Education Department Bulletin

Published fortnightly by the University of the State of New York

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

No. 451 ALBANY, N. Y. JULY 15, 1909

New York State Museum

JOHN M. CLARKE, Director

Museum bulletin 132

THE MINING AND QUARRY INDUSTRY

OF

NEW YORK STATE

REPORT OF OPERATIONS AND PRODUCTION DURING 1908

BY

D. H. NEWLAND

ALBANY

UNIVERSITY OF THE STATE OF NEW YORK

1909

M212r-Je9-2500

New York State Education Department
Science Division, June 7, 1909

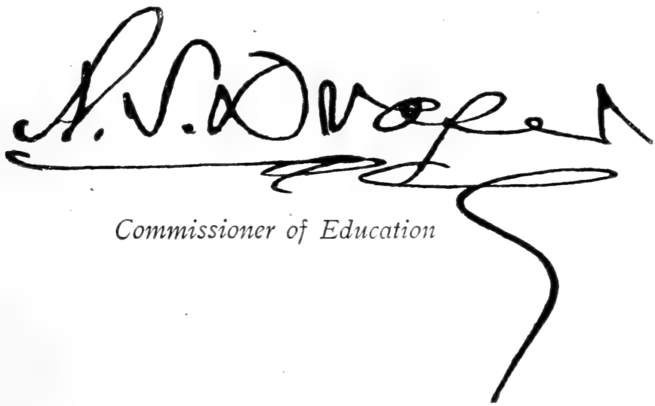
Hon. Andrew S. Draper LL.D.
Commissioner of Education

My dear sir: I have the honor to transmit herewith for publication as a bulletin of the State Museum, the report on the *Mining and Quarry Industry of New York State for 1908,* prepared by David H. Newland, Assistant State Geologist.

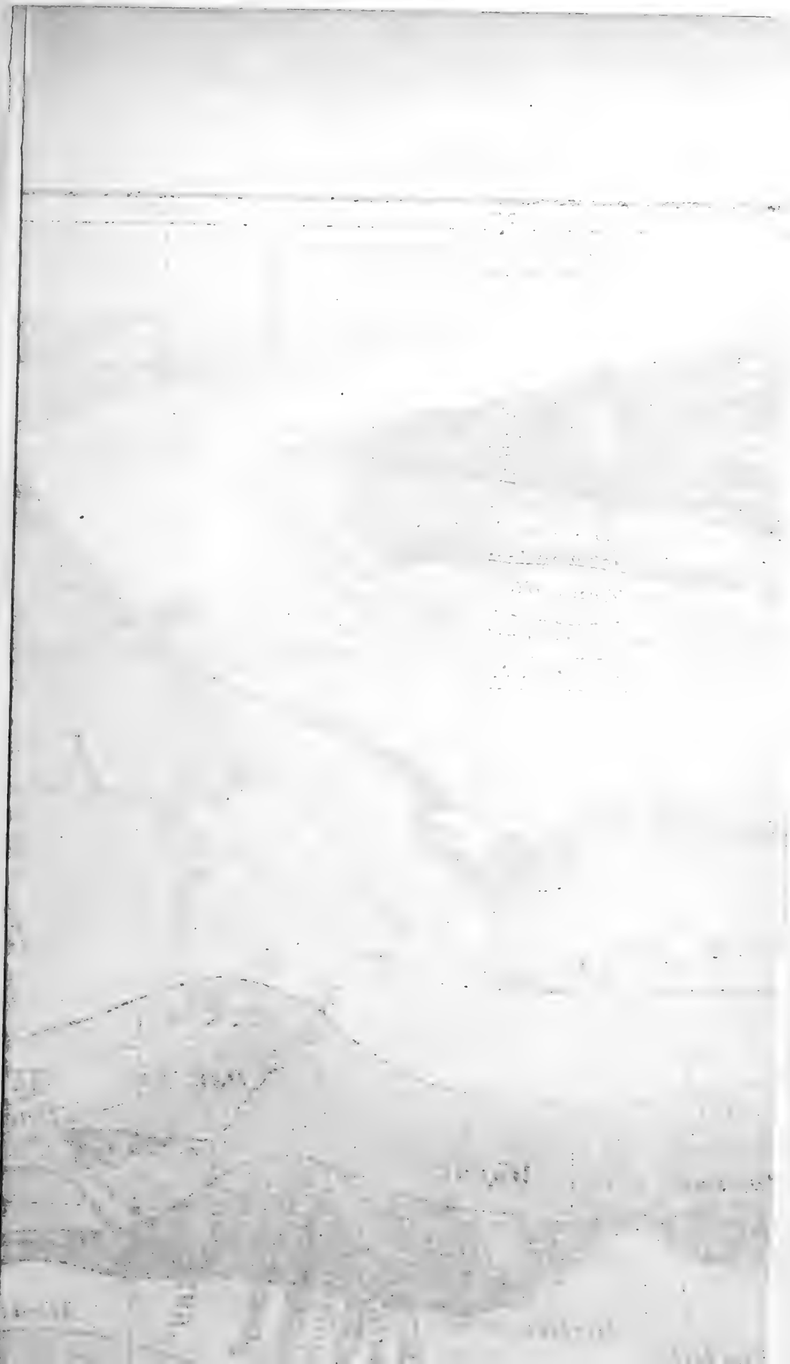
Very respectfully
John M. Clarke
Director

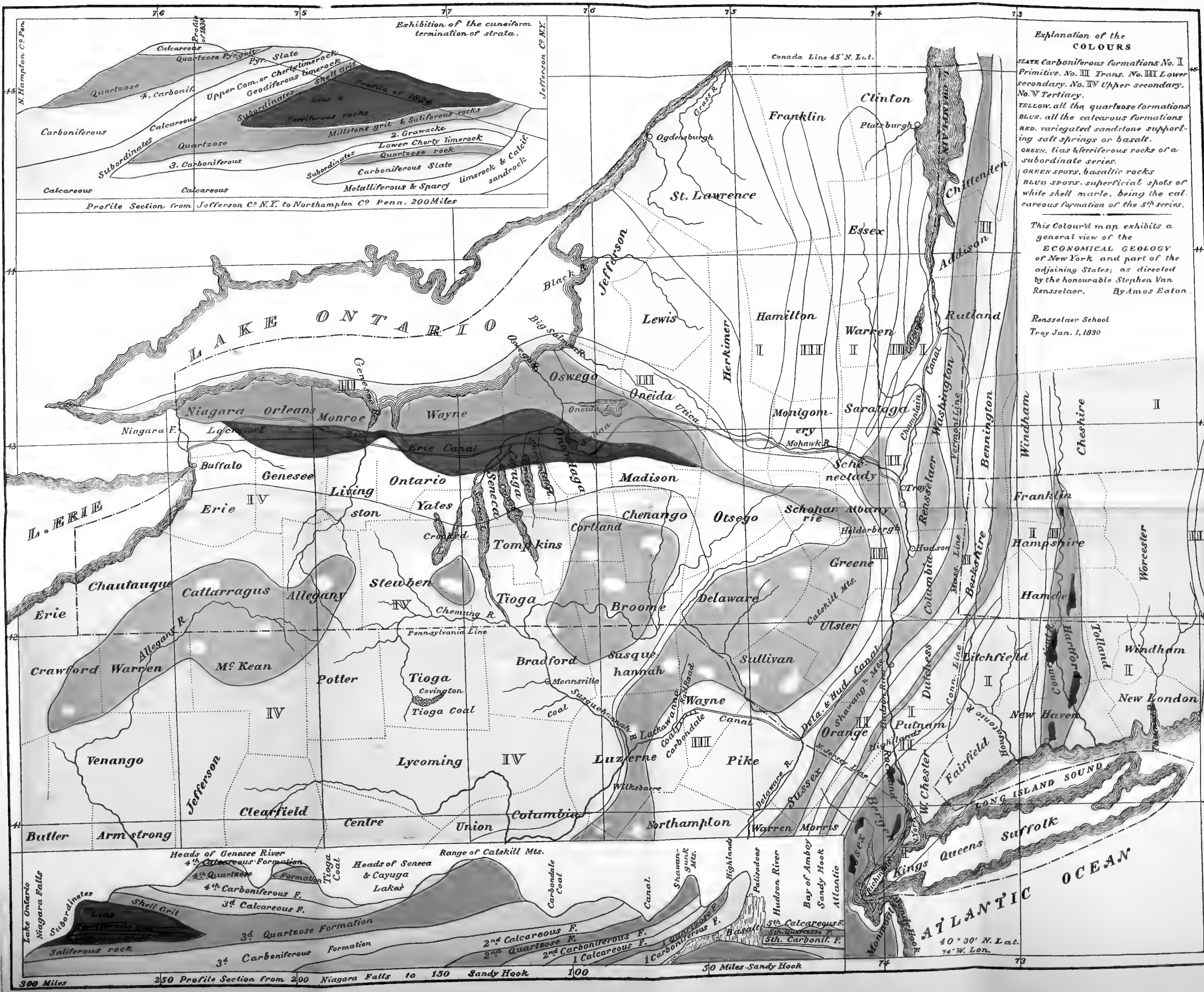
State of New York
Education Department
COMMISSIONER'S ROOM

Approved for publication this 7th day of June 1909



Commissioner of Education





Explanation of the COLOURS
SLATE. Carboniferous formations No. I Primitive. No. II Trans. No. III Lower secondary. No. IV Upper secondary. No. V Tertiary.
YELLOW. all the quartzose formations
BLUE. all the calcarous formations
RED. variegated sandstone supporting salt springs or basalt.
GREEN. lias & ferriferous rocks of a subordinate series.
GREEN SPOTS. basaltic rocks
BLUE SPOTS. superficial spots of white shell marle, being the calcareous formation of the 5th series.
This Colour'd map exhibits a general view of the ECONOMICAL GEOLOGY of New York and part of the adjoining States; as directed by the honourable Stephen Van Rensselaer. By Amos Eaton.
Rensselaer School Troy Jan. 1, 1830
Exhibition of the cuneiform termination of strata.
Profile Section from Jefferson Cº N.Y. to Northampton Cº Penn. 200 Miles
N. Hampton Cº Pen.
Jefferson Cº N.Y.
Profile of 1830
Profile of 1824
Calcareous
Quartzose Pyrgrit
Pyr. Slate
Upper Com. or Cherty limerock
Geodiferous limerock
Shell Grit
Quartzose
4. Carbonif.
Subordinates
Lias &
Ferriferous rocks
Millstone grit & Saliferous rocks
2. Grawacke
Lower Cherty limerock
Quartzose rock
Carboniferous Slate
Metalliferous & Sparry limerock & Calcif. sandrock
3. Carboniferous
Carboniferous
Calcareous
Canada Line 45° N. Lat.
LAKE ONTARIO
L. ERIE
ATLANTIC OCEAN
LONG ISLAND SOUND
Franklin
Clinton
Plattsburgh
Ogdensburgh
St. Lawrence
Essex
Chittenden
Addison
Jefferson
Lewis
Herkimer
Hamilton
Warren
Rutland
Oswego
Oneida
Utica
Montgomery
Saratoga
Washington
Bennington
Windham
Cheshire
Niagara
Orleans
Monroe
Wayne
Lockport
Erie Canal
Niagara F.
Buffalo
Genesee
Ontario
Livingston
Onondaga
Cayuga
Seneca
Madison
Schenectady
Mohawk R.
Troy
Rensselaer
Vermont Line
Erie
Yates
Chenango
Otsego
Schoharie
Albany
Helderbergh
Hudson
Franklin
Hampshire
Worcester
Crooked
Tompkins
Cortland
Greene
Columbia
Berkshire
Mass. Line
Chautauque
Cattarragus
Allegany
Steuben
Tioga
Broome
Delaware
Catskill Mts.
Hampden
Chemung R.
Allegany R.
Pennsylvania Line
Ulster
Crawford
Warren
Mc Kean
Potter
Tioga
Covington
Tioga Coal
Bradford
Meansville
Susquehannah
Sullivan
Dutchess
Litchfield
Connecticut
Hartford
Tolland
Windham
New London
Wayne
Canal
Dela. & Hud. Canal
Orange
Putnam
New Haven
Fairfield
Housatonic R.
Venango
Jefferson
Lycoming
Luzerne
Pike
Sussex
W. Chester
Rockland
Carbondale
Lackawanna
Wilksbarre
Delaware R.
N. Jersey Line
Highlands
Clearfield
Centre
Union
Columbia
Northampton
Warren
Morris
Bergen
Essex
Butler
Armstrong
Kings
Queens
Suffolk
Richmond
Monmouth
40° 30' N. Lat.
74° W. Lon.
Lake Ontario
Niagara Falls
Subordinates
Lias
Shell Grit
Ferriferous
Saliferous rock
Heads of Genesee River
4th Calcareous Formation
4th Quartzose
4th Carboniferous F.
3d Calcareous F.
3d Quartzose Formation
3d Carboniferous Formation
Tioga Coal
Heads of Seneca & Cayuga Lakes
Range of Catskill Mts.
Carbondale Coal
Canal
Shawangunk Mts.
Highlands
Palisadoes
Hudson River
Bay of Amboy
Sandy Hook
Atlantic
2nd Calcareous F.
2nd Quartzose F.
2nd Carboniferous F.
1 Calcareous F.
1 Quartzose F.
1 Carboniferous F.
Basalt
5th Calcareous F.
5th Quartzose F.
5th Carbonif. F.
300 Miles
250 Profile Section from 200 Niagara Falls to 150 Sandy Hook 100
50 Miles Sandy Hook

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PREFACE

This report deals briefly with the current discoveries, developments and production of mineral materials in New York State and follows the general plan of the preceding issues published each year since 1904. The main purpose of its preparation is that it may be of service to those engaged in exploitation of our resources, or otherwise interested in them.

It is proper to mention that the statistics of production relating to the year 1908 have been collected and partially compiled in collaboration with the Division of Mineral Resources of the United States Geological Survey, to whom credit is accordingly due for share in so much of the work. The descriptive text and notes, as well as the treatment of the statistics themselves, however, are independent of such cooperation.

The author desires to express grateful recognition of the assistance given by the mining and quarry enterprises of the State, numbering nearly 2000 in all, which have cordially responded to the requests for information.

INTRODUCTION

The year 1908, which will be remembered as an after-panic year, witnessed a marked reversal of conditions in the mineral industries of the State. To the prosperity and steady expansion that had so long obtained in these industries succeeded general depression and contraction, which continued with little or no relief throughout the 12 months. There were few mines or quarries that did not curtail operations, and many were closed down for at least a part of the year. The decline in productive activity was out of proportion to the rate of growth in the preceding years, so that the outputs of most materials were well below the totals recorded for 1907. Though the setback will doubtless prove only a temporary feature, it is certain that some time must elapse before the former activity is fully restored.

The census of production that has been conducted for the present and previous issues of this report covers some 30 different materials which are mined or quarried in this State. The total value of the output reported for 1908 based upon the materials in their crude or first marketable forms was $29,519,785. Compared with the total of $37,141,006 recorded in 1907 this showed a decrease of $7,621,221, or about 20 per cent. The output in 1907 was the largest ever made in the State, though it did not greatly exceed that of 1906 which was valued at $37,132,832. The corresponding total for 1905 was $35,470,987 and for 1904 $28,-812,595, or a little less than the total for last year.

Among the different departments of the mineral industry iron mining was one that experienced the full measure of the depression, as it also had been among the first to respond to the prosperous conditions of the preceding years. The output amounted to 697,-473 long tons against 1,018,013 tons in 1907. Under favorable conditions, instead of this decrease, there would have been without doubt a large gain that might have set a new mark for the industry in New York. The production was made by 10 mining companies as compared with 13 who reported active in 1907. The loss was shared by all the districts though in larger portion by the mines on the Clinton hematite belt which has been under recent development, while the Adirondack magnetite mines made the most favorable showing. The value of the iron produced in 1908 was $2,098,247.

The clay materials aggregated in value $8,918,863, as compared with $12,688,868 in the preceding year. The decrease of about 30 per cent was due both to a smaller output by the plants and to a reduction in market values. The combined output of brick, tile, fireproofing and terra cotta used for building purposes was valued at $6,071,850 as against $8,909,392 in 1907. In 1906 these materials represented a value of $11,063,433. The number of building brick made last year was 1,066,533,000 of which 817,-459,000, or about three fourths, represented common brick from the Hudson river region. Along with the decline in building materials there was a large decrease in the ceramic industry, the value of the pottery manufactures amounting to $1,653,241 as compared with $2,240,895 in 1907. The number of plants that were engaged in clay manufacturing of all kinds was 240, or two less than in 1907.

The value of the quarry products for 1908 was $6,615,614 against $7,890,327 in the preceding year, a falling off of 16 per cent. The total was divided according to the various uses into: building stone $1,264,403; monumental stone $139,077; curb and flagstone $928,511; crushed stone $2,659,016; other uses $1,624,607. The output of slate, millstones and limestone used in making hydraulic cement is not included in the figures. Of the different kinds of stone, granite was the one to show a gain and this was accounted for by its increased use for paving blocks and crushed stone. The quarries of the State are able to supply almost every variety of rock for building and other purposes, though there is a large importation from other states.

The manufactures of hydraulic cement contributed a production last year valued at $2,254,758. In 1907 the value amounted to $2,971,820. Of the product last year 1,988,874 barrels valued at $1,813,622 consisted of portland cement and 623,588 barrels valued at $441,136 of natural rock cement. The latter industry has shown a steady decline for a number of years past due to general conditions in the trade. On the other hand the situation in the portland cement industry may be expected to improve and there is every prospect that the State will soon have a much larger share in the production than at present.

From the salt mines and wells there was obtained last year 9,005,311 barrels valued at $2,136,736. The showing was better relatively than in many other branches of the mineral industry; as compared with the figures for 1907 (9,657,543 barrels valued at $2,449,178) there was a falling off in production of less than 7 per cent. For many years the output of the State increased very rapidly and it now amounts to about one third of the total for the entire country. Onondaga county where salt making was first introduced more than a century ago still held the leading place last year, though most of its product was not put into marketable form but was consumed for the manufacture of soda products. Livingston and Wyoming counties lead in the production of rock and brine salt respectively for the trade.

The mines and quarries of gypsum contributed an output of 318,046 short tons, or nearly the same as in 1907 when it amounted to 323,323 short tons. The value of the different gypsum materials including plaster of paris, wall plaster and gypsum sold in crude condition was $760,759 in 1908 against $751,556 in the preceding year. The gypsum industry has grown remarkably in the last few years, the output of the State having increased nearly tenfold in the decade from 1898. With the inexhaustible supplies afforded by the local deposits and the unrivaled facilities for reaching the principal eastern markets there is every prospect that the production will soon reach even greater proportions.

The combined value of the petroleum and natural gas produced in the State last year was $3,059,308 against $2,536,349 in 1907. The quantity of petroleum taken from the wells amounted to 1,160,128 barrels valued at $2,071,533 as compared with 1,052,324 barrels valued at $1,736,335 in the preceding year. The natural gas production was valued at $987,775 against $800,014 in 1907; the volume of gas amounted to 3,860,000,000 cubic feet against 3,052,145,000 in the preceding year. The exhaustion of both the petroleum and natural gas pools does not seem to be imminent, judging from the records of production for recent years.

A product of which the State has almost a natural monopoly is fibrous talc, which is found in St Lawrence county in extensive deposits and of superior quality. The material is consumed mostly in the paper trade and is shipped to all parts of the country as well as to foreign mills. The output of ground talc last year amounted to 70,739 short tons valued at $697,390 and showed a good gain over the total for 1907 which was reported as 59,000 short tons with a value of $501,500.

The garnet mines in the Adirondacks were worked last year on a much reduced scale. The output of 2480 short tons valued at $79,890 was less than half that for 1907, when 5709 short tons with a value of $174,800 was reported. The decline may be ascribed to the smaller demand for abrasive materials during the year.

Crystalline graphite was mined in Essex, Warren and Saratoga counties. The output amounted to 1,932,000 pounds valued at $116,100 against 2,950,000 pounds valued at $106,951 in 1907.

The mineral springs of the State reported sales last year of 8,007,092 gallons valued at $877,648, or about the same as in the preceding year. Saratoga county with the famous Saratoga and Ballston springs contributed about $175,000 to the total value.

Among the other mineral products of the State last year were apatite, carbon dioxid, clay, diatomaceous earth, emery, feldspar, marl, millstones, metallic paint, slate, pigment, pyrite, quartz, slate, sand and sand lime brick, the collected value of which amounted to $1,904,472 as compared with $2,318,764 in 1907.

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, mar and sand and gravel exclusive of glass sand.

Mineral production of New York in 1907

PRODUCT	UNIT OF MEASUREMENT	QUANTITY	VALUE
Portland cement	Barrels	2 108 450	$2 214 090
Natural rock cement	Barrels	1 137 279	757 730
Building brick	Thousands	1 366 842	7 424 294
Pottery	....	....	2 240 895
Other clay products	....	....	3 023 679
Crude clay	Short tons	3 927	6 163
Emery	Short tons	1 223	13 057
Feldspar and quartz	Long tons	8 723	36 230
Garnet	Short tons	5 709	174 800
Glass sand	Short tons	1 200	1 380
Graphite	Pounds	2 950 000	106 951
Gypsum	Short tons	323 323	751 556
Iron ore	Long tons	1 018 013	3 750 493
Millstones	....	....	21 806
Metallic paint	Short tons	5 269	59 521
Slate pigment	Short tons	620	3 700
Mineral waters	Gallons	8 000 000	1 000 400
Natural gas	1000 cubic feet	3 052 145	800 014
Petroleum	Barrels	1 052 324	1 736 335
Pyrite	Long tons	49 978	162 430
Salt	Barrels	9 657 543	2 449 178
Roofing slate	Squares	11 686	53 625
Slate manufactures	....	....	1 175
Sand lime brick	Thousands	16 610	109 677
Granite	....	....	195 900
Limestone	....	....	3 182 447
Marble	....	....	1 571 936
Sandstone	....	....	1 998 417
Trap	....	....	941 627
Talc	Short tons	59 000	501 500
Other materials*a*	....	....	1 850 000
Total value	....	....	$37 141 006

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 1908

PRODUCT	UNIT OF MEASUREMENT	QUANTITY	VALUE
Portland cement	Barrels	1 988 874	$1 813 622
Natural rock cement	Barrels	623 588	441 136
Building brick	Thousands	1 066 533	5 200 951
Pottery	....	....	1 653 241
Other clay products	....	....	2 064 671
Crude clay	Short tons	4 697	11 605
Emery	Short tons	690	8 860
Feldspar and quartz	Short tons	16 413	68 148
Garnet	Short tons	2 480	79 890
Graphite	Pounds	1 932 000	116 100
Gypsum	Short tons	318 046	760 759
Iron ore	Long tons	697 473	2 098 247
Millstones	....	....	18 341
Metallic paint	Short tons	5 750	54 500
Slate pigment	Short tons	922	7 376
Mineral waters	Gallons	8 007 092	877 648
Natural gas	1000 cubic feet	3 860 000	987 775
Petroleum	Barrels	1 160 128	2 071 533
Pyrite	Long tons	23 775	104 798
Salt	Barrels	9 005 311	2 136 736
Sand and gravel	....	....	1 130 291
Sand lime brick	Thousands	8 239	55 688
Slate	....	....	111 217
Granite	....	....	367 564
Limestone	....	....	3 119 835
Marble	....	....	692 857
Sandstone	....	....	1 711 585
Trap	....	....	723 773
Talc	Short tons	70 739	697 390
Other materials*a*	....	....	333 648
Total value	....	....	$29 519 785

a Includes apatite, carbon dioxid, diatomaceous earth and marl.

CEMENT

The past year was a critical period for the cement trade. The depression which marked the last quarter of 1907 continued throughout the following 12 months with little or no abatement so far as the market for cement was concerned. Though production was kept down to a relatively low level in an effort to maintain some relation with the needs of consumers, the close of the year found most plants holding in stock a larger share of their output than usual and market conditions affording small encouragement for the immediate future. While the current season will witness, doubtless, a substantial betterment in the trade, the indications based on the first months pointed to slow progress extending over some time rather than a rapid recovery.

The combined production of portland and natural cement in New York State amounted in 1908 to 2,612,462 barrels valued at $2,254,-758. In 1907 the combined total was 3,245,729 barrels and the value $2,971,820. There was thus a decrease in output of 633,267 barrels, or nearly 20 per cent. The loss was mostly in the natural product which reached the lowest figure attained in a great many years.

Of portland cement the output of 1,988,874 barrels valued at $1,813,622 as against 2,108,450 barrels valued at $2,214,090 in the preceding year showed a decline of less than 6 per cent. The value of the cement per barrel, however, averaged only $.91 in 1908 compared with $1.05 in 1907. There were seven companies who operated during the whole or part of the year, or two less than in 1907. The works of the Hudson Portland Cement Co. at Hudson and of the Iroquois Portland Cement Co. at Caledonia were closed down throughout the season. The former company was recently bought out by the Atlas Portland Cement Co., a Pennsylvania corporation, which it is understood will dismantle the plant and erect new works at Greenport with a capacity of 5000 barrels a day. The plant of the Iroquois Portland Cement Co. was taken over in May 1908 by the Marengo Portland Cement Co. After extensive improvements the latter company intended to restart operations this spring. The Seaboard Cement Co. of Alsen and the Knickerbocker Portland Cement Co. of New York were organized during the year to engage in cement manufacture in the Hudson river region.

In the natural cement industry the main feature of the year's record was a further decline of production which amounted to 623,588 barrels valued at $441,136 against 1,137,279 barrels valued at $757,730 for 1907. There were six firms who were operative, or two less than in the preceding year. Of the total, three companies in the Rosendale district contributed 579,588 barrels with a value of $419,936.

The accompanying table gives the production of both portland and natural cement in New York State since 1890.

Production of cement in New York

YEAR	PORTLAND CEMENT		NATURAL CEMENT	
	Barrels	Value	Barrels	Value
1890	65 000	$140 000	3 776 756	$2 985 513
1891	87 000	190 250	3 931 306	3 046 279
1892	124 000	279 000	3 780 687	3 074 781
1893	137 096	287 725	3 597 758	2 805 387
1894	117 275	205 231	3 446 330	1 974 463
1895	159 320	278 810	3 939 727	2 285 094
1896	260 787	443 175	4 181 918	2 423 891
1897	394 398	690 179	4 259 186	2 123 771
1898	554 358	970 126	4 157 917	2 065 658
1899	472 386	708 579	4 689 167	2 813 500
1900	465 832	582 290	3 409 085	2 045 451
1901	617 228	617 228	2 234 131	1 117 066
1902	1 156 807	1 521 553	3 577 340	2 135 036
1903	1 602 946	2 031 310	2 417 137	1 510 529
1904	1 377 302	1 245 778	1 881 630	1 207 883
1905	2 117 822	2 046 864	2 257 698	1 590 689
1906	2 423 374	2 766 488	1 691 565	1 184 211
1907	2 108 450	2 214 090	1 137 279	757 730
1908	1 988 874	1 813 622	623 588	441 136

CLAY

The manufacture of clay materials is the largest of the mineral industries of the State. The clays are mostly of the commoner grades but they are widespread in their distribution and well adapted for building brick, which is the leading product. Every section and nearly every county of the State is represented in that branch of the industry. Paving brick, fire brick, drain tile, sewer pipe, building tile and fireproofing are also made in certain sections from local clays.

The resources in white burning clays or kaolin, on the other hand, are limited. Some deposits on Long Island and Staten Island approach kaolin in color and burning qualities though they are employed mainly for terra cotta. The dearth of these clays has been a drawback to the development of the ceramic industry in the State, but of late this branch has shown considerable progress. The kaolin used is shipped to the potteries from other states or is imported from Europe. Porcelain and semiporcelain tableware, porcelain electrical supplies, sanitary ware, as well as the common grades of pottery, are now quite important items in the list of clay manufactures.

Production of clay materials

Details of the production of clay materials in New York State during the last two or three years are given in the tables herewith. The figures are based on reports received from practically all of the manufacturers in every department. A comparison of the values reported for the different products in the tables shows that the industry experienced a decided setback in 1908. The year was one of great depression in nearly all lines of clay manufactures, contrasting strongly with the three preceding years when there was unexampled prosperity. The demand for clay building materials was specially poor, due to the small amount of new construction undertaken in New York and other large cities of the State. With the decline in demand there was an accompanying decrease in the prices received for the materials which reached a level below that of any recent year. Another factor that affected adversely the trade in building brick was the large stocks carried over by the plants from the preceding season. This was particularly influential in the Hudson river region which supplies the New York market. The final months of 1908 witnessed a gradual betterment in the conditions that continued into the current year. It is generally expected that the industry will soon regain a measure at least of its former prosperity.

The aggregate value of the clay manufactures of all kinds in 1908 was $8,918,863. Compared with the total for the preceding year, which was $12,688,868, there was a falling off of $3,770,005, or about 30 per cent, in the reported value. Of the 61 counties in the State 44 were represented in 1908 as having an output of this class of mineral materials. The number of individual plants in operation was 240 as compared with 242 in 1907 and 265 in 1906.

Among the different materials, building brick had the largest aggregate decrease. The total value reported by the manufacturers of these materials was $5,200,951 against $7,424,294 in 1907, showing a decline of $2,223,343. Of the aggregate, common brick accounted for $5,064,194 as compared with $7,201,525, and front and fancy pressed brick for $136,757 as compared with $222,769 for the preceding year. The production of vitrified paving brick was valued at $211,289 against $184,306, showing an increase for the year. Fire brick and stove lining amounted to a value of $545,951 against $624,033. The manufactures of drain tile amounted to $273,134 against $162,167; and of sewer pipe to $133,716 against $463,500. The production of terra cotta was valued at $709,360 as compared with $1,224,300 in 1907; fireproofing at $91,377 as compared with $45,672; and building tile at $70,162 as compared with $215,126. 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 $29,680 against $104,575 in 1907. The potteries of the State reported an output valued at $1,653,241 as compared with $2,240,895 in the preceding year.

Production of clay materials

MATERIAL	1906	1907	1908
Common brick	$9 302 165	$7 201 525	$5 064 194
Front brick	386 124	222 769	136 757
Vitrified paving brick	178 011	184 306	211 289
Fire brick and stove lining	527 659	624 033	545 951
Drain tile	166 645	162 167	273 134
Sewer pipe	95 142	463 500	133 716
Terra cotta	1 037 387	1 224 300	709 360
Fireproofing	120 282	45 672	91 377
Building tile	217 475	215 126	70 162
Miscellaneous	129 402	104 575	29 680
Pottery	1 795 008	2 240 895	1 653 241
Total	$13 955 300	$12 688 868	$8 918 863

A distribution of the production among the counties in which it was made shows that Ulster county held first place last year in regard to value of output. It reported a total of $819,947, made up almost wholly of building brick. In 1907 the county ranked second to Onondaga county. Rockland county advanced from third to second place with a total of $800,603, represented entirely by building brick. Orange county which stood fifth in 1907 advanced to the fourth place with a value of $747,637. Onondaga county fell from first to the fifth place and contributed $734,880; it is the largest manufacturer of pottery in the State. The other counties that reported a value of over $100,000 in 1908 were Erie ($632,048); Dutchess ($605,371); Richmond ($587,919); Albany ($538,213); Kings ($416,474); Columbia ($283,720); Saratoga ($245,878); Monroe ($240,087); Schenectady ($238,750); Rensselaer ($233,-995); Westchester ($226,062); Ontario ($214,246); Steuben

($166,544); Suffolk ($125,430); and Chautauqua ($128,866). Queens county should also be included in the foregoing list, but the value is withheld in order not to reveal the individual figures.

Production of clay materials by counties

COUNTY	1906	1907	1908
Albany	$675 099	$540 341	$538 213
Allegany	111 683	111 751	44 627
Broome	12 000	8 250	*a*.........
Cattaraugus	35 500	41 234	*a*.........
Cayuga	17 860	14 832	13 280
Chautauqua	99 085	113 350	128 866
Chemung	90 000	88 940	89 000
Clinton	4 800	4 250	3 920
Columbia	489 750	433 357	283 720
Dutchess	975 410	781 262	605 371
Erie	804 159	786 703	632 048
Fulton	2 600	2 000	*a*.........
Greene	399 298	237 620	113 373
Jefferson	36 722	20 352	17 897
Kings	575 973	574 863	416 474
Livingston	*a*.........	*a*.........	53 555
Madison	16 800	32 000	12 550
Monroe	341 870	583 664	240 087
Nassau	163 700	105 000	71 390
Niagara	10 832	16 282	10 892
Oneida	103 263	98 315	88 606
Onondaga	1 094 635	1 331 443	734 880
Ontario	343 040	342 810	214 246
Orange	1 170 695	789 297	747 637
Queens	*a*.........	*a*.........	*a*.........
Rensselaer	296 762	321 016	233 995
Richmond	896 789	1 121 524	587 919
Rockland	1 767 012	1 258 467	800 603
Saratoga	388 450	256 275	245 878
Schenectady	92 700	83 637	238 750
Seneca	39 525	*a*.........	nil
Steuben	209 052	186 124	166 544
Suffolk	138 500	127 610	125 430
Tompkins	*a*.........	7 100	*a*.........
Ulster	1 465 457	1 324 476	819 947
Warren	34 500	25 000	*a*.........
Washington	22 033	22 990	11 295
Westchester	536 189	390 773	226 062
Other counties*b*	496 886	505 960	401 808
Total	$13 955 300	$12 688 868	$8 918 863

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 includes Genesee, Herkimer, Livingston, Montgomery, New York, Queens, St Lawrence, Seneca and Wayne counties. In 1908, aside from counties marked *a* are included Genesee, Herkimer, Montgomery, New York, St Lawrence, Tioga and Wayne counties.

Manufacture of building brick

The output of common building brick in 1903 amounted to 1,056,769,283 valued at $5,064,194. In addition there were made 9,763,649 front and fancy pressed brick valued at $136,757, making an aggregate output of brick for building purposes of 1,066,532,932 valued at $5,200,951. The total number manufactured in the preceding year was 1,366,842,000 valued at $7,424,294, consisting of 1,351,591,000 common brick valued at $7,201,525 and 15,251,000 front and fancy pressed brick valued at $222,769. The manufacture of building brick was carried on in 37 counties by a total of 196 companies or individuals. In 1907 there were 36 counties represented with a total of 205 producers, and in 1906 there were 37 counties with 213 producers.

The average price received for common brick throughout the State in 1908 was $4.79 a thousand as compared with $5.33 a thousand in 1907 and $5.98 a thousand in 1906. Front and fancy pressed brick averaged $14 a thousand in 1908 against $14.61 a thousand in 1907 and $15.68 a thousand in 1906. The prices are based on sales at the yards.

Production of common building brick

COUNTY	1907		1908	
	Number	Value	Number	Value
Albany	60 210 000	$300 141	55 677 000	$255 013
Broome	1 500 000	8 250	*a*	*a*
Cayuga	1 804 000	10 832	1 309 000	8 480
Chautauqua	7 967 000	49 876	8 046 011	50 919
Chemung	13 289 000	88 940	14 833 000	89 000
Clinton	650 000	4 250	640 000	3 920
Columbia	84 972 000	433 357	61 971 000	283 720
Dutchess	149 130 000	781 262	132 003 973	605 371
Erie	52 282 000	309 697	35 960 325	202 943
Greene	35 876 000	184 620	12 094 825	57 723
Jefferson	2 667 000	20 352	2 321 749	17 897
Livingston	*a*	*a*	490 000	3 555
Monroe	25 198 000	148 462	15 617 815	93 730
Nassau	17 000 000	102 000	11 675 000	63 890
Niagara	2 681 000	16 282	1 543 014	10 892
Oneida	15 126 000	94 560	17 436 000	83 731
Onondaga	22 460 000	146 160	14 028 000	76 030
Ontario	2 600 000	18 200	2 768 000	16 946
Orange	154 502 000	789 297	151 869 000	747 637
Rensselaer	15 488 000	78 540	10 949 400	60 723
Richmond	39 205 000	180 569	25 398 500	89 083

Production of common building brick (*concluded*)

COUNTY	1907		1908	
	Number	Value	Number	Value
Rockland........	232 018 000	$1 258 467	173 926 094	$800 603
St Lawrence.....	800 000	6 000	*a*..........	*a*.......
Saratoga........	50 798 000	254 385	51 034 000	243 728
Steuben.........	3 287 000	29 818	2 651 890	21 870
Suffolk..........	20 130 000	124 610	20 108 150	122 430
Tompkins.......	1 100 000	7 100	*a*..........	*a*.......
Ulster...........	260 404 000	1 322 476	179 165 560	816 947
Warren..........	5 020 000	25 000	*a*..........	*a*.......
Washington......	2 750 000	14 300	*a*..........	*a*.......
Westchester......	59 307 000	323 553	39 801 577	184 774
Other counties*b*..	11 370 000	70 169	9 452 400	52 639
Total.......	1 351 591 000	$7 201 525	1 056 769 283	$5 064 194

a Included under "Other counties."
b Includes in 1907 Genesee, Herkimer, Livingston, Montgomery, New York, Queens, St Lawrence and Wayne. In 1908 the following counties are included: Allegany, Broome, Fulton, Herkimer, Montgomery, St Lawrence, Schenectady, Tioga, Tompkins, Warren and Washington.

Hudson river region. The greater part of the brick production of the State is made in the Hudson river valley, in the stretch from Rensselaer and Albany counties southward to Westchester county. There is probably no other region in the whole country that compares with it in the number of brick plants and annual output. Practically the entire product belongs to the common grade of building brick and is marketed in New York city and vicinity. With its facilities for cheap water transportation the industry of this section has little competition from other centers of brick manufacture that ship by railroad.

The brick clays are found in terraced deposits on either side of the river, reaching from water level to a hight of 300 feet or more in places. They are interbedded with, and sometimes covered by, layers of sand and gravel. Their thickness may exceed 100 feet, though usually it is much less. Some clay is obtained by dredging from the bed of the river, such operations being conducted in the vicinity of Haverstraw. The Hudson river clays are generally of marly character, due to the presence of from 3 to 6 per cent of lime carbonate.

In the nine counties included in the region, there are more than 125 brickyards with a combined capacity of about one and a half billion of brick a year. The average product, however, falls considerably short of that amount.

During the past season, the depressed conditions in the building trade were responsible for a very small output from this region. On the whole business was poorer than for a long time with prices throughout most of the year at so low a level as to afford little or no profit to the manufacturer. An unfavorable factor in the early part of the year was the large number of brick carried over by the yards from 1907, amounting to fully 300,000,000 according to reliable estimates, though by a purposed delaying of active operations beyond the usual time its influence upon prices was lessened to a considerable extent. The season of manufacture was very short, as the yards also closed earlier than usual. The prevailing prices in the early part of the year were about $4.50 a thousand. As the season advanced there was a gradual improvement; and shipments were made at $4.75 and $5 in the summer. The upward tendency continued throughout the fall and early winter with the revival of building operations, and at the close of the year the prices reached as high as $6.75 and $7. The stocks held along the river at the beginning of the current season were smaller than usual.

The total number of common brick marketed from the Hudson river region in 1908 was 817,459,000 as compared with an output of 1,051,907,000 in 1907. The figures for the past year were compiled from the sales of the yards, while for the preceding year they were based on the output, so that some allowance must be made in comparing the totals. The actual production last year was no doubt smaller than the number reported as sold. The largest production on record was in 1906, when it amounted to 1,230,692,000, or about 50 per cent more than that for 1908.

There were 114 plants in operation last year with an average product of 7,171,000 against a total of 122 plants and an average product of 8,622,000 in 1907.

The value of the brick averaged $4.75 a thousand in 1908 and $5.20 a thousand in 1907, showing a decline of nearly 10 per cent. The highest price received in recent years was in 1905 when the average for the entire output of the region was $6.54 a thousand.

The decline in the production was generally distributed over the nine counties of the region, and all reported a smaller total than in 1907, though the largest falling off was in Rockland and Ulster counties. Ulster county stood first in size of output, as in the preceding year, with a total of 179,166,000 valued at $816,947. Rockland county maintained its place as the second largest producer in the region and reported a total of 173,926,000 valued at $800,603. Orange county ranked third in the list, the same as in 1907; its total was 151,869,000 valued at $747,637.

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

Output of common brick in the Hudson river region in 1908

COUNTY	NUMBER OF PLANTS	OUTPUT	VALUE	AVERAGE PRICE PER M
Albany	12	55 677 000	$255 013	$4 57
Columbia	4	61 971 000	283 720	4 57
Dutchess	18	132 004 000	605 371	4 58
Greene	4	12 095 000	57 723	4 77
Orange	8	151 869 000	747 637	4 92
Rensselaer	6	10 949 000	60 723	5 54
Rockland	29	173 926 000	800 603	4 60
Ulster	26	179 166 000	816 947	4 55
Westchester	7	39 802 000	184 774	4 64
Total	114	817 459 000	$3 812 511	$4 75

Other clay materials

The manufacture of paving brick was carried on during 1908 in Chautauqua, Greene, Onondaga and Steuben counties. There were five companies engaged in the business and the output was 14,570,-140 valued at $211,289. In 1907 there were but four producing companies with a production of 12,296,000 valued at $184,306. The additional producer in the 1908 production was Chautauqua county, which made no output in 1907.

Fire brick and stove lining were manufactured in Albany, Erie, Kings, Rensselaer, Richmond, Schenectady, Washington and Westchester counties by a total of 12 companies. The output of fire brick amounted in value to $442,967 and of stove lining to $102,984, a combined value of $545,951. In 1907 the value of the fire brick was $384,217 and of stove lining $239,816, a combined value of $624,033, 13 companies being represented in the output. The 1908 figures include a small production of acid proof brick from Onondaga county.

Draintile and sewer pipe were made in Albany, Cayuga, Erie, Genesee, Madison, Monroe, New York, Oneida, Onondaga, Ontario, Saratoga, Steuben and Washington counties, the only change in counties from 1907 being the addition of New York county with a small production of sewer pipe. The output of draintile was valued at $273,134 against $162,167 in 1907, and the output of sewer pipe was $133,716 against $463,500 in 1907. There were 22 companies engaged in these industries as compared with 19 in 1907 and 26 in 1906.

The output of terra cotta, fireproofing and building tile came from Allegany, Chautauqua, Erie, Kings, Monroe, New York, Ontario, Rensselaer, Richmond, Steuben and Westchester counties. Albany, Genesee, Onondaga and Queens counties which produced in 1907 reported no output in 1908, while Erie, Ontario and Steuben counties, not producing in 1907, made an output in 1908. Thirteen companies were active in 1908 as compared with 14 in 1907. The production of terra cotta was valued at $709,360 against $1,224,300 in 1907; fireproofing at $91,377 against $45,672 in 1907; and building tile at $70,162 against $215,126 in 1907. Of the 1907 figures for the building tile output over half consists of roofing tile and the remainder of floor tile and decorative wall tile.

Pottery

Though pottery-clays do not occur in abundance within the bounds of New York State, the manufacture of the various grades of pottery is well represented. About the only materials of local origin employed in the industry are the stoneware clay of Onondaga county and the slip clay of Albany, while the products of the potteries embrace stoneware, earthenware, clay tobacco pipes, china tableware, art pottery, porcelain electrical supplies, chemical and sanitary ware, etc. The kaolin used is brought in from other states or imported from England. Much of the stoneware clay comes from New Jersey and the feldspar from Canada.

The number of potteries that were active in 1908 was 25, and of these all but one reported their production. The value of the output as shown by the returns, including an estimate for the single producer not reporting, amounted to $1,653,241, a sum considerably less than that of the preceding year. It may be remarked, however, that the total of $2,240,895 for 1907 was actually about $200,000 in excess of the proper valuation for that year, owing to the inclusion of extraneous material in the returns of electric supplies. The value of such pottery in 1908 was based on the porcelain alone, exclusive of the hardware trimmings.

The following counties were represented in the production: Albany, Erie, Kings, Livingston, Madison, Nassau, Onondaga, Ontario, Schenectady, Suffolk, Washington and Westchester. Onondaga county with six active firms was first in importance of output, which was valued at $637,796. Erie county with two producers stood second and Ontario county with three was third. Onondaga and Erie counties produced most of the tableware. The electric supplies were made chiefly in Schenectady and Ontario counties.

Value of production of pottery

WARE	1906	1907	1908
Stoneware	$84 031	$65 271	$44 712
Red earthenware	30 234	28 296	31 645
Porcelain and semiporcelain *a*	835 000	1 181 162	900 548
Electric and sanitary supplies	768 236	869 378*b*	595 247
Miscellaneous	77 507	96 788	81 089
	$1 795 008	$2 240 895	$1 653 241

a Includes china tableware and cream-colored ware.
b Includes a value of about $200,000 for hardware trimmings used in electric supplies.

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 shipped to points without the State. In 1908 returns were received from eight producers in this branch of the industry whose total shipments amounted to 4697 short tons valued at $11,605. The corresponding total for 1907 was 3927 short tons valued at $6163, and for 1906 it was 5477 short tons with a value of $9125. Besides slip clay the shipments included fire clay, brick clay and the white clay of Staten Island.

EMERY

There was a large falling off in the production of emery last year, the total amounting to 690 short tons valued at $8860 as compared with 1223 short tons valued at $13,057 in 1907. The decrease in quantity was thus 533 tons and in value $4197. The output was also smaller than in any recent year previously, the total for 1906 having been 1307 short tons valued at $13,870; for 1905, 1475 short tons valued at $12,452 and for 1904, 1148 short tons valued at $17,220. The statistics have been based on the crude material before grinding or other treatment except the rough cobbing to which it was subjected at the quarries. The rock was all shipped from Peekskill and distributed among the manufacturers of emery wheels and other emery abrasives, whose plants are mainly located in Pennsylvania.

The list of producers in 1908 included: Blue Corundum Mining Co., Easton, Pa.; Keystone Emery Mills, Frankford, Pa.; Tanite Co., Stroudsburg, Pa., and J. R. Lancaster, Peekskill. The total emery mined, as above given, exceeded somewhat the shipments from Peekskill, as these amounted to 579 short tons.

The emery is a mixture of corundum, spinel and magnetite, the corundum of course being the ingredient of most value. It occurs as a very hard and dense rock, of dark gray to nearly black color, sometimes showing the corundum in well developed prismatic crystals of lighter shade. There is considerable variation in regard to the mineral composition, and Magnus[1] who examined thin sections of the material reports that in some specimens the corundum constitutes over 50 per cent of the mass, while in others it is almost wanting. The emery occurs in the form of lenses and bands within an area of gabbroic intrusives known as the Cortlandt series. It is to be regarded, doubtless, as a segregation of the

[1] Abrasives of New York. N. Y State Geol. 23d An. Rep't. 1904.

igneous magna, quite similar in general features to the titaniferous magnetites that occur in gabbros and anorthosites. Some of the deposits were worked in the early days for iron ore, but the material proved too refractory for successful treatment in the furnace. The emery is not regarded in the trade as equal to the Grecian or Turkish product, though it is said to be very serviceable when made into wheels with a vitreous bond.

FELDSPAR

The small demand for feldspar among pottery manufacturers last year was reflected in a decreased output of the better grades of the mineral, i. e. the potash feldspars free from iron or other obnoxious impurities. On the other hand, the production of unselected feldspar, such as finds employment for roofing material, poultry grit, abrasive purposes, etc. showed a substantial gain over the quantity reported in 1907.

The occurrence of pegmatite, from which feldspar is obtained, is limited in this State to the Adirondack Precambric area and the southeastern region of crystalline rocks. The pegmatite forms dikes, sheetlike masses or irregular bodies, usually in association with larger masses of allied intrusive rocks of which it often constitutes but a coarser phase. Most occurrences have the composition of granite, containing besides feldspar a considerable proportion of quartz and smaller amounts of mica, hornblende or rarely pyroxene. The presence of iron-bearing minerals has an important bearing upon the quality of the product, since for pottery purposes it is absolutely essential that the feldspar contain nothing more than a trace of iron. When occurring in segregated particles their elimination can be effected sometimes by careful cobbing. In addition to those already enumerated, pyrite, magnetite and tourmalin are among the iron-bearing minerals commonly found in pegmatite. For pottery uses the potash feldspars (microcline and orthoclase) are the only ones produced in New York State and they seem to have the preference in that trade, though for what reason is not well understood. The plagioclase feldspars are found in the Adirondack pegmatites which are chiefly quarried for roofing material.

The quarries now active in the State are situated in Westchester, Essex and Saratoga counties. Those near Bedford, Westchester co. produce most of the pottery feldspar. They are operated by P. H. Kinkel's Sons who grind a large part of the output before shipment. The quartz obtained in the quarry operations also finds sale as a material for making wood filler. In the Adirondacks, the Claspka Mining Co. with a quarry near Batchellerville, Saratoga co. produces a small quantity of pottery feldspar, which is shipped crude to Trenton, N. J. The Crown Point Spar Co., Inc., is a recent enterprise with quarries and a mill near Crown Point. The property at Rock pond, Essex co. formerly owned by the International Mineral Co. is now operated by the Barrett Manufacturing Co. who use the output in the manufacture of "amatite" roofing.

Some attention was given during the past year to an occurrence of pegmatite near Corinth, Saratoga co. The American Feldspar & Milling Co. was organized to develop the property, but no shipments were made, except for experiment. The pegmatite is stated to occur in a dike 60 feet wide and traceable for 2000 feet on the line of strike. The outcrop is about 3 miles distant and 700 feet above the railroad.

The total production of feldspar in New York in 1908 amounted to 14,613 short tons valued at $53,148. The prices received at the quarries for the pottery grades ranged from $3 a long ton for crude to $6.50 a short ton for ground feldspar. The common grades of crushed feldspar brought about $3 a short ton.

GARNET

The conditions in the abrasive garnet trade during 1908 did not encourage activity among the Adirondack mines and the production showed a decided drop from the record figures reported in the preceding year. The demand was affected to some extent by an accumulation of stocks in the hands of abrasive manufacturers carried over from 1907, though the consumption of abrasives ot all kinds was no doubt much below normal. With the improvement noticed in the latter part of the year it is anticipated that market conditions will be more favorable during the current season.

No new companies engaged in the mining of garnet during 1908. The North River Garnet Co. with mines and mill on Thirteenth lake carried on as heretofore the largest operations. For three months in the first part of the year the company's plant was closed down, while in the last three months it ran on a reduced scale. On Gore mountain the mines of H. H. Barton & Sons Co. produced only a fraction of their usual quota. The Crehore mine near North River was inoperative throughout the year. The property of G. W. Smith near Keeseville was taken over under lease by Mr E. Schaaf-Regelman and produced a small quantity of massive garnet, mostly for the foreign market.

A recent feature of the garnet trade has been the appearance of Spanish garnet, which was first imported in 1907. The mineral is said to occur in detrital material along streams and is collected and sorted by hand. It can hardly replace the domestic garnet to any great extent owing to its fine size, though it is imported at a cost much below that attainable by mines in this country. The imports of Spanish garnet in 1907 amounted to a value of $6432. They fell off in 1908 to $2095. The average value placed on the consignments was about $16.40 a long ton, or less than one half the average selling price of domestic garnet. There is no duty on abrasive garnet. Garnet sands are of frequent occurrence along the streams and lake shores of the Adirondacks, but so far as observed they are too finely comminuted to be valuable for abrasive uses.

The output of the Adirondack mines in 1908 amounted to 2480 short tons valued at $79,890. In the preceding year the total was 5709 short tons with a valuation of $174,800. The sales of garnet in 1908 amounted to 1996 short tons. Notwithstanding the small demand, there was no falling off in the prices which have been maintained at about the same level for many years past. The margin of profit is small and most of the output is sold on contracts covering the annual requirements of the consumers.

GRAPHITE

In the graphite industry of New York the most notable feature of the past year was a large decrease in production. The amount reported by the Adirondack mines was 1,932,000 pounds with a valuation of $116,100. In 1907 the total was 2,950,000 pounds valued at $106,951, while in 1906 it was 2,811,582 pounds valued at $96,084. The largest amount reported in any recent year was in 1905 when the production reached 3,897,616 pounds valued at $142,948.

The statistics indicate a considerable gain in the value of the material which averaged 6 cents a pound in 1908 as compared with 3.6 cents a pound in the preceding year, though this may be partly due to a somewhat different standard used in reporting the values last year. The graphite after its first separation from the gangue undergoes repeated refinings, by which products of varying purity and market value are secured. The finest grades of crystalline graphite from the Adirondacks bring from 10 to 20 cents or even more a pound.

The American mine owned by the Joseph Dixon Crucible Co. has for a number of years furnished most of the graphite obtained in the State. The mine is situated at Graphite near Hague on Lake George. The graphite occurs as disseminated scales or flakes in a quartzite of the Precambric series. The quartzite is quite widely distributed in the eastern Adirondacks, but no other locality has been found where it carries so coarse a flake and at the same time is so free from other scaly minerals. The Joseph Dixon Crucible Co. owns a mine also just north of Hague near the lake shore and on Lead hill west of Ticonderoga, but these were not operated in 1908. The product of the American mine, after the first separation at the local mill, is refined at the company's mill at Ticonderoga.

The Crown Point Graphite Co. was operative for a short time only during the past year, as it was engaged in building a mill at the mines near Chilson lake, Essex co. The deposit belongs to a different type than that described above, the graphite occurring in bunches and scattered flakes within beds of crystalline limestone. The process of separation devised by the company is said to consist in crushing the limestone to a powder and recovering the graphite on screens. Where the quartzite is the gangue, the graphite is separated by gravity or flotation methods. The Crown Point Graphite Co. has a finishing mill at Crown Point Center.

The Glens Falls Graphite Co. made a small production in 1908 from the mines at Conklingville, Saratoga co. The graphite is found in a quartz schist, a feldspathic representative of the Precambric sediments.

Extensive beds of the graphitic quartzites occur near Rock pond, Essex co., 7 miles north of the American mine, and have been under development by John D. Bly of Crown Point. The work done in the past year has shown the existence of a rich seam, which assays up to 20 per cent carbon, and a very large area of lower grade rock.

The Saratoga Graphite Co. has been recently organized for the purpose of working a deposit near Saratoga Springs.

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.

Manufacture. Most of the gypsum that is mined or quarried in the State undergoes some kind of preparation before shipment. In the case of the material sold to portland cement manufacturers, however, a portion is shipped in lump form to be later crushed at the cement works and mixed with the clinker before grinding. A part of the gypsum, also, is crushed at the mines and shipped in bags. A very small quantity is sold in calcined condition to cement makers who prefer to use the material in that form. For agricultural purposes the gypsum is always ground to a very fine product which is marketed under the name of land plaster. The manufacture of calcined plasters calls for the greater part of the output of gypsum at the present time. By calcination the gypsum is converted into plaster of paris or stucco in which form it is used largely as a structural material, also for casts, molds and in plate glass manufacture. The calcination is performed generally in vertical kettles, covered at the top, and provided with mechanical stirrers for keeping the material in constant motion so as to prevent overburning. In one or two of the more recently erected plants, the calcining process is carried out in a rotary kiln of the Cummer type, which has an important advantage of being continuous in its work. For plaster of paris the temperature of burning does not exceed 350° to 380° F. as a maximum. Wall plasters and cement plasters are made from plaster of paris by addition of some organic or mineral substance which serves to retard the setting process. Wall plasters may also contain some fiber, such as hair, fibrous talc, or a wood fiber made from basswood or willow. A product known as wall board consists of layers of paper cemented with plaster of paris, forming thin sheets which can be nailed to the studding and joists of buildings in the place of lath and which are then covered with a coat of plaster.

The manufacture of gypsum products is carried on in the State by other than the producing companies, and there are a number of plants that make wall plaster, etc. from gypsum purchased from the local mines or imported. The imported gypsum comes mostly from Nova Scotia. No attempt to secure information of such operations has been made in connection with this report.

The mining companies who are engaged in the calcined plaster trade have plants in Syracuse and vicinity; at Wheatland and Garbutt, Monroe co.; Oakfield, Genesee co.; and Akron, Erie co.

Production and trade. The market conditions last year were rather poor, with a recession in both demand and prices. The decrease in portland cement production affected the trade to some extent, while the falling off in building operations was an adverse factor in the calcined plaster industry. However, the production of crude gypsum showed only a small loss as compared with the record output of 1907. The total reported by the mining companies was 318,046 short tons against 323,323 short tons in 1907, a decrease of 5277 tons, or less than 2 per cent for the year. The output was 262,486 short tons in 1906, 191,860 short tons in 1905, and 151,445 short tons in 1904.

The growth of the industry suffered only a temporary check, and its prosperity in the future seems assured by reason of the inexhaustible character of the local deposits and their exceptional situation with regard to the principal markets. Within the last 10 years the State has gained a leading position in the trade, the production having increased during that period from an average of about 30,000 tons annually to the present total of over 300,000 tons.

Of the quantity of crude rock that was reported as mined or quarried last year about 65 per cent was converted into calcined plasters by the producing companies. Their figures showed a total of 160,930 short tons of plaster of paris, wall plaster, etc. valued at $574.757 as compared with a total output of 145,684 tons valued at $533,265 in 1907. The amount of ground gypsum or land plaster made was 5712 short tons valued at $14,255 against 15,441 short tons valued at $38,859 in 1907. The portion sold in crude condition to cement manufacturers and for other purposes amounted to 95,146 short tons valued at $171,747 against 91,060 short tons valued at $179,432 in the preceding year.

Production of gypsum

MATERIAL	1907		1908	
	Short tons	Value	Short tons	Value
Total output, crude........	323 323	....	318 046	....
Sold crude................	91 060	$179 432	95 146	$171 747
Ground for land plaster....	15 441	38 859	5 712	14 255
Wall plaster, etc. made.....	145 684	533 265	160 930	574 757
Total value...........	....	$751 556	....	$760 759

The Gypsum Products Co. has engaged in the mining of gypsum near Oakfield, Genesee co., shipping a small quantity last year for the first time.

The Interstate Gypsum Co. is a new organization, owning a property near Akron, Erie co.

The Empire Gypsum Co. has erected a calcining plant at Garbutt, Monroe co. The gypsum is taken from the company's mine near by, which is worked on the room and pillar system. The calcining plant is equipped with a jaw crusher, rolls, cylindrical dryer, pulverizer and three 11-ton vertical kettles. The gypsum is manufactured into plaster of paris and wall plaster. A part of the crude rock is shipped to glass factories in the Pittsburg district where it is calcined and employed as cement in the grinding of plate glass.

IRON ORE

The iron mining industry received a decided setback last year and for the first time in a number of years the output showed a decrease. During the decade from 1898 to 1907 the State's production gained steadily, reaching a total of 1,018,013 long tons in the latter year as compared with 179,951 long tons in 1898. Under favorable conditions of the iron trade there would have been a further increase last year, which probably would have set a new mark for the industry in New York. Several properties had been brought to the producing stage when the depression began and compelled a suspension of operations. With the contraction of the market the operative mines reduced their output and a few closed down entirely. Before the end of 1908 conditions showed some improvement, though it can hardly be expected that prosperity will be fully restored much before the close of the current year.

There were 10 companies which reported a production of iron ore in 1908 against 13 companies so reporting in the preceding year. One new producer, the Cheever Iron Ore Co., was added to the list, so that out of the number of active companies in 1907 four were closed down throughout the year.

The accompanying table gives the production of iron ore distributed according to kinds for the period 1890–1908 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. The production of magnetite as given in the table represents high grade ore and concentrates suitable for furnace use and not the mine output which is considerably larger as much of the ore 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
1908	663 648	33 825	Nil	Nil	697 473	2 098 247	3 01

The total output reported by the mines in 1908 was 697,473 long tons valued at $2,098,247. Compared with the preceding year when the output amounted to 1,018,013 long tons valued at $3,750,493 there was a decrease of 320,540 tons or 31 per cent. The average value of the ore was $3.01 a ton against $3.68 a ton in 1907.

Classified as to variety the production consisted of 663,648 long tons of magnetite valued at $2,031,457 and 33,825 long tons of hematite valued at $66,790. A large portion of the magnetite was marketed in the form of concentrates with an approximate content of 65 per cent iron, while the rest was lump ore ranging from about 52 to 60 per cent iron. The hematite ore was mainly derived from the Clinton deposits and probably averaged about 40 per cent in iron content.

In the Adirondack region the active producers were Witherbee, Sherman & Co., and the Port Henry Iron Ore Co. at Mineville; the Chateaugay Ore & Iron Co. at Lyon Mountain; the Cheever Iron Ore Co. at Port Henry; and the Benson Mines Co. at Benson Mines. The producers in southeastern New York were the Sterling Iron & Railway Co., who operated the Lake mine, and the Hudson Iron Co., who operated the Forest of Dean mine.

The output of hematite was made by the Old Sterling Iron Co. with mines near Antwerp, Jefferson co., and by the Furnaceville Iron Ore Co. of Ontario Center, Wayne co. and C. A. Borst of

Clinton, Oneida co. The Rossie Iron Ore Co., the Fair Haven Iron Co. and the Ontario Iron Ore Co., who were active in 1907, made no output last year.

Mineville. Though there was less activity in mining last year, the properties of both Witherbee, Sherman & Co. and the Port Henry Iron Ore Co. continued in steady operation. The output of the two companies totaled 502,663 long tons as compared with 751,155 long tons in 1907, which was the largest amount hitherto recorded for the district. The Old Bed mines, which include the "21," Joker and Bonanza workings, contributed the larger part of the total, the remainder coming from the Harmony shafts, Smith mine and Barton hill tunnel which belong to Witherbee, Sherman & Co.

Despite the contraction of mine output there has been no interruption in the progress of the works of development and improvement that were started previous to the depression, and the conditions of the properties may be considered as better than at any time in the past. With the return of a normal iron market the companies will be able to profit from an increased output which can be maintained from present ore reserves for several years to come. The combined productive capacity of the two companies is now about 1,000,000 tons a year.

The principal underground developments during the year were connected with the new shaft of the Port Henry Iron Ore Co. on the "21" property, and the exploration in the Joker-Bonanza, Harmony and Barton hill mines by Witherbee, Sherman & Co. The shaft sunk by the former company was bottomed at a depth between 500 and 600 feet and the ore was encountered within a short distance. It will have a hoisting capacity of 1500 tons a day, more than twice the output formerly secured from the incline.

The results obtained with the diamond drill in exploring the southerly part of the Joker-Bonanza ground during the past year afforded much new information regarding the form of that deposit and brought to light the existence of another magnetite body below it. In the southernmost sections some change was shown in the shape of the Bonanza-Joker body as previously mapped,[1] though the exact modifications can not now be fully stated. Drill holes put down into the foot wall from the workings above revealed a

[1] See description by J. F. Kemp in N. Y. State Mus. Bul. 119. 1908. p. 72 *et seq.*

magnetite deposit apparently of large extent. In one hole 71 feet of ore was encountered split into two portions by a horse, and in another hole 34 feet of solid ore was found. The ore probably belonged to a single seam, but further exploration will be necessary to clear up the relations. The Harmony mines, the most recent of the Mineville workings, made a good record and will be capable of a large yield when in full operation. Some of the ore now mined can scarcely be distinguished from the rich, coarsely crystalline magnetite found in the Barton hill group. The latter mines were not actively exploited last year as work was concentrated on the new adit designed to tap the ore bodies in their downward extension. The adit was driven to a point 500 feet north of the old Arch pit, or 1700 feet from the portal. Ore was found in a nearly continuous seam, but of variable thickness, sharply compressed in places and again swelling out to form a body of good size. The deposits were thus far from exhausted by the early operations.

Lake Sanford. The exploration of the titaniferous magnetites near Lake Sanford, Essex co. was continued in 1908 with results fully commensurate with anticipations. Up to October 1, 1908 the Tahawus Iron Co., who recently took over the properties, had drilled 26 holes on the Sanford ore body to an average depth of 199 feet without reaching the lower limits of the ore. The available ore in this deposit alone amounts to many millions of tons. Experiments in mill treatment have confirmed the view that a portion of the titanium can be removed by crushing and passing over magnetic separators with additional benefit as regards the iron content. A product averaging about 60 per cent iron and not more than 6 or 7 per cent titanium can be made without difficulty. The company has secured a charter for the construction of an electric road which will probably be built from Lake Champlain to Tahawus. An alternative route has been surveyed from the Adirondack branch of the Delaware & Hudson Railroad.

Lyon Mountain. Owing to the destruction by fire of the new mill early in 1908 the mines at Lyon Mountain did not make the expected output last year. The loss of the plant was critical, inasmuch as many improvements in the way of a central electric power station, new trackage, etc. had just been completed that should have led to important economies. The old mill was again placed in commission.

Benson mines. The Benson Mines Co. was operative during a part of the year, but made only a fraction of the output of which the mines are capable. An important addition to the equipment that is to be provided according to the company's plans is a nodulizing plant for the treatment of the concentrates. The process of nodulizing iron ore was first applied to the residues obtained from burning pyrites in the manufacture of acids. Experiments with the process on some magnetic concentrates have shown that it has a beneficial effect in lowering the sulfur content and agglomerating the fine particles into lumps that are better adapted for the blast furnace. The apparatus employed for the purpose consists of a long rotary kiln usually heated by gas, into which the material is fed and where it is subjected to a temperature that produces incipient fusion. The rotary motion of the kiln prevents the formation of a solid cake and the product comes out in the form of nodules or lumps from ¼ to ½ inch in diameter. Though magnetite is one of the most resistant minerals to heat, it is said that the nodulizing of concentrates can be effected without difficulty, probably owing to the small quantities of impurities present and the influence of the highly heated gases which may reduce it partially to metallic condition.

Salisbury mine. This mine situated 2 miles north of Salisbury Center, Herkimer co. is expected to begin shipments during the current season. It has been under development for some time by the Salisbury Steel & Iron Co. The mining and milling plants have been nearly completed and the railroad extended 6 miles north from Dolgeville to the mill site at Irondale. The mill has a capacity of 500 tons crude ore a day; it is equipped with Ball-Norton drum and belt type of magnetic separators which have been so successfully used elsewhere on Adirondack magnetites. A cobbing machine is designed to effect a preliminary separation of the lump ore as mined into furnace and mill products. The mill stands at the base of the hill below the main shaft with which it is connected by means of a Bleichert aerial tramway 6250 feet long. Gas engines of 750 horse power using producer gas will supply power for the mines and mill. The installation and developments completed and under way call for an expenditure of about $500,000.

Clinton hematite mines. There was a cessation of development work on the Clinton belt last year and only two mines made any shipments. The producers were C. A. Borst at Clinton and the Furnaceville Iron Ore Co. at Ontario Center. A resumption of activity may be expected with the return of favorable trade conditions.

A detailed account of the Clinton ores and their local occurrence was published in 1908 by the New York State Museum.[1] The resources in these ores were found to be very large, the estimated quantity available in the three principal areas taking into account only seams above 18 inches thick and within 500 feet from the surface reaching 600,000,000 tons. Though, of course, much of this will not be commercially mineable for a long time to come, yet there are large quantities so situated as to permit extraction at a comparatively low cost.

MILLSTONES

The production of millstones, although much smaller than formerly, is still an important industry in certain sections of Ulster county. This area furnishes nearly all of the millstones produced in the United States, the other producing states being Pennsylvania, Virginia and North Carolina. In addition to the domestic supply a large number of millstones and buhrstones are annually imported from France and other European countries.

The New York stone is known as Esopus stone, a name derived from a former name for Kingston, which was an important shipping point. It is a firm white conglomerate varying in fineness from that of a coarse sandstone to a coarse conglomerate with some pebbles 2 inches in diameter. It is composed of partially rounded whitish quartz pebbles in a silicious matrix. The stone is obtained from certain beds of Shawangunk grit, a rock lying unconformably upon the Hudson River shales and formerly correlated with the Oneida conglomerate, but now known to lie in the horizon of the Salina. Its thickness varies from 50 to 200 feet.

The quarrying operations are carried on along the northern border of the Shawangunk mountain, in Rochester and Wawarsing townships, Ulster co., mainly along the line of the New York, Ontario and Western Railroad at Wawarsing, Kerhonkson, Accord, Kyserike, Granite, St Josen and Alligerville, while New Paltz and Kingston also are shipping points.

Quarrying is carried on with but a small equipment, the stone being worked out by hand bars, wedges and sometimes with the use of powder. It is dressed by hand at the quarry into millstones and chasers. The millstones are dressed into stones varying in

[1] Iron Ores of the Clinton Formation in New York State, by D. H. Newland & C. A. Hartnagel. N. Y. State Mus. Bul. 123.

diameter from 15 inches to 54 inches or even larger and are used for the grinding of paint, grain, cement, gypsum etc. The chasers are stones dressed to run on edge on a platform of blocks of the same material, and are used in grinding heavier material such as quartz, feldspar, barite etc. Depending largely on their weight for crushing the fragments, they are of large size varying in diameter, as produced in 1908, from 54 to 72 inches.

The production has been decreasing steadily for some years owing to the introduction of roller mills in flour making, and ball mills, emery stones and other improved grinding machinery in other industries. The demand for millstones is now largely from corn-grinding mills in the south and from gypsum and plaster mills, while chasers are still used in quartz, feldspar and barite mills.

Millstones varied in value in 1908 from $3 for 15 inch, to $45 for 54 inch stones, while chasers sold for $30 to $70 varying in size from 54 to 72 inches.

The production in 1908 amounted to $18,341 as against $21,806 in 1907. The number of millstones made was 871 and chasers 182, and in addition a small production of blocks and disks for use in roll crushers.

MINERAL PAINT

Under this title are included the natural mineral colors which require nothing more than washing or grinding in their preparation for the market. The raw materials found in the State that have been used for the purposes are iron ore, ocher, shale and slate. New York is also one of the leading producers of artificial pigments, specially those made from lead, but the crude materials are mostly derived from without the State.

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

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

Both shale and slate are ground for mineral paint, their color depending largely upon the amount and character of the iron oxids present. When there is a large proportion of ferric oxid the shale and slate may be sold as metallic paint. At Randolph, Cattaraugus co. beds of green, brown and bluish shale occurring in the Chemung formation have been worked by the Elko Paint Co. In years past red shale from the base of the Salina formation has been obtained in Herkimer county for paint. A similar material occurring in the Catskill series has been worked at Roxbury, Delaware co. The red slate of Washington county, which belongs to the Cambric, is also ground for paint. The Algonquin Red Slate Co. of Worcester, Mass. and A. J. Hurd of Eagle Bridge, are producers of this material.

A product known as mineral black has been made from the slates found in the Hudson River series. Certain beds contain considerable carbon in a finely divided almost graphitic condition which gives them a dense black color.

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

The production of mineral paints in 1908 was as follows: metallic paint and mortar color, 5750 short tons valued at $54,500; slate pigment 922 short tons valued at $7376. In 1907 the following quantities were reported: metallic paint and mortar color 5269 short tons valued at $59,521; slate pigment 620 short tons valued at $3700. These quantities include only the output made by manufacturers within the State from local materials.

MINERAL WATERS

New York has held for a long time a leading position among the states in the utilization of mineral waters. The different springs, of which over 200 have been listed as productive at one time or another, yield a great variety of waters in respect to the character and amount of their dissolved solids. There are some that contain relatively large amounts of mineral ingredients and are specially valuable for medicinal purposes; Saratoga Springs, Ballston Springs, Richfield Springs and Lebanon Springs are among the more noted localities for such waters. Numerous other springs are more particularly adapted for table use, containing only sufficient mineral matter perhaps to give them a pleasantly saline taste. Both kinds of waters are generally carbonated and sold in small bottles.

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

Character of mineral waters. Among the spring waters that contain mineral ingredients in appreciable quantity those characterized by the presence of alkalis and alkaline earths are the most abundant in 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 occurring 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.

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

Carbon dioxid. Besides the sale of mineral waters, an extensive industry has been developed in the State in connection with carbon dioxid which is given off by some of the springs. The collection, storage and shipment of the gas for use in making carbonated beverages and for other purposes have received attention at Saratoga Springs, where the industry has become of greater importance even, as regards the value of the output, than the trade in the mineral waters themselves. Over 30 wells have been driven in that vicinity for gas alone. The carbon dioxid is pumped to the surface together with the water, separated from the latter at the well and then conveyed to gas holders, similar to those used by municipal gas plants, where it is stored preparatory to charging into cylinders. The cylinders are made to withstand the heavy pressure necessary to liquefy the gas and are of two sizes, the smaller holding about 25 pounds and the larger from 40 to 50 pounds. The principal producers are the New York Carbonic Acid Gas Co., the Lincoln Spring Co. and the Natural Carbonic Gas Co. The gas is said to be superior to that produced by the calcination of magnesite or other artificial methods.

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

NAME	LOCALITY
Baldwin Mineral Spring	Cayuga, Cayuga co.
Diamond Rock Spring	Cherry Creek, Chautauqua co.
Mrs D. N. Palmer	West Portland, Chautauqua co.
Breesport Oxygenated Mineral Spring	Breesport, Chemung co.
Chemung Valley Spring	Elmira, Chemung co.
Chemung Spring	Chemung, Chemung co.
Lebanon Mineral Spring	Lebanon, Columbia co.
Monarch Spring	Matteawan, Dutchess co.
Mt Beacon Spring	Matteawan, Dutchess co.
Mount View Spring	Poughkeepsie, Dutchess co.
Ayers Amherst Mineral Spring	Williamsville, Erie co.
Lehn Rock Spring	Williamsville, Erie co.
Beauty Spring Water Co.	Lyons Falls, Lewis co.
Cold Spring	New York Mills, Oneida co.
Glacier Spring	Franklin Springs, Oneida co.
Lithia Polaris Spring	Boonville, Oneida co.
G. Wells Smith	Franklin Springs, Oneida co.
W. W. Warner	Franklin Springs, Oneida co.
Geneva Lithia Spring	Geneva, Ontario co.
Red Cross Spring	Geneva, Ontario co.
Crystal Spring	Oswego, Oswego co.
Deep Rock Spring	Oswego, Oswego co.
Great Bear Spring	Fulton, Oswego co.
J. Heagerty	Oswego, Oswego co.
Os-we-go Spring	Oswego, Oswego co.
Redstone Spring	Oswego, Oswego co.
Mammoth Spring	North Greenbush, Rensselaer co.
Shell Rock Spring	East Greenbush, Rensselaer co.
City Spring	Rosebank, Richmond co.
Massena Mineral Spring	Massena Springs, St Lawrence co.
Arondack Spring	Saratoga Springs, Saratoga co.
Artesian Lithia Spring	Saratoga Springs, Saratoga co.
Chief Spring	Saratoga Springs, Saratoga co.
Congress Spring	Saratoga Springs, Saratoga co.
Geyser Spring	Saratoga Springs, Saratoga co.
Hathorn Spring	Saratoga Springs, Saratoga co.
Hides Franklin Spring	Saratoga Springs, Saratoga co.
High Rock Spring	Saratoga Springs, Saratoga co.
Patterson Mineral Spring	Saratoga Springs, Saratoga co.
Saratoga Seltzer Spring	Saratoga Springs, Saratoga co.
Saratoga Carlsbad Spring	Saratoga Springs, Saratoga co.
Star Spring	Saratoga Springs, Saratoga co.
Washington Lithia Spring	Saratoga Springs, Saratoga co.
Red Jacket Spring	Seneca Falls, Seneca co.
H. W. Knight	Seneca Falls, Seneca co.

NAME	LOCALITY
Pleasant Valley Mineral Spring	Rheims, Steuben co.
Sulphur Spring	Hornby, Steuben co.
Setauket Spring	Setauket, Suffolk co.
Sparko Crystal Spring	Huntington, Suffolk co.
Elixir Spring	Clintondale, Ulster co.
Sun Ray Spring	Ellenville, Ulster co.
Vita Spring	Fort Edward, Washington co.
Briarcliff Table Water	Briarcliff Manor, Westchester co.
Gramatan Spring Water Co.	Bronxville, Westchester co.
Putnam Spring Water Co.	Peekskill, Westchester co.

Production. The magnitude of the business carried on in connection with the production and sale of mineral waters is shown by statistics received for the year 1908. The number of springs reporting sales was 48, and the amount of water sold was 8,007,092 gallons valued at $877,648. The value is based on the retail prices, but does not include bottles or carriage. The statistics are known to be incomplete, but it is almost impossible to make a thorough canvass owing to the many changes that take place in the industry from year to year. No account has been made of the water used locally in hotels, sanatoriums etc. The actual value of the production was probably not far from $1,000,000.

In addition the production of carbon dioxid from the wells at Saratoga Springs should be taken into account. In recent years this has amounted to between 4,000,000 and 5,000,000 pounds with an average value probably of about $300,000.

Business in 1908 was generally below the normal. The spring resorts were especially affected by the financial depression and were frequented by greatly reduced numbers. In the case of Saratoga Springs the season was the worst that has been experienced in a long time, due to a combination of circumstances, of which the dissensions among the proprietors of the springs have not been the least influential. The courts were applied to for injunctions against the carbon dioxid producers while a law was passed by the Legislature prohibiting the use of pumps to increase the flow of the springs. A more recent development has been the securing of a legislative enactment to bring the springs under State supervision by purchase of the land on which the more important wells are located.

Analyses of new springs. The following analyses relating to new springs have been reported. The Diamond Rock Spring is situated at Cherry Creek, Chautauqua co., the Redstone Spring at Oswego and the Weedsport Spring at Weedsport, Cayuga co. All are examples of the spring waters of nonmedicinal character that are sold for family and office use. The amounts of dissolved mineral matter are expressed in grains per United States gallon.

	DIAMOND ROCK SPRING	REDSTONE SPRING	WEEDSPORT SPRING
$NaCl$	.48	31.41	.03
$CaSO_4$	9.36	....	8.54
$MgSO_4$	1.88	....	1.29
Na_2SO_4	....	3.40	.22
K_2SO_4	.07	....	....
$CaCO_3$	....	2.19	1.74
$FeCO_3$	....	....	.06
Na_2CO_3	*a*.43	7.64	....
$MgCO_3$	*b*3.09	1.17	....
$NaNO_3$	.74	....	....
SiO_2	tr	.35	....
CO_2 (free)	....	....	2.66

*a*Reported as $NaHCO_3$.
*b*Reported as $Mg(HCO_3)_2$.

NATURAL GAS

The natural gas fields of the State are found in the central and western parts, south from Lake Ontario. There are 15 counties that contain productive fields. Though scarcely comparable as regards size with the gas pools found in the Appalachian region farther south, the fields appear to have a long life, as instanced by those in Chautauqua county where the first holes were put down over 80 years ago and which are still productive. The gas fields of Cattaraugus county have been under development since 1865. Despite the continuous drain upon the resources, the yield of gas has increased markedly of recent years in response to the greater activity in exploration.

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, Brockton, 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. The information received for the year 1908 showed that there were about 1000 gas wells in the State, the output of which was used for lighting and heating purposes, not including the wells in the oil regions of Cattaraugus and Allegany counties that supplied gas for pumping petroleum. The wells were operated by about 200 individuals and companies. Chautauqua county had more than one half of the total number of producers, though most of them were individuals operating only a single well for private use. Aside from them the production of the fields was largely controlled by 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 as nearly as it can be distributed. The total value in 1908 amounted to $987,775 against a value of $800,014 in 1907, a gain of $187,761 for the year.

