaga fauna is the outgrowth of the Oriskanian fauna of the North Atlantic type plus the migration during Onondaga time of other North Atlantic forms by way of the Connecticut trough and invasions from the far south through the Indiana basin. The Hamilton fauna is the descendant of that of the Onondaga plus North European migrants by way of the Connecticut trough, South American arrivals by way of the Indiana basin, and slight invasions from the Dakota sea by way of Traverse straits. These three openings then remained in existence during the greater part of Upper Devonic time."

This rather full statement in regard to conceptual waterways has been made not for the purpose of criticism, but in order to synthesize as far as possible certain elements of apparently conflicting nature. The test of a sound judgment is its ability to unify various and sometimes even dissonant concepts. In the present instance it becomes necessary to reconcile with the evidence furnished by Helderbergian and Oriskanian invertebrates in favor of an invasion from the northeast, certain other evidence that appears at first sight discordant, namely, the failure of any Lower Devonic vertebrates to take part in the migration. As will be seen from an inspection of the faunal lists, the abundant and rather diversified fish fauna occurring in the synclinal basin of the Restigouche near Campbellton, N. B., is without a single representative in rocks of Lower or Middle Devonic age in the Appalachian province. No traits are observed in the Onondaga or Hamilton fish faunas which can be ascribed to an immigration from eastern Canada by way of the putative water route called by Clarke the "Appalachian strait," and by Dana the "Connecticut trough," which is supposed to have been open during the late Siluric and greater part of the Devonic. None of the Appalachian Mesodevonic vertebrates can be regarded as the genetic descendant of forms that existed at an earlier period in the maritime provinces in eastern North America. The problem is to reconcile this diversity of evidence without contradiction, and it is believed that a solvent will be found in Dr Clarke's recent determination of the Gaspé sandstones as of later than Oriskanian age.

In his sketch of the geology of Percé, published in 1904, Dr Clarke declared that the fairly rich marine fauna of the lower beds about Gaspé Basin reveals evidence of both early and late Devonic age, and that the prevailing sedimentation is of the same aspect as characterizes both in New York and Europe the deposits of the Devonic or Old Red lakes and lagoons. This preliminary statement strikes at the root of the whole matter, and sounds the keynote of an interpretation which has since been more fully evaluated by the skilful New York State Geologist. The results of his extended investigation of the invertebrate paleontology of the Gaspé Devonic remain as yet unpublished, but an idea of their general import may be gathered from the following extract from a private communication, which we are enabled to present here through the courtesy of Dr Clarke:

" The profusion of evidence that has been obtained from a study of invertebrate paleontology seems indubitably to indicate that the Gaspé sandstones are not of the geological age assigned to them by Logan and the Canadian geologists generally. That is to say, they are not Oriskanian, for, though they contain certain Oriskany species, these are the survivors of the earlier limestone faunas of that region persisting during the incursion of a distinctively Hamilton Lamellibranch and Brachiopod fauna from the southwest.

Dawson subdivided the Gaspé sandstone into three parts: the lower division coordinated with the Oriskany and Onondaga; the middle, equivalent to the Hamilton group; and an upper conceived to be equivalent to the Chemung. This entirely arbitrary subdivision was based upon the distribution of the terrestrial flora, and is not, I think, in any way borne out by the present evidence. The weakness of the comparison lies in the attempt to correlate with true marine deposits the very heavy mantle of sands of telluric, delta or lagoon origin conformable in every way physiographically to the Old Red deposits elsewhere, the few marine fossils which it contains being the accumulation of overwash from outside during times of stress. Ells and Low have suggested the probability that the fish-bearing beds at Scaumenac and Campbellton were laid down in an area separated from the more northerly region by barriers of old land, and in my judgment this is an entirely probable condition, not eliminating the possibility of connection between the two basins at some point further westward."

Indeed, as early as 1883, it was noted by R. W. Ells that a number of invertebrate fossils from the northern limit of the Gaspé Devonic were " strongly typical of the Hamilton formation," thus leading to the inference that " the Gaspe sandstone series, of the coast, is probably of the same age, though the absence of typical shells in a large portion of it makes their separation more difficult." The same author had previously described the beds at Campbellton, N. B., before they were found to contain fish remains, and had pronounced upon their equivalence with the lower part of the Gaspé sandstones. This opinion was based upon evidence of paleobotany, and, having been confirmed a few years afterward by J. W. Dawson, is now generally accepted. Indeed, Logan seems to have entertained similar views as early as 1863 [Geol. Can. p. 450]. As for the plant and fish-bearing beds at Scaumenac bay, on the Quebec side of the Restigouche, these are asserted by Dawson to be "no doubt the equivalents and continuation of the upper part of the Gaspé sandstones." In the absence of a more precise indication of their age, these beds are commonly referred to as Upper Devonic, and their vertebrate content favors that conclusion.

In the light of Dr Clarke's coordination of the Gaspé sandstone series with rocks of Postoriskanian age, we are no longer required to look in that direction, nor to the probably contemporaneous Campbellton fauna for the origin of the Onondaga fish fauna found in New York State. On the other hand it may be conceded as rather more likely that there was some movement among vertebrate organisms in the reverse direction, for such an hypothesis would account for the presence of a typical Onondaga species, Machaeracanthus sulcatus, at different levels in the Gaspé series (Logan's Divisions 1 and 6). The genus Cephalaspis is common to both the Gaspé series and Campbellton beds, and together with the majority of forms from the latter horizon is indicative of Old Red sandstone conditions.

Reverting now to the Hudson Bay Middle Devonic fauna, we find that, as listed by Whiteaves, it is unmistakably of about the same age as the Onondaga. According to Schuchert, its faunal facies "is more that of the Mississippian type than any other known in America." This similarity is therefore held to indicate that there was at least intermittent connection between the two basins during Onondaga time, and persisting well into the Hamilton. It is admitted, however, that the question as to how the stream of migration entered the Hudson Bay area during the Middle Devonic is not so easy to answer. Precisely at this point some light is thrown on the problem by vertebrate paleontology. A number of specimens of Macropetalichthys sullivanti (=M. rapheidolabis) are recorded by Bell and Whiteaves from the country immediately west and south of Hudson and James bays. This exclusively Onondaga species (Mr Schuchert inadvertently calls it a Hamilton fossil) is most abundant in Ohio and Indiana, and decidedly less common in New York State. The same genus, represented by some two or three species, occurs also in the Eifelian Devonic, which is equivalent practically to the Onondaga, and in the slightly earlier horizon in Bohemia designated as étage G^1. No trace of it occurs, however, in the Mesodevonic of the maritime provinces of eastern North America. One may readily infer that this genus and its various associates are indigene in Bohemia, a part of the vertebrate fauna from étage G^1 being inceptive in étage F.

Thence it spread northeastward into Russia, westward into the Eifel District, and northwestward into the Hudson and James Bay region. From this latter region we may suppose it to have passed southward through Ontario by means of a passageway connecting with the Appalachian gulf over the area that is now occupied by Ohio and Indiana, where the fauna reached its climacteric. The most conspicuous elements of the fauna are Arthrodires and Ptyctodonts, groups which began immediately upon their introduction to attain a most remarkable development. Throughout the Hamilton and later Devonic, conditions must have been eminently favorable in the Appalachian sea for the further specialization of armor-clad Dipnoans of the type represented by Dinichthys and its congeners. Like their earliest predecessors, they became of greatest importance locally in Ohio.

The wide interest to all concerned with the philosophy of paleontology and the far-reaching significance of such detailed investigations as are brought together here, are very effectively set forth in the following paragraphs.

There are no other means for attaching significance to a truth except by perceiving its relations to other truths. Thus far we have been concerned principally in assembling, and to some slight extent in correlating recognizable truths; in a word, facts of observation have been brought into orderly array. The next step is to examine them in their bearing upon other known facts, to deduce their general significance, and to assign to the results a commensurate worth in surveying the whole field of paleontological inquiry. The ultimate yield of scientific study is the fruition of philosophical ideas.

To obtain a large perspective of the body of facts at our disposal, it is desirable to marshal them in different ways, and to examine them from different points of view. Their relevancy from a geological standpoint needs consideration, with the object of drawing from them conclusions of geological import. In still larger measure it behooves us to consider them as an increment to zoological science, compacting its substantial framework and vastly extending our knowledge of the evolutionary history of organisms. Are we proposing to ourselves an explanation of life, our vision must include not only living matter as we find it today, but also those manifestations of it that existed in the remote past. Side by side with the development of the individual we must examine the evolutionary history of the race. The more we learn of vital processes now operating, the better able are we to understand their operation in times anterior to our own. Comparisons that are enlightening when made between members of the modern fauna may often be profitably extended so as to include members of extinct faunas. Where the time element acts as an impediment to our studies it must be eliminated so far as possible. Zoology of the past does not differ in essence from zoology of the present, any more than ancient history differs fundamentally from modern.

Among other large problems that suggest themselves in reviewing our knowledge of Devonic fishes are those relating to the habits and mode of life of the creatures represented, their adaptation to physical environment, the effects of such adaptation as manifested in their structural modifications and subsequent racial history, and finally the important topics of migration and geographical distribution. All of these issues, though subsidiary to the main theme, offer nevertheless fruitful fields for exploration. It would take us too far astray from the immediate purpose of this paper to consider all of these matters seriatim, particularly as materials are already at hand for those who may wish to pursue them further. For instance, in regard to the habits and mode of existence of ancient forms of fish life, many suggestive hints are contained in the writings of Claypole, Dollo, Jaekel, Kemna and others.

A large and very important literature exists on the subject of faunal migrations in general, and geographical distribution, which will be referred to later. The question of adaptation to environment has been less fully treated than others in the above category, since, from the nature of the case, our information is more deficient in this respect. The viewpoint, however, is exceedingly instructive, and such light as is obtainable from it is most welcome. That we have not overstated the truth must be clear to all who have gained a right understanding of the working of this principle in analogous cases. As convenient an illustration as any is furnished by human history. One of the notable phenomena in the annals of mankind, and one of the most beneficent in its subtle and far-reaching consequences, is the marvelous civilization attained by the ancient Hellenes. Yet the unfolding and superb blossoming of the flower of Greek genius, together with its rare beauty while it lasted — this surprising spectacle utterly fails of comprehension except as we take account of influences of heredity and environment. To understand Athenian character and habits, or to attempt to account for that civilization which flourished, as Milton says,

> Where on the Aegean shore a city stands
> Built nobly, pure the air, and light the soil,

it is above all things imperative to understand the conditions of Attic soil and climate. For as soon as one inquires critically into the physical surroundings of the classical Athenian, one discovers that his culture is not primarily dependent upon his peculiar character, but is very largely the resultant of his outward circumstances, and influenced to a marked degree by his climate. One perceives, therefore, that ample justification exists for the following statement, taken from a very readable work on classical antiquity (Tucker's *Life in Ancient Athens*), with which we will conclude our remarks on this head:

"From the bare facts that the Athenian lived in a land which supplied a frugal and simple, but sufficient and wholesome diet, in a climate which makes for sociable outdoor life without producing languor, in an atmosphere which sets off whatsoever things are shapely and beautiful, on a soil furnished with a plentiful supply of excellent material for plastic art — from these simple facts should we start before we attempt to understand those ways which characterize what is loosely called his 'civilization.'"

There is yet another way in which we may view the sum total of facts resulting from paleontological inquiry, or even the small part of it which is here brought together. We may seek to interpret our collection of facts from the humanistic standpoint. Granted that this knowledge does not appreciably affect our vital interests, what is it worth to us in other respects? How far does knowledge of this sort tend to enlarge human consciousness? Does reflection upon it tend to vivify our perception of the workings of natural law? And if so, does there not arise from fulness of perception a keener sense of the nobility and dignity of the relation man bears to the wonderful planet he inhabits, and is there not a quicker response on his part to the suggestions which that clarified sense awakens? There can be but one answer to this last question. It is inevitable that there should be a prompt and vigorous response from within when once it is realized that "whatever else man may be, he is the sum of a series of actions linked with all that has gone on before upon this earth." The experience is no less common in paleontology than in other sciences that, after one has gained sufficient insight, ideas and impressions of a certain sort enter our minds, sharpen our vision, and enlarge our mental horizon by elevating us to a summit of observation unattainable before. Possibly there belongs to paleontology an even larger quota of these emancipating conceptions than is true of other sciences, in view of its predominant historical interest — being, as it were, a limitless extension of universal history.

To realize to some extent what the loss of these emancipating conceptions would mean to us, it is only necessary to contrast the olden-time idea of creation with modern evolutionary beliefs. Or, regarding the paleontological record as the continuous unfolding of consciousness, whose beginnings are coeval with the origin of protoplasm, and whose crowning resultant is man, we may picture to ourselves the contracted outlook, the void in our knowledge, and the impoverishment of ideas that would be our portion in case no documents had been preserved to instruct us of the far distant past. Imagine our loss were the records of early human history obliterated. What would be our poverty had the grandeur of Rome been dissolved into a mass of meaningless ruins, had the splendid story of Greece and Athens been blotted out, had we remained unconscious that Marathon was ever fought, or that such a one as Socrates had ever lived; had we no line from Homer, no thought from Plato, no inspired word from Palestine vibrating through the ages!

Again let it be said that conceptions of this nature are not foreign to the scope or peculiar province of paleontology. They are, in fact, inherent in all science; they are not mixed with it, but combined with it, and hence do not properly form either its distillate or residuum. If there be any who question how far these ideas are relevant to the study of fossil fishes, we may be allowed to recommend all such to read the lives of Louis Agassiz and Hugh Miller, especially the recent character study of the latter by Mr Mackenzie (1906). An answer is recorded there so plainly that he who runs may read. Wherever the work of Miller is remembered and appreciated, it is not for the value of his discoveries, nor for his contributions to science, but for the native shrewdness, clearness, intensity and discernment with which he drew philosophical conclusions from the study of nature. And his impulse in this direction was first quickened and set in motion by his discovery of fish-bearing nodules in the Old Red sandstone of the north of Scotland. We can not forbear in this connection to quote the following passage from an address delivered a few years ago by M. Albert Gaudry, president of one of the sections of the French Academy:

"Quand on passe à Cromarty, dans le Nord de l'Écosse, on aperçoit une colonne érigée en l'honneur de l'ouvrier carrier Hugh Miller; en cassant des pierres, l'ouvrier de Cromarty admirait qu'on y trouvât des créatures fossiles, et il en tirait des pensées si hautes qu' il est devenu un des paléontologistes célèbres de la Grande-Bretagne. Beaucoup de gens sont comme Miller: c'est chose étonnante que l'ardeur avec laquelle, dans tous les pays du monde, on brise les roches pour surprendre les secrets des temps passés: bâtis hier, les Musées de paléontologie sont aujourd' hui trop petits."

Graptolites of New York. At this writing the second volume (Memoir 11) of the monograph of the Graptolites, prepared by Dr Rudolf Ruedemann is leaving the press. Volume 1 (Memoir 7) on the species of the earlier rocks was issued in 1905. The present work embraces the later forms and completes the subject embracing most if not all species reported from the United States of this interesting and long extinct group of organisms. In this volume there are altogether 149 species and varieties of graptolites described. The greater part of these come from the upper part of the Lower Siluric (Champlainic), the great majority from the Trenton shales; a smaller part from the Siluric zones distinguished in the upper part of the Lower Siluric, which broadly correspond to the Black river — lower Trenton, middle — upper Trenton, Utica and Lorraine beds. All of these can be correlated with well known European zones.

In view of the fact that the slate belt of eastern New York has furnished a practically complete succession of graptolite beds, extending from the top of the Cambric to nearly the top of the Lower Siluric, the conditions of deposition of graptolite beds are fully investigated and the conclusion reached that graptolite shales are, as a rule, deposited in the same region for longer intervals than most other fossiliferous rocks. This leads to the inference of the origin of their beds in deeper parts of the sea than most of the fossiliferous rocks. This conception is found to be in full accord with the views held by Suess, Neumayr and Haug in regard to the deeper sea origin of the deposits in geosynclines and is also applicable to the Paleozoic Appalachian geosyncline, as far as the Lower Siluric era is concerned. The graptolite shales of the Appalachian geosyncline reappear in Arkansas and the Indian Territory and again in the Rocky mountains, but are absent in the vast intervening area. These facts suggest that the Appalachian and Rocky mountains geosynclines were connected in the south by a westerly bend of the Appalachian geosyncline now buried in the Gulf of Mexico or the Gulf States, a northern embayment of which is, however, still exposed in Arkansas and the Indian Territory.

A synoptic view of the genera of the graptolites of the United States is given. This brings out graphically the fact of three successive culminating periods of the graptolites, each marked by the appearance of a new group or order that has given to the class a new lease of life by advancing to a new structure. The first of these is the dichograptid culmination in the Beekmantown shale; the next the dicellograptid-diplograptid climax in the Trenton shale and the last the monograptid culmination in the Siluric. The structural and phylogenetic causes of these culminations will be made the subject of a separate study.

A separate chapter is devoted to the morphology of the spines of the graptolites since these represent one of the striking features of numerous forms. It is found that in the great majority of forms the spines are placed distinctly on the most exposed parts in response to stimuli from the environment. In many others (dwarfed phylogenetic forms) a general spinosity is clearly but an expression of waning vital power and in a third important group, the most typical representative of which is Glossograptus, a general spinosity is produced by a tendency to repetition of the lateral spines commonly found in any graptolite at the sicular extremity. In Lasiograptus and related forms finally the spines were found to result from the suppression of thecal structures caused by restraint of environment, or in an endeavor to lighten the periderm.

Another chapter was invited by the multitude of forms of the appendages of the sicular extremity of Climacograptus bicornis occurring in the Normanskill shales. It was found that the several varieties based on the forms of these appendages are all connected by transitions and represent one complex system mark-ing the climacteric period of the species. In a further chapter the possible influence of the presence of spines on the development of a retioloid structure in the periderm is investigated and the inference attained that even the spinose forms of Diplograptus possess in their thick periderm a layer of retioloid meshes, and of stronger ledges, and that the development of this layer is roughly proportional to that of the spines. This cause has combined with the tendency of the rhabdosomes to become lighter after the floating and swimming habit had been adopted, and produced the order Retiolitidae with a reticulate periderm.

The dilatations, "disks," wings or vesicles of the nemacaulus of Diplograptus, Climacograptus and Cryptograptus are separately considered and evidence brought forward to show that they were inflations of the outer periderm of the nemacaulus through which the virgula or axis passes uninterrupted.

The verification by a recent investigation by Schepotieff, of a former observation by the writer, that the axis of the sicula (the virgula) passes through the nemacaulus and into the rhabdosome, is discussed in a further chapter. Other chapters on the morphology of the graptolites are devoted to the asymmetric section of the rhabdosome in some graptolites (as Climacograptus typicalis), to the axes of the Dicranograptidae, the morphology of the thecae of the Dichograptidae and Dicranograptidae.

In a part entitled "Notes on Phylogeny" the phylogenetic relations of the Leptograptidae and Dicranograptidae are first discussed and the derivation of Dicranograptus from Dicellograptus shown. It is argued that the branches of the Dicranograptidae formed together always a more or less slender double spiral whereby certain advantages of the arrangement of the thecae and a great elasticity of the suspended rhabdosome were attained, but at the same time the strain at the further (sicular) end where the two branches are connected, increased; hence the formation of the biserial portion in Dicranograptus to strengthen this end.

A synoptic and synonymic list of graptolites recorded from North America concludes the general part of the memoir.

A Devonic brittlestar

In a recent publication[1] I called incidental attention to the discovery by D. D. Luther of specimens of Helianthaster in the Portage (Cashaqua) shales at Interlaken, N. Y. a village lying on the divide

[1] Report State Paleontologist 1906, p. 36.

between Seneca and Cayuga lakes. The discovery was an interesting one as the genus had not before been known in the American Paleozoic rocks, but no attempt was then made to analyze the structure of the specimens. A halftone plate of the better of the two individuals found was given and the intimation made that the species was not identical with the German H. rhenanus F. Roemer, the only form hitherto referred to the genus. The publication of this figure induced Prof. H. P. Cushing of Adelbert College, to call my attention to a slab of similar fossils in his possession which had years ago been acquired by the late Samuel G. Williams while professor of geology at Cornell University. This specimen has been placed in my hands; it is from the Portage beds at Earl's quarry, Ithaca.

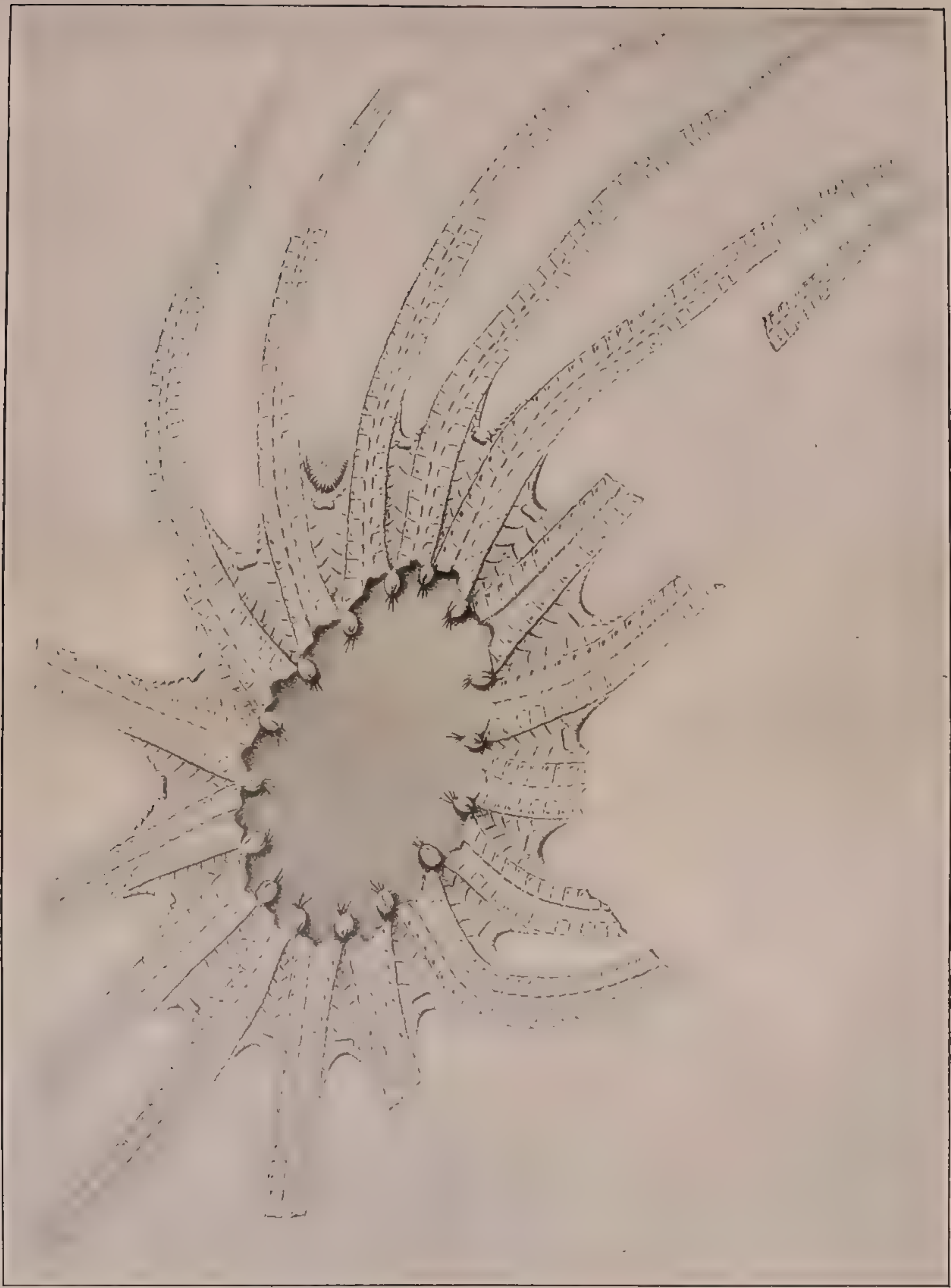
We have now five individuals of this species of Helianthaster, the two from Interlaken of which one displays the ventral aspect of the arms and the other appears to be an external cast of the same side of another individual; both of these are damaged about the oral region. The Earl's quarry slab carries three individuals all in ventral aspect, and all casts. Of one of these the mouth parts are missing but in the other two they are retained, in one particularly well. Not long ago I was successful in obtaining a magnificent specimen of Helianthaster from Bundenbach which has admirably lent itself to preparation and which elucidates some points of structure not recited by Stürtz in his admirable account of the structure of H. rhenanus and is indeed of much more commanding proportions than the material illustrated by that author.

As this genus is a novelty in New York paleontology it is of interest to call attention to these recent discoveries with such detail as the preservation of the specimens permits. Helianthaster, from its original description by F. Roemer[1] was a hardly recognizable genus. It was only after Stürtz rediscovered and analyzed the species from the Bundenbach shales that an approximate conception of this very commanding ophiuran was attained[2] and it is in the light of these determinations alone that the specimens here considered can be intelligently interpreted.

In regard to Helianthaster rhenanus the description given by Roemer in founding the genus [*op. cit.* p. 147] was based on specimens pyritized but involved in the shale in the usual mode of preservation of the Bundendach starfish and no attempt was

[1] Paleontographica. 1862. v. 9.

[2] Paleontographica. 1885. 32 81, pl. 8, fig. 3, 3a; 1889, 36: 218, pl. 26, fig. 14, 15, 15a; pl. 27, fig. 14.



Helianthaster rhenanus F. Roemer
Stürtz's figure (Paleontographica, v. 36, pl. 27) slightly reduced; showing the ventral aspect

Helianthaster roemeri nov. Bundenbach. Natural size

made to solve the difficult problem of removal of the matrix and exposure of structural details. Roemer figured the best but not the largest of his specimens [pl. 28] and the number of arms assigned by him to this species is 16. Stürtz finds this number also (14–16). At all events the species is large and its arms relatively numerous in contrast with other Paleozoic ophiurans. The disk is mostly covered by the converging arms and the length of any one of the latter from the point where it becomes free to its tip is almost equal to the axis of the disk which in both the German and American specimens seems not to be normally circular but often elliptical.

The New York specimens, Helianthaster gyalum nov. are smaller than H. rhenanus. The *arms* are more numerous and appear to be quite uniformly 24–25. Compared to H. rhenanus they are relatively short, but very long compared with the size of the disk which is much suppressed, and on none of the specimens, all showing the oral surface, is any distinct evidence of it visible, so deeply do the arms cut into it and so closely do they lie together. Notwithstanding this apparent retreat of the disk the *madreporiform plate* is very large. This organ is preserved in but one example and but here it overlaps two adjoining interbrachial angles and the mouth parts pertaining thereto. Instead of being a flat or concave elongate plate as in H. rhenanus it is highly convex and circular; its surface markings less distinct and coarse than in that species.

The great *oral aperture* is margined by a series of pronounced "jaws" or sharp projecting elevated angles the sides of which take origin from the margins of adjoining arms. These oral projections are slightly expanded at their tips into blunt points comparable to but smaller than the "Höcker" of H. rhenanus but like these carry small spines projecting inward. The solidity and strength of these mouth parts is indicated by their prominence and elevation as shown in figure. It is probable that in this expression there is represented a combination of dorsal and ventral structure with the latter predominant by compression. Stürtz has been able to distinguish the dorsal and ventral details in H. rhenanus and assigns to the former a pair of divergent thickened crescentic narrow and vertical plates departing from the axis of each arm and each member joining one of the adjacent pair, thus producing the projecting oral processes. In our specimens it is not possible to discriminate these structures further than to recognize in them a combination of these oral plates with the spinous oral processes. The reentrant angle at the base of each arm is narrow, long and acute, much more extreme in these respects than in H. rhenanus and very much more elevated.

In the structure of the arms there is essential agreement with that described for H. rhenanus. On the ventral aspect there are two rows of plates " in corresponding condition to each other, which never touch along the arm axis." Apparently in H. gyalum there is a slight tendency to alternation of opposite ventral plates as shown on the mold of these structures in the Ithaca specimen. The separation of these series of ventral plates is exhibited on the mold as a solid uninterrupted ridge representing a longitudinal slit. The lateral plates are well defined and bear several spines each, in contradistinction to the German species which is described as having but a single spine on each lateral.

A comparison of Stürtz's most complete individual of H. rhenanus and the specimen of Helianthaster from the Bundenbach slates obtained by me as that species, leads to the impression that they are not the same. The differences will be seen on examination of the figures here given of each. Stürtz's H. rhenanus has the free arms relatively very long, the disk correspondingly small, the reentrant angles of the disk heavily plated. The last named structures seem entirely absent on my specimen though the specimen presents a very clear oral surface; moreover the arms number 28 in contrast to the usual 14–16 of H. rhenanus, and both lateral and dorsal plates are enormously spinous. I think the differences are sufficiently distinctive to justify the designation of this species as H. roemeri.

FIELD MEETING OF AMERICAN GEOLOGISTS

The Geological section (E) of the American Association for the Advancement of Science held a summer field meeting at and near Plattsburg, N. Y., July 3–11, inclusive, to which all members of the Geological Society of America and the Association of American Geographers were invited. The itinerary for these meetings was planned and guided by members of the staff of this survey and as the excursions and addresses were most instructive and given under most favorable skies to a large company of geologists, an account of the proceedings, taken from the report of the secretary, Dr F. P. Gulliver [Science, Sept. 27, 1907] is inserted here.

The preliminary trip on July 3 was made to visit " The Gulf " at Covey hill. This drive of some 30 miles from Mooers, N. Y., across the Canadian boundary was exceedingly interesting to all students

Plate 12

Helianthaster gyalum. A mold of one of the specimens showing the elevated "jaws" and the madreporiform plate

Helianthaster gyalum. A slab bearing a number of specimens: from the Portage beds, Earl's quarry, Ithaca

of glacial geography. The marine and glacial shore lines were visited on the route westward from Mooers, and the party stopped for lunch in "The Gulf," near the two lakes which show the location of the gorge that represents the ancestor of Niagara. The noon talk, given by J. B. Woodworth, who has worked out the glacial history of this region, was on

Abandoned shore lines

At "The Gulf" Professor Woodworth spoke in substance as follows: "The Gulf" and Covey hill north of it constitute a locality of critical importance in the study of water levels in the Champlain and St Lawrence valleys. "The Gulf" pertains to the closing stages of the great ice-dammed lakes which formed in front of the ice in its retreat from the territory of the United States. When "The Gulf" was being excavated by a powerful torrent of water, the ice sheet still hugged the northern side of Covey hill, itself the northermost spur of the Adirondacks.

The waters which entered "The Gulf" came from the west, the region of Lake Iroquois, whose waters would have taken this path after the ice retreat offered a lower outlet than that at Rome. The waters passed from "The Gulf" into Lake Vermont, the preglacial lake occupying the valley of the present Lake Champlain. Lake Vermont could not at this stage of its existence have risen above the surface of the water in the waterfall pools of "The Gulf." The lower lake is now 645 feet above sea level. The sea could not at this latitude have stood higher than the bottom of "The Gulf."

With the further retreat of the ice from the northern slope of Covey hill the water, which had previously discharged through "The Gulf" on the south side of the hill, flowed around the northern slope of the hill and emptied into the sea. The salt water came in, and the history of the great glacial lake was completed.

Signs of wave action occur on the Champlain side of the Adirondacks as high as 720 feet, but these higher water levels do not continue about the northern side of Covey hill north of "The Gulf." A good beach is continuous from the Champlain valley about Covey hill into the upper St Lawrence valley with an altitude of 450 feet at Covey hill. Higher signs of probable wave action occur up to 570 feet, merging into beaches evidently made by torrential waters confined between the hillside and the retreating ice front.

"The Gulf" was properly understood by Ebenezer Emmons to have been made by a powerful torrent flowing where now no stream can flow. Gilbert, with the knowledge of the glacial theory, sought for a torrent spillway along the retreating ice sheet, and considered "The Gulf" the outlet for the glacial waters. "The Gulf" therefore is an integral part of the wonderful story of the great glacial lakes, and the political chance which has drawn the boundary line between Canada and the United States across "The Gulf" serves doubly to remind us of its living type, the gorge of Niagara.

On Thursday, July 4, those who had taken the preliminary trip to Covey hill drove from Mooers southward to West Chazy along many abandoned shore lines, at elevations varying from 300 to 600 feet above the present sea level. At West Chazy others joined the party from Plattsburg, and all met on Cobblestone hill, where a halt was made for an hour to study the remarkable beaches of cobbles showing pronounced bars, spits and hooks, at levels of 600 feet and over above sea level.

These beaches of heavy glacial detritus were laid down in a freshwater glacial lake, when the ice stood a short distance north of this point, by the waters discharging from the northwest over Flat Rock from the Altona spillway.

Thence the party drove across the bare Potsdam sandstone over the Altona spillway, where striking evidences were seen of the scouring action of torrential glacial waters. After lunch at a spring of water running from the Potsdam sandstone in the spillway the party listened to a talk by Prof. H. L. Fairchild on

Lake Iroquois extinction

Lake Iroquois was the great glacial water held in the Ontario basin while the Laurentian ice mass occupied the St Lawrence valley and forced the overflow by the Rome outlet to the Mohawk and Hudson valleys. This original Iroquois outlet was effective for several thousand years, and determined the water level for nearly the whole existence of the glacial waters.

When the ice body weakened, and the front receded on the salient which projects northeastward from the Adirondacks into Canada, a lower escape for the ice-dammed waters was opened across the Covey hill ridge, precisely at the International boundary.

"The Gulf," as it is locally known, is a great cut in Potsdam sandstone, long since noted by Emmons and Gilbert, and recently described by Woodworth. The present altitude of the head of the Covey outlet is over 900 feet, but at the time it was opened the locality was about 460 feet lower than today, and the initiation of

Plate 14

Beach, north slope of Covey Hill, Canada

Beach, north slope of Covey Hill, Canada

Covey Hill, Canada

Curved end of bar, Cobblestone hill, Altona, N. Y.

Cobblestone hill Altona, N. Y., Professor C. H. Hitchcock in picture

the river flow must have been inferior to the Rome level, which is now 440 feet.

After at least many centuries of flow this predecessor of the St Lawrence river, carrying the overflow of the second stage of Iroquois waters (or Hypo-Iroquois), was extinguished by the ice recession opening a yet lower pass, on the north slope of Covey hill. This third phase of the Iroquois waters was short-lived and of rapidly falling levels, the river flow past the ice front only terracing the sandstone slope.

When the waters were lowered about 450 feet below the Gulf channel, they became confluent with the oceanic waters, and the Ontario basin was occupied by the Gilbert gulf, a branch of the Champlain or Hochelagan sea.

On Friday the parties from Mooers and Plattsburg met at Chazy where Professor Cushing and Dr Ruedemann showed the visiting geologists many interesting features of the Chazy limestone, the local succession of beds, the characteristic fossils, the faults, and the dissection which have produced the present topography. After supper, while waiting for the train to Plattsburg, the party sat on the hotel porch and listened to a talk by Dr R. Ruedemann on

The Lower Siluric paleogeography of the Champlain basin

The relations of the faunas of the Beekmantown, Fort Cassin, Chazy, Black River, Trenton, and Utica beds to those of the Atlantic and Pacific basins and the Mississippian sea were discussed, and by means of these relations the probable marine connections of the Chazy basin and the Levis channel with the oceanic basins traced. It was suggested that the Beekmantown sea, while extending as far as the Newfoundland embayment, held an American epicontinental fauna; that the Fort Cassin fauna did not reach Canada, but flourished in the Appalachian trough to the south of the Chazy basin, and also spread westward into the epicontinental sea. The typical Chazy fauna is thus far recorded only for the Chazy basin and the southern Appalachian trough. It extended as far as the Mingan islands, and came probably from the Atlantic basin. There is also evidence that it had some connection with the American epicontinental sea.

The Black River and Trenton faunas, while largely American in their aspects, contain European species as the first of the Lower Siluric; and the connection of the Trenton sea with the Atlantic ocean can not be doubted. In Utica time the channel became so wide that an oceanic current could enter the epicontinental sea from the northwest, bringing with it new faunal elements, and spreading mud shales over a large area of eastern North America.

The evidence of a deeper sea in the Levis channel, furnished by the series of Lower Siluric graptolite shales, was also presented, and the relations of the graptolite shales to the mobile parts of the earth crust, the geosynclines, briefly mentioned.

Friday evening the party went to Cliff Haven, 3 miles south of Plattsburg, where the authorities of the Champlain Assembly had placed at the disposal of Section E the New York cottage, in which the party were delightfully housed for five days. Excursions were made each day to various points, and in the evening all returned to the broad piazzas of the cottage, where they sat and discussed the various trips, within a few feet of one of the striking fault-line scarps of the region, looking out over the waters of Lake Champlain.

On Saturday morning, July 6, the party gathered on the steam launch kindly furnished by the State of New York, and under the guidance of Professor Cushing, Dr Ruedemann and Professor Hudson, took a charming sail on Lake Champlain. The party visited Crab and Valcour islands and studied the Palezoic sediments which are there so beautifully exposed with their many interesting structural features.

At noon the party enjoyed the delightful hospitality of Prof. and Mrs George H. Hudson of Plattsburg at their charming camp on Valcour island. After lunch a talk was given by John M. Clarke on

Lake Champlain

Dr Clarke spoke of the origin of the Lake Champlain valley as the result of a series of downthrown fault blocks having the evident aspect of a *graben*. He referred to the later evidence as confirmatory of Logan's conception of the Lake Champlain fault and indicated that this origin was borne out by the present attitude of the downthrown Paleozoics against the abrupt eastern scarps of the Adirondack crystalline shield.

Reference was also made by the speaker to the possibility that the geographical name Trembleau, which designates the prominent headland and mountain ridge just south of Port Kent, embodies the record of an ancient seismic disturbance, and with this as a text fuller reference was made to the Canadian earthquake of 1663

Plate 19

Cuspate foreland, Valcour, N. Y.

Maclurea magna, Chazy, N. Y.

which appears from the records preserved in contemporary documents to be the severest disturbance this continent has ever suffered from terrestrial dislocations. This earthquake was evidently a movement of the Paleozoics against the crystalline shield along the course of the St Lawrence river or the St Lawrence fault, and its destructive effects from Montreal down to Tadousac were tremendous. It seemed to the speaker quite reasonable to infer that this displacement must have been continued along the contact line of the Paleozoics and the crystallines in the direction of the Champlain fault, although the historic records for this region are very meager.

After lunch the party divided, one portion spending the afternoon on the shores of Valcour island studying stratigraphy and paleontology. The others sailed southward to the delta of Ausable river, where a landing was made and photographs taken showing some of the recent shore-line changes. Thence this party sailed across the lake between Stave and Providence islands, and then northward along the Vermont shore, returning to Cliff Haven.

In the evening in the auditorium of the Catholic Summer School the one formal gathering of the Plattsburg meeting took place. The Rev. John Talbot Smith LL.D., president of the summer school, welcomed the geologists in the name of the authorities of Champlain Assembly and introduced the vice president of Section E, Dr Alfred C. Lane, who gave his vice presidential address on the " Early Surroundings of Life."

Prof. B. K. Emerson thanked the authorities of the Champlain Assembly for their hospitable reception of Section E.

On Sunday various features of the local geology were visited by members of the section. Others attended services at the chapel on the grounds.

At noon the party were entertained most delightfully by the Hon. Smith M. Weed and his family at his summer home on the shores of Lake Champlain. In the afternoon another sail was taken in a steam launch on Lake Champlain.

In the evening Prof. George H. Hudson, of the Plattsburg Normal School, showed the laboratories and some of the work of his students. The members then met in the science classroom, and listened to an informal talk by Professor Hudson on " Blastoidocrinus and its Type," illustrated by 50 lantern slides. The slides of Billings's type were from negatives possessing an amplification of 10 diameters, and showed in a remarkable manner many points of structure not before noted in the specimen. The outer folds of the hydrospires were seen to extend under the interbrachials to the edges of the bibrachials. The position of the stem was shown to be not normal, as Billings supposed, but thrust up into the coelomic cavity and separating the basals from the radials. There were no features to show a specific difference between the Canadian type and the more perfect Valcour island specimen, but the type served to corroborate in a clear manner much of the detail worked out from the latter and published in Bulletin 107 of the New York State Museum.

On Monday, July 8, the party went by train from Plattsburg to Lyon Mountain, and spent the day studying the magnetite mines under the guidance of Mr Newland. After lunch the section listened to a paper by D. H. Newland on

The iron ores of the Adirondack region

Four varieties of iron ores are found within the limits of the Adirondack region, each constituting a more or less independent class of deposits as regards geological associations and mode of origin. The varieties are as follows: (1) nontitaniferous magnetites, (2) titaniferous magnetities, (3) hematites, (4) limonites. In respect to the relative age or period of formation, it is probable that the magnetites of class 1 are the oldest, since they antedate the metamorphism and structural disturbances that affected the region during Precambric times. The titaniferous ores were formed before the oldest of the fossiliferous rocks of the region (the Potsdam sandstone) was deposited, and are generally regarded to be contemporaneous with the igneous inclusions in which they occur. The hematite ores are probably later than the Potsdam; while the limonites have the character of bog ores and are relatively recent surface concentrations.

The nontitaniferous magnetites are the most widespread of all the ores in their geographical distribution, and have been in the past and still are the main source of supply for the region. In a strict sense they are hardly deserving of the name that has been applied to them by geologists, since they nearly always carry titanium, though the amount is small, usually but a fraction of one per cent. These ores are found in all parts of the Adirondacks, except the central which is occupied by the great gabbro-anorthosite mass. They are associated with different members of the Precambric crystalline series including gneisses of igneous derivation with the mineralogy of granites and syenites, with gneisses of doubtful relationships, and with the schists and limestones of the sedimentary (Grenville) type. Their origin is obscure, a problem that has been fruitful in discussion and theorizing among geologists. It is doubtful if any one of the explanations that have been advanced is satisfactory as a general basis for the whole group; rather it would seem that the varying conditions surrounding the character and associations of the deposits indicate that they have been formed by a complexity of processes which may have differed materially in individual cases.

The titaniferous magnetites are distinguished from those of the preceding group by their higher percentage of titanium, which ranges from about 3 or 4 per cent, as a minimum up to a maximum of 10 or 15 per cent, and by the fact that they are always inclosed by basic igneous rocks of the gabbro family. They have been described by Prof. J. F. Kemp as basic segregations formed during the cooling and consolidation of the wall rocks, an explanation that is generally regarded as correct. Some of the largest deposits of iron ores in the region belong to this class, those of Lake Sanford being specially extensive. After a long period of inactivity, due to the difficulties encountered in smelting the ores in the blast furnaces, attention is now being directed to the deposits with a view to their utilization. It has been found that the ores in some cases at least are not simply magnetite carrying titanium uniformly through its mass, but that they consist of a mixture of magnetite and ilmenite, the former having almost no titanium, a condition that is favorable to their commercial treatment.

The hematite ores are practically limited to the western Adirondack region of St Lawrence and Jefferson counties. In this area the Grenville schists and limestones attain wide development, forming an interbedded series which has been upturned and sharply folded. Granite intrusions are numerous, but there is a noticeable lack of the basic igneous rocks that occur abundantly in the central and eastern Adirondacks. The ore bodies consist of lenticular, tabular, or irregular masses inclosed within belts of the schist and limestone, or lying along the contact of these rocks as at the Caledonia mine. Stringers and larger bands of ore often extend out from the main bodies for considerable distances into the foot and hanging walls. The deposits have originated, without much doubt, by a process of replacement. They grade at the borders into the wall rock and frequently inclusions may be found that show complete transition from the rock to the ore. Where the walls are schist, the ore often preserves the appearance of banding and cleavage, and not uncommonly carries a small percentage of graphite, the only mineral that seems to have successfully resisted the solvent action of the iron-bearing solutions.

As to the source from which the iron has come, the explanation advanced by C. H. Smyth jr, merits full acceptance since it meets the conditions surrounding the geology of the deposits. His theory is that the iron has been derived from pyrite and magnetite, which occur abundantly in the schist in the immediate vicinity of the ore bodies. By oxidation the pyrite would yield ferrous and ferric sulfates, which would be readily taken up by the underground circulations. Free sulfuric acid would also result and react upon the veins and disseminations of megnetite. By reaction with the limestone and the minerals of the schist, the solutions would decompose and the iron precipitate as carbonate and limonite. By subsequent alteration these minerals have been changed to hematite. Residual masses of carbonate are occasionally found in the deposits. Whenever the Potsdam sandstone is found in contact with the ore, the lower layers show a deep iron stain, evidently the effect of impregnation by the iron-bearing solutions.

The fourth class of iron ores, the limonites, are not of much importance in the Adirondack region. The deposits are, as already stated, superficial accumulations due to the washing and leaching of the neighboring rocks and soils. They seldom, if ever, exist of sufficient size and richness to repay working, at least under present conditions.

On Tuesday an excursion to Keeseville and the Ausable chasm was made by train and tallyho. Professors Woodworth and Cushing showed the party the marine delta of the Ausable river, the former lake shore lines, the post-Hochelagan gorge of the Ausable river cut in Potsdam sandstone, the Potsdam conglomerate, the northern slope of Trembleau mountain, and the anorthosite.

In the evening at the Champlain Club Prof. H. P. Cushing discussed the

Evidences of physical oscillations during the Cambro-Silurian in northeastern New York

as brought out by a general study of the stratigraphy of the region. There was a great Potsdam subsidence on the northeast, diminishing to zero westward. The succeeding Beekmantown depression encroached further on the land than did the Potsdam on the southern margin of the region, but like that was greatest on the northeast. During the Beekmantown occurred an uplift which caused cessation of deposition in all the region except the eastern border, confining the later Beekmantown and the Chazy deposits to that district. Oscillation then occurred between the Beekmantown and the Chazy, pinching out the Chazy to the south. Depression then ensued on the south and west, and the Lowville beds were deposited. The Black River limestone followed, this being the first formation found on all three sides of the region, which indicates connecting waters and similar conditions on these sides.

In the following Trenton time it seems likely that the waters nearly overspread the entire present Adirondack region, though shore-line conditions and small subsidence are characteristic of the Mohawk valley region.

Utica shale conditions came in from the east, and gradually encroached westward on the Trenton, so that the one thickens as the other thins, the Trenton thickest on the west, the Utica on the east. Following the Utica came the uplift which brought most of the region above sea level.

On Wednesday, July 10, the party regretfully bade goodbye to the hospitable authorities of the Catholic Summer School, and took the delightful sail down Lake Champlain.

At Baldwins, the steamboat terminal at the northern end of Lake George, the party were met by Prof. J. F. Kemp, by whom they were guided in the Lake George valley. The first stop was Hague, where the graphite bed at the Lakeside mine was studied. The bed is 10 feet thick, and consists of a graphite schist in which graphite supplies the micaceous mineral. Feldspar, quartz and a little pyrite constitute the associated minerals. In physical aspect the beds appear but slightly changed from a shaly sandstone. The floor and roof rocks are a garnet-feldspar gneiss with much sillimanite. The pegmatitic phases are frequent. The several methods of origin, organic; hydrocarbons akin to petroleum; the influence of eruptive rocks, etc., were passed in review. The forms of occurrence of graphite in the Adirondacks, in crystalline limestones, pegmatite veins, and schists or quartzites were set forth. The invariable association even of the graphite-bearing pegmatites with Grenville sediments was emphasized, and the schists seemed most probably a metamorphosed carbonaceous sediment, or one which had been impregnated with a heavy oil.

The party next visited the potholes on Indian Kettles point, 2 miles north of Hague. These interesting relics of the glacial epoch are on a rocky point, and 15 feet or more above the present lake.

In the evening a brief exposition of the local geology and physiography was given by J. F. Kemp, and illustrated by manuscript maps. The sediments of the Grenville series are the oldest rocks, now greatly metamorphosed. A syenitic series of eruptives, the most extensive of the local formations, succeeded the Grenville, and these are also greatly metamorphosed. There are also rocks intermediate between syenite and gabbro; true gabbros and granites. Lastly came a few basaltic dikes. There are no late Paleozoics in the region, but the Potsdam and Beekmantown are near or in the Lake George basin. The physiography was believed by the speaker to be chiefly due to block faulting, which was freshened up by the ice-sculpturing of the glacial epoch.

The next morning the party proceeded to Huletts, and visited an igneous contact on Tafts point. At Huletts dock interesting pegmatites and the effects of shearing and faulting were seen. Three sets of displacement could be detected. The party were kindly taken about the lake by Dr Smith Ely Jeliffe in his launch, adding greatly to their pleasure and profit. After lunch in the charming summer home of Professor and Mrs Kemp the members continued south through the lake and dispersed.

III

REPORT OF THE STATE BOTANIST

The State Botanist reports that the interval between the collecting seasons of 1906 and 1907 was devoted to office work which consists of the examination and identification as far as possible of unidentified collected material and the accumulated contributed material, the preparation of the annual report and the incorporation of the new material in the herbarium. The field work has been principally a continuation of the investigation and collection of specimens of the Crataegus flora and mycological flora. Of the former, considerable collections have been made in two specially prolific localities, one near Corning, Steuben co., the other near Clayton, Jefferson co. Collections here were made both in the flowering and in the fruiting period of these plants. The identification of much of this material has not yet been made.

The season of 1907 has been singularly like that of 1906 in its unfavorable influence on the mushroom crop. Frequent rains with prevailing low temperature occurred early in the season. These were followed by a long period of dry weather which was exceedingly unfavorable to mushroom growth. Notwithstanding these adverse conditions about 25 species of fungi have been added to the list of already known New York species. Of these, seven appear to be new or undescribed. In addition to these, eight species of flowering plants have been added to the State flora, but four of these are introduced plants. One alga, one hepatic moss and 10 lichens are among the additions to the flora. Most of these additions are due to the interest and activity of correspondents. Specimens of plants of various kinds, representing 125 species not new to the herbarium, have been collected. These serve to illustrate better and more completely the range and variation of their respective species. A list of the names of these and of those new to the herbarium accompanies this report.

Tests have been made of the edibility of several species of mushrooms. Eight of these have been approved and added to the list of edible fungi of New York, bringing the whole number up to 191. Descriptions and colored figures of these will be given in accordance with the plan recently followed.

In answer to requests for information concerning plants either personally or by letter, 891 identifications of species have been made for 86 applicants.

Stewart H. Burnham, assistant, has disinfected the collections of 1906 which needed such treatment, labeled and arranged them in their proper places, assisted in conducting the correspondence of the office, in the identification of specimens and in giving to inquirers the desired information concerning them. He has continued the work on a card catalogue of the fungi described by the State Botanist and prepared a list of these for publication.

Species added to the herbarium

New to the herbarium

Ajuga reptans *L.*
Biatora prasina *Fr.*
Biatorella simplex *(Dav.) B. & R.*
Boletus niveus *Fr.*
Centaurea solstitialis *L.*
Cetraria glauca *(L.) Ach.*
Chaetomium sphaerospermum *C. & E.*
Cladonia bacillaris *(Del.) Nyl.*
Clitocybe subcyathiformis *Pk.*
Clitopilus subplanus *Pk.*
Crataegus anomala *Sarg.*
C. plana *Sarg.*
C. suborbiculata *Sarg.*
Cronartium ribicola *Dietr.*
Diaporthe parasitica *Murr.*
Flammula pulchrifolia *Pk.*
Galium erectum *Huds.*
Hygrophorus coloratus *Pk.*

H. lacmus *Fr.*
Hypocrea polyporoidea *B. & C.*
Lactarius minusculus *Burl.*
Leaia piperata *Banker*
Lecidea platycarpa *Ach.*
Lophiotrema semiliberum (*Desm.*)
Lotus corniculatus *L.*
Metzgeria conjugata *Lindb.*
Monilia crataegi *Diedicke*
Myxosporium necans *Pk.*
Nolanea suaveolens *Pk.*
Parmelia cetrata *Ach.*
P. perforata (*Jacq.*) *Ach.*
Pholiota duroides *Pk.*
Physcia hypoleuca (*Muhl.*) *Tuck.*
Polyporus spraguei *B. & C.*
Polystictus montagnei *Fr.*
Rinodina oreina (*Ach.*) *Mass.*
Russula aeruginea *Fr.*
Sphaeropsis lyndonvillae *Sacc.*
S. persicae *E. & B.*
Stereocaulon coralloides *Fr.*
Stropharia bilamellata *Pk.*
Trentepohlia umbrina (*Kutz.*) *Born.*
Tubercularia davisiana *Sacc.*
Viola vagula *Greene*

Not new to the herbarium

Aecidium clematidis *DC.*
Ae. grossulariae (*Gmel.*) *Schum.*
Agaricus arvensis *Schaeff.*
Alsine longifolia (*Muhl.*) *Britton*
Amanita caesarea *Scop.*
A. formosa *G. & R.*
A. phalloides *Fr.*
A. rubescens *Fr.*
Amanitopsis farinosa *Schw.*
A. vaginata (*Bull.*) *Roze*
Aronia nigra (*Willd.*) *Britton*
Aster divaricatus *L.*
A. panic. bellidiflorus (*Willd.*)
Blitum capitatum *L.*
Boletus albocarneus *Pk.*
B. castaneus *Bull.*
B. chromapes *Frost*
B. clintonianus *Pk.*
B. elbensis *Pk.*
B. nebulosus *Pk.*
B. ravenelii *B. & C.*
B. subaureus *Pk.*
B. subtomentosus *L.*
Calvatia elata (*Mass.*) *Morg.*
Cantharellus cibarius *Fr.*
C. cinnabarinus *Schw.*
C. floccosus *Schw.*
C. minor *Pk.*
Carya amara Nutt.
C. glabra odorata (*Sarg.*)
Castanea dentata *Borkh.*
Chrysanthemum leucanthemum *L.*
Clitocybe amethystina (*Bolt.*)
C. candicans *Fr.*
C. laccata (*Scop.*) *Fr.*
Clitopilus caespitosus *Pk.*
Collybia acervata *Fr.*
C. dryophila (*Bull.*) *Fr.*
C. lacunosa *Pk.*
C. platyphylla *Fr.*
Conringia orientalis (*L.*) *Dum.*
Cortinarius torvus *Fr.*
Crataegus bissellii *Sarg.*
C. uniflora *Moench.*
Cypripedium arietinum *R. Br.*
Cystopus amaranthi *Berk.*
Dasystoma virginica (*L.*) *Britton*
Deconica bullacea *Bull.*
Dryopteris goldieana (*Hook.*) *Gray*
Eleocharis ovata (*Roth*) *R. & S.*
Erysimum cheiranthoides *L.*
Erysiphe polygoni *DC.*
Euphorbia polygonifolia *L.*
Flammula lubrica *Fr.*
Fraxinus lanceolata *Borck.*
F. pennsylvanica *Marsh.*
Fuligo ovata (*Schaeff.*) *Macb.*
Fusisporium destruens *Pk.*
Galium mollugo *L.*
Habenaria blephariglottis (*Willd.*)
H. ciliaris (*L.*) *R. Br.*
Helotium citrinum (*Hedw.*) *Fr.*
Helvella infula *Schaeff.*
Hydnum fennicum *Karst.*
H. septentrionale *Fr.*
Hygrophorus borealis *Pk.*
H. ceraceus *Fr.*
H. coccineus (*Schaeff.*)
H. marginatus *Pk.*
H. pratensis (*Pers.*) *Fr.*
Hypholoma candolleanum *Fr.*
H. capnoides *Fr.*
H. incertum *Pk.*
H. subaquilum *Banning*
H. sublateritium (*Schaeff.*)
Lactarius camphoratus *Fr.*
L. insulsus *Fr.*
L. oculatus (*Pk.*) *Burl.*
L. subdulcis *Fr.*
L. varius *Pk.*
Lentinus spretus *Pk.*
Lenzites separia *Fr.*
Lepiota acerina *Pk.*
Lycoperdon gemmatum *Batsch*
L. glabellum *Pk.*
L. subincarnatum *Pk.*
Marasmius glabellus *Pk.*
M. minutus *Pk.*
M. subnudus (*Ellis*) *Pk.*
Mycena rosella *Fr.*
Panus torulosus *Fr.*
Paxillus involutus *Batsch*

Phlebia radiata *Fr.*
Pholiota aggericola *Pk.*
P. caperata *Fr.*
P. discolor *Pk.*
P. praecox *Pers.*
Polyporus adustus *Willd.*
P. betulinus *Fr.*
P. caesius *Fr.*
P. cuticularis (*Bull.*) *Fr.*
Polystictus biformis *Klotz*
P. pergamenus *Fr.*
Psilocybe conissans *Pk.*
Puccinia andropogonis *Schw.*
P. coronata *Cd.*
Russula crustosa *Pk.*
R. decolorans *Fr.*
R. emetica *Fr.*
R. fallax *Fr.*
R. obscura *Rom.*
R. ochrophylla *Pk.*
R. pectinatoides *Pk.*
R. squalida *Pk.*
R. uncialis *Pk.*
R. variata *Banning*
R. virescens *Schaeff.*
Salix serissima (*Bail.*) *Fern.*
Thelephora palmata (*Scop.*) *Fr.*
Tricholoma personatum *Fr.*
T. vaccinum *Pers.*

Trees represented by trunk sections in the State Museum collection

Abies balsamea (*L.*) *Mill.*
Acer pennsylvanicum *L.*
A. rubrum *L.*
A. saccharum *Marsh.*
A. saccharinum *L.*
A. rubrum *L.* (*curly grain*)
Aesculus hippocastanum *L.*
Ailanthus glandulosus *Desf.*
Alnus incana (*L.*) *Willd.*
Amelanchier canadensis *T. & G.*
Aralia spinosa *L.*
Betula lenta *L.*
B. lutea *Michx.*
B. nigra *L.*
B. papyrifera *Marsh.*
B. populifolia *Marsh.*
B. papyrifera *Marsh.* (unblackened bark)
Carpinus caroliniana *Walt.*
Carya alba *Nutt.*
C. amara *Nutt.*
C. microcarpa *Nutt.*
C. porcina *Nutt.*
C. sulcata *Nutt.*
Castanea dentata (*Marsh.*) *Borkh.*
Celtis occidentalis *L.*
Cornus florida *L.*
Chamaecyparis thyoides (*L.*) *B.S.P.*
Crataegus punctata *Jacq.*
C. crus-galli *L.*
Diospyros virginiana *L.*
Fagus americana *Sweet*
Fraxinus americana *L.*
F. nigra *Marsh.*
F. pennsylvanica *Marsh.*
Gymnoclados dioicus *Koch*
Juglans cinerea *L.*
J. nigra *L.*
Juniperinus virginiana *L.*
Larix americana *Michx.*
Liquidamber styraciflua *L.*
Liriodendron tulipifera *L.*
Magnolia acuminata *L.*
Morus rubra *L.*
Nyssa sylvatica *Marsh.*
Ostrya virginiana (*Mill.*) *Koch*
Picea rubens *Sarg.*
Pinus echinata *Mill.*
P. resinosa *Ait.*
P. rigida *Mill.*
P. strobus *L.*
Platanus occidentalis *L.*
Populus candicans *Ait.*
P. deltoides *Marsh.*
P. dilatata *Ait.*
P. grandidentata *Michx.*
P. heterophylla *L.*
P. tremuloides *Michx.*
Prunus avium *L.*
P. pennsylvanica *L.f.*
P. serotina *Ehrh.*
Quercus acuminata (*Michx.*) *Houda*
Q. alba *L.*
Q. coccinea *Muench.*
Q. marilandica *Muench.*
Q. minor (*Marsh.*) *Sarg.*
Q. palustris *Muench.*
Q. platanoides (*Lam.*) *Sudw.*
Q. prinus *L.*
Q. rubra *L.*
Q. velutina *Lam.*
Rhus typhina *L.*
Robinia pseudacacia *L.*
Salix amygdaloides *Anders.*
S. nigra *Marsh.*
Sassafras officinale *N. & E.*
Thuja occidentalis *L.*
Tilia americana *L.*
Tsuga canadensis (*L.*) *Carr.*
Ulmus americana *L.*
U. fulva *Michx.*
U. racemosa *Thomas*
Viburnum lentago *L.*

Species still unrepresented

Acer negundo *L.*
A. nigrum *Michx.*
Carya tomentosa *Nutt.*
Fraxinus lanceolata *Borck.*
Gleditsia triacanthos *L.*
Picea canadensis (*Mill.*) *B. S. P.*
P. mariana (*Mill.*) *B. S. P.*
Pinus divaricata (*Ait.*) *Sudw.*
P. virginiana *Mill.*
Populus balsamifera *L.*
Quercus macrocarpa *Michx.*
Tilia heterophylla *Vent.*
T. michauxii *Nutt.*

IV

REPORT OF THE STATE ENTOMOLOGIST

The State Entomologist reports that the climatic conditions of 1907 have departed widely from those of normal years and, as a result the development of animal and plant life was exceptionally late. Warm weather finally came on very rapidly and all vegetation grew at such a rate that insects appeared unable to inflict material damage in many cases, consequently there has been an unusual dearth of injurious outbreaks, particularly in the early part of the year, and presumably due largely to this cause. An exceptional event was the capture by Dr Theodore P. Bailey of this city, of two specimens of the exceedingly rare Leucobrephos brephoides Walk; the specimens were taken the last of April in St Lawrence county and deposited in the State Museum.

Fruit tree insects. The *San José scale* is one of the most serious insect enemies of the horticulturist. The spread of earlier years has continued, and in places where very little effort has been made to check its ravages, the scale has become extremely abundant and in some instances at least, has practically ruined the crop. Our experiments of earlier years show very clearly that a lime-sulfur wash is thoroughly effective in destroying the scale as well as beneficial in checking certain other insect pests and fungous diseases. We have steadfastly insisted that it was wiser to use some such material than to employ the more easily applied mineral oils or preparations of the same, known as "soluble oils," because the latter under certain conditions may seriously injure the trees. This has been done in the face of a determined effort by interested parties to introduce oils and oil preparations as the most available remedies for San José scale. Despite the fact that these last named materials are valuable under some conditions, it remains true that we must still rely in large measure upon the lime-sulfur wash for the control of this pest. Our conservative recommendations, we believe, have deterred many from seriously injuring valuable orchards by making injudicious use of the more dangerous oil preparations.

The operations of the *grape root worm* in the Chautauqua region have been observed during the season and, in our judgment, there is a marked improvement over the conditions of earlier years. This change is partly due to the higher price of grapes and the consequent better care and fertilization given the vineyards, though it is probable that natural conditions have been of material service in reducing the numbers of this pest. It is still true that this enemy is abundant in limited areas, and danger of serious injury to vineyards here and there is by no means past.

Shade tree protection. Continued devastations by several shade tree pests have necessitated the giving of considerable attention to this phase of economic entomology. A bulletin on the *white marked tussock moth* and the *elm leaf beetle,* our two most injurious species, was issued in May and a number of warning articles sent to the press throughout the State. The general result has been highly beneficial and much interest has been aroused. The agitation of earlier years secured the appointment of a forester by the city of Albany. This official was placed in charge of the trees, and the spraying with poison resulted in marked benefit, despite the hindrances incident to work of that character. The city of Troy, through municipal agencies, accomplished considerable along this line. Before very long a number of other cities will be compelled, by the severity of insect depredations, to adopt some protective measures or lose many valuable trees. The experience of the last decade has demonstrated beyond all question the possibility of protecting our trees from injuries by such leaf feeders as the elm leaf beetle and the white marked tussock moth. It is practical to spray the trees so thoroughly that even in localities where the elm leaf beetle and the tussock moth caterpillars are rather abundant, there will be no serious injury to the foliage, and those interested in this work should insist upon the maintenance of such a standard.

Gipsy and brown tail moths. The work of last year in watching for the appearance of these insects within the borders of New York State, has been continued. Many caterpillars of various species, all native, however, have been sent in by different correspondents, some fearing that they had found one or the other of these pests. These fears, we are pleased to state, were groundless and, so far as known to us at the present time, neither of these species has obtained a foothold within our boundaries.

Several days in June were spent in the New England territory infested by these species, investigating in particular the recently undertaken work of destruction by means of parasites. Thousands of these beneficial parasites have been brought into this country, taken to the laboratory at Saugus, reared to maturity, the dangerous hyperparasites destroyed and the beneficial forms liberated under conditions favorable to their multiplication. Our investigations showed that certain of these European enemies had survived the winter and that there is at least a fair prospect of considerable benefit resulting from this systematic importation of natural enemies. The general situation is distinctly more encouraging than was the case last year. A general campaign of repression has been conducted most vigorously and the beneficial result therefrom is easily seen in Boston and vicinity. Furthermore, the Federal Department of Agriculture is cooperating with the Massachusetts authorities in an effort to prevent the further spread of the gipsy moth in particular. This latter phase of the work consists largely in keeping all highways free from caterpillars, so as to make it impossible for automobiles to carry these leaf feeders into uninfested regions. The gipsy moth is being combated strenuously in Rhode Island and Connecticut and there is a very strong probability that the few insects in the last named state will be speedily exterminated.

Forest insects. There were two outbreaks the past season of exceptional interest. The striped maple worm, Anisota rubicunda Fabr. was very abundant on sugar maples in Berlin and Stephentown, Rensselaer co., stripping the leaves from large blocks of forest and proving injurious over hundreds of acres. The snow-white linden moth, Ennomos subsignarius Hübn. was extraordinarily abundant on beech trees in the Catskills, defoliating large areas in and about the township of Hardenburgh. Both of these outbreaks are unusual, as neither of these species has been injurious in New York State for some years. Detailed accounts of these insects have been prepared and will be published in the Entomologist's report.

Aquatic insects. The studies of our fresh-water insects have been continued. Dr James G. Needham has completed his report on the work done at Old Forge, N. Y. in 1905, and it will be published as an appendix to the Entomologist's report. The monograph on the Stone flies (Plecoptera) begun by Dr Needham several years ago, is nearly completed and will prove an addition to our knowledge of this group. Dr Cornelius Betten, who has been studying the Caddis flies (Trichoptera) for the past six years, has nearly completed his report upon these forms. The investigations of these two gentlemen relate to a group which is of great economic importance owing to its value as fish food.

Gall midges. This group comprises among its members, several insects of prime economic importance, such as the Hessian fly, the wheat midge, pear midge and some other destructive forms. Furthermore, there is every probability that some other of our native species may become destructive in the near future. Our investigations have already disclosed hitherto unsuspected injuries by members of this group. We have succeeded in identifying several European forms not previously known to occur in this country. During the season we succeeded in rearing over 100 species, a considerable number of them proving to have been undescribed. The State collections in this group represent probably over 600 species. We have already described over 250 new forms, and it would not be surprising if, after working over the material, there were nearly as many more to characterize in addition to those previously described by other workers. The classification of the American species has been in a chaotic state, making it practically impossible to identify many of our forms. Our work, now well in hand, will revise the classification of this group.

The rearing of these insects requires much time and attention, and the success achieved last season was due very largely to the work of Assistant Entomologist D. B. Young. The collecting of the insects and the galls in the field also requires considerable time, and much of this work has been attended to by assistant I. L. Nixon. Mr J. R. Gillett was engaged throughout the summer in making microscopic mounts of these insects, some 2000 slides being prepared.

Publications. Numerous economic articles have been contributed by the Entomologist to the agricultural and local press. The large number of new species of Cecidomyiidae taken in 1907 made it advisable to issue preliminary descriptions of some, and a paper issued in advance of the report, entitled "New Species of Cecidomyiidae," published January 30, characterizes 179 new species. The second volume of Insects Affecting Park and Woodland Trees, New York State Museum memoir 8, appeared February 25 and has repeatedly proved its usefulness during the past season. The demand for information respecting shade tree pests led to the issuing of a special bulletin on the white marked tussock moth and elm leaf beetle, Museum bulletin 109, which appeared May 10, while the report of the Entomologist, owing to delays, was not issued till July 16.

Collections. The special collecting and rearing of Cecidomyiidae by members of the office staff, has resulted in very large additions to this group, which are particularly valuable because many of the forms are represented by both sexes, and in not a few instances by the larvae and the gall from which the insects were reared. Other additions to the State collections have been large, there being a total of over 10,000 pinned specimens. A number of very desirable species have been obtained through exchange.

The additions to the State collection during the past three or four years have ranged from 10,000 to 15,000 pinned specimens, all of which have to be properly labeled, assigned to their various groups and eventually determined. There has been, since the present entomologist took charge of this office, an approximately sixfold increase in the size of the State collection. A large proportion of the curatorial work in connection with arranging the collections devolves upon the assistants, and it is a pleasure to state that material progress has been made along this line. Assistant Entomologist D. B. Young has, during the past year, given considerable time to classifying the parasitic wasps, Ichneumonidae, and a portion of the Braconidae and also Hymenoptera belonging to the following groups: Pompilidae, Larridae, Bembecidae, Nyssonidae, Philanthidae, Pemphredonidae and Crabronidae. He has also done more or less incidental work with the Diptera. Assistant I. L. Nixon determined and arranged a number of the solitary bees, Andrenidae, assisted in arranging the Ichneumonidae and determined and arranged many of the Curculionidae. In addition he went over the Hill collection, noticed below, repairing and arranging many of the specimens and is responsible for a portion of the catalogue of this collection.

The Hill collection, an exceptionally valuable addition to the State collections, was received through the generosity of Erastus D. Hill, Carrie J. Hill Van Vleck and William W. Hill, heirs of the late William W. Hill, who desired that their father's work should be maintained as a permanent memorial of his labors in entomology. This collection consists of some 10,000 specimens, representing approximately 3500 species and is in excellent condition. It contains a large number of native species as well as representatives from Europe, Asia and Africa. The catalogue of the species is included as an appendix to the Entomologist's report.

V

REPORT ON THE ZOOLOGY SECTION

Research and field work have claimed the major attention of the Zoologist and the Taxidermist during this year. It has not been deemed worth while to consume much time upon the exhibition collections, in view of the complete rearrangement which will be necessary with the occupation of the new building. As usual the birds have received the chief attention. The New York series has been restored to order and many new mounts replace old ones. A portion of the older material replaced is available for loan to schools. The avifauna of the State is now represented by all but 17 of the species recognized as occurring within our borders, an increase of 17 since the last report. Among the species thus added are some specially noteworthy, such as the record specimens of European linnet and yellow-billed tropic-bird for which we are indebted to the generosity of their owners, and New York specimens of Gyrfalcon and passenger pigeon. A specimen of scaled petrel is also among the accessions. Several of the forms still missing are not rare, but no specimens of satisfactory quality have been proffered. In order that the friends of the museum may be aware of its needs, the list of these lacking species is subjoined:

Skua, *Megalestris skua* (Brunn.)
Trudeau's tern, *Sterna trudeaui* Aud.
Black-capped petrel, *Aestrelata hasitata* (Kuhl)
Booby, *Sula sula* (Linn.)
Black brant, *Branta nigricans* (Lawr.)
Barnacle goose, *Branta leucopsis* (Bechst.)
Eskimo curlew, *Numenius borealis* (Forst.)
Burrowing owl, *Speotyto cunicularia hypogaea* (Bonap.)
Skylark, *Alauda arvensis* Linn.
Holboell's redpoll, *Acanthis linaria holboelli* (Brehm)
Baird's sparrow, *Ammodramus bairdii* (Aud.)
Lark sparrow, *Chondestes grammacus* (Say)
Lawrence's warbler, *Helminthophila lawrenci* (Herrick)
Brewster's warbler, *Helminthophila leucobronchialis* (Brewst.)
Palm warbler, *Dendroica palmarum* (Gmel.)
Townsend's solitaire, *Myadestes townsendi* (Aud.)
Bicknell's thrush, *Turdus aliciae bicknelli* (Ridgw.)

From the hypothetic list the following six species, three less than last year:

Lesser fulmar, *Fulmarus glacialis minor* (Kjar.)
European teal, *Nettion crecca* (Linn.)
Masked duck, *Nomonyx dominicus* (Linn.)
Cory's least bittern, *Ardetta neoxena* Cory
Cooper's sandpiper, *Tringa cooperi* Baird
European green-finch

A group of Sora rail has been completed and awaits casing.

A family of black bears, consisting of a female with two cubs, and a male, is being mounted by the Ward Natural Science Establishment, after sketches submitted by Mr Charles Livingston Bull. The female is shown in an attitude of protection for the young against the possibly unfriendly intentions of the male. Mr Bull entitles his drawing "The Intruder."

The Taxidermist is engaged upon a mount of the muskrat and its haycock nest, showing the construction of the interior.

The Zoologist has continued his studies of the Arachnida, and has completed a synoptic check list and key to all the known acarians, phalangids, pseudoscorpions, pycnogonids and xiphosurans occurring within the borders of our State. This work will be offered for publication as soon as the illustrative diagrams have been prepared, and will be followed shortly by the list of New York spiders compiled last year, which requires some additional keys, thus giving a complete index to the present knowledge of our arachnid fauna. In the prosecution of this labor he has been impressed by the need for systematic work upon our species of mites, and especially the gall mites, or Eriophyidae. As an appendix to the check list he is preparing a list of all the forms of mite galls and their host plants recorded from this country, together with a number of new forms occurring in the collections; of this list of nearly 150 forms of galls, only about one fifth have had their mites described and named. A collection of pressed specimens of these mite galls has been commenced and contains many interesting Cecidia. A large collection of the spiders, mites and other arachnids of the State is now available for study.

The reserve collection of Unionidae, or fresh-water mussels, has been partially rearranged and made available for use in illustrating the forthcoming report on those forms. This rearrangement should be completed as rapidly as possible. It is already evident that the State collection of these forms is unusually large and symmetrical, a fact which its scattered condition did not reveal.

The Zoologist terminated his official connection with the museum on September 15th, but his interest and good will still bind him to it, and he hopes to complete the check lists above mentioned at an early date.

Birds of New York. The first volume of this work covering the general and introductory discussion and specifically the accounts of the water birds with 39 plates in color, is practically ready to

communicate for printing. The scope of the work is such as to make it necessary to devote two volumes to the memoir. The preparation of the second volume is well forwarded and it is expected that the entire work will be in press during the coming year.

VI

REPORT ON THE ARCHEOLOGY SECTION

The wampums of the Iroquois Confederacy. By virtue of the action of the Onondaga Nation in 1898 in electing the University of the State of New York the wampum keeper of the "Five Nations and Six Nations, and each of them" and by the purchase of these wampums at that time through the Onondaga Nation as keeper of all the wampums of the Iroquois Confederacy from the funds of the State Museum, these invaluable archives of the Confederacy have come into the custodianship of the Director of the State Museum, to whom, by the action of the President of the Onondaga Nation, has been transmitted the historic title Ho-san-na-ga-da — Keeper of the Name. Although complete records of these wampums have been kept in the manuscript files of the museum it seems well to make the record more permanent and decisive by introducing in this place photographic copies of each piece of wampum received at that time from the chiefs of the Onondaga Nation. These illustrations are herewith given.

Work of the section. As an organized department of the State Museum, the Archeological section began on October 19, 1906. The work which devolves upon this section has necessitated its subdivision into several subsections as follows: archeology, ethnology, anthropometry and osteology, and philology and folklore.

Each of these branches is necessary for the preservation and study of the prehistoric and recent relics and remains of the New York aborigines. The work necessary to carry on each of these branches is nothing less than enormous as will be realized when it is stated that it is required that one person, the Archeologist, carry on field work in archeology for at least four or five months of the year, collect ethnologic specimens from the Indians, study, classify and catalogue all the archeologic and ethnologic material acquired, study, measure, record and catalogue all the features of the human remains exhumed from the ancient graves and ossuaries, to collect and record legends and ceremonial rituals and songs from the Indians, and to transmit proper reports covering these activities.

Onondaga National Council House

ONONDAGA CASTLE, NEW YORK

TO ALL TO WHOM THESE PRESENTS MAY COME, GREETING:

[illegible] 29 [illegible] Onondaga [illegible]
University of the State of New York
THE KEEPER OF THE WAMPUM AND THE WAMPUM RECORDS
[illegible] Five Nations and the Six Nations, and did at that time sell and [illegible] national wampums [illegible] nations;

And further [illegible] the State Museum [illegible] University of the State of New York, [illegible] designated by said University as the custodian of said wampums and that payment for said wampums [illegible] from the funds of said State Museum, and also of the fact that, by virtue [illegible] 189[illegible] the New York [illegible] in view [illegible] THE NEW YORK STATE [illegible] THE [illegible] NATIONAL WAMPUMS

I, [illegible] Thomas, Chief of the Onondaga Nation, by virtue of [illegible] vested, [illegible] authority during their term of service forever, the name

Ho-sän-nä-gä-dä

[illegible] shall be recognized by all Iroquois Nations and by all people as the [illegible] the custodian of the wampums of the Iroquois of the State of New York

[illegible] at Onondaga Castle, N.Y. in the presence of

In testimony whereof [illegible] and seal this 22d day of January in the year [illegible]

David R. Hill

Arthur C. Parker (Gawaso-wa-neh)

Ha-ha-wis Baptist Thomas his mark

It is also necessary for the Archeologist to instal new collections and rearrange old ones.

Condition of the collections. The archeologic material which has been accumulating for the past 60 years has never been systematized nor properly arranged. This is due largely to the fact that until now there has never been a permanent curator and, largely also, to the fact that there has not been adequate space nor proper cases for the arrangement and exhibition of the specimens. Probably two thirds of the material is in storage and has been packed so long that we are unfamiliar with our own resources.

The Archeologist has rearranged the ethnological collection in the Capitol so as to present a systematic exhibition of specimens illustrating costumes, weapons, ornaments, ceremonial objects, silver work, games and articles used in the preparation of food. An arbitrary arrangement of things by classes, such as wooden objects, metallic objects, etc., is objectionable. Of greater human interest and scientific value is the arrangement according to use. This system we are following.

Archeologic and modern ethnologic material should not be exhibited in the same cases. We have, therefore, endeavored to separate the two classes as far as crowded conditions would permit. The rearrangement of the archeologic material is a work which has just begun. The task of cataloguing the specimens is well under way. No museum serial catalogue has ever been prepared and nearly all of the specimens are without adequate data and means of identification. This is a matter which is to be remedied at once.

Publications. The value of the work of the archeological section of the museum depends upon the facts and specimens which it discovers in the field and upon the method by which knowledge of these facts and artifacts are brought to public notice. Bearing this in mind the Archeologist prepared a bulletin illustrating and describing the collection which he secured during the season of 1906. This work is entitled *Excavations in an Erie Indian Village and Burial Site at Ripley, Chautauqua Co., N. Y.* As a work it has had a very favorable reception among the recognized archeologists of the country.

Archeology as a science has often been regarded as having small practical bearing upon the needs and requirements of practical life. This is not entirely true and to awaken a wider interest in the work the Archeologist has in preparation a publication which it is believed will appeal to a wide circle of interests. This work, *Art*

1 Council summons, calling the clans to a meeting. This belt is said to be a memorial to the clan laws of Hiawatha. By some it is considered an alliance belt sealing a pact between the Seven Nations of Canada and the Iroquois.

2 Treaty belt. Originally there were five diagonal bars.

3 Remembrance belt. Records the treachery of a French missionary at Onondaga who sought to summon the French army from Canada. It is an admonition against the French religion.

4 Caughmauwaugua belt. Records an alliance between the Caughmauwauga tribe and the St Regis band. The crooked lines indicate that the former had forsaken the old ways for the white man's religion.

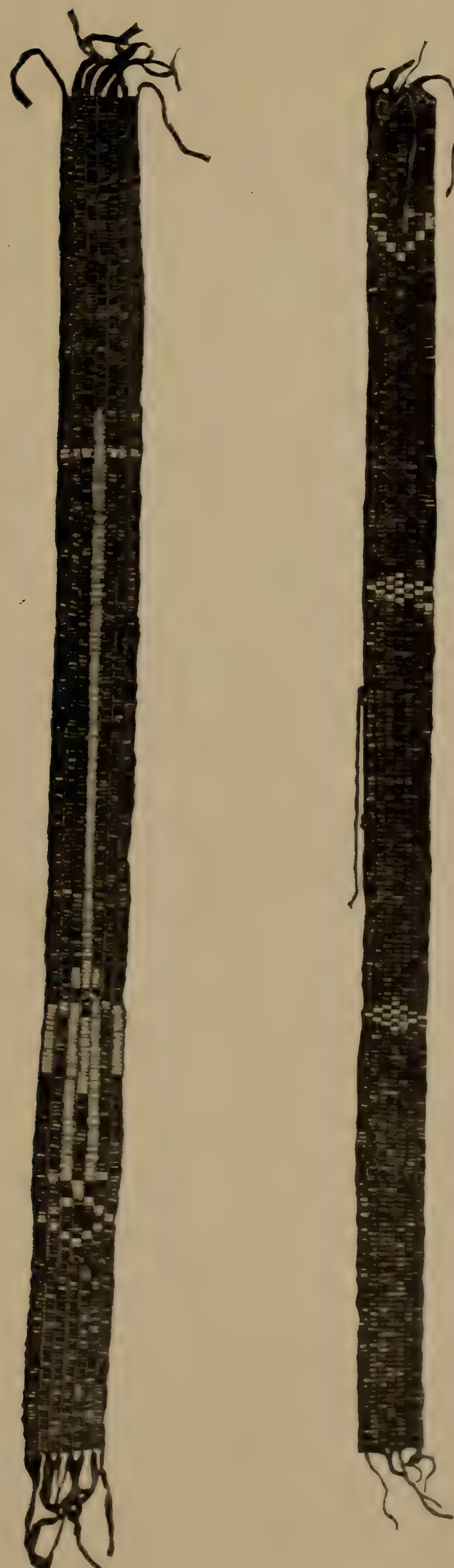
5 Condolence belt of the Senecas once held by Governor Blacksnake. It was used in mourning councils in the ceremony of raising the new names and new sachem to office.

6 Huron alliance belt, said to symbolize the alliance of the Hurons with some other tribe. After the overthrow of the Hurons in 1650 it became a Seneca belt and was taken to Canada after the Revolutionary War.