Production of natural gas

COUNTY	1905	1906	1907	1908
Allegany-Cattaraugus	$204 430	$247 208	$250 159	$264 736
Chautauqua	26 232	94 345	106 411	153 019
Erie*a*	281 253	317 554	320 199	451 869
Livingston*b*	41 805	52 805	55 780	54 083
Onondaga	16 825	16 385	17 030	13 837
Oswego	13 583	13 182	10 585	12 800
Wyoming*c*	22 872	25 100	39 850	37 431
Total	$607 000	$766 579	$800 014	$987 775

a Includes a part of the production of Genesee county.
b Includes also Seneca, Schuyler, Steuben, Ontario and Yates counties.
c Includes also Niagara and Genesee counties.

The quantity of gas produced in 1908 was approximately 3,860,000,000 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 the flow, the estimate is very close to the actual production. No account is made, however, of the gas consumed by oil producers for pumping. The quantity of gas yielded by the wells in 1907 was 3,052,145,000 cubic feet; in 1906, 3,007,086,000 cubic feet; and in 1905, 2,399,987,000 cubic feet. The value of the natural gas reported by the producing companies varied 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 1908 was about 26 cents a thousand.

New developments. There was unusual activity shown last year in the drilling of new wells and the results on the whole were very encouraging as indicated by the augmented production.

In Chautauqua county the principal developments have been in the fields near Silver Creek, Sheridan and Westfield, on the shores of Lake Erie, where the gas is found at depths of from 1900 to 2300 feet in what is considered the white Medina sandstone. At Silver Creek and Sheridan the South Shore Natural Gas Fuel Co. and the Silver Creek Gas & Improvement Co. have drilled a number of wells in the past three or four years. The latter company alone has 25 wells. The companies supply Sheridan, Silver Creek, Forestville and Dunkirk. The Welch Gas Co. at Westfield has three producing wells, of which one was completed in 1908. This well found the gas at 2230 feet. The Frost Gas Co. completed five new wells last year making 14 in all. The wells are located in the towns of Sheridan and Pomfret at depths of from 1900 to 2100 feet, and the gas is piped to Dunkirk.

Important developments have been made recently near Pavilion, Genesee co. by the Pavilion Natural Gas Co. and the Alden-Batavia Natural Gas Co. The former company has nine wells which supply gas to Leroy and Pavilion. The Alden-Batavia Co. has eight wells in the same vicinity the flow of which is piped to Pavilion and Batavia. One well was completed in 1908, which gave a flow of 500,000 cubic feet a day from a depth of 1700 feet. The same company drilled a well at Fargo in the town of Darien finding gas at 1249 feet.

PEAT

There have been no practical developments in the utilization of the peat deposits of the State since those mentioned in the issue of this report for the year 1906. The subject has continued to receive much attention, however, and further experiments along similar lines may follow. The results thus far attained in the use of peat for fuel purposes seem discouraging enough though they should be judged perhaps as bearing upon the success of special processes rather than as having much significance with regard to the ultimate outcome of experimentation.

The destruction by fire last year of the peat plant erected by the International Fuel & Power Co. for operation on Black lake unfortunately prevented the publication of any details of its efficiency under working conditions. This was the most extensive enterprise that has yet been undertaken in this country and involved an outlay, it is reported, of about $200,000. The peat was to be excavated by dredging, dried artificially and made into briquets; all the machinery requisite for the work was mounted on a self-propelling barge. Though up to the present no active steps have been taken to rebuild the plant, investigations of the peat deposits in Black lake and vicinity have been under way.

Experiments in connection with the use of peat in paper manufacture, to which reference was made in a previous report, have not yielded any apparent results, so far as the establishment of an industry is concerned. The company that was organized for developing the peat beds near Oswego was a subsidiary of the enterprise at Capac, Mich. which operated for a time making coarse grades of paper from peat. Samples of peat from Oswego and Glens Falls were treated in the Michigan plant, and the material from the former place was reported as well adapted for use in paper.

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 permanence of the pools. Many of the wells drilled 25 years ago or more are still producing a sufficient quantity to make their operation profitable. Practically all of the production is now 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 remunerative. The product is transported to the refineries by pipe lines. The following companies handle practically all of the output of 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 1908 amounted to 1,160,128 barrels as compared with 1,052,324 barrels in the preceding year. The following table shows the total in each year since 1891. The statistics are from the *Mineral Resources of the United States Geological Survey,* except those for the years 1904 to 1907 inclusive which have been compiled from the receipts of oil reported by the companies above mentioned.

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
1908	1 160 128	2 071 533

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

The records of new wells for 1908 as compiled and published by the *Oil City Derrick* show that about 450 wells were completed during the year in New York State. Of the number 60 were "dry" holes and the increment from the new production amounted to about 750 barrels a day.

PYRITE

The St Lawrence Pyrite Co. with mines at Hermon, St Lawrence co. was the only active producer of pyrite during the past year. The American mine near Gouverneur was closed down in 1907 and, though subsequent exploratory work revealed new supplies of ore, there seems to be little likelihood of a resumption of operations in the near future. The High Falls deposits which were taken over on option by the Oliver Mining Co. made a small output in the way of experiment, but no regular mining was undertaken.

A brief account of the St Lawrence county deposits was given in previous issues of this report. Further details relating to the mining and milling of the ores have been published by Felix A. Vogel of the St Lawrence Pyrite Co.[1] This company acquired

[1] The Mineral Industry. 1908. 16:845–51.

the old Stella mines in 1905 to which it subsequently added other property until its holdings now aggregate about 25,000 acres. At the start Stella no. 2 mine was unwatered and explored, and connection was made with the Stella no. 1 mine situated 800 feet to the south which was found to be on the same vein. A second deposit known as the Anna vein, situated below and 1600 feet southeast of the Stella, was then developed.

The Stella veins dip about 28°, while the shaft on the Anna vein has a slope of 45°. The dip is toward the northwest. The ore is hoisted through no. 1 shaft on the Stella and no. 4 on the Anna vein. In the former mine levels are run at close intervals owing to the flat dip, and the ore is removed by breast stoping. The Anna vein is worked in levels 75 feet apart by stoping and milling. This vein is paralleled by several deposits within the hanging wall which have been intersected by a crosscut from no. 4 shaft. Very little water is encountered in the workings.

The deposits are described by Mr Vogel as bedded veins conformable to the gneisses and schists which inclose them. They are apparently related to certain igneous intrusions, though their precise derivation is not known. The ore carries from 15 to 40 per cent sulfur, the highest grade being found in the old Stella mine. The Anna vein averages 24 per cent.

The mill erected by the St Lawrence Pyrite Co. has a capacity of 500 tons a day. Concentration is effected by Hancock jigs, supplemented by Hartz jigs and Overstrom tables. The concentrates carry from 40 to 48 per cent sulfur. They are shipped to acid burners in the East and Middle West.

SALT

The salt producers of the State felt the effects of the commercial crisis last year, though in respect to output their showing was relatively better than that made by many other branches of the mineral industry. The depression, however, served to check for the time the upward progress of the local trade. For many years the industry had undergone rapid and almost uninterrupted growth which placed it in a leading position among the salt-producing states of the country. The output of nearly 10,000,000 barrels reported in 1907 was about one third of the total recorded for the United States in that year and showed a sixfold increase for the local industry during the last quarter of a century.

The total quantity of salt produced from mines and wells in

1908 was 9,005,311 barrels of 280 pounds against 9,657,543 barrels in the preceding year. The decrease amounted to 652,232 barrels, or a little under 7 per cent. The value of the output was $2,136,736 as compared with $2,449,178 for 1907. The production fell a little short of the quantity reported in 1906, but was larger than any total reported previous to that year.

Expressed on a tonnage basis the output last year amounted to 1,260,743.5 short tons against 1,352,056 short tons in 1907, showing a decrease of 91,312.5 short tons.

A smaller output was indicated in the returns for both brine salt and rock salt, though the former showed relatively a greater loss. It is to be noted, however, that only a part of the brine salt included in the production of the State was actually sold or used in that form. The largest producer of brine, the Solvay Process Co., consumed all of its output in the manufacture of soda products, including soda ash, carbonate, bicarbonate etc. With this single exception the companies who were engaged in the industry marketed their product in the form of rock and brine salt.

There were 32 mines or works that contributed to the production last year, as compared with 33 in 1907. They were distributed among the following counties: Genesee 1, Livingston 3, Onondaga 20, Schuyler 2, Tompkins 3, Wyoming 3. The International Salt Co., which is the largest producer of the various grades of brine salt for the market, operated three plants: Ithaca works, Ithaca; Cayuga works, Myers and Glen works, Watkins. The Yorkshire works at Warsaw, operated by the company in 1907, were inactive last year. There were no new firms added to the list during the year.

The large number of plants in Onondaga county may be explained by the development of the solar process of salt manufacture in Syracuse and vicinity where it has been carried on for a long time by individuals and companies who have received their supply of brine from wells located on State lands. The brines are distributed among the evaporating plants through pipe lines. The control of the lands and wells was relinquished by the State last year through a sale to the Onondaga Pipe Line Co. and the Mutual Pipe Line Co. of Syracuse. The property was transferred for the nominal sum of $15,000. This terminated the long established interests of the State in salt manufacture. The output of solar salt in Syracuse and vicinity has been marketed for many years through the Onondaga Coarse Salt Association.

Details as to the production of salt in 1907 and 1908 are given herewith. The various grades listed as common fine, common coarse, table and dairy, coarse solar and packers are those employed in the trade and are based upon the methods of manufacture and purposes for which the salt is used. Table and dairy salt includes the finest grades of artificially evaporated salt, specially prepared for the table and for butter and cheese making; it brings the highest price in the market. Under common fine is listed the other grades of fine, artificially evaporated salt that are not specially prepared. Common coarse represents the coarser product from artificial evaporation, while coarse solar is that made by the solar process. This process is used only by the manufacturers in Onondaga county. Packers salt includes the product sold to meat packers and fish salters. Under "Other grades" are listed agricultural salt and other kinds not specified in the returns from producers, as well as the entire output of rock salt and of salt in brine used for the manufacture of soda products. As will be observed the salt thus listed bears a much smaller value per barrel than the grades first mentioned, due largely to the fact that the salt consumed in brine is given only a nominal valuation.

Of the different counties that were represented in the returns received for 1908, Onondaga held first place in regard to output, though most of its production was made by the Solvay Process Co. and was not marketed in the form of salt. The relative rank of the counties according to their output of marketable salt was as follows: Livingston, Wyoming, Tompkins, Schuyler, Onondaga and Genesee.

Livingston county furnished the entire product of rock salt. The Retsof Mining Co. operated the mine at Retsof and the Sterling Salt Co. the mine at Cuylerville. The latter mine began production in the fall of 1906. Mines were opened several years ago at Livonia and Greigsville, but they have not been recently active. The single manufacturer of brine salt in Livingston county was the Genesee Salt Co. with works at Piffard. The combined output of rock and brine salt from the county in 1908 was valued at $842,594.

Wyoming county, represented by the Iroquois Salt Co. of Perry, the Rock Glen Salt Co. of Rock Glen and the Worcester Salt Co. of Silver Springs, made an output valued at $352,281.

In an accompanying table is given the production of salt in New York State during the period of 25 years from 1884 to 1908 inclusive. It is noticeable that while the industry has grown rapidly the value of the product has increased in a much smaller ratio. The figures for the years previous to 1904 are quoted from the annual volumes of the *Mineral Resources.*

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
Other grades*a*	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.

Production of salt by grades in 1908

GRADE	BARRELS	VALUE	VALUE PER BARREL
Common fine*a*	941 682	$372 485	$ .39
Common coarse	194 593	72 427	.37
Table and dairy	1 188 636	631 987	.53
Coarse solar	520 607	117 136	.22
Packers	36 114	14 515	.40
Other grades*b*	6 123 679	928 186	.15
Total	9 005 311	$2 136 736	$ .237

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

Production of salt in New York since 1884

YEAR	BARRELS	VALUE
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
1908	9 005 311	2 136 736

SAND AND GRAVEL

BY HENRY LEIGHTON

The sand industry is one of New York State's large mineral industries and deserves recognition in a statistical summary of mining and quarry operations. It can best be discussed by dividing it into its various branches.

Molding sand. One of the most important uses of sand is in the casting of the metals — brass, iron, steel etc.— the sand being used in forming the mold around which, or into which, the molten metal is poured and allowed to cool.

Owing to the various metals used, the variations in size, shape and complexity of the castings, and to the various methods in use by foundrymen, it is impossible to define in a general way the characters of a molding sand. All kinds of sand are used, both singly and in admixture with other sands, clays, glues, molasses etc., each serving for a distinct variety of casting.

Sharp, angular sand free from clay, sandy loam, clayey sand and even fine gravel are all used in the foundries, but the material having by far the most universal use and serving the most purposes, is a fine grained clayey sand or loam, and it will be the only type of molding sand discussed in this paper.

Although an experienced foundryman can usually gage quite accurately the value of a sand by an ordinary visual examination and the " feel " of a moist sample, yet there are definite qualities which a sand must possess in order to be classed as a brass sand, core sand, sand for rough castings, etc.

A pure white quartz sand when moistened and packed into a definite form, seems to have no tendency to " stand up " well in a firm mass, but on the slightest touch crumbles and falls apart. In casting, the sand must be of such a character that after firmly tamping it around the pattern, the latter may be drawn out and the walls or projections of the cavity will retain their position until the metal can be poured in, and also exposed portions must resist the abrading action of the stream of metal. This property is termed the " bonding power " and can be measured by various means such as by making briquets of the sand and determining their tensile strength. The chief factors determining the bonding power are (1) the amount of clay present in the sand; (2) the amount of water with which it was tempered; (3) the amount of tamping given it. In special cases various clays or certain organic substances are added to increase the bonding power. In a series of tests made on molding sands of Wisconsin[1] the clay percentage ranged from a slight amount up to 39.44 per cent with an average in 34 samples of 13.18 per cent. After the sand has been several times subjected to the heat in casting, its clay content becomes dehydrated, loses its plasticity and bonding power and the sand becomes " dead."

Permeability is the property which all molding sands must possess to a certain extent, of allowing the steam, heated air, or other gases to pass through the pores of the sand and escape during the casting. The permeability of a sand depends upon the amount of pore space or voids and upon the shape and size of such voids, the latter factor being as important as the former. The work of King and Slichter[2] has demonstrated that the porosity of a sand depends on the size and arrangement of the grains, that a sand composed of well rounded grains will have a smaller amount of

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[1] Ries. Wis. Geol. Sur. Bul. 15. 1906. p. 205.

[2] U. S. Geol. Sur. 19th An. Rep't, pt. 2, p.209–15, 306.

pore space when tamped than a sharp, angular sand, that a fine grained sand will usually have a greater porosity than a coarse grained, and that the minimum porosity can be obtained by a mixture of rounded grains of several sizes.

If a sand does not possess the desired permeability a mixture of some other sand is often added to increase the pore space. The coarser sands, since they have the larger pores, although their total porosity may be less than a fine sand, have usually the greater permeability.

The size of the particles is of importance in determining the use of the sand. For a brass casting, for small iron castings or for any work which requires delicate lines in the mold, a fine sand is very essential, and sand for such work usually will pass almost completely through a sieve with 100 meshes to the inch. Sands for general iron casting are often much coarser, while the sands used in making cores are very coarse, sometimes almost ranging into gravels.

Chemical analysis, although of less importance than a physical examination, sometimes indicates the importance of detrimental impurities such as calcium carbonate, an excess of iron oxids, etc. Microscopic examination may also show certain minerals which would be easily attacked by the hot metal, but ordinarily these are of rare occurrence in molding sands.

Distribution. As we have already seen, sands used for molding purposes have a wide range in character and are therefore not strictly limited to one type of occurrence. They occur both as residual deposits, alluvial and beach sand of both Quaternary and present age and as glacial deposits, all of which types are represented in this State. The most widely known molding sand in the State and a sand recognized as a standard by foundrymen is the Quaternary sands bordering the Hudson river and extensively worked in Saratoga, Schenectady and Albany counties. Other counties in the same belt producing molding sand at the present time are Essex, Rensselaer, Greene, Dutchess, Orange and Washington. The sand throughout this area is very easily obtained, as it lies in beds covered only by a thin coating of soil or sod. The soil and sod over an area of a few rods is carefully stripped off until the sand is reached. The sand is taken out and transported to the railroad or river and either piled in large rectangular heaps or placed directly in cars, or loaded into barges. The beds of good sand vary from 8 inches up to 8 feet in thickness, and a bed 1 foot thick over 1 acre yields approximately 1200 tons. The finer grades of sand usually occur in the thinner beds. As a rule, beds under 8 inches in thickness are not taken out. The dealers generally buy the sand rights of an area from the owner, paying him $75 to $800 per acre for the privilege of removing the sand, the work being done by men acquainted with the various grades and their value. After the sand has been removed and the soil or sod replaced the farm is as well suited for agricultural purposes as before.

Scattered throughout the rest of the State are numerous sand beds which are being worked for molding sand as well as for building sand. They are mainly Quaternary sands deposited in isolated patches by the action of glacial waters during the glacial period. Returns have been received from Erie, Livingston, Cayuga, Niagara and Oneida counties, the latter two counties producing only core sand.

Near Poughkeepsie at one time a residual sand overlying a Potsdam limestone was quarried and used as a molding sand.[1]

The large railroad foundries at Dunkirk and Depew are largely supplied with molding sand from Erie county.

The statistics gathered from the molding sand producers, although not complete, indicate in a general way the importance of the industry, the total production for last year being 312,819 short tons valued at $277,290. Comparing this with the production in 1907 (693,293 short tons valued at $539,674) as given by the United States Geological Survey we note a decided falling off. This is probably due, however, to the sluggishness of all iron and steel work during the year. Of the total amount the Hudson river region contributed 299,320 tons valued at $270,145. From counties outside of this area returns are incomplete, the production in Erie county and vicinity being of much greater importance than the returns would indicate.

Core sand used in connection with molding sand is obtained at scattered localities, the county showing the largest production being Oneida. The total production of the State was 27,624 short tons valued at $22,371.

Glass sand. The use of sand in the manufacture of glass is an important feature of the sand trade, and sand suitable for such a purpose is of high value.

Glass sand is obtained either from deposits of unconsolidated silicious sand of exceptional purity or from sandstones and quartzites, which have to be crushed.

[1] Merrill. N. Y. State Mus. Bul. 19. 1898. p. 225.

For the various grades of glass, sands of varying purity may be used. For the highest grade such as is used in cut glass ware and in lens-making a pure white sand containing practically 100 per cent quartz or silica must be used, as a fraction of a per cent of iron will impart a greenish tinge to the glass, the presence of clay will detract from its brilliancy and transparency, while other impurities will also ruin its value. For the manufacture of window glass and plate glass, where a slight greenish tinge will do no harm, a sand containing as much as one half per cent of iron oxid is frequently safely used, while sands with a slightly greater percentage of iron, have been used, the color being removed during the fusion by certain oxidizing agents such as manganese or arsenic which oxidizes the green ferrous silicate to a less conspicuous ferric silicate. For the cheaper grades of glass such as are used in bottle manufacture, structural glass, etc., a sand of less purity may be used but rarely does the percentage of silica fall below 97.5.

Aside from the consideration of the size of the deposit, the distance from railroads or waterways, cost of haulage etc., the owner of a prospective glass sand deposit should make a thorough examination of his sand under a microscope to determine its probable purity and physical characteristics. The necessary qualifications to be observed by simple tests are summed up by Burchard[1] as follows:

The sand should be nearly white in color; it should be of medium fineness (passing a 20 to 50 mesh horizontal sieve); the grains should be uniform in size, even and angular, or, less preferably, they may be rounded. A simple chemical test may be employed by heating the sand in a dilute acid. Effervescence indicates the presence of lime; loss of color shows the presence of clay impurities. Iron in the most minute quantities may be detected by dissolving sand in hydrofluoric acid and adding potassium ferrocyanid which produces a blue precipitate if iron is present. Complete quantitive analysis as well as a furnace test should be made as a final determination of the character of a prospective sand.

Some sands may be partially purified by washing processes which remove clay, mica scales, organic matter, etc. while in some cases where the iron exists as magnetite grains some form of magnetic separation may be effective.

The glass sand industry has been on the decline in this State for several years and at present the only producing area is that

[1] U. S. Geol. Sur. Bul. 285. p. 454.

around Cleveland in Oswego county. A quantity of glass sand was at one time produced in Oneida county from the Oneida lake area and a quartz rock was crushed at Ellenville in Ulster county. The exhaustion of some of the Oneida lake beds and the closing down of a number of the New York State glass factories have combined, however, to bring the industry to its present condition.

Building sand. The one great universal use of sand is for building purposes, either mixed with cement, making cement mortar or mixed with lime to form the ordinary lime mortar. For these purposes, specifications usually call for a clean, sharp sand free from clay or other impurities and frequently stipulate that it be screened. The addition of sand to portland cement, if the proper sand and mixture are used, not only decreases the final cost as compared to pure cement, but also increases the strength of the resulting mortar. Experiments carried on by Mr L. C. Sabin[1] seem to indicate that the mineral composition of the sand need not necessarily be of quartz grains but that a sand composed of any mineral, even limestone, will make a good mortar, provided that the grains are not of such a character as to undergo further serious alteration. In regard to the shape of grain he states that sharp and angular grains are the most satisfactory although lenticular grains give good satisfaction. The sand should be of coarse grain or a mixture of coarse and fine grains, such sands packing together so as to leave less pore space and therefore requiring a relatively small amount of cement to form an impervious mortar. A small percentage of clay or rock dust is not objectionable provided the mortar is not to come in contact with sea water which causes some disintegration of such a material.

New York State is well supplied with building sand. The greater part of the State was buried under the glacial sheet during the glacial period and instead of a mantle of residual clay such as covers nonglaciated areas, we have covering the surface an irregular mantle of boulder clay containing pockets of stratified sand and gravel, sorted and deposited by the glacial streams and lakes, while the more recent waters have also re-sorted some of the material and deposited it along the present streams. Almost every farm in central and western New York contains a sand and gravel pit; large amounts are found along the Niagara river, Lake Erie, Lake Ontario, while the borders of the Hudson have some large banks of it which were deposited while the Hudson river waters were at

[1] Sabin, L. C. Cement and Concrete. New York, 1907. p. 184.

higher levels. A large sand business is carried on on Long Island where the beach sands are pumped or sucked up through tubes and loaded onto barges for shipment. Among the more important glacial deposits containing sand beds are elevated deltas of former streams emptying into the glacial lakes, kames and beaches and bars of the former glacial lakes.

The building sand business is carried on usually to supply a local demand, since, owing to the widespread occurrence of sand, very little need be shipped. The larger cities are all well supplied with material close at hand. New York city obtains its supply mainly from the Long Island beaches. Buffalo has a good supply on the shores of Lake Erie, although most of it is shipped from the Canadian shore. Rochester is supplied by the large glacial deposits known as Pinnacle and Cobb's hills. Syracuse obtains sand from the glacial deposits surrounding the city, and Albany is supplied from the large terraces north of the city along the river.

This year, the first attempt was made to collect statistics and the results are far from being complete. The sand producers are so numerous, and the industry is so widespread and so unstable that to gather together all the production, specially that of building sand, is an almost impossible task.

The following table gives the production by uses of the various sands in 1908, with the 1907 production as published by the United States Geological Survey included for comparison.

Under the heading "Other sands" are included glass sand (one producer), fire sand, polishing sand, etc. The gravel includes gravel for road making, for concrete and for roofing.

Production of sand and gravel

MATERIAL	1907	1908
Molding sand	$539 674	$277 290
Core sand	....	22 371
Building sand	925 028	666 809
Other sands[a]	51 271	43 368
Gravel	251 548	120 453
Total	$1 767 521	$1 130 291

a Includes glass sand, fire sand, furnace sand, filter sand, engine sand and polishing sa

SAND-LIME BRICK

The sand-lime brick industry received a decided set back in 1908, having been seriously affected by the decrease in building activity in the State. No new plants were in operation and several firms retired from the business. Only six plants made sales of this product during the year and of these only four manufactured any brick.

The Watertown Sand Lime Brick Co., a firm which reported a large output in 1907, has gone into bankruptcy, while two firms idle in 1907 have retired permanently from business, viz, the Newburg Sand Lime Brick Co. and the Roseton Sand Lime Brick Co. Two new firms have been organized but are not yet in operation, the Grant Brick Co. of Brooklyn and the Atlas Brick Co. with a plant at Nassau.

The total production for the year was 8,239,450 brick valued at $55,688 against a production in 1907 of 16,610,000 brick valued at $109,677, a decrease of 49 per cent. The average price per thousand of the common sand-lime brick in 1908 was $6.44, while front and fancy brick averaged $9.11 and $10 respectively. The six companies making sales in 1908 were as follows:

NAME	LOCATION
Buffalo Sandstone Brick Co.	Buffalo
Rochester Composite Brick Co.	Rochester
Paragon Plaster Co.	Syracuse
Sandstone Brick Co.	Schenectady
Schenectady Brick Co.	Schenectady
Granite Brick Co.	Glens Falls

SLATE

Roofing slate of various colors is obtained in Washington county near the Vermont state line. The industry has been carried on there for the last half century or more, but it has shown little tendency toward expansion commensurate with the progress of the quarry industry in general. The total value of the output of slate in 1908 was $111,217 as compared with a valuation of $54,800 in 1907, $61,921 in 1906, $95,009 in 1905 and $93,600 in 1904. Practically the entire product was used for roofing purposes. The manufacture of other slate materials, such as mantels, floor tiling, blackboards, billiard tables, etc., has not been developed in the New York district, though it plays an important part in the slate industry of Vermont and Pennsylvania.

The main product of Washington county is red slate. This is the most valuable variety of roofing slate. The color is an attractive shade of red or reddish brown which does not change on exposure. Red slate brings an average of $7 or $8 a square and is shipped all over the country and even abroad for use on fine buildings. The principal quarries are near Granville and North Granville on the north end of the slate belt. Sea green, purple and variegated slates are obtained around Middle Granville, Salem and Shushan. The red and green varieties sometimes occur in alternating beds in the same quarry. Black slate has been worked at different times in the southern portion of the metamorphic belt, but the operations apparently have not been a commercial success. There are abandoned quarries at Hoosick, New Lebanon and New Hamburg. The quarry of the last mentioned locality was developed about 10 years ago.

The quantity of roofing slate made in 1908 was 13,735 squares valued at $111,119. The average price received was $8.09 a square, a much higher average than was received for the product of other slate districts in the east, due to the fact that most of the output consisted of red slate, of which the New York quarries have a natural monopoly. The production was distributed among 11 firms and individuals, most of whom operated on a small scale.

STONE

BY HENRY LEIGHTON

The quarrying of stone for building purposes, road and pavement construction and for various other purposes is one of the most widespread and important of the State's industries, furnishing employment to 4000 or 5000 wage-earners and annually producing about $7,000,000 worth of stone ($6,615,614 in 1908).

The rocks of the State, ranging in age from the very earliest Precambric to early Carbonic and comprising igneous, metamorphic and stratified representatives, are abundantly able to supply almost every type of rock desired for building purposes, save some ornamental stone. Notwithstanding the large amount of local stone used, considerable quantities of stone are annually imported into the State; granites from New England, limestones from Indiana and sandstones from Ohio, coming from large centers of production where development is on such a large scale that the stone can be shipped into the State at a price almost as low as that asked for local material.

The industry, however, with the enormous amount of building construction, road improvement and canal work in the State is in a flourishing condition and will probably show a large advance in the coming year.

In the following discussion of the quarry industries the subjects of slate, millstones and rock quarried for cement are omitted and will be found discussed under separate headings.

As one might expect, the quarry industries suffered under the general stagnation of business in 1908 and reported a production of $6,615,614 against $7,890,327 in 1907, a loss of 16 per cent. Of the total, limestone quarries produced $3,119,835, or 47 per cent, sandstone amounted to $1,711,585, or 25 per cent, trap $723,-773, or 11 per cent, marble $692,857 or 10 per cent, and granite $367,564, or 5 per cent. All kinds of stone showed a falling off in their output except granite which, owing to increased use of crushed stone and paving blocks, showed a decided increase. The increased public interest in good roads, the barge canal construction and concrete work in general, is the cause of a large demand for crushed stone and this item is the largest of the total stone production, namely $2,659,016, or 40 per cent, a decrease from that of 1907 of $162,457.

Next in value is the production of rubble, riprap, lime, and miscellaneous products with a value of $1,624,607 against $1,642,-232 in 1907. The value of the building stone produced was $1,264,403 against $2,208,545. Flagstone and curbing, with an output chiefly of bluestone, were valued at $928,511 against $1,064,193 in 1907. The production of monumental stone which is mostly of marble also showed a decrease, having a value of $139,077 in 1908 and $162,359 in 1907.

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	TOTAL VALUE	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	305 730	1 998 417
Trap.............	*a*	....	....	939 027	2 000	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."

Production of stone in 1908

VARIETY	BUILDING STONE	MONUMENTAL	CURBING AND FLAGGING	CRUSHED STONE	ALL OTHER	TOTAL VALUE
Granite..........	$71 122	$27 585	*a*	$152 783	$116 074	$367 564
Limestone........	245 655	....	$15 668	1 647 629	1 210 883	3 119 835
Marble...........	567 444	111 492	....	....	13 921	692 857
Sandstone........	380 182	....	912 843	135 741	282 819	1 711 585
Trap.............	....	....	....	722 863	910	723 773
Total........	$1 264 403	$139 077	$928 511	$2 659 016	$1 624 607	$6 615 614

a Included under "All other."

Granite

Under the strict use of the word, granite is an entirely crystalline igneous rock made up of potash feldspar and quartz, with usually small amounts of either mica, hornblende or pyroxene. Among quarrymen and builders, however, the name granite is given to various other types of rocks, such as the heavier and darker colored diorites, norites and gabbros, syenite which resembles granite but lacks quartz, and the bedded or banded rock known as gneiss or schist. The broader use of the term will be employed in this discussion.

Two main areas of extensive outcrops of granitic or gneissic rocks can be recognized: the Adirondack region and the area comprising the Highlands of the Hudson. The Adirondack mountains are made up of large masses of crystalline rocks, anorthosites, norites, gneisses and granites, and around the borders of this mass many quarries have been opened. At present there are but few active quarries which are located as follows: West Chazy, Clinton co.; Ausable Forks, Essex co.; Gloversville, Fulton co.; Little

Falls, Herkimer co.; and Wellesley and Picton islands, Jefferson co.

Throughout the whole Adirondack region and the bordering area there is an immense amount of building stone, durable and capable of taking a fine polish, but at present lack of demand and the inaccessibility of some of the outcrops have prohibited any extensive development.

In the area comprising the Hudson River Highlands in Putnam, Orange, Rockland and Westchester counties and in New York county are large masses of granite, gneiss and schists all of which have been worked. In Westchester county, following the river from Peekskill to Yonkers, is a belt of gneissic rock in which many small quarries are located, those in operation in 1908 being at Scarsdale, Glenville, Yonkers, Peekskill, New Rochelle and Hastings. The only other active quarry reporting from the Highland region was one operated for crushed stone at Carmel in Putnam county. In former times quarries were in operation in Rockland and Orange counties and on Manhattan Island, furnishing some gneissic stone for buildings in New York and for some of the West Point buildings.

The chief use of granite in the State is in the form of crushed stone for roads, concrete and railroad ballast, and by far the largest share of this material is quarried and prepared in Little Falls where an increasing output is made year by year. The rock used is properly a syenite, an outlier of the Adirondack border.

The Westchester and Putnam county material, owing to its gneissic character, is better adapted for a building stone than for crushing or paving purposes and the output is sold mainly as rough building stone. Some of the granites and less schistose gneisses, however, are dressed and polished and present a very handsome appearance.

The greater part of the Jefferson county granite was used in 1908 in making paving blocks. The output of monumental stone, though considerable, was not as great as the beauty and durability of the stone would warrant. The beautiful pink color, good polish and durability should give to this stone a wider demand specially for interior decoration and for monumental work.

At Ausable Forks, Essex co. a dark green syenite is quarried and utilized as a building and monumental stone, taking a handsome polish.

The production of granite last year showed a remarkable and gratifying advance over that of 1907 or in fact over that of any recent year, the total value for 1908 being $367,564 as against $195,900 in 1907 and $255,189 in 1906, an increase over the year 1907 of 87 per cent. This increase is specially noteworthy when we realize that other building stone and brick showed a decided falling off in 1908. The gain seems to be a general one in the granite industry, being confined to no special district nor to any special use of the granite. All counties report an increased production and all uses are represented in the increase except the building stone which shows a decrease of 18 per cent as compared with the preceding year. Among the important advances were the large production of crushed stone at Little Falls and the substantial increase in the paving block business in Jefferson county, carried on by the Picton Island Red Granite Co. and J. Leopold & Co. During the year the former company opened up a new quarry of pink granite near the water's edge and with the good quality of the stone and good transportation facilities they anticipate a large output.

The stone of the Hudson River Highland area, although it showed a substantial increase in production, situated as it is so near the large New York market, should have a larger demand as it occurs in inexhaustible amounts. The more gneissic, less massive varieties make good foundation stone while some of the true massive granites take a good polish and are well suited for monumental work.

Production of granite

	1906	1907	1908
Building stone	$231 190	$84 774	$71 122
Monumental	4 119	9 613	27 585
Crushed stone	13 980	92 950	152 783
Rubble, riprap	2 423	5 600	15 351
Other kinds *a*	3 477	2 963	100 723
Total	$255 189	$195 900	$367 564

a Includes in 1908 curbing, paving blocks, and minor uses.

Limestone

Owing to the many purposes for which limestone seems particularly adapted, and because of its wide distribution in the State, it holds first place in importance among the quarry products. As crushed stone for road building and concrete work, it has attained a wide use; as a building stone, its ease of dressing and quarrying and its durability favor it; large quantities are burned into lime; a large amount is annually consumed as a flux, and it has as well many minor uses.

With the exception of some crystalline, metamorphic limestone that is quarried and sold as flux or burned into lime, the stone classed under this head is all of a massive noncrystalline character. The limestones occur in formations from the Cambric to the Devonic systems, the chief limestones used being the Beekmantown, Chazy, Trenton, Lockport dolomite, Cobleskill, Onondaga and Tully. They vary in color from gray and brown to blue or black, while the white and lighter colored limestones are rare. In chemical composition they vary from almost pure calcium carbonate to dolomite and frequently become argillaceous, arenaceous, ferruginous or silicious.

The total production of limestone in 1908 exclusive of stone used in cement manufacture was valued at $3,119,835, a small decrease over the production of 1907, which was $3,182,447, or about 2 per cent. This decrease seems to be fairly evenly distributed over the various uses of the stone and as well over the various counties, none of which shows a marked decrease or increase in production during the year. The production was distributed among the various products as follows: crushed stone $1,647,629; building stone $245,655; lime $401,728; furnace flux $230,117; other uses $594,706. The lime made by the Solvay Process Co. and by the Union Carbide Co. in connection with their products is included under "Other uses" in 1908 while in previous years it appears under "Lime."

Production of limestone

MATERIAL	1906	1907	1908
Crushed stone	$1 590 205	$1 725 203	$1 647 629
Lime made	*a*795 348	*a*888 309	401 728
Building stone	229 479	189 782	245 655
Furnace flux	287 816	338 127	230 117
Rubble, riprap	32 975	14 588	*c*
Flagging, curbing	8 067	13 123	15 668
Miscellaneous	19 939	13 135	*b* 579 038
Total	$2 963 829	$3 182 447	$3 119 835

a Includes Solvay Process Co.'s lime.
b Includes lime made by Solvay Process Co. and Union Carbide Co., also rubble and riprap.
c Included in "Miscellaneous."

Crushed stone. The crushing of limestone for application in macadam road construction is one of the important uses of the stone. Its value for this purpose depends on the facts that it is easy to crush and that when rolled to a smooth surface the particles of limestone bind themselves together into a firm impervious mass. With the increasing demand for good roads in all parts of the State the crushed stone industry is becoming more and more important. In general, however, with other industries the production received a setback in 1908, it being valued at $1,647,629 while in 1907 it was $1,725,203. Erie stands first among the counties as a producer with a production of $369,754 as against $250,720 in 1907. It is followed in order by the following counties, the production for 1907 being included in brackets: Dutchess $233,261 [$399,244]; Rockland, one producer; Ulster $169,414 [none]; Genesee $122,310 [$200,150]; Onondaga $108,768 [$63,885] and Albany $104,250 [$126,920].

Lime. The manufacture of lime by the calcination of limestones is an industry carried on in the State from earliest times. On a small scale it is carried on in almost every county where limestone is found, as it requires but a relatively small outlay of money to establish a plant. The greater part of the production, however, comes from a few counties, where larger firms have developed the industry. The statistics for 1908, included herewith, represent only lime made and sold as such either hydrated or unslacked. The production of the Solvay Process Co. of Onondaga county and of the Union Carbide Co. of Jefferson county has been transferred to the column headed "Other uses." The total production of lime excluding these two firms was $401,728, a slight decrease over the production of 1907. This production was distributed over 20 counties of which one county, Warren, produced 42 per cent of the total, while four counties, Warren, Jefferson, Clinton and Washington, together produced 76 per cent of the total production. The production of these counties with their 1907 production inclosed in brackets is as follows: Warren $170,832 [$212,539]; Jefferson $52,454 [$30,871]; Clinton $45,000 [$62,000]; and Washington $36,960 [$54,400].

Building stone. The use of our native limestones for building construction is rather restricted and the chief use is for foundations and bridge work. The competition with Bedford limestone and other building materials seems to retard any large development of the local limestone quarries for building stone. Nevertheless a gain is shown in the production, the value for 1908 being $245,655 as compared with $189,782 in 1907. The gain has been due mainly to an increased production from the Newport Construction Company's quarry at Newport, Herkimer co., and an increase in the Schoharie county production. Erie county still leads in production, the 1908 value being $112,409 as against $114,351 in 1907. Following it in order are Schoharie county with a production of $30,555; Herkimer county $30,000; Onondaga county $16,709; Jefferson county $13,513.

Furnace flux. Limestone used in smelting operations for flux is quarried and shipped to the various metallurgical establishments in the State. The blast furnaces around Buffalo use a large quantity of New York State material quarried from the Onondaga limestone beds of Erie and Genesee counties, the larger quarries being situated at Williamsville and Clarence, Erie co. and at North Leroy, Genesee co.

The iron furnaces of the Adirondack region use limestones quarried at Chazy, Clinton co., and Port Henry, Essex co., and other localities report small amounts of limestone sold as flux and utilized in nearby blast furnaces.

With the true limestone flux we include, also, a quantity of marble quarried at Gouverneur, St Lawrence co. and shipped to Ohio blast furnaces.

The total production of flux for 1908 was valued at $230,117, while the 1907 output was valued at $338,127, the decrease being due to the sluggishness of the iron and steel trade. Of this amount Erie and Genesee counties produced $191,970, or about 82 per cent of the total, Erie county producing $138,563 as against $202,845 in 1907; Genesee county $53,407 as against $82,863 in 1907. St Lawrence county produced $14,606, increasing the output of 1907 which was $9843, while Clinton county produced $5640 as against $19,200 in 1907, and Essex county also produced a large output. Other counties reporting a production were Cayuga, Columbia, Madison, Oneida, Rensselaer, Seneca and Westchester.

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
Other counties*a*	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.

Production of limestone by counties in 1908

COUNTY	CRUSHED STONE	LIME MADE	FURNACE FLUX	BUILDING STONE	OTHER USES	TOTAL
Albany	$104 250	....	....	$200	$500	$104 950
Cayuga	39 051	$400	$510	6 216	2 500	48 677
Clinton	18 136	45 000	5 640	8 250	7 592	84 618
Columbia	3 700	....	4 500	360	....	8 560
Dutchess	233 261	1 600	....	....	512	235 373
Erie	369 754	515	138 563	112 409	33 711	654 952
Fulton	4 666	12 840	....	....	....	17 506
Genesee	122 310	2 520	53 407	2 461	100	180 798
Greene	3 270	....	....	1 000	....	4 270
Herkimer	6 085	3 607	....	30 000	5 180	44 872
Jefferson	2 500	52 454	....	13 513	133 521	201 988
Lewis	780	4 000	....	888	80	5 748
Madison	27 993	....	3 000	....	14 340	45 333
Monroe	14 002	21 756	....	3 981	176	39 915
Montgomery	8 561	....	....	5 343	6 416	20 320
Niagara	12 950	5 400	....	2 622	16 500	37 472
Oneida	26 150	....	50	4 000	1 000	31 200
Onondaga	108 768	*a*1 450	....	16 709	*a*355 105	482 032
Rensselaer	15 700	....	100	3 425	6 750	25 975
St Lawrence	462	7 305	14 606	723	562	23 658
Saratoga	12 259	....	....	625	2 271	15 155
Schoharie	32 971	232	....	30 555	....	63 758
Seneca	1 340	400	60	1 120	2 980	5 900
Ulster	169 414	2 530	....	....	500	172 444
Warren	16 000	170 832	....	1 005	3 357	192 194
Washington	55 860	36 960	....	250	....	93 070
Westchester	38 509	22 927	37	....	....	61 473
Other counties *b*	198 927	9 000	9 644	....	1 053	218 624
Total	$1 647 629	$401 728	$230 117	$245 655	$594 706	$3 119 835

a Lime used by Solvay Process Co. included in "Other uses."
b Includes Essex, Ontario, Orange, Orleans, Rockland and Schenectady.

Marble

True marble, a crytalline limestone, is fairly abundant in New York State, though its occurrence is limited to the metamorphic regions, including the Adirondack region and the lower Hudson valley. The industry is concentrated into three main areas: Gouverneur, St Lawrence co.; South Dover, Dutchess co.; and Tuckahoe, Westchester co. Aside from these there are two firms producing limestone which, as it is capable of taking a fine polish and is used for interior decorations and for monumental work, is classed as marble in the trade. The quarries are located near Plattsburg in Clinton county, where a Chazy limestone is quarried, and at Glens Falls, Warren co., where a fine grained Trenton limestone is polished and sold as black marble.

The Tuckahoe stone is a rather coarse grained pure white dolomitic marble. It is quarried and dressed for building stone almost entirely, and it has been used in the construction of some notable buildings in Washington, New York and Boston. The South Dover region also produces a pure white dolomitic marble which when dressed makes a handsome and durable stone. Among the recent structures of this stone is the new office building of the House of Representatives in Washington which is partly faced with this white marble. One new firm, the Dover White Marble Co., has been organized and is installing an electric air channeling plant and is also engaged in stripping and opening their quarries. St Lawrence county is at present the chief producer of marble in the State. The marble quarried near Gouverneur is light gray to dark blue in color, of coarse grain, and takes a very handsome polish. A large part of it is shipped as monumental stone, considerable building stone and rubble also being sold. A certain quantity of it is also shipped to Ohio for use as a flux, this production, however, being tabulated under limestone.

The total production of the State in 1908 was $692,857 as against $1,571,936 in 1907, a large decrease. This extraordinary drop in production was mainly caused by a decrease in the production of marble for building purposes at South Dover and Tuckahoe. The only producer in the South Dover area in 1908 was the South Dover Marble Co., while at Tuckahoe the Waverly Marble Co., for many years a large producer, has ceased operations permanently after operating during a part of 1908. This quarry, the famous Norcross quarry, has been in operation for half a century and has furnished stone for many noted structures, particularly the Metropolitan Life Insurance building in New York city, with its massive tower. Aside from the production of building stone at Tuckahoe, the Tuckahoe Lime & Lumber Co. and its successor, the Marbolith Stone Co., used considerable stone in a finely crushed condition for making an "artificial stone," with a cement base.

In the Gouverneur district, although a drop in production was reported and was inevitable under the trade conditions of 1908, the decrease was by no means serious. Building stone, both rough and dressed, was produced to the value of $131,037 as compared with $146,190 in 1907; monumental stone $111,492 as against $152,746 in 1907. A new firm, the New York White Marble Co., has been incorporated and has spent the year in development. Prospects in December were favorable for a very brisk year in 1909. The Extra

Dark Marble Co. has been purchased by Mr Newton Aldrich and will be enlarged, while the other large companies contemplate increasing their output.

At Plattsburg, Clinton co. the Rutland-Florence Marble Co. during the year quarried a large amount of Chazy limestone which was sold as marble for interior decorations.

The black Trenton limestone of Glens Falls was also quarried by one firm, Finch, Pruyn & Co. and sold in rough state for building stone.

Production of marble

VARIETY	1906	1907	1908
Building marble	$337 365	$1 408 190	$567 444
Monumental	99 100	152 746	111 492
Other kinds	24 450	11 000	13 921
Total	$460 915	$1 571 936	$692 857

Sandstone

Sandstone is more widely distributed over the State than any other stone. Many large areas underlain by good sandstones, however, are not worked at present, because of the abundant supply of better stone which can be cheaply obtained from the more extensively developed areas. In western New York to the south of Lake Ontario an extensive quarrying industry is carried on in the Medina sandstone, the operations being confined mainly to Orleans county. This stone is a medium grained, usually red stone, although some white stone has been extracted. It has been used in a number of important buildings and forms a beautiful and durable stone. It has also a wide use in street work as paving blocks and curbing. Quarries in the Medina formation have also been worked in Niagara, Monroe, Wayne and Oswego counties. In the northern Adirondack region, in Jefferson, St Lawrence and Franklin counties, a large amount of sandstone of Potsdam age has been quarried both as building stone and as flagging. The stone varies from pink to gray and from a firm hard quartzite to a friable sandstone. The main production at present comes from the vicinity of Burke in Franklin county and consists chiefly of flagging, which is shipped to Montreal and other Canadian cities.

Along the Hudson river from Orange county northward to Washington county various beds of sandstone occur in the Hudson river formation. They are quarried for rubble, local building stone and crushed stone in Albany, Greene and Dutchess counties, and in former times were taken out at many other localities.

Minor sandstones, in which from time to time quarries are opened, are the Oneida conglomerate, Clinton and the Triassic brownstones, the latter now practically abandoned.

By far the most important sandstone, both as to areal distribution and annual output, is the variety known as bluestone.

Bluestone. This variety of sandstone constitutes one of the important sources of wealth of certain sections of the State. It is a name applied to certain, usually bluish, evenly bedded sandstones occurring in the upper Devonic strata. Its importance lies in the fact that it splits in thin regular horizontal slabs along planes known as lifts, and that these slabs are in turn intersected by two sets of joints lying at about right angles which facilitate the extraction of blocks of convenient size.

The stone taken out in most districts is classed under three heads: (1) "flagging," the thin slabs used for sidewalks; (2) "edge" stone, or thicker slabs which are used in curbing, as Belgian bridge in crosswalks and as sills and coping in construction work; (3) "rock," or rough more or less square blocks which may be dressed or sold in rough condition for building and for bridge construction. Among the minor uses are for crushed stone and for rubble and riprap, for which purposes the waste rock is almost entirely used. As a flagging, bluestone is suitable because of the even surface obtainable with little or no dressing and because after long usage it does not assume a slippery surface.

The bluestone quarries are usually situated upon the hillsides and the waste material is dumped down the slope, while the stone is hauled in wagons down the slopes to the shipping points. Flagstones and curbstones are usually roughly hand dressed while building stone, sills etc. are dressed in various mills situated in the district.

The area from which bluestone is obtained extends roughly from Albany, Greene and Ulster counties on the east, due westward through Sullivan, Delaware, Broome and Chenango counties and so on to Lake Erie.

There are four main districts in the area: (1) the Hudson river region comprising Greene and Ulster counties and having for its main outlet the Hudson river; (2) the Delaware river district, Broome, Delaware and Sullivan counties with the main transportation on the railroads following along the Delaware river and its branches. The principal railroads are the Erie, New York, Ontario and Western and the Delaware and Eastern; (3) Chenango county with the main shipping centers at Norwich and Oxford; and (4) Wyoming county with the main quarries around Warsaw and Portageville. In addition to these districts bluestone has been or is being quarried to some extent in almost every county throughout the main area, the counties represented in the production for 1908 including besides those mentioned, Albany, Otsego, Tioga, Yates, Allegany, Cattaraugus and Chautauqua.

The industry in the Hudson river district is chiefly controlled by a few large shippers with docks at Catskill, Saugerties and Rondout. To these points the stone is hauled by wagons, sometimes from a distance of from 10 to 15 miles. Quarrying is carried on throughout all the year except the most severe portions of the winter, and by the time navigation opens up on the river the shippers have a large stock on hand. Shipments are made almost entirely by water on barges, and owing to the accompanying low transportation charge this district controls the market in New York city and ships to numerous other coast markets on Long Island sound, etc.

The quarrying of bluestone is one of the important industries of the Delaware valley region in Broome, Delaware and Sullivan counties. The quarries are usually situated far up on the sides of the hills and the quarrying and transportation of the stone down the steep hillsides is attended with some difficulty. The stone is taken out by numerous small producers, many of whom simply work a quarry at odd times when other work is unavailable, while others develop their property more extensively. In this area at present the small producers sell nearly all their stone to a few large dealers or shippers who maintain "docks," or loading places, and railroad switches at various places on the lines of the New York, Ontario and Western, Erie, and Delaware and Eastern. The market for this district is mainly inland cities easily reached by railroad from the shipping points, and includes Philadelphia, Binghamton, Syracuse, Rochester etc. The output is mostly flag and curbstone.

In Chenango county the output is also mainly flag and curb and the market is, as in Delaware county, the inland New York State cities.

The Wyoming county stone, however, is used mainly for building purposes, very little flagging or curbing being shipped. The industry centers around Warsaw and Portageville where several companies operate extensive quarries and load the stone onto cars directly from the quarries.

The quarries outside of these four areas are operated usually to supply local demand or for use in nearby cities and the individual output is generally small.

A list of firms and individuals shipping stone during 1908 is appended. Most of these operate quarries and also buy of small quarrymen in their vicinity.

In gathering statistics of bluestone it is impracticable to attempt a canvass of all the individual producers, many of whom operate only in a small way and more or less spasmodically. The tabulations herewith are based on figures obtained from dealers and such large producers as ship their product direct to market. A slight duplication doubtless exists in the tables owing to the fact that the shippers buy or exchange stone with each other for purposes of convenience, and such exchanges or purchases are almost impossible to eliminate from their reports, yet it is believed that the figures as given are substantially correct.

As is brought out in the tables, the year 1908 was a dull year for most of the districts, but the falling off in production was no more than might be expected in a year when building and constructional work was so greatly depressed. The consensus of opinion of the bluestone dealers seems to be that the coming year 1909 will show an active demand for their stone and that the industry will resume its wonted activity.

The Hudson river district was an exception to the general rule and its production exceeded that of 1907 by $74,762. The total production by districts for the years 1907 and 1908 was as follows, the 1907 production being inclosed in brackets: Hudson river $368,657 [$293,895]; Delaware river $447,784 [$703,428]; Wyoming county $174,214 [$196,769]; Chenango county $93,667 [$106,703]; other districts $27,064 [$15,132]. Comparison between the production of the Delaware river district in 1907 and 1908 is hardly just since it is probable that in 1907 considerable stone quarried in Pennsylvania, but sold by New York dealers, was included in the figures. There would, no doubt, however, still be shown a decrease in production for 1908.

DIRECTORY OF BLUESTONE DEALERS

NAME	OFFICE
Delaware river district	
Broome co.	New York city
Deposit Stone Co.	New York city
Erie Bluestone Association	Gulf Summit
J. W. Lockwood	Deposit
P. S. Madden	
Delaware co.	
M. L. Connor	Walton
E. J. Cotter	Hancock
Thomas Johnston	Horton
George W. Kazenstein	Hancock
W. O. King	Sidney
Kirkpatrick Bros.	Hancock
Estate of N. L. Lupton	Cooks Falls
James Nevins's Sons	Fish's Eddy
Cyrus Peak	Long Eddy
W. J. Randall	Hancock
W. P. Schneider	East Branch
Herbert Shaw	Walton
Standard Bluestone Co.	Jersey City, N. J.
Travis & Kingsbury	Hale Eddy
N. E. Whipple	Walton
Sullivan co.	
Kenney Bros.	Long Eddy
Anthony Manny	Hankins
Henry Prigge	Hoboken, N. J.
C. B. Tyler	Roscoe
J. D. Woolsey	Livingston Manor
Hudson river region	
Greene co.	
James Leach	Tannersville
Smith & Yager	Catskill
George S. Young	Platt Clove
Ulster co.	
William Craft	Quarryville
Hudson River Bluestone Co.	Kingston
John Maxwell's Sons	Saugerties
McArthur Bros., Winston & Co.	Brown Station
Benjamin Murray	Saugerties
Ulster & Delaware Bluestone Co.	Allaben

Chenango county

Earl Brown	Oxford
Chenango Bluestone Co.	Norwich
Clarke, Conroy & Co.	Norwich
Keeley Bros.	Oxford
James Masterson	South Oxford
J. W. Ryan	Norwich

Wyoming county

American Bluestone Co.	Warsaw
Portageville Bluestone Co.	Portageville
Warsaw Bluestone Co.	Warsaw

Other districts

Albany co.	
Edwin Stewart	South Berne
Cummings Bros.	Voorheesville
Allegany co.	
L. Gorton	Belmont
Cattaraugus co.	
William Brondart	Franklinville
James Rounds	Olean
Cayuga co.	
Henry Murray	Kings Ferry
Chautauqua co.	
L. L. Pierce	Fredonia
Genesee co.	
Acra Bluestone Co.	Acra
Madison co.	
George Standt	Canastota
Oneida co.	
Charles Dawes	Clinton
Otsego co.	
Edwin Adams	Cooperstown
Mrs. Mary Gazlay	Cooperstown
Ingalls Stone Co.	Binghamton
J. K. Palmer & Co.	Clearfield, Pa.
Schenectady co.	
Ellis Stone Co.	Schenectady
Tioga co.	
Gilbert B. Edgecombe	Waverly
Yates co.	
Louis A. Cheney	Himrods

The total production of sandstone for the year was $1,711,585 against $1,998,417 in 1907, a decrease of 15 per cent. A number of smaller quarries were idle during the year and the larger firms report a decreased demand for their stone. Thirty counties are represented in the total. The decrease was distributed over the output of building stone and the curb and flagstone. The constantly increasing demand for crushed stone is shown by the fact that the value of the output of crushed stone increased from $55,818 in 1907 to $135,741 in 1908, an increase of 143 per cent.

Classified as to uses the output for 1908 was as follows, the production in 1907 being included in brackets: building stone $380,182 [$525,799]; curbing and flagstones $912,843 [$1,051,070]; paving blocks $239,239 [$320,301]; crushed stone $135,741 [$55,818]; rubble and riprap $28,792 [$24,812]; other uses $14,818 [$20,617].

The bluestone district furnished in 1908, 67 per cent of the total sandstone quarried, with a total production of $1,151,386.

Orleans county was by far the largest producer outside of the bluestone area and the total output was $398,287 against $542,218 in 1907. This county produced paving blocks to a value of $227,537 or nearly all produced in the State.

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

Production of sandstone in 1908

DISTRICT	BUILDING STONE	CURBING AND FLAGGING	PAVING BLOCKS	CRUSHED STONE	RUBBLE, RIPRAP	ALL OTHER
Bluestone						
Hudson river......	$26 400	$296 607	....	$45 650	....	....
Delaware river....	43 597	428 372	....	1 630	$4 185	....
Chenango co......	54 871	27 309	....	319	....	$11 168
Wyoming co......	170 722	450	....	....	3 042	....
Other districts....	13 199	5 820	....	8 045	....	....
Total bluestone...	$308 789	$758 558	....	$55 644	$7 227	$11 168
Sandstone						
Orleans co.......	$59 138	$111 455	$227 537	$8 687	$1 470	....
Other districts....	12 255	52 830	11 702	71 410	20 095	$3 650
Total sandstone..	$71 393	$154 285	$239 239	$80 097	$21 565	$3 650
Combined total...	$380 182	$912 843	$239 239	$135 741	$28 792	$14 818

Trap

Trap is a name commonly applied to a series of igneous rocks, distinguished chiefly by their basic composition, their fine grain, and, because of their basicity, by a dark color. In mineral composition they differ from granite in the total absence of quartz and by the more basic character of their feldspars. They consist mainly of plagioclase (soda lime feldspar) and pyroxene. In diabase, by far the most common rock type of the series, the feldspars have crystallized out in needle or lathlike forms, forming an interlocking network, with the pyroxene filling up the interstices.

Trap appears usually in two forms of occurrence: (1) as dikes which are usually vertical, wall-like masses of rock, which have been intruded while in semifluid condition into fissures, from some molten mass below; (2) as sheets which are intrusions of similar character but which have been forced between the bedding planes of sedimentary strata and have a horizontal position.

Of the first type, the dikes, there is an abundance around the borders of the Adirondacks especially in Clinton and Essex counties. However, owing to their small size or their inaccessibility, they are with the exception of one near Greenfield, Saratoga co. and one at Little Falls, Herkimer co. of no present commercial importance.

The sheet of diabase forming the Palisades and altogether in New York and New Jersey, having an outcrop of some 70 miles and a thickness of 300 to 800 feet, is the most valuable trap mass in the State. Rockland and Richmond counties are the chief producers.

The chief use of trap at the present time is in the form of crushed stone for use as a material in macadam road construction. Its peculiar interlocking crystallization and the abundance of pyroxene have given to the rock a very decided toughness, and, since this property is accompanied by the quality of the separate particles to bind into a firm mass after the road is constructed, the material has attained a well earned reputation as one of the best road metals.

The other important uses are in the form of crushed stone for concrete construction and for railway ballast. As a building or monumental stone diabase is of little importance. In the first place its toughness makes it an extremely expensive stone to quarry and to dress, and then too its somber hue is generally objectionable, although in monumental work the contrast between the hammered and polished surface is a pleasing feature.

The production of trap in 1908 was confined to the dike near Greenfield, Saratoga co., where considerable road metal was taken out, and to the Rockland county quarries at Haverstraw, Nyack, Mt Joy and Rockland Lake. The crushing plant of the Quinroy Construction Co. at Port Richmond, Richmond co. was destroyed by fire in March 1908 and no output was made. They will probably rebuild their plant during the coming season.

Owing to the general decrease in construction work during 1908, because of business depression, the output of trap rock fell below that of 1907, the total value in 1908 being $723,773 as against $941,627 in 1907. About 81 per cent of the production was sold for macadamizing roads and the remainder used for concrete construction and railway ballast.

Production of trap

MATERIAL	1907		1908	
	CUBIC YARDS	VALUE	CUBIC YARDS	VALUE
Crushed stone for roads	362 904	$349 485	755 754	$584 837
Crushed stone for other purposes..................	619 550	589 542	175 144	138 026
Paving blocks, etc.........	....	2 600	....	....
Other....................	....	....	1 113	910
Total.................	982 454	$941 627	932 011	$723 773

TALC

Talc deposits, remarkable for their size and character, are found in St Lawrence county. They are exploited on a large scale and furnish most of the ground talc used in this country, besides a considerable quantity for export. The product is commonly sold under the name of mineral pulp, which is suggestive of its principal application; much of the talc has a fibrous texture that is preserved even after fine grinding and this feature makes it particularly valuable for incorporation in paper stock. Foliated talc which occurs in subordinate quantity, is also produced to some extent by the mines.

Features of the occurrence. The supply of fibrous and foliated talc is obtained from a single district, in southwestern St Lawrence county. Geologically the limits of the district can be quite sharply defined. The talc is associated with crystalline limestones and schists of Grenville age, which occupy a belt some 12 miles long and from 1 to 3 miles wide extending in a northeasterly direction nearly across the towns of Fowler and Edwards. The belt is inclosed by gneisses, largely of granitic and dioritic composition, no doubt in part at least of igneous derivation; while dark hornblendic gneisses of uncertain origin are not uncommon. A small area of the gneisses is included in the central part of the belt with the Grenville bordering it on all sides.

The talc deposits occur along minor belts within the limestones and tremolite schists. They are locally described as veins, but really have nothing in common with them, being beds or layers interstratified with the limestones. They have the same strike and dip as the latter and are at times continuous for long distances, as at Talcville where workable deposits extend fully a mile along the outcrop.

The derivation of the talc has been explained by C. H. Smyth jr as due to chemical alteration of silicates produced during the metamorphism of the limestone. Originally an impure calcareous sediment, the limestone under dynamic influences, has taken on a crystalline character and became impregnated with silicates, chiefly tremolite, actinolite and pyroxene. Certain beds seem to have contained sufficient magnesia and silica to permit a complete transformation into tremolite, forming a tremolite schist, while other layers with a preponderance of lime have undergone a partial change, showing scattered crystals and aggregates of silicates within the crystalline limestone. Tremolite is always the principal silicate in vicinity of the talc beds, though elsewhere pyroxene (enstatite and diopside) is common. The change from tremolite to talc is a result of weathering, and takes place readily under the influence of ground waters holding carbon dioxid. A coordinate process has produced serpentine from the same silicates, though this mineral is seldom found with the talc, being confined so far as observed to the outlying areas. The principle determining the nature of the end product, whether talc or serpentine, seems to be a problem not yet solved. The alteration of tremolite to talc, according to Van Hise,[1] may be given the following chemical formula:

$$Ca\,Mg_3\,Si_4\,O_{12} + H_2O + CO_2 = H_2\,Mg_3\,Si_4\,O_{12} + CaCO_3$$

The alteration is accompanied by an increase in volume of talc and calcite amounting to 25.61 per cent, though if the talc alone is considered there is a decrease of .83 per cent as compared with the tremolite. There is little or no calcite present in the talc; it has doubtless been removed by the water circulations during the process of alteration.

The beds under exploitation range from a few feet up to 50 feet or more in thickness. They are inclined at varying angles, usually between 30° and 60°, from the horizontal. The dip is uniformly toward the northwest. Masses and seams of unaltered tremolite are sometimes included within the deposits.

Character of the talc. The characteristic product of the region has a fibrous texture, belonging to the variety known as agalite. It is in fact a pseudomorph of tremolite, to which the fibrous

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[1] Treatise on Metamorphism, p. 286.

texture is to be ascribed. Occasionally masses of very large fibers in closely compacted parallel arrangement are met with, very similar in appearance to amphibole asbestos. The usual grade, however, consists of a belted mass of interlacing fibers, seldom more than a fraction of an inch in length, and sometimes so fine as to resemble massive talc.

On the western end of the talc belt, the mineral is quite often foliated. Certain mines in this section yield the foliated variety in quantity, as intercalated seams in the fibrous talc. The name rensselaerite has commonly been applied to the foliated variety, but such usage is not warranted. The type specimens of rensselaerite collected and described by Ebenezer Emmons show it to be harder than talc and more nearly allied to serpentine in physical character, while it is an alteration product of pyroxene. The foliated talc is white with often a greenish tint and at times yields quite large and transparent leaves, resembling selenite.

Near the surface the deposits show discoloration from iron and organic matter, but at a little depth they yield material which when ground is a beautiful opaque white, light in texture and very uniform.

The only defect in the talc from this section is the presence oftentimes of a certain amount of grit which is hard to eliminate from the ground product. It can be traced to fine particles of quartz disseminated through the talc and in the case of the fibrous variety also to the existence of some unaltered tremolite. Samples of the prepared fiber when examined under the polarizing microscope will commonly reveal a little of the original tremolite. The proportion of grit is so small as to have little or no effect upon the uses of the talc for many purposes, yet it limits the market to some extent, and efforts have been made to devise a method for its separation, though up to the present time without much success.

Mining of talc. The mine openings are situated along the outcrop of the talc beds which have a northeasterly strike in conformity with that of the inclosing limestones. With the exception of the mines owned by the Union Talc Co. near Silvia lake on the southwestern end of the belt they lie in proximity to the Oswegatchie river, which furnishes most of the power used in the talc mills. The American and Arnold mines of the Union Talc Co. are 2 or 3 miles south of the river. In the central part of the belt near Fullerville the Ontario Talc Co. owns three mines. The eastern portion of the belt around Talcville includes the mines of the

United States Talc Co. and the several properties of the International Pulp Co., the largest producer in the district. A new company, the Uniform Fiber Talc Co., is at present opening a mine just west of Talcville.

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

Both machine drills of the percussion type and hand drills are employed in the mines. The talc is easily penetrated, though the holes must be cleaned at frequent intervals to prevent binding of the drills, and on that account the machines have not the usual advantage over hand work as regards economy. The rock is blasted by dynamite. It splits readily along the bedding or cleavage planes. The large blocks or slabs from blasting are reduced by sledges to a size convenient for handling. From the stopes the talc is loaded into cars and run out to the incline where it is dumped into skips for hoisting to the surface. It is aimed to leave the gritty and impure talc in the walls and pillars and to send only the milling grade to the surface.

Preparation for the market. The processes in use for grinding and preparing the talc have been gradually evolved out of long-continued experimentation. It is said that the first prepared talc sent from the district was ground in a gristmill. With the discovery of the value of the fibrous variety as a paper filler attention was given to the methods of treatment which have been perfected until the various grades now marketed are recognized as standard and find general favor in the paper trade. The development of the industry began to take on a permanent character about 1880 and in the next decade attained nearly its present importance.

The mills, all of which are run in connection with the mines, number seven or eight in all. They have a combined capacity of about 100,000 tons of prepared talc a year. With one or two exceptions they are situated along the Oswegatchie river in the stretch between Edwards and Gouverneur, the sites being selected with reference to water power facilities.

The reduction of the talc is accomplished in several stages. The lump talc, as mined, is first broken in a jaw crusher of the Blake type. The broken product is then run through a cone grinder or through rolls where it is reduced to 1 inch size or less. In the third stage the crushed product may be ground between burstones of special manufacture or in a centrifugal grinder of which the Griffin mill is the common type. After this grinding the finest material may be removed by screening or by fans which blow it into settling chambers and forms one of the grades for the market. The remainder undergoes a final reduction in pebble mills. Alsing cylinders are generally employed for the last stage. They are 8 or 10 feet long and 6 feet in diameter and are lined with porcelain brick. They make from 20 to 25 revolutions a minute. Their charge consists of about 1 ton of talc and 3 tons of flint pebbles. The grinding of a single charge takes from 2 to 5 hours depending upon the grade of product that is desired. The fibrous character of the talc is maintained throughout the grinding to the end product so that it is difficult to size the ground talc by screening; consequently the grades of fiber are generally regulated by the duration of the final grinding process.

The foliated talc undergoes essentially the same treatment. The coarser grades as finished have a scaly appearance much like ground mica and can be used as a substitute in some of its applications. This variety is ground also to an impalpable powder and employed for the same purposes as massive talc. The milling of either variety represents the greater part of the expense of production of the talc for the market.

The finished product is shipped in sacks holding 50 pounds each. Quotations are made from Gouverneur as shipping point, though the mills along the Oswegatchie river are near the line of the Gouverneur & Oswegatchie railroad and their output is loaded directly into cars. The product of the mills off the line of this railroad is hauled by teams to Gouverneur.

Uses. The talc from this district, as already stated, is mainly used in the paper trade. The fibrous product goes into book and writing paper as filler and finisher, and it is used to a considerable extent, though perhaps not so widely, in newspaper. It is more readily incorporated with paper stock than clay and at the same time has a beneficial influence upon the strength of the paper. For wallpaper the foliated talc is often employed to give a lustrous surface. The manufacturers of gypsum wall plasters are consumers of talc which takes the place of hair, wood fiber or asbestos in these plasters. Among minor uses are in the manufacture of waterproof paints, steam pipe coverings and toilet powders.

Production. The production of talc in recent years has averaged about 65,000 tons. Of late there has been no decided expansion from year to year, though the tendency on the whole has been upward rather than to remain stationary. This appears from the following table which gives the output and value for each year since 1896.

Production of talc in New York

YEAR	SHORT TONS	VALUE	VALUE PER TON
1896	46 089	$399 443	$8 67
1897	57 009	396 936	6 96
1898	54 356	411 430	7 57
1899	54 655	438 150	8 02
1900	63 500	499 500	7 87
1901	62 200	483 600	6 99
1902	71 100	615 350	8 65
1903	60 230	421 600	7 ..
1904	65 000	455 000	7 ..
1905	67 000	519 250	7 75
1906	64 200	541 600	8 43
1907	59 000	501 500	8 50
1908	70 739	697 390	9 86

The production in 1908 of 70,739 short tons valued at $697,390 was considerably above that of the preceding year due mostly to the shortage of supply in 1907 brought about by the burning of one of the larger milling plants. There was also an increase in the average prices received for the ground talc, the average of nearly $10 a ton being the highest for a long time. At the low prices which prevailed in some of the years past, there was little or no profit for the mining companies, and the present level can not be considered as excessive. As the gain was made during a year of depression in the paper trade and in other lines of industry which are consumers of talc, the outlook for steadier and more remunerative prices in the immediate future seems very assuring.

New developments. The new mill at Hailesboro built by the International Pulp Co. to replace the old mill which was destroyed by fire has been completed and placed in operation. The mill has a nominal capacity of 100 tons of ground talc a day adding about 25 tons a day to the former capacity.

The Uniform Fiber Talc Co. was organized in September 1908 and secured a talc property on Wintergreen hill belonging to the N. H. Freeman farm just west of Talcville. Plans have been made looking toward the construction of a mill near the mine, for which purpose the Sullivan water power on the Oswegatchie river about ½ mile above Dodgeville has been purchased. The power will be transmitted to the mill by electricity. The company intends to make an output of from 30 to 50 tons a day. A vertical shaft put down on the property encountered a bed of fibrous talc of good grade.

The Ontario Talc Co. has continued the development of the Potter mine below Fullerville with favorable results, finding an excellent grade of fibrous talc.

INDEX

Education Department Bulletin

Published fortnightly by the University of the State of New York

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

No. 453 ALBANY, N. Y. AUGUST 15, 1909

New York State Museum

JOHN M. CLARKE, Director

Museum bulletin 133

FIFTH REPORT OF THE DIRECTOR OF THE SCIENCE DIVISION

INCLUDING THE

62D REPORT OF THE STATE MUSEUM, THE 28TH REPORT OF THE STATE GEOLOGIST, AND THE REPORT OF THE STATE PALEONTOLOGIST FOR 1908

ALBANY

UNIVERSITY OF THE STATE OF NEW YORK

1909

M210r-F9-1500

New York State Education Department
Science Division, February 8, 1909

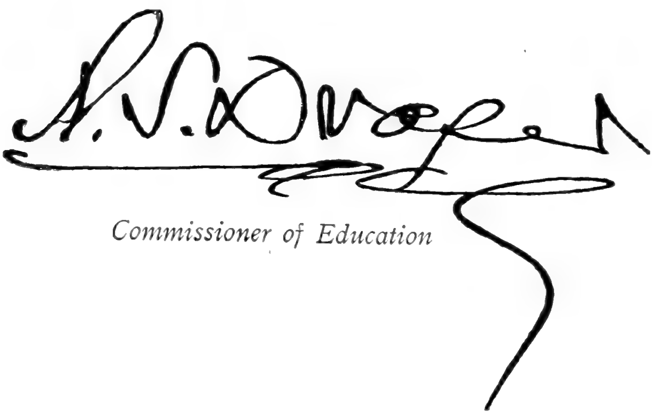
Hon. Andrew S. Draper LL.D.
Commissioner of Education

SIR: I have the honor to communicate herewith the annual report of the Director of the Science Division and recommend its publication in the usual form, as a bulletin of the State Museum.

Very respectfully
JOHN M. CLARKE
Director

State of New York
Education Department
COMMISSIONER'S ROOM

Approved for publication this 9th day of February 1909



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DIRECTOR'S REPORT FOR 1908

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 1907–8. It constitutes the 62d annual report of 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.D., 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 State Historical Museum

VII Report on the Archeology section

VIII The Protection of Natural Monuments

IX Publications of the year

X Staff of the Science Division and State Museum

XI Accessions to the 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

In my report of the past two years full statements have been made concerning the general condition of the collections which, from force of circumstances, have undergone no change during the current year except in the increase shown by the list of accessions given on succeeding pages. For these accessions, which excellently serve to indicate the public interest in the museum as well as the assiduity of its staff, provision can be made only by removal of other collections into storage.

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

Operations directed toward the execution of a geological map on the topographic base of 1 mile to the inch have continued along lines which have been followed for several years.

Central and western New York. Reports completed and awaiting publication cover the areal geology of the following quadrangles: Syracuse, Morrisville, Cazenovia, Auburn-Genoa, Honeoye-Wayland (these to be produced as double sheets) and Phelps. Field work has been completed by Mr Luther for the Caledonia quadrangle and progress made on the Batavia and Attica sheets; by Mr Whitnall on the Chittenango sheet and by Prof. W. J. Miller on the Port Leyden sheet. The report on the Remsen quadrangle has been completed by Professor Miller and is now in press.

All the foregoing maps, except the last two, are of regions where the rocks are unaltered Paleozoic sediments and the problems involved are those of exact classification and distribution of these deposits. The Remsen region is largely composed of such formations but also embraces an area of crystalline rocks, while the Port Leyden area is chiefly covered by crystallines.

Northern New York. The area of active operation in this region embraced the district west and southwest of the Adirondacks and a portion of the Lake Champlain territory on the east of the mountains.

In my last report reference was made to the work of Prof. H. P. Cushing upon the Theresa and Alexandria Bay quadrangles. This has been brought to completion and the survey extended to include the Grindstone, Clayton and Cape Vincent quadrangles. With collaboration of Prof. C. H. Smyth jr and Dr Ruedemann the field work for the entire five quadrangles was closed and the report on the work is in course of preparation. Dr Ruedemann mapped the St Vincent and southern half of the Clayton quadrangles and Professor Smyth gave most of his attention to the somewhat complicated crystalline geology of Wellesley island while Professor Cushing mapped the rest of the areas specified. The problems involved in this region are significant and have required cautious work both in the sedimentaries and the crystallines. The Paleozoic rocks here present members not elsewhere represented in New York and the actual relations of these sedimentary formations to those on the east and southeast of the Adirondack area are not as yet entirely clear. Much assistance in this work was derived from consultation with Dr H. M. Ami of the Geological Survey of Canada and E. O. Ulrich of the United States Geological Survey, both of whom spent some time in this field.

The chief purpose in extending the area of these operations was to determine with accuracy the distribution and magnitude of the

Pamelia (Stones river) formation in the region. It was found to extend across the Clayton quadrangle with increasing thickness and into Canada in much greater force than could have been inferred. About Kingston it has much the same thickness as in the Clayton region and it probably runs from there westward all the way across Ontario as the basal member of the Paleozoic series of that district. It also extends up the Black river valley in greater thickness than could have been anticipated from any published descriptions of the region. Detailed field work has definitely determined an unconformity between it and the overlying Lowville limestone.

The Paleozoic rocks of the district display a series of low folds in two directions, one trending northeast and another of later date and minor amount trending northwest and folding the earlier folds, producing domes at intersections of the arches of the two sets and shallow basins at trough intersections.

It is specially noticeable in the southern half of the Clayton area that the dip of the rocks and the direction of the drainage coincide. Wherever the gradient of the streams becomes steeper than the dip, there has resulted a local downcutting which brings to light the lower strata in patches entirely inclosed by the higher; illustrated particularly by the exposure of irregular patches along active or abandoned stream channels, of the Lowville limestone in the midst of a blanket of the Black River limestone. Dr Ruedemann who has studied and plotted these areas regards them as of identical character with the "Fenster" of the German geologists, windows out of which look the lower formations. As an English term of equivalence he proposes the expression *erosion inliers* as distinguished from the more usual depositional inliers which are of tectonic origin. Besides these erosion inliers the same area also exhibits patches of the Lowville beds exposed in the mantle of overlying Black River limestone by solution of the latter along joint planes making *solution inliers*. Though these are usually of small area yet some are large enough to record on the topographic base. Another erosional phenomenon of interest better exhibited on the Clayton sheet than elsewhere in the State is expressed by long tongues of Black River beds capping narrow ridges that project northward in groups from the Black River zone. The ridges in each group are of subequal width and parallel to each other. They are believed by Dr Ruedemann to have originated from the plucking action of the glacial ice along joint planes and their main direction is consequently parallel to the direction of the principal joints in each locality and to the movement of the ice.

The Precambric rocks of the district comprise old sediments of Grenville age and various igneous rocks of later age which have freely cut the Grenville schists. The latter show a thickness of several thousand feet, the greater part comprised in a series of rocks of varied nature within which are thin bands of white limestone and of quartzite, with much impure limestone. Unless the series has been overturned the limestone is at the bottom and the heavier quartzite at the top. The oldest of the igneous rocks is the Laurentian granite gneiss, two considerable bathylithic sheets of which lie in part in the mapped area and have been designated the Antwerp and the Alexandria bathyliths. The gneiss is full of inclusions of the Grenville rocks and clearly shows that it has absorbed large quantities of the Grenville, with the production of certain mixed rocks.

The Grenville limestone has had a singular bleaching effect on the red granite gneiss, turning it white. All the granite dikes that cut the limestone are white and the edges of the larger masses have the same color in the vicinity of the limestone; in fact the color change in the granite is an infallible indication of approach to the limestone, as repeatedly tested and proved in the field.

An analogous change is observable at granite-quartzite contacts, the granite becoming more acid, tending to bleach and showing much more frequent joints. Over the area mapped the granite gneisses seem to have been deficient in mineralizing fluids and have not notably altered the Grenville rocks, the granite showing more noticeable contact effects than the sediments.

The later igneous rocks comprise a small streak of syenite, one of diorite, a very small one of gabbro and a fairly large mass of coarse red granite, the Picton granite, which seems to be the latest of all, has a considerable extent of outcrop on Grindstone and Wellesley islands and a much wider extent across the border in Canada, though on the New York side it makes little show except for an abundance of dikes which cut all the other rocks. On the islands the granite is full of inclusions of the other rocks and on Wellesley they are remarkably abundant, have retained their original orientation, their strikes and dips being uniform and concordant with those of the main areas of the rocks away from the granite, so that they can be mapped into belts of quartzite, amphibolites and granite gneiss with as much exactitude as though the later granite were not present. This is taken to imply that here the very roof of this portion of the bathylith is now at the surface, the inclusions representing those parts last torn away from the cover formerly overlying the granite which was then in such viscous condition that the inclusions have moved but little from their point of detachment. Unlike the granite gneiss, this Picton granite was well supplied with mineralizing agents and has produced considerable contact effect on the adjacent rocks, notably a striking development of tourmalin.

There is also a considerable development of wide trap dikes on Grindstone and Wellesley islands from which an abundant and cheap supply of the very best road rock can be readily obtained.

Eastern Adirondacks. The mapping of the Elizabethtown-Port Henry quadrangles is reported by Professor Kemp as practically complete and the manuscript of the bulletin prepared. This is a complicated region including the extensive iron bodies of Mineville and vicinity and has required repeated review. An exposition of the Mineville mines and ores prepared by Professor Kemp has been published during the year as a special part of Bulletin 119, *Geology of the Adirondack Magnetic Iron Ores.* The regions referred to carry, along the shore of Lake Champlain, an interesting display of the Paleozoic formations which have been specially reviewed by Dr Ruedemann who has found that the Paleozoic areas which are of semioval or semielliptic shape, opening toward the lake and suggesting embayments, consist of groups of small fault blocks bounded on the west by northeasterly master faults and broken up again by transverse faults at various angles to the former. The small blocks may dip in various directions but hold a prevailing dip away from the mountains or toward the east. The work on the Ausable and Westport quadrangles has progressed. The geology involved herein is similar to that on the Elizabethtown and Port Henry sheets and with the adjustment of the latter, the other work will lend itself to readier solution.

Southeastern New York. *Geology of the Hudson Highlands and cooperation with the New York City Board of Water Supply.* An agreement entered into in the past year by the chief engineer of the Board of Water Supply of New York City and the State Geologist gives to the latter access to the highly important records of deep seated geologic structure from the southern Catskills southward to the mouth of the Hudson, acquired in the course of the remarkable engineering undertaking with which that board is concerned. By innumerable deep borings on both sides of the Hudson river and through its bed, in a region where the geology is highly complex, the operations of the board's engineers have assembled a body of data of extraordinary importance bearing upon the physiography and geological structure of the lower Hudson valley and the adjoining region. Two years ago the areal survey of the Highlands quadrangles was placed in charge of Dr Charles P. Berkey who has also become associated as geologist with the Board of Water Supply. This double professional interest enables Dr Berkey to assemble and combine all the data most effectively. During the past season more time was spent upon structural and petrographic details of this work than on a continuance of areal mapping, as this was made necessary from the accumulation of drill records and similar data. It is of interest to note that these deep seated data do not intimate any inaccuracy in the determination from the surface, of the stratigraphic succession or of general interpretation. On the contrary these well established factors were a constant guide to the engineering exploration and to the interpretation of data gathered throughout the work. But the data available are so abundant and well distributed as to enable the construction of cross sections with exceptional accuracy. The preliminary explorations of the Catskill Aqueduct are largely finished. More complete data, such as may be gathered as the tunnels progress will not be obtainable for several years and it therefore seems advisable to arrange the present matter for immediate use. This is being done in the form of a bulletin which will present an outline of the geology of southeastern New York as now understood, and a discussion of the significance of the newer factors.

In further areal work in the Highlands additional limestone occurrences have been noted some of which at least are clearly interbedded or included in the gneisses. These interbedded limestones (probably of Grenville age) are now known in the Highlands proper at occasional points from the vicinity of Brewster near the Connecticut line to Tuxedo lake near the New Jersey line, but they appear to be most frequent in the central or Hudson River belt. An important connecting link between the gneisses of New York city and of the Highlands proper was found in the discovery of interbedded limestones in the city at the type locality of the Fordham gneiss. Three points were found near Jerome Park reservoir in the Borough of the Bronx where the limestones are surely of this interbedded relation. In two of them the structural relations are unusually clear. They are small beds but lie within small anticlinal folds in such a way as wholly to preclude the possibility of infolding of overlying strata. In all cases these oldest limestones are very impure. At Jerome Park reservoir they carry an abundance of chondrodite and many unusual minerals, such as actinolite, sphalerite and galenite.

It is fairly certain that the gneiss series in southwestern New York can best be regarded as a unit formation, the basis of which is a metamorphosed sediment into which are intruded in a highly complex manner igneous masses of various kinds and sometimes of so large amount as to wholly obscure the original type. In some localities these igneous masses largely predominate and may merit local names but in all cases seen they give evidence of being distinctly younger than the associated recrystallized sediments.

An additional complexity has been observed in the vicinity of Brewster in the Carmel quadrangle on the southeast margin of the Highlands. Several narrow but remarkably continuous strips of limestone occur in the schist. The most reasonable explanation of them is that they are interbedded with the Manhattan schist. All of the crystalline formations have been traced to the State line in this vicinity, crossing the border into both Danbury and Ridgefield, Conn. In comparing the formations of the New York side, which have been followed in this investigation continuously from their type localities in New York city, with the new (1906) areal geologic map of Connecticut, the following points of correlation are established:

1 Two belts of crystalline limestone known on the New York side as *Inwood* limestone continue into Connecticut, the one into Danbury and the other into Ridgefield, as "Stockbridge" limestone.

2 Two belts of older gneisses, considered on the New York side as equivalent to the *Fordham* gneiss, continue into Connecticut as the "Becket" gneiss.

3 One belt of schist, somewhat more complex than usual by reason of intrusions, known as *Manhattan* schist on the New York side, continues into Ridgefield, Conn. but on the Connecticut map is not differentiated from the "Becket" gneiss.

In the Poughkeepsie quadrangle the work of areal survey has been carried on by Prof. C. E. Gordon. This quadrangle embraces a portion of the Highlands of southeastern New York, known generally as the Fishkill mountains, which on the north are overlapped by and faulted with the lower Paleozoics which extend northward in the Hudson valley. Frequently the Highland mass has overridden the newer strata and presents today many anomalous relationships with the latter. From these clearly marked and extensive fault and thrust movements we may infer the existence of similar ones to the south and east which may serve to explain some of the difficult phenomena there exhibited, in the presence, or absence, or metamorphism of the younger rocks and in the intrarelationships among the basal gneisses.

Thrust movements of considerable magnitude, measured by hundreds or a few thousand feet, are occasional and numerous smaller adjustment faults are frequent. No evidence has been secured of displacements on the west of the Highlands axis which are supposed to have carried the strata for distances of miles; and were the strata that once overlay this region to be restored it is probable that the extent of overturning and overthrusting could be measured by a few thousand feet.

The present altitude of the Highlands with respect to the neighboring Paleozoics serves in general as no indication of the former early relations between these great rock divisions. Folding, faulting and erosion, each or all, perhaps, repeated, have combined to efface the original early relationship. We seize upon what time has left with the hope of untangling the maze that now confronts us.

The sky-line of the summits of the Highlands knobs and ridges even with that of more distant hills among the younger rocks presents the aspect of a former base level that is unmistakable. What masses of overlying strata have been removed from these crystalline Highlands rocks we can only guess from the thickness of those to the northward, the character of the folding there, and the length of time the region has suffered denudation. Lofty mountain ridges were reduced from alpine hights to a peneplain. From their stumps we are obliged to construct our imperfect history of the region.

Perhaps in no other place in eastern North America is the contact of the lowest Paleozoics on the underlying Precambric better preserved than on the flanks of the Highlands of southeastern New York and nowhere is it better shown than on the northern slope of the Fishkill mountains.

Here for considerable distances the basal Cambric quartzite rests unconformably upon the folded basal gneisses. The forces of erosion that have removed the quartzite and the overlying limestones, which once filled the northern valleys of these mountains, have cut deeply enough to expose a faulted block of the basal Paleozoics where the relationships have been well preserved. The usual abnormal relationships present along this border as a result of thrust faulting are here absent. In many places the close proximity of folded gneiss and overlying quartzite show the great discordance in the dip of the two and less distinctly, though plainly, in that of the strike. In places the two are so near that for all practical purposes we are dealing with the actual contacts. The relationship presents the aspect of an overlapping sea. Leaving the gneisses at the south, one successively passes over the quartzite and overlying limestones northward until lost in the close folding there prevailing. Erosion has greatly trenched the comparatively soluble limestones of the Fishkill belt and has planed these strata down nearly to a common level across the faults and folds. The confusion resulting does not conceal the substantial thickness of the limestone strata and the great thickness of the slates and schists of the Hudson valley to the northward only strengthens the conviction that they, with the limestones, once covered the tops and filled the valleys of the Highlands over which they were carried by an overlapping sea that progressively advanced over a subsiding Precambric land mass.

It is proposed in the later report to discuss in this connection the occurrence of scattered masses of the younger rocks met with in the Highlands and to suggest explanations for these occurrences. It is purposed, also, to discuss the significance of the great block fault south of the Highlands, which has dropped the younger rocks of southeastern New York and the shattering which the Highlands mass received from the forces producing this and other faults. Some treatment will necessarily be given to the proposition that a combination of forces, acting as a gigantic couple, the resultant of the westward tangential pressures operated with the Adirondack Precambric buttress to induce strike and transverse faulting of an exceptionally violent sort in the powerfully elastic rocks of the Hudson valley.

Highlands of the quadrangle. The general petrography and stratigraphy point to a Precambric sedimentary series with a Precambric intrusive sill, or bathylith, and some apparently later intrusions. The discovery of an altered limestone interbedded with the gneisses, the heterogeneous character of the gneisses themselves and the occurrence of repetitions within them of certain rock types, as well as, apparently, some plainer evidence of bedding, are taken as the principal evidences of a sedimentary origin. Microscopic evidence will be presented. No graphitic strata have been noted. The structural features belong both to Precambric and later time. Later deformations have been superimposed on earlier ones during the later period of mountain making. In the town of Fishkill, lying within the younger rocks and extending from near the base of the Bald Hill spur northeastward for a distance of 5 miles and terminating in a faulted block known as "Fly mountain," is a narrow inlier of Precambric rocks which will be shown to be a part of the Highlands.

Reconnaissance through the Highlands indicates the essential similarity between the basal gneisses of this quadrangle and the rest of the northern Highlands. Within the quadrangle there is no evidence of more than one sedimentary series. Considerable shearing has occurred and is considered responsible for some of the foliation. Later faulting and shearing have obscured earlier features. There is given as a result of pressure always applied in the same general direction and from the factors just mentioned an isoclinal character to these rocks that simulates an immense monoclinal series of sediments. Continuity has been broken, and repetitions by earlier folding have been sheared out, by faulting. If the identification of the stratum of serpentinous rock, interbedded with the gneiss, as an altered limestone be correct, the general resemblance which these gneisses have to the other basal gneisses of the Highlands has confirmation in that fact. Recent work by Berkey[1] in Manhattan shows limestones interbedded with the Fordham gneiss, which strengthen the correlation previously made by him of the Fordham gneiss with the gneisses of the Highlands.

Poughquag quartzite. This formation which intermittently appears, overlying the gneisses along their northern border, from the type locality at Poughquag, Dutchess co., to the Hudson river is undoubtedly of Lower Cambric age. Fossils have not been found in this formation, but the blue limestone immediately overlying it, into which it grades, has yielded the opercula of Hyolithellus micans. The relationship of the quartzite to the gneiss and of the quartzite to the overlying limestones and calcareous shales as seen south of Johnsville, in the East Hook, are very similar to those near Stissing mountain, at Stissing Junction and Attlebury, farther north in Dutchess county, which have been proved to be Lower Cambric by the discovery of Olenellus in the quartzite and of opercula of H. micans in the overlying limestone. The rusty friable Olenellus quartzite described by Walcott and Dwight and found by the writer west of Stissing Junction could not be located in the Fishkill mountains.

[1] Science N. S. v. 28, no. 730, p. 936.

A small patch of the basal quartzite was found resting on the granite gneiss at Fly mountain, evidently faulted with it. It was also found reposing on a small inlier of these rocks outcropping between the base of the Bald Hill spur and the southern extremity of the Glenham gneiss belt, in the town of Matteawan. These facts afford additional evidence of the age of the rocks of the Glenham belt.

Fishkill limestone. This belt of Cambro-Ordovicic limestone as displayed within the quadrangle has yielded fossil evidence of its age despite the metamorphism it has undergone. In the Hook district south of Johnsville, where the strata have been preserved in more nearly their original relationship, I have found the scanty but conclusive evidence of the age of the blue, compact limestone overlying the hard, compact quartzite in the presence of well preserved opercula of Hyolithellus micans. In the town of Fishkill, northwest of the road from Fishkill Village to Matteawan, between it and the Glenham gneiss belt, and extending a couple of miles roughly paralled with the outcrop of the latter, I have traced a belt of hard limestone weathering grayish white, but showing buff-colored markings on fresh surfaces, with weathered surfaces showing among the lichens the closely compacted whorls of what I believe to be Ophileta compacta Salter. The belt can not be traced beyond the road from Fishkill Village to Wappingers Falls. Faults and metamorphism have greatly obscured, if they have not obliterated it. In the limestone at Old Hopewell, near the old furnace, and just north of Gregory's gristmill, I have found fragments of Orthoceras and one complete specimen, as yet unidentified, weathered out on the surfaces of a gray, banded crystalline limestone, very close to marble in the degree of metamorphism which it shows.

We have evidence of the presence of the lowest Cambric and the lowest Ordovicic in this limestone belt, by the discovery for the first time, of actual fossils. In the final report other less certainly defined but important details may more pertinently be discussed.

Wappinger limestone (Barnegate limestone, Mather). In this belt, first called the "Barnegate limestone," by Mather, but because of the association which the Wappinger creek has with it for many miles, now more commonly called the "Wappinger limestone," additional confirmatory discoveries have been made which extend somewhat the boundaries of certain terranes within it. In two old, abandoned quarries on the farm of Mr Byer, near Manchester Bridge, 3 miles east of Poughkeepsie, the Trenton conglomerate, so well displayed at Pleasant Valley and Rockdale, was found filled with Solenopora compacta and crinoid stems, and overlain by hard, blue, medium bedded limestones carrying a rather full assemblage of brachiopods, with an occasional trilobite, all of apparent Trenton affinities. Southeast of Poughkeepsie on the Spackenkill road, on the farm of Mr Ruppert, in a quarry being worked for lime, in a hard, thick-bedded limestone, coils resembling gastropods and a Hyolithellus were discovered and above these in the somewhat thinner beds in the upper part of the quarry, Lingulepis pinniformis and a trilobite probably Ptychoparia, thus confirming the occurrence and abundance of the Potsdam fauna as first discovered by Dwight nearer Poughkeepsie, 2 miles north of this quarry. The now known localities of Potsdam fossils within this quadrangle and the thickness of the strata show it to be a prominently developed terrane.

Numerous smaller patches of limestone, or limestone conglomerate, occurring as inliers in the slates to the east of Wappinger creek have been noted and mapped, but can not be discussed here and may be left for the fuller report.

Slates. The Paleozoic rocks of this quadrangle present a complicated structural and stratigraphic problem. The structural features and many details can not be more than alluded to in this report.

Recalling the faulted proximity which Lower Cambric rocks have to those of Ordovicic age at the north, as at Bald mountain, Washington co., the slates and schists in the eastern part of the quadrangle were studied for such relationships. The small limestone inliers were examined in this connection. The possibility of the Normanskill and the Utica occurring in the western slates was considered; but no evidence of any of these was secured. Fossils were hard to find. In the slates they were noted at many of the localities where previously discovered, but were not seen at others. The general relationships suggested nothing older than the Trenton limestone of the region. Only one new fossil locality was discovered in the slates. At Swartoutville, 2 miles north of Brinckerhoff, between Fishkill Village and Hopewell Junction in fissile, broken slates, along a fault between them and the barren northwest margin of the Fishkill limestone, brachiopod fragments were discovered. Their examination has only suggested a horizon of Trenton or later age.

The slates present many lithologic variations and many interesting stratigraphic and structural relations which can not be given here.

Metamorphism. In this report the general fact of greater metamorphism of the Paleozoics to the east should be noted. Reconnaissance in Dutchess county reveals that the metamorphism of these rocks is a function of the distance of these strata from the Hudson river in the northern portion of the county. At the south apparently the increment by which metamorphism approaches a given degree is greater per unit distance, and apparently is in some way related to the proximity of the Highlands mass.

The map and complete presentation of details and conclusions are reserved for a later and fuller report on the geology of the Poughkeepsie quadrangle.

Surficial geology

The examination of the glacial and postglacial deposits and their interpretation in terms of the agents performing the work has been continued during the past season by Prof. H. L. Fairchild in the region about the east end of Lake Ontario, especially in the area covered by the Grindstone, Alexandria Bay, Cape Vincent, Clayton and Theresa quadrangles. The glacial and glaciolacustrine features are striking and peculiar; over all the area the deposits were laid down under the deep waters of Lake Iroquois and the north and east portions of the area were also covered by the marine waters of Gilbert gulf. In the lowering of these waters all the land surfaces were wave swept and in consequence the drift is mostly gathered into the depressions. The two striking drift features are the extensive clay plains which occupy the valleys and the lower tracts and the few boulder moraines. The drift sheet as a whole is scanty and many extensive tracts are essentially bare rock. The striking physiographic features are the hummocks or rock knobs in the districts of crystalline rocks, the broad plains produced by the sedimentaries and the clay plains of the lowlands and valleys.

Suggestions are found of a Prewisconsin glaciation, though no interglacial or warm climate deposits are yet determined. Over large tracts of the limestone the surface has been worn into broad furrows and ridges, a huge "washboard" structure which has lost its original glacial polish and striae. A later ice abrasion has cut these parallel ridges usually at a considerable angle. The old planation surfaces have lost much of their glacial character. In the central and eastern parts of the State two sheets of till are indicated, one superimposed on the other. The indications are that the later ice invasion was very weak.

The southward overflow of the ice-impounded waters held in the Black river valley built high and broad deltas in the vicinity of Trenton and Trenton Falls, and later north of Rome. During the time of this overflow and earlier, glacial waters were also held in the Mohawk valley much above the Iroquois level, and on the west and south flanks of the Adirondacks above the Black river waters. The existence of these high waters has been found to be due to the ice blockade of the Mohawk valley. As the Labradoran ice sheet waned and the Adirondack rock surface was exposed the Ontarian ice lobe pushed eastward into the upper Mohawk valley while the Hudson river lobe pushed westward up the same valley. At an early stage of this opposing flow through the Mohawk valley the westward flow of the Hudson lobe prevailed and excellent drumlins were formed by westward moving ice, as far as Cedarville, 12 miles southeast of Utica. Professor Brigham has reported the presence of west pointing drumlins in the Johnstown district.

It is quite possible that the earliest waters which gathered in the valleys of the Adirondacks found escape across the Mohawk glacier to Susquehanna drainage. Certainly there came a time when an open lake was held in the Mohawk valley between the two opposing ice lobes. The earliest overflow of this Mohawk glacial lake seems to have been across the col 6 miles east of Richfield Springs and at the head of the Otsego valley, with present elevation of 1360 feet. The many broad delta plains at 1440 feet on the south flank of the Adirondacks correlates with this outlet when allowance is made for the postglacial deformation of the land. A lower escape of the Mohawk lake was found at Cedarville at the head of the Unadilla valley, with altitude 1220 feet. This pass correlates with the conspicuous sand plains at 1300 feet altitude. Possibly a still lower escape was found at Bouckville to the Chenango valley at 1160 feet. But soon the overflow was shifted to the eastward by the backing away of the ice front from the face of the Helderberg scarp, 10 miles southwest of Schenectady.

The Schoharie valley had held glacial waters (as shown by Professor Brigham in my last report) with earliest outlet by one or more of the three passes at the head of the basin, at 1920 feet. Later the Schoharie waters blended with the Mohawk waters with overflow by the outlets leading to Susquehanna drainage, as noted above. The pass at 1500 feet to the Schenevus valley never carried any flood. The pass south of Middleburg to the Catskill creek, at 1200 feet, has a little swash channel across it, but was never cut by a river. The failure of flow across this col seems to be due to the Hudson ice flow blockading the Catskill valley.

When the ice front receded on the Helderberg scarp the Mohawk lake (including the Schoharie waters) found escape to the Hudson valley. The face of the Helderberg is strongly terraced by centuries of river work. This channeling continues southward along the west side of the Hudson valley where the rivers flowed alongside the ice tongue.

The lowest pass of this episode lies between Esperance and Delanson at 840 feet, now utilized by the Delaware and Hudson Railroad. This outlet correlates with numerous delta plains in the Mohawk valley, striking examples of which may be seen about Prospect and Trenton Falls, at 1100 to 900 feet.

The Delanson outlet was abandoned when the ice front weakened on the rock scarp west of Schenectady and at Rotterdam Junction. The blockade at this stage correlates with many plains in the upper Mohawk valley and with broad plains in the Sacandaga valley, already noted by Brigham. These have altitudes of 900 down to 700 feet.

The low altitude of the glacial waters in the upper Mohawk region forces us to the conclusion that the rock barrier at Little Falls must have been removed early in the history of the Postwisconsin drainage through the Mohawk valley, and long before it received the flood from the area of the Great Lakes. It appears to be more likely that the pass was chiefly cut by Prewisconsin drainage.

By the study of the several points of outflow of the glacial waters as indicated above, in comparison with their correlating sand plains reaching west to beyond Rome, it becomes possible to determine with some degree of exactness the limits of the two ice lobes (Ontario and Hudson) at certain critical stages of their waning. A series of large maps has been prepared to show in a general way the recession of the ice sheet over New York.

Industrial geology

Iron ores. The investigation of the State's iron ore fields — a work that has been under way for some time — was brought to partial completion during the past year by the publication of final reports upon the Adirondack magnetite district and the Clinton belt of hematite ores. These are the two largest fields and have the greatest commercial importance at present as well as for the immediate future. It is intended eventually to continue the investigations so as to provide similar reports upon the other districts, thereby giving for the first time a comprehensive account of these deposits throughout the State. The subject of iron ore supplies is just now engaging unusual attention, due to the enormous growth recently in the consumption of iron and steel and a realization of the need of preparing to meet a correspondingly large advance in the years to come. With the increased demands made upon the mining fields, there has been a very appreciable falling off in the grade of the ores shipped to furnaces, a feature that is bringing new sources of supply within reach of practical utilization. A renewed interest is already manifest in both the Adirondacks and the Clinton district by the many developments that have taken place during the last year or so.

The Adirondack region has furnished altogether nearly 40,000,000 tons of magnetite, mainly of high grade character. While important bodies of that kind still remain, sufficient to furnish an equivalent output at least in the future, the main resources consist of low grade ores, in which the magnetite is associated with gangue minerals and which require concentration before using in the furnace, and of the titaniferous magnetites hitherto held in little regard. Concentration is already being practised successfully on nontitaniferous ores carrying as low as 35% iron. There are numerous and large bodies of such ores awaiting development. In the report attention was called also to the possibility of utilizing the titaniferous magnetites, as some careful experiments have shown that the titanium can be partially removed by a process of concentration similar to the method employed for the other magnetites. Their amenability to concentration is dependent upon the fact that the titanium, in many cases at least, is mostly segregated as ilmenite, while the magnetite carries a subordinate amount only of that element. If concentration proves to be practicable on a commercial scale, there is no doubt that the deposits will come into immediate use, since the magnetites aside from their titanium content are admirably adapted to furnace use. It is understood that further tests along this line are in progress with reference to the Lake Sanford ore bodies which have recently been explored with highly satisfactory results.

The report on the Clinton ores includes a number of new sections showing the occurrence and stratigraphic relations of the ore seams over a portion of the belt hitherto unexplored. These sections were prepared from the records of drill holes put down during the fall and winter of 1907–8 under a special appropriation for the purpose. The drill cores have been securely boxed and stored in the museum. As a result of the field investigations which have extended over every part of the Clinton formation in its extent from Herkimer county on the east to Niagara county on the west, the distribution of the ore seams has been ascertained in a general way with some definiteness. Though the seams are nearly everywhere present over the middle part of the belt, it is only in a relatively few areas that they are of size and character to have possible value for mining. The main resources are represented by the areas lying in Oneida, Cayuga and Wayne counties. Sufficient information is not yet at hand to afford a full and exact estimate of the quantity available, but a calculation based on seams above 18 inches thick and within 500 feet from the surface indicates that there is fully 600,000,000 tons of ore within these areas. With a total production of but 4,000,000 or 5,000,000 tons it is evident that the resources are capable of a much larger development than they have undergone up to the present time.

Mines and quarries. The annual bulletin presenting the developments and production statistics of all the mineral industries of the State was published in July, bringing the record down to the end of 1907. It is proposed to continue its issue, but for the current year the work of canvassing the industries will be carried out under cooperation with the United States Geological Survey. According to the plan adopted there is to be collected only a single set of returns, and the compilations will be made available for the uses of both offices.

MEMORANDUM OF AGREEMENT BETWEEN THE DIVISION OF MINERAL RESOURCES OF THE UNITED STATES GEOLOGICAL SURVEY AND THE STATISTICAL BRANCH OF THE NEW YORK STATE GEOLOGICAL SURVEY

In order to avoid a multiplicity of requests for statistical information for mine and quarry operations and also in order that the State Geologist may keep in touch with the mineral producers in the economic development of mineral resources of the State, the following agreement between the State Geologist and the Division of Mineral Resources of the United States Geological Survey is made:

Early in the fall of each year (by October 1st if possible) a list of the mineral producers in the State of New York, as the United States Geological Survey has them, is to be sent to the State Geologist who will check with the lists in the possession of the State

Survey and make such corrections as he may be able to from the State Survey records. These lists will then be returned to the Division of Mineral Resources of the United States Geological Survey.

Blanks for the collection of the statistics will be printed each year at the expense of the United States Geological Survey. Franked envelops for the transmission of the statistical blanks will be addressed in the office of the Federal Survey, and the blanks either numbered or having the name and address of the operator written thereon will be inclosed in these envelops with a circular letter from the Director of the Geological Survey. A franked envelop addressed to the State Geologist will be inclosed in the envelop with the circular letter and blanks and all will be sent unsealed to the State Geologist in order that he may inclose such additional circular to the operators as he may desire sent. By rubber stamp or otherwise the State Geologist will also indicate on the blank that the work is done by cooperation of the two surveys. On the return of the blanks to the State Geologist, he will have each report carefully scrutinized and see that it is in proper form for tabulation. He will make such transcript for his own uses as he may desire and then forward the reports to the United States Geological Survey. The second request for reports from producers who have not responded to the first inquiries will be prepared in the same manner in the office of the Federal Survey and transmitted to the State Geologist. If it is found advisable to send additional inquiries by mail the same plan will be followed except in the case of registering the letters, in which case they will have to be mailed from Washington. After the attempts to secure returns by mail have been exhausted the State Geologist will undertake to secure the reports from the delinquent operators by personal visits of himself or assistants.

In the publication of the statistical reports of the State Survey and of the United States Geological Survey, credit for the cooperative plan will be given.

JOHN M. CLARKE
State Geologist

E. W. PARKER
Statistician in Charge,
Division of Mineral Resources,
United States Geological Survey

During the period in which the statistics have been collected, there has been a very satisfactory growth of the mineral industries of the State. The total output of all materials reported by the individual producers for 1907 was valued at $37,427,405. The corresponding values for previous years were: $37,132,832 in 1906; $35,470,987 in 1905 and $28,812,595 in 1904. The different items entering into the calculations number about 35 and include only the crude products or such as are in their first marketable forms.

SEISMOLOGICAL STATION

The Bosch-Omori instruments installed in the State Museum in March 1906 have given practically continuous service to the present time. Altogether they have furnished records of 35 different earthquakes, of which nine occurred during the year ending September 30, 1908. In the preceding year which seems to have been one of notable seismic activity, there were recorded 19 shocks. The remaining seven were registered in the period from March 10 to October 1, 1906.

The records obtained during the year just elapsed are listed in the accompanying table. When additional details relative to the individual disturbances have been available they are appended as notes. The character of the records varies to a marked degree, depending upon the wave motion set up by each shock, the distance of the focus and other factors not as yet well understood. Hence, it is not always possible to give the different elements characterizing a disturbance with satisfactory completeness, though in many cases, specially in respect to the more violent earthquakes, the records can be used as a reliable basis for deduction.

So far the instruments have recorded no earth movements of local origin. The sources of the disturbances have been widely distributed, but none of them nearer probably than 2000 miles. In a majority of instances, perhaps, they have been related to the series of readjustments that has taken place recently in the Cordilleran region of North and South America, as manifested by the extremely forceful earthquakes of San Francisco, Valparaiso and Central Mexico and a number of smaller ones within that zone. These seem to have been due to tectonic displacements or fault slips. With the relief of stress they have undoubtedly afforded, a period of comparative repose may be expected to follow and to continue for some time. The nearest region of disturbance to which local records can be definitely referred is the West Indies. There have been several shocks of notable size registered at Albany that could not be traced to any known occurrence on land and were probably of submarine origin.

The Albany station has communicated its observations from time to time to the International Seismological Association for record in its reports and to the California Earthquake Commission. The latter has recently published a comprehensive account of the San Francisco earthquake.

Full details of the local station have appeared 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″; hight above sea level, 85 feet; weight of each pendulum including arm 11.283 kilograms; distance of center of gravity from rotating axis, 84.6 centimeters; period of pendulums approximately 30 seconds; multiplying ratio 10. The machines have no artificial damping apparatus.

RECORD OF EARTHQUAKES AT ALBANY STATION, OCTOBER 1, 1907 TO OCTOBER 1, 1908

Standard time

Date	Beginning preliminaries	Beginning principal part	Maximum	End	Max. amplitude
1907	h. m.	h. m.	h. m.	h. m.	mm.
Oct. 16	9 04 a. m.	9 15½	9 16	10 00	150
Oct. 20	11 36 p. m.	....	....	1 30	....
Dec. 30	12 32½ p. m.	12 43	12 45	1 30	70
1908					
Feb. 1	6 20 p. m.	6 32	....	7 30	....
Mar. 26	6 09½ p. m.	6 24	6 25	8 15	55
Mar. 26	10 53½ p. m.	11 08	....	12 00	5
May 15	3 47 a. m.	3 55	....	4 30	....
Aug. 13	7 55 p. m.	8 03	....	8 49	....
Sept. 21	2 01 a. m.	2 12	....	3 23	....

When the amplitude was less than 1 millimeter as a maximum, it has not been given.

October 16. A record of a microseism which appears to have been transmitted around the globe. It was reported by many of the foreign stations. Judging from the local tracing, the focus was approximately 5000 miles distant in a direction south of west, somewhere between the Hawaiian islands and the coast of Mexico. It was undoubtedly submarine. Slight shocks were reported from California on the same date.

October 20. Slight wave motion extending over a period of two hours. Also reported by the stations on the Isle of Wight and at Laibach, Austria. The focus seems to have been in central Asia, probably in Bokhara where several towns were badly shaken and damaged.

December 30. A severe disturbance, perhaps from the same zone as the earthquake of October 16. The origin is estimated at 4000 miles from Albany. The shocks appear to have left no trace on land and can be assigned without much doubt to a submarine source.

February 1. Slight movements of unknown origin.

March 26. A record of the earthquake that occurred in the State of Guerrero, Mexico, and is reported to have destroyed Chilapa, a town 115 miles south of the City of Mexico. Two distinct series of vibrations were registered, beginning nearly five hours apart. The first was the more violent and represented the distinctive shocks. The records by both pendulums were of the same degree of magnitude. The indicated distance of the origin, according to the Omori formula, was 3000 miles, which is about the actual distance.

May 15. Small vibrations, lasting about 40 minutes. No indication of origin shown by the records. The shocks were registered also by the station operated by the Weather Bureau near Washington and according to its reports were probably from a source in Central America or in the adjacent region of the Pacific.

August 13. An indefinite microseism somewhat similar in character to the preceding.

September 21. Perhaps connected with a submarine earthquake reported as causing heavy waves off the coast of Mexico on September 23.

MINERALOGY

In the section of mineralogy, the work of research has progressed along the lines of a monograph on the crystal forms of New York calcite, now nearing completion. A mass of excellent material from a number of widely distributed localities was available for this study, which has already yielded eight forms new to the species.

A notable collection of minerals from the celebrated localities of northern New York and Canada has been acquired by purchase from Mr A. F. Nims of Philadelphia, N. Y. This collection which was assembled by the late Charles D. Nims contains many excellent specimens from localities no longer accessible, particularly a series of 225 specimens of danburite from Russell, St Lawrence co., a large suite of oligoclase from Fine, St Lawrence co. including many specimens which give fine moonstone reflections and several large crystals twinned according to the albite law.

[illegible]

[illegible]

[illegible]

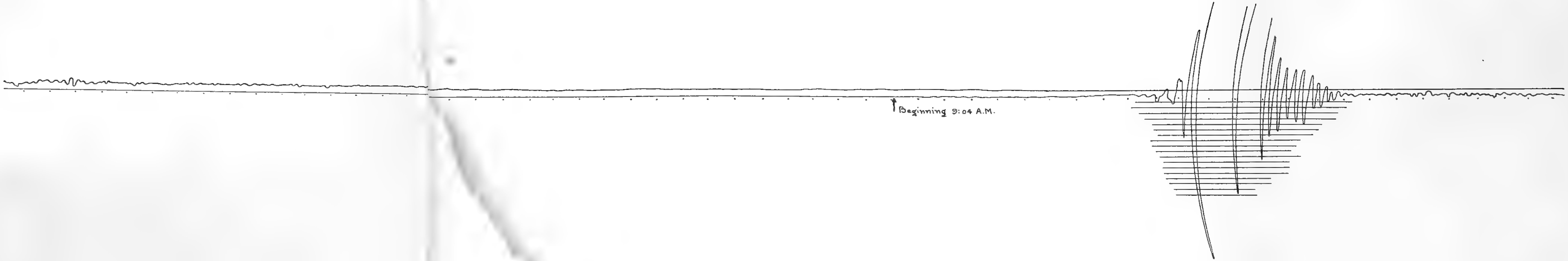
[illegible]

[illegible]

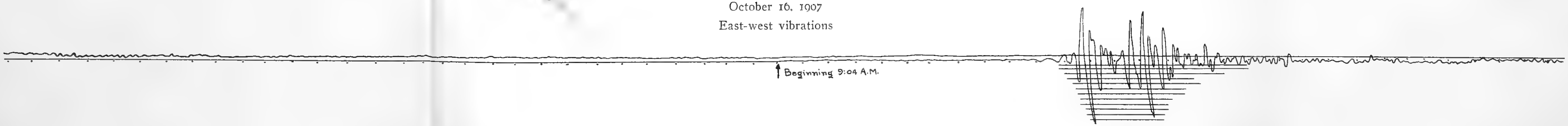
[illegible]

Seismograms

October 16, 1907
North-south vibrations

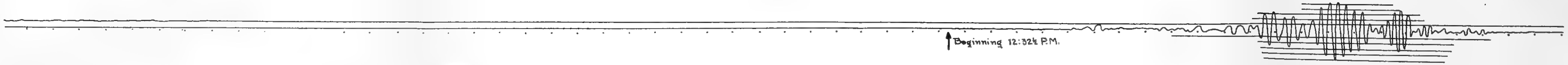


October 16, 1907
East-west vibrations



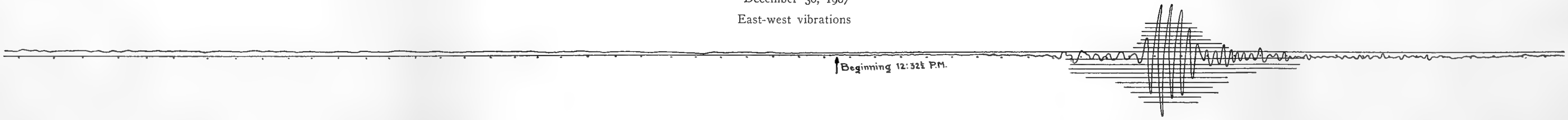
Seismograms

December 30, 1907
North-south vibrations



December 30, 1907

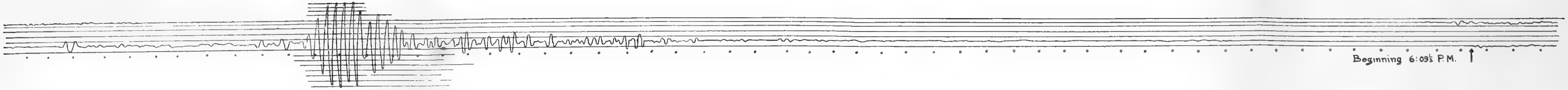
East-west vibrations



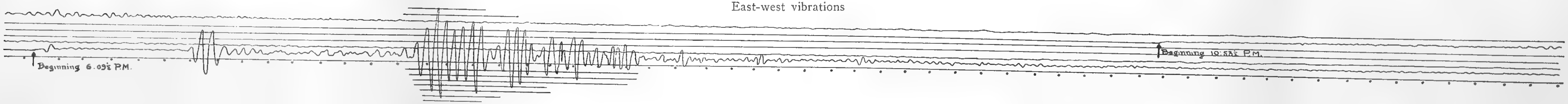
Seismograms

Mexican earthquake

March 26, 1908
North-south vibrations



March 26, 1908
East-west vibrations



PALEONTOLOGY

Early Devonic faunas. The work of the paleontologist on this subject, which has been in process during a number of years, has now been brought to a conclusion so far as concerns its scope as expressed in volumes 1 and 2 of Memoir 9. The second volume of the memoir is now entirely printed. The contents of volume 1 were largely devoted to a close comparison of the Devonic faunas of Gaspé, Quebec with those of New York. In volume 2 these comparisons are extended to the faunas of Dalhousie, N. B., northeastern and northern Maine. The data available for these studies have been somewhat comprehensive and are drawn from regions which have heretofore elicited but slight attention from geologists. The array of facts therefrom presented has thus in considerable measure the value of new knowledge and the conclusions of broader import bearing on the origin and dispersion of the faunas and also indicative of the ancient geography of the continent are here restated.

General conclusions

From the considerations given based chiefly on the analyses of the faunas we may justly draw some reasonable inferences as to the connections of the northeast basins of the early Devonic with those to the south and west. Such inferences can be stated only as probable for there still remains in eastern Quebec and northern Maine an extensive area whose structure is insufficiently known to afford entire security in indicating the boundaries of these passages. Some of these inferences have already been set forth in their proper place but to restate them briefly we conclude:

1 There was a definite and clear passage from Gaspé into New York and the more southern Appalachians during the period of the Helderbergian, where a well defined element of the Helderbergian flourished in the St Alban beds at the base of the Gaspé limestone series.

2 A similar open way existed at approximately or actually the same time, connecting the Dalhousie beds of northern New Brunswick with the Helderbergian of New York.

3 That these two passages seem to have converged and united into one toward the west and south, for while each carries a clear predominance of Helderberg species, the two have comparatively little in common, the fauna of one representing essentially one congeries, that of the other a different congeries of species which are apparently commingled in New York.

4 That in the later stage represented by the profuse fauna of the Grande Grève limestones the northern passage broadened while the Dalhousie passage became extinct; and that passage remained open till much later in the Devonic than Helderbergian time. This fact is evinced by the somewhat lessened though by no means obliterated presence of Helderberg species, by the full development of characteristic Oriskany species in the purest limestone medium and the existence of certain types of still later (Onondaga) age in minor phases of development. The opinion has been expressed that during this period of the Grande Grève limestones the Gaspé Basin was a place of rapid fructification and departure of the fauna toward the southwest.

5 In northern Maine that part of the Devonic represented by the arenaceous sediments of Aroostook county must have pertained to a distinct geographic passageway and have been more or less obstructed southward during the period of the Oriskany. It is quite possible that the same channel was open in its southwest extent during Helderbergian time as indicated by the fauna of the Square Lake limestone, though the differences therein from the New York Helderbergian would still indicate that the way was then not entirely clear open and carried basins of special development.

6 The development of the early Devonic fauna in Piscataquis and Somerset counties, Me., though this series of rocks is apparently not widely separated in continuity or direction from the Aroostook county faunas, is unlike the latter, is more decided in its representation of New York Oriskany types, and yet has many special features in common with those of Aroostook county. At all events this area indicates no entire severance from the former and also declares for a wide open passage southward.

7 As far southward as northern Maine the calcareous character of the Oriskany facies is already lost in spite of its predominance further north and east, yet in this regard it can not be said to conform more fully with the New York development for that, in spite of common repute, has been abundantly shown to be more calcareous than arenaceous, save as the limestones of the New York Oriskany carry large percentages of silica and weather freely to a silicious residuum.

8 The more southerly of these passages show in their fauna traits which the northerly do not, namely, a striking array of affiliations with the Coblentzian fauna of the Transatlantic. It would be difficult to assign any other reason for this than that

the northerly passages ended in the open sea or that that part of the geosyncline in which they flourished failed entirely of continuity with the eastern continent while more southerly parts left freer connection with the east at contemporaneous periods. These affiliations with European faunas have been specifically indicated in the text and imply a well defined westward invasion along these eastern channels in this early period of the Devonic.

9 There was still another quite well defined channel of this time which has not here been specially considered, namely that represented by the beds of Perry, Me.— St John, New Brunswick — Annapolis, Nova Scotia. This southernmost Devonic channel is little known at present. Its fossils have been studied by Dawson and Matthew for the New Brunswick and Nova Scotia occurrences and by Williams for the manifestations in Washington county, Me. We have had extensive collections from the last but the preservation is not favorable and yet good enough to demonstrate that exact information in regard thereto is still to be desired.

10 All these various channels of the early Devonic in the northeast converged southwestward. It is probable however that they passed on southward, after the union of some of them, by different thoroughfares. We here come face to face with certain hypotheses with substantial evidence behind them but they may be stated in terms which will permit of their modification after more detailed knowledge is acquired.

11 The possible trunk troughs entering the southern portions of the geosyncline may be indicated thus:

a **Connecticut valley trough.** The valley of the Connecticut is ancient, probably not differing in origin from the parallel valleys of Lake Champlain and the Hudson as a graben valley or at least outlined by a zone of master faulting. Between the crystalline boundaries of this trough at Lake Memphremagog and southward are evidences showing that it was open earlier that the Devonic, as witness the limestones at Littleton, N. Y. with species of Dalmanites (D. lunatus Lambert) apparently of very late Siluric age.

At Lake Memphremagog are grits carrying Taonurus which have been identified by Dr Ami with the Esopus grit but the argillites both above and below these grits contain fossils; a Dalmanites similar to the D. coxius of the Grande Grève limestone, an Orthoceras of distinctive character, with traces of other fossils. While the Taonurus alone can not be taken as a safe guide for identification with the Esopus horizon of New York yet the accessory evidence is confirmatory of an age for these deposits essentially equivalent to the Oriskany.

Still farther south at the north line of Massachusetts is the well known occurrence of partly metamorphosed Paleozoic fossils at Bernardston, contained in a limestone and an overlying quartzite. These fossils, of which I have had opportunity to examine large series, are invariably distorted in the quartzite where they most abound so that any resemblance they may assume is too often a resemblance by distortion and a determination thereof carries a large element of fiction and imagination. I believe, however, that the conclusions reached long since by Whitfield in regard to the age of these rocks, that the limestones with large crinoid columns are Helderbergian and the quartzites above with distorted brachiopods are Oriskany, is as close an approximation to the truth as the facts permit.

We must now again call attention to the altitude of the Helderbergian and Oriskanian rocks in the Helderberg mountains of New York. They stand in an escarpment facing the west, north and east overlain by the great thickness of later Devonic constituting the Catskill mountains. Their faces are terraced faces of erosion. Their former extent was in the directions which they face. Beyond any doubt these rocks extended eastward of the Hudson and into western Massachusetts. In the view of Prof. B. K. Emerson, the ultimate authority on the crystallines of Massachusetts, there was here in western Massachusetts an undoubted Precambric north-south ridge whose position above water was indicated by the presence of a Cambric quartzite fringing the greater portion of the outcrops. This may have been and undoubtedly was repeatedly depressed and elevated and the adjoining Siluric masses brought to day but there are no antagonistic considerations for not assuming that it was all transgressed during the Devonic and these Devonic deposits removed entirely by erosion. Toward the north of this region near the north line of the state is a break in the Precambric ridge which is of considerable width, extending into Vermont and this may have well served as a passage for Devonic sediment from New York into the Connecticut trough. East of the Connecticut river there is only a limited area of Precambric near the Rhode Island line, extending south into Connecticut along Long Island sound. This is everywhere margined by a quartzite interpreted as Cambric, and this with the fossil-bearing Cambric localities at Nahant, North Attlebury and Braintree was raised into land and so continued through Siluric and Devonic time, no rocks of this age being determinable. Professor Emerson regards all the rocks above these mentioned as Carbonic coextensive with the Worcester and Mansfield coals.

These conclusions give evidence enough of an old land barrier bounding a trough of Devonic waters in which the metamorphosed beds of Bernardston at least were deposited. The rest may have been removed by erosion, but in eastern New York between the Hudson and the Massachusetts line and in the direction of the Devonic rocks of Bernardston lies an extensive sheet of coarse clastic material known as the Rensselaer grit which at this point requires brief attention.

Rensselaer grit. Rensselaer and Columbia counties, New York, lying east of the Hudson river and in the general direction of continuity between the Helderberg-Catskill escarpment and the Bernardston Devonic outcrops of the Connecticut valley, are extensively mantled by heavy arenaceous deposits lying unconformably on the unfolded Cambric and Lower Siluric strata beneath. The character and distribution of this rock was clearly outlined by Lieutenant Mather in his report on the first geological district (1843) and it was regarded by him as equivalent in age with the Shawangunk grit of Ulster and Orange counties on the west of the river.

The early geologists held the Shawangunk grit to be an eastern representation of the Oneida grit of central New York and this conception has been quite generally promulgated. Mr T. Nelson Dale has been one of the latest investigators of this region and has acquired an intimate knowledge of the stratigraphic relations of this terrane to the unconformable rocks beneath and we owe to him the conclusion that the upfolding of the lower and upper terranes pertains to different dates, the former to the Taconic and the latter to the Postdevonic or Carbonic movement which also produced the more southerly synclines now represented by Becraft mountain, Columbia county. Mr Dale has correlated the Rensselaer grit with the entire Oneida-Medina sedimentation of eastern New York. In recent investigations carried on by C. A. Hartnagel [*see* Mus. Bul. 107. 1907. p. 51] it is shown with approximate conclusiveness that in the typical sections of central New York the Oneida conglomerate is not a formational unit but actually lies within the Medina sandstones; that, further, the Shawangunk grit, on stratigraphic evidence alone, is of an age much later than the Medina formation and being overlain by rocks of Postsalina age is presumably the eastern representation of Salina deposition. The confirmation of this conclusion as to the value of the Shawangunk grit was afforded by the discovery of an extensive eurypterid fauna in the interbedded shales of the Shawangunk grit, as described by the writer [*see op. cit.* p. 294]. Mr Hartnagel has indicated the improbability of this Siluric age of the Rensselaer grit or its equivalence to the Oneida-Medina sediments with the following arguments: (1) the extensive gap by nondeposition between the eastern terminus of the Oneida conglomerate, in Herkimer county, and the Rensselaer grit plateau, (2) the long time interval which must be postulated to account for the Taconic folding and the erosion that preceded the deposition of the grit, (3) the gradual transgression northward of arenaceous sediments over the eroded folds, the Shawangunk grits being a more southerly and hence earlier representative of such transgression.

The region of the Rensselaer grit has recently been carefully searched for fossils but though this evidence still fails and its absence can not be explained by secondary changes in the rocks, the stratigraphic considerations indicate the propriety of assigning a distinctly later than Medina age to this formation.

Near the edge of this plateau no beds of later than Trenton age have been observed and there are apparently no outliers to bridge the gap between the late Siluric and early Devonic outliers of Becraft mountain, Mt Bob and the southernmost outliers of Rensselaer grit in the town of Austerlitz, Columbia co. This last named outlier is of especial interest as it lies but 20 miles northeast of Becraft mountain and is a considerable distance south of the main Rensselaer grit plateau. For these reasons it has been closely studied but found to be in no way lithologically different from the grit of Rensselaer county at the north, containing the same alternations of grit with red and greenish slates.

From the presence of only the closing stage of the Upper Siluric at Becraft mountain and in the Helderberg near Albany (Countryman hill),— the two places where the deposits of the Siluro-Devonic basin of New York approach nearest to the Rensselaer grit plateau — it may be properly inferred that the Upper Siluric sea of New York did not extend into the present area of the Rensselaer grit plateau at any time except possibly in the latest (Manlius) stage of that period. In regard to the latter, the problem is the same as in regard to the Helderberg limestones in general which are exposed at Becraft mountain and of which the Rensselaer grit might be conceived as representing the littoral facies. In favor of this view it may be said that both formations rest on the same basis (Cambric and Lower Siluric slate) and that, on account of the rising of the Taconic mountains in early Siluric time, there may have existed a littoral facies of the Helderberg rocks to the east. But this view is strongly opposed by the fact that the Helderberg rocks do not show any indications of approach to a littoral region at Becraft mountain, but retain the same lithologic characters that they possess over a vast area. There would hence have to be assumed an extremely abrupt and improbable change in facies in the short distance of 20 miles from Becraft mountain to the outlier at Austerlitz. A somewhat different cause is presented by the Oriskany sandstone, Esopus grit and Schoharie grit which not only contain sand and grit at Becraft mountain and in the Helderbergs, but in some places, as at Whiteport and Kingston, contain conglomerate beds. It is altogether probable that the material of these conglomerates was derived from the south and the Oriskany sandstone is too thin a layer (30 feet) at Becraft mountain, to be correlated with the thick mass of the Rensselaer grit (1400 feet). It is, however, possible that the Esopus and Schoharie grits which at Becraft mountain have a combined thickness of 300 feet and are similarly barren in fossils, once continued northeastward into the Rensselaer grit trough. Since they represent an invasion of the sea that came from the south and spread northward in the direction of the Rensselaer grit plateau, and the overlapping Rensselaer grit is clearly the product of an invading, not a receding, sea, it is a reasonable proposition that the Rensselaer grit was deposited in a long narrow embayment extending northward from the Oriskany-Esopus-Schoharie grit sea of southern New York. But in this case also, there is still to be explained the extremely rapid change from the typical Esopus grit of Becraft mountain to the red and green slates and coarse grits of the Austerlitz outlier, and the fact that the Esopus grit is thicker southward (700 feet in Orange county), and thins out toward Becraft mountain. The regular succession of the various members of the Lower and Middle Devonic in Becraft mountain with the same lithologic characters as in the Helderbergs and much farther west and south is in itself cumulative evidence that the Helderberg sea extended farther east than the present Rensselaer plateau and with unchanged or but little changed conditions.

It must further be considered that the Rensselaer grit plateau represents a deposit in a long submeridional Appalachian trough. Its pebbles of coarse and fine gneiss came from a short distance and the numerous Lower Cambric pebbles probably from places north of the plateau. Its deposits suggest those of an embayment receiving its materials from the north. The entire absence of the fossils occurring in the nearby Becraft mountain formations favors this conception of estuarine conditions.

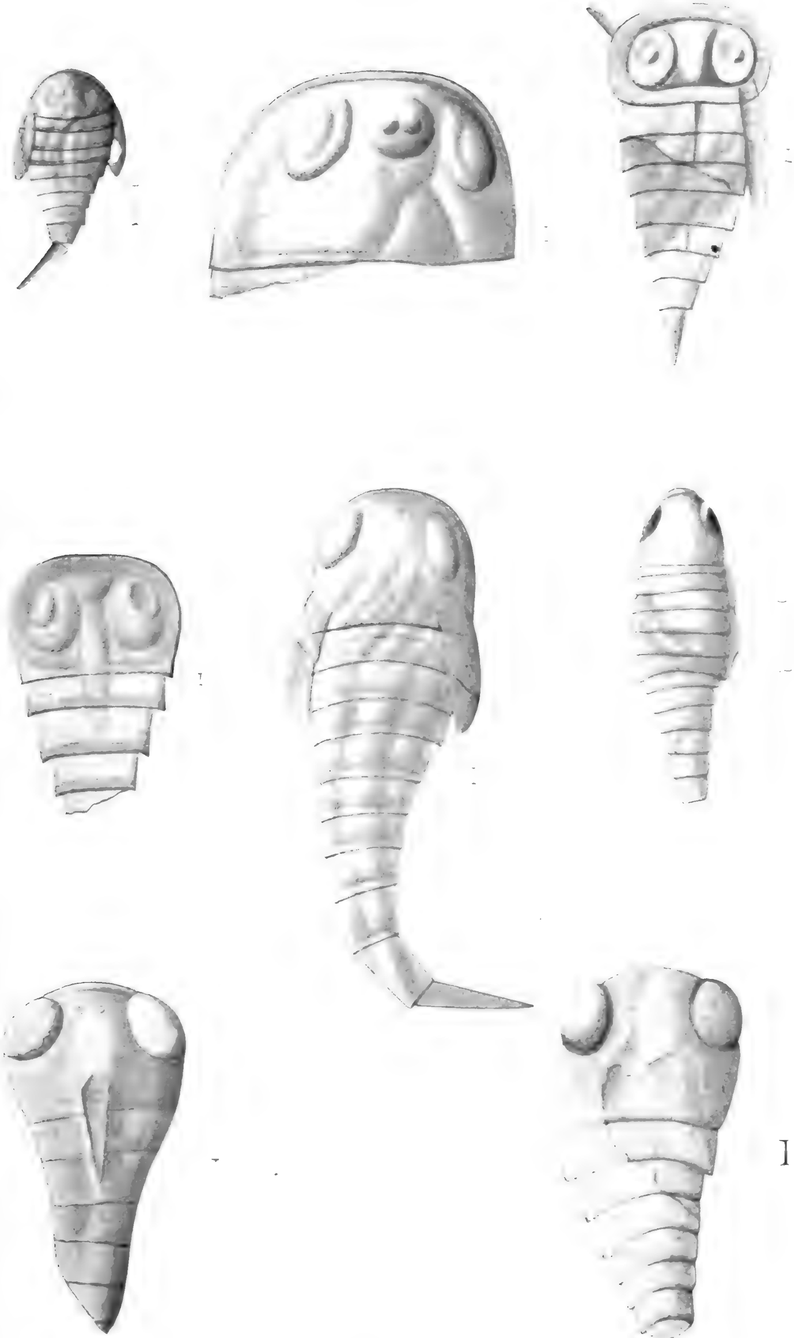
The evidence compels us to grant that the Rensselaer grit is of later than Siluric age; there is some good reason for regarding it an eastern deposit contemporary with the early Devonic, but the alternative proposition stands open, that its estuarine character and great thickness suggest identity with the Catskill beds which stand sheer on the other side of the Hudson river in hights of several thousand feet and only 30 miles away from the outlier at Austerlitz.

b **Dana** indicated by the term "**Worcester trough**," a hypothetical Appalachian waterway in which the Carbonic beds of Worcester, Mass., eastern Massachusetts and Rhode Island were deposited. This is a more easterly northeast-southwest passage than the Connecticut trough and we can derive no satisfactory evidence of its existence during the Devonic. Indeed the statements made above indicate that, though this region may have been receiving deposits during the Cambric, it was a land body during the period with which we are now concerned and was not opened again for the reception of sediments till the beginning of the Carbonic. We are compelled therefore to dismiss the Worcester trough as having any bearing, from present evidence, on the theme before us.

c **The Perry-St John-Annapolis Devonic channel,** lying further to the south and east of those we have considered, is today represented by deposits still largely covered by the sea. Its far easterly course and its isolation seem to indicate that it had nothing in common with the rest, that it must have entered the southern Appalachians by a way of which we know nothing.

12 We are thus impelled to conclude from the factors given that the line of passage southwestward from all the channel basins we have specially discussed, into the New York Helderbergian-Oriskany channel was by way of the Connecticut trough; that the Gaspé, Dalhousie, Aroostook and in a sense the Piscataquis-Somerset channels were independent isolated passages for a part of their distance only and that they converged eventually southward to contemporaneous or successive unity.

Plate 1



Eurypterida

13 We have observed that the passage from New York through to Gaspé and New Brunswick was undisturbed during the earliest stages of the Devonic. Probably in the later stage represented by the extensive Grande Grève limestones it was less clear, the channel widened out into a basin of rapid propagation from which migration to the southwest took place freely. We believe the evidence fully indicates that during all these stages of the Eodevonic the direction of migration was from the north inward and southward. Reference has been made to the occurrence of the Eodevonic on St Helens island, Montreal and to the presumption that it indicates the remnant of a backset along the St Lawrence trough of these waters, rather than any connection with New York through the Champlain trough. We find no reason for modifying this view as there is no single factor which presumes a Paleozoic water connection along the Champlain graben during a period so late as the Devonic.

14 The Gaspé sandstones indicate (as we have suggested) a general breaking down of the barriers of the northern channel, by a transgression over the Siluric beds adjoining and a widening out of the area in such a way as to constitute in large part flood deposit or barachois conditions throughout the eastern part of the Gaspé peninsula. These conditions continued throughout the Middle Devonic as shown by the notable percentage of New York Hamilton species in these rocks commingled with highly typical survivors of the earlier or Grande Grève fauna. The New York species are here clearly the invaders, having entered this province by the still open waterway from the southwest. The remains themselves, whether of Grande Grève or Hamilton species, we regard as overwashed into their present position from outside the barrier bounding the barachois and not native to the sandy terrigenous sediments, abounding in plant remains with which they are associated.

Monograph of the Eurypterida. Recent years of field exploration have brought to light very extensive collections of these interesting ancient crustacea from New York and beyond any doubt such a wealth of material representing this extinct order has never before been brought together. It has been the purpose of the Paleontologist to utilize this exceptional material as the basis of a revision of the group and as an opportunity for expanding and summarizing his previous publications on this subject. During the past year the Assistant Paleontologist has been able to devote considerable study to this subject with results of much interest. The investigation has progressed sufficiently to permit the restoration of all the hard anatomy of the principal genera of the order. Stylonurus, which has been known as one of the largest of these creatures, attaining a length of 5 — 6 feet, proves, on study of smaller species from Otisville, materially different in structure from the generally accepted restoration. It has also been possible to restore the genera Eusarcus and Dolichopterus with all their appendages and to assemble all parts of the integument of the largest Pterygotus occurring in the New York formations. Other results of significance are the recognition of the genus Drepanopterus; the identity of the eye structure of Pterygotus with that of Limulus shown by the presence of an outer smooth thick cornea which is separable from an inner layer of lenses; the demonstration that the chelicerae of Pterygotus consist of long unjointed arms carrying the terminal pincers; and the close relationship of the genera Stylonurus and Dolichopterus brought out by transitional forms and the identity of new structures observed in their New York representatives.

The genus Stylonurus is resolved into three subdivisions for which the subgeneric terms Stylonurus *sensu stricto,* Ctenopterus and Homalopterus are introduced. These divisions are based mainly on the character of the legs.

The genus Hughmilleria has been shown to agree in the structure of its compound eyes with Eurypterus, although the position of these suggests a closer relationship to Pterygotus.

The Cambric genus Strabops possesses the full complement of 12 dorsal segments instead of 11, as hitherto supposed, and has small compound eyes placed far back and near the lateral margin. The investigation of the larval forms of a number of Siluric species has shown that some of these pass through a stage identical in its most important features with the adult Cambric Strabops.

The ontogeny of Eurypterids is for the first time investigated and the development of species of the genera Eurypterus, Eusarcus, Hughmilleria, Pterygotus and Stylonurus is traced as far back as the nepionic or larval stage, and a number of larval characters are established which appear to be common to all and of significance in phylogenetic relation.

Both the restorations of the genera and the investigation of the ontogeny have allowed conclusions on the phylogeny of the Eurypterids, as well as their morphology and mode of life.

Plate 2

Eusarcus newlini [illegible]

The following North American genera and species are noted. Those from the area of the State of New York or its borders are marked by an asterisk:

Eurypterus
- *approximatus *Hall & Clarke*
- boylei *Whiteaves*
- kokomoensis *Miller & Gurley*
- *lacustris *Hall*
- *mansfieldi *Hall*
- *maria *Clarke*
- mazonensis *Meek & Worthen*
- *microphthalmus *Hall*
- *pachychirus *Hall*
- *pennsylvanicus *Hall*
- *pittsfordensis *Sarle*
- *potens *Hall*
- *prominens *Hall*
- *pustulosus *Hall*
- *remipes *DeKay*
- *robustus *Harlan*
- *stylus *Hall*
- *sp. nov.*

Eusarcus
- *cicerops (*Clarke*)
- newlini (*Claypole*)
- *scorpionis *Grote & Pitt*

Dolichopterus
- *macrochirus *Hall*
- *otisius (*Clarke*)
- **sp. nov.*

Drepanopterus
- *sp. nov.*

Echinognathus
- clevelandi *Walcott*

Hughmilleria
- *shawangunk *Clarke*
- *socialis *Sarle*
  - *var.* robustus *Sarle*

Pterygotus
- *cobbi *Hall*
- *grandis (*Pohlman*)
- *globicaudatus *Pohlman*
- *macrophthalmus *Hall*
- **sp. nov.*

Strabops
- thacheri *Beecher*

Stylonurus (Ctenopterus)
- *beecheri (*Hall*)
- *cestrotus (*Clarke*)
- *excelsior *Hall*
- **myops* (Clarke)
- **sp. nov.*
- **sp.*
- **sp.*
- **sp.*
- **sp.*

This list shows that with the exception of six species all American forms known thus far have come either from New York or closely adjoining districts.

The following species names have been rejected as synonyms:

E. eriensis *Whitfield*
E. giganteus *Pohlman*
Eusarcus grandis *Grote & Pitt*
Pterygotus acuticaudatus *Pohlman*
P. buffaloensis *Pohlman*
P. bilobus *Pohlman*
P. cummingsi *Grote & Pitt*
P. osborni *Hall*
P. quadraticaudatus *Pohlman*

The James Hall Memorial Tablet

It has seemed appropriate to some of the late Prof. James Hall's active associates on the Geological Survey of this State to commemorate the beginning of his important work by the erection of an appropriate if modest memorial. Professor Hall, on the organization of the Geological Survey in 1836, was designated as assistant to Dr Ebenezer Emmons in the latter's survey of the second or northern district of the State. The following year however he was appointed geologist in charge of the fourth or western district. Here he laid the foundation not alone of his later achievements but of the classification of a large part of the New York series of geological formations. His final report on the fourth district issued in 1843 has from that date been a compendium and standard exposition of the geology of western New York and on this foundation was reared the superstructure of his still greater accomplishments in the paleontology of New York. It was from the rocky gorge of the Genesee river that the geologist was best able to decipher the succession of the rock strata and on one of these rock cliffs close to the Genesee river amid the very picturesque surroundings of Glen Iris, a bronze tablet commemorative of these facts has been erected with the approval of the State's trustees of Letchworth Park, The American Scenic and Historic Preservation Society.

III

REPORT OF THE STATE BOTANIST

The work of the State Botanist the past year has been chiefly a continuation of the work of the preceding year. It has consisted of the collection and preparation of specimens of plants for the herbarium, the preparation of descriptions of such as do not appear to have been described, and in some cases the preparation of colored illustrations of them, the testing of the edible qualities of promising species and the identification of specimens of plants brought or sent to the office by correspondents and others who have desired information concerning them. A constant outlook has been kept for indications of the chestnut disease that has recently attacked chestnut trees with destructive consequence in the parks of New York city and Brooklyn and their vicinity. A special trip of investigation was made to Dutchess county, which had been reported as the most northern limit known of its occurrence. No indication of the disease was found there, nor in the counties of Albany,

Plate 3

James Hall tablet, Letchworth Park; on a weathered joint face of Portage sandstone

Plate 4

James Hall tablet, Letchworth Park, facing the Genesee river

Rensselaer and Steuben where special search has been made for it. On the other hand, wherever special observation has been made of chestnut trees they have appeared to be in good health and vigor and unusually full of fruit. While the abundant crop of fruit may prove to be somewhat exhaustive of the vigor of the trees it does not seem probable that the serious consequences of the disease that have been predicted by some writers will be realized. Very destructive outbreaks of parasitic fungi are usually dependent on unusual climatic conditions and are of short duration. In no case are they likely to exterminate the host plant.

Specimens of plants sent or brought to the office of the State Botanist for identification or for other information are always welcome, for in this way not only is the desired information obtained by the person seeking it but also interesting and valuable plant specimens are sometimes added to the museum collections. The number of identifications made in such cases the past year is 1640. The number of persons for whom identifications have been made is 127.

In many parts of the State the season just passed has been strangely adverse to the mushroom crop. Rain was not lacking in the early part of the season, but the prevailing low temperature apparently prevented the development of mushrooms that otherwise would doubtless have appeared. Later in the season when the prevailing temperature was more favorable, the necessary rain and moisture were lacking. This unfavorable condition continued so late in the season that those species which usually appear in August and September either failed entirely to appear or appeared much later in the season. Reports state that very large crops of the common mushroom, Agaricus campester L. have appeared in a few localities in November. This is nearly or quite two months later than its usual time. The light fall rains, which were unusually late, gave the mycelium its first opportunity to develop. These rains were followed by exceptionally fine mild and sunny weather which was very favorable to the development and spread of the mycelium or "spawn." The result was a very abundant crop of mushrooms in those places where a rich soil aided the favorable weather conditions.

The new species and varieties of fungi described by the State Botanist are now so numerous and the periodicals, reports and bulletins containing these descriptions are so many and so scattered and the inquiries concerning the place where one and another of them can be found are so frequent that it has seemed quite desirable that a list of these species be given with the places of their publication. This has been prepared and will doubtless be of aid to all interested in mycology.

IV

REPORT OF THE STATE ENTOMOLOGIST

The State Entomologist reports that a number of species of insects have inflicted serious injuries upon both fruit and shade trees. A most interesting phenomenon was the widespread and abundant flight of the snow-white linden moth. An unusual feature was the capture, within the limits of the city of Albany, of two specimens of a small, green, subtropical cockroach.

Fruit tree insects. Fruit trees in the western part of the State were seriously injured in some sections by the cigar case bearer, a species which is very rarely abundant enough to cause material damage in the Hudson river valley. Depredations by this case bearer were frequently associated with severe damage to a small plant mite known as the blister mite. Western fruit growers were also greatly exercised by the caterpillars of the white marked tussock moth eating into the young fruit, a troublesome departure from the normal habit. The fall cankerworm was unusually abundant and destructive on eastern Long Island and in the vicinity of New York city. The San José scale is one of the most serious insect pests of the horticulturist. The warm, dry weather during the latter part of the season was favorable to the unrestricted multiplication of this insect, and in some cases orchards have become very badly affected. Our observations show that, as a rule, fruit growers are experiencing much less trouble in keeping this scale insect in check than was the case in earlier years. Early spring applications of a lime-sulfur wash are giving good results. Some parties are finding satisfaction from applications of a miscible or so called "soluble" oil. We have preferred, as a rule, to confine our recommendations to a material like the lime-sulfur wash, which is not only effective but safe and also valuable in controlling fungus diseases. Numerous observations have been made on the above mentioned and other insects.

It is gratifying to state that conditions in the Chautauqua grape belt have materially improved, so far as injury by the grape root worm is concerned. Though this insect is generally distributed throughout the grape belt, severe injuries by it have been confined to restricted areas. The grape blossom midge was responsible for an unprecedented outbreak, and destroyed from 50 to 75% of the blossoms on one acre of Moore's early grapes at Fredonia. It was generally present throughout the grape section and somewhat abundant in limited portions of certain vineyards. It is probable that this species has been responsible for failure to fruit in other cases where the losses were attributed to some unknown cause or possibly to unfavorable weather conditions. This insect is now under investigation. We hope to solve its life history next spring, a necessary preliminary to devising a practical method of preventing serious injury in the future.

Shade tree protection. Ravages by the elm leaf beetle have been very severe in many Hudson valley cities and villages and, as a result, popular interest in the welfare of our shade trees has greatly increased. This concern has been accentuated by extensive defoliations inflicted by the white marked tussock moth, a species which has been quite injurious in Buffalo for some years past.

Injuries by these and other shade tree pests have emphasized most strongly the recommendations of the Entomologist and, as a result, more than ever before is being done to protect shade trees. The work of the city forester of Albany has been very beneficial in spite of certain hindrances. The city of Buffalo has at last committed itself to a definite policy of shade tree protection. A forester has been appointed and excellent work already accomplished in that municipality. The authorities of several villages have given careful consideration to shade tree protection and there is a good prospect that more will be done another year. The work against the gipsy moth, noticed below, has resulted in a marked improvement in the spraying outfit. We believe that certain of this apparatus, modified to suit our conditions, could be adopted to advantage and would prove of much benefit, since, by making the spraying easier and quicker, it would afford largely increased efficiency. Work upon shade tree insects, consisting mostly of local examination and recommendation, has consumed much time and has been productive of marked improvement in the welfare of the trees.

Gipsy and brown tail moths. These two insects have continued their injurious work in Massachusetts, the first named being by far the more destructive. The gipsy moth has been found in small numbers at both Springfield and Greenfield, Mass., as recorded in our previous report. Points where this insect was likely to become established have been closely watched and as yet it has not been found in this State. A warning placard, illustrating this species and the brown tail moth, has been conspicuously posted in many post offices and other public places in the State. Prompt and efficient treatment of isolated colonies, should they be found in this State, is of utmost importance if extended injury is to be avoided.

The work against the gipsy moth in Massachusetts, as revealed by a personal examination the past summer, is being prosecuted with great vigor. The residential sections are in excellent condition, though large woodland areas have been seriously damaged. The work with parasites, conducted by that state in cooperation with the federal government, is most encouraging. The staff in charge of this work has been materially strengthened during the past year, and its efficiency increased by the dispatch of a special agent to Japan, who secured some promising parasites which already have been bred through one generation in this country, and lead to the hope that they may soon become important factors in controlling this species. The control of the gipsy and brown tail moths should be encouraged in every possible manner, since it is much more economical to check them in a restricted area than to allow the struggle to extend over a wide territory.

Forest insects. The extensive outbreaks by the green striped maple worm, recorded in our previous report, have been continued in southern Rensselaer county, and it is probable that this species was associated, as last year, with the antlered maple caterpillar. The depredations by the snow-white linden moth, also noticed in our preceding report, were continued in the Catskills and extensive injuries in the Adirondacks were also brought to our attention. The only hope of preventing damage of this character is by the encouragement of natural agents, prominent among which may be mentioned native birds. The efficiency of insectivorous birds has been repeatedly emphasized by the Entomologist.

The bark borers or Scolytidae comprise a large number of very destructive species. The literature relating to this group is greatly scattered and comparatively inaccessible, hence a bibliographic catalogue is a necessary preliminary to further work upon these insects. We have submitted, as an appendix to the Entomologist's report, a catalogue of the described Scolytidae of America north of Mexico by Mr J. M. Swaine.

Gall midges. The studies upon this important group have progressed very successfully. We have already prepared preliminary keys for the separation of most forms into subfamilies, tribes, genera and species, together with tables giving the food habits of those which have been reared. Some idea of the magnitude of this work may be gained when it is remembered that we have studied over 300 bred species and now recognize 700 species, representing about 50 genera. The systematic arrangement alone of this large number of microscopic insects is an immense task; in addition to the above, many descriptions have been drafted and numerous biological notes transcribed.

The later work upon these insects has of necessity been confined mostly to systematic study, owing to the fact that material was coming in faster than it could be worked up in a satisfactory manner. We have succeeded in rearing during the past season, in spite of the pressure of other matters, about 75 species, the biology of most of which was previously unknown. There is on hand a large series of galls from which some extremely desirable material may be expected another season. The work upon this group is so well in hand that there should be no difficulty in bringing it to a successful conclusion in the near future.

The rearing and care of breeding jars containing gall midges requires much time. Assistant Entomologist D. B. Young had general charge of this work and was ably assisted by Miss Fanny T. Hartman. In addition, Mr Young rendered material service in separating the large material into the major groups, while Miss Hartman has made over 600 microscopic preparations.

Flies and mosquitos. The ubiquitous and well known house fly has been the recipient of much attention because recent investigations show it may be the responsible agent, under certain conditions, in the dissemination of typhoid fever and other grave intestinal disorders. Observations upon its life history and habits have established the practicability of largely reducing if not eliminating this menace to health and personal comfort. A press bulletin on this insect was issued and this will be supplemented by a more extended account.

There is much interest in the control of mosquitos. The Entomologist inspected the work in progress on the Flushing meadows and has kept in touch with similar operations in other localities. Attention has also been given to the control of fresh-water species, especially the malarial carrying form. The practicability of such work has been established and we look for a great extension of interest in the local suppression of these annoying pests.

Aquatic insects. The studies of insects inhabiting our fresh waters have been continued by Dr James G. Needham. His report on the work done at Old Forge was made public in the Entomologist's report for 1907. Dr Needham is now engaged in completing his monographic account of the stone flies (Plecoptera), a work which should be ready for the printer some time during the coming winter. Dr Betten has made good progress in his studies of the caddis flies (Trichoptera), and it is expected that his work upon this group will soon be completed.

Publications. Many popular economic notices have been contributed by the Entomologist to the agricultural and local press, and a few accounts of more general interest have been widely disseminated through the agency of the associated press. A large number of Cecidomyiidae, reared in 1907, rendered it advisable to publish preliminary descriptions of these, and a reprint from the report for that year, entitled *New Species of Cecidomyiidae II,* was issued October 26, 1907. Owing to numerous delays in printing, the report for last year did not appear during the fiscal year, as a large amount of time was necessarily expended upon the more technical part in carrying it through the press.

Collections. The additions to the collections have not been as numerous as in preceding years, owing to the necessity of giving more attention to the arrangement and classification of material on hand. A number of previously unknown Cecidomyiidae were reared and several important gaps in our knowledge respecting this group filled.

Several extremely desirable accessions, aside from those mentioned above, have been made to our biological collections. One of the most interesting was a complete series representing the egg, larva, pupa and adult of the remarkable Taeniorhynchus perturbans Walk., generously contributed by Mr J. Turner Brakely of Hornerstown, N. J., the discoverer of the early stages and one of the most active in working out the life history of this previously very elusive species.

Two important additions have been made to the exhibit collections, namely, an enlarged model of the onion fly, showing the egg, maggot, puparium, adult fly and an onion infested by maggots; also an enlarged model of the cigar case bearer, showing its work upon apple leaves. Both of these were executed by Mrs Otto Heidemann of Washington, D. C.

The arrangement and classification of the collection has received much attention. Assistant Entomologist D. B. Young has separated the Staphylinidae into their major groups and determined many species. He has also given considerable time to the arrangement of the Syrphidae. The completion of the catalogue of the Hill collection occupied much time during the past year. Miss Hartman also assisted in the preparation of this catalogue and has done much general curatorial work, such as mounting, labeling and caring for insect specimens.

General. The tacit limitations of earlier years confined the studies of the economic entomologist to insect enemies of well recognized farm crops, such as corn, potatoes, fruits, or to those forms annoying or injurious to domestic animals. The later extensive insect depredations upon shade and forest trees have served to emphasize the practical importance of this field. The more recent discoveries that malaria and yellow fever are transmitted by mosquitos, and that typhoid fever and other intestinal diseases may be conveyed by house flies, has made the entomologist a most welcome ally of the sanatorian. Furthermore, careful investigations of injurious and dangerous insects have repeatedly demonstrated the value of such studies as a necessary preliminary to practical control work on the farm or marsh, in the orchard or even about the home. Prophylactic measures against yellow fever, malaria and typhoid must depend in large measure upon an intimate knowledge of the habits of certain insects and their part in the dissemination of the dangerous germs. The study of injurious insects is by no means completed. There is great need of investigations that can not be adequately conducted with our present resources. The exhibit collections should be strengthened by a series of well executed enlarged models of the smaller, more injurious insects. Such a departure would increase the practical and educational value of the entomologic exhibits, particularly as the significance of some of the more recent discoveries can not be adequately portrayed without such aid.

V

REPORT ON THE ZOOLOGY SECTION

The present Zoologist did not enter upon his duties until the 1st of February last, and considerable time was necessarily devoted to becoming acquainted with the material at present in the museum and with its most urgent needs.

Inasmuch as the work upon the new museum building has already started, it seemed best to devote as much time as possible to the collections in order that a proper showing may be made when the new quarters are ready. With this end in view the specimens on hand have been carefully examined and a list made of the material of which there is special need. It is intended to illustrate by groups as far as possible all the mammals of the State and as the total number of these is only 81, including 10 of the Cetacea (whales) which would not be suitable for such treatment, there appears no reason why at least the majority should not be so shown. At present 18 species, not including the whales, are not represented in the collections and many others only by old and worn specimens. Donations along these lines would be most welcome.

The collection of birds is in much better condition and the number of New York species entirely lacking has been reduced to 18, six of which belong to the hypothetical list.

We have been particularly fortunate this year in receiving from Dr R. W. Shufeldt, as a gift, his very fine collection of disarticulate avian skeletons. This collection is probably equal to any in this country. Two hundred species mostly North American are represented in it, the majority by complete skeletons. The collection, of which the complete list is given under accessions, consists of 237 complete skeletons, 48 skulls, 63 sterna and 17 hyoids. It should also be mentioned in this connection that the collection includes many of the types described and figured in Dr Shufeldt's papers, among which are found complete male and female skeletons of the Carolina paroquet (Conuropsis carolinensis) now nearly extinct.

To the collection of reptiles and amphibians a number of the Ward casts have been added, and the old faded alcoholic specimens are being replaced by new ones as opportunity arises.

The best method of exhibiting the fish is a problem still undecided. The taxidermist has, however, a method of mounting these which it is believed will prove a step in advance of anything yet accomplished. He is at present working on a group showing yellow perch (Perca flavescens), and sunfish (Eupomotis gibbosus) in their natural surroundings.

The muskrat group upon which work was begun last year has been placed on exhibition. This shows two muskrats near a muskrat house, while the rear of the group is a cross section of the chamber and passageways.

The group of black bear has been received, but will not be displayed until such accessories have been added as seem desirable to make the scene as attractive as possible.

Three more bird groups have been put on exhibition. One shows a sora rail with nest and young; the other two are winter scenes. the first made up of three snow buntings and the other of Canadian nuthatches and American goldfinches in their winter plumage.

The taxidermist is at present constructing, in addition to the above mentioned fish group, a group of mink and one of white-footed mice. These should all be ready for exhibition by the spring.

Birds of New York. In 1844 this State published as one of the volumes of the *Natural History of New York* a comprehensive and finely illustrated treatise on the birds of the State, prepared by the eminent ornithologist, James E. De Kay. Since its date of issue this work has been of fundamental value to all students of the birds and may justly be regarded as, in a large degree, the primary inspiration of the present widespread interest among the people of the State in the science of ornithology.

In 1904, 60 years from its publication, I urgently recommended to the Commissioner of Education that a restudy of this field was desirable in order to bring together increments to knowledge during the long period which had elapsed without interest therein on the part of the State and to meet the very general and lively concern in the subject among our citizens.

Consequent on the approval of this recommendation the preparation of a monographic treatment of the subject was assigned to Prof. E. Howard Eaton. The undertaking was a large one, involving great labor, accurate knowledge and painstaking devotion. But it has now been carried so far that the conclusion of the work is in sight and the first of the two quarto volumes is about to be delivered from the press. This volume 1 will carry something over 300 pages and 42 plates in color with various distribution tables and numerous cuts.

A synopsis of the first volume is here appended:

BIRDS OF NEW YORK. VOLUME I

Class **Aves**
Subclass **Carinatae**

Order **Pygopodes**
Diving birds

Family **Colymbidae**
Grebes

Colymbus holboelli (*Reinhardt*)
(*Holboell grebe*)
Colymbus auritus *Linnaeus*
(*Horned grebe*)
Podilymbus podiceps (*Linnaeus*)
(*Pied-billed grebe*)

Family **Gaviidae**
Loons

Gavia immer (*Brünnich*)
(*Loon*)
Gavia arctica (*Linnaeus*)
(*Black-throated loon*)
Gavia stellata (*Pontoppidan*)
(*Red-throated loon*)

Family **Alcidae**
Auks, Guillemots etc.