Plate 22

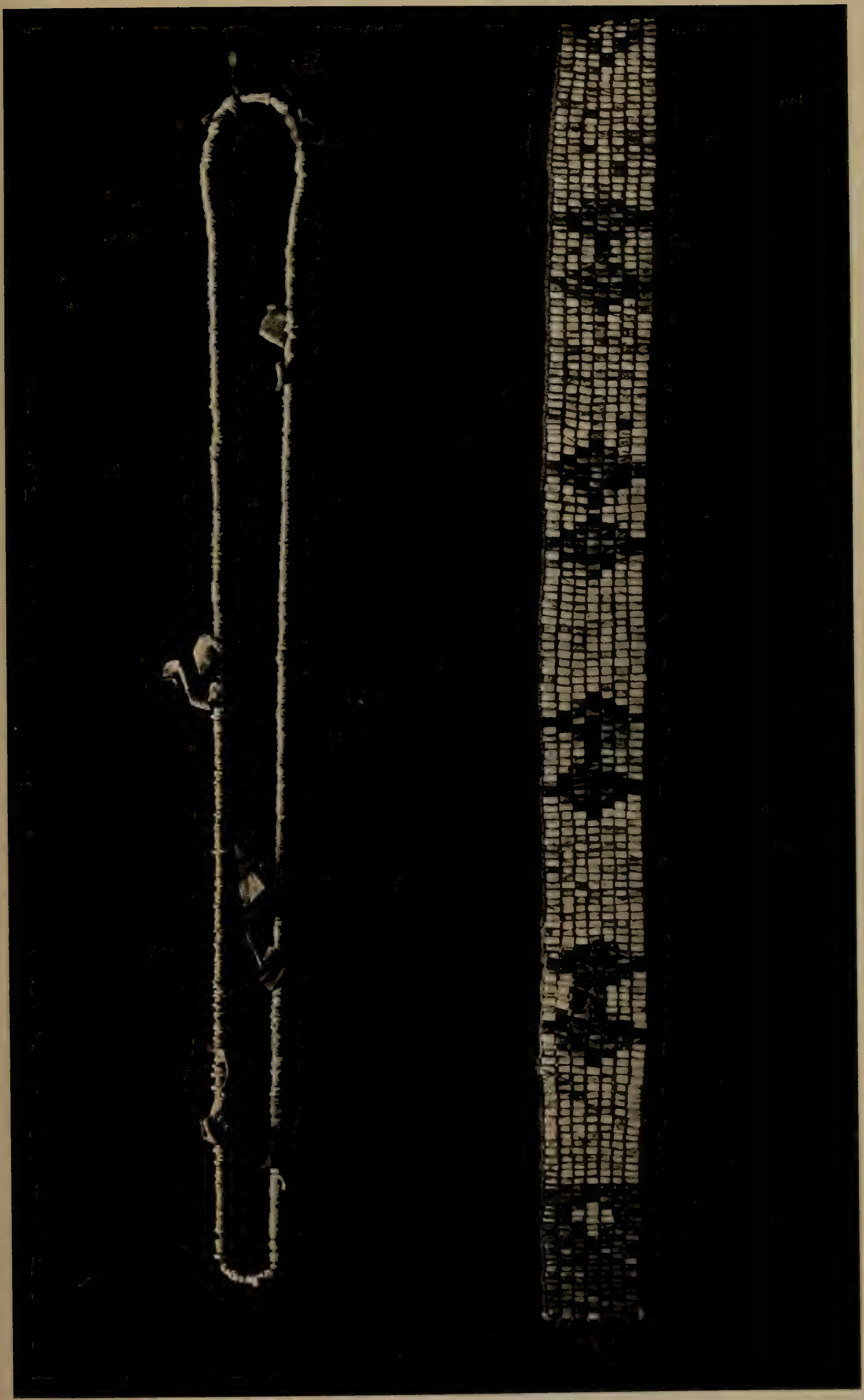
Plate 23

1 2



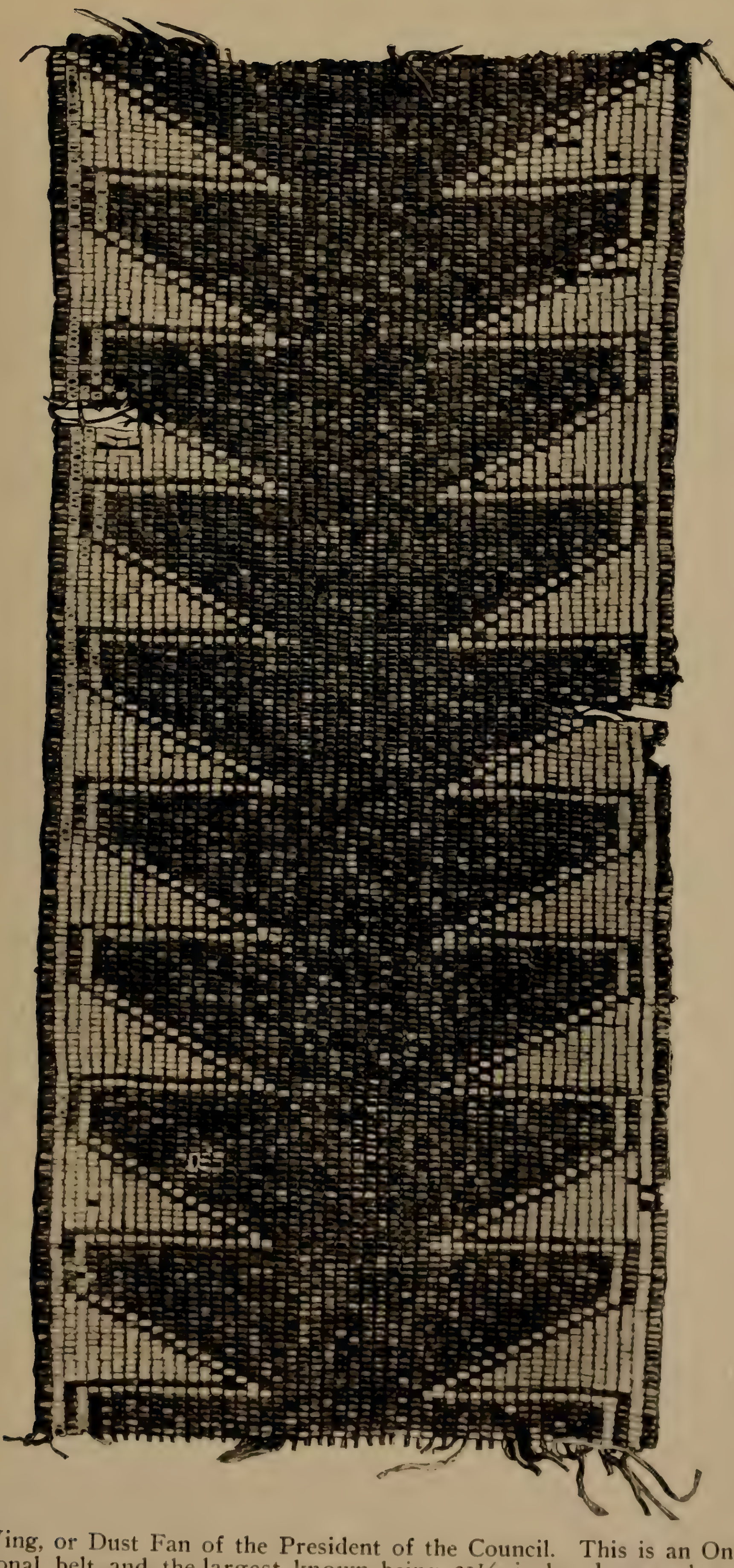
1 Same as figure 3, plate 22
2 Same as figure 5, plate 22

1 2



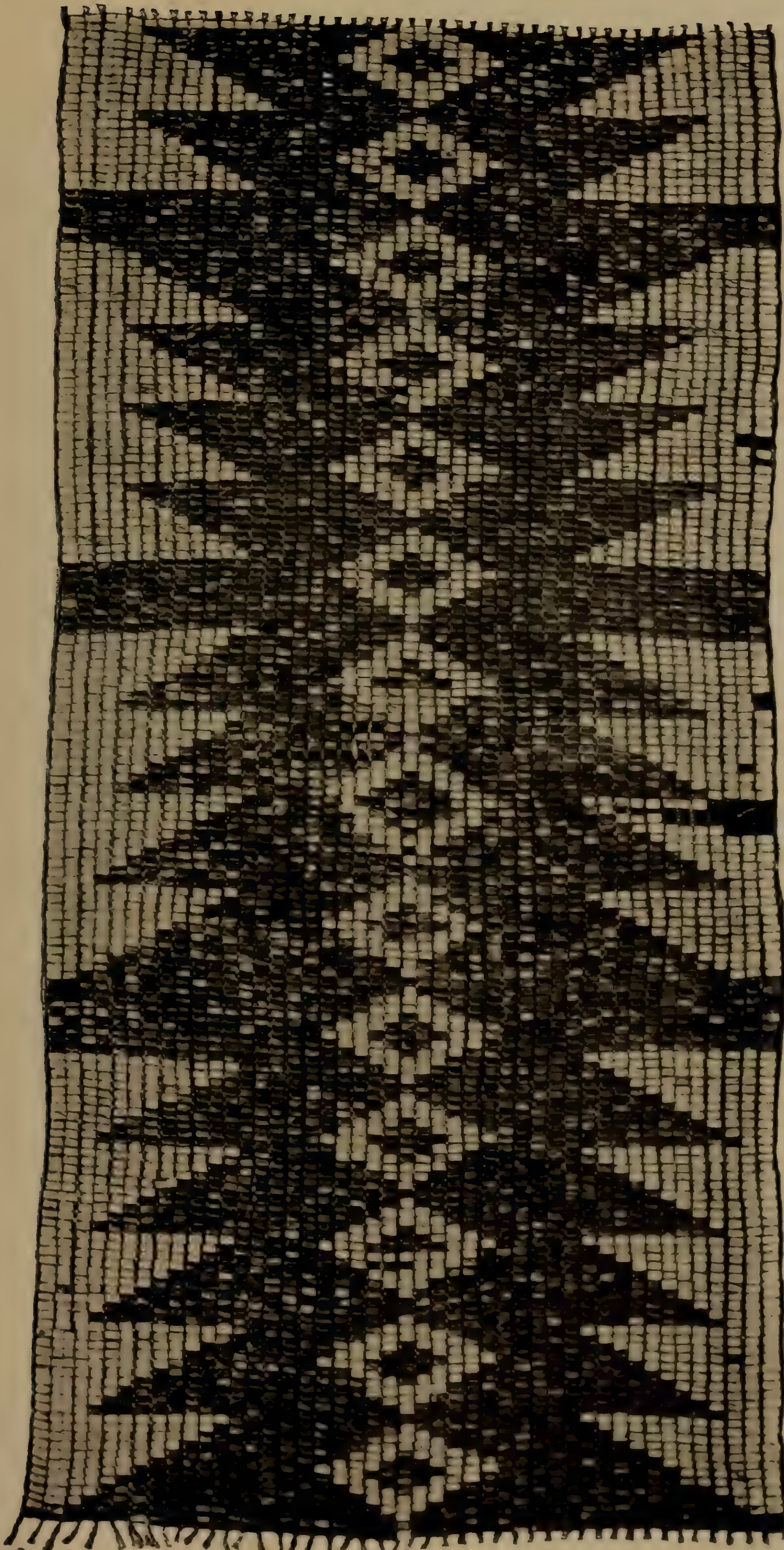
1 String of disk wampum used by the Canadian Delawares in naming ceremonies.

2 Same as figure 1, plate 22



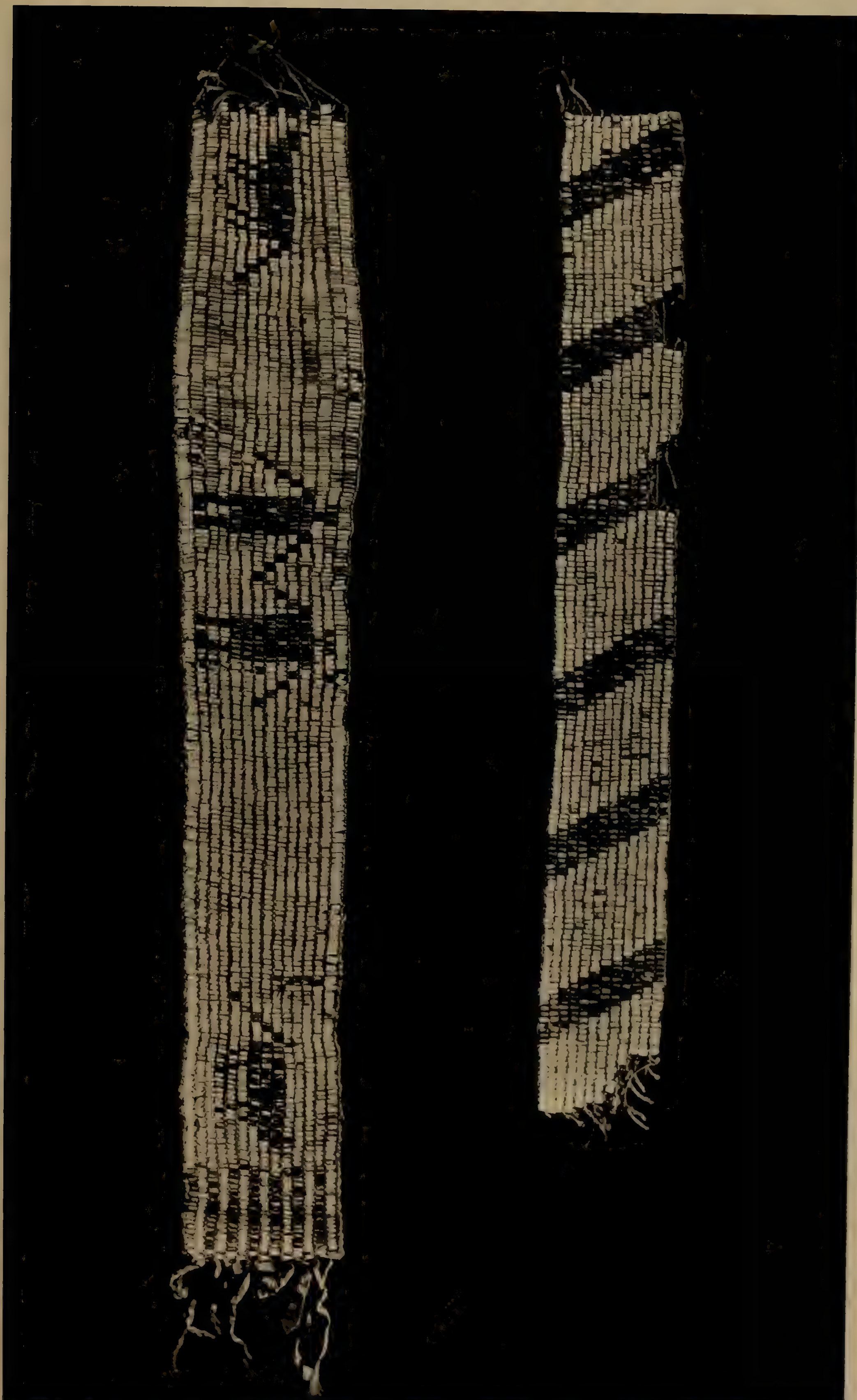
Wing, or Dust Fan of the President of the Council. This is an Onondaga national belt and the largest known, being 31½ inches long and 50 beads wide. The design is said to represent an endlessly growing tree which symbolizes the perpetuity of the league.

Plate 26



To-ta-da-ho belt. Sometimes called the Presidentia. It is the second largest belt known, being 27 inches long and 45 beads wide. The series of diamonds in the center is said to represent a covenant chain always to be kept bright.

1 2



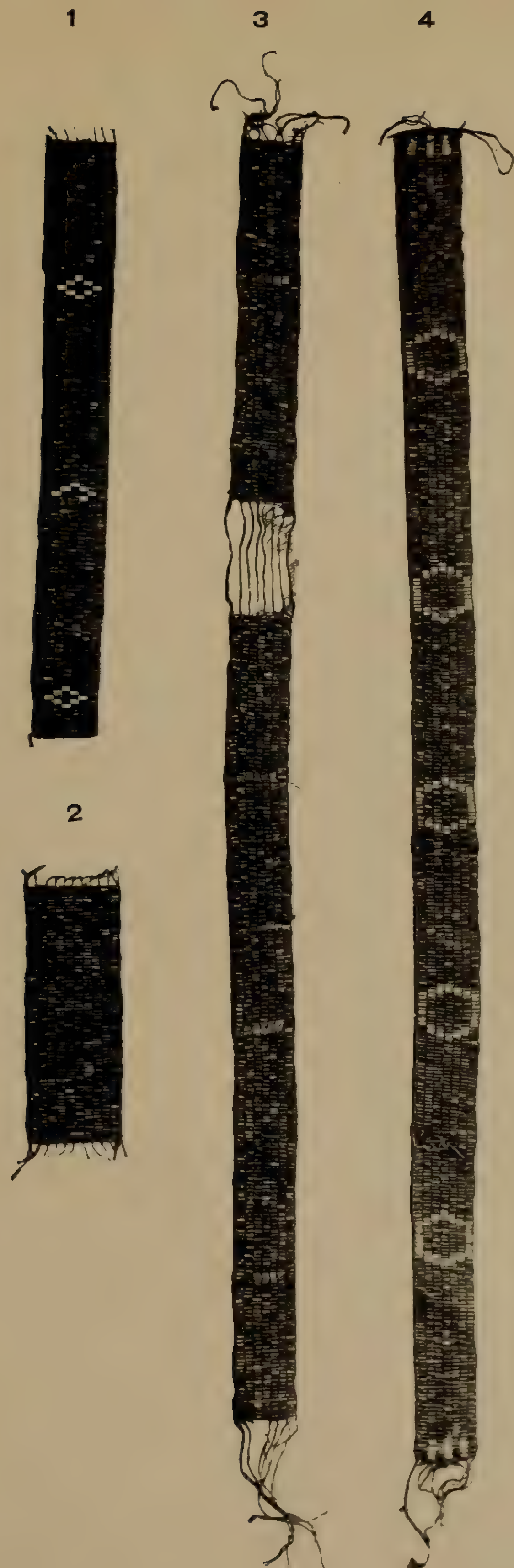
1 Wolf treaty belt. Said to represent the alliance of the Mohawks with the French. The wolves at either end symbolize the "Door Keepers" of the league. This was a Mohawk national belt.

2 Alliance belt, said to commemorate the entrance of the Tuscaroras in 1713. Onondaga national belt

Plate 28

1 Nomination belt used by the Seneca women to confirm the nomination of the sachems which they chose for office. This was the Seneca women's national belt.

2 Hospitality or Welcome belt. Said to have been used in league councils by the presiding chief in welcoming the delegates.



1 The Five Nations alliance belt. A perpetual reminder of the national union. This belt is mutilated.

2 Gyantwaka treaty belt. A fragment of the belt passed to the Indians at the sealing of the Cornplanter reservation treaty. Other portions of the belt were cut up and divided among the heirs of Cornplanter.

3 Cornplanter's personal belt. This belt and a beautifully engraved tomahawk, both in the State Museum, are probably the only relics of the distinguished chief who destroyed all his effects for religious reasons.

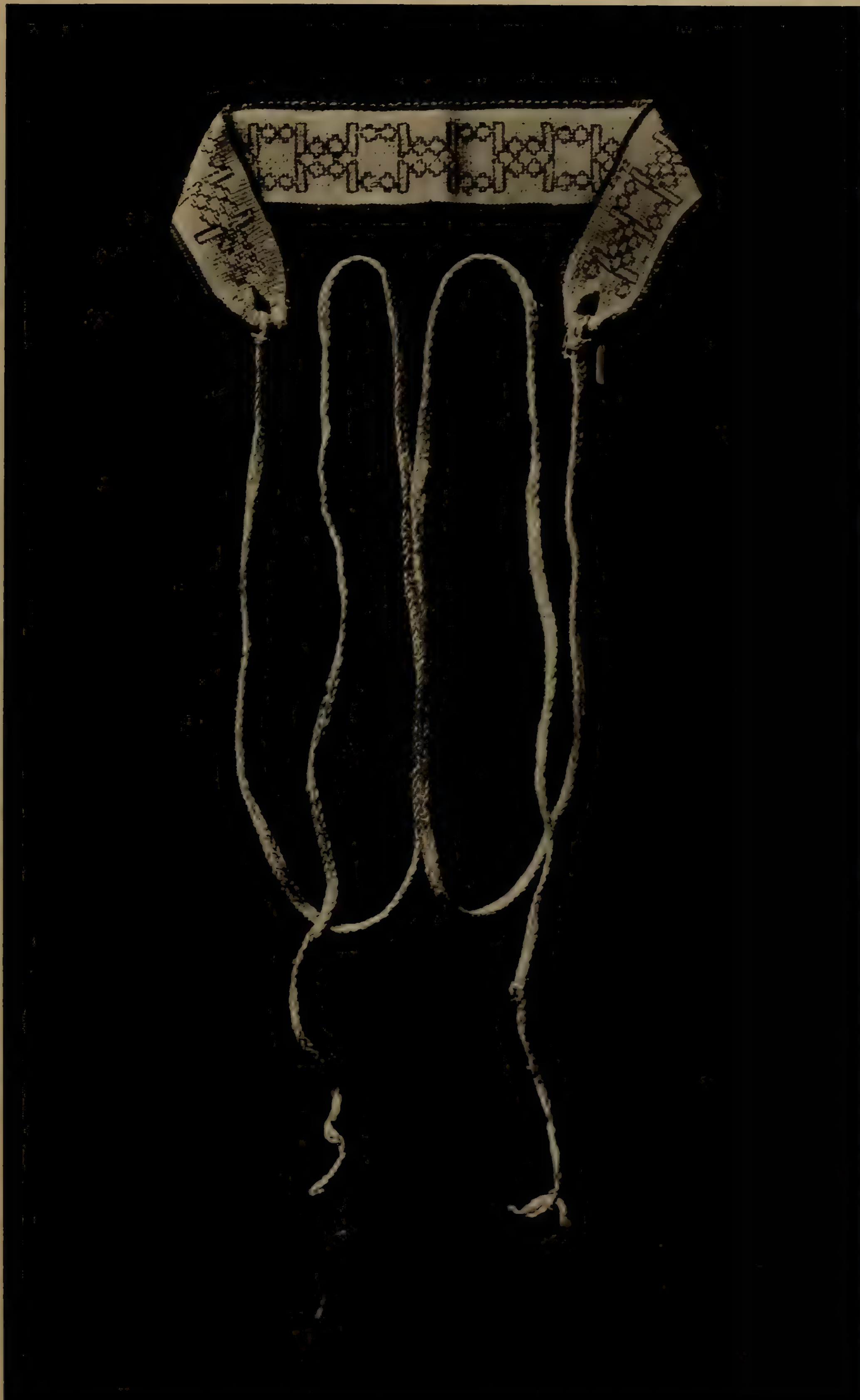
4 Belt of the Keeper of the Western Door. Sometimes called the Parker belt, from Gen. Ely S. Parker who held it as the Do-ni-ha-ga-wa of the confederacy of the Five Nations.

Plate 30

1 2

1 Ransom belt. If presented by the youngest unmarried female, the relative of a murderer, to the avenger of the slain it would ransom the life of the guilty party.

2 The Lewis H. Morgan belt. Made at Tonawanda in 1850. Said to symbolize the peace between clans and villages. This never was a national belt.



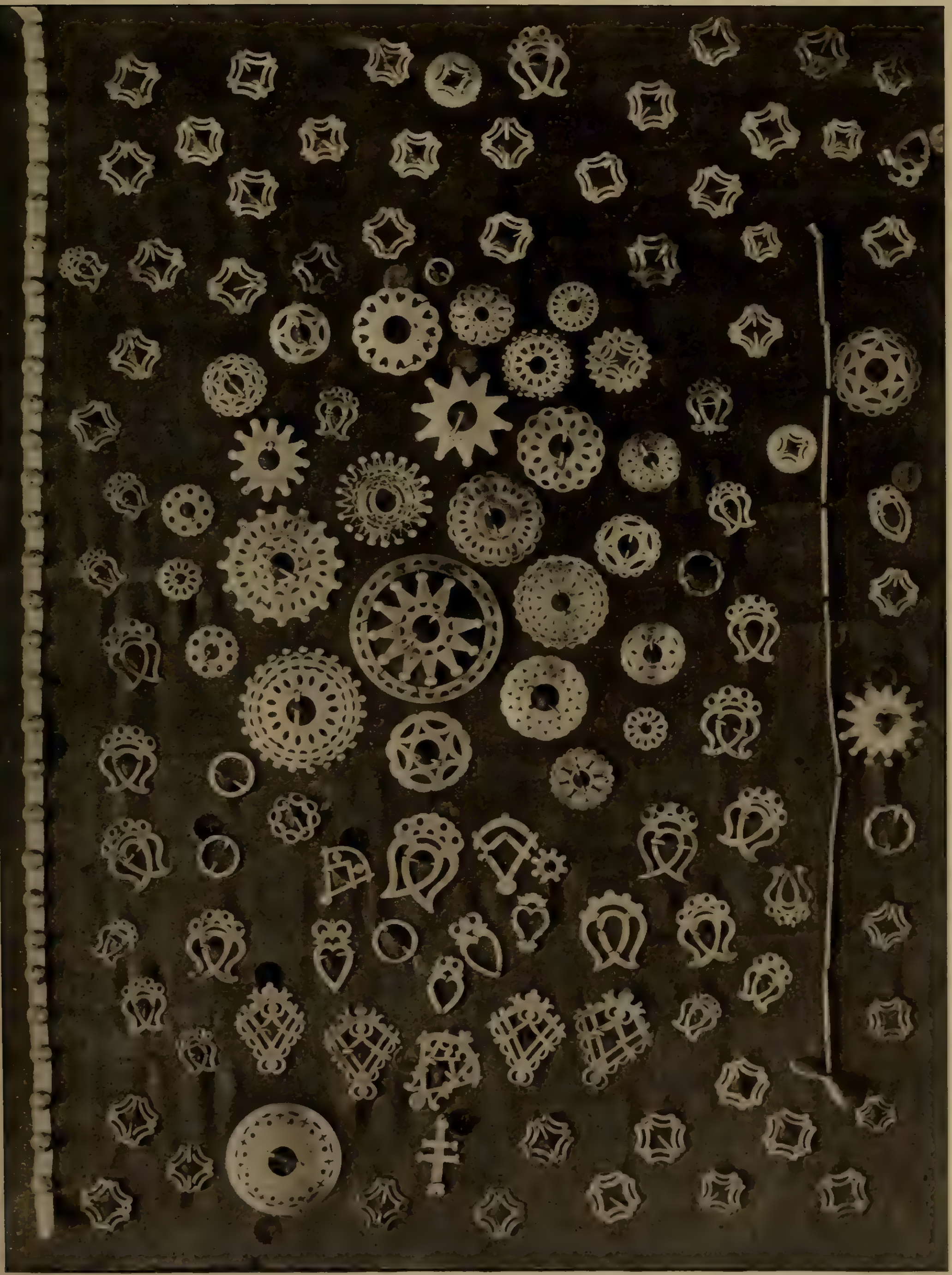
Pack strap woven from basswood bark fiber. Mohawk

Cayuga necklace of worked deer phalanges and knee rattles of deer hoofs

Plate 33

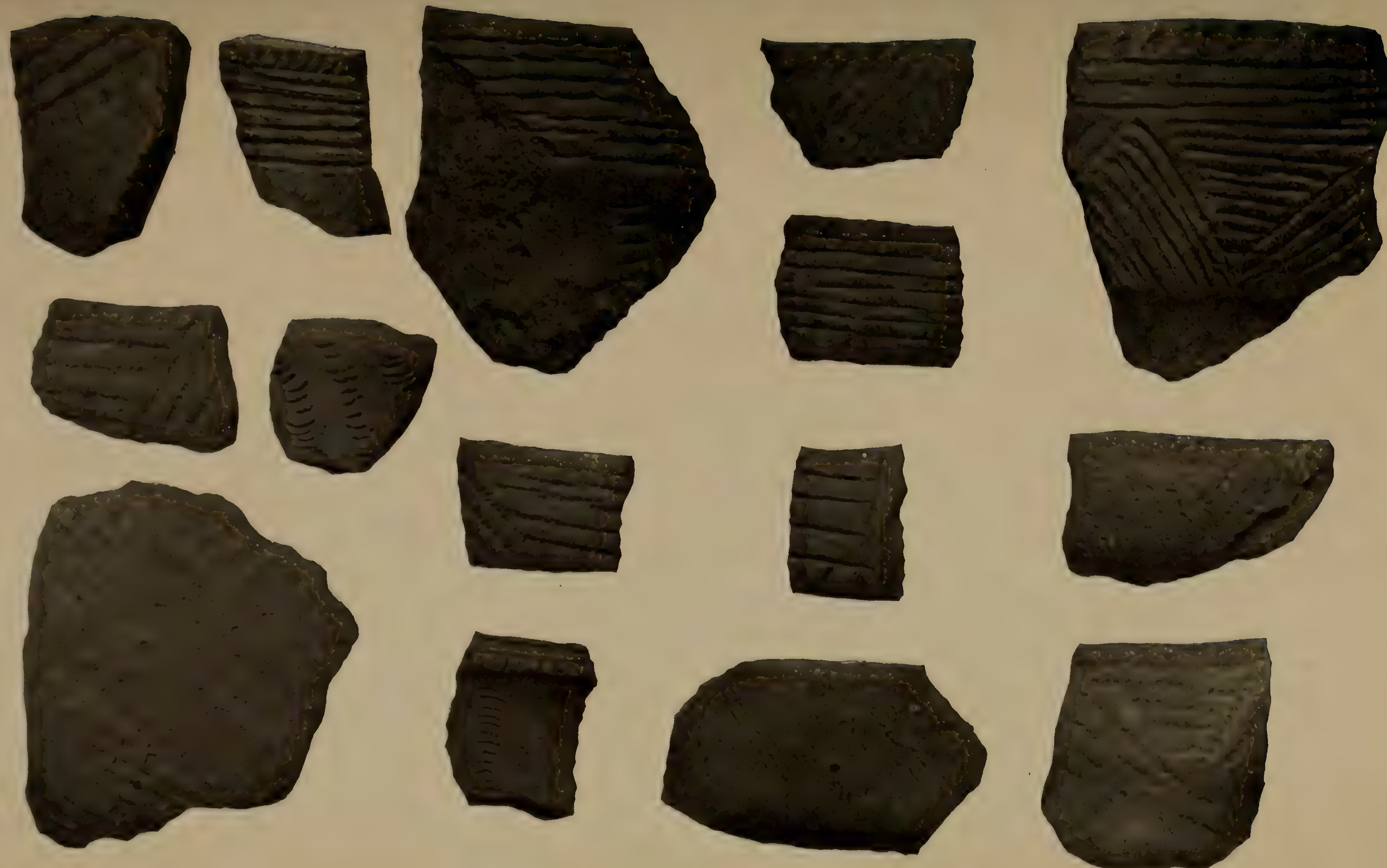
Red Jacket's side pouch and knife sheath. Buckskin, embroidered with porcupine quills

Plate 34



Part of the Harriet Maxwell Converse collection of silver brooches

Plate 35



Potsherds showing range of ornamentation of pottery; Luke I. Fitch collection

Plate 36

Maternity pipe from mound; two views. Probably post-Columbian

and Symbolism of the New York Indians, it is hoped, will fill a want felt by artists, designers and craftsmen in general. It will set forth the forms of artistic creations, decorations by incision, quill embroidery, bead work, carving, stamping, painting and metal work devised by the New York Indians.

Public interest. That public interest in the archeology of this State is steadily increasing is attested by the large numbers of inquiries received by mail and by the number of visitors who personally state the inquiries. Full replies in all cases have been given.

Collections acquired. Several valuable collections of archeologic and ethnologic material have been acquired for the museum during the past year.

Among these are collections from W. H. Hill and M. R. Harrington, of New York city; and L. I. Fitch of Manlius, N. Y.

The Hill collection embraces a number of valuable pieces of silver work such as disks and crowns, bead work and two pieces of wampum, one a belt and one a wristlet.

The Harrington collection is one of the most valuable acquired for many years and consists of ethnologic material purchased from the Iroquois on the Grand River reservation in Canada. Many of the specimens were lacking in our collections and could not be obtained among the New York Iroquois.

The Fitch collection consists of Onondaga archeologic material obtained from Pompey Hill, N. Y., and includes specimens that range from the prehistoric forms down to articles of modern time.

The Archeologist visited the Indian reservations during the summer and acquired a number of valuable objects which up to this time had not been represented among the ethnologic series. Among these objects may be mentioned prayer rattles, ceremonial headdresses, an Indian silversmith's outfit of tools, blow guns, ceremonial robes and mats.

FIELD WORK IN ARCHEOLOGY, 1907

Following out the plan to thoroughly examine each culture district in New York State, the field researches in archeology during the season of 1907 were made in the territory reputed to be that of the Eries. The coast or lake shore culture having been examined last year with splendid result, it seemed advisable to examine the region upon and about the Chautauqua hills. Numbers of sites had been noted here and for at least 60 years it had been a territory interesting to archeologists, although no excavation had ever been made systematically. Excavations made 30 years ago in some sites had yielded large quantities of human remains and the ploughing of other places had produced annual crops of relics in others. Nothing definite was known of the character of these places, nor of the stage of art and culture represented by them. Commonly they are described as being the remains and artifacts of the Eries whom history places in this region.

A survey of Chautauqua county led to the discovery that there were at least three distinct cultures or successive occupations of this region differentiated by very wide characters. There seems some evidence also of a fourth occupation. The oldest occupation definitely traceable is that characterized by the notched and shouldered arrow point and spear point, by the total absence of pottery and bone implements, by the absence of pits except a few shallow ones containing charcoal only. The village sites of this culture and occupation are situated alike on hills and in valleys and seem to have been spread out rather than close together. On sites of this description the gorget, bird and banner stone and other polished slate articles have been found, although most of the celts are of the common type, that is, symmetrical and equilateral. Stone pipes are sometimes found, some of which are of the mound-builder type. Mounds in which these same articles have been discovered seem to indicate that the mounds are relics of this occupation. These mounds are nowhere as large as those of Ohio and Wisconsin, and seldom exceed 50 feet in diameter and 8 or 10 feet in hight. On sites of this description grooved axes are sometimes found although they seem to have been acquired from another culture elsewhere by trade or otherwise. The human remains of the occupation are extremely rare and probably none have ever been found suitable for measurement or comparison.

The second distinct culture is that known as the Huron-Iroquois and is susceptible of two divisions, the prehistoric and historic. The historic or second stage of this culture is undoubtedly Erian, but the prehistoric or first stage is better termed Huron-Iroquois and differs from the second in several material points.

The third culture or occupation traceable is that of the Confederated Iroquois, presumably the Senecas who held tracts of land here during the late part of the 18th and early part of the 19th centuries. This occupation was not of long duration nor are its evidences widely traceable.

The early Huron-Iroquois occupation is characterized by inclosures surrounded by low walls of earth, by ossuary burials, by triangular arrow points, by a lack of notched spears, by a lack of objects buried in the graves, by their pottery, by shallow pits containing no bone objects nor bone refuse, but frequently some pottery and flint chippings. The earth inclosures vary in area from less than an acre to 5 or even 7 acres. When convenient, points of land extending from a terrace out into the valleys were fortified at the neck and cut off from the general plane. The earth circles or inclosures and fortified necks are locally termed " Indian forts " and some undoubtedly were such. Some old writers have called them " ceremonial rings " and have expatiated on the wonders of the " true circles." Investigation, on the contrary, demonstrated that only a few approach true circles and adduces no evidence to prove them of a ceremonial character. Often they have been erroneously regarded as works of the Mound Builders.

The later Huron-Iroquoian occupation becomes more specific and is recognizable as the Erian. It differs from the older occupation in that the burials contain flint and shell objects, pottery of different form and decoration. Refuse, that is broken bone implements, potsherds, rejected flints and entire objects, evidently swept in accidentally, is found in abundance in pits and sunken fireplaces.

The later Erian occupation, the historic, that is to say those sites which yield objects of European manufacture, differ noticeably from the earlier sites in several respects. The pottery seems to have undergone a gradual change until the Eries were destroyed, the most varied forms and decorations being of the historic period.

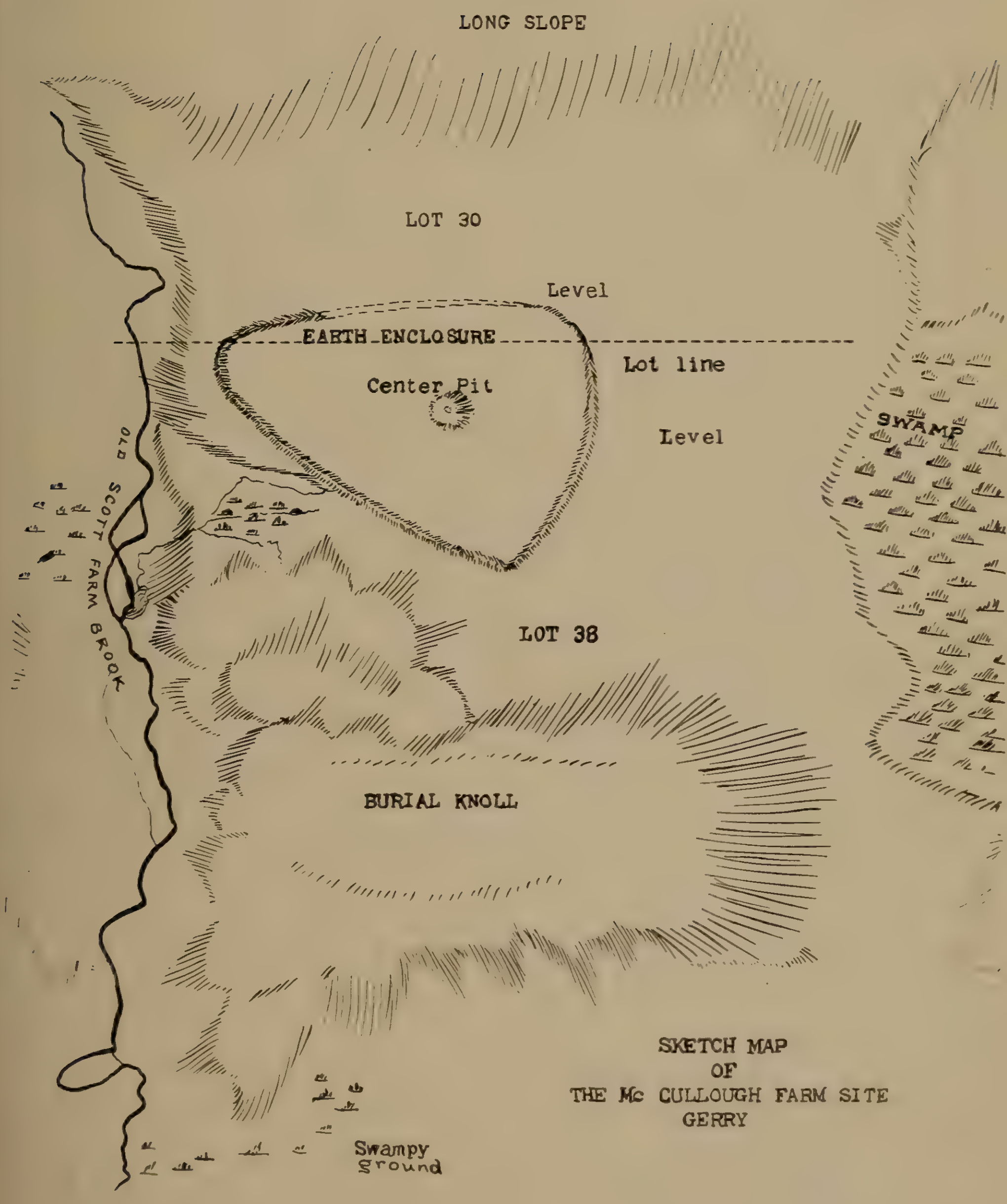
Early in the month of May a preliminary examination was made of some of the earthworks in that part of Chautauqua county lying south of the Chautauqua range of hills in the Allegheny-Ohio watershed. The outlook seemed a promising one, judging from the abundance of earthworks visited and reported. The Cassadaga valley was of especial interest and a season's campaign of investigation was planned for this region. Upon the uneven stream-cut hills that rise from the ancient lake bottoms were found everywhere traces of an early people which seemed eminently worthy of study. How numerous are the fort sites may be suggested when it is stated that from a hill just over the town line in Charlotte are to be seen the sites of seven and possibly eight fort and camp sites.

McCullough earth inclosure. One of the sites to which considerable attention was devoted is situated in a sugarbush on the Martin McCullough farm, lot 38, Gerry township. Here surrounded by a swamp from which rise sloping hills is a rise of land some 3 feet above the swamp level. Upon this rise of ground is an oval or rather kite-shaped earthwork 1297 feet in circumference. The wall is now from 22 inches to 24 in hight and is composed of the earth which was scooped from an outer ditch bordering the wall. This earthen ridge first attracted the attention of Obed Edson who some 50 years ago was engaged in running the lot lines. Some mention of it is contained in the various county histories to which he has contributed or written. Numbers of men distinguished in archeologic science have visited the place and more than a dozen years ago representatives of the Smithsonian Institution made some investigations there. To the west of the earth wall rises a small knoll which appeared to be composed of glacial sand and to the north running through a little valley is a brooklet. Within the wall are numerous pits or depressions 5 or 6 feet in diameter and 3 to 9 inches deep. These, upon examination, proved to be shallow refuse pits with an original depth of from 1 to 2½ feet. A rather remarkable pit is situated almost in the center of the inclosure and measures 157 feet in circumference with a depth of 5 feet. The earth wall is surrounded on its outer side by a ditch which is at present but little more than a foot below the normal level of the surface. The wall at present is on the average 8 or 9 feet through at the base and the crest of the ridge rises 2 feet in places. The ditch and wall are entirely visible in lot 38 and the wall may be traced in lot 30 where the ground has been cultivated for several years. An enormous white pine stump stands on the northwestern side of the wall. A cross-section of this stump was made by Hon. Obed Edson and more than 400 rings were counted. At the northwest corner of the earthwork where the stump stands, the surface of the ground is 20 feet higher than the brook bed which lies to the north 25 feet distant. At the lot line on the east the earth wall takes an abrupt turn almost at right angles and runs about parallel to the line for 450 feet.

Within the inclosure at about its mid point is the bowl-shaped depression, previously mentioned. This pit is 5 feet deep and 50 feet in diameter. In area the inclosure is about 3 acres.

It was found after some expenditure of time that very little in the line of movable material data bearing on the original inhabitants could be hoped for. Specimens of the arts and manufactures were few and fragmentary. However, bearing in mind that the problem was to discover the identity and characters of the builders of the

Plate 37



SKETCH MAP
OF
THE Mc CULLOUGH FARM SITE
GERRY

The central pit in the McCullough earth inclosure

View looking over the burial knoll. Ossuary 5 was found near the stump shown in the left-hand corner of the picture.

earthworks, it was deemed advisable to continue until it could be thoroughly studied and every important fact obtainable brought to light. Since the area within the inclosure refused to divulge all the desired information, it was sought to discover the burials and wring from the crumbling bones of these swamp dwellers some word or fact to dispel the mystery.

Burials

Post holes were dug in the ridge to the west of the earth-walled inclosure to discover, if possible, whether or not there were any burials, it being the spot most suited for graves, in point of accessibility. The surrounding ground was swampy and the loam but a few inches in depth when a stiff clay or hard pan was encountered. The knoll on the other hand was dry and sandy.

After 40 tests had been made, running from the brook on the north in a southerly direction, an area of disturbed earth was found and a trench staked out for systematic excavation. Following the rule the trench was 1 rod wide. Trench 1 was run over the crest of the ridge from south to north.

Burial 1, was found at 16′ in the middle of the trench 20″ below the surface. A root-eaten skeleton of a young female was discovered. The skull was crushed at the top. Only the skull and upper ribs and upper arm bones were found. The other bones were not to be found. The head lay to the northeast, face northwest. 28″ southeast and above the head was an ash pit 18″ deep. It was filled with white ashes. The superincumbent soil was sandy and intermixed with bits of charcoal.

Burial 2. At 16′ on the west side of the trench, 36″ below the surface and opposite burial 1, burial 2 was discovered. The skeleton was that of an adult male and lay in a flexed position. Measurements of the skeleton as it lay led to the following data: 33″ from top of skull to heel; knee to back, 9″; pelvis to top of head, 33″. The soil was strewn with charcoal bits and potsherds. A black fibrous phosphate was noticeable in the grave soil.

Two empty graves were found between this burial and the next (No. 3). Their character as graves was shown by the soft, loose and disturbed soil which lay surrounded by the hard, undisturbed grit. It was an easy matter to shovel out the grave soil because of its looseness, without disturbing the wall of the grave. Only a few fragments of bones were discovered in these empty graves.

Burial 3. Discovered at 34′ on the west side of trench 1, 26″

down. Skeleton was that of an infant 8 or 9 years old. The skull was crushed. The body lay in a grave outlined by a row of flat stones placed upright on edge. Orientation: head, east-southeast; face north-northwest; right side, flexed. Body lay east-southeast by north-northwest. From top of head to end of toes 2′ 3″. Black phosphate in grave. Ash pit south of skull at 18″. Grave soil much disturbed.

Burial 4, was found at 33′ on the east side of the trench. The depth was 25″ and the grave outline 60″ by 35″. A decayed male skeleton lying in the usual flexed position. Orientation: head, south-southeast; face west-southwest, left side. The skeleton as it lay measured 36″ from top of head to heel and 15″ from knee to back. The superincumbent grave soil was much disturbed. An ash pit 2½′ in diameter and 1′ deep was found just south of the grave.

Between graves 3 and 4 there was a streak of disturbed earth 30″ deep, as if the entire ground had once been turned over to this depth. There was a thin separating wall as if there had been two other graves here.

Burial 5. At 40′ on the east side of trench 1 the tops of two boulders were struck and a few inches north of them a heavy bed of white ashes. Beneath the ash bed, 11″ from the surface of the ground the tops of several skulls were touched. Careful excavation revealed a small ossuary containing the remains of parts of 14 skeletons.

The bones were placed in a rectangular heap measuring northeast to southwest, 2′ 4″, by northwest to southeast, 1′ 8″. The large bones, femora, tibiae, etc., lay northwest and southeast. Six skulls were arranged around the top of the ossuary and beneath them were four others, all broken. When the bones were removed 27 femora were found which would indicate parts of 14 individuals. The earth had packed about the outer bones and had not fallen into the interstices of the bone heap below. The area of the disturbed earth was, in diameter, 4′ 6″. The two boulders south of the ossuary had probably been placed as hidden markers. Large stones had not been encountered before in the sand of the knoll.

Just beyond the ossuary to the south was a large ash pit 48″ in diameter.

In depth the ossuary was 16″, or from the top of the ground to the bottom, 27″.

Burial 6. This grave was discovered at 37′ outside of trench 1, on the west side. It was 36″ deep, 36″ wide and 55″ long.

Grave 2, McCullough site

Grave 3, McCullough site

Grave 6, McCullough farm site, Gerry, N. Y.

Ossuary 5, McCullough site

This grave unlike the others seems to have been an original burial, that is to say, the earth had not been overturned more than once. The other graves seem to have been used several times, the bones being removed for ossuary burial or other disposition, and a new body interred therein.

The skeleton was that of an adult male of mature years, (about 60). A heron's lower mandible was found at the forehead as if it had been used as a hairpin.

The earth had packed about the limbs and neck and left in the clay-mixed sand a cast of the body. A black phosphate surrounded the bones, the remains of the animal tissue.

Measurements of position gave the following data: knee to back, 17″; atlas to *os innominata* 2′ 5″; atlas to end of tarsus, 3′ 2″.

Orientation: head east; face, south; left side, flexed.

Bones in good condition except those of the two lower arms.

Burial 7. Another grave was opened at 44′ on the west side. It was 30″ deep and contained only a few decayed vertebrae and a deposit of grave dirt. The larger bones had probably been removed for ossuary burial.

Burial 8. At 49′ on the west side, grave 8 was found. It was 19″ deep and contained a few decayed bones, part of a femur and the crushed remains of a child's skull. Over this grave was a layer of shale slabs. At the south end of the grave was a boulder 12″ in diameter. It was 18″ below the surface.

The skull lay with the top east. A large piece of shale lay directly beneath the pelvis. Between this grave and the next was an ash bed 7″ deep.

Burial 9. At 50′ in trench 1 touching the line on the east side, 20″ below the surface, the top of another ossuary was uncovered. Excavation disclosed a bone pile 48″ from north to south and 33″ from east to west.

Unlike burial 5, the first ossuary, this was a promiscuous heap of bones cast without order upon a group of 20 skulls arranged in an oval. Four inferior maxillae, 6 broken femora, 5 humeri, a number of ulnae, radii, vertebrae, an astragalus, tarsus, ribs and pelvis were found in the heap over the skulls.

Of the 20 skulls, 10 were male and 9 female. Parts of another skull were found, but the sex could not be determined.

Over the ossuary was a glacial boulder about 18″ by 18″ and a covering of shale and fossiliferous Chemung rock.

Four craniums from the ossuary were in good condition and four others in condition for measurements. All are interesting for the characters they exhibit.

Burial 10. At 50′ on the west side of trench 1 was an empty grave 24″ deep. Over it had been cast a quantity of broken stone.

From the north wall of the ossuary, running north for a foot was a top layer of burned stone. The earth here had not been disturbed.

Trench 1 was temporarily abandoned at 54′ and a parallel and adjacent trench run on the west side.

Burial 11. At 5′ in the middle of trench 2 burial 11 was discovered. The grave area was 4′ by 4′ and the depth 2 feet. The skeleton was that of a female. The skull was crushed. The arms were flexed to face, the left hand being under the left cheek.

Orientation: head, east; face, south; left side, flexed. Head thrown back.

Burial 12. Burial 12 was at 10′ in the middle west side of trench 2. It was an empty grave with disturbed earth to the depth of 48″

Burial 13. Grave 13 was on the east side of trench 2 at 31′. It was 28″ deep and contained the decayed root-eaten skeleton of an adult female.

Area of grave, 3′ by 4′.

Orientation: head, east; face, north; flexed.

There was a small ash pit at the head of the grave.

Burial 14. Found at 43′ in the middle of trench 2.

This grave was 28″ deep and 3′ by 3′ in area and contained a male skeleton in a poor state of preservation. The tibiae were noticeably platycnemic.

Trench 3 ran parallel with 2 on the west.

Burial 15. Grave 15 at 4′ on the west side of trench 3 was 19″ deep, 19″ wide and 30″ long. There were no bones except the broken skull and the neck vertebrae.

Orientation: head, east-southeast; face, south-southwest.

Burial 16. Burial 16 at 44′ on east side of trench 2 was 36″ deep and contained the pelvic bones and sacrum of a young adult. No other bones were in the grave. This fact seems to point to a removal of the skull and larger bones for reburial.

Burial 17. At 36′ in trench 3, 18′ south of ossuary 1, pit 5, the third ossuary was discovered.

Six skulls were arranged in the form of an ellipse and the other bones thrown in the opening. These bones besides arm and leg bones, included ribs, pelves, phalanges, astragali tibiae, and vertebrae. There were two female skulls.

Burial 18. This burial was in the middle of trench 3 at 19′ and 18′ south of the ossuary (17). On the bottom of the grave a few potsherds were discovered but no visible trace of bone.

The problem of the many empty graves in the burial knoll was at first a puzzling one. Some graves contained a few ribs, some a pelvis, one or two arm bones and teeth and others were entirely empty except for traces of bone dust.

As a hypothesis the theory was then advanced that the parts of skeletons, the larger limb bones and skulls had been removed from the graves and deposited in the ossuaries; that the graves had been left, open or filled, for use again. The ossuary burial is a Huron, or perhaps more properly a Huron-Iroquois custom, and has usually, perhaps entirely, been held a mere matter of superstition or ceremonial custom. The presence of empty graves and overflowing ossuaries suggested the theory of the *economic utility of the ossuaries.* The virgin earth being difficult to dig, but once disturbed never packing as hard as before, it would have been a matter of labor, time and space saving to exhume the remains of the dead and reinter them in an ossuary, and to use the empty graves again as burial places.

These theories are only tentative and not to be regarded as established until numbers of other places shall have shown the same characteristics. It is also of importance that more than one observer should have noted them.

Excavations within the inclosure. The ground within the earth wall has not been disturbed since its aboriginal occupation except in places where sugar boilers had been erected.

Over 120 basinlike depressions were scattered over the surface and varied in diameter from 3′ to 10′, and in depth, from 6″ to a foot. These pits were examined to discover their purport. Only six yielded anything in the way of relics. These consisted of flint chips, fire broken stones, pottery fragments and arrowheads. The earth was not disturbed in any case, except in that of the deep middle pit, for a depth of more than 30″, the underlying soil being hard and impenetrable by crude implements.

Middle pit. This pit was carefully excavated. The soil was disturbed for about 9″ below its modern surface except at the bottom where there was an ash pit 4′ in depth and 4′ in diameter. Mingled through the soil of the large pit was found a quantity of pottery, flint and jaspar chips, heat cracked stones and a number of triangular flint points. In the ash pit at the bottom, objects of the same character were found.

The presence of this large central excavation presents the problem of its purpose. To solve this question a number of hypothetical answers are adduced for consideration:

1st, it may have been a central refuse pit; 2d, it may have been a place of assembly, its gradual slope affording a seating place; 3d, it may have been an inner stockade; 4th, it may have been a reservoir into which water was conducted from the spring on the hillside to the east; 5th, it may have been excavated to obtain earth for filling in the northwest corner of the inclosure which is low and sloping toward a small gully which drains a spring marsh.

A careful examination of the ground showed that the northwest corner had been filled in, presumably with the soil excavated from the central pit. This examination also led to the several considerations. That the pit was not a reservoir is shown by the fact that ashes and refuse matter were found within it, though not in large quantities. That it was not a reservoir is also indicated by the fact that no ditch or outlet could be discovered. However, one may have existed and the pit been a reservoir previous to its use as a refuse dump, if such it was. The refuse matter in the pit did not occur in such quantities that it would be differentiated from "occupied soil" elsewhere, so that it may have been an inner stockade or place of assemblage.

Extent and character of occupation. There is evidence enough to point out that there was no long occupation of the site, the surface soil being but slightly disturbed to any depth. This evidence also suggests a settled occupation only in winter. The shallow pits seem to have been dug during the frozen season by alternately thawing and digging and in many instances also, to have been the sunken floors of lodges. If animal bones had been buried some would have remained as human bones did elsewhere in the site. This suggests that they were cast on the surface and afterward devoured by animals or lost by decay.

Purpose of the earth wall. The earth wall and trench are palpably parts of a fortification. From the crest of the wall, without doubt, rose a line of palisades which surrounded the inclosure. Indeed traces of these post holes were discovered all along on the ridge.

One of the strange facts which at once appears a curious anomaly is that if this inclosure had been a fortification why such a position should have been selected, when, from the hillock to the west, arrows and stones or other missiles could have been easily thrown into the wall-protected inclosure. This very thing would have rendered the fort of little use in times of war or invasion. Two considerations then appear: first, that it was not a true fortification designed to protect the inhabitants from men only, but made for a protection from the wolves and other wild beasts which infested the region even in historic times; or second, that the enemies of the age held the acres of the dead as sacred spots and would not under any provocation desecrate the burial ground on the hill to use it as a vantage point from which to assail the living within the inclosure which the burial knoll overlooked.

Camp site outside of inclosure. To the southwest of the burial knoll rises another glacial kame which in length runs east and west. This kame contained 10 large ash pits, the one on the summit being 5′ deep and filled with carbonaceous earth, burnt sandstone and charred corn. Between this kame and the inclosure, the earth had almost everywhere been disturbed and there was a heavy mixture of white ash and charcoal as if the vegetation and trees had been burned over many times. No implements were found here except a celt at the west end of the kame.

The soft mellow loam here also suggests its employment as a garden spot, possibly a cornfield. Charred corn was found in some of the pits.

Age of the remains. Several considerations determine the age of the remains. The absence of European articles at this place is a good indication that it is prehistoric. The difference between the characters of the occupation and those of the early historic Eries points out a pre-Erian or early Erian people. That they were early Iroquoian is evident from an examination of the artifacts but that they were early Erian is manifest by certain differences in form of culture and occupation. The remains would seem to be at least 500 years old and even a greater age may be ascribed.

No detailed description of the osteological remains of the aboriginal inhabitants of New York has even been attempted. It is the plan of the archeological section, therefore, to begin a systematic study of all the human remains which can be obtained within the limits of the State and finally issue a more or less complete report upon the subject. There is indeed a great need for such a guide, for the scientific value of such data has been almost entirely overlooked. A detailed study of the osteological remains found at the locality described (Gerry) is being made in the laboratory, all the approved osteometric measurements and indexes being taken. Although this work is but partially completed at this writing, it is possible to give some of the figures and a few descriptions of the various morphological characters which the bones exhibit.

Crania. The crania, for convenience in study, have been ranged in three classes as follows: brachycephalic, with indexes above 80; mesaticephalic, with indexes between 75 and 80; and dolichocephalic, with indexes below 75.

It is not possible in a preliminary report of this kind to describe at length each skull or give the various minor measurements. Type skulls of each group will, therefore, be taken.

Specimen 4503, a male taken from burial 5. This skull is the best preserved of any found and is the heaviest, weighing 24 ounces. It is that of a person of mature years, between 50 and 60. The teeth which remain are well preserved, but there are cavities in the superior right canine and in the adjoining premolar. On the right side in the upper jaw the molars are entirely lacking and the matrices filled. The third molar on the left seems to have been lost a short time before death. The first premolar on the left is abnormal in that it grows out at an angle. This has resulted in it being worn obliquely and protruding over the premolar beneath. On the opposite side the premolar is normal in form, but between it and the canine there is a supernumerary tooth. The denture of the lower jaw is normal and there are no cavities in the teeth which remain. On the left side all the premolars are gone and the matrices healed and closed. On the right side one molar and the other teeth remain.

The inferior maxillary is well preserved. It is remarkable for the squareness of the chin, the mental tubercules on either side being pronounced. They flare out from the body of the maxillary and give the chin a width of 57 millimeters.

The sigmoid notch is crescentic and not parabolic. In breadth, measuring from the crests of the coronoid processes, the jaw is 107 millimeters, and a line drawn from a point midway between the angles to the point of the chin gives a length of 70 millimeters.

The palate is worthy of note because of its several peculiarities. The transverse suture has entirely united and several spinous processes have formed on each side of the sagittal suture. The posterior palatine canal on the right is larger than that of the left due to the absorption or the retarded growth of the septum. These

Plate 41

Two views of skull 4503, from grave 6, McCullough site. Breadth index, 71.6

canals are not normal in form. The external base of the skull presents several other interesting features, one of which is the form of the *foramen magnum.*

An examination of the upper portion of the skull shows that the sutures have begun to amalgamate. This is especially noticeable in the coronal suture where it disappears after touching the temporal ridge. On the left side, however, there is an excrescence formed by two spinous processes that arise a millimeter above the plane of the alesphenoid. These excrescences are thin and calcareous and appear to be the result of an injury.

The supraciliary ridges are heavy and their surface covered with fine convolutions. The frontal bone slopes back and the forehead is low. The occipital region is full but asymmetric, the left side being larger. The nasal bone curves sharply out from the face lifting *rhinion* above the plane of *dacryon.* This suggests a wide and prominent probocis which must have appeared in life formidable as accentuated by the beetling brows. The whole appearance of the skull with its many ridges indicates an extraordinary musculature. A list of the principal rectilinear measurements follows:

Maximum length, 187 mm
Maximum width, 134 mm
Basal hight, measured from basion to bregma, 141 mm
Auricular hight, 120 mm
Horizontal circumference, 525 mm
Auriculo-nasal length, 95 mm
Auriculo-prosthionic length, 100 mm
Basi-nasal length, 108 mm
Basi-prosthionic length, 98 mm
Nasi-prosthionic length, 76 mm
Bi-zygomatic breadth, 137 mm
Bi-stephanic, 118 mm
Orbital hight, 38 mm
Orbital width, 45 mm
Nasal hight, 55 mm
Nasal width, 26 mm

INDEXES

Part	Measurement	Decimal indexes	Classification
Breadth	$\frac{134}{187}$	71.6	Dolichocephalic
Hight	$\frac{141}{187}$	75.4	Metriocephalic
Alveolar	$\frac{98}{108}$	90.79	Orthognathous
Nasal	$\frac{26}{55}$	47.3	Leptorrhine

Part	Measurement	Decimal indexes	Classification
Facial	$\frac{76}{137}$	48.1	Chamaeprosope
Stephano-zygomatic	$\frac{118}{137}$	86.1	Phenozygous
Orbital	$\frac{38}{45}$	84.4	Mesosmic

Capacity 1649.2 ccm

Specimen 4550; an adult mature male. The facial portion is missing and was probably lost during the process of ossuary burial. The sutures are distinct but the coronal is in an advanced stage of synostosis. On either side this suture is not visible below the temporal ridge except for a centimeter on the right side. The left orbit has a wide supraorbital notch which the right does not present. The supraorbital ridges are similar to those on the other male skulls and the glabella full. The frontal dome slopes back and there are no eminences. On the right side of the temporal, the squamous suture has united posteriorly with the parietal for a distance of 25 millimeters. On either side the alesphenoid has united with the parietal. On the right the temporal ridge is not well developed although on the left it is plainly visible. There is a Wormian bone at the point of union between the parietals and the occipital bone, and two a centimeter above the point where the superior temporal line touches the lambdoid suture.

Below are enumerated the principal measurements possible in this specimen.

	Millimeters		Millimeters
Maximum length	185	Basion-nasion	109
Maximum breadth	140	Bi-stephanic	113
Basion bregma	140	Auricular hight	125
Circumference	510		

The only indexes possible follow:

Part	Data	Index	Classification
Breadth	$\frac{140}{185}$	75.5	Dolichocephalic
Hight	$\frac{140}{185}$	75.5	Metriocephalic

Capacity 1531.7 ccm

Plate 42

Two views of skull 4548 from ossuary. Index, 77.7

Specimen 4548; a mesaticephalic female skull found in ossuary 9. It is in a fair state of preservation although it is very fragile. It is that of a female of perhaps mature years. The teeth are entirely lacking, those on the upper jaw having undoubtedly been lost during the process of reinterment. In the lower jaw the canines and incisors were the only ones remaining at the time of death. The matrices of the other teeth have closed. Upon the cranium, the sutures though distinct have lost their intricacies, but none of the bones have affected synostosis.

The measurements in millimeters of this specimen follow:

DIMENSIONS

	Millimeters		Millimeters
Maximum length	175	Basi-prosthionic length	170
Breadth	136	Bi-zygomatic breadth	136
Basal hight	132	Bi-stephanic breadth	111
Circumference	502	Orbital hight	37
Auricular hight	120	Orbital width	41
Auriculo-nasal length	89	Nasal hight	50
Auriculo-prosthionic length	98	Nasal width	25
Basi-nasal length	106		

These measurements give the following indexes of proportions:

Part	Data	Index	Classification
Breadth	136/175	77.7	Mesaticephalic
Hight	132/175	77.4	Metriocephalic
Aveolar	95/102	93.1	Orthognathous
Nasal	25/50	50	Mesorrhine
Facial	71/136	52.9	Leptrosope
Stephano-zygomatic	113/136	83	Phenozygous
Orbital	37/41	90.2	Megasemic

Capacity 1437 ccm

Specimen 4554; female skull, brachycephalic in form. Almost the entire top has been destroyed by the pressure of the superincumbent earth, but not enough to prevent most of the measurements. Only three teeth remain, the others having been lost in process of reburial. The palate is wide, having a length of 50 millimeters and a width of 42, which gives an index of 84.

The orbits of this skull differ from most of the others. They more nearly approach a circular form and have no angles at the turns.

	Millimeters		Millimeters
Length	163	Orbital high	38
Breadth	133	Orbital width	42
Nasion to prosthion	72	Bi-zygomatic breadth	133
Nasal length	48	Basion to prosthion	98
Nasal width	26	Basion to nasion	102

These measurements give the following indexes:

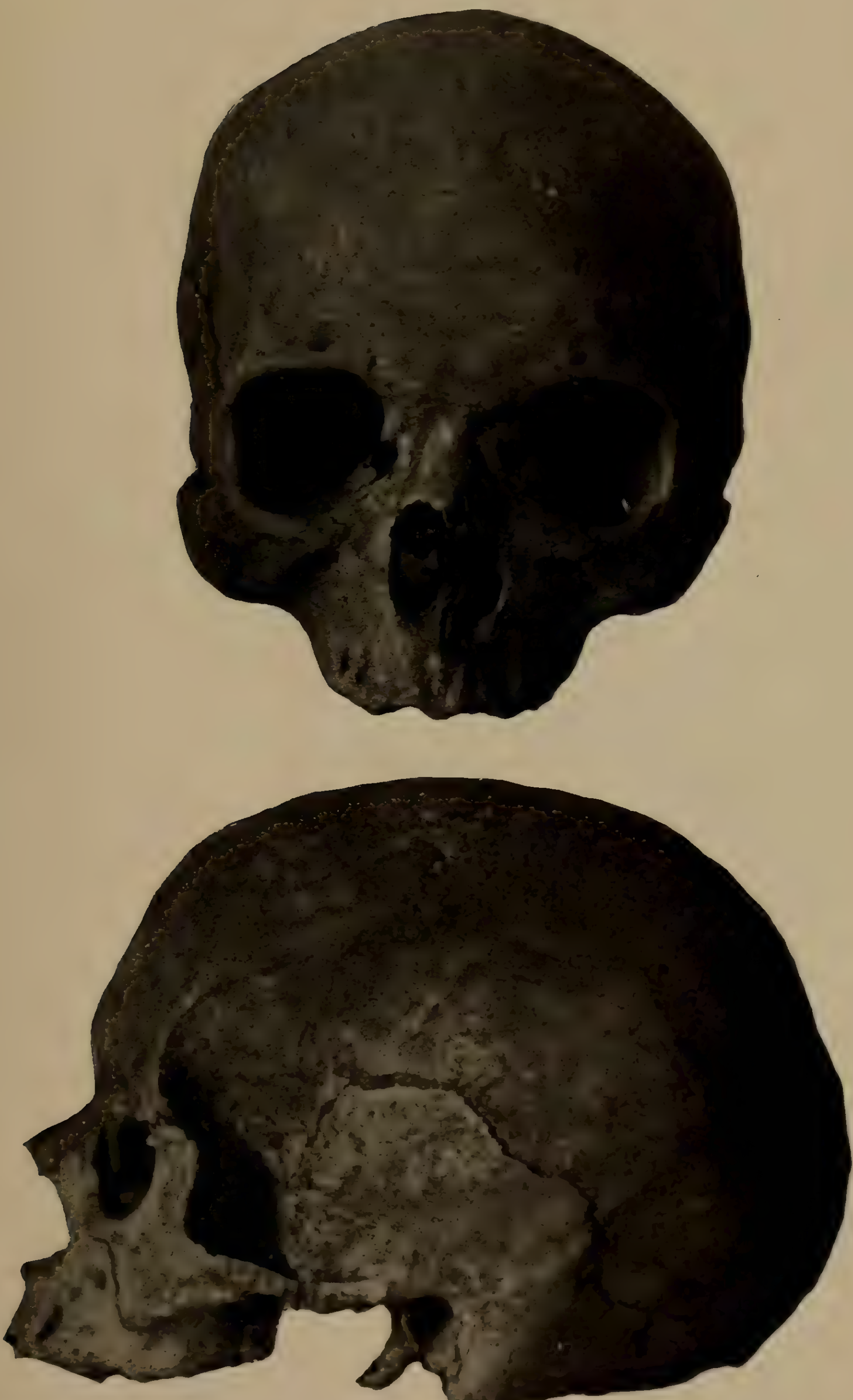
Part	Data	Index	Classification
Breadth	$\frac{133}{163}$	81.6	Brachycephalic
Aveolar	$\frac{98}{102}$	96	Orthognathous
Nasal	$\frac{26}{48}$	58.3	Platyrrhine
Orbital	$\frac{38}{42}$	95	Megasemic

Capacity indeterminate

Femora. There are a number of morphological variations in the collection of femora which command attention at once. The more striking anomalies only will be mentioned here. They are those termed the third or supernumerary trochanter and platymeria. Each of these characters is found in a large percentage of the femora, the supernumerary trochanter in about 40 per cent and platymeria in 60 per cent. For the several variations which these femora present a brief description of several is here appended.

Specimen 4522; right femur, probably male, weighs 9½ ounces. It is heavily built and has a heavy gluteal ridge for a distance of 6 centimeters below the lesser trochanter. The superior extremity is normal (Indian) though the digital fossa is deep.

Plate 43



Two views of skull 4551. Index, 76.6

Plate 44

Two views of skull 4552. Index, 74.1

There is a tuberosity of slight elevation resembling a third trochanter and below it and extending within 35 millimeters in a diametrical plane of the superior arterial foramen is the hypotrochanteric fossa. Its depth is accentuated by a flangelike projection of the shaft. The femur is not especially platymeric, index 74.3.

The lower portion of the femur is apparently normal although the external tuberosity is large, but this seems a characteristic of many of the femora.

Specimen 4505; a typical shaft. It is 428 millimeters in length and weighs 10½ ounces. In color it is a straw yellow and like all the other bones bears no sign of fossilization. The neck is long and the ball bears a deep lozenge-shaped fossa of the interarticular ligament. The *linea aspera* is heavy and above the arterial foramen becomes the gluteal ridge, the width of which is accentuated by the flangelike projection on the anterior border of the shaft. Above this ridge is the third or supernumerary trochanter. The sagittal diameter of the shaft is 24 millimeters and the transverse 34, which gives the platymeric index 70.6.

Specimen 4516; a short heavy femur with a length of 435 millimeters and a weight of 11 ounces. The upper portion is heavy and abnormal in several characters. The neck is short and the great trochanter heavy. These characters give the upper portion of the femur a wide, heavy appearance and the upper part of the head or ball rises scarcely a centimeter above the top of the great trochanter. The portion of the ball surrounding the fossa of the interarticular ligament is flattened and the fossa is small. On the internal side of the ball at its juncture with the neck there is a depression 12 millimeters in length and a millimeter wide. The digital fossa is deep, wide and filled with small tubercles. The cavity reaches down along the intertrochanteric ridge to the lesser trochanter. The shaft is not platymeric.

Specimen 4513; a large shaft, probably male, with a length of 470 millimeters and a weight of 11 ounces. It is noticeably platymeric and has an index of 63.1. Part of the great trochanter is broken and with it the upper part of the external border of the shaft. An elevation in the bone just where it is broken seems to indicate that a third trochanter had been broken off.

Tibiae. One of the peculiarities of the tibiae which is at once apparent to the most superficial observer is the transverse flattening of the tibial shaft which gives it a saberlike appearance. This anomaly is present in 75 per cent of the tibiae from Gerry and therefore must be regarded as a character normal to the race. The platycnemic tibiae are all those of adults, those of adolescents being less pronounced. The indexes taken from specimens range as follows:

Number	Length	Diameters	Index
4540	broken	20 –39	51.3
4700	broken	19 –34	55.8
4546	broken	23 –39	56.4
4536 B	390	21.5–38	56.6
4536 A	381	21.5–38	56.6
4538	402	23 –38	60.5
4541	376	22 –36	61.1
4542	355	22 –36	61.1
4544	367	22 –35	62.09
4543	398	25 –38	68.4
4547	336	24 –33	72.7
4545	365	24 –33	72.7

Humeri. An examination of the humeri from the Gerry site revealed a percentage of 40 with the perforated olecranon cavity. In the Edson-Reed donation from the Dennison site are 19 humeri, 12 perforated and 7 nonperforated. This gives a percentage of 58.3 perforated. The tibiae from the site are greatly flattened, some giving an index of 18mm–35mm = 51.7. That the perforations are natural and not due to a decay of the septum is patent from a microscopical examination of the edges of the perforations where the external osseous surface appears unbroken. In some of the nonperforated specimens the osseous septum is of tissue thinness and is translucent when held to the light. Where one of these has become broken the fracture line is radically different from the border of natural perforation. Some superficial investigators have endeavored to explain these perforations by the disappearance of the septum by decay, but even a hasty examination fails to justify this assumption.

Artifacts. Pottery. The specimens of pottery secured in the Cassadaga valley consist entirely of fragments. Several crushed pots, however, may be restored. In thickness this pottery is less than that from the shore of Lake Erie. It is mostly tempered with pulverized shell and is comparatively light in weight. The incised designs are few and simple in character and are of the early Iroquoian style. Nearly all the specimens were found in ash pits, although a few fragments were found in a grave filling.

Plate 45

Platymeric femora. The third trochanter is especially noticeable in the hird and fourth specimens.

Plate 46

Platycnemic tibiae from the McCullough site. The fourth tibia has an index of 54.

Plate 47

Perforated humeri from the McCullough site, Gerry, N. Y.

Plate 48

Humeri from the Dennison site. All but the last two have the olecranon fossa perforated.

Stone objects. Articles of stone were not numerous and at the Gerry site only three celts were found and these outside the inclosure on the higher ground.

No hammer stones or anvils were found but arrow chippings and triangular flint points were fairly numerous.

Bone objects. No bone implement or object of any description was found in the village site and the only bone object found whatever was the heron bill near the forehead of the male skeleton in grave 6.

Sites examined

A list of the earthworks and village sites examined in Chautauqua and Cattaraugus counties follows. From two to five days or more were spent in the examination of each in order to determine their character and the culture represented.

1 An earthwork situated on a bluff at the confluence of a small brook with Mill creek is described by the old inhabitants as a circular work with a deep depression in the center. This is situated on the Margaret Harris farm. No part of the earth wall remains although the excavation in the center is yet visible. It however seems natural rather than artificial. Few traces of occupation could be discovered although several days were spent in testing and excavating. Some flints and fire-cracked stones were strewn on the bank above Mill creek, but there were no pits or pottery.

This work is mentioned in State Museum bulletin 32, *Aboriginal Occupation of New York,* as no. 24 in Chautauqua county.

2 There was an extensive earthwork and village site in the heart of the village of Sinclairville. Cheney's plan and description are erroneous. The site was examined and a map made from an actual survey by Hon. Obed Edson of Sinclairville. This earthwork belongs to the prehistoric Huron-Iroquois, and triangular points and pottery are found each year as the lawns are graded and gardens tilled.

3 **The Edmunds site.** An interesting camp site, discovered on Pine hill is situated on the Edmund's farm in the town of Charlotte. 27 pits were opened here and a quantity of pottery found. Two crushed pots were found in pits on the nose of a sandy projection that ran out from Pine hill into the valley of Edmund's brook. One large pit had a stoned floor and was walled with slabs of shale. This was evidently a cache or storage cellar. The Edmund's site is about one mile from Cassadaga creek and is situated between the Dunkirk, Allegany Valley & Pittsburgh track

and the Dunkirk road. At the foot of the hill just above the little flat washed out by the brook a large ash bed was discovered. This ash bed is 27′ by 47′ in dimensions and 36″ deep. It was filled with carbonized material and disintegrated sandstone and drift boulders. Several of these large ash beds were examined in the locality but nothing which would give a clue as to their purpose could be discovered.

4 The Dennison site in the township of Gerry lies about a quarter of a mile from the Charlotte township line. It is crossed by the old Chautauqua road, but now may only be traced by careful examination. This work was explored and partially excavated in 1887 by Hon. Obed Edson of Sinclairville who donated to the museum some of the human remains which he had taken from a large ossuary here. The site is of the early Iroquoian type and no occupied soil could be discovered.

5 A site on which a group of 12 pits are still visible is situated on the Sears farm near the site previously described. Nothing could be discovered in the pits although all were excavated.

6 The McCullough site on Gerry hill has already been described at length.

7 A glacial kame near Cassadra lake has a row of pits across the top. These were opened, but nothing except a few kernels of charred corn, a few flint chips and fire-broken stones remains to tell of their Indian origin.

8, 9, 10 Three places near Cassadaga lake were examined. All were old sites of early Iroquois culture.

11 At the head of Cassadaga lake upon the dividing ridge of the watershed a small camp site was discovered.

12 An interesting ash bed situated on the H. Carlson farm in lot 46, Gerry, was examined. This bed is upon a little promontory that juts out into the valley of a small stream sometimes called Phelps pasture brook and is easily discovered by the low mound of black earth which rises a foot or two above the surrounding surface.

The bed is 40′ by 45′ in dimensions and 4′ deep. It is composed of a light sandy soil intermixed and colored black by large quantities of pulverized carbonaceous material. Large numbers of sandstone blocks and granite boulders cracked and crumbling are distributed through the mass. A large white pine stump 4½ feet in diameter crowns the bed so that the work is plainly not that of white people. Numbers of these ash heaps are found throughout the county and form a problem yet to be solved.

13 One of the largest earthworks in Chautauqua county was situated on the old Partridge-Harris farm in the village of Gerry. The wall of this work has been plowed down but originally inclosed an area of about six acres. Excavations here revealed deep disturbances, but none of the pits contained bone objects nor pottery in any quantity. Hammerstones, celts, potsherds, arrowheads and a pipe stem were found in the occupied layer.

14 Some most interesting sites are to be found in the valley of Clear creek in the township of Ellington. The "Old Fort" in Ellington village is one of the most notable in Chautauqua county. Several days were spent here examining the inclosure for pits and burials. Several large ash pits were opened and a quantity of pottery and a dozen arrow points, triangular type, were found. The culture is early Iroquoian and prehistoric.

The earthwork is oval in form with a gate at the eastern end. It is situated upon a steep hill which runs out into the valley and as a strategic position is almost ideal. An examination of the map herewith presented demonstrates this fact.

15 The Boyd site is situated near the line of lots 47 and 39 in Ellington and is found upon a level plateau which forms the edge of a stream-cut terrace just above the valley of Clear creek. This fort was described by T. A. Cheney in the 5th Annual Report of the State Museum, but his survey does not appear entirely accurate.

No deep pits were found here and the occupied layer was thin. Culture: Early Iroquoian, prehistoric.

16 Opposite this site upon the terrace on the opposite side of the valley, 1700 feet distant, is another earthwork. This work, however, is a circular one. Excavation revealed that it was of the early Iroquoian culture with triangular arrow points and early pottery. No long occupation.

17 A circular fort in the town of Clear Creek had a large central pit but was not available for excavation.

18 Between the "Old Fort" and Ellington and the Clear Creek fort is a glacial kame which contains what appear to be old burials. Here notched and shouldered points and a gorget were found.

19 Several small camp sites were visited and examined in Conewango in Cattaraugus county.

20 A site on the Marshall farm in Sherman.

21 A mound at Findley lake on the Hill farm.

22 Large pits in numbers at the head of Findley lake.

23 Pits in Kennedy near the Randolph town line.

24 A large mound on the Cheney farm in Poland.

25 Two mound sites at Falconer.

26 An old burial site in Victoria on Chautauqua lake.

27 Two mounds at Vandalia, at the confluence of Chipmunk creek and the Allegany river.

28 The sites of the mounds at the mouth of Olean creek.

29 Mound on the Sunfish property in Great Valley.

30 Earthwork site at Point Peter on Cattaraugus creek.

31 Village site in Elko.

32 Burial site at Old Town in Elko.

33 Village site at Onoville on the Allegany.

34 Village site on the banks of Clear creek in Erie county.

35 Earthwork on Zoar hill in Otto.

36 Earthwork on the McNeil farm in Westfield.

37 Village and burial site on Chautauqua creek, Westfield.

38 Two fort sites on the Almey farm in Gerry.

39 Earth ring site and occupied kame 40 rods distant from 38.

40 Site at High Banks near Irving.

41 Silverheel's site on the Cattaraugus reservation. Probably early Seneca.

Excavations conducted here by the owner of the property yielded some interesting specimens of entire pottery and bone objects. These objects will be acquired for the State Museum.

The results of the examination of the foregoing sites are reserved for fuller description. Two important facts may here be stated with propriety.

1st, That the Senecas occupied western New York west of the Genesee, having fixed villages long before the Revolutionary War. The date of these sites may be fixed shortly after 1656. This fact is supported alone by the testimony of archeology and the evidence is too overwhelming to be disputed.

2d, That the Senecas in western New York, west of the Genesee, made pottery and flints at the same time when they used European articles extensively. Iron, glass, broken china ware, flint chips, broken pottery and bone implements have all been found in the same pits.

Notable accessions

Wampums. A wampum belt 22 inches long and 8 rows wide was purchased from W. C. Hill of New York city. The design consists of six diagonal bars of white beads, three bars on each side of a central cross, the arms of which radiate from a central square composed of eight white beads. The beads are strung on a vegetable twine, probably hemp.

The belt is said to have come from Oldtown, Maine, where it had been held by the Penobscot Indians. It is said to be of Iroquois manufacture and to be a " condolence belt." It is a command and summons to a condolence council at Onondaga, represented by the central cross.

A wristband of modern stringing is another wampum piece of interest. It is said to have been an old Mohawk wristband which has been restrung to preserve the design, the original warp having decayed and become broken.

The Archeologist secured on the reservations several ceremonial wampum strings of considerable interest. One is a string of purple beads hung from a streamer of black ribbon in five strands of thirty-two beads each. At the end of each string is a small piece of deer-skin. This wampum is said to have been a Seneca condolence string, that is a string used in the ceremony of a mourning council. Another string of purple wampum divided in two strands is represented as the " death horns." It was held by a sachem until his death when it was passed to his successor in office as a symbol of name and office.

A string of mixed purple and white beads arranged in two strands is a " name." One strand consists of beads arranged as follows: 2 purple, 1 white, 2 purple, 1 white, 2 purple, 2 white, 4 blocks the same, then 5 purple, 2 white, ending with 1 purple bead held on the string by a small knot of yellow ribbon. The other strand consists of bars of 4 purple beads with a white bead interposed between. A faded purple ribbon holds the beads on the linen string.

A " runner's " or messenger's summons composed of 50 purple beads strung on gut and tied to a notched stick is a condolence council call. There are four notches on the stick which mean that four days' time is given in which to appear at the council.

A Canadian string of mixed disk wampum and colored beads forms an interesting mate of the disk string secured in 1898 by Mrs H. M. Converse. The string is strung on heavy cotton thread and there are knots of colored ribbon tied at intervals. Mr M. R. Harrington who secured this piece says that it is the last Tutelo name string and obtained with great difficulty. The Tutelos are an adopted captive tribe originally of Siouxan culture.

Silver ornaments. The Archeologist secured nearly a hundred silver brooches of various sizes from the Allegany Senecas. These brooches are of various sizes and forms and furnish a valuable addition to the State collection.

A collection of 19 large silver disks ranging from 6 inches in diameter down to 2 inches was included in the Hill collection. These disks are represented as Algonquin ornaments secured at Oldtown, Maine. In this collection were two silver crowns one of which is the largest in the State collection.

Some rare brooches were included in the M. R. Harrington collection. In this collection also was a pair of earrings very similar to those figured by Morgan in the early Museum reports.

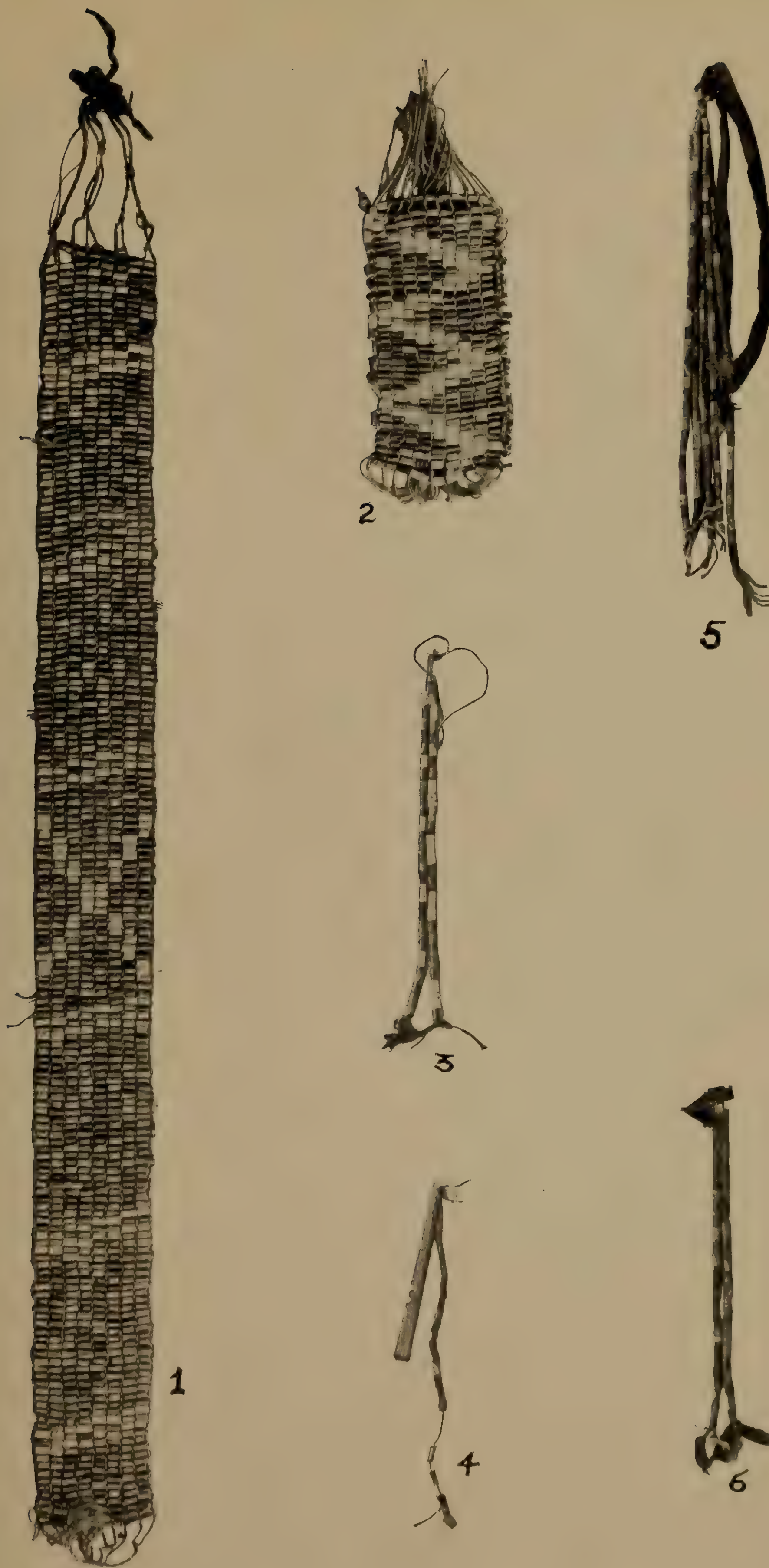
Several pairs of silver earrings of interesting form were purchased from the Indians by the Archeologist. Some of the specimens have glass gems in settings.