Fratercula arctica (*Linnaeus*)
(*Puffin*)
Cepphus grylle (*Linnaeus*)
(*Black guillemot*)
Cepphus mandti (*Lichenstein*)
(*Mandt guillemot*)
Uria troile (*Linnaeus*)
(*Murre*)
Uria lomvia (*Linnaeus*)
(*Brünnich murre*)
Alca torda *Linnaeus*
(*Razor-billed auk*)
Alle alle (*Linnaeus*)
(*Dovekie*)

Order **Longipennes**

Family **Stercorariidae**
Skuas and jaegers

Megalestris skua (*Brünnich*)
(*Skua*)

Stercorarius pomarinus (*Temminck*)
(*Pomarine jaeger*)
Stercorarius parasiticus (*Linnaeus*)
(*Parasitic jaeger*)
Stercorarius longicaudus *Vieillot*
(*Long-tailed jaeger*)

Family **Laridae**
Gulls and terns

Pagophila alba (*Gunnerus*)
(*Ivory gull*)
Rissa tridactyla (*Linnaeus*)
(*Kittiwake*)
Larus hyperboreus *Gunnerus*
(*Glaucous gull*)
Larus leucopterus *Faber*
(*Iceland gull*)
Larus kümlieni *Brewster*
(*Kümlien gull*)
Larus marinus *Linnaeus*
(*Great black-backed gull*)
Larus argentatus *Pontoppidan*
(*Herring gull*)
Larus delawarensis *Ord*
(*Ring-billed gull*)
Larus atricilla *Linnaeus*
(*Laughing gull*)
Larus philadelphia (*Ord*)
(*Bonaparte gull*)
Larus minutus *Pallas*
(*Little gull*)
Xema sabini (*Sabine*)
(*Sabine gull*)
Gelochelidon nilotica (*Hasselquist*)
(*Gull-billed tern*)
Sterna caspia *Pallas*
(*Caspian tern*)
Sterna maxima *Boddaert*
(*Royal tern*)
Sterna sandvicensis acuflavida (*Cabot*)
(*Cabot tern*)
Sterna trudeaui *Audubon*
(*Trudeau tern*)

Sterna forsteri *Nuttall*
(*Forster tern*)
Sterna hirundo *Linnaeus*
(*Common tern*)
Sterna paradisaea *Brünnich*
(*Arctic tern*)
Sterna dougalli *Montagu*
(*Roseate tern*)
Sterna antillarum (*Lesson*)
(*Least tern*)
Sterna fuscata *Linnaeus*
(*Sooty tern*)
Hydrochelidon nigra surinamensis (*Gmelin*)
(*Black tern*)

Family **Rhynchopidae**
Skimmers
Rynchops nigra *Linnaeus*
(*Black skimmer*)

Order Turbinares
Tube-nosed swimmers

Family **Puffinidae**
Fulmars, Shearwaters and Petrels
Fulmarus glacialis (*Linnaeus*)
(*Fulmar*)
Puffinus borealis *Cory*
(*Cory shearwater*)
Puffinus gravis (*O'Reilly*)
(*Greater shearwater*)
Puffinus puffinus (*Brünnich*)
(*Manx shearwater*)
Puffinus lherminieri *Lesson*
(*Audubon shearwater*)
Puffinus griseus (*Gmelin*)
(*Sooty shearwater*)
Aestrelata hasitata (*Kuhl*)
(*Black-capped petrel*)
Aestrelata scalaris *Brewster*
(*Scaled petrel*)

Family **Procellariidae**
Stormy petrels
Thalassidroma pelagica (*Linnaeus*)
(*Stormy petrel*)
Oceanodroma leucorrhoa (*Vieillot*)
(*Leach petrel*)
Oceanites oceanicus (*Kuhl*)
(*Wilson petrel*)

Order Steganopodes
Totipalmate birds

Family **Phaethontidae**
Tropic birds
Phaethon americanus *Grant*
(*Yellow-billed tropic bird*)

Family **Sulidae**
Gannets
Sula leucogaster (*Boddaert*)
(*Booby*)
Sula bassana (*Linnaeus*)
(*Gannet*)

Family **Phalacrocoracidae**
Cormorants
Phalacrocorax carbo (*Linnaeus*)
(*Cormorant*)
Phalacrocorax auritus (*Lesson*)
(*Double-crested cormorant*)

Family **Pelecanidae**
Pelicans
Pelecanus erythrorhynchus *Gmelin*
(*American white pelican*)
Pelecanus *fuscus Linnaeus*
(*Brown pelican*)

Family **Fregatidae**
Man-o'-war birds
Fregata aquila (*Linnaeus*)
(*Man-o'-war bird*)

Order Anseres
Lamellirostral swimmers

Family **Anatidae**
Ducks, Geese and Swans

Subfamily **Merginae**
Mergansers
Mergus americanus *Cassin*
(*American merganser*)
Mergus serrator *Linnaeus*
(*Red-breasted merganser*)
Lophodytes cucullatus (*Linnaeus*)
(*Hooded merganser*)

Subfamily **Anatinae**

River ducks

Anas platyrhynchos *Linnaeus*
(*Mallard*)

Anas rubripes *Brewster*
(*Black duck*)

Chaulelasmus streperus (*Linnaeus*)
(*Gadwall*)

Mareca penelope (*Linnaeus*)
(*Widgeon*)

Mareca americana (*Gmelin*)
(*Baldpate*)

Nettion crecca (*Linnaeus*)
(*European teal*)

Nettion carolinensis (*Gmelin*)
(*Green-winged teal*)

Querquedula discors (*Linnaeus*)
(*Blue-winged teal*)

Querquedula cyanoptera (*Vieillot*)
(*Cinnamon teal*)

Spatula clypeata (*Linnaeus*)
(*Shoveler*)

Dafila acuta (*Linnaeus*)
(*Pintail*)

Aix sponsa (*Linnaeus*)
(*Wood duck*)

Subfamily **Fuligulinae**

Sea and bay ducks

Netta rufina (*Pallas*)
(*Rufous-crested duck*)

Marila americana (*Eyton*)
(*Redhead*)

Marila vallisneria (*Wilson*)
(*Canvasback*)

Marila marila (*Linnaeus*)
(*American scaup duck*)

Marila affinis (*Eyton*)
(*Lesser scaup duck*)

Marila collaris (*Donovan*)
(*Ring-necked duck*)

Clangula clangula americana (*Bonaparte*)
(*American golden-eye*)

Clangula islandica (*Gmelin*)
(*Barrow golden-eye*)

Charitonetta albeola (*Linnaeus*)
(*Buffle-head*)

Harelda hyemalis (*Linnaeus*)
(*Old squaw*)

Histrionicus histrionicus (*Linnaeus*)
(*Harlequin duck*)

Camptorhynchus labradorius (*Gmelin*)
(*Labrador duck*)

Somateria dresseri (*Sharpe*)
(*American eider*)

Somateria spectabilis (*Linnaeus*)
(*King eider*)

Oidemia americana *Swainson*
(*American scoter*)

Oidemia deglandi *Bonaparte*
(*White-winged scoter*)

Oidemia perspicillata (*Linnaeus*)
(*Surf scoter*)

Erismatura jamaicensis (*Gmelin*)
(*Ruddy duck*)

Chen hyperborea hyperborea (*Pallas*)
(*Lesser snow goose*)

Chen hyperborea nivalis (*Forster*)
(*Greater snow goose*)

Chen caerulescens (*Linnaeus*)
(*Blue goose*)

Anser albifrons gambeli (*Hartlaub*)
(*American white-fronted goose*)

Branta canadensis (*Linnaeus*)
(*Canada goose*)
(*Hutchins goose*)

Branta canadensis hutchinsi (*Richardson*)

Branta bernicla glaucogastra (*Brehm*)
(*Brant*)

Branta nigricans (*Lawrence*)
(*Black brant*)

Branta leucopsis (*Bechstein*)
(*Barnacle goose*)

Olor columbianus (*Ord*)
(*Whistling swan*)

Olor buccinator (*Richardson*)
(*Trumpeter swan*)

Order **Herodiones**

Herons

Family **Ibididae**

Ibises

Guara alba (*Linnaeus*)
(*White ibis*)

Plegadis autumnalis (*Hasselquist*)
(*Glossy ibis*)
Plegadis guarauna (*Linnaeus*)
(*White-faced glossy ibis*)

Family Ciconidae
Storks
Mycteria americana *Linnaeus*
(*Wood ibis*)

Family Ardeidae
Bitterns and Herons
Botaurus lentiginosus (*Montagu*)
(*American bittern*)
Ixobrychus exilis (*Gmelin*)
(*Least bittern*)
Ixobrychus neoxenus (*Cory*)
(*Cory least bittern*)
Ardea herodias *Linnaeus*
(*Great blue heron*)
Herodias egretta (*Gmelin*)
(*American egret*)
Egretta candidissima (*Gmelin*)
(*Snowy heron*)
Hydranassa tricolor ruficollis (*Gosse*)
(*Louisiana heron*)
Florida caerulea (*Linnaeus*)
(*Little blue heron*)
Butorides virescens (*Linnaeus*)
(*Green heron*)
Nycticorax nycticorax naevius (*Boddaert*)
(*Black-crowned night heron*)
Nyctanassa violacea (*Linnaeus*)
(*Yellow-crowned night heron*)

Order Paludicolae

Family Gruidae
Cranes
Grus americana (*Linnaeus*)
(*Whooping crane*)
Grus mexicana *Müller*
(*Sandhill crane*)
Rallus elegans *Audubon*
(*King rail*)
Rallus crepitans *Gmelin*
(*Clapper rail*)
Rallus virginianus *Linnaeus*
(*Virginia rail*)
Porzana carolina (*Linnaeus*)
(*Sora*)
Coturnicops noveboracensis (*Gmelin*)
(*Yellow rail*)
Creciscus jamaicensis (*Gmelin*)
(*Black rail*)
Crex crex (*Linnaeus*)
(*Corn crake*)
Ionornis martinica (*Linnaeus*)
(*Purple gallinule*)
Gallinula galeata (*Lichenstein*)
(*Florida gallinule*)
Fulica americana *Gmelin*
(*American coot*)

Order Limicolae
Plover, snipe, etc.

Family Phalaropidae
Phalaropes
Phalaropus fulicarius (*Linnaeus*)
(*Red phalarope*)
Lobipes lobatus (*Linnaeus*)
(*Northern phalarope*)
Steganopus tricolor *Vieillot*
(*Wilson phalarope*)

Family Recurvirostridae
Avocets
Recurvirostra americana *Gmelin*
(*American avocet*)

Family Himantopodidae
Stilts
Himantopus mexicanus (*Müller*)
(*Black-necked stilt*)

Family Scolopacidae
Snipe etc.
Scolopax rusticola *Linnaeus*
(*European woodcock*)
Philohela minor (*Gmelin*)
(*American woodcock*)
Gallinago delicata (*Ord*)
(*Wilson snipe*)
Macrorhamphus griseus (*Gmelin*)
(*Dowitcher*)
Macrorhamphus scolopaceus (*Say*)
(*Long-billed dowitcher*)
Micropalama himantopus (*Bonaparte*)
(*Stilt sandpiper*)
Tringa canutus *Linnaeus*
(*Knot*)

Arquatella maritima (*Brünnich*)
(*Purple sandpiper*)
Pisobia maculata (*Vieilott*)
(*Pectoral sandpiper*)
Pisobia fuscicollis (*Vieillot*)
(*White-rumped sandpiper*)
Pisobia cooperi (*Baird*)
(*Cooper sandpiper*)
Pisobia bairdi (*Coues*)
(*Baird sandpiper*)
Pisobia minutilla (*Vieillot*)
(*Least sandpiper*)
Pelidna alpina alpina *Linnaeus*
(*Dunlin*)
Pelidna alpina sakhalina (*Vieillot*)
(*Red-backed sandpiper*)
Erolia ferruginea (*Brünnich*)
(*Curlew sandpiper*)
Ereunetes pusillus (*Linnaeus*)
(*Semipalmated sandpiper*)
Ereunetes mauri *Cabanis*
(*Western sandpiper*)
Calidris leucophaea (*Pallas*)
(*Sanderling*)
Limosa fedoa (*Linnaeus*)
(*Marbled godwit*)
Limosa haemastica (*Linnaeus*)
(*Hudsonian godwit*)
Totanus melanoleucus (*Gmelin*)
(*Greater yellow legs*)
Totanus flavipes (*Gmelin*)
(*Lesser yellow legs*)
Helodromas solitarius (*Wilson*)
(*Solitary sandpiper*)
Catoptrophorus semipalmatus (*Gmelin*)
(*Willet*)
Catoptrophorus semipalmatus inornatus *Brewster*
(*Western willet*)
Pavoncella pugnax (*Linnaeus*)
(*Ruff*)
Bartramia longicauda (*Bechstein*)
(*Bartramian sandpiper*)
Tringites subruficollis (*Vieillot*)
(*Buff-breasted sandpiper*)
Actitis macularia (*Linnaeus*)
(*Spotted sandpiper*)
Numenius americanus *Bechstein*
(*Long-billed curlew*)
Numenius hudsonicus *Latham*
(*Hudsonian curlew*)
Numenius borealis (*Forster*)
(*Eskimo curlew*)
Numenius arquatus (*Linnaeus*)
(*European curlew*)

Family **Charadriidae**
Plovers

Vanellus vanellus (*Linnaeus*)
(*Lapwing*)
Squatarola squatarola (*Linnaeus*)
(*Black-bellied plover*)
Charadrius dominicus *Müller*
(*American golden plover*)
Oxyechus vociferus (*Linnaeus*)
(*Killdeer*)
Aegialitis semipalmata (*Bonaparte*)
(*Semipalmated plover*)
Aegialitis meloda (*Ord*)
(*Piping plover*)
Ochthodromus wilsonius (*Ord*)
(*Wilson plover*)

Family **Arenariidae**
Turnstones

Arenaria interpres morinella (*Linnaeus*)
(*Ruddy turnstone*)

Family **Haematopodidae**
Oyster catchers

Haematopus palliatus (*Temminck*)
(*American oyster catcher*)

Order Gallinae
Gallinaceous birds

Family **Odontophorinae**
American partridges, quails

Colinus virginianus (*Linnaeus*)
(*Bobwhite*)

Family **Tetraonidae**
Grouse

Canachites canadensis canace (*Linnaeus*)
(*Canada grouse*)
Bonasa umbellus umbellus (*Linnaeus*)
(*Ruffed grouse*)

Bonasa umbellus togata (*Linnaeus*)
(*Canadian ruffed grouse*)
Lagopus lagopus (*Linnaeus*)
(*Willow ptarmigan*)
Tympanuchus cupido (*Linnaeus*)
(*Heath hen*)
Lyrurus tetrix (*Linnaeus*)
(*Black grouse*)
Tetrao urogallus *Linnaeus*
(*Capercaillie or Capercailzie*)

Family **Phasianidae**
Pheasants
Phasianus colchicus *Linnaeus*
(*English pheasant*)
Phasianus torquatus *Gmelin*
(*Ring-necked pheasant*)

Family **Meleagridae**
Turkeys
Meleagris gallopavo silvestris (*Vieillot*)
(*Wild turkey*)

Order **Columbae**
Family **Columbidae**
Pigeons
Ectopistes migratorius (*Linnaeus*)
(*Passenger pigeon*)
Zenaidura macroura carolinensis (*Linnaeus*)
(*Mourning dove*)
Columbigallina passerina terrestris *Chapman*
(*Ground dove*)

VI

HISTORICAL MUSEUM

In my report of last year was published a statement setting forth the propriety of the establishment of a State historical museum, the statutory authority of the Regents of the University to inaugurate and uphold such an undertaking and outlining a logical plan for such a museum. The proposition as therein stated was submitted to the Regents committee on the State Museum and with their unanimous approval laid before the Board which also unanimously

Voted, That the report of the committee be adopted and that the Commissioner of Education be authorized to direct the establishment of such a State Historical Museum through the Director of the State Museum.

Following this favorable action the general plan of the proposed historical museum was embodied in a circular and distributed very widely throughout the State to all historical associations and to a large number of individuals interested either locally or generally in the history of the State. The response to this circular was general, cordial and even enthusiastic. It has been evident from the first that the successful outcome of this project would depend less on an approving sentiment than on actively contributing participation, particularly in view of the fact that it has been distinctly not the purpose to ask special appropriations, but to carry the undertaking along with present means so far as these could be made available. It is fully realized that such a collection must grow slowly and it is not hoped to reach with a leap the end aimed at. The owners of historical relics throughout the State, seeking to dispose of them in such a way as to guarantee their care and perpetuate their associations, will make them of greatest use to the public by depositing them with the museum.

In the execution of the plan it has seemed wise to begin at the beginning, with our aboriginal culture wherein there is a logical and working connection with the past and present operations represented by the section of Archeology. It is eminently proper that the remarkable achievement of the Iroquois Confederacy, which affords a unique example of native culture and democratic polity, should be conserved and reportrayed as fully and as effectively as it is now possible to do. The general scheme for such an Iroquois collection involves:

1 The assembling in proper association of the relics of the Iroquois nation now or to be in the possession of the State.

2 The preparation of a series of life-size groups of figures expressing the various phases of the domestic, industrial and military life of the native tribes, with careful detail as to costumes, accessories and scenery, the work to be executed by expert artists and craftsmen and the models cast from the best living types. Each of these groups, of which six are now planned, would contain five or more life figures and have a front length of 15 to 20 feet.

3 A series of busts, mounted on suitable pedestals, of typical Iroquois heads, one of each of the Six Nations.

It is very agreeable and encouraging to be able to record a substantial evidence of private interest in this public undertaking. Mrs Frederick F. Thompson of New York, a daughter of former Gov. Myron H. Clark, has given the sum of $15,000 for the execution of this plan for an Iroquois collection, which on its completion is to be known as *The Myron H. Clark Museum of Iroquois Culture.*

Work on the preparation of this collection has begun, the models are being assembled and the sculptor to execute the casts is engaged.

VII

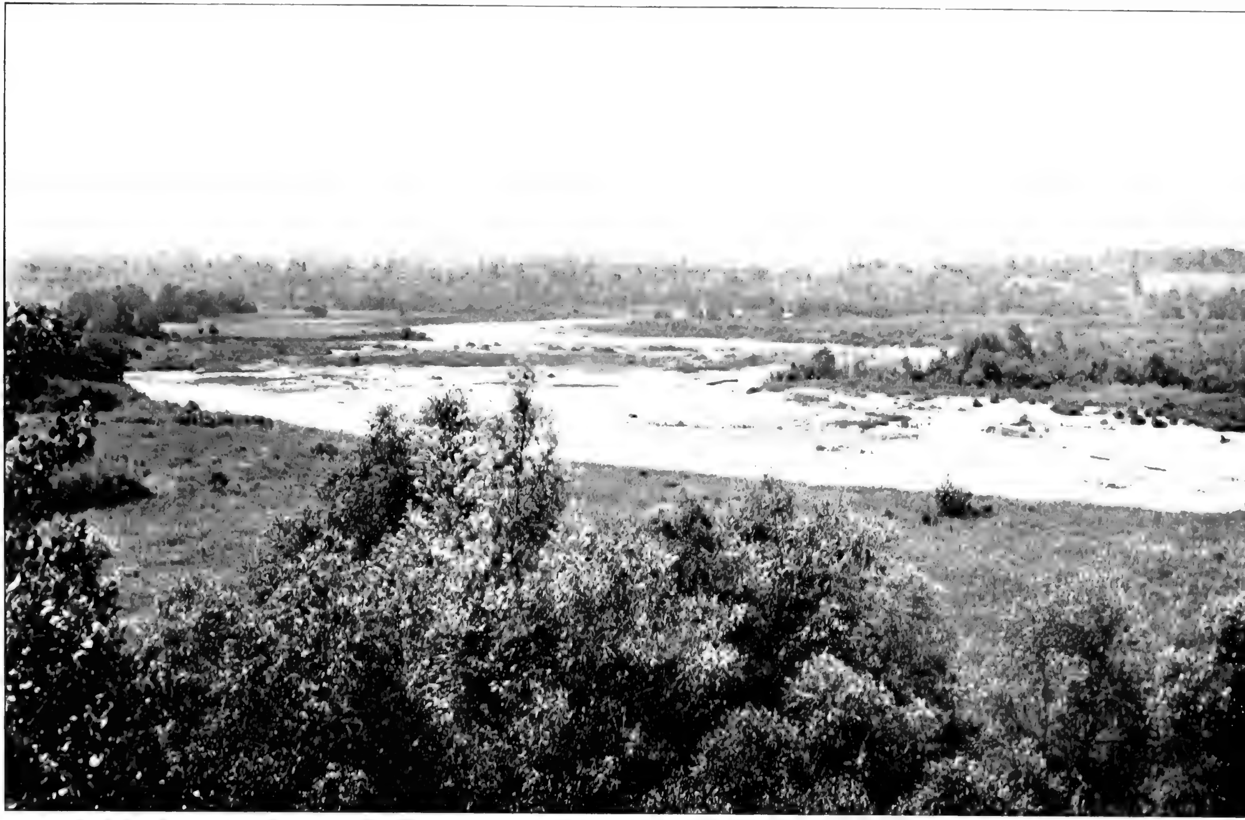
ARCHEOLOGY

Field work in archeology began in May when certain localities in Essex, Warren and Clinton counties were visited to determine the availability of the sites. A number of interesting sites of former Algonquin occupancy were examined in the vicinity of

Plate 5

High Banks site, near Irving, N. Y. The view shown in the photograph is of the northeast end. The village site is 750 feet to the right (southwest).

Plate 6



View of the Cattaraugus valley from the High Banks village site. On the Chautauqua hills in the background are several Preiroquoian village sites and forts and several early Iroquoian sites. The modern sites are all on the Erie county side, that in the foreground. The creek waters in this picture are low. High water covers all low points and frequently floods the fields.

Plattsburg. At Dresden, Washington co., a camp site was discovered and excavated, about 150 specimens of pottery and flints being collected.

In June investigations were made in Madison and Onondaga counties. Fifteen sites in the Pompey group were examined and six near the Madison-Onondaga county line. All of the sites mentioned indicated that they had been dug into from time to time during a period of more than 50 years and the specimens that were found have been scattered.

On June 22 work was commenced on the High Banks site a mile and a half from Lake Erie on the Cattaraugus creek in the Cattaraugus Reservation, Erie county. The High Banks site[1] is an interesting one archeologically and several collectors have endeavored to lease it for excavation. It is situated on a natural knoll perched upon the edge of the alluvial bluff that overlooks the Cattaraugus valley. It is a spot well adapted for fortification or refuge. At the base of the bluff are copious springs. An old trail runs down the steep bank to the flood plain of the creek but at its lower end has been washed away by the stream. A swale is yet visible along the bottom of the bluff and is plainly an old arm of the stream now 2000 feet to the southwest. From the top of the bluff human bones, pottery and old refuse material have fallen out with each spring's landslide and the old inhabitants tell of a large number of skeletons which rolled down the bank during 1881 to 1885 when a rapid current from the creek ran through the swale and undercut the bank.

Excavation soon revealed that the knoll top was covered only by a village soil layer, there being no burials. Postholes were dug over an area of five acres about the knoll for burials but none could be discovered. The top of the knoll was covered by five large refuse heaps, presumably the kitchen refuse of as many lodges. These refuse heaps and the ground about them were excavated with great care and more than 600 good specimens taken therefrom. These artifacts are familiar types of pottery, bone and antler implements and ornaments, polished stone objects, chipped stones, cut brass, worked iron, shell articles, glass beads and fragments of European pottery. There are also a number of articles

[1] The High Banks site is situated on the farm of the late Ruth Stephenson. Ruth Stephenson was Red Jacket's stepdaughter and Red Jacket's bones rested in her house for some time before their reinterment in Forest Lawn, Buffalo. The Indians have several legends about the site and still regard it with superstition.

made from fossils. A detailed list of the articles discovered in the lodge refuse heaps may be found in the list of accessions.

An examination and comparison of these articles points out their manufacture by the Senecas. They are similar in every way to Seneca articles from central New York of the period 1654–1779. They are so dissimilar to types known to be Erie and Neutral that even though the site is on reputed Erian territory, their Seneca origin is apparent.

The Archeologist's examination of this site as well as many others in the region of the Cattaraugus valley only confirms the conclusion that the Senecas occupied the valley some time after the Erie war in 1654.

In plate 11 a number of pipes are illustrated; that these pipes are not Erian but Senecan is at once apparent to those familiar with the two types.

Mouth of the Cattaraugus site. An old site at the mouth of the Cattaraugus creek was examined with some interesting results. Few ash pits could be discovered and the site seems to have belonged to some Preiroquoian culture. There was no pottery to be found but notched arrow points and knives were common on the surface, as also were celts; gorgets have also been found here.

Excavations in this site as well as in other places point out the early occupancy of this region by a Preiroquoian people, presumably some early Algonquin branch familiar with soapstone pots but unacquainted with pottery.

Several sites along the shore of Lake Erie indicate also a later Algonquin people familiar with pottery. A good example of such a site is the crescentric earthwork near Sheridan, Chautauqua co.

From the site at the mouth of the Cattaraugus were found over a hundred flints of various colors. The material is similar to that from Ohio.

Central New York sites. A number of interesting sites were examined in Monroe, Ontario and Livingston counties. Many of the places in this region have been excavated by local collectors, but a number are yet available. Where such a general interest prevails in archeology, the activity of collectors in excavating the sites in this neighborhood has lessened the number of sites available to archeologists from museums. Hundreds of sites in the Genesee valley have been opened and a great wealth of material taken out. Nearly a month was spent in the vicinity of West Rush, Monroe co. and more than 20 sites examined for future

Plate 7

The southwest end of the Silverheels site. The graves were found near the top of the point. Some of the objects found here are shown in plates 10 and 12

Plate 8

Mouth of the Cattaraugus site. The site lies several hundred feet back from the shore of Lake Erie. The mouth of the creek is shown in the right background

investigation. Several hundred specimens of pottery, flint objects, shell and bone articles and skeletons were collected in this region.

Silverheels site. This site is situated a half mile from High Banks up the Cattaraugus. Here in 1903 the Archeologist with Mr M. R. Harrington opened more than 50 Indian graves and secured a fine collection of pottery and other objects for the Peabody Museum of Archeology and Ethnology. The manager of the farm upon which the site is located forbade further excavation, thinking the relics of great commercial value. During the spring of 1908, however, the Archeologist secured a good collection of objects from the site, notably 2 pottery vessels, 2 pipes, a fragment of a rush basket, a *Towisas* tortoise rattle, a bone comb, a stone charm, otter effigy, a gourd cup preserved by contact with copper, etc. All the pottery from the Silverheels site is Senecan, and not Erian, in form and ornamentation.

Ripley site. Some additional excavations were conducted at Ripley under the direction of the Archeologist, by Mr Everett R. Burmaster, a field assistant. Mr Burmaster opened several graves in a portion of the site where burials had not been hitherto found. Among the valuable specimens are several crushed pottery vessels, a fragmentary turtle-shell rattle, a bone comb, bone beads and several skeletons. The bone comb is of the early fork type and has three teeth only. The turtle-shell rattle was plainly visible in the grave and contained a handful of gravel stones. When taken up the carapace fell apart. This object is of considerable interest in the light of comparative studies.

Pottery restoration. Many of the finest types of pottery vessels found in graves and ash pits are crushed into a number of fragments. Some specimens taken out embrace 20 pieces and others 100 or more. Pottery in this condition is interesting, but far more so if the fragments are cemented together and the vessel restored. The work of restoring pottery vessels has been carried on by Mr Martin Sheehy who, by exercising great patience, has restored more than 20 vessels from the Ripley, Gerry and High Banks sites.

Public interest. The large number of letters of inquiry received from this as well as other states indicates a keen interest in matters pertaining to New York Indians. The range of inquiry has covered almost every feature of the Indian culture, language, folklore, ceremonies, costumes, customs, arts, industries, textiles, ornaments etc.

A large number of collectors have visited the Archeologist's laboratory bringing with them specimens for opinion and identification.

Publications. During the early part of the fiscal year the Archeologist spent some time in editing and annotating the *Myths and Legends of the New York State Iroquois,* collected by the late Mrs Harriet Maxwell Converse. Some 133 printed pages were added to the original manuscript which covered only 50. This work, issued as Museum bulletin 125, has been received very favorably by the press and by those interested in Iroquois ethnology. With the Iroquois themselves it is regarded most favorably, which is perhaps the best possible recommendation.

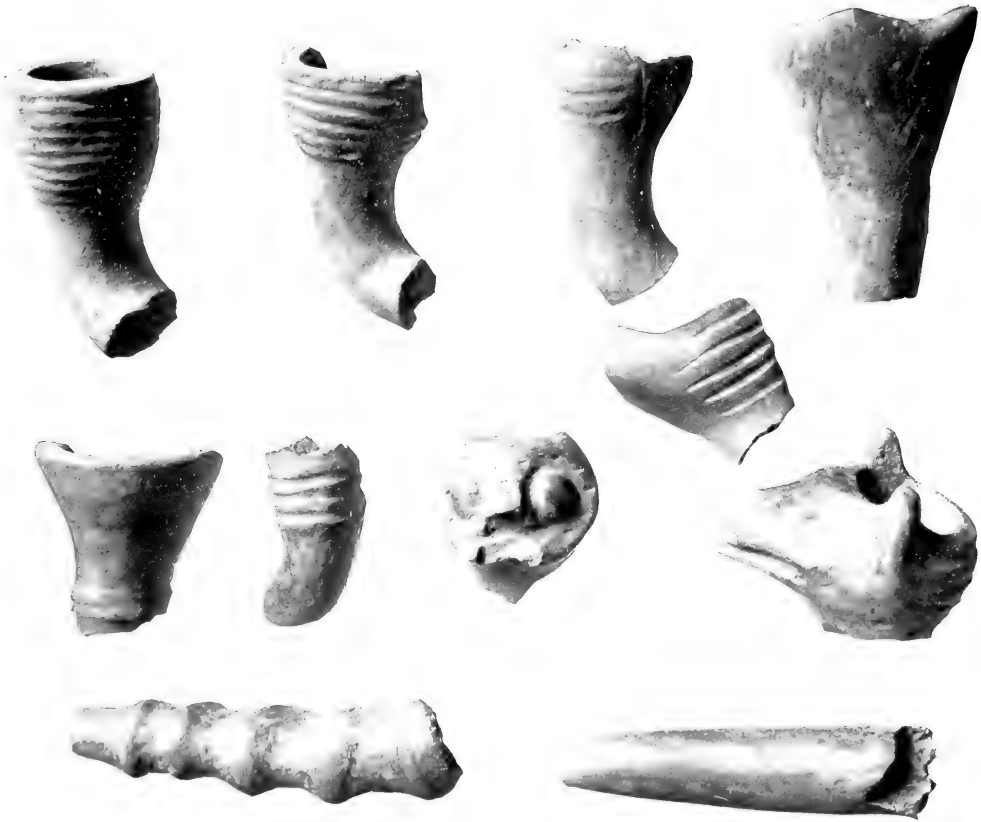
Frauds. The Archeologist wishes to caution museums and collectors against fraudulent specimens from Chautauqua, Erie, Cattaraugus and Onondaga counties, where such articles have been offered for sale. In Chautauqua, Erie and Cattaraugus counties the Archeologist has examined three collections containing imitations of stone implements, some of which have incised pictographs. Several frauds from the Cattaraugus Reservation are Indian made without a doubt but are of quite modern manufacture. A number of bowl shaped "mortars" in Monroe county were originally made by a blacksmith 30 or 40 years ago for water vessels to be used in poultry yards. Stone molds for mill machinery have also been mistaken for Indian relics.

ETHNOLOGY

Progress in ethnological research has been specially satisfactory and many valuable objects have been acquired. These accessions include clothing, hunting implements, ceremonial objects, basket maker's outfits, a silversmith's outfit, silver ornaments and a burden strap in process with all the fabrics necessary for its completion.

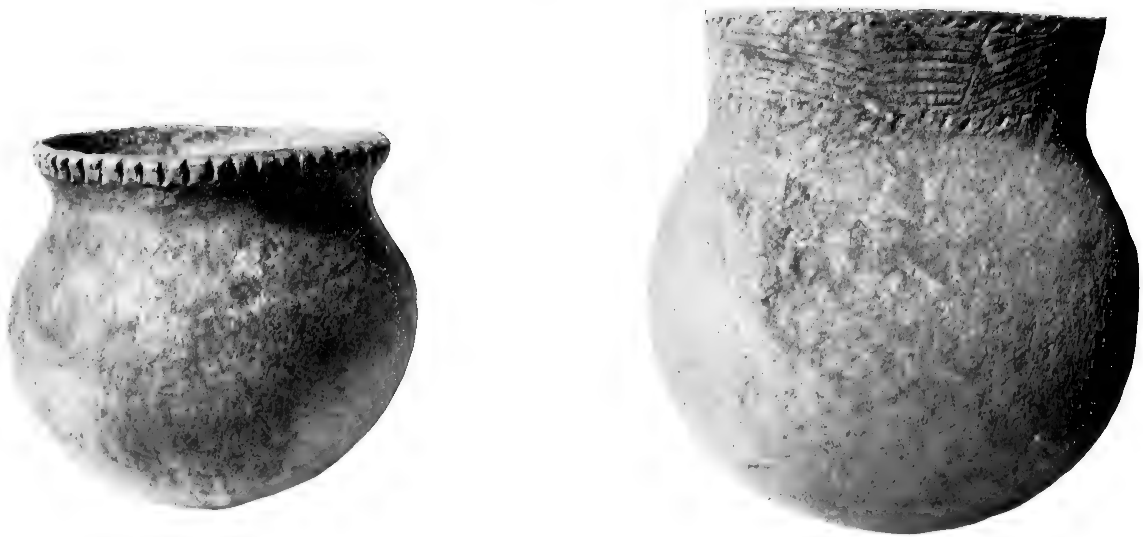
The great scarcity of ethnological material on the New York reservations makes it difficult to add much to our collections from that source. Private collectors and museums have the great bulk of Iroquois artifacts, save those which are buried in their old villages. The Iroquois have lost many of their ancient arts, and most of their old-time costumes and ceremonial paraphernalia have been taken by collectors. The Indians have done little in the way of replacing these articles. Most of the ethnological specimens purchased this year, however, were obtained from the Indians themselves. An especially noteworthy addition is the silversmith's outfit. In the Archeologist's paper on *The Silverwork of the Iroquois* the following description is found:

Plate 9



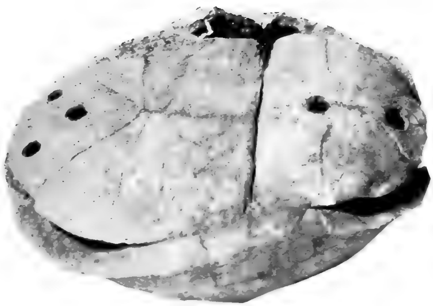
Types of pipe bowls and stems from High Banks site. Collected 1908

Plate 10



Pottery vessels from the Silverheels site, near Irving, N. Y. Collected 1908

Plate 11



1

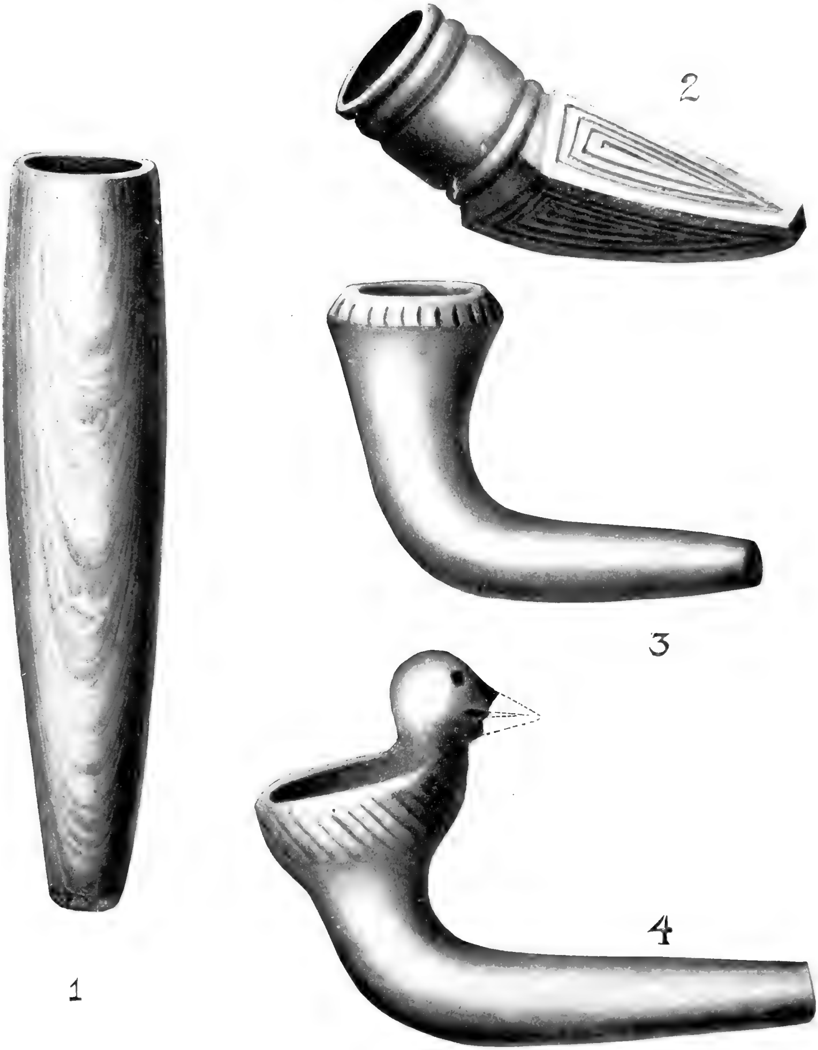
2

3

4

Objects from graves near Irving, N. Y. 1 Tortoise rattlebox such as is used by the Seneca Towiisas Society. 2 Bone comb. 3 Small gourd and rattle. The gourd has been preserved by contact with the brass rattle. 4 Small brass kettle

Plate 12



Types of pipes of four succeeding occupations in Erie and Chautauqua counties. 1 Early form from mound. 2 Early form of pottery pipe from early Iroquoian (?) culture. 3 Erie clay pipe. 4 Seneca pipe of clay

SENECA SILVERSMITH'S TOOL OUTFIT

During the autumn of 1907 the writer was informed by a number of Indians from the Allegany Reservation that there was a silversmith's outfit of tools in the possession of Silversmith George, an old Seneca Indian living near Tunesassa on the Allegany river. Knowing the extreme rarity of such tool kits an immediate effort was made to secure it. Smith George was visited and the outfit purchased for a few dollars. It was incomplete but at the time the State Museum had not a single Indian silverworker's tool. As much information was obtained as could be imparted by Mr George, whose deceased brother had been the real skilled worker. During the summer of 1908 another outfit was located on the Cattaraugus Reservation. It was in the possession of Mrs Nancy Mohawk and was purchased through the good offices of Chief Delos Big Kittle, known to his fellow tribesmen as Chief Soinowa. This outfit was complete except for the brass patterns which had been loaned to a son in law. It was promised that they would be restored for a few dollars more and added to the outfit already in hand.

The outfit as it stood consisted of an old stained pine table with a drawer which had been partitioned off to contain the various tools which consisted of more than a hundred chisels, several homemade saws fashioned from case knives, a blow pipe, a candlestick, hammers, pinchers, a small table vise, punches, dies, awls, gravers, files etc., and several boxes of silver cuttings, chips, brooches in process, earrings in process, glass in various stages of the shaping process for mounts etc. A small partition contained several flint drills and a flint graver, also eight pieces of flat deer bone in process of manufacture into gaming buttons.

As in the case of the outfit secured on the previous year as many data as the Indian owners could furnish, prompted by vigorous questioning, were secured. Questions which might suggest answers were not asked in any instance, this being a better method to employ when interrogating Indians unaccustomed to analytical studies, and who many times will acquiesce to a suggested reply.

The outfit purchased from Mrs Mohawk, according to her statement, once belonged to Chief Tommy Jemmy, who was once tried for murder in Buffalo, his offense being the execution of a witch in accord with the national laws of the Seneca Indians. His defense by Red Jacket was a masterpiece of eloquence and a stinging rebuke to meddlers with Indian affairs who teach Indians a thing one moment and punish them the next for following that teaching. Red Jacket's philippic is now one of the classics of Indian oratory. Jemmy's silversmithing tools passed to his descendants and finally to Mrs Mohawk.

A number of photographs were taken showing the uses of the various tools. Several experiments were conducted in die stamping, graving and melting silver by blowpiping a candle flame upon the metal held in the hollow in a piece of hard wood. The silver melted, fused and with the withdrawal of the flame hardened into a small button.

Origin of Iroquois silversmithing. A few additional notes from the Archeologist's paper previously mentioned will be found of immediate interest.

Iroquois silversmithing and silver work are subjects worthy of the attention of ethnologists. Silver brooches are among the most sought for of the later day products of Iroquois art. Beauchamp, Converse and Harrington have each interesting accounts of the brooches but none of them has indicated how the Iroquois first obtained their knowledge of silver working or have suggested how the patterns of the most common forms were secured. Mrs Converse wrote "I fail to find in illustrations of jewelry ornamentation of either the French, English or Dutch, designs that have been actually followed in the hammered coin brooch of the Iroquois." Harrington remarks in his excellent paper, the best yet issued on the subject, "Before concluding, a few words concerning the art of silversmithing among the Iroquois may not be out of place. Of course such a discussion must necessarily be almost entirely theoretical. Taking the brooches first, it seems possible that we may look for their ultimate origin in the ornaments of copper, mica and other materials, thought to have been sewed or tied upon garments as ornaments by many tribes of the precolonial period. As Beauchamp says, 'Apparently the brooch was the evolution from the gorget for some (early) ornaments of this kind were tied on, not buckled.' He mentions and figures such a crude broochlike ornament of copper found on an Onondaga site of 1677. It is difficult to surmise how the buckle tongue fastening originated, or if borrowed whence it came. Perhaps the idea was in some way derived from the old-fashioned shoe or belt buckle of the colonists. Examining the patterns, the Masonic type speaks for itself, as being clearly of European origin; but other forms are not so easily traced. The heart type surmounted by an apparent crown looks suspiciously European also; but we can not prove that the heart, which occurs so often in all kinds of Iroquois carving and bead work, is not a pattern native to the people. The crown-shaped ornament above possibly represents a feathered headdress, or sometimes an owl's head. . . "

The Archeologist became interested in Indian silver ornaments in his early boyhood when he associated with other Seneca boys on the reservation. His mother, Mrs Frederick E. Parker, was fortunate enough to secure a large collection of the silver brooches, known to the Indians as *ĕnius'-kä,* which was exhibited at the Buffalo International Exposition in 1888. Many of the rarer forms from this collection with two of the Governor Blacksnake wampum belts were given later to Mrs H. M. Converse and are now in the New York State Museum. Subsequently the Archeologist collected a large number of brooches which he added to the above mentioned

Plate 13

A Seneca silversmith at his work bench. The silversmith is cutting out a star-shaped brooch.

A Seneca silversmith at his work bench. Melting a lump of silver by blowpiping a candle flame upon the silver which lies in the hollow of a wooden block

collection. After his appointment as Archeologist of the State Museum his studies of Iroquois silver work were continued and during the past two years more than a hundred specimens of the silver worker's art have been added to the State Museum collections. With the acquisition of the silversmiths' outfits previously mentioned, the question of the origin of the brooches was taken up along different lines. Several clues were followed. One important suggestion was given by some illustrations of circular brooches from burial mounds in Great Britain. Another important clue was furnished by a friend who had visited the museums in Scotland.

In order to clear up the matter the following letter was written to Dr Joseph Anderson, Curator of the National Museum of Antiquities of the Society of Antiquaries of Scotland, in Edinburgh:

New York State Museum
Albany, N. Y., December 2, 1908

Dr Joseph Anderson, Curator
National Museum of Antiquities
Edinburgh, Scotland

MY DEAR SIR: The Indians of New York State for two hundred years have made, with their native tools, articles of silver, known as Indian brooches, which in some respects are similar, I am told, to buckles and brooches which have been used in Scotland for centuries. I am sending you, herewith, a pamphlet describing the Indian ornaments and should be greatly obliged if you would let me know, by referring to the plates and numbers, which are similar to Scotch forms. Any literature or photographs which you have describing the articles in question would be most welcome to me. I am preparing a monograph on Iroquois Indian silver work for our museum and any information you may give will be gratefully acknowledged.

Very sincerely
[*Signed*] ARTHUR C. PARKER
Archeologist, New York State Museum

In reply to this inquiry, Dr Anderson wrote:

Society of Antiquaries of Scotland
National Museum of Antiquities
Queen Street, Edinburgh, Dec. 15th, 1908

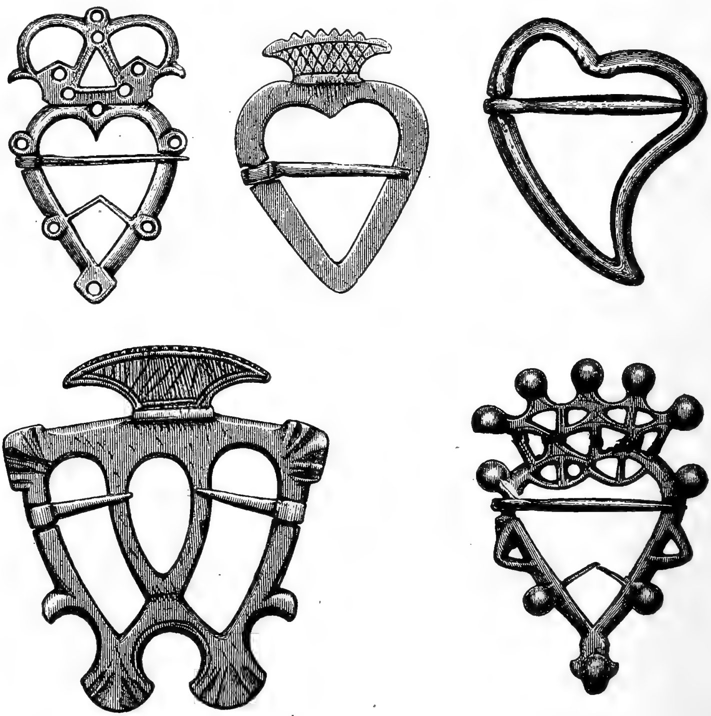
DEAR SIR: In reply to your note as to the silver brooches made by the Iroquois Indians, I think that nearly all of those figured in the plates of the pamphlet you kindly sent me are imitations and adaptations of the Scottish Luckenbooth brooches, so called because they were chiefly sold in the Luckenbooths around about St Giles's Church, Edinburgh. This applies to all those modeled on the design of a single or double heart, crowned, and also to the simpler forms of a heart alone. The Masonic badges seem also to be imitated from originals, but they need not necessarily have been Scottish.

I enclose a short note by a former fellow of this society, Robert Sheills of Neenah, Wisconsin, which gives some curious facts that tend to explain the widespread dissemination of these brooches from the old country among the Indian allies of the British both in Canada and the States. I also add a page of our museum catalog on which some of the Scottish specimens of the Luckenbooth brooches are figured.

Yours very truly

To Arthur C. Parker [*Signed*] JOSEPH ANDERSON
New York State Museum
Albany, N. Y.

The inclosure in this letter illustrating the Scotch Luckenbooth brooches is reproduced herewith. The leaves from the *Proceedings of the Society of Antiquaries of Scotland,* February 12, 1900, pages 220, 222, sent as an inclosure with the letter contain the following record:



Scotch Luckenbooth brooches.

1 By Robert Sheills, F.A.A. Scot., Neenah, Wisconsin, United States of America.

Indian socketed spearhead or knife of native copper, 4½ inches in length by 1⅛ inches in breadth, from Neenah, Wisconsin.

Two *Luckenbooth brooches,* three small pendant crosses (of the shape shown in fig. 1), a circular mounting with five included circles and 11 small buckles all cut out of thin sheet brass, found together in excavating an Indian mound at Kaukauna, Outagamie co., State of Wisconsin.

Mr Sheills has supplied the facts for the following account of the locality and circumstances connected with the discovery of these curious relics of the old intercourse between the British and the Indians. Kaukauna is on the Fox river, 23 miles west of Green bay, which is one of the very oldest settlements in North America, at the south end of a large bay of Lake Michigan and the mouth of the Fox river. It was the seat of a Jesuit Mission and a depot for fur traders. The river was the highway to the Mississippi. Its sources are on the south side of the watershed of Lake Superior. It runs in a southerly course to the city of Portage, where it turns easterly to the bay. The Wisconsin river pursues a similar course to Portage, where a slight watershed deflects it westerly to the Mississippi. The two rivers come within three or four miles of each other and are now joined by a canal. The Indian traders used to take their canoes up the Fox river by Kaukauna and Neenah to Portage, carry them over the slight ridge, and go down the Wisconsin to Prairie du Chien on the Mississippi. Mr P. V. Lawson, ex-mayor of Manasha, has written an account of the circumstances in which these Luckenbooth brooches, crosses, and other trade articles came to be buried in the Indian mounds on this route. The method of obtaining the friendship of the Indian tribes during the occupation of the French and English was by making presents to the savages. By lavish gift making the British had the strong support of all the savage tribes of the northwest, even after the treaty of 1789, and up to and all through the War of 1812. From memoranda found in the Canadian archives it appears that there were given to a chief from the upper country, among other items: "three hundred brooches, twelve pair ear-bobs." By means of such gifts nearly every tribe in the great northwest fought on the British side.

A second letter of inquiry was sent to Dr Anderson, as follows:

New York State Museum

Albany, N. Y., December 29, 1908

Joseph Anderson, Esq.
National Museum of Antiquities
Edinburgh, Scotland

Dear sir: I have received your letter of the 15th inst., relative to the silver brooches made by the Iroquois Indians after the models of the old Scotch Luckenbooth brooches and am deeply obliged to you for the information which you have furnished. There are several matters concerning these brooches upon which I should be glad to have you enlighten me.

First, what is the earliest record that you have of the manufacture of these brooches?

Second, for what purpose were they employed, that is, how worn upon the clothing?

Third, what distinctive names are given to the various types of these brooches respectively? The single heart and crown brooch I assume to be copies from the Douglass crest, but I am not so sure what name would be given to the double heart brooch, N. G. 44, page 359 of your catalogue.

Are there any sets of tools, dies and punches in your museum which were used by the makers of this silver work? I have collected several sets of these tools which were used by the Iroquois Indians for cutting out the brooches, so that there is no question that the Indians themselves imitated them. If you have any reference to old documents which tell of the distribution of these ornaments to the Indians in Canada and other British Indians in North America, it would be of material assistance to have a note of them.

Under separate cover I am sending you several bulletins of this museum which may interest you in your comparative studies.

Respectfully yours
[*Signed*] ARTHUR C. PARKER
Archeologist

Under date of Jan. 9th, 1909, Dr Anderson replied:

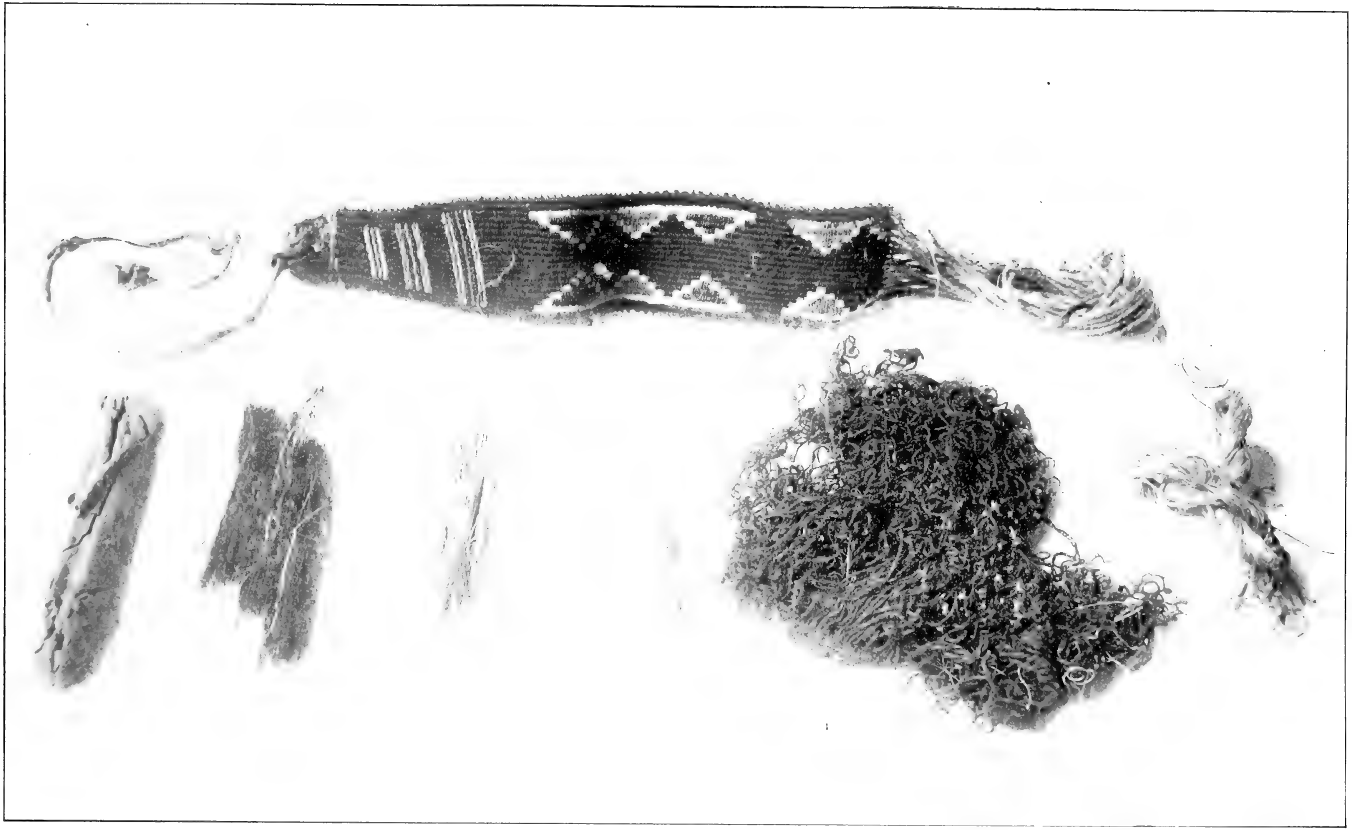
DEAR SIR: The earliest period for the manufacture of the heart-shaped and other shapes of the Luckenbooth brooches is a matter of inference, and may be 17th rather than 18th century. I do not know any record mentioning them specifically. The name, "Luckenbooth brooches," is an antiquary's invention, because they were sold in the stalls or Luckenbooths around St Giles's Church in the High street of Edinburgh. But they were not confined to Edinburgh or to the Luckenbooths there.

They were worn by women and children in the fastening of a bodice or collar or such part of dress. Being so made they were inserted for the fastening of thick stuffs.

There are no distinctive names given to the different types of these brooches, unless by descriptive phrases, such as heartshaped, crowned hearts, double hearts, crowned or not as may be, etc.

I do not think the brooches that partake of the heart shape were made in imitation of the Douglass crest, or have any relation to the family or traditions of the Douglasses. They were mostly used as love tokens, or betrothal gifts, and the choice of the heart shape or the crowned heart or the double heart for these purposes is sufficiently obvious. Moreover they frequently bear inscriptions, initials or posies, for instance on one in the museum is the inscrip-

Plate 14



Gusháå or burden strap in process of manufacture, showing colored moose hair, native hemp cord and basswood fiber. Collected by A. C. Parker

tion "Wrong not the —— whose joy thou art," the blank for the word heart being supposed to be supplied by the form of the brooch itself.

There are no sets of tools, dies or punches for making brooches, in the museum. I never saw or heard of any such.

Yours very truly
[*Signed*] JOSEPH ANDERSON

These letters and documents speak for themselves and leave us to infer either one of two things: First, The Indians furnished the idea for the brooches which were adopted by Europeans, the Scotch in particular, and the brooches were made in quantities in Scotland afterward and sent to America to be traded to the Indians; or, second, the Scotch, or other Europeans, carried them to America where they caught the fancy of the Indians who received them as gifts or in trade, and later manufactured them themselves. The second hypothesis seems more probable in the light of the evidence. There are few brooch patterns in the possession of collectors or museums. In every case within the writer's knowledge the majority of the patterns were lost or not accessible. An examination of some of the patterns indicates their manufacture by die cutting, the dies being true edged and geometrically perfect. The patterns which we are describing were not made with chisels used singly in cutting out the parts of the design, or if so the tools were of a character which might be expected to be found in the possession of a skilled jeweler. Through information given by the Director of this museum, the Archeologist has found that a set of die stamps had been in the possession of an Albany jeweler whose forebears also were jewelers and who sold many sets of patterns to the Indians in times past. A fuller description of these dies with a study of the Iroquois silversmithing art found in a paper by the Archeologist, *Silverwork of the Iroquois*.[1]

Seneca burden strap in process. During the autumn of 1903 when the Archeologist was engaged in archeological field work on the Cattaraugus Reservation, an old Indian informed him that he had a relic of interest which he had found in an old chest and which he wished to sell. The "relic" turned out to be a burden strap, gus'-ha, in an incomplete condition. The hemp card, the elm bark warp fiber and bundles of moose hair of various colors, were packed in the box with the "strap" and the entire process and materials of the weaving were made apparent. The peculiar part of the process is the fact that the belt is com-

[1] Manuscript prepared for publication in a museum bulletin on Iroquois Ethnology.

pleted in all its details as the weaving proceeds; that is to say, the weaving is not first completed and then the belt beaded and embroidered, but beading and embroidery are applied as the weaving proceeds. An examination of plate 14 where the belt and material are illustrated will make the meaning clear.

The burden strap was purchased from Peter Snyder for a New York collector who had at that time an interesting collection. Last winter the belt came into the possession of the State Museum where it forms a unique collection.

The story of the belt is, that it was started in 1811 by Hanging Kittle, into whose family Mary Jemison, the white captive, had been adopted. When Hanging Kittle died the belt was left incomplete, for reasons understood by the Indians, and more than a quarter of a century later it was wrapped up by a Mrs Snyder, a Seneca woman, and the grandmother of Peter Snyder who sold the belt. Peter said he had frequently heard the story of the belt which had been designed for his father who was to use it to carry venison from the Allegheny river hunting grounds to his home. The newspaper wrapping found about the strap was dated 1843.

Masks. Another series of articles of exceptional interest is the set of masks used by the Ie'i-'dos O-ä'-no or Society of Charm Keepers. These masks differ from those used by the False Face Company and are never used in the mask ceremonies. The Archeologist was fortunate enough to obtain several flashlight pictures of the society and will include them in a later report on the Animal Societies of the Iroquois.[1]

Folklore. Satisfactory progress has been made in the collection of myths and folk tales, 20 being recorded when attending the midwinter celebration in January 1908. Twelve good phonograph records were made of folk songs of unusual interest. This section now has a valuable collection of Seneca folk tales, and ceremonial texts.

Art and symbolism of the Iroquois. The study of the decorative art and symbolism of the Iroquois has been continued. Designs have been copied from many decorated Indian artifacts from New York State, belonging to the museum.

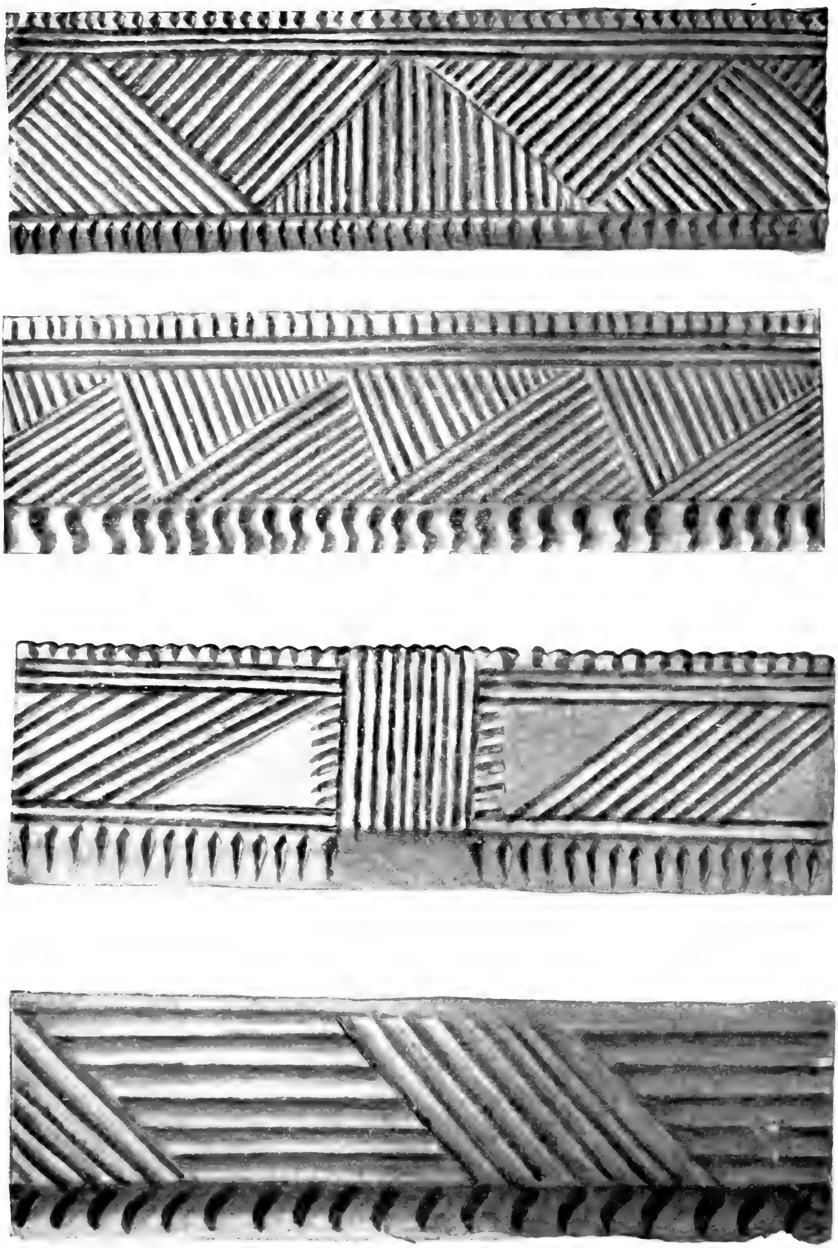
In plate 9 is shown a number of pattern designs taken from decorated rims of pottery vessels. The designs are typically Iroquois and as motifs for border decoration are not without value to art students and practical designers. The patterns are simple

[1] *See also* Parker, A. C., Iroquois Medicine Societies. American Authropologist, July-Sept., 1909.

Plate 15

Masks used by the Ie'dos Company, a Seneca society. The third mask is used by the shaman who is reputed to be able to see through the wooden mask although it has no perforation for the eyes. This set of masks is the only one in any museum. These masks are not used by the False Face Company nor are they ever used in public ceremonies. Collection of 1908

Plate 16



Decorative motifs from Iroquois pot rims

in their composition, the technic is bold in its execution and the effect is striking without being offensive. In combining designs of straight lines such results are not easy to obtain and the success of the Iroquois designers in effecting such pleasing combinations is a tribute to their artistic skill.

Seneca societies

During the winter of 1904–5 the Archeologist made the discovery that many of the so called dances of the Iroquois, such as the Bear dance, the Bird dance or the Buffalo dance, were but public ceremonies of secret or semisecret societies. He has continued his studies of the rites of the native societies of the Iroquois, has translated many rituals, and recorded the ceremonial songs and chants on phonograph records.

Prefatory to his notes on the animal societies and other societies of the Senecas, the Archeologist makes the following observations which may be of some interest to those unacquainted with folk societies of aboriginal or primitive peoples:

Secret societies of the Senecas

The instincts and necessities of primitive man were similar to those of other animals. Self-preservation was the first instinct and all others were subordinate. In order to preserve himself it was necessary to obtain food. He destroyed animals for two purposes, that he might eat their flesh and that he might not be destroyed. Animals likewise sought men for food. Naturally this was not agreeable to man, being against his primal instincts. Man, being a thinking animal, able to compare, began to think whether it was not as disagreeable for beast animals to be eaten by men as for human animals to be eaten by beasts. An idea of this kind once implanted resulted in infinite development and gave rise to a great number of beliefs and customs.

Probably no people realized so fully that they were animals as "primitive man." He saw himself one of the species of animals among a host of others. But though he realized this, there was not a moment that he did not regard himself the superior animal and think that all others should be subservient to his wishes. At the same time he thought that beasts had rights that should be respected. He closely observed the beasts and learned whatever he could from them. He supposed that other animals were constituted mentally much as he. Observing their seeming display of intelligence he thought some of them exceedingly wise, having access to knowledge of which he was ignorant. When he could not understand certain of their habits he was awed, and called them mysterious. He supposed animals capable of communicating one with the other and species with species. Indeed many circumstances seemed to point to the truth of this supposition until it became a fixed belief. If a man were unjust to animals they would communicate the fact to all other animals who would seek opportunity to revenge. If he were just and kind they would appreciate his goodness and give him "luck," warn him of danger and protect him in peril. The condition of primeval man and of his descendants who continued to live in the primitive way was one of continual danger. It was necessary for him to protect himself, his mate and his offspring from famine, from the attacks of animals, from the elements, from accidents and disease. The state of nature and the state of human society made his life one of continual struggle to accomplish these ends. Man, therefore, sought to eliminate all unnecessary dangers and to seek protection of any kind. Regarding animals as he did it was natural that he should have sought their good will and protection.

To primitive man dreams were oracles. Regarding himself as one of the animals or thinking animals mentally endowed as men are and living in close contact with animals, it is reasonable to suppose that savage man dreamed of ways by which he could secure the favor of animals, and, at the same time, dreamed what the wishes of animals were. Savage races are great dreamers and their dreams are in many ways different in character from those of civilized men. When primitive men dreamed, in many instances they felt bound to abide by the dictates of the dream. If they could not understand the vision, they consulted an interpreter of dreams. Desirous of the patronage of animals the dreamer would dream how to secure the favor of certain beasts or birds. In this manner may have originated personal totems and many customs.[1] As time went these dreams came to be related as actual experiences and were handed down as real happenings of the mysterious past. To the savage the past was always mysterious.

[1] Although "medicine men" versed in the lore of their people assert to those under their influence that the origin of certain customs and ceremonies as set forth in the legends are actually true, yet to outsiders they will sometimes admit that they originated in dreams. Esquire Johnson, the aged Seneca chief, whose relations are found elsewhere in the Archeologist's notes, said in an interview with Mrs. Asher Wright, "All the dances, feasts and other ceremonies originated in dreams."

Savage man thought more of holding the favor of animals than he did the good will of men in other communities than his own and for this reason was in certain things more considerate of beasts than men. He could slaughter whole tribes of men but unless certain animals were regarded as especially "bad medicine" he did not dare ruthlessly to kill them. Some animals were reputed more wise than others and came to be looked upon as "medicine animals." Such were thought to be able to protect man from the dangers of the elements, from accidents, and from diseases. In order to keep the favor of these animals it was necessary to perform certain rites and offer gifts. Since it was necessary to kill these medicine animals for food and for clothing there were ceremonies in which the permission of the animal was first sought before it was killed and afterward ceremonies of expiation

These primitive rites, ceremonies and customs have been held by the American aborigines for ages and even when tribes became in a degree civilized they were loath to abandon them. The Iroquois who have had three centuries of contact with the white man still cling to these ideas and among the Seneca-Iroquois of today there exist several "animal societies." Each has a well preserved legend setting forth its origin. Among the Senecas, who cling to their early beliefs, sickness and ill luck, famine and catastrophies of nature are supposed to be caused by witches, evil spirits or angry "medicine animals." Witches being "humans" are killed when discovered and there are many rites and charms for discovering witches and nullifying their machinations. With spirits and animals it is otherwise. Societies of remote origin hold formulas for driving away evil spirits and appeasing the *no-twai's-hä* or souls of the dead that are supposed to work evil. Societies for preserving the rites necessary to please animals and animal spirits rigorously enforce the laws relating to the pacification of the "medicine animals" and when the animals are made angry by neglect or insult they know the rites necessary to prevent calamity. Or, if they neglect the "spirit" to an extreme, and disease, pestilence, flood, famine or earthquakes result, they are still able to restore their good will.

Of these animal societies the following are still existent: the Eagle Society, the Otter Company, the Iē′′dos Company, the Pygmy Society, the Buffalo Society and the Bear Society. Other "medicine societies" are the Little Water Company, the O'gi′wē People, the Singers for the Dead, the False Face Company, and the Husk Face Band, and the To-wii′-säs, Sisters of the Dio-he′-ko.

Intellectually undeveloped men, as well as men of today, seek primarily the conditions which give their acquired or natural necessities, desires, inclinations, ideas and instincts the greatest comfort, freedom and satisfaction. In short, not only is freedom from antagonizing and destructive elements sought but pleasurable sensations also, the stimuli to coincide with both natural and acquired ideas. To attain these desired conditions the Iroquois like other races had their religion, their folk beliefs and their mystical societies.

A list of some of these societies with a very brief summary of their distinguishing features follows:

Nia-gwai' O-ä'-no, the Bear Society

1 The ritual of the Bear Society consists of 20 songs and a dance. At stages in the song and dance berry juice is drunk.

2 The ceremony is opened by offering tobacco incense to the spirits of bears. During this ceremony a speech is recited.

3 The sign of membership, or in other words the badge, is one black streak drawn diagonally on the right cheek.

4 The chief of the Bear Society is a woman.

5 The object of the society is to cure the diseases of its members or candidates by chanting its songs. The Bear song is believed to be a powerful remedy for fevers and rheumatism.

6 The chief woman blows on the head of the patient.

7 A person becomes a member of this society by dreaming that he or she must or by calling upon it for services.

8 No one but members may engage in its public dances.

9 After a ceremony the members depart bearing with them parts of bear pudding that had been cooked at the ceremony.

Sha-dot-gē''-a', the Eagle Society

1 The ritual of this society consists of 10 songs and a dance. The song is called *Ga-ne' gwa-a' O-ä-no* or the great eagle ceremony.

2 Every member engaging in a ceremony must paint each cheek with a round spot of carmine.

3 The Bird Society ceremony is considered as the most sacred next to the Great Feather dance.

4 It is believed that this society holds in its songs the most potent song charm known. It is said that the dying have been revived by it and completely restored.

5 No one but members may engage in its ceremonies.

6 A person may become a member by dreaming it necessary or by asking for its services.

7 Its membership is divided into two classes, the first, consisting of members belonging to the phratry of four greater clans and the second, of those belonging to the five lesser clans.

8 In its ceremonies, special costumes are worn and fans made of feathers held in the hand of each of the four dancers.

9 The Bird Society rattle is a small one made of a dried gourd, into which a dozen or so kernels of corn have been inclosed, and fitted with a wooden handle. Small bark rattles are used patterned after the bark false-face rattles.

10 In its public ceremonies each class of members is represented by two dancers, and two speakers.

11 The dancers dance in a squatting position.

12 During the ceremony any speaker desiring to make a speech strikes a striped pole held by the pole keeper and immediately the song, rattles, and dancers become silent. After a speech the speaker presents the dancers with a gift of bread or any other thing of which birds are fond.

13 Each speaker in his address upholds the clans which he represents and derides the others until the closing draws near when each apologizes for his derogatory remarks and begs to be pardoned.

14 In its private sessions the members feast on a boar's head.

15 Public ceremony of the Bird Society has only recently been the custom.

Iē''dos O-ä'-no, or Society of Mystic Animals

1 The ritual of this society consists of several score of songs and several dances.

2 The society is said to have been introduced among the Senecas by the western Iroquois-speaking people.

3 The principal ceremonies are:

a Gai-iu'' wĕ^n' o'go-wa
b Ga-ha-di-ya'' go^n
c Gai''-do

4 While chanting the rituals rattles of dried gourds are used exclusively for keeping time.

5 During the (*b*) and (*c*) ceremonies, mentioned above, only one member sings at a time.

6 The *Iē''-dos* is regarded as a strictly secret organization.

7 Its chief is said to be a man who is possessed of clairvoyant powers, being able to see through a wooden mask which has no openings and discover the ceremonial doll wherever it be hidden in the lodge. This chief is also able to juggle with fire while wearing his mask.

8 The ceremonies of the *Iē"dos* are said to be a cure for fever and skin diseases.

9 After the ceremonies the members feast on the head of a bear, the chief passing it around while each member tears off a mouthful with his teeth.

Additional notes on the Iē"dos Company

1 The Iē"dos Company is a band of "medicine" people whose object is to preserve and perform the rites thought necessary to keep the continued good will of the "medicine" animals. According to the traditions of the company these animals entered in ancient times into a league with them. The animals taught them the ceremonies necessary to please them and said that should these be faithfully performed they would continue to be of service to mankind. They would cure disease, banish pain, displace the causes of the disasters of nature and overcome ill luck.

2 Every member of the company has an individual song to sing in the ceremonies and thus the length of the ceremony depends on the number of the members. When a person enters the Iē"dos he is given a gourd rattle and a song. These he must keep with care, not forgetting the song or losing the rattle.

3 The head singers of the Iē"dos are two men who chant the dance song. This chant relates the marvels that the medicine man is able to do and as they sing he proceeds to do as the song directs. He lifts a red-hot stone from the lodge fire and tosses it like a ball in his naked hands. He demonstrates that he can see through a mask carved from wood and having no eyeholes by finding various things about the lodge. He causes a doll to appear as a living being and mystifies the company in other ways. It is related that new members sometimes doubt the power of the mystery man and laugh outright at some of the claims which he boasts. In such a case he approaches the doll and though his face be covered by a wooden mask cuts the string that holds its skirt on. The skirt drops exposing the legs of the doll. Then the doubting woman laughs for every one else is laughing, at the doll she supposes, but she shortly notices that every one is looking at her, and to

her utmost chagrin, discovers that her own skirt string has been cut and that she is covered only by her undergarments. Immediately she stops laughing and never afterwards doubts the powers of the medicine man, who when he cut the doll's skirt string by his magic power cuts hers also by magic.

The Iē′′dos Company may be regarded as the first degree of the Secret Medicine Lodge; Little Water Company being known with the Dark dancers of the Pygmy Society as the Ho-no'-tci-no′′-gä. This information was given by Chief Edward Cornplanter.

De-gï′′-ya'-go^{n} O-ä-no, Buffalo Society

1 The ritual of this society consists of a number of songs which relate the story of its origin.

2 After a Buffalo ceremony each member carries away a portion of Buffalo pudding. (For receipt *see* "Corn and other vegetable foods of the Senecas.")[1]

De-wa-ŋon-diis′-soñ-daik-to'. Pygmy Society (the Dark dance ceremony)

1 The ritual of this ceremony consists of 102 songs divided into four sections as follows: the first section, 15 songs; the second, 23 songs; the third, 30 songs; and the fourth, 34 songs.

2 The wet drum and horn rattle are used during this ceremony for keeping time.

3 The Dark dance is designed to propitiate certain spirits and to secure the beneficent offices of others, thus the ceremony is performed for appeasing the spirits of a charm that has become impotent or one which is feared, such as flying head's hair or *ni-a′′-gwa-hē′-s* tooth.

This ceremony also pleases the elves and secures their good will ("It is the religion of the Jo-gä′-o^{n}." Sainowa.) People who live near the reputed haunts of elves often order a Dark dance to cure certain ills that are thought to be punishments.

In order of importance the following "charms" are "members" of the society and are called *Ho-tci-ne' ga-dah,* Invisible aids.

1 Jo-gä′-o^{n}=pygmies
2 Jo-di′′-gwa-do′′=great horned serpent
3 Shon-do-wĕk-o-wä=blue panther
4 De-wŭt-yo-wa-is= "explosive bird, like wren, explodes from hollow in tree." (Mythical)

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[1] Bulletin in preparation.

Others of equal rank are:

5 Diat-da-gwŭt=white beaver
6 Oh-no-wa-ot-gont or Ga-ne′-ont-twŭt=corn bug
7 Ot-nä-yont=sharp legs animal, a mythical monster
8 O′-niä-ta=small dry hand
9 Da-gwŭn-no-yä-ent=wind spirit
10 Nia′′-gwa-he=naked bear

The "charms" of these Ho-tci-no-gä kept by members are as follows: None of no. 1 or 2 "Because they are sacred and use their minds for a charm."

3 Panther's claw
4 Feathers
5 Beaver's (white) castor
6 Bone of sharp legs
7 Corn bug, itself
8 Dry hand
9 Hair of wind spirit
10 Nia′′-gwa-hē's bones.

A translation of the opening ceremony of this society is here given:

YOT-DON-DAK-KOH

Opening ceremony of the Pygmy Society

We now commence to thank our Creator.
Now we are thankful that we who have assembled here are well.
We are thankful to the Creator for the world and all that is upon it for our benefit.
We thank the sun and the moon.
We thank the Creator that so far tonight we are all well.
Now I announce that *A. B.* is to be treated.
Now this one *C. D.* will throw tobacco in the fire.
Now these will lead the singing, *E.* and *F.*
So I have said.

The "tobacco thrower" advances to the fire and seating himself takes a basket of Indian tobacco and speaks as follows:

Now the smoke rises!
Receive you this incense!
You who run in the darkness.
You know that this one has thought of you
And throws this tobacco for you.
Now you are able to cause sickness.
Now when first you knew that men beings were on earth you said
"They are our grandchildren."
You promised to be one of the forces for men being's help
For thereby you would receive offerings of tobacco.

So now you get tobacco, you, the pygmies. (Sprinkles tobacco on the fire.)

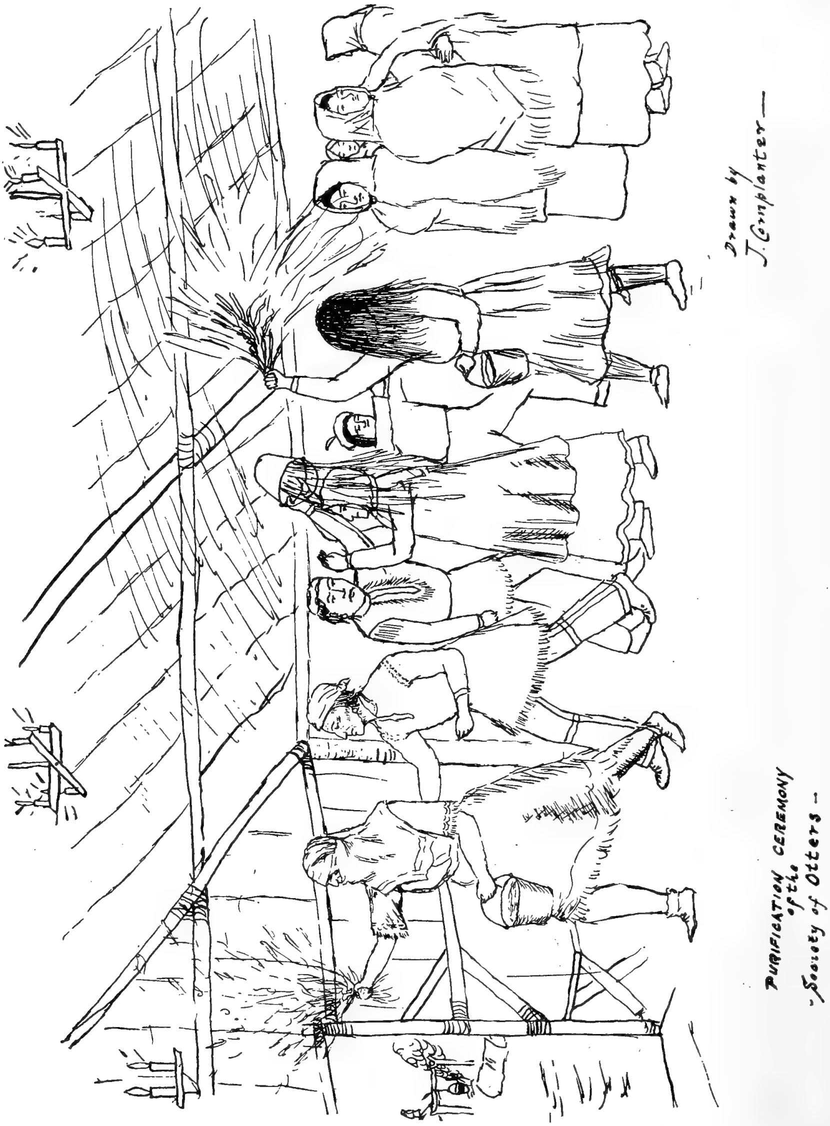
Now is the time when you have come,
You and the members have assembled here tonight.
Now again you receive tobacco, you, the pygmies. (Throws tobacco.)
You are the wanderers of the mountain,
You have promised to hear us whenever the drum sounds,
Even as far away as a seven days' journey.
Now all of you receive tobacco. (Throws tobacco.)
You well know the members of this society,
So let this cease. (The maliferous influence causing sickness).
You are the cause of a person, a member, becoming ill.
Henceforth give good fortune for she (or he) has fulfilled her duty and given you tobacco.
You love tobacco and we remember it,
So also you should remember us.
Now the drum receives tobacco,
And the rattle also.
It is our belief that we have said all
So now we hope that you will help us.
Now these are the words spoken before you all,
You who are gathered here tonight.
So now it is done.

Dâ-wän'-don, or Otter Society

1 The Society of Otters, *Dâwändon*, is a band of people organized to propitiate the otters and other water animals who are supposed to exercise an influence over the health, fortunes and destinies of men. The otter, who is the chief of the small water animals, including the fish, is a powerful medicine animal and besides having his own special society is a member of the *Iē'-dos* and the *Hono'tcino''gä.*

2 The Otters may appear at any public thanksgiving, as the Green Corn dance and the Midwinter thanksgiving. After a tobacco throwing ceremony, *hayänt'wŭtgŭs*, the three women officers of the *Dâwändon* each dip a bucket of the medicine water from the spring or stream, dipping down with the current, and carry it to the council house where they sprinkle every one whom they meet by dipping long wisps of corn husk in the water and shaking them at the people. If the women succeed in entering the council house and sprinkling every one without hindrance they will go for more water and continue until stopped. The only way in which they may be forced to discontinue their sprinkling is for some one, just before she sprinkles him, to snatch the pail and throw the entire contents over her head. The Otter woman will then say, "*Hât'ĕ-gäii, niä-weh!*" meaning, "Enough, I thank you." She will then retire.

3 The Otters are specially active during the midwinter ceremony and when the water is thrown over their heads it very often freezes, but this is only something to be enjoyed. The women when pos-



Purification ceremony of the Society of Otters, a Seneca women's winter ceremony

sessed with the spirit of the otter are said to be unaware of their actions and sometimes when they are particularly zealous the whistle of the otter is heard. This greatly frightens the people who regard it as a manifestation of the presence of the "great medicine otter." The women afterward deny having imitated the otter's call saying that they were possessed with the otter and have no knowledge of what they did.

4 The Otter Society has no songs and no dances. They are simply organized to give thanks to the water animals and retain their favor. When some one is ungrateful to the water animals, as a wasteful fisherman or a hunter who kills muskrats or beaver without asking permission or offering tobacco to their spirits, they become strangely sick, so it is believed. The otters then go to a spring and hold a ceremony after which they enter the sick man's lodge and sprinkle him with the spring water hoping thereby to cure him.

Opening or tobacco throwing ceremony of the False Face Company

Now receive you this tobacco, you, *Shagodowegowa,* the great false face,

Now it is that you have come to where your grandchildren are gathered.

Now you are taking the place of the great false faces who are wandering in the rocky valleys and mountains.

Now you are the ones who think much of this sacred tobacco.

Now we wish to make a request of you. So we always offer this sacred tobacco, (literally, real tobacco), when we ask anything of you.

We pray that you help us with your power.

You can go over all the earth.

In the center of the earth is a great pine tree and that is the place of your resting. It is there that you rub your rattle when you come to rest.

Now then this tree receives this tobacco.

We ask that you watch over us and exercise your power to protect us from anything harmful.

We hold in mind that you have ever done your duty in past times and we ask that you continue (vigilant) henceforth.

We use this tobacco when we ask favors of you for you are very fond of this tobacco.

Now your cane gets tobacco. The great pine tree to its top is your cane.

Now you, the husk faces, you get tobacco also.

You have been associated with the false faces in times past. Now you receive tobacco for you have done your duty.

So it is finished.

VIII

THE PROTECTION OF NATURAL MONUMENTS

In the hope of stimulating among intellectual centers a proper regard for the unique or exceptional work of nature, the accompanying circular was generally distributed early in the year to local scientific and patriotic societies and to private individuals. Its purport was directed less to the regard of the greater scenic effects of the State than to the minor phenomena which often constitute a special local attraction and have a genuine scientific or historic merit which ought to commend them to protection. Such lesser objects are easily overridden and effaced with the advance of settlement and industrial development. A proper sentiment, well aroused, will prevent their destruction and leave to posterity something better than regrets for their disappearance. It has seemed proper for this department to take the initiative in this matter even though it may not be practicable to press the movement by substantial assistance.

THE PROTECTION OF NATURAL MONUMENTS

It might seem unpatriotic to say that they do some things in the old country better than we do. They certainly do good things which in our busy community life we have not yet got around to. One of these is the local protection of places and objects of particular *natural* interest. We have done well in the conservation of historic spots, and the State of New York is most creditably dotted over with monuments commemorating great events, and with small reservations where large deeds have been done. Few communities are without some memorial permanently marking the telling facts of their history, and fortunate indeed is the town that has an organized spirit for such efforts; twice blest in a man or a few men willing upon their own initiative to make such a spirit bear fruit.

The conservation of especially interesting *natural objects* comes somewhat late in the development of the sentiment of a community, with the increase in the appreciation of nature's works. There are lovers of birds who see with profound regret the disappearance of certain of their friends once common in the region, but gradually driven away by the encroachments of commerce upon their nesting places. There are lovers of plants who know the few remaining spots where rare flowers bloom or rare ferns may be found. What comparison does a loyal citizen make between a noble tree which has seen the centuries roll by, which has stood sentinel over the community since the cradle days of the settlement, and the light or telephone company which lops off one of its branches to let a wire go through or thrusts an ugly pole into its boughs? A wooden telephone pole with its crosstrees is today in our cities and villages the cross on which every sentiment of good and decent taste is crucified. There are persons in most every community who can be better spared than some of its venerable trees. It is not only the age of a tree that entitles it to guardianship; there are some which have especial associations with distinguished personages of the past, others may be the last survivors of a race which once abounded but whose companions have disappeared under the woodsman's axe. A great glacial rock boulder projecting alone from some meadow or hillside, tells a romantic age long story which should not be menaced by the workman's sledge. There are bits of swamp still profuse in rare orchids, and clumps of woodland where the rare birds still nest but which will soon be robbed of their possessions if measures are not taken for their protection.

Let us cite, for an example, the *Bergen swamp* in Genesee county, famous among botanists as a spot where still linger the Painted trillium, yellow Clintonia, the twin flower or Linnaea and rare orchids such as the White cypripedium and numerous northern plants which, scarce or wanting in all other localities of western New York, thrive in the cool recesses of this spot or on its open bogs among the Cranberries, Huntsman's cup and Andromedas. Here northern birds, the Hermit thrush, Winter wren and Canadian warbler find their breeding place. Here are the coverts of the Grouse, Woodcock and other game birds and a center of their dispersal. The indwellers in this place are threatened by the incursions of commerce, of ruthless sport, of agricultural aggression, but this swamp if protected would not alone continue to play its part in regulating the flow of the river which runs out of it into the Genesee, but afford a reserve for its rare flowers and birds and form a charming bit of the North Woods — a boreal island — in western New York, with the towns of Rochester, Batavia, Buffalo, Tonawanda, Lockport, Medina and Albion within easy reach of its attractions.

In Germany, substantial progress has been made in protecting such objects of natural interest. The methods employed and the results achieved are interesting. An old fir tree gnarled with years in the forest of Lueneburg is set apart and protected for its very age and fascinating ugliness. A little patch of dwarf birch, a rare survivor of the postglacial flora, is preserved and protected in the vicinity of Hamburg. A considerable area of forest near Muenster is protected because of its profusion in certain rare species of lichens. In Schleswig a great glacial boulder resting on a low knoll has been set aside, the ground immediately about it acquired and a road laid out to it. In Brandenburg a little lake with its swamp, the Plage, has been reserved on account of its botanic interest and in Marienwerder a bit of lake and woods where rare water birds nest. A local society in Gotha has acquired a small pond and swamp and has transferred to it rare plants threatened with extinction and has also introduced new plants foreign to the region, such as our common Sarracenia or Pitcher-plant.

Such results as these have been attained very largely through the activity of local societies and are the outcome of local pride and intelligent appreciation. Prussia, however, has an official, duly appointed by the Cultus Minister as State Commissioner for the Preservation of Natural Memorials, and through his activity, aided by the official forestry organization, much is possible which would be more difficult here without such aid. The State of New York may some time in the not too distant future have such an agency to bring about these desirable ends, but even without it much can be done now by local societies and zealous individual effort. The State has seen its duty to acquire and preserve a beautiful but expensive spot in Watkins glen; it ought to see its way to conserve that still more marvelous work of nature, the Ausable chasm, but the preservation of the lesser objects should fall to the proper pride of the localities where they are situated.

No part of this large State is without such objects appealing to the thoughtful citizen for protection — the rock bridge over the Perch river near Watertown; the unique burless chestnut near Freehold; the immense Arbor vitae on the outlet of Lake Colden; the extinct volcano near Schuylerville, once a redoubt during the Champlain wars of the Revolution; the Diamond Rock at Lansingburg with its beautiful Indian legend — each community knows best its own natural monuments.

We desire to bring these considerations to the notice of local scientific and civic organizations. The members of such societies are always open to appeals to civic pride; many of them are lovers and appreciative students of nature who must see with increasing regret the gradual disappearance of, or injury to, such objects of natural interest.

It is respectfully requested that this circular be laid before your society. It is hoped that its members may see the propriety of appointing a standing committee to inquire into the possibility of local protection. It is not too soon. The opportunity once gone, it is forever too late. The damage once done can never be repaired. Local loyalty based upon intelligent appreciation is a first essential to success; the next, sympathetic interest on the part of the legal owner of such objects. With the first assured, the second is not difficult to secure. It will not cost much to put a protecting fence about a rare or venerable tree or authoritative notices of warning about and within reservations of field and woodland, glen or swamp, worthy of conservation for their natural interest. It is worth while doing this; lovers of nature and the out of doors, students of science everywhere, intelligent members of every community in this and following generations will rejoice that you have done these things.

The Science Division of the Education Department desires to be helpful in such undertakings as are here outlined. It seeks to encourage them and will do so with all the means at its disposal and all the influence it possesses. It asks to be kept informed in regard to efforts of this kind and the specific objects toward which they are directed. It wishes to be in a position to compile a list of the natural monuments which are or should be protected and to issue information in regard to efforts made toward their protection for the information and encouragement of the general public.

JOHN M. CLARKE
June 1908 *Director*

IX

PUBLICATIONS

A list of the scientific publications issued during the year 1907–8 with those now in press and treatises ready for printing is attached hereto. The publications issued are 21 in number on a variety of topics covering the whole range of our scientific activities. They embrace 2378 pages of text, 288 plates and 20 maps.

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 Fourth Report of the Director, State Geologist and Paleontologist for the fiscal year ending September 30, 1907. 212p. 56pl.

Contents:

Memoirs

2 No. 9 pt 1 Early Devonic of New York and Eastern North America. By John M. Clarke. 366p. 70pl. 5 maps.

Contents:

3 No. 11 Graptolites of New York. Part 2, Graptolites of the Higher Beds. By R. Ruedemann. 584p. 2 tab. 31pl.

Contents:

Bulletins

Geology

4 No. 119 Geology of the Adirondack Magnetic Iron Ores. By D. H. Newland. With a report on the Mineville-Port Henry Mine Group. By J. F. Kemp. 184p. 14pl. 8 maps.

Contents:

5 No. 120 Mining and Quarry Industry of New York. 4th report. By D. H. Newland. 82p.

Contents:

6 No. 123 Iron Ores of the Clinton Formation in New York State. By D. H. Newland and C. A. Hartnagel. 76p. 14pl. 3 maps.

Contents:

Paleontology

7 No. 118 Geologic Map and Descriptions of the Portage and Nunda Quadrangles including a map of Letchworth Park. By John M. Clarke & D. D. Luther. 52p. 16pl. 4 maps.

Contents:

Entomology

8 No. 124 Report of the State Entomologist for the fiscal year ending September 30, 1907. 542p. 44pl.

Contents:

Botany

9 No. 122 Report of the State Botanist for the fiscal year ending September 30, 1907. 178p. 5pl.

Contents:

Archeology

10 No. 117 An Erie Indian Village and Burial Site. By A. C. Parker. 102p. 38pl.

Contents:

Geological maps

11 Nunda-Portage Quadrangles

IN PRESS

Memoirs

12 Early Devonic of New York and Eastern North America. Part 2

13 Birds of New York

Bulletins

Geology

14 Later Glacial Waters in Central New York

15 Geneva-Ovid Quadrangles

16 Remsen Quadrangle

Zoology

17 Osteology of Birds

Entomology

18 Report of the State Entomologist for the fiscal year ending September 30, 1908

Archeology

19 Myths and Legends of the New York State Iroquois

X

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. M.A., *Assistant in Geology*
Henry Leighton, *Assistant in Economic Geology*
D. Dana Luther, *Field Geologist*

Herbert P. Whitlock C.E., *Mineralogist*
George S. Barkentin, *Draftsman*
Joseph Morje, *First clerk*
H. C. Wardell, *Preparator*
Paul E. Reynolds, *Stenographer*
C. J. Robinson, *Clerk*
Martin Sheehy, *Machinist*

Temporary assistants

Precambric geology

Prof. H. P. Cushing, Adelbert College
Prof. J. F. Kemp, Columbia University
Dr C. P. Berkey, Columbia University
Prof. C. H. Smyth jr, Princeton University
Prof. C. E. Gordon, Massachusetts Agricultural College

Stratigraphic geology

G. H. Hudson, Plattsburg State Normal School
Prof. W. J. Miller, Hamilton College

Geographic geology

Prof. Herman L. Fairchild, Rochester University

Paleontology

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

Ephraim P. Felt, B.S. D.Sc., *State Entomologist*
D. B. Young, *Assistant State Entomologist*
Fanny T. Hartman, *Assistant*
Anna M. Tolhurst, *Stenographer*
J. Shafer Bartlett, *Page*

ZOOLOGY

Frank H. Ward, *Zoologist*
Alfred J. Klein, *Taxidermist*

Temporary assistants

E. Howard Eaton, Canandaigua
Dr E. J. Letson, Buffalo

ARCHEOLOGY

Arthur C. Parker, *Archeologist*

XI

ACCESSIONS

ECONOMIC GEOLOGY

Donation

Dannemora Granite Co. Dannemora. Granite, polished (Keystone), Dannemora	1
Juvet, L. V. Glens Falls. Marble, polished, Buck Mountain, Lake George	1
Ross, James. Linlithgo. Manganese ores from McCormick, S. C.	17
Total	19

PALEONTOLOGY

Donation

Clarke, John M. Series of Chemung fossils from Warren, Pa. Collected by F. A. Randall	31
Cambric fossils from Province of Estland, Russia. Collected by A. Mickwitz	25
Gillard, John. Stafford. Fossils from Stafford limestone	350
Fossil fish from Onondaga limestone	5
His excellency Governor and Mrs Allardyce, Falklands Islands. Eodevonic fossils from Falkland Islands	20
Hamling, J. E. Barnstaple, Eng. Devonic fossils:	
Spirifer disjunctus	4
S. laevicostus	1
S. hystericus	1
Phacops latifrons	1
Petraia	1
Cucullaea hardingii	1
Cyathophyllum caespitum	2
Pleurodictyum problematicum	1
Hudson, *Prof.* **G. H.** Fossils from the Chazy limestone, Valcour Island	17
Katzer, *Dr* **Friedrich.** Types of Devonic Fossils, "Grundzüge der Geologie des unteren Amazonasgebietes" 1903, pl. XII, fig. 3 A, 3 B	2

Also 5 fossils and 2 plaster casts from Middle Devonic, Ererè, Brazil 7

Mattimore, H. S. Trilobites from near Schoharie 2

Barnard, A. W. Ridgewood, N. J. Coral (Favosites), Indian Ladder, Albany co 1

Kelley, F. W. Albany. Coral (Favosites), Howes Cave, Schoharie co 1

von Koenen, *Prof. Dr* **A.** Göttingen, Germany. Upper Devonic fossils from the Enkeberg, Westphalia:

Aganides lentiformis *Sandberger* 2
A. sulcatus *Münster* 1
Cheiloceras enkebergense *Wedekind* 1
C. verneuilli *Münster* 1
Clymenia angustiseptata *Münster* 1
C. dunkeri *Münster* 1
C. enkebergensis *Wedekind* 2
C. frechi *Wedekind* 2
C. hexagona *Wedekind* 1
C. involuta *Wedekind* 2
C. lotzei *Wedekind* 1
C. pompeckji *Wedekind* 1
C. roemeri *Wedekind* 1
C. sandbergeri *Wedekind* 1
C. striata *Münster* 1
C. subflexuosa *Münster* 1
Dimeroceras bergense *Wedekind* 1
D. gümbeli *Wedekind* 1
D. padbergense *Wedekind* 1
Praeglyphioceras pseudosphaericum *Frech* 2
Prolobites delphinus *Sandberger* 2
P. delphinus *var.* atava *Frech* 1
P. delphinus *var.* ellipticus *Wedekind* 1
Sporadoceras angustisellatum *Wedekind* 1
Sporadoceras clarkei *Wedekind* 1
S. contiguum *Münster* 2
S. discoidalis *Wedekind* 1
S. münsteri *von Buch* 1
S. rotundum *Wedekind* 1
Tornoceras planidorsatum *Münster* 2
T. sandbergeri *var.* dillensis *Drev* 1
T. rotundodorsatum *Wedekind* 1

Mesozoic fossils:

Coelodus mantelli *Ag* 1
Mesodon 1
Lexicodon zugleri *Meyer* 1
Stephanoceras trijungeus *Münster* 1
Ancycloceras crassum *von Koenen* 3

Exchange

Emerson, *Prof.* **B. K.** Amherst, Mass. Fossils from Turkish Empire. 62

Purchase

Arey, A. L. Types used in New York State Museum memoir 5 Guelph Formation and Fauna of New York State 1903 93
Guelph fossils from vicinity of Rochester 150
Bishop, I. P. Eurypterids from Buffalo quarries 2
Kazenstein, *Mrs* **Fannie.** Fossil plant from near Hancock, Delaware co. 1
Krantz, *Dr* **F.** Bonn, Germany. European trilobites 6
Ward's Natural Science Establishment, Rochester. Development series of Sao hirsuta Bar 20

Collection

Braun, Frederick. Fossils from Onondaga limestone vicinity of Leroy and Caledonia 144
Eurypterids from Herkimer co 800
Clarke, J. M. Fossils from Gaspé county, Canada .... bbls 51
Hudson, *Prof.* **G. H.** Chazy fossils from Valcour Island 4
Types used in paper by G. H. Hudson "On some Pelmatozoa from the Chazy limestone of New York" New York State Museum bulletin 107. 1907 19
Luther, D. D. Starfishes and crinoids from near Naples 74
Loose slabs (sponges) from Italy Hollow gully, Yates co 7
Fish, Paropsonema etc., from near Naples 15
Hamilton fossils from near Darien 5
Eurypterids from Morganville 4
Luther, D. D. *&* **Braun, Frederick.** Starfishes and crinoids from Italy Hollow gully near Naples 75
Ruedemann, R. Fossils from Trenton limestone near Crown Point. 5
Large Lowville slabs with Tetradium from Chaumont 6
Fossils from Lowville, Black River and Pamelia limestone collected during mapping of Clayton topographic sheet 100
Van Deloo, Jacob. Chazy fossils from Keeseville 50
Fossils from Potsdam sandstone, Ausable Chasm 3
Wardell, H. C. Eurypterids from Shawangunk grit, Otisville 24
Oriskany and Schoharie grit fossils from Erie railroad cut near Highland Mills 35
Oriskany fossils from Glenerie 400
Eurypterids from roadway near Ray Ball's house 3 miles north of Cedarville, Herkimer co 35
Hamilton fossils from near Mt Marion station, Ulster co 15

Total 26744

MINERALOGY

Donation

Cameron, T. Pyrite, Hermon 38
Stafford, M. A. Pittsfield, Mass. Rutile in quartz. Mt Holyoke, Mass. 5

Bender, R. W. Hudson. Gypsum crystals, Hudson	35
Hearn, J. A. Burwell, Ga. Halloysite, Burwell, Ga	4
Hindshaw, H. H. New York	
Magnesite, Marquenta, Venezuela	1
Orthoclase, Owl's Head	2
Fluorite, Chalcopyrite and quartz, Benson Mines	1
Hartnagel, C. A. Albany. Corundum	1
Chadwick, G. H. Canton	
Calcite, Schenectady	5
Calcite, Catskill	6

Purchase

Nims, A. F. Philadelphia	
Apatite (large), Burgess, Can	3
Apatite (crystals), Burgess, Can	80
Muscovite, Lena River, Can	1
Titanite, Grattan, Can	479
Titanite and pyroxene, Grattan, Can	3
Pyroxene, Grattan, Can	531
Orthoclase and pyroxene, Grattan, Can	27
Orthoclase and titanite, Grattan, Can	1
Pyroxene and wernerite, Grattan, Can	2
Quartz (amethyst), Nova Scotia, Can	5
Analcite and natrolite, Nova Scotia, Can	1
Apophyllite, Nova Scotia, Can	17
Quartz (flint nodule), Dover, Eng	1
Barite and siderite, Weardale, Eng	1
Tetrahedrite, Clausthal, Ger	1
Garnet, Fort Wrangel, Alas	7
Quartz (geodes), Iowa	10
Cyanite, Tyrringham, Mass	5
Diaspore, Chester, Mass	2
Rutile, Magnet Cove, Ark	3
Chromite, Lancaster co., Pa	9
Wavellite, York co., Pa	2
Chromite in serpentine, Hoboken, N. J	1
Mesolite (harringtonite), Weehawken, N. J	1
Apophyllite and calcite, Bergen Hill, N. J	2
Datolite, Bergen Hill, N. J	2
Vanuxemite, Franklin, N. J	1
Crocidolite, Cumberland, R. I	1
Margarite, Trumbull, Conn	1
Lazulite, Lincoln co., N. C	1
Brochantite, Utah	1
Wulfenite, Utah	1
Borax, Clear Lake, Col	1
Orthoclase, Hammond	15
Orthoclase and pyroxene, Hammond	7
Orthoclase and amphibole, Hammond	2

Orthoclase and titanite, Hammond	2
Orthoclase and wernerite, St Lawrence co	1
Microcline (large), Pitcairn	5
Microcline, Pitcairn	156
Microcline and pyroxene, Pitcairn	18
Microcline and amphibole, Pitcairn	8
Microcline and muscovite, Pitcairn	2
Microcline and titanite, Pitcairn	1
Oligoclase, Fine	311
Oligoclase (moonstone), Fine	39
Pyroxene and wernerite, Yellow Lake	1
Pyroxene (diopside) De Kalb	57
Pyroxene and microcline, Pitcairn	7
Pyroxene and wernerite, St Lawrence co	1
Pyroxene (malacolite), Richville	2
Pyroxene, Gouverneur	6
Pyroxene, Pitcairn	86
Pyroxene (crystals), Pitcairn	325
Pyroxene, St Lawrence co	201
Amphibole, Edwards	8
Amphibole (tremolite), Edwards	1
Amphibole (hexagonite), Edwards	53
Amphibole (tremolite), Gouverneur	249
Chalcopyrite and pyrite in quartz, Fowler	2
Sphalerite and galena, Rossie	1
Sphalerite and fluorite, Macomb	1
Pyrite and sphalerite, Hermon	9
Pyrite, Hermon	box, 1
Pyrite (in matrix), Hermon	26
Pyrite (crystals), Hermon	24
Pyrite and amphibole, Hermon	1
Fluorite, Macomb	453
Quartz, Natural Bridge	63
Quartz, Fowler	12
Quartz (pseudomorphs), St Lawrence co	85
Quartz and hematite, Fowler	4
Quartz, dolomite and prochlorite, Antwerp	1
Quartz and hematite, Antwerp	2
Limonite on hematite, St Lawrence co	1
Goethite on dolomite, Antwerp	1
Calcite, Rossie	1
Calcite (cleavage), Rossie	7
Calcite, St Lawrence co	2
Calcite, Natural Bridge	173
Calcite and fluorite, St Lawrence co	15
Calcite (cleavages), Diana	42
Pyrolusite and quartz, St Lawrence co	1
Spinel in serpentine and limestone, Sommerville	5
Amphibole and magnetite, Edwards	3
Amphibole, St Lawrence co	26

Amphibole (pargasite), Rossie		3
Wernerite and pyroxene (large), Pierrepont		1
Wernerite, Pierrepont		30
Wernerite and pyroxene, Pierrepont		4
Wernerite, Rossie		1
Wernerite, Yellow Lake		4
Wollastonite, Natural Bridge		2
Tourmalin and pyroxene, Pierrepont		1
Tourmalin in quartz, Pierrepont		1
Tourmalin, Pierrepont		245
Tourmalin, Gouverneur		339
Tourmalin, Edwards		23
Phlogopite, Edwards		15
Talc, Edwards		19
Danburite (large), Russell		7
Danburite, Russell		218
Biotite, Natural Bridge		1
Talc (pseudomorph after amphibole), St Lawrence co		1
Serpentine (pseudomorph after pyroxene), Gouverneur		11
Serpentine, Edwards		19
Titanite, Natural Bridge		289
Apatite, St Lawrence co		1
Apatite, Gouverneur		1
Barite, hematite and quartz, Fowler		1
Barite, siderite and hematite, Sommerville		1
Barite, Rossie		8
Barite, Richville		7
Chabazite,	Loc. ?	2
Muscovite	"	1
Garnet in epidote	"	1
Garnet in quartz	"	1
Epidote in quartz	"	2
Vesuvianite	"	1
Aragonite	"	1
Psilomelane	"	1
Garnet in mica schist	"	20
Barite	"	2
Opal (hyalite)	"	1

Mitchell, C. De Kalb

Diopside (crystals) De Kalb	6
Tourmalin, De Kalb	4

Hodge, *Capt.* **R. S.** Antwerp

Calcite, Antwerp	10
Calcite, Sommerville	8
Chalcopyrite, Sommerville	11
Pyrite, Sommerville	10

Vrooman, Howard, Albany. Quartz (crystals), Castleton 34

Collection

Assistant State Geologist. Diopside, De Kalb	19
Mineralogist. Quartz, Whitehall	5
Calcite, West Camp	17
Calcite, South Bethlehem	26
Wardell, H. C.	
Sulphur and gypsum on limestone, Lime Rock	1
Calcite on limestone, Hudson	1
Total	5266

BOTANY

Plants added to the herbarium

New to the herbarium

Aecidium importatum *Henn.*
Amanita glabriceps *Pk.*
A. porphyria *Fr.*
Aster vittatus *Bu.*
Botrytis plebeja *Fres.*
Brassica japonica *Sieb.*
Calicium alboatrum *Floerk.*
Celtis crassifolia *Lam.*
Cephalozia lunulaefolia *Dum.*
Cercospora rudbeckiae *Pk.*
Clitocybe comitialis *Pers.*
Collybia hirticeps *Pk.*
Cololejeunea biddlecomiae (*Aust.*)
Commelina communis *L.*
Crataegus admiranda *S.*
C. barbara *S.*
C. bella *S.*
C. boothiana *S.*
C. brachyloba *S.*
C. celsa *S.*
C. cerasina *S.*
C. clintoniana *S.*
C. conferta *S.*
C. congestiflora *S.*
C. cruda *S.*
C. dayana *S.*
C. finitima *S.*
C. foliata *S.*
C. gloriosa *S.*
C. gracilis *S.*
C. implicata *S.*
C. limosa *S.*
C. luminosa *S.*
C. notabilis *S.*
C. oblita *S.*
C. placiva *S.*
C. promissa *S.*
C. pulchra *S.*
C. radiata *S.*
C. robusta *S.*
C. slavini *S.*
C. strigosa *S.*
C. tortuosa *S.*
C. xanthophylla *S.*
Dacryomyces corticioides *E. & E.*
Diaporthe atropuncta *Pk.*
Diplodina robiniae *Pk.*
Fusarium aurantiacum *Cd.*
Geoglossum alveolatum *Durand*
Gloeosporium medicaginis *E. & K.*
Gonatobotrys lateritia *Pk.*
Hygrophorus sphaerosporus *Pk.*
Hymenula musae *Pat.*
Hypholoma fragile *Pk.*
Lactarius peckii *Burl.*
Lecanora fuscata (*Schrad.*) *Th. Fr.*
Leptosphaeria inquinans *Pk.*
Leucolejeunea clypeata (*Schw.*)
Lophocolea macouni *Aust.*
L. minor *Nees*
Massariovalsa sudans (*B. & C.*) *Sacc.*
Melaconis modonia *Tul.*
Mnium orthorrhynchium *B. & S.*
Myxosporium castaneum *Pk.*
Nardia crenuliformis (*Aust.*) *Lindb.*
Nectria sambuci *E. & E.*
Neottiella polytrichi (*Schum.*) *Mass.*
Pellia endiviaefolia (*Dicks.*) *Dum.*
Phoma corni *Fckl.*

P. lagenariae (*Thuem.*) *Sacc.*
Phyllosticta orbicula *E. & E.*
Polyporus arcularis (*Batsch*) *Fr.*
P. delectans *Pk.*
P. trabeus *Rostk.*
Puccinia agrostidis *Plow.*
P. albiperidia *Arth.*
P. campanulae *Carm.*
P. phlei-pratensis *E. & H.*
Pucciniastrum potentillae *Kom.*
Rhinotrichum curtisii *Berk.*
Solanum rostratum *Dunal*
Sorosporium saponariae *Rud.*
Sphenolobus hellerianus (*Nees*)
Sporodesmium pluriseptatum (*K. & H.*)
Tricholoma subcinereum *Pk.*
Trichothecium candidum *Wallr.*
Uromyces caricinus *E. & E.*
U. scirpi (*Cast.*) *Burr.*
Volutella cucurbitina *Pk.*

ENTOMOLOGY

Donation

Hymenoptera

Hough, R. B. Lowville. Amphibolips prunus Walsh, oak plum gall, Sept., from Michigan

Harrington, Daniel. Cambridge. Trichiocampus viminalis Fallen, poplar sawfly larvae, Aug. 21

Woodford, L. L. Pompey. Kaliosysphinga ulmi Sund., leaf miner on elm, June 16

Von Schrenk, Hermann. St Louis, Mo. Urocerus edwardsii Brulle, Jan. 7

Coleoptera

State Agricultural Department. Eccoptogaster rugulosus Ratz., fruit tree bark beetle on pear, following work of Tmetocera ocellana? Sept. 15, from Rochester

Peck, C. H. Albany. Cryptorhynchus lapathi Linn., mottled willow borer, larvae on balm of gilead, Aug. 10, from Corning

Belden, D. B. Fredonia. Tyloderma fragariae Riley, strawberry crown borer, June 11

Newbury, J. G. Coxsackie. Pissodes strobi Peck, white pine weevil, larvae on pine, July 6

Barber, G. H. Westfield. Chelymorpha argus Licht., argus tortoise beetle, larvae on grape, June 25

Milligan, A. E. Schuylerville. Galerucella luteola Müll., elm leaf beetle, larvae and pupae, July 9

Von Steenburgh, J. C. Ballston. Plagionotus speciosus Say, sugar maple borer, adult on maple, June 26

Shanks, *Dr* **S. G.** Albany. Photinus? pyralis Linn., firefly, serial, longitudinal and transverse sections, adult

Diptera

Brakeley, J. T. Hornerstown, N. J. Culex perturbans Walk., all stages, June and July

Clarke, *Miss* **Cora H.** Magnolia, Mass. A number of Cecidomyiid galls

Siphonaptera

Kathan, Dudley R. Schenectady. Pulex irritans Linn., common human flea, adult; Ctenocephalus canis Curt., cat and dog flea, adult, July 24

Lepidoptera

Dutche, M. J. Oakwood Heights, S. I. Basilona imperialis Dru., imperial moth, larva, Sept. 3

Kelly, *Dr* A. B. Albany. Larva of the preceding on maple, Aug. 12

Thompson, J. A. Rochester. Hyphantria textor Harr., fall web worm, larvae on apple, July 7

Otterson, H. N. Bolton, Mass. Halisidota caryae Harr., hickory tussock moth, larvae, July 8

Thornton, Irving T. Orchard Park. Larvae of the preceding, July 6

Graves, George S. Newport. Tolype velleda Stoll., lappet moth, larva, July 22

Mair, A. Oakdale, L. I. Alsophila pometaria Harr., fall canker worm, young, June 5

Reel, C. Gordon. Kingston. Ennomos subsignarius Hübn., snow-white linden moth, adult, July 23, through Forest, Fish and Game Com'n

Ensign, W. O. Livingston Manor. Pupae of the preceding on oak, July 3

Covert, H. W. Waterford. Ania limbata Haw., filament bearer or horned spanworm, larva, June 6

Englehardt, G. P. Brooklyn. Memythrus tricinctus Harr., M. polistiformis Harr., M. simulans Grote, M. asilipennis Boisd., M. dolii Neum., Aegeria apiformis Clerck, Sesia bassiformis Walk., S. albicornis Hy. Edw., S. corni Hy. Edw., S. pyri Harr., S. scitula Harr., S. rubristigma Kellicott, and S. pyralidiformis Walk. Apr. 30

Niles, T. F. State Department of Agriculture. Thyridopteryx ephemeraeformis Haw., bag worm, larvae on red cedar, July 7, from Germantown, N. Y.

Holmes, F. B. Albany. Sitotroga crealella Oliv., adult in popcorn, Aug. 14

Thompson, J. A. Rochester. Tischeria malifoliella Clem., apple leaf miner, larvae on apple, July 7

Odonata

Goldring, Winifred. Slingerland. Hetaerina americana Fabr., adult, Aug. 26

Hemiptera

American Nursery Co. New York city. Phylloxera caryaecaulis Fitch, hickory gall aphid, adults and young on hickory, June 8

Munson-Whitaker Co. New York city. Gall of preceding on hickory, Sept. 1

Woodford, L. L. Pompey. Colopha ulmicola Fitch, cockscomb elm gall, June 18

Thornton, Irving T. Orchard Park. Young of preceding on elm, July 6

Freeman, *Mrs* **George H.** Loudonville. Pemphigus acerifolii Riley, on maple, Sept. 19

Downing, George S. Albany. Pemphigus tessellata Fitch, nymphs on alder, Aug. 24

Herliky, John. Brooklyn. Chermes abietis Linn., spruce gall aphid, young on Norway spruce, June 22

Terry, Seth Sprague. Elizabethtown. Galls of preceding, July 30

Laney, C. C. Rochester. Galls of preceding on spruce, Aug. 10

Nill, John. Star Lake. Dead adults of preceding on spruce, Aug. 31

Kenney, W. E. Brooklyn. Aspidiotus perniciosus Comst., San José scale, adult on hornbeam, Oct. 13

Aspinwall, J. Newburgh. Eulecanium tulipiferae Cook, tulip tree scale, young on tulip tree, Apr. 6

Brignall, E. S. Schenectady. Pulvinaria innumerabilis Rathv., cottony maple scale, adults on elm, June 2

Niles, *Mrs* **Stephen.** Coeymans. Same as preceding, on maple, June 12

Concklin, E. R. Pomona. Adults of preceding on maple, June 24

Downer, Frank H. New Rochelle. Phenacoccus acericola King, false maple scale, young on maple, Oct. 12

Beakley, G. F. Johnstown. Same as preceding, May 29

Huested, S. B. Blauvelt. Adult of preceding on maple, July 29

Brignall, E. S. Schenectady. Gossyparia spuria Mod., elm bark louse, adults on elm, June 2

Kenney, W. E. Brooklyn. Same as preceding, Aug. 3

Mains, *Mrs* **W. C.** Mt Vernon. Young of preceding on elm, Sept. 16

Menand, L. Albany. Icerya purchasi Mask., cottony cushion scale, on acacia, Feb. 25

Orthoptera

Lansing, *Mrs* **Abraham.** Albany. Panchlora hyalina Stoll., on book, Mar. 6

Gillett, J. R. Albany. Same as preceding, on apples, Mar. 26

Isoptera

Mare Co., A. T. De La. New York city. Termes flavipes Koll., white ant, adult, Feb. 3

Exchange

Diptera

CULICIDAE

Banks, C. S. Government Entomologist, Manila, P. I. Myzomyia ludlowii Theob., M. mangyana Banks, Myzorhynchus barbirostris V. d. W., M. vanus Walk., Stegomyia aurostriata Banks, S. persistans Banks, S. samarensis Ludl., Worcesteria grata Banks, Helecoetomyia pseudotaeniata Giles, Leucomyia cuneatus Theob., Culex fatigans Wied., C. microannulatus Theob., Mansonia uniformis Theob., Banksinella luteolateralis Theob., Finlaya aranetana Banks, F. poicilia Theob., Aedomyia squamipenna Arriz.

DOLICHOPODIDAE

Aldrich, J. M. Moscow, Idaho. Psilopodinus mundus Wied., Agonosoma filipes ? Loew, A. scintillans Loew, Mesorhaga albiciliata Ald., Diaphorus mundus Loew, D. opacus Loew, Asyndetus syntormoides Wheel., Chrysotus barbatus Loew, C. discolor Loew, C. picticornis Loew, Argyra robusta Jno., Leucostola cingulata Loew, Porphyrops effilatus Wheel., Syntormon affine Wheel., Neurigona carbonifer Loew, Medeterus aurivittatus Wheel., Hydrophorus philombrius Wheel., Scellus vigil O. S., Aphrosyllus praedator Wheel., Dolichopus acuminatus Loew, D. albicoxa Ald., D. detersus Loew, D. lobatus Loew, D. ovatus Loew, D. pugil Loew, D. setifer Loew, D. sexarticulatus Loew, D. setosus Loew, Gymnopternus crassicauda Loew, G. debilis Loew, G. frequens Loew, G. phyllophorus Loew, Hercostomus unicolor Loew, Tachytrechus vorax Loew, Pelastoneurus laetus Loew, P. lamellatus Loew, P. neglectus Wheel.

TABANIDAE

Hine, J. S. Columbus, O. Chrysops vittatus Wied., Tabanus fronto O. S., T. tener O. S., T. trispilus Wied.

Purchase

Heidemann, *Mrs* Otto. Washington, D. C.
- Onion fly, Phorbia ceparum Meig., enlarged models representing the egg, maggot, puparium, adult and an infested onion
- Cigar case bearer, Coleophora fletcherella Fern., an enlarged model representing the larva and its operations on an apple leaf

Kny-Scheerer Co. New York city
- Honey bee, Apis mellifica Linn., life history group
- European hornet, Vespa crabro Linn., life history group
- Ground beetle, Calosoma sycophanta Linn., life history group
- Corn stalk fly, Chlorops taeniopus Curtis life history (in alcohol)
- Cabbage butterfly, Pieris rapae Linn., life history group
- 4 insects in amber

ZOOLOGY

Donation

Mammals

Robinson, *Major*. West Point. Cave rat, Neotoma pennsylvanica Stone, skins.......... 2

Richard, William. Cody, Wy. Long-tailed weasel, Putorius longicauda (Bon), skin.......... 1

Birds

Alexander, Charles P. Johnstown

Least flycatcher, Empidonax minimus Baird, eggs 4
Catbird, Dumetella carolinensis (Linn.), eggs 3
Robin, Planesticus migratorius (Linn.), eggs 5
Blue jay, Cyanocitta cristata (Linn.), eggs 5
Hermit thrush, Hylocichla guttata pallasii (Cab.), eggs .. 3
Kingfisher, Ceryle alcyon (Linn.), eggs 5
Brown thrasher, Toxostoma rufum (Linn.), eggs 3
Bluebird, Sialia sialis (Linn.), eggs 4

Ashbury, L. O. Auburn

Blackburnian warbler, Dendroica blackburniae (Gmel.), skin 1
Bay-breasted warbler, Dendroica castanea (Wils.), skin 1
Cerulean warbler, Dendroica cerulea (Wils.), skin 1
American redstart, Setophaga ruticilla (Linn.), skin 1
Scarlet tanager, Piranga erythromelas Vieill., skin 1

Eaton, E. H. Geneva. Sora, Porzana carolina (Linn.), mounted specimen 1

Judd, W. W. Albany

Song sparrow, Melospiza melodia (Wils.), nest and eggs 6
Robin, Planesticus migratorius (Linn.), nest and eggs 3

Klein, A. J. Albany. Red-shouldered hawk, Buteo lineatus (Gmel.), skins juv 3

Ward, *Dr* **S. B.** Albany

Broad-winged hawk, Buteo platypterus (Vieill.), mounted specimens 2
Wilson's snipe, Gallinago delicata (Ord.), mounted specimen 1
Sora, Porzana carolina (Linn.), mounted specimen 1
Pintail, Dafila acuta (Linn.), mounted specimen 1
Loon, Gavia immer (Brünn.), mounted specimen 1

Reptiles and batrachians

Alexander, Charles P. Johnstown

Brown snake, Storeria occipitomaculata (Storer) 1
Red eft, Diemictylus viridescens (Raf.) form miniatus (Raf.) 1
Two-lined salamander, Spelerpes bilineatus (Green) 4
Red-backed salamander, Plethodon cinereus erythronotus (Green) 1
Toad, Bufo lentiginosus (Shaw) juv 1

Haebler, *Dr* **P. B.** Albany. Hog-nosed snake, Heterodon platirhinus (Latreille) (melanistic) 1

Leighton, H. Albany. Ring-necked snake, Diadophis punctatus (Linn.) 1

Lodge, W. L. Albany

Brown snake, Storeria occipitomaculata (Storer) 1
Garter snake, Thamnophis sirtalis (Linn.) 1
Milk snake, Lampropeltis doliata triangula (Boie) 1
Tiger triton, Amblystoma tigrinum (Green) juv 1

Vrooman, I. H. jr. Albany
Dusky salamander, Desmognathus fusca (Raf.)........... 1
Two-lined salamander, Spelerpes bilineatus (Green)....... 3
Red-backed salamander, Plethodon cinereus erythronotus (Green)... 1

Arachnida, Myriapoda and Crustacea

Bean, *Dr* **Tarleton H.** Albany
Crawfish, Cambarus bartoni (Fabr.)......................... 2
Isopod, Mancasellus brachyurus (Haeger)............. 15
Dey Ermand, H. H. Albany. Heteropoda venatoria (Linn.)... 1
Lodge, W. L. Albany
Spider, Lycosa carolinensis Hentz......................... 1
Thousand-legged worm, Spirobolus marginatus (Say)...... 1
Miller, *Miss* **Helen.** Albany
Dolomedes tenebrosus Hentz.............................. 1
Epeira sclopetaria (Clerck)................................ 2
E. insularis Hentz... 3
Vrooman, I. H. jr. Albany
Agelena naevia Bosc.. 2
Epeira displicata Hentz.................................... 1
E. patagiata (Clerck)....................................... 1
Theridium tepidariorum Koch.............................. 1
Ward, *Miss* **Cornelia.** Rochester
Epeira trifolium Hentz...................................... 1
Epeira patagiata (Clerck)................................... 1
Epeira domiciliorum Hentz................................. 1
Prothesima ecclesiastica Hentz............................ 1
Theridium tepidariorum Koch.............................. 1
Pirata insularis Emerton.................................... 1
Zabriskie, J. Z. Brooklyn. Pseudoscorpion, Chelifer muricatus, nest and molted skin.................................. 1

Mollusca

Bean, *Dr* **Tarleton H.** Albany
Physa heterostropha (Say)................................. 3
Lymnaea decidiosa (Say)................................... 3
Zonitoides arboreus (Say)................................. 1

Purchase

Mammals

Elliott, Joseph. Beaver River. Porcupine, Erethizon dorsatus (Linn.) skins.. 4
Ward's Natural Science Establishment, Rochester. Black bear, Ursus americanus Pallas, group of......................... 4

Birds

Braislin, *Dr* **W. C.** Brooklyn

Kittiwake, Rissa tridactyla (Linn.), skins 2
Great black-backed gull, Larus marinus Linn, skin 1
Ring-billed gull, Larus delawarensis Ord., skin 1
American scoter, Oidemia americana Swains., skin 1
American coot, Fulica americana Gmel., skin 1
Red phalarope, Phalaropus fulicarius (Linn.), skin 1
Northern phalarope, Tobipes lobatus (Linn.), skin 1
Knot, Tringa canutus Linn., skin 1
American golden plover, Charadrius dominicus Müll., skin 1
Night hawk, Chordeiles virginianus (Gmel.), skin 1
Olive-sided flycatcher, Nuttallornis borealis (Swains.), skins 2
Wood pewee, Myiochanes virens (Linn.), skin 1
Least flycatcher, Empidonax minimus Baird, skin 1
Fish crow, Corvus ossifragus Wilson, skin 1
Starling, Sturnus vulgaris Linn., skin 1
Bronzed grackle, Quisculus quiscula aeneus (Ridg.), skin. 1
American crossbill, Loxia curvirostra minor (Brehm), skins 2
Pine siskin, Spinus pinus (Wilson), skins 2
Vesper sparrow, Pooecetes gramineus (Gmel.), skin 1
Ipswich sparrow, Passerculus princeps (Maynard), skins .. 2
Grasshopper sparrow, Coturniculus savannarum australis (Maynard), skin 1
Chipping sparrow, Spizella passerina (Bechstein), skin 1
Field sparrow, Spizella pusilla (Wilson), skin 1
Northern shrike, Lanius borealis Vieill., skin 1
White-eyed vireo, Vireo griseus (Boddaert), skins 2
Blue-winged warbler, Helminthophila pinus (Linn.), skins. 2
Tennessee warbler, Helminthophila peregrina (Wilson), skin 1
Blackburnian warbler, Dendroica blackburniae (Gmel.), skin 1
Palm warbler, Dendroica palmarum (Gmel.), skins 2
Connecticut warbler, Oporornis agilis (Wilson), skins 2
American pipit, Anthus rubescens (Tuntsall), skins 2
Catbird, Dumetella carolinensis (Linn.), skin 1
Brown thrasher, Toxostoma rufum (Linn.), skin 1
Carolina wren, Tryothorus ludovicianus (Lath.), skins .. 2
House wren, Troglodytes aedon Vieill., skin 1
Brown-headed nuthatch, Sitta pusilla Lath., skin 1
Tufted titmouse, Baeolophus bicolor (Linn.), skin 1
Carolina chickadee, Penthestes carolinensis (Audubon), skin 1
Wood thrush, Hylocichla mustelina (Gmel.), skin 1
Wilson's thrush, Hylocichla fuscescens (Steph.), skin 1
Grey-cheeked thrush, Hylocichla aliciae (Baird), skin 1

Bicknell's thrush, Hylocichla aliciae bicknelli (Ridg.), skin 1
Olive-backed thrush, Hylocichla ustulata swainsonii (Cab.) skins 2

Worthen, C. K. Warsaw, Ill.
Great skua, Megalestris skua (Brünn.), skins 2
Roseate tern, Sterna dougalli Montag., skin 1
Booby, Sula leucogastra (Boddaert), skin 1
Burrowing owl, Speotyto cunicularia hypogaea (Bonaparte), skin 1

Reptiles

Ward's Natural Science Establishment, Rochester
Copperhead, Ancistrodon contortrix (Linn.), cast 1
Hog-nose snake, Heterodon platirhinus (Latreille), cast 1
Green snake, Liopeltis vernalis (Harlan), cast 1
Milk snake, Lampropeltis doliata triangula (Boie), cast 1
Dusky garter snake, Thamnophis sirtalis obscura (Cope), cast 1
Ribbon snake, Thamnophis saurita (Linn.), cast 1
Ring-neck snake, Diadophis punctatus (Linn.), cast 1

Invertebrates

Ward's Natural Science Establishment, Rochester
Portuguese man-of-war, Physalia arethusa (Til.), glass model 1
Actinia, Mesembrianthemum rubra G., glass model 1
Corallium rubrum Lam., glass model 1

Collection

Mammals

Members of the museum staff, *Mr* **E. Seymour Woodruff** *and* *Mr* **I. H. Vrooman jr.** Albany
White-footed mouse, Peromyscus leucopus noveboracensis (Fisch.), skin 1
Northern white-footed mouse, Peromyscus maniculatus gracilis (Leî. C.), skins 4
Evotomys gapperi (Vigors), skin 1
Microtus pennsylvanicus (Ord.), skin 1
Canadian porcupine, Erethizon dorsatus (Linnaeus), skin 1
Muskrat, Fiber zibethicus Linnaeus, skin 1
Woodchuck, Arctomys monax (Linnaeus), skin 1
Short-tailed shrew, Blarina brevicauda (Say), skin 1
New York weasel, Putorius noveboracensis Emmons, skin 1
Little red bat, Lasiurus borealis (Müller), skin 1

Birds

Herring gull, Larus argentatus Pontop., skin	1
Hooded merganser, Lophodytes cucullatus (Linn.), skin	1
American golden-eye, Clangula clangula americana Faxon, skin	1
Green heron, Butorides virescens (Linn.), skin	1
Woodcock, Philohela minor (Gmel.), skins	2
Black-bellied plover, Squatarola squatarola (Linn.), skin	1
Broad-winged hawk, Buteo platypterus (Vieill.), skin	1
Belted kingfisher, Ceryle alcyon (Linn.), skins	2
Hairy woodpecker, Dryobates villosus (Linn.), skins	3
Yellow-bellied sapsucker, Sphyrapicus varius (Linn.), skin	1
Flicker, Colaptes auratus luteus Bangs., skin	1
Phoebe, Sayornis phoebe (Lath.), skins	2
Olive-sided flycatcher, Nuttallornis borealis (Swains.), skins	2
Yellow-bellied flycatcher, Empidonax flaviventris Baird, skins	2
Alder flyctcher, Empidonax traillii alnorum Brewster, skin	1
Least flycatcher, Empidonax minimus Baird, skin	1
Blue jay, Cyanocitta cristata (Linn.), skins	2
Canada jay, Perisoreus canadensis (Linn.), skins	2
Red-winged blackbird, Agelaius phoeniceus (Linn.), skin	1
Rusty blackbird, Euphagus carolinus (Müll.), skin	1
American goldfinch, Astragalinus tristis (Linn.), skins	2
Snowflake, Plectrophenax nivalis (Linn.), skins	3
Grasshopper sparrow, Coturniculus savannarum australis (Maynard), skin	1
Henslow's sparrow, Ammodramus henslowii (Aud.), skin	1
White-throated sparrow, Zonotrichia albicollis (Gmel.), skins	2
Chipping sparrow, Spizella passerina (Bechstein), skins	2
Slate-colored junco, Junco hyemalis (Linn.), skin	1
Lincoln's sparrow, Melospiza lincolnii (Aud.), skins	2
Fox sparrow, Passerella iliaca (Merr.), skin	1
Towhee, Pipilo erythrophthalmus (Linn.), skin	1
Rose-breasted grosbeak, Zamelodia ludoviciana (Linn.), skins	2
Scarlet tanager, Piranga erythromelas Vieill., skin	1
Barn swallow, Hirundo erythrogaster Bodd., skin	1
Tree swallow, Iridoprocne bicolor (Vieill.), skins	3
Northern shrike, Lanius borealis Vieill., skin	1
Red-eyed vireo, Vireosylva olivacea (Linn.), skin	1
Philadelphia vireo, Vireosylva philadelphica (Cassin), skin	1
Blue-headed vireo, Lanivireo solitarius (Wilson), skins	2
Nashville warbler, Helminthophila rubricapilla (Wilson), skin	1

Black-throated blue warbler, Dendroica caerulescens (Gmel.), skin	1
Myrtle warbler, Dendroica coronata (Linn.), skin	1
Magnolia warbler, Dendroica magnolia (Wilson), skins	3
Cerulean warbler, Dendroica caerulea (Wilson), skin	1
Bay-breasted warbler, Dendroica castanea (Wilson), skin	1
Blackburnian warbler, Dendroica blackburniae (Gmel.), skin	1
Black-throated green warbler, Dendroica virens (Gmel.), skins	2
Ovenbird, Seiurus aurocapillus (Linn.), skins	2
Maryland yellowthroat, Geothlypis trichas (Linn.), skins	4
Canadian warbler, Wilsonia canadensis (Linn.), skins	3
Brown thrasher, Toxostoma rufum (Linn.), skins	2
White-breasted nuthatch, Sitta carolinensis Lath., skin	1
Red-breasted nuthatch, Sitta canadensis Linn., skins	2
Golden-crowned kinglet, Regulus satrapa Licht., skin	1
Wood thrush, Hylocichla mustelina (Gmel.), skin	1
Gray-cheeked thrush, Hylocichla aliciae (Baird), skin	1
Olive-backed thrush, Hylocichla ustulata swainsonii (Cab.), skins	2

Batrachians

Salamander, Plethodon cinereus cinereus (Green)	3
Red-backed salamander, Plethedon cinereus erythronotus (Green)	2
Striped salamander, Spelerpes bilineatus (Green)	2
Dusky salamander, Desmognathus fusca (Raf.)	6
Red eft, Diemictylus viridescens miniatus (Raf.)	2

Arachnids

Tetragnatha laboriosa Hentz	1
Tetragnatha grallator Hentz	1
Epeira silvatica Emerton	3
Argiope riparia (Hentz)	1
Argiope transversa (Hentz)	1
Lycosa nidicola Emerton	1
Lycosa frondicola Emerton	1
Lycosa communis Emerton	1
Pirata montana Emerton	2
Pirata insularis Emerton	2
Agelena naevia Basc.	3
Linyphia marginata Koch	6
Theridium frondeum Hentz	1
Epiblemum scenicum (Clerck)	1
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Many small spiders not yet identified

The Shufeldt collection of avian osteology presented by *Dr* **R. W. Shufeldt,** New York

American eared grebe, Colymbus nigricollis californicus (Heerm.)	1 skeleton
Red-throated loon, Gavia stellata (Pontop.)	1 hyoid
Razor-billed auk, Alca torda Linn.	1 skeleton
Ring-billed gull, Larus delawarensis Ord	1 "
Bonaparte gull, Larus philadelphia (Ord.)	1 "
Short-tailed albatross, Diomedea albatrus Pall.	2 skulls
Albatross species ?	1 misc. bones
Pintado petrel, Daption capensis (Linn.)	1 skeleton
Red-billed tropic-bird, Phaethonaethereus Linn.	4 "
Florida cormorant, Phalacrocorax auritus floridanus (Aud.)	1 hyoid
Mallard, Anas platyrhynchos Linn.	3 skulls
Green-winged teal, Nettion carolinensis (Gmel.)	1 skeleton
	4 skulls
Blue-winged teal, Querquedula discors (Linn.)	1 sternum
Shoveler, Spatula clypeata (Linn.)	1 "
Rufous-crested duck, Netta rufina Pall.	1 skeleton
Canada goose, Branta canadensis (Linn.)	1 "
Trumpeter swan, Olor buccinator (Rich.)	1 skull
Wild duck species ?	1 "
Glossy ibis, Plegadis autumnalis (Hasselq.)	1 skeleton
Great blue heron, Ardea herodias Linn.	1 "
Little blue heron, Florida caerulea (Linn.)	1 "
Green heron, Butorides virescens (Linn.)	1 "
California clapper rail, Rallus obsoletus Ridgw.	2 "
Clapper rail, Rallus crepitans Gmel.	1 "
Corn crake, Crex pratensis Bechs.	1 "
American coot, Fulica americana Gmel.	1 sternum
Wilson snipe, Gallinago delicata (Ord.)	1 skull
Long-billed dowitcher, Macrorhampus scolopaceus (Say)	1 "
Least sandpiper, Pisobia minutilla (Vieill.)	2 skeletons
Solitary sandpiper, Helodromas solitarius (Wils.)	2 "
Long-billed curlew, Numenius americanus (Bechs.)	1 "
	3 skulls
	1 sternum
Black-bellied plover, Squatarola squatarola (Linn.)	1 skeleton
Mountain plover, Podasocys montanus (Towns.)	1 "
Surf bird, Aphriza virgata (Gmel.)	1 "
Black turnstone, Arenaria melanocephala (Vig.)	1 "
Texan quail, Colinus virginianus texanus (Lawr.)	2 sterna
California partridge, Lophortyx californica (Shaw.)	1 skeleton

Canada grouse, *Canachites canadensis* (Linn.).	1 skeleton
	1 misc. bones
Ruffed grouse, *Bonasa umbellus* (Linn.)..........	2 skeletons
	1 misc. bones
Welch ptarmigan, *Lagopus welchi* (Brewst.).......	1 skeleton
Sharp-tailed grouse, *Pediocaetes phasianellus* (Linn.)......	1 skull
Sage grouse, *Centrocercus urophasianus* (Bonap.)......	1 "
Wild turkey, *Meleagris gallopavo* Linn........	2 skulls
Series of wild and domestic turkeys....................	10 "
Jungle fowl, *Gallus bankiva* Temm..............	2 skeletons
Domestic fowl	2 skulls
Chachalaca, *Ortalis vetula maccalli* Baird.....	1 skeleton
Mourning dove, *Zenaidura macroura carolinensis* (Linn.)	2 "
White-fronted dove, *Leptotilta fulviventris brachyptera* (Salv.)	1 "
White-winged dove, *Melopelia asiatica* (Linn.)..	1 skeleton
Domestic pigeon	1 "
Turkey vulture, *Cathartes aura septentrionalis* (Wied.)	2 skeletons
Sarcorhamphus gryphus (Linn.).............	1 hyoid
Swallow-tailed kite, *Elanoides forficatus* (Linn.)	1 sternum
Marsh hawk, *Circus hudsonius* (Linn.)..........	4 skeletons
	1 skull
Sharp-shinned hawk, *Accipiter velox* (Wils.).....	3 skeletons
	1 sternum
Cooper's hawk, *Accipiter cooperi* (Bonap.)......	2 skeletons
	1 sternum
American goshawk, *Astur atricapillus* (Wils.)..	1 hyoid
Western red-tail, *Buteo borealis calurus* (Cass.)	3 skeletons
Mexican goshawk, *Asturina plagiata* Schlegel....	1 "
American rough-legged hawk, *Archibuteo lagopus sanctijohannis* (Gmel.)	1 "
Golden eagle, *Aquila chrysaetos* (Linn.).........	1 sternum
White gyrfalcon, *Falco islandus* Brünn.........	1 skull
Prairie falcon, *Falco mexicanus* Schlegel.........	1 skeleton
Duck hawk, *Falco peregrinus anatum* (Bonap.)	1 hyoid
Pigeon hawk, *Falco columbarius* Linn..........	4 skeletons
Sparrow hawk, *Falco sparverius* Linn...........	5 "
	1 sternum
American osprey, *Pandion haliaëtus carolinensis* (Gmel.)	1 skeleton
American barn owl, *Aluco pratincola* (Bonap.)...	1 misc. bones
American long-eared owl, *Asio wilsonianus* (Less.)	2 skeletons
Richardson owl, *Glaux funerea richardsoni* (Bonap.)......	1 sternum
Saw-whet owl, *Glaux arcadica* (Gmel.)..........	1 "
	1 hyoid

Texas screech owl, *Otus asio maccalli* (Cacc.)...	1 sternum
Great horned owl, *Bubo virginianus* (Gmel.)....	1 sternum
Snowy owl, *Nyctea nyctea* (Linn.)...............	2 hyoids
Hawk owl, *Surnia ulula* (Linn.)..................	5 legs
	2 hyoids
Burrowing owl, *Speotyto cunicularia hypogoea* (Bonap.)	1 skeleton
Burrowing owl, *Speotyto* sp. ?.....................	1 misc. bones
Elf owl, *Micropallas whitneyi* Cooper........	2 skeletons
Carolina parrquet, *Conuropsis carolinensis* (Linn.)..	2 "
Road runner, *Geococcyx californicus* (Less.).	3 "
Yellow-billed cuckoo, *Coccyzus americanus* (Linn.)..	1 "
Cuckco, *Cucullus canorus* Linn..................	1 "
Coccystes glandarius Linn..................	1 "
Nanondes undulatus Vig. & Hors..............	1 hyoid
Unidentified parrot	1 skeleton
Hairy woodpecker, *Dryobates villosus* (Linn.)..	1 "
Harris woodpecker, *Dryobates villosus harrisi* (Aud.)..	2 "
	1 hyoid
Gairdner woodpecker, *Dryobates pubescens gairdneri* (Aud.)	2 skeletons
Nuttall woodpecker, *Dryobates nuttalli* (Gamb.).	1 sternum
White-headed woodpecker, *Xenopicus albolarvatus* (Cass.)	1 "
Red-naped sapsucker, *Sphyrapicus varius nuchalis* Baird	2 skeletons
Williamson sapsucker, *Sphyrapicus ruber thyroides* (Cass.)	1 "
Pileated woodpecker, *Phloeotomus pileatus* (Linn.)..	1 "
	3 sterna
Red-headed woodpecker, *Melanerpes erythrocephalus* (Linn.)	2 skeletons
Californian woodpecker, *Melanerpes formicivorus bairdi* Ridgw........................	1 sternum
Lewis woodpecker, *Asyndesmus lewisi* Riley...	8 skeletons
Red-bellied woodpecker, *Centurus carolinus* (Linn.)..	1 skeleton
Gila woodpecker, *Centurus uropygialis* (Baird)	1 "
Red-shafted flicker, *Colaptes cafer collaris* (Vig.)..	1 "
Green woodpecker, *Picus viridis* Linn...........	1 hyoid
Dryobates sp. ?..	1 skeleton
Nighthawk, *Chordeiles virginianus* (Gmel.)...	1 skull
Western nighthawk, *Chordeiles virginianus henryi* (Cass.)	1 lot of bones
Texan nighthawk, *Chordeiles acutipennis texensis* (Lawr.)	2 skeletons

White-throated swift, Aeronautes melanoleucus Baird	2 skeletons
Blue-throated hummingbird, Cyanolaemus clemensiae (Less.)	2 sterna
Black-chinned hummingbird, Trochilus alexandri Bourc. & Muls	1 sternum
Costa hummingbird, Calypte costae (Bourc.)	1 "
Anna hummingbird, Calypte anna (Less.)	2 sterna
Broad-tailed hummingbird, Selasphorus platycercus (Swains.)	1 sternum
Rufous hummingbird, Selasphorus rufus (Gmel.)	10 skeletons
Calliope hummingbird, Stellula calliope Gould	3 "
	2 sterna
Broad-billed hummingbird, Cynanthus latirostris Swains	1 sternum
Kingbird, Tyrannus tyrannus (Linn.)	1 skeleton
Crested flycatcher, Myiarchus crinitus (Linn.)	2 "
Say phoebe, Sayornis saya (Bonap.)	1 "
Vermilion flycatcher, Pyrocephalus rubineus mexicanus (Scl.)	1 "
American magpie, Pica pica hudsonia (Sab.)	1 "
Blue jay, Cyanocitta cristata (Linn.)	1 skull
Steller jay, Cyanocitta stelleri (Gmel.)	1 skeleton
Blue-fronted jay, Cyanocitta stelleri frontalis (Ridgw.)	1 sternum
Long-crested jay, Cyanocitta stelleri diademata (Bonap.)	1 skeleton
Woodhouse jay, Aphelocoma woodhousei (Baird)	1 "
California jay, Aphelocoma californica (Vig.)	1 "
American raven, Corvus corax Linn	3 skeletons
	1 skull
American crow, Corvus brachyrhynchos Brehm	2 "
	1 sternum
Lamprocorax panayensis (Cab.)	2 skeletons
Pinon jay, Cyanocephalus cyanocephalus Wied	7 "
	1 sternum
Starling, Sturnus vulgaris Linn	1 skeleton
Red-winged blackbird, Agelaius phoeniceus (Linn.)	1 "
	10 skulls
Western meadowlark, Sturnella neglecta (Aud.)	1 skeleton
Scott oriole, Icterus parisorum Bonap	1 sternum
Hooded oriole, Icterus cucullatus sennetti Ridgw	1 skeleton
Orchard oriole, Icterus spurius (Linn.)	1 "
Bullock oriole, Icterus bullocki (Swains.)	1 "
Oriolus chinensis Linn	1 "

Sarcops calvus (Linn.)	3 skeletons
Sarcops melanonotus Grant	1 "
Brewer blackbird, Euphagus cyanocephalus (Wagl.)	1 "
	1 sternum
Western evening grosbeak, Hesperiphona vespertina montana (Ridgw.)	10 skeletons
Cassin purple finch, Carpodacus cassini Baird	4 "
American crossbill, Loxia curvirostris minor (Brehm.)	3 "
Redpoll, Acanthis linaria (Linn.)	1 "
Pine siskin, Spinus pinus (Wils.)	1 "
	1 skull
Gambel sparrow, Zonotrichia leucophrys gambeli (Nutt.)	1 skeleton
Brewer sparrow, Spizella breweri Cass	1 sternum
Black-chinned sparrow, Spizella atrogularis (Cab.)	1 "
Bell sparrow, Amphispiza belli (Cass.)	1 "
Spurred towhee, Pipilo maculatus montanus (Swarth)	1 skeleton
Green-tailed towhee, Pipilo chlorurus (Towns.)	1 "
Cardinal, Cardinalis cardinalis (Linn.)	2 "
Black-headed grosbeak, Zamelodia melanocephala (Swains.)	1 "
Blue grosbeak, Guiraca caerulea (Linn.)	1 "
Lark bunting, Calamospiza melanocorys Stejn	1 "
	1 sternum
Louisiana tanager, Piranga ludoviciana (Wils.)	1 "
Summer tanager, Piranga rubra (Linn.)	1 skeleton
Barn swallow, Hirundo erythrogaster (Bodd.)	3 "
Bank swallow, Riparia riparia (Linn.)	2 "
Bohemian waxwing, Bombycilla garrula (Linn.)	1 sternum
Cedar waxwing, Bombycilla cedrorum Vieill	2 skeletons
Phainopepla, Phainopepla nitens (Swains.)	1 sternum
Northern shrike, Lanius borealis Vieill	1 skeleton
White rumped shrike, Lanius ludovicianus excubitorides (Swains.)	4 "
	1 skull
Philadelphia vireo, Vireosylva philadelphica (Cass.)	1 hyoid
Gray vireo, Vireo vicinior Coues	1 sternum
Cape May warbler, Dendroica tigrina (Gmel.)	1 hyoid
Audubon warbler, Dendroica auduboni (Towns.)	1 sternum
Bay-breasted warbler, Dendroica castanea (Wils.)	1 hyoid
Black-throated gray warbler, Dendroica nigrescens (Towns.)	1 sternum
Canadian warbler, Wilsonia canadensis (Wils.)	1 hyoid
American redstart, Setophaga ruticilla (Linn.)	1 skeleton

American dipper, Cinclus mexicanus unicolor (Bonap.)	2 skeletons
Sage thrasher, Oroscoptes montanus (Towns.)	1 sternum
Mockingbird, Mimus polyglottos (Linn.)	1 "
Catbird, Dumetella carolinensis (Linn.)	1 skull
Brown thrasher, Toxostoma rufum (Linn.)	1 skeleton
Palmer thrasher, Toxostoma curvirostre palmeri (Coues)	1 "
Leconte thrasher, Toxostoma lecontei (Lawr.)	2 sterna
Cactus wren, Heleodytes brunneicapillus couesi (Sharpe)	1 skeleton
Rock wren, Salpinctes obsoletus (Say)	1 "
Parkman wren, Troglodytes aedon parkmani (Aud.)	1 "
Brown creeper, Certhia familiaris americana (Bonap.)	1 "
Slender-billed nuthatch, Sitta carolinensis aculeata (Cass.)	3 "
Pygmy nuthatch, Sitta pygmaea Vig.	8 "
Gray titmouse, Baeolophus inornatus griseus (Ridgw.)	4 "
Carolina chickadee, Penthestes carolinensis (Aud.)	1 "
Mountain chickadee, Penthestes gambeli (Ridgw.)	1 skull
	2 sterna
Chestnut-backed chickadee, Penthestes rufescens (Towns.)	1 skeleton
Pallid wren-tit, Chamaea fasciata phaea Osgood	1 "
Lead-colored bush-tit, Psaltriparus plumbeus Baird	2 "
Verdin, Auriparus flaviceps (Sund.)	2 "
	1 sternum
Accentor modularis (Linn.)	2 skeletons
Golden-crowned kinglet, Regulus satrapa Licht.	1 skeleton
Ruby-crowned kinglet, Regulus calendula (Linn.)	2 skeletons
Townsend solitaire, Myadestes townsendi (Aud.)	5 "
American robin, Planesticus migratorius (Linn.)	1 sternum
Western robin, Planesticus migratorius propinquus (Ridgw.)	1 skeleton
	1 skull
Mountain bluebird, sialia currucoides (Bechs.)	1 sternum
Unidentified	8 sterna
	384

ARCHEOLOGY

Purchase

Griffiths, H. Ripley

Stone bowl	1
Spears	6
Celts	2

Jimerson, George. Irving

Gages for splitting basket splints	6

Kittle, D. B. Lawton

Leggings ... pair,	1
Bows	6
Red mask	1
Beaded belt	1
Mask, semilunar eyes	2
Ceremonial masks	3
Tools used by brooch maker	140
Silver worker's table	1
Husk tray	1
Deer bone buttons in process of making	8
Husk sleeping mat	1
Manuscript notes	2

Dennes, Charles. Irving

Twisted axe	1

Reed, W. L. Syracuse

Jesuit medal	1

Cornplanter, E. Lawton

Medicine packet	1
Books from Cattaraugus Mission Press	2

Parker, F. E. New York

Haida pipe	1
Medicine rattle	1
Moccasins ... pair,	1
Feather fan	1
Husk ceremonial	1

Benedict, M. Lake George

Algonquin beaded belt	1
Roll of splints, Algonquin	1
Basket "	1
Gages, Algonquin	2

Mohawk, Nancy. Lawton

Gage, Seneca	1
Ring "	1
Manuscripts, etc	2

Thomas, Baptist

Manuscript	1

Snyder, Peter. Versailles

Burden strap in process of manufacture	1
Roll of elm bark cord	1
Roll of elm bark shreds	1
String, sinew	1
Colored moose hair, packages	12
Native hemp (package)	1

Kennedy, Irving

Pots from graves (4 broken)	6
Pipes	2
Iron knives	2
Tomahawk iron	1
Stone axe (broken)	1
Woven basket from grave	1
Hammer stone	1
Beads	150
Pipestone beads	25
Shell beads	25
Buckskin and copper beads	20
Copper beads on string	125
Pipestone beads	6
Buckskin fragment preserved by contact with copper	1
Turtleshell box	1
Bone comb	1
Stone charm	1
Brass kettle and gourd	2
Copper bell	1
Iron rings	2
Pestle	1
Bone tubes	10
Arrow heads	25

Excavation

Parker A. C. High Banks site near Irving

Arrow heads, general layer	14

From Lodge site 1

Pottery, bear's head effigy	1
Iron chisel	1
Pipe stem, coiled decoration	1
Pipe stem fragment	1
Perforated dog tooth	1
Pot fragments . . . bag,	1
Iron point	1
Flint scrapers	4
Pipe stem, coiled serpent	1
Thin scraper	1
Flint reject	2
Triangular flint points	5
Notched deer incisor	1
Pipe bowl fragment	1
Broken flint points	11
Scrapers	2
Flint reject	1
Miscellaneous objects in bag	14
Miscellaneous objects in box	7
Pipe stems	3
Piece of worked brass	1
Notched point	1
Pipe stem	1
Pipe bowl fragment	1
Triangular brass arrow point	1
Scraper	1
Oval flint knife	1
Potsherd	1
Bone awl	1
Bone flaking tool	1
Flint points	[illegible]
Cylindrical bead	1
Worked bone	1
Bone bead	1
Bone punch	1
Worked bird bone	1
Rough knife, chert	1
Triangular point	1
Scraper	1
Part of brass earring	1
Wampum shell cone	1

Lodge site 2

Incised bone tube	1
Bone handle	1
Worked tarsal bone	1
Chert knife	1
Worked point	1
Pipe bowl, square top	1
Celt, adzlike	1
Brass ornament	1
Triangular point	1
Long triangular point	1
Brass ornament	1
Copper knife	1
Arrowhead	1
Pipe bowl fragments	2
Pipe stem, serpent decoration	1
Brass triangle	1
Brass point	1
Gray chert point	1
Brass arrow points	2
Bone tube, 7 and 13 tally marks	1
Disk wampum bead	1
Incised bone bead	1
Polished tube of bone	1
Rude bone face	1
Pottery pipe face	1
Broken stem of flat pipe	1
Shell bead	1
Incised shell	1
Chert knife	1
Disk bead	1
Pipe stem	1
Small objects in bag	20
Potsherd	1

Lodge site 3

Worked bear's molar	1
Chert scraper, handled	1
Pipe bowl, duck effigy	1
Chunk of iron	1
Pot rim, sherd	1
Worked shell	1
Scraper	1
Pipe stem	1
Knife blade	1

Pipe stems	3
Flint point	1
Brass chopping knife	1
Pipe stem tips	4
Brass lock shield	1
Bowl of small pipe	1

Lodge site 4

Bowl of small pipe	1
Bowl of red clay pipe	1
Piece of worked antler	1
Worked object of ankylosed tarsus	1
Fragments of European trade pipe	2
Flint arrow points	10
Pipe stem fragments	2
Rim of small pot	1
Shell object	1
Bear tusks	3
Pipe stem tips	3
Pipe stem fragments	3
Rude flints	3
Edge of brass chisel	1
Serrated brass strip	1
Hematite nodule	1
Fossil, worked	1
Large piece of worked brass	1
Pieces of worked brass	
Square of brass, perforated	1
Triangular brass arrow points	2
Pieces of worked brass	2
Iron knife, no. 61	1
Perforated shells	4
Pipe bowl fragments	2
Jasper nodule, split	1
Brass cone	1
Pot rim fragments	4
Fragment bead tube	1
Knife blade, iron	1
Antler points	2
Naturally perforated stone	1
Pottery face from pipe bowl	1
Polished bone tube	1
Owl's head effigy from pipe	1
Edged stone	1
Pot rim fragment	1
Worked fish bone	1
Elk tooth	1
Pipe bowl fragments	2
Part of brass arm band	1
Flint arrow point	1
Part of pipe bowl	1
Pot rims	6
Scrapers	6
Disk of brass	1
Flint points	10
Pot rim	1
Worked sheet brass	1
Pipe bowl	1
Bone bead	1

Lodge site 5

Curved scraper	1
Bone tubes	2
Pipe bowl	1
Pipe neck	1
Flint knife	1
Worked bone	1
Miscellaneous objects in bag	14
Wampum bead, "Roanoke"	1

General layer

Potsherds	13
Net sinker	1
Arrow points	6
Pot bottom	2
Bone beads	6
Antler	1
Pipe bowl fragments	6
Pipe stem	1
Worked brasses	4
Marine shell, venus	1
Small bones.............boxes,	5
Unnumbered specimens, mostly potsherds, in box	120

West Rush

Box containing skeleton	1
Celts	3
Arrow points	52
Fragments of human bones	12
Pieces of pottery	25
String of shell beads	1

Dresden

Fragments of pottery	82
Arrow points	14
Miscellaneous	54

Pompey hill

Arrow points	19
Pottery in bag	1
Animal bones in bag	1
Human phalanx, incised	1

Ripley

Brown sandstone pipe	1
Bone beads	7
Crushed pot	1
Crushed tortoise shell	1
Skeleton, broken	1
Skeleton of child, broken	1
Broken bone comb, fork type	1
Bone bead	1

ONE HUNDRED YEARS OF NEW YORK STATE GEOLOGIC MAPS 1809-1909

BY HENRY LEIGHTON

In geology as in other sciences, no satisfactory understanding of the subject can be acquired without a knowledge of the history of its development. As Geikie says "it is eminently useful, now and then, to pause in the race, and to look backward over the ground that has been traversed, to mark the errors as well as the successes of the journey."

We have thought it of interest to review briefly the development of geology in New York State as evidenced by the published maps, and to publish a list of such maps arranged in chronological order and indexed; this list not only to serve as a reference index to all geological maps of the State but, as well, to show briefly the development of the science of geology in the State.

For the clear interpretation of the geology of a region, both in the distribution and structural features of its rocks, geologic maps are almost indispensable as an accompaniment to a written description. This fact was comprehended by the very early observers, and even before geology as a science was recognized, geologic or, more correctly, mineralogic maps were drawn. By all writers the credit for the publication of the first map showing geological features has been given to Jean Etienne Guettard who in 1751[1] issued a map of Paris and its environs. This was more of a mineralogic than a geologic map, its author seemingly having no conception of geological structure or sequence of formations. Guettard, unlike many scientists of his time and many more following him, was not of a speculative turn of mind, but believed strongly in observation as the best means of deriving important scientific truths. Originally a botanist, in his botanical excursions he became interested in the minerals and fossils he came across, and soon became convinced of the fact that minerals and fossils were not promiscuously distributed over and through the rocks but were arranged in definite bands.

He then conceived the idea[2] of fixing his observations by the use of a map showing the mineral and fossil localities, which were indi-

[1] Mem. Acad. Roy. Sciences, France. 1751.

[2] A similar plan, although probably unknown to Guettard, was proposed in a paper presented before the Royal Society of London in 1683.

cated by broad divisions or bands. Of these bands, there were three: the Sandy band, the Marly band and the Schistose or Metalliferous band. Although rough in outlines, this map even yet indicates in a general way the character of the rocks of the Paris basin. His work on this and several other maps attracted considerable attention at the time and the Academy of Science[1] stated that the work "opens up a new field for geographers and naturalists, and forms, so to speak, a link between two sciences which have hitherto been regarded as entirely independent of each other." Geikie[2] from whom these facts in regard to Guettard's work have been taken, says that this "gifted Frenchman" may be called the father of all the national geological surveys which have been instituted by the various civilized nations of the old and the new worlds.

The earliest map in colors, showing the aereal distribution of rocks was that of J. F. W. Charpentier, of the Mining School at Freiberg. This was published in 1778 at Leipsig, accompanying his *Mineralogische Geographie der Chursachsischen Lande,* and the distribution of gneiss, schist, loam, granite, limestone etc. was indicated by the use of eight tints.[2]

Previous to the year 1809 a few sketches concerning the geology of the United States had appeared, several of them dealing with New York State. The first definite geological mapping, however, was the work of William McClure who has been termed by various writers "The father of American Geology," "the William Smith of America," etc. This map was a hand-colored geologic chart of the United States east of the Mississippi, and was published with his paper on *Observations on the Geology of the United States,* in the Transactions of the American Philosophical Society of Philadelphia. Appearing when the influence of Werner and his classifications were at their hight and Hutton's more rational views had not yet been accepted by the majority, it strongly favored the Wernerian classification, the rocks being indicated in four colors called Primitive, Transition, Secondary or Floetz, and Alluvial.