Possibly the most valuable ethnological acquisition was a set of Indian silversmith's tools, purchased from a brother of the last Allegany brooch maker, George Silversmith. The outfit consists of small iron and steel chisels, made by the silversmith himself. A massive blowpipe of brass, store hammers and files were included. The silver used for brooch making was obtained by beating Canadian silver coins to the desired thinness when the pattern was traced on and cut out with the chisels. A set of earring and ring punches form an important part of the outfit.

Several Indian made finger rings were also acquired and are the only specimens in the State collection.

Masonic emblem. One of the most interesting specimens of the white man's art found on an Indian site is a large Masonic emblem of copper found by Luke I. Fitch on an old Onondaga site near Pompey, Onondaga co. The square and compasses in the emblem are surrounded by a belt embossed with the roses of York and the Scottish thistles. Several Iroquois Indians late in the 18th century and early in the 19th were Free Masons, notably Brant and Red Jacket. Whether the emblem was worn by some Indian or by a white man is not known, but the probabilities are that it was lost by some colonial soldier or agent sent among the Onondagas.

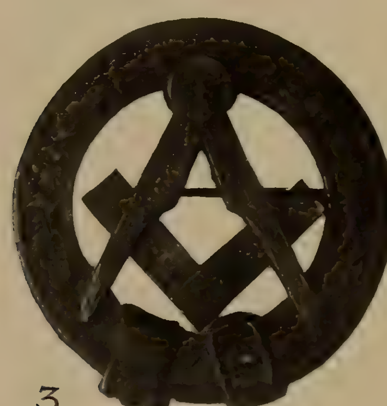
Several Masonic brooches of Indian make are in the museum collection of Iroquois silver work.



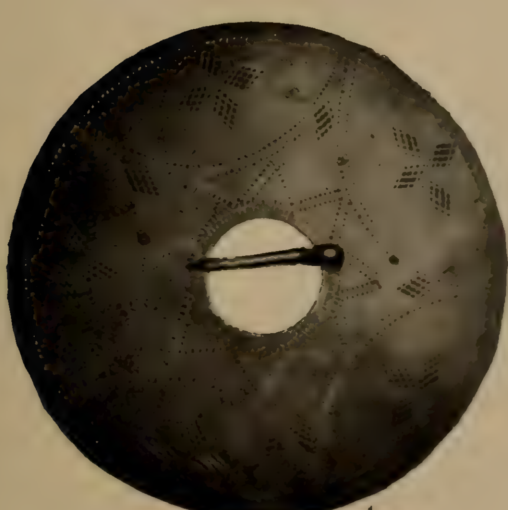
Wampum articles acquired during 1907
1 Council belt. 2 Wrist band. 3 Name string. 4 Messenger's summons.
5 Condolence wampum. 6 Chief's horns

1

2



3



4

5

Metallic ornaments acquired during 1907
1 Silver head band. 2 Silver brooch. Pattern conventionalized from Masonic emblem. 3 Masonic emblem in copper from village site near Pompey. 4 Algonquin disk brooch in silver. 5 Seneca brooch in silver.

VII

A STATE HISTORICAL MUSEUM

Section 22 of the University Law as amended to 1904 reads in part as follows:

State Museum: how constituted. All scientific specimens and collections, works of art, objects of historic interest and similar property appropriate to a general museum, if owned by the State and not placed in other custody by a specific law, shall constitute the State Museum.

The State of New York has made provision for the acquisition and preservation of historical records but these only in the form of documents, written or printed, of which the State Library has now become a vast treasure-house. The Bureau of Military Statistics pertaining to the department of the Adjutant General has brought together by voluntary cooperation an extensive store of military relics, in very large part memorials of the Civil War; the State Historian is authorized by law to "collect, collate, compile, edit and prepare for publication all official records, memoranda and data relative to the Colonial Wars, War of the Revolution, War of Eighteen Hundred and Twelve, Mexican War and War of the Rebellion, together with all official records, memoranda and statistics affecting the relations between this commonwealth and foreign powers, between this State and other States and between this State and the United States." He is not empowered to acquire other historical materials than the data above referred to, nor has he authority of law or appropriations to acquire historical "objects" as distinguished from records, memoranda and documents. There is thus no department of the State which has adequate authority, breadth of scope and available funds for acquiring and conserving "objects" of historical importance, in distinction from historical "documents," except the Education Department through the agency of the State Museum.

Importance of a State historical museum

Throughout the history of the commonwealth no systematic effort has ever been made on the part of the State to conserve the relics of its history. In the early career of the State Museum a good many objects pertaining to the early culture of the community came into its possession, but in the development of the museum, materials regarded as of more purely scientific character were considered as the proper field of the institution and its activities in acquisition were restricted to that scope. The sphere of its functions is now broadened by the University law above cited.

The State has shown an appreciative spirit and most laudable activity in the acquisition or protection of places with historic associations. With or without volunteer private cooperation, it has taken over historic property, marked with commemorative monuments sites of momentous and critical events in its history, raised imposing memorials on its battlefields and statutes to some of its distinguished sons. The spirit which has inspired these results has been born and nursed into expression by a multitude of patriotic societies, some of general, others of more local scope. But further than this in the conservation of its historical materials the State has not gone. It has left wholly to local civic associations the conservation of the relics of its history. There is scarcely an intelligent community in the State which has not an historical society engaged not merely in retelling the often half remembered story of local events but conserving the materials associated with the early stages of its progress and the personal careers of its distinguished citizens.

It would be impossible to estimate the value of the collections of these societies to the student of New York history and the edification, satisfaction and pride with which these are contemplated by the citizens of this State. But these results have been achieved alone by private organizations moved by the same proper spirit which may justly require of the State that it conserve the monuments of its own cultures.

If there is ever to be a State Historical Museum certainly it is time to inaugurate it and if the effort is made it should be made persistently, with a clearly defined purpose in view. Time is passing. New York has behind it 300 years of successive cultures and back of that the cultures of the aborigines. It is no longer easy to acquire the relics of these cultures. In another generation they will all have passed into the possession of public or private museums.

It is with the relics of the different settlements rather than with its critical events that an historical museum should concern itself. Such collections of historical objects should depict in the truest and most realistic fashion the modes and means of living in each successive phase of culture, should reproduce by proper association a faithful picture of domestic life and habitudes. The educational value of such demonstrative collections would be of high quality and an essential supplement to the training of the schools.

New York need not, because of its relative youth, invite the difficulties which have confronted other countries with longer histories, in the formation of historical museums. The making of such collections has always been too long deferred. But New York may well follow the example and hope for the results which other nations have achieved in this direction, for in all the countries of Europe are no collections of whatever character of so general interest and instructiveness to the public as the Historical Museums such as those of Amsterdam, Hamburg, Berlin, Nuremberg, Zürich and Basel.

Plan for a State historical museum

There is a vast difference between a miscellaneous assortment of historical objects, each out of its proper association with only its individual story to tell or its personal associations to invite attention, and an historical museum scientifically arranged with its objects all brought into their proper historic perspective. There are thousands of valuable historic relics in local collections of the State, which must by the very nature of the conditions under which they are brought together be left to tell their story as best they can by themselves. There is but one method however in which such objects can be made adequately to present their full signficance and that is the method of proper association. As an outline of what a State historical collection might be the following suggestions are made.

In general, a portrayal of the successive or contemporaneous cultures in this State by a reproduction of the mode of life and dress in the various phases of our civilization. For such purposes a series of rooms assigned to the various cultures would display

1 The domestic life of the aborigines: an Indian lodge appropriately equipped with the daily utensils of the aborigines, the squaw at the hand-mill; the potter molding clay vessels and pipes, the brooch maker and the arrow maker with their equipments. It would be vastly to the credit of a State like New York, the home of the Iroquois Confederacy, the earliest and mightiest of all aboriginal leagues, the seat of momentous events in Indian and frontier history, the founder and supporter of the State Museum which is the possessor of priceless and unexampled collections of Iroquois culture relics and the official custodian of the archives of the Six Nations, to go still further into the realistic portrayal of Indian life

and customs by the reproduction of certain important ceremonials and councils of which there remain today but stories on printed pages. New York could afford to keep this romantic period of its history before the eye and transmit it in reasonable fulness and force to posterity.

2 The domestic life of the Dutch culture, represented by one or two rooms, say a living room and kitchen equipped with the utensils and materials appropriate to the period of the Dutch settlement.

3 Some portrayal of the German culture of the upper Hudson, Schoharie and Mohawk valleys — a culture which though transient left a recognizable impress on the community. Also of the Huguenot settlements in Ulster county and the lower Hudson valley.

4 Rooms equipped with the furnishings of the English colonial revolutionary period before the invasion of the French influence.

5 An adequate representation of life on the frontier of Central Western New York before the extinction of the Indian land titles and the Massachusetts claims.

Such a carefully coordinated collection would naturally be supplemented by other materials which could not be placed in such associations but would help to complete the portrayal of past cultures.

In the geological department of the State Museum an earnest effort is being made to bring together materials which will demonstrate the historical development and present working of such industries as depend upon the natural mineral resources of the State. In this undertaking a willing and appreciative cooperation with the producers of the State has been elicited. With the very best reason the State Museum may hope for an equally zealous cooperation of the citizens in the formation of an historical collection.

There are still to be had from the descendants of the older families of this State many historical relics; few are treasured, more are not. Some are merely harbored for their associations, many are lying in garrets and barns. An appeal to the patriotic instinct coupled with an assurance that such relics if placed in the State's custody will not only never be deprived of their personal associations, but be placed in their proper surroundings, should not fail to be effective.

It is submitted that such an historical collection as is here outlined for New York should exist and that the acquisition of such materials by the State should not be delayed. There is no historical collection in America arranged on such a basis as here suggested.

VIII

PUBLICATIONS

A list of the scientific publications issued during the year 1906–7 with those now in press and treatises ready for printing is attached hereto. The publications issued are 14 in number on a variety of topics covering the whole range of our scientific activity. They embrace 2472 pages of text, 213 plates and 38 maps (3 colored).

The labor of preparing this matter, verifying, editing and correcting is onerous and exacting. Taken altogether it excellently indicates the activity and diligence of the staff of this division.

Annual report

1 Third Report of the Director, State Geologist and Paleontologist for the fiscal year ending September 30, 1906. 186p.

Contents:

Memoirs

2 No. 8 Insects Affecting Park and Woodland Trees. By E. P. Felt. v.2, 548p. 22pl.

Contents:

3 No. 10 The Devonic Fishes of the New York Formations. By C. R. Eastman. 236p. 15pl.

Contents:

Bulletins

Geology

4 No. 106 Glacial Waters in the Lake Erie Basin. By H. L. Fairchild. 88p. 14pl. 9 maps.

Contents:

5 No. 107 Geological Papers. 388p. 56pl. 1 map.

Contents:

6 No. 111 Drumlins of Central Western New York. By H. L. Fairchild. 58p. 28pl. 19 maps.

Contents:

Contents:

7 No. 115 Geology of the Long Lake Quadrangle. By H. P. Cushing. 88p. 20pl. 1 map.

Contents:

8 No. 112 Mining and Quarry Industry of New York. 3d report. By D. H. Newland. 82p.

Contents:

Paleontology

9 No. 114 Geologic map of the Rochester and Ontario Beach Quadrangles. By C. A. Hartnagel. 38p. 1 map.

Contents:

Entomology

10 No. 109 White Marked Tussock Moth and Elm Leaf Beetle. By E. P. Felt. 34p. 8pl.

Contents:

11 No. 110 Report of the State Entomologist for the fiscal year ending September 30, 1906. 152p. 3pl.

Contents:

Botany

12 No. 116 Report of the State Botanist for the fiscal year ending September 30, 1906. 108p. 12pl.

Contents:

Archeology

13 No. 108 Aboriginal Place Names of New York. By W. M. Beauchamp. 336p.

Contents:

14 No. 113 Civil, Religious and Mourning Councils and Ceremonies of Adoption. By W. M. Beauchamp. 118p. 7pl.

Contents:

Geological maps

15 Rochester and Ontario Beach quadrangles

16 Long Lake quadrangle

IN PRESS

Memoirs

17 Early Devonic of Eastern North America
18 Graptolites of New York. Pt 2, Graptolites of the Higher Beds

Bulletins

Geology and paleontology

19 Later Glacial Waters in Central New York
20 Geology of the Geneva-Ovid quadrangles

Archeology

21 An Erie Indian Village and Burial Site

PREPARED

Maps of the following quadrangles showing rock geology

Cazenovia	Honeoye-Wayland	Phelps
Auburn	Theresa	Remsen
Morrisville		

IN PREPARATION

Maps of the following quadrangles showing rock geology

Caledonia	Moravia	Chittenango
Alexandria	Highlands	Genoa

Maps of the following quadrangles showing rock geology
Amsterdam-Broadalbin-Fonda-Gloversville
Rouse Point
Schuylerville

Paleontology

Monograph of the Devonic crinoids
Genera of the Paleozoic corals
Descriptions of Devonic plants

Entomology

Report of the State Entomologist for the fiscal year ending September 30, 1907

Botany

Annual Report of the State Botanist for the fiscal year ending September 30, 1907

IX

STAFF OF THE SCIENCE DIVISION AND STATE MUSEUM

The members of the staff, permanent and temporary, of this division as at present constituted are:

ADMINISTRATION

John M. Clarke, *Director*
Jacob Van Deloo, *Director's clerk*

GEOLOGY AND PALEONTOLOGY

John M. Clarke, *State Geologist and Paleontologist*
David H. Newland, *Assistant State Geologist*
Rudolf Ruedemann Ph.D., *Assistant State Paleontologist*
C. A. Hartnagel B.S., *Assistant in Economic Geology*
D. Dana Luther, *Field Geologist*
Herbert P. Whitlock, C.E., *Mineralogist*
George S. Barkentin, *Draftsman*
William S. Barkentin, *Lithographer*
Joseph Morje, *First clerk*
H. C. Wardell, *Preparator*
Anna M. Byrne, *Stenographer*
C. J. Robinson, *Clerk*
Martin Sheehy, *Machinist*

Temporary assistants

Precambric geology

Prof. H. P. Cushing, Adelbert College
Dr C. P. Berkey, Columbia University

Stratigraphic geology

Prof. T. C. Hopkins, Syracuse University
H. O. Whitnall, Colgate University
G. H. Hudson, Plattsburg State Normal School
Prof. W. J. Miller, Hamilton College

Geographic geology

Prof. Herman L. Fairchild, Rochester University
Prof. J. B. Woodworth, Harvard University
Prof. A. P. Brigham, Colgate University

Paleontology

Dr C. R. Eastman, Harvard University
David White, United States Geological Survey
Dr T. Wayland Vaughan, United States Geological Survey
Edwin Kirk, Columbia University

BOTANY

Charles H. Peck M.A., *State Botanist*
Stewart H. Burnham, *Assistant,* Glens Falls

ENTOMOLOGY

Ephriam P. Felt B.S. D.Sc., *State Entomologist*
D. B. Young, *Assistant State Entomologist*
I. L. Nixon, *Assistant*
Anna M. Tolhurst, *Stenographer*
J. Shafer Bartlett, *Page*

Temporary assistants

Dr James G. Needham, Lake Forest College
Cornelius Betten, Lake Forest College
John R. Gillett, Albany

ZOOLOGY

George H. Chadwick, *Zoologist*
George L. Richards, *Taxidermist*

Temporary assistants

E. Howard Eaton, Canandaigua
Dr E. J. Letson, Buffalo

ARCHEOLOGY

Arthur C. Parker, *Archeologist*

Maintenance. The provision made by the Legislature of 1907 for the maintenance of the scientific work in all its branches and for the payment of all permanent and temporary services was $46,840.

X

ACCESSIONS

ECONOMIC GEOLOGY

Donation

Picton Island Red Granite Co. New York. Cubes (12") of red and pink granite, polished, from quarries on Picton Island, near Clayton 2

Ross, James. McCormick, S. C. Specimens of manganese ores from McCormick, S. C. 27

Warren, *Prof.* **C. H.** Boston, Mass. Specimens of titaniferous magnetite from Cumberland, R. I. 8

Collection

Assistant State Geologist. Iron ores and associated rocks, Minerva, Essex county 3

Iron ores and rocks, Port Leyden, Lewis county 6

Assistant in Economic Geology. Clinton hematite, Furnaceville Iron Ore Co., Ontario 6

Clinton hematite, Fair Haven Iron Co., Sterling Station 5

Specimens of shale showing fauna from layers directly above the Clinton ore at Sterling Station 50

Clinton hematite, specimens from iron bed directly above the Pentamerus limestone, Second creek, Sodus 5

Clinton hematite, from Mareness Cagwin farm, Verona 10

Clinton hematite, from Timothy Smith's farm, Verona 2

Clinton hematite, from James Wilson farm, (Klein ore bed) Verona .. 3

Clinton hematite (fossil ore from upper bed) E. W. Claus farm, Verona 10

Total 137

PALEONTOLOGY

Donation

Gillard, John. Stafford. Fossils from Stafford limestone, Stafford .. 250

Purchase

Breger, C. L. Ithaca. Fossil sponges from the Ithaca beds, Cornell Heights, Ithaca 40

Grebel, Wendler & Co. Geneva, Switzerland. *Eurypterus fischeri* 4

Series of graptolites 97

Krantz, *Dr* **F.** Bonn, Germany. Crustacea from various horizons and localities in Europe 98

Ward's Natural Science Establishment. Rochester. Trilobites from various formations in Europe 5

Olenellus thompsoni Hall. Lower Cambric, Swanton, Vt. . 4

Trilobites from various formations and localities in the United States and Europe 12

Collection

Assistant State Paleontologist. Lower Siluric and Siluric fossils from Lake Champlain, Black River and Mohawk regions 250

—— **& Cushing,** *Prof.* **H. P.** Lower Siluric fossils from Theresa quadrangle 200

Fossils, mostly from the Pamelia limestone in Jefferson county 45

Cushing, *Prof.* **H. P.** Lingula from the Potsdam (Beekmantown passage zone) of the Theresa quadrangle........ 24
Luther, D. D. Gomphoceras from concretion in Cashaqua shale........ 1
Wardell, H. C. Crustaceans from shaly layers in Shawangunk grit, Erie Railroad quarry, Otisville, Orange county........ 400
Fossils from Erie Railroad cut, western side of Pine hill near Highland Mills, Orange county........ 200
Fossils from the Onondaga and Stafford limestones near Leroy and Stafford, Genesee county........ 150

Total........ 1780

MINERALOGY

Donation

Carpenter, F. Silver and niccolite, Cobalt, Quebec, Can........ 1
Calcite (stalactitic), Camillus valley........ 1
Smith, J. A. Bisbee, Ariz. Gypsum, New Mexico........ 2
Dutcher, Louis, O. Albany. Pyrite, Colorado........ 6
Gilmore, Chas. M. Albany. Hypersthene, pyrites........ 1
Cameron, Thomas. Hermon. Calcite, Caledonia mine........ 1
Ross, J. McCormick, S. C. Psilomelane and barite, McCormick S. C........ 3
Hindshaw, H. H. New York. Cyanite, Chester, Mass........ 1
Calcite, Smith's Basin........ 1

Quartz,	Lyon Mountain	314
Quartz and asbestos	"	4
Quartz and hematite	"	3
Amphibole (hornblende)	"	24
Amphibole (hornblende) and asbestos	"	3
Hornblende, asbestos and calcite	"	1
Hornblende and orthoclase	"	1
Amphibole (asbestos)	"	1
Calcite	"	49
Apatite	"	19
Apatite in orthoclase	"	4
Magnetite	"	5
Magnetite in amphibole	"	3
Microcline	"	8
Microcline and quartz	"	1
Pyroxene	"	2
Pyroxene in microcline	"	1
Titanite	"	1
Epidote and stilbite	"	1
Epidote in microcline	"	1

Pruyn, *Mrs* **J. V. L.** Albany. Pyrite, Elba, Italy........ 7

Quartz	"	6
Hematite	"	26

Amphibole (asbestos), Corsica........ 2
Celestite and biotite in lava, Monte Somma, Italy........ 1
Epidote, Croce di Monde, Italy........ 1
Wollastonite and amphibole, Vesuvius crater, Italy........ 2
Vesuvianite and muscovite, Bosco Reale, Italy........ 1
Gypsum, Remita, Italy........ 1
Pyroxene in lava, Torre del Greco, Italy........ 1
Chrysolite in lava, vicinity of Vesuvius, Italy........ 1
Quartz, orthoclase and biotite, Sorrento, Italy........ 1
Chrysolite, Capo di Sebastiano, Italy........ 1
Volcanic rock, vicinity of Vesuvius, Italy........ 1
Limestone, vicinity of Vesuvius, Italy........ 1
Muscovite, Capo di Quaglia, Italy........ 1

Garnet, vesuvianite and anorthite, Capo di Quaglia, Italy	1
Biotite and chrysolite, vicinity of Vesuvius, Italy....................	1
Garnet and vesuvianite, Vesuvius, Italy	1
Gypsum, Monte Somma, Italy..	1
Epidote, Torre del Greco, Italy......................................	1
Chrysolite and quartz, Capo di Monte, Italy........................	1
Galena in limestone, Vesuvius, Italy..............................	1
Hematite (specular), Monte Somma, Italy..........................	2
Vesuvianite, garnet and anorthite, vicinity of Vesuvius, Italy.......	1
Vesuvianite and garnet, Vesuvius, Italy..............................	2
Chrysolite in lava, St Giorgio a Cremano, Italy......................	1
Vesuvianite and calcite, Vesuvius, Italy............................	1
Calcite, Vesuvius, Italy..	1
Vesuvianite and epidote, Vesuvius, Italy............................	1
Meionite, Vesuvius, Italy..	1
Muscovite and hematite, Vesuvius, Italy............................	1
Epidote and garnet, Vesuvius, Italy................................	1
Leucite in lava, Monte Somma, Italy................................	1
Wollastonite and amphibole, Vesuvius, Italy........................	2
Vesuvianite, Vesuvius, Italy..	1
Wollastonite and muscovite, Vesuvius, Italy.........................	1
Nephelite, Sebastiano, Italy..	1
Stilbite, Vesuvius, Italy..	1
Calcite (calcareous tufa), Vesuvius, Italy..........................	1
Leucite in lava, Monte Somma, Italy................................	1
Leucite in lava, Capo di Sebastiano................................	1
Amphibole in lava, Vesuvius, Italy.................................	1
Garnet and muscovite, Vesuvius, Italy..............................	1
Chrysolite and biotite, Vesuvius, Italy.............................	1
Leucite in lava, Torre del Greco, Italy.............................	1
Vesuvianite, Vesuvius, Italy..	2
Amphibole (hornblende), Vesuvius, Italy............................	1
Vesuvianite, Vesuvius, Italy..	1
Anorthite, Vesuvius, Italy..	1
Chrysolite and pyroxene, Sebastiano, Italy	1
Biotite and feldspar, Capo di Monte, Italy..........................	1
Garnet and muscovite, Vesuvius, Italy..............................	1
Chrysolite and muscovite, Vesuvius, Italy..........................	1
Sulphur, Vesuvius, Italy..	2
Sulphur in lava, Vesuvius, Italy....................................	2
Leucite (crystals), Capo di Sebastiano..............................	10
Sal ammoniac on lava, Vesuvius, Italy	1
Vesuvianite and muscovite, Vesuvius, Italy.........................	1
Nephelite and amphibole, Vesuvius, Italy...........................	1
Amphibole (tremolite), vicinity of Mont Blanc, Switzerland..........	1
Dolomite and pyrite " " "	1
Rhodochrosite " " "	1
Amphibole (bissolite) " " "	1
Epidote " " "	1
Galena and sphalerite " " "	1
Garnet " " "	2
Axinite " " "	1
Tourmalin " " "	1
Pyrite " " "	5
Fluorite " " "	1
Quartz " " "	2
Quartz (smoky) " " "	1
Serpentine " " "	1
Epidote " " "	1
Siderite " " "	1
Galena " " "	1
Realgar " " "	1
Calcite " " "	2

Malachite, vicinity of Mont Blanc, Switzerland			1
Staurolite and cyanite	"	"	1
Lapis Lazuli	"	"	1
Amphibole	"	"	1
Aragonite	"	"	1
Chalcopyrite	"	"	2
Molybdenite	"	"	1
Siderite	"	"	1
Azurite, Chessy, France			1

Purchase

Hodge, *Capt.* R. S. Antwerp. Millerite, Antwerp 18
Hematite, Antwerp 20
Ankerite " 19
Chalcodite " 25
Quartz " 8
Dolomite " 3
Goethite " 5
Calcite " 10
Newbury, J. O. Ripley. Garnet in gneiss, Ripley 1
Comptoir Min. et. Geol. Suiss. Geneva. Danburite, Piz Casanel, Spain 1
Krantz, F. Bonn, Germany. Calcite, Egremont, England 2
Barite and dolomite, Egremont, England 1
Calcite, Ith, Brunswick, Germany 1
Annabergite, Laurium, Greece 1
Apatite adularia and quartz, Rhone glacier, Switzerland 2
Aximite, Obira, Province of Bango, Japan 1
Hessite and gold, Botes, Transylvania 1
Opal (precious) pseu. after glauberite, White Cliffs, South Australia. 1
Beryl (aqua marine) Minas Geraes, Brazil 1
Liroconite, Wheal Garland, Cornwall 1
Wagnerite, Werfen Salzburg, Austria 1
Boracite, Hohenfels, Hanover, Germany 2
Halite with liquid inclusions, Hildesia, Hildesheim, Germany 1

Collection

Members of the Museum staff. Calcite, Sterlingbush .... 1000[1]
Assistant State Geologist. Amphibole (tremolite), Gouverneur 4
Assistant in Economic Geology. Calcite in limestone, Accord 1
Mineralogist. Zircon in orthoclase and quartz, Crown Point 49
Biotite in orthoclase and quartz " 8
Mica (altered) " 1
Quartz " 8
Pyroxene (large), Lead hill mine, Ticonderoga 2
Pyroxene and graphite " " 7
Wernerite " " 1
Zircon in microcline, Spar bed " 5
Muscovite in microcline " " 1
Tourmalin (large), Buck Mt pond, Ticonderoga 2
Tourmalin " " 8

[1] This number is estimated. The material is contained in packages (barrels and crates) and weighs 12 tons.

Amphibole (tremolite) Buck Mt pond, Ticonderoga	3
Serpentine in calcite " "	1
Amphibole altering to serpentine, Buck Mt pond, Ticonderoga	1
Calcite, Alsen	19
Calcite (large), Smith's Basin	1
Calcite " "	10
Calcite, Fort Miller	5
Quartz, Crystal rock, Lansingburg	33
Quartz, Glenmont	7
Amphibole (tremolite), Gouverneur	51
Amphibole " loose crystals, Gouverneur	30
Amphibole (actinolite), Gouverneur	5
Cushing, H. P. Cleveland, O. Corundum (crystals), Craigmont, Ontario, Can	4
Corundum in syenite, Craigmont, Ontario, Can	1
Wernerite in syenite " " "	1
Wernerite " " "	2
Nephelite altering to sodalite, Bancroft "	2
Total	2041

ENTOMOLOGY

Donation

Hymenoptera

Hilton, *Miss* Hazel C. Old Chatham. Sphex ichneumonea Linn., adult, Aug. 20

Brown, L. F. Cobleskill. Pelecinus polyturator Dru., adult, Sept. 5

Mitchell, *Miss* E. G. Washington, D. C. Andricus seminator Harr., wool sower, gall on oak, June 10; A. ?petiolicola Bass., oak leaf stalk gall, June 23, from East Orange, N. J.

Burnham, S. H. Albany. Andricus singularis Bass., oak leaf apple gall on oak, June 17; Rhodites bicolor Harr., spiny bullet gall on rose, June 17, from Shushan, N. Y..

Coleoptera

Bogue, Virgil. Albion. Xyleborus dispar Fabr., pear blight beetle, adult on peach, June 4

Pettis, C. R. Lake Clear Junction, N. Y. Lachnosterna ? fusca Froh., May beetle, larvae attacking roots of seedling pines, Aug. 19

Woodruff, E. S. Wawbeck. Lachnosterna ? fusca Froh., May beetle, larvae on roots of evergreens, Aug. 27

Peck, C. H. Albany. Plesiocis cribrum ? Casey, adult on Polyporus on spruce, May 21, from Woburn, Mass.

Pearsall, R. F. Brooklyn. Acoptus suturalis Lec.; Piazurus oculatus Say; Conotrachelus anaglypticus Say; Iphthimus opacus Lec.; Oncideres cingulata Say; Dorcus parallelus Say; Corymbites hamatus Say; Geopinus incrassatus Dej.; Dicaelus dilatatus Say; Notiophilus sibiricus Mots.; Calosoma externum Say; Carabus serratus Say, Jan. 21

Alexander, Charles P. Gloversville, has contributed a number of species, some extremely desirable, in return for numerous identifications.

Diptera

Alcott, D. W. East Greenbush. Olfersia americana Leach, adult on barred owl, Oct. 25

Clarke, *Miss* **C. H.** Boston, Mass. Agromyza (?) aeneiventris Fall., larvae, Nov. 11

Cockerell, T. D. A. Boulder, Col. Trypeta bigeloviae Ckll., galls, June 24, from Florissant, Col.

Joutel, L. H. New York. A number of Cecidomyiid galls

Thompson, *Dr* **M. T.,** lately deceased, formerly of Clark University, Worcester, Mass. A number of Cecidomyiidae, mostly bred species

Clarke, *Miss* **Cora H.** Boston, Mass. Cecidomyiid galls taken mostly in the vicinity of Magnolia, Mass., a few near Boston

Bryant, Owen. Cohasset, Mass. Numerous Cecidomyiidae

Mitchell, *Miss* **Evelyn G.** Washington, D. C. Cecidomyiid galls, mostly from the vicinity of Washington

Tucker, E. S. Plano, Texas. Cecidomyiidae from Kansas and Texas

Cockerell, *Prof.* **T. D. A.** Boulder, Col. Cecidomyiid galls and adults

Fletcher, *Dr* **James.** Central Experimental Farms, Ottawa, Can. Several Cecidomyiid galls

Jarvis, *Prof.* **T. D.** Ontario Agricultural College, Guelph, Ont. Numerous Cecidomyiid galls

Willing, T. N. Regina, Sask, N. W. T. A number of Cecidomyiid galls

Criddle, Norman. Treesbank, Manitoba, Can. A number of Cecidomyiid galls and bred adults

Howell, J. Highland Falls. Cecidomyia verrucicola O. S., linden leaf galls on linden or basswood, Nov. 14

Fisher, W. S. High Spire, Pa. Asphondylia conspicua O. S., galls and larvae on Rudbeckia laciniata, Aug. 18

Forbes, *Prof.* **S. A.** Urbana, Ill. Neocerata rhodophaga Coq., adult and larvae, Dec. 8

Stowell, E. Channing. Dublin, N. H. Taeniorhynchus perturbans Walk., adults, July 30; Eucorethra underwoodi Undw., larvae, Aug. 28

Marshall, D, T. Hollis, L. I. Culex pipiens Linn., house mosquito, adults, Sept. 23; Culicada sollicitans Walk., salt marsh mosquito, adults, Aug. 3

Pearsall, R. F. Brooklyn. Tipulidae, several species; Pediscia albivitta Walk.; Xylota vecors O. S., Jan. 21

Lepidoptera

Hill collection

This is an exceptionally valuable addition to the State collections, consisting of some 10,000 specimens, representing approximately 3500 species. It is in excellent condition and was donated by Erastus D. Hill, Carrie J. Hill Van Vleck and William W. Hill, heirs of the late William W. Hill of Albany. The catalogue of this collection is given in the Entomologist's report.

Booth, A. J. Manila, P. I. Attacus atlas Linn., adult, Sept. 17

Greene, F. J. Centre Berlin. Anisota rubicunda Fabr., green striped maple worm, on maple, Aug. 12; Heterocampa guttivitta Walk., on maple, Aug. 12

Hill, *Mrs* Alex. Hiland. Palenville. Epizeuxis denticulalis Harv., adult, July 31

Stearns, W. A. Centre Berlin. Heterocampa guttivitta Walk., larvae, on maple, Aug. 22

Chew, J. M. Newburgh. Ennomos subsignarius Hubn., snow-white linden moth, adults, Sep. 9

Bailey, *Dr* T. P. Albany. Leucobrephos brephoides Walk., adult, April, from St Lawrence county

Lackay, W. E. Rensselaer. Phobetrom pithecium Abb. & Sm., hag moth caterpillar, larvae on maple, Sept. 17.

Huested, S. B. Blauvelt. Zeuzera pyrina Fabr., leopard moth, on apple, Oct. 30

Alexander, C. P. Gloversville. Eucosma scudderiana Clem., larvae on solidago, Feb. 27

Eldridge, C. E. Leon. Ancylus nubeculana Clem., apple leaf folder, larvae on apple, Sept. 17

Knox, *Miss* A. A. New York city. Mompha brevivittella Clem. and M. eloisella Clem., adults on Oenothera grandiflora, Oct. 16

Pearsall, R. F. Brooklyn. Philopsia nivigerata Walk.; Euchoeca exhumata Pears cotype; Mesolueuca immanata Haw.; Petrophora fluctuata Linn.; Orthofidonia exornata Walk.; Sicya macularia Harr.; Therina endropiaria Walk.; Plagodis serinaria H-S; P. phlogosaria Guen., Jan. 21, from Indian Valley, Catskill Mts

Hemiptera

Barger, *Mrs* Milton. St Lawrence county. Phylloxera caryaecaulis Fitch, hickory gall aphid, galls on hickory, May 27

Hagen, C. W. Sparrowbush. Empoasca mali LeB., apple leaf hopper, adult on apple, July 1

Kidder, G. S. Port Henry. Myzus cerasi Fabr., cherry aphis, adults on cherry, July 12

Guyett, F. E. Rensselaer. Nectarophora pisi Kalt., pea aphid, adults on peas, July 13

Howe, C. D. Pisgah Forest, N. C. Chermes pinicorticis Fitch, pine bark aphis on pine, Apr. 30

Cockerell, *Prof.* **T. D. A.** Boulder, Col. Phoenacoccus marlatti Ckll., on date palm, Mar. 30, from Tempe, Arizona

Fletcher, *Dr* **James.** Central Experimental Farms, Ottawa, Can. Aspidiotus forbesi John., cherry scale, adults on basswood, Apr. 25

Wohlers, R. Williamsville. Aspidiotus ostreaeformis Curtis, European fruit scale, adults and young on plum, May 8

Courtney, N. J. Cornwall-on-Hudson. Aspidiotus perniciosus Comst., San José scale on apple, Apr. 15

Stone, D. D. Oswego. Aspidiotus perniciosus Comst., San José scale, adults on currant, May 30

Peck, C. H. Albany. Aulacaspis rosae Bouché, rose scale, adults and larvae on raspberry, Mar. 29

Hicks, Isaac & Son. Westbury Station. Chionaspis pinifoliae Fitch, pine leaf scale, eggs on pine, Nov. 9

Merritt, *Mrs* **Douglas.** Rhinebeck. Gossyparia spuria Mod., elm bark louse, females on elm, June 15

Orthoptera

Fairman, C. E. Lyndonville. Nyctobora holosericia Klug., giant cockroach, adult, July 1, from Albany

Mallophaga

Alcott, D. W. East Greenbush. Docophorus syrnii? Pack. adult on barred owl Oct. 25

Chadwick, G. H. Docophorus syrnii? Pack. on barred owl, Nov. 13; Haematopinus antennatus? Osb. on gray squirrel, Nov. 8; Lipeurus baculus Nitzsch on pigeon, Nov. 4; Lipeurus sp. on Gadwall duck, Nov. 4; Goniocotes compar Nitzsch on pigeon, Nov. 4; Trinoton luridum Nitzsch on Gadwall, Oct. 30; same, on duck, Nov. 8; same Burrow Golden eye

Corrodentia

Voelckel, Emil. Wakefield, New York city. Atropos divinatoria Fabr., book louse, adult, Oct. 30

Mairs, *Mrs* **Edwin H.** Irvington-on-Hudson. Psocus venosus Burm., adult on decayed vegetable matter, Aug. 24, from Washington, Conn.

Exchange

Diptera

Johnson, *Prof.* **C. W.** Boston, Mass. Neaspilota achilleae Johns., N. albidipennis Loew., N. vernoniae Loew., Trypeta palposa Loew., Stenomyia tenuis Loew., Chaetopsis apicalis Johns., Tetanops luridipennis Loew., Melieria obscuricornis Loew., Rivellia brevifasciata Johns., R. quadrifasciata Macq., Thelaira leucozona Panz., Paraprosena apicalis Desv., Echinomyia florum Walk., Opsidia gonioides Coq., Chaetoplagia atripennis Coq., Sturmia nigrita Town., Epigrymyia polita Town., Actia pilipennis Fall., Trichopoda plumipes Fabr., Alophora aeneoventris Will., Hydrophorus eldoradensis Wheeler, H. viridiflos Walk., Neurigona lateralis Say, Agonosoma unifasciatum Say (bicolor Loew.), Psilopodinus comatus Loew., Mallophora orcina Wied., Erax maculatus Macq. (lateralis Macq.), Laphria canis Will., L. sericea Say, Atomosia puella Wied., A. sayii Johns., Cerotainia macrocera Say, Nicocles pictus Loew., Deromyia platyptera Loew., Stichopogon argenteus Say, Holopogon guttula Wied., Holcocephala calva Loew., Lasiopogon terricola Johns., Cyrtopogon lutatius Walk., Psilocurus nudiusculus Loew., Laphystia sexfasciata Say, Leptogaster annulatus Say, L. pictipes Loew., Geron calvus Loew., G. sigma Coq., Systoechus solitus Walk., Anthrax ceyx Loew., A. edititia Say, A. lucifer Fabr., Exoprosopa eremita O. S., Tabanus fuscopunctatus Macq., T. recedens Walk., T. sparus Whitney, Chrysops nigrilimbo Whitney.

Melander, *Prof.* **A. L.** Pullman, Wash. Caenia spinosa Loew., Parydra quadrituberculata Loew., P. limpidipennis Loew., Hydrellia hypoleuca Loew., Paralimna appendiculata Loew., Tephritis variabilis Doane, T. finalis Loew., Ensina humilis Loew., Spilographa diffusa Snow, Sepedon armipes Loew., Tetanocera plumosa Loew., T. pallida Loew., Sciomyza pubera Loew., S. nana Fall., S. humilis Loew., Criorhina scitula Will., Xylota flavitibia Bigot, Eristalis temporalis Thom., E. occidentalis Will., E. bastardii Macq., Volucella esuriens Fabr., Mesogramma boscii Macq., Syrphus diversipes Macq., Platychirus chaetopodus Will., Chrysogaster stigmata Will., C. lata Loew., Chrysotoxum derivatum Walk.

Orthoptera

Britton, *Dr* **W. E.** New Haven, Conn. Spharagemon bolii Scud., S. saxatile Morse, Psinidia fenestralis Serv., Scirtetica marmorata Harr., Paroxya floridana Thom., Orphulella speciosa Scud., O. pelidna Burm.

ZOOLOGY

Donation

Mammals

Alexander, C. P. Gloversville. Say's bat, Myotis subulatus (Say). 1

Paine, J. A. Tarrytown. Deer mouse, Peromyscus leucopus noveboracensis (Fischer). 1

Wales, *Mrs* **L. J.** Kenoza Lake. Little brown bat, Myotis lucifugus (Le Conte). 2

Birds

Alexander, C. P. Gloversville. Winter wren, Anorthura hiemalis (Vieill.) 1
Saw-whet owl, Nyctala acadica (Gmel.) 1
Ashbury, L. O. Auburn. American hawk owl, Surnia ulula caparoch (Müll.) 1
Northern pileated woodpecker, Ceophloeus pileatus abieticola Bangs 1
Badger, Geo. B. Amityville. Turnstone, Arenaria interpres (Linn.) 1
Richard, Will. Cody, Wyoming. Northern phalarope, Phalaropus lobatus (Linn.) 3
Wilson's phalarope, Steganopus tricolor (Vieill.) 1
American avocet, Recurvirostra americana (Gmel.) 1
Western willet, Symphemia semipalmata inornata Brewst. 1
Townsend's solitaire, Myadestes townsendii (Aud.) 1
Rothaupt, Geo. Jerusalem, Albany co. English sparrow, passer domesticus (Linn.), albinistic specimen 1
Thayer, Gerald. Monadnock, N. H. European linnet, Acanthis cannabina (Linn.), taken at Scarboro, N. Y., in 1894; *first N. Y. State record* 1
Vroman, Wilson N. State Department of Agriculture. American goshawk, Accipiter atricapillus (Wils.) 1
Ward's Nat. Sci. Estab. Rochester. Ring-necked pheasant, Phasianus torquatus (Gmel.) 1
Whaley, Robert. Sterlingbush. Red-shouldered hawk, Buteo lineatus (Gmel.) 1

Reptiles and batrachians

Alexander, C. P. Gloversville. Ring-necked snake, Diadophis punctatus (Linn.) 1
Brown snake, Storeria occipitomaculata (Storer) 1
Red-backed salamander, Plethodon cinereus erythronotus (De Kay) 3
Striped-backed salamander, Spelerpes bilineatus (Green) 2
Dusky salamander, Desmognathus fuscus (Raf.) 3
Wood frog, Rana sylvatica (Le Conte) 1
Cook, John. Albany. Ring-necked snake, Diadophis punctatus (Linn.) 1
Young, D. B. Albany. Blue-spotted salamander, Plethodon glutinosus (Green)? 1

Fish

Higgins, T. F. Schenectady. Common gurnard, Prionotus carolinus (Linn.) 1

Arachnida

Alexander, C. P. Gloversville and Johnstown. Numerous sendings of spiders and mites, including many forms new to the collection, and some undescribed species. Not yet fully listed.

Beach, *Mrs* **Chas.** Catskill Mountain House. Spider, Epeira displicata (Hentz), yellow var........ 1
Chadwick, *Miss* **Nathalie.** Catskill. Spider, Steatoda borealis (Hentz) 1
Congdon, *Miss* **L. C.** Catskill. Grass spider, Agelena naevia (Walck) 1
Spider. Pardosa sp. 1
Cook, John. Albany. Crab spider, Xysticus sp........ 1
Dobbin, Frank. Shushan. Galls of Eriophyes on alder leaves...... 3
Duncan, George T. Rochester. Heteropoda venatoria (Linn.) and other spiders........ 7
Fletcher, *Dr* **James.** Ottawa, Canada. Gall of Eriophyes on Spiraea salicifolia, and spiders........ 5
Foster, *Miss* **Marion.** New Paltz. Galls of Eriophyes acericola (Garman)........ 2
Hall, C. K. East Schodack. Spider, Epeirastrix (Hentz)...... 1
Joutel, L. H. New York city. Galls of Eriophyes on ash and poplar.. 2
Little, *Miss* **E. W. C.** Menands. Triangle spider, Hyptiotes cavatus (Hentz) 1
Mirguet, John, and **Laird, James.** Rochester. Spiders and phalangids, not fully listed........ 17
Mitchell, *Miss.* East Orange, N. J. Galls of Eriophyes acericola (Garman) 3
Weeks, A. H. Jamaica, L. I. Two sendings of spiders, not fully listed. 15
Wilke, A. F. T.. Paterson. Golden-rod spider. Misumena aleatoria (Hentz)........ 1

Myriapoda and crustacea

Alexander, C. P. Gloversville. Several sendings not yet classified.
Chadwick, *Mrs* **C. S.** Catskill. Shrimps, Asellus communis

Mollusca

Alexander, C. P. Gloversville. Zonitoides arboreus (Say) 1
Polygyra albolabris (Say)........ 1
Polygyra palliata (Say)........ 1
Philomycus carolinensis (Bosc.)........ 1
Agriolimax campestris (Binney)........ 2
Succinea ovalis Say (obliqua)........ 2
Succinea ovalis tot teniana Lea........ 1
Limnaea desidiosa Say........ 1
Physa niagarensis (?) Lea........ 5
Aplexa hypnorum (Linn.)........ 1
Planorbis bicarinatus Say........ 2
Letson, *Dr* **E. J.** Buffalo Society of Natural Science. Polygyra tridentata (Say) 2
Polygyra albolabris (Say) 2
Polygyra thyroides (Say)........ 2
Polygyra palliata (Say)........ 2
Polygyra exoleta (Say)........ 2

Lampsilis ventricosus (Barnes)	1
Lampsilis luteolus (Lamk.)	2
Lampsilis ligamentinus (Lamk.)	1
Lampsilis alatus (Say)	2
Lampsilis gracilis (Barnes)	1
Obovaria ellipsis (Lea)	1
Strophitus edentulus (Say)	1
Symphynota compressa (Lea)	1
Symphynota costata (Raf.)	1
Alasmidonta calceolus (Lea)	2
Unio gibbosus Barnes	2
Quadrula undulata (Barnes)	1

Purchase

Birds

Ashbury, L. O. Auburn. Gyrfalcon, Falco rusticolus gyrfalco (Linn.) 1

Coale, H. K. Chicago. Black rail, Porzana jamaicensis (Gmel.) 2

Eaton, E. H. Rochester. Blue geese, Chen caerulescens (Linn.) 2

American egret, Ardea egretta (Gmel.) 1

Langille, *Rev* **J. H.** Kensington, Md. Yellow-billed tropic bird, Phaethon americanus (Grant) taken at Knowlesville, N. Y.; *first N. Y. State record* 1

Parker, Foster. Cayuga. Black-bellied plover, Squatarola squatarola (Linn.) 1

Turnstone, Arenaria interpres (Linn.) 1

Rose-breasted grosbeak, Zamelodia ludoviciana (Linn.) . 1

Van Valkenburgh, Edward. West Ghent. (per H. J. Richardson) Red-shouldered hawk, Buteo lineatus (Gmel.), albino 1

Ward's Natural Science Establishment. Rochester. Ivory gull. Pagophila alba (Gunn.) 1

Little gull, Larus mintus (Pall.) 1

Yellow-billed tropic bird, Phaethon americanus (Grant) . . . 1

Pintail, Dafila acuta (Linn.) 1

Rufous-crested duck, Netta rufina (Pall.) 1

White-winged scoter, Oidemia deglandi (Bonap.) 1

White-bellied brant, Branta bernicla glaucogastra (Brehm) 1

Red phalarope, Crymophilus fulicarius (Linn.) 1

Red-backed sandpiper, Tringa alpina pacifica (Coues.) . . 1

Passenger pigeon, Ectopistes migratorius (Linn.) 1

Red headed woodpecker, Melanerpes erythrocephalus (Linn.) 1

Webster Co., F. B. Hyde Park, Mass. Whooping crane, Grus americana (Linn.) 1

Gray kingbird, Tyrannus dominicensis (Gmel.) 1

Chestnut-collared longspur, Calcarius ornatus (Towns.) 1

Worthen, C. K. Warsaw, Ill. Pied-billed grebe, *Podilymbus podiceps* (Linn.) 2
Parasitic jaeger, *Stercorarius parasiticus* (Linn.).. 1
Sabine's gull, *Xema sabinii* (Sab.).......... 1
Royal tern, *Sterna maxima* (Bodd.).......... 1
Arctic tern, *Sterna paradisaea* (Brünn).......... 1
Black tern, *Hydrochelidon nigra surinamensis* (Gmel.).......... 1
Fulmar, *Fulmarus glacialis* (Linn.).......... 1
Sooty shearwater, *Puffinus fuliginosus* (Strickland)...... 1
Scaled petrel, *Aestrelata scalaris* (Brewst.).......... 1
Brown pelican, *Pelecanus fuscus* (Linn.).......... 1
Man-o'-war bird, *Fregata aquila* (Linn.).......... 1
Red-breasted merganser, *Merganser serrator* (Linn.).. 1
European widgeon, *Mareca penelope* (Linn.).......... 2
Cinnamon teal, *Querquedula cyanoptera* (Vieill.).... 1
Harlequin duck, *Histrionicus histrionicus* (Linn.).... 1
Brant, *Branta bernicla* (Linn.).......... 1
White ibis, *Guara alba* (Linn.).......... 1
Glossy ibis, *Plegadis autumnalis* (Hasselq.).......... 1
Snowy heron, *Ardea andidissima* Gmel.......... 1
Little blue heron, *Ardea caerulea* Linn.......... 2
Northern phalarope, *Phalaropus lobatus* (Linn.).......... 1
Dunlin, *Tringa alpina* (Linn.).......... 1
Red-backed sandpiper, *Tringa alpina pacifica* (Coues) 1
Semipalmated sandpiper, *Ereunetes pusillus* (Linn.).... 1
Western sandpiper, *Ereunetes occidentalis* (Lawr.)...... 1
Sanderling, *Calidris arenaria* (Linn.).......... 2
Greater yellow-legs, *Totanus melanoleucus* (Gmel.).. 1
Western willet, *Symphemia semipalmata inornata* (Brewst.).......... 1
Black-bellied plover, *Squatarola squatarola* (Linn.).. 1
Semipalmated plover, *Aegialitis semipalmata* (Bonap).. 1
Willow ptarmigan, *Lagopus lagopus* (Linn.).......... 1
Swallow-tailed kite, *Elanoides forficatus* (Linn.)..... 1
Sharp-shinned hawk, *Accipiter velox* (Wils.).......... 1
Sainson's hawk, *Buteo swainsoni* (Bonap.).......... 2
Northern hairy woodpecker, *Dryobates villosus leucomelas* (Bodd.).......... 1
Alder flycatcher, *Empidonax traillii alnorum* Brewst. 1
Starling, *Sturnus vulgaris* Linn.......... 1
Bullock's oriole, *Icterus bullocki* (Swains.).......... 1
European goldfinch, *Carduelis carduelis* (Linn.)...... 1
Sharp-tailed sparrow, *Ammodramus caudacutus* (Gmel.) 2
Nelson's sparrow, *Ammodramus nelsoni* (Allen)...... 2
Painted bunting, *Cyanospiza ciris* (Linn.).......... 1
Orange-crowned warbler, *Helminthophila celata* (Say) 2
Northern parula warbler, *Compsothlypis americana usneae* (Brewst.).......... 1
Cape May warbler, *Dendroica tigrina* (Gmel.).......... 1

Batrachia

Ward's Natural Science Establishment. Rochester. Hellbender, Cryptobranchus alleghenienis Daudin.......... 1

Fish

Duncan, George T. Rochester. Wall-eyed pike, Stizostedion vitreum (Mitch.) 1

Exchange

Tucker, E. S. Lawrence, Kan. Spiders.......................... 16

Collection

Mammals

Red squirrel, Sciurus hudsonicus loquax (Bangs).......... 2
White-footed mouse, Peromyscus leucopus noveboracensis (Fischer) 1
Meadow mouse, Microtus pennsylvanicus (Ord.)............ 1
Muskrat, Fiber zibethicus (Linn.) (with material for mounted nest) 1
Woodland jumping-mouse, Napaeozapus insignis (Miller)..... 1
Big brown bat, Vespertilio fuscus (Beauvois.)................ 1

Birds

Ring-billed gull, Larus delawarensis (Ord.).................. 1
Mallard, Anas boschas (Linn.).............................. 1
Black duck, Anas obscura (Gmel.).......................... 1
Red-legged black duck, Anas obscura rubripes............... 1
Gadwall, Chaulelasmus streperus (Linn.).................. 1
Green-winged teal, Nettion carolinensis (Gmel.).......... 2
Blue-winged teal, Querquedula discors (Linn.)............ 1
Pintail, Dafila acuta (Linn.)............................... 1
Lesser scaup duck, Aythya affinis (Eyt.).................... 2
American golden-eye, Clangula clangula americana (Faxon) 3
Barrow's golden-eye, Clangula islandica (Gmel.).......... 2
Old squaw, Harelda hyemalis (Linn.)...................... 1
American coot, Fulica americana (Gmel.).................. 1
American woodcock, Philohela minor (Gmel.).............. 1
Knot, Tringa canutus Linn.................................. 1
Least sandpiper, Tringa minutilla (Vieill.)................... 1
Semipalmated sandpiper, Ereunetes pusillus (Linn.)...... 1
Sanderling, Calidris arenaria (Linn.)........................ 1
Solitary sandpiper, Helodromas solitarius (Wils.)........ 2
Bartramian sandpiper, Bartramia longicauda (Bechst.)... 1
Spotted sandpiper, Actitis macularia (Linn.)................ 1
Black-bellied plover, Squatarola squatarola (Linn.)...... 3
American golden plover Charadrius dominicus (Müll.)...... 1
Semipalmated plover, Aegialitis semipalmata (Bonap.)...... 2
Turnstone, Arenaria interpres (Linn.)....................... 2

English pheasant, *Phasianus colchicus* (Linn.)	1
Sharp-shinned hawk, *Accipiter velox* (Wils.)	1
Yellow-bellied sapsucker, *Sphyrapicus varius* (Linn.)	1
Ruby-throated hummingbird, *Trochilus colubris* (Linn.)	1
Alder flycatcher, *Empidonax trailli alnorum* (Brewst.)	1
Least flycatcher, *Empidonax minimus* (Baird)	2
Meadowlark, *Sturnella magna* (Linn.)	1
Redpoll, *Acanthis linaria* (Linn.)	2
Greater redpoll, *Acanthis linaria rostrata* (Coues)	1
Savanna sparrow, *Ammodramus sandwichensis savanna* (Wils.)	1
Grasshopper sparrow, *Ammodramus savannarum passerinus* (Wils.)	1
Sharp-tailed sparrow, *Ammodramus caudacutus* (Gmel.)	2
Seaside sparrow, *Ammodramus maritimus* (Wils.)	1
White-throated sparrow, *Zonotrichia albicollis* (Gmel.)	3
Song sparrow, *Melospiza fasciata* (Gmel.)	1
Towhee, *Pipilo erythrophthalmus* (Linn.)	1
Scarlet tanager, *Piranga erythromelas* Vieill	1
Cedar waxwing, *Ampelis cedrorum* (Vieill.)	2
Nashville warbler, *Helminthophila rubricapilla* (Wils.)	1
Yellow warbler, *Dendroica aestiva* (Gmel.)	1
Myrtle warbler, *Dendroica coronata* (Linn.)	3
Magnolia warbler, *Dendroica maculosa* (Gmel.)	1
Black-throated green warbler, *Dendroica virens* (Gmel.)	1
Pine warbler, *Dendroica vigorsii* (Aud.)	1
Yellow palm warbler, *Dendroica palmarum hypochrysea* Ridgw.	1
Water-thrush, *Seiurus noveboracensis* (Gmel.)	1
Northern yellow-throat, *Geothlypis trichas brachydactyla* (Swain.)	2
Wilson's warbler, *Wilsonia pusilla* (Wils.)	1
Brown thrasher, *Harporhynchus rufus* (Linn.)	1
Winter wren, *Anorthura hiemalis* (Vieill.)	1
Golden-crowned kinglet, *Regulus satrapa* (Licht.)	3
Ruby-crowned kinglet, *Regulus calendula* (Linn.)	1

Reptiles and batrachians

Wood tortoise, *Chelopus insculptus* (Le Conte)	1
A number of salamanders not yet identified	

Invertebrates

Several hundred specimens of spiders, mites and mite-galls have been collected, with incidentally some myriapods, entomostraca and mollusca.

Total	323

ARCHEOLOGY

Donation

Hartnagel, C. A. Stone pipe stem from Union Springs
Cleveland, A. A. Triangular "bear's head" stone
Parker, A. C. String of condolence wampum
Edson, Obed & Reed, Richard. Parts of 5 skeletons

Purchase

Woodworth, A. R. Springboro, Pa. The following from Ithaca

35 arrow and spearheads
1 pestle
4 celts
1 pipe with 4 stem holes

Fitch, Luke I. Manlius

7 smooth perforated coins
1 Martin Van Buren token
1 penny of 1804
1 copper point
11 brass arrowheads
1 iron gun wormer
4 iron awls
1 lead spiral
3 small lead spirals
1 thimble
1 copper scrap
1 part of a hinge
2 lead seals
2 lead rings with knobs
14 Jesuit rings
1 Masonic brooch
6 "hawk" bells
7 iron knives
1 flint lock
1 bullet mold
1 gun wormer
1 pair shears
4 potsherds
2 awls
1 beaver tooth
1 chunk of antler
9 iron awls
1 pick, iron
5 thimbles
1 lead cylinder
4 copper points
2 brass jinglers
1 phalanx bone
2 bone fishhooks, fine specimens
2 jew's-harp handles
8 kaolin pipe bowls
2 iron hooks
7 string Indian trade beads
1 string of shell beads
1 wolf's tooth, perforated
1 elk's tooth, perforated
1 string of beads
1 bone pipe bowl
1 pendant
1 disk
1 string of beads
1 double-pointed awl, bone
1 knife or awl of bone
1 fish bone awl
3 perforated teeth
12 bone beads
2 wolf teeth
19 awls, bone

Hill, Walter C. New York

1 old Iroquois beaded cap used in 1847
1 set of 19 old Penobscot silver disks, Oldtown, Me.
2 Iroquois silver crowns
1 bark basket, Algonquin
1 wampum belt, called the condolence belt. Purple background and six bars of white, cross and square in the middle
1 game, platter dice; platter and 6 dice

Harrington, M. R. New York

1 false face. Onondaga
1 pack strap, Canadian type
1 drum and 3 sticks
1 large flute, cedar. Cayuga
1 bone necklace. Cayuga
1 gorget with shell string attached. Cayuga
1 pair deer hoof knee rattles
1 necklace of buckskin, etc.
1 knife sheath and knife. Cayuga
1 pair shoe packs. Cayuga
1 scraper for removing snow from clothing
1 string Tuteli adoption wampum
1 wooden bowl

ARTICLES FROM ST REGIS RESERVATION

1 woman's legging
1 fragment of legging, beaded
1 carved cradle board
1 bean or sugar bos, bark

ARTICLES FROM MUNCEYTOWN, ONT.

2 bark bowls
1 coiled basket
1 bark bag
1 bark spoon

ARTICLES FROM MORAVIANTOWN, ONT.

2 bowls
4 wooden spoons
1 pack strap
1 pudding stick
1 tomahawk fragment
5 brooches, silver
1 pair earrings
1 knife
8 baskets
1 wooden bowl
1 pack frame
1 splint cutter

Collection

20 skulls
40 femora
Parts of 65 skeletons from McCullough farm, Gerry
125 potsherds, in 2 boxes
50 arrow points
5 spears
2 celts
1 crushed pot
1 small celt
5 hammerstones
1 pipe stem
1 heron's bill, from grave
2 pottery vessels, crushed
1 bag pottery from central pit, Gerry
1 bag pottery from ash deposits
1 bag stone implements
2 celts
10 arrow points
1 pottery vessel
1 pipe
1 pestle
1 net sinker
2 gorgets from Cassadaga
1 bag flints
1 gorget, Irving

Purchase and collection in the field

1 wampum string, runner's announcement
1 pair baby moccasins
1 wampum string, condolence or "horns"
1 pair women's leggings
1 burden strap
40 silver brooches
2 ladles
1 paddle
1 Eagle dance rattle
1 Prayer-rattle
1 pair women's leggings
1 woman's dress, ceremonial
20 brooch maker's tools
1 large round brooch
23 square brooches, silver
1 ceremonial overdress
1 earring and pendant
1 silver and glass ear pendant
1 flute
1 Eagle dance headdress, heron feathers
2 deer skin gambling mats
1 buffalo skin ceremonial robe
1 turtle shell rattle
1 flute, Logan
1 blow pipe
1 corn seive basket

Total .... 722+

XI

Appendix A

NEW ENTRIES ON GENERAL RECORD OF LOCALITIES OF AMERICAN PALEOZOIC FOSSILS BELONGING TO STATE MUSEUM

Alphabetic list of localities

Brownsville (Jefferson co.), 3589
Buffalo (Erie co.), 3565
Chazy (Clinton co.), 3580, 3584
Clinton (Oneida co.), 3598, 3599
Crabb island (Clinton co.), 3586
Delhi (Delaware co.), 3557
East Canada creek (Fulton co.), 3587
Eskdale, New Brunswick, Can., 3563
Evans Mills (Jefferson co.), 3568, 3572, 3588, 3593, 3608, 3610, 3611
Griswold (Wyoming co.), 3560
Highland Mills (Orange co.), 3600, 3601, 3602
Indian river (Jefferson co.), 3610
Ingham Mills (Herkimer co.), 3594
Ithaca (Tompkins co.), 3556
La Fargeville (Jefferson co.), 3604, 3605, 3609
Lebanon, Ohio, 3567
Le Raysville (Jefferson co.), 3570, 3574, 3603
Lorraine gorge (Jefferson co.), 3596
Otisville (Orange co.), 3564
Perch lake (Jefferson co.), 3571, 3575
Plattsburgh (Clinton co.), 3576
Pulaski (Oswego co.), 3597
Sandy Hill (Saratoga co.), 3595
Sanfords Corners (Jefferson co.), 3588, 3590, 3591
Saratoga Springs (Saratoga co.), 3573
Sloop island (Clinton co.), 3586
Smith's Landing (Greene co.), 3561
Stafford (Genesee co.), 3559
Stone Mills (Jefferson co.), 3606, 3607
Swanton, Vt., 3562
Theresa (Jefferson co.), 3558, 3569, 3612
Valcour island (Clinton co.), 3579, 3581, 3585
Valcour (Clinton co.), 3578
Watertown (Jefferson co), 3582, 3583, 3592
Waterville (Oneida co.), 3366

New York localities according to counties

Names in italics are new to the record.

CLINTON CO.
Chazy
Crabb island
Plattsburg
Sloop island
Valcour
Valcour island

DELAWARE CO.
Delhi

ERIE CO.
Buffalo

GENESEE CO.
Stafford

GREENE CO.
Smith's Landing

HERKIMER CO.
East Canada creek
Ingham Mills

JEFFERSON CO.
Brownville
Evans Mills
Indian river
La Fargeville
Le Raysville
Lorraine
Lorraine gorge
Pamelia Four Corners
Perch lake
Sanfords Corners
Stone Mills
Theresa
Watertown

ONEIDA CO.
Clinton
Waterville

ORANGE CO.
Highland Mills
Otisville

OSWEGO CO.
Pulaski

SARATOGA CO.
Sandy Hill
Saratoga Springs

TOMPKINS CO.
Ithaca

WYOMING CO.
Griswold

Index to formations

Lower Cambric, 3562
Potsdam, 3610, 3612
Greenfield limestone, 3573
Fort Cassin beds, 3578

Record of new localities

3556 Ithaca beds. Cornell Heights, Ithaca. Abandoned quarry on the south side of the highway at the foot of the slope below the trolley loop; 270 feet above Spirifer laevis zone, 672 ft A. T. C. L. Breger purchase, 1906

3557 Oneonta sandstone. Delhi, Delaware co. H. J. Alden purchase 1906

3558 Potsdam. Beekmantown passage zone of the Theresa quadrangle. H. P. Cushing coll. 1907

3559 Stafford limestone. Stafford. John Gillard, donor, 1907

3560 Portage (Cashaqua shale). From concretion in Cashaqua shale in bank of Murder creek near Griswold, Wyoming co. D. D. Luther coll. 1906

3561 Lower Becraft (Scutella). Catskill Cement Co.'s quarry, Smith's Landing, Greene co. G. H. Chadwick, coll. and donor

3562 Lower Cambric. Swanton, Vt. Ward's Natural Science Establishment purchase

3563 Carbonic. Eskdale, New Brunswick, Can. F. Krantz purchase 1907

3564 Salina. Upper layers of Shawangunk grit along Erie Railroad, 2½ miles from Otisville toward Port Jervis. H. C. Wardell coll. 1907

3565 Bertie waterlime. Buffalo. Ward's Natural Science Establishment purchase 1907

3566 Bertie waterlime. Waterville. Ward's Natural Science Establishment purchase 1907

3567 Hudson river group. Lebanon, Ohio. Ward's Natural Science Establishment purchase 1907

3568 Potsdam (Beekmantown passage beds). Evans Mills, Jefferson co. H. P. Cushing & R. Ruedemann coll. 1907

3569 Potsdam (Beekmantown passage beds). Theresa, Jefferson co. H. P. Cushing & R. Ruedemann coll. 1907

3570 Theresa limestone. Le Raysville, Jefferson co. H. P. Cushing & R. Ruedemann coll. 1907

3571 Theresa limestone (top of). 1¼ mile east of Perch lake, Jefferson co. H. P. Cushing & R. Ruedemann coll. 1907

3572 Theresa limestone. Evans Mills, Jefferson co. H. P. Cushing & R. Ruedemann coll. 1907

3573 Greenfield limestone. Beeler quarry, Saratoga Springs. R. Ruedemann coll. 1907

3574 Pamelia limestone (near base). Le Raysville, Jefferson co. H. P. Cushing & R. Ruedemann coll. 1907

3575 Pamelia limestone. 1¼ mile east of Perch lake, Jefferson co. H. P. Cushing & R. Ruedemann coll. 1907

3576 Middle Chazy (base). 1 mile north of Plattsburgh. R. Ruedemann coll. 1907

3577 Middle Chazy. Sloop island, Lake Champlain. R. Ruedemann coll. 1907

3578 Fort Cassin beds. Valcour, Clinton co. R. Ruedemann coll. 1907

3579 Lower Chazy. South shore of Valcour island. R. Ruedemann coll. 1907

3580 Trenton (lower 50 ft). Below sawmill on Little Chazy river, Chazy. R. Ruedemann coll. 1907

3581 Upper Chazy (bottom of). Valcour island. R. Ruedemann coll. 1907

3582 Black river (cherty beds). Diamond island, Watertown. R. Ruedemann coll. 1907

3583 Black river (middle bed). Diamond island, Watertown. R. Ruedemann coll. 1907

3584 Black river (top). Jones's quarry, Chazy, Clinton co. R. Ruedemann coll. 1907

3585 Trenton (loose). Valcour island, Clinton co. R. Ruedemann coll. 1907

3586 Trenton. Crabb island, Clinton co. R. Ruedemann coll. 1907

3587 Trenton (upper third). East Canada creek, Fulton co. R. Ruedemann coll. 1907

3588 Lowville (upper). Between Evans Mills and Sanford's Corners, Jefferson co. H. P. Cushing & R. Ruedemann coll. 1907

3589 Lowville. 3½ miles north of Brownville, Jefferson co. H. P. Cushing & R. Ruedemann coll. 1907

3590 Lowville. Section along railroad and south of Sanford's Corners (bottom of cliff). H. P. Cushing & R. Ruedemann coll. 1907

3591 Lowville (near top). 1 mile south of Sanford's Corners, Jefferson co. H. P. Cushing & R. Ruedemann coll. 1907

3592 Lowville (upper). Quarry opposite filter plant, Watertown. H. P. Cushing & R. Ruedemann coll. 1907

3593 Lowville. Evans Mills, Jefferson co. H. P. Cushing & R. Ruedemann coll. 1907

3594 Lowville. Inghams Mills, Herkimer co. R. Ruedemann coll. 1907

3595 Utica shale (base). Sandy Hill, Saratoga co. R. Ruedemann coll. 1907

3596 Lorraine. Lorraine gorge, Lorraine, Jefferson co. R. Ruedemann coll. 1907

3597 Lorraine beds. Pulaski. R. Ruedemann coll. 1907

3598 Clinton shale (overlying upper iron ore bed). Clinton. R. Ruedemann coll. 1907

3599 Clinton shale (overlying lower iron bed). Clinton. R. Ruedemann coll. 1907

3600 Oriskany. Erie Railroad cut, Pine hill near Highland Mills, Orange co. H. C. Wardell coll. 1907
3601 Schoharie (upper layers). Erie Railroad cut, Pine hill near Highland Mills, Orange co. H. C. Wardell coll. 1907
3602 Schoharie. At edge of woods about 300 yards north of Erie Railroad cut at Pine hill near Highland Mills, Orange co. H. C Wardell coll. 1907
3603 Lowville (base). ½ mile northeast of Le Raysville, Jefferson co. H. P. Cushing coll. 1907
3604 Pamelia limestone (base). La Fargeville, Jefferson co. H. P. Cushing coll. 1907
3605 Pamelia limestone (base). ½ mile east of La Fargeville, Jefferson co. H. P. Cushing coll. 1907
3606 Pamelia limestone. 2 miles south of Stone Mills, Jefferson co. H. P. Cushing coll. 1907
3607 Pamelia limestone. 1 mile east of Stone Mills, Jefferson co. H. P. Cushing coll. 1907
3608 Pamelia limestone (base). Evans Mills, Jefferson co. H. P. Cushing coll. 1907
3609 Pamelia limestone. 2 miles southwest of La Fargeville, Jefferson co. H. P. Cushing coll. 1907
3610 Potsdam sandstone. Indian River 3 miles north of Evans Mills, Jefferson co. H. P. Cushing coll. 1907
3611 Pamelia limestone (base). ¼ mile south of Evans Mills, Jefferson co. H. P. Cushing coll. 1907
3612 Potsdam sandstone. 2 miles west of Theresa, Jefferson co. H. P. Cushing coll. 1907
3613 Pamelia limestone (base). 1 mile east of Perch lake, Jefferson co. coll. 1907
3614 Pamelia limestone (base). 1 mile northeast of Perch lake, Jefferson co. H. P. Cushing coll. 1907
3615 Pamelia limestone (base). 3 miles east of Perch lake, Jefferson co. coll. 1907
3616 Pamelia limestone. 1 mile east of Pamelia Four Corners, Jefferson co. H. P. Cushing coll. 1907
3617 Theresa limestone. 2 miles north of Perch lake, Jefferson co. H. P. Cushing coll. 1907
3618 Pamelia limestone (base). 1 mile east of Perch lake, Jefferson co. H. P. Cushing coll. 1907
3619 Pamelia limestone. 1 mile northeast of Evans Mills, Jefferson co. H. P. Cushing coll. 1907
3620 Theresa limestone. 2 miles northeast of Perch lake, Jefferson co. H. P. Cushing coll. 1907
3621 Pamelia limestone (base). 1 mile northwest of Perch lake, Jefferson co. H. P. Cushing coll. 1907
3622 Pamelia limestone (base). 2 miles northwest of Evans Mills, Jefferson co. H. P. Cushing coll. 1907
3623 Pamelia limestone (base). 2 miles east of Perch lake, Jefferson co. H. P. Cushing coll. 1907

3624 Pamelia limestone (base). 2½ miles north of Evans Mills, Jefferson co. H. P. Cushing coll. 1907

3625 Pamelia limestone. 1 mile west of Evans Mills, Jefferson co. H. P. Cushing coll. 1907

3626 Lowville limestone (base). 1 mile west of Le Raysville, Jefferson co. H. P. Cushing coll. 1907

Record of foreign localities

Specimens bearing lemon yellow tickets

255 Siluric. Lövenich, Rhenish Prussia. F. Krantz purchase

256 Lower Siluric. Königshof, Germany. Ward's Natural Science Establishment purchase

257 Cambric. Skrej, Bohemia. Ward's Natural Science Establishment purchase

258 Lower Siluric. Osek, Bohemia. Ward's Natural Science Establishment purchase

259 Siluric. Beraun, Bohemia. Grebel, Wendler & Co. purchase

260 Siluric. Gothland, Sweden. Grebel, Wendler & Co. purchase

261 Siluric. Dudley, England. Grebel, Wendler & Co. purchase

262 Devonic. Ferrones, Spain. Grebel, Wendler & Co. purchase

263 Siluric. Drabow, Bohemia. Grebel, Wendler & Co. purchase

264 Siluric. Rotziküll, Island of Oesel, Baltic sea. Grebel, Wendler & Co. purchase

265 Upper Siluric. Rotziküll, Island of Oesel, Baltic sea. F. Krantz purchase

266 Devonic. Forfarshire, Scotland. F. Krantz purchase

267 Siluric. Gera, Thuringia, Germany. Grebel, Wendler & Co. purchase

268 Siluric. Westmoreland, England. Grebel, Wendler & Co. purchase

269 Siluric. Skellgill Beck, Ambleside, England. Grebel, Wendler & Co. purchase

270 Siluric. Goni, Sardinia Island, Mediterranean sea. Grebel, Wendler & Co. purchase

271 Siluric. Vallongo, Portugal. Ward's Natural Science Establishment purchase

272 Lower Siluric. Isvos on the Walchow, Russia. Ward's Natural Science Establishment purchase

273 Lower Siluric. Angers, France. Ward's Natural Science Establishment purchase

274 Cambric. Andrarum, Sweden. Ward's Natural Science Establishment purchase

275 Lower Devonic. Eifel, Germany. Ward's Natural Science Establishment purchase

276 Lower Siluric. Hostin, Bohemia. Ward's Natural Science Establishment purchase

277 Lower Siluric. Étage D, d1 sta. Benigna, Bohemia. Ward's Natural Science Establishment purchase

278 Lower Siluric. Étage D, d5. Lejckov, Bohemnia. Ward's Natural Science Establishment purchase

279 Devonic. St German le Fouilloux, Mayenne, France. F. Krantz purchase
280 Devonic. Rhisnes, Belgium. F. Krantz purchase
281 Cambric (Shineton shales). Shropshire, England. F. Krantz purchase
282 Lower Siluric. Girvan, Scotland. F. Krantz purchase
283 Upper Siluric. Muirkirk, Scotland. F. Krantz purchase
284 Siluric. Naninne, Namur, Belgium. F. Krantz purchase
285 Lower Permic. Nürschan, Bohemia. F. Krantz purchase

THE BEGINNINGS OF DEPENDENT LIFE

BY JOHN M. CLARKE

For a number of years the writer has endeavored to assemble material from the older faunas which might illuminate the incipient expressions of dependent life. It is through this avenue only that the problem of the origin of the symbiotic conditions which now pervade all nature can ultimately be approached with hope of resolution.

The dependent condition of individual existence is one of the manifold presentments of organic adaptation which is to be comprehended best by comparison of the complicated conditions prevalent today with their simpler expressions in the early life of the earth. Adaptation is in large measure a sociological problem of immediate concern. It is not proper to consider the more serious features of sociological adaptation as merely analogous to organic adaptation. In human society dependence means simplicity, that is, loss of complexity; it reduces moral independence and induces idleness, beggary, misery and crime. Here is no question of analogy, but rather of continuity of mode, of cause and effect, penetrating human society. Such laws as govern its fundamental and primary manifestations are to be sought in the primitive life of the earth.

I am fully aware of what extensive data are essential to adequate conclusions in this inquiry and how far-reaching the bearings of the inquiry must be. At this time I should go no further perhaps than to point out some of the very numerous and most instructive expressions of these conditions which it has been practicable to bring together, abiding in the hope of eventually collating more copious data. I shall not go too far, however, in suggesting certain obvious inferences which seem entirely justified by these data and by the general principles of adaptation.

Dependent life, whether expressed in the often extraordinarily complicated conditions of parasitism, or in more simple symbiotic manifestations such as commensalism or mutualism or still more simply in the merely fixed condition of the individual through the whole or a part of its life, involves conditions of degeneration. These degenerative effects are relative; they may involve an individual in most of its essential organs and functions, a genus, a family or an entire class of organisms. Such effects may be restricted to only a part or certain parts of an organism and special degenerate organs are recognized throughout the higher forms of nature.

Degeneration follows adaptation. It may be primarily the result of special adaptation in the individual for its own protection producing no more than a condition of fixation. This is degeneracy in essence because it involves dependence. Discovered and perfected by the organism as helpful against its enemies or in the winning of food, it continues into atrophy of organs no longer needed; such atrophy once begun extends to other organs as the adaptation and dependence become more complete, till in the end all the organs in succession become involved in accordance with the lessened demand upon them; the alimentary, the locomotive, the sensory, all except those involving the function of reproduction. Nature is permeated with such degeneration. Few, probably no members of the whole vast fauna and flora of the earth are free of the bond of supporting others at the cost of their own effort and vitality. From the protozoa and bacteria to man and the oak every greater or less division of nature is riddled with these dependent organisms.

The path of evolution is specialization, chiefly by adaptation; only occasionally is evolution progress. The upward march of organic nature is before the eye, palpable, pleading and perspicacious, but degeneracy is largely unseen, impalpable, sequestered and ignored. Often though expressed openly, even throughout great natural divisions, it is not apprehended. Progress involves complication of structure; simplicity of structure too often means derivation by degeneration from the complex rather than initiation of upward advance.

The total result of degeneracy in nature and in human society presents itself to us as the outgrowth of a primitive miscarriage in the normal upward trend of nature which has grown in intensity with the passage of time till now it presents to the philosophic mind the appalling condition of a widespread downward impetus throughout the living world whose tendency is to undermine that which still stands upright. Degenerative tendencies in organic and in social life increase and intensify by their own impetus, like a stone rolling down hill. It has not been shown that there is in nature any power to redeem itself when degenerative adaptation has once begun, any hope of salvation within the organism or group of organisms, of turning back, recouping and starting again on the upward path. In the face of the counter evidence here set forth, the conclusion is unavoidable that, for a large part of humanity ethical philosophies are inefficient and illusive.

The lines of progress in organic life have steered wide of these dependent existences or have maintained their charted course in spite of them.

Great groups of organisms, classes, orders and subkingdoms have been so permeated by degeneracy of growth that their life, lasting, it may be, from almost the dawn of existence to the present, has had no other outcome than to perpetuate a depraved race. Such a race, however broad its boundaries and long its perdurance, has been entirely outside the general path of that upward advance which has led to the higher expressions of life. I would cite the mollusks as such a great division of organisms. Created free and independent, their almost universal acquisition of shell protection has kept them down to earth or made them grubbers in the mud of the ocean. Only a few of them, by acquirement rather than by endowment, sail the seas, and the floating habit, says a well known writer, is nearly related to the sessile. They have progressed only within the narrow limitations of their own race. Out of them has come nothing better. No lines of progressive evolution lead from the higher organisms back to them, but all pass them by. We do not even know the real relations of the great subdivision of the Mollusca to the molluscoids — the brachiopods and bryozoans; whether these are not degenerative expressions from the early mollusks rather than stages along the line of development to higher molluscan forms. We do know that all have filled the earth and sea of today with representatives in no substantial degree different from their ancestors of the Silurian.

Were we to begin an investigation of the degenerate condition pervading nature and to start with man and his more than one hundred species of parasites, there would be but one conclusion of our excursion; it was clearly stated long ago:—the whole creation groaneth and travaileth.

In the more innocent expressions of symbiosis termed mutualism and commensalism, where associations of organisms are purely social and apparently harmless or even mutually advantageous to the participants, it is probable that the outcome is infallibly deleterious.

The glass rope sponge (Hyalonema) has its coil of rope, by which it anchors itself to the sea bottom, incrusted and shielded by a coral (Polythoa), which spreads like a thin wrap of felt all about it, while its ally the Venus Flowerbasket (Euplectella) imprisons a crab in its interior behind the bars it throws across its aperture but feeds it with ever changing water currents; worms and anthozoan corals grow together, with the tubes of the former surrounded by the cells of the latter, both sweeping the water currents together for food which may go to either mouth; dead snail shells in which hermit crabs have taken residence are often beset with sea anemones (Sagartia and Adamsia) whose stinging cells may scare away the enemies of the crab, while the crab favors the fixed anemones by moving his establishment from place to place, thus to new feeding grounds.

All these conditions seem on the surface entirely harmless or positively advantageous to all parties involved; that is advantageous in the sense that they make life easier, less arduous, discourage activity and perfect adaptation. Perfect adaptation, however advantageous to the individual concerned, is the very expression of degeneration in symbiotic life. Throughout nature complete adaptation makes for stability and long life, incomplete adaptation for the restless activity which leads to progress.

The general effect then of all symbiotic conditions is degenerative. They themselves arise from degenerate tendencies and could not exist save that degeneration had already set in. They are expressions of this condition and serve to confirm and transmit this tendency. The fact is tremendously evident that even the most innocent of symbiotic, dependent or attached conditions of growth is the leaven of progressive degeneracy.

It is well known that the critical methods of morphology and embryology have been requisite to determine the original ancestral independence of the most debased of parasites. While the doctors of the middle ages wondered over the barnacles and pictured them as growing on trees, dropping thence to the ground transformed into geese, their real nature as debased crustaceans was not unfolded till the life history of the creatures showed that their early stages were free and predatory, and the adult condition one of extreme adaptation by progressive loss of functions and organs. Thus the parasitic and dependent habit is always preceded by a free and predatory condition. Once the dependent habit is established the capacity for reaction grows weaker; degenerative adaptation creeps still further back in the life of successive generations and the degradation of the adult state becomes more profound.

The all pervading conditions of symbiosis and dependence in living creatures are largely beyond the reach of our present inquiry. We are endeavoring to seek some clew to the origin of dependent life from its earliest and simplest expressions. The parasitic conditions of the present organic world are complicated in the extreme as a result of progressive and easy adaptation; often two, three and sometimes four hosts are necessary to the full life course of the dependent. Usually these present extreme conditions are expressed only by soft-bodied terrestrial organisms. The evidences of dependent life presenting themselves to the paleontologist must be chiefly of marine origin and wholly adapted to a single host; they must moreover be wholly simple in their expression or may be easily misconceived. There are certain of these simple expressions of long standing; we find them in existing nature and the ancient faunas show that such associations began far back in the history of life. To some of these we shall make special reference. Besides these a multitude of illustrations of dependent and attached forms of organisms can be drawn from every hand in the ancient as well as the recent faunas. They call for no special illustration but they nevertheless enforce our consideration of the origin of this condition.

So far as our facts go there are but few evidences of true parasitic conditions in the Paleozoic faunas. The oldest and clearest is the well known case of the coalition of the limpetlike snail Platyceras and the crinoids. The snail settles down at an early age on the dome of the crinoid, placing the aperture of the shell over the anal vent of its host and remains attached for an indefinite period of its subsequent life.

It is clear that the snail depends for its food on the waste from the crinoid and the fact that it remains attached for a very considerable period of its existence is shown by specimens of the crinoid dome bearing successive scars made by the enlarging growth of the mouth of the snail shell. Though this is the most extreme expression of ancient parasitism known to us, it was evidently of a very elastic kind and by no means affected all individuals of this genus of shells. This combination makes its first appearance in the early Devonic and seems to have become intensified in the great crinoid plantations of the early Carbonic but in either formation the examples of the actual dependent combination are in very slender proportion to the number of individuals of either snail or crinoid. Some of the snails acquired this habit of parasitic dependence, others evidently did not. Apparently it was in some measure an individual adjustment. Yet the more general dependence of this snail Platyceras on the crinoids is indicated by the fact that quite generally Paleozoic strata carrying an abundance of the one also abound in the other.

Time has not extinguished this affiliation, for the existing seas afford occasional evidence of similar relation between the limpets and the crinoids. Our material seems to throw some light on the inception of this dependent habit. A crinoid, Glyptocrinus, from the Lower Siluric is occasionally found inclosing in its arms a holostomatous snail, Cyclonema, not attached to the dome, for the shell had not the limpet habit of attachment, but lying free in such attitude as to get the full advantage of the crinoid's waste.

True dependence is also indicated by a similar association between the crinoids of the Carbonic rocks and the starfish Onychaster. The starfish adjusts itself, mouth downward over the anal aperture of the crinoid. Our specimens showing this condition have been caught in this act of feeding. The flexible character of the starfish made the attachment easily subject to change. This association too is one that time has not cured.