Although crude in all details and but a poor substitute for the later maps of the United States, when one recalls that the science was still in its infancy, that the stratigraphic studies of Murchison and others were still in the future, that petrography had but recently become a science, he can not but marvel at the results achieved. Then, too, McClure, in common with all the geological

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[1] Mem. Acad. Roy. Sciences, France. 1751; Jour. p. 105.

[2] Geikie, Founders of Geology, p. 22.

pioneers in the United States, had to contend with a woeful lack of facilities. As has been said by his biographer, "He went forth with his hammer in hand and his wallet on his shoulder, pursuing his researches in every direction, often amid pathless tracts and dreary solitudes, until he had crossed and recrossed the Allegheny mountains no less than 50 times. He encountered all the privations of hunger, thirst, fatigue and exposure, month after month and year after year until his indomitable spirit had conquered every difficulty and crowned his enterprise with success." On the map, the distribution of the formations in New York State is given as follows: the Primitive appears as a strip in southeastern New York; the Transition as a strip northwest of the Primitive extending from Hudson southwest to the State line; the Secondary or Floetz, as covering all western and central New York, bounded on the north by the Mohawk; the Alluvial, on the southern half of Long Island.

An interesting fact brought out by McClure's investigations was the occurrence of salt springs and gypsum beds in eastern Tennessee and as far north as Oneida lake, N. Y. He mapped these beds in Tennessee only, but says, "it is probable that this formation is on the same great scale which is common to all the other formations on this continent: at least rational analogy supports the supposition, and we may hope one day to find, in abundance, these two most useful substances which are generally found mixed or near each other." This indicates the keen insight of this early geologist in foreseeing the valuable beds of salt and gypsum discovered since then in our Silurian strata. This same map and text was published in a French journal in 1811 and a reprint of it may be found in the report of the United States National Museum (for 1904) 1906, facing page 189.

Mr McClure was never satisfied with this map on account of the poor base map on which he represented his geological features. So after traveling in Europe and making further excursions throughout the United States, he revised and published it in much better shape in 1818. Regarding New York State he says, "During an excursion last summer an opportunity was afforded of ascertaining and extending the limits of the transition in the states of Pennsylvania and New York, as well as the boundary of the great primitive formation, north of the Mohawk, and fixing the limits of the transition on Lake Champlain and in the state of Vermont with more precision." The principal changes on the New York map are the coloring of a large portion of the Adirondacks as

Primitive, an extension of the Transition up the east side of the Hudson into Washington county, and the extension of the green strip, representing salt and gypsum deposits, as far north as Schoharie county.

The sections accompanying this map are divided into the same formations and show no very definite idea of the correct structure of the region.

The year 1816 brought into the arena of geologic work a man whose work was to have a profound influence on the scientific thought of his time and country. This man was Amos Eaton. Born in Chatham in 1776, he pursued the study and practice of law till the year 1816 when, although 40 years of age, he became interested in the teachings of Professor Silliman at Yale, relinquished his law practice, and began the study of geology and mineralogy under Silliman. Such was the energy and enthusiasm of Eaton that in a year or so he had mastered the science, and began a series of excursions, on foot, throughout New England and New York, giving short lectures on natural history all along his route. He also delivered a course of such lectures at Williams College, which aroused great interest in natural history in that institution. The inspiration of this scientific teacher attracted the attention of Governor DeWitt Clinton of New York State and, on his invitation, in 1818, Professor Eaton delivered a course of lectures before the State Legislature. The interest in natural history, created by his untiring devotion to the cause and by his numerous lectures and writings, specially by his writings and maps published after he had been appointed senior professor of science at the Rensselaer School at Troy, were destined to bring about the organization of the State Natural History Survey. He may justly be termed the father of New York State geology, for to him, above all others, the State owes its wonderful achievements in geologic work. His first important work was an *Index to the Geology of the Northern States,* written as a textbook and published in 1818. This contained a geologic section which included the region east of the Catskills and extended east to Boston. This was followed a few years later by other published sections, including New York State, but all were very crude measured by present standards and were strongly tinged by Wernerism.

During this period a new means for the publication of short geological papers and small maps was brought into being by the founding of Silliman's *Journal* in 1818 and soon papers and maps of a geologic nature began to appear in its pages as can be seen by a glance at the index, those between 1822 and 1834 being small black and white etchings.

We come now to the publication of the first geologic map of New York State as a unit. This was Eaton's map published with his "Textbook" in 1830. This is a curiously interesting hand-colored map of the State. On it he divided the regular deposits according to the following Wernerian scheme: five "classes" called Primitive, Transition, Lower Secondary, Upper Secondary and Tertiary were distinguished and these in turn were each divided into three formations called "Carboniferous," "Quartzose" and "Calcareous." The colors represented on the map are six, one color, slate, representing all the "Carboniferous" formations, the Roman numerals I, II and III representing whether they belonged to the "Primitive" or "Secondary (Lower or Upper)." Other colors represented the quartzose and calcareous formations, the variegated red sandstone, one color being used for both the present Medina and the Triassic red sandstone, or as he says "sandstones supporting salt springs or basalt," the "lias or ferriferous rocks of a subordinate series" roughly corresponding to the present Salina shales, Basaltic rocks and "superficial shell marl" scattered in spots over the southern tier of counties.

Professor Eaton made a poor attempt at mapping the Adirondacks. As they appear on his map they consist of alternating bands of Primitive and Secondary Carboniferous and Calcareous rocks. He notes in the text various Adirondack rocks most of which are now known to be igneous, but says, "we infer that granite, mica slate, hornblende rock, talcose slate, granular quartz and granular limestone had all been *deposited* and become indurated before any plants or animals had been created."

In the early thirties, various influences were brought to bear upon the New York State Legislature, toward the establishment of a museum of natural history and a geological survey of the State. First of these was the work done by Professor Eaton from 1820 to 1830, which has already been noted. This work was carried on under the patronage of Hon. Stephen Van Rensselaer. In 1834 the Albany Institute[1] presented to the Legislature a memorial asking for the establishment of a State Museum, and in 1835 the New York Lyceum of Natural History (The American Institute of the City of New York) presented a similar petition or memorial.[2]

[1] Senate Document no. 75. 1834.

[2] Assembly Document no. 374. 1835.

Induced by these expressions of public sentiment, the Legislature passed a resolution in 1835 asking the Secretary of State to report to that body a method for obtaining a natural history survey of the State, and for collecting, and preserving specimens collected, and for publishing reports. Such a report was presented to the Legislature of 1836, by Hon. John A. Dix, Secretary of State, and was adopted by the Legislature, and the Natural History Survey was organized. The scientific staff of the Survey in 1836 consisted of John Torrey, Botanist; James E. DeKay, Zoologist; Lewis C. Beck, Mineralogist; W. W. Mather, Ebenezer Emmons, Lardner Vanuxem and Timothy A. Conrad, Geologists; the four geologists each being assigned to a definite section of the State. In 1837, Conrad was made Paleontologist and James Hall who had been the year before assistant under Professor Emmons, was appointed to succeed Vanuxem, who took Conrad's place. This early survey was, as Merrill[1] says, "an organization which has left a more lasting impression upon American geology than any that has followed it or preceded it."

The reports of this early survey contained various maps, the first of which was a most interesting and quaint birdseye map of the Genesee river and vicinity, showing geological features. It was a black and white sketch map showing the river as seen from an elevated observation point. The rock geology is indicated by short notes printed along the margins and on the sketch; such as "Fucoides in sandstone," "dark argillaceous shales," "beds of gypsum Garbutts mills," "Calymene in green shales," etc. Glaciated surfaces are indicated, small sketches of fossils depicted, the horizontality of the beds exposed in portions of the gorge, and many interesting features shown. Prof. Eben N. Horsford, although his name appears only as the delineator of this map, in reality worked out by his own efforts whatever geological features are depicted thereon. Born at Moscow, N. Y., he became interested in the fossils of the region and in his excursions accumulated quite an extensive knowledge of the local geology and paleontology. He was at one time principal of the Albany Female Academy and subsequently became Rumford professor of chemistry at Harvard.

This was followed by other maps and sections in the reports of the geologists of the various districts and in the four quarto volumes published in 1842 and 1843. Of these the most import-

[1] U. S. Nat. Mus. Rep't for 1904. 1906. p. 344.

ant was that by James Hall, a Geological Map of the Middle and Western States, which has had a powerful influence on the geology of eastern United States. This hand-colored map indicates the phenomenal advance made in stratigraphy since the publication of Eaton's map of the State 12 years before, and Hall's map appears with divisions, a number of which have remained almost as set down, to the present day. In the interval between the two maps, Murchison and Sedgwick in Great Britain had carried on their stratigraphic studies clearing up or even beginning a real classification of sedimentary strata. The efforts of these men were felt in America, and New York State forged its way to the front under the leadership of James Hall, who in turn was guided by the overruling persuasion of Murchison.

Accompanying these reports and published separately was also the famous "1842" map of the State Geologists. Previous to its appearance all geologic mapping had been greatly hampered by a lack of accurate base maps on which to indicate the geological formations. Therefore the State had a special map engraved for use by the survey and this was used in the 1842 map. This was hand-colored, prepared by the four geologists, Emmons, Hall, Vanuxem and Mather. They had been obliged to create what was called the "New York system" of rocks including the strata from the Potsdam to the Carboniferous, as they were as yet unable to correlate the various strata with Murchison's Cambrian, Silurian and Devonian. The central mass of the Adirondacks was all colored as Primary.

Dr Emmons's views in regard to the Taconic system were at variance with those of other geologists and later (1844) he prepared a map on the same base as the former one, but having his Taconic system upon it. This has been called the "Emmons map." It was, however, never widely distributed. The 1842 map, as Professor Marcou says,[1] marked "a second starting point in American geology" and adds that it gave a good classification of the American paleozoic rocks due mainly to the researches of Emmons and Vanuxem, an unjust comment due to his personal dislike to Professor Hall, and giving him but scant credit for his important share in the work.

The next published maps were those of Sir Charles Lyell accompanying his North American travels. They dealt with western New York, but included one United States map, the New York

[1] U. S. Geol. Sur. Bul. 7. 1884. p. 59.

portion of which he compiled from the early Natural History reports, since he says he had not yet seen the 1842 map. County maps, black or white etchings, next began to appear in the New York Society of Agriculture Transactions but are of little importance.

In 1865 there was published by the Canadian Geological Survey in its report of progress for 1863, a Geologic Map of Canada and the Northern Portion of the United States. The Canadian portion of this map was prepared by Sir W. E. Logan while the United States portion was compiled under the authority of Prof. James Hall. It is of interest in connection with this paper because of the fact that the New York State geology indicated upon it is the first authoritative revision of the 1842 map. The map is on a scale of 125 miles to the inch and is very well colored. It was in reality a reduction from a much larger map on a scale of 25 miles to the inch which although already engraved in 1863 was not published till 1867. This larger map was published separately and not widely distributed. It is said that but three copies were sent to the United States.

Up to this time colorations of maps in this country had been done by hand, a tedious and often unsatisfactory process. In European countries, schemes for color printing had been devised and successfully carried out, as early as 1843. In America, however, the chromolithographic methods supplanted but slowly the hand coloration and although the first map printed in color appeared in 1853 in Massachusetts, no such work was carried on in New York State till 1875. The first map with printed colors in the State appears to have been the map of New York State and the Eastern States by Hall appearing in the Museum reports.

The early Museum reports, the first of which appeared in 1848, contained but few maps previous to 1884 and the maps of the period 1875 to 1885 were published mainly by the *American Journal of Science* and other private publications, by James D. Dana and others, and dealt with eastern and southeastern New York.

The maps appearing in the years 1885 and 1886 dealt also with eastern New York with the exception of a map of Ontario county by John M. Clarke, and several maps dealing with the oil region of Allegany county were the first economic maps to be published.

In the nineties the most notable feature was the earnest endeavor made to work out the relation in the Adirondack crystalline area. This work was commenced in 1895 by Kemp and a number of maps appear in that decade by Cushing, Kemp and others. Glacial geology was also represented in the decade by H. L. Fairchild's maps on the glacial geology of western New York. Since 1900 the progress in mapping the geology has proceeded rapidly along all lines, numerous areal, economic, stratigraphic, paleogeographic and pleistocene maps all having been published. The main efforts, at present, are toward a complete geologic map of the State using the quadrangles surveyed by the United States Geological Survey as a base, and a number of such quadrangles have been published. In this way, piece by piece, like the forming of a mosaic picture, the detailed geology of the State is being worked out.

The last complete map of the State was the 1901 map by F. J. H. Merrill corrected up to date from the Hall-McGee map of 1894. This represents the results of all the geologic work done previous to that time and is a fitting map with which to compare the earlier efforts of McClure and Eaton.

We have now reached the hundredth anniversary of the geologic map of the United States and incidentally of this State, and although there is yet much to be done, the work from now on must be of detailed character and we may expect no great changes in the general map. We have reviewed the five complete maps: the McClure 1809, the Eaton 1830, the 1842 map, the Hall map of 1894 and lastly the Merrill map of 1901, and we have also noted the smaller sections mapped by counties, townships and even quadrangles.

In making up the chronological list the date given on the margin indicates the date of publication, and does not represent the date on the map or the year of which an annual report is a review, these dates where given having been inclosed in parentheses. Under the years the maps are arranged alphabetically by authors.

The author has aimed at getting together all geologic maps dealing with New York State geology. It is realized that some have probably been overlooked, but all of importance are probably included. Many maps used in textbooks and other such literature, which are evidently but copies of some maps listed here, have purposely been omitted. Maps of the United States and other large maps simply including New York State as a portion of a larger area have been listed but sparingly, only the more interesting of such having been examined. Following the chronologic list is an index by means of which, it is hoped, the maps dealing with a certain section of the State or maps by certain authors can readily be located in the chronologic list.

CHRONOLOGICAL LIST OF MAPS SHOWING GEOLOGY OF NEW YORK STATE

References made simply to museum bulletins, museum reports or geologist's reports, refer to publications of the New York State Museum. Exact titles are printed in italics.

(1) 1809 **McClure, William.** *Map of the United States of America*; colored geologically. Accompanies "Observations on the Geology of the United States" by William McClure. Am. Phil. Soc. Trans. 1809. Ser. 1, v. 6 (front). 54 x 45 cm. Scale about 1 in. to 75 m. A hand-colored map representing five divisions: Primitive, Transition, Secondary, Salt and Alluvial.

(2) 1818 ——— Colored sections across the United States. Accompanies "Observations on the Geology of the United States" by William McClure. Am. Phil. Soc. Trans. 1818. n. s. v. 1, facing p. 91. Two of these sections include New York State.

(3) 1818 ——— *Map of the United States of America.* Accompanies "Observations on the Geology of the United States" by William McClure. Am. Phil. Soc. Trans. 1818. n. s. v. 1 (front). 44 x 33 cm. Scale about 1 in. = 95 m. A hand-colored map with a number of changes since the map of 1809.

(4) 1818 **Eaton, Amos.** A geological section extending from the Catskills to Boston. Accompanies "Index to the Geology of the Northern States." ed. 1, 1818. A black and white section.

(5) 1820 **Akerly, Samuel.** Geological section from neighborhood of Sandy Hook, N. J., northward through the Highlands in New York toward the Catskill mountains. Accompanies "Essay on the Geology of the Hudson River" by S. Akerly. 1820.

(6) 1820 **Eaton, Amos.** Section from the Susquehanna river near Jericho, N. Y. to Boston, Mass. Accompanies "Index to the Geology of the Northern States," by Amos Eaton. ed. 2, 1820. A black and white section showing a lithologic classification of strata.

(7) 1822 **Barnes, D. H.** Geological section of Canaan mountain. Am. Jour. Sci. 1822. v. 5, facing p. 8. Black and white.

(8) 1822 **Barton, D. W.** A map of the Catskills. Accompanies "Notice of the Geology of the Catskills," by D. W. Barton. Am. Jour. Sci. 1822. v. 4, facing p. 277. Black and white with geological indications.

(9) 1822 **Eaton, Amos.** *Geological Profile of the Rocks from Onondaga Salt Springs, N. Y. to Williams College, Mass.* Accompanies "A Geological and Agricultural Survey of Rensselaer Co.," by Amos Eaton, 1822. Black and white. Scale 1 in. = 10 m

(10) 1824 **Dewey, Chester.** *Geological Map of the County of Berkshire, Mass., and a Small Part of the Adjoining States.* Am. Jour. Sci. 1824. v. 8, facing p. 200. A hand-colored map 20 x 30 cm, including portions of Rensselaer, Columbia and Dutchess counties.

(11) 1824 (1822) **Eaton, Amos.** *Geological Profile Extending from the Atlantic to Lake Erie.* Accompanies "A Geological and Agricultural Survey of the District Adjoining the Erie Canal," by Amos Eaton. 1824. Pt 1.

(12) 1830 ——— *Colored Map Exhibiting a General View of the Economical Geology of New York and Parts of Adjoining States.* Accompanies "A Geological Text Book," by Amos Eaton, 1830. A hand-colored map of the State. The first geological map of New York State. 31 x 38 cm.

(13) 1832 **Young, J. B. & Heron J.** *A Geological Mineralogical Map of Part of Orange Co.* Am. Jour. Sci. 1832. 21:321. Scale 1 in. = 2 m. A black etching.

(14) 1838 **Hall, James.** *Section from the Mouth of the Genesee River to Instantur, Pa.* N. Y. State Assembly Doc. 200, 2d Rep't on 4th dist. 1838. Shows in black and white a vertical section.

(15) 1838 **Horsford, E. N.** *Geology of the Genesee River.* Accompanies N. Y. State Assembly Doc. 200. 2d Rep't on 4th dist. by James Hall. 1838. Shows various rock outcrops in black and white.

(16) 1841 **Emmons, E.** *Map of the Tertiary of Essex County.* N. Y. State Assembly Doc. 150, 1841, 5th Rep't of the Geologist of the 2d dist. 1841. A black and white etching showing outcrops of rocks (Calciferous, Potsdam, gneiss etc. with Tertiary (?).

(17) 1842 **Emmons, Vanuxem, Mather & Hall.** *Geologic Map of the State of New York.* Colored geologic map published separately. 92 x 99 cm. Scale 1 in. = 12 m.

(18) 1842 **Emmons, E.** *Geological Map of Clinton County.* Geol. N. Y. pt 2. 1842. pl. 17. Primary, Calciferous, Potsdam, Chazy, Birdseye, Trenton etc.

(19) 1842 ——— *Map of Jefferson County.* Geol. N. Y. pt 2. 1842. pl. 16. A hand-colored map showing Primary, Lorraine, Trenton, Potsdam, Calciferous etc.

(20) 1842 ——— Sections in the 2d geological district. Geol. N. Y. pt. 2. 1842. pl. 6-12. Colored geological sections.

(21) 1842 **Percival, James G.** A map of Connecticut including a portion of New York. Scale 1 in.= 5 m. Accompanies "Report on the Geology of Connecticut." 1842.

(22) 1843 **Cozzens, Issacher, jr.** *A Geological Map of New York or, Manhattan Island.* Accompanies "A Geological History of Manhattan or New York Island" by I. Cozzens, 1843 (front). Shows the geology in colors and is accompanied by two sections.

(23) 1843 **Hall, James.** *Geological Map of the Middle and Western States.* Geol. N. Y. pt 4. 1843. Follows p. 685. Scale 1 in.= 30 m. A large hand-colored geological map accompanied by a section sheet.

(24) 1843 ——— Sections in the 4th geological district. Geol. N. Y. pt 4. 1843. pl. 2-13. Colored geological sections.

(25) 1843 **Mather, W. W.** *Geological and Mineralogical Map of Part of Orange County.* Geol. N. Y. pt 1. 1843. pl. 41. Black and white.

(26) 1843 ——— Geological sections in the 1st geological district. Geol. N. Y. pt 1. Various plates.

(27) 1843 ——— North end of New York Island and sketch of Sterling Iron Mine. Geol. N. Y. pt 1. 1843. pl. 30. Colored geological maps.

(28) 1843 ——— Map of the Hudson river district near Rhinebeck, Germantown etc. Geol. N. Y. pt 1. 1843. pl. 29. A colored sketch map.

(29) 1843 ——— Map of area from Barnegat to Fishkill-on-the-Hudson. Geol. N. Y. pt 1. 1843. pl. 28. A colored geologic sketch map with two sections.

(30) 1843 ——— Geological sections on Long Island. Geol. N. Y. pt 1. 1843. pl. 4.

(31) 1843 ——— Geological sections of New York Island, and Lansingburg, Rensselaer co. Geol. N. Y. pt 1. 1843. pl. 3.

(32) 1843 ——— Oyster Pond Point, Sands Point, etc. Geol. N. Y. pt 1. 1843. pl. 2. Small sketches of the geology and topography.

(33) 1843 ——— Map of Rockland county, Westchester county, Long Island and Staten Island and New York Island. Geol. N. Y. pt 1. 1843. pl. 1. A large colored geologic map.

(34) 1844 **Emmons, E.** *Agricultural and Geological Map of the State of New York.* Same as " 1842 " map of the four geologists but contains the Taconic system.

(35) 1845 **Lyell,** *Sir* **Charles.** *Map of the Niagara District.* Accompanies " Travels in North America," by Sir Charles Lyell. 1845. v. 1, facing p. 30. A hand-colored map showing the strata Medina to Helderberg.

(36) 1845 ——— *Birdseye View of the Falls of Niagara and Adjacent Country Colored Geologically.* Accompanies " Travels in North America," by Sir Charles Lyell. 1845. v. 1 (front). Color printing used on this map. A panoramic view of the country from Lake Erie to Lewiston. This is the first example of color printing found on any geologic map in the United States, and was done in London.

(37) 1845 ——— *Geological Map of the United States and Canada.* Accompanies " Travels in North America," by Sir Charles Lyell. 1845. v. 2 (front). A very nicely hand-colored map. The New York portion was drawn from data obtained from the 1842 and 1843 reports of the Natural History Survey, as he had not seen the large map.

(38) 1850 **Fitch, Asa.** Geological sections across Washington county. N. Y. Agric. Soc. Trans. (1849). 1850. v. 9, facing p. 820.

(39) 1850 ——— Geological map of Washington county. N. Y. Agric. Soc. Trans. (1849). 1850. v. 9, facing p. 907. A black and white etching showing surficial deposits.

(40) 1853 **Marcou, Jules.** *Geological Map of the United States and British Provinces of North America.* Published with an explanatory text 1853. Scale 1 in. = 90 m. A hand-colored map showing the geology of New York State divided into Devonic, Upper and Lower Siluric, Igneous and metamorphic, copper trap, New Red sandstone, Tertiary and Quaternary.

(41) 1860 **Geddes, George.** *Geological and Topographical Map of Onondaga County.* N. Y. Agric. Soc. Trans. (1859). 1860. v. 19, facing p. 218. Scale 1 in. = 1¾ m. A large hand-colored map showing the areal geology from the Clinton to the Genesee formations accompanied by one structural section.

(42) 1862 **Denniston, Goldsmith.** Map of Steuben county. N. Y. Agric. Soc. Trans. (1861). 1862. v. 21, facing p. 548. 43.5 x 42.5 cm.

(43) 1863 ——— Map of Orange county. N. Y. Agric. Soc. Trans. (1862). 1863. v. 22, facing p. 136. The soils and rock outcrops are indicated by writing. 59 x 47.5 cm.

(44) 1865 **Credner, H.** *Geologische skizze von New York.* Accompanies "Geognostistiche skizze der umgegend von New York." H. Credner, in Zeit. Deut. Geol. Gesel. 1863. v. 17, Taf. 13.

(45) 1865 **Logan, *Sir* W. E.** (**& Hall, James**). *Geological Map of Canada.* Geological Survey of Canada. Atlas accompanying report of progress from commencement to 1863. 1865. Scale 1 in. = 125 m. A colored geologic map, including geology of a part of the United States by Hall. The New York portion was the first authoritative revision of the 1842 map.

(46) 1866 ——— *Geological Map of Canada.* Geological Survey of Canada, published separately. Scale 1 in. = 25 m. This map is the same as the one published in 1865 but on a larger scale. The 1865 map was in reality a reduction from this map.

(47) 1875 **Carll, J. F.** Map covering a portion of western New York. 2d Geol. Sur. of Penn. Rep't 1. Report of progress in Venango co. 1875. p. 57–108.

(48) 1875 **Hall, James.** Map of eastern United States. Mus. Rep't 27 (1873). 1875. 70 x 50 cm. This is the first geologic map dealing with New York State which was colored by color printing in this country. It shows the relations of the Niagara and Lower Helderberg formations.

(49) 1880 **Dana, J. D.** *Limestone Areas of Westchester County.* Am. Jour. Sci. 1880. ser. 3, v. 20, pl. 5, facing p. 359. Scale 1 in. = 3 m. A plain map showing limestone areas in blue.

(50) 1880 ——— *Limestone areas of Dutchess, Westchester and Putnam Counties, etc.* Am. Jour. Sci. 1880. ser. 3, v. 20, facing p. 450. A black and white map showing limestone, archaean and trap formations. Scale 1 in. = 10 m.

(51) 1880 ——— *Part of Western Cortlandt.* (Westchester co.) Am. Jour. Sci. 1880. ser. 3. 20: 194. A black and white geologic map.

(52) 1880 ——— *Geological Map of Part of New York and New Jersey from Prof. G. H. Cook's map of New Jersey.* Am. Jour. Sci. 1880. ser. 3, v. 20, pl. 9. A black and white geologic map of portions of Orange and Rockland counties.

(53) 1881 **Britton, N. L.** *A Geological Map of Richmond County.* N. Y. Acad. Sci. Ann. 1882. v. 2, pl. 15, facing p. 161. Also in Columbia School of Mines Quart. 1881. v. 2, pl. 1. Scale 1 in. = 2 m. 18 x 21 cm.

(54) 1881 **Dana, J. D.** *Geological Map of Southern Westchester County and Northern New York Island.* Am. Jour. Sci. 1881. ser. 3, v. 21, pl. 19. Scale 1 in. = 2 m. A plain map with limestone areas plotted in blue. 23.5 x 32.5 cm.

(55) 1881 ——— *Map of Parts of New York and New Jersey.* Am. Jour. Sci. 1881. ser. 3. 22: 106. A black and white geologic map of portions of Orange and Rockland counties.

(56) 1881 ——— Map of Stony Point (Rockland co.). Am. Jour. Sci. 1881. ser. 3. 22: 112. A small black and white map, the Triassic, limestone and conglomerate being indicated by writing.

(57) 1881 ——— Map of Part of Western Cortlandt showing Peekskill, Verplanck, Tompkins Cove and Cruger Limestone Areas by Horizontal Linings. Am. Jour. Sci. 1881. ser. 3. 22: 107. Black and white etching.

(58) 1882 **Hall, James.** New York State. In report of Public Service of the State of New York. Scale 1 in. = 38 m. A black and white map.

(59) 1882 **Johnson,** *Dr* **Lawrence.** *A Geological Map Designed to Illustrate a Paper on the Parallel Drift of Hills of Western New York.* Am. Jour. Sci. 1882. v. 2, pl. 18, facing p. 288. A black and white map with formations indicated by name and dotted boundaries. The first map dealing with glacial geology.

(60) 1884 **Davis, W. M.** A map showing portion of Greene county. Appalachia 1884. 3: 20–33. Accompanies paper by W. M. Davis on "Little Mountains East of the Catskills." Scale 1 in. = $\frac{3}{5}$ m. A black and white geological map of region near Catskill, with numerous sections.

(61) 1884 ——— Map of Greene county. Harvard Coll. Mus. Comp. Zool. Bul. 1884. 7: 311–29. Accompanies paper on Folded Helderberg limestones east of the Catskills.

(62) 1884 **Wright, B. H.** Map of Yates county. Mus. Rep't 35 (1881). 1884, between pl. 15 and 16. A colored geological map showing formations Marcellus to Chemung and salt, gas and stone quarries. 24 x 21 cm.

(63) 1885 **Clarke, J. M.** *A Geological Map of Ontario county.* Geol. Rep't 4 (1884). 1885. Facing p. 8. A colored map showing formations Salina to Chemung and Quaternary. Scale 1 in. = $2\frac{1}{2}$ m. 36 x 33.5 cm.

(64) 1885 **Dana, J. D.** *Geologic Map of the Taconic Region.* Am. Jour. Sci. 1885. ser. 3. v. 29, facing p. 222. Includes northeast Ancram and Copake townships in Dutchess and Columbia counties.

(65) 1885 **Ford, S. W.** Vicinity of Schodack Landing. Am. Jour. Sci. 1885. ser. 3. 29: 17. A small black and white geologic map showing the Lorraine and Lower Potsdam.

(66) 1885 **Hall, C. E.** *Geologic Map of Essex county.* Geol. Rep't 4 (1884). 1885. Facing p. 23. 48 x 40.5 cm.

(67) 1885 **Wendt, A. F.** *Map of Putnam County.* Am. Inst. Min. Eng. 1885. v. 13, facing p. 488. Gives simply mine locations.

(68) 1886 **Beecher, C. E. & Hall, C. E.** Map showing results of field work in Mohawk valley. Geol. Rep't 5 (1885). 1886. Facing p. 8. Scale 1 in. = 6 m. A map of partial geology in colors; Little Falls to Amsterdam.

(69) 1886 **Hitchcock, Charles H.** Map showing distribution of iron ores in New York State. 10th Census Rep't. 1886. v. 15. Scale 1 in. = 25 m.

(70) 1886 **Smock, J. C.** *Map of Archaean Areas of the Highlands, east of the Hudson River.* Mus. Rep't 39 (1885). 1886. Facing p. 184. Scale 1 in. = $6\frac{3}{10}$ m. A black and white map showing Archaean areas east of the Hudson river. 11 x 18.5 cm.

(71) 1887 **Ashburner, C. A. & Carll, J. F.** Map of the oil regions of Pennsylvania and New York. Am. Inst. Min. Eng. 1887. 15: 540. Scale 1 in. = 50 m. A black and white map showing developed oil pools.

(72) 1887 **Dana, J. D.** *Geologic Map of Middle and Northern Berkshire.* Am. Jour. Sci. 1887. ser. 3. p. 432.

(73) 1887 **Hitchcock, C. H.** *Geological Map of the United States and Parts of Canada.* Am. Inst. Min. Eng. Trans. 1887. v. 15. facing p. 486. A colored geological map, scale 1 in. = 115 m.

(74) 1887 **Williams, S. G.** Map showing geographic distribution of Tully limestone in central New York. Geol. Rep't 6 (1886). 1887. Facing p. 28. Scale 1 in. = 8 m. Tully limestone mapped in blue on plain map. 37.5 x 19 cm.

(75) 1888 **Ashburner, C. A.** *Map of the Allegany Oil and Gas District.* Am. Inst. Min. Eng. 1888. 16: 958. Scale 1 in. = $1\frac{3}{5}$ m. A black and white map showing the area of oil territory and the pipe lines.

(76) 1888 ——— *Sketch Geological Map of Portions of New York and Pennsylvania.* Am. Inst. Min. Eng. 1888. v. 16, pl. 1, facing p. 958. Scale 1 in. = 25 m. A colored geologic map showing formations Medina to Carboniferous.

(77) 1888 **Kemp, J. F.** *Geologic Map of the Vicinity of Rosetown.* Am. Jour. Sci. 1888. ser. 3. 36: 248.

(78) 1888 **Martin, D. S.** *Geological Map of New York City.* Accompanied by pamphlet, 1888. Scale 1 in. = 2 m.

(79) 1888 **Walcott, C. D.** *Geologic Map of Part of Eastern New York, Western Vermont, Western Massachusetts and Northwestern Connecticut.* Am. Jour. Sci. 1888. ser. 3. 35: 346, pl. 3. Shows the geology of the region east of the Hudson river in colors. Scale 1 in. = 10 m.

(80) 1889 **Smock, J. C.** Map showing location of iron ore mines in New York State. Mus. Bul. 7. 1889. Facing title-page. Scale 1 in. = 16 m.

(81) 1890 **Darton, N. H.** *Geologic Map of Northern New Jersey and Adjacent Portions of New York and Pennsylvania.* U. S. Geol. Sur. Bul. 67. 1890 (front); *also* U. S. Geol. Sur. Bul. 85. 1892. p. 24–25. Scale 1 in. = 8½ m. A colored map. 22 x 22 cm.

(82) 1890 ——— Map of Rockland county. U. S. Geol. Sur. Bul. 67. 1890. p. 40. Scale 1 in. = 1½ m. A black and white geologic map showing Triassic, Cambrian, Archaean etc.

(83) 1890 **Smock, J. C.** Map of New York State (economic). Mus. Bul. 10. 1890. Facing p. 396. Scale 1 in. = 15 m. A plain map on which the location of all building stone quarries is indicated in red. 58 x 60 cm.

(84) 1892 **Lincoln, D. F.** Map of Finger Lake region. Am. Jour. Sci. 1892. ser. 3. 44: 291. A black and white map showing the glacial geology and the Corniferous and Tully limestone boundaries dotted in.

(85) 1892 **Russell, I. C.** *Newark-Virginia and Other Newark Areas.* U. S. Geol. Sur. Bul. 85. 1892. p. 20–21. Scale 1 in. = 35 m. A colored map showing the Newark traps, etc. in southeastern New York.

(86) 1892 **Van Hise, C. R. (after McGee and Hitchcock).** *Geological Map of the Northeastern States.* U. S. Geol. Sur. Bul. 86. 1892. Facing p. 348. New York State colored in two colors representing Post-Algonkian and unclassified Precambric.

(87) 1893 **Dale, T. N.** *Region between the Taconic Range and the Hudson Valley.* U. S. Geol. Sur. 13th An. Rep't pt 2. 1893. pl. 97. Scale 1 in. = 5 m. The geology of Rensselaer and Columbia counties shown on a colored map.

(88) 1893 **Hobbs, W. H.** A geological map of the Mt Washington district. Jour. Geol. 1893. v. 1, facing p. 726. Shows the geology of the eastern part of Columbia and Dutchess counties, in black and white.

(89) 1893 **Kemp, J. F. & Marsters, V. F.** *General Map of Lake Champlain Region showing Distribution of Dikes.* U. S. Geol. Sur. Bul. 107. 1893. pl. I. Dikes are plotted on plain map. 20 x 35 cm.

(90) 1893 ——— *Sketch Map of Dikes at Split Rock and Vicinity.* U. S. Geol. Sur. Bul. 107. 1893. p. 40. A black and white geological map showing distribution of dikes.

(91) 1893 ——— *Sketch Map of Dikes on Mill Brook near Port Henry.* U. S. Geol. Sur. Bul. 107. 1893. p. 40. Scale 1 in. = 100 ft. A small black and white map showing dikes.

(92) 1893 ——— *Sketch Map of Dikes on Trembleau Point near Port Kent.* U. S. Geol. Sur. Bul. 107. 1893. p. 45.

(93) 1893 **Merrill, F. J. H.** Map of the salt region of Genesee, Livingston and Wyoming counties. Mus. Bul. 11. 1893 (cover). Scale 1 in. = 3 m. On plain map the underground contours of the salt beds are given and the location of the wells. 52 x 32.5 cm.

(94) 1893 ——— Map of New York State showing distribution of the Salina group and salt and gypsum deposits. Mus. Bul. 11. 1893 (cover). Scale 1 in. = 16 m. 38 x 55 cm.

(95) 1894 **Baldwin, S. P.** *Lake Champlain and its Pleistocene Area.* Am. Geol. 1894. v. 13, facing p. 170. A black and white map showing sand deltas, eskers etc.

(96) 1894 **Clarke, J. M.** Map showing location of salt wells and mines in western New York. Geol. Rep't 13 (1893). 1894. Facing p. 22; *also* Mus. Rep't 47 (1893). 1894. Facing p. 215.

(97) 1894 ——— Map showing area of Onondaga salt group. Geol. Rep't 13 (1893). 1894. Facing p. 14; *also* Mus. Rep't 47 (1893). 1894. Facing p. 208. A plain map with the Onondaga salt group plotted in blue. 37 x 14.5 cm.

(98) 1894 **Cushing, H. P.** Map of Chazy township, Clinton county. Geol. Soc. Am. Bul. 1894. v. 6, facing p. 284. Accompanies paper on Faults of Chazy township. Scale 1 in. = $\frac{3}{4}$ m. A black and white geologic map with sections.

(99) 1894 ——— Map of a portion of Clinton county. Geol. Rep't 13 (1893). 1894. Facing p. 480; *also* Mus. Rep't 47 (1893). 1894. Facing p. 674. Scale 1 in. = 2 m. A black and white geologic map.

(100) 1894 ——— Map of parts of Clinton county. Geol. Rep't 13 (1893). 1894. Facing p. 478; *also* Mus. Rep't 47 (1893). 1894. Facing p. 672. Scale 1 in. = 2 m. A black and white geologic map.

(100a) 1894 **Darton, N. H.** Map of southwestern part of Albany county. Geol. Rep't 13 (1893). 1894. Facing p. 254; *also* Mus. Rep't 47 (1893). 1894. Facing p. 448. Scale 1 in. = $1\frac{3}{10}$ m. A black and white stereogram.

(101) 1894 ——— *Region around Saugerties.* Geol. Rep't 13 (1893). 1894. Facing p. 317; *also* Mus. Rep't 47 (1893). 1894. Facing p. 504. Scale 1 in. = 1 m. A black and white stereogramic map showing formations Hudson River series to Hamilton.

(102) 1894 ——— *Geologic Map of Kingston Region,* Ulster co. Geol. Rep't 13 (1893). 1894. Facing p. 318; *also* Mus. Rep't 47 (1893). 1894. Facing p. 512. Scale 1 in. = 3000 ft. A black and white geologic map and sections.

(103) 1894 ——— *Stereogram of Shawangunk Mountain in Ulster county.* Geol. Rep't 13 (1893). 1894. Facing p. 346; *also* Mus. Rep't 47 (1893). 1894. Facing p. 540. Scale 1 in. = 3 m. A black and white stereogram showing formations Hudson River to Hamilton.

(104) 1894 ——— Rosendale cement region, Ulster county. Geol. Rep't 13 (1893). 1894. Facing p. 326; *also* Mus. Rep't 47 (1893). 1894. Facing p. 520. Scale 1 in. = 1 m. A black and white stereogramic map.

(105) 1894 **Davis, W. M.** Map of southern part of the Kingston region. Geol. Rep't 13 (1893). 1894. Facing p. 329; *also* Mus. Rep't 47 (1893). 1894. Facing p. 523. Scale 1 in. = ½ m. Black and white map showing Cauda galli grit to Hudson River series, with sections.

(106) 1894 **Hall, James.** *Preliminary Geologic Map of New York.* Published separately. This map was compiled by W. J. McGee and is known as the McGee map.

(107) 1894 ——— A map showing salt-producing districts of western New York. Geol. Rep't 13 (1893). 1894. Facing p. 22; *also* Mus. Rep't 47 (1893). 1894. Facing p. 215. On plain map the districts are marked in color. 34.5 x 21.5 cm.

(108) 1894 **Kemp, J. F.** Map of St Armand township, Essex county. Geol. Rep't 13 (1893). 1894. Facing p. 470; *also* Mus. Rep't 47 (1893). 1894. Facing p. 664. Scale 1 in. = 2 m. A black and white geologic map.

(109) 1894 ——— Map of North Elba township, Essex county. Geol. Rep't 13 (1893). 1894. Facing p. 470; *also* Mus. Rep't 47 (1893). 1894. Facing p. 664. Scale 1 in. = 3½ m. A black and white geologic map.

(110) 1894 ——— Map of Keene township, Essex county. Geol. Rep't 13 (1893). 1894. Facing p. 68; *also* Mus. Rep't 47 (1893). 1894. Facing p. 662. Scale 1 in. = 3½ m. A black and white geologic map.

(111) 1894 ——— Map of Lewis township, Essex county. Geol. Rep't 13 (1893). 1894. Facing p. 466; *also* Mus. Rep't 47 (1893). 1894. Facing p. 660. Scale 1 in. = 3½ m. A black and white geologic map.

(112) 1894 ——— Map of Elizabethtown township, Essex county. Geol. Rep't 13 (1893). 1894. Facing p. 466; *also* Mus. Rep't 47 (1893). 1894. Facing p. 660. Scale 1 in. = 3½ m. A black and white geologic map.

(113) 1894 ——— Map of Crown Point township, Essex county. Geol. Rep't 13 (1893). 1894. Facing p. 456; *also* Mus. Rep't 47 (1893). 1894. Facing p. 650. Scale 1 in. = 2¾ m. A black and white geologic map.

(114) 1894 ——— Map of Essex township, Essex county. Geol. Rep't 13 (1893). 1894. Facing p. 460; *also* Mus. Rep't 47 (1893). 1894. Facing p. 654. Scale 1 in. = 3 m. A black and white geologic map.

(115) 1894 ——— Map of Chesterfield township, Essex county. Geol. Rep't 13 (1893). 1894. Facing p. 462; *also* Mus. Rep't 47 (1893). 1894. Facing p. 656. Scale 1 in. = 3½ m. A black and white geologic map.

(116) 1894 ——— A map of Willsborough township, Essex county Geol. Rep't 13 (1893). 1894. Facing p. 462; *also* Mus Rep't 47 (1893). 1894. Facing p. 656. A black and white geologic map.

(117) 1894 **Merrill, F. J. H.** *Economic and Geologic Map of New York State.* Accompanies "New York at the World's Columbian Exposition," the report of the Board of Managers of New York's exhibit, 1894. Scale 1 in. = 14 m. A complete colored geologic map of the State, also giving the location of all economic deposits. 59 x 67 cm.

(118) 1894 **Smyth, C. H. jr.** Map of parts of Jefferson and St Lawrence counties. Geol. Rep't 13 (1893). 1894. Facing p. 493; *also* Mus. Rep't 47 (1893). 1894. Facing p. 686. A black and white geologic map.

(119) 1894 **White, T. G.** *Enlarged Map of Shores of Willsboro Bay and Willsboro Point, showing Distribution of Dikes.* N. Y. Acad. Sci. Trans. 1894. v. 13, pl. VII. Scale 1 in. = 4500 ft. Shows dikes and other geologic features.

(120) 1894 ——— Geologic map of Essex and Willsboro townships, Essex county. N. Y. Acad. Sci. Trans. 1894. v. 13, pl. VI. Scale 1 in. = 1½ m.

(121) 1895 **Darton, N. H.** Preliminary geologic map of the Mohawk valley region. Geol. Rep't 14 (1894). 1895. Facing p. 33; *also* Mus. Rep't 48 (1894). 1895. v. 2, facing p. 33. Scale 1 in. = 7 m.

(122) 1895 ——— *Sketch Map of Region North of Mayfield.* Geol. Rep't 14 (1894). 1895. p. 46; *also* Mus. Rep't 48 (1894). 1895. 2: 46. Scale 1 in. = ½ m. A black and white geologic map.

(123) 1895 **Fairchild, H. L.** *Salient Features of the Glacial Geology of Rochester, N. Y.* Am. Geol. 1895. v. 16, facing p. 40. Scale 1 in. = 1⅞ m. Shows area of various glacial deposits.

(124) 1895 **Kemp, J. F.** *Geologic Map of Moriah and Westport Townships, Essex county.* Mus. Bul. 14. 1895. Following p. 355; *also* Mus. Rep't 48, v. 1, facing p. 356. Scale 1 in. = 1 m. A black and white geologic map on topographic base. 38 x 44 cm.

(125) 1895 **Merrill, F. J. H.** *Geological Map of a Part of Southeastern New York.* Mus. Bul. 15. 1895 (cover); *also* Mus. Rep't 48 (1894). 1895. v. 1, after index to Bul. 15. Scale 1 in. = 4 m. A colored geologic map, 23 x 35 cm.

(126) 1895 ——— *Economic and Geologic Map of New York State.* ed. 2 of no. 117; Bul. 15. 1895 (cover); *also* Mus. Rep't 48 (1894). 1895. v. 1, facing p. 365.

(127) 1895 **Ries, H.** *Map of New York State Showing Location of Clay Deposits and Manufactories.* Mus. Bul. 12. 1895. (in cover); *also* Mus. Rep't 48 (1894). 1895. v. 1, facing p. 262. Scale 1 in. = 14 m. 56 x 67 cm.

(128) 1896 **Fairchild, H. L.** *Map of Victor Kame Area.* Jour. Geol. 1896. v. 4, facing p. 139. Scale 1 in. = 1⅜ m. Shows various glacial deposits near Victor, Ontario co.

(129) 1896 ——— *Map of Mendon Kame Area.* Jour. Geol. 1896. v. 4, facing p. 145. Scale 1 in. = 1⅓ m. Shows various glacial deposits around Mendon, Monroe co.

(130) 1896 ——— *Map of Junius Kame Area.* Jour. Geol. 1896. v. 4, facing p. 151. Scale 1 in. = 1⅗ m. Shows various glacial deposits around Junius, Seneca co.

(131) 1896 ——— *General Map of the Irondequoit-Sodus District.* Jour. Geol. 1896. v. 4, facing p. 131. Scale 1 in. = 15 m. Shows location in black and white of four kame areas.

(132) 1896 **Ries, H.** *Map of Augen-gneiss Area.* Bedford. Am. Geol. 1896. v. 18, facing p. 261. Scale 1 in. = 1 m. Shows extent of augen-gneiss, diorite, dikes and pegmatite veins around Bedford.

(133) 1897 **Bishop, I. P.** *Economic and Geologic Map of Erie county.* Geol. Rep't 15 (1895). 1897. Facing p. 392; *also* Mus. Rep't 49 (1895). 1898. v. 2, facing p. 392. Scale 1 in. = 4 m. On plain map shows gas territory, wells, quarries, cement and brick factories. 21 x 32 cm.

(134) 1897 **Clarke, J. M.** *Geologic Map Showing the Distribution of the Portage Group, etc.* Geol. Rep't 15 (1895). 1897. p. 60; *also* Mus. Rep't 49 (1895). 1898. pt 2, p. 60. Scale 1 in. = 5 m. A colored geologic map of a portion of western New York.

(135) 1897 ——— *Geologic Map of a Part of Chenango and Cortland Counties.* Geol. Rep't 15 (1895). 1897. Facing p. 42; *also* Mus. Rep't 49 (1895). 1898. pt 2, p. 42. Scale 1 in. = 5 m. A colored geologic map.

(136) 1897 **Cushing, H. P.** *Map of Clinton county.* Geol. Rep't 15 (1895). 1897. Facing p. 503; *also* Mus. Rep't 49 (1895). 1898. v. 2, facing p. 503. Scale 1 in. = 5½ m. Shows on a black and white map the Precambrian boundary.

(137) 1897 ——— Map of Altona township, Clinton county. Geol. Rep't 15 (1895). 1897. p. 563; *also* Mus. Rep't 49 (1895). 1898. 2: 563. Scale 1 in. = 2⅗ m. A black and white geologic map.

(138) 1897 ——— Map of Chazy township, Clinton county. Geol. Rep't 15 (1895). 1897. p. 567; *also* Mus. Rep't 49 (1895). 1898. 2: 567. Scale 1 in. = 2 m. A black and white geologic map.

(139) 1897 ——— Map of Champlain township, Clinton county. Geol. Rep't 15 (1895). 1897. p. 572; *also* Mus. Rep't 49 (1895). 1898. 2: 572. Scale 1 in. = 2 m. A black and white geologic map.

(140) 1897 ——— Map of Beekmantown township, Clinton county. Geol. Rep't 15 (1895). 1897. p. 560; *also* Mus. Rep't 49 (1895). 1898. 2: 560. Scale 1 in. = 3 m. A black and white geologic map.

(141) 1897 ——— Map of Plattsburg and Schuyler Falls townships, Clinton county. Geol. Rep't 15 (1895). 1897. p. 553; *also* Mus. Rep't 49 (1895). 1898. 2: 553. Scale 1 in. = 3 m. A black and white geologic map.

(142) 1897 ——— Map of Peru township, Clinton county. Geol. Rep't 15 (1895). 1897; *also* Mus. Rep't 49 (1895). 1898. 2:550. Scale 1 in. = 3 m. A black and white geologic map.

(143) 1897 ——— Map of Ausable township, Clinton county. Geol. Rep't 15 (1895). 1897. p. 546; *also* Mus. Rep't 49 (1895). 1898. 2: 546. Scale 1 in. = 3 m. A black and white geologic map.

(144) 1897 ——— Map of Black Brook, Clinton county. Geol. Rep't 15 (1895). 1897. p. 542; *also* Mus. Rep't 49 (1895). 1898. 2: 542. Scale 1 in. = 3 m. A black and white geologic map.

(145) 1897 ——— Map of Saranac township, Clinton county. Geol. Rep't 15 (1895). 1897. p. 539; *also* Mus. Rep't 49 (1895). 1898. 2: 539. Scale 1 in. = 3 m. A black and white geologic map.

(146) 1897 ——— Map of Dannemora township, Clinton county. Geol. Rep't 15 (1895). 1897. p. 536; *also* Mus. Rep't 49 (1895). 1898. 2: 536. Scale 1 in. = 3 m. A black and white geologic map.

(147) 1897 ——— Map of Ellenburg township, Clinton county. Geol. Rep't 15 (1895). 1897. p. 533; *also* Mus. Rep't 49 (1895). 1898. 2: 533. Scale 1 in. = 3 m. A black and white geologic map.

(148) 1897 **Darton, N. H. & Hall, J.** *Preliminary Geologic Map of Albany county.* Geol. Rep't 15 (1895). 1897. v. 1, facing p. 738; *also* Mus. Rep't 49 (1895). 1898. v. 2, facing p. 738. Scale 1 in. = 1 m. A colored geologic map on topographic base. 74.5 x 78 cm.

(149) 1897 **Fairchild, H. L.** Maps accompanying paper on Lake Warren shore lines in western New York and the Geneva beach. Geol. Soc. Am. Bul. 1897. v. 8, pl. 30.

(150) 1897 ——— *Pleistocene Geology of Western New York.* Geol. Mag. 1897. v. 4, facing p. 529. Scale 1 in. = 25 m. A black and white map showing glacial deposits.

(151) 1897 **Kemp, J. F.** *Geologic Map of Newcomb Township,* Essex county. Geol. Rep't 15 (1895). 1897. p. 604; *also* Mus. Rep't 49 (1895). 1898. v. 2, facing p. 604. Scale 1 in.= 2½ m. A black and white geologic map.

(152) 1897 ——— *Geologic Map of Minerva Township,* Essex county. Geol. Rep't 15 (1895). 1897. p. 602; *also* Mus. Rep't 49 (1895). 1898. v. 2, facing p. 602. Scale 1 in. = 2 m. A black and white geologic map.

(153) 1897 ——— *Geologic Map of Ticonderoga Township,* Essex county. Geol. Rep't 15 (1895). 1897. Facing p. 600; *also* Mus. Rep't 49 (1895). 1898. v. 2, facing p. 600. Scale 1 in. = 1⅝ m. A black and white geologic map.

(154) 1897 ——— Map of Schroon township, Essex county. Geol. Rep't 15 (1895). 1897. Facing p. 592; *also* Mus. Rep't 49 (1895). 1898. v. 2, facing p. 592. Scale 1 in. = 1⅝ m. A black and white geologic map.

(155) 1897 ——— Map of North Hudson township, Essex county. Geol Rep't 15 (1895). 1897. Facing p. 590; *also* Mus. Rep't 49 (1895). 1898. v. 2, facing p. 590. Scale 1 in. = 1¼ m. A black and white geologic map.

(156) 1897 ——— Map of St Armand township, Essex county. Geol. Rep't 15 (1895). 1897. Facing p. 588; *also* Mus. Rep't 49 (1895). 1898. v. 2, facing p. 588. Scale 1 in. = 1½ m. A black and white geologic map.

(157) 1897 ——— Map of Wilmington township, Essex county. Geol. Rep't 15 (1895). 1897. Facing p. 586; *also* Mus. Rep't 49 (1895). 1898. v. 2, facing p. 586. Scale 1 in. = 2 m. A black and white geologic map.

(158) 1897 ——— Map of Jay township, Essex county. Geol. Rep't 15 (1895). 1897. Facing p. 582; *also* Mus. Rep't 49 (1895). 1898. v. 2, facing p. 582. Scale 1 in. = 1¾ m. A black and white geologic map.

(159) 1897 ——— Map of Chesterfield township, Essex county. Geol. Rep't 15 (1895). 1897. Facing p. 580; *also* Mus. Rep't 10 (1895). 1898. v. 2, facing p. 580. Scale 1 in. = 1¾ m. A black and white geologic map.

(160) 1897 **Luther, D. D.** *Geological Map of Onondaga County.* Geol. Rep't 15 (1895). 1897. Facing p. 302; *also* Mus. Rep't 49 (1895). 1898. pt 2, facing p. 302. Scale 1 in. = 1 m. A colored geologic map. 34 x 38 cm.

(161) 1897 ——— Map of Naples township, Ontario county. Geol. Rep't 15 (1895). 1897. p. 236; *also* Mus. Rep't 49 (1895). 1898. 2: 236. A colored geologic map, topography in shading. 16.5 x 17 cm.

(162) 1897 **Merrill, F. J. H.** Map of New York State showing location of stone quarries. Mus. Bul. 17. 1897 (in cover); also Mus. Rep't 50 (1896). 1898. v. 1. Scale 1 in. = 12 m. Shows location of building stone and road metal quarries. 68 x 92 cm.

(163) 1897 ——— *Map of New York State Showing Distribution of Rocks Useful for Road Material.* Mus. Bul. 17. 1897 (in cover); *also* Mus. Rep't 50 (1896). 1898. v. 1. Scale 1 in. = 24 m. 34 x 44 cm.

(164) 1897 **Prosser, C. S.** Map of Central New York showing distribution of the Hamilton and Chemung series. Geol. Rep't 15 (1895). 1897. Facing p. 87; *also* Mus. Rep't 49 (1895). 1898. 2: 87. Scale 1 in. = 5 m. A colored geologic map.

(165) 1897 **Ries, H.** Map showing the mines and quarries of Orange county. Geol. Rep't 15 (1895). 1897. p. 475; *also* Mus. Rep't 49 (1895). 1898. 2: 475. Scale 1 in. = 4 m. A plain map indicating the location of the mines and quarries.

(166) 1897 ——— Map of a portion of Orange county. Geol. Rep't 15 (1895). 1897. p. 415; *also* Mus. Rep't 49 (1895). 1898. pt 2, p. 415. Scale 1 in. = 1 m. A black and white geologic map.

(167) 1897 ——— *Geologic Map of Orange County*. Geol. Rep't 15 (1895). 1897. Facing p. 395; *also* Mus. Rep't 49 (1895). 1898. pt 2, p. 395. Scale 1 in. = about 2½ m. A colored geologic map. 34 x 44 cm.

(168) 1897 ——— Map of Warwick township, Orange county. Geol. Rep't 15 (1895). 1898. p. 408; *also* Mus. Rep't 49 (1895). 1898. pt 2, p. 408. Scale 1 in. = 1 m. A black and white geologic map.

(169) 1897 ——— A map of Bull Hill, Orange county. Geol. Rep't 15 (1895). 1897. p. 420; *also* Mus. Rep't 49 (1895). 1898. 2:420. A black and white geologic map.

(170) 1897 ——— Map of the region west of Cornwall, Orange county. Geol. Rep't 15 (1895). 1897. p. 427; *also* Mus. Rep't 49 (1895). 1898. 2:427.

(171) 1897 ——— Map of Chester township, Orange county. Geol. Rep't 15 (1895). 1897. p. 428; *also* Mus. Rep't 49 (1895). 1898. 2 : 428. Scale 1 in. = 1 m. A black and white geologic map.

(172) 1897 ——— Map of Deer Park township, Orange county. Geol. Rep't 15 (1895). 1897. p. 470; *also* Mus. Rep't 49 (1895). 1898. 2 : 470. Scale 1 in. = 1 m. A black and white geologic map.

(173) 1897 ——— Map of Hamptonburg township, Orange county. Geol. Rep't 15 (1895). 1897. p. 472; *also* Mus. Rep't 49 (1895). 1898. 2 : 472. Scale 1 in. = ⅔ m. A black and white geologic map.

(174) 1897 **Ruedemann, R.** Map accompanying paper on evidence of current action in the Ordovician of New York. Am. Geol. 1897. v. 19, pl. 22.

(175) 1898 **Fairchild, H. L.** *Map Showing Glacial Lake Geology of Western New York*. Geol. Soc. Am. Bul. 1898. v. 10, pl. 3. A black and white map showing distribution of kames, drumlins etc.

(176) 1898 **Kemp, J. F.** Map of the Lake Placid region. Mus. Bul. 21. 1898. (cover); *also* Mus. Rep't 52 (1898). 1900. Scale 1 in. = 1 m. Colored geologic map on topographic base, including Lake Placid and region to the east. 33 x 34 cm.

(177) 1898 **Merrill, F. J. H.** A relief and geologic map of New York State. Mus. Bul. 19. 1898 (cover); *also* Mus. Rep't 51 (1897). 1899. v. 1, facing p. 102. Scale 1 in. = 24 m. On a relief map, the extent of the geologic systems is shown in colors. 33 x 43 cm.

(178) 1898 ——— Map of Davenport's neck, New Rochelle. Mus. Rep't 50 (1896). 1898. v. 1, pl. VI. Scale 1 in. = 1250 ft. Shows outcrops of serpentine and Ordovician schist.

(179) 1898 **Quereau, E. C.** Jamesville lake (glacial). Geol. Soc. Am. Bul. 1898. v. 9, pl. 12.

(180) 1899 **Bishop, I. P.** Map of portion of Cattaraugus county. Geol. Rep't 17 (1897). 1899. Facing p. 62; *also* Mus. Rep't 51 (1897). 1899. v. 2, facing p. 62. Scale 1 in. = 1⅗ m. The oil and gas fields plotted in black and white.

(181) 1899 **Cushing, H. P.** Portion of Potsdam and Pierrepont townships, St Lawrence county. Geol. Rep't 16 (1896). 1899. p. 25; *also* Mus. Rep't 50 (1896). 1899. 2 : 25. Scale 1 in. = $\frac{2}{3}$ m. Shows outcrops and quarries in black and white.

(182) 1899 ——— *Geological map of Franklin county.* Geol. Rep't 18 (1898). 1899 (in cover); *also* Mus. Rep't 52 (1898). 1900. v. 2 (in cover). Scale 1 in. = 5 m. A colored geologic map. 29 x 39 cm.

(183) 1899 ——— Map of St Lawrence and Franklin counties. Geol. Rep't 16 (1896). 1899. Facing p. 4; *also* Mus. Rep't 50 (1896). 1899. v. 2, facing p. 4. Scale 1 in. = 5 m. Shows in black and white the outcrops of the various formations.

(184) 1899 **Dale, T. N.** *Map of Slate Belt of Vermont and New York.* U. S. Geol. Sur. 19th An. Rep't 1899. pt 3, p. 176. Scale 1 in. = $2\frac{3}{4}$ m. A colored geologic map on topographic base.

(185) 1899 ——— *Quarry Map of Slate District* (Washington co.). U. S. Geol. Sur. 19th An. Rep't. 1899. pt 3, p. 268. Scale 1 in. = $\frac{1}{2}$ m. Shows part of eastern Washington co. A colored geologic and topographic map.

(186) 1899 ——— *Map of Hampton and Granville Showing Slate Quarries* (Washington co.). U. S. Geol. Sur. 19th An. Rep't pt 3. 1899. p. 266. Scale 1 in. = $\frac{1}{2}$ m. A colored geologic and topographic map.

(187) 1899 **Fairchild, H. L.** *Map Showing Shore Lines and Outlets of Glacial Lakes in Central New York.* Am. Jour. Sci. ser. 4. 1899. v. 7, pl. 6. Scale 1 in. = 8 m. A black and white map.

(188) 1899 **Fisher, W. L.** *Geologic Map of Delaware County.* Geol. Rep't 17 (1897). 1899. Facing p. 104; *also* Mus. Rep't 51 (1897). 1899. v. 2, facing p. 104. Scale 1 in. = 5 m. Colored geologic map. 32 x 34 cm.

(189) 1899 **Grabau, A. W.** Map of Hamburg township, Erie county. Geol. Rep't 16 (1896). 1899. Facing p. 230; *also* Mus. Rep't 50 (1896). 1899. v. 2, facing p. 230. A black and white map showing outcrops of Hamilton group.

(190) 1899 **Kemp, J. F.** *Map of Lake Sanford (Essex co.) Region Showing Location of Ore Bodies.* U. S. Geol. Sur. 19th An. Rep't pt 3. 1899. Facing p. 410.

(191) 1899 ——— *Map of Portions of Elizabethtown and Westport* (Essex co.). U. S. Geol. Sur. 19th An. Rep't pt 3. 1899. p. 398. Scale 1 in. = 1 m. A colored geologic and topographic map.

(192) 1899 ——— Map of portion of Hamilton co. Geol. Rep't 18 (1898). 1899. Facing p. 141; *also* Mus. Rep't 52 (1898). 1900. v. 2, facing p. 141. Scale 1 in. = $2\frac{1}{2}$ m. A black and white geologic map.

(193) 1899 ——— Map of vicinity of Wells village, Hamilton county. Geol. Rep't 18 (1898). 1899. Facing p. 144; *also* Mus. Rep't 52 (1898). 1900. v. 2, facing p. 144. Scale 1 in. = about $\frac{1}{2}$ m. A black and white geologic map.

(194) 1899 ——— Map of Johnsburg township, Warren county. Geol. Rep't 18 (1898). 1899. Facing p. 158; *also* Mus. Rep't 52 (1898). 1900. v. 2, facing p. 158. Scale 1 in. = 2 m. A black and white geologic map.

(195) 1899 ——— Map of Fort Ann township, Washington county. Geol. Rep't 18 (1898). 1899. Facing p. 162; *also* Mus. Rep't 52 (1898). 1900. v. 2, facing p. 162. Scale 1 in. = 2 m. A black and white geologic map.

(196) 1899 ——— & **Newland, D. H.** Map of Long Lake and Indian Lake townships, Hamilton county. Geol. Rep't 17 (1897). 1899. Facing p. 552, *also* Mus. Rep't 51 (1897). 1899. v. 2, facing p. 552. Scale 1 in. = 6 m. A black and white geologic map.

(197) 1899 ——— Map of Newcomb township, Essex county. Geol. Rep't 17 (1897). 1899. Facing p. 550; *also* Mus. Rep't 51 (1897). 1899. v. 2, facing p. 550. Scale 1 in. = 3 m. A black and white geologic map.

(198) 1899 ——— Map of Minerva township, Essex county. Geol. Rep't 17 (1897). 1899. Facing p. 550; *also* Mus. Rep't 51 (1897). 1899. v. 2, facing p. 548. A black and white geologic map.

(199) 1899 ——— Map of Bolton township, Warren county. Geol. Rep't 17 (1897). 1899. Facing p. 534; *also* Mus. Rep't 51 (1897). 1899. v. 2, facing p. 534. Scale 1 in. = 2¼ m. A black and white geologic map.

(200) 1899 ——— Map of Chester township, Warren county. Geol. Rep't 17 (1897). 1899. Facing p. 536; *also* Mus. Rep't 51 (1897). 1899. v. 2, facing p. 536. Scale 1 in. = 2½ m. A black and white geologic map.

(201) 1899 ——— Map of Hague township, Warren county. Geol. Rep't 17 (1897). 1899. Facing p. 538; *also* Mus. Rep't 51 (1897). 1899. v. 2, facing p. 538.

(202) 1899 ——— Map of Fort Ann township, Washington county. Geol. Rep't 17 (1897). 1899. Facing p. 530; *also* Mus. Rep't 51 (1897). 1899. v. 2, facing p. 530. Scale 1 in. = 2¼ m. A black and white geologic map.

(203) 1899 ——— Map of Whitehall village and ridge to the west. Geol. Rep't 17 (1897). 1899. Facing p. 522; *also* Mus. Rep't 51 (1897). 1899. v. 2, facing p. 522. Scale 1 in. = ½ m. A black and white geologic map.

(204) 1899 ——— Map of Whitehall township, Washington county. Geol. Rep't 17 (1897). 1899. Facing p. 520; *also* Mus. Rep't 51 (1897). 1899. v. 2, facing p. 520. Scale 1 in. = 1¾ m. A black and white geologic map.

(205) 1899 ——— Map of Dresden township, Washington county. Geol. Rep't 17 (1897). 1899. Facing p. 514; *also* Mus. Rep't 51 (1897). 1899. v. 2, facing p. 514. Scale 1 in. = 2¼ m. A black and white geologic map.

(206) 1899 ——— Map of Putnam township, Washington county. Geol. Rep't 17 (1897). 1899. Facing p. 512; *also* Mus. Rep't 51 (1897). 1899. v. 2, facing p. 512. Scale 1 in. = 1¾ m. A black and white geologic map.

(207) 1899 ——— Map of part of Warren county. Geol. Rep't 17 (1897). 1899. Facing p. 546; *also* Mus. Rep't 51 (1897). 1899. v. 2, facing p. 546. Scale 1 in. = 4 m. A black and white geologic map.

(208) 1899 ——— Map of Horicon township, Warren county. Geol. Rep't 17 (1897). 1899. Facing p. 544; *also* Mus. Rep't 51 (1897). 1899. v. 2, facing p. 544. Scale 1 in. = 2 m. A black and white geologic map.

(209) 1899 **Kümmel, H. B.** Map of portion of Tarrytown and Ramapo quadrangles. Geol. Rep't 18 (1898). 1899. (pocket); *also* Mus. Rep't 52 (1898). 1900. v. 2 (in pocket). Scale 1 in. = 1 m. Colored geologic map on topographic base, showing extent of Triassic rocks. 44 x 45 cm.

(210) 1899 ——— *Newark Area of New Jersey and New York.* Jour. Geol. 1899. 7: 23. A small black and white geologic map.

(211) 1899 ——— *Map of Newark Rocks in New York State.* N. J. Geol. Sur. (1898). 1899. p. 46. Scale 1 in. = 5 m. A small black and white geologic map of southeastern New York.

(212) 1899 **Luther, D. D.** Geologic map of the salt region, western and central New York. Geol. Rep't 16 (1896). 1899. Facing p. 172; *also* Mus. Rep't 50 (1896). 1899. v. 2, facing p. 172. Scale 1 in. = 16 m. A colored geologic map including also location of salt wells and mines. 24 x 45 cm.

(213) 1899 **Orton, E.** Portion of Chautauqua county. Mus. Bul. 30. 1899. Facing p. 492; *also* Mus. Rep't 53 (1899). 1901. v. 1, facing p. 492. Scale 1 in. = 6 m. Colored geologic map Ripley to Irving. 22 x 7 cm.

(214) 1899 **Prosser, C. S.** Map showing distribution of middle and upper Devonian rocks in central New York. Geol. Rep't 17 (1897). 1899. Facing p. 65; *also* Mus. Rep't 51 (1897). 1899. v. 2, facing p. 65. Scale 1 in. = 5 m. A colored geologic map. 61 x 38.5 cm.

(215) 1899 **White, T. G.** *Map of the Vicinity of Frankfort Hill* (Herkimer co.) Mus. Rep't 51 (1897). 1899. Facing p. 154. Scale 1 in. = 1 m. A geologic map on topographic base. 31.5 x 16.5 cm.

(216) 1899 ——— Map of portions of Oneida and Lewis counties. Mus. Rep't 51 (1897). 1899. v. 1, facing p. 154. Scale 1 in. = 2½ m. A black and white geologic map of the Precambric boundary. 16 x 49.5 cm.

(217) 1900 **Clarke, J. M.** *Geological Map of the Becraft Mountain Synclinal,* Columbia county. Mus. Mem. 3. 1900. Facing p. 12; *also* Mus. Rep't 53 (1899). 1901. v. 2, facing p. 12. Scale 1 in. = 120 rd. Black and white map.

(218) 1900 **Prosser, C. S.; Cumings, (E. R.) & Fisher, (W. L.).** Geologic map of Amsterdam quadrangle. Mus. Bul. 34. 1900 (in cover); *also* Mus. Rep't 54 (1900). 1902. v. 1, facing p. 484. Scale 1 in. = 1 m. Colored geologic map on topographic base. 33 x 44.5 cm.

(219) 1900 **Ries, H.** Map of New York State showing location of clay and shale deposits and factories. Mus. Bul. 35. 1900 (in cover); *also* Mus. Rep't 54 (1900). 1902. v. 2 (in cover). Scale 1 in. = 12 m. 93.5 x 69.5 cm.

(220) 1901 **Cushing, H. P.** *Geological Map of Part of Clinton County.* Geol. Rep't 19 (1899). 1901. Facing p. r40; *also* Mus. Rep't 53 (1899). 1901. v. 1, facing p. r40. Scale 1 in. = 5 m. A colored geological map.

(221) 1901 ——— *Geological Map of Portion of Clinton County.* Geol. Rep't 19 (1899). 1901. Facing p. r39; *also* Mus. Rep't 53 (1899). 1901. v. 1, facing p. r39. Scale 1 in. = 1 m. A colored geologic map on topographic base, accompanied by 3 sections.

(222) 1901 **Grabau, A.** Map of Niagara river and vicinity. Mus. Bul. 45. 1901 (in cover); *also* Mus. Rep't 54 (1900). 1902. v. 4 (in cover). Scale 1 in. = 1 m. A colored geologic map on topographic base. 38 x 84.5 cm.

(223) 1901 **Greenwood, J. W.** Map of oil territory of Allegany county. Geol. Rep't 19 (1899). 1901. Facing p. r107; *also* Mus. Rep't 53 (1899). 1901. v. 1, facing p. r107. Scale 1 in. = 3½ m. A black and white map showing proven oil and gas territory. 17 x 25.5 cm.

(224) 1901 **Kemp, (J. F.) & Hill, (B. F.).** Map of Caldwell township, Warren county. Geol. Rep't 19 (1899). 1901. Facing p. r22; *also* Mus. Rep't 53 (1899). 1901. v. 1, facing p. r22. Scale 1 in. = 1¼ m. A black and white geologic map.

(225) 1901 ——— Map of the "Noses," Montgomery and Fulton counties. Geol. Rep't 19 (1899). 1901. Facing p. r32; *also* Mus. Rep't 53 (1899). 1901. v. 1, facing p. r32. Scale 1 in. = 1 m. Shows outcrops of Granville gneiss along Erie canal on topographic base.

(226) 1901 ——— Map of northern Fulton county. Geol. Rep't 19 (1899). 1901. Facing p. r29; *also* Mus. Rep't 53 (1899). 1901. v. 1, facing p. r29. Scale 1 in. = 5 m. A black and white geologic map.

(227) 1901 ——— Map of northern Saratoga county. Geol. Rep't 19 (1899). 1901. Facing p. r28; *also* Mus. Rep't 53 (1899). 1901. v. 1, facing p. r28. Scale 1 in. = 4 m.

(228) 1901 ——— Map of Queensbury township, Warren county. Geol. Rep't 19 (1899). 1901. Facing p. r26; *also* Mus. Rep't 53 (1899). 1901. v. 2, facing p. r26. Scale 1 in. = 2 m. A black and white geologic map.

(229) 1901 **Leverett, (F.) & Taylor, (F. B.).** Pleistocene maps of western New York. U. S. Geol. Sur. Monogr. 41. 1901. pl. 21, 23, 26. Various maps showing the extent of glacial lakes.

(230) 1901 **Leverett, F.** Map showing glaciated area of Olean quadrangle. U. S. Geol. Sur. Monogr. 41. 1901 (in pocket). Scale 1 in. = 1 m. A topographic map showing the glaciated and nonglaciated area of the district.

(231) 1901 ——— A pleistocene map of central United States. U. S. Geol. Sur. Monogr. 41. 1901. pl. 2. Shows glacial deposits in western New York in colors.

(232) 1901 ——— *Pleistocene Features Southeast of Buffalo.* U. S. Geol. Sur. Monogr. 41. 1901. pl. 25. Scale 1 in. = 2¾ m. A colored map.

(233) 1901 ——— *Pleistocene Map of Part of Dunkirk, Cherry Creek and Silver Creek Quadrangles.* U. S. Geol. Sur. Monogr. 41. 1901. pl. 19. Scale 1 in. = 2¾ m. A colored pleistocene map on topographic base.

(234) 1901 ——— Map of portions of Pennsylvania, Ohio and New York. U. S. Geol. Sur. Monogr. 44. 1901. pl. 15. Scale 1 in. = 20 m. Shows in colors the pleistocene features of southwestern New York.

(235) 1901 ——— *Pleistocene Map of the District between Niagara River and Rochester.* U. S. Geol. Sur. Monogr. 41. 1901. pl. 3. Scale 1 in. = 3 m. A colored pleistocene map on topographic base.

(236) 1901 **Merrill, F. J. H.** *Geologic Map of New York State.* Issued separately with accompanying description. Mus. Bul. 56. 1902. Scale 1 in. = 5 m.

(237) 1901 **Ries, H.** Map of New York State showing location of limestone quarries, marl beds and cement plants. Mus. Bul. 44. 1901 (in cover); *also* Mus. Rep't 54. (1900). 1902. v. 3 (in cover). Scale 1 in. = 12 m. 72 x 74 cm.

(238) 1901 ——— Map of New York State showing limestone formations. Mus. Bul. 44. 1901 (cover); *also* Mus. Rep't 54 (1900). 1902. v. 3 (in cover). Scale 1 in. = 24 m. A colored geologic map of the various limestones of the State. 44.5 x 35 cm.

(239) 1901 **Ruedemann, R.** Map of portion of Albany and Rensselaer counties. Mus. Bul. 42. 1901. Facing p. 480; *also* Mus. Rep't 54 (1900). 1902. v. 3, facing p. 480. Scale 1 in. = 1 m. A colored stratigraphic map showing subdivisions of the Hudson River beds. 24.5 x 51.5 cm.

(240) 1901 **Smyth, (C. H. jr).** *Geologic Map of Portions of St Lawrence and Jefferson Counties.* Geol. Rep't 19 (1899). 1901. Facing p. r85; *also* Mus. Rep't 53 (1899). 1901. v. 1, facing p. r85. Scale 1 in. = 2½ m. A colored geologic map. 16.5 x 26.5 cm.

(241) 1901 **Woodworth, J. B.** Map of Oyster Bay and Hempstead quadrangles, Long Island. Mus. Bul. 48. 1901 (in cover); *also* Mus. Rep't 54 (1900). 1902. v. 4 (in cover). Scale 1 in. = 1 m. A colored pleistocene map, on a topographic base. 35 x 71 cm.

(242) 1902 **Cushing, H. P.** *Geologic Map of the vicinity of Saranac Lakes.* Mus. Rep't 54 (1900). 1902. v. 1, facing p. r25. Scale 1 in. = 5 m. A colored geologic map.

(243) 1902 **Eckel, E. C.** *Quarry Map of Southeastern New York.* Geol. Rep't 20 (1900). 1902. Facing p. r143; *also* Mus. Rep't 54 (1900). 1902. v. 1, facing p. r143. Scale 1 in. = 5 m. Location of quarries in red on plain map. 28.5 x 38 cm.

(244) 1902 **Finlay, G. I.** Geologic map of Minerva township, Essex county. Geol. Rep't 20 (1900). 1902. Facing p. r102; *also* Mus. Rep't 54 (1900). 1902. v. 1, facing p. r102. Scale 1 in. = 2¾ m. A colored geologic map.

(245) 1902 **Hollick, (A.) & Merrill, (F. J. H.).** Map of Staten Island quadrangle. Historical geology sheet. U. S. Geol. Sur. Folio 83. 1902. Scale 1 in. = 1 m. A colored geologic map on topographic base.

(246) 1902 **Merrill, F. J. H.** Map of Brooklyn quadrangle — Historical geology sheet. U. S. Geol. Sur. Folio 83. 1902. Scale 1 in. = 1 m. A colored geologic map on topographic base.

(247) 1902 ——— **& assistants.** Map of Harlem quadrangle — Structure section sheet. U. S. Geol. Sur. Folio 83. 1902. Scale 1 in. = 1 m. A colored geologic map with interpolated sections.

(248) 1902 ——— Geologic map of Harlem quadrangle. U. S. Geol. Sur. Folio 83. 1902. Scale 1 in. = 1 m. Colored geologic map on topographic base.

(249) 1902 **Salisbury, (R. D.) & Peet, (C. E.).** Map of Staten Island quadrangle — Surficial geology sheet. U. S. Geol. Sur. Folio 83. 1902. Scale 1 in. = 1 m. A colored pleistocene map on topographic base.

(250) 1902 ——— Map of Brooklyn quadrangle — Surficial geology sheet. U. S. Geol. Sur. Folio 83. 1902. Scale 1 in. = 1 m. A colored pleistocene map on topographic base.

(251) 1902 ——— **& Kümmel, (H. B.).** Map of Harlem quadrangle — Surficial geology sheet. U. S. Geol. Sur. Folio 83. 1902. Scale 1 in. = 1 m. A colored pleistocene map on topographic base.

(252) 1902 **van Ingen, G.** Map of portions of Clinton and Essex county. Mus. Bul. 53. 1902. Facing p. 539; *also* Mus. Rep't 55 (1901). 1903. Facing p. 539. Scale 1 in. = 1 m. Outcrops of Beekmantown and Potsdam formation in colors on topographic map.

(253) 1903 **Clarke, J. M.** Map of New York State showing location of mastodon remains. Mus. Bul. 69. 1903. p. 921; *also* Mus. Rep't 56 (1902). 1904. v. 2, facing p. 921. Scale 1 in. = 60 m.

(254) 1903 ——— **Glenn, (L. C.) & Butts, (C.).** Geologic map of Olean quadrangle. Mus. Bul. 69. 1903 (in cover); *also* Mus. Rep't 56 (1902). 1904. v. 2 (in cover). Scale 1 in. = 1 m. A colored geologic map on topographic base. 34.5 x 45.5 cm.

(255) 1903 ——— **& Luther, (D. D.).** Map of Union Springs and vicinity. Mus. Bul. 69. 1903. Facing p. 131; *also* Mus. Rep't 56 (1902). 1904. v. 2. Scale 1 in. = 1 m. A colored geologic map on topographic base. 18.5 x 22 cm.

(256) 1903 ——— Stratigraphic map of the Portage divisions west of Seneca lake. Mus. Bul. 69. 1903 (in cover); *also* Mus. Rep't 56 (1902). 1904. v. 2 (in cover). Scale 1 in. = 10 m. The various divisions of the Portage indicated in colors. 25 x 54 cm.

(257) 1903 **Cleland, H. F.** *Geologic Map of the Cayuga Lake Region.* U. S. Geol. Sur. Bul. 216. 1903. Facing p. 14. Scale 1 in. = 6 m. A colored geologic map.