Much more abundant than these exhibitions of parasitism are those of the commensal habit as indicated by our illustrations of worms and corals, worms and sponges, barnacles and corals.

In the natural and expected course of procedure commensalism is the precursor of parasitism, and commensal associations became established more abundantly and at an earlier date than the other. Such mutual associations among members of the groups here indicated have been continued till today, not in precisely similar manifestation but in like alliances between individuals of the different divisions.

The protected sedentary condition, effected either by the agency of a special organ, as among most of the old brachiopods during a part or all of their life, or by the cementation of the shell to the rocks or some like object, is so widespread as to here command attention as a still simpler expression of dependent life. That the attached condition among organisms involves and expresses degeneration and necessarily promulgates still further decline, biologists are well agreed.[1] An argument therefore to show that groups of attached organisms like the corals, the sponges, the bryozoans, are degenerate and that their apparent simplicity of structure is less a primitive than a derived condition, is not here called for.

As we contemplate the earliest faunas of the earth we find that adherent and attached forms of life are in a notably less proportion than in the faunas succeeding. Bryozoans, crinoids, corals, sponges, attached worms are extremely rare; trilobites and brachiopods enormously predominate. The trilobites were crawlers and swimmers. The brachiopods however were of different habit. The predominating forms were the inarticulate species allied in structure to the living Lingula and, if allied also in habit, burrowed in the mud of the sea bottom with their fleshy pedicles, potentially not actually attached. Some of the genera with long pedicle sheaths may not have had this habit but have been actually attached to solid objects by their arm; this was undoubtedly the habit of the articulate brachiopods also until the time came with the maturity of these creatures when the arm was atrophied and they fell back on the sea bottom, free but still incapable of locomotion. In this condition, like many bivalves (e. g. Mya, the soft-shelled clam, which lies buried in the mud with no power to get any way but further in) they were potentially attached though actually independent.

To the faunas earlier than the Cambric with their probable decrease of attached organisms, we can not appeal. We can, however, still follow the line of our argument into those earlier faunas which still remain unrevealed.

In all shell bearing organisms the shell is not a primitive but a secondary development. Primitive organisms, as all considerations of biology insist, were shell-less throughout their existence — a conclusion not only indicated by ontogeny but by philosophy. The generally accepted conception that the archetype of organic life was a naked free-swimming pelagic creature may be supplemented by the proposition that the primitive condition of all organisms even after departure from the radicle was still naked and free. We must conceive that only as the independent soft-bodied animals of the earliest

[1] See especially Arnold Lang. Einfluss der festsitzenden Lebensweise.

faunas adapted themselves to life in shallow waters did the necessity for shell protection arise for with this change from a free-swimming to a creeping or stationary littoral habit came the lessened capacity for escape by locomotion. As Lang has said, the coast is full of dangers; the waves beat violently against it, the regularly returning tide keeps the waters ever moving. From these attacks of nature's blind forces the creatures must protect themselves. Some, in times of stress, seek deep water, some scuttle into protected spots or bury themselves in the sand, and others catch hold of stable bodies, attaching themselves by suction or fixation. But all these resorts are inefficient without the addition of shell protection; that once achieved, the animals may rejoice and flourish in the play of the waves which brings them nourishment with decreased exertion on their part. The primary step toward a degeneration which in the lapse of ages has led to the dependent life conditions of today would seem with reason to lie in the forced reduction of this locomotive power and adaptation to a sedentary condition resulting in the necessity for the formation of a protective shell.

ILLUSTRATIONS OF PALEOZOIC SYMBIOTIC ASSOCIATIONS

The instances here given are some of the more instructive occurrences of this sort that have come under my notice. They are not in all cases common though they exemplify consociations which are familiar in like groups of the living world. The record of their number will doubtless be much increased as such objects come under closer observation. The collection of such data from the early periods of the world's life is not likely to be carried too far for it is here, rather than in a profuser and much more complicated later development, that the factors of symbiosis are the more easily legible.

Worms and Corals

The coexistence of the tubicolous worms with the corals is one of the commonest phenomena of present seas. It became established at a very early stage in the earth's history and in the Devonic coral reefs the habitude had already become widespread and varied. It was palpably less frequent in Siluric times, at least our material would so indicate, and when it does present itself, the expression is quite simple. In most cases it is an elementary expression of commensalism. Worm and coral may start to grow together directly on settling down from the free larval state, or conjunction may be formed by attachment of the annelid larva after the growth of the coral has well progressed; in both cases the growth of the latter engulfs the former save at its tentacled aperture.

The coral Zaphrentis or Cystiphyllum and the worm Gitonia corallophila. I give this latter designation to what appear to be chiefly straight worm tubes found in simple cyathophylloids such as those mentioned. The worm has attached itself at any stage of the coral growth and quite often its tubes are found projecting in considerable number from the calyx of the coral disordering the septa by its thickened stereom and taking just the position most advantageous to its feeding with the help of the coral's tentacles [pl. 2, fig. 1]. Often these tubes seem to puncture the thecal walls of the coral where actually they have become overgrown or left behind by the increase of coral substance. It is not usual to find both of these conditions in one corallite. Plate 2, figure 3, shows a Zaphrentis with a series of small worm apertures at its base; figure 2 is an enlargement of the thecal wall of Zaphrentis with two apertures one of which shows distinctly the wall of the tube; figure 4 is a Cystiphyllum with apparently short-lived worm tubes established at different growth stages of the coral. In figures 5, 6 of the same plate are two views of a tube both ends of which seem to open into the calyx of a small Zaphrentis. If I interpret the growth of this worm correctly it started almost concurrently with the coral and like the worm on Pleurodictyum kept both ends up. It will be seen by examination of these figures that the course of the worm tube is singularly erratic; both branches have kept close to the margin of the calyx, one has come pretty straight up, while the other in its late stages made almost a half circuit of the calyx.

All the examples above cited are from the Onondaga limestone of the Lower Devonic.

The corals Monticulipora and Stromatopora and the worm Gitonia sipho. These compact, stony, massive structures covered with thousands of arms reaching out for new supplies of nourishment, seem to have especially invited the settlement of straight tubed worms which, for convenience, are designated as Gitonia sipho.

A very striking example is that illustrated in plate 1, figure 4, where the coral has overgrown the face and eyes of a moulted head shield of the trilobite Dalmanites and a series of worms has started growing obliquely upward from the very beginning of the coral (Monticulipora) growth. This specimen is from the Onondaga limestone.

A very similar combination is shown in figure 3, plate 1, which represents a colony of Favosites sphericus (Helderbergian) with worms of like character. Figures 1, 2 are of a Stromatopora from the Cobleskill (Uppermost Siluric) limestone, one showing the worm apertures on the weathered surface, the other being a polished face of the same specimen with many cross-sections of oblique tubes.

The tabulate coral Pleurodictyum; the worm Hicetes innexus; a sponge, and the gastropod Loxonema (sometimes Pleurotomaria) or the brachiopod Chonetes [*see* plates 3, 4]. This is a very remarkable and most instructive combination and we have illustrated it quite fully on the accompanying plates. The combination of the coral and the worm has long been known and the sandstone casts of the base of Pleurodictyum with the "coiled central body" or "wormlike object" are common in the Lower Devonic (Coblentzian) of Germany and have frequently been illustrated.

Pleurodictyum is a compound coral growing in small lens shaped colonies with large cells and the genus is widely distributed in faunas of Lower and Middle Devonic time. We may mention P. lenticulare Hall of the Helderbergian of New York and its variety laurentinum of the Grande Grève limestone of Gaspé; P. convexum Hall, Onondaga limestone; P. problematicum Goldfuss of the Coblentzian; P. constantinopolitanum Archiac and Verneuil, from the lowest Devonic of the Bosphorus; P. amazonicum Katzer of a similar age in the Amazonas and P. styloporum Eaton from the Middle Devonic Hamilton shales of New York. The concurrence of the coral and its convoluted worm has been noted in several of the species here mentioned but the varying degree of its frequency is instructive. Thus in the earliest species, P. lenticulare, I have seen the worm tube very rarely, after the examination of a considerable number of examples; in the var. laurentinum not at all; never in the large species P. convexum Hall of the Onondaga limestone. The single illustrations of P. amazonicum and P. constantinopolitanum show its presence but enable one to form no conception of its prevalence. The combination is frequent enough in P. problematicum to have given rise to the specific name of the coral. The Middle Devonic P. styloporum has afforded the material for most of the illustrations here given. Of this very common species in the calcareous shales of the Hamilton I have been able to critically examine several hundred individuals and it is safe to say that the worm is present in the majority of examples. It is easy to determine its presence on inspection of the tentacular surface of the coral by the contrast between its round tubes and the angular coral cells. All the specimens here figured to show the convolutions of the worm have been drawn from actual preparations.

The history of the combination in P. styloporum is as follows: At the close of the free-swimming larval stage the coral, in fully eight cases out of ten, selected and attached itself to a dead or living shell of the gastropod Loxonema hamiltoniae. Directly upon fixation or even actually contemporaneous with it was the attachment of the larval worm upon the incipient coral or alongside it. In many cases, such as that illustrated in plate 4, figure 3, the worm tube is directly fixed to the gastropod; again it may be free of the gastropod, and separated from it by the thickened basal theca [*see* pl. 4, fig. 1, 2]. With the multiplication of cell growth and the upward trend of the coral, the worm began its convoluted growth, its tube growing as much at one end as at the other. Some of the existing serpulid worms have their eyes on the hinder end of the body at the tentacular surface; it is fair to presume that at this early period this advanced stage of degeneracy had not been reached and the tube was thus kept open at both ends. In view of the regularity of coiling shown in some of the commensal worm tubes it is interesting to notice that in this case the worm after making a start, gets its double coil into parallelism for a half to an entire turn and then each arm starts off into a direct course following the radial path of the coral cells. These branches often pass in and out between the cells, keeping their extremities always at the tentacular surface and very seldom is there evidence of the worm encroaching on the polypite cells. Still this may occur and the worm tube occasionally becomes encased by a young polypite and holds a position in the center of the cell [pl. 4, fig. 4].

There may be other worms encased in the thickened base of this coral as shown in figures 1, 2, plate 4, but it is not yet clear where their apertures lie as I have never seen but two annelid openings at the surface of the adult coral. It is quite possible that originally opening on the tentacular surface at an early stage of coral growth they have been buried in the later accumulations of stereom. There are long tubular passages between the corallites in early growth stages which have not been described in the structure of this coral genus and in sections these are confounded with worm tubes but in etched specimens such as have here principally served for illustration, their nature is clear.

In this interesting combination there is still another member—a small calcareous sponge. It has come to my notice several times. The one here figured was taken from the tube of the worm but whether that is its usual position or whether it may seat itself in one of the coral calyces or whether indeed it is a usual member of the consociation can not clearly be regarded as established.

I have given (pl. 4) some illustrations which show how readily the dead parts of these organisms become incrusted with serpulid worms. Figure 8 is the surface of a part of a dead Loxonema to which a Pleurodictyum had grown and figure 7 shows the inside of an old tube of the commensal worm Hicetes innexus, itself incrusted with minute worm tubes.

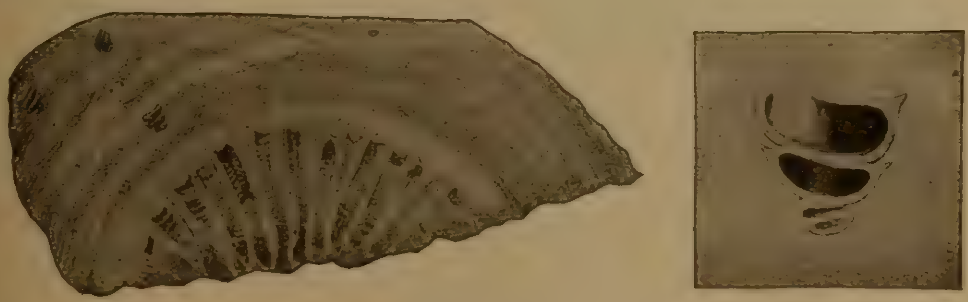
Interesting as is this instance of commensalism, its most extraordinary feature is the amazing evidence of selection by the larval coral of the body to serve as the base on which it is to grow. I have stated above that a very evident majority of the colonies of this coral Pleurodictyum as it occurs in the Hamilton shales are attached to an organic object and that this organic base in approximately 80 per cent of the cases is a shell of Loxonema hamiltoniae. Occasionally the shell may be a Pleurotomaria of one or another species. I have no record of its being any other than one of these gastropods. On the other hand the German Pleurodictyum problematicum fixes itself by decided preference to the brachiopod Chonetes sarcinulatus Schlotheim. I have examined a considerable number of specimens of this Coblentzian species but have seen no other shell used for attachment nor have I found record of any other. Though I can not use percentages with reference to the frequency of this occurrence, this palpable fact remains that as between these two closely allied if not identical corals, one selects a gastropod, the other a brachiopod as its base of attachment. Emphasis is to be put on the word "selects" for among the brilliant examples of selective adaptation none could be more striking than this. The floor of the New York ocean was covered with Chonetes and of the German ocean with gastropods during the life of this coral. Were either wanting in the other fauna, hundreds of other species of organisms lined the sea bottom. The coral was not deprived of its choice.

Taken as a whole this combination is very complicated commensalism from a date so ancient as the Devonic, more extreme than any other yet known from the Paleozoic rocks. But we find a somewhat parallel case in the present described by Bouvier as occurring in the Gulf of Aden — a coral and a worm growing together, and hidden in the coral substance a gastropod on which both settled down when the partnership began; furthermore there appears to be a small bivalve in association with the worm. Other somewhat similar cases might be cited.

The Devonic coral Acervularia and the spiral worm Streptindytes acervulariae; a Siluric Stromatopora with a somewhat similar spiral worm, Streptindytes concoenatus; a Devonic Stromatopora with the spiral worm, Streptindytes compactus. The first of these occurrences was described some years ago by Prof. Samuel Calvin [On a New Genus and Species of Tubicolar Annelida. Am. Geol. 1:24. 1888]. It is the case of a large annelid whose tube measures $\frac{1}{8}$ to $\frac{1}{4}$ inch in diameter growing upward in numbers among the cells of the compound coral Acervularia davidsoni Edw. & H. from the Middle Devonic rocks of Iowa. The species has not before been illustrated and I have to thank Dr Calvin for the privilege of introducing the accompanying cut of this interesting commensal [pl. 1, fig. 7].

Another example of these spiral commensal worms (Streptindytes concoenatus) is afforded by the Stromatopora reefs of the Cobleskill limestone (Upper Siluric). The illustration here given [pl. 1, fig. 5, 6], affords some idea of how a small mass of Stromatopora may be quite riddled with these minute corkscrews. This is taken from a single section across a small colony in which it is apparent that these worms have become sessile at different stages of growth in the coral mass as they start at different levels in the colony. It is also clear that the worm tube made at least one horizontal convolution before starting on its upward spiral growth and it is more than likely that its elongated spiral is due to the requirement of keeping its tentacular end up at the feeding surface of the growing coral. These tubicolous worms have very plastic tubes and readily adjust themselves to surroundings. In the worm of Pleurodictyum (Hicetes innexus) the early spiral form was soon lost, perhaps because the corallites are so large and close that such growth was effectually obstructed. I have given here some illustrations of a worm from the Hamilton group described by Hall as Spirorbis angulatus from closely attached examples showing but one or two entirely horizontal volutions. These silica etchings show how quickly in later growth the tube departs from the horizontal position and draws out into a loose spiral even when not confronted by the necessity of keeping its feeding end on a level with that of some companion organism [pl. 2, fig. 8-11].

The third of these combinations is illustrated by a specimen for which I am again indebted to Professor Calvin. A little colony of Favosites has had its tentacular surface entirely overgrown with a Stromatopora. Within the substance of the Stromatopora is a multitude of spiral worm tubes not stretched out into loose volutions as in the other instances mentioned, but keeping their two or three volutions in close contact and resembling an Autodetus without its external smoothly sloping surface. The edges of these tubes are apparently always angular. These little worms have started growth anywhere on the substance of the Stromatopora and instead of growing like a Spirorbis with whorls broadly attached for a turn or two, have coiled closely upward and ceased growth in every case very abruptly. This case is singularly instructive as showing that the worm failed to keep pace in growth with the coral and confessed its natural limitations of growth, while in the other cases cited the worm apparently has had the ability to adapt itself to this upward growth by stretching out its tube into loose curves and keeping its aperture always clear at the surface. The little Streptindytes compactus however was not equal to this struggle for existence except as it planted its successors in-



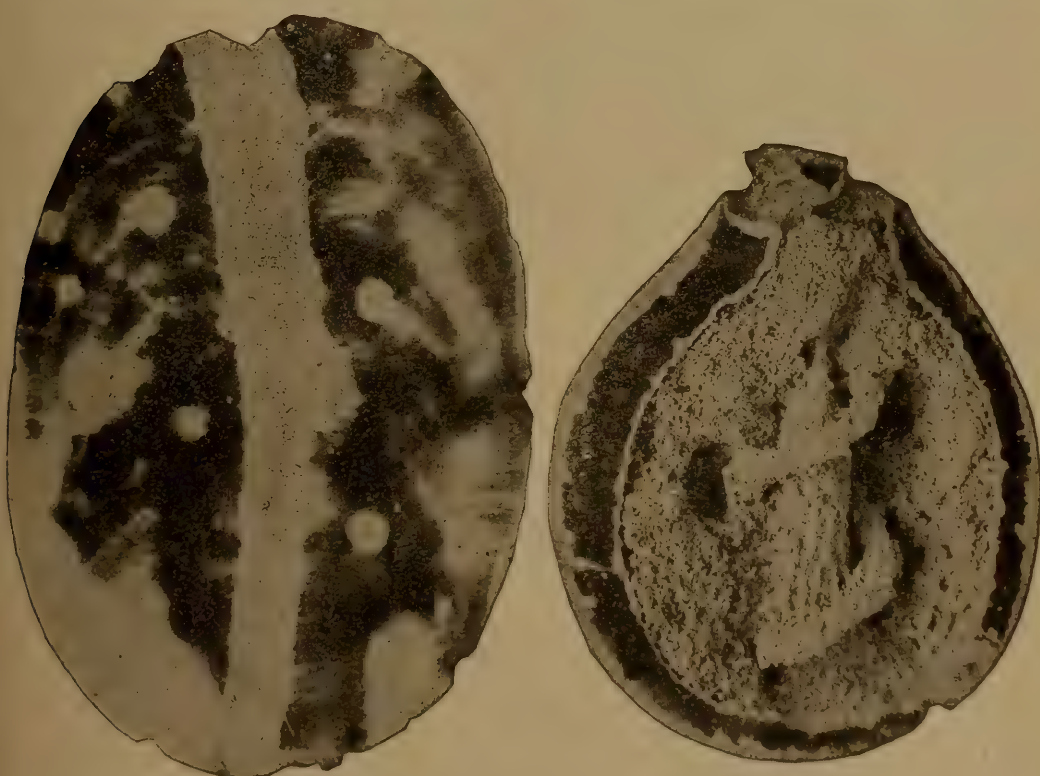
Stromatopora with embedded spiral annelid tubes. Streptindytes compactus, located at various stages of the growth of the coral. The character of the annelid tube is shown in the enlargement at the right (x 5). The Stromatopora has entirely overgrown a small Favosites colony. Middle Devonic. Iowa discriminately over the coral at its various levels of growth. How well it struggled to maintain itself is indicated by the presence of fully 30 individuals on a surface of this coral 2 inches square. The single specimen of this species observed is from the Middle Devonic Cedar Valley beds at Iowa City, Iowa.

Worms and Sponges

We find in more than a single instance among the fossil hexactinellid sponges of the family Dictyospongidae evidences of worm tubes attached to the inner wall or cloaca of the sponge and living in a condition of commensalism. Such worms have been observed in the species Hydnoceras tuberosum var. glossema and Prismodictya telum Hall & Clarke, from the sponge plantations of the Upper Devonic in western New York [pl. 5, fig. 1, 2]. In a considerable number of individuals of the latter species from the same locality nearly all showed the presence

of the annelid commensal and as the surface of the impression left in the sands by the worm tube is in all cases crossed by the reticulated skeleton of the sponge it is inferred that the position of the former was internal. These are silicious sponges allied to Euplectella and though we find no parallel expression of commensalism in the living glass sponges, yet Euplectella carries a parasite in the form of a crustacean which in youth enters its open cloacal cavity and remains there so that when the sponge has in adult growth built the terminal or sieveplate over its aperture the crustacean is wholly and permanently caged.

A very commanding illustration of the association between the sponges and spiral annelids is afforded by a series of specimens displayed in the British Museum. These I am able to reproduce here by the kindness of the trustees of that Museum from photographs made by permission of the Keeper of the Department of Geology, through the friendly agency of Dr F. A. Bather. In all these specimens it would appear that the worm, which has made a tube of large dimensions, began its commensal existence early in the life of the sponge and has coiled upward in a very loose spiral about and just within the cloacal wall. Of the figures given here two



These and the figure on the preceding page represent silicified sponges with spiral annelid tubes from the English Chalk. In the upper figure (locality unknown) and the lower right-hand figure (Beckhampton), the exposed worm tube is coiled about a vertical tube which appears to be the silicified wall of the cloaca. These spirals are obviously in reversed direction. The lower left-hand figure is a direct print from a thin section of another sponge in which the position of the worm tube, cloaca and concentric structure of the sponge are shown. Prepared by Dr. Bather. Figures about natural size. British Museum (Natural History) Department of Geology: A. 475; 55117 are of specimens so broken as to expose the interior. Solid flint has replaced the outer part of the sponge body, but in the disintegrated silica of the interior the tube of the cloaca stands vertical with hardened walls about which the worm tube seems to coil like a beanstalk on a pole. The transparent section which is reproduced from a direct print, shows with probably more accuracy the actual distance of the tube from the cloaca. It is extremely instructive to note that the direction of coiling is unlike in the two specimens exposing the spiral, while in the section it would be impossible to determine whether the course of the coiling is dextral or sinistral.

Barnacles and Corals

The barnacles of today express to us one of the extreme results of modification through adaptation to a parasitic condition. I have ventured to suggest on a previous occasion that the Siluric barnacles of the genus Lepidocoleus [pl. 5, fig. 3] are an expression of these creatures before such modifications set in. It is regularly segmented throughout its length, its biserial row of plates being open on one side only for the protrusion of the appendages. The forms known as Turrilepas, Plumulites and Strobilepis of the Devonic, are not of greatly different structure. We know however of fully modified acorn barnacles in the Devonic Protobalanus and Palaeocreusia. The latter is parasitic on a Favosite coral of the Onondaga limestone (Lower Devonic), in which it appears to be embedded by the overgrowth of the polypites rather than by burrowing its way into the colony as do sometimes the acorn barnacles of the present [pl. 5, fig. 4, 5].

Crinoids and Cystids with Gastropods

We are here presented with what appear to be instances of genuinely dependent parasitism—where an attached organism relies upon its host for its nutriment and existence. They constitute the earliest instances we can cite of a dependence between organisms that has become essential rather than merely convenient and it is of extraordinary interest because we find some clue here to the origin of the habit. The attachment of the limpetlike gastropod Platyceras to the calyx of the crinoid of the Paleozoic has already been referred to and many instances of it have been cited and illustrated.[1] This attachment is so effected that the mouth of the shell is seated directly over the anal aperture of the crinoid so that the former may catch the digestal waste of the latter. Upon this waste the Platyceras palpably sustains itself. So many instances of this conjunction have passed under examination that no question can arise as to the fact that such attachment is solely for feeding purposes. Suggestions which have been occasionally made that the attachment is rather accidental than otherwise, as attachment to some substantial object is the habit of the gastropod, are not borne out by the evidence afforded by multitudes of these cases. It is quite certain, however, that in the Devonic and Carbonic faunas where this habit became most prevalent, there was always a predominant percentage of the gastropods that did not lend themselves to it; nor have we reason yet to conclude that the habit once inaugurated necessarily continued during the remaining life of the individual. It did continue for a considerable period of the shell's existence as the very instructive figure 6 on plate 6 indicates, the concentric scars being the successive impressions of the lip of the shell as its growth enlarged, while its position relative to the after opening of the crinoid is unaltered.

The history of this form of dependence is extraordinary and illuminating. Throughout the Siluric the crinoids and cystids abounded but mollusks of the limpetlike construction of Platyceras were few. Moreover the crinoids were for the most part built with slender domes well hedged about by delicate arms, and on these domes the mollusk might have found difficulty in securing a footing.

The earliest intimation of the tendency on the part of a mollusk to seek its food from the rejectamenta of the crinoid is afforded by an example of a Lower Siluric Glyptocrinus which holds within its arms and in a feeding posture a shell of the holostomatous gastropod Cyclonema bilix. One might regard the occurrence accidental if it had not been observed more than once.

In the Upper Siluric, Platyceras had become somewhat more abundant but its numerical development did not reach that of the allied mollusk Diaphorostoma and in plate 6, figure 1, we have an illustration of a small shell of this latter genus attached over the after of the cystid Caryocrinus ornatus (Rochester shale). Thus far in time no examples have come to our observation of

[1] See particularly C. R. Keyes. Synopsis of American Carbonic Calyptraeidae. Acad. Nat. Sci. Phila. Proc. 1890. p. 150. The author here records a long list of these parasitic associations and especially indicates the effect of this condition in modifying the aperture of the gastropod.

attachment between Platyceras and the crinoids. With the opening of the Devonic the development of Platyceras became enormous, so much so that the calcareous phase of the earliest Devonic has been termed the Platyceras stage. The crinoids also were common at this time, but cases of any dependent conjunction of the two are extraordinarily rare; the only instance of this early date known to me is that cited by Drevermann from the Coblentzian. Little by little, however, the habit was assumed and becoming more frequent in the Middle Devonic it seems to have attained a culmination in the faunas of the earlier Carbonic. During all the ages which have intervened between the

Silicified specimens of Platyceras attached to the dome of Megistocrinus farnsworthi White, from the Middle Devonic of Iowa. The perfect adjustment of the shell to the crinoid is seen in the adaptation of its margin to every irregularity of the surface of the dome. Loaned by Prof. Samuel Calvin

Paleozoic and the present there is no record which has come to my notice to prove that this ancient habit has had an uninterrupted existence. The crinoids and the limpets have continued and certainly the detailed records of Mesozoic and Cenozoic faunas should have given some account of this habit had it perdured. We have remarked that the consociation was always an easy one to which even at its hight not all the members of the genus Platyceras were compelled. In the absence of demonstration, it may be fair to hold it possible that the descendants of these mollusks really abandoned this form of attachment and rebounded from the degenerative condition which it involved; this would be a fact of profound significance if it indicates that an organism once started on the downward path can take a new hold of life and regain its independence. Yet we are doubtless not justified in such a conclusion. In the present seas all gastropods of truly parasitic habit are parasites on the Echinoderma, the class to which the crinoids belong. Crinoids are few today and appear to be relatively free from these attachments, but their allies, the starfish and sea urchins, are still beset by the gastropods, often so reduced by the degeneration of their condition as to be scarcely recognizable. This far-reaching and general condition of depravity would seem a direct inheritance of the ancient conditions we have portrayed.[1]

Crinoids and Starfish

We have some very interesting instances of association between the crinoids and the ophiuran Onychaster flexilis Meek & Worthen. Three of these are here figured, one a copy from Wachsmuth and Springer's figure of Actinocrinus multiramosus W. & Sp., the others drawn from specimens in the possession of Mr Fred Braun. In the first the starfish has encircled with its arms the dome of the crinoid, mouth downward in such an attitude as to suggest though probably not to demonstrate that it was diligently attending to the waste of the crinoid. As the arms of the crinoid have been broken away the act of the starfish is exposed in all its nakedness. In the specimens of the Onychaster with Barycrinus hoveyi Hall, the arms of the two creatures have become completely entangled and fixation for feeding purposes at least is entirely effective. In respect to the end sought and attained this condition is one of parasitism but one still subject to the control of the individual. There seems no reason to assume that the starfish is here endeavoring to suck the life out of the crinoid itself and it would be going further than the facts justify to interpret this demonstration solely as an act of feeding like that of the common starfish of today in its attacks upon the oyster.

I quote here some remarks from Wachsmuth and Springer's *North American Crinoidea Camerata* [1897, p. 566], concerning the relations of Platyceras and Onychaster to the high domed crinoid Actinocrinus multiramosus.

Of this large and beautiful species we obtained at Indian Creek and Canton over forty specimens, most of them in excellent preservation, with the arms attached; and it is very remarkable that nearly one half of them have either a Platyceras attached to the

[1]The brothers Sarasin have described a very interesting case of the parasitic attachment of a limpetlike Platyceras to a living starfish, in which the former by an extension of its mouth into a snout which penetrates the test of the starfish, sucks out the nutritious fluids *Ergebniss einer Forschungsreise auf Ceylon, v. I*]. While the parasitic condition between the limpets and crinoids of the Paleozic was elastic, this is fixed and beyond repair. Other living snails parasitic on the allies of the crinoids are interestingly described in the *Naturwissenschaftliche Wochenschrift*, January 17, 1904.

tegmen, or a specimen of Onychaster between the arms and coiled around the anal tube. This, so far as we know, is the first instance in which a Platyceras has been found in contact with a Crinoid with a long anal tube; in all cases heretofore noticed the Crinoid had an anal opening directly through the tegmen, and the Gastropod was fastened invariably with the anterior portion of the shell over the opening. This led to the supposition, for which there seemed to be good reasons, that the Mollusk obtained its nourishment, in part at least, from the excrements of the Crinoid. This, however, was impossible in the case before us, where the anal tube, with the anus at the distal end, extends out far beyond the tips of the arms, and, so far as observed, bends abruptly to one side, so that neither the opening nor the refuse matter could have been in contact with the Mollusk.

In more frequent association with this Actinocrinus is the Onychaster, and it is worthy of note that this species of ophiuran is rarely found by itself. Nor has it been observed at Indian Creek on any of the other Crinoids, while at Canton it appears also on most of the specimens of Scytalocrinus robustus (Hall), a species with a large ventral tube, and the anus located far down at the anterior side; but with this exception we have not seen it on any other species. The fact that this Ophiurid is only found associated with certain species, and there always under similar conditions, and the frequency of this occurrence, would seem to indicate that the position between the arms of these crinoids was its favorite resting place, in which it either found protection, or some special facility for obtaining nourishment.

These specimens are from the Crawfordsville limeshale of the Lower Carbonic (Mississippian).

Crinoids and Myzostomum

All the known living species of the minute wormlike creature Myzostomum (60 to 70 in number) are parasitic on the crinoids whereon they form galls or swellings by the overgrowth of the test. Similar galls have been noted on both Mesozoic and Paleozoic species of crinoids by Bather, Shipley, Fraas and other writers, and they are generally ascribed to the Myzostoma.

Coral on a Coral

The case of Caunopora. It is now quite generally conceded that Caunopora which has commonly been regarded as a hydroid coral like Stromatopora, but with sharply defined, definitely walled tubes, is actually a laminate hydroid overgrowing a series of erect tubes like those of Syringopora or Aulopora, carrying oblique dissepiments within. Caunopora placenta Phillips is a Devonic species.

Fistulipora occidens presents a similar coalition of a hydroid coral and the primitive tubulate Aulopora. This species was described from the Upper Devonic Lime Creek shales of Rockford, Iowa, by Hall [N. Y. State Mus. 23d Rep't. 1873. p. 228, pl. 10, p. 9, 10] who recognized the fact that the large pores on the surface of the coral are projecting tubes of Aulopora. An interesting feature of this concurrence is that colonies of the Fistulipora are quite as frequently without the Aulopora as with it.

One may compare with these instances the interesting case mentioned by Whitfield of the recent coral Ctenophyllia, entirely inclosed by a hemispherical growth of Meandrina labyrinthica (described in Am. Mus. Nat. Hist. Bul. 1901. 14: 221).

In addition to the instances given above of actual commensal conditions, I am taking this occasion to append a brief account of certain ancient pseudoparasitic organisms of boring habit. These come frequently under the eye of the paleontologist but very little attention has been given to them, occasional incidental references being for the most part the sum of our knowledge of the Paleozoic expressions. The literature of the later formations contains random accounts of such organic relics but I should be going too far afield in this instance to make definite allusion to these.[1]

These boring bodies infesting the dead shells which form a large part of the material of the paleontologist are very likely to be either minute algae or fungi, or sponges of genera producing similar effects to the living Cliona or Vioa. The work of the former has had some notice [*see* Duncan Quar. Jour. Geol. Soc. 1876. p. 205; Kölliker. Zeitschr. Wiss. Zoolog. 1859, 10: 215; Loomis, N. Y. State Mus. Bul. 39. 1900. p. 223] and their tubules are recognizable by contrast by their microscopic size and the occasional presence of hyphal swellings. The total amount of deterioration and disintegration of skeletons caused by these minute organisms was doubtless great even in Paleozoic times.

The work of boring sponges, however, on ancient organisms has been a far more effective cause of destruction and waste of dead shells. There are certain conditions of preservation in which these borings enforce themselves on the attention, especially when the student has to deal with an arenaceous matrix from which all the calcareous matter of the shells has been dissolved leaving sharp

[1] Very instructive instances of these later expressions are cited in a recent paper by E. Schütze, Die bohrenden und schmarotzenden Fossilien der schwäbischen Meeresmolasse, Jahresb. d. Ver. f. vaterl. Naturk. in Württ. 63, 1907. p. 81-84; Bericht ueb. 29 Versamml. d. Oberrhein. geolog. Vereins zu Wörth, 1906; Zeitschr. f. Mineral. Geol. u. Palaeont. Jahrg. 1.

and clean casts of the borings; or when these natural conditions are reproduced artificially by removing the calcareous material from a lime shale.

Probably the first attempt to characterize with a definite name these undoubted sponge borings was that of McCoy [Brit. Paleoz. Foss. 1855. p. 260, pl. 1B, fig. 1, 1a] who illustrated under the name Vioa prisca a series of simple straight club-shaped casts of borings occurring in the shell substance of the pelecypod identified as Pterinea demissa Conrad of the Upper Siluric. It is probably safer not to designate these sponge relics by the name of any genus now living and I propose, in speaking of several distinct forms of them, to employ the term Clionolithes.

The straight clavate tubes of Clionolithes priscus (McCoy) usually originate at the edge of a dead shell and expand gently inward; probably the sponge nested at the club-shaped extremity of the hole, drawing the water currents in to itself. It is not always the case that the shell was dead before the work of these borers began. There are several illustrations given here to show that a brachiopod or pelecypod may have been attacked by these sponges at any growth stage and that after the attack had begun the growth of the shell continued. There is a curious simultaneousness in the attacks of these pseudoparasites—all started in at once and frequently one such attack is not followed by others [*see* pl. 8, fig. 2, 4]. This form, C. priscus, was quite common in the late Siluric and very abundant throughout the Devonic.

Clionolithes radicans designates a quite different expression of this boring habit. Here the tubes radiate and branch outward from a center, giving a decided rootlike expression to the resultant very complicated combination of tubes. These branching tubes often unite, fuse or anastomose producing a somewhat irregularly reticulated expression. This sponge particularly infested the living and dead shells of the brachiopods, finding entrance less often at the margin than through the pores on the surface of the shell. The complex of tubules is small in comparison with those of C. priscus and it is not unusual to find both of these forms infesting the same shell. This boring sponge, so far as my observation extends, is restricted to the Devonic.

Clionolithes reptans has threadlike vermiform tubes which wander loosely and at random through the shell substance of both brachiopods and pelecypods.

Clionolithes palmatus, a singular form assuming broad sparsely branched palmate hollow fronds and found only in the pelecypods and gastropods of the Portage group (Upper Devonic).

Among these boring bodies is another, which judging only from the form of its tubes must have been very unlike the rest. I have observed it only in the brachiopods of the Coblentzian sandstone and in order to express its notable difference from the other borings mentioned shall designate it as Caulostrepsis taeniola. In these the borers began at the edge of the shell and the casts of their borings are long, narrow tapelike tongues with an elevated edge all the way around. This corded edge is a continuous tube while the area between is a narrow flat space connecting the tubes of the loop. I hesitate to assign this curious form to the sponges; it has in miniature a resemblance to some of the worm casts found on the surface of old rocks, but the evident open connexion between the tubes of the loop makes it difficult to allot to this boring its probable maker.

Boring pelecypods were not unknown in the early Paleozoic. Instances are rare indeed but a very striking example is the small Modiomorphalike shell Corallidomus concentricus described by Whitfield from the Cincinnati shales of Ohio [*see* Geol. Ohio. 1893. 7: 493, pl. 13]. The figure given by this author shows a colony of the coral Labechia ohioensis Nicholson perforated by scores of burrows in some of which the shell itself is found. Such occurrences have been freely described in Mesozoic faunas and boring insects in the woods of the Tertiary.

EXPLANATION OF PLATES

PLATE 1

1 Part of the weathered surface of a Stromatopora from the Cobleskill limestone, Schoharie, N. Y., showing the openings of the worm tubes Gitonia sipho

2 A section of the same colony permeated with such tubes

3 A colony of Favosites sphericus Hall from the New Scotland beds (Helderbergian) with similar tubes

4 A head of the trilobite Dalmanites overgrown with a colony of Monticulipora in which is embedded a series of Gitonia sipho. Onondaga limestone, Becraft mountain, N. Y.

5 Sections of spiral tubes (Streptindytes concoenatus) in a colony of Stromatopora. The apparent difference in direction of volution in these is due entirely to the different depth and angle at which the tubes are cut. From the Cobleskill limestone (Upper Siluric) Schoharie. x 2

6 An enlarged restoration of the characters of these worm tubes. x 5

7 Streptindytes acervulariae Calvin: two tubes in a colony of Acervularia davidsoni E. and H. x 1.5. From the Middle Devonic of Roberts Ferry, Iowa

PLATE 1.

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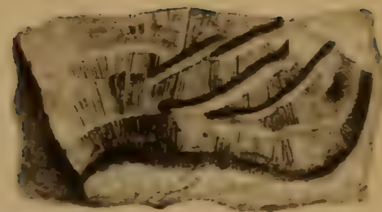

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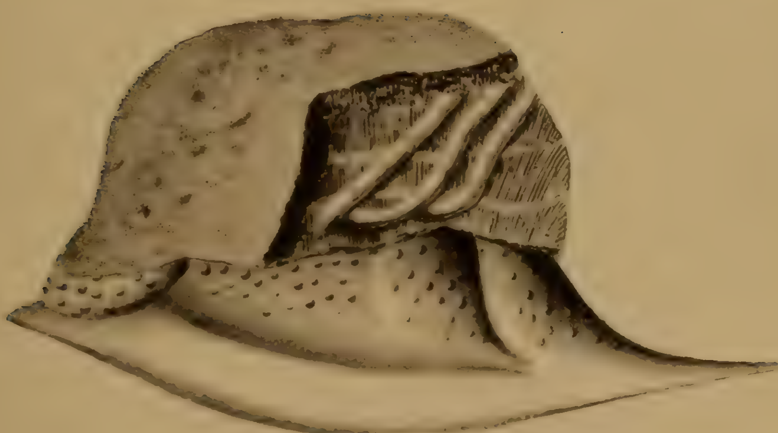

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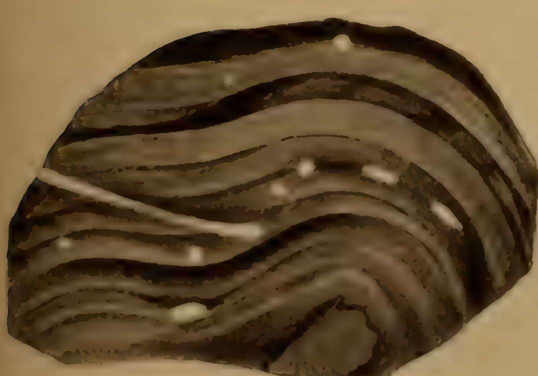

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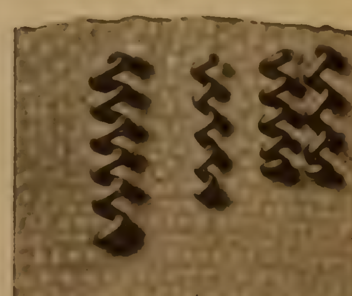

PLATE 2

1 A calyx of Zaphrentis with a number of tube openings of Gitonia corallophila

2 Tubes of the same character opening outward through the lateral walls of Zaphrentis; much enlarged

3 A Zaphrentis with tube openings at the base

4 A Cystiphyllum with short tubes opening outward through the thecal walls

5, 6 A Zaphrentis from two points of view to show the course of a tube of Gitonia corallophila with both ends opening outward in the calyx

All these specimens are from the Onondaga limestone (Lower Devonic).

7 Caunopora — a schematic section showing the Syringopora- or Auloporalike tubes overgrown by the Stromatopora substance; coral on coral

8-11 Enlarged figures of Spirorbis angulata Hall, a worm tube from the Hamilton group of New York. These specimens are silica replacements etched from limestone (Menteth limestone), and show the tendency of the tube to unwind in a lax spiral as soon as fixation is firmly established.

PLATE 2.

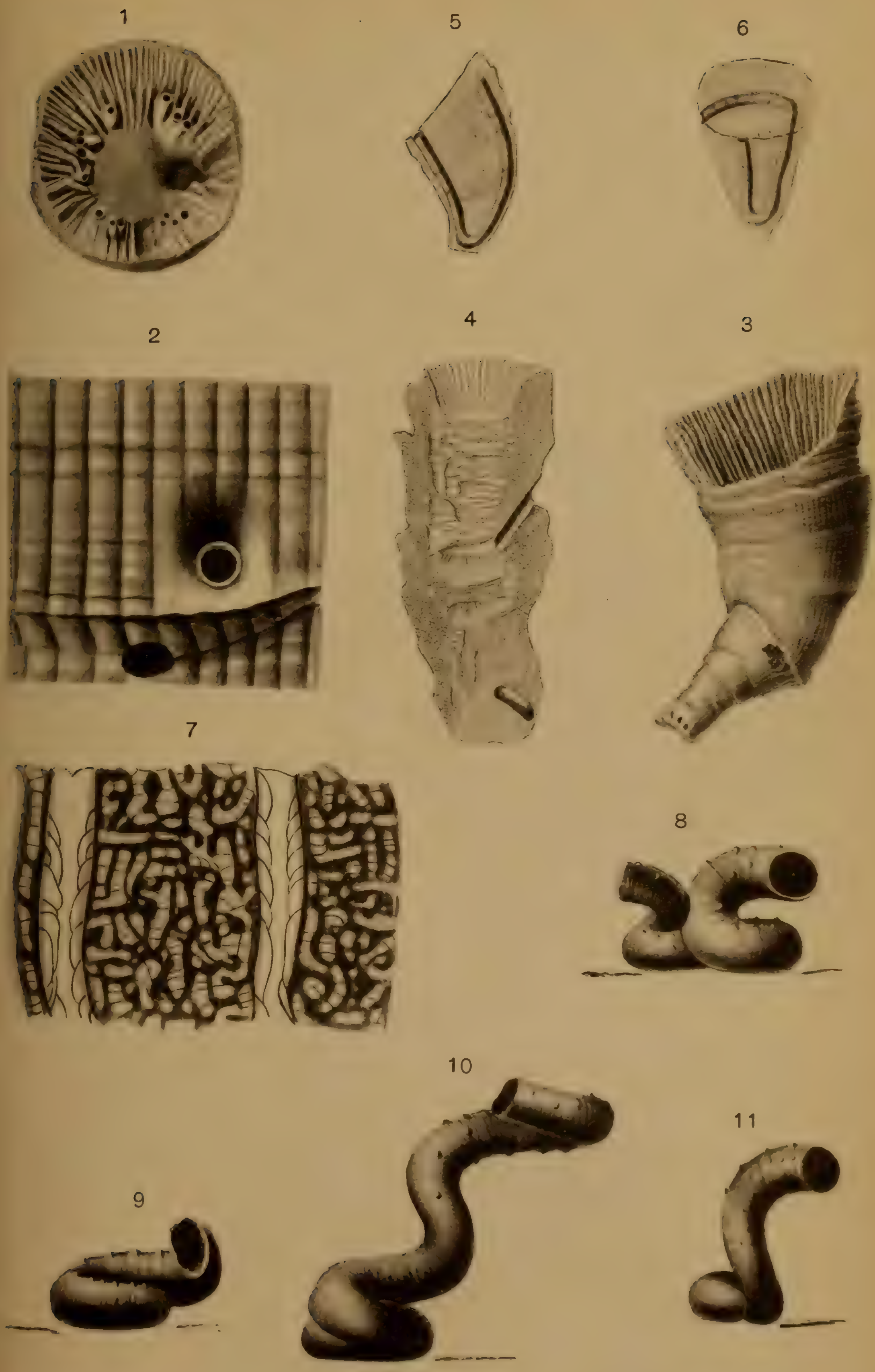

PLATE 3

A series of drawings to illustrate the commensalism of Pleurodictyum and the worm Hicetes innexus

1, 2 Top and side views of a corallum of Pleurodictyum styloporum Eaton from the Hamilton shales of New York. The worm tubes are clearly seen at x-x on the surface of the colony.

3 Vertical section of a corallum showing sections of the convoluted tube near its base

4 The under side of a corallum with impression of the gastropod Loxonema hamiltoniae to which it is attached

5 An etching which has removed the base of the coral and shows the initial convolutions of the worm tube

6 The form of the entire tube, drawn from an actual specimen

7 The basal surface of Pleurodictyum problematicum attached to the brachiopod Chonetes sarcinulatus Goldfuss. This specimen is from the Coblentzian at Stadtfeld.

8 An etching of the basal part of P. styloporum showing the chief worm and a wormlike extension which appears to arise from the base of a polypite and turn into an upward course between the cells

PLATE 3

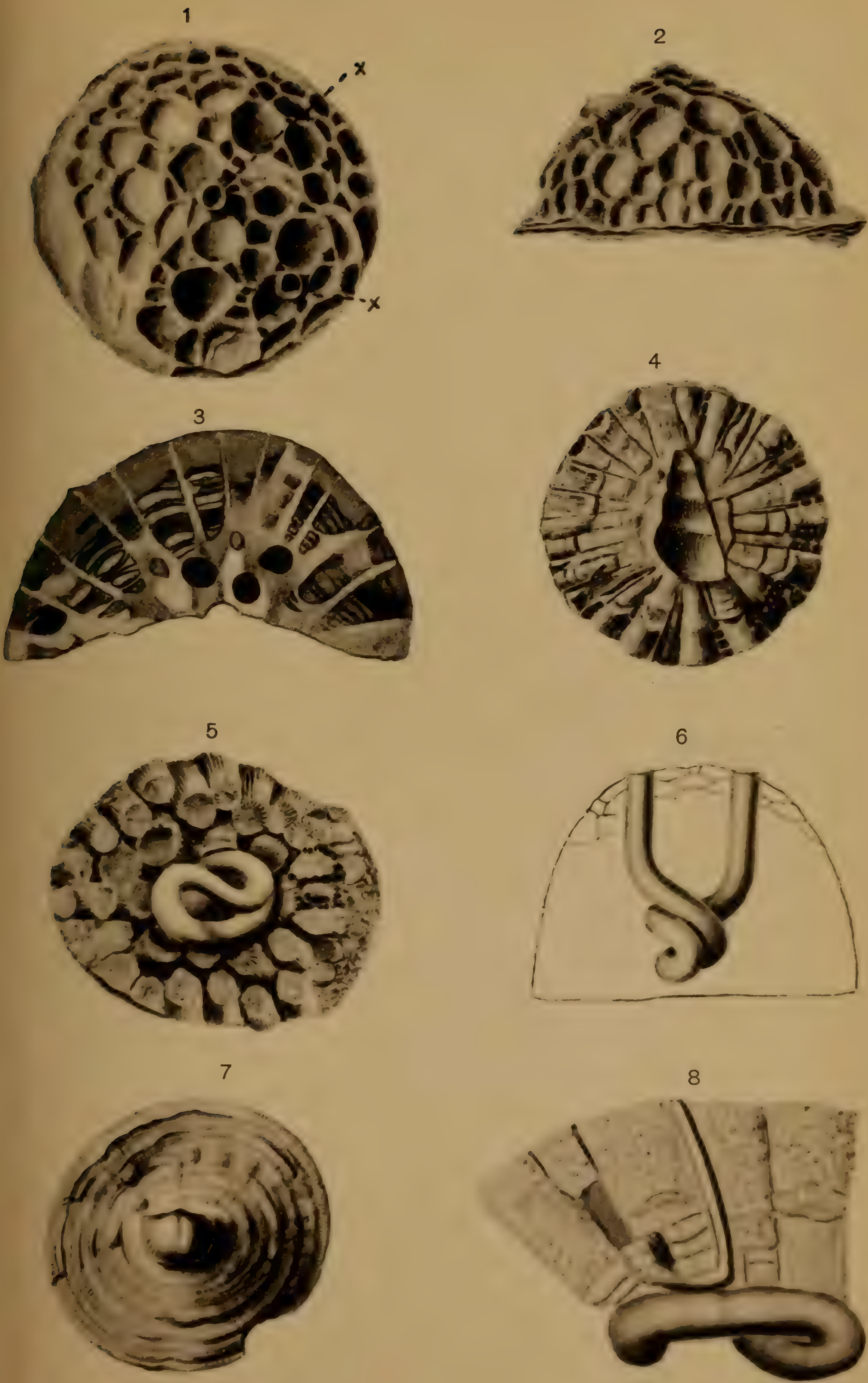

PLATE 4

Continuation of the illustration of Pleurodictyum and Hicetes, etc.

1, 2 Sections of P. styloporum showing not only the large worm but the smaller ones in the thickened base of the coral

3 An etching of P. styloporum showing actual attachment of the worm tube Hicetes to the surface of the gastropod Loxonema

4 The tube Hicetes penetrating one polyp cell and passing thence into another

5 The small sponge found in the tube of the large worm Hicetes

6 Chonetes sarcinulatus Goldfuss, the brachiopod to which P. problematicum usually is attached. (After F. Roemer)

7 The greatly enlarged interior surface of the worm tube Hicetes with slender serpulid worm tubes attached

8 The enlarged surface of part of a Loxonema, covered with small serpulids. This specimen of Loxonema had served as base of attachment for P. styloporum.

9 Loxonema hamiltoniae Hall

PLATE 4.

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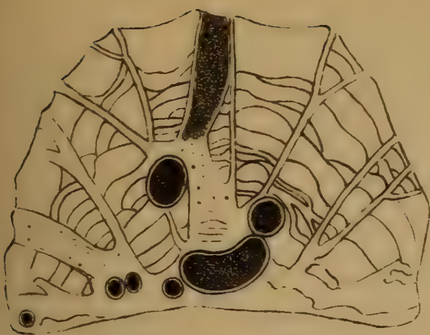

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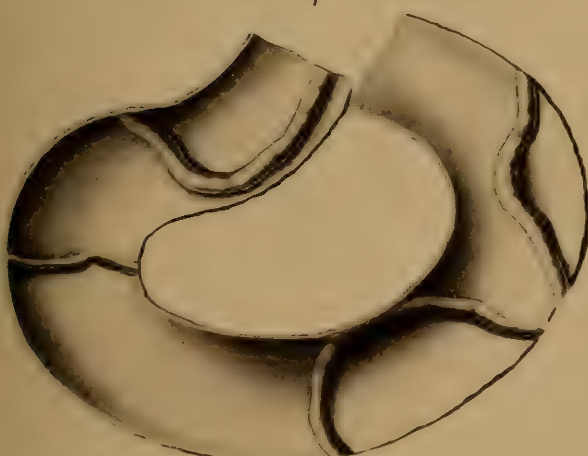

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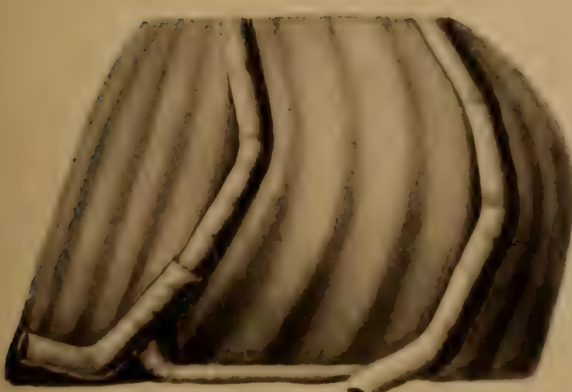

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PLATE 5

1 Hydnoceras tuberosum Conrad var. glossema H. & C. A silicious hexactinellid sponge with markings of worm tubes on the inner side of the recticulum. From the Chemung group (Upper Devonic) of southwestern New York

2 Another silicious sponge, Prismodictya telum H. & C. with similar worm tubes also from the Chemung group of New York

3 The barnacle Lepidocoleus jamesi of the Lower Siluric (Cincinnati group) showing the unatrophied condition of the animal whose segmentation may be regarded as represented by the paired valves which meet at the edge allowing room for the protrusion of the appendages

4, 5 Palaeocreusia devonica Clarke, a barnacle buried in a colony of Favosites hemisphericus partly by burrowing and partly by overgrowth of the coral. From the Onondaga limestone, Leroy, N. Y.

PLATE 5

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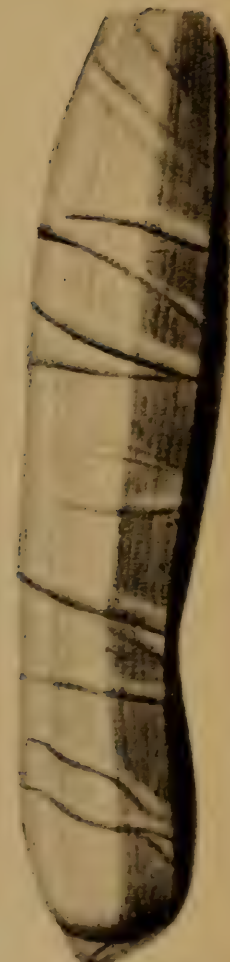

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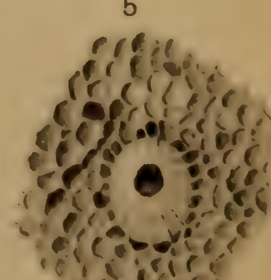

PLATE 6

1 Caryocrinites ornatus Say, a cystid having a small gastropod (Strophostylus) attached and covering the apertures of the summit. From the Upper Siluric (Rochester) shale of western New York

2 Glyptocrinus (decadactylus Hall) with a holostomatous gastropod, Cyclonema bilix, inclosed within the arms in an attitude of feeding at or near the anal aperture of the crinoid. From the Cincinnati shale

3, 4 Cromyocrinus simplex with attached Platyceras of relatively large size, its anterior portion covering the anal aperture of the crinoid while the rest of the lip of the snail extends over the entire hight of the calyx. Carbonic limestone, Moscow, Russia

5 Platyceras enveloping the dome of Arthracantha punctobrachiata Williams [after Hinde, Ann &. Mag. Nat. Hist. 1885]. From the Hamilton group

6 A part of the tegmen of Strotocrinus regalis Hall showing the successive growth marks made by an attached Platyceras, always keeping its anterior extremity over the anal aperture of the crinoid [after Keyes, Acad. Nat. Sci. Phila. Proc. 1890. pl. 2, fig. 7]. From the Carbonic (Mississippian) of Crawfordsville, Ind.

7 Platyceras infundibulum Meek & Worthen attached to the anal surface of Platycrinus hemisphericus M. & W. [after Keyes *ut. cit.* fig. 10]

8 Actinocrinus multiramosus Wachsmuth & Springer. The calyx with a starfish (Onychaster) fastened to the anal tube [after Wachmuth & Springer *ut cit.* pl. 55, fig. 3]

PLATE 6

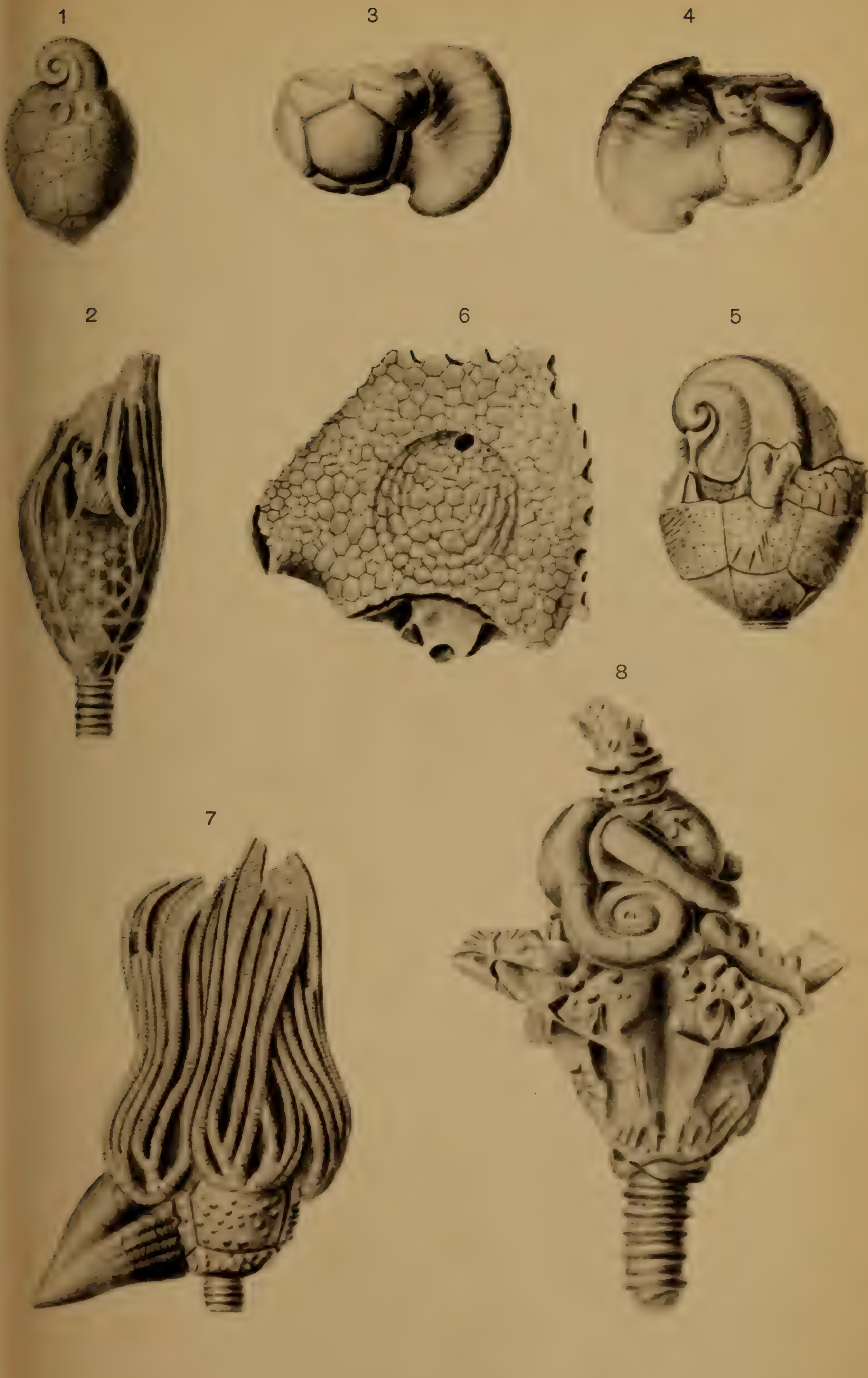

PLATE 7

1, 2 Two specimens of Barycrinus hoveyi Hall with the starfish Onychaster flexilis intertwined within the arms. (Mississippian) Carbonic. Crawfordsville, Ind. From the collection of F. Braun

PLATE 7

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PLATE 8

1 Clionolithes (Vioa) priscus McCoy, cast of borings in a shell of Pterinea demissa (Conrad) McCoy [after McCoy, Brit. Paleoz. Foss. pl. 1B, fig. 1, 1a]

2 The same. A series of clavate tubes in the shell substance of Leptocoelia flabellites (Conrad) all starting from the margin of the valve at a definite period of growth in the shell. x 2. Oriskany sandstone, Highland Mills, N. Y.

3 The same in a valve of Spirifer from the Chemung group near Sideling hill, Maryland. x 3

4 The same. A valve of Aviculopecten from the Chemung group (Upper Devonic) of Allegany county, N. Y. with a series of borings all beginning at a definite growth stage of the shell beyond which shell growth has continued, indicating that the mollusk was alive when the borings were begun and continued to live while they were making

5 A valve of Spirifer granulosus from the Hamilton shales of New York, with several such borings

6 A tube cast in the valve of the brachiopod Leptostrophia perplana (Conrad). The sponge started to bore at the thickened cardinal process of the dorsal valve and on account of the thinness of the valve was compelled to make its tube broader than high. At the inner end the tube spreads out and shows a tendency to divide. x 3. From the Hamilton shales of New York

7 Another example of a flattened tube cast on a thin shelled pelecypod of the Hamilton group, N. Y.

8 Clavate borings in a valve of Leptostrophia oriskania, Oriskany limestone, Becraft mountain, N. Y., x 3

PLATE 8.

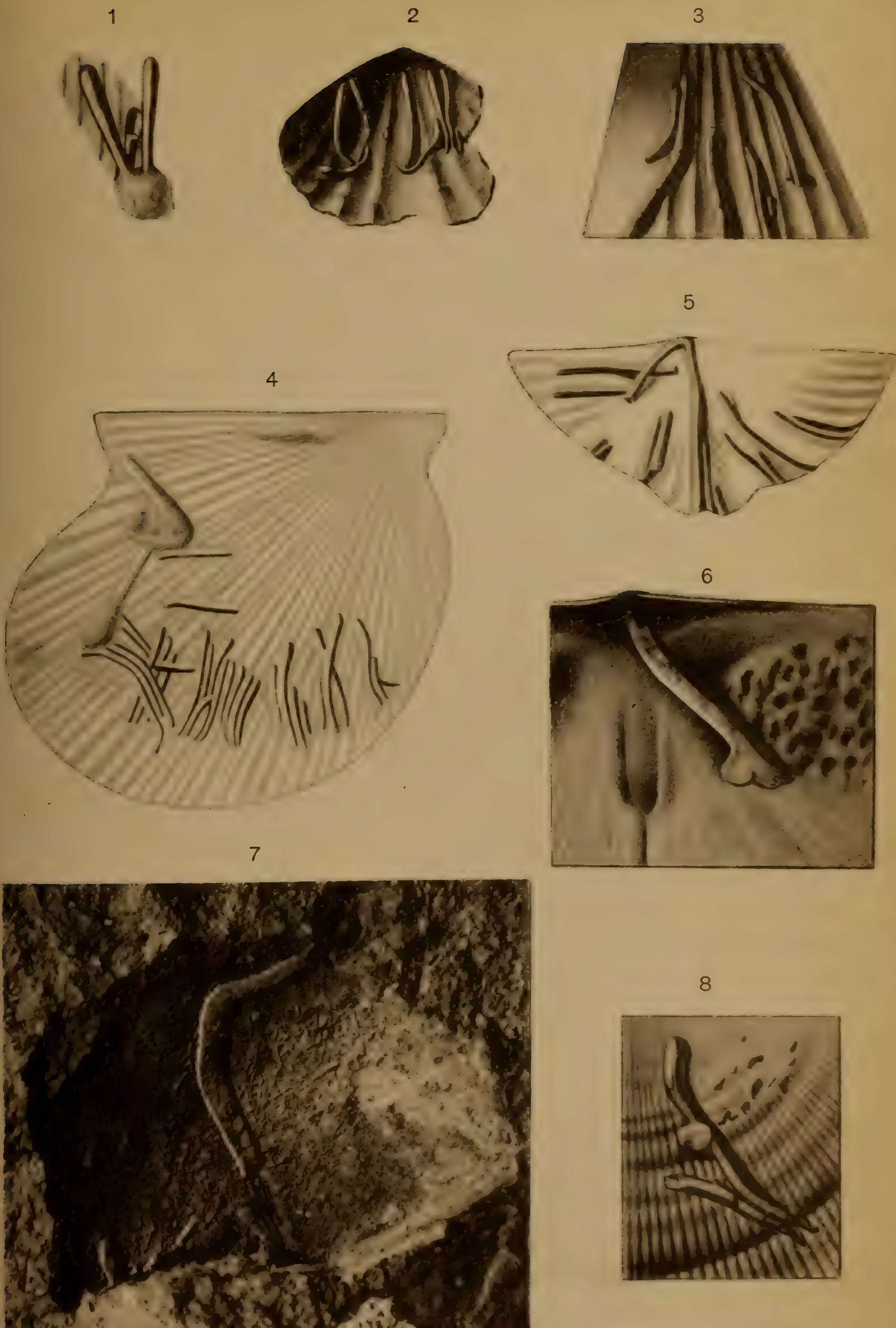

PLATE 9

1 Clionolithes priscus (McCoy). A specimen of Leptostrophia magnifica Hall, from the Grande Grève limestone (Lower Devonic) of Gaspé with several straight clavate tubes extending in from the margin of the shell. Where the shell substance has disappeared at the right of the specimen are seen numerous examples of the branched boring, Clionolithes radicans.

2 Clionolithes radicans. An etched specimen of an old shell of the brachiopod Dalmanella superstes H. & C. of the Chemung shales of New York with a multitude of irregularly branching borings riddling the shell and apparently starting inward from the shell margin. x 8

PLATE 9

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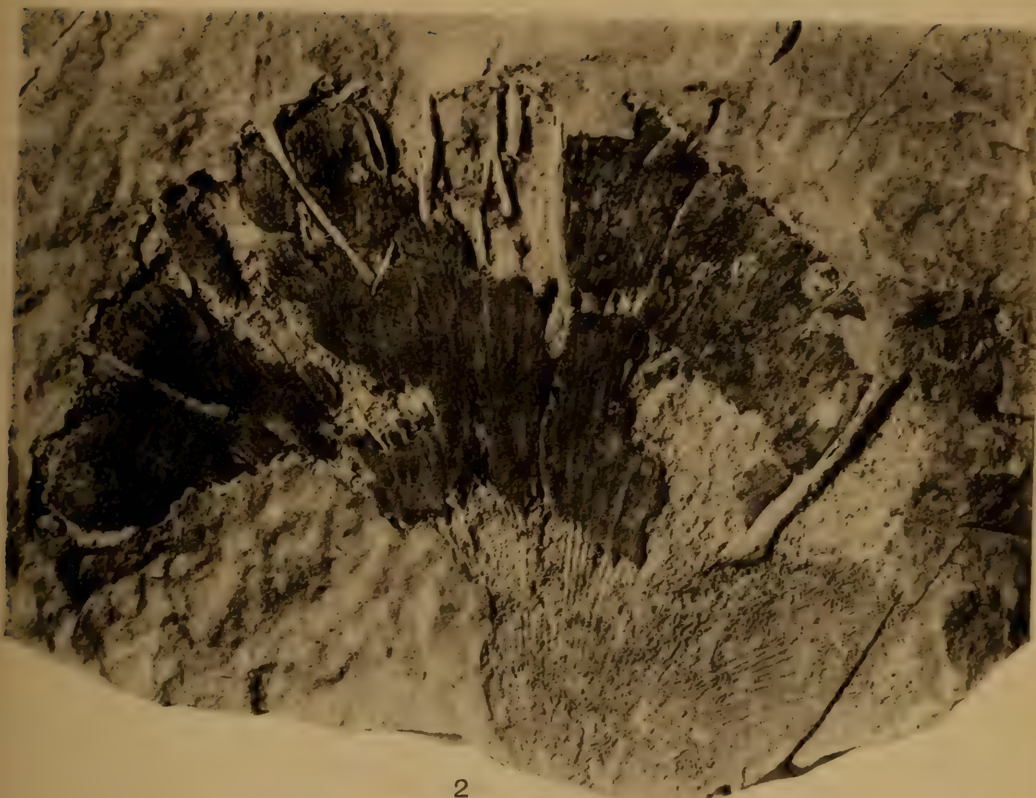


2

PLATE 10

A greatly enlarged view of an etched specimen of the brachiopod Atrypa reticularis Linné, whose outer surface has been overgrown with a monticuliporoid coral and whose shell substance was perforated with branching clusters of the tubes of Clionolithes radicans. From the Onondaga limestone, Becraft mountain, N. Y.

PLATE 10

PLATE 11

1 Clionolithes radicans, a single cluster of tube casts, x 5 in the substance of the shell of Atrypa reticularis from the Chemung sandstone of Mansfield, Pa.

2 The same. A silicified replacement of a tube cluster within the shell substance of Leptostrophia magnifica Hall, standing in relief on the surface of the valve. From an enlarged photograph, which also shows the casts of the small tubules constituting a proper part of the structure of this shell and through one of which it is probable that the sponge entered. From the Grande Grève limestone (Lower Devonic) Gaspé

3 Clinolithes reptans; sparse, diffuse tubules in the substance of a shell of Leptostrophia oriskania, Oriskany limestone, Becraft mountain, N. Y. Greatly enlarged

PLATE 11.

3

1

2

PLATE 12

1 Clionolithes palmatus. A valve of the pelecypod Loxopteria dispar Sandberger, from the Portage beds (Upper Devonic) of Correll's point, N. Y. in the substance of which this cluster of frond-shaped cavities lies. x 2

2 The same. A somewhat more diffuse cluster in the shell substance of Loxonema danai Clarke from the same formation and locality. x 5

3 Caulostrepsis taeniola. Stropheodonta cf. gigas McCoy from the Seigener schichten (Coblentzian) of Seifen. The margin of the brachiopod has been entered on all sides simultaneously by these borers forming loop-shaped tubes which are joined by a thin median cavity. Together with these are simple tube casts of Clionolithes priscus. I owe this specimen to the kindness of Prof. E. Kayser.

4 The same on Stropheodonta protaeniolata Maurer, same locality [after Maurer]

5, 6, 7 Large circular perforations in the valves of brachiopods, probably made by the radula of predatory gastropods. In figure 5 the brachiopod is Spirifer medialis Hall from the Hamilton shales of New York; figure 6, Meristella from the Oriskany limestone of Glenerie, N. Y.; and figure 7 a small Spirifer granulosus Conrad from the Hamilton rocks. In 5 and 7 the hole is on the dorsal valve and has precisely the same position with reference to the shell and the animal within which the gastropod was doubtless seeking. The hole, figure 6, has the same position on the ventral valve of Meristella. It is interesting to observe that the Spirifer in figure 5 and the Meristella in figure 6 succeeded in forestalling the purposes of the enemy by secreting a false floor beneath the hole after it had perforated the shell. Spirifer, figure 7 may have fallen a victim to the attack as the hole is not sealed. These are instructive illustrations of the early acquisition of this perforating mode of attack by the gastropods.

PLATE 12.

1

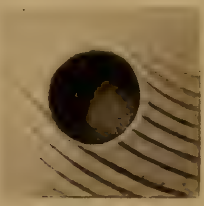
2

3

5

4

6



7

PLATE 13

A colony of the coral Favosites niagarensis Hall which has partially overgrown a small plantation of the cyathophylloid coral Amplexus, but not to such extent as to interfere with the calyces of the latter

From the Niagaran formation near Monticello, Iowa. The print has been kindly loaned by Dr Samuel Calvin.

PLATE 13

INDEX

Education Department Bulletin

Published fortnightly by the University of the State of New York

Entered as second-class matter March 3, 1908, at the Post Office at Albany, N. Y., under the act of Congress of July 16, 1894

NO. 429 ALBANY, N. Y. AUGUST 15, 1908

New York State Museum

JOHN M. CLARKE, Director

CHARLES H. PECK, State Botanist

Museum bulletin 122

REPORT OF THE STATE BOTANIST 1907

ALBANY

UNIVERSITY OF THE STATE OF NEW YORK

1908

Mb169r-F8-2000

STATE OF NEW YORK

EDUCATION DEPARTMENT

New York State Education Department
Science Division, February 3, 1908

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

My dear sir: I communicate herewith, for publication as a bulletin of the State Museum, the annual report of the State Botanist for the fiscal year ending September 30, 1907.

Very respectfully

John M. Clarke
Director

State of New York
Education Department
COMMISSIONER'S ROOM

Approved for publication this 3d day of February 1908

A. S. Draper
Commissioner of Education

Education Department Bulletin

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NO. 429 ALBANY, N. Y. AUGUST 15, 1908

New York State Museum

JOHN M. CLARKE, Director

Museum bulletin 122

REPORT OF THE STATE BOTANIST 1907

Dr John M. Clarke, Director of the State Museum:

I have the honor of submitting to you my report of work done in the botanical department of the State Museum during the year 1907.

Specimens of plants have been collected in the counties of Albany, Greene, Herkimer, Jefferson, Oneida, Onondaga, Putnam, Rensselaer, Saratoga and Steuben.

Specimens of plants have been contributed by correspondents and others which were collected in the counties of Albany, Essex, Franklin, Herkimer, Monroe, New York, Onondaga, Ontario, Orleans, Richmond, Seneca, Steuben, Tompkins, Ulster, Warren and Washington.

The number of species of which specimens have been added to the herbarium is 203. Of these, 82 are new to the herbarium, 121 are not. Of those new to the herbarium, 45 are new species, 38 being species of Crataegus, 7 of fungi. A list of the names of the added species is given under the caption, " Species added to the herbarium."

The number of those who have contributed specimens is 72. This includes those who have contributed specimens of extralimital species and also those who have sent specimens for identification merely, if the specimens were rare or if for any other reason they were considered desirable or worthy of preservation. A list of the names of contributors and of their respective contributions is given under the heading " Contributors and their contributions." Under the heading, " Species not before reported " may be found the names of species added to our flora, with localities, remarks and descriptions of new species, except in species of the genus Crataegus. Localities and descriptions of new species of these are given in the three papers on this subject in another part of the report. These papers have been prepared and kindly contributed by the eminent and expert dendrologist, Prof. C. S. Sargent. Unfortunately many of these species are not represented in our collection by specimens and can not yet be counted as additions to the herbarium. The whole number of species of this genus added to our flora is 88, making the number of New York species of this genus now known 185. But specimens of nearly all the new species credited to Coopers Plains and vicinity have been collected by the writer, and with the specimens contributed by Mr G. D. Cornell, these species are with one or two exceptions all now represented in the herbarium.

The past season, in its relation to the mushroom crop has been very similar to that of 1906. Early in the season there were sufficient rains but cool weather. These conditions were followed by a long period of dry weather unfavorable to the mushroom growth, and crowding it into a short period late in the season. The number of species whose edible qualities have been tried and approved is 8. These have been illustrated on five plates and described as in the plan followed in the preceding report. The whole number of New York edible species now illustrated is 191. The number of plates illustrating them and the poisonous and unwholesome species is 114.

A revision has been made of the New York species of the somewhat difficult genus Pholiota. The number of species now recognized as belonging to it is 32. Revised descriptions of these have been written and a key prepared to facilitate the tracing of the species to their respective descriptions.

The number of those seeking information from the botanical department concerning the identity of plants or their character is 117. The number of identifications made is 891.

My assistant, Mr Stewart H. Burnham, has disinfected the collections of 1906 which needed such treatment, labeled and arranged them in their proper places, assisted in conducting the correspondence of the office, in the identification of specimens of inquirers and in giving them the desired information. He has prepared a typewritten catalogue of the species of fungi described by the State Botanist, and made a typewritten copy of the present report.

Respectfully submitted

CHARLES H. PECK

Albany, December 31, 1907 *State Botanist*

SPECIES ADDED TO THE HERBARIUM

New to the herbarium

Ajuga reptans *L.*
Biatora prasina *Fr.*
Biatorella simplex (*Dav.*) *B. & R.*
Boletus niveus *Fr.*
Centaurea solstitialis *L.*
Cetraria glauca (*L.*) *Ach.*
Chaetomium sphaerospermum *C. & E.*
Cladonia bacillaris (*Del.*) *Nyl.*
Clitocybe subcyathiformis *Pk.*
Clitopilus subplanus *Pk.*
Crataegus acerba *S.*
C. affinis *S.*
C. amoena *S.*
C. anomala *S.*
C. barryana *S.*
C. bella *S.*
C. claytoniana *S.*
C. comans *S.*
C. cornellii *S.*
C. desueta *S.*
C. dewingii *S.*
C. dissociabilis *S.*
C. diversa *S.*
C. floridula *S.*
C. frutescens *S.*
C. fucata *S.*
C. gracilis *S.*
C. ignea *S.*
C. inopinata *S.*
C. insignata *S.*
C. inusitula *S.*
C. limosa *S.*
C. macrocalyx *S.*
C. nescia *S.*
C. numerosa *S.*
C. ovatifolia *S.*
C. pellecta *S.*
C. plana *S.*
C. ramosa *S.*
C. recta *S.*
C. repulsans *S.*
Crataegus rubrolutea *S.*
C. singularis *S.*
C. spatifolia *S.*
C. spinifera *S.*
C. spissa *S.*
C. steubenensis *S.*
C. structilis *Ashe*
C. suavis *S.*
C. suborbiculata *S.*
C. uncta *S.*
C. verrucalis *Pk.*
Cronartium ribicola *Dietr.*
Diaporthe parasitica *Murr.*
Flammula pulchrifolia *Pk.*
Galium erectum *Huds.*
Hygrophorus coloratus *Pk.*
H. lacmus *Fr.*
Hypocrea polyporoidea *B. & C.*
Lactarius minusculus *Burl.*
Leaia piperata *Banker*
Lecidea platycarpa *Ach.*
Lophiotrema semiliberum (*Desm.*)
Lotus corniculatus *L.*
Metzgeria conjuncta *Lindb.*
Monilia crataegi *Diedicke*
Myxosporium necans *Pk.*
Nolanea suaveolens *Pk.*
Parmelia cetrata *Ach.*
P. perforata (*Jacq.*) *Ach.*
Pholiota duroides *Pk.*
Physcia hypoleuca (*Muhl.*) *Tuck.*
Polyporus spraguei *B. & C.*
Polystictus montagnei *Fr.*
Rinodina oreina (*Ach.*) *Mass.*
Russula aeruginea *Fr.*
Sphaeropsis lyndonvillae *Sacc.*
S. persicae *E. & B.*
Stereocaulon coralloides *Fr.*
Stropharia bilamellata *Pk.*
Trentepohlia umbrina (*Kütz.*) *Born.*
Tubercularia davisiana *Sacc. & Trav.*
Viola vagula *Greene*

Not new to the herbarium

Aecidium clematidis *DC.*
Ae. grossulariae (*Gmel.*) *Schum.*
Agaricus arvensis *Schaeff.*
Alsine longifolia (*Muhl.*) *Britton*
Amanita caesarea *Scop.*
A. formosa *G. & R.*
A. phalloides *Fr.*
A. rubescens *Fr.*
Amanitopsis farinosa (*Schw.*)
A vaginata (*Bull.*) *Roze*
Aronia nigra (*Willd.*) *Britton*
Aster divaricatus *L.*
A. panic. bellidiflorus (*Willd.*)
Blitum capitatum *L.*
Boletus albocarneus *Pk.*
B. castaneus *Bull.*
B. chromapes *Frost*
B. clintonianus *Pk.*
B. elbensis *Pk.*
B. nebulosus *Pk.*
B. ravenelii *B. & C.*
B. subaureus *Pk.*
B. subtomentosus *L.*
Calvatia elata (*Mass.*) *Morg.*
Cantharellus cibarius *Fr.*
C. cinnabarinus *Schw.*
C. floccosus *Schw.*
C. minor *Pk.*
Carya amara *Nutt.*
C. glabra odorata *Sarg.*
Castanea dentata *Borkh.*
Chrysanthemum leucanthemum *L.*
Clitocybe amethystina (*Bolt.*)
C. candicans *Fr.*
C. laccata (*Scop.*) *Fr.*
Clitopilus caespitosus *Pk.*
Collybia acervata *Fr.*
C. dryophila (*Bull.*) *Fr.*
C. lacunosa *Pk.*
C. platyphylla *Fr.*
Conringia orientalis (*L.*) *Dum.*
Cortinarius torvus *Fr.*
Crataegus bissellii *S.*
C. uniflora *Muench.*
Cypripedium arietinum *R. Br.*
Cystopus amaranthi *Berk.*
Dasystoma virginica (*L.*) *Britton*
Deconica bullacea *Bull.*
Dryopteris goldieana (*Hook.*) *Gray*
Eleocharis ovata (*Roth*) *R. & S.*
Erysimum cheiranthoides *L.*
Erysiphe polygoni *DC.*
Euphorbia polygonifolia *L.*
Flammula lubrica *Fr.*
Fraxinus lanceolata *Borck.*
F. pennsylvanica *Marsh.*
Fuligo ovata (*Schaeff.*) *Macb.*
Fusisporium destruens *Pk.*
Galium mollugo *L.*
Habenaria blephariglottis (*Willd.*)
H. ciliaris (*L.*) *R. Br.*
Helotium citrinum (*Hedw.*) *Fr.*
Helvella infula *Schaeff.*
Hydnum fennicum *Karst.*
H. septentrionale *Fr.*
Hygrophorus borealis *Pk.*
H. ceraceus *Fr.*
H. coccineus (*Schaeff.*)
H. marginatus *Pk.*
H. pratensis (*Pers.*) *Fr.*
Hypholoma candolleanum *Fr.*
H. capnoides *Fr.*
H. incertum *Pk.*
H. subaquilum *Banning*
H. sublateritium (*Schaeff.*)
Lactarius camphoratus *Fr.*
L. insulsus *Fr.*
L. oculatus (*Pk.*) *Burl.*
L. subdulcis *Fr.*
L. varius *Pk.*
Lentinus spretus *Pk.*
Lenzites sepiaria *Fr.*
Lepiota acerina *Pk.*
Lycoperdon gemmatum *Batsch*
L. glabellum *Pk.*
L. subincarnatum *Pk.*
Marasmius glabellus *Pk.*
M. minutus *Pk.*
M. subnudus (*Ellis*) *Pk.*
Mycena rosella *Fr.*
Panus torulosus *Fr.*
Paxillus involutus *Batsch*
Phlebia radiata *Fr.*
Pholiota aggericola *Pk.*

Pholiota caperata *Fr.*
P. discolor *Pk.*
P. praecox *Pers.*
Polyporus adustus *Willd.*
P. betulinus *Fr.*
P. caesius *Fr.*
P. cuticularis (*Bull.*) *Fr.*
Polystictus biformis *Klotz.*
P. pergamenus *Fr.*
Psilocybe conissans *Pk.*
Puccinia andropogonis *Schw.*
P. coronata *Cd.*
Russula crustosa *Pk.*
Russula decolorans *Fr.*
R. emetica *Fr.*
R. fallax *Fr.*
R. obscura *Rom.*
R. ochrophylla *Pk.*
R. pectinatoides *Pk.*
R. squalida *Pk.*
R. uncialis *Pk.*
R. variata *Banning*
R. virescens *Schaeff.*
Salix serissima (*Bail.*) *Fern.*
Thelephora palmata (*Scop.*) *Fr.*
Tricholoma personatum *Fr.*
T. vaccinum *Pers.*

CONTRIBUTORS AND THEIR CONTRIBUTIONS

Miss H. C. Anderson, Lambertville, N. J.

Russula vesca *Fr.*
Sclerotinia tuberosa (*Hedw.*) *Fckl.*

Miss G. S. Burlingham, Mexico

Lactarius aspideoides *Burl.*
L. bensleyae *Burl.*
Lactarius circellatus (*Batt.*) *Fr.*
Peckiella hymenioides *Pk.*

Mrs E. B. Blackford, Boston, Mass.

Boletus gracilis laevipes *Pk.*
Omphalia serotina *Pk.*

Miss M. C. Burns, Middleville

Cantharellus floccosus *Schw.*

Mrs G. M. Dallas, Philadelphia, Pa.

Oxydendrum arboreum (*L.*) *DC.*

Mrs H. C. Davis, Falmouth, Me.

Helvella infula *Schaeff.*

Mrs L. L. Goodrich, Syracuse

Chrysanthemum leucantheum tubuliforme (*Tenney*)

Mrs C. W. Harris, Brooklyn

Biatora chlorantha *Tuck.*
B. laureri (*Hepp.*) *Tuck.*
Cetraria ciliaris (*Ach.*) *Tuck.*
C. glauca (*L.*) *Ach.*
C. lacunosa *Ach.*
C. oakesiana *Tuck.*
Cladonia bacillaris (*Del.*) *Nyl.*
C. caespiticia (*Pers.*) *Flk.*
C. cristatella *Tuck.*
C. delicata (*Ehrh.*) *Fr.*
C. fimb. coniocraea (*Flk.*)
C. fimb. tubaeformis *Fr.*

Cladonia furcata *(Huds.) Schrad.*
C. furc. paradoxa *Wainio.*
C. grac. dilatata *(Hoffm.)*
C. pyx. chlorophaea *(Spreng.)*
C. pyx. neglecta *(Flk.)*
C. rangiferina (L.) *Hoffm.*
C. turgida *(Ehrh.) Hoffm.*
C. verticillata *Hoffm.*
Evernia furfuracea *(L.) Mann.*
E. prunastri *(L.) Ach.*
Graphis scripta *Ach.*
Lecanora pallida *(Schreb.) Schaer.*
L. subfusca *(L.) Ach.*
Parmelia borreri rudecta *Tuck.*
P. olivacea *(L.) Ach.*
P. oliv. panniformis *Nyl.*
P. perforata *(Jacq.) Ach.*
Parmelia perlata *(L.) Ach.*
P. physodes *(L.) Ach.*
P. saxatilis *(L.) Fr.*
P. saxatilis sulcata *Nyl.*
Peltigera horizontalis *(L.) Hoffm.*
Pertusaria communis *DC.*
P. velata *(Turn.) Nyl.*
Physcia aquila detonsa *Tuck.*
Pyrenula nitida *Ach.*
Pyxine sorediata *Ach.*
Ramalina calic. fastigiata *Fr.*
Stereocaulon coralloides *Fr.*
Sticta amplissima *(Scop.) Mass.*
S. pulmonaria *(L.) Ach.*
Umbilicaria pust. papulosa *Tuck.*
Usnea barbata ceratina *Schaer.*
U. barbata florida *Fr.*

Miss A. Hibbard, West Roxbury, Mass.

Lactarius hibbardae *Pk.*

Miss M. F. Miller, Washington, D. C.

Metzgeria conjugata *Lindl.*

Miss A. M. Patterson, Stanford University, Cal.

Agaricus pattersonae *Pk.*
Amanitopsis velosa *Pk.*
Hypholoma appendiculatum *(Bull.)*
H. longipes *Pk.*
Lactarius rufulus *Pk.*
Lactarius xanthogalactus *Pk.*
Pleurotus olearius *DC.*
Pluteolus luteus *Pk.*
Psathyrella caespitosa *Pk.*
Tricholoma personatum *Fr.*
Volvaria speciosa *Fr.*

Mrs A. M. Smith, Brooklyn

Alsia abietina *Sull.*
Antitrichia californica *Sull.*
Aulacomnium androgynum *Schwaegr.*
Claopodium crispifolium *(Hook.)*
Dicranoweisia cirrhata *Lindl.*
Dicranum bonjeani *DeNot.*
D. fuscescens *Turn.*
D. scoparium *Hedw.*
Eurhynchium oreganum *(Sull.)*
E. stokesii *B. & S.*
E. stoloniferum *(Hook.)*
Fontinalis antipyretica *L.*
Fontinalis kindbegii *R. & C.*
Hylocomium loreum *(L.) Schimp.*
H. proliferum *(L.) Lindb.*
H. triquetrum *(L.) B. & S.*
Isothecium brewerianum *L. & J.*
Neckera douglasii *Hook.*
N. menziesii *Drumm.*
Philonotis fontana *Brid.*
Plagiothecium undulatum *B. & S.*
Polytrichum juniperinum *Willd.*
Racomitrium canescens *Brid.*
Scleropodium caespitosum *B. & S.*
S colpophyllum *(Sull.) Grout.*

Miss T. L. Smith, Worcester, Mass.

Coprinus jonesii *Pk.*

Miss J. B. Spruance, Katahdin Iron Works, Me.

Gomphidius flavipes *Pk.*

Miss M. L. Sutliff, Sacramento, Cal.

Omphalia pyxidata (*Bull.*) *Fr.*
Polyporus volvatus *Pk.*

Mrs E. Watrous, Hague

Cypripedium arietinum *R. Br.*
Dryopteris goldieana (*Hook.*) *Gray*
Helvella gracilis *Pk.*
Phegopteris polypodioides *Fee*
Polystichum braunii (*Spenner*) *Fee*

Miss M. T. Wheeler, Keene Valley

Blitum capitatum *L.*

J. C. Arthur, Lafayette, Ind.

Puccinia agropyri *E. & E.*
Puccinia crandallii *P. & H.*

E. Bartholomew, Stockton, Kan.

Calvatia rubroflava (*Crag.*) *Morg.*
Collybia subsulphurea *Pk.*
Lactarius vellereus *Fr.*
Lycoperdon pulcherrimum *B. & C.*
Tylostoma mammosum *Fr.*

M. S. Baxter & V. Dewing, Rochester

Carex tribuloides reducta *Bailey*
Cyperus filic. macilentus *Fernald*
Eleocharis ovata (*Roth.*) *R. & S.*
Euphorbia polygonifolia *L.*
Meibomia paniculata (*L.*) *Kuntze*
Polygonum lapathifolium *L.*
Senecio obovatus *Muhl.*
Sisymbrium altissimum *L.*

H. C. Beardslee, Ashville, N. C.

Amanita russuloides *Pk.*

H. Blauvelt, Coeymans

Fusicladium pirinum (*Lib.*) *Fckl.*

F. S. Boughton, Pittsford

Lentinus lepideus *Fr.*

C. W. Boyd, Tupper Lake

Clavaria fistulosa *Fr.*

F. J. Braendle, Washington, D. C.

Amanita coccola *Scop.*
Amanitopsis volvata (*Pk.*) *Sacc.*
Armillaria mucida (*Schrad.*) *Pers.*
Pholiota confragosa *Fr.*
Pleurotus lignatilis *Fr.*
P. ostreatus (*Jacq.*) *Fr.*
Polyporus brumalis (*Pers.*) *Fr.*

S. H. Burnham, Sandy Hill

Biatorella simplex (*Dav.*) *B. & R.*
Clitocybe laccata *Scop.*
Clitopilus caespitosus *Pk.*
Cortinarius croceus *Fr.*
Crepidotus croceitinctus *Pk.*
Geoglossum nigritum (*Fr.*) *Cke.*
Hygrophorus lacmus *Fr.*
Lecidea platycarpa *Ach.*
Polyporus admirabilis *Pk.*
P. hispidus (*Bull.*) *Fr.*
Rinodina oreina (*Ach.*) *Mass.*
Salix candida *Fluegge*
Viola vagula *Greene*

G. H. Chadwick, Albany

Calyptospora goeppertiana *Kühn*
Geaster hygrometricus *Pers.*
Morchella esculenta (*Pers.*) *Fr.*

T. T. Clohessy, Utica

Russula aeruginea *Fr.*

G. D. Cornell, Coopers Plains

Crataegus acerba *S.*
C. amoena *S.*
C. dissociabilis *S.*
C. diversa *S.*
C. frutescens *S.*
C. fucata *S.*
C. gracilis *S.*
C. inopinata *S.*
Crataegus numerosa *S.*
C. pellecta *S.*
C. plana *S.*
C. ramosa *S.*
C. repulsans *S.*
C. rubrolutea *S.*
C. suavis *S.*
C. uncta *S.*

J. J. Davis, Racine, Wis.

Aecidium laricis *Kleb.*
Phytopthora thalictri *Wils. & Dav.*

S. Davis, Boston, Mass.

Clavaria amethystinoides *Pk.*
C. ornatipes *Pk.*
Cortinarius nigrellus *Pk.*
Deconica bryophila *Pk.*
Eccilia cinericola *Pk.*
E. subacus *Pk.*
Entoloma deminutivum *Pk.*
E. murinum *Pk.*
Flammula betulina *Pk.*
Galera hypnorum (*Batsch*) *Fr.*
Helvella macropus brevis *Pk.*
Hygrophorus peckii *Atk.*
Hypholoma candolleanum *Fr.*
Inocybe agglutinata *Pk.*
I. decipiens *Bres.*
Inocybe fuscodisca (*Pk.*) *Mass.*
I. hirtellum *Bres.*
I. infelix *Pk.*
I. praetervisa *Quel.*
I. proximella *Karst.*
I. rimosa (*Bull.*) *Fr.*
Leotia punctipes *Pk.*
Naucoria sororia *Pk.*
Omphalia gerardiana *Pk.*
Panaeolus papilionaceus *Fr.*
Pholiota marginella *Pk.*
Psathyrella betulina *Pk.*
Russula pusilla *Pk.*
Tricholoma personatum *Fr.*
Tubaria furfuracea *Pers.*

W. T. Davis, New Brighton

Crataegus uniflora *Muench.*

J. Dearness, London, Ont.

Dermatea crataegicola *Durand*
Diaporthe microstroma *E. & E.*
D. ulmicola *E. & E.*
Didymosphaeria thalictri *E. & D.*
Puccinia caricis-asteris *Arth.*
Pucciniastrum potentillae *Kom.*

F. Dobbin, Shushan

Biatora prasina *Fr.*
Cladonia digit. ceruchoides *Wain.*
Parmelia cetrata *Ach.*
Physcia hypoleuca (*Muhl.*) *Tuck.*
Rinodina constans (*Nyl.*) *Tuck.*
Trentepohlia umbrina (*Kütz.*) *Born.*

E. J. Durand, Ithaca

Microglossum viride (*Pers.*) *Boud.*
Sclerotinia fructigena (*Pers.*)

S. C. Edwards, New Brighton

Armillaria mellea *Vahl*
Fomes annosus *Fr.*
Lenzites sepiaria *Fr.*

C. E. Fairman, Lyndonville

Eutypella angulosa (*Nke.*) *Sacc.*
Lophiotrema semiliberum (*Desm.*)
Ophiochaete herpotricha (*Fr.*) *Sacc.*
Sphaeropsis lyndonvillae *Sacc.*
Sphaeropsis persicae *E. & B.*

G. B. Fessenden, Boston, Mass.

Clitocybe subnigricans *Pk.*

O. E. Fischer, Detroit, Mich.

Clitocybe pulcherrima *Pk.*
C. morbifera *Pk.*
Fistulina pallida *B. & R.*
Pleurotus elongatipes *Pk.*

N. M. Glatfelter, St Louis, Mo.

Boletus pachypus *Fr.*
Boletus subglabripes *Pk.*
Pluteus leoninus coccineus *Cke.*

F. O. Grover, Oberlin, O.

Dothiorella aberrans *Pk.*

C. Guillet, Toronto, Ont.

Claudopus nidulans (*Pers.*) *Pk.*
Clitocybe nobilis *Pk.*
Collybia hirticeps *Pk.*
Geaster limbatus *Fr.*
Omphalia curvipes *Pk.*
O. vestita *Pk.*
Sarcoscypha coccinea (*Jacq.*) *Fr.*

C. C. Hanmer, East Hartford, Conn.

Leptoglossum microsporum (*C. & P.*) *Sacc.*

W. E. Harding, Linden

Centaurea solstitialis *L.*

G. G. Hedgcock, St Louis, Mo.

Ceratostromella moniliformis *Hedgcock*

G. T. Howell, Rockville, Ind.

Daedalea confragosa (*Bolt.*) *Pers.*
Hypholoma rugocephalum *Atk.*
Lentinus cochleatus *Fr.*
Lentinus microspermus *Pk.*
L. vulpinus *Fr.*
Mycena leaiana *Berk.*

C. E. Jones, Selkirk

Conringia orientalis (*L.*) *Dum.*
Lotus corniculatus *L.*

C. H. Kauffman, Ann Arbor, Mich.

Boletus atkinsoni *Pk.*
Collybia campanella *Pk.*
Clitopilus conissans *Pk.*
Cortinarius rubripes *Pk.*
Entoloma peckianum *Burt*
Hydnum kauffmani *Pk.*
Pleurotus porrigens *Pers.*
Polyporus aurantiacus *Pk.*
P. osseus *Kalchb.*
Polystictus velutinus *Fr.*
Poria fuscocarnea *Pers.*

R. H. Lane, Jolon, Cal.

Mycena acicula (*Schaeff.*) *Fr.*

G. G. Lansing, Romulus

Laestadia bidwellii *Ellis*

W. H. Leibelsperger, Fleetwood, Pa.

Cordyceps herculea (*Schw.*) *Sacc.*

C. G. Lloyd, Cincinnati, O.

Phycomyces nitens (*Ag.*) *Kze.*

J. McPherson, Trenton, N. J.

Phoenix dactylifera L. (undeveloped fruit)

A. P. Morgan, Harrison, O.

Marasmius siccus *Schw.*

G. E. Morris, Waltham, Mass.

Amanita porphyria *Fr.*
Badhamia lilacina (*Fr.*) *Rost.*
Balansia hypoxylon (*Pk.*) *Atk.*
Clavaria platyclada *Pk.*
Clitocybe adirondackensis *Pk.*
Cortinarius multiformis *Fr.*
C. rigidus (*Scop.*) *Fr.*
Entoloma variabile *Pk.*
Fuligo ovata (*Schaeff.*) *Macbr.*
Geoglossum americanum *Cke.*
Guepinia aurea *Mont.*
Helvella gracilis *Pk.*
Hygrophorus borealis *Pk.*
Hygrophorus caprinus (*Scop.*) *Fr.*
H. lacmus *Fr.*
Leotia chlorocephala *Schw.*
Leptonia abnormis *Pk.*
Marasmius siccus *Schw.*
Mycena epipterygia *Scop.*
M. galopoda *Fr.*
Nolanea conica *Pk.*
Panus strigosus *B. & C.*
Pholiota duroides *Pk.*
Polyporus volvatus *Pk.*
Tricholoma grammopodium (*Bull.*) *Fr.*
Tylostoma americanum *Lloyd*

G. E. Morris & S. Davis, Mass.

Entoloma modestum *Pk.*
Mycena alcalina *Fr.*
Naucoria tabacina bicolor *Pk.*

W. A. Murrill, New York

By exchange

Diaporthe parasitica *Murrill*

J. J. Neuman, Horicon, Wis.

Hydnum sulcatipes *Pk.*
Irpex nodulosus *Pk.*
Myriadoporus induratus *Pk.*
Poria medulla-panis (*Pers.*) *Fr.*
P. obducens *Pers.*
Steccherinum adustulum *Banker*

R. S. Phifer, Danville, Va.

Lycoperdon pulcherrimum *B. & C.*

R. R. Riddell, Albany

Lepiota naucinoides *Pk.*

F. J. Seaver, New York

Cordyceps militaris (*L.*) *Link*
Gloniopsis smilacis (*Schum.*)
Hypocrea gelatinosa (*Tode*) *Fr.*
H. patella *C. & P.*
Hypoderma commune (*Fr.*) *Duby*
Hypomyces aurantius (*Pers.*) *Fckl.*
Hypoxylon sassafras *Schw.*
Nectria aureofulva *C. & E.*
N. cinnabarina (*Tode*) *Fr.*
Rosellinia aquila (*Fr.*) *DeNot.*

E. B. Sterling, Trenton, N. J.

Hygrophorus psittacinus (*Schaeff.*)
Lycoperdon gemmatum *Batsch*
Russula pusilla *Pk.*
Tricholoma fumidellum *Pk.*
Volvaria speciosa *Fr.*

F. C. Stewart, Geneva

Cronartium ribicola *Dietr.*

D. R. Sumstine, Wilkinsburg, Pa.

Collybia hirticeps *Pk.*
Flammula eccentrica *Pk.*
Monilia aureofulva *C. & E.*
Rhinotrichum sumstinei *Pk.*
Thelephora caryophyllea (*Schaeff.*)
Zygodesmus pannosus *B. & C.*
Zygodesmus rubiginosus *Pk.*

H. von Schrenk, St Louis, Mo.

Lepiota xylophila *Pk.*

J. M. Van Hook, Wooster, O.

Flammula betulina *Pk.*
Russula compacta *Frost*

H. L. Wells, New Haven, Conn.

Lepiota americana *Pk.*
Tricholoma alboflavidum *Pk.*
Tricholoma columbetta *Fr.*

F. B. Wheeler, Syracuse

Cortinarius lilacinus *Pk.*
Lactarius turpis *Fr.*
Sporodina aspergillus (*Scop.*) *Schroet.*

T. E. Wilcox, Washington, D. C.

Boletus bicolor *Pk.*
B. caespitosus *Pk.*
B. chrysenteron *Fr.*
B. retipes *B. & C.*
B. subsanguineus *Pk.*
Hydnum fennicum *Karst.*
Phylloporus rhodoxanthus (*Schw.*)
Polystictus sanguineus (*L.*) *Mey.*
Russula chamaeleontina *Fr.*
R. crustosa *Pk.*
R. rugulosa *Pk.*
Tricholoma personatum *Fr.*

B. C. Williams, Newark

Stropharia bilamellata *Pk.*

H. C. Wilson, Peabody, Mass.

Russula pectinatoides *Pk.*

D. B. Young, Albany

Marasmius minutus *Pk.*

SPECIES NOT BEFORE REPORTED

Ajuga reptans L.

In waste grassy places. Remsen, Oneida co. June. Introduced from Europe and sparingly naturalized.

Biatora prasina Fr.

Bark of sugar maple, Acer saccharum L. Shushan, Washington co. March. Frank Dobbin.

Biatorella simplex (Dav.) B. & R.

Rocks. Helderberg mountains. July. S. H. Burnham. This is Lecanora privigna (Ach.) Nyl.

Boletus niveus Fr.

Sandy soil. Karner, Albany co. August. This has by some been considered a white variety of Boletus scaber Fr. It appears to us to be worthy of specific distinction, for it differs from that species not only in the color of the pileus but also in its smaller tubes and in the character of the stem, which is adorned with mere scurfy or appressed squamules instead of the conspicuous dotlike fibrous scales of the stem of B. scaber.

Centaurea solstitialis L.

Linden, Genesee co. August. W. E. Harding. This plant was introduced from Europe into California many years ago. Whether the plant has come here from the west or is the result of a more recent introduction from Europe is uncertain.

Cetraria glauca (L.) Ach.

On dead hemlock, Tsuga canadensis Carr. Panther mountain, Essex co. June. Mrs C. W. Harris.

Chaetomium sphaerospermum C. & E.

Bottom of a barrel standing in a damp cellar. Menands, Albany co. September. The spores in our specimens vary from globose to broadly elliptic and from .0003–.0004 of an inch in diameter.

Cladonia bacillaris (Del.) Nyl.

Decaying wood. Adirondacks. July. Mrs C. W. Harris.

Cladonia delicata (Ehrh.) Fl.

Decaying wood. Near Chilson lake, Essex co. August. Mrs C. W. Harris. Sand Lake, Rensselaer co. C. H. Peck. This was formerly reported as a variety of Cladonia squamosa, but it is now deemed worthy of specific distinction.

Clavaria ornatipes n. sp.

Clubs 1–2 inches tall, gregarious, sparingly branched; stem slender hairy, fuscous or brown, the branches irregular, terete, whitish, grayish or cinereous, the tips acute or obtuse; spores broadly elliptic or subglubose, .0003–.00045 of an inch long, .00024–.0003 broad.[1]

In low swampy woods, usually among mosses. Sand Lake.

In New York State Museum Report 24, page 82 this was referred to Clavaria trichopus Pers. After seeing specimens of it from other localities and finding it constantly differing from the descriptions of that species, which is called "snowy white" and is much branched, it has seemed to us to be distinct.

Clitocybe subcyathiformis Pk.

In damp places under shrubs. Karner. October. For the description of this species see article on "Edible Fungi."

Clitopilus subplanus n. sp.

Pileus thin, broadly convex or nearly plane, slightly depressed in the center or distinctly umbilicate, glabrous, whitish or grayish white, flesh white; lamellae thin, close, adnate or slightly decurrent, dingy flesh colored; stem slender, glabrous, terete or compressed, stuffed or hollow, colored like the pileus; spores flesh colored, angular, uninucleate, .0004–.0005 of an inch long, 00024–.0003 broad.

Pileus 1–1.5 inches broad; stem 1–1.5 inches long, 1–2 lines thick.

Among fallen leaves and decaying vegetable matter in woods. Sand Lake, Rensselaer co. and Gansevoort, Saratoga co. July and August.

This is closely related to Clitopilus carneoalbus With. from which I have separated it because of the more umbilicate

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[1] Latin descriptions of this and other new species may be found in the last chapter of this report.

pileus, the absence of any reddish tints in the pileus, its stuffed or hollow stem and specially of its larger spores which are longer than broad.

Crataegus anomala Sarg.

Crown Point, Essex co. and Fort Ann, Washington co. Flowers in May, fruit ripens in September. The plants now referred to this species were formerly credited to C. exclusa Sarg. from which they may be separated by the fruit which is distinctly narrowed toward the base. The species was founded on specimens collected in Canada.

Crataegus suborbiculata Sarg.

Letchworth park, Wyoming co. Flowers in May, fruit ripens the last week in September. This species also was founded on specimens collected in Canada. It is placed in the group Punctatae.

The following species of Crataegus are here reported by name only as additions to our flora. The names are arranged under their respective groups. Nearly all are new species of which descriptions, localities and remarks are contained in the three chapters on Crataegus, immediately following the present one.

CRUS-GALLI

Crataegus arduennae *S.*
C. cerasina *S.*
C. geneseensis *S.*
C. robusta *S.*

PUNCTATAE

Crataegus barbara *S.*
C. celsa *S.*
C. desueta *S.*
C. dewingii *S.*
C. notabilis *S.*

PRUINOSAE

Crataegus acerba *S.*
C. amoena *S.*
C. aridula *S.*
C. barryana *S.*
C. bronxensis *S.*
C. clintoniana *S.*
C. congestiflora *S.*
C. cruda *S.*
Crataegus dissociabilis *S.*
C. foliata *S.*
C. gracilis *S.*
C. implicata *S.*
C. inusitula *S.*
C. livingstoniana *S.*
C. macera *S.*
C. macrocalyx *S.*
C. numerosa *S.*
C. oblita *S.*
C. ovatifolia *S.*
C. pellecta *S.*
C. placiva *S.*
C. plana *S.*
C. promissa *S.*
C. pulchra *S.*
C. radiata *S.*
C. ramosa *S.*
C. rubrolutea *S.*
C. strigosa *S.*
C. tortuosa *S.*
C. uncta *S.*
C. xanthophylla *S.*

TENUIFOLIAE

Crataegus bella *S.*
C. boothiana *S.*
C. claytoniana *S.*
C. conferta *S.*
C. fucata *S.*
C. gracilipes *S.*
C. ignea *S.*
C. insignata *S.*
C. leptopoda *S.*
C. luminosa *S.*
C. nescia *S.*
C. recta *S.*
C. slavini *S.*
C. spatifolia *S.*
C. suavis *S.*

MOLLES

Crataegus radians *S.*

FLABELLATAE

Crataegus dayana *S.*
C. gloriosa *S.*
C. letchworthiana *S.*
C. limosa *S.*
C. steubenensis *S.*

COCCINEAE

Crataegus chateaugayensis *S.*
C. harryi *S.*
Crataegus neobaxteri *S.*
C. puberis *S.*
C. spissa *S.*
C. verrucalis *Pk.*

INTRICATAE

Crataegus cornellii *S.*

ANOMALAE

Crataegus affinis *S.*
C. brachyloba *S.*
C. floridula *S.*
C. inopinata *S.*
C. repulsans *S.*
C. simulans *S.*
C. singularis *S.*

TOMENTOSAE

Crataegus admiranda *S.*
C. calvini *S.*
C. comans *S.*
C. efferata *S.*
C. finitima *S.*
C. frutescens *S.*
C. honeoensis *S.*
C. spinifera *S.*
C. structilis *Ashe*
C. venustula *S.*

Cronartium ribicola Dietr.

On living leaves of black currant, Ribes nigrum L. Agricultural Experiment station grounds. Geneva. September 26, 1906. F. C. Stewart. This is an injurious parasitic fungus which has probably been recently introduced into this country. Its aecidial form, Peridermium strobi, occurs on the trunk and branches of white pine to which it is more injurious than the Cronartium is to currant bushes. Fortunately this form has not yet been detected in this country and it is possible that we may yet be free from it.

Diaporthe parasitica Murr.

Parasitic on the branches of chestnut trees to which it is injurious and eventually destructive. Various places in the vicinity of New

York. Our specimens are from Bronx park. There are two forms of the plant, a summer or conidial form which was collected in July, and a winter or perfect form bearing ascospores, which was collected in December. Received from W. A. Murrill in exchange. Specimens have also been communicated by G. G. Atwood which were collected in Westchester co.

Flammula pulchrifolia n. sp.

Pileus fleshy but thin, hemispheric becoming convex, slightly viscid when moist, hygrophanous, fibrillose or, in large specimens, squamulose in the center and fibrillose on the margin, pale pink or pallid on the margin and pink in the center, flesh white, taste bitter and unpleasant; lamellae thin, close, adnate, sometimes slightly sinuate, whitish, soon bright tawny or Indian yellow becoming bright tawny ochraceous with age; stem equal or nearly so, stuffed or hollow, pallid, sometimes yellowish at the base, fibrillose at the top from the remains of the veil; spores bright tawny ochraceous in a thick layer, ochraceous buff in a thin one, .0003 of an inch long, .0002–.00024 broad.

Pileus 1–2 inches broad; stem 1–1.5 inches long, 1.5–2 lines thick.

Decaying wood of hemlock, Tsuga canadensis Carr. Menands, Albany co. July and August.

This beautiful species is easily recognized by the pink tint of the pileus, the bitter flavor of its flesh and the peculiar bright colors of its lamellae and spores. The fibrils at the top of the stem when stained by the falling spores might be mistaken for a slight annulus.

Galium erectum Huds.

Abundant along a stream in an upland field 3 miles southeast of Utica. June. J. V. Haberer. The upright bedstraw is a recently introduced plant and is related to wild madder, Galium mollugo L.

Hygrophorus coloratus n. sp.

Pileus fleshy, convex or nearly plane, often umbonate, even, very viscid or glutinous, yellowish red-orange or bright red, flesh white, yellow under the cuticle; lamellae unequal, distant, arcuate, adnate or decurrent, white, sometimes tinged with yellow, interspaces venose; stem equal or tapering upward, glutinous, stuffed or hollow, white or slightly tinged with yellow, sometimes when young showing a slight floccose veil near the top; spores .0003–.0004 of an inch long, .0002–.00024 broad.

Pileus 1–2.5 inches broad; stem 2–3 inches long, 2–4 lines thick.

Under tamarack and balsam fir trees. Fulton Chain, Herkimer co. October.

This is a beautiful species of Hygrophorus closely related to H. speciosus Pk. and H. aureus Arrh. From the last I have separated it because of its different habitat, its frequently umbonate pileus, its white or whitish stem and its partial floccose white veil. By this last character and its persistently red or orange colored pileus it is separable from H. speciosus Pk. and H. bresadolae Quel. It is possible that further observation may prove that all these are forms of one variable species.

Hygrophorus lacmus Fr.

Ground in woods of deciduous trees. Wilburs Basin, Saratoga co. November. S. H. Burnham. A single specimen.

Hypocrea polyporoidea B. & C.

Bark and decorticated wood of beech, Fagus americana Sweet. Adirondack mountains. Lake Pleasant, Hamilton co. and Star lake, St Lawrence co. August.

Lactarius minusculus Burl.

Among fallen leaves and mosses under white birches. Menands, Albany co. July. This species has hitherto been confused with L. subdulcis Fr. and has been separated because of its smaller size and acrid or tardily acrid taste.

Leaia piperata Banker

Decaying wood. East Schaghticoke, Rensselaer co. H. J. Banker. Meadowdale, Albany co. September. Remarkable for its dissected pileus and its hot peppery flavor.

Lecidea platycarpa Ach.

Rocks. Vaughns, Washington co. August. S. H. Burnham.

Lophiotrema semiliberum (Desm.) Sacc.

Dead grass stems. Lyndonville, Orleans co. May. C. E. Fairman.

Lotus corniculatus L.

Selkirk, Albany co. C. E. Jones. An introduced plant sparingly naturalized.

Metzgeria conjugata Lindb.

Perpendicular surface of rocks. Shandaken, Ulster co. June. Miss M. F. Miller.

Monilia crataegi Diedicke

Parasitic on living leaves of various species of thorn bushes. It causes the leaves to turn brown and die and is therefore more or less injurious to the plant it attacks, according to the severity of the attack. The fungus is at first whitish, but soon becomes cinereous. When fresh it emits a strong odor. In the typical form of the fungus the spores are said to be 13 μ long, 11 μ broad. In our specimens they vary from 12–20 μ long, and 11–12 μ broad. Painted Post, Steuben co. Also Clayton, Jefferson co. and near Albany. May and June.

Myxosporium necans n. sp.

Acervuli in longitudinal series, erumpent, whitish within, spores oozing out in whitish or yellowish white tendrils or masses; spores oblong or elliptic, .00024–.0004 of an inch long, .00008–.000012 broad, often binucleate, supported on slender sporophores.

Bark of living chokecherry, Prunus virginiana L. North Greenbush, Rensselaer co. June. The fungus attacks the trunk near the base and soon kills the shrub.

Nolanea suaveolens n. sp.

Pileus submembranous, convex, umbilicate, obscurely fibrillose or unpolished, indistinctly striate on the margin, smoky brown; lamellae thin, unequal, close, adnate, whitish becoming dingy pink; stem slender, glabrous, hollow, brown; spores angular, uninucleate, .0004–.0005 of an inch long, .00024–.0003 broad.

Pileus 6–10 lines broad; stem 1.5–2 inches long, .5 of a line thick. Woods. Sand Lake, Rensselaer co. August.

The dried specimens emit an agreeable odor similar to that of Lactarius camphoratus or L. glyciosmus. This character is suggestive of the specific name.

Parmelia perforata (Jacq.) Ach.

Trees. Near Chilson lake, Essex co. June. Mrs C. W. Harris.

Parmelia cetrata Ach.

Trunks of trees in swamps. Shushan, Washington co. May. Frank Dobbin.

Physcia hypoleuca (Muhl.) Tuckm.

Trunks of trees. Shushan. April. Frank Dobbin.

Pholiota duroides Pk.

Ground in woods near Syracuse. August. G. E. Morris and C. H. Peck. For description of this species see article on "New York Species of Pholiota."

Polyporus alboluteus E. & E.

Decaying prostrate trunk of spruce, between Long lake and Mud pond, Hamilton co. Imperfect specimens of this rare species were formerly referred to Lenzites sepiaria dentifera, in New York State Museum Report 40, page 75. It has been found but once in our State. The type specimens were collected in Colorado, the only other locality at present known for the species. A new genus, Aurantiporellus, has recently been founded by Dr Murrill on this species.

Polyporus spraguei B. & C.

On old stumps of oak and chestnut. Sand Lake, Rensselaer co. and Wading River, Suffolk co. July and August.

Polystictus montagnei Fr.

Ground. Sand Lake, Rensselaer co. and Piseco, Hamilton co. This is a rare species with us. A single specimen was found in each locality. It is distinguished from allied species by the large size of its pores. The pileus is often very irregular.

Rinodina oreina (Ach.) Mass.

Peaked rock near Shushan, Washington co. July. S. H. Burnham.

Russula aeruginea Fr.

Near Utica. August. T. T. Clohessy. Near Gansevoort, Saratoga co. C. H. Peck.

Sphaeropsis lyndonvillae Sacc.

Dead branches of a cultivated species of Althaea. Lyndonville, Orleans co. C. E. Fairman.

Sphaeropsis persicae E. & B.

Dead branches of flowering almond, P r u n u s j a p o n i c a Thunb. Lyndonville. May. C. E. Fairman.

Stereocaulon coralloides Fr.

Rocks. Mt Marcy. July. C. H. Peck. Near Chilson lake, Essex co. June. Mrs C. W. Harris.

Stropharia bilamellata Pk.

In a plowed field near Newark, Wayne co. September. B. C. Williams. See article on "Edible Fungi."

Trentepohlia umbrina (Kütz.) Born.

Bark of canoe birch, B e t u l a p a p y r i f e r a Marsh. Shushan, Washington co. May. Frank Dobbin.

Tubercularia davisiana Sacc. & Trav.

Parasitic on R h y t i s m a s a l i c i n u m (Pers.) Fr. Catskill mountains.

Viola vagula Greene

Low damp ground near Vaughns, Washington co. May. S. H. Burnham.

SOME ADDITIONS TO THE CRATAEGUS FLORA OF WESTERN NEW YORK

BY C. S. SARGENT

The following paper is based chiefly on collections and observations made by Mr John Dunbar of Rochester in Buffalo and Niagara Falls between 1901 and 1906. In it are also included a few species distinguished at Rochester since the publication in the fourth volume of the Proceedings of the Rochester Academy of Science in 1903 of my paper on *Crataegus in Rochester,* and a few others discovered in the valley of the Genesee river south of Rochester by Messrs Baxter and Dewing of Rochester, and in Canandaigua and Chapinville, Ontario co. by the Rochester botanists.

1 NUTLETS WITHOUT VENTRAL CAVITIES

I CRUS-GALLI

Leaves obovate, cuneate, coriaceous, dark green and shining above, mostly glabrous, usually serrate only above the middle, their veins thin except on vigorous shoots and often within the parenchyma; calyx glabrous; fruit oblong to subglobose; nutlets 1–3, obtuse and rounded at the ends, prominently ridged on the back.

Veins within the parenchyma
  Stamens 10 or less
    Anthers rose color..1 C. crus-galli var. pyracanthifolia
    Anthers white ....2 C. arduennae
Veins prominent
  Anthers pale pink
    Stamens 9–10 ....3 C. geneseensis
    Stamens 10–20
      Flowers at least 1.8 cm in diameter, in broad many-flowered corymbs; leaves broadly ovate; fruit crimson; spines stout..4 C. robusta
      Flowers not more than 1.2 cm in diameter, in few-flowered corymbs; leaves narrowly obovate; fruit bright cherry-red; spines slender ....5 C. cerasina

Crataegus crus-galli var. pyracanthifolia Aiton

Hort. Kew. II. 170 (1788). Sargent, Silva N. Am. XIII. 39, t. 637; Bot. Gazette XXXV. 100; Man. 369.

Niagara Falls, J. Dunbar and C. S. Sargent (⚹ 17), September 16, 1904, J. Dunbar, September 27, 1905 and June 1906; Rochester, Baxter and Dewing (⚹ 314), June 10 and October 15, 1905; also at Niagara on the Lake, Ontario and in Delaware.

Crataegus arduennae Sargent

Bot. Gazette XXXV. 377 (1903); Man. 373, f. 291; Acad. Sci. Phila. Proc. 582 (1905).

South Buffalo, B. H. Slavin (※ 14), June 6 and October 1906; also southern Ontario, through southern Michigan to northeastern Illinois, and in eastern Pennsylvania.

Crataegus arduennea was first described as entirely glabrous but there are often a few hairs on the upper side of the midribs of the young leaves; and a few minute hairs can be found occasionally on the young pedicels of the Buffalo plant.

Crataegus geneseensis n. sp.

Glabrous with the exception of a few hairs on the young leaves. Leaves obovate-oblong, short pointed at the rounded or acute apex, gradually narrowed from near the middle to the concave-cuneate entire base, and finely serrate above, with usually incurved teeth; nearly fully grown when the flowers open about the 1st of June and then thin, slightly hairy along the upper side of the midribs, dark yellow-green and lustrous above and pale below, and at maturity subcoriaceous, dark green and very lustrous on the upper surface, pale yellow-green on the lower surface, 4.5–5 cm long and 2–2.5 cm wide, with thin prominent midribs, and conspicuous primary veins extending obliquely to above the middle of the leaf; petioles slender, narrowly wing-margined sometimes nearly to the base, slightly hairy on the upper side while young, soon glabrous, 5–8 mm long; leaves on vigorous shoots oval and acuminate to obovate and rounded at the apex, concave-cuneate at the base, coarsely serrate, often deeply lobed, 6–7 cm long and 3.5–4 cm wide, with thick midribs, and stout broadly winged rose colored petioles. Flowers 1–1.2 cm in diameter, on slender pedicels, in wide lax many-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes slender, elongated, acuminate, minutely glandular serrate near the base, reflexed after anthesis; stamens 9–11, filaments persistent on the fruit; anthers pink; styles 1, 2 or rarely 3. Fruit ripening in the middle of October, on slender drooping reddish pedicels, in few-fruited clusters, short-oblong, full and rounded at the ends, scarlet, lustrous, marked by large dark dots, 1.2–1.5 cm long and 1–1.2 cm wide; calyx little enlarged, with a deep narrow cavity, and spreading lobes, their tips often deciduous from the ripe fruit; flesh thin, yellow, dry and mealy; nutlets 1–3, obtuse at the ends, rounded and slightly grooved on the back, about 8 mm long, and 6 mm in diameter.

A tree 3–4 m high, with a trunk sometimes 3 dm in diameter, widespreading branches forming a broad flat topped open head, and slender slightly zigzag branchlets light orange-green and marked by many pale lenticels when they first appear, pale orange colored in their first season and dull gray-brown the following year, and armed with slender nearly straight, light brown ultimately gray spines 4–4.5 cm long and persistent and become branched on old stems.

Banks of the Genesee river above Rochester, J. Dunbar (⨳ 1 type), June 1 and October 23, 1903; Tuscarora, Baxter and Dewing (⨳ 295, a much older tree with smaller leaves), September 14, 1904, and May 30, 1905.

Crataegus robusta n. sp.

Leaves glabrous, oblong-obovate, gradually narrowed or rounded and usually short pointed at the apex, narrowed from above the middle to the cuneate entire base, and finely doubly serrate above, with straight grandular teeth; nearly fully grown when the flowers open about the 10th of June and then thin and lustrous above, and at maturity subcoriaceous, dark green and very lustrous on the upper surface, pale yellow-green on the lower surface, 5–6 cm long and 3.5–4 cm wide; leaves on vigorous shoots often 8–9 cm long and 5–6 cm wide, with prominent pale yellow midribs and 6 or 7 pairs of prominent primary veins; petioles stout, wing-margined often to below the middle, glandular early in the season toward the apex, often tinged with red in the autumn, 7–12 mm in length. Flowers 1.8 cm in diameter, on elongated slender glabrous pedicels, in broad lax many-flowered corymbs; calyx-tube narrowly obconic, glabrous, the lobes slender, acuminate, glandular serrate; stamens 10–20; anthers pale pink; styles usually 2 or 3, surrounded at the base by a narrow ring of pale tomentum. Fruit ripening the end of September, on long slender drooping pedicels, in few-fruited clusters, short-oblong to obovate, crimson, lustrous, marked by occasional large pale dots, about 2 cm long and 7–8 mm wide; calyx prominent, with a broad shallow cavity, and spreading and reflexed or appressed narrow lobes, dark red on the upper side below the middle and often deciduous from the ripe fruit; flesh thin, yellow-green, dry and mealy; nutlets 2 or 3, gradually narrowed at the ends, rounded at the base, ridged on the back, with a low grooved ridge, about 1 cm. long, and 5 mm wide.

A tree 5–6 m high, with a trunk covered with dark scaly bark and sometimes 3 dm in diameter, thick widespreading branches forming a symmetrical round-topped head often 6–7 m in diameter, and stout nearly straight pale orange-brown lustrous branchlets marked while young with oblong pale lenticels, light gray and shining in their second season, and armed with straight red-brown shining spines 5–7 cm in length, persistent and becoming branched on the old trunk and branches.

Banks of the Niagara river above the falls, J. Dunbar and C. S. Sargent (※ 16 type), September 16, 1904, J Dunbar, June 12, 1905; Buffalo, J. Dunbar (※ 26), September 30, 1904, May 28, June 12 and September 26, 1905.

Crataegus cerasina n. sp.

Leaves oblong-obovate, acute or rounded at the apex, gradually narrowed and concave-cuneate at the entire base and sharply doubly serrate above, with straight glandular teeth; nearly half grown when the flowers open about the 10th of June and then glabrous with the exception of a few caducous pale hairs on the upper side of the midribs, thin, dark green and lustrous above and pale below, and at maturity subcoriaceous, dark yellow-green and shining on the upper surface, light yellow-green on the lower surface, 5–6.5 cm long and 2.6–3.5 cm wide, with slender yellow midribs, and 5 or 6 pairs of thin, prominent primary veins; petioles slender, wing-margined to below the middle, 1.2–1.5 cm in length; leaves on vigorous shoots coriaceous, often slightly lobed toward the apex, more coarsely serrate and sometimes 7 cm long and 5 cm wide, with stout midribs, more prominent veins, and thick broadly winged reddish petioles about 1 cm in length. Flowers 1.2 cm in diameter, on long slender glabrous pedicels, in few usually 7–10-flowered compact corymbs; calyx-tube narrowly obconic, glabrous, the lobes slender, elongated, acuminate, glandular serrate, slightly hairy on the inner surface toward the base, reflexed after anthesis; stamens 10–20; anthers pale pink; styles usually 2. Fruit ripening from the middle to the end of September, on slender reddish pedicels, in 1–5-fruited drooping clusters, short-oblong, full and rounded at the ends, bright cherry-red, very lustrous, marked by occasional large pale dots, 1–1.2 cm long and 8–10 mm wide; calyx little enlarged, with a deep narrow cavity, and slender spreading, persistent lobes dark red on the inner surface toward the base and slightly serrate near the middle; flesh thin, yellow, dry and mealy; nutlets 2, full and rounded at the ends, ridged on the back, with a hight broad ridge, 7–8 mm long, and 4–5 mm wide.

A tree 5–7 m high, with a tall trunk 2–3 dm in diameter, covered with ashy gray scaly bark, spreading and ascending branches forming a wide open round-topped head, and slender nearly straight branchlets light olive-green and glabrous when they first appear, becoming light orange color and lustrous during their first season and dark gray-brown the following year, and armed with many slender nearly straight bright chestnut-brown shining ultimately dark gray-brown spines 3–5 cm in length.

Niagara Falls, J. Dunbar and C. S. Sargent (※22, type), September 16, 1904, J. Dunbar, June 12, 1905; also (※ 22A and 22B), J. Dunbar and C. S. Sargent, September 16, 1904, and J. Dunbar, June 12, 1906.

II PUNCTATAE

Leaves usually thin, mostly acute or occasionally rounded at the apex, their veins prominent; stamens 20; fruit short-oblong or rarely subglobose or obovate, often conspicuously punctate; flesh usually dry and mealy.

Anthers rose color or yellow; leaves obovate, often acutely lobed above the middle, especially on vigorous shoots, more or less villose below; fruit flattened at the ends, marked by large dots, dark red or bright yellow ....1 C. punctata

Anthers dark rose color; leaves rhombic, glabrous at maturity
- Leaves subcoriaceous; flowers on stout villose pedicels; calyx thickly coated with matted white hairs; fruit subglobose, crimson, very lustrous ....2 C. celsa
- Leaves thin; flowers on slender glabrous pedicels; calyx glabrous; fruit short-oblong or sometimes slightly obovate, orange-red slightly lustrous ....3 C. notabilis

Anthers pink; corymbs and leaves glabrous
- Leaves oblong-obovate, acuminate at the base; fruit obovate..4 C. barbara
- Leaves ovate to oval or orbicular, abruptly narrowed at the base; fruit short-oblong ....5 C. dewingii

Crataegus punctata Jacquin

Hort. Vind. 1. 10, t. 28 (1770). Sargent, Silva N. Am. IV. 103, t. 184; Man. 389, f. 308; Acad. Sci. Phila. Proc. 583 (1905).

Buffalo, J. Dunbar (※5), May 21 and September 25, 1903; also from Canada to Illinois and to the mountains of western North Carolina.

Crataegus celsa n. sp.

Leaves rhombic to oblong-obovate, acute or acuminate at the apex, gradually narrowed and concave-cuneate at the entire base, finely doubly serrate above, with incurved glandular teeth, and slightly divided above the middle into 4 or 5 pairs of small acute lobes; about half grown when the flowers open during the last week of May and then membranaceous, light yellow-green and sparingly villose especially on the midribs and veins, and at maturity subcoriaceous, glabrous, dark green and lustrous on the upper surface, pale on the lower surface, 5–7 cm long and 3.5–5 cm wide, with slender prominent midribs and 5–7 pairs of primary veins extending obliquely toward the apex of the leaf and deeply impressed on its upper side; petioles slender, narrowly wing-margined often nearly to the middle, slightly villose while young, soon becoming glabrous, often rose color in the autumn, 1.5–2 cm in length; stipules linear, minutely glandular, fading brown, caducous; leaves on vigorous shoots thicker, more coarsely serrate and sometimes 9–10 cm long and 8–9 cm wide, with thick rose colored midribs and stout broadly winged petioles. Flowers 1.5 cm in diameter, on stout villose pedicels, in compact many-flowered hairy corymbs, with linear to linear-obovate slightly glandular caducous bracts and bractlets; calyx-tube narrowly obconic, thickly coated with long matted white hairs, the lobes wide, acuminate, glandular serrate, glabrous on the outer, villose on the inner surface below the middle; stamens 20; anthers small, dark rose color; styles usually 3. Fruit ripening early in October, on stout reddish drooping pedicels, in wide many-fruited clusters, subglobose, full and rounded at the ends, crimson, very lustrous, marked by large pale dots, about 1 cm long and 8 or 9 mm wide; calyx prominent, with a deep narrow cavity, and large spreading, closely appressed, light green persistent lobes; flesh thin, yellow, dry and mealy; nutlets 3, full and rounded at the ends, or narrow and acuminate at the apex, rounded and slightly ridged on the back, with a broad low ridge 7–8 mm long, and 5 mm wide.

An arborescent shrub sometimes 7 m high, with numerous stems covered with dark gray scaly bark, spreading and ascending branches, and stout slightly zigzag branchlets dark olive-green and sparingly hairy when they first appear, becoming light orange-brown, very lustrous and marked by large oblong lenticels in their first season and pale gray-brown the following year, and armed with numerous stout nearly straight purple shining spines 5–6 cm long, often pointing toward the base of the branch, and generally persistent on old stems.

Niagara Falls, J. Dunbar (※ 32, type), September 28, 1905, and May 28, 1906.

Similar to Crataegus pausiaca Ashe, in habit, in the color of the branchlets and in the shape and venation of the leaves, this species differs from it in its larger flowers on much shorter pedicels, in the more villose calyx-tube and much broader, more foliaceous calyx-lobes, and in the smaller subglobose crimson fruit on shorter stalks.

Crataegus notabilis n. sp.

Leaves rhombic, acuminate, gradually narrowed and acute at the entire base, coarsely doubly serrate above, with incurved or straight glandular teeth, and divided above the middle into 2 or 3 pairs of small acuminate spreading lobes; when they unfold slightly tinged with red and glabrous with the exception of a few scattered pale hairs along the upper side of the midribs, membranaceous and about half grown when the flowers open at the end of May, and at maturity thick and firm, glabrous, smooth and dark yellow-green on the upper surface, pale blue-green on the lower surface, 6–7 cm long and 4–4.5 cm wide, with prominent yellow midribs, and thin primary veins extending very obliquely to the points of the lobes; petioles slender, broadly wing-margined often to below the middle, occasionally furnished early in the season with minute deciduous glands, glabrous, 2–3 cm in length; stipules linear, glandular, fading brown, caducous. Flowers 1.2 cm in diameter, on long slender glabrous pedicels, in usually 6–8-flowered lax thin-branched corymbs, with linear bracts and bractlets, the lower peduncles from the axils of the upper leaves; calyx-tube broadly obconic, glabrous, the lobes slender, acuminate, entire or slightly dentate above the middle, glabrous on the outer, slightly villose on the inner surface, reflexed after anthesis; stamens 20; filaments persistent on the ripe fruit; anthers large, red-purple; styles 3–5. Fruit ripening early in October, on long drooping pedicels, in few-fruited clusters, short-oblong or slightly obovate, full and rounded at the ends, orange-red, marked by occasional large dark dots, 8–10 mm long, 7–8 mm in diameter; calyx prominent, with a short tube, a deep narrow cavity, and slender spreading persistent lobes; flesh thin, yellow, hard and dry; nutlets 3–5, rounded at the ends, ridged on the back, with a broad, low grooved ridge, light colored, 5–6 mm long, and about 4 mm wide.

An arborescent shrub 5–7 m high, with stout ascending and spreading stems covered with dark gray scaly bark, small spreading branches forming a narrow open head, and slender slightly zigzag glabrous branchlets dull orange-green and marked by many small pale lenticels when they first appear, becoming light orange-brown or chestnut-brown and lustrous in their first season and dull gray-brown, the following year, and armed with numerous very slender nearly straight dark chestnut-brown or purplish shining ultimately ashy gray spines 3.5–5 cm in length, persistent and becoming branched on old stems.

Buffalo, J. Dunbar (※ 14, type), June 1 and September 24 and 30, 1904.

Crataegus barbara n. sp.

Glabrous with the exception of the hairs on the inner surface of the calyx-lobes. Leaves oblong-obovate, acuminate, gradually narrowed to the long slender acuminate entire base, finely serrate above, with minute incurved teeth, and only slightly lobed near the apex; nearly fully grown when the flowers open during the first week of June and then thin, dark green, smooth and lustrous above and pale below, and at maturity subcoriaceous, dark green and very lustrous on the upper surface, pale on the lower surface, 5.5–7 cm long and 2.5–3 cm wide, with stout yellow midribs, and thin very prominent primary veins extending obliquely toward the apex of the leaf; petioles slender, narrowly wing-margined nearly to the middle, 1.5–2.5 cm in length; leaves on vigorous shoots oblong to obovate, narrowed to the ends, more coarsely serrate, often deeply divided into 1 or 2 narrow acuminate lateral lobes, frequently 9–10 cm long and 4.5–6 cm wide, with stout broadly winged petioles. Flowers 1.3–1.5 cm in diameter, on long slender pedicels, in wide lax many-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, glabrous, the lobes slender, acuminate, finely glandular serrate, glabrous on the outer, sparingly villose on the inner surface, reflexed after anthesis; stamens 20; anthers pale pink; styles 2–4. Fruit ripening the middle of October, on long slender reddish pedicels, in drooping few-fruited clusters, oblong-obovate, rounded at the apex, gradually narrowed from below the middle, abruptly compressed at the often oblique base and decurrent on the pedicels; calyx little enlarged, with a very narrow deep cavity, and spreading closely appressed persistent lobes, flesh thin, juicy, pale yellow; nutlets 3–5, acute at the ends or narrowed and rounded at the base, ridged on the back, with a low grooved ridge, 7–8 mm long, and 4–5 mm wide.

A tree sometimes 7 m high, with a short trunk 2–2.5 dm in diameter, erect branches forming a broad open head, and stout zigzag glabrous branchlets, light orange-yellow and marked by large pale lenticels when they first appear, becoming light orange color and lustrous in their first season, and armed with numerous nearly straight or curved spines 2.5–6 cm long and becoming dark gray or purple in their second or third seasons.

Brighton, near Rochester, B. H. Slavin (※ 2, type), October 14, 1903, and June 4, 1905.

Crataegus dewingii n. sp.

Leaves ovate to oval or rarely orbicular, acuminate, abruptly concave-cuneate at the entire base, finely doubly serrate above, with straight glandular teeth, and very slightly divided above the middle into 4 or 5 pairs of small acuminate lobes; deeply tinged with red when they unfold, about half grown when the flowers open at the end of May and then thin, yellow-green and glabrous with the exception of a few caducous hairs along the upper side of the midribs, and at maturity thin but firm in texture, dark green and lustrous on the upper surface, pale bluish green on the lower surface, 5–7 cm long and 4–5 cm wide, with stout yellow midribs, and thin primary veins arching obliquely to the points of the lobes; petioles slender, wing-margined at the apex, villose on the upper side while young, slightly glandular, 2.5–3 cm in length; leaves on vigorous shoots often oblong-ovate, more coarsely serrate, deeply divided into broad lateral lobes and 5–6 cm long. Flowers 1.8–2 cm in diameter, on slender glabrous pedicels, in 4–13-flowered lax corymbs, with broadly obovate to linear-obovate caducous bracts and bractlets fading brown; calyx-tube broadly obconic, glabrous, the lobes abruptly narrowed from the base, broad, acuminate, entire or slightly serrate near the middle, glabrous on the outer, sparingly villose on the inner surface, reflexed after anthesis; stamens 20; anthers pink; styles 4 or 5, surrounded at the base by a narrow ring of pale tomentum. Fruit ripening from the middle to the end of September, on stout red pedicels, in few-fruited drooping clusters, short-oblong, full and rounded at the ends, crimson, pruinose, becoming lustrous, marked by many small pale dots, 1–1.2 cm in diameter; calyx little enlarged, with a broad deep cavity, and spreading often incurved persistent lobes villose on the upper side; flesh thin, hard, dry and mealy; nutlets 4 or 5, gradually narrowed and rounded at the ends, ridged on the back, with a high narrow ridge, 7–8 mm long, and 4–5 mm wide.

A tree sometimes 8 m high, with a trunk 2 m long and 1.5 dm in diameter, covered with ridged and scaly gray bark, drooping and widespreading branches, and slender nearly straight glabrous branchlets dull red and marked by pale lenticels when they first appear, becoming bright chestnut-brown and lustrous in their first season and pale gray-brown the following year, and armed with few slender nearly straight chestnut-brown shining spines 3–3.5 cm long.

Open thickets in clay soil, Belfast, Allegany co., Baxter and Dewing (※ 285, type), September 14, 1904, May 29 and September 14, 1905; (※ 212X), May 30, 1903, September 14, 1904, September 19, 1905.

This interesting species, which is doubtfully referred to this group, is named for Mr Vincent Dewing who with Mr Baxter has carefully studied and industriously collected the large number of species of Crataegus growing in several of the towns of the upper Genesee valley in New York.

III PRUINOSAE

Fruit subglobose to short-oblong or obovate, red or green, often slightly 5-angled, generally pruinose especially during the summer; flesh hard and dry; leaves thin to subcoriaceous.

Stamens 20
  Anthers rose color, pink or red
    Leaves glabrous
      Corymbs glabrous
        Corymbs many-flowered........................1 C. pruinosa
        Corymbs few-flowered
          Leaves cuneate at the base; fruit conspicuously 5 angle and mammillate below the middle............2 C. arcana
          Leaves often rounded at the broad base; fruit not mammillate
            Leaves subcoriaceous; flowers not less than 1.8 cm in diameter, on long pedicels............3 C. gracilis
            Leaves thin; flowers 1.2–1.4 cm in diameter, on short pedicels..................................4 C. amoena
      Corymbs villose............................5 C. clintoniana
    Young leaves roughened above by short white hairs......6 C. oblita
  Anthers yellow
    Leaves glabrous ....7 C. cognata
    Leaves slightly hairy above while young
      Leaves oblong-ovate; corymbs many-flowered; spines short and stout ....8 C. formosa
      Leaves broadly ovate; corymbs few-flowered; spines long and slender ....9 C. leiophylla

Stamens 10 or less
  Anthers rose color, purple or pink
    Leaves glabrous
      Fruit short-oblong
        Leaves slightly lobed; fruit cherry-red, pruinose, 1–1.2 cm in diameter..10 C. pulchra
        Leaves deeply lobed; fruit crimson, not pruinose, 1.5–1.7 cm in diameter..11 C. radiata
      Fruit obovate ....12 C. aridula
    Leaves villose above while young
      Fruit obovate
        Flowers not more than 1.6 cm in diameter, in very compact 4–6-flowered corymbs; stamens usually 5; anthers dark rose color ....13 C. congestiflora
      Fruit subglobose ....15 C. maineana
        Flowers at least 2cm in diameter, in broad loose corymbs; stamens 10; anthers pink.....................14 C. plana
      Fruit subglobose..................................15 C. maineana
    Leaves scabrate above while young
      Leaves thick
        Leaves blue-green
          Stamens 10; fruit short-oblong to obovate..16 C. placiva
          Stamens 5; fruit obovate..................17 C. tortuosa
        Leaves yellow-green ....18 C. xanthophylla
      Leaves thin
        Leaves blue-green
          Flowers in 2–8-flowered compact corymbs; fruit subglobose, pruinose..................................19 C. implicata
          Flowers in wide lax many-flowered corymbs; fruit oblong-obovate, not pruinose......................20 C. promissa
        Leaves yellow-green
          Leaves scabrate at maturity
            Flowers not more than 1.5 cm in diameter; calyx-lobes glabrous; fruit short-oblong, on drooping pedicels........... ....21 C. strigosa
            Flowers at least 2 cm in diameter; calyx-lobes villose on the inner surface; fruit obovate, on erect pedicels.......... ....22 C. barryana
          Leaves glabrous at maturity
            Anthers dark rose color; calyx-lobes short and broad; fruit on long drooping pedicels ....23 C. foliata
            Anthers pale pink; calyx-lobes long and slender; fruit on shorter pedicels ....24 C. cruda
  Anthers yellow; flowers on villose pedicels, in compact 5–7-flowered corymbs; styles hirsute to the middle; young leaves scabrate........... ....25 C. inusitula

Crataegus pruinosa K. Koch

Verhandl. Preuss. Gart. Verein, neue Reihe 1. 246 (1854). Sargent, Silva N. Am. XIII. 61, t. 648; Man. 411, f. 331; Acad. Sci. Phila. Proc. 585 (1905).

Buffalo, J. Dunbar (※ 2, 6 and 45), 1902–5.

Crataegus arcana Beadle

Bilt Bot. Studies 1. 122 (1902). Sargent, Bot. Gazette XXXV. 101; Acad. Sci. Phila. Proc. 588 (1905).

Niagara Falls, J. Dunbar and C. S. Sargent (※ 24), September 16, 1904; J. Dunbar, May 28, 1905; also eastern Pennsylvania to western North Carolina.

Crataegus gracilis n. sp.

Leaves ovate, acuminate, rounded or abruptly cuneate at the broad entire base, sharply doubly serrate above, with straight glandular teeth, and divided into 3 or 4 pairs of short acuminate lateral lobes; when they unfold deeply tinged with red and glabrous with the exception of occasional caducous hairs along the upper side of the midribs, nearly fully grown when the flowers open at the end of May and then membranaceous and dull yellow-green, and at maturity subcoriaceous, dark blue-green, smooth and lustrous on the upper surface, paler on the lower surface, 5–6 cm long and 3.5–4 cm wide, with slender yellow midribs and 4 or 5 pairs of thin primary veins; petioles slender, slightly wing-margined at the apex, glandular, with occasional scattered dark glands, 8–10 mm long; stipules linear or linear-falcate, glandular, fading rose color, deciduous; leaves on vigorous shoots coriaceous, nearly triangular, mostly truncate at the base, coarsely serrate, deeply lobed, often 8–9 cm long and 9–10 cm wide, with stout reddish midribs, broadly margined conspicuously glandular petioles 2–2.5 cm in length, and foliaceous lunate coarsely serrate stipules. Flowers about 1.8 cm in diameter, on long slender glabrous pedicels, in compact 6–10-flowered corymbs, with linear glandular red bracts and bractlets; calyx-tube broadly obconic, glabrous, the lobes abruptly narrowed from broad bases, slender, acuminate, glabrous, entire or occasionally minutely glandular toward the base; stamens 20; anthers pale pink, filaments persistent on the fruit; styles 3–5, surrounded at the base by tufts of long pale hairs. Fruit ripening late in September, on slender drooping pedicels, in few-fruited clusters, depressed-globose, green tinged with red or orange color, pruinose, about 1 cm in diameter; calyx prominent, with a short tube, a broad shallow cavity, and wide-spreading and slightly incurved lobes, dark red on the upper side toward the base; flesh thin, dry, greenish yellow; nutlets 3–5, full and rounded at the base, narrowed and rounded at the apex, ridged on the back, with a high rounded ridge, dark colored, 8–9 mm long, and about 5 mm wide.

A shrub 2–3 m high, with numerous ascending stems spreading into broad thickets, and covered below with ashy gray bark, and stout slightly zigzag glabrous branchlets green tinged with red when they first appear, soon becoming bright chestnut-brown and lustrous and marked by large pale lenticels, and armed with many stout nearly straight chestnut-brown shining spines 4–6 cm long and usually pointing toward the base of the branch.

Niagara Falls, J. Dunbar and C. S. Sargent (※26, type), September 16, 1904, J. Dunbar, May 28, 1905.

Crataegus amoena n. sp.

Leaves ovate, acute or acuminate, concave-cuneate or rounded at the entire base, finely doubly serrate above, with straight or incurved glandular teeth, and divided above the middle into 2 or 3 pairs of broad acute lobes; slightly tinged with red when they unfold, about half grown when the flowers open at the end of May and then thin, smooth and light yellow-green above and pale below, and at maturity thin but firm in texture, dark bluish green on the upper surface, pale on the lower surface, 4–6 cm long, 3.5–5 cm wide, with slender midribs often tinged with rose in the autumn, and 3 or 4 pairs of obscure primary veins; petioles slender, slightly wing-margined at the apex, deeply grooved, sparingly glandular while young, 1.5–2.5 cm in length; stipules linear, glandular, fading brown, caducous; leaves on vigorous shoots rounded or cuneate at the broad base, 6–7 cm long and 5–6 cm wide. Flowers 1.2–1.4 cm in diameter, on short slender pedicles, in compact most 4–6 flowered corymbs; calyx-tube broadly obconic, the lobes gradually narrowed from wide bases, short, acuminate, generally entire; stamens 20; anthers creamy white suffused with pink; styles 3–5. Fruit ripening from the middle to the end of October, on stout erect pedicels, in few-fruited clusters, subglobose to short-oblong, dark red, pruinose, 1–1.2 cm in diameter; calyx prominent, with a broad deep cavity, and spreading lobes dark red on the upper side toward the base; flesh thin, hard, greenish yellow; nutlets 3–5, gradually narrowed and rounded at the ends, ridged on the back, with a high narrow rounded ridge, dark colored, about 7 mm long, and 5 mm wide.

A shrub 3–4 m high, with ascending and spreading stems covered below with dark red bark, and slender slightly zigzag branchlets olive-green deeply tinged with red when they first appear, becoming bright chestnut-brown and very lustrous and marked by occasional large dark lenticels in their first season and dull gray the following year, and armed with numerous slender nearly straight purple spines 4–6 cm long, and persistent and branched on old stems.

Niagara Falls, J. Dunbar and C. S. Sargent (✻21, type), September 16, 1904, J Dunbar, May 28, 1905.

Crataegus clintoniana n. sp.

Leaves ovate, acuminate, cuneate or rounded at the entire base, finely and often doubly serrate above, with straight glandular teeth, and divided into 4 or 5 pairs of narrow acuminate lateral lobes; when they unfold tinged with red, sparingly villose on the upper surface and villose below along the midribs and veins and furnished with axillary tufts of matted pale hairs, nearly half grown when the flowers open about the 20th of May and then thin, light yellow-green, still sparingly hairy principally along the under side of the midribs and veins and pale bluish green below, and at maturity thin, yellow-green, smooth and glabrous on the upper surface and nearly glabrous on the lower surface, 4–5 cm long and 3.5–4 cm wide, with slender midribs, and usually 4 pairs of thin primary veins; petioles slender, slightly wing-margined at the apex, glabrous, sparingly glandular while young, 1–1.5 cm in length; leaves on vigorous shoots abruptly cuneate or rounded at the broad base, coarsely serrate, deeply lobed, often 6–7 cm long and broad, with stout broadly winged glandular petioles 2.5–3 cm in length. Flowers 2 cm in diameter, on slender villose pedicels, in compact mostly 5- or 6-flowered corymbs; calyx-tube narrowly obconic, glabrous, the lobes slender, acuminate, nearly entire, glabrous, reflexed after anthesis; stamens 20; anthers bright red; styles 3–5, generally 5, surrounded at the base by a broad ring of pale hairs. Fruit ripening early in October, on stout reddish pedicels, in few-fruited erect clusters, subglobose but often rather broader than high, distinctly angled, orange-red, lustrous, marked by numerous small pale dots, 1.2–1.4 cm in diameter; calyx prominent, with a short tube, a broad deep cavity, and small spreading or reflexed lobes persistent on the ripe fruit; flesh thick, yellowish green, dry and mealy; nutlets usually 5, narrowed and rounded at the ends, slightly grooved on the back, 6–7 mm long, and 4–5 mm wide.

A narrow shrub thin in habit, 5–6 m high, with many small stems covered with dark gray scaly bark, spreading and ascending branches, and slender nearly straight branchlets glabrous and orange-green slightly tinged with red when they first appear, becoming red-brown and lustrous during their first season and dull gray-brown the following year, and armed with numerous, thin, straight, light chestnut-brown shining, ultimately dull gray spines 4–5 cm in length, persistent, very numerous and becoming branched on the old stems.

Low wet woods, Buffalo; J. Dunbar (※ 8, type), May 21 and September 29, 1903, September 26, 1905. Not common.

This handsome and distinct species is named in memory of George W. Clinton (1807–85), a distinguished judge of the Supreme Court of the city of Buffalo and a critical student of the plants growing in the neighborhood of that city.

Crataegus oblita n. sp.

Leaves oblong-ovate to nearly triangular, acuminate, rounded, subcordate or abruptly concave-cuneate at the broad entire or glandular base, finely doubly serrate above, with straight glandular teeth, and divided often only above the middle into 4 or 5 pairs of wide acuminate spreading lobes; about one third grown when the flowers open the 25th of May and then membranaceous, yellow-green, roughened above by short white hairs and pale and glabrous below, and at maturity thin but firm in texture, dull blue-green, smooth and lustrous on the upper surface, pale bluish green on the lower surface, 5–6.5 cm long and 4.5–5 cm wide, with thin yellow midribs, and slender primary veins extending obliquely to the points of the lobes; petioles very slender, slightly wing-margined at the apex, sparingly villose while young on the upper side, soon glabrous, 3–4 cm in length; leaves on vigorous shoots subcoriaceous, truncate or rounded at the base, more coarsely serrate and more deeply lobed, often 5.5–6 cm long and wide. Flowers 1.5–1.6 cm in diameter, on long slender glabrous pedicels, in lax mostly 4–6-flowered corymbs; calyx-tube narrowly obconic, glabrous, the lobes gradually narrowed from broad bases, wide, acuminate, entire or occasionally slightly toothed near the middle, glabrous, reflexed after anthesis; stamens 20; anthers rose color; styles 4 or 5, surrounded at the base by a narrow ring of pale hairs. Fruit ripening the end of September, on slender drooping pedicels, in few-fruited clusters, obovate, full and rounded at the apex, slightly narrowed to the rounded base, crimson, pruinose, finally becoming lustrous, marked by large pale dots, 9–11 mm long and 9–10 mm in diameter; calyx enlarged and prominent, with a broad deep cavity, and spreading and appressed usually persistent slightly serrate lobes dark red on the upper side below the middle; flesh thin, yellow-green, dry and mealy; nutlets 4 or 5, thin and compressed at the rounded ends, rounded and slightly grooved or irregularly ridged on the back, 6–7 mm long, and 4–5 mm wide.

A shrub 4–5 m high, with small ascending stems covered with pale gray bark, spreading branches and slender slightly zigzag glabrous branchlets, dark reddish brown and marked by pale lenticels when they first appear, becoming dark chestnut-brown and very lustrous in their first season and dull red-brown the following year, and armed with slender straight slightly curved dull chestnut-brown spines 3–5 cm long.

Borders of thickets in low moist soil, Buffalo, J. Dunbar (※ 16, type), June 1, 1904, May 28, 1906, J. Dunbar and C. S. Sargent, September 24, 1904.

Crataegus cognata Sargent

Rhodora V. 58 (1903).

Buffalo, J. Dunbar (※ G), October 1901, May 26 and October 6, 1902, May 21 and September 29, 1903; (※ 23), September 30, 1904, June 12, 1905; (※ 38), June 12 and September 26, 1905; Niagara Falls, J. Dunbar and C. S. Sargent (※8), September 16, 1904, J. Dunbar, June 12, 1905; (※ 15), J. Dunbar and C. S. Sargent, September 16, 1904, J. Dunbar, May 26, 1905; near Hemlock lake, Livingston co., Henry T. Brown (※ 15 and 26), May and October 1906; also southern and western New England and eastern New York.

Crataegus formosa Sargent

Rochester Acad. Sci. Proc. IV. 101 (1903).

Buffalo, J. Dunbar, October 6, 1902, September 26, 1905, May 28, 1906, Niagara Falls, J. Dunbar (※ 1), October 7, 1902, May 22, 1903; also at Rochester, New York.

Crataegus leiophylla Sargent

Rochester Acad. Sci. Proc. IV. 99 (1903).

Buffalo, J. Dunbar, September 26, 1905, May 25, 1906; also at Rochester, New York.

The anthers in this species were first described as pale yellow; further observations show that they are slightly tinged with pink.

Crataegus pulchra n. sp.

Glabrous. Leaves ovate to oval, acuminate, rounded or occasionally cuneate at the entire base, finely often doubly serrate above, with straight glandular teeth, and divided very slightly above the middle into 3 or 4 pairs of short broad acuminate lobes; deeply tinged with red when they unfold, more than half grown when the flowers open at the end of May and then thin, yellow-green above and paler below, and at maturity thin, yellow-green, 4.5–5.5 cm long and broad, with slender yellow midribs, and obscure primary veins; petioles slender, slightly wing-margined sometimes nearly to the middle, glandular with minute dark glands, 2–2.5 cm in length. Flowers about 1.8 cm in diameter, on slender pedicels, in compact mostly 6–8-flowered corymbs, with linear acuminate glandular bracts and bractlets fading rose color; calyx-tube broadly obconic, the lobes slender, acuminate, entire or sparingly glandular toward the apex, reflexed after anthesis; stamens 10; anthers maroon; styles 2–4. Fruit ripening the middle of September, on short stout pedicels, in drooping 2–3-fruited clusters, short-oblong, full and rounded at the ends, cherry-red, pruinose, marked by small pale dots, 1–1.2 cm in diameter; calyx prominent, with a broad shallow cavity, and widespreading or closely appressed usually persistent lobes dark red on the upper side; flesh thin, yellow, dry or mealy; nutlets 2–4, narrowed and acute at the ends or rounded at the base, ridged on the back, with a narrow rounded ridge, light colored, about 8 mm long, and 5 mm wide.

A shrub 1–2.5 m high, with small stems spreading into thickets, and slender nearly straight branchlets orange-green tinged with red when they first appear, becoming chestnut-brown, lustrous and marked by small pale lenticels in their first season, and dark red-brown the following year, and armed with thin nearly straight purple ultimately gray-brown spines 3–5 cm long.

Niagara Falls, J. Dunbar and C. S. Sargent (※25, type), September 16, 1904, J. Dunbar, May 28, 1905; Buffalo, (※11) J. Dunbar, September 30, 1904, and May 28, 1905; (※23), J. Dunbar and C. S. Sargent, September 16, 1904, J. Dunbar, May 28, 1905.

Crataegus radiata n. sp.

Glabrous. Leaves ovate, acuminate, cuneate or rounded at the entire base, coarsely doubly serrate above, with straight gland-tipped teeth, and divided into 3 or 4 pairs of narrow acuminate spreading lateral lobes; nearly half grown when the flowers open about the

20th of May and then thin, smooth and yellow-green above and pale blue-green below, and at maturity thin but firm, dark dull blue-green on the upper surface and pale on the lower surface, 5–7 cm long and 4–5 cm wide, with prominent yellow midribs, and slender primary veins arching obliquely to the points of the lobes; petioles slender, wing-margined to below the middle, glandular, with persistent glands, often rose color in the autumn, 1.5–2 cm in length; leaves on vigorous shoots subcoriaceous, rounded at the broad base, more coarsely serrate and more deeply lobed and sometimes 8–9 cm long and broad, with stout broadly winged conspicuously glandular petioles. Flowers 1.8–2 cm in diameter, on slender elongated pedicels, in loose usually 5- or 6-flowered long-branched corymbs; calyx-tube narrowly obconic, the lobes slender, acuminate, entire; stamens 9 or 10; anthers dark red; styles usually 4, surrounded at the base by a narrow ring of pale tomentum. Fruit ripening about the 1st of October, on stout reddish pedicels, in few-fruited drooping clusters, short-oblong, full and rounded at the ends, crimson, lustrous, marked by many small dark dots, 1.5–1.7 cm in diameter; calyx little enlarged, with a narrow deep cavity, and closely appressed lobes persistent on the ripe fruit; flesh thick, yellow, dry and mealy; nutlets usually 4, narrowed at the ends, rounded at the base, ridged on the back, with a broad grooved ridge, light colored, 6–7 mm long, and 4–5 mm wide.

A shrub 4–6 m high, with numerous small stems covered with dark gray scaly bark, small spreading branches, and slender zigzag branchlets dark orange-green when they first appear, becoming bright chestnut-brown and very lustrous in their first season and dull red-brown the following year, and armed with many slender slightly curved purple shining spines 3.5–4 cm long, persistent and very numerous on old stems.

Buffalo, J. Dunbar (✻ 3, type), October 6, 1902, May 21 and September 29, 1903, J. Dunbar and C. S. Sargent, September 24, 1904.

Crataegus aridula n. sp.

Glabrous. Leaves ovate, acuminate, cuneate or concave-cuneate at the entire base, sharply doubly serrate above, with straight glandular teeth, and divided into 5 or 6 pairs of narrow acuminate spreading lobes; nearly full grown when the flowers open during the first week of June and then thin, dark yellow-green, smooth above and pale below, and at maturity thin, dark bluish green on the upper surface, pale on the lower surface, 4–5 cm long and

3.5–4.5 wide, with thin midribs and primary veins; petioles slender, slightly wing-margined at the apex, glandular, with minute scattered glands, 2–3 cm in length; leaves on vigorous shoots deltoid to rhombic, thin, coarsely serrate, often 6–7 cm long and broad, with slender wing-margined conspicuously glandular petioles. Flowers on long slender pedicels, in 5–7-flowered compact corymbs, with linear to linear-obovate glandular bracts and bractlets fading rose color; calyx-tube broadly obconic, the lobes gradually narrowed from the base, slender, acuminate, entire or occasionally sparingly dentate below the middle; stamens 10; anthers red; styles 2 or 3. Fruit remaining hard and dry in the autumn, obovate, dark red, marked by many large pale dots, pruinose, about 1 cm long and 8–9 mm wide; calyx prominent, with a long tube, a deep narrow cavity, and spreading persistent lobes; flesh thin, yellowish green; nutlets 2 or 3, rounded at the base, acute at the apex, ridged on the back, with a low rounded ridge, light colored, 7–8 mm long, and 4–5 mm wide.

A shrub, with slender nearly straight branchlets, olive-green tinged with red when they first appear, becoming light chestnut-brown and lustrous in their first season and ultimately dark gray-brown, and armed with straight slender dark purplish spines 2.5–3 cm in length.

Niagara Falls, J. Dunbar (※ 3, type), October 7, 1902, and June 1, 1904.

Crataegus congestiflora n. sp.

Leaves ovate, acuminate, rounded or abruptly cuneate at the entire base, finely doubly serrate above, with straight glandular teeth, and slightly divided into 5 or 6 pairs of broad spreading acuminate lateral lobes; more than half grown when the flowers open during the last week of May and then membranaceous, light yellow-green and covered above by short white hairs and pale bluish green and glabrous below, and at maturity thin, dark blue-green, dull and glabrous on the upper surface and paler blue-green on the lower surface, 4–6 cm long and 3–4.5 cm wide, with thin yellow midribs and primary veins; petioles slender, slightly wing-margined at the apex, sparingly glandular, 1.5–2.5 cm in length; leaves on vigorous shoots short-pointed at the apex, rounded at the broad base, more coarsely serrate and more deeply lobed, about 6–7 cm long and 5–6 cm wide. Flowers 1.4–1.5 cm in diameter, on slender glabrous pedicels, in very compact mostly 4–6-flowered corymbs;

calyx-tube narrowly obconic, glabrous, the lobes wide, acuminate, entire or occasionally irregularly toothed toward the apex, glabrous, bright red above the middle, reflexed after anthesis; stamens 5–8, usually 5; anthers dark rose color; styles 3 or 4, surrounded at the base by a wide ring of pale tomentum. Fruit ripening the end of October, on slender reddish pedicels, in 4- or 5-fruited spreading clusters, somewhat obovate, full and rounded at the apex, slightly narrowed and sometimes decurrent on the pedicel at the base, marked by many pale dots, crimson, pruinose, 1–1.2 cm long and 9–11 mm wide; calyx little enlarged, without a tube, with a narrow shallow cavity, and spreading persistent lobes often serrate toward the apex and dark red on the upper side; flesh thin, yellow, dry and mealy; nutlets 2 or 3, narrowed and rounded at the ends or acute at the apex, ridged on the back, with a broad grooved ridge, 6–7 mm long, and 4–5 mm wide

A shrub 3–4 m high, with small stems covered with dark gray bark, ascending and spreading branches, and very slender zigzag glabrous branchlets light green, slightly tinged with red when they first appear, becoming bright chestnut-brown and very lustrous in their first season and dull reddish brown the following year, and armed with numerous thin slightly curved light brown shining spines, becoming purple and ultimately gray, and 2.5–3 cm long.

Buffalo, J. Dunbar (※19, type), September 30, 1904, May 27, 1905; (※31), September 30, 1904; (※44), September 26, 1905.

Crataegus plana n. sp.

Leaves oblong-obovate, acuminate, rounded or rarely cuneate at the entire base, finely doubly serrate above, with straight glandular teeth, and slightly divided above the middle into 3 or 4 pairs of small spreading acuminate lobes; tinged with red and sparingly villose on the upper surface and in the axils of the veins below when they unfold, almost fully grown and nearly glabrous when the flowers open about the 20th of May and then thin, light yellow-green and smooth above and bluish green below, and at maturity thin, glabrous, dark green and somewhat lustrous on the upper surface and pale blue-green on the lower surface, 4–5 cm long and 3–4 cm wide, with slender yellow midribs, and thin primary veins extending obliquely to the points of the lobes; petioles slender, wing-margined often to the middle, slightly glandular while young, 1.5–2 cm in length; leaves on vigorous shoots subcoriaceous, broadly ovate to suborbicular, rounded or cordate at the base, more coarsely serrate and more deeply lobed, and sometimes 6–7 cm wide, with stout broadly winged petioles glandular throughout the season. Flowers 2 cm in diameter, on slender glabrous pedicels, in usually 5–7-flowered corymbs, with linear glandular bracts and bractlets fading rose color; stamens 10, filaments persistent on the ripe fruit; anthers pale pink; styles 3–5, surrounded at the base by a broad ring of pale hairs. Fruit ripening from the first to the middle of October, on slender pedicels, in few-fruited erect clusters, short-oblong, somewhat rounded at the base, bright green when fully grown, crimson at maturity, pruinose, marked by many small pale dots; calyx prominent, without a tube, with a broad deep cavity, and widespreading persistent lobes dark red on the upper side below the middle; flesh thin, yellow-green, hard, dry and mealy; nutlets 3–5, rounded at the ends, rounded and slightly grooved on the back, light colored, 5–6 mm long, and about 4 mm wide.

A shrub 3–4 m high and broad, with several stout erect stems covered with dark scaly bark, small spreading and ascending branches, and very slender glabrous branchlets, light chestnut-brown and lustrous in their first season, dark dull reddish brown the following year, and armed with numerous slender nearly straight chestnut-brown and shining, ultimately dark gray spines 3–4 cm long.

Buffalo, J. Dunbar (※ 4, type), October 6, 1902, May 21, 1903; near Hemlock lake, Livingston co., H. T. Brown (※ 3), May and October 1906.

Crataegus maineana Sargent

Rochester Acad. Sci. Proc. IV. 106 (1903).

Buffalo, J. Dunbar (※ D), September 25, 1901, May 28, 1906; Niagara Falls, J. Dunbar, September 28, 1905, May 28, 1906; also near Rochester, New York.

Crataegus placiva n. sp.

Leaves ovate, acuminate, rounded, truncate or abruptly concave-cuneate at the broad entire or glandular base, finely doubly serrate above, with straight glandular teeth, and divided into 2 or 3 pairs of short broad acuminate lateral lobes; deeply tinged with red when they unfold, nearly fully grown when the flowers open at the end of May, and then thin, yellow-green and roughened above by short white hairs and pale and slightly hairy in the axils of the veins below, and at maturity thick, glabrous, smooth, dark blue-green on the upper surface, pale on the lower surface, and 4–5 cm long and broad, with slender midribs and 3 or 4 pairs of thin primary veins; petioles slender, slightly wing-margined at the apex, glandular throughout the season, often tinged with red in the autumn, 2–3 cm in length; stipules linear, glandular, fading brown, caducous; leaves on vigorous shoots subcoriaceous, truncate at the base, coarsely serrate, more deeply lobed and often 7–8 cm long and wide. Flowers 2 cm in diameter, on elongated slender glabrous pedicels, in compact usually 5- or 6-flowered corymbs, with linear to linear-obovate glandular bracts and bractlets; calyx-tube broadly obconic, glabrous, the lobes short, slender, acuminate, glabrous, entire; stamens 10; filaments persistent on the ripe fruit; anthers purplish red; styles 3 or 4, surrounded at the base by a broad ring of long matted white hairs. Fruit ripening from the first to the middle of October, short-oblong, full and rounded at the ends or obovate and slightly narrowed at the base, bright orange-red, pruinose, marked by small pale dots, 1–1.2 cm in diameter; calyx prominent, without a tube, with a broad shallow cavity, and widespreading persistent lobes dark red on the upper side below the middle; flesh thin, yellow, dry and mealy; nutlets 3 or 4, narrow and rounded at the ends, slightly ridged on the back, with a low rounded ridge, about 7 mm long, and 4–5 mm wide.

A shrub sometimes 5 m high, with ascending stems covered with dark gray scaly bark, spreading branches, and slender zigzag glabrous branchlets dark orange-green more or less deeply tinged with red when they first appear, becoming dull chestnut-brown and marked by small pale lenticels in their first season and dull reddish brown the following year, and armed with slender slightly curved shining spines 5–6 cm long, persistent and very numerous on old stems and branches.

Buffalo, J. Dunbar (※ 22, type), Septembei 30, 1904, May 28, 1905; (※ 27), September 30, 1904, May 28, 1906.

Crataegus tortuosa n. sp.

Leaves oblong-ovate, abruptly cuneate or rarely rounded at the entire base, finely doubly serrate above, with straight or incurved glandular teeth, and slightly divided into 4 or 5 pairs of broad acuminate spreading lobes, about half grown when the flowers open at the end of May and then membranaceous, yellow-green, slightly roughened above by short white hairs and glabrous below, and at maturity thick, blue-green, smooth and glabrous on the upper surface, 5–6.5 cm long and 4.5–5 cm wide, with stout yellow midribs sometimes tinged with rose color in the autumn, and thin remote primary veins extending to the points of the lobes; petioles stout, wing-margined at the apex, sparingly glandular early in the season, tinged with rose color in the autumn, 2–4 cm in length; leaves on vigorous shoots usually broader and rounded or cordate at the base, more deeply lobed and sometimes 6–7 cm long and wide. Flowers on short slender glabrous pedicels, in compact 3–8, usually 5-flowered corymbs, with small linear rose colored bracts and bractlets; calyx-tube narrowly obconic, the lobes short and broad, minutely serrate near the middle, glabrous, red and glandular at the acuminate apex, reflexed after anthesis; stamens usually 5; anthers purplish red; styles 2–4, surrounded at the base by a broad ring of long pale hairs. Fruit ripening the end of September, on stout drooping reddish pedicels, in few-fruited clusters, obovate, full and rounded at the apex, abruptly narrowed at the base, bright orange-red, pruinose, marked by numerous pale dots, lustrous, 1–1.2 cm long, and 8–10 mm wide; calyx-tube little enlarged, with a broad shallow cavity, and narrow spreading lobes dark red on the upper side below the middle, their tips incurved or more often deciduous from the ripe fruit; nutlets 2 or 3, narrow and rounded at the ends, prominently ridged on the back, with a broad deeply grooved ridge, light colored, 7–8 mm long, and 4–5 mm wide.