(258) 1903 **Dickinson, H. T.** Map of the bluestone region of the eastern Catskills. Mus. Bul. 61. 1903 (in cover); *also* Mus. Rep't 56 (1902). 1904. v. 1 (in cover). Scale 1 in. = 1 m. Map showing quarries and ledges of bluestone on the topographic base. 45 x 45.5 cm.

(259) 1903 ——— Map of New York State showing Hamilton group and bluestone quarries. Mus. Bul. 61. 1903 (in cover); *also* Mus. Rep't 56 (1902). 1904. v. 1. Scale 1 in. = 12 m. On railroad map the lower boundary of the Hamilton group is indicated together with the location of bluestone quarries. 64.5 x 72 cm.

(260) 1903 **Glenn, (L. C.) & Butts, (C.).** Geologic map of Salamanca quadrangle. Mus. Bul. 80. 1903 (in cover); *also* Mus. Rep't 57. (1903). 1905. pt 1, v. 1 (in cover). Scale 1 in. = 1 m. A colored geologic map on topographic base.

(261) 1903 **Grabau, A. W.** Map of Becraft mountain in Columbia county. Mus. Bul. 69. 1903 (in cover); *also* Mus. Rep't 56 (1902). 1904. v. 2 (in cover). Scale 1 in. = 6 m. A colored stratigraphic and paleontologic map on topographic base, accompanied by two section sheets. 32 x 42 cm. 15 x 36.5 cm. 60 x 19 cm.

(262) 1903 **van Ingen, (G.) & Clark, (P. E.).** Map of region around Rondout. Mus. Bul. 69. 1903. Facing p. 1178; *also* Mus. Rep't 56 (1902). 1904. v. 2. Scale 1 in. = 1140 ft. A black and white geologic map with sections.

(263) 1903 **Woodworth, J. B.** Map of part of Northumberland township. Geol. Rep't 21 (1901). 1903. Facing p. r16; *also* Mus. Rep't 55 (1901). 1903. Facing p. r16. Scale 1 in. = 1 m. A colored geologic map on topographic base.

(264) 1903 ——— Map of Starr's Knob, Northumberland. Geol. Rep't 21 (1901). 1903. Facing p. r18; *also* Mus. Rep't 55 (1901). 1903. p. r18. A small black and white geologic map.

(265) 1904 **Adams, G. I.** *et al. Map Showing Area of Salina Group in Central New York and Gypsum Producing Localities.* U. S. Geol. Sur. Bul. 223. 1904. Facing p. 34. Scale 1 in. = 30 m. A black and white map.

(266) 1904 **Clarke, (J. M.) & Luther, (D. D.).** Geologic map of Canandaigua and Naples quadrangles. Mus. Bul. 63. 1904 (in cover); *also* Mus. Rep't 56 (1902). 1904. v. 2 (cover). Scale 1 in. = 1 m. A colored geologic map on a topographic base.

(267) 1904 ——— Map of western New York showing the Portage division. Mus. Mem. 6. 1904. Facing p. 198; *also* Mus. Rep't 57 (1903). 1905. pt 3, facing p. 198. A colored stratigraphic map of the Portage division, Seneca lake to Lake Erie.

(268) 1904 **Dale, T. N.** *Hudson Valley from the Hoosic River to Kinderhook Creek.* U. S. Geol. Sur. Bul. 242. 1904. Facing p. 12. Scale 1 in. = 2 m. A colored geologic map on topographic base.

(269) 1904 **Bishop, I. P. (From Greenwood, J. W., 1899).** Maps of proven oil and gas territory in Allegany and Cattaraugus counties. Geol. Rep't 22 (1902). 1904. Facing p. r43; *also* Mus. Rep't 56 (1902). 1904. v. 1, facing p. r43. Scale 1 in. = 4 m. A black and white map.

(270) 1904 **Sarle, C. J.** Map of Monroe county showing mineral resources. Geol. Rep't 22 (1902). 1904. Facing p. r75; *also* Mus. Rep't 56 (1902). 1904. v. 1, facing p. r75. Scale 1 in. = 5 m. The mineral resources indicated in red on a plain map.

(271) 1905 **Clarke (J. M.) & Luther, (D. D.).** Geologic map of Tully quadrangle. Mus. Bul. 82. 1905 (in cover); *also* Mus. Rep't 58 (1904). 1906. v. 2. Scale 1 in. = 1 m. A colored geologic map on topographic base.

(272) 1905 ——— Geologic map of Watkins-Elmira quadrangles. Mus. Bul. 81. 1905 (in cover); *also* Mus. Rep't 58 (1904). 1906. v. 3. Scale 1 in. = 1 m. A colored geologic map on topographic base.

(273) 1905 **Cushing, H. P.** *Outcrop Map of Portions of the Towns of Chazy and Champlain, Clinton County.* Mus. Bul. 95. 1905. pl. 12; *also* Mus. Rep't 58 (1904). 1906. v. 1, facing p. 406. Scale 1 in. = 1 m. Outcrops indicated in colors.

(274) 1905 ——— *Outcrop Map of Portions of Townships of Plattsburg and Peru, Clinton County.* Mus. Bul. 95. 1905. Facing p. 408; *also* Mus. Rep't 58 (1904). 1906. v. 1, facing p. 408. Scale 1 in. = 1 m. Outcrops indicated in colors.

(275) 1905 ——— Geologic map of Little Falls quadrangle. Mus. Bul. 77. 1905 (in cover); *also* Mus. Rep't 57, v. 1, pt 1 (in cover). Scale 1 in. = 1 m. A colored geologic map on topographic base. Accompanied by a section sheet.

(276) 1905 **Dale, T. N.** *Map of the Taconic Region.* U. S. Geol. Sur. Bul. 272. 1905. Facing p. 10. Scale 1 in. = 5½ m. Shows relief and kinds of rock. A lithologic map.

(277) 1905 (1892) ——— **& Prindle, (L. M.).** Geologic map of portions of Beekmantown and Pawling townships, Dutchess co. Geol. Rep't 23 (1903). 1905. Facing p. 195; *also* Mus. Rep't 57 (1903). 1905. Facing p. 195. Scale 1 in. = 1 m. A colored geologic map on topographic base.

(278) 1905 **Darton, N. H.** Geologic map of Mohawk valley. Mus. Bul. 95. 1905. Facing p. 410; *also* Mus. Rep't 58 (1904). 1906. v. 1, facing p. 410. Scale 1 in. = 8 m. A colored geologic map. Reprint with slight changes from 14th An. Rep't State Geol. 1894.

(279) 1905 **Merrill, F. J. H.** *Map of New York State Showing Location of all Economic Deposits.* Geol. Rep't 23 (1903). 1905 (in cover); *also* Mus. Rep't 57 (1903). 1905 (in cover). Scale 1 in. = 12 m. A plain map showing economic deposits by symbols.

(280) 1905 ——— *Geological Map of New York State.* Mus. Bul. 85. 1905 (in cover); *also* Mus. Rep't 58 (1904). 1906. v. 2 (in cover). Scale 1 in. = 14 m. A reprint of No. 117. Shows geologic features and location of all economic deposits.

(281) 1905 ——— **& Magnus, (H. C.).** Map of Rye, N. Y. and vicinity (Westchester co.). Geol. Rep't 23 (1903). 1905. Facing p. 193; *also* Mus. Rep't 57 (1903). 1905. Facing p. 193. Scale 1 in. = 1 m. A geologic map on topographic base.

(282) 1905 **Ogilvie, I. H.** Geologic map of Paradox Lake quadrangle. Mus. Bul. 96. 1905 (in cover); *also* Mus. Rep't 58 (1904). 1906. v. 1 (in cover). Scale 1 in. = 1 m. A colored geologic map on topographic base.

(283) 1905 **Shimer, H. W.** Map of Trilobite mountain, Orange county. Mus. Bul. 80. 1905. Facing p. 175; *also* Mus. Rep't 57 (1903). 1905. pt 1, v. 1, facing p. 175. Scale 1 in. = ⅓ m. A black and white geologic map.

(284) 1905 **Woodworth, J. B.** Map of Hudson River and Lake Champlain area. Mus. Bul. 84. 1905. Facing p. 190; *also* Mus. Rep't 58 (1904). 1906. v. 1, facing p. 190. Scale 1 in. = 40 m. Glacial deposits indicated in red on a topographic map.

(285) 1905 ——— Map of part of Plattsburg quadrangle. Mus. Bul. 84. 1905. Facing p. 168; *also* Mus. Rep't 58 (1904). 1906. v. 1, facing p. 168. Scale 1 in. = 1 m. Glacial deposits around Port Kent indicated in red on a topographic map.

(286) 1905 ——— Map of part of Port Henry quadrangle. Mus. Bul. 84. 1905. Facing p. 156; *also* Mus. Rep't 58 (1904). 1906. v. 1, facing p. 156. Scale 1 in. = 1 m. Glacial deposits indicated in red on topographic map.

(287) 1905 ——— Map of part of Ticonderoga quadrangle. Mus. Bul. 84. 1905. Facing p. 154; *also* Mus. Rep't 58 (1904). 1906. v. 1, facing p.154. Scale 1 in. = 1 m. Glacial deposits around Crown Point and Street-Road indicated in red on a topographic map.

(288) 1905 ——— Map of portion (central) of Glens Falls quadrangle. Mus. Bul. 84. 1905. Facing p. 142; *also* Mus. Rep't 58 (1904). 1906. v. 1, facing p. 142. Scale 1 in. = 1 m. Glacial deposits indicated in red on topographic map.

(289) 1905 ——— Map of portion (southern) of Glens Falls quadrangle. Mus. Bul. 84. 1905. Facing p. 140; *also* Mus. Rep't 58 (1904). 1906. v. 1, facing p. 140. Scale 1 in. = 1 m. Glacial deposits indicated in red on topographic map.

(290) 1905 ——— Map of part (northern) of Schuylerville quadrangle. Mus. Bul. 84. 1905. Facing p. 138; *also* Mus. Rep't 58 (1904). 1906. v. 1, facing p. 138. Scale 1 in. = 1 m. Glacial deposits indicated in red on topographic map.

(291) 1905 ——— Map of part (central) of Schuylerville quadrangle. Mus. Bul. 84. 1905. Facing p. 136; *also* Mus. Rep't 58 (1904). 1906. v. 1, facing p. 136. Scale 1 in. = 1 m. Glacial deposits indicated in red on topographic map.

(292) 1905 ——— Map of part of Troy quadrangle. Mus. Bul. 84. 1905. Facing p. 124; *also* Mus. Rep't 58 (1904). 1906. v. 1, facing p. 136. Scale 1 in. = 1 m. Glacial deposits indicated in red on topographic map.

(293) 1905 ——— Map of part of Catskill quadrangle. Mus. Bul. 84. 1905. Facing p. 122; *also* Mus. Rep't 58 (1904). 1906. v. 1, facing p. 122. Scale 1 in. = 1 m. Glacial deposits indicated in red on topographic map.

(294) 1905 ——— Map of part of Rhinebeck quadrangle. Mus. Bul. 84. 1905. Facing p. 120; *also* Mus. Rep't 58 (1904). 1906. v. 1, facing p. 120. Scale 1 in. = 1 m. A glacial terrace at Hyde Park indicated in red on a topographic map.

(295) 1905 ——— Map of part of Poughkeepsie quadrangle. Mus. Bul. 84. 1905. Facing p. 118; *also* Mus. Rep't 58 (1904). 1906. v. 1, facing p. 118. Scale 1 in. = 1 m. Glacial terraces around New Hamburg indicated in red on a topographic map.

(296) 1905 ——— Map of part of Newburgh quadrangle. Mus. Bul. 84 1905. Facing p. 116; *also* Mus. Rep't 58 (1904). 1906. v. 1, facing p. 116. Scale 1 in. = 1 m. Glacial deposits indicated in red on a topographic map.

(297) 1905 ——— Map of part of West Point quadrangle. Mus. Bul. 84. 1905. Facing p. 112; *also* Mus. Rep't 58 (1904). 1906. v. 1, facing p. 112. Scale 1 in. = 1 m. Glacial deposits indicated in red on a topographic map.

(298) 1905 ——— Map of part of Tarrytown quadrangle. Mus. Bul. 84. 1905. Facing p. 94; *also* Mus. Rep't 58 (1904). 1906. v. 1, facing p. 94. Scale 1 in. = 1 m. Glacial deposits indicated in red on a topographic map.

(299) 1905 ——— Map of surficial geology of the Mooers quadrangle. Mus. Bul. 83. 1905 (in cover); also Mus. Rep't 58 (1904). 1906. v. 1 (in cover). Scale 1 in. = 1 m. A colored surficial geologic map on topographic base.

(300) 1905 ——— Map of Chazy and Beekmantown townships, Clinton county. Mus. Bul. 83. 1905. Facing p. 13; *also* Mus. Rep't 58 (1904). 1906. v. 1, facing p. 13. Scale 1 in. = 1 m. The "Ingraham esker" indicated in green on a topographic map.

(301) 1906 **Graubau, A. W.** Geologic map of Schoharie and Cobleskill valleys. Mus. Bul. 92. 1906 (in cover); *also* Mus. Rep't 58 (1904). 1906. v. 3 (in cover). Scale 1 in. = 1 m. A colored geologic map on topographic base.

(302) 1906 **Luther, D. D.** Geologic map of Penn Yan and Hammondsport quadrangles. Mus. Bul. 101. 1906; *also* Mus. Rep't 59, v. 2. Scale 1 in. = 1 m. A colored geologic map on topographic base. Accompanied by one section sheet.

(303) 1906 ——— **& Bishop, (I. P.).** Geologic map of the Buffalo quadrangle. Mus. Bul. 99. 1906; *also* Mus. Rep't 59. v. 2. Scale 1 in. = 1 m. A colored geologic map on topographic base.

(304) 1907 **Berkey, C. P.** Map of southeastern New York. Mus. Bul. 107. 1907. p. 363; *also* Mus. Rep't 60 (1906). 1908. v. 2, p. 363. Scale 1 in. = 10 m. A black and white map showing extent of Harrison diorite, Cortlandt series, etc.

(305) 1907 **Cushing, H. P.** Geologic map of Long Lake quadrangle. Mus. Bul. 115. 1907 (in cover); *also* Mus. Rep't 60 (1906). 1908. v. 2 (cover). Scale 1 in. = 1 m. A colored geologic map on topographic base.

(306) 1907 **Fairchild, H. L.** Map of part of Pulaski quadrangle. Mus. Bul. 111. 1907. pl. 5; *also* Mus. Rep't 60 (1906). 1908. v. 2, after p. 394. Scale 1 in. = 1 m. Shows distribution of drumlins, on a topographic map.

(307) 1907 ——— Map of part of Fulton quadrangle. Mus. Bul. 111. 1907. pl. 6; *also* Mus. Rep't 60 (1906). 1908. v. 2, facing p. 296. Scale 1 in. = 1 m. Shows distribution of drumlins near Oswego, on a topographic map.

(308) 1907 ——— Map of part of Macedon quadrangle. Mus. Bul. 111. 1907. pl. 15; *also* Mus. Rep't 60 (1906). 1908. v. 2, facing p. 406. Scale 1 in. = 1 m. Shows distribution of drumlins around Walworth, on a topographic map.

(309) 1907 ——— Map of part of Albion quadrangle. Mus. Bul. 111. 1907. pl. 17; *also* Mus. Rep't 60 (1906). 1908. v. 2, facing p. 410. Scale 1 in. = 1 m. Shows distribution of drumlins around Elba, Genesee county, on a topographic map.

(310) 1907 ——— Map of part of Caledonia quadrangle. Mus. Bul. 111. 1907. pl. 20; *also* Mus. Rep't 60 (1906). 1908. v. 2, after p. 414. Scale 1 in. = 1 m. Shows distribution of drumlins around Linwood.

(311) 1907 ——— Map of central and western New York. Mus. Bul. 111. 1907. pl. 1; *also* Mus. Rep't 60 (1906). 1908. v. 2, facing p. 391. Scale 1 in. = 12 m. Distribution of drumlins shown on topographic map.

(312) 1907 ——— A part of the Buffalo quadrangle. Mus. Bul. 106. 1907. Facing p. 76; *also* Mus. Rep't 59 (1905). 1907. v. 1, facing p. 76. Scale 1 in. = 1 m. Bars of Lake Dana plotted on a topographic map.

(313) 1907 ——— Map of part of Silver creek quadrangle. Mus. Bul. 106. 1907. Facing p. 74; *also* Mus. Rep't 59 (1905). 1907. v. 1, facing p. 74. Scale 1 in. = 1 m. Glacial deposits indicated on a topographic map.

(314) 1907 ——— Map of parts of Silver creek and Cherry creek quadrangles. Mus. Bul. 106. 1907 (in cover); *also* Mus. Rep't 59 (1905). 1907. v. 1 (in cover). Scale 1 in. = 1 m. Various glacial deposits indicated on a topographic map.

(315) 1907 ——— Map of parts of Westfield and Dunkirk quadrangles. Mus. Bul. 106. 1907 (in cover); *also* Mus. Rep't 59 (1905). 1907. v. 1 (in cover). Scale 1 in. = 1 m. Glacial deposits indicated on a topographic map.

(316) 1907 ——— Map of part of western New York. Mus. Bul. 106. 1907 (in cover); *also* Mus. Rep't 59 (1905). 1907. v. 1 (in cover). Scale 1 in. = 5 m. Glacial deposits indicated in colors on a plain map.

(317) 1907 ——— Map of part of Erie county. Mus. Bul. 106. 1907 (in cover); *also* Mus. Rep't 59 (1905). 1907. v. 1 (in cover). Scale 1 in. = 1 m. Glacial deposits indicated on a topographic map.

(318) 1907 ——— Map of Attica, Depew and part of Buffalo quadrangles. Mus. Bul. 106. 1907 (in cover); *also* Mus. Rep't 59 (1905). 1907. v. 1 (in cover). Scale 1 in. = 1 m. Glacial deposits indicated on a topographic map.

(319) 1907 ——— Map of Batavia and part of Caledonia quadrangles. Mus. Bul. 106. 1907 (in cover); *also* Mus. Rep't 59 (1905). 1907. v. 1 (in cover). Scale 1 in. = 1 m. Glacial deposits indicated on a topographic map.

(320) 1907 ——— Map of central New York. Mus. Bul. 111. 1907. pl. 2; *also* Mus. Rep't 60 (1906). 1908. v. 2, facing p. 392. Scale 1 in. = 22 m. A black and white map showing various glacial phenomena.

(321) 1907 **Hartnagel, C. A.** Geologic map of Rochester and Ontario Beach quadrangles. Mus. Bul. 114. 1907 (in cover); *also* Mus. Rep't 60 (1906). 1908. v. 1 (cover). A colored geologic map on a topographic base.

(322) 1907 ——— Map of Cornwall station and vicinity, Orange county. Mus. Bul. 107. 1907; *also* Mus. Rep't 60 (1906). 1908. v. 2, facing p. 42. Scale 1 in. = ¼ m. A colored geologic map on topographic base.

(323) 1908 **Clarke, (J. M.) & Luther, (D. D.).** Geologic map of Letchworth Park, Portageville. Mus. Bul. 118. 1908; *also* Mus. Rep't 60 (1906). 1908. v. 1 (cover). Scale about 1 in. = ¼ m. A colored geologic map of the Park and vicinity.

(324) 1908 **Horsford, E. N.** *Geology of the Genesee River*, Portage to Lake Ontario. Mus. Bul. 111. 1908; *also* Mus. Rep't 60 (1906). 1908. v. 1. Scale about 1 in. = 2½ m. A reproduction of map No. (15) 2d Rep't 4th Dist. 1838.

(325) 1908 **Luther, D. D.** Geologic map of Nunda and Portage quadrangles. Mus. Bul. 118. 1908; *also* Mus. Rep't 60 (1906). 1908. v. 1 (cover). Scale 1 in. = 1 m. A colored geologic map on a topographic base.

(326) 1908 **Newland, D. H.** Map of the Adirondack region. Mus. Bul. 119. 1908. p. 8. Scale 1 in. = about 25 m. A black and white map showing principal formations and the iron ore deposits.

(327) 1908 ——— **& Hartnagel, (C. A.).** Map of parts of Oriskany and Utica quadrangles. Mus. Bul. 123. 1908. p. 60. Scale 1 in. = 1 m. The outcrops of Clinton ore indicated in red on a topographic map.

(328) 1908 ——— Map of New York State. Mus. Bul. 123. 1908. p. 8. Scale about 1 in. = 25 m. The outcrop of Clinton formation indicated in red on a plain map.

(329) 1908 ——— Map of part of Macedon quadrangle. Mus. Bul. 123. 1908. p. 70. Scale 1 in. = 1 m. Line of outcrop of Clinton iron ore indicated in red on a topographic map.

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A PECULIAR LANDSLIP IN THE HUDSON RIVER CLAYS

BY D. H. NEWLAND

The glacial and postglacial clays of the Hudson valley when occurring in large bodies on slopes are very prone to subsidence or flowage and occasionally are precipitated *en masse* as landslides of notable magnitude. There is record of frequent damage by such disturbances to the cities and towns that occupy the terraces along either bank of the Hudson; Albany and Troy, for example, have suffered repeated loss by the disruption of buildings and engineering works founded upon the clays.[1]

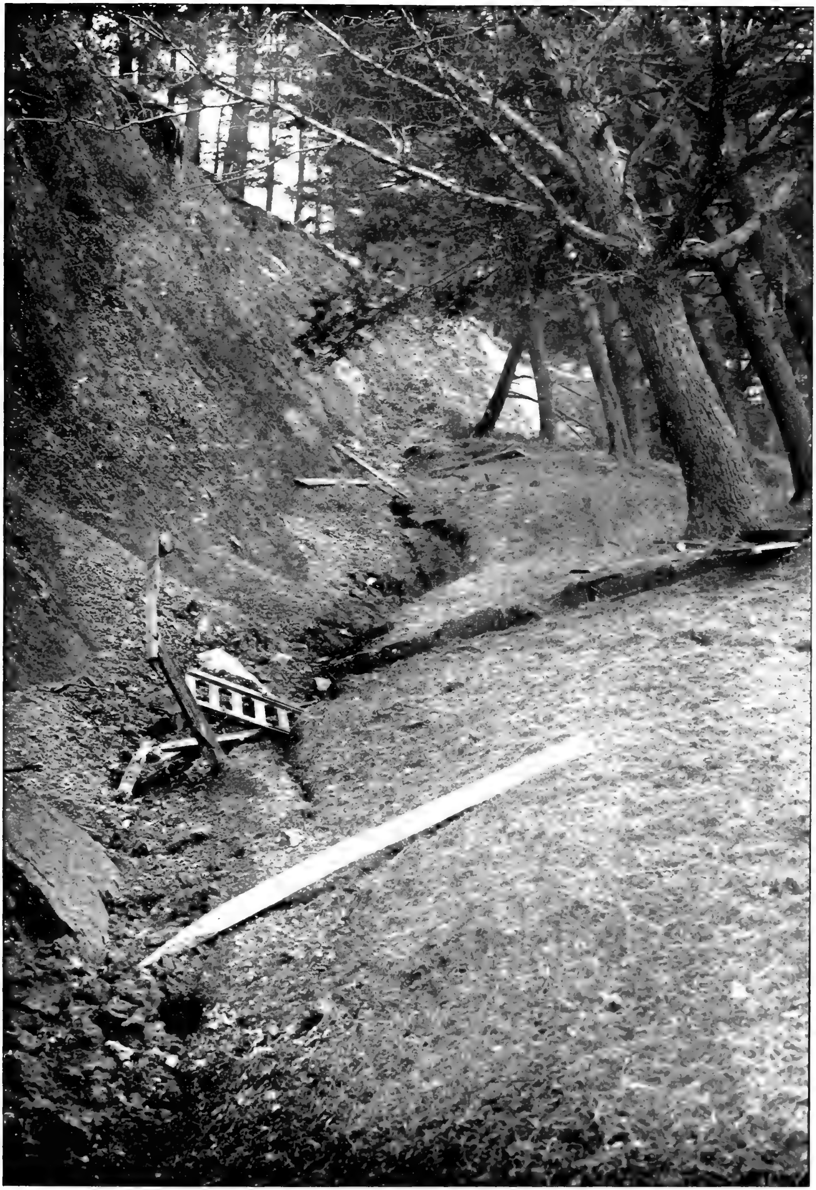
The landslip illustrated herewith took place March 26, 1908, at Stockport, Columbia co., a short distance east of the Hudson river. It involved a relatively small area, and the main interest centers around the peculiar form which it exhibited and the explanation of its origin in the light of surrounding conditions.

In the area south of Stockport creek, below its junction with Claverack creek, there is a terrace lying at about the 100-foot contour, or at a like elevation above the Hudson of which it forms the bank for some distance. The terrace has been dissected by small streams that in places have cut deeply into the clays, though it still presents a fairly uniform surface with an abrupt descent to the valley bottoms on the north and west. One of the small streams on the north side leads through a ravine past Stockport cemetery to enter Stockport creek opposite Columbiaville. The northern bank of this ravine, which was involved in the slip, rises from 60 to 75 feet and is made up of well stratified clays resting upon the Hudson River shale. The shale, however, is not exposed within the ravine, so that the whole thickness of the clays can not be stated.

The subsidence, as appears from the accompanying illustrations, assumed the form of a block fault. A section of the bank 250

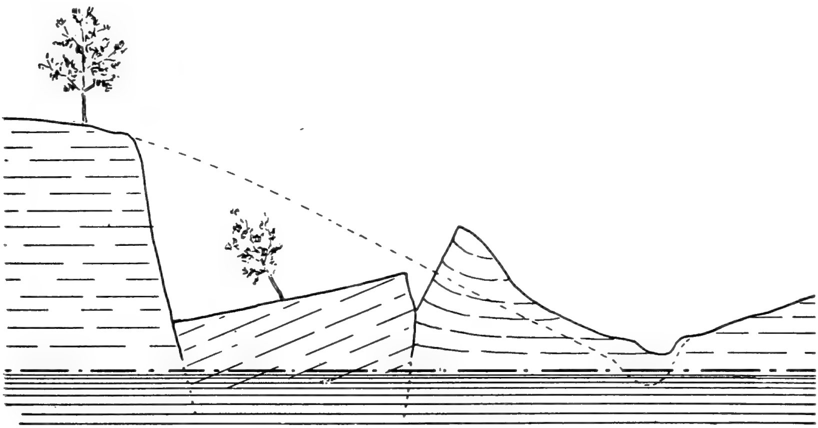
[1] Several landslides are mentioned in Mather's report on the first district (1843). The most notable one occurred at Troy on January 1, 1837, and involved a mass of clay estimated at 200,000 tons which was loosened from the face of a terrace and was precipitated a distance of 800 feet toward the river, sweeping away houses in its course and destroying several lives. By another landslip on March 17, 1859, a building in course of erection for St Peter's College at Troy was demolished. In Albany many small slips and subsidences have occurred, as shown by the displaced or cracked walls of buildings. A recent example was the subsidence of a bank of clay on the north side of Elk street, whereby a whole row of houses was displaced and rendered uninhabitable.

Plate 1



Landslip at Stockport, N. Y. Looking eastward along the northern fracture plane. The tilting of the block is shown by the trees which were left standing in an inclined position.

feet long and from 35 to 50 feet wide was fractured along two approximately parallel lines and the included mass dropped a distance of fully 40 feet along the northern fracture plane. This plane had a slope of 80° toward the ravine. It showed a smooth surface against which the sunken block abutted so closely as to leave no opening. The walls of the second fracture within the ravine inclined away from each other (due to the decided tilt of the fallen block toward the north and the upraising of the adjacent beds) and were separated by a gap 15 feet wide and nearly as deep.



Vertical section across the fault planes. Original slope of hill is indicated by the dotted line, while the heavy broken horizontal line shows the approximate water level.

The clay beds behaved very much like solidified rocks. In their mass they were but little cracked or disturbed by the subsidence. The beds above water level had become fairly dry by evaporation and absorption of moisture by plant growth after the spring rains, so that at the time of the occurrence they must have been firm and tenacious.

The principal factor in determining the nature of the slip was, no doubt, the presence of an underlying mass of water-soaked semiliquid clay beneath the dry upper beds, approximately following the level of the stream. Evidence of this liquid clay was observed in the lowest part of the ravine where a considerable quantity had accumulated by extrusion during the subsidence. The upper beds were thus probably in a state of delicate equilibrium, ready to be precipitated from any slight cause which seems to have been furnished by opening of the parallel fissures some time before the slip. The ultimate source of strain which gave rise to the fissuring may be found in a possible undermining of the upper beds by underground flowage.

The pressure exerted by the fall of the block was communicated by the semiliquid clay to the beds next to the stream which were raised up and shoved a few feet to the south. The volume of the displacement was estimated roughly at between 4000 and 5000 cubic yards.

There can be little basis for connecting the slip with a movement in the underlying Hudson River shales, though such a relation might be suggested by the known occurrences of postglacial faulting in the region. A rock fault at all commensurate to that observed at the surface would have had far-reaching effects, and even a slight dislocation, such as would supply merely an impulse in precipitating the mass of clay already in delicate equilibrium, could scarcely have happened, for it would have been accompanied by earth tremors of sufficient magnitude at least to have been detected by the seismograph at Albany.

In this connection it may be noted that the slip occurred within a short time after the heavy earthquake of March 26th in southern Mexico. The transmitted vibrations from the earthquake were registered at Albany beginning at 6.10 p. m. Though they were of exceptional magnitude, it would hardly seem justifiable to infer any direct relation between the two phenomena.

The writer is indebted to Mr H. P. Whitlock for the accompanying illustrations and to Mr C. R. Van de Carr, on whose property the landslip occurred, for information and courtesies extended during his visit to the locality.

Plate 2

Landslip at Stockport, N. Y. Opening along southern fracture

SOME ITEMS CONCERNING A NEW AND AN OLD COAST LINE OF LAKE CHAMPLAIN

BY GEORGE H. HUDSON

The summer of 1908 brought the waters of Lake Champlain to a remarkably low level. The *Plattsburg Press* for October 26, 1908 contained the following item:

The water in Lake Champlain has reached the lowest mark. The previous low water mark was made in 1881, but Saturday [October 24, 1908] this mark was passed by a quarter of an inch. Since 1827 it has been the custom of the navigators on the lake to keep a record of the low water reached during the year. In 1827 a low mark was evidently reached, for there is an old bench mark standing at Shelbourne harbor made at that time. October 16, 1881 all records were passed. At that time the steamers of the Champlain Transportation Company were running to Ticonderoga. Pilot E. S. Rockwell of the *Ticonderoga* was on the lake at the time and says that the steamers had to be run into the mud at the Ticonderoga dock in order to have the gang plank reach from the boat to the dock. Pilot Rockwell said that the water was so low that there was only one cut by which the steamers could enter Plattsburg harbor.

On November 16, 1908, the same paper recorded the water level as "two inches below the lowest mark."

In 1905, in a moderately sheltered position and at a level where wave action had kept the rock clean but had failed to cut farther back into the soil covering, a copper bolt was driven into the rock surface of Valcour island to be used as a basis for contour work. On October 10, 1908, the water level of Lake Champlain was 3.107 meters below this bolt and on November 7, 1908, it was 3.186 meters below it. A plank with a painted scale 9 feet long is attached to the steamboat landing at the Plattsburg dock, and on November 28, 1908, the water was 8.9 inches below the foot of this plank and the bottom of the scale. As the water at the time of the spring freshets sometimes completely covers the docks and may rise to or over the 9 foot mark, we may place the distance in level between exceptionally high and exceptionally low water at about 10 feet, and this is but slightly exceeded in the elevation of the bare rock shores of Valcour island where these are due to the annual washing of the waves. Of this exposed surface the upper foot or two may not be covered for some seasons in succession and the lower foot or two may be free from the action of water only in exceptional seasons.

Plate 1 presents a view taken November 7, 1908. The foreground is near the water level and the little potholes have been filled by the waves of a moderate sea which was running at the time. The upper portions of this exposed rock area are practically as they were left by the Wisconsin ice sheet. These are the portions rarely covered or covered but a month or two in the year. In the immediate foreground the potholes have become confluent and this represents that portion of the rock surface which is rarely uncovered and which has thus been acted upon more persistently by water, wave and undertow. Plate 2 is a view of a portion of this region near the water level of September 27, 1908. The character of the little potholes on the glaciated surface is here better seen as is also their increasing number per unit area, as we reach near the water level of the right-hand lower corner.

In the bay back of the lighthouse is a very perfect and interesting roche moutoneeée bearing a record which also testifies to present stability of the water level of Lake Champlain. The position is here much more sheltered and the little potholes [*see* pl. 3] do not appear to descend to so great a depth as in the former locality. To the left they occur at a lower level and have become confluent. These little potholes were not cut by pebbles. Not one in several hundreds has a pebble in it and no pebble could have found a lodging on the steep and smooth glaciated sides of these "sheepbacks." They all contain sand however and were cut by water vortexes carrying sand and finer silt. They rarely exceed 12 centimeters in diameter, unless confluent, and many are very much smaller. They are cut also in very steep sides as shown in plate 4, where they appear as glacial sections of small potholes. The maintenance of a water vortex carrying material which ever cuts back and widens the rock at one side, while the other side of the vortex is not inclosed, and which thus continues to develop the vertical and conical character of the excavation, is of special interest.

Potholes are said to "often point to the former existence of rapids or falls" and the term usually carries with it the idea of much larger excavations than those found on the shores of Valcour island. The potholes of rivers and glacial streams are not due to wind action on water and are not confined to one level

Plate 1

Part of a glaciated shoreline in Noel bay, Valcour island, the glaciated surface of the foreground being destroyed by sand cut cup holes. From a photograph taken November 7, 1908

Plate 2

A nearer view of a portion of the territory immediately to the right of that shown in plate 1. From a photograph taken September 27, 1908

Plate 3

View in the bay back of the lighthouse on Valcour island. The small boulders in the foreground are nearly all from the washed till. From a photograph taken October 17, 1908

Plate 4

The glaciated boss here shown is not the same as that on plate 3 but is from the same bay. A 30 centimeter rule was placed in one of the cup holes. From a photograph taken October 17, 1908

line that may reach many miles. These lake excavations caused by wave and undertow are not only smaller and more shallow than stream potholes but are cut at the same level on a line surrounding a large territory and any higher linear series would be indicative not of the phenomena of former stream action, rapids or falls, but of former wave action. A new term for these shore line excavations would be conducive to clear thinking and on account of their difference in diameter, depth, position, arrangement, locality and manner of formation, a new term is certainly due them. The name *cupholes* is proposed and will be used hereafter.

That these cupholes are due in great measure to vortexes in the undertow from wave action is shown by plate 5, which presents a view of the seaward end of the glaciated rock boss in part shown in plate 3. The cupholes are arranged in curving lines which all run from the central ridge of the rock mound and take the lines of the undertow. Many cupholes may be seen to have become confluent and the figure makes a very interesting study. The absence of pebbles is shown, as is also the presence of minor cupholes within the major.

Just under the edge of the water all the cupholes have become confluent and the result is a distinct shelf, about a foot wide, cut completely around a more exposed portion of this glaciated boss. Just outside the edge of the shelf is a fine clay bottom from which the action of the present low water has removed some few centimeters and cut the surface into a very irregular pattern indicative of varying density. Whether or not Lake Champlain is repeating a former process and removing some of its own sediment or whether the low water is removing the sediment of the Hochelagan sea, where it covers the till, is not at all certain; but the distinct rock shelf cut by the cupholes would indicate that Lake Champlain had never cut lower.

These cupholes may be found around the entire island and extending deepest where the undertow is greatest. There is no higher line shown on the island and the retreating Hochelagan sea found no resting place until the waters were freshened by the stream inflow and the lake reached the present comparatively stable level.

The figures given show in each case glaciated surfaces running from above high water mark to below low water mark. This feature is present to a greater or less degree on every side of the island and in many places the waves have not yet succeeded in removing the till. For instance, in Spoon bay, one may remove the till and find scratched and polished bed rock where the same is covered by water for half the year. Nearly vertical cliffs rise from these beaches and yet the beach shelf is glaciated. Plate 6 shows the character of the western portion of the south cliff. Its upper edges have been rounded by glacial action and but few large fragments of the wall have fallen since glacial time. The eastern part of this cliff, which is nearly as high, has been cut in rocks which dip easterly with sufficient angle to expose strata that reached from the very bottom of the Chazy beds to near their top. This cliff shows abundant signs of glaciation and contains one large pothole about half way down its face. At the base of this cliff is the wave-cut shelf shown partly exposed in plate 7. Within a few feet of where the man is holding an oar, the waves of the low water level have carried away some fallen debris and exposed a bed of glacial till in which the dark, washed, Trenton pebbles (still partially embedded) contrast strongly with the pale, water-eroded surface of the clay. Nearer the bank the clay of the till, at least in its upper portion, is somewhat interstratified with very fine sands due no doubt to glacial drainage over the cliff. Such a drainage is indicated by the pothole. A top dressing a foot and more thick, consisting of fallen fragments from the cliff and heavy, rounded, granitic boulders, about half and half, serves to break the force of the waves and undertow. The heavier masses are well bedded in a coarse gravel which becomes much finer nearer the bottom. The transition from the clean, fine, washed gravel to the clay of the till is sharp and distinct. This till was uncovered and then excavated to the depth of 2 feet in two different places and found to contain only well worn, polished, and scratched pebbles.

The wave-cut bench is here more than 30 meters wide. The cliff at the right is of hardest, massive, middle Chazy and on both sides of this point streams of glacial till have cut down the weaker rocks of the cliff and going seaward lowered the shelf level by from 2 to 4 feet on both sides of the exposed portion shown in plate 7. Plate 8 shows a similar shelf at the same level extending far to the south and west of Garden island. The man in the boat has his oar resting on the rock bottom more than a hundred meters aut. Evidences of preglacial wave-cut shelves

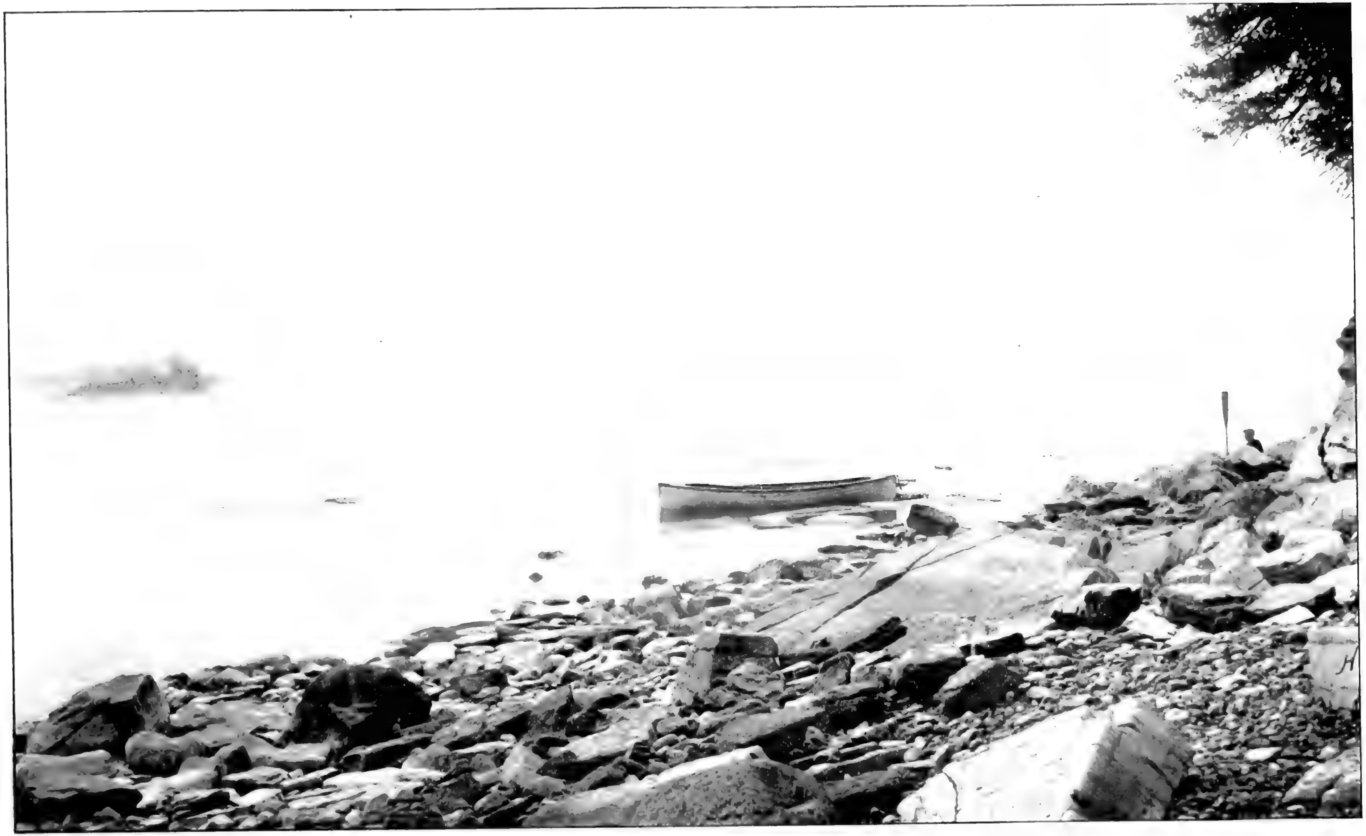
Plate 5

The seaward end of the sheep's back partly shown in plate 3. The shadow at the end is of a person standing in a boat which was held across the front to still the ripples. The divergence of the rows of cup holes is still more marked under water but the water was not quiet enough to allow it to appear in the photograph. Dotted lines have been drawn to express more fully the divergence of the chains of cup holes. From a photograph taken October 24, 1908

Plate 6

Part of the south shore of Valcour island

Plate 7



The wave cut shelf of Lake Valcour is seen, partly submerged, in the vicinity of the boat. The edges of the slightly dipping beds appear somewhat like breaking waves. From a photograph taken October 24, 1908. The atmosphere was full of smoke from Adirondack fires.

Plate 8

The old wave cut shelf of Lake Valcour revealed by the low water. The rock cliff of Garden island is immediately back of the observer. From a photograph taken October 24, 1908. Air filled with smoke from Adirondack fires

are also found at Crab island, Bluff point, Plattsburg, and without doubt may be found elsewhere in the present lake basin. The evidence from Valcour island, however, is in itself sufficient to demonstrate the presence of a preglacial lake which for many thousands of years remained at a stable level very close to that at present attained by Lake Champlain. For this ancient lake the name Lake Valcour is proposed.

TYPES OF INLIERS OBSERVED IN NEW YORK

BY RUDOLF RUEDEMANN

The geology of the State of New York is so varied that it furnishes striking examples of nearly all important geologic phenomena. It is the purpose of this paper to direct attention to the illustrations found here of a group of such phenomena which has hitherto not received the attention it deserves and has therefore been described in a rather loose terminology. These phenomena are the inliers scattered throughout the State which have been currently described or cited as "outliers."

The direct occasion of this note has been the observation of a peculiar group of detached outcrops observed by the writer while engaged in mapping a portion of the Clayton sheet. These were found to be of types (produced by corrasion and solution) not mentioned in the textbooks.

The term inlier originated in England about 50 years ago and Page in his Handbook of Geologic Terms (1865) defines it thus [p. 256]: "Inlier, a term introduced by Mr Drew, of the Geological Survey, to express the converse of outlier. It means . . . a space occupied by one formation which is completely surrounded by another that rests upon it."

This original definition is retained in the *Century Dictionary,* while Shaler, in the *Standard Dictionary,* defines inlier as "A former outlier or uneroded portion of an older rock which, having formed an island or an elevation during some later deposit, has thus become embedded in a younger rock." This definition takes notice of but one of many possible modes of production of inliers.

If we wish to derive the definition by taking the converse of the current one of an outlier [*see* Geikie, *Earth Sculpture*] as "A detached mass of rock resting upon and surrounded on all sides by older rocks" we obtain the following: A detached mass of rock surrounded on all sides by younger rocks that rest upon the unexposed portions of it. There exist, however, as we shall presently see, but a few kinds of inliers that are detached masses, while the great majority are continuous with the mother rock. A definition which is to embrace all these classes must, therefore, be given a wider scope and omit reference to the feature of detachment. For this reason, the definition which we find in Scott's

Introduction to Geology [1907. p. 384] is the most satisfactory.[1] It reads: "Inliers differ from outliers in not necessarily being *isolated masses* of rock, but merely isolated *outcrops* of older beds which are surrounded by newer strata, though underground they may be continuous with very extensive areas of beds. An inlier is thus a larger or smaller mass of rock surrounded by beds which are geologically younger than itself." Three groups of inliers are recognized by Scott, viz those produced by folding (anticlines, domes), by faults ("horsts") and the buried outliers.

A survey of all outcrops of rocks within the State which, being surrounded by beds geologically younger, fall under this definition of inliers, has furnished various expressions of these phenomena which naturally fall into two fundamentally different larger groups as regards their primary causes. The first group is produced solely by the agency of water in its different forms, in either depositing or eroding. We distinguish these as deposition and erosion inliers. The other group is caused by the diastrophism of the earth, resulting in folds and faults.

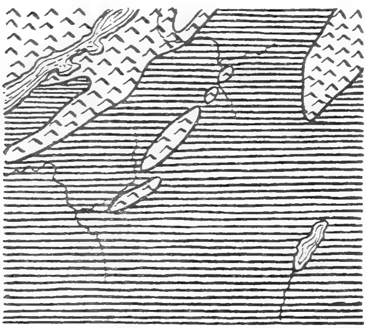
We will now proceed to consider these groups separately. It may, however, be mentioned at the outset that, since nature does not recognize the clean and simple division lines drawn by man, the examples which she furnishes us in this instance are mostly the result of several of the processes here cited as producing inliers, and they will be placed under those agencies which appear to have been most active in their production.

1 **Deposition inliers.** The inliers which are produced by the deposition of newer beds around outliers comprise that form originally and still now most generally understood under the term inliers. As Scott states, "the isolated 'stacks' and pillars on the seacoast are outliers but a movement of depression submerging them in the sea would eventually result in their being buried in newer deposits, thus changing them into inliers." Inliers which originate from true outliers i. e. detached portions of formations, will, in practice, be difficult to distinguish from the second group of deposition inliers, namely, those resulting from the deposition of newer rocks around mere erosional irregularities of still continuous strata, a case that must prevail in all folded regions. We are not aware of instances of the first kind in this State, although the required conditions, i. e. slightly disturbed strata buried by an advancing sea, would seem to have been fulfilled repeatedly in the

[1] *See also* Geikie, J. Structural and Field Geology. 1908.

Helderberg regions. There are, however, good instances of the formation of such inliers, still going on, seen in the islands of our large fresh-water lakes, especially in Lake Champlain, where the islands composed of Paleozoic rocks are being surrounded and gradually buried by the deep alluvial deposits filling up the lake. This is for instance well shown in the case of Valcour island, near the mouth of Ausable river which is rapidly pushing a delta into the lake.

Another group of depositional inliers, however, is well represented in this State. The best instances of this are the numerous hummocks of Grenville and other Precambric rocks protruding through the Potsdam sandstone on the north and especially on the northwest side of the Adirondacks. These are especially well seen in the region south of Alexandria bay [*see* fig. 1, 2]. They originated from the irregular surface of the Precambric floor resulting from the differing hardness of the rocks. The mostly small, elongate hills emerge now from beds of Potsdam sandstone which by their position and the coarser texture of their basal portions, clearly show deposition upon and against these hills. The latter were not true outliers in Potsdam time, since their strata were still in connection with the Adirondack mass, but they have



Inliers of Precambric rocks in Potsdam sandstone near Alexandria, N. Y. Scale 15 m. = 1 in.

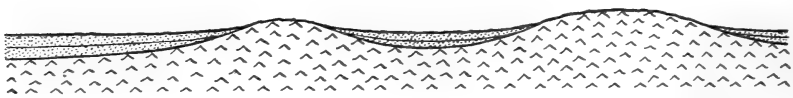


FIG. 2 Diagrammatic section of Precambric inliers near Alexandria, N. Y.

Precambric — Potsdam sandstone

become true inliers in the Potsdam formation because exposed again through the agency of erosion. It is then illogical to term these outcrops outliers as is generally done, since they do not fulfil the conditions of an outlier which according to the current conception is a detached mass of rock, resting upon and surrounded on all sides by older rocks. These supposed outliers are only "detached" on the surface, but still connected with the

Adirondack Precambrics under the Potsdam formation, by rocks of the same kind.

Some most interesting examples of the style of inliers last mentioned are observed in the Little Falls sheet, mapped by Professor Cushing. We here especially note the Middleville inlier [*see* text fig. 3, 4]. This is an outcrop of syenite rocks in the bottom of the deep valley of West Canada creek. Although it is obvious that the corrasion by the river is the final cause of the exposure of this rock mass, it follows also from the absence of exposures of the same rock farther up and down the valley, that the syenite here protrudes into the overlying and surrounding Beekmantown beds in consequence of the irregularity of the surface of the Adirondack plateau over which the Beekmantown sea advanced. The syenite is of the same age as the other syenite intrusions associated with the Grenville series of the Adirondacks and a portion of the Adirondack massive. Underground it is

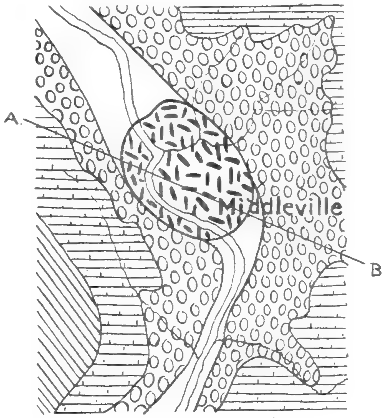


FIG. 3 Inlier of Precambric in Beekmantown limestone at Middleville, N. Y. Scale 1 m. = 1 in.

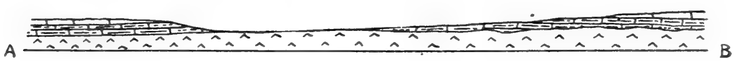


FIG. 4 Section of inlier at Middleville, N. Y.
Precambric Beekmantown

connected with the larger and better known Little Falls inlier consisting of a like syenite. Since the latter, however, is much involved in strong faults and obviously owes much of its prominence to "horst" structure, we will mention it more fully under that caption.

A much smaller group of inliers of Precambric rocks in the Potsdam sandstone similar to those on the northwest and north side of the Adirondacks, is also found on the east side, about Port Henry. The Potsdam there rests as a thin veneer on a steeply tilted fault block and in several places knolls of Precambric rocks which clearly were once small islands in the shallow Potsdam sea, project above the much eroded Potsdam beds [*see* text fig. 5].

As the numerous inliers on the northwest side of the Adirondacks and those of Middleville and Little Falls are only outlying portions

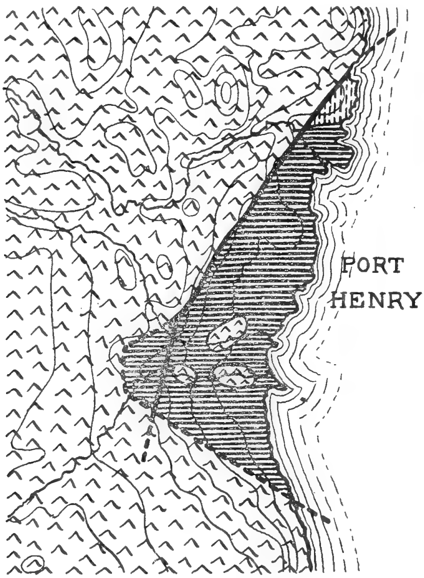
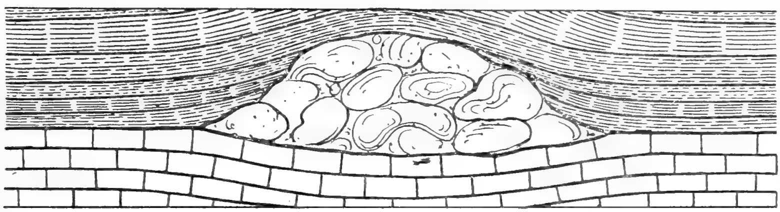


FIG. 5 Inliers of Precambric [legend: chevron pattern] in Potsdam sandstone [legend: ruled pattern] at Port Henry, N. Y. Scale 1 m. = 1 in.

of the Adirondack massive, which have become inliers by burial under Paleozoic rocks and subsequent partial exposure by erosion, so the whole Adirondack massive is but an outlying portion of the Canadian shield or protaxis, that once was more or less buried under lower Paleozoic rocks and is now an immense inlier in them. It might be well to distinguish inliers of this magnitude from the smaller ones as *of the first order.* We shall see that the same distinction can be made in regard to the other groups of inliers, and indeed has been made before by Suess in regard to the "horsts."

This Adirondack inlier of the first order which lies at the southeast side of the Canadian shield, has a complete counterpart in another inlier of similar size and corresponding position on the southwest side of the shield in the Wisconsin Precambric area ("Isle Wisconsin"). We consider that the position of these two inliers in regard to the Canadian shield and the Great Lakes indicates a symmetry of structure that is of some importance for the understanding of the geological structure of the eastern United States.

As a third group of depositional inliers may be distinguished the relatively rare and unimportant case where current mounds and ridges have been buried under younger sediments and later become exposed as inliers. An example of this kind is furnished by the Le Claire limestone of Iowa[1] that forms mounds 50 feet high or over and in regard to which it was already suggested by Hall that "at the close of the Niagara huge mounds and ridges were built on the bottom of the shallow Silurian sea, in part by the accumulation *in situ* of corals, crinoids and molluscous shells, and in part by the drift of calcareous sediments under strong currents."



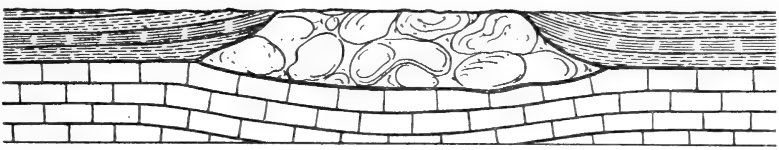


Fig. 6 Lens or reef resting upon Clinton limestone and extending into Rochester shale. (Copy from Sarle)
Fig. 7 Same worn down and forming inlier

As these current mounds later project from the softer and more easily eroded rocks that once buried them, and thus form inliers, so also limestone mounds which grow on the bottom of the ocean through the action of corals, bryozoans and the accumulation of mollusks, may become buried in shales and later project from these as "lenses." Such reef structures have been described by Sarle[2] as reefs in the Clinton formation of western New York. When they indicate an older horizon than the overlying shale, they constitute true inliers. This is frequently the case in western New York, where they represent the top of the Clinton limestone and

[1] Iowa Geol. Sur. Rep't, 11:305.
[2] Sarle, C. J. Amer. Geol. 1901. 28:282.

project into the Niagaran Rochester shale. One may then find, on abraded surfaces, as at Lockport, the lens contrasting as a white inlier with the dark shale [*see* text fig. 6, 7].

2 **Erosion inliers.** We distinguish in this class between *corrasion inliers* which have resulted from river corrasion; *solution inliers;* and *glacial erosion inliers* in which the ice is thought to have been the exposing agent.

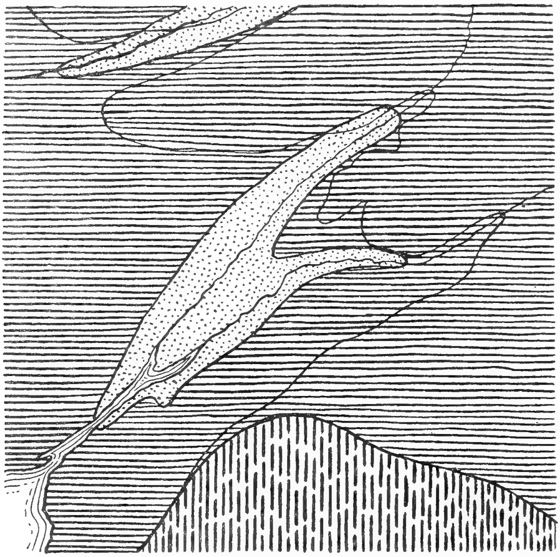


FIG. 8 Inlier of Lowville limestone in Black River limestone at the head of Guffin bay, Jefferson county, N. Y. Scale 1 m. = 1 in.

a Corrasion inliers. The first group we have found excellently exemplified in small and simple forms in the southern portion of the Clayton sheet. As the sketch maps inserted indicate [*see* text fig. 8, 9, 10], these inliers consist of strips of Lowville limestone exposed along brooks and surrounded on all sides by Black River limestone. The conditions which have produced this peculiar form of inlier — which judging from our maps is very rarely seen in other parts of the State — are the following: The coincidence of the dip of the beds and of the course of the brook and a resistance of the underlying Lowville limestone to erosion that is greater than that of the Black River beds. The brook, as a rule, reaches the inlier by a fall and finally leaves it by very gradually passing again upon the overlying rock [*see* text fig. 10, p. 172]. That means that for some distance the gradient of the brook is greater than the dip of the rocks, but finally falls again below the dip, as in the Chaumont inlier where the brook

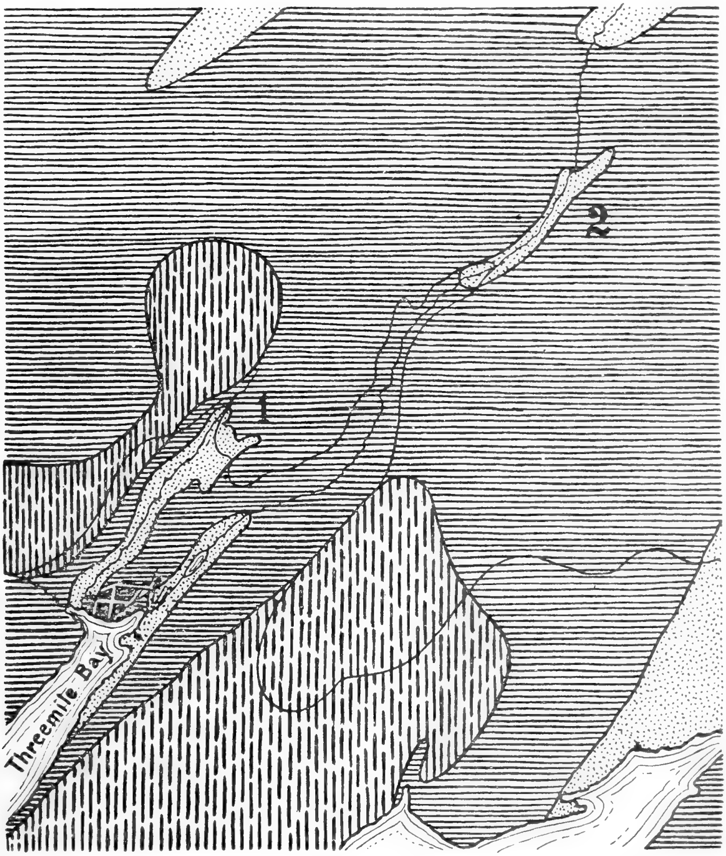


Fig. 9 Three Mile Bay inlier (1) and Three Mile Creek inlier (2) in Jefferson county, N. Y. [dotted] Lowville limestone. [lined] Black River limestone. Scale 1 m. = 1 in.

reaches the backwater of the lake.[1] It follows from this description of this group of inliers that we can expect to find them only where they follow the dip of the rocks, i. e. in New York, in general in north-south flowing rivers. Among these there occur some very interesting examples of erosion inliers, and more will undoubtedly become known as accurate and detailed mapping pro-

[1] Taking this explanation of this inlier as granted, and also the post-glacial age of the brook, then it follows that since the lake water is now backing up into the inlier, the lake must have been rising relatively to the land since the formation of the inlier.

ceeds. The largest one, a most striking example of this kind, is the inlier of Beekmantown rocks along West Canada creek, extending

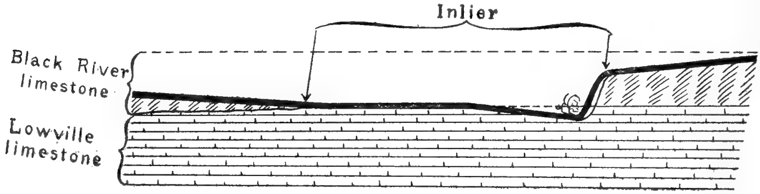


FIG. 10 Diagrammatic section of Three Mile Creek inlier. The black line indicates the creek.

about 12 miles from above Poland to a few miles below Middleville [*see* text fig. 11]. Above the inlier the river flows on Trenton limestone and below on alluvium, which, however, rests quite surely on Trenton and younger rocks, as evidenced by Cushing's map of the Little Falls quadrangle. If it should continue down the river, it would be connected with the Little Falls inlier of Beekmantown and Precambric rocks, which is principally due to block tilting. While the West Canada creek inlier, as we may call it, appears at first glance as a simple and plain case of corrasion inlier, the facts that the river there flows parallel to the edge of the Precambric boundary of the Adirondacks and that the rocks dip away from this old land or towards the southwest, indicate the possibility of a more complex origin of this inlier. While it might be assumed that since the dip is very small (but 2° according to Cushing), it must be easy for the rapidly descending river to overcome the small southern component of this dip and to reach the Beekmantown beds, the fact that the Precambric rocks appear within the Beekmantown beds may indicate that both Precambric and superjacent Beekmantown rocks formed here an old prominence below the Trenton, which has been cut into in this inlier.

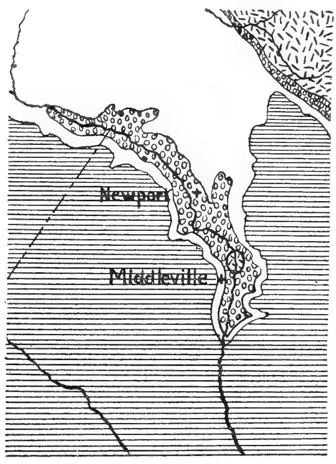


FIG. 11 Inlier of Beekmantown limestone [dotted box] in Trenton limestone [blank box] along West Canada creek, N.Y. Scale 7.5 m. = 1 in.

A plainer and simpler case of an erosion inlier is furnished on the Penn Yan-Hammondsport sheet of New York,[1] where an iso-

[1] Luther, D. D. N. Y. State Mus. Bul. 101. 1906.

lated patch, about 4 miles long, of Neodevonic West Hill sandstones and shales appears in the deep valley of Meads creek below Monterey, from below the overlying High Point sandstone, and

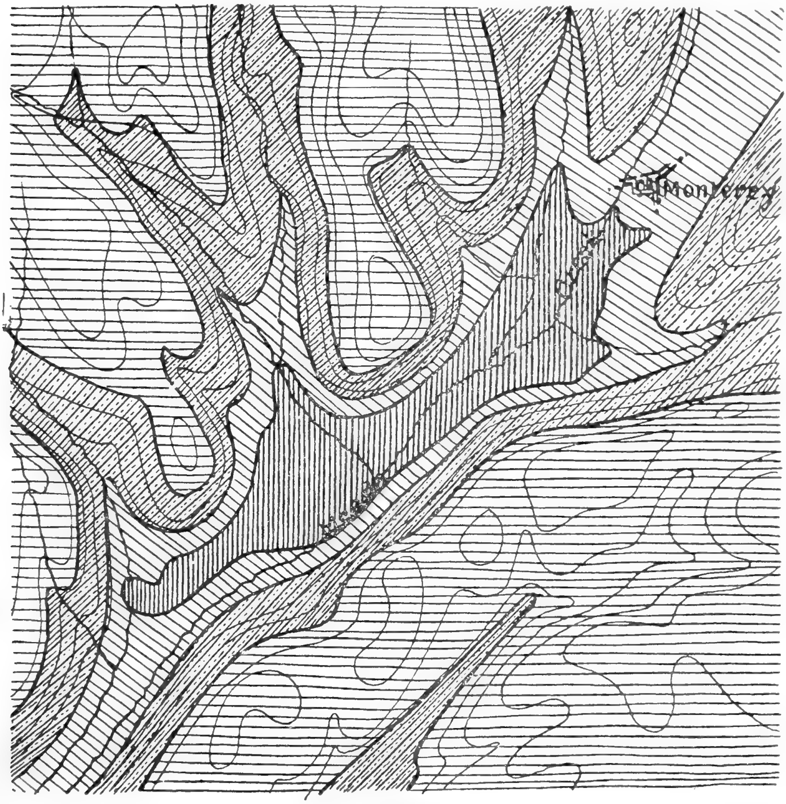
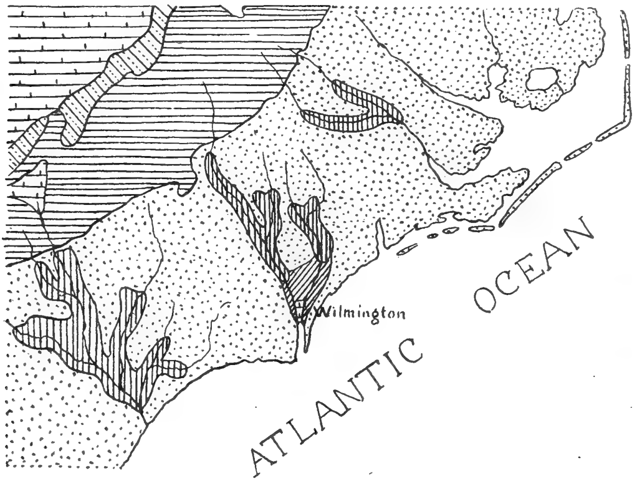


FIG. 12 Inlier of West Hill sandstone in High Point sandstone and superjacent beds, below Monterey, N. Y. Scale 1 m. = 1 in.

is surrounded by all the following beds of the series up to and including the Chemung sandstones and shales [*see* text fig. 12]. It is apparent that here the gradient of the creek is locally greater than the southwestern component of the southern dip of the rocks.

The last two instances seem to indicate that it is not necessary that the dip and course of a brook coincide for the formation of an inlier, as long as the gradient of the brook becomes greater than the component of the dip of the rocks that runs in the direction of its course.

It would not seem probable that inlier resulting from different steepness of gradient of river course and dip of rocks, where the two are equally directed, should assume large proportions since this would presuppose but a slight difference of steepness in the two and a like direction over a long distance. Nevertheless the geologic maps reveal such large inliers. An especially clear example seems to be that of the inliers on the coastal plain of the Carolinas[1] [*see* text fig. 13]. There we see the Upper Cretaceous



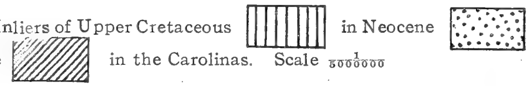


FIG. 13 Inliers of Upper Cretaceous [vertical hatching] in Neocene [dotted] and Eocene [diagonal hatching] in the Carolinas. Scale $\frac{1}{5000000}$

appear in long tortuous strips, 70 miles and more in length, from under the Neogen along the Pedee river, the branches of Cape Fear river and Neuse river, in order to disappear again under tertiary beds above the mouths of these rivers. The relations of the strike of the tertiary and cretaceous formations and of the courses of the rivers to the coast line indicate that the dips and river courses are approximately coincident.

b Solution inliers. In some of the small inliers of Lowville limestone in the Black River limestone of the Watertown region, there is fair evidence that solution has played an important part in the removal of the overlying rock. This is especially the case in the inlier along Perch river below Limerick [*see* text fig. 14, 15]. The longitudinal section shows that the river plunges with a high fall from the Black River into the Lowville, upon whose hard bed it flows for half a mile in order to disappear above the "Natural Bridge" under the Black River limestone. Just to the south of the

[1] Willis, B. Carte Géologique del' Amérique du Nord. 1906.

Natural Bridge it reappears, flows a short distance upon Lowville beds and disappears again under Black River limestone, not to reappear for another half mile. This last half mile is the most important for the understanding of the process which produced the inlier farther up. The course of the river can here be followed through the woods by a distinct depression that is covered with large, variously tilted Black River slabs and partly bounded on the sides by Black River cliffs. It is here manifest that the Black River strata as a whole have been sinking down along the river as in a graben, being eaten away underneath by the dissolving water. Finally, the blocks become so small that freshets are able to remove them entirely and the river again flows in the open and on the underlying Lowville beds. While it is quite apparent that this and other inliers of the same kind wander upward, after they are started, by the waterfall at the upper end, the original cause of the phenomenon is quite clearly the water that along the joints, which are here strongly developed, passes between and under the Black River blocks until it reaches the harder and less soluble Lowville beds. The fall at the upper end is to all appearances a secondary development.

It is obvious that this group of inliers is essentially a Karst phenomenon and that these inliers correspond to the "Dolinen," so well known in the Karst plateau of Austria. We must, therefore, expect to find other examples in the limestone regions of the State. The Helderberg plateau presents a number of instances of depressions or sink holes in the limestones through which the underlying rocks appear. Most

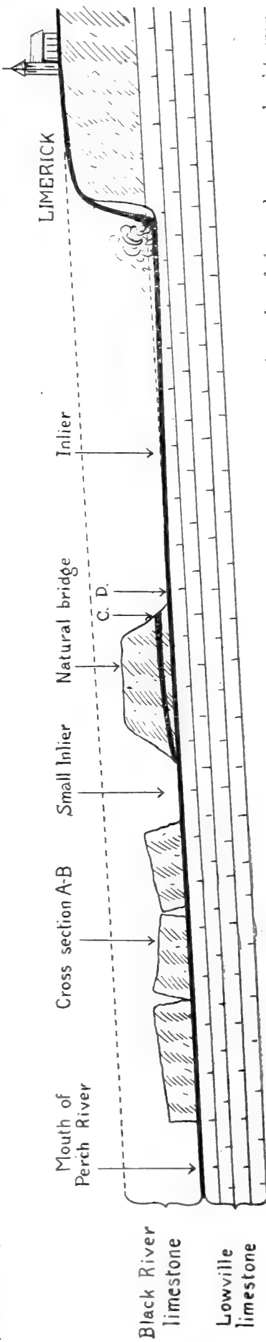


FIG. 14 Diagrammatic section of Perch River inliers: C, high water subterranean course through the joints and cracks of the rocks; normal subterranean course on the surface of the Lowville limestone

of them are too small to have been indicated on the preliminary maps, although there is no doubt that the mapping of the quadrangles will bring out a considerable number of them. One, a

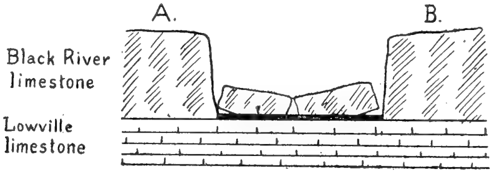


FIG. 15 Diagrammatic cross section of Perch river at AB in figure 14

quarter of a mile long, where the Esopus shale appears from under the Onondaga limestone, is shown on Darton's map of Albany county [N. Y. State Geol. Rep't for 1895] directly south of Clarksville.

Many such small inliers are also to be expected in the Salina beds, where the gypsum beds have been dissolved out. As an example that has found expression on the maps, we cite the exposure of Salina gypsum in the Salina (Bertie) waterlime north of Union Springs.[1] The gypsum beds form here a good horizon, which in several places is exposed from under the overlying Bertie waterlime, partly by natural erosion (sinking in of the surface through partial solution of the gypsum) and partly by quarrying.

There exists in the United States a region where large solution inliers are the most prominent physiographic feature of the country. This is where the Carboniferous limestones in Kentucky and Tennessee, through their great solubility, provide subterranean courses for the atmospheric waters. There the majority of the brooks disappear in sink holes. Frequently these sink holes grow into larger depressed areas, so called "sinks," and in some cases these depressed areas, arising from subterranean solution by the ground water, are square miles in size. They are then locally called "coves." In these "sinks" and "coves" the older formations are exposed as true inliers. We insert here a sketch [*see* text fig. 16-18] of a sink and of a cove taken from the Standingstone (Tenn.) Folio, which is used in Salisbury and Atwood's instructive paper, *The Interpretation of Typographic Maps*[2] to illustrate the effects of ground water. In this special case the Newman limestone forms inliers in the overlying Pennington shale.

[1] *See* N. Y. State Mus. Bul. 69. 1903. Map facing p. 1130.

[2] Salisbury, R. D. & Atwood, W. W. Professional Paper No. 60, U. S. Geol. Sur. 1908.

c Glacial erosion inliers. As inliers caused by glacial erosion we consider those cases where in the Finger Lake region an

FIG. 16 Sketch map of "Icy Cove" from Standingstone folio, Tenn. Scale $\frac{1}{62500}$

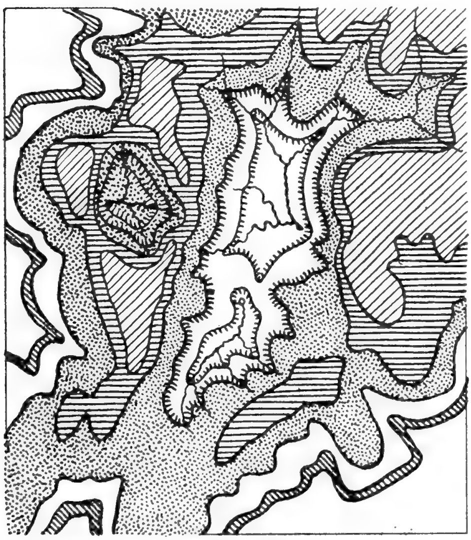


FIG. 17 Geologic map of "Icy Cove," showing the Newman limestone [ ] forming the bottom of the depression and the Pennington shale [dotted] and following formations the walls

overdeepening of the valleys has taken place that leads to exposures of deeper beds surrounded by younger beds, a process ascribed by some glacialists to glacial erosion. While on account of the con-

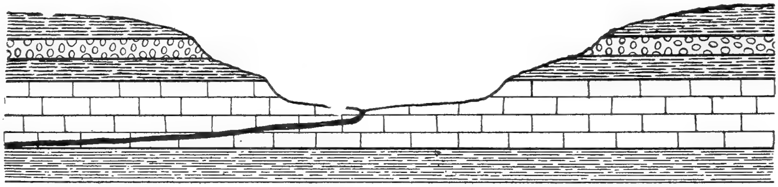


FIG. 18 Diagrammatic section of a "sink" or "cove", the black line indicating the subterranean water course

siderable depth of most of these lakes, there is no doubt that their bottoms reach down even into Siluric beds when their shores are in the Devonic, but the maps do not suggest this fact, except in a very few instances. One of these that appears quite convincing is the exposure of Middlesex black shale along the west branch of Keuka lake[1] and in the lower portion of the valley lying in the continuation of the lake [*see* text fig. 19]. This long outcrop of Middlesex shale is entirely isolated and surrounded by the overlying Neodevonic beds (Cashaqua shale, etc.) In this case it would seem that the north-south flowing brook, emptying at Branchport, and running with the dip of the rocks, found itself in the condition described above under corrasion inliers and thus might have alone been competent to produce a part of the inlier, although its short length and small size and the great length of the inlier and depth of lake basin indicating a great amount of erosion, are now entirely out of proportion and glacier ice is therefore to be appealed to as a factor, especially in regard to the inlier of the west branch of the lake.

We have thus far considered the inliers which originate from the agency of water, in either depositing or eroding. We now turn to the more important groups of inliers produced by diastrophism. These are the fold and fault inliers.

3 **Fold inliers.** These are formed *a* on the summits either of a_1 normal anticlines or a_2 domes ("uplifts," "parmas") or *b* through overturned folds ("Klippen").

We will first consider those very frequent cases of inliers of rocks, appearing on summits of normal folds through erosion.

[1] Luther, D. D. Penn Yan-Hammondsport Quadrangles, N. Y. State Mus. Bul. 101. 1906.

a Normal anticline inliers. In this group it will be advantageous to distinguish between the long bandlike inliers produced by long typical folds and the short elliptical inliers which result from the short pitching anticlines [brachyanticlines Lory, *see* E. Haug, Traité de Géologie, 1907. p. 204] with periclinal extremities. Examples of the first group are found in the folded region in the eastern part of the State where the long narrow strips of Lower Cambric, especially north of the Hoosic river, represent, according to the present conception of the structure of this region, more or less complex anticlines.[1] The Cambric is here surrounded or thought to protrude from Lower Siluric rocks. This conception is shown in Dale's section of the north end of the Taconic range. It is, however, possible that the relations of the Cambric to the Lower Siluric are greatly different in the slate belt and we will recur to this point under the heading of overthrust inliers [*see* p. 188]. To find undoubted macroanticlinal inliers we have to go outside of the State, to the northern extension of our folded regions, to Vermont, and to the Allegheny mountains. Here are long belts of Cambric rocks inclosed by the Lower Siluric areas and such of the

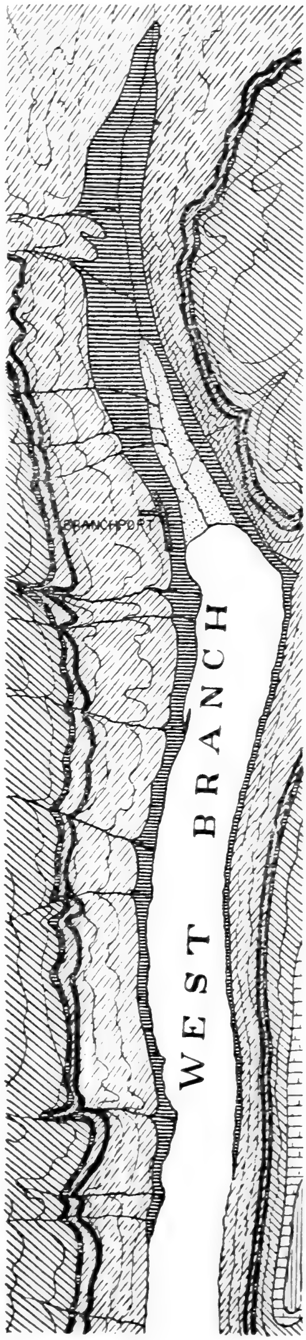


FIG. 19 Inlier of Middlesex black shale in Cashaqua shale and superjacent formations. Alluvium. 100 foot contours. Scale 1 m. = 1 in.

[1] *See* Dale. Am. Jour. Sci. 4 s. 1904. 17:185.

latter protruding from still younger rocks. But it is certain that not only the Cambric belts in eastern New York but also some of the large inliers of basal gneisses along the eastern boundary partake of the nature of folded or anticline inliers; this would seem to be especially clear in the case of the large inlier, beginning near Dover Plains (east of Poughkeepsie) and extending northeast along the Housatonic river. This is surrounded on the west and south sides by a belt of crystalline limestone. The Highlands themselves are a "horst" [*see* p. 186] as we shall see later.

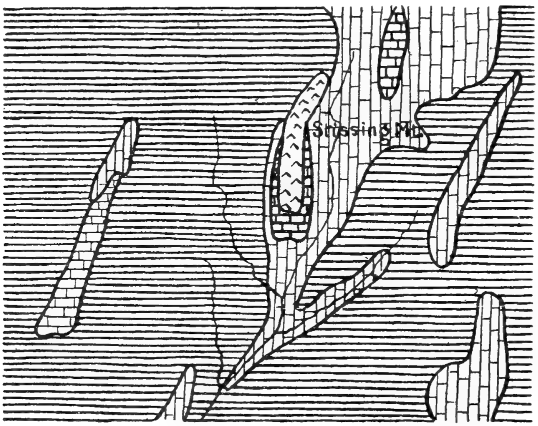


Fig. 20 Inlier of Precambric rocks in Georgian and Lower Siluric limestone and shale at Stissing mountain, N. Y. Scale 15 m. = 1 in.