A shrub sometimes 5–6 m high, with stout stems, very tortuous horizontal or ascending branches, and slender slightly zigzag glabrous branchlets, dark orange-green when they first appear, becoming bright chestnut-brown and marked by dark lenticels in their first season and dull reddish brown the following year, and armed with numerous stout nearly straight bright chestnut-brown shining ultimately dull gray spines 2–3 cm long.

Buffalo, J. Dunbar, (⋕ 25, type), September 30, 1904, May 28 and September 26, 1905; J. Dunbar and C. S. Sargent (⋕ 29), September 30, 1904; (⋕ 17), September 24, 1904, J. Dunbar, May 28, 1905.

Crataegus xanthophylla n. sp.

Leaves broadly ovate, acuminate, rounded or cuneate at the entire or glandular base, sharply doubly serrate, with straight glandular teeth, and divided above the middle into 3 or 4 small acuminate lobes; nearly half grown when the flowers open at the end of May and then thin, light yellow-green and roughened above by short white hairs and pale blue-green and glabrous below, and at maturity thick and firm to subcoriaceous, glabrous, smooth and dark yellow-green on the upper surface, pale yellow-green on the lower surface, 6–8 cm long and 5–7 cm wide, with stout yellow midribs and 4 or 5 pairs of slender primary veins; petioles stout, slightly wing-margined at the apex, glandular, with minute persistent glands, often rose color in the autumn, 2–3.5 cm in length. Flowers 1.5 cm in diameter, on slender glabrous pedicels, in compact usually 5–7-flowered corymbs; calyx-tube broadly obconic, glabrous, the lobes short and broad, acuminate, glabrous, coarsely glandular serrate above the middle, reflexed after anthesis; stamens 10; anthers red; styles 3 or 4, surrounded at the base by a broad ring of pale tomentum. Fruit ripening early in October, on stout drooping dark red glabrous pedicels, in few-fruited clusters, short-oblong, full and rounded at the ends, orange-red, slightly pruinose, marked by small pale dots, 1–1.2 cm long; calyx little enlarged, with a broad shallow cavity, and spreading persistent glabrous lobes dark red on the upper side below the middle; nutlets 3 or 4, acute at the ends, ridged on the back, with a narrow ridge, dark colored, 7–8 mm long, and about 4 mm wide.

A shrub 5–6 m high, with numerous slender spreading stems covered with pale gray bark, small ascending branches, and slender slightly zigzag glabrous branchlets, dark orange-green and marked by small pale lenticels when they first appear, becoming bright red-brown the following year, and armed with a few slender shining spines 2.5–3 cm long.

Buffalo, J. Dunbar (⚹1, type), October 6, 1902, May 26, 1906.

Crataegus implicata n. sp.

Leaves ovate to oval, acuminate and short-pointed at the apex, rounded and 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 spreading lobes; nearly fully grown when the flowers open at the end of May and then yellow-green and slightly roughened above by scattered white hairs, and at maturity membranaceous, dark bluish green and smooth on the upper surface, pale blue-green on the lower surface, 3.5–4.5 cm long and 3–4 cm wide, with thin midribs, and slender primary veins; petioles very slender, sparingly glandular through the season, 1–2.5 cm in length; stipules linear to linear-falcate, glandular-serrate, fading brown, persistent; leaves on vigorous shoots subcoriaceous, broadly ovate, more deeply lobed, often 5 cm long and wide, with foliaceous lunate coarsely serrate persistent stipules. Flowers 1.3–1.5 cm in diameter, on slender glabrous pedicels, in very compact mostly 5- or 6-flowered corymbs, with linear glandular bracts and bractlets; calyx-tube narrowly obconic, glabrous, the lobes slender, acuminate, nearly entire, red and glandular at the apex, reflexed after anthesis; stamens 5–8; anthers dark rose color; styles 3 or 4, surrounded at the base by a narrow ring of pale tomentum. Fruit ripening at the end of September, on short dark red pedicels, in usually 1–3-fruited drooping clusters, subglobose to ovate, pruinose, marked by many small pale dots, 1–3 cm long, 1–1.1 cm in diameter; calyx prominent, with a short tube, a small deep cavity, and spreading minutely serrate persistent lobes dark red on the upper side below the middle; flesh thick, yellow, dry and mealy; nutlets 3 or 4, narrowed and acute at the ends or rounded at the base, rounded or slightly ridged on the back, with a low ridge, light colored, 6–7 mm long, and 4 mm wide.

A thin intricately branched shrub sometimes 4 m high, with irregularly spreading stems covered at the base with dark gray bark, and slender glabrous branchlets dark orange-green tinged with red when they first appear, becoming in their first season bright chestnut-brown, lustrous and marked by numerous dark lenticels, dull gray-brown the following year, and armed with many straight purplish shining ultimately dull gray-brown spines 4–6 cm long and very numerous and branched on old stems.

Buffalo, J. Dunbar (※ 39, type), May 28 and September 26, 1905.

Crataegus promissa n. sp.

Leaves oblong-ovate, acuminate, gradually narrowed and concave-cuneate at the entire or glandular base, sharply doubly serrate above, with straight or incurved glandular teeth, and deeply divided into 4–6 pairs of slender acuminate lobes; about one third grown when the flowers open the first of June and then thin, yellow-green and roughened above by short white hairs, and at maturity thin, glabrous, dark blue-green and smooth on the upper surface and pale blue-green on the lower surface, 5–5.8 cm long and 4–7 cm wide, with slender yellow midribs, and thin primary veins arching to the points of the lobes; petioles slender, wing-margined at the apex, sparingly glandular through the season, 4–4.5 cm in length; stipules linear-obovate, glandular, fading brown, caducous; leaves on vigorous shoots thick, cuneate at the base, coarsely serrate, deeply lobed, sometimes 8–9 cm long and 7–8 cm wide, with broadly winged petioles and foliaceous lunate coarsely serrate persistent stipules. Flowers 1.6 cm in diameter, on slender elongated glabrous pedicels, in broad lax many-flowered corymbs, with linear to oblong-obovate glandular caducous bracts and bractlets; calyx-tube narrowly obconic, glabrous, the lobes long, narrow, acuminate, entire or slightly dentate below the middle, glabrous, reflexed after anthesis; stamens 5–7; anthers pink; styles 3 or 4, surrounded at the base by a broad ring of long white hairs. Fruit ripening at the end of September, on long slender drooping pedicels, in many-fruited clusters, oblong-obovate, tapering at the long base, crimson, lustrous, 1–1.2 cm long and 7–8 mm wide; calyx little enlarged, with a small shallow cavity, and reflexed often closely appressed elongated narrow lobes; flesh thin, dry and mealy; nutlets 3 or 4, rounded at the base, acute at thet apex, only slightly ridged on the back, 8–9 mm long, and about 4 mm wide.

A shrub 3–4 m high, with numerous stems covered with dark gray scaly bark, ascending branches, and slender zigzag glabrous branchlets bright orange-green more or less tinged with purple when they first appear, becoming light chestnut-brown and marked by large pale lenticels in their first season and pale gray-brown the following year, and armed with slender slightly curved light chestnut-brown shining spines 4–5 cm long, often pointing to the base of the branch, and compound and persistent on old stems.

Niagara Falls, J. Dunbar, (✻ 4, type), May 21 and September, 1903, June 1, 1904; J. Dunbar and C. S. Sargent (✻ 19), September 16, 1904, J. Dunbar, May 28, 1905, J. Dunbar (✻ 30), September 27, 1905, May 28, 1906.

Crataegus strigosa n. sp.

Leaves ovate, acuminate and long pointed at the apex, cuneate at the entire base, finely doubly serrate above, with straight glandular teeth, and divided into 5 or 6 pairs of small acuminate spreading lateral lobes; more than half grown when the flowers open at the end of May and then membranaceous, yellow-green and roughened above by short rigid white hairs and pale and glabrous below, and at maturity thin, yellow-green and scabrate on the upper surface and light yellow-green on the lower surface, 4–5 cm long and 3.5–4 cm wide, with stout midribs, and 5 or 6 pairs of prominent primary veins; petioles slender, slightly wing-margined at the apex, glandular throughout the season, 2–2.5 cm in length. Flowers

1.5 cm in diameter, on slender glabrous pedicels, in 5–8-, usually 5–6-flowered compact corymbs, the lowest peduncle generally from the axis of an upper leaf; calyx-tube narrowly obconic, glabrous, the lobes small, acuminate, entire or slightly glandular, glabrous, reflexed after anthesis; stamens 7–10; anthers purple; styles 3–5, surrounded at the base by a narrow ring of pale hairs. Fruit ripening early in October, on stout reddish drooping or spreading pedicels, in few-fruited clusters, short-oblong, full and rounded at the ends, scarlet, lustrous, marked by occasional dark dots, 1.3–1.4 cm long, 1–1.1 cm in diameter; calyx little enlarged, without a tube, with a narrow deep cavity, and small spreading or closely appressed persistent lobes, dark red on the upper side below the middle; flesh thin, yellow, dry and mealy; nutlets 3–5, narrowed and rounded at the ends or acute at the apex, ridged on the back, with a broad rounded or grooved ridge, light colored, 6–7 mm long, and about 4 mm wide.

A shrub 3–4 m high, with stout stems covered with dark scaly bark, ascending branches, and slender somewhat zigzag glabrous branchlets dark olive-green tinged with red when they first appear, becoming light chestnut-brown, lustrous and marked by many small dark lenticels in their first season, and armed with slender slightly curved light chestnut-brown shining spines 3–6 cm long.

Buffalo, J. Dunbar (※ 20, type), September 30, 1904 and May 28, 1905.

Crataegus barryana n. sp.

Leaves broadly ovate, rounded or abruptly cuneate at the wide base, sharply doubly serrate, with straight glandular teeth, and very slightly divided into 4–6 pairs of small acuminate spreading lobes; nearly half grown when the flowers open about the 20th of May and then thin, dark yellow-green and roughened above by short white hairs and pale and glabrous below, and at maturity thin but firm in texture, dull yellow-green, scabrate and lustrous on the upper surface, glaucous on the lower surface, 6–8 cm long and 5–7 cm wide, with slender midribs, and thin primary veins extending obliquely to the points of the lobes; turning yellow in the autumn; petioles slender, narrowly wing-margined at the apex, slightly villose on the upper side while young, becoming glabrous, sparingly glandular, with persistent glands, 3–5 cm in length; leaves on vigorous shoots rounded or slightly cordate at the broad base, more coarsely serrate and more deeply lobed, often 8–9 cm long and broad. Flowers 2 cm in diameter, on stout glabrous pedicels, in compact mostly 7–10-flowered corymbs; calyx-tube narrowly obconic, glabrous, the lobes slender, acuminate, entire or sparingly dentate, glabrous on the outer, slightly villose on the inner surface, reflexed after anthesis; stamens 7–10; anthers purple; styles 3 or 4, surrounded at the base by a narrow ring of pale tomentum. Fruit ripening the middle of October, on stout erect or spreading reddish pedicels, in few-fruited clusters, obovate, full and rounded at the apex, abruptly narrowed at the rounded base, crimson, marked by small pale dots, pruinose, about 1.8 cm long and 1.5 cm wide; calyx little enlarged, with a narrow shallow cavity, and spreading persistent lobes villose above and dark red on the upper side below the middle; flesh thick, dark yellow, dry and mealy; nutlets usually 3, narrowed and rounded at the ends, prominently ridged on the back, with a broad grooved ridge, 7–8 mm long, and about 5 mm wide.

A shrub 4–5 m high, with small spreading or ascending branches covered with dark scaly bark and forming an open irregular head, and slender glabrous branchlets dark orange-brown and marked by numerous pale lenticels when they first appear, becoming dull red-brown in their first season and light gray-brown the following year, and armed with slender slightly curved light red-brown spines 3.5–4 cm long, long persistent and often becoming branched on old stems.

Rochester, common in moist heavy soil, J. Dunbar (✱ 37, type), October 14, 1902, May 20, 1903.

At the suggestion of Mr Dunbar this species is named for William C. Barry of Rochester, whose practical knowledge and business ability have been powerful in advancing horticulture in America.

Crataegus foliata n. sp.

Leaves crowded, ovate-oblong, acuminate, rounded or concave-cuneate at the base, coarsely doubly serrate, and slightly divided into 4 or 5 pairs of small acuminate spreading lobes; more than half grown when the flowers open at the end of May and then membranaceous, yellow-green, slightly roughened above by short white hairs and glabrous below, and at maturity thin but firm in texture, glabrous, smooth, yellow-green on the upper surface and paler on the lower surface, 5–7 cm long and 4–5 cm wide, with stout yellow midribs and slender primary veins; petioles stout, slightly wing-margined at the apex, glandular while young, often rose color in the autumn, 2.5–3 cm in length; leaves on vigorous shoots rounded or cordate at the broad base, coarsely serrate, more deeply lobed, 6–7 cm long and broad, with short stout conspicuously glandular petioles. Flowers 1.5–1.6 cm in diameter, on long slender glabrous pedicles, in broad lax usually 8–12-flowered corymbs; calyx-tube narrowly obconic, glabrous, the lobes stout, broad, acuminate, slightly serrate usually only above the middle, glabrous on the outer, sparingly villose on the inner surface, reflexed after anthesis; stamens 7–10; anthers dark rose color; styles usually 3. Fruit ripening early in October, on long slender red drooping pedicels, in few-fruited clusters, obovate, crimson, lustrous, marked by numerous small pale dots, 1–1.2 cm long and 8–10 mm wide; calyx prominent, with a narrow deep cavity, and spreading or slightly appressed persistent lobes dark red on the upper side below the middle; flesh thin, yellow, dry and mealy; nutlets 3, narrowed and acute at the ends or rounded at the base, prominently ridged on the back, with a broad doubly grooved ridge, dark colored, 6–7 mm long, and about 4 mm wide.

A leafy shrub 3–4 m high, with ascending tortuous stems covered with dark scaly bark, stout glabrous branchlets purple and marked by large pale lenticels when they first appear, becoming light chestnut-brown and lustrous in their first season and light reddish brown the following year, and armed with stout straight or slightly curved bright chestnut-brown and shining ultimately dull gray-brown spines 1.5–4 cm. long.

Niagara Falls, J Dunbar and C. S. Sargent (※ 20, type, and 27), September 16, 1904; J. Dunbar, May 28, 1905.

Crataegus cruda n. sp.

Leaves ovate, acuminate, rounded or abruptly or gradually narrowed and cuneate at the entire base, sharply doubly serrate above, with straight glandular teeth, and slightly divided often only above the middle into 4 or 5 pairs of small acuminate spreading lobes; nearly half grown when the flowers open during the last week of May and then membranaceous, yellow-green and scabrate above and paler and glabrous below, and at maturity thin but firm in texture, yellow-green, smooth, glabrous, 5–6 cm long and 4–4.5 cm wide; petioles very slender, slightly wing-margined at the apex, glabrous, 2.5–3 cm in length; leaves on vigorous shoots coarsely serrate, more deeply lobed, gradually narrowed below into broad-winged petioles, often 9–10 cm long and 6–7 cm wide. Flowers 1.2–1.4 cm in diameter, on very slender glabrous pedicels, in long-branched lax usually 7–10-flowered corymbs; calyx-tube narrowly obconic, glabrous, the lobes long, slender, acuminate, usually entire, glabrous, reflexed after anthesis; stamens 5–8; anthers pale pink; styles 3 or 4, surrounded at the base by a broad ring of pale tomentum. Fruit ripening at the end of September, on slender drooping red pedicels, in few-fruited clusters, obovate, scarlet, lustrous, marked by small pale dots, 1.2–1.5 cm long and about 1 cm wide; calyx little enlarged, with a wide shallow cavity, and spreading and appressed persistent lobes dark red on the upper side below the middle; flesh thick, yellow, sweet and juicy; nutlets 3 or 4, acute at the ends, slightly ridged or grooved on the back, about 7 mm long, and 3 mm wide.

A shrub 3–4 m high, with dark gray stems, and stout zigzag glabrous branchlets dark orange-green when they first appear, becoming dark chestnut-brown or orange-brown and marked with numerous small dark lenticels in their first season and dull reddish brown the following year, and armed with very stout straight or slightly curved light red-brown shining spines 4–6 cm land and branched and persistent on old stems.

Niagara Falls, J. Dunbar (✲ 31, type), September 27, 1905, and May 28, 1906.

Crataegus inusitula n. sp.

Leaves broadly ovate, acuminate and long pointed at the apex, rounded or abruptly concave-cuneate at the broad entire base, coarsely doubly serrate above, with straight glandular teeth, and divided usually only above the middle into 3 or 4 pairs of short broad acuminate lobes; tinged with red when they unfold, not more than one third grown when the flowers open about the first of June and then bluish green and roughened above by short white hairs and pale and slightly villose in the axils of the veins below, and at maturity subcoriaceous, dark blue-green, smooth or scabrate on the upper surface, pale blue-green and glabrous on the lower surface, 4–7 cm long and 2.5–5 cm wide, with thin yellow midribs and 3 or 4, usually 3 pairs of slender primary veins; petioles slender, slightly wing-margined at the apex, sparingly hairy on the upper side while young, becoming glabrous, glandular, with minute persistent glands, 1.5–3.5 cm in length; leaves on vigorous shoots thicker, rounded at the broad base, more coarsely serrate and more deeply lobed, often 7–8 cm long and 6–7 cm wide. Flowers 1.5 cm in diameter, on long slender sparingly villose pedicels, in compact mostly 5–7-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube broadly obconic, glabrous, the lobes gradually narrowed from wide bases, short, acuminate, entire or irregularly dentate, glabrous, reflexed after anthesis; stamens 10, filaments persistent on the fruit; anthers yellow; styles 3 or 4, densely coated with white hairs from the base nearly to the middle, surrounded by a narrow ring of pale tomentum. Fruit ripening at the end of September, on slender still slightly hairy pedicels, in few-fruited drooping clusters, short-oblong, full and rounded at the ends or slightly narrowed at the apex, dull greenish red, pruinose, marked by large pale dots, about 1 cm in diameter; calyx little enlarged, with a deep narrow cavity, and spreading lobes, their tips incurved and often deciduous from the ripe fruit; flesh thin, yellow, dry and mealy; nutlets 3 or 4, narrowed and rounded at the ends or acute at the apex, irregularly grooved or occasionally slightly ridged on the back, 6–7 mm long, and 4–5 mm wide.

A shrub, with slender nearly straight glabrous branchlets, green tinged with red when they first appear, becoming bright chestnut-brown, lustrous and marked by numerous pale lenticels in their first season and dull reddish brown the following year, and armed with slender slightly curved or straight chestnut-brown shining spines 2.5–3 cm long.

In moist soil, Chapinville, Ontario co., J. Dunbar and C. S. Sargent (※ E, type), October 1, 1902, M. S. Baxter, May 30 and September 20, 1903.

This and Crataegus delawarensis Sargent are the only species of *Pruinosae* that have yet been seen with 10 stamens and yellow anthers. From C. delawarensis it differs in the scabrate young leaves and villose pedicels, and from all other species in the dense covering of hairs on the lower part of the styles.

IV TENUIFOLIAE

Fruit short-oblong to obovate, red or scarlet, lustrous; anthers rose color or pink; leaves thin, hirsute on the upper surface while young.

Stamens 10 or less
  Leaves yellow-green
    Leaves glabrous at maturity; pedicels glabrous
      Fruit usually short-oblong
        Stamens 10; anthers pink
          Flowers 1.6 cm in diameter, in wide loose corymbs ....1 C. slavini
          Flowers not more than 1.2 cm in diameter, in compact corymbs ....2 C. boothiana
        Stamens 7–10; anthers dark rose color...........3 C. suavis
      Fruit obovate..4 C. colorata
    Leaves scabrate at maturity; pedicels villose...5 C. rubicunda

Leaves blue-green
Leaves glabrous at maturity
Fruit short-oblong
Leaves oblong-ovate, deeply lobed, usually only above the middle; fruit often 1.4 cm in length.................6 C. ornata
Leaves broadly ovate, laterally lobed; fruit generally not more than 1 cm long...........................7 C. bella
Leaves oval, only slightly lobed............8 C. genialis
Fruit obovate...................................9 C. tenuiloba
Leaves scabrate at maturity...................10 C. streeterae
Stamens 20
Leaves broadly ovate; flowers in compact corymbs; fruit short-oblong, in erect clusters....................................11 C. conferta
Leaves oblong-ovate; flowers in wide long-branched corymbs; fruit obovate, in drooping clusters..............................12 C. luminosa

Crataegus slavini n. sp.

Leaves oblong-ovate, acuminate, broad and rounded or gradually narrowed and cuneate at the base, finely doubly serrate, with straight glandular teeth, and divided into 5–8 pairs of widespreading often incurved acuminate lateral lobes; nearly half grown when the flowers open about the 25th of May and then thin, yellow-green and roughened above by short white hairs and pale and glabrous below, and at maturity thin but firm in texture, bright yellow-green, smooth and lustrous on the upper surface and pale and glaucous on the lower surface, 4.5–7 cm long and 4–5.5 cm wide, with stout midribs and slender primary veins arching obliquely to the points of the lobes; petioles slender, slightly wing-margined at the apex, glandular, with minute persistent glands, 2–3 cm in length; leaves on vigorous shoots thin, rounded or slightly cordate at the base, more deeply lobed, often 6–7 cm long and 5–6 cm wide. Flowers 1.5–1.6 cm in diameter, on long slender glabrous pedicels, in wide lax, mostly 8–10-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, glabrous, the lobes abruptly narrowed from broad bases, slender, acuminate, entire or occasionally obscurely dentate, glabrous, reddish, reflexed after anthesis; stamens 10; anthers pink; styles 3 or 4, surrounded at the base by a narrow ring of matted pale hairs. Fruit ripening from the first to the middle of October and persistent after the fall of the leaves, on slender reddish pedicels, in few-fruited drooping clusters, short-oblong or slightly obovate, somewhat angled, bright orange-red, lustrous, marked by numerous small pale dots, 1.2–1.4 cm long, and about 1 cm wide; calyx prominent, with a narrow deep cavity, and spreading and slightly incurved lobes, dark red on the upper side below the middle, their tips often deciduous from the ripe fruit; flesh thick, yellow, sweet and succulent; nutlets 3 or 4, narrowed at the ends, acute at the apex, prominently ridged on the back, with a broad deeply grooved ridge, 6–7 mm long, and 4 mm wide.

A shrub 3–4 m high, with erect intricately branched stems covered with pale gray bark and spreading into broad thickets, and slender nearly straight glabrous branchlets, dark orange color and marked by many pale lenticels when they first appear, becoming dull reddish brown in their first season and dark gray-brown the following year, and armed with straight or slightly curved chestnut-brown shining spines 3–4 cm long.

Brighton near Rochester, B. H. Slavin (※ 1, type, and 4), October 12, 1903, May 24, 1904.

This species is named for Bernard Henry Slavin of Seneca park, Rochester, for many years a diligent and careful student and collector of Crataegus in western New York.

Crataegus boothiana n. sp.

Leaves ovate, acuminate and often long pointed at the apex, rounded at the base, finely often doubly serrate, with straight slender glandular teeth, and divided into 5 or 6 pairs of acuminate spreading lobes; tinged with red when they unfold, nearly half grown when the flowers open about the 20th of May and then membranaceous, yellow-green and roughened above by short white hairs and pale and glabrous below, and at maturity thin, light yellow-green, glabrous and lustrous on the upper surface and pale bluish green on the lower surface, 5–6 cm long and 4–4.5 cm wide, with slender midribs, and thin primary veins extending obliquely to the points of the lobes; petioles slender, slightly wing-margined at the apex, glabrous, glandular, with occasional minute scattered often persistent glands, 1–2.5 cm in length; leaves on vigorous shoots rounded or often cordate at the broad base, deeply lobed, with stout winged conspicuously glandular petioles. Flowers about 1.2 cm in diameter, on slender glabrous pedicels, in compact mostly 8–10-flowered corymbs; calyx-tube narrowly obconic, glabrous, the lobes slender, acuminate, entire or slightly toothed near the base, glabrous, red above the middle, reflexed after anthesis; stamens 10; filaments persistent on the fruit; anthers pink; styles 3, surrounded at the base by a narrow ring of pale tomentum. Fruit ripening the middle of September, on short reddish pedicels, in few-fruited drooping clusters, short-oblong, full and rounded at the ends, bright orange-red, lustrous, marked by occasional small pale dots, 1–1.2 cm long and 8–9 mm wide; calyx prominent, with a broad shallow cavity, the lobes elongated, spreading, dark red on the upper side below the middle, their tips usually deciduous from the ripe fruit; flesh thin, yellow, slightly juicy; nutlets 3, narrowed and rounded at the base, acute at the apex, ridged on the back, with a narrow high ridge, 5–6 mm long, and 3–4 mm wide.

A shrub 2–2.5 m high, with small erect stems forming an open irregular head, and slender nearly straight glabrous branchlets light green tinged with red when they first appear, becoming dull reddish brown and marked by small pale lenticels in their first season and dull gray-brown the following year, and armed with stout or slender nearly straight purplish shining spines 2.5–3 cm long.

Wooded banks, near Rochester, J. Dunbar (※ 132, type), September 8, 1902, May 16 and September 16, 1903; Murray, common, M. S. Baxter (※133), October 11, 1902; Filmore, Baxter and Dewing (※309), September 4, 1905.

At the suggestion of Mr Dunbar this species is named in memory of Charles Miller Booth, M. D. (October 12, 1830–January 30, 1906), a resident of Rochester during nearly the whole of his life and a careful student of the flora of western New York, especially of the mosses and grasses in which he was particularly interested.

Crataegus suavis n. sp.

Leaves ovate, acuminate, rounded or abruptly concave-cuneate at the entire base, doubly serrate above, with slender glandular teeth, and divided into 5 or 6 pairs of acuminate spreading lateral lobes; tinged with red and roughened above by short white hairs when they unfold, about half grown when the flowers open at the end of May and then membranaceous, yellow-green, smooth and scabrate above, and at maturity thin, yellow-green, smooth and glabrous on the upper surface and pale on the lower surface, 5.6–7 cm long and 4.5 cm wide, with slender yellow midribs, and thin primary veins arching obliquely to the points of the lobes; petioles slender, slightly wing-margined at the apex, glandular, with persistent glands, 2–2.5 cm long; stipules linear to linear-obovate, glandular, foliaceous and lunate on vigorous shoots, glandular, caducous. Flowers 1.5 cm in diameter, on slender elongated glabrous pedicels, in lax thin branched usually 7–10-flowered corymbs, with linear glandular bracts and bractlets fading brown; calyx-tube narrowly obconic, glabrous, the lobes long, slender, acuminate, entire, glabrous, reflexed after anthesis; stamens 7–9; anthers light rose color; styles 2 or 3, surrounded at the base by a narrow ring of pale tomentum. Fruit ripening from the middle to the end of September, on slender drooping pedicels, in few-fruited clusters, short-oblong, full and rounded at the ends or slightly narrowed toward the base, orange-red, lustrous, marked by small pale dots, 1–1.3 cm long, and 8–9 mm wide; calyx little enlarged, with a deep narrow cavity, and slender closely appressed lobes, their tips often deciduous from the ripe fruit; flesh thick, pale yellow, sweet and juicy; nutlets 2 or 3, gradually narrowed and rounded at the ends, ridged on the back, with a low deeply grooved ridge, 7–8 mm long, and about 4 mm wide.

A shrub sometimes 4 m high, with small erect stems and branches, and slender slightly zigzag glabrous branchlets, dark orange-green deeply tinged with purple when they first appear, becoming dull reddish-brown and marked by small pale lenticels in their first season and light gray-brown the following year, and armed with slender straight purplish spines 2.5–3.5 cm long.

Buffalo, J. Dunbar (※ 9, type), September 29, 1903, June 1, 1905, and May 28, 1905; (※ 18), J Dunbar, May 28, 1905.

Crataegus colorata Sargent

Rochester Acad. Sci. Proc. IV. 123 (1903).

Buffalo, common, J. Dunbar, September 26, 1905, May 28, 1906; Niagara Falls, J. Dunbar, September 28, 1905; also near Rochester, New York.

Crataegus rubicunda Sargent

Rochester Acad. Sci. Proc. IV. 121 (1903).

Buffalo, J. Dunbar, May 21, 1903, May 28, 1906; also near Rochester, New York.

Crataegus ornata Sargent

Rochester Acad. Sci. Proc. IV. 120 (1903).

Buffalo, J. Dunbar (※ 42), October 6, 1902, May 28, 1906; also near Rochester, New York.

Crataegus bella n. sp.

Leaves ovate, acuminate, rounded or abruptly cuneate at the broad entire base, finely doubly serrate above, with straight slender glandular teeth, and divided into 4 or 5 pairs of narrow acuminate spreading lateral lobes; dark red and covered on the upper surface with short white hairs when they first appear, nearly fully grown when the flowers open at the end of May and then membranaceous, light yellow-green and scabrate above and pale below, and at maturity thin but firm in texture, dark bluish green and very smooth on the upper surface, pale blue-green on the lower surface, 3.5–4.5 cm long and 3–3.5 cm wide, with slender midribs and thin primary veins; petioles slender, slightly wing-margined at the apex, glandular, with large dark glands occasionally persistent during the season, often rose color in the autumn, 1.5–2 cm in length; leaves on vigorous shoots rounded or slightly cordate at the base, and usually as broad as long, with stout broad-winged rose colored petioles. Flowers 1.6 cm in diameter, on slender glabrous pedicels, in crowded many-flowered corymbs, with linear bracts and bractlets fading brown; calyx-tube narrowly obconic, glabrous, the lobes slender, elongated, entire or sparingly dentate, glabrous, reflexed after anthesis; stamens, 10; anthers rose color; styles 3 or 4, surrounded at the base by a narrow ring of pale hairs. Fruit very showy, in wide many-fruited erect or spreading clusters, full and rounded at the ends or slightly narrowed from below the middle to the base, scarlet, lustrous, marked by many small pale dots, about 1 cm long and 8–9 mm wide; calyx prominent, with a broad deep cavity, and spreading or slightly incurved persistent lobes red on the upper side toward the base; flesh thick, yellow, sweet and juicy; nutlets 3 or 4, narrowed and acute at the ends, ridged on the back, with a broad doubly grooved ridge 7–8 mm long, and 4–5 mm wide.

A shrub 3–4 m high, with stout ascending tortuous stems, small spreading branches, and slender zigzag branchlets dark purple and puberulous when they first appear, soon glabrous, becoming bright chestnut-brown and lustrous in their first season and dull gray-brown the following year, and armed with stout straight or slightly curved bright chestnut-brown shining ultimately dull gray-brown spines 2.5–3.5 cm long.

Buffalo, J. Dunbar (※ 24, type), September 24, 1904, May 28, 1905.

Crataegus genialis Sargent

Rhodora V. 148 (1903).

Buffalo, J. Dunbar and C. S. Sargent (✻18), September 24, 1904, J. Dunbar, May 21, 1905; also eastern New York and western Massachusetts.

Crataegus tenuiloba Sargent

Rochester Acad. Sic. Proc. IV. 122 (1903).

Buffalo, J. Dunbar (✻19 and 30), September 30, 1904, May 28, 1905; also near Rochester, N. Y.

Crataegus streeterae Sargent

Rochester Acad. Sci. Proc. IV. 119 (1903).

Buffalo, J. Dunbar, May 28, 1906; Niagara Falls, September 27, 1905, May 28, 1906; also at Rochester, N. Y.

Crataegus conferta n. sp.

Leaves broadly ovate, acuminate or rounded and short pointed at the apex, rounded or slightly cordate at the entire base, finely serrate above, with straight glandular teeth, and slightly divided into 3 or 4 pairs of small acuminate spreading lobes; tinged with red and covered above with soft white hairs when they unfold, nearly fully grown when the flowers open at the end of May and then membranaceous, light yellow-green and scabrate above, and at maturity thin, grabrous, yellow-green and smooth on the upper surface, paler on the lower surface, 3–4 cm long and 3–3.5 cm wide, with comparatively stout midribs, and 4 or 5 pairs of thin primary veins; petioles slender, slightly wing-margined at the apex, glandular throughout the season, 1.5–1.8 cm in length; leaves on vigorous shoots somewhat thickened, cuneate at the base, more coarsely serrate, more deeply lobed, and often 5–6 cm long and 4–5 cm wide, with stout shorter broadly winged petioles. Flowers 1.8 cm in diameter, on short glabrous pedicels, in very compact crowded usually 7–8-flowered showy corymbs, with linear glandular bracts and bractlets; calyx-tube broadly obconic, the lobes slender, elongated, entire or sparingly dentate, glabrous, reflexed after anthesis; stamens 20; filaments persistent on the ripe fruit; anthers rose color; styles 3, surrounded at the base by a narrow ring of pale tomentum. Fruit ripening at the end of September, on short stout reddish pedicels, in compact few-fruited erect clusters, short-oblong, slightly narrowed from the middle to the ends, orange-red, lustrous, marked by small pale dots, about 1.2 cm long and 8 mm wide; calyx little enlarged, with a deep narrow cavity, and small closely appressed persistent lobes bright red on the upper side; flesh thick, yellow, dry and sweet; nutlets 3, narrowed and acute at the ends or broader and rounded at the base, rounded and only slightly ridged on the back, about 7 mm long, and 4 mm wide.

A shrub 3–4 m high, with small ascending stems, and slender nearly straight branchlets dark orange-green more or less tinged with purple and puberulous when they first appear, soon glabrous, becoming bright chestnut-brown, lustrous, and marked by numerous small dark lenticles in their first season and dull reddish brown the following year, and armed with stout straight or slightly curved chestnut-brown shining spines 2–3 cm long.

Buffalo, J. Dunbar (⚹ 10, type), May 28 and September 26, 1905; J. Dunbar (⚹ 37), May 28, 1905.

Crataegus luminosa n. sp.

Leaves oblong-ovate, acuminate, rounded, truncate or rarely cuneate at the entire base, finely doubly serrate above, with straight glandular teeth, and slightly divided into 4 or 5 pairs of small acuminate lateral lobes; deeply tinged with red and covered on the upper surface with soft white hairs and glabrous below when they unfold, about half grown when the flowers open at the end of May and then yellow-green and scabrate above, and at maturity thin, glabrous, smooth and yellow-green on the upper surface, pale on the lower surface, 5–6 cm long and 3.5–4.5 cm wide, with slender yellow midribs and thin primary veins extending to the points of the lobes; petioles very slender, slightly wing-margined at the apex, glandular throughout the season, often tinged with rose color in the autumn, 2–3 cm in length; stipules linear, glandular, fading brown, caducous; leaves on vigorous shoots long-pointed, cordate at the base, more coarsely serrate and more deeply lobed. Flowers 1.8 cm in diameter, on long slender glabrous pedicels, in wide long-branched usually 8–10-flowered corymbs, the lowest peduncles from the axils of upper leaves; calyx-tube broadly obconic, glabrous, the lobes short, slender, sparingly dentate near the middle, glabrous on the outer, slightly villose on the inner surface, reflexed after anthesis; petals reflexed; stamens 20; anthers dark red; styles 5, surrounded at the base by a narrow ring of pale tomentum. Fruit ripening early in September and soon falling, on stout red pedicels, in few-fruited drooping clusters, obovate, rounded at the apex, gradually narrowed from above the middle to the base, dark crimson, lustrous, marked by many small pale dots; calyx little enlarged, with a deep narrow cavity, the lobes usually deciduous from the ripe fruit; flesh thick, yellow, soft and juicy; nutlets 5, thin, rounded at the base, gradually narrowed and acute at the apex, slightly grooved on the back, about 7 mm long, and 4–5 mm wide.

A shrub sometimes 5 m high, with numerous ashy gray stems, small ascending and spreading branches, and slender slightly zigzag branchlets, dark orange-green deeply tinged with purple when they first appear, becoming in their first season light chestnut-brown, lustrous and marked by many small pale lenticels, and dull gray-brown the following year, and armed with stout slightly curved chestnut-brown or purplish spines 3–4 cm long.

Low wet woods, Buffalo, J. Dunbar (※ 36, type), May 28 and September 26, 1905.

V MOLLES

Fruit subglobose to obovate, scarlet, pubescent at the ends; flesh thick and succulent; nutlets 3–5, narrowed at the ends, usually slightly ridged; corymbs hairy; leaves thin, broad, cuneate or rounded at the base; stamens 15–20; anthers rose color.

Crataegus radians n. sp.

Leaves oval to ovate, acuminate, concave-cuneate or rounded at the often unsymmetrical glandular base, sharply doubly serrate above, with straight glandular teeth, and divided often only above the middle into 6 or 7 pairs of slender acuminate spreading lobes; nearly half grown when the flowers open about the 20th of May and then thin, light yellow-green and roughened above by short white hairs and villose below, and at maturity thin, yellow-green and scabrate on the upper surface, paler and coated below on the slender midribs and primary veins with matted white hairs, 6–8.5 cm long and 4–5 cm wide; petioles slender, slightly wing-margined at the apex, villose, 2.5–3.5 cm in length; leaves on vigorous shoots rounded or truncate at the broad base, more coarsely serrate and more deeply lobed, often 9–10 cm long and 8–9 cm wide, with slender glandular petioles. Flowers 1.7–1.9 cm in diameter, on slender villose pedicels, in wide lax 5–16-flowered hairy corymbs, with linear-obovate to linear glandular bracts and bractlets fading brown and mostly persistent until the flowers open; calyx-tube narrowly obconic, thickly coated with long white hairs, the lobes gradually narrowed from wide bases, slender, acuminate, entire or minutely and irregularly glandular serrate, glabrous on the outer, sparingly villose on the inner surface, reflexed after anthesis; stamens 15–20, usually 20; anthers dark rose color; styles 4 or 5, surrounded at the base by a narrow ring of long white hairs. Fruit ripening from the 20th to the end of September, on stout villose reddish pedicels, in few-fruited drooping clusters, short-oblong, full and rounded at the ends or obovate and slightly narrowed at the base, crimson, lustrous, puberulous at the ends, marked by large pale dots; calyx little enlarged, with a deep narrow cavity, and slender spreading recurved usually persistent lobes dark red on the upper side below the middle; flesh thin, juicy, dark yellow; nutlets 4 or 5, gradually narrowed and acute at the ends or rounded at the base, rounded and grooved or irregularly ridged on the back, 6–7 mm long, and 4–5 mm wide.

An arborescent shrub 7–8 m high, with stout spreading stems covered with light gray scaly bark, small spreading and ascending branches forming an open irregular head, and slender slightly zigzag branchlets, covered when they first appear with long matted white hairs, light red or orange-brown, pubescent and marked by pale lenticels in their first season, darker colored and glabrous the following year and ultimately ashy gray, and armed with slender nearly straight chestnut-brown shining spines 4.5–5 cm long.

Low moist woods, Rochester (Knickerbocker woods), Baxter and Dewing (※ 302, type), October 10, 1904, May 21 and September 24, 1905, J. Dunbar, May 21, 1905.

VI FLABELLATAE

Fruit short-oblong to oval or obovate, scarlet, lustrous, 1.5–2 cm long; flesh succulent; nutlets 3–5, grooved and occasionally ridged on the back; leaves large, thin, ovate to oblong, more or less acutely lobed; anthers rose color or pink.

Stamens 20
- Leaves broadly ovate, glabrous above at maturity; fruit obovate .... 1 C. dayana
- Leaves oblong-ovate, scabrate above at maturity; fruit short-oblong .... 2 C. limosa

Stamens 10
- Anthers pink; leaves ovate, glabrous above at maturity; fruit obovate .... 3 C. letchworthiana

Anthers rose color; leaves broadly ovate, scabrate above at maturity; fruit short-oblong........................4 C. pedicellata

Stamens 7–10

Flowers 2.4 cm in diameter, on slightly villose pedicels, in broad 10–15-flowered corymbs; anthers pale pink; fruit short-oblong, truncate at the apex, often unsymmetrical and mammillate at the base..5 C. gloriosa

Flowers not more than 1.5 cm in diameter, on densely villose pedicels, in compact 8–10-flowered corymbs; anthers dark rose color; fruit subglobose to oval..........................6 C. sejuncta

Stamens 5–7, usually 5

Leaves oval to ovate, light yellow-green; flowers cup-shaped, on glabrous or slightly villose pedicels; fruit oblong to oval...7 C. holmesiana

Leaves oblong-ovate, dark yellow-green; flowers not cup-shaped; pedicels densely villose; fruit short-oblong..........8 C. acclivis

Crataegus dayana n. sp.

Leaves broadly ovate, acuminate, abruptly concave-cuneate or rounded at the entire or glandular base, sharply doubly serrate, with slender glandular teeth, and divided into 6 or 7 pairs of narrow acuminate spreading lateral lobes; when they unfold tinged with rose color and coated with soft white hairs more abundant on the lower than on the upper surface, nearly two thirds grown when the flowers open the last week of May and then very thin, yellow-green and scabrate above and pale and slightly hairy along the midribs and veins below, with short sometimes persistent hairs, and at maturity thin, dark yellow-green, smooth and glabrous on the upper surface, pale on the lower surface, 8–10 cm long and 7–9 cm wide, with stout midribs, and primary veins arching to the point of the lobes; petioles slender, wing-margined at the apex, slightly villose while young, becoming glabrous, rose colored in the autumn, 3–4 cm in length; stipules linear, only slightly glandular, fading brown, caducous; leaves on vigorous shoots thicker, cordate at the broad base, very coarsely serrate, more deeply lobed and often 10–11 cm long and wide, with stout glandular red petioles 2–2.5 cm in length, and foliaceous lunate glandular serrate deciduous stipules. Flowers 2–2.2 cm in diameter, on long stout slightly hairy pedicels, in wide lax long-branched usually 10–14 flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, glabrous, the lobes gradually narrowed from broad bases, long, acuminate, coarsely glandular serrate above the middle, glabrous on the outer, slightly villose on the inner surface, reflexed after anthesis; stamens 20; anthers pink; styles 3 or 4, surrounded at the base by a narrow ring of pale tomentum. Fruit ripening from the first to the middle of September and soon falling, on long stout glabrous reddish drooping pedicels, in few-fruited clusters, obovate, full and rounded at the apex, gradually narrowed from above the middle to the base and sometimes decurrent on the pedicel, crimson, lustrous, marked by many small pale dots; calyx prominent, with a wide very deep cavity, and spreading and incurved coarsely serrate persistent lobes dark red on the upper side toward the base; flesh thick, dark yellow, juicy and edible; nutlets 3 or 4, acute at the ends, ridged on the back, with a narrow high ridge, 7–8 mm long, and about 5 mm wide.

A tree sometimes 5 m high, with a trunk occasionally 3 dm in diameter, covered with ashy gray bark, spreading horizontal branches forming a compact shapely head, and slender slightly zigzag glabrous branchlets dark orange-green deeply tinged with purple when they first appear, becoming bright chestnut-brown, very lustrous and marked by small pale lenticels in their first season and dull reddish brown the following year, and armed with slender nearly straight bright chestnut-brown shining spines 3.5–4.5 cm long; or an arborescent shrub, with numerous small stems.

Buffalo, J. Dunbar and C. S. Sargent (※ 7, type), September 24, 1904, J. Dunbar, May 28, 1905.

This handsome tree is named in memory of David Fisher Day (June 11, 1829–August 21, 1901), the author with Judge Clinton, of *A Catalogue of the Native and Naturalized Plants of the City of Buffalo and its Vicinity* (1883), and of *A Catalogue of the Flowering and Fern-like Plants growing without Cultivation in the Vicinity of the Falls of Niagara* (1888).

Crataegus limosa n. sp.

Leaves oblong-ovate, acuminate, concave-cuneate or gradually narrowed and rounded at the entire base, coarsely doubly serrate above, with straight glandular teeth, and divided often only above the middle into 6 or 7 narrow acuminate lobes; more than half grown when the flowers open from the 15th to the 20th of May and then very thin, bright green and roughened above by short white hairs and pale bluish green and glabrous below, and at maturity thin, dark yellow-green and scabrate on the upper surface and pale yellow-green on the lower surface, 6–8 cm long and 4–5 cm wide, with stout orange colored midribs, and thin primary veins extending obliquely to the points of the lobes; petioles slender, narrowly wing-margined at the apex, slightly hairy on the upper side while young, soon glabrous, occasionally minutely glandular, 1.5–2.5 cm in length; leaves on vigorous shoots more deeply lobed and often 8–9 cm long and 6–6.5 cm wide. Flowers 1.8 cm in diameter, on long slender slightly hairy pedicels, in mostly 8–10-flowered compact thin-branched corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, glabrous, the lobes slender, elongated, minutely glandular-dentate, glabrous on the outer, pubescent on the inner surface, reflexed after anthesis; stamens 20–25; anthers red; styles 2–4, surrounded at the base by a narrow ring of pale tomentum. Fruit ripening the end of September, on stout nearly glabrous reddish pedicels, in few-fruited drooping clusters, short-oblong, full and rounded at the ends, crimson, lustrous, marked by large pale dots, 1–1.2 cm long and 8–10 mm wide; calyx little enlarged, with a deep narrow cavity, and spreading reflexed lobes red below the middle on the upper side and often deciduous from the ripe fruit; flesh thick, yellow, sweet and succulent; nutlets 2, narrowed and rounded at the ends or acute at the apex, ridged on the back, with a high often doubly grooved ridge, about 7 mm long, and 4 mm wide.

An arborescent shrub 5–7 m high, with widespreading stems often 2 dm in diameter and 1 m long covered with gray scaly bark, small drooping branches, forming a wide irregular open head, and slender zigzag glabrous branchlets dark orange-yellow and marked by pale lenticels when they first appear, becoming light chestnut-brown and lustrous in their first season and dull gray-brown the following year, and armed with few slender slightly curved chestnut-brown shining spines 3–4 cm long.

In the dense shade of thick woods, Hagaman's swamp near Rochester, J. Dunbar (X QQ), October 12, 1901, September 26, 1903, May 19 and September 26, 1902.

Crataegus letchworthiana n. sp.

Leaves ovate, acute or acuminate, concave-cuneate or rounded at the broad entire base, finely doubly serrate above, with straight glandular teeth, and slightly divided usually only above the middle into 3 or 4 pairs of small spreading acuminate lobes; slightly tinged with red when they unfold, nearly half grown when the flowers open at the end of May and then thin, yellow-green and covered above by soft white hairs and pale and slightly villose along the midribs and veins below, and at maturity thin but firm in texture, yellow-green, smooth and glabrous on the upper surface, still slightly hairy along the slender yellow midribs and primary veins on the lower surface, 5–6 cm long and 4–5 cm wide; petioles slender, slightly wing-margined at the apex, hairy along the upper side when young, becoming nearly glabrous, glandular, with minute persistent glands, 1.5–2.5 cm in length; leaves on vigorous shoots rounded or slightly cordate at the base, long-pointed, more coarsely serrate, deeply divided into spreading or incurved lateral lobes, and 6–7 cm long and broad. Flowers 2 cm in diameter, on long slender slightly hairy pedicels, in broad rather compact mostly 10–15-flowered corymbs; calyx-tube narrowly obconic, glabrous, the lobes slender, acuminate, finely glandular serrate below the middle, glabrous on the outer, pubescent on the inner surface, reflexed after anthesis; stamens 10; anthers pink; styles 2–4. Fruit ripening early in September, on glabrous reddish pedicels, in drooping many-fruited clusters, obovate and rounded at the apex, gradually narrowed at the base, scarlet, lustrous, marked by many small pale dots, 1.2–1.3 cm long and 1–1.1 cm in diameter; calyx little enlarged, with a wide shallow cavity, and spreading often persistent lobes dark red on the upper side below the middle and slightly hairy above; flesh thick, yellow, sweet and juicy; nutlets 2–4, narrowed and rounded at the ends, or acute at the apex, prominently and irregularly ridged on the back, with a broad deeply grooved ridge or rounded and slightly grooved on the back, 7–8 mm long, and 5–6 mm wide.

A tree 8–10 m high, with a trunk often 3 dm in diameter, spreading and ascending branches forming a broad round-topped symmetrical head, and slender glabrous branchlets orange-green and slightly tinged with red when they first appear, becoming dull light chestnut-brown and marked by small pale lenticels in their first season and light gray-brown and rather lustrous the following year.

Meadows near Portage, Baxter and Dewing (※ 249), September 7, 1904 and May 29, 1905.

This beautiful tree is named for the distinguished philanthropist, William P. Letchworth of Buffalo, for a long time chairman of the State Board of Charities of New York, on whose farm at Portage I saw it in the autumn of 1904.

Crataegus pedicellata Sargent

Bot. Gazette, XXXI. 226 (1901); Silva N. Am. XIII, 101, t. 677; Rochester Acad. Sci. Proc. IV. 116; Man. 448, f. 365.

Buffalo, J. Dunbar, September 26, 1905, May 28, 1906; abundant through Monroe and Ontario counties, New York.

Crataegus gloriosa n. sp.

Leaves ovate, acuminate, gradually narrowed and rounded or abruptly concave-cuneate at the entire base, coarsely doubly serrate above, with straight glandular teeth, and slightly divided into 4 or 5 pairs of stout acuminate spreading lateral lobes; more than half grown when the flowers open from the 20th to the end of May and then yellow-green and roughened above by short white hairs and paler and slightly hairy along the midribs and primary veins below, and at maturity thin, slightly convex, dark green and scabrate on the upper surface, pale yellow-green and often still slightly hairy on the thin yellow midribs and primary veins below, 6–8 cm long and 5–7 cm wide; petioles slender, slightly wing-margined at the apex, sparingly villose on the upper side while young, often becoming glabrous, occasionally glandular, 3–4 cm in length; leaves on vigorous shoots thicker, rounded or abruptly cuneate at the base, more coarsely serrate and more deeply lobed, often 10–12 cm long and 9–10 cm wide, with prominent midribs and veins, and stout glandular petioles. Flowers 2.2–2.4 cm in diameter, on long slender slightly villose pedicels, in wide erect or spreading 10–15-flowered corymbs, with oblong-obovate to linear glandular rose colored bracts and bractlets often persistent until the flowers open; calyx-tube narrowly obconic, glabrous, tinged with red, the lobes abruptly narrowed from broad bases, large, acuminate, coarsely glandular serrate, glabrous on the outer, slightly villose on the inner surface, reflexed after anthesis; claws of the petals concave and forming conspicuous cavities; stamens 7–10; anthers light pink; styles 3–5, surrounded at the base by a wide ring of long white hairs. Fruit ripening the middle of September, on stout slightly hairy reddish pedicels, in few-fruited erect or spreading clusters, short-oblong, broad and truncate at the apex, sometimes slightly narrowed below and then often unsymmetrical at the base by the development of a mammillate process adnate to the pedicel, deep crimson, very lustrous, marked by large pale dots, 1.8–2.2 cm long and 1.5–1.8 cm in diameter; calyx prominent, with a broad deep cavity, and erect and incurved persistent lobes; flesh thick, yellow, sweet, very juicy, of excellent flavor; nutlets 3–5, acute at the apex, rounded and slightly ridged on the back, 6–7 mm long, and 3–4 mm wide

A tree often 8–9 m high, with a tall trunk covered with pale close bark, and sometimes 3 dm in diameter, spreading and ascending branches forming a broad symmetrical round-topped head, and slender slightly zigzag glabrous branchlets dark orange color and marked by numerous pale lenticels when they first appear, becoming light reddish brown and lustrous in their first season and pale orange-brown the following year, and armed with few stout straight or slightly curved chestnut-brown shining spines 3–3.5 cm long.

Clay soil near the borders of woods, Rochester, J. Dunbar (※ L, type), May 31, 1901, J. Dunbar and C. S. Sargent, September 27, 1901, September 19 1902; Rochester (Knickerbocker woods), Baxter and Dewing (※ 304), May 21 and September 25, 1905.

Formerly referred to Crataegus pedicellata Sargent, the "L" tree of Rochester is distinct from that species in its larger flowers peculiar in the development of sacklike cavities at the base of the petals, by its pink not dark rose colored anthers, by the much larger and more lustrous fruit usually mammillate at the base and ripened 10 to 12 days earlier, and by its convex leaves. In habit, in its large and abundant flowers, and in the large and brilliant abundant fruits, C. gloriosa is not surpassed in beauty by any North American Crataegus.

Crataegus sejuncta Sargent

N. Y. State Mus. Bul. 105. 62 (1906).

Buffalo, J. Dunbar (※ 34), May 28 and September 30, 1905; also near Albany, New York, and in western New England.

Crataegus holmesiana Ashe

Jour. Elisha Mitchell Sci. Soc. XVI. pt II. 78 (1899), Sargent, Bot. Gazette XXXI. 10; Silva N. Am. XIII. 119, t. 676; Rochester Acad. Sci. Proc. IV. 114; Man. 449, f. 366.

Buffalo, J. Dunbar (※ 35), September 30, 1904, May 28, 1905; also near Rochester, New York and eastward to eastern Massachusetts and eastern Pennsylvania.

Crataegus acclivis Sargent

Rochester Acad. Sci. Proc. IV. 115 (1903); Man. 459, f. 367.

Niagara Falls, J. Dunbar, September 28, 1905, May 28, 1906; also near Rochester and Albany, New York.

VII DILATATAE

Fruit medium size, subglobose, scarlet; calyx much enlarged; nutlets 5, prominently ridged on the back; corymbs many-flowered; stamens 20; anthers rose color; leaves thin, on vigorous shoots as broad or broader than long.

Crataegus durobrivensis Sargent

Trees and Shrubs 1. 3, t. 2 (1902); Rochester Acad. Sci. Proc. IV. 114. Sargent and Peck, N. Y. State Mus. Bul. 105. 64 (1906).

Niagara Falls, J. Dunbar, September 28, 1905; near Hemlock lake, Livingston co., Henry T. Brown, May and October 1906; also near Rochester and Albany, New York.

VIII COCCINEAE

Leaves cuneate at the base, subcoriaceous or thin dark green and lustrous above; fruit subglobose, 9–15 mm in diameter.

Stamens 5–10
  Anthers pale yellow
    Leaves subcoriaceous; fruit 1.2–1.5 cm in diameter..1 C. coccinea
    Leaves thin; fruit usually less than 1 cm in diameter ....2 C. dodgei
  Anthers rose color
    Leaves thin; fruit 1–1.3 cm in diameter............3 C. puberis
Stamens, 20; anthers pink; leaves thin; ovate to oval or rhombic.......... 4 C. neo-baxteri

Crataegus coccinea Linneus

Spec. 1. 476 (1753). Sargent, Bot. Gazette XXXI. 14; Silva N. Am. XIII. 133, t. 683; Man. 459, f. 375.

Buffalo, J. Dunbar (⚹40), May 31, June 12 and September 26, 1905; also on the New England coast and in the valley of the St Lawrence river.

Crataegus coccinea var. **rotundifolia** Sargent

Bot. Gazette XXXI. 14 (1900); Silva N. Am. XIII. 134; Man. 460; Acad. Sci. Phila. Proc. IV. 631.

Buffalo, J. Dunbar (⚹E), September 25, 1901; (⚹33), September 30, 1904 and May 28, 1905; also common from Canada to eastern Pennsylvania.

Crataegus dodgei Ashe

Jour. Elisha Mitchell Sci. Soc. XIX. 26 (March 1903). Sargent, Acad. Sci. Phila. Proc. 632 (1905); Rhodora VII. 213 (Crataegus gravesii Sargent, Rhodora V. 159 (June 1903)). (Crataegus fallens Gruber, Bucks County Nat. Sci. Club. Proc. 1. 19 (October 1903)).

Buffalo, J. Dunbar (⚹ B), September 25, 1901, May 26 and October 6, 1902, (⚹ 12), September 29, 1903 and June 1, 1904; also from southern Michigan to eastern Massachusetts and eastern Pennsylvania.

Crataegus puberis n. sp.

Leaves rhombic to obovate, acuminate, gradually narrowed and concave-cuneate at the long entire base, finely doubly serrate above, with straight or incurved glandular teeth and slightly divided above the middle into 4 or 5 pairs of small acuminate lobes; more than half grown when the flowers open from the 20th to the 25th of May and then thin, dark yellow-green and covered above by soft white hairs and paler and villose below, and at maturity thin and firm in texture, dark green and glabrous on the upper surface, light yellow-green and nearly glabrous on the lower surface, 4.5–5.5 cm long and 3–4.5 cm wide, with slender slightly villose yellow midribs and veins; petioles slender, broadly wing-margined at the apex, hairy on the upper side, 1.5–3 cm in length. Flowers 1.2–1.3 cm in diameter, on slender densely villose pedicels, in compact 5–10-flowered corymbs, with linear glandular bracts and bractlets fading brown and often persistent until the flowers open; calyx-tube narrowly obconic, thickly coated with long matted pale hairs, the lobes slender, acuminate, obscurely glandular serrate, glabrous on the outer, sparingly villose on the inner surface, reflexed after anthesis; stamens 5–7; anthers dark rose color; styles 3 or 4, surrounded at the base by a narrow ring of pale tomentum. Fruit ripening about the middle of October, on slender slightly villose erect pedicels, in few-fruited clusters, short-oblong, full and rounded at the apex, slightly narrowed below, orange-red, lustrous, marked by pale dots, 1–1.3 cm long and 9–10 mm in diameter; calyx little enlarged, with a wide shallow cavity, and spreading and erect or recurved lobes dark red on the upper side below the middle; nutlets 3 or 4, rounded at the ends, rounded and only slightly grooved on the back, 6–7 mm long, and 4–5 mm wide.

A shrub sometimes 6–7 m high, with numerous stout gnarled stems covered with scaly bark, spreading and ascending branches, and slender nearly straight branchlets dark green and coated with matted white hairs when they first appear, becoming light orange color and glabrous during their first season and dull gray-brown the following year, and armed with occasional very slender nearly straight orange colored ultimately gray-brown spines 1–1.5 cm in length.

Borders of swamps and river bottoms in rich alluvial soil, near Belfast, Allegany co., Baxter and Dewing (❧ 220, type), May 24, September 17 and October 17, 1903.

Crataegus neo-baxteri n. sp.

Leaves ovate to oval or rhombic, acuminate, cuneate and often unsymmetrical at the entire base, finely serrate above, with straight or incurved glandular teeth, and slightly divided above the middle into 4 or 5 pairs of small acuminate lateral lobes; nearly fully grown when the flowers open at the end of May and then thin, yellow-green, smooth and glabrous with the exception of a few hairs along the upper side of the midribs, and at maturity thin but firm in texture, yellow-green, glabrous, 4–4.5 cm long and 2–3.5 cm wide, with slender orange colored midribs and primary veins; petioles very slender, slightly wing-margined and sometimes minutely glandular at the apex, sparingly hairy along the upper side while young, becoming nearly glabrous, 2–2.5 cm in length. Flowers 1.8–2 cm in diameter, on very long slender glabrous pedicels, in wide lax 7–10-flowered corymbs, with linear glandular caducous bracts and bractlets, fading brown; calyx-tube narrowly obconic, glabrous, the lobes slender, acuminate, entire or occasionally obscurely dentate, glabrous, reflexed after anthesis; stamens 20, filaments persistent on the ripe fruit; anthers pink; styles 2 or 3, surrounded at the base by a narrow ring of pale hairs. Fruit ripening the end of September, on long very slender spreading reddish pedicels, in few-fruited clusters, short-oblong, full and rounded at the ends, rich deep red marked by large pale dots and covered by a thick glaucous bloom, 1–1.3 cm long and nearly as broad; calyx little enlarged, with a wide deep cavity, and spreading and recurved lobes often deciduous from the ripe fruit; flesh thin, yellow, dry and mealy; nutlets 3 or 4, gradually narrowed and rounded at the ends, slightly ridged on the back, 6–7 mm long, and about 4 mm wide.

A shrub 6–7 m high, with thin stems, spreading branches forming a broad symmetrical head, and slender glabrous branchlets light orange color when they first appear, becoming light chestnut-brown and lustrous in their first season and light gray-brown the following year, and armed with slender nearly straight red-brown spines 2–3 cm long.

Clay banks near Tuscarora, Livingston co., Baxter and Dewing (✻ 251, type), May 30 and September 23, 1905.

With this species, described by its discoverers as being " as ornamental a species as we know in the genus," I am glad to associate the name of Mr M. S. Baxter, as the species which I named for him in the Proceedings of the Rochester Academy of Science, volume 4, page 107 was afterward found to have been described a few months earlier by Ashe under another name from plants growing in Pennsylvania.

IX ANOMALAE

Fruit medium size, short-oblong, orange-scarlet; nutlets occasionally furnished with obscure ventral depressions; leaves usually cuneate at the base, thickish to subcoriaceous, scabrate above while young; petioles slender, elongated; flowers in many-flowered corymbs; anthers rose color or pink.

Stamens 20; leaves ovate to oval, divided above the middle into short broad lobes; fruit short-oblong..........................1 C. brachyloba
Stamens 10
  Leaves ovate to oval or suborbicular, often rounded at the base, nearly smooth at maturity; fruit subglobose.......2 C. dunbari
  Leaves oval, scabrate above at maturity; fruit short-oblong.........
  ....3 C. asperifolia
Stamens 5–15; leaves oval to obovate, scabrate above at maturity; fruit subglobose..4 C. scabrida

Crataegus brachyloba n. sp.

Leaves ovate to oval, acuminate, concave-cuneate at the entire base, finely doubly serrate above, with straight or incurved glandular teeth, and divided usually only above the middle into 5 or 6 pairs of very short acuminate spreading lobes; slightly tinged with red when they unfold, roughened above by short white hairs and glabrous below, more than half grown when the flowers open during the last week of May and then membranaceous, yellow-green and scabrate on the upper surface and pale on the lower surface, and at maturity thick to subcoriaceous, dark blue-green, smooth and glabrous above, pale below, 5–7 cm long and 3.5–5 cm wide, with slender yellow midribs, and 5 or 6 pairs of thin primary veins; petioles slender, slightly wing-margined at the apex, glabrous, glandular often through the season, with minute scattered glands, and 2–3 cm in length; stipules linear, acuminate, glandular, fading brown, caducous; leaves on vigorous shoots subcoriaceous, long-pointed and acuminate at the apex, gradually narrowed and rounded at the base, coarsely serrate, with thick midribs and stout broadly winged conspicuously glandular rose colored petioles. Flowers 1.5 cm in diameter, on slender glabrous pedicels, in wide mostly 8–12-flowered corymbs, their lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, glabrous, the lobes gradually narrowed from wide bases, entire, red and glandular at the acuminate apex, reflexed after anthesis; stamens 20, filaments often persistent on the ripe fruit; anthers pink; styles 3–5, surrounded at the base by a narrow ring of pale tomentum. Fruit ripening at the end of September, on slender reddish pedicels, in few-fruited erect clusters, short-oblong to obovate, orange-red, lustrous, marked by large pale lenticels, about 1 cm long and 8–10 mm wide; calyx little enlarged, with a narrow deep cavity, and closely appressed lobes dark red on the upper side below the middle; flesh thin, yellow-green, dry and mealy; nutlets usually 4, narrowed and acute at the ends or rounded at the base, rounded or ridged on the back, with a low broad ridge, light colored, 7–8 mm long, and about 4 mm wide.

A shrub 4–5 m high, with crowded slender fastigiate light gray branches, the lower spreading, the upper ascending, and stout only slightly zigzag glabrous branchlets light orange-green when they first appear, becoming dull olive-brown and marked by small dark lenticels in their first season and dull gray-brown the following year, and armed with few stout nearly straight dull dark chestnut-brown spines 2.5–3 cm in length.

Buffalo, J. Dunbar (※ 41, type), May 28, June 12 and September 26, 1905.

Crataegus dunbari Sargent

Rochester Acad. Sci. Proc. IV. 126 (1903).

Buffalo, J. Dunbar (※ 43), September 26, 1905, May 28, 1906; also near Rochester, New York.

Crataegus asperifolia Sargent

Rhodora III. 31 (1901). Sargent and Peck, N. Y. State Mus. Bul. 105. 64 (1906).

Buffalo, J. Dunbar (※ 13), September 29, 1903, June 1 and September 20, 1904; (※ 46), May 28, 1906; (※ 43), September 26, 1905, May 28, 1906; also near Albany, New York and in western New England.

Crataegus scabrida Sargent

Rhodora III. 29 (1901); Silva N. Am. XIII. 133, t. 677.

Belfast, Allegany co., Baxter and Dewing (※ 210), May 29 and September 17, 1903, September 13, 1904, May 29 and September 19, 1905; also in western New England.

2 NUTLETS WITH LONGITUDINAL CAVITIES ON THE VENTRAL FACES

X TOMENTOSAE

Fruit pyriform to subglobose or short-oblong, 1–1.5 cm in diameter, lustrous, orange or scarlet; nutlets 2 or 3, usually obtuse at the ends and prominently ridged on the back.

Leaves thin, with midribs and veins only slightly impressed on their upper surface; fruit obovate to short-oblong.

Stamens 20
- Anthers yellow..1 C. structilis
- Anthers pink..2 C. finitima

Stamens 10; anthers yellow ....3 C. venustula

Leaves thick to subcoriaceous or coriaceous on vigorous shoots, with midribs and veins deeply impressed on their upper surface; fruit subglobose to short-oblong or ovate, scarlet.

Stamens 20
- Anthers pink; leaves nearly glabrous at maturity; pedicels slender
  - Leaves ovate to obovate; flowers 1–1.2 cm in diameter, on slightly villose pedicels................................4 C. succulenta
  - Leaves oblong-ovate to oval, 1.6–1.8 cm in diameter, on densely villose pedicels................................5 C. admiranda
- Anthers rose color; leaves rhombic to oval or ovate, pubescent below at maturity; flowers on stout densely villose pedicels...6 C. calvini

Stamens 10; anthers yellow
- Leaves rhombic to oval or obovate; flowers on short pedicels, in compact corymbs; calyx-lobes densely villose on the inner surface; fruit at least 1.2 cm in diameter, in drooping clusters; spines stout, nearly straight ....7 C. ferentaria
- Leaves broadly obovate to elliptic; flowers on long slender pedicels, in wide corymbs; calyx-lobes only slightly villose on the inner surface; fruit only 7–8 mm in diameter, in erect clusters; spines long, slender, usually curved....................8 C. macracantha

Crataegus structilis Ashe

Jour. Elisha Mitchell Sci. Soc. XIX. 12 (1903). Gruber, Bucks County (Penn.) Nat. Sci. Club Proc. I. 3. Sargent, Acad. Sci. Phila. Proc. 656 (1905).

Seneca park, Rochester, B. H. Slavin, 1906; also in eastern Pennsylvania and in Ontario and southern Michigan.

Crataegus finitima n. sp.

Leaves rhombic to oblong-ovate, acuminate and long-pointed at the apex, gradually narrowed and concave-cuneate at the acuminate entire base, sharply doubly serrate above, with straight glandular teeth, and divided above the middle into 4 or 5 pairs of small acuminate lobes; nearly fully grown when the flowers open about the 20th of May and then membranaceous, bright yellow-green, scabrous and sparingly villose along the midribs above and pale and slightly villose below, and at maturity thin but firm in texture, light green, smooth, lustrous and glabrous on the upper surface, and pale blue-green and villose-pubescent on the lower surface especially on the slender yellow midribs and thin pale primary veins extending very obliquely to the points of the lobes, 7.5–9 cm long and 4.5–5 cm wide; petioles slender, broadly wing-margined at the apex, villose on the upper side while young, soon glabrous, occasionally glandular early in the season, with minute glands, often rose color in the autumn, 2–3 cm in length; stipules linear, only slightly glandular, fading rose color, caducous; leaves on vigorous shoots sometimes obovate and rounded at the apex, more coarsely serrate and 8–9 cm long and 6–7 cm wide. Flowers 1.6 cm in diameter, on slender pedicels thickly covered with matted pale hairs, in wide villose 20–30-flowered corymbs, the lower peduncles from the axils of upper leaves, their bracts and bractlets linear, glandular, fading brown, caducous; calyx-tube narrowly obconic, covered with long white hairs, the lobes long, slender, acuminate, minutely glandular serrate below the middle, slightly villose on both surfaces, reflexed after anthesis; stamens 20; anthers pink; styles 2 or 3, surrounded at the base by a narrow ring of pale tomentum. Fruit ripening about the first of October, on short erect reddish pedicels in many-fruited clusters, short-oblong to subglobose, full and rounded at the ends, orange-red, lustrous, marked by large pale dots, about 1 cm in diameter; calyx prominent, with a narrow shallow cavity, and elongated spreading narrow coarsely serrate lobes red toward the base and puberulous on the upper surface; flesh thick, yellow, sweet and succulent; nutlets 2 or 3, broad, rounded at the ends, ridged on the back, with a low narrow ridge, penetrated on the inner face by broad deep cavities, about 6 mm long, and 4 mm wide

A tree or arborescent shrub 6–7 m high, sometimes with a trunk 2–2.5 dm in diameter and 2 m long covered with dark bark divided into narrow ridges, large spreading branches, and stout slightly zigzag glabrous branches light orange-green when they first appear, becoming bright chestnut-brown, very lustrous and marked by oblong pale lenticels in their first season and dull red-brown the following year, and armed with many stout slightly curved chestnut-brown or purplish shining spines 6–8 cm long and often pointing toward the base of the branch, persistent and branched on old stems.

Niagara Falls, C. S. Sargent (✱ 6, type), September 19, 1901, J. Dunbar, May 22, 1903, September 29, 1904, May 28, 1906.

Crataegus venustula n. sp.

Leaves oblong-ovate, acuminate, sharply or abruptly concave-cuneate at the entire base, coarsely doubly serrate above, with straight glandular teeth, and divided into 5 or 6 pairs of small acuminate spreading lateral lobes; nearly fully grown when the flowers open during the last week of May and then membranaceous, dark yellow-green and roughened above by short white hairs, and pale and slightly villose along the midribs below, and at maturity thin but firm in texture, dark green, smooth and lustrous on the upper surface, pale yellow-green on the lower surface, 5–7 cm long and 3.5–4.5 cm wide, with slender dark yellow midribs, and thin primary veins arching obliquely to the points of the lobes; petioles slender, wing-margined at the apex, sparingly glandular while young, villose on the upper side early in the season, soon glabrous, 2–2.5 cm in length; leaves on vigorous shoots broadly ovate to oval, mostly rounded at the base and often 8–9 cm long and 7–8 cm wide, with stout broadly winged glandular petioles. Flowers on slender glabrous pedicels, in wide usually 15–20-flowered thin-branched corymbs; calyx-tube narrowly obconic, glabrous, the lobes long, slender, acuminate, coarsely glandular serrate, glabrous on the outer, villose on the inner surface, reflexed after anthesis; stamens 10; anthers pale yellow; styles 2 or 3, surrounded at the base by a narrow ring of white tomentum. Fruit ripening early in October, on stout erect red pedicels, in drooping many-fruited clusters, subglobose, often slightly broader than high, crimson, lustrous, marked by large pale dots, about 1 cm in diameter; calyx prominent, with a broad deep cavity, and long closely appressed coarsely serrate persistent lobes villose on the upper side and red toward the base; flesh thick, yellow, sweet and succulent; nutlets 2 or 3, broad and rounded at the ends, rounded and ridged on the back, with a broad low grooved ridge, penetrated on the inner faces by deep cavities, 6–7 mm long, and about 4 mm wide.

A shrub 3–4 m high, with slender erect stems covered with dark scaly bark, small erect branches, and thin nearly straight branchlets light olive-green and lustrous in their first season and dull gray-brown the following year, and armed with stout straight or slightly curved light chestnut-brown shining spines 3–3.5 cm in length.

Niagara Falls, J. Dunbar (※14, type), June 1, 1904, May 28, 1906, J. Dunbar and C. S. Sargent, September 16, 1904.

Crataegus succulenta Link

Handbook II. 76 (1831). Sargent, Silva N. Am. XIII. 139, t. 131; Rochester Acad. Sci. Proc. IV. 133; Man. 497, f. 411; Acad. Sci. Phila. Proc. 675 (1905). Sargent & Peck, N. Y. State Mus. Bul. 105. 72 (1906).

Buffalo, J. Dunbar (※21), September 29, 1903, September 20, 1904, June 12, 1905; Niagara Falls, J. Dunbar (※29), June 12 and September 27, 1905, J. Dunbar (※7), May 22 and September 29, 1903; also eastern New York to southern New England and Michigan.

Crataegus admiranda n. sp.

Leaves oblong-obovate to oval, acute or acuminate at the apex, concave-cuneate and gradually narrowed to the long entire base, finely doubly serrate above, with straight glandular teeth, and very slightly divided above the middle into 4 or 5 pairs of small acuminate spreading lobes; nearly half grown when the flowers open during the first week of June and then thin, yellow-green, lustrous and roughened above by short white hairs and pale and villose below especially along the midribs and veins, and at maturity dark yellow-green, lustrous, smooth and glabrous on the upper surface, pale and almost glabrous on the lower surface, 6–8 cm long and 4–5 cm wide, with stout midribs often rose color in the autumn, and slender primary veins extending obliquely to the points of the lobes; petioles slender, slightly wing-margined sometimes to the middle, villose on the upper side while young, becoming almost glabrous, usually rose color in the autumn, 1.5–1.8 cm in length; leaves on vigorous shoots subcoriaceous, broadly ovate to oval, gradually narrowed and rounded at the base, more coarsely serrate, often 7–8 cm long and 6–7 cm wide. Flowers 1.6–1.8 cm in diameter, on long slender pedicels coated with matted pale hairs, in wide usually 18–20-flowered hairy corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, densely villose, the lobes slender, acuminate, coarsely glandular serrate, villose on the outer, slightly villose on the inner surface, reflexed after anthesis; stamens

20; anthers pale pink; styles 2 or 3. Fruit ripening early in October, on stout villose erect or spreading reddish pedicels, in few-fruited clusters, subglobose to short-oblong or ovate, bright cherry-red, lustrous, marked by pale dots, 1.2–1.4 cm in diameter; calyx little enlarged, with a deep narrow cavity, and spreading and appressed lobes often deciduous from the ripe fruit; flesh yellow, soft and succulent; nutlets 2 or 3, gradually narrowed and rounded at the ends, ridged on the back, with a broad slightly grooved ridge, penetrated on the inner surface by large shallow cavities, 7–8 mm long, and 5–6 mm wide.

An arborescent shrub 3–4 m high, with stems covered with dark gray bar, spreading branches forming a round-topped open head, and stout nearly straight branchlets, light orange-green, slightly hairy and marked by large lenticels when they first appear, becoming light red-brown and lustrous in their first season and dull dark reddish brown the following year and armed with stout nearly straight chestnut-brown or purplish shining spines 5–6 cm long, becoming branched and very abundant on old stems.

Niagara Falls, J. Dunbar (※2), October 7, 1902, June 7 and September 18, 1906.

Crataegus calvini n. sp.

Leaves rhombic to oval or ovate, acuminate or acute at the apex, gradually narrowed and concave-cuneate or rounded at the entire base, coarsely doubly serrate above, with straight glandular teeth, and very slightly divided above the middle into 4 or 5 pairs of small acuminate lobes; more than half grown when the flowers open about the first of June and then thin, yellow-green and slightly roughened above by short white hairs and pale and pubescent below, and at maturity subcoriaceous, dark green, smooth, glabrous and lustrous on the upper surface, paler and pubescent on the lower surface principally on the stout rose colored midribs and slender primary veins extending obliquely to the points of the lobes, 5–7 cm long and 4–5 cm wide; petioles stout, narrowly wing-margined sometimes to the middle, villose-pubescent on the upper side while young, becoming glabrous, rose colored in the autumn, 1–1.5 cm in length; leaves on vigorous shoots broadly ovate to oval or rarely obovate, short-pointed and acute at the apex, more coarsely serrate, often 9–10 cm long and 7–8 cm wide. Flowers 1.2–1.5 cm in diameter, on short stout densely villose pubescent pedicels, in broad many-flowered thick-branched hairy corymbs, with foliaceous oblong-obovate acuminate glandular serrate bracts and bractlets fading brown and persistent until the flowers open, the long lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, thickly coated with matted pale hairs, the lobes abruptly narrowed from broad bases, wide, acuminate, laciniately glandular serrate, sparingly hairy toward the base on the outer surface, slightly villose on the inner surface, reflexed after anthesis; stamens 20; filaments often persistent on the ripe fruit; anthers light rose color; styles 2, surrounded at the base by a broad ring of tomentum. Fruit ripening late in September, on slender reddish hairy pedicels, in wide lax many-fruited drooping clusters, oval to ovate, full and rounded at the ends, scarlet, lustrous, marked by large pale dots; calyx prominent, with a wide deep cavity, and closely appressed persistent lobes dark red above at the base and villose on the upper surface; flesh thin, yellow, sweet and succulent; nutlets 2, full and rounded at the base, narrow and rounded at the apex, slightly ridged on the back, with a narrow grooved ridge, deeply penetrated on the inner face by long wide cavities, about 7 mm long, and 4 mm wide.

A shrub 2.5–3 m high, with numerous stems covered with dark gray bark, spreading branches, stout zigzag glabrous branchlets light yellow-green when they first appear, becoming bright chestnut-brown, very lustrous and marked by large pale lenticels in their first season and dull red-brown the following year, and armed with nearly straight stout or slender purplish shining spines 3–4 cm long.

Rich alluvial soil, near Canandaigua, Ontario co., C. C. Laney (※ A. type), October 14, 1901, C. S. Sargent, October 1, 1902, M. S. Baxter, May 30 and September 20, 1903.

This handsome species is named for Mr Calvin Cook Laney, superintendent of the parks of the city of Rochester, New York, a keen and enthusiastic student of Crataegus, by whom it was first noticed in 1901.

Crataegus ferentaria Sargent

Rochester Acad. Sci. Proc. IV. 135 (1903); Rhodora VII. 184.

Buffalo, J. Dunbar (※ 15), June 1, 1904, May 28 and June 12, 1905; also near Rochester and Utica, New York and eastward to New England.

Crataegus macracantha Koehne

Deutsche Dendr. 236 (1893). Sargent, Silva N. Am. XIII. 147, t. 689; Rochester Acad. Sci. Proc. IV. 135; Man. 501, f. 415.

Crataegus glandulosa macracantha Lindley, Bot. Reg. XXII. t. 1912 (1836).

Crataegus coccinea var. macracantha Dudley, Cornell Univ. Bul. II. 33 (1886).

Niagara Falls, J. Dunbar (※28), June 12 and September 28, 1905; also near Rochester, New York and eastward to New England.

NOTES ON A COLLECTION OF CRATAEGUS MADE BY MR G. D. CORNELL IN THE NEIGHBORHOOD OF COOPERS PLAINS, STEUBEN COUNTY, NEW YORK.

BY C. S. SARGENT

PUNCTATAE

Crataegus desueta n. sp.

Leaves rhombic to slightly obovate, acuminate at the ends, finely doubly serrate, with straight glandular teeth, and divided above the middle into 5 or 6 pairs of slender acuminate spreading or recurved lobes; when they unfold tinged with red and covered on the upper surface with long soft white hairs, more than half grown when the flowers open about the middle of May and then very thin, light yellow-green and nearly glabrous above and pale and glabrous below, and at maturity thin but firm in texture, dark yellow-green, smooth, glabrous and lustrous on the upper surface, pale yellow-green on the lower surface, 5–6 cm long and 3–4 cm wide, with slender prominent yellow midribs and primary veins; petioles slender, slightly wing-margined at the apex, sparingly hairy on the upper surface, 1.5–2.5 cm in length; leaves on vigorous shoots oval to obovate, usually abruptly long-pointed at the apex, concave-cuneate at the base, more coarsely serrate, more deeply lobed and often 6–7 cm long and 4.5–5 cm wide. Flowers about 1.5 cm in diameter, on slender slightly villose pedicels, in lax mostly 8–10-flowered corymbs, the much elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, glabrous, the lobes long, slender, acuminate, entire or occasionally glandular dentate near the base, glabrous, reflexed after anthesis; stamens 10; anthers rose color; styles 2–4, surrounded at the base by a narrow ring of pale tomentum. Fruit ripening late in September, on long slender glabrous or slightly hairy drooping pedicels, in few-fruited clusters, short-oblong full and rounded at the ends, scarlet, lustrous, marked by small pale dots, 1–1.2 cm long, 8–10 mm in diameter; calyx prominent, with a deep narrow cavity, and much elongated erect and incurved nearly entire persistent lobes dark red on the upper side below the middle; flesh thin, dark yellow, dry and mealy; nutlets usually 3 or 4, narrowed and acute at the ends or rounded at the apex, rounded and only slightly grooved on the back, 6.5–7 mm long, and 4–4.5 mm wide.

A shrub not more than 4 m high, with numerous small erect or slightly spreading stems covered with dark gray bark, small ascending branches and slender nearly straight glabrous branchlets, dark orange-green and marked by pale lenticels when they first appear, becoming bright chestnut-brown in their first season and dull gray-brown the following year, and armed with slender nearly straight chestnut-brown shining spines 4.5–5.5 cm long, and often persistent and becoming stout and dark gray on old stems.

Rich moist hillsides, Coopers Plains, G. D. Cornell (✻ 23, type), September 21, 1905, May 27 and September 24, 1906, (✻ 23A), September 23, 1905, May 17, 1906, (✻ 9), September 17, 1905, May 28, 1906.

PRUINOSAE

Stamens 20

Anthers rose color or pink

Crataegus beata Sargent

Rochester Acad. Sci. Proc. IV. 97 (1903).

Hillsides, Coopers Plains, G. D. Cornell (✻ 102), September 1906, June 1907; also valley of the Genesee river, New York.

Crataegus arcana Beadle

Bilt. Bot. Studies I. 122 (1902). Sargent, Bot. Gazette XXXV. 101; Acad. Sci. Phila. Proc. 588 (1905).

Rich hillsides, Coopers Plains, G. D. Cornell (✻ 28), September 30, 1906, May 25 and October 28, 1907; also Niagara Falls, New York and eastern Pennsylvania to western North Carolina.

Crataegus pellecta n. sp.

Glabrous with the exception of the hairs on the upper side of the young leaves and petioles. Leaves ovate, acuminate, rounded or abruptly cuneate at the entire base, finely doubly serrate above, with straight glandular teeth, and slightly divided above the middle into 3 or 4 pairs of small spreading acuminate lobes; about half grown when the flowers open at the end of May or early in June and then thin, light yellow-green above and slightly hairy along the upper side of the midribs and paler below, and at maturity thin, dull bluish green, 5–6 cm long and 3.5–4.5 cm wide, with thin prominent midribs and primary veins; petioles slender, slightly wing-margined at the apex, sparingly villose on the upper side while young, 2.5–3 cm in length; leaves on vigorous shoots broadly ovate, usually rounded at the base, more deeply lobed, and often 5–6 cm long and wide. Flowers 2–2.4 cm in diameter, on long slender pedicels, in mostly 4–10-flowered lax corymbs, the lower peduncles from the axils of upper leaves; calyx-tube broadly obconic, the lobes gradually narrowed from broad bases, short, acuminate, entire or occasionally dentate near the middle, reflexed after anthesis; stamens 20; anthers faintly tinged with pink; styles 3–5. Fruit ripening at the end of October, on stout erect pedicels, in few-fruited clusters, short-oblong to subglobose or often rather broader than long, slightly angled toward the base, dark red, pruinose, 1.2–1.4 cm in diameter; calyx prominent, with a broad deep cavity tomentose in the bottom, and small spreading persistent lobes; flesh thin, tinged with red, dry and mealy; nutlets 3–5, acute at the ends or rounded at the apex, rounded and slightly grooved on the back, 6.5–7 mm long, and about 5 mm wide.

A shrub sometimes 3–4 m high, with numerous small stems, ascending branches, and slender nearly straight branchlets dark orange-green tinged with red when they first appear, becoming dark chestnut-brown, lustrous and marked by small dark lenticels in their first season and dull reddish brown the following year, and armed with stout slightly curved bright chestnut-brown shining spines 3–4 cm long.

Rich hillsides, Coopers Plains, G. D. Cornell (※ 86, type), October 20, 1906, June 8, 1907.

Crataegus amoena Sargent

Rich hillsides, Coopers Plains, G. D. Cornell (※97), October 28, 1906, June 5, 1907; (※ 38), October 1, 1905, June 2, 1907; (※89), October 28, 1906, June 8, 1907; also at Niagara Falls, New York.

Crataegus gracilis Sargent

Rich hillsides, Coopers Plains, G. D. Cornell (※40), May 26, 1906, June 1907.

Crataegus ramosa n. sp.

Glabrous with the exception of the hairs on the young leaves. Leaves oblong-ovate, acuminate, rounded or abruptly cuneate at the broad base, finely doubly serrate, and divided into 3 or 4 pairs of short broad acuminate lobes; when they unfold deeply tinged with red, villose above and furnished below with axillary tufts of short hairs; more than half grown when the flowers open at the end of May or early in June and then thin, yellow-green, glabrous and paler below than above, and at maturity thin but firm in texture, dark yellow-green, smooth and lustrous on the upper surface, paler on the lower surface, 4.5–6 cm long and 3.5–5 cm wide, with thin midribs and primary veins; petioles slender, slightly wing-margined at the apex, conspicuously glandular while young, with usually deciduous glands, 2–2.5 cm long; leaves on vigorous shoots subcoriaceous, ovate, acuminate, rounded or slightly cordate at the base, coarsely serrate, deeply lobed, often 7–8 cm long and wide, with stout broad-winged coarsely glandular petioles, and linear falcate glandular caducous stipules. Flowers 2–2.8 cm in diameter, on long slender pedicels, in 5–8-flowered compact corymbs, with linear-obovate to linear bracts and bractlets fading brown and often persistent until the flowers open, the long lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes gradually narrowed from the base, long, slender, acuminate, red and glandular at the apex, entire or irregularly glandular dentate, reflexed after anthesis; stamens 20; anthers pink; styles 3–5, surrounded at the base by a narrow ring of pale tomentum. Fruit on long slender drooping red pedicels, in few-fruited clusters, ripening and falling at the end of October, short-oblong to oval, full and rounded at the ends, red, pruinose, becoming lustrous, marked by large dots, 1.2–1.3 cm long, 1–1.1 cm in diameter; calyx prominent, with a short tube, a wide deep cavity, broad and tomentose in the bottom, and small spreading persistent lobes; flesh green, dry and hard; nutlets 3–5, narrowed and acute at the ends or rounded at the base, ridged on the back, with a high narrow slightly grooved ridge, 7–7.5 mm long, and 4–4.5 mm wide.

A shrub 3 m high, with small intricately branched stems covered with light gray bark, small ascending branches forming a compact round-topped head, and stout straight or slightly zigzag branchlets deeply tinged with red when they first appear, becoming light chestnut-brown, lustrous and marked by numerous small dark lenticels in their first season and pale gray-brown the following year, and armed with slender straight light chestnut-brown shining spines 3.5–4 cm long.

Rich hillsides, Coopers Plains, G. D. Cornell (98, type), October 21, 1906, June 5, 1907.

Anthers yellow

Crataegus cognata Sargent

Rhodora V. 58 (1903).

Hillsides, Coopers Plains, G. D. Cornell (※ 6, 43 and 103), September and October 1905, May 1906; also southern Ontario, through western New York to western and southern New England.

Crataegus rubro-lutea n. sp.

Glabrous with the exception of the hairs on the young leaves. Leaves ovate to oval, acuminate, rounded or cuneate at the entire base, finely doubly serrate above, with straight or incurved glandular teeth, and slightly divided above the middle into 3 or 4 small acuminate spreading lobes; bronze color and roughened above by short white hairs and furnished below with axillary tufts of hairs when they unfold, more than half grown when the flowers open late in May or early in June and then thin, yellow-green, nearly glabrous and paler below than above, and at maturity thin but firm in texture, dull yellow-green, smooth and glabrous on the upper surface, pale yellow-green on the lower surface, 4–5 cm long and 3.5–4 cm wide, with prominent yellow midribs, and primary veins still furnished with a few axillary hairs; petioles slender, slightly wing-margined at the apex, glandular with small dark often persistent glands, 1.5–2 cm in length; stipules linear, green, glandular-serrate, caducous; leaves on vigorous shoots subcoriaceous, ovate, rounded or subcordate at the broad base, often 4.5–5.5 cm long and wide and often broader than long. Flowers 1.8–2.2 cm in diameter, on long slender pedicels, in wide, lax, mostly 6–10-flowered corymbs, the elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes gradually narrowed from the base, wide, short, acuminate and glandular at the apex, entire or minutely glandular dentate, reflexed after anthesis; stamens 20; anthers pale yellow; styles 4 or 5. Fruit on long slender red drooping pedicels, in few-fruited clusters, ripening and falling from the middle to the end of October, subglobose and often broader than high, or obovate and abruptly narrowed at the base, slightly angled, light orange-red, lustrous, marked by large dark dots, 1.2–1.5 cm in diameter; calyx prominent, with a short tube, a broad deep cavity tomentose in the bottom, and small spreading slightly incurved appressed lobes; flesh hard, mealy, light orange-red; nutlets 4 or 5, narrowed and acute at the ends, ridged on the back, with a high narrow often deeply grooved ridge, 6–6.5 mm long, and 4–4.5 mm wide.

A shrub 3–4 m high, with numerous small stems covered with dark gray bark, spreading and ascending branches forming an open head, and slender nearly straight branchlets, light green when they first appear, becoming light chestnut-brown, lustrous and marked by small dark lenticels in their first season and dull red-brown the following year, and armed with numerous stout or slender, straight or slightly curved chestnut-brown shining spines 1–1.5 cm long.

Hillsides, Coopers Plains, G. D. Cornell (※ 96, type), October 21, 1906, June 5, 1907.

Stamens 15–20; anthers pale rose color.

Crataegus macrocalyx n. sp.

Glabrous with the exception of the hairs on the young leaves. Leaves ovate, acuminate, rounded or cuneate at the base, finely and often doubly serrate above, with straight glandular teeth, and divided into 4 or 5 pairs of short broad acuminate spreading lobes; sometimes deeply 3-lobed on stump shoots; tinged with red and setose above when they unfold, nearly fully grown when the flowers open late in May and then very thin, yellow-green and nearly glabrous, and at maturity thin, yellow-green and scabrate on the upper surface, pale bluish green on the lower surface, 5–6 cm long and 4.5–5 cm wide, with thin rose colored midribs and primary veins; petioles slender, slightly wing-margined at the apex, glandular, with minute often persistent glands, 2–3 cm in length; stipules linear to linear-falcate, acuminate, glandular, fading brown, caducous. Flowers 1.8–2.5 cm in diameter, on long slender pedicels, in narrow mostly 5–7-flowered corymbs, the elongated lower peduncles from the axils of upper leaves; calyx-tube broadly obconic, the lobes separated by wide sinuses, gradually narrowed from the base, short, slender and glandular at the apex, entire or occasionally dentate, reflexed after anthesis; stamens 15–20; anthers pale rose color; styles 3 or 4, surrounded at the base by a narrow ring of pale hairs. Fruit ripening the end of October, on slender spreading red pedicels, in few-fruited clusters, short-oblong, full and rounded at the ends, slightly angled, red, pruinose, marked by small pale dots, 1–1.2 cm in diameter; calyx very prominent, with a broad deep cavity narrow and tomentose in the bottom, and spreading lobes dark red on the upper side below the middle; flesh green, dry and mealy; nutlets 3 or 4, acute at the ends, rounded and slightly grooved or irregularly ridged on the back, 6.5–7 mm long, and 4–4.5 mm wide.

A shrub 2–3 m high, with stems covered with dark gray bark, ascending branches and slender slightly zigzag branchlets dark green and marked by pale lenticels when they first appear, becoming bright chestnut-brown and lustrous in their first season and dull reddish brown the following year, and armed with slender straight dark chestnut-brown shining ultimately dull gray spines 1.5–2 cm long.

Rich hillsides, Coopers Plains, G. D. Cornell (✕41, type), May 28 and October 3, 1906.

Stamens 10 or less

Anthers rose color

Leaves smooth

Crataegus numerosa n. sp.

Glabrous with the exception of the hairs on the upper surface of the young leaves. Leaves oblong-ovate, long-pointed and acuminate at the apex, abruptly concave-cuneate or occasionally rounded at the entire base, coarsely often doubly serrate above, with straight glandular teeth, and divided into 4 or 5 pairs of short broad acuminate lateral lobes; bronze color when they unfold, about one third grown when the flowers open at the end of May and then very thin, dark yellow-green, smooth, lustrous and slightly hairy along the midribs above and glaucous below, and at maturity thin, dull yellow-green on the upper surface, very pale bluish green on the lower surface, 5–6 cm long and 4–5 cm wide, with slender yellow midribs, and thin primary veins arching obliquely to the points of the lobes; turning yellow in autumn before falling; petioles slender, slightly wing-margined at the apex, pubescent on the upper side while young, soon becoming glabrous, 2.5–3.5 cm in length. Flowers 1.5–2 cm in diameter, on slender pedicels, in small mostly 5–8-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes separated by wide sinuses, short, broad, glandular and red at the acuminate apex, entire or minutely glandular dentate near the base, reflexed after anthesis; stamens 10; anthers rose color; styles 3–5, usually 3 or 4, surrounded at the base by a narrow ring of pale hairs. Fruit ripening the middle of October, on long drooping pedicels, in few-fruited clusters, obovate, rounded at the apex, abruptly narrowed and often mammillate at the base, scarlet, pruinose, marked by large pale dots, about 1 cm long and 9–10 mm in diameter; calyx little enlarged, with a short tube, a broad deep cavity tomentose in the bottom, and small spreading lobes red on the upper side; flesh yellow, thin and dry; nutlets 3 or 4, acute at the ends or slightly narrowed and rounded at the apex, ridged on the back, with a low grooved ridge, 5–5.6 mm long, and 4–4.5 mm wide.

A narrow shrub sometimes 4 m high, with stems covered with gray-green scaly bark, small ascending branches, and slender slightly zigzag branchlets deeply tinged with red when they first appear, becoming bright chestnut-brown, lustrous and marked by pale lenticels in their first season and dull reddish brown the following year, and armed with stout straight or slightly curved chestnut-brown shining spines 2–3.5 cm long, very numerous and becoming branched on old stems and branches.

Rich hillsides, Coopers Plains, common; G. D. Cornell (※32, type), September 21, 1905, May 26, 1907; (※87), October 21, 1906.

Crataegus uncta n. sp.

Glabrous with the exception of the hairs on the young leaves. Leaves ovate, acuminate, rounded at the entire base, finely doubly serrate above, with straight glandular teeth, and slightly divided above the middle into 2 or 3 pairs of small acuminate spreading lobes; when they unfold bronze color and slightly hairy on the upper surface and in the axils of the veins below, nearly fully grown when the flowers open at the end of May and then very thin, nearly glabrous, smooth and dark yellow-green above and pale below, and at maturity thin but firm in texture, dark yellow-green, 4–4.5 cm long and 3–3.5 cm wide, with thin midribs and primary veins; petioles slender, slightly wing-margined at the apex, pubescent on the upper side while young, soon becoming glabrous, occasionally glandular, 1.5–2 cm in length; leaves on vigorous shoots thicker, often truncate at the broad base, more coarsely serrate and more deeply lobed, 6–7 cm long and 5–6 cm wide. Flowers 1.5–2 cm in diameter, on long slender pedicels, in small mostly 4–8-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes short, broad, acuminate and glandular at the apex, coarsely glandular serrate, reflexed after anthesis; stamens 8–10; anthers slightly tinged with rose color; styles 4 or 5, surrounded at the base by a broad ring of white tomentum. Fruit ripening the end of September, on long slender drooping pedicels, in few-fruited clusters, broader than long, truncate at the wide apex, slightly narrowed to the base; red, lustrous, marked by large pale dots, 1.2–1.4 cm in diameter; calyx little enlarged, with a deep narrow cavity, and small spreading or incurved persistent lobes; flesh thick, deeply tinged with red; nutlets 4 or 5, acute at the base, abruptly narrowed and rounded or acute at the apex, rounded and grooved or irregularly ridged on the back, about 7 mm long, and 3.5–4 mm wide.

A shrub 3–4 m high, with stems covered with dark gray-brown bark, ascending branches and stout nearly straight branchlets dark orange-green and marked by large pale lenticels when they first appear, becoming dark chestnut-brown and lustrous in their first season and dull gray-brown the following year, and armed with stout straight purplish shining spines 3.5–4 cm long.

Hillsides, Coopers Plains, G. D. Cornell (※61, type), May 26 and September 21, 1906.

Crataegus plana Sargent

Hillsides, Coopers Plains, G. D. Cornell (※ 2), September 30, 1905, May 25, 1906, (※ 36), October 1, 1905, May 26, 1906, (※101), September 21, 1906, June 5, 1907; also in the Genesee valley and near Buffalo, New York.

Crataegus dissona Sargent

Rhodora V. 60 (1903); Bot. Gazette XXXV. 379; Acad. Sci. Phila. Proc. 601 (1905).

Coopers Plains, G. D. Cornell (※4), October 8, 1905, May and October 1906 (※ 53), October 1, 1905, May 26, 1906; also Illinois to western and southern New England and to eastern Pennsylvania.

Leaves scabrate

Crataegus ovatifolia n. sp.

Leaves ovate, long-pointed and acuminate at the apex, gradually or abruptly narrowed and concave-cuneate at the entire base, finely often doubly serrate above, with straight glandular teeth, and slightly divided above the middle into 3 or 4 pairs of narrow acuminate spreading lobes; deeply tinged with red and covered by soft white hairs on the upper surface when they unfold, about half grown when the flowers open at the end of May and then very thin, yellow-green above and glabrous below, and at maturity thin, dark yellow-green, slightly hairy and scabrate on the upper surface, pale bluish green on the lower surface, 4–5 cm long and 3–3.5 cm wide, with thin midribs and primary veins; petioles very slender, slightly wing-margined at the apex, sparingly villose on the upper side while young, soon becoming glabrous, glandular, with minute generally deciduous glands, 2–2.5 cm in length; leaves on vigorous shoots thicker, rounded or abruptly cuneate at the base, more coarsely serrate and more deeply lobed, often 6 cm long and 4–4.5 cm wide. Flowers 1.7–2 cm in diameter, on long slender glabrous pedicels, in compact mostly 5–10-flowered corymbs, the lower peduncles from the axils of the upper leaves; calyx-tube narrowly obconic, the lobes gradually narrowed from wide bases, long, slender, acuminate, entire or minutely glandular serrate, glabrous, reflexed after anthesis; stamens 10; anthers red; styles 3 or 4, surrounded at the base by a narrow ring of pale hairs. Fruit ripening late in October and often persistent during the winter, on slender drooping reddish pedicels, in few-fruited clusters, obovate, full and rounded at the apex, gradually narrowed at the base, scarlet, pruinose, marked by large dark dots, 1–1.2 cm long, 8–10 mm in diameter; calyx prominent, with a broad deep cavity wide and tomentose in the bottom, and spreading persistent lobes dark red on the upper side below the middle; flesh thin, greenish yellow, rather juicy; nutlets 3 or 4, acute at the ends, ridged on the back, with a broad low grooved ridge, 6–6.5 mm long, and 4–4.5 mm wide.

A shrub 3–4 m high, with numerous small stems covered with ashy gray bark and often spreading into large thickets, ascending branches, and slender nearly straight branchlets dark orange-green and marked by pale lenticels when they first appear, becoming bright chestnut-brown and lustrous in their first season and dull red-brown the following year, and armed with slender straight or slightly curved dark chestnut-brown shining spines 3–4.5 cm long, often persistent and becoming compound on old stems.

Coopers Plains, G. D. Cornell (⚹ 1, type), September 21, 1905, May 27, 1906 (⚹ 24), May 24 and September 21, 1905 (⚹ 33), October 1906, May 1907.

Crataegus barryana Sargent

Hillsides, Coopers Plains, G. D. Cornell (⚹ 27), September 21, 1905, May 25 and October 14, 1906, May and October 1907; also near Rochester, New York.

Crateagus acerba n. sp.

Leaves ovate to rhombic, acuminate at the apex, cuneate at the entire base, sharply often doubly serrate above, with straight or incurved glandular teeth, and divided usually above the middle into 3 or 4 pairs of narrow acuminate spreading lobes; deeply tinged with red, strigose above and glabrous below when they unfold, about half grown when the flowers open late in May or early in June, and then thin, yellow-green and scabrate on the upper surface and paler on the lower surface, and at maturity thin but firm in texture, dark dull bluish green and still slightly roughened above and paler below, 4–5 cm long and 3.5–4 cm wide, with thin midribs and primary veins; petioles slender, slightly wing-margined at the apex, pubescent on the upper side while young, soon becoming glabrous, glandular with minute usually deciduous glands 2–2.5 cm in length; stipules linear to linear-obovate, glandular, green, caducous; leaves on vigorous shoots thicker, broadly ovate, rounded, truncate or cuneate at the base, coarsely serrate, more deeply lobed and often 6–7 cm long and broad, with stout conspicuously glandular petioles 2.5–3 cm in length. Flowers 1.6–1.9 cm in diameter, on long slender glabrous pedicels, in small mostly 5–9-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, glabrous, the lobes slender, glandular at the acuminate apex, minutely glandular serrate near the middle, glabrous, often bright red, reflexed after anthesis; stamens 5–7; anthers light rose color; styles 3 or 4, surrounded at the base by a narrow ring of pale tomentum. Fruit falling late in October without becoming soft, on stout drooping pedicels, in few-fruited clusters, full and rounded at the apex, abruptly narrowed at the base, crimson, pruinose, marked by small pale dots, 1–1.2 cm long and 9–10 mm in diameter; calyx little enlarged, without a tube, with a deep narrow cavity tomentose in the bottom, and small spreading and incurved lobes dark red on the upper side; flesh green, dry and hard; nutlets 3 or 4, acute at the ends, rounded and grooved or ridged, with a high narrow ridge on the back, 6–6.5 mm long, and 4–4 5 mm wide.

A dense shrub 3–4 m high, with stems covered with dark gray bark, ascending branches forming a narrow compact head, and stout slightly zigzag glabrous branchlets deeply tinged with red when they first appear, becoming light chestnut-brown, lustrous and marked by dark lenticels in their first season and dull gray-brown the following year, and armed with stout straight or slightly curved chestnut-brown shining spines 3–3.5 cm long.

Coopers Plains, G. D. Cornell (※84, type), October 7, 1906, June 3, 1907.

Crataegus dissociabilis n. sp.

Leaves broadly ovate to triangular, acuminate, rounded, truncate or abruptly cuneate at the wide entire base, finely often doubly serrate above, with small glandular teeth, and slightly divided usually only above the middle into 3 or 4 pairs of small acuminate lobes; when they unfold deeply tinged with red and covered on the upper surface with soft white hairs and slightly hairy in the axils of the veins below, nearly fully grown when the flowers open late in May or early in June, and then thin, light yellow-green, scabrate and slightly hairy on the midribs above, and at maturity thin, yellow-green, slightly roughened and lustrous on the upper surface, pale bluish green on the lower surface, 3.5–4 cm long and 3–4 cm wide, with thin midribs, and primary veins arching obliquely to the points of the lobes; petioles slender, slightly wing-margined at the apex, glandular while young, with mostly deciduous glands, 1.5–3 cm in length. Flowers 1.5–2 cm in diameter, on slender glabrous pedicels, in compact mostly 5–10-flowered corymbs, with linear-obovate to linear glandular bracts and bractlets fading brown and deciduous before the flowers open, the long lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, glabrous, the lobes gradually narrowed from the base, slender, glabrous, red and glandular at the acuminate apex, irregularly and coarsely glandular serrate usually only below the middle, reflexed after anthesis; stamens 5–10; anthers pale rose color; styles 3 or 4. Fruit ripening and falling late in September, on long slender drooping pedicels, in few-fruited clusters, obovate, full and rounded at the apex, abruptly narrowed at the base, light cherry-red, very pruinose, marked by large pale dots, about 1 cm long and 9 mm in diameter; calyx little enlarged, without a tube, with a wide deep cavity narrow in the bottom, and small spreading lobes dark red on the upper side; flesh pink, sweet and juicy; nutlets 3 or 4, acute or acuminate at the base, gradually narrowed and rounded at the apex, ridged on the back, with a broad deeply grooved ridge, 6–7 mm long, and 4–4.5 mm wide.

An arborescent shrub 3–4 m high, with a short stem sometimes 1.5 dm in diameter, covered near the ground with dark scaly bark, small ascending and spreading branches, and slender nearly straight glabrous-branchlets, dark orange-green tinged with red when they first appear, becoming dark chestnut-brown, lustrous and marked by pale lenticels in their first season and dull red-brown the following year, and armed with slender slightly curved purple shining spines 2.5–4 cm long.

Coopers Plains, G. D. Cornell (※88, type), September 22, 1906, June 8, 1907.

Anthers pale yellow

Crataegus inusitula Sargent

Rich hillsides, Coopers Plains, G. D. Cornell (※ 57), May 26 and October 14, 1906, May and September 1907; also at Chapinville, Ontario co.

The Coopers Plains plant differs from the type of Crataegus inusitula in the fewer hairs on the pedicels, which are sometimes nearly glabrous.

TENUIFOLIAE

Stamens 10 or less; anthers rose color, red or pink

Crataegus ignea n. sp.

Glabrous with the exception of the hairs on the upper surface of the young leaves and calyx-lobes. Leaves oblong-ovate, long-pointed and acuminate at the apex, rounded or abruptly concave-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 spreading lateral lobes; deeply tinged with red and covered on the upper surface with soft white hairs when they unfold, more than half grown when the flowers open at the end of May or early in June, and then thin, yellow-green, still slightly hairy above and pale below, and at maturity thin but firm in texture, dull yellow-green and slightly roughened on the upper surface, pale yellow-green on the lower surface, 4–5 cm long and 2.5–4 cm wide, with thin yellow midribs and primary veins; petioles slender, slightly wing-margined at the apex, sparingly villose while young, soon becoming glabrous, occasionally glandular, often dark rose color in the autumn, 1.5–2.5 cm in length; stipules linear to lanceolate, glandular, with bright red glands, green, caducous; leaves on vigorous shoots thick, ovate, acute, rounded, truncate or subcordate at the broad base, more coarsely serrate, more deeply lobed, and often 6–7 cm long and 5–6 cm wide, with thick conspicuously glandular petioles. Flowers 1.5–1.7 cm in diameter, on long slender pedicels, in compact mostly 6–12-flowered corymbs, the elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes slender, red and acuminate at the apex, very minutely glandular serrate or entire, glabrous on the outer, slightly villose on the inner surface, reflexed after anthesis; stamens 7–10; anthers dark rose color; styles 2–4, usually 3. Fruit ripening at the end of September, on slender drooping or spreading reddish pedicels, in few-fruited clusters, short-oblong, truncate at the ends, scarlet, lustrous, marked by small pale dots, about 1 cm long and 8–9 mm in diameter; calyx little enlarged, with a deep narrow cavity, and spreading slightly incurved persistent lobes; flesh thick, pale yellow; nutlets 3 or 4, narrowed and rounded at the ends, ridged on the back, with a broad low grooved ridge, about 6 mm long, and 4.5–5 mm wide.

A shrub sometimes 3–4 m high, with stems covered with ashy gray bark, ascending branches forming a narrow rather open head, and extremely slender slightly zigzag branchlets deeply tinged with red when they first appear, becoming dark chestnut-brown, lustrous and marked by small pale lenticels in their first season and dull red-brown the following year, and armed with stout straight or slightly curved light chestnut-brown shining spines 2.5–4 cm long.

Rich hillsides, Coopers Plains, G. D. Cornell (※83, type), September 22, 1906, June 5, 1907.

Crataegus recta n. sp.

Glabrous with the exception of the hairs on the upper side of the young leaves. Leaves ovate, long-pointed and acuminate at the apex, rounded or abruptly concave-cuneate at the base, finely often doubly serrate, with straight or incurved glandular teeth, and slightly divided into 5 or 6 pairs of small acuminate spreading lobes; deeply tinged with red and roughened on the upper surface by short white hairs when they unfold, more than half grown when the flowers open at the end of May or early in June, and then thin, yellow-green, still slightly hairy especially along the midribs above, and at maturity thin, yellow-green, lustrous and slightly roughened on the upper surface, paler on the lower surface, 5–6 cm long and 3.5–4.5 cm wide, with slender midribs and thin primary veins extending obliquely to the points of the lobes; petioles slender, slightly wing-margined at the apex, very glandular while young, the glands generally caducous, 1.5–2.5 cm in length; leaves on vigorous shoots coarsely serrate and sometimes 8–9 cm long and 5–6 cm wide, with foliaceous lunate persistent stipules. Flowers 1.5–1.8 cm in diameter on long slender pedicels, in compact mostly 5–12-flowered corymbs, the elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, gradually narrowed from the base, the lobes long, slender, acuminate, deep rose color above the middle, glandular serrate, reflexed after anthesis; stamens 5–9; anthers light rose color; styles 2 or 3. Fruit ripening the middle of September, on slender drooping pedicels, in few-fruited clusters, short-oblong, truncate at the apex, rounded and depressed at the base, scarlet, lustrous, marked by pale dots, 9–10 mm long and 8–9 mm in diameter; calyx little enlarged, with a deep narrow cavity tomentose in the bottom, and small spreading or incurved persistent lobes; flesh thin, light orange color; nutlets 2 or 3, gradually narrowed and rounded at the ends, ridged on the back, with a low broad grooved ridge, about 5 mm long and 4 mm wide.

A narrow shrub sometimes 4 m high, with fastigiately erect stems covered with dark green bark scaly near the ground, erect branches and stout nearly straight branchlets dark green when they first appear, becoming light chestnut-brown, lustrous and marked by large pale lenticels in their first season and dull reddish brown the following year, and armed with stout straight or slightly curved light chestnut-brown ultimately gray spines 2.5–3.5 cm long.

Rich hillsides, Coopers Plains, G. D. Cornell (※85, type), September 16, 1906, June 3, 1907, (※81), June and September 1907.

Crataegus spatifolia n. sp.

Glabrous with the exception of the hairs on the upper surface of the young leaves. Leaves oblong-ovate, long-pointed and acuminate at the apex, rounded, subcordate or abruptly cuneate at the broad base, finely often doubly serrate, with straight glandular teeth, and divided into 5–7 pairs of broad acuminate spreading or reflexed lateral lobes; more than half grown when the flowers open about the 1st of June and then thin, yellow-green, slightly hairy and rough above, and at maturity thin, dark yellow-green, smooth and lustrous on the upper surface, pale bluish green on the lower surface, 6–7 cm long and 5–6 cm wide, with slender midribs, and thin primary veins arching obliquely to the points of the lobes; petioles slender, slightly wing-margined at the apex, occasionally glandular, 3–3.5 cm in length; leaves on vigorous shoots subcoriaceous, cordate or truncate at the base, more coarsely serrate and more deeply lobed, and often 6–7 cm long and wide. Flowers 1.4–1.9 cm in diameter, on long slender pedicels, in wide lax mostly 8–16-flowered corymbs, the elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes gradually narrowed from the base, long, slender, red and glandular at the acuminate apex, entire or minutely glandular dentate, reflexed after anthesis; stamens 8–10; anthers pale rose color; styles 3 or 4. Fruit ripening at the end of September, on long drooping reddish pedicels, in few-fruited clusters, short-oblong, full and rounded at the ends, crimson, lustrous, marked by large pale dots, 1–1.1 cm long and 8–9 mm in diameter; calyx little enlarged, with a deep narrow cavity, and spreading often incurved persistent lobes; flesh thin, light yellow; nutlets 2–4, gradually narrowed and rounded or acute at the ends, ridged on the back, with a low grooved ridge, 6–6.5 mm long, and 4–4.5 mm wide.

A shrub 4–5 m high, with stems covered with greenish gray bark, ascending branches, and stout nearly straight branchlets dark orange-green more or less tinged with red when they first appear, becoming dark chestnut-brown, lustrous and marked by pale lenticels in their first season and dull gray-brown the following year, and armed with slender slightly curved dark red-brown shining spines 3–4 cm long.

Hillsides near Coopers Plains, G. D. Cornell (※90, type), September 27, 1906, June 8, 1907.

Crataegus fucata n. sp.

Glabrous with the exception of the hairs on the young leaves and calyx-lobes. Leaves ovate, long-pointed and acuminate at the apex, rounded or abruptly cuneate at the often glandular base, sharply doubly serrate above, with straight glandular teeth, and slightly divided usually only above the middle into 3 or 4 pairs of small acuminate spreading lobes; when they unfold slightly tinged with red, covered above by short white hairs and glabrous below, about a quarter grown when the flowers open in the last week of May and then very thin, light yellow-green and still hairy on the upper surface, and at maturity thin but firm in texture, dark yellow-green and slightly roughened above and pale bluish green below, 5–6 cm long and 4.5–5 cm wide, with thin yellow midribs and primary veins; petioles slender, slightly wing-margined at the apex, glandular while young, with mostly deciduous glands, often rose color in the autumn, 2–3 cm in length; leaves on vigorous shoots rounded or subcordate at the base, coarsely serrate, deeply lobed and often 5.5–6 cm long and broad. Flowers about 1.5 cm in diameter, on slender pedicels, in small compact mostly 8–10-flowered corymbs, the lowest peduncle from the axil of an upper leaf; calyx-tube narrowly obconic, the lobes slender, acuminate, minutely dentate or entire, glabrous on the outer, furnished on the inner surface with occasional hairs, reflexed after anthesis; stamens 5–9; anthers dark rose color; styles 3–5, surrounded at the base by a narrow ring of pale tomentum. Fruit ripening and falling late in September, on slender drooping pedicels, in few-fruited clusters, short-oblong to oval, slightly narrowed at the ends, often unsymmetrical and somewhat mammillate at the base, crimson, lustrous, 9–10 mm long and 8–9 mm in diameter; calyx little enlarged, with a wide shallow cavity, and spreading and appressed lobes, red and sparingly villose on the upper side; flesh thin, yellow, slightly tinged with red; nutlets usually 3 or 4, narrowed and rounded at the ends, ridged on the back, with a broad high doubly grooved ridge, 5–6 mm long, and 4–4.5 mm wide.

A shrub 3–4 m high, with ascending and spreading flexuose stems forming a wide open head and covered below with ashy gray bark, small spreading branches, and slender 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 dull red-brown the following year, and armed with numerous stout straight or slightly curved chestnut-brown shining spines 3.5–4.5 cm long.

Rich hillsides, Coopers Plains, G. D. Cornell (※62, type), May 26 and September 21, 1906, May and September 1907.

Crataegus nescia n. sp.

Glabrous with the exception of the hairs on the young leaves and petioles. Leaves ovate, acuminate, cuneate or on vigorous shoots truncate or rounded at the entire base, sharply often doubly serrate above, with straight glandular teeth, and slightly divided into 4 or 5 pairs of narrow acuminate spreading lateral lobes; more than half grown when the flowers open about the 20th of May and then very thin, light yellow-green and roughened above by short white hairs and paler and glabrous below, and at maturity thin, yellow-green, smooth and glabrous on the upper surface, light bluish green on the lower surface, 4–6 cm long and 3.5–5 cm wide, with thin midribs and primary veins; petioles slender, slightly wing-margined at the apex, sparingly hairy on the upper side while young, soon becoming glabrous, 1.5–2.5 cm in length. Flowers 1.5–1.8 cm in diameter, on long slender pedicels, in small compact mostly 5–12-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes slender, acuminate, entire or minutely glandular dentate near the middle, reflexed after anthesis; stamens 4–8; anthers bright pink; styles 2–4, usually 3, surrounded at the base by a narrow ring of pale tomentum. Fruit ripening and falling early in October, on slender drooping pedicels, in few-fruited clusters, short-oblong to slightly obovate, full and rounded at the ends, scarlet, lustrous, marked by small pale dots, 1–1.2 cm long and 9–10 mm in diameter; calyx little enlarged, with a deep narrow cavity and spreading and appressed or incurved generally persistent lobes dark red on the upper side below the middle; flesh thin, yellow tinged with pink; sweet and juicy; nutlets usually 3, narrowed and rounded at the ends, ridged on the back, with a broad deeply grooved ridge, 5.5–6 mm long, and 4–4.5 mm wide.

A slender shrub 3–4 m high, with stems spreading into small clumps, and covered with light gray bark scaly near the ground, long slender ascending dark greenish branches, and slender wand-like conspicuously zigzag branchlets dark orange-green when they first appear, becoming light chestnut-brown, lustrous, and marked by pale lenticels in their first season and light gray-brown the following year, and armed with stout straight or usually slightly curved chestnut-brown shining spines 2.5–4 cm long.

Rich hillsides, near Coopers Plains, G. D. Cornell (※46, type), May 25 and October 3, 1906.

Crataegus insignata n. sp.

Glabrous with the exception of the hairs on the young leaves. Leaves ovate, acuminate, rounded or abruptly cuneate at the base, finely often doubly serrate, with straight glandular teeth, and slightly divided usually only above the middle into 5 or 6 pairs of narrow acuminate spreading lobes; more than half grown when the flowers open about the 20th of May and then thin, yellow-green and roughened above by short white hairs, and at maturity thin, yellow-green, scabrate on the upper surface, paler on the lower surface, 5–6 cm long and 4.5–6 cm wide, with stout midribs, and thin prominent primary veins extending to the points of the lobes; petioles slender, slightly wing-margined at the apex, 3–3.5 cm in length. Flowers 1.3–1.6 cm in diameter, on short slender pedicels, in compact mostly 6–14-flowered corymbs, the elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes long, slender, acuminate, entire or minutely glandular dentate below the middle, reflexed after anthesis; stamens 5–8; anthers pale rose color; styles 2–5, usually 3 or 4, surrounded at the base by a narrow ring of pale tomentum. Fruit ripening late in October, on short pedicels, in few-fruited drooping clusters, short-oblong, slightly narrowed to the rounded ends, deeply impressed at the insertion of the stalk, dull red, 9–10 mm long, and 8–9 mm in diameter; calyx little enlarged, with a deep narrow cavity tomentose in the bottom, and spreading and appressed lobes, their tips often deciduous from the ripe fruit; flesh thin, orange color, sweet and juicy; nutlets usually 3 or 4, narrowed and rounded at the ends, ridged on the back, with a broad deeply grooved ridge, 6–6.5 mm long, and 4–4.5 mm wide.

A shrub 4–5 m high, with numerous small ascending stems covered near the ground with ashy gray scaly bark, small spreading gray-brown branches, and stout slightly zigzag branchlets dark orange-green and marked by pale lenticels when they first appear, becoming dark chestnut-brown or purple and lustrous in their first season and dull gray-brown the following year, and armed with few stout slightly curved light chestnut-brown ultimately gray spines 2–2.5 cm long.

Hillsides, Coopers Plains, G. D. Cornell (※63, type), May 23 and September 21, 1906.

Crataegus bella Sargent

Hillsides, Coopers Plains, G. D. Cornell (※31), September 21, 1905, May 20, 1906; also at Buffalo, and at Chippewa, Ontario.

Crataegus genialis Sargent

Rhodora V. 148 (1903).

Hillsides, Coopers Plains, G. D. Cornell (※44), September 24, 1905, May 25, 1906, May and September 1907 (※47), September 28, 1905, May 24 and September 4, 1906.

Crataegus suavis Sargent

Hillsides, Coopers Plains, G. D. Cornell (99), September 22, 1906, June 3, 1907; also at Buffalo.

Crataegus glaucophylla Sargent

Rhodora V. 140 (1903); Rochester Acad. Sci. Proc. IV. 120 (1903).

Hillsides, Coopers Plains, G. D. Cornell (※48), September 28, 1905, May 23, 1906; also southern Michigan and through Ontario to western New England.

Crataegus matura Sargent

Rhodora III. 24 (1901); V. 144 (1903).

Hillsides, Coopers Plains, G. D. Cornell (*21), September 21, 1905, May 21, 1906, (*59) May 24 and September 21, 1906; also Genesee valley, New York to western New England.

Crataegus streeterae Sargent

Rochester Acad. Sci. Proc. IV. 119 (1903).

Hillsides, Coopers Plains, G. D. Cornell (*5), September 21, 1905, May 24, 1906, (* 82) September 16, 1906, May 30, 1907; also at Rochester, Buffalo, Niagara Falls, New York, and in southern Michigan.

Crataegus ornata Sargent

Rochester Acad. Sci. Proc. IV. 120 (1903).

Hillsides, Coopers Plains, G. D. Cornell (*95), September 21, 1906, June 2, 1907; also valley of the Genesee river, New York and southern Ontario.

FLABELLATAE

Crataegus steubenensis n. sp.

Leaves ovate, long-pointed and acuminate, rounded at the base, finely often doubly serrate, with straight or reflexed glandular teeth, and slightly divided above the middle into 5 or 6 pairs of small spreading acuminate lobes; slightly tinged with red when they unfold, nearly half grown when the flowers open about the 20th of May and then thin, yellow-green and strigose above and paler and glabrous below, and at maturity thin but firm in texture, yellow-green and scabrate above, pale below, 5–6 cm long and 4.5–5 cm wide, with thin prominent midribs often rose color late in the season, and conspicuous primary veins extending obliquely to the points of the lobes; petioles slender, slightly wing-margined at the apex, villose while young, becoming glabrous, occasionally sparingly glandular, often rose color in the autumn, 2.5–3 cm in length. Flowers 2–2.3 cm in diameter, on long slender sparingly villose pedicels, in lax mostly 7–14-flowered corymbs, the elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes long, slender, acuminate, glandular serrate, glabrous on the outer, slightly villose on the inner surface, reflexed after anthesis; stamens 20; anthers pale rose color; styles 3–5, usually 5. Fruit ripening the end of September, on long slender glabrous red drooping pedicels, in few-fruited clusters, obovate, full and rounded at the apex, abruptly narrowed at the base, scarlet, lustrous, marked by large pale dots, 1–1.2 cm long, and 9–10 mm in diameter; calyx prominent, with a broad deep cavity, and elongated spreading persistent lobes; flesh thick, yellow, sweet and juicy; nutlets usually 5, thin and acute at the ends, flat and slightly grooved on the back, 6–6.5 mm long, and 4–4.5 mm wide.

A narrow shrub 3–4 m high, with small stems covered with pale gray bark, erect branches forming a narrow open head, and stout slightly zigzag branchlets deeply tinged with red when they first appear, becoming light orange-brown, lustrous and marked by numerous pale lenticels in their first season and dull gray-brown the following year, and armed with few stout slightly curved light chestnut-brown shining spines 2–2.5 cm long.

Hillsides, Coopers Plains, G. D. Cornell (※49, type), September 28, 1905, May 21 and September 21, 1906.

COCCINEAE

Crataegus dodgei Ashe

Jour. Elisha Mitchell Sci. Soc. XIX. 26 (March 1903). Sargent, Acad. Sci. Phila. Proc. 632 (1905); Rhodora VII. 213 (1905).

Moist hillsides near Coopers Plains, G. D. Cornell (※30), September 21, 1905, May 26, 1906; also southern Michigan to southern New England.

INTRICATAE

Stamens 10; anthers pale yellow

Crataegus intricata Lange

Bot. Tidskr. XIX. 246 (1894). Sargent, Rhodora III. 28 (1901).

Moist hillsides, Coopers Plains, G. D. Cornell (※25), September 30, 1905, June 2, 1906, September 1907; also eastern New York and western and southern New England.

Crataegus foetida Ashe

Ann. Carnegie Mus. I, pt III. 389 (1902). Sargent, Acad. Sci. Phila. Proc. 641 (1905); Rhodora VII. 219 (1905).

Moist hillsides, Coopers Plains, G. D. Cornell (※34), October 1, 1905, June 2, 1906, (※55) October 8, 1905, June 4, 1906, (※98) September 1907; also Genesee valley, New York to western Massachusetts and eastern Pennsylvania.

Crataegus verecunda Sargent

Rochester Acad. Sci. Proc. IV. 109 (1903).

Moist hillsides, near Coopers Plains, G. D. Cornell (※ 51), October 1, 1905, June 2, 1906 (※ 56), October 8, 1905, May 30, 1906; grooved ridge, 7–8 mm long, and 4.5–5 mm wide.
also at Rochester and near Albany, N. Y.

Crataegus cornellii n. sp.

Glabrous with the exception of the hairs on the upper surface of the young leaves. Leaves oval and acuminate at the ends to ovate-acute and abruptly cuneate at the base, finely doubly serrate, with straight glandular teeth, and divided into 4 or 5 pairs of small acuminate lateral lobes; about half grown when the flowers open late in May or early in June and then very thin, dark yellow-green and slightly hairy above, especially on the midribs and veins, and paler below, and at maturity thin but firm in texture, dark yellow-green, smooth and glabrous on the upper surface, pale yellow-green on the lower surface, 4–4.5 cm long and 3–4 cm wide, with thin midribs and primary veins; petioles slender, slightly wing-margined at the apex, often rose color in the autumn, 1–1.2 cm in length; leaves on vigorous shoots ovate, truncate at the broad base, deeply 3-lobed by narrow sinuses, the terminal lobe often lobed toward the apex, and 3.5–5.5 cm long and broad, with stouter glandular petioles. Flowers about 1.5 cm in diameter, on short slender pedicels, in compact mostly 4–10-flowered simple corymbs, with linear-obovate to linear conspicuously glandular bracts and branchlets fading rose color; calyx-tube narrowly obconic, the lobes broad, acuminate, glandular serrate, often widened and laciniately divided toward the apex, reflexed after anthesis; stamens 10; anthers pale yellow; styles 3–5, usually 3. Fruit ripening the end of September, on short stout erect or spreading pedicels, in few-fruited clusters, obovate, rounded at the apex, abruptly narrowed at the base, light orange-yellow, lustrous, marked by small dark dots, 1.3–1.4 cm long and 1–1.2 cm in diameter; calyx very prominent, with a short tube, a wide deep cavity, and elongated spreading and appressed persistent lobes dark red on the upper side below the middle; flesh thin, yellow, dry and hard; nutlets usually 3, rounded and obtuse at the ends, ridged on the back, with a broad low slightly grooved ridge, 7–8 mm long and 4.5–5 mm wide.

A shrub about 1 m high, with small intricately branched erect stems, and slender nearly straight branchlets deeply tinged with red when they first appear, becoming bright chestnut-brown, lustrous, and marked by small pale lenticels in their first season and dull red brown the following year, and armed with very numerous slender nearly straight chestnut-brown shining spines 5.5–6 cm long.

Moist hillsides, Coopers Plains, C. H. Peck (※67, type), June 2 and September 21, 1906.

I am glad to associate with this distinct and pretty species the name of the industrious and careful student of the thorns which cover the hills surrounding his home.

Crataegus modesta Sargent

Rhodora III. 28 (1901); Acad. Sci. Phila. Proc. 635 (1905).

Moist hillsides, Coopers Plains, G. D. Cornell (※39), September 21, 1905, June 2, 1906; also western Vermont and eastern New York to eastern Pennsylvania.

ANOMALAE.

Stamens 10 or less; anthers rose color

Crataegus singularis n. sp.

Leaves ovate to oval, long-pointed and acuminate at the apex, gradually or abruptly narrowed to the concave-cuneate or rounded entire base, coarsely often doubly serrate above with straight glandular teeth, and slightly divided usually only above the middle into 5 or 6 pairs of small acuminate spreading lobes; nearly half grown when the flowers open about the 20th of May and then very thin, convex, dark yellow-green and strigose above and pale yellow-green and slightly villose along the primary veins below, and at maturity thin, glabrous, dark yellow-green and scabrate on the upper surface, light yellow-green and glabrous on the lower surface, 6–7 cm long and 4–4.5 cm wide, with slender yellow midribs and primary veins; turning yellow in the autumn before falling; petioles slender, slightly wing-margined at the apex, sparingly hairy on the upper side while young, soon becoming glabrous, glandular, with minute dark glands, often rose color in the autumn, 2–3 cm in length; leaves on vigorous shoots long-pointed, narrowed and rounded at the base, more coarsely serrate, deeply lobed, with slender acuminate lobes, often 6–7 cm long and 5.5–6 cm wide. Flowers 1.5–1.9 cm in diameter, on long slender slightly villose pedicels, in compact mostly 6–15-flowered corymbs, the elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, glabrous, the lobes long, slender, red and acuminate at the apex, finely glandular serrate, glabrous on the outer, slightly villose on the inner surface, reflexed after anthesis; stamens 5–8; anthers dark rose color; styles 2–4, usually 3. Fruit ripening from the middle to the end of September, on slender drooping pedicels, in few-fruited clusters, short-oblong, full and rounded at the ends, scarlet, lustrous, marked by large pale dots, 1.3–1.5 cm long, 8–10 mm in diameter; calyx little enlarged, with a narrow deep cavity, and elongated spreading and incurved lobes slightly hairy on the upper side; flesh orange-yellow slightly tinged with pink, thick and juicy; nutlets 2 or 3, full and rounded at the ends, or when 3 gradually narrowed at the ends, ridged on the back, with a broad low slightly grooved ridge, marked on the inner faces by broad depressions, 6–7 mm long, and about 4 mm wide.

A shrub 2–3 m high, with stems covered with gray-brown bark, ascending and spreading branches, and stout slightly zigzag glabrous branchlets light orange-green and marked by pale lenticels when they first appear, becoming light olive-green, lustrous and marked by small pale lenticels in their first season and dull gray-brown the following year, and armed with stout slightly curved light red-brown ultimately dark gray spines 3.5–4 cm long.

Rich hillsides, Coopers Plains, G. D. Cornell (※20, type), September 21, 1905, May 24, 1906 (※26, with less deeply divided leaves and nearly glabrous pedicels), September 21, 1905, May 14, 1906.

Crataegus repulsans n. sp.

Leaves ovate to rhombic, acuminate and long-pointed at the apex, abruptly or gradually narrowed and concave-cuneate at the entire base, finely often doubly serrate above, with straight or incurved glandular teeth, and slightly divided usually only above the middle into short broad acuminate spreading lobes; nearly fully grown when the flowers open in the last week of May and then thin, yellow-green and strigose above and pale and glabrous below, and at maturity thin but firm in texture, dull yellow-green, glabrous and scabrate on the upper surface, paler on the lower surface, 4–5 cm long and 3–3.5 cm wide, with thin yellow midribs and primary veins; petioles slender, slightly wing-margined at the apex, sparingly hairy on the upper side while young, soon becoming glabrous, 1.2–1.6 cm in length; leaves on vigorous shoots abruptly narrowed at the apex into long broad acuminate points, gradually narrowed to the rounded base, thicker, more coarsely serrate, and often 7–8 cm long and 5–5.5 cm wide, with stout rose colored petioles. Flowers 1.5–1.9 cm in diameter, on long slender slightly villose pedicels, in small mostly 5–8-flowered corymbs, the elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, glabrous, the lobes gradually narrowed from the base, red and glandular at the acuminate apex, minutely glandular serrate, glabrous on the outer, slightly villose on the inner surface, reflexed after anthesis; stamens 5–9; anthers rose color; styles 1–3, usually 2. Fruit ripening the end of September, on slender slightly hairy erect pedicels, in few-fruited clusters, short-oblong to subglobose, orange-red, lustrous, marked by small pale dots, 9–10 mm in diameter; calyx prominent, with a deep wide cavity, and elongated spreading and appressed lobes villose on the upper surface; flesh yellow, dry and mealy; nutlets 2 or 3, gradually narrowed and rounded at the ends, or when 3 acuminate at the base and broad and rounded at the apex, ridged on the back, with a broad low grooved ridge, marked on the inner face, by broad depressions, 6–6.5 mm long, and 3.5–4 mm wide.

A shrub 3–4 m high, with stems covered with greenish gray bark, ascending branches, and stout slightly zigzag glabrous branchlets dark orange-green and marked by pale lenticels when they first appear, becoming bright orange-brown and very lustrous in their first season and pale gray-brown the following year, and armed with very numerous stout straight or slightly curved light chestnut-brown shining spines 4–5 cm long.

Rich hillsides, Coopers Plains, G. D. Cornell (※45, type), September 24, 1905, May 28, 1906.

Crataegus inopinata n. sp.

Leaves ovate to oval, acuminate, cuneate or rounded at the entire base, coarsely doubly serrate above, with straight glandular teeth, and occasionally very slightly divided above the middle into small acute lobes; bronze color when they unfold, about half grown when the flowers open in the last week of May and then thin, light yellow-green and roughened above by short white hairs and pale and slightly villose in the axils of the veins below, and at maturity thin but firm in texture, dark yellow-green and scabrate on the upper surface, light yellow-green and glabrous on the lower surface, 4.5–6 cm long and 4–5 cm wide, with thin prominent yellow midribs and primary veins; petioles stout, slightly wing-margined at the apex, glabrous, sparingly glandular early in the season, usually with deciduous glands, generally rose color in the autumn, 2–3 cm in length; leaves on vigorous shoots rounded at the base, coarsely serrate, rarely slightly lobed, and often 8–10 cm long and 6–7.5 cm wide, with stout broadly winged conspicuously glandular petioles. Flowers 1–1.2 cm in diameter, on slender slightly villose pedicels, in narrow compact mostly 10–16-flowered corymbs; calyx-tube narrowly obconic, glabrous, the lobes wide, acuminate and red at the apex, glandular serrate, glabrous on the outer, villose on the inner surface, reflexed after anthesis; stamens 5–7; anthers pale rose color; styles 2 or 3, surrounded at the base by a narrow ring of long white hairs. Fruit ripening the end of September, on stout slightly spreading pedicels, in few-fruited clusters, subglobose, dark red, lustrous, marked by small pale dots, 1–1.1 cm in diameter; calyx little enlarged, with a broad shallow cavity, small spreading and closely appressed persistent lobes villose and dark red on the upper side; flesh thick, juicy, orange color; nutlets 2 or 3, rounded at the ends, ridged on the back, with a broad high doubly grooved ridge slightly penetrated on the inner faces by wide depressions, 5–5.5 mm long, and 3.5–4 mm wide.

A shrub occasionally 6–8 but more often 3–4 m high, with stout stems covered with dark bark scaly near the ground, ascending branches forming an open irregular head, and stout slightly zigzag glabrous branchlets dark orange-yellow and marked by pale lenticels when they first appear, becoming dark chestnut-brown and lustrous in their first season and dull reddish brown the following year, and armed with numerous stout straight or slightly curved chestnut-brown shining spines 3.5–6 cm long.

Rich hillsides, near Coopers Plains, G. D. Cornell (※ 60, type), May 26 and September 21, 1906, June and September, 1907.

TOMENTOSAE

Leaves thin

Anthers rose color; stamens 12–20

Crataegus diversa n. sp.

Leaves oblong-obovate, acute, acuminate or rarely rounded at the apex, gradually narrowed to the long concave-cuneate entire base, coarsely often doubly serrate above, with straight glandular teeth, and sometimes slightly divided above the middle into 2 or 3 pairs of small acute lobes; nearly half grown when the flowers open the middle of June and then thin, light yellow-green and slightly roughened above by short white hairs and pale and villose on the midribs and veins below, and at maturity thin but firm in texture, dark yellow-green, glabrous and smooth on the upper surface, still villose on the lower surface along the stout midribs and prominent primary veins, 6–8 cm long and 4.5–5 cm wide; petioles stout, wing-margined to below the middle, tomentose early in the season, becoming pubescent or nearly glabrous, 8–12 mm in length. Flowers 1.3–1.6 cm in diameter, on short stout villose pedicels, in compact mostly 15–18-flowered hairy corymbs, the elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, coated with long matted white hairs, the lobes long, slender, acuminate, glabrous on the outer, villose on the inner surface, reflexed after anthesis; stamens 12–20; anthers rose color; styles 2, surrounded at the base by a narrow ring of pale tomentum. Fruit ripening late in September, on slightly hairy red drooping pedicels, in few-fruited clusters, oval or slightly obovate, crimson, lustrous, marked by small pale dots, 9–10 mm long, and 6–7 in diameter; calyx little enlarged, with a short tube, a deep wide cavity, and small spreading and appressed often deciduous lobes dark red and villose on the upper side; flesh thin, yellow, dry and mealy; nutlets 2, rounded at the ends, rounded and slightly ridged on the back, penetrated on the inner faces by large deep cavities, 5–5.5 mm long, and 3–3.5 mm wide.

A shrub 3–4 m high, with numerous small erect stems covered with ashy gray bark, small ascending slightly spreading branches forming an open head, slender nearly straight branchlets covered when they first appear with long matted white hairs, becoming light orange-brown or chestnut-brown, lustrous, puberulous and marked by pale lenticels at the end of their first season, and dull reddish brown in their second or third years, and armed with straight slender chestnut-brown and shining ultimately dull gray spines 3–4 cm long, occasionally persistent and compound on old stems.

Hillsides, near Coopers Plains, G. D. Cornell (※70, type), June 18 and September 21, 1906 (※78), June and October 1906, 1907.

Well distinguished from Crataegus tomentosa Linneus, by the color of the branches and spines, the smaller number of stamens, and by the shape and color of the fruit.

Anthers pink; stamens 20

Crataegus spinifera n. sp.

Leaves ovate to obovate, acute or acuminate, gradually narrowed and concave-cuneate at the entire base, and sharply often doubly serrate above, with straight glandular teeth; about one third grown when the flowers open the 1st of June and then very thin, dark yellow-green and covered above by soft white hairs and pale and villose below along the midribs and veins, and at maturity thin but firm in texture, yellow-green, smooth and lustrous on the upper surface, pale bluish green and still slightly villose on the lower surface on the stout yellow midribs and slender primary veins, 5.5–7 cm long and 3.5–5 cm wide; petioles stout, narrow wing-margined to below the middle, slightly hairy on the upper side while young, soon becoming glabrous, 1–2 cm in length; leaves on vigorous shoots abruptly cuneate or rounded at the base, often slightly lobed toward the apex, and frequently 7–8 cm long and 5–6 cm wide. Flowers about 1.5 cm in diameter, on slender villose pedicels, in broad lax hairy mostly 20–30-flowered corymbs, the elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, coated with long matted white hairs, the lobes long, slender, glandular serrate, villose, reflexed after anthesis; stamens 20; anthers pale pink; styles 2–4. Fruit ripening the end of September, on long stout slightly hairy red drooping pedicels, in broad many-fruited clusters, subglobose to slightly ovate, scarlet, lustrous, sparingly hairy at the ends, marked by large pale dots, becoming soft and succulent, 1–1.2 cm in diameter; calyx little enlarged, with a deep narrow cavity, and small spreading and appressed lobes hairy on the upper side; flesh yellow, thin and dry; nutlets 2–4, slightly narrowed and rounded at the ends, ridged on the back, with a broad low grooved ridge, irregularly penetrated on the inner faces by broad deep cavities, 6–7 mm long, and 4–5 mm wide.

A dense round-topped shrub 3–4 m high, with small intricately branched stems spreading in thickets and covered with dark gray-brown scaly bark, ascending flexuous greenish gray branches, and slender slightly zigzag glabrous branchlets dark orange-green and marked by pale lenticels when they first appear, becoming orange-brown and lustrous in their first season and dull gray-brown the following year, and armed with numerous stout nearly straight purple shining spines 4–5 cm long.

Hillside, Coopers Plains, G. D. Cornell (※66, type), June 4 and September 21, 1906.

Anthers pale yellow; stamens 20

Crataegus structilis Ashe

Jour. Elisha Mitchell Sci. Soc. XIX. 12 (1903). Sargent, Acad. Sci. Phila. Proc. 656 (1905).

Hillsides, near Coopers Plains, G. D. Cornell (※50), September 30, 1905, June 18, 1906, (※52), June 13 and September 21, 1906, (※ 69), June 18 and September 21, 1906, (※ 71), with stamens sometimes reduced to 15), June and September 1906; also Illinois and southern Michigan, and through southern Ontario to the valley of the Genesee river, New York and eastern Pennsylvania.

Crataegus comans n. sp.

Leaves ovate to rhombic, acute at the apex, concave-cuneate at the entire base, and coarsely doubly serrate above, with straight glandular teeth; tinged with red when they unfold, about half grown when the flowers open from the 10th to the middle of June and then thin, yellow-green and roughened above by short white hairs most abundant on the midribs and veins, paler and villose below especially on the midribs and veins, and at maturity thin but firm in texture, dull yellow-green, smooth and lustrous on the upper surface, pale yellow-green and still villose below, 4.5–6 cm long and 3.5–5 cm wide, with stout midribs, often rose color in the autumn, and thin prominent primary veins; petioles stout, wing-margined nearly to the base, villose, 4–5 mm in length. Flowers 1.2–1.5 cm in diameter, on short stout densely villose pedicels, in very compact hairy mostly 10–15-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, slightly hairy, the lobes short, slender, minutely glandular serrate, nearly glabrous on the outer, slightly hairy on the inner surface, reflexed after anthesis; petals sometimes tinged with pink; stamens 20; anthers pale yellow; styles 2 or 3. Fruit ripening late in September, on long slender hairy erect pedicels, in wide many-fruited clusters, short-oblong to subglobose, orange-red, lustrous, covered with short pale hairs most abundant at the base, 7–8 mm in diameter; calyx little enlarged, with a short tube, a wide deep cavity and small spreading and appressed persistent lobes villose on the upper surface; flesh thin, yellow, becoming soft and succulent; nutlets usually 2, suborbicular, rounded and slightly grooved on the back, penetrated on the inner faces by broad deep cavities, about 5 mm long, and 2–2.5 mm wide.

A shrub 2–3 m high, with stems covered with pale gray bark, ascending branches, and slender nearly straight branchlets dark orange-red and covered with long matted pale hairs when they first appear, becoming light orange-red and lustrous and still hairy in their first season and dark gray-brown the following year, and armed with slender straight or slightly curved gray spines 2.5–3 cm long.

Hillsides, Coopers Plains, G. D. Cornell (✕35, type), June 13 and September 21, 1906.

Leaves thick

Stamens 20; anthers purple

Crataegus frutescens n. sp.

Leaves obovate, gradually narrowed and acute or rounded at the apex, concave-cuneate at the entire base, finely often doubly serrate above, with straight glandular teeth, and slightly divided generally only above the middle into 3 or 4 pairs of small acuminate lobes; faintly tinged with bronze color and slightly hairy above, especially along the midribs, when they unfold, more than half grown when the flowers open late in May or early in June, and then thick, light yellow-green and nearly glabrous above and pale and villose on the midribs and veins below, and at maturity subcoriaceous, conspicuously reticulate venulose, dark yellow-green, smooth and very lustrous on the upper surface, light yellow-green and still slightly hairy on the lower surface along the stout rose colored midribs and slender primary veins, 4–5 cm long and 3.5–4 cm wide; petioles stout, slightly wing-margined to below the middle, sparingly villose while young, soon becoming glabrous, often deep rose color in the autumn, 7–10 mm in length; leaves on vigorous shoots ovate to oval, more coarsely serrate and 6–6.5 cm long and 5–6 cm wide, with stout broadly winged often glandular petioles. Flowers 1.4–1.6 cm in diameter, on slender villose pedicels, in compact mostly 10–15-flowered corymbs, with long narrow obovate to linear acuminate glandular caducous bracts and bractlets, the long lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, slightly hairy at the base, glabrous above, the lobes gradually narrowed, short, broad, acuminate, finely glandular serrate, glabrous on the outer, slightly villose on the inner surface, reflexed after anthesis; stamens 20; anthers purple; styles 2 or 3. Fruit ripening the end of September, on slender slightly hairy erect pedicels, in few-fruited clusters, short-oblong, full and rounded at the ends, scarlet, very lustrous, marked by large pale dots, 7–8 mm in diameter; calyx little enlarged, with a broad deep cavity, and small spreading and appressed lobes; flesh yellow, dry; nutlets 2 or 3, gradually narrowed and rounded at the ends, rounded and slightly ridged on the back, penetrated on the inner faces by deep narrow cavities, 4.5–5 mm long, and about 3 mm wide.

A shrub sometimes 2 m high, with stems covered with dark greenish gray bark and spreading into thickets, small ascending branches, slender nearly straight glabrous branchlets light orange-green and marked by pale lenticels when they first appear, light chestnut-brown and very lustrous in their first and second seasons and dull reddish brown the following year, and armed with numerous stout slightly curved chestnut-brown shining spines 3–4 cm long, compound and long persistent on old stems, and accrescent bright rose colored very conspicuous inner bud scales deciduous before the opening of the flower buds.

Coopers Plains, G. D. Cornell (※ 37, type), September 21, 1905, June 3, 1906.

Stamens 10 or less; anthers pale yellow

Crataegus ferentaria Sargent

Rochester Acad. Sci. Proc. IV. 135 (1903); Rhodora VII. 184 (1905).

Hillsides, Coopers Plains, G. D. Cornell (※ 22), September 21, 1905, June 2, 1906; also southern Ontario to eastern New England.

NEW YORK SPECIES OF CRATAEGUS FROM VARIOUS LOCALITIES

BY C. S. SARGENT

PRUINOSAE

Crataegus bronxensis n. sp.

Leaves ovate, acuminate, gradually or abruptly narrowed and concave-cuneate at the entire base, sharply often doubly serrate above, with straight glandular teeth, and divided above the middle into 3 or 4 pairs of short acuminate lobes; nearly half grown when the flowers open late in May and then thin, light yellow-green and slightly hairy especially on the midribs above, and paler and sparingly villose along the midribs and veins below, with persistent hairs, and at maturity very thin, dark bluish green and scabrate on the upper surface, pale blue-green on the lower surface, 4.5–5.5 cm long and 3–4 cm wide, with slender midribs, and thin primary veins extending very obliquely to the points of the lobes; petioles slender, wing-margined at the apex, glabrous, glandular, with occasional mostly persistent glands, often rose colored in the autumn, 2.5–3 cm in length; leaves on vigorous shoots sometimes rounded at the broad base, more coarsely serrate and more deeply lobed, and often 6–7 cm long and 5–6 cm wide. Flowers 1.8–2 cm in diameter, on short slender slightly hairy pedicels, in compact mostly 5–7-flowered corymbs, with linear acuminate bracts and bractlets fading brown and often persistent until the flowers open, the lower peduncles from the axils of upper leaves; calyx-tube broadly obconic, glabrous, the lobes abruptly narrowed from wide bases, slender, acuminate, entire or occasionally minutely glandular dentate, glabrous on the outer, slightly villose on the inner surface, reflexed after anthesis; stamens 20; anthers light pink; styles 4 or 5. Fruit on erect slender pedicels, in few-fruited clusters, falling late in the autumn without becoming soft, subglobose or rather broader than high, apple-green, slightly pruinose, becoming lustrous, marked by large dark dots, 1–1.2 cm in diameter; calyx prominent, with a short tube, a broad shallow cavity, and spreading and reflexed often deciduous lobes dark red on the upper side below the middle; flesh thin, green, dry and hard; nutlets 4 or 5, gradually narrowed and rounded at the ends, rounded and grooved or irregularly ridged on the back, 6–6.5 mm long and about 4 mm wide.

A shrub, with slender slightly zigzag glabrous branchlets orange-green more or less tinged with red when they first appear, becoming light chestnut-brown, lustrous and marked by pale lenticels in their first season and dull red-brown the following year, and armed with numerous slender straight or slightly curved chestnut-brown shining spines 3.5–5.5 cm long.

In Bronx park, New York city, W. W. Eggleston (※ 154, type), October 5, 1904, May 25, 1907.

Crataegus livingstoniana n. sp.

Glabrous with the exception of the hairs on the upper side of the leaves. Leaves ovate, acuminate, abruptly cuneate or rounded at the entire base, coarsely often doubly serrate above, with straight glandular teeth, and slightly divided into 4 or 5 pairs of small acuminate spreading lobes; about half grown when the flowers open in the last week of May and then very thin, yellow-green and slightly hairy above and pale below, and at maturity thin, light yellow-green, smooth or occasionally hairy and roughened on the upper surface, paler on the lower surface, 5–7 cm long and 4–5.5 cm wide, with thin midribs, and primary veins extending obliquely to the points of the lobes; petioles slender, slightly wing-margined at the apex, occasionally glandular, 1.5–3 cm in length; leaves on vigorous shoots thicker, rounded or cordate at the base, more deeply lobed and more coarsely serrate. Flowers 1.6–1.8 cm in diameter, on long slender pedicels, in mostly 5–8-flowered corymbs, the elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes gradually narrowed from the base, long, slender, glandular and acuminate at the apex, minutely glandular dentate, reflexed after anthesis; stamens usually 8; anthers dark red; styles 3–5, surrounded at the base by a narrow ring of pale tomentum. Fruit ripening the middle of October, on stout spreading or drooping pedicels, in few-fruited clusters, short-oblong, full and rounded at the ends, red, lustrous, marked by many small pale dots, 1.2–1.5 cm long and 1–1.2 cm in diameter; calyx prominent, with a deep narrow cavity pointed and tomentose in the bottom, and elongated spreading and incurved persistent lobes dark red on the upper side; nutlets 3–5, narrowed and acute at the ends or when 3 rounded at the ends, rounded and grooved or slightly ridged on the back, 6.5–7 mm long, and about 4 mm wide.

An arborescent shrub sometimes 5–6 m high, with stems 1–1.5 dm in diameter covered with ashy gray bark, ascending branches forming a narrow fastigiate head, and slender nearly straight branchlets dark orange-green and marked by pale lenticels when they first appear, becoming light chestnut-brown and lustrous in their first season, dull gray the following year, and armed with occasional stout nearly straight light chestnut-brown shining spines 2.5–3 cm long.

Roadside, near east bank of Hemlock lake, Livingston co., Henry T. Brown (※23, type), May 28 and October 1906, (※13) May 28 and October 13, 1906, (※18, with 6–8 stamens) May 18 and October 1906, (※16, with rather lighter colored anthers) May and October 1906.

Crataegus macera n. sp.

Leaves ovate, rounded, truncate or cuneate at the entire base, finely often doubly serrate above, with glandular teeth, and slightly divided into 5 or 6 pairs of small acuminate lateral lobes; more than half grown when the flowers open the end of May and then thin, dark yellow-green, slightly hairy above and pale and glabrous below, and at maturity very thin, dull yellow-green and scabrate on the upper surface, paler on the lower surface, 4–5 cm long, and 3.5–4 cm wide, with thin midribs and primary veins; petioles slender, slightly wing-margined at the apex, glandular while young, 1.5–2.5 cm in length; leaves on vigorous shoots thin, truncate or rounded at the broad base, more coarsely serrate, more deeply lobed, and often 6.5–7 cm long and 6.6–5 cm wide, with slender rose colored glandular petioles. Flowers about 2 cm in diameter, on long slender glabrous pedicels, in wide mostly 6–10-flowered corymbs, the elongated lower peduncles from the axils of upper leaves; calyx-tube broadly obconic, glabrous, the lobes separated by wide sinuses, gradually narrowed from the base, long, slender, acuminate and glandular at the apex, entire or occasionally glandular dentate above the middle, glabrous on the outer, sparingly villose on the inner surface, reflexed after anthesis; stamens 5–7, usually 7; anthers light rose color; styles 4 or 5, surrounded at the base by a ring of pale tomentum. Fruit ripening the middle of October, on slender drooping pedicels, in few-fruited clusters, subglobose to short-oblong, scarlet, lustrous, marked by small dark dots, about 1 cm in diameter; calyx little enlarged, with a broad deep cavity tomentose on the inner surface, and spreading lobes dark red on the upper side below the middle; flesh yellow-green, dry and mealy; nutlets 4 or 5, gradually narrowed and rounded at the ends or acute at the base, ridged on the back, with a broad high grooved ridge, 6–6.5 mm long, and 4.5–5 mm wide.

An arborescent shrub 5–6 m high, with numerous light ashy gray stems sometimes 1.3–1.5 dm in diameter, spreading and drooping branches, and slender slightly zigzag branchlets dark orange-green and marked by pale lenticels when they first appear, becoming light chestnut-brown and lustrous in their first season and dull gray-brown the following year, and armed with numerous slender often recurved chestnut-brown shining spines 3.5–4.5 cm long.

Moist soil in dense thickets, near the east bank of Hemlock lake, Livingston co., Henry T. Brown (※22, type), May 28 and October 16, 1906.

TENUIFOLIAE

Crataegus leptopoda n. sp.

Glabrous with the exception of the hairs on the upper surface of the young leaves and petioles. Leaves oblong-ovate, gradually narrowed at the base, finely often doubly serrate, with straight glandular teeth, and slightly divided into 6 or 7 pairs of narrow acuminate spreading lobes; about half grown when the flowers open in the last week of May and then very thin, yellow-green and slightly roughened above by short white hairs and pale below, and at maturity thin, smooth and dull dark yellow-green on the upper surface, paler on the lower surface, 6–7 cm long and 3.5–4 cm wide, with slender midribs and primary veins; petioles very slender, slightly wing-margined at the apex, sparingly hairy on the upper side while young, soon becoming glabrous, glandular, with minute often persistent glands, 2–3 cm in length. Flowers about 1.5 cm in diameter, on long slender pedicels, in mostly 10–12-flowered narrow corymbs, the elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes gradually narrowed from the base, long, slender, red and glandular at the acuminate apex, entire or minutely glandular dentate near the middle, reflexed after anthesis; stamens 5–10; anthers dark red or maroon; styles 3 or 4, surrounded at the base by a narrow ring of pale tomentum. Fruit ripening late in September, on long slender drooping pedicels, in few-fruited clusters, obovate, rounded at the apex, gradually narrowed at the base, bright cherry-red, lustrous, marked by small pale dots, 1–1.2 cm long, and 8–9 mm in diameter; calyx little enlarged, with a shallow narrow cavity and erect or incurved persistent lobes dark red on the upper side below the middle; flesh thin, yellow-green and juicy; nutlets 3 or 4, acuminate at the base, narrow and rounded at the apex, slightly ridged on the back, with a rounded ridge 6–6.5 mm long, and about 4 mm wide.

A shrub sometimes 5 m high, with stout slightly zigzag branchlets dark orange-green and marked by pale lenticels when they first appear, becoming dark chestnut-brown and lustrous in their first season and dull gray-brown the following year, and armed with numerous stout curved or nearly straight chestnut colored shining spines 3.5–4 cm long, persistent and simple on the stem.

East bank of Hemlock lake, Livingston co., H. T. Brown (※26 type), May 28 and October 3, 1906, (※25, with lighter colored anthers) May and September 1906.

Crataegus gracilipes n. sp.

Glabrous with the exception of the hairs on the upper surface of the leaves. Leaves ovate, long-pointed and acuminate at the apex, gradually or abruptly narrowed and concave-cuneate at the entire base, sharply often doubly serrate, with long straight glandular teeth, and divided often only above the middle into 5 or 6 pairs of long slender acuminate spreading lobes; nearly fully grown when the flowers open in the last week of May and then very thin, light yellow-green, lustrous and slightly hairy above and pale and glaucous below, and at maturity thin, scabrate and dull yellow-green above, paler below, 7–8 cm long and 4.5–6 cm wide, with slender midribs and primary veins; petioles slender, slightly wing-margined at the apex, glandular while young, with minute deciduous glands, 3–5 cm in length. Flowers about 1.5 cm in diameter, on long slender pedicels, in mostly 5–12-flowered corymbs, the elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes gradually narrowed from the base, slender, very long, acuminate and red at the apex, finely glandular serrate usually only near the middle, reflexed after anthesis; stamens 6–8; anthers light red; styles 3 to 5. Fruit ripening the end of September, on long slender drooping pedicels, in few-fruited clusters, narrow-obovate, gradually narrowed and rounded at the apex, gradually narrowed to the long slender base, scarlet, lustrous, 1.2–1.3 cm long, 6–7 mm wide; calyx little enlarged, with a deep wide cavity, and spreading persistent lobes; flesh yellow-green, thick and juicy; nutlets 3–5, narrowed and acute at the ends, or when 3 broader and rounded at the apex, ridged on the back, with a broad low slightly grooved ridge, 6.5–7 mm long, and 5–5.5 mm wide.

A shrub sometimes 6 m high, with small stems covered with pale gray bark, ascending and drooping tortuous branches, and slender branchlets deeply tinged with red and marked by pale lenticels when they first appear, becoming dark chestnut-brown and lustrous in their first season and dark dull gray-brown the following year, and armed with stout slightly curved or straight dull chestnut-brown spines 2.5–3 cm long.

Thickets in moist soil, near the eastern bank of Hemlock lake, Livingston co., New York, Henry T. Brown (※21, type), May 28 and October 4, 1906.

Crataegus claytoniana n. sp.

Glabrous with the exception of the hairs on the young leaves. Leaves oblong-ovate, acuminate, rounded or abruptly cuneate at the base, finely often doubly serrate above, with straight or incurved glandular teeth, and divided into 4 or 5 pairs of slender spreading acuminate lateral lobes; bronze-red and covered above by short white hairs when they unfold, more than half grown when the flowers open about the 10th of June and then thin, light yellow-green and still hairy above and pale and glabrous below, and at maturity thin, dark yellow-green and slightly roughened on the upper surface, light yellow-green on the lower surface, 3–4.5 cm long and 2.5–3 cm wide, with thin midribs and primary veins; petioles slender, slightly wing-margined at the apex, glandular, with occasional persistent glands, 1.5–2.5 cm in length; leaves on vigorous shoots thicker, long-pointed, rounded or truncate at the broad base, more coarsely serrate and more deeply lobed, and often 5–6 cm long and 4–5 cm wide, with stout rose colored midribs, and conspicuously glandular petioles. Flowers 1–1.2 cm in diameter, on slender pedicels, in small lax 5–10-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes slender, acuminate and red at the apex, entire or occasionally minutely glandular dentate, reflexed after anthesis; stamens 5–8; anthers red; styles 2 or 3. Fruit ripening the end of September, on short drooping pedicels, in 1–3-fruited clusters, subglobose to short-oblong, scarlet, lustrous, 1–1.2 cm long, about 1 cm in diameter; calyx little enlarged, with a wide shallow cavity, and spreading mostly persistent lobes bright red on the upper side below the middle; flesh thick, rather juicy, yellow slightly tinged with red; nutlets 2 or 3, narrowed and rounded at the ends, ridged on the back, with a low broad slightly grooved ridge, 6.5–7 mm long, and 4–4.5 mm wide.

A shrub 3–4 m high, with stout stems, long slender erect or diverging branches, and slender nearly straight branchlets dark orange-green more or less tinged with red when they first appear, becoming light chestnut-brown, lustrous and marked by small pale lenticels in their first season and dark grayish brown the following year, and armed with slender straight or slightly curved bright chestnut-brown shining spines 2.5–3 cm long.

Clayton, Jefferson co., C. H. Peck (※3, type), June 14 and September 27, 1907.

COCCINEAE

Crataegus chateaugayensis n. sp.

Leaves ovate, acuminate or acute at the apex, concave-cuneate or rarely rounded at the entire base, finely often doubly serrate above with straight glandular teeth, and divided into 4–6 pairs of small acuminate spreading lateral lobes; deeply tinged with red when they unfold, about half grown when the flowers open in the first week of June, and then thin, yellow-green and roughened above by short white hairs and glabrous below, and at maturity dark yellow-green, smooth and slightly villose along the midribs on the upper surface, and paler and lustrous on the lower surface, 5.5–6.5 cm long, and 3.5–4 cm wide, with slender midribs rose colored in the autumn, and thin primary veins arching obliquely to the points of the lobes; petioles slender, slightly wing-margined at the apex, sparingly villose on the upper side while young, becoming glabrous, glandular, with numerous dark usually persistent glands, 2–3 cm in length. Flowers 1.6–1.8 cm in diameter, on long slender glabrous or occasionally slightly hairy pedicels, in compact mostly 10–12-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, glabrous, the lobes long, slender, acuminate and red at the apex, coarsely and conspicuously glandular dentate, reflexed after anthesis; stamens 5; filaments persistent on the ripe fruit; anthers dark rose color; styles 4 or 5, surrounded at the base by a narrow ring of pale tomentum. Fruit ripening the middle of September, on stout drooping red glabrous or occasionally slightly hairy pedicels, in few-fruited clusters, short-oblong to oval, scarlet, marked by large pale dots, slightly pruinose, 1.2–1.4 cm long, 8–10 mm in diameter; calyx prominent, with a short tube, a wide cavity tomentose in the bottom, and spreading and reflexed persistent lobes; flesh thick, firm light yellow; nutlets 4 or 5, gradually narrowed and rounded at the base, thicker and rounded at the apex, ridged on the back, with a broad low deeply grooved ridge, 7–9 mm long, and 3.5–4 mm wide.

An arborescent shrub or tree 7–8 m high, with stout slightly zigzag glabrous branchlets, dark green and marked by pale lenticels when they first appear, becoming orange-brown or chestnut-brown in their first season and dull gray-brown the following year, and armed with very numerous stout straight or slightly curved light chestnut-brown shining spines 4–7 cm long.

Near Chateaugay lake, Franklin co., J. G. Jack (※1, type), September 15, 1903, June 8, 1905.

Crataegus spissa n. sp.

Leaves ovate, acuminate, gradually narrowed and concave-cuneate at the entire base, sharply doubly serrate above, with straight glandular teeth, and divided usually only above the middle into 4 or 5 pairs of small acuminate lobes; tinged with red and covered with long white hairs when they unfold, nearly half grown when the flowers open at the end of May and then thin, yellow-green and roughened above by short hairs and paler and glabrous below, and at maturity thin, dark yellow-green, smooth, glabrous and lustrous on the upper surface, pale yellow-green on the lower surface, 4–5 cm long and 3–4 cm wide, with slender yellow midribs, and thin primary veins arching obliquely to the points of the lobes; petioles slender, wing-margined at the apex, sparingly villose on the upper side while young, soon becoming glabrous, glandular with often persistent glands, 1.2–2 cm in length; leaves on vigorous shoots thicker, often rounded or truncate at the broad base, more coarsely serrate and more deeply lobed, 7–9 cm long and 7–8 cm wide, with broadly winged glandular petioles. Flowers 1.2–1.3 cm in diameter, on short glabrous or slightly hairy pedicels, in small very compact 5–10-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, glabrous, the lobes gradually narrowed from broad bases, acuminate, glandular dentate usually only above the middle, glabrous on the outer, villose on the inner surface, reflexed after anthesis; stamens 10; anthers pink or purplish red; styles 3 or 4, surrounded at the base by a narrow ring of pale tomentum. Fruit ripening the middle of September, on short drooping pedicels, in few-fruited clusters, subglobose to oval, scarlet, lustrous, marked by small pale dots; calyx little enlarged, with a wide shallow cavity, and small spreading serrate lobes, their tips often deciduous from the ripe fruit; flesh thin, yellow, dry and mealy; nutlets 3 or 4, gradually narrowed and rounded at the ends, ridged on the back, with a long narrow ridge, 6–7 mm long, and 3.5–4 mm wide.

A shrub 3–4 m high, with numerous small stems, ascending or suberect branches, and slender slightly zigzag glabrous branchlets dark orange-green when they first appear, becoming bright chestnut-brown, lustrous and marked by pale lenticels in their first season and dull gray-brown the following year, and armed with numerous slender straight or slightly curved chestnut-brown shining spines 3.5–6 cm long.

Dry sandy or rocky soil, North Elba, Essex co., common and the prevailing species, C. H. Peck (※41, type), May 27, June 2 and September 18, 1903, (※41′) July 22 and September 18, 1904.

Crataegus verrucalis n. sp., Peck

Leaves ovate to slightly obovate, acuminate and long-pointed at the apex, gradually narrowed and cuneate at the base, finely often doubly serrate, with straight glandular teeth, and divided usually only about the middle into 4 or 5 pairs of slender acuminate spreading lobes; bronze-red and covered on the upper surface with short white hairs when they unfold, more than half grown when the flowers open at the end of May or early in June and then thin, yellow-green and still slightly hairy above and paler below, and at maturity thin, yellow-green on the lower surface, 4–4.5 cm long and 2.5–3 cm wide, with thin prominent midribs, and rather obscure primary veins; petioles slender, slightly wing-margined at the apex, glabrous, glandular, with often persistent glands, 1.5–2 cm in length; leaves on vigorous shoots broadly ovate to suborbicular, rounded at the base, more coarsely serrate and more deeply lobed. Flowers 1.2–1.4 cm in diameter, on short slender slightly villose pedicels, in small compact 4–10-flowered hairy corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, villose, the lobes slender, acuminate, glandular dentate, glabrous on the outer, sparingly villose on the inner surface, reflexed after anthesis; stamens 5–10; anthers red; styles 2–4, usually 3. Fruit ripening from the middle to the end of September and often persistent until after the leaves have fallen, on slender slightly hairy drooping, pedicels, in few-fruited clusters, subglobose to short-oblong, scarlet, lustrous, 1–1.2 cm long and 8–10 mm in diameter; calyx little enlarged, with a deep narrow cavity, and small spreading often deciduous lobes; flesh thin, yellow; nutlets usually 3, acute at the base, thicker and rounded at the apex, ridged on the back, with a low doubly grooved ridge, 6.5–7 mm long, and 3.5–4 mm wide.

A shrub or small tree 2–4 m high, with a stem sometimes 5 dm in diameter and like the long slender mostly erect branches covered with dark brown verrucose bark, and slender glabrous branchlets yellow-green and marked by pale lenticels when they first appear, becoming light chestnut-brown and lustrous in their first season and dark red-brown the following year, and armed with numerous stout straight light chestnut-brown shining spines 3.5–4 cm long.

Adirondack region, common; C. H. Peck (※ 1fc, type), June 18 and October 1, 1907.

Related to Crataegus praecoqua Sargent, Crataegus verrucalis may be distinguished from that species by its smaller leaves and flower clusters, fewer stamens and styles, by its smaller and late hanging fruit, and by the peculiar wartlike excrescences on the bark.

Crataegus harryi n. sp.

Glabrous with the exception of the hairs on the upper surface of the young leaves and on the calyx-lobes. Leaves obovate, gradually narrowed and acute or acuminate at the apex, concave-cuneate at the entire base, or occasionally oval and acuminate at the ends, sharply doubly serrate, with straight glandular teeth, and divided above the middle into numerous short slender acuminate lobes; nearly fully grown when the flowers open the last of May and then very thin, dark yellow-green and covered above by soft white hairs and paler below, and at maturity thin, dull light yellow-green and scabrate on the upper surface and yellow-green and lustrous on the lower surface, 6–7 cm long and 4–4.5 cm wide, with slender yellow midribs and primary veins; petioles slender, slightly wing-margined at the apex, 1.5–3 cm in length; leaves on vigorous shoots thicker, deeply lobed, more coarsely serrate, and often 12–14 cm long and 8–9 cm wide. Flowers 1.3–1.5 cm in diameter, on slender pedicels, in wide mostly 7–15-flowered corymbs, the long lower peduncles from the axils of upper leaves; calyx-tube very narrow, obconic, the lobes long, slender, acuminate, minutely glandular dentate, glabrous on the outer, villose on the inner surface, reflexed after anthesis; stamens 5 or 6; anthers pink; styles 2–4. Fruit ripening and falling early in October, on slender reddish pedicels, in few-fruited spreading clusters, short-oblong to slightly obovate, rounded at the ends, cherry-red, lustrous, marked by small pale dots, about 1 cm long and 8–9 mm in diameter; calyx prominent, with a wide deep cavity tomentose in the bottom, and long spreading and incurved persistent lobes; flesh thin, yellow-green, dry and mealy; nutlets 2–4, rounded at the base, gradually narrowed and acute at the apex, or when 4 acute at the ends, ridged on the back, with a high broad irregularly grooved ridge 7–7.5 mm long, and about 5 mm wide.

A slender tree sometimes 8 m high, with a short trunk occasionally 2 dm in diameter and covered with pale gray very scaly bark, small spreading dark gray branches spotted with lighter gray, and very slender nearly straight branchlets dark orange-brown and marked by pale lenticels when they first appear, becoming light yellow-brown and lustrous in their first season and dull light gray-brown the following year, and armed with occasional slender nearly straight or slightly curved light chestnut-brown spines 2.5–3 cm long.

Borders of woods in low bottom lands of Wet-stone brook near the Honeoye state road, Richmond, Ontario co., Henry T. Brown (※38, type), May 28 and October 17, 1906.

Both Brown and Henry having been used in forming specific names in Crataegus, Crataegus harryi, one of the most distinct and interesting of his discoveries will serve to commemorate the name of Henry T. Brown of Rochester, New York, who has carefully studied and collected the numerous thorns found by him near Hemlock and Honeoye lakes in Livingston and Ontario counties.

ANOMALAE

Crataegus simulans n. sp.

Leaves ovate to slightly obovate or oval, acuminate or rounded at the apex, gradually narrowed to the concave-cuneate entire base, sharply often doubly serrate above, with straight glandular teeth, and slightly divided usually only above the middle into 4 or 5 pairs of small acuminate spreading lobes; nearly fully grown when the flowers open in the last week of May and then thin, yellow-green and slightly roughened above by short white hairs and paler and glabrous below, and at maturity thin, dull yellow-green and scabrate on the upper surface, paler on the lower surface, 5–6 cm long and 2.5–5 cm wide, with thin light yellow midribs and primary veins; petioles slender, slightly wing-margined at the apex, sparingly villose on the upper side while young, soon becoming glabrous, often rose colored in the autumn at the base, 1.5–2.5 cm in length; leaves on vigorous shoots somewhat larger, more deeply lobed and more coarsely serrate. Flowers 1.8–2 cm in diameter, on long slender slightly villose pedicels, in wide lax mostly 9–14-flowered corymbs, the elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes abruptly narrowed at the base, long, slender, acuminate, minutely glandular dentate, glabrous on the outer, slightly hairy on the inner surface, reflexed after anthesis; stamens 10; anthers light pink; styles 3 or 4, surrounded at the base by a few pale hairs. Fruit ripening early in October, on long slender reddish pedicels furnished with occasional hairs, in few-fruited clusters, short-oblong to slightly obovate, bright red, lustrous, marked by small pale dots, 8–10 mm long and 7–9 mm in diameter; calyx prominent, with a short tube, a broad shallow cavity narrowed and tomentose in the bottom, and elongated persistent lobes villose and bright red on the upper side; flesh thin, yellow-green, dry and mealy; nutlets 3 or 4, gradually narrowed and rounded, or when 4 acute at the ends, ridged on the back, with a broad high grooved ridge, more or less penetrated on the inner faces by long wide depressions, 6.5–7 mm long, and 4–4.5 mm wide.

A shrub 3–4 m high, with small stems covered with pale gray bark, spreading horizontal and drooping branches, and very slender nearly straight branchlets, light orange-green and marked by pale lenticels when they first appear, becoming light chestnut-brown and very lustrous in the first season and pale gray-green in their third year, and armed with slender nearly straight dark purple spines 4–5 cm long.

Near the road along the east side of Hemlock lake, Livingston co., Henry T. Brown (※11, type), May 28 and October 3, 1906.

This species has the foliage, habit and general appearance of a *Coccineae*. From that group it is excluded by the depressions on the inner faces of the nutlets which are sometimes as much developed as in some of the species of *Tomentosae*. On many of the nutlets these depressions are much less deep than on others, however, and as they show so much variation in this character it is perhaps best to place it among the *Anomalae*, which by the discovery of this species appears to be even more closely related than was before supposed; on one hand with the *Coccineae* and on the other with the *Tomentosae*.

Crataegus floridula n. sp.

Glabrous with the exception of the hairs on the young leaves and calyx lobes. Leaves ovate to oblong-ovate or oval, long-pointed and acuminate at the apex, gradually narrowed and concave-cuneate at the entire base, finely doubly serrate above, with straight glandular teeth, and slightly and irregularly divided usually only above the middle into 3 or 4 pairs of small acute lobes; slightly tinged with red when they unfold, nearly fully grown when the flowers open the first week of June and then very thin, dark yellow-green and slightly hairy above especially along the midribs, and glabrous and glaucous below, and at maturity thin, dark bluish green, smooth and lustrous on the upper surface, pale blue-green on the lower surface, 5–7 cm long and 3–4.5 cm wide, with thin yellow midribs and primary veins; petioles very slender, slightly wing-margined at the apex, sparingly glandular, with mostly deciduous glands, often tinged with red in the autumn, 1.8–2.5 cm in length; leaves on vigorous shoots thicker, occasionally rounded at the base, more coarsely serrated, more deeply lobed, and often 7–8 cm long and 5.5–6.5 cm wide, with foliaceous lunate often persistent stipules. Flowers 1.2–1.3 cm in diameter, on long slender pedicels, in very narrow compact 4–8-flowered corymbs, the much elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes long, slender, acuminate and rose colored at the apex, entire or furnished near the base with 1 or 2 glands, glabrous on the outer, slightly villose on the inner surface, reflexed after anthesis; stamens 5–8; anthers red or purple; styles 3 or 4. Fruit ripening late in September, on slender drooping pedicels, in loose clusters, short-oblong to somewhat obovate, slightly narrowed at the ends, crimson, lustrous, 1.1–1.2 mm long, and 7–8 mm in diameter; calyx little enlarged, with a deep narrow cavity, and reflexed and appressed lobes dark red on the upper side below the middle and often deciduous from the ripe fruit; flesh thin, greenish yellow; nutlets 3 or 4, usually 3, gradually narrowed and rounded at the ends, or when 3 broader at the apex than at the base, marked on the inner face by shallow irregular depressions, 6.5–7 mm long, and about 4 mm wide.

A shrub 2–3 m high, with gray stems, 2.5–5 cm in diameter near the ground, ascending 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 dull reddish brown the following year, and armed with stout slightly curved chestnut-brown shining spines 2.5–3 cm long.

Piseco, Hamilton co., C. H. Peck (✻62, type), June 10 and September 16, 1904.

TOMENTOSAE

Crataegus efferata n. sp.

Leaves oblong-ovate to rhombic, acute or acuminate at the apex, abruptly or acutely concave-cuneate at the entire base, finely often doubly serrate above, with straight or incurved glandular teeth, and sometimes slightly divided above the middle into 3 or 4 pairs of small acute lobes; more than half grown when the flowers open the last days of May and then very thin, yellow-green and slightly hairy above on the midribs and covered below by soft pale hairs, and at maturity thin but firm in texture, light yellow-green, very smooth and glabrous on the upper surface, pale and villose-pubescent on the lower surface on the stout often rose colored midribs and slender primary veins and veinlets, 5.5–7.5 cm long and 4–6 cm wide; petioles stout, narrowly wing-margined often to the base, hairy on the upper side while young, becoming nearly glabrous and often dark rose color in the autumn, 1.5–1.8 cm in length; leaves on vigorous shoots thicker, more coarsely serrate, more deeply lobed, and often 7–8 cm long and 5–6 cm wide. Flowers about 1.2 cm in diameter, on long slender slightly villose pedicels, in small rather compact 10–15-flowered hairy corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, coated with short white hairs, the lobes abruptly narrowed at the base, long, wide, acuminate, laciniately glandular serrate, glabrous on the outer, slightly villose on the inner surface, reflexed after anthesis; stamens 16–20; anthers light rose color; styles 2 or 3. Fruit ripening early in October, on long slender slightly hairy red pedicels, in few-fruited spreading or drooping clusters, subglobose, scarlet, very lustrous, marked by large pale dots, 8–9 mm in diameter; calyx prominent, with a deep narrow cavity, and long spreading lobes dark red on the upper side below the middle; flesh thick, yellow-green, becoming soft and succulent when fully ripe; nutlets usually 2, nearly orbicular, rounded and slightly ridged on the back, penetrated on the inner face by long narrow deep cavities, 4.5–5 mm long, and 3–3.5 mm wide.

An arborescent shrub 5–7 m high, with stout stems covered with dark brown scaly bark, erect and spreading branches, and stout slightly zigzag glabrous branchlets light orange-yellow when they first appear, becoming dark chestnut-brown, very lustrous and marked by small pale dark lenticels in their first season and dull reddish brown the following year, and armed with numerous very stout straight or slightly curved light chestnut-brown shining spines 4–5 cm long, compound and long persistent on old stems and branches.

Banks of the outlet of Hemlock lake at Hemlock railroad station, Livingston co., New York, Henry T. Brown (※6, type), May 28 and October 4, 1906.

Crataegus honeoyensis n. sp.

Leaves oval to ovate or slightly obovate, rounded or acute at the apex, gradually or abruptly narrowed and concave-cuneate at the entire base, sharply doubly serrate above, with straight or incurved glandular teeth, and sometimes slightly divided above the middle into 2 or 3 pairs of short broad acuminate lobes; nearly fully grown when the flowers open in the last week of May and then thin, yellow-green, smooth, lustrous and slightly hairy along the midribs above and pale bluish green and covered below with short soft hairs, and at maturity thick, reticulate-venulose, dull yellow-green, smooth and glabrous on the upper surface, pale and slightly hairy on the lower surface on the stout rose colored midribs, and slender primary veins extending very obliquely to the apex of the leaf, 6–8 cm long and 4–4.5 cm wide; petioles stout, narrowly wing-margined sometimes to the base, slightly hairy on the upper side, often rose color in the autumn, 1.5–2 cm in length; leaves on vigorous shoots rather thicker, ovate or oval, more coarsely serrate, more deeply lobed, and sometimes 8–10 cm long and 5–6 cm wide. Flowers about 1.5 cm in diameter, on long slender drooping villose pedicels, in narrow compact many-flowered corymbs, the long lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, covered with long scattered pale hairs, the lobes long, wide, acute, laciniately glandular serrate, villose, reflexed after anthesis; stamens 20; anthers pale pink, styles 2 or 3, surrounded at the base by a narrow ring of pale tomentum. Fruit ripening the end of September, on stout slightly hairy erect reddish pedicels, in few-fruited clusters, short-oblong or slightly ovate, scarlet, lustrous, marked by small pale dots, 8–10 mm in diameter; calyx prominent, with a broad deep cavity, and elongated spreading persistent lobes slightly hairy and dark red on the upper side; flesh thin, dry and yellow, becoming soft and succulent; nutlets 2 or 3, rounded at the ends, or when 3 acute at the base, ridged on the back, with a low broad slightly grooved ridge, penetrated on the inner faces by shallow cavities, 6–6.5 mm long, and 4–4.5 mm wide.

A narrow shrub 3–4 m high, with small ashy gray stems, ascending branches, and stout slightly zigzag glabrous branchlets light orange-green and marked by pale lenticels when they first appear, becoming light chestnut-brown and very lustrous in their first season and light reddish-brown the following year, and armed with stout straight purplish shining spines 3.5–4 cm long and pointing toward the apex of the branch.

Roadside west of Honeoye lake, Ontario co., New York, H. T. Brown (※35, type), May 28 and October 16, 1906.

REMARKS AND OBSERVATIONS

Aster paniculatus bellidiflorus (Willd.) Burg.

A form answering well to the description of this subspecies was found growing plentifully near the railroad station at Cairo, Greene co. in September.

Carya glabra odorata Sargent

Specimens were collected near Dykemans, Putnam co. June. The leaflets are generally five and the lowest pair are generally much smaller than the pair above them. The fruit is subglobose with a thin husk.

Castanea dentata Borkh.

Fruiting specimens of the remarkable tree near Freehold, Greene co. known as the "burless chestnut" were obtained in September. The fruit at that time was quite small, but the nuts show the exposed manner of their development. The tree is mentioned in Sargent's *Silva of North America,* volume IX, page 14, footnote.

Clitopilus caespitosus Pk.

This rather rare and singular mushroom, has appeared in several localities this season and has shown a wider range of variation than formerly. The pileus varies from 1–4 inches broad and the lamellae from slightly rounded behind or subsinuate to slightly decurrent. The mode of growth is not always strictly cespitose for occasionally single specimens are found. The color of the spores is very similar to that of the spores of Tricholoma personatum Fr., T. nudum (Bull.) and T. sordidum Fr. but in the colors of the plant it is more closely related to Clitopilus noveboracensis Pk. another species with very pale pink spores.

Clitopilus conissans Pk.

This species was described from inadequate material collected in a dry time and showing the specific characters imperfectly. Undue weight was given to the red color of the spores and the plant was thereby referred to a genus with which it has but little affinity. Specimens observed and collected this season indicate that its true relationship is with Psilocybe on account of the entire absence of a veil and its general habit. Its characters place it near P. spadicea, but the plants also have a striking similarity to Hypholoma hydrophilum, but from both, the species is separated by the color of the lamellae and spores. A new description follows.

Psilocybe conissans n. comb.

Clitopilus conissans N. Y. State Mus. Rep't 41:64; 42:45

Pileus fleshy but thin, broadly convex becoming nearly plane, glabrous, hygrophanous, pale chestnut or watery ferruginous and striatulate on the margin when moist, pale alutaceous or pale buff and sometimes slightly rugose when dry, flesh whitish; lamellae thin, close, rounded behind, adnexed or rarely adnate, bay verging to dark purple or liver color; stem equal, rather slender, firm, glabrous, hollow, curved or flexuous, white, veil none; spores vinaceous, elliptic, .0003–.0004 of an inch long, .00016–.0002 broad, (8–10 μ long, 4–5 μ broad).

Cespitose on or about the base of deciduous trees. Catskill and Adirondack mountains, also at Gansevoort, Saratoga co. September and October. Cystidia occur sparingly on the lamellae.

Collybia lacunosa Pk.

In *New York State Museum Report* 26, page 51 this plant is described under the name Agaricus (Tricholoma) lacunosus. Its texture is too tough to permit its reference to the genus Tricholoma and it is here placed in the genus Collybia as a better place for it. It is a pretty little golden yellow mushroom inhabiting decaying wood. It is neither common nor plentiful.

Crataegus bissellii Sargent

A small shrub whose flowers have pale pink anthers soon fading to pale yellow or whitish was found near Staatsburg, Dutchess co. and referred to this species. A similar shrub but having flowers with bright red anthers occurs in North Greenbush, Rensselaer co. As the anthers of the flowers of C. bissellii are described as either pink or rose purple the North Greenbush shrub is also referred to this species.

Cypripedium arietinum R. Br.

Near Hague, Warren co. Mrs E. Watrous. This is a rare species in our State and it is becoming more scarce from year to year. It is therefore gratifying to add this new locality to those previously known. Mrs Watrous sends both flowering and fruiting specimens.

Erysimum cheiranthoides L.

A small form 6–10 inches tall with leaves scarcely more than one inch long was found growing about water holes in a pasture near Clayton, Jefferson co.

Geoglossum peckianum Cke.

Specimens of this rare species were found growing among hair cap mosses near Wading River, Suffolk co. August. A slender form of Geoglossum nigritum (Fr.) Cke. was found by S. H. Burnham growing among sphagnum in a marsh near Shushan.

Habenaria ciliaris (L.) R. Br.

This beautiful orchid still lingers near Karner in what appears formerly to have been a swamp hole. It was discovered there two years ago and was in fine flowering condition at that time, July 22. The past season it was in the same flowering condition August 18, illustrating strikingly the influence of the season in retarding the development of vegetation.

Hydnum septentrionale Fr.

The difference between the young plant and the mature one is very great, and to illustrate this difference a figure of each is given on plates 9 and 10 in *Icones Hymenomycetum*. A specimen of the young plant was found near Fine, St Lawrence co. growing on the trunk of a standing sugar maple. It corresponds beautifully with the Friesian figure.

Hypholoma sublateritium (Schaeff.) Fr.

This species has been unusually abundant the latter part of the season. It has, in those cases coming under my observation, shown a darker and more uniformly brownish red color of the cap than is shown in H. perplexum Pk. This, taken in connection with its stuffed stem, makes the separation of the two quite easy. Its flavor, however, is not always bitter, as is indicated by the descriptions of the European plant.

Morchella deliciosa Fr.

The name of the delicious morel implies that it is specially agreeable as an article of food. In confirmation of this I am pleased to make the following quotation from a letter received concerning it. "On two successive days this month, May 1907, I have collected on my lawn in Patterson, N. J. a double handful of Morchella deliciosa, had them cooked and have eaten them with the result that they were quite as palatable as the common mushroom." Unfortunately the species is not very common and, like other morels, its time of occurrence is limited to a short period early in the season.

Polyporus volvatus Pk.

This singular species of polyporus inhabits the trunks of various coniferous trees. It emerges from holes made in the bark by insect borers. While young, the pores, from which the spores drop, are concealed by a thin prolongation of the exterior coat of the pileus, which forms a continuous membrane beneath them. In due time the central part of this membrane opens in a circular aperture and reveals the mouths of the pores and the heaps of pinkish spores that have fallen from them and lodged on the inner surface of the membrane about the aperture. Small insects are often found inside the wrapper and apparently feeding on the spores. In some specimens of the polyporus received early in the season small holes were observed in the wrapper and insects were found in the cavity dusted with and evidently feeding on the spores, for there was no evidence of their having eaten or bored into the substance of the fungus. The appearance indicated that the borers had eaten one or two holes through the wrapper before its aperture had been formed and that they had thereby gained entrance to the storehouse of spores on which they were feeding. In the examples in which the insects were found within specimens with no small apertures in the wrapper it is clear that they gained entrance through the larger natural aperture. It is possible that one purpose of the visit of the insects is to deposit eggs within the fungus, for this species of polyporus is one specially liable to be quickly destroyed by insect larvae developing within. Here appears to be a peculiar case of mutual benefit between insect and fungus. The insect bores holes through the bark of the tree. Through these holes the spores of the fungus have access to the sapwood of the tree and through them also the mycelium of the fungus finds an exit to the external light and air where it forms the fruiting body and develops its spores. These in turn furnish food and a place for propagation to insects.

Salix serissima (Bail.) Fern.

A fine clump of this late willow was found growing in a wet place by the roadside near Fulton Chain, Herkimer co. This is the third station known for it in the Adirondack region.

Sphaeronema pruinosum Pk.

On the trunk of the low June berry, Amelanchier spicata (Lam.) Dec. Arnold clearing near Fulton Chain. June. This rare fungus was published in *New York State Museum Report* 24, page 85. 1872. Apparently the same species was published under the same name by Berkeley and Curtis in Grevillea 2:177. 1874.

EDIBLE FUNGI

Lycoperdon subincarnatum Pk.

PINKISH PUFFBALL

PLATE 114, FIG. 1–6.

Gregarious or cespitose; peridium 6–12 lines broad, globose or subglobose, sessile, the surface covered with small close subpyramidal granular or spiny warts which in the mature plant fall, leaving minute pits in the surface of the inner peridium, pinkish brown; capillitium and spores olivaceous; spores globose, .00016–.0002 of an inch broad.

The pinkish puffball is found in woods, growing on decaying wood, stumps, and prostrate trunks of trees and may be found from July to September. It is peculiar to this country. It rarely exceeds one inch in diameter and except when growing in dense clusters it is quite regularly globose and either sessile or with a very short sterile base. It is easily distinguished by its dull pinkish brown color and sessile peridium while immature, and by the grayish minutely pitted inner peridium of the mature or old plants. It is well to remove the exterior peridium before cooking. The texture is a little tough and the flesh is not highly flavored, but when fried in butter it is agreeable to the taste, digestible and harmless. No puffball should be eaten after its flesh has lost its white color.

Lycoperdon gemmatum Batsch

STUDDED PUFFBALL

PLATE 114, FIG. 7–15

Scattered, gregarious or cespitose; peridium 10–20 lines broad, globose, depressed globose or obovate, obtuse or umbonate, generally abruptly narrowed below into a more or less stemlike base, the surface covered with warts of unequal size, the larger ones solid, conic or pyramidal, bluntly pointed, early deciduous, intermingled with smaller granular and more persistent ones, where falling leaving small pale dotlike spots on the inner peridium, about which the smaller warts form rows of minute dots, white, whitish, grayish or brownish, the apex or umbo sometimes more highly colored than the rest, the old denuded peridium grayish, brownish or cinereous, often retaining the dotlike spots for a long time; capillitium and spores olivaceous; spores globose, .00016 of an inch broad.

The studded puffball grows on the ground and on decaying wood, in woods, groves and open places and may be found from June to October. It is a common and a very variable species. It is readily distinguished from all our other species by the peculiar character of its larger gemlike warts and the pale dots they leave on the inner peridium when they have fallen. The anastomosing rows of the smaller warts often give a reticulate appearance to the surface. The stemlike sterile base is sometimes cylindrical and nearly equal in diameter to the diameter of the peridium, sometimes it is much more narrow and again it may gradually taper downward. In some cases it is very short or wanting, in others it exceeds the peridium in length. In large specimens it may be coarsely pitted at the top or plicately grooved, the grooves often extending upward and forming plications on the base of the peridium. In some specimens both the grooves and pits occur. The larger warts are usually more numerous and conspicuous on the upper half of the peridium and are smaller and more scattered toward the base. Sometimes they are tipped with black or brown, and in some specimens they are more closely placed than in others.

The outer coat should be removed before cooking. In the raw state the taste is disagreeable, but cooking destroys this and makes a very palatable dish of this common puffball.

Clitocybe subcyathiformis n. sp.

SAUCER CLITOCYBE

PLATE 110, FIG. 1–6

Pileus fleshy but thin, broadly convex or nearly plane becoming centrally depressed, glabrous, hygrophanous, watery white when moist and often obscurely striatulate on the thin soon spreading margin, white when dry, sometimes slightly colored in the center, flesh white, taste mild; lamellae thin, moderately close, adnate or slightly decurrent, white or whitish; stem equal or slightly tapering upward, stuffed, fibrillose-reticulate, whitish, often with a whitish mycelioid tomentum at the base; spores elliptic, .00024–.0003 of an inch long, .00016–.0002 broad.

The saucer clitocybe is gregarious and grows among fallen leaves under alders and white birches, and occurs late in the season. Its cap is 1–2 inches broad; its stem 1–1.5 inches long and 2–4 lines thick. It is generally white throughout. In the character of the stem the species is related to the cup shaped clitocybe, C. cyathiformis Fr., but in its white color, in its thin quickly expanding margin, and closer gills it is more closely related to C. dealbata Sow. The central depression of the cap is partly due to the elevation of the thin margin. The upper surface of the cap is therefore concave or saucer shaped and does not become funnel form. The margin is sometimes wavy or irregular. The small size and rarity of the species detracts from its importance as an edible species, but its agreeable flavor and harmless character make it worthy of a place in our list of edible species.

Collybia dryophila (Bull.) Fr.

OAK LOVING COLLYBIA

PLATE III, FIG. 1–11

Pileus thin, convex or nearly plane, sometimes depressed in the center with the margin elevated and often wavy or irregular, glabrous, obtuse, variable in color, pale alutaceous, yellowish, dark tan or chestnut, flesh white; lamellae thin, close, narrow, rounded behind, slightly adnexed or nearly free, white or whitish, rarely tinged with yellow; stem equal, thickened toward the base or bulbous, glabrous, hollow, commonly colored like the pileus; spores elliptic, .00024–.0003 of an inch long, .00012–.00016 broad.

The oak loving collybia is one of our most common mushrooms. It occurs in woods, groves, open places and pastures and appears at any time from early spring to late autumn, when there is a sufficient degree of warmth and moisture. A favorite place of growth for it is among fallen pine leaves or under pine trees. It also grows on decaying wood. It may be solitary, gregarious or tufted. In dense tufts the caps are usually very irregular on account of mutual pressure. They are 1–3 inches broad, the stem 1–3 inches long and 1–3 lines thick. The flesh is slightly tough but agreeable to the taste and perfectly harmless.

Russula pusilla Pk.

SMALL RUSSULA

PLATE 110, FIG. 7–14

Pileus very thin, convex or nearly plane, sometimes slightly or umbilicately depressed in the center, glabrous, even or slightly striate on the margin, red, often darker in the center, flesh white, taste mild; lamellae broad, moderately close, subventricose, adnate or slightly rounded behind, white becoming yellowish ochraceous or ochraceous buff with age or in drying; stem stout, solid or spongy within, soft, white; spores globose, slightly tinged with yellow, .0003 of an inch broad.

The small russula is not common but it sometimes occurs in considerable quantity and may be found from July to October. In the typical form the cap is less than an inch broad and the stem less than an inch long, but in specimens sent me by an esteemed correspondent and enthusiastic mycologist, Mr E. B. Sterling, the caps range from 3 lines to 2 inches broad, but the stem is in no case more than an inch long. The color of the caps is dark red or crimson, usually darker or brownish in the center. The coloring matter is soluble in water. If the plants are washed in water, the water becomes red, if stewed in milk without previous washing the milk becomes red, but this does not detract from the flavor and edibility of the mushroom. The pellicle of the pileus is separable and when wet, appears to be viscid, but in the growing condition of the mushroom the viscidity is not apparent. The plants grow on the bare soil or among short grass under pine trees. Mr Sterling writes concerning them that they have been very abundant between October 2 and October 11 and that on the afternoon of the latter date under two pine trees he collected for the table 120 specimens. He says "I consider them without doubt the best of the Russula family for eating. They taste good raw and when fried in butter, flavored and served hot, are delicious." Through his kindness I have had the opportunity of testing the edibility of this rare little mushroom and have no hesitation in placing it in the list of our excellent edible species.

Crepidotus malachius B. & C.

SOFT SKINNED CREPIDOTUS

PLATE 112, FIG. 1–4

Pileus fleshy, thin on the margin, thicker at the base, reniform, orbicular, cuneate or flabellate, convex or nearly plane, sometimes depressed behind, sessile or with a very short inconspicuous white tomentose stem, glabrous or slightly tomentose at the base, hygrophanous, watery white or grayish white and striatulate on the thin margin when moist, white when dry, flesh white; lamellae thin, close, rounded behind, white or whitish becoming brownish ferruginous; spores globose, .00025–0003 of an inch broad.

The soft-skinned crepidotus is a common species and grows on damp decaying wood in woods or shaded places. Much decayed prostrate mossy trunks of trees constitute a favorite habitat for it. It may be scattered, gregarious or imbricated in its mode of growth. It occurs from June to September. The cap is 1–2.5 inches broad and is sessile, or if it has a stem this is so short that the cap appears from above to be sessile. In wet weather or after rain it has a water soaked appearance and slight shadowy striations on the margin. As the moisture escapes, the cap becomes a clearer white and the striations disappear. The moisture disappears from the thickest part of the cap first, the thinnest part last. The species may be separated from our other white and closely allied forms by its more glabrous cap and globose spores.

Stropharia bilamellata Pk.

DOUBLE GILLED STROPHARIA

PLATE 112, FIG. 5–10

Pileus fleshy, convex, becoming nearly plane in large plants, even, obtuse, glabrous, whitish or yellowish, flesh white; lamellae thin, close, adnate, purplish brown in the mature plant; stem commonly short, solid, sometimes hollow in large plants, white, annulate, the annulus thick, white, with lamellae on the upper surface; spores elliptic, .0004–.0005 of an inch long, 0002–.0003 broad.

The double gilled stropharia is a rare species of which the first specimens received were collected in California. A second collection, of which samples were received, was made in Washington, D. C., and a third which enabled me to test its edibility was received from Newark, Wayne co. where it was found growing in a cultivated field.

The species is well marked by the peculiar character of its collar. On the upper surface are miniature gills which radiate from the stem to the margin of the collar. These are narrow, white and uneven or dentate on the margin. They are sometimes stained by the spores, but these have probably fallen from the true gills above. In some instances the inner extremity of the false gills extends upward on the stem and appears to connect with the gills above. This peculiar character of the collar seems to be shown in Stropharia coronilla (Bull.) Fr. and forcibly suggests the thought that our plant is specifically the same as the European. The two correspond in several other characters and were there not several discrepancies between the American plant and the description of the European there could be no doubt of their specific unity. The following comparison shows the differences.

	AMERICAN	EUROPEAN
Pileus	white or yellowish	Tawny, ochraceous
Stem	solid or hollow, equal, or tapering upward	Stuffed, tapering downward
Collar	broad, white, gills on the upper surface	Narrow with radiating violaceous striae or upper surface sulcate plicate
Gills	without cystidia	With cystidia
Spores	10-12 μ x 6-8 μ	10 μ x 5 μ

On account of these differences it has seemed best to consider our plant distinct from the European, though it must be acknowledged that the similarity in the peculiar and unusual character of the gills almost outweighs the discrepancies between our plant and the descriptions of the European.

The cap is white or yellowish, glabrous, obtuse, the flesh is white and our plant, like the European, has a peculiar or radishlike odor. The mature gills are purplish brown with a white edge. The stem is commonly solid, but in large or old specimens it is sometimes clearly hollow. It is equal in diameter or tapering upward.

Boletus niveus Fr.

SNOWY BOLETUS

PLATE 113, FIG. 1–5

Pileus fleshy, convex, becoming broadly convex or nearly plane, glabrous, white or grayish white, flesh white; tubes nearly plane in the mass, becoming convex with age, depressed around the stem, their mouths minute, whitish when young, becoming brownish with age; stems long, rather slender, equal or tapering upward, solid, scurfy or appressed scaly, grayish; spores oblong-fusiform, .0005–.0008 of an inch long, .0002–.00024 broad.

The snowy boletus is so closely related to the scabrous stemmed boletus that it is treated as a variety of it in *Hymenomycetes Europeae*. But it has recently been raised again to specific rank. It differs from the scabrous stemmed boletus not only in the color of its cap but also in its smaller tube mouths and in the character of its stem which lacks the fibrous black or reddish points which so distinctly mark B. scaber. Sometimes the whitish cap becomes tinged with green or bluish green, specially on the margin. The species is rare, having been observed and collected by the writer twice only, and both times in one locality. It occurs in August and is gregarious in its mode of growth. Its cap is 2–4 inches broad, its stem 3–5 inches long and 3–6 lines thick. Its edible qualities are similar to those of the scabrous stemmed boletus.

NEW YORK SPECIES OF PHOLIOTA

Pholiota Fr.

The genus Pholiota belongs to the series Ochrosporae which is characterized by spores of an ochraceous or subferruginous color. It is not in all cases sharply limited from allied genera because of the varying character of some of its species. It corresponds in structure to Armillaria in the white spored series and Stropharia in the brown spored series. In the group Phaeotae of the terrestrial species the spores are brown enough to cause some difficulty in deciding whether a given species should be placed in Pholiota or Stropharia. The variability in the development of the veil may also cause some perplexity. Species in which the veil is but slightly developed and very fugacious are liable to be referred to the genus Flammula or Naucoria. In Pholiota ornella Pk. the remains of the slight veil are so conspicuously adherent to the margin of the pileus as to suggest a reference to the genus Hypholoma unless the spore color is carefully noted. The prominent characters of the genus are:

Hymenophorum continuous with the stem; lamellae attached to the stem; stem annulate.

Some of the species grow on the ground, but the greater number grow on dead or decaying wood.

KEY TO THE SPECIES

Plants terrestrial 1
Plants lignatile 12
Plants growing on or among mosses .... minima
1 Spores ferruginous 2
1 Spores fuscoferruginous 5
2 Pileus 2 inches or more broad .... caperata
2 Pileus less than 2 inches broad 3
3 Pileus hygrophanous .... rugosa
3 Pileus not hygrophanous 4
4 Pileus slightly striate on the margin .... filaris
4 Pileus even on the margin .... togularis
5 Pileus squamulose .... angustipes
5 Pileus glabrous 6
6 Pileus viscid when moist .... aggericola
6 Pileus not viscid 7
7 Pileus subochraceous 8
7 Pileus not subochraceous 9
8 Annulus persistent, lamellae very broad .... temnophylla
8 Annulus fugacious, lamellae narrow .... howeana
9 Stem solid .... johnsoniana
9 stem hollow 10
10 Pileus white, commonly rimose areolate .... vermiflua
10 Pileus not pure white, commonly even 11
11 Spores more than .0003 of an inch long .... praecox
11 Spores less than .0003 of an inch long .... duroides
12 Pileus and stem squamose or squamulose 13
12 Pileus alone squamose or squamulose 18
12 Pileus neither squamose nor squamulose 21
13 Pileus viscid when moist 14
13 Pileus not viscid 16
14 Pileus with red or purple hues when young .... ornella
14 Pileus with no red or purple hues 15
15 Pileus brown or yellowish brown .... albocrenulata
15 Pileus bright yellow .... adiposa
15 Pileus lemon yellow .... limonella
15 Pileus whitish with dense tawny erect scales .... squarrosoides
16 Pileus more than 1 inch broad 17
16 Pileus not more than 1 inch broad .... erinaceëlla
17 Pileus with squarrose tawny scales .... squarrosa
17 Pileus with superficial pale yellow scales .... flammans
18 Pileus viscid when moist .... comosa
18 Pileus not viscid 19
19 Annulus well developed, persistent .... spectabilis
19 Annulus slight, fugacious 20
20 Stem hollow .... curvipes
20 Stem solid .... luteofolia
21 Pileus dry .... lutea
21 Pileus hygrophanous 22

22 Pileus more than 2 inches broad....................................23
22 Pileus not more than 2 inches broad..............................24
23 Pileus when dry cinnamon or ferruginous..................cerasina
23 Pileus when dry yellow......................................acericola
24 Pileus viscid when moist..................................discolor
24 Pileus not viscid..25
25 Pileus yellow when dry.....................................autumnalis
25 Pileus tawny when dry......................................confragosa
25 Pileus whitish or yellowish buff when dry................marginella

TERRESTRIAL

Spores ferruginous

Pholiota minima Pk.

SMALLEST PHOLIOTA

Pileus membranous, hemispheric or campanulate, umbonate, glabrous, hygrophanous, brown and striatulate on the margin when moist, pale buff or yellowish white when dry; lamellae rather close subventricose, adnexed, ferruginous; stem slender, glabrous, solid, shining, similar to the pileus in color, annulus near the middle, slight, evanescent; spores elliptic, .0003 of an inch long, .0002 broad.

Pileus 2–4 lines broad; stem 8–12 lines long, .25 line thick.

Among hair cap mosses, Polytrichum. Catskill mountains. September. An extremely small species and a very rare one. It was discovered 20 years ago and has not been found since. It is separable from Pholiota mycenoides Fr. by its smaller size, paler color, umbonate pileus and solid stem. The umbonate pileus also separates it from P. pumila Fr.

Pholiota caperata (Pers.) Fr.

WRINKLED PHOLIOTA

State Mus. Rep't 54. p.182, pl.73, fig.1–5.

Pileus fleshy, firm, thin toward the margin, ovate becoming broadly campanulate or convex, obtuse, glabrous or often whitened in the center by whitish flocci or silky fibrils, generally more or less wrinkled, yellow, flesh white; lamellae moderately close, adnate, often uneven on the edge, whitish becoming ferruginous; stem equal, solid, stout, sometimes bulbous, glabrous or slightly floccose, white or whitish, the membranous annulus white, thick on the edge; spores subelliptic, .0005–.0006 of an inch long, .00025–.0003 broad.

Pileus 2–4 inches broad; stem 2–5 inches long, 5–10 lines thick.

Scattered or somewhat gregarious, in woods, mossy swamps and open places. July to October. Common. Edible.

This is a fine large pholiota easily recognized by its peculiar wrinkled pileus and the white pruinosity or floccose covering of the center of the pileus. Sometimes, however, specimens may occur in which neither the wrinkles nor the flocci are present. Occasionally there is the semblance of a volva at the base of the stem. The annulus is usually well developed, white and persistent.

Pholiota rugosa Pk.

RUGOSE PHOLIOTA

Pileus thin, broadly conic or campanulate becoming expanded and often umbonate, hygrophanous, yellowish red or ferruginous and striatulate on the margin when moist, pale yellow or buff and commonly rugose when dry; lamellae close, adnexed, minutely denticulate on the edge, yellowish white becoming ferruginous or brownish ferruginous, the interspaces venose; stem equal or slightly thickened toward the base, straight or flexuous, hollow, fibrillose or squamulose below the annulus, pruinose or mealy above, pallid, the annulus membranous, with radiating ridges or striations on the upper surface, white; spores .0004–.0005 of an inch long, .00024–.00028 broad.

Pileus 6–12 lines broad; stem 1–2 inches long, 1–2 lines thick.

Ground and among decaying chips. Adirondack region. September. The species is closely related to Pholiota togularis (Bull.) Fr. from which it is separated by the hygrophanous pileus, the adnexed lamellae and the peculiar striations of the annulus.

Pholiota filaris (Fr.) Pk.

THREAD STEM PHOLIOTA

Pileus submembranous, campanulate becoming broadly convex or nearly plane, obtuse, even, but slightly striate on the margin, ochraceous; lamellae thin, close, adnate, ventricose, yellow becoming pale ferruginous; stem filiform, flexuous, glabrous, pallid, the annulus well developed, distant, white; spores .0003 of an inch long, .0002 broad.

Pileus 4–6 lines broad; stem 1–2 inches long, scarcely half a line thick.

Woods and open places. Adirondack and Catskill mountains. August. This is closely related to the next following species, with which it was united as a variety by the illustrious Fries. It may be separated by its smaller size, and the slightly striate margin of the pileus.

Pholiota togularis (Bull.) Fr.

LITTLE CLOAK PHOLIOTA

Pileus thin, campanulate becoming nearly plane, orbicular, obtuse, glabrous, even, not striate on the margin, pale ochraceous; lamellae thin, close, adnate, ventricose, yellow becoming pale ferruginous; stem equal, hollow, slender, fibrillose, yellow at the top, brownish toward the base; spores .0003 of an inch long. 0002 broad.

Pileus 10–15 lines broad; stem 2–3 inches long, 1–2 lines thick.

Ground in woods. Adirondack mountains. August. This and the two preceding species may yet be found to be varieties of one very variable species. They are closely allied to each other but may be distinguished by the characters given.

Spores fusco-ferruginous

Pholiota angustipes Pk.

NARROW STEM PHOLIOTA

Pileus fleshy, hemispheric becoming convex or nearly plane, slightly viscid when moist, squamulose with minute dotlike appressed scales, brown or grayish brown becoming ochraceous brown or subalutaceous, flesh whitish, taste unpleasant; lamellae thin, close, sinuate, whitish or creamy yellow becoming tawny brown; stem equal or tapering downward, flexuous, stuffed or hollow, squamose, whitish or cinereous; spores naviculoid, .0003 of an inch long, .00016–.0002 broad.

Pileus 1–2.5 inches broad; stem 1.5–3 inches long, 2–3 lines thick.

Cespitose. In pastures, commonly near or around old stumps. Otsego and Albany counties. July to October.

This species is related to the European Pholiota terrigena Fr. and Pholiota punctulata Kalchb. but from both it differs in the darker color of the pileus and in its slight viscidity. By reason of its densely tufted mode of growth the caps are often closely crowded and irregular.

Pholiota aggericola Pk.

BROWN PHOLIOTA

Pileus fleshy, convex becoming nearly plane or slightly depressed in the center by the upcurving of the margin, glabrous, viscid when moist and slightly striatulate on the margin, brown or blackish brown, sometimes darker in the center; lamellae subdistant, sinuate, decurrent with a tooth, pallid or grayish becoming rusty brown; stem equal or slightly tapering upward, fibrous, solid, colored like or a little paler than the pileus, whitish above the membranous annulus; spores elliptic, .0004–.0005 of an inch long, .00024 broad.

Pileus 1–2 inches broad; stem 1.5–3 inches long, 2–4 lines thick.

Banks by roadsides and among fallen leaves in woods. Albany county and Adirondack mountains. July to October. The pileus sometimes fades to a rusty brown hue.

P. aggericola retirugis Pk. Pileus rugosely reticulated.

Pholiota indecens Pk. is probably not distinct from this species, it differing in its dry pileus. This possibly was due to its being collected in a dry time. It has been collected but once.

Pholiota temnophylla Pk.

CUT GILLED PHOLIOTA

Pileus fleshy, hemispheric becoming convex, smooth, ochraceous yellow; lamellae very broad, adnexed, obliquely truncate at the inner extremity, brownish ferruginous; stem equal, glabrous, hollow, white, the annulus well developed, membranous, white; spores brownish ferruginous, broadly elliptic, .0004–.0005 of an inch long, .0003–.00035 broad.

Pileus 1–2 inches broad; stem 2–4 inches long, 2–4 lines thick.

Grassy ground by roadsides. Rensselaer county. June.

In color this species resembles Naucoria semiorbicularis (Bull.) Fr. but its annulus at once separates it from that. It also approaches Pholiota praecox (Pers.) Fr. in some respects, but its large size and peculiar broad lamellae are distinguishing characters. It has been found but once.

Pholiota howeana Pk.

HOWE PHOLIOTA

Pileus convex becoming nearly plane, fragile, smooth, subumbonate, yellowish, sometimes darker in the center; lamellae thin, close, rounded behind, eroded on the edge, whitish becoming ferruginous brown; stem equal or slightly thickened at the base, glabrous, hollow, colored like the pileus; spores .0003–.0004 of an inch long, .0002–.00024 broad.

Pileus 1–3 inches broad; stem 2–4 inches long, 2–4 lines thick.

Ground in woods and bushy places. Adirondack mountains, Albany and Sullivan counties. June, July and August. This species was formerly referred doubtfully to the genus Stropharia, but it now seems better to put it in Pholiota.

Pholiota johnsoniana Pk.

JOHNSON PHOLIOTA

Pileus fleshy, soft, brittle, broadly convex or nearly plane, glabrous, thin on the margin and sometimes striatulate when moist, yellowish in the center, whitish on the margin, sometimes wholly yellowish, flesh white, flavor agreeable; lamellae thin, close, rounded behind, slightly adnexed, whitish becoming rusty brown; stem equal, glabrous, solid, slightly striate at the top, the annulus thick, white; spores brown with a slight ferruginous tint, .00024–.0003 of an inch long, .00016–.0002 broad.

Pileus 2–4 inches broad; stem 1.5–3 inches long, 3–5 lines thick.

Grassy ground in pastures. Not common. Albany and Essex counties. September.

The spores of this species have such a decidedly brown hue that the species was thought to belong to the genus Stropharia. But in a good light a slight rusty tint can be detected. It is therefore placed with the brownish ferruginous spored species of Pholiota.

Pholiota vermiflua Pk.

WORMY PHOLIOTA

State Mus. Bul. 75. p.32, pl.86, fig.12–20.

Pileus convex or nearly plane, glabrous or sometimes floccose on the margin, commonly rimose areolate, specially in the center, white, sometimes slightly tinged with yellow, flesh white; lamellae close, adnexed, white becoming ferruginous brown, generally minutely eroded on the edge; stem equal, hollow, striate at the top, white, the white annulus more or less floccose on the lower surface, lacerated, often evanescent; spores .0005 of an inch long, .0003 broad.

Pileus 2–4 inches broad; stem 2–3 inches long, 3–5 lines thick.

Rich soil in grain fields, waste places and about manure heaps. Albany, Essex and Monroe counties. June, July and August. Edible.

From the early pholiota, to which it is related, it may be separated by its larger size, thicker flesh, stouter stem, whiter color and by the greater tendency of the surface of the pileus to crack into areas.

Pholiota praecox (Pers.) Fr.

EARLY PHOLIOTA

State Mus. Mem. 4. p.159, pl.57, fig.1–5.

Pileus convex or nearly plane, soft, glabrous, whitish, often tinged with yellow or tan color, flesh white; lamellae thin, close, adnexed, whitish becoming brownish or rusty brown; stem slender, equal, glabrous or slightly mealy when young, stuffed or hollow, whitish, the annulus white, entire, sometimes fugacious; spores .0004–.0005 of an inch long, .00024–.0003 broad.

Pileus 1–2 inches broad; stem 1.5–3 inches long, 2–2.5 lines thick.

Grassy ground, lawns, etc. Common. May to July. Edible.

Pholiota praecox minor (Batt.) Pileus scarcely more than 1 inch broad, its margin appendiculate with the remains of the veil, annulus generally wanting. Grassy places. State Mus. Mem. 4, p. 160, pl.57, fig. 6–8.

Pholiota praecox sylvestris Pk. Pileus convex, glabrous, whitish, brown or rusty brown in the center. In thin woods. State Mus. Mem. 4, p. 160, pl. 57, fig. 9–11.

Pholiota duroides n. sp.

HARDISH PHOLIOTA

Pileus thin, convex becoming nearly plane, glabrous or slightly rimose squamose in the center, varying in color from creamy white to ochraceous buff either wholly or in the center only, flesh white, taste mild; lamellae thin, close, narrow, adnexed, sometimes broadly sinuate and having a decurrent tooth, whitish becoming brown or rusty brown; stem equal or nearly so, stuffed or hollow, glabrous, whitish, the annulus thick and cottony, often lacerated and evanescent, white; spores broadly elliptic, .00024–.00028 of an inch long, .00016–.0002 broad.

Pileus 1–2 inches broad; stem 1–2 inches long, 2–4 lines thick.

Rocky ground near Syracuse. August and September. G. E. Morris, who has found it both in the locality given and in Massachusetts.

It is similar to Pholiota dura (Bolt.) Fr. but may be separated from it by its different colors, softer substance and specially by its smaller spores. These are more brown than the spores of Pholiota praecox Pers. and make it doubtful whether the species would not better be placed in the genus Stropharia.

LIGNATILE

Pileus viscid or dry, not hygrophanous

Pholiota albocrenulata Pk.

CRENULATE PHOLIOTA

Pileus fleshy, firm, convex or campanulate, obtuse or umbonate, viscid, squamose, yellowish brown, the scales brown or blackish, floccose, easily separable; lamellae broad, subdistant, sinuate, white crenulate on the edge, grayish becoming ferruginous; stem firm, equal or slightly tapering upward, stuffed or hollow, squamose, pallid or brownish below the slight fugacious annulus, white and furfuraceous above; spores subelliptic, pointed at the ends, .0004–.0005 of an inch long, .00024–.0003 broad.

Pileus 1–3 inches broad; stem 2–4 inches long, 2–5 lines thick.

Base of trees or on prostrate trunks and decaying wood, specially of sugar maple, Acer saccharum L. Essex and Otsego counties. July and August.

This species is rare and somewhat variable. It is never abundant and often solitary in its mode of growth. The scales of the pileus sometimes disappear leaving the surface of the cap mottled with brown spots. Under a lens the edge of the lamellae appear as if beaded with minute white globules. The margin of the pileus is sometimes adorned by the adhering fragments of the veil.

Pholiota adiposa Fr.

FAT PHOLIOTA

State Mus. Mem. 4. p. 160, pl. 57, fig. 12–17.

Pileus fleshy, firm, hemispheric or broadly conic becoming convex, viscid or glutinous, squamose, yellow, flesh whitish; lamellae close, adnate, yellow or yellowish becoming ferruginous; stem equal or slightly thickened at the base, solid or stuffed, squamose, yellow or sometimes reddish or tawny toward the base, the annulus slight, floccose, fugacious; spores elliptic, .0003 of an inch long, .0002 broad.

Pileus 1–4 inches broad; stem 2–4 inches long, 3–6 lines thick.

Single or cespitose. Stumps and dead trunks of trees in or near woods. Not rare. September to November. Edible.

The scales of the pileus are easily separable and sometimes disappear with age. They are generally more highly colored than the pileus. The annulus is often absent in mature specimens and by no means conspicuous in young ones.

Pholiota limonella Pk.

LEMON COLORED PHOLIOTA

Pileus thin, convex or nearly plane, sometimes umbonate, viscid, squamose, lemon yellow; lamellae narrow, close, rounded behind, adnexed, whitish becoming ferruginous; stem equal, solid, squamose with recurved scales, smooth above the lacerated annulus, colored like or a little paler than the pileus; spores elliptic, .0003–.00035 of an inch long, .0002–.00024 broad.

Pileus 1–2 inches broad; stem 1.5–2.5 inches long, 2–3 lines thick.

Cespitose. Prostrate trunks of beech, Fagus americana Sweet, in woods. Delaware county. September. This is a very beautiful species of pholiota, but it is as rare as it is beautiful. It has been found but once. It is easily distinguished from its allies by its bright lemon yellow color.

Pholiota squarrosoides Pk.

SHARP SCALE PHOLIOTA

State Mus. Mem. 54. p. 183, pl. 73, fig. 6–15.

Pileus fleshy, firm, subglobose when young, then convex, viscid, squamose, the scales terete, erect, pointed, tawny, densely crowded in the center, scattered toward the margin, there revealing the whitish color of the pileus, flesh white; lamellae close, sinuate, whitish becoming brownish ferruginous; stem equal, firm, solid or stuffed, rough with numerous recurved tawny scales below the floccose or lacerated annulus, smooth and white above; spores elliptic, .0002 of an inch long, .00016 broad.

Pileus 1–4 inches broad; stem 2–4 inches long, 3–5 lines thick.

Single or cespitose. Old stumps and prostrate trunks of deciduous trees. Edible. Of excellent flavor.

P. squarrosoides faginea Pk. Plant smaller than in the type and scales more scattered. On dead trunks of beech, Fagus americana Sweet.

The sharp scale pholiota may be distinguished from Pholiota squarrosa Müll. by its viscid pileus, its compact, erect, pointed scales, its sinuate lamellae and its smaller brownish ferruginous spores.

Pholiota ornella Pk.

ORNATE PHOLIOTA

Agaricus (Hypholoma) ornellus Pk. State Mus. Rep't 34. p. 42.
Pholiota appendiculata Pk. State Mus. Bul. 94. p.33, pl. P, fig.8–17.

Pileus fleshy, firm, convex or nearly plane, viscid when moist, shining, squamose with appressed spotlike scales, appendiculate with fragments of the veil, dark red when young, soon fading to pink, finally becoming yellowish brown or grayish brown, flesh at first purplish red, specially in the lower part, whitish or pale yellow when mature; lamellae thin, close, rounded behind, adnexed or decurrent with a tooth, pale yellow or almost white becoming brownish ferruginous; stem short, firm, solid or with a small cavity, white above, brownish and squamose below the slight fugacious annulus, white within, the veil white or pale yellow, at first concealing the young lamellae, soon breaking into fragments and adhering partly to the margin of the pileus and partly to the stem; spores .00024–.0003 of an inch long, 00016–.0002 broad.

Pileus 1–3 inches broad; stem 1–1.5 inches long, 2–4 lines thick.

Single or in tufts. Decaying wood and sawdust. Adirondack region, Saratoga and Tompkins counties. July to October.

This is a rare species with us and a very perplexing one. The annulus in its best development consists of a mere circle of scales around the upper part of the stem. The greater part of the veil usually adheres to the margin of the pileus. The species has some characters suggestive of Flammula polychroa Berk. from which, however, it may be separated by its squamose pileus without any umbo, its more fully developed and white or yellowish veil and its differently colored and adnexed lamellae. From the appendiculate margin it was referred to the genus Hypholoma. Specimens collected later and having a better developed annulus were described as a Pholiota. The viscid pileus with its spotlike scales and appendiculate margin and red, pink or purplish hues, fading with age to grayish brown or yellow brown, are characteristic of the species.

Pholiota erinaceëlla Pk.

BRISTLY PHOLIOTA

Agaricus detersibilis Pk. State Mus. Rep't 28. Bot. ed. p. 49.

Pileus thin, hemispheric or convex, dry, densely coated with small erect separable pyramidal or spinelike scales, tawny brown; lamellae broad, close, adnexed, pallid becoming cinnamon brown; stem equal, stuffed or hollow, densely squamulose below the slight annulus, often curved, colored like the pileus; spores naviculoid, .0003–.00035 of an inch long, .00016–.0002 broad.

Pileus 6–12 lines broad; stem 6–12 lines long, 1 line thick.

Dead and decaying trunks of deciduous trees in woods. Adirondack mountains, Schoharie and Oneida counties. June to September.

The small soft crowded scales of the pileus, which are easily rubbed away, constitute a prominent character of this species. The annulus is little more than the abrupt termination of the scaly coating of the stem. The name under which the species was first described was found to be preoccupied. This made it necessary to give it another name, and the one here given was chosen.

Pholiota squarrosa Müll.

SCALY PHOLIOTA

Pileus fleshy, firm, broadly conic becoming convex or nearly plane, dry, covered wih tawny squarrose scales, yellowish or yellowish brown; lamellae narrow, close, adnate or slightly decurrent, pallid becoming ferruginous; stem equal or nearly so, often flexuous, solid or stuffed, adorned with recurved scales, pallid or tawny brown; spores .0003 of an inch long, .00016 broad.

Pileus 1–3 inches broad; stem 3–5 inches long, 3–5 lines thick.

Prostrate trunks of trees in woods. Adirondack mountains and Rensselaer county. August.

A variable and showy species growing chiefly in dense tufts. The scales of the pileus give it a very rough appearance, specially in the young plant.

Pholiota flammans Fr.

YELLOW SCALE PHOLIOTA

Pileus fleshy, thin, convex becoming nearly plane, dry, sometimes umbonate, yellow or tawny yellow, adorned with paler yellow superficial scales, flesh yellowish; lamellae thin, close, rounded behind, adnexed, yellow becoming ferruginous; stem equal, straight or flexuous, squamulose, stuffed or hollow, yellow; spores minute, elliptic, .00016–.0002 of an inch long, .00012–.00015 broad.

Pileus 1–2 inches broad; stem 2–3 inches long, 2–3 lines thick.

Decaying wood and prostrate trunks of trees in woods. Adirondack mountains. August and September.

The yellow scale pholiota is one of our most beautiful species. Its deep yellow or tawny pileus adorned with the paler sulfur colored delicate scales is an attractive sight. The plants grow singly or in tufts.

Pholiota comosa Fr.

HAIRY PHOLIOTA

Pileus fleshy, firm, convex, obtuse, viscid, squamose with hairy or floccose superficial separable white scales, tawny, flesh compact, white; lamellae broad, slightly decurrent, white becoming brownish clay color; stem somewhat bulbous at first, becoming elongated with age, often curved, solid, fibrillose, whitish, the annulus floccose, soon disappearing; spores brownish ferruginous, elliptic, .0003–.0004 of an inch long, .0002–.00024 broad.

Pileus 3–4 inches broad; stem 2–4 inches long, 6–12 lines thick.

Decaying wood of deciduous trees. Monroe county.

The hairy pholiota is a rare species in our State. The locality given is the only one in which the species has been found in our limits. It is doubtful if the variety alba Pk. [*State Mus. Rep't* 38, p. 86] belongs to it. It neither agrees in color nor in the size of the spores with the typical form. The specimen from Pittsford, Monroe co. is paler than the European plant but in other respects it shows the specific characters. The bulbous base of the stem is a prominent and peculiar character, tapering gradually into the stem above and having an abrupt short radicating point below.

Pholiota spectabilis Fr.

ORANGE PHOLIOTA. SHOWY PHOLIOTA

Pileus fleshy, compact, convex becoming nearly plane, dry, the cuticle rupturing and forming silky or fibrillose scales, yellow or tawny orange, flesh pale yellow, taste bitter; lamellae close, narrow, adnate or slightly decurrent, yellow becoming ferruginous; stem ventricose or slightly thickened downward, solid, slightly radicating, peronate, mealy above the annulus, fibrillose toward the base; spores elliptic, .0008–.0009 of an inch long, .0002–.00024 broad.

Pileus 2–4 inches broad; stem 2–4 inches long, 6–10 lines thick.

Single or cespitose. Decaying wood and stumps. Queens county. Very rare.

Pholiota curvipes Fr.

CURVE STEM PHOLIOTA

Pileus fleshy but thin, convex becoming nearly plane, obtuse, dry squamulose with minute appressed floccose scales, tawny yellow; lamellae thin, close, adnate, yellow becoming tawny; stem equal or rarely thickened at the base, slender, commonly curved, stuffed or hollow, fibrillose with a slight radiately floccose annulus, yellow; spores naviculoid, .0003–.0004 of an inch long, .0002–.00024 broad.

Pileus 10–18 lines broad; stem about 1 inch long, 1–2 lines thick.

Decaying wood. Adirondack region and Oneida county. July to September.

Our specimens vary in the color of the stem, it being in some cases ferruginous toward the base. The spores also are a little larger than the dimensions given in *Sylloge,* but the general agreement with the characters of the species is so good that it does not seem best to separate our plant.

Pholiota luteofolia Pk.

YELLOW GILLED PHOLIOTA

Pileus fleshy, firm, convex, dry, squamulose, fibrillose on the margin, pale red or yellowish; lamellae broad, subdistant, sinuate, serrate on the edge, yellow becoming bright ferruginous; stem firm, fibrillose, solid, often curved from its place of growth, annulus slight, fugacious; spores bright ferruginous, .00028 of an inch long, .00016 broad.

Pileus 1–2 inches broad; stem 1–2.5 inches long, 3–5 lines thick.

Subcespitose. Dead trunks of birch trees, Betula lutea Mx. Sullivan county. September. The reddish color of the pileus often fades with age. The species is rare and has not been collected recently. In some of its characters it shows a close relationship to Pholiota tuberculosa Fr. from which it may be separated by the absence of a bulbous base to the stem.

Pholiota lutea Pk.

YELLOW PHOLIOTA

Pileus fleshy, firm, convex, dry, slightly silky and sometimes minutely floccose squamulose in the center, buff yellow, often a little darker in the center, the thin incurved margin slightly surpassing the lamellae, flesh pale yellow, odor pleasant, taste bitter; lamellae thin, close, rounded behind, adnexed, pale yellow becoming dark ferruginous; stem firm, solid, thickened at the base, fibrillose, colored like the pileus, the annulus superior, slight, fugacious; spores ferruginous, .0003 of an inch long, .0002 broad.

Pileus 2–4 inches broad; stem 2–3 inches long, 3–5 lines thick.

Decaying wood and trunks of trees in woods. Essex county. August.

Pileus hygrophanous

Pholiota cerasina Pk.

CHERRY PHOLIOTA

Pileus fleshy, firm, broadly convex, glabrous, hygrophanous, cinnamon color when moist, yellow when dry, odor amygdaline, flesh yellow; lamellae close, sinuate, yellow becoming cinnamon or ferruginous; stem equal, solid, sometimes curved, furfuraceous above the annulus, which is slight and fugacious; spores elliptic, minutely rough, .0003 of an inch long, .0002 broad.

Pileus 2–4 inches broad; stem 2–4 inches long, 2–4 lines thick.

Commonly cespitose. Old prostrate trunks of trees in woods. Cayuga county. August.

A rare species. The amygdaline or cherry odor suggests the specific name.

Pholiota acericola Pk.

MAPLE PHOLIOTA

Pileus fleshy but thin, broadly convex or nearly plane, glabrous, often rugosely reticulate or corrugated, hygrophanous, yellow or sometimes smoky yellow with the center or umbo brownish; lamellae close, sinuate, commonly longitudinally wrinkled when dry, grayish becoming brownish ferruginous; stem equal or thickened at the base, hollow, fibrillose striate, white or whitish with a large membranous, persistent, deflexed, white annulus; spores elliptic, .00035 of an inch long, .00024 broad.

Pileus 1–3 inches broad; stem 2–4 inches long, 3–5 lines thick.

Mossy trunks of maple trees in woods. Essex, Lewis, Otsego and Schoharie counties. July to September.

This species may be easily recognized by its well developed annulus, its rugosely reticulate or pitted pileus and the rugosely wrinkled lamellae of the dried plant. The reticulations of the surface of the pileus usually disappear in drying. When growing in much decayed wood white strings of mycelium develop in the wood.

Pholiota discolor Pk.

FADING PHOLIOTA

Pileus thin, convex becoming nearly plane or slightly depressed, glabrous, viscid, hygrophanous, cinnamon rufous and striatulate on the margin when moist, bright ochraceous yellow when dry; lamellae narrow, close, pallid or whitish becoming ferruginous; stem equal, hollow, fibrillose, whitish or pallid, sometimes with a white mycelioid tomentum at the base, the annulus distinct, persistent; spores elliptic, .0003 of an inch long, .0002 broad.

Pileus 8–16 lines broad; stem 1.5–3 inches long, about 1 line thick.

Single or cespitose. Decaying wood and prostrate trunks of trees in woods. Not rare. July to October.

The change of color from the moist to the dry state is well marked. The color of the pileus is similar to that of the next following species but the viscid pileus separates it. Pholiota discolor caespitosa Pk. is a mere form, unworthy of being considered a variety.

Pholiota autumnalis Pk.

AUTUMN PHOLIOTA

Agaricus (Naucoria) autumnalis Pk. State Cab. Rep't 23. p. 92.

Pileus fleshy but thin, convex, hygrophanous, cinnamon rufous and striatulate on the margin when moist, dingy yellow when dry;

lamellae thin, close, slightly sinuate, adnate or slightly decurrent, yellowish becoming subferruginous; stem slender, equal, hollow, fibrillose, colored like but paler than the pileus or sometimes brownish toward the base; spores .0003–.0004 of an inch long, .0002–.00024 broad.

Pileus 6–16 lines broad; stem 1–2 inches long, 1–2 lines thick.

Single or cespitose. Decaying wood in woods. Albany, Rensselaer and Essex counties. September to November. The annulus is sometimes but slightly developed, and such specimens are liable to be mistakenly referred to the genus Naucoria.

Pholiota confragosa Fr.

ROUGH PHOLIOTA

Pileus fleshy but thin; convex becoming nearly plane, fragile, obtuse, floccose squamulose becoming naked, hygrophanous, cinnamon rufous and striate on the margin when moist, tawny when dry; lamellae thin, close, adnate, very narrow, rufous; stem equal, hollow, fibrillose below the spreading membranous annulus, striate above, pallid or pale ferruginous; spores .00028–.0003 of an inch long, .0002–.00024 broad.

Pileus 1–2 inches broad; stem 1–2.5 inches long, 2–3 lines thick.

Single or cespitose. Decaying wood and prostrate mossy trunks in woods. Adirondack mountains. September.

The scales of the pileus are generally so minute that they are easily overlooked. The whole plant is nearly of one color. It is quite fragile and should be handled carefully. The dimensions of the spores are taken from the American plant, as the publications of the European authors do not agree in respect to this character.

Pholiota marginella Pk.

SLIGHTLY MARGINED PHOLIOTA

Pileus fleshy, convex becoming nearly plane, glabrous, hygrophanous, yellowish red or subferruginous and usually striatulate on the margin when young or moist, whitish or yellowish buff when dry, the young margin slightly silky with whitish fibrils; lamellae thin, close, adnexed, minutely eroded on the edge, whitish becoming dark ferruginous; stem equal or nearly so, flexuous, fibrillose below the slight fugacious annulus, mealy or pruinose above, stuffed or hollow, whitish or pallid, sometimes with a white myceloid tomentum at the base; spores elliptic, .00024–.0003 of an inch long, .00016–.0002 broad.

Pileus 1–2 inches broad; stem 2–4 inches long, 2–4 lines thick.

Single or cespitose. Decaying wood. Essex county. June. Found but once. The species is apparently related to Pholiota marginata (Batsch) from which it may be distinguished by its even fibrillose margin, adnexed lamellae and paler uniformly colored stem. In drying, the moisture, as usual in hygrophanous species, first disappears from the center of the pileus.

LATIN DESCRIPTIONS OF NEW SPECIES OF PLANTS

Crataegus verrucalis

Frutex vel arbor parva, 2–4 m alta, trunci diametro 2.5–5 cm; ramis longis, tenuibus, divergentibus, erectisve, trunci ramorumque magnorum cortice verrucoso, spinis leviter curvatis rectisve, castaneis, nitidis, 2.5–4 cm long.

Folia ovata vel subovata, acuta acuminatave, basi rotundata vel cuneata, pullulantia tincta fusco-rubro et superiore pubescentia, matura flava-viridia, nitida, glabra, 4–4.5 cm long. 2.5–3 cm lat., in ramis robustis late ovata vel suborbiculata, basi rotundata.

Flores 4–10 in quoque corymbo, 1.2–1.4 cm lat. pediculis leviter villosis, calycis lobis extus glabris, intus hirtellis, staminibus 5–10, antheris rubris, stylis 2–4, plerumque 3.

Poma subglobosa ovaliave, 1–1.2 cm long. 8–10 mm lat., vivida rubra, persistentiora, seminibus plerumque 3, 6.5–7 mm long. 3.5–4 lat.

In locis montanis.

Clitocybe subcyathiformis

Pileo carnoso, tenui, late convexo, demum subplano vel centro depresso, glabro, hygrophano, madido albido striatulatoque margine, sicco albo vel centro leviter flavido, carne alba, sapore miti; lamellis tenuibus, subconfertis, adnato-decurrentibus, albidis; stipite subaequale, farcto, fibrilloso-reticulato, albido, saepe basi albo tomentoso; sporis ellipsoideis, 6–8 x 4–5 μ.

Pileus 2.5–5 cm lat.; stipes 2.5–4 cm long., 4–8 mm. lat.

In locis humidis sub alnis betulisque.

Hygrophorus coloratus

Pileo carnoso, convexo subplanove, saepe umbonato, levi, viscoso, luteo, aurantiaco vel cinnabarino, carne alba, sub pellicula flava; lamellis inaequalibus, distantibus, arcuatis, adnato-decurrentibus, albis flavescentibusve; stipite aequale, subinde deorsum incrassato, glutinoso, farcto cavove, albo vel leviter flavo, in juventute subinde velo floccoso ad apicem; sporis 8–10 x 5–6 μ.

Pileus 2.5–6.5 cm lat.; stipes 5–7.5 cm long., 4–8 mm lat.

In locis humidis sub arboribus laricinis abietinisque.

Clitopilus subplanus

Pileo tenui, late convexo, demum subplano, centro leviter depresso aut distincte umbilicato, glabro, albido, carne alba; lamellis tenuibus, confertis, adnato-decurrentibus, sordide incarnatis; stipite tenui, glabro, tereti compressove, farcto, demum cavo, albido; sporis incarnatis, angulosis, uninucleatis, 10–12 x 6–8 μ.

Pileus 2.5–4 cm lat.; stipes 2.5–4 cm long., 2–4 mm lat.

Inter folia putrescentia in silvis.

Nolanea suaveolens

Pileo submembrano, convexo, umbilicato, obscure fibrilloso impolitove, margine indistincte striato, fumoso; lamellis tenuibus, inaequalibus, confertis, adnatis, albidis, demum sordide rosaceis; stipite tenue, glabro, cavo, fusco; sporis angulosis, uninucleatis, 10–12 x 6–8 μ.

Pileus 1.5–4 cm lat.; stipes 3–5 cm long., 1 mm lat.

In silvis. Specimina exsiccata odorem gratum, Lactarii glyciosmi et L. camphorati illum simulantem emittunt.

Pholiota duroides

Pileo tenui, convexo, demum subplano, glabro, subinde centro leviter rimoso-squamoso, ex albo ochraceoluteo; carne alba, sapore miti; lamellis tenuibus, confertis, angustis, adnexis, subinde late sinuatis et dente decurrentibus, albidis, demum fusco-ferrugineis; stipite aequale, farcto cavove, glabro, albido, annulo crasso, lanuginoso, saepe lacerato evanescenteque, albo; sporis late ellipticis, 6–8 x 4–5 μ.

Pileus 2.5–5 cm lat.; stipes 2.5–5 cm long., 4–8 mm lat.

In silvis. E Pholiota dura (Bolt.) Fr. in colore, carne molliore sporisque minoribus differit. Inter Pholiotam et Strophariam ambigua.

Flammula pulchrifolia

Pileo carneo, tenui, hemisphaerico, deinde convexo, viscidulo, hygrophano, fibrilloso, subinde centro squamuloso, margine fibrilloso, rosaceo, subinde pallido; carne alba, amara; lamellis tenuibus, confertis, adnatis, subinde leviter sinuatis, albidis, mox nitide luteis vel fulvo-ochraceis; stipite aequale, farcto cavove, pallido, saepe basi flavo, apice fibrilloso e velo; sporis in strato tenui fulvo-ochraceis, in strato crasso ochraceo-luteis, 7.5–8 x 5–6 μ.

Pileus 2.5–5 cm lat.; stipes 2.5–4 cm long., 3–4 mm lat.

Ad lignum Tsugae canadensis Carr.

Clavaria ornatipes

Gregaria, 2.5–5 cm alta, sparse ramosa; stipite gracile, hirsuto, fusco; ramulis paucis, irregularibus, teretibus, albidis griseis vel cinereis, acutis obtusisve; sporis late ellipticis vel subglobosis, 8–11 x 6–8 μ.

Inter muscos in locis humidis silvarum.

Clavaria trichopus Pers. *New York State Museum Report* 24, page 82. Noster fungus est distinctus in colore, habitate paucitateque ramorum.

Myxosporium necans

Acervuli in lineis longis sub epidermide nidulantes, erumpentes, intus albidi; conidiis oblongo-ellipticis in massas albas cirrosve flavido-albos expulsis, saepe binucleatis, 6–10 x 2–3 μ.

In cortice Pruni virginianae L. vivae. Fungus fruticem mox necat.

EXPLANATION OF PLATES

PLATE 110

Clitocybe subcyathiformis Pk.

Saucer Clitocybe

1 Immature plant with moist pileus
2 Immature plant with dry pileus
3 Mature plant with center of pileus slightly colored
4 Two mature plants united at the base
5 Vertical section of the upper part of a mature plant
6 Four spores, x 400

Russula pusilla Pk.

Small Russula

7, 8 Two immature plants showing the upper surface of the pileus
9, 10 Two larger immature plants showing color of the lamellae
11 Large mature plant showing color of the lamellae
12 Vertical section of an immature plant
13 Vertical section of a mature plant
14 Four spores, x 400

Fig. 1-6.
CLITOCYBE SUBCYATHIFORMIS Pk.
SAUCER CLITOCYBE

Fig. 7-14.
RUSSULA PUSILLA Pk.
SMALL RUSSULA

PLATE III

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Collybia dryophila (Bull.) Fr.

OAK LOVING COLLYBIA

1 Immature plant
2 Cluster of three plants, two of them immature
3, 4 Two plants with the pileus more highly colored
5 Mature plant with the pileus fully expanded
6 Immature plant with pileus highly colored and stem bulbous
7 Mature plant with pileus highly colored and stem bulbous
8 Vertical section of the upper part of an immature plant
9 Vertical section of the upper part of a mature plant with expanded pileus
10 Transverse section of a stem
11 Four spores, x 400

COLLYBIA DRYOPHILA (BULL.) FR.

OAK LOVING COLLYBIA

PLATE 112

Crepidotus malachius B. & C.

SOFT SKINNED CREPIDOTUS

1 Mature plant showing the upper surface of the pileus
2 Mature plant showing the lower surface of the pileus
3 Vertical section of a mature plant
4 Four spores, x 400

Stropharia bilamellata Pk.

DOUBLE GILLED STROPHARIA

5 Immature plant with pileus convex
6 Mature plant with pileus expanded
7 Vertical section of the upper part of an immature plant
8 Vertical section of the upper part of a mature plant
9 Transverse section of a stem
10 Four spores, x 400

FIG. 1-4.
CREPIDOTUS MALACHIUS B. & C.
SOFT SKINNED CREPIDOTUS

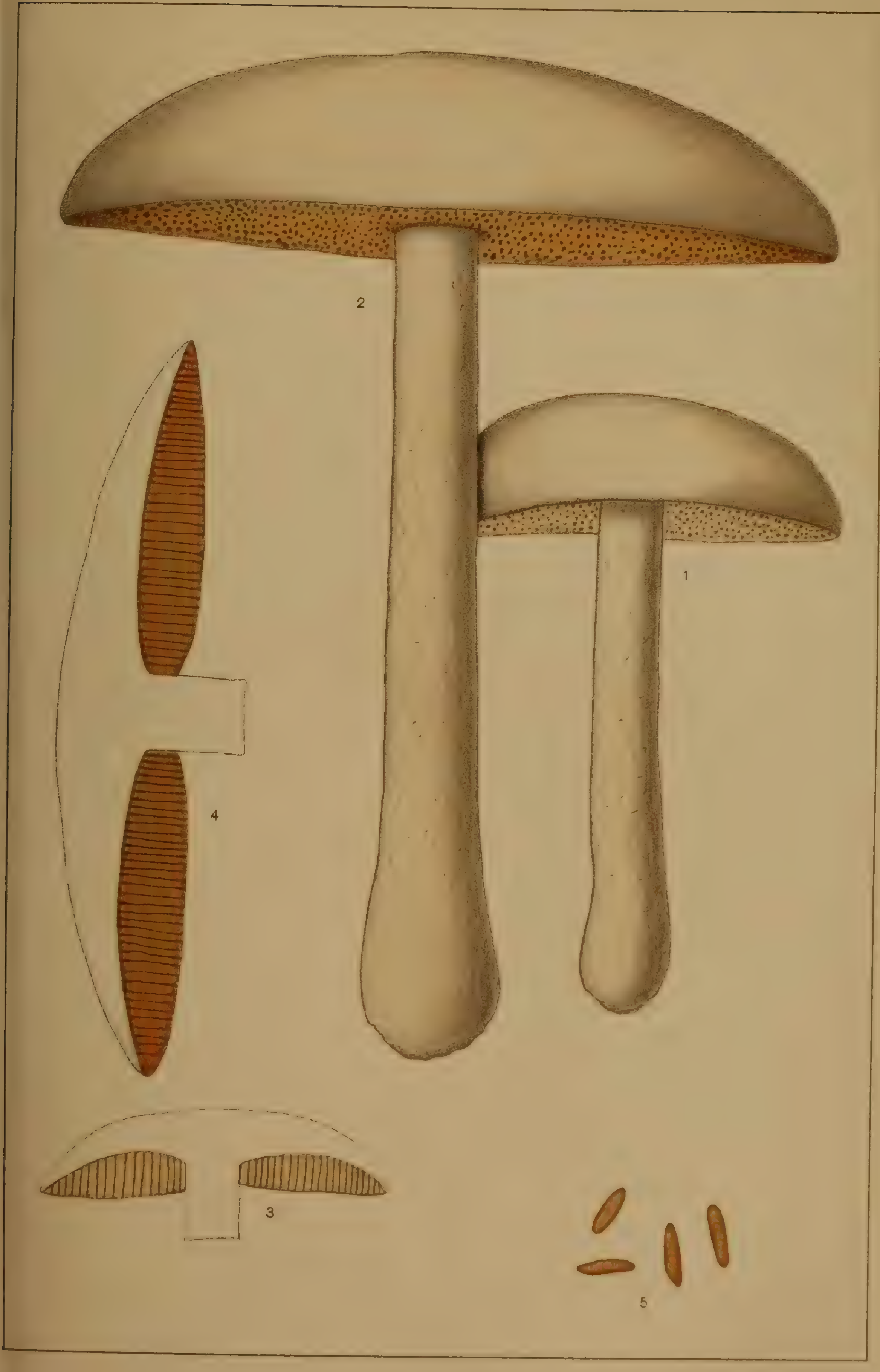
FIG. 5-10.
STROPHARIA BILAMELLATA PK.
DOUBLE GILLED STROPHARIA

PLATE 113

Boletus niveus Fr.

Snowy Boletus

1 Immature plant
2 Mature plant
3 Vertical section of the upper part of an immature plant
4 Vertical section of the upper part of a mature plant
5 Four spores, x 400



BOLETUS NIVEUS Fr.
SNOWY BOLETUS

PLATE 114

Lycoperdon subincarnatum Pk.

Pinkish Puffball

1 Cluster of three plants
2 Plant darker colored
3 Mature plant showing pitted peridium
4 Vertical section of an immature plant
5 Vertical section of a mature plant
6 Four spores, x 400

Lycoperdon gemmatum Batsch

Studded Puffball

7 Immature plant of usual size and shape
8 Immature plant showing an umbo
9 Sessile plant showing reticulated surface from which the larger warts have fallen
10 Long stemmed plant showing plicate base of peridium and upper part of stem, also reticulated place from which the larger warts have fallen
11 Long stemmed plant with larger warts closely placed and upper part of stem coarsely pitted
12 Vertical section of a small immature plant
13 Vertical section of a mature plant with stem tapering downward
14 An old denuded discolored plant
15 Four spores, x 400

FIG. 1-6.
LYCOPERDON SUBINCARNATUM PK.
PINKISH PUFF BALL

FIG. 7-15.
LYCOPERDON GEMMATUM BATSCH
STUDDED PUFF BALL

INDEX

New York State Education Department

New York State Museum

JOHN M. CLARKE, Director

PUBLICATIONS

Packages will be sent prepaid except when distance or weight renders the same impracticable. On 10 or more copies of any one publication 20% discount will be given. Editions printed are only large enough to meet special claims and probable sales. When the sale copies are exhausted, the price for the few reserve copies is advanced to that charged by second-hand booksellers, in order to limit their distribution to cases of special need. Such prices are inclosed in [ ]. All publications are in paper covers, unless binding is specified.

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

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

Director's annual reports 1904–date.

These reports cover the reports of the State Geologist and of the State Paleontologist. Bound also with the museum reports of which they form a part.

Report for 1904. 138p. 20*c*. 1905. 102p. 23pl. 30*c*. 1906. 186p. 41pl. 35*c*. 1907. 212p. 50pl. 50*c*.

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

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

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

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

Separate volumes of the following only are available.

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

Paleontologist's annual reports 1899–date.

See first note under Geologist's annual reports.

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

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

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

Report	*Price*	*Report*	*Price*	*Report*	*Price*
1	$.50	9	$.25	15 (En 9)	$.15
2	.30	10	.35	16 (" 10)	.25
5	.25	11	.25	18 (" 17)	.20
6	.15	12	.25	19 (" 21)	.15
7	.20	13	.10	20 (" 24)	.40
8	.25	14 (En 5)	.20	21 (" 26)	.25
				22 (" 28)	.25

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

Botanist's annual reports 1867–date.

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

Separate reports for 1871–74, 1876, 1888–98 are out of print. Report for 1899 may be had for 20c; 1900 for 50c. Since 1901 these reports have been issued as bulletins [*see* Bo 5–9].

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

Museum bulletins 1887–date. O. *To advance subscribers,* $2 *a year or* $1 *a year for division* (1) *geology, economic geology, paleontology, mineralogy;* 50c *each for divisions* (2) *general zoology, archeology and miscellaneous,* (3) *botany,* (4) *entomology.*

Bulletins are also found with the annual reports of the museum as follows:

Bulletin	*Report*	*Bulletin*	*Report*	*Bulletin*	*Report*	*Bulletin*	*Report*
G 1	48, v.1	M 4	59, v.2	En 7–9	53, v.1	Ar 3	52, v.1
2	51, v.1	Pa 1	54, v.1	10	54, v.2	4	54, v.1
3	52, v.1	2, 3	54, v.3	11	54, v.3	5	" v.3
4	54, v.4	4	" v.4	12, 13	" v.4	6	55, v.1
5	56, v.1	5, 6	55, v.1	14	55, v.1	7	56, v.4
6	57, v.1, pt 1	7, 9	56, v.2	15, 18	56, v.3	8, 9	57, v.2
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11	59, v.1	11–14	58, v.3	23, 24	58, v.5	Ms 1, 2	56, v.4
Eg 5, 6	48, v.1	15, 16	59, v.2	25, 26	59, v.2		
7	50, v.1	Z 3	53, v.1	Bo 3	52, v.1	*Memoir*	
8	53, v.1	4	54, v.1	4	53, v.1	2	49, v.3
9	54, v.2	5–7	" v.3	5	55, v.1	3, 4	53, v.2
10	" v.3	8	55, v.1	6	56, v.4	5, 6	57, v.3
11	56, v.1	9	56, v.3	7	57, v.2	7	" v.4
12, 13	58, v.2	10	57, v.1, pt 1	8	58, v.4	8, pt 1	59, v.3
14, 15	59, v.1	11, 12	58, v.4	9	59, v.2	8, pt 2	59, v.4
M 2	56, v.1	En 3	48, v.1	Ar 1	50, v.1		
3	57, v.1, pt 1	4–6	52, v.1	2	51, v.1		

The figures in parenthesis in the following list indicate the bulletin's number as a New York State Museum bulletin.

Geology. **G1** (14) Kemp, J. F. Geology of Moriah and Westport Townships, Essex Co. N. Y., with notes on the iron mines. 38p. 7pl. 2 maps. Sep. 1895. 10*c.*

G2 (19) Merrill, F. J. H. Guide to the Study of the Geological Collections of the New York State Museum. 162p. 119pl. map. Nov. 1898. *Out of print.*

G3 (21) Kemp, J. F. Geology of the Lake Placid Region. 24p. 1pl. map. Sep. 1898. 5*c.*

G4 (48) Woodworth, J. B. Pleistocene Geology of Nassau County and Borough of Queens. 58p. il. 9pl. map. Dec. 1901. 25*c.*

G5 (56) Merrill, F. J. H. Description of the State Geologic Map of 1901. 42p. 2 maps, tab. Oct. 1902. 10*c.*

G6 (77) Cushing, H. P. Geology of the Vicinity of Little Falls, Herkimer Co. 98p. il. 15pl. 2 maps. Jan. 1905. 30*c.*

G7 (83) Woodworth, J. B. Pleistocene Geology of the Mooers Quadrangle. 62p. 25pl. map. June 1905. 25*c.*

G8 (84) —— Ancient Water Levels of the Champlain and Hudson Valleys. 206p. 11pl. 18 maps. July 1905. 45*c.*

G9 (95) Cushing, H. P. Geology of the Northern Adirondack Region. 188p. 15pl. 3 maps. Sep. 1905. 30*c.*

G10 (96) Ogilvie, I. H. Geology of the Paradox Lake Quadrangle. 54p. il. 17pl. map. Dec. 1905. 30*c.*

G11 (106) Fairchild, H. L. Glacial Waters in the Erie Basin. 88p. 14pl. 9 maps. Feb. 1907. *Out of print.*

G12 (107) Woodworth, J. B.; Hartnagel, C. A.; Whitlock, H. P.; Hudson, G. H.; Clarke, J. M.; White, David: Berkey, C. P. Geological Papers. 388p. 56pl. map. May 1907. 90*c, cloth.*

Contents: Woodworth, J. B. Postglacial Faults of Eastern New York.
Hartnagel, C. A. Stratigraphic Relations of the Oneida Conglomerate.
—— Upper Siluric and Lower Devonic Formations of the Skunnemunk Mountain Region.
Whitlock, H. P. Minerals from Lyon Mountain, Clinton Co.
Hudson, G. H. On Some Pelmatozoa from the Chazy Limestone of New York.
Clarke, J. M. Some New Devonic Fossils.
—— An Interesting Style of Sand-filled Vein.
—— Eurypterus Shales of the Shawangunk Mountains in Eastern New York.
White, David. A Remarkable Fossil Tree Trunk from the Middle Devonic of New York.
Berkey, C. P. Structural and Stratigraphic Features of the Basal Gneisses of the Highlands.

G13 (111) Fairchild, H. L. Drumlins of New York. 58p. 28pl. 19 maps. July 1907. *Out of print.*

G14 (115) Cushing, H. P. Geology of the Long Lake Quadrangle. 88p. 20pl. map. Sep. 1907. 25*c.*

Fairchild, H. L. Later Glacial Waters in Central New York. *In press.*

Berkey, C. P. Geology of the Highlands of the Hudson. *In preparation.*

Cushing, H. P. Geology of the Theresa Quadrangle. *In preparation.*

Economic geology. **Eg1** (3) Smock, J. C. Building Stone in the State of New York. 152p. Mar. 1888. *Out of print.*

Eg2 (7) —— First Report on the Iron Mines and Iron Ore Districts in the State of New York. 6+70p. map. June 1889. *Out of print.*

Eg3 (10) —— Building Stone in New York. 210p. map, tab. Sep. 1890. 40*c*.
Eg4 (11) Merrill, F. J. H. Salt and Gypsum Industries of New York. 92p. 12pl. 2 maps, 11 tab. Ap. 1893. [50*c*]
Eg5 (12) Ries, Heinrich. Clay Industries of New York. 174p. 2pl. map. Mar. 1895. 30*c*.
Eg6 (15) Merrill, F. J. H. Mineral Resources of New York. 224p. 2 maps. Sep. 1895. [50*c*]
Eg7 (17) —— Road Materials and Road Building in New York. 52p. 14pl. 2 maps. Oct. 1897. 15*c*.
Eg8 (30) Orton, Edward. Petroleum and Natural Gas in New York. 136p. il. 3 maps. Nov. 1899. 15*c*.
Eg9 (35) Ries, Heinrich. Clays of New York; their Properties and Uses. 456p. 140pl. map. June 1900. $1, *cloth*.
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