Numerous short, pitching or brachyanticlines that form inliers, project from the Hudson River shale belt. One of the best examples of this group is Stissing mountain, northeast of Poughkeepsie [*see* text fig. 20]. It consists of an elliptic outcrop of gneiss, surrounded by a belt of Cambric rocks on all sides except the north, the whole projecting from the plateau of metamorphic Lower Siluric shales. This outcrop of gneiss is 20 miles away from the larger Housatonic inlier. It also distinguishes itself from the many smaller inliers of Cambric rocks in the neighborhood by the fact that it does not follow the northeast direction of the latter, but strikes due north. This indicates that this remarkable protrusion of gneiss through the thick belt of Cambric and Lower Siluric rocks is probably due to a cross folding that combines with the normal fold, a frequent cause of brachyanticlines.

A nearly continuous line of small elliptic anticlinal inliers of Cambric rocks (mostly limestone), gneiss patches and Trenton

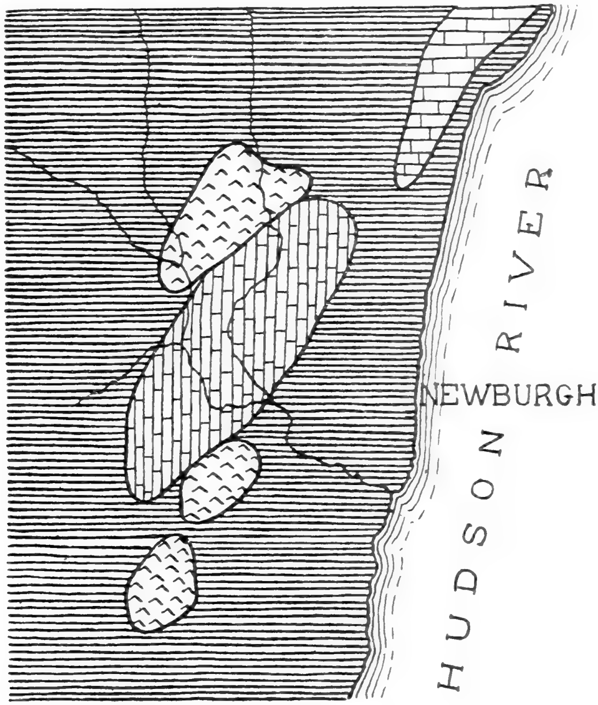


FIG. 21 Inliers of gneiss [gneiss pattern] Georgian [brick pattern] and Cambro-Siluric limestones [vertical brick pattern] in Lower Siluric shale [horizontal line pattern] at Newburgh, N. Y. Scale 5 m. = 1 in.

limestone extends in southwest direction from Stissing mountain toward and beyond Newburgh. In the close neighborhood of Newburgh there are no less than three small gneiss and one Cambric limestone inliers[1] [*see* text fig. 21], and a series of small inliers of gneisses and Cambric rocks extends thence along the north side of the Skunnemunk mountains. Ries gives four sections through one of these (Bull hill) which clearly show its composition of an open, normal anticline but also indicate that faulting may, to some extent, have influenced the production of some of these inliers.

[1] *See* Ries, H. N. Y. State Geologist's Rept. for 1895. 1:395.

Smaller anticline inliers may sometimes be also observed in the plateau regions of the central part of the State where a series of gentle folds representing further extension of the Appalachian mountain folding have been traced by Kindle.[1] Occasionally a small inlier will even bring out the presence of a fold in a region where there seem to be no indications of folding at all. Thus the writer observed a small Lowville limestone inlier coming up from Lake Ontario at Three Mile bay (Clayton quadrangle, N. Y.). This [*see* text fig. 9, inlier 1] follows first the brook, but about ¾ of a mile above its mouth, it leaves the brook and rises upon the hillside, ending just east of the Three Mile Bay railroad station. Here, in a quarry, the arch of the fold is exposed in the Lowville limestone beds, with the Black River on the flanks.

In the arid regions of the West, where neither drift nor alluvial deposits obscure the outlines of inliers, the intimate relations of inliers and folds are much clearer shown and forms of bizarre outline produced by atmospheric weathering. We insert, as an example [*see* text fig. 22, 23] taken almost at random, a sketch from the Pueblo folio, Col.

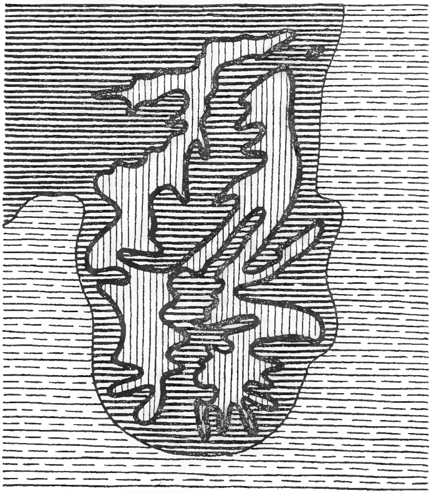


FIG. 22 Inlier on crest of arch on Pueblo folio, Col. Carlisle shale and sandstone. Niobrara shale. Niobrara limestone. Scale $\frac{1}{125000}$

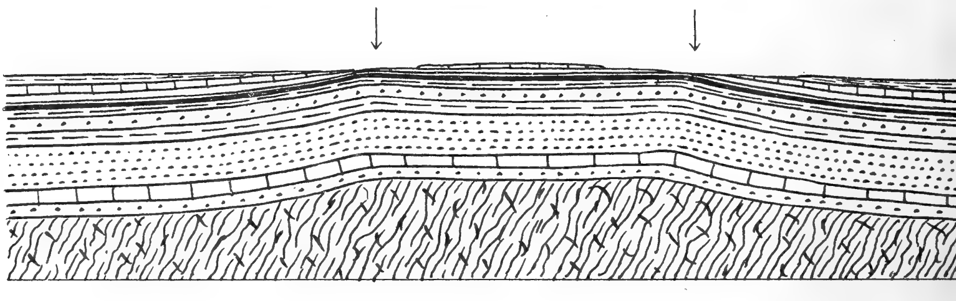


FIG. 23 Cross section of arch showing formation of inlier. Pueblo folio, Col.

[1] Kindle, E. M. Jour. Geol. 1904. v. XII, no. 4, p. 281. *See also* Luther, D. D. N. Y. State Mus. Bul. 128. Colored section.

[Geol. Atlas of the United States] of an inlier of Carlisle shale (Cretaceous, subdivision of the Benton formation) in the Niobrara formation (shale and limestone) on the crest of the Rock Canyon arch, a broad anticlinal fold. A few miles farther north the same arch produces at the crossing with the Kansas river an inlier where not less than three of the underlying formations are brought to view.

The last inlier mentioned which is caused by a low, broad and long anticline brings us to those anticlines which, being little longer than wide, are known as

a Uplifts, parmas and domes. The State of New York does not contain any of these structures. For this reason we cite only two instances of inliers arising from these structures, one representing the smaller domes, and one those of the first order.

Kindle[1] has described from northern Indiana, small outcrops (about a quarter of a mile is the diameter of one given) of Niagara limestone which form dome-shaped elevations, possessing quaquaversal dips and are surrounded and partly covered by Devonian shales, thus forming inliers of Niagara beds in Devonic rocks. These domes are considered by Kindle as analogous to the "mud-lumps" at the mouth of the Mississippi. They formed islands during a large part of the early Devonic and were then covered by the Devonic Black shale, thus corresponding in their origin partly to our first group of deposition inliers, with the difference, however, that the prominences of the sea bottom in that group were thought to result merely from erosion.

Domes of the first order are in this country typically represented by the Cincinnati and Nashville "uplifts" [*see* text fig. 24], which have been termed *domes, uplifts,* a *geanticline* by Dana and designated as a "*parma*" by Suess. This broad and low anticline, which is a secondary phenomenon in the great Paleozoic mediterranean basin played an important rôle during Paleozoic time in separating minor basins. It is now recognized by the fact that the Lower Siluric forms two extensive inliers, a northern one, the Cincinnati uplift on both sides of the middle course of the Ohio, a southern one, the Nashville uplift in Tennessee. The latter presents in the long, pinnate offshoots along the Cumberland and Tennessee rivers, excellent examples of the paramount influence of corrasion in finally exposing the deeper beds.

4 **Fault inliers.** Inliers are produced on the upthrow side of faults. Two groups can be distinguished in this class, (*a*) those

[1] Kindle, E. M. Am. Jour. Sci. 1903. 15:459.

that are bounded by one fault and (*b*) those that lie between two faults (horst). We have good examples of both kinds in this State, at the hand of which we will note their general characters.

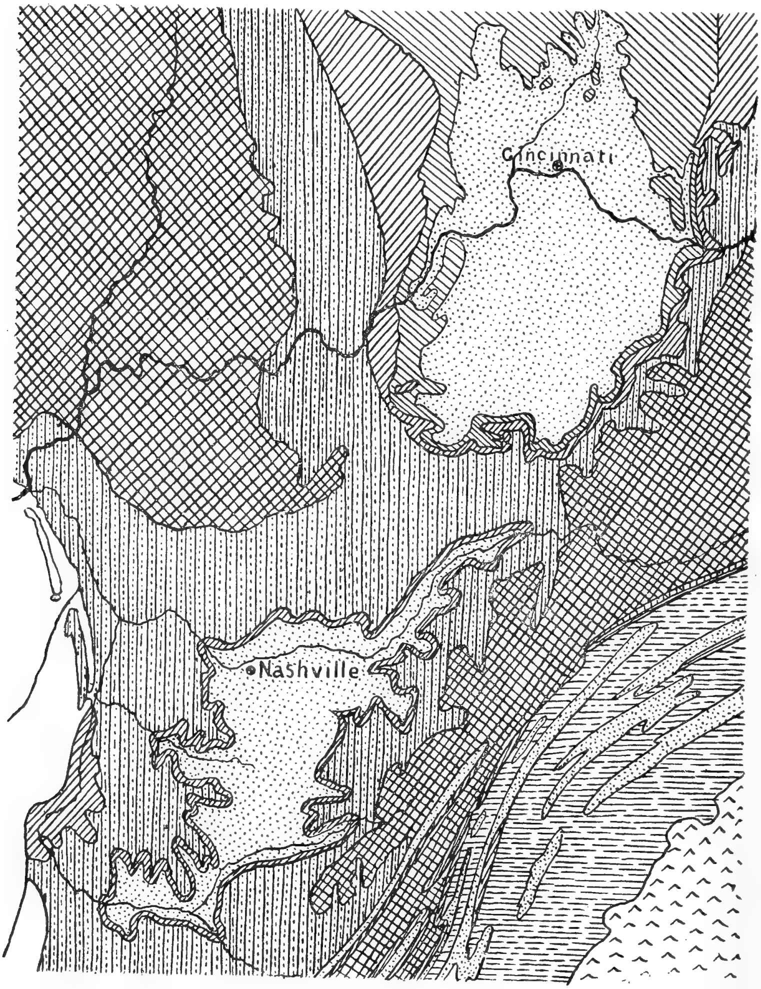


FIG. 24 Ohio basin with the Cincinnatti and Nashville inliers. [dotted] Lower Siluric; [diagonal hatching] Upper Siluric; [diagonal hatching] Devonic; [vertical lines] Mississippian; [cross-hatching] Pennsylvanian. Scale $\frac{1}{5000000}$

The best ones are furnished by the Mohawk valley, which is crossed by a system of northeast striking faults, mostly with the downthrow side on the east.[1] Consequently there protrude patches of Precambric rocks, as at Sprakers, Little Falls, and the "Gulf" (north of Little Falls), or of Beekmantown and Trenton from the Utica shales [*see* text fig. 25, 26]. Several of these are involved with a second fault, and will be mentioned under the next group; others, however, as the Beekmantown inlier at Tribes Hill, at Fonda Bush, the Precambric inlier at Sprakers, that at the Gulf and the western portion of the Precambric inlier at Little

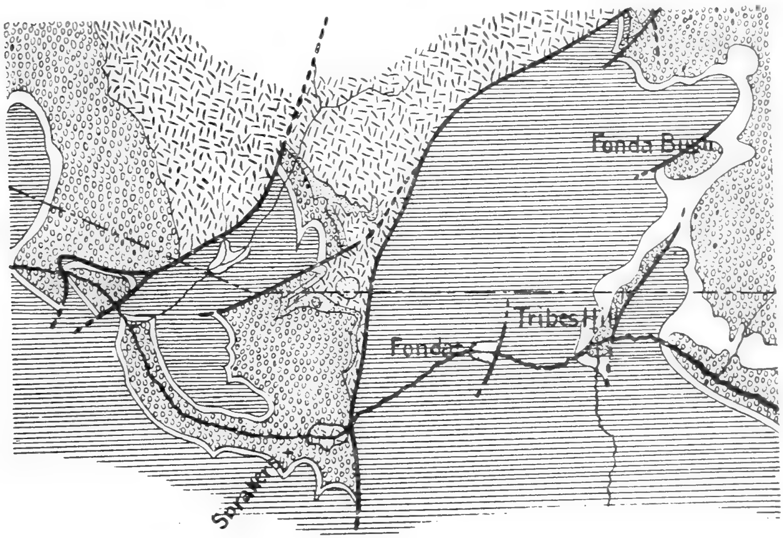


FIG. 25 Sketch map of the faulted region of the Mohawk river in eastern Fulton county, N. Y. showing the inliers at Sprakers, Fonda, Tribes Hill and Fonda Bush. [pattern] Precambric rocks; [pattern] Potsdam sandstone; [pattern] Beekmantown limestone; [pattern] Trenton limestone; [pattern] Utica shale. Scale 7.5 m. = 1 in.

Falls are, according to the sections furnished by Darton and Cushing, brought up by the tilting of the blocks along one fault plain. Corrasion has in all these cases served as an accessory agent in exposing the deeper rocks. Where least disturbed by corrasion, they are readily recognized by their outline, which consists of a straight line along the fault and as a rule of a more or less curved boundary on the other side, the whole inlier approaching a segment in form. The areas of Paleozoic sedimentaries on the west side of Lake Champlain which also are broken up into vari-

[1] *See* Darton, N. H. N. Y. State Geol. Rep't for 1894. 1895. p. 30.

ously tilted fault blocks will no doubt furnish other examples of these inliers when fully mapped. Likewise the folded region on the east side of the Hudson and in Orange county contains inliers whose principal cause is faulting, but all of these are also more or less involved in folding.

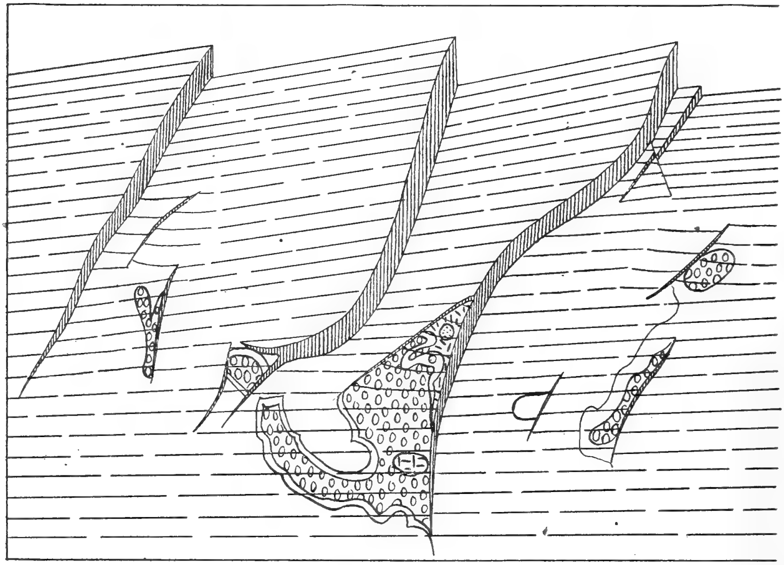


FIG. 26 Diagram of faulted and tilted blocks in eastern Fulton county, N. Y. (after Darton). Looking north; showing relations of inliers of text figure 25 to faults

Where a block has remained standing between two faults inclining away from each other, a horst is produced. This group of inliers has typically the form of a parallelogram or of a rectangle. The greater portion of the Precambric inlier at Little Falls, that to the east of the town, partakes of the nature of a horst by being included between two parallel faults of opposite throw, as shown by Cushing [*see* text fig. 27, 28].

As a horst of the first order in this State, we have probably to consider the large inlier of gneisses and associated rocks of the Highlands, since Berkey[1] has shown that this block is bounded by two parallel faults between Cornwall and Peekskill. It is stated by Berkey [*loc. cit.* p. 374] that the northern fault consists rather of a succession of them, " each separate fault line striking out toward the northeast into the bounding slates and its place

[1] Berkey, C. P. N. Y. State Mus. Bul. 107. 1907.

taken by another nearer the margin." This seems to indicate that the breaking down of the flanks has taken place in steps as in the

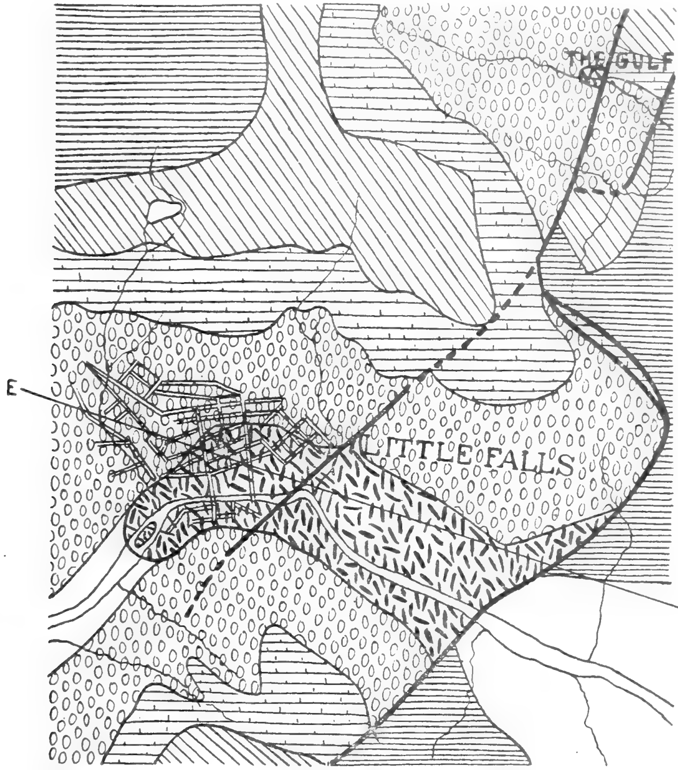


FIG. 27 Inlier of Precambric rocks [swatch] in Beekmantown limestone [swatch]. [swatch] Trenton limestone; [swatch] Dolgeville beds; [swatch] Utica shale. Scale 1 m. = 1 in.

typical horsts of Europe. In one of the northern faults the fault plane has been observed [p. 775], and it was found to dip steeply to the southeast making it a reversed fault, or overthrust.

FIG. 28 Section through inlier at Little Falls (after Cushing)

As the section through a part of the Highlands by Professor Berkey shows, the great fault on the other (southern) side hades in the same direction. This large fault block is hence bounded by two systems of parallel faults that both hade in the same direction (southeast). It might therefore be considered to be more of the character of an overthrust wedge [*see* below] than of the horst, in which, when typically developed, the faults incline away from each other. It is, however, apparent that in the general sense of a horst, as now understood in Europe, as a fault block that is on the upthrow side with reference to all the area around it [*see* text fig. 29], the Highlands fulfill all conditions of this type of structure.

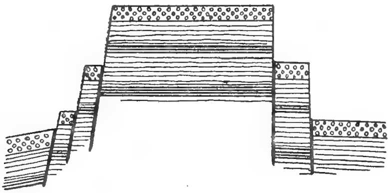


FIG. 29 A horst (after Haug)

c Branching fault inliers. A small division of raised blocks, appearing as inliers is formed by *branching faults,* where a triangular block remains standing between the branches. The Mohawk valley furnishes again a few good examples of this group [*see* text fig. 25] of inliers, that are mostly recognized by their subtriangular outline. Below St Johnsville we find a triangular outlier of Beekmantown with a surrounding band of Trenton emerging from the Utica shale, and the Noses fault (below Sprakers) with its branch, the Ephratah branch fault, forms another triangular Beekmantown inlier.

d Wedge inliers. As wedge inliers or "wedges" we designate here inliers that are found between two overthrusts. There is no doubt that many such wedges exist in our eastern, much overthrust slate belt, but the close isoclinal folding of the belt obscures the faulted structure there to such an extent, that it is preferable to select typical examples from less disturbed areas. The Appalachians furnish many clear cases of this structure, of which we select, on account of the great difference in age of the adjoining rocks, one from the Briceville folio, Tenn. [Geol. Atlas of the United States, 1896]. It will be seen in the section [*see* text fig. 30] that five overthrust faults are there recognizable between them containing three wedges of Siluric rocks, which on the surface form narrow, bandlike inliers in Carboniferous rocks, sometimes flanked by a narrow strip of Devonic rocks.

e Overthrust inliers. We designate as overthrust inliers those which result from the extensive transportation of older rocks over younger ones along more or less horizontal thrust planes, resulting from overturned anticlines ("fold thrusts" of Willis) and from "surface thrusts" (Willis). As an example we insert a portion [text fig. 31] of the Rome (Ga.) folio, showing inliers of Cambric

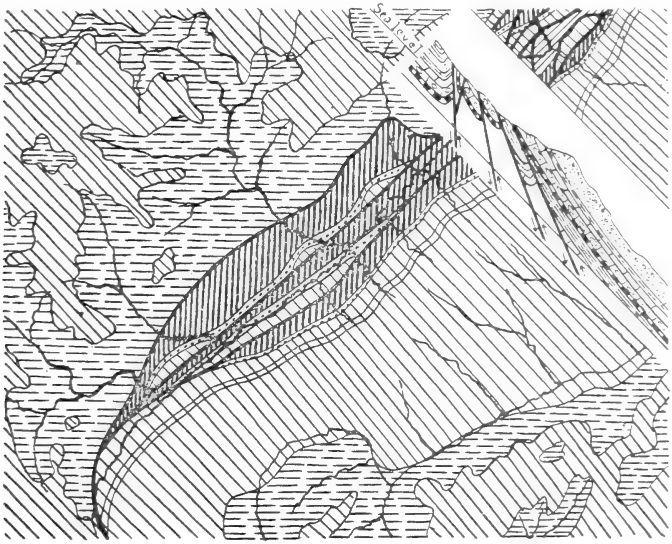


FIG. 30 Wedge inlier from Briceville folio, Tenn. Siluric (Rockwood formation); Devonic (Chatanooga shale); Carboniferous (Lee conglomerate); Carboniferous (Briceville shale). Scale $\frac{1}{125000}$

rocks in Carboniferous beds, appearing as small synclines, but which in fact, as shown by the section are but the erosion remnants of a huge, closely folded overthrust plate of the kind that has been so much discussed in late years by the Alpine geologists [their "Ueberschiebungen" or "charriages," *see* text fig. 32].

It is possible that the slate belt of eastern New York represents such an overthrust region of the first order. We see the strongest arguments for this view in the long fault that separates the Lower Siluric and Cambric rocks east of the Hudson which is known to be an overthrust fault; and in the fact that in several places, as most clearly near Whitehall, the littoral facies of the Cambric and Lower Siluric (Potsdam sandstone, Beekmantown dolomite and Trenton limestone) and the graptolite-bearing shale facies of the same formations come into contact, which implies — granted the original separation of the two facies by either a barrier or differences of depth — an extensive westward transportation of the shales. If one further considers that the former series, at that locality, is fully undisturbed and the other abruptly folded in closely packed

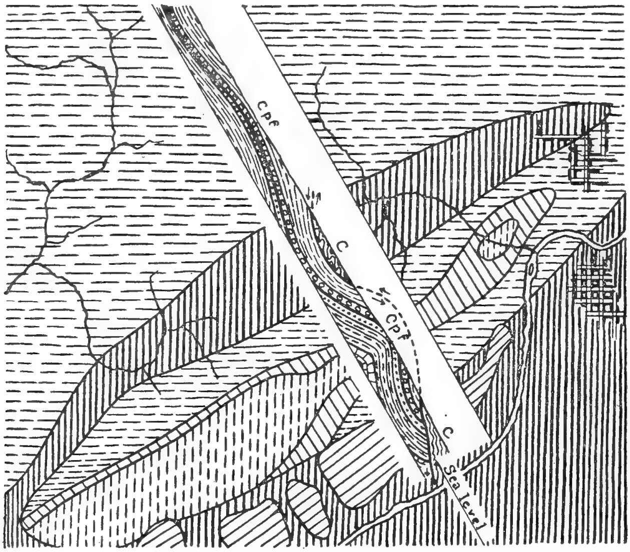


FIG. 31 Shows formation of inliers by overthrusts. From Rome quadrangle (Ga.—Ala.). (C in section) Cambric (Conasarga formation); Carboniferous (Floyd shale). Scale $\frac{1}{125000}$

anticlines, it must be inferred that the folded mass has, as a whole, been pushed upon the first series to an unknown extent. Dr Ulrich with whom I had the pleasure of discussing this view during our summer trips into the Champlain region, reached independently a like view, finding positive evidence of such a great charriage in the conditions surrounding the

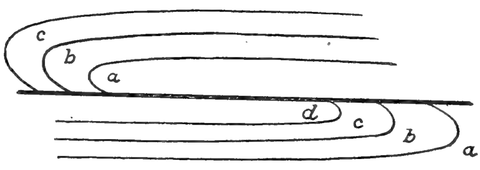


FIG. 32 Charriage (after Haug)

north end of the Taconic mountains, where a small "outlier" of Stockbridge limestone appears in the Cambric rocks and belts of "Hudson slate" accompanying the Cambric inlier [*see* text fig. 33] on the west. It is there quite probable that the whole folded plate of Cambric rocks has been pushed along a slightly inclined fault plain from the east over the Lower Siluric rocks, and that the outlier of Stockbridge limestone does not rest in

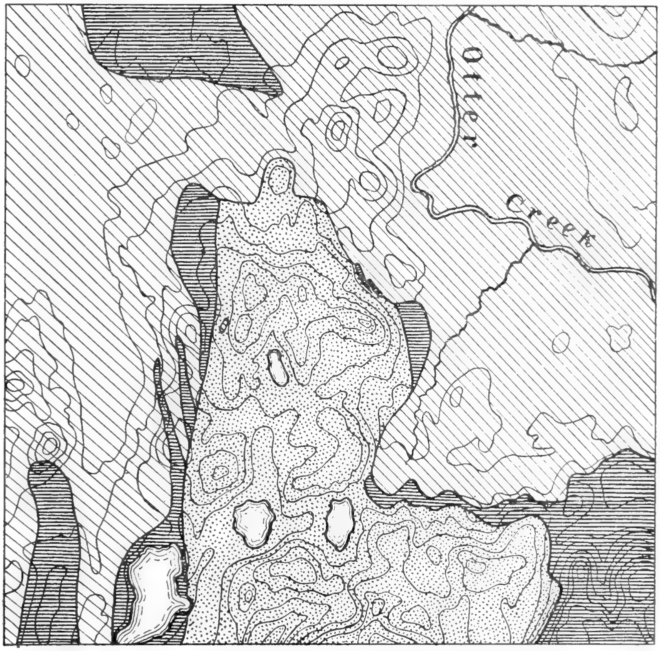


FIG. 33 North end of Taconic range (copy from Dale). Lower Cambric slate; Stockbridge limestone; "Hudson" slate

a small syncline of the Cambric, as it would seem, but protrudes from below the Cambric or is a "Fenster," as the European geologists term it (an outlier of younger rock protruding through older rock in consequence of extensive overthrust and partial weathering away of the overthrusted mass). We have attempted in Museum bulletin 42 [1901. p. 556] to indicate this condition for the Albany region. If we assume this overthrust to have still more approached the horizontal and the transportation along the thrust plane to have been quite extensive, we get conditions which seem to explain many of the greater phenomena of the slate belt. We insert here a section, given by Dale, from the neighborhood of Schodack Landing, south of Albany, showing well the overthrust of the Cambric rocks over the Lower Siluric [text fig. 34].

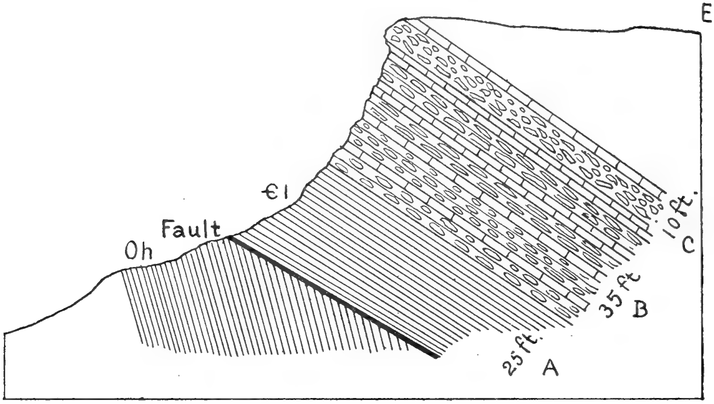


FIG. 34 Diagram section showing the relation of the Lower Cambric limestone (B, C) and shale (A) to the Hudson shale (Oh) as exposed at the localities near Schodack Landing in Rensselaer county. (Copy from Dale)

We also refer in this connection to the section from the Rome (Ga.) folio, inserted here as example of overthrust inliers, as showing that extensive overthrusts of like character as the one here assumed are actually known to occur in the southern Appalachians.

If Dr Ulrich's and the writer's conception of the structure of the slate belt is correct, the belts of "Hudson slate" between the Stockbridge limestone and the Cambric at the north end of the Taconic mountains are most probably wedges between thrust faults.

There have been distinguished, altogether, 14 kinds of inliers in this essay, which are of very different importance. They may be grouped as follows:

A Caused by action of water

1 *Deposition inliers,* resulting from burying by newer strata of
  - *a* original outliers
  - *b* erosional irregularities of surface
  - *c* lenses and reefs

2 *Erosion inliers,* comprising those resulting from
  - *a* corrasion — corrasion inliers
  - *b* solution — "sinks" and "coves"
  - *c* glacial erosion — glacial erosion inliers

B Caused by diastrophism

3 *Fold inliers,* formed
- *a* on the summits of anticlines
  - a_1 on macroanticlines — normal anticline inliers
  - a_2 on brachyanticlines — brachyanticline inliers
  - a_3 domes — uplifts, geanticlines, parmas
- *b* through overturned folds (klippen)

4 *Fault inliers,* formed
- *a* on upthrow side of single faults — segment inliers
- *b* on upthrow side of double faults — horsts
- *c* between branching faults — branching fault inliers
- *d* between overthrust faults — wedge inliers
- *e* through extensive overthrust — overthrust inliers

SOME MARINE ALGAE FROM THE TRENTON LIMESTONE OF NEW YORK

BY R. RUEDEMANN

The early paleontologists described as algae all fossil bodies from the marine beds which in their habit had some similarity to plants, whether or not any organic structure or substance was shown, and in so doing created a burdensome mass of names. The tendency of late has been to doubt the vegetable nature of all so called Paleozoic seaweeds; or to follow Nathorst[1] who, after proving the mechanic or animal origin of many of them, makes the presence of a rind of coal the ultimate criterion. Solms-Laubach,[2] however, will not admit this, since "the coal may entirely disappear in the course of time from remains that are undoubtedly organic, if they are deposited in a porous rock."

The actual presence of fossil algae in at least one of the Paleozoic formations of New York, viz the Chemung, was demonstrated a few years ago by David White.[3] It is pointed out by this eminent paleobotanist that plant life of the class Algae must have been very abundant in the Siluric and Devonic eras and that the apparent rarity of undoubted Paleozoic seaweeds is due to several causes one of which is here cited as having a direct bearing on the material in hand and the discussion to follow. This is the partial explanation of the apparent rarity, resting "in the remarkable similarities in form and habit between many algae and certain contemporaneous low animal types, specially among the sponges and sertularians, whose structure was so much better suited to preservation as to establish a presumptive hypothesis that the resemblant forms must embrace the animal characters of structure and would not have been preserved but for the presence of the latter."

A reaction from the tendency to refer the distinctly preserved algoid remains to the animal rather than to the vegetable kingdom may be said to have set in in the last decade of the preceding century. It is denoted by investigations of Rothpletz, Alexander Brown, Stolley and Whitfield. The first named author[4] began by referring to the algae, G i r v a n e l l a p r o b l e m a t i c a Nichol-

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[1] Nathorst, A. G. Kongl. Svenska Akad. Handl. 1881. v. 18, n. 7.

[2] H. Graf zu Solms-Laubach. Fossil Botany. 1891. p. 47.

[3] White, David. N. Y. State Mus. Bul. 52. 1902. p. 593.

[4] Aug. Rothpletz: Fossile Kalkalgen aus den Familien der Codiaceen und der Corallineen. Zeitschr. d. deutsch. geol. Ges. 43 Bd. 1891. p. 295.

son and Etheridge from the Lower Siluric of Ayrshire, England, placing it with some doubt among the Codiaceae to which he also referred the Mesozoic Sphaerocodium. Both Girvanella and Sphaerocodium form compact bodies essentially composed of an intricate mass of fine continuous tubes. Alexander Brown next took up the problem of the taxonomic position of Solenopora,[1] a genus that in Solenopora compacta (Billings), its genotype, is well represented in the Lower Siluric of New York, and discovered its cellular structure (a tubular one was assumed before), finding that its cells bear great similarity to those of certain living and fossil coralline algae and that there are also traces of tetrasporangia and conceptacles corresponding to those of the recent Corallineae, to which he therefore refers Solenopora as a possible ancestor of the recent nullipores.[2]

E. Stolley[3] in 1893 demonstrated the presence of indubitable calcareous algae in boulders of northern Germany derived from the Lower Siluric of Sweden and described a number of forms which exhibit relationship to the recent Bornetella and the triassic Gyroporella, and all of which were undoubtedly verticillate Siphoneae except one (Arthroporella catenularia) which consists of chains of spheric and pear-shaped bodies and is compared with the Eocene Ovulites.

Finally, Whitfield[4] placed a form hitherto referred to the graptolites (Bythograptus laxus) among the algae, principally for the reason that the secondary branches are connected by distinct articulations with the central stipe and that proper cell apertures are absent or indistinguishable.

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[1] Brown, Alexander. On the Structure and Affinities of the Genus Solenopora. Geol. Mag. IV. 1894. p. 145.

[2] Professor Rothpletz has lately published the results of his most thorough and painstaking investigations of these difficult and problematic forms [*see* Ueber Algen und Hydrozoen im Silur von Gotland und Oesel, in Kongl. Svenska Vetensk. Handl. Bd. 43, no. 5, 1908] positively placing Girvanella problematica, and Sphaerocodium, to which also a Siluric form is referred, as well as Solenopora, among the algae. As most important for the taxonomic position of Solenopora, he considers the presence of perforations of the cell walls discovered by him, the arrangement of the concentric rows of cells and the similarity of the tubular, isolated sporangia in Solenopora gotlandica and the Archaeolithothamnia.

In a review by Steinmann (Zeitschr. für Induktive Abstammungs-und Vererbungslehre, Bd. 1, Hft. 4, p. 405, 1909) that has just come to hand the existence of probable transitional forms (in the Permian limestones of Sicily and the Jurassic) between the Siluric Solenopora and Lithothamnium, that begins in the Cretaceous period, is pointed out.

[3] Ueber silurische Siphoneen. Neues Jahrbuch 1893. 2:135.

[4] Whitfield, R. P. On New Forms of Marine Algae from the Trenton Limestone, with Observations on Bythograptus laxus Hall. Bul. Am. Mus. Nat. Hist. 1894. v. 6, art. 16, p. 351.

Bythograptus laxus comes from the Trenton limestone of Platteville, Wis. The same locality has furnished a small number of other forms of vegetable aspect, which are also described on good ground as marine algae in the same publication.

In a later paper[1] Professor Whitfield created a new genus *Palaeodictyota,* for a form from the Niagaran of New York before described as a graptolite (Inocaulis anastomotica Ringueberg) believing the same to be a marine alga. The present writer has lately [N. Y. State Mus. Mem. 11. 1908. p. 20] shown that *Palaeodictyota* has the tubular composition and the cell apertures of a graptolite of the order Dendroidea.

These facts serve to show that there is a group of graptolites that in their habitus approach so much that of the seaweeds that since the time when Goeppert referred *Dictyonema* to the fucoids announcing the discovery of a fructification (cystocarp) like that of *Callithamnion* on its branches, botanists have still thought it possible they might be plant remains, and *Dictyonema* is still cited in the great standard systematic work, Engler-Prantl's "Die natürlichen Pflanzenfamilien" [1 Teil, 2. Abt. 1897. p. 554] among the doubtful seaweeds.

While searching for graptolites in the Trenton limestone of Glens Falls, N. Y., the writer has discovered a congeries of like character with that from the Trenton group of Platteville, Wis. It is rather with the intention of recording the occurrence of this rare group of fossils in the eastern Trenton than for the purpose of discussing the problem of the vegetable or animal character of these fossils that this note is published. We also insert for this reason a form from Glens Falls that gives fair evidence of being a graptolite of the order Dendroidea but has also a vegetable appearance and is associated with the others, and we desire to state in this connection our belief that the evidence in every single case has to be weighed separately.

The small assemblage of Trenton fossils at Glens Falls was found in thin patchy seams of very fine grained black shale intercalated in the shaly limestone forming the hanging wall of the abandoned "Black marble" quarries on the south side of the Hudson river. The layer containing the fossils is about 16 feet above the base of the Trenton.

Besides the algal remains the bed has been found during this investigation to contain also small fragments of true graptolites of

[1] Bull. Am. Mus. Nat. Hist. 16, art. 36, p. 399 (1902).

the genera Climacograptus, Cryptograptus etc. On account of the great interest which this graptolite occurrence has in regard to a possible correlation by intercalation of the corresponding graptolite horizon with the limestone series of the Trenton, this faunule will be studied separately after more extensive collecting.

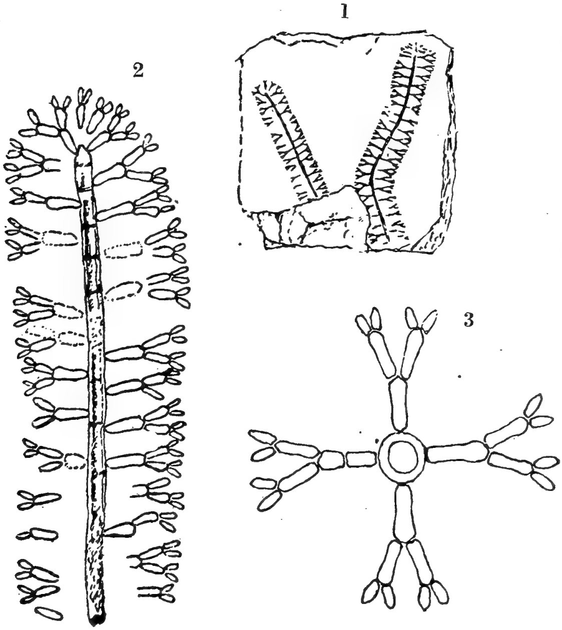
The fact of the occurrence of graptolites proper together with the supposed marine algae may seem suggestive of the graptolite nature of all the fossils, especially if it is taken in account that some of the algoid forms exhibit in the carbonaceous films they have left, the distinctness and sharpness of graptolite remains in spite of their subdivision into hair-fine branches. On the other hand it could be urged that from the well recognized evidence of the growth of many graptolites on seaweeds the concurrence of the two in the same bed is a logical corollary. But, if the surrounding conditions at Glens Falls are taken into account, it becomes evident that the graptolites and the algoid fossils belong to different marine life zones. The very irregular surface of the thin bedded limestone and the patchy distribution of the black shale in depressions of the limestone, indicate that the deposition took place in rather turbulent water. The comminuted condition of the true graptolites shows that they drifted in from the open sea, while the fine preservation of the much more delicate algalike remains indicates that they grew where they are found and were sessile forms of the l'ttoral zone.

Dr Hovey has had the kindness to send me the types of two of the species of marine algae described by Professor Whitfield, for comparison and study. The structural details of these — presently to be described — leave no doubt of their vegetable origin. One is a distinct coralline alga from the Trenton of Middleville, N. Y. [*see* pl. 1, fig. 1], the other (Callithamnopsis fruticosa) a seaweed from the Trenton of Platteville, Wis. The latter is so closely related to one of the Glens Falls forms (C. delicatula) that by inference the latter must also be an alga although its structural features are not as distinctly seen. We will for this reason first note these two longer known species of manifest algal character and then attempt to demonstrate the vegetable nature of the Glens Falls forms by reference to them.

Primicorallina Whitfield

This genus of calcareous algae was erected for a single species, P. trentonensis Whitfield, from the Trenton limestone of Middleville. The form is described by its author as follows: " (The specimens) consist of a central or longitudinal axis which is hollow and jointed, and of whorls of lateral branches of pinnules, apparently four, possibly five in number, radiating from the central axis and forming a cylindrical body in the aggregate. The pinnules of the whorls are composed of three elements each; a first joint which diverges from the central axis gives origin to two secondary joints, while each of these supports two still smaller joints or pinnulae."[1]

We insert here three of the original accurate figures by the author of the genus [text fig. 1-3] and add a camera drawing of one



Primicorallina trentonensis Whitfield
FIG. 1 Slab with specimens. Nat. size
FIG. 2 Type, x 4
FIG. 3 Transverse section. (Copies from Whitfield)

of the type specimens [*see* pl. 1, fig. 1], to bring out a few characters not noted in the original description.

[1] The following is the original description of the genotype: "Fronds of small size, represented by cylindrical tufts of greater or less length, and of from one sixth to one fourth of an inch in diameter. Axis of the frond irregularly cylindrical and jointed; the joints count about 30 to the inch and are nearly twice as long as thick. Pinnules four, or perhaps five, from each joint of the axis, composed of cylindrical, oval or clavate joints; those originating on the axis are of nearly an equal length with the axial joints, and each supports two others on the outer end of very nearly or somewhat shorter length, but of less thickness; these again each support two others which are short oval in outline and of not more than half the length of the others. Bifurcations of the pinnules diverging at an angle of about 30 to 35 degrees to each other."

A thick calcareous incrustation is found between the axial canal formerly occupied by the axial cell, or cells, and a thin, carbonaceous outer film. The axial canal becomes visible in the principal branch of the thallus where the tube is crushed [*see* pl. 1, fig. 1] and also an axial canal of the branchlets can be seen in the same specimen on the right-hand side. The calcium carbonate of the fossil contrasts by its dark brown and sometimes amber color with that of the matrix and of other fossils indicating a certain amount of carbonaceous matter still contained in it. In thin sections made through a few joints a deep black thin layer was seen on the outside and a less distinct one lining the axial canal, showing that the calcareous deposition took place within an outer membrane or gelatinous sheath. The outer black layer fails to show traces of former pores and the calcareous deposition is crystalline and devoid of structure.

Professor Whitfield describes the branchlets or pinnules as repeatedly bifurcating. The fact, however, that this bifurcation is seen in both the longitudinal and transverse sections of the same specimen suggests that also in the branchlets the division took place in double dichotomies or in whorls of four branches; and in fact in one place [*see* pl. 1, fig. 1 at a and b] three branchlets are seen at the second division (at a) and in one three at the third (at b). The thallus is hence composed of a system of verticils of branches. The joints of the main stem are cylindrical, little contracted at the articulations, those of the branchlets, however, are clavate, somewhat bulbous at the distal end and with rounded extremities. The terminal branchlets are pyriform, distinctly pointed at the distal extremity and round and bulbous at the other.

Thin sections through the few fragments of joints of the main stem and branchlets have not furnished any indication of the presence of cavities suggestive of conceptacles. The fructifications may have consisted of terminal sporangia that were easily detachable and were lost, or we may have only sterile thalli before us, or again, the terminal pyriform branchlets may have contained the conceptacles at their apexes and these may have become obscured by secondary crystallization. It probably will require more material than is available now to discover the fertile branches.

Professor Whitfield referred this form to the coralline algae (Corallinaceae), as shown by the name, probably on good ground as long as the verticillate arrangement of the branchlets of the second and third orders was not recognized. A verticillate arrangement throughout the whole thallus such as this form possesses is, however, not observed among the coralline algae which for the most part possess only a flat, incrusting thallus and in the erect forms, as in Corallina, are bifurcating or irregularly branching, mostly in but one plane. The habitus of Primicorallina as restored in this publication [*see* pl. 1, fig. 2], is distinctly that of one of the verticillate Siphoneae and well comparable to that of Dasycladus or Polyphysa and other genera of the Dasycladaceae. Since calcification takes place also in several of the genera of this order of algae, and other calcareous verticillate Siphoneae were already abundant in the Lower Siluric seas, as shown by Stolley, it is preferable to place Primicorallina with the verticillate Siphoneae.

A reference of Primicorallina to the Dasycladaceae invites comparison to the other verticillate Siphoneae described by Stolley from the Swedish Lower Siluric. The latter forms differ in having the branchlets incrusted like the recent calcareous genera of Dasycladaceae (Cymopolia, Bornetella and Neomeris), to such an extent that a solid cylindric mantle is formed in which the branchlets are imbedded. In Primicorallina the incrustation of the axial cell and of the branchlets is comparatively slight, so that all the branchlets remain free. This is obviously only a difference in grade of calcification. Another difference rests seemingly in the segmentation of the stem which suggests a composition of the stem of more than one cell while in the verticillate Siphoneae it consists of but one, the axial cell. But it is here to be remembered that on one hand the axial canal in Primicorallina shows no or but little contraction (as far as can be seen from the few type specimens without breaking them) at the articulations and may well result from a single axial cell and that, on the other hand, an articulation of the whole thallus without subdivision of the axial cell exists also in the recent Cymopolia.

From Arthroporella Stolley, which consists of a chain of spheric and pear-shaped bodies such as the branchlets of Primicorallina might also form when seen in sections, the latter genus differs in having these bodies articulate while in Arthroporella the incrustation is continuous and is also distinctly porous.

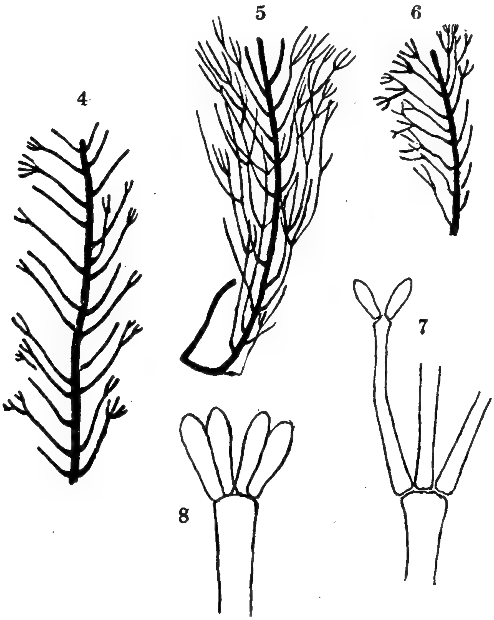
It is very probable that Primicorallina has not only interest as one of the earliest known calcareous verticillate Siphoneae but that it is also of importance in explaining the origin of certain Trenton limestones of granular and oolitic texture. Small grains which are the separate joints of this form fill the otherwise fine grained limestone containing the type specimens. It is therefore obvious that accumulations of these joints are competent to form a peculiarly granular limestone that may at times appear to be made up of comminuted crinoidal fragments and again as of undistinctly oolitic structure. The writer has collected a specimen of limestone at Glens Falls that entirely consists of just such granules which in a few places still retain their original serial arrangement and which, in spite of the obscuration of their structure by secondary processes, quite certainly are derived from calcareous algae. Stolley has already pointed out that the Siphoneae attained not only a high development in Siluric time but that they also grew in great abundance and that they will be found to have formed many limestones in that era. If Solenopora is a Coralline alga, then also that family of algae must have contributed largely to the formation of our Trenton limestone by the var. trentonensis of Solenopora compacta.

Callithamnopsis Whitfield

Professor Whitfield has proposed this new genus of fossil algae for a form before described by Professor Hall as Oldhamia fruticosa from the Trenton limestone of Platteville, Wis. We have before us a new species from the Trenton of New York referable to this genus and will for this reason enter a little more fully on the discussion of the structure of the better preserved genotype, C. fruticosa. We insert here copies of some of the original figures [text fig. 4–7] illustrating this type and also a camera drawing [pl. 1, fig. 3] of ours of one of the types to show more clearly some of the important features of the form.

The concise original diagnosis of the genus is: "Frond articulate, branched, branches opposite in pairs, in whorls near the upper end of the joints, and composed of single joints between bifurcations."

The camera drawing of the type specimen here reproduced shows the following characters: A distinctly monopodial growth of the thallus with a thick branch of uniform thickness. This retains in some parts a thick carbonaceous test. Where the latter is broken out, a distinct sharp median longitudinal line is seen on the impression dividing the latter into two convex halves, the whole giving the impression of being produced by the crushing of a hollow stem. The apex of the branch is seen to be rounded and sharply defined. In several parts of the main branch distinct transverse lines are visible which suggest a segmentation of the same corresponding to that of the branchlets. The branchlets of



Callithamnopsis fruticosa Whitfield
FIG. 4–6 Type specimens, x 3.
FIG. 7 Articulation of branchlets, further enlarged
FIG. 8 Terminal branchlets. (Copies from Whitfield)

the first order are always arranged in pairs. Their base is somewhat swollen and also articulates with the main branch. The branchlets of the first order are long and slender. They bear a whorl of four or more shorter branchlets of the second order and each of these again four (or more) short bulbous terminal branchlets in the specimen figured. In others these are again seen to grow out to branchlets of the length of those of the preceding order. No traces of fructification could be found.

The habit of C. fruticosa is clearly algal and there are a number of recent genera, especially among the Florideae, with which it could be readily compared in this respect. Its branching is verticillate in the distal parts and therefore invites comparison rather with forms other than Callithamnion which is typically represented by bifurcating forms. The mode of branching and general structure is so much like that of the preceding genus, Primicorallina, that Callithamnopsis could be considered as a closely related form lacking the incrustation of carbonate of lime.

Professor Hall referred originally to his Oldhamia fruticosa intertwining slender branches which have been separated by Professor Whitfield and described as Chaetomorpha ? prima [*see* text fig. 9, 10]. A specimen on the same slab with some of the types of Callithamnopsis fruticosa reproduced in plate 1, figure 4, leaves, however, no doubt that these stems twisted together are but branches of the latter species which in drifting have become stripped of the branchlets of the higher orders and at the same time through their flaccidity became twisted around each other.

The specimen here figured demonstrates at the same time that the main branch of C. fruticosa bifurcated once or twice, the resulting branches bearing pairs of branchlets.

Chaetomorpha ? prima Whitfield
FIG. 9, 10 Type specimens. (Copies from Whitfield)

Callithamnopsis delicatula sp. nov.

Plate 1, figure 5; plate 2, figures 1, 2

Description. Thallus consisting of segmented monopodial or bifurcating main branch bearing whorls of branchlets which in their turn divide repeatedly in whorls of branchlets of higher order. The main branch is apparently bifurcated. At least such a division is indicated by the specimen plate 2, figure 1, and it would agree with the bifurcation of the main branch in the genotype. It is segmented, for transverse lines that alternate with the whorls are seen in at least one of the specimens [pl. 1, fig. 5]. The branchlets of the next order are somewhat bulbous at their bases and produce an annulation of the main branch. To some extent the latter is also seen to contract between the whorls [*see* pl. 1, fig. 5]. The branchlets are extremely slender and flaccid and therefore much subjected to current dragging [*see* pl. 2, fig. 2]. The whorls of the branchlets of higher orders are far apart and consist only of three or four branchlets. On account of their length the branchlets are liable to form so dense a mass that they completely envelop the main branch. No fructification has been observed.

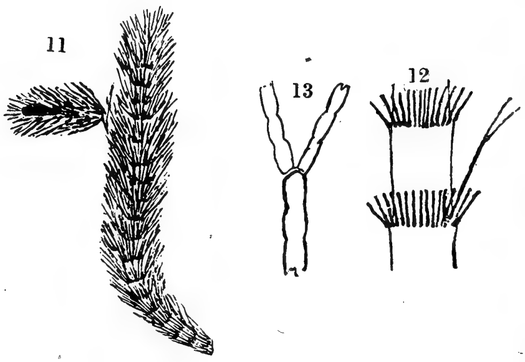
This alga probably possessed a very delicate and minute thallus, the largest fragments not attaining 20 mm in length. The carbonaceous test of the branches is much thinner than in the genotype and also than that of the associated algae in the Trenton limestone at Glens Falls and only visible with good light.

From the genotype it is distinguished by the generally greater tenderness of the whole thallus, that finds its expression in the thinner main branch and thinner and more flaccid branchlets and also in the closer arrangement of the whorls on the main stipe. The contraction of the latter between the annuli produced by the bases of the whorled branchlets constitutes another difference.

Horizon and locality. In the Trenton limestone at Glens Falls, N. Y.

Chaetocladus Whitfield

For a new species of supposed algae from Platteville, Wis., Professor Whitfield has proposed the genus Chaetocladus, characterizing the same as consisting of " Marine plants with jointed cylindrical stems giving off whorls of hairlike filaments at given distances."



Chaetocladus plumula Whitfield

FIG. 11 Type specimen, x 3
FIG. 12, 13 Further enlargements. (Copies from Whitfield)

We insert the original drawings [*see* text fig. 11–13] of this peculiar form for comparison with the form here referred to that genus. It will be seen from the second figure that the branchlets may bifurcate again.

Chaetocladus sardesoni sp. nov.

Plate 2, figures 3–11

Professor Sardeson sent me some years ago a piece of magnesian limestone from the Bellerophon bed (Trenton-Galena bed 2 of his system) at Minneapolis that contains numerous fragments of the thallus of an exceedingly delicate alga easily mistaken for a graptolite on account of the regularity of its structural features.

The specimens are very slender and preserved only as a brown, mostly thin film, which, however, shows very plainly under water or glycerine. Occasionally also thicker carbonaceous portions are observable. They consist essentially of a uniformly thick or very gradually tapering main axis and regularly arranged whorls of very thin, filamentous branches which from their position in all specimens observed, would seem to have sharply bent upward outside of this thickened base and grown subparallel to the main axis. There were six or more in one whorl. No conclusive traces have been seen in the main axis of either transverse walls, indicating a segmentation or articulation, or of longitudinal walls suggesting a composition of thecal tubes of graptolitic character.[1] The absence of the latter partitions is also suggested by the smooth outside of the main branch.

On account of the arrangement of the branchlets in close whorls on the main branch and the absence of a further division of the branchlets, either by bifurcation or formation of whorls, this species is best brought under Chaetocladus, although it will be noticed that it represents a transitional form between the extremely densely whorled Chaetocladus plumula Whitfield that possesses hardly any further division and Callithamnopsis delicatula that possesses like whorls on the main branch but also a further subdivision of the branchlets that gives it the habitus of a Callithamnopsis.

The most interesting feature of Chaetocladus sardesoni consists in the bulbous swellings of the bases of the branchlets forming the annuli around the main branch. These bulbs are seen in several specimens to have been hollow and to be formed by thicker tissue [*see* pl. 2, fig. 9]. They may therefore possibly have contained sexual or nonsexual propagative organs and correspond to conceptacles observed in some Florideae in a similar position.

Corematocladus gen. nov.

Ety. *Κόρημα* = a broom, *Κλάδος* = a young branch

Thallus composed of thick subcylindric stem that is surrounded by a dense mass of filamentous, frequently subdividing branches. Genotype, Corematocladus densa sp. nov.

[1] In regard to this observation we have to rely mainly on the natural sections produced by the splitting of the stem through the middle since thin sections failed on account of the flattening of the stem to reveal distinct structures.

Corematocladus densa sp. nov.

Plate 3, figures 1–5

The thallus is small, about 28 mm in diameter and 30+ mm long. It consists of a thick central stem or stipe which most probably was a cylindric branch, but possibly may also have been platelike and attached to other bodies, thus representing only the attachment plate. Its surface is corticated, being covered with a pavement of plates, some of which are distinctly ringlike [*see* pl. 3, fig. 4, 5]. These rings seem to have been the bases of the filamentous branchlets which from their distinct preservation may also have been strongly corticated. The latter bifurcate frequently, the bifurcations apparently following each other more rapidly in the distal portions and in some places they appear to be whorled, dividing into three or probably four branchlets. There are six or more bifurcations in each branchlet from the base to the extremity. The branchlets diverge at small angles and become subparallel. They appear rather rigid and become thinner with each bifurcation, the basal portion reaching about .3 mm in width, the distal portion but .1 mm and less. They are seen to be furnished with transverse walls that in the proximal portion are about twice as far apart from each other as the branchlet is wide and that divide the latter into squarish segments in the distal portion. Directly below the bifurcations the continuity of the branchlet is frequently seen to be interrupted and the segments are slightly inflated on both sides of the line of interruption giving the impression of an articulation.

The systematic position of this small but striking form is at present still very doubtful. The habitus is decidedly more that of an alga than of either a graptolite or of a colonial stock of sertularian or anthozoan affinities, although the strong and glossy carbonaceous test seems highly suggestive of the graptolite nature of the fossil. The absence, however, of cell apertures on the multitude of branchlets[1] and the distinctness of the transverse walls where the test is broken through the middle (they do not show on the smooth outside) are characters favoring a reference to the vegetable kingdom. It must not be forgotten on the other hand that the main axis or stipe might be the theciferous part, the ringlike bases of the branches, the apertures of thecae, while the branchlets themselves were but filamentous processes of the thecae, the form being a Den-

[1] There were seen a few subcircular scars or openings on the test which however are in the place of bifurcations and apparently are produced by the breaking off of one of the branches at the articulation.

droid graptolite and representing a genus near Thamnograptus or Inocaulis. With that supposition, however, the transverse walls and bifurcations of the branchlets would be difficult of explanation.

We do not know of either an alga or an animal form of the Coelenterata with which Corematocladus densa could be directly compared by its habitus. While there are many species forming caespitose tufts among the Florideae, which order on account of the frequent development of strong cortical cells and the transverse septation of the filaments would principally suggest itself for reference, none possess a structure the direct counterpart of that of our species. There are, however, various forms in other orders of marine algae which by their composition of a thick main axis that bears a dense mass of bifurcating filamentous branchlets invite comparison. As such a genus Penicillus among the Codiaceae might be cited, in which an incrusted stipe bears a dense terminal mass of frequently bifurcating filaments.

Munier Chalmas had thought to have discovered this latter form in thin ovoid or fusiform calcareous shells of the Tertiary described as Ovulites which possess on their surface pores surrounded by fine lines inclosing polygonal spaces, the whole forming a structure suggesting somewhat of the main stipe of Corematocladus densa; but as Solms-Laubach has pointed out, no such reticulated design is seen on the surface of the calcified membrane of Penicillus, although he recognizes Ovulites as a calcareous alga. Our form may have been similar in the structure of the main stipe to Ovulites although possessing instead of the calcification a thick noncalcareous cortex.

Horizon and locality. In the lower third of the Trenton limestone at Glens Falls, N. Y.

Mastigograptus ? flaccidus sp. nov.

Plate 3, figure 6

Associated with the described supposed marine algae in the shaly intercalation of the Trenton at Glens Falls and by their flaccid character and carbonaceous film, quite apparently belonging to the same class with them, occur slender wormlike irregularly bent carbonaceous bodies that are distinctly but the macerated fragments of larger organisms. In one case the proximal extremity was observed which is well fitted to throw light on the true nature of this form [*see* pl. 3, fig. 6]. This shows a small attachment plate from which a slender main stipe arises that monopodially gives off equally flaccid and slender branches. Both the stipe and the branches exhibit at regular intervals circular to transversely elliptic slightly projecting apertures surrounded by a thickened rim and appear to alternate on opposite sides of the stem and branches.

There are no traces of internal walls observable in the badly flattened specimens.

While it is perfectly conceivable that all the apparent apertures could be but the former places of attachment of lost branches, it is also quite as sure that this form, found in another association, would be unhesitatingly referred to the graptolites and brought into the neighborhood of Mastigograptus where it closely resembles in general habit and structure the Utica form, M. arundinaceus (Hall).

As in the case of Corematocladus densa the carbonaceous test is so thick and so glossy that it is more suggestive of the chitinous periderm of a graptolite than of the cortex of an alga and it would require unmistakable algal characters in the composition of the branches and the propagative organs to warrant a reference to the vegetable kingdom.

Horizon and locality. In the shaly intercalation of the lowest limestone beds overlying the "Black marble" at Glens Falls, N. Y.

Concluding Remarks

There are in this paper more fully noted three species of fossils from the Trenton rocks of New York whose position among the marine algae seems fairly well established. These are:

Primicorallina trentonensis *Whitfield* Callithamnopsis delicatula *sp. nov.*
Corematocladus densa *sp. nov.*

The first named is a calcareous alga, which before was placed among the Coralline algae, but is believed by the writer to be a verticillate Siphonea. The other two forms possess only carbonaceous tests and are characterized by the great mass of thin branchlets borne on the axial stem. In Callithamnopsis delicatula these branchlets are arranged in whorls, in the other form they are irregularly distributed on the thick axial stem and frequently bifurcate. The aspect of these forms is that of Florideae and their habitus, which alone is now available, permits of comparison with several families of that class.

It is probable that calcareous algae have played an important rôle in the formation of the limestones of the Trenton formation. This is not only suggested by the frequency of the small joints of Primicorallina in the rock which contains the types, but also by the fact that there occur peculiarly granular and oolitic limestones in the Mohawkian stages (not only in the Trenton and Black River limestone, but also in the Lowville limestone) which may be strongly suspected to be of vegetable origin. In Europe similar rocks of the Lower Siluric have been recognized by Stolley to owe their origin to verticillate Siphoneae. There is neither any doubt that forms corresponding to the important rock-forming nullipores of later eras have been very active then and productive of much of our Lower Siluric limestones, at least in Chazy to Trenton times. This is 1) indicated by the common occurrence in some of our Mohawkian rocks of Solenopora compacta, a form that is placed among the calcareous algae by Rothpletz and considered as either an ancestor of the Coralline algae or as representing an earlier development of a corresponding or parallel branch of the algae, and 2) it is demonstrated by the composition of whole beds of all three divisions of our Chazy by the small nodular bodies described by Seely[1] as a new type of sponge under the name of Strephochetus with a small number of species. Professor Seely's careful figures of microscopic sections, especially of his S. ocellatus, leave, however, no doubt that Strephochetus is identical with Girvanella N. & E. The latter had already been suspected by Nicholson and Etheridge, and later has been proved by Rothpletz to be a calcareous alga, that invites comparison with the Siphonean family Codiaceae. If Girvanella is an alga, much of our Chazy limestone is of vegetable origin.

Also our Beekmantown beds contain strata filled with similar small flat pebbles that are highly suggestive of the water biscuits of our lakes.[2] For these, occurring frequently in upper D. in the so called "Wing conglomerate of Vermont," Seeley has erected the genus Wingia,[3] considering them again as sponges. It is an inviting task to investigate these and other forms of pebbles of the Beekmantown and late Paleozoic stages as to their possible vegetable origin.

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[1] Seely, H. M. Some Sponges of the Chazy Formation. Vt. State Geol. Rep't 1902. p. 151.

[2] Calcareous water biscuit have been described from Canandaigua lake where they largely contribute to the composition of the beach, by Clarke [N. Y. State Mus. Bul. 39. 1900. p. 195]. They are glomerated masses of algae such as are known from many European lakes ("algoid lake balls") that by their own metabolic processes have caused a deposition of carbonate of lime on them. The similarity of the structure of these water balls to that of Girvanella has induced Seward [Fossil Plants, 1895. 1: 125] to place the latter genus among the Schizophyate, a view opposed by Rothpletz [*loc. cit.* p. 5].

[3] Seely, H. M. Contribution to the Geology and Paleontology of Vermont. Vt. State Geol. 5th Rep't 1906. p. 25.

Finally, there is also evidence that already the early Cambric rocks of this State may carry remains of algae. The Lower Cambric shales contain in a number of localities in the slate belt of eastern New York east of Albany, numerous specimens of a stately form [*see* text fig. 14] that was first discovered by T. N. Dale and has been described by Walcott[1] as Oldhamia (Murchisonites) occidens.

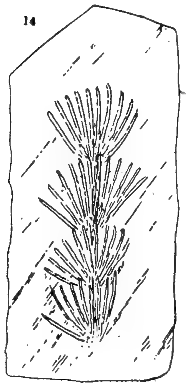

FIG. 14 Oldhamia (Murchisonites occidens. Walcott Original figure. (Copy from Walcott)

The original Oldhamia is now currently considered as of purely mechanical origin [*see* Solms-Laubach, p. 50 and H. Potonié, Lehrbuch der Pflanzenpalaeontologie, 1899. p. 32]. O. occidens, which is by Walcott provisionally referred to the calcareous algae and by Dale to the nullipores, is only found as casts on the surface of a smooth silicious slate and therefore, notwithstanding its highly suggestive form, is still a very doubtful vegetable fossil. The habitus of the form as figured by Walcott is not that of a nullipore, but rather that of one of the many Florideae with whorls of branchlets.

The inference from the before stated facts is that the earlier Paleozoic rocks of New York contain, or are indeed partly composed of, masses of calcareous algae, and that possibly these are even traceable back into early Cambric time. All of these forms require, however, microscopic study of their structure by a competent phytopaleontologist to establish their vegetable origin beyond doubt, and to determine their taxonomic relations by the discovery of the propagative organs.

No calcareous algae have as yet been made known from our Devonic rocks, although their presence there can not be doubted. The Devonic of this State has thus far furnished to us of indubitable algal remains, only the large Thamnocladus clarkei White from the Chemung, that according to its author has the greatest similarity in the external characters with the Fucaceae, and the giant stem of Nematophytum crassum from the Hamilton group of Orange co., N. Y., that is in the New York State Museum and is also referred to the Fucaceae.[2]

[1] Walcott, C. D. Discovery of the Genus Oldhamia in America. U. S. Nat. Mus. Proc. 1894. v. 17, no. 1002, p. 313–15. *See also* Dale, T. N. Geology of the Hudson Valley between the Hoosic and the Kinderhook. U. S. Geol. Sur. Bul. 242. 1904. p. 13.

[2] Penhallow, D. P. U. S. Nat. Mus. Proc. 1893. 16: 117. *See also* Prosser, C. S. Am. Geol. 1902. 29: 372.

EXPLANATIONS OF PLATES

PLATE 1

Primicorallina trentonensis Whitfield

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1 One of the type specimens redrawn, to show the verticillate arrangement of the branchlets of the second order at *a* and those of the third order at *b*

2 Restoration of a thallus

Trenton limestone, Middleville, N. Y.

Callithamnopsis fruticosa (Hall)

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3 One of the type specimens redrawn to show the apex of the main branch and the articulation of the branchlets at the division points and the paired arrangement of those of the first order

4 A specimen on the same slab with the types, exhibiting the twisting of the bifurcating main branches

Trenton limestone, Platteville, Wis.

Callithamnopsis delicatula sp. nov.

See plate 2, figure 1

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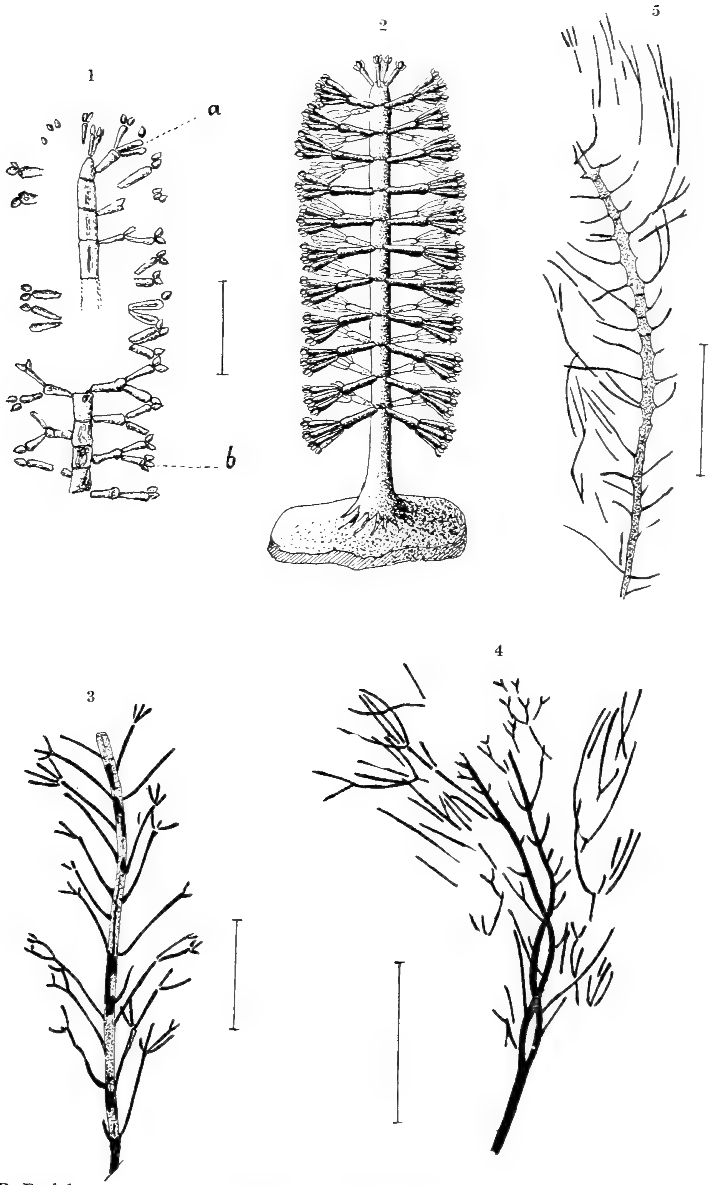
5 Large fragment of thallus showing the segmentation, the alternate contractions and expansions of the branch and the verticillate arrangement of the branchlets

Trenton limestone, Glens Falls, N. Y.

Originals of figures 1, 3, 4 in the American Museum of Natural History, that of figure 5 in the New York State Museum

Plate I



R. R. del.

Siluric marine algae

PLATE 2

Callithamnopsis delicatula sp. nov.

See Plate 1, figure 5

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1 Fragments of two branches in close approximation indicating their production by bifurcation of a single branch

2 A fragment of thallus showing the habitus of the same and the apex. The upper and lower portions lie in different planes of the shale. The specimen shows the effect of current dragging.

Trenton limestone, Glens Falls, N. Y.

Chaetocladus sardesoni sp. nov.

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3, 4, 7 Fragments of the thallus showing, in natural sections, the main branch and the whorls of branchlets

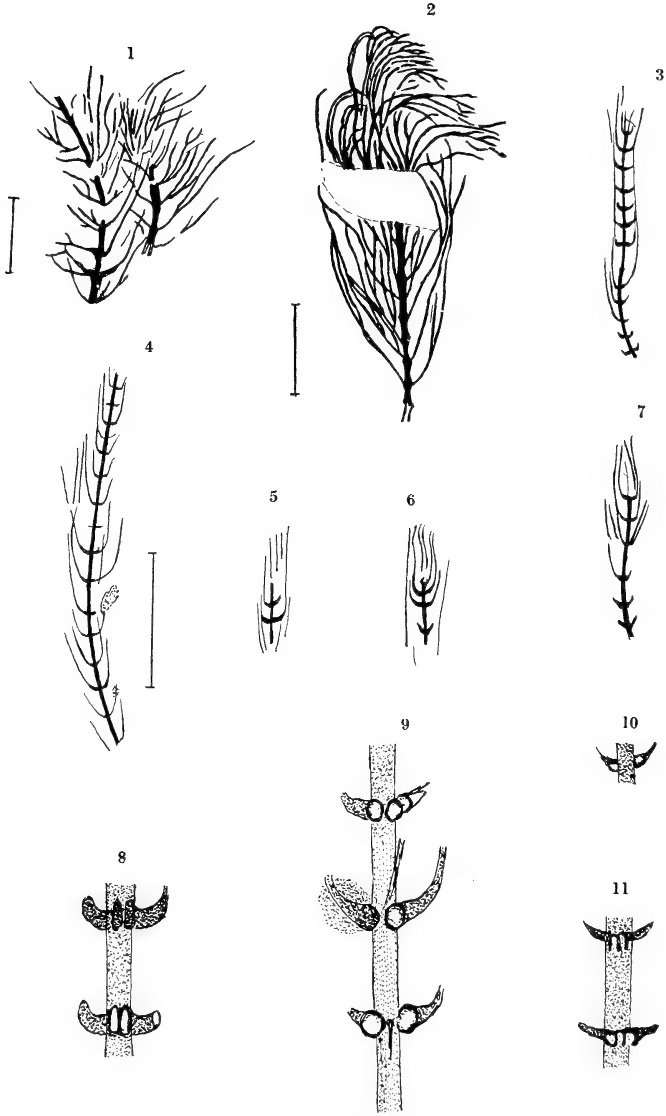
5, 6 The apexes of specimens showing the whorls of branchlets

8–11 Some portions of the thallus more enlarged to show the bulbous bases of the branchlets and their cavities, possibly conceptacles

Trenton-Galena limestone, Minneapolis, Minn.

The originals of all figures are in the New York State Museum.

Plate 2



R. R. del.

Siluric marine algae

PLATE 3

Corematocladus densa sp. nov.

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1 Specimen retaining the thick main branch. Natural size
2 Another specimen (cotype) in which the stipe is either lost or covered by shale, but the corona of small branchlets is shown. Natural size
3 A young thallus with thin stipe, showing well the verticillate arrangement of the branchlets. Natural size
4 Enlargement of a portion of the original of figure 1, to show the surface character of the stipe and the mode of division of the branchlets
5 Enlargement of a small fragment of the thallus showing the bases and the segmentation of the branchlets

Trenton limestone, Glens Falls, N. Y.

Mastigograptus ? flaccidus sp. nov.

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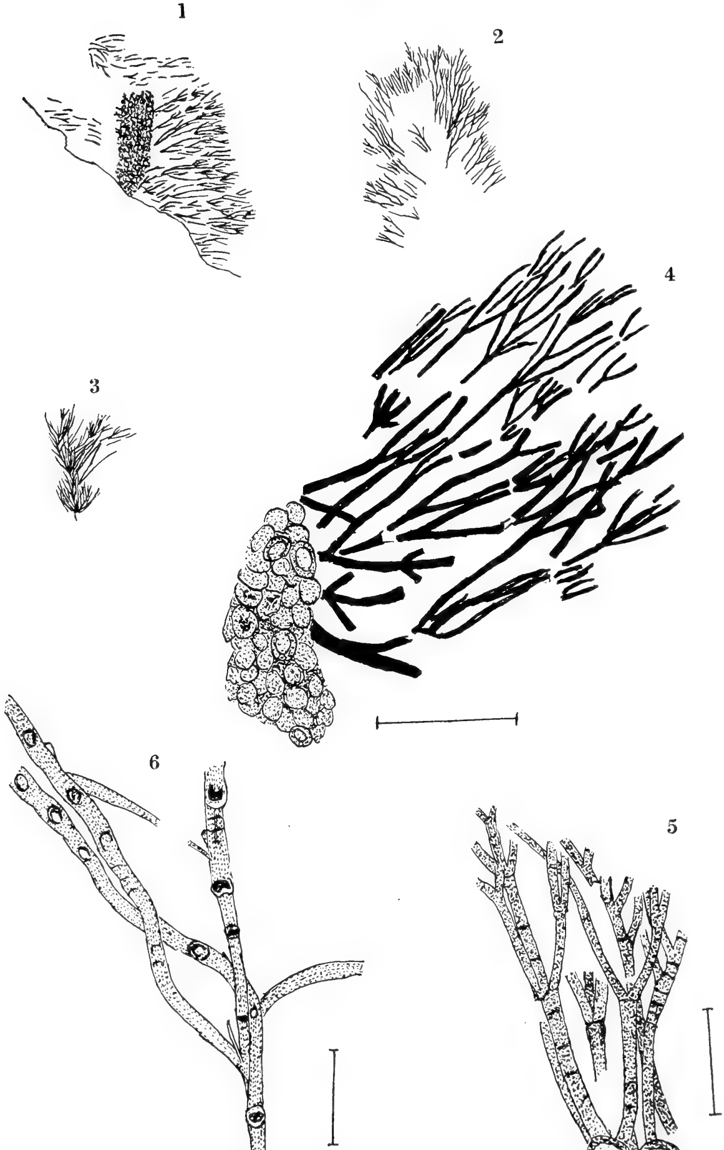
1 Type specimen (holotype). A graptolite that is associated with the algae

Trenton limestone, Glens Falls, N. Y.

All originals are in the New State Museum

Plate 3



R. R. del.

Siluric marine algae

SOME PARALLEL GROUPINGS OF CALCITE CRYSTALS FROM THE NEW JERSEY TRAP REGION

BY H. P. WHITLOCK

1 Calcite from Plainfield, N. J.

The attention of the writer was recently called to some interesting parallel groupings of calcite crystals which were collected in 1903 by Mr Alfred C. Hawkins of Sewaren, N. J., from a locality

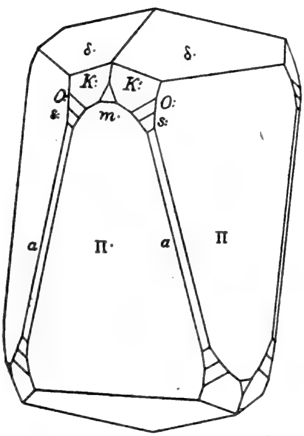


FIG. 1

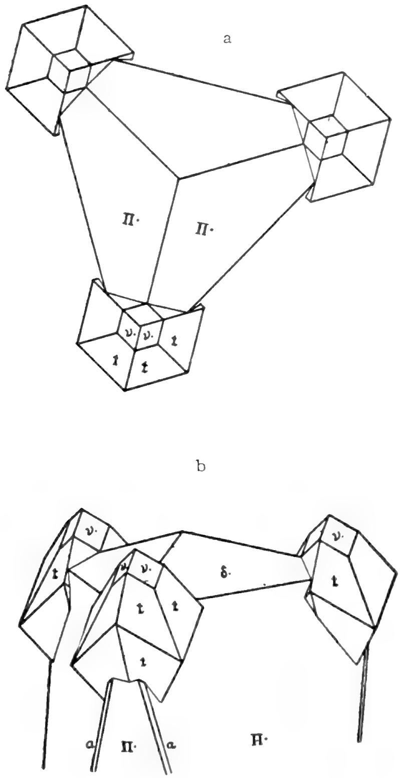


FIG. 2

about 1 mile west of Plainfield, N. J. The writer wishes to express his thanks to Mr Hawkins for the loan of the three specimens which form the basis of this note and for his description of the locality.

The calcite crystals were collected from a road material quarry situated in the first ridge of the Watchung mountains. They occur in vertical veins in Watchung basalt associated with zeolites.

Many of the specimens formerly obtained showed large and beautiful calcite combinations. Those which through Mr Hawkins's kindness are available consist of built-up individuals formed of two superposed types in parallel position and evidently representing two generations of calcite deposition. The compound individuals average 30 millimeters in vertical length. The crystal elements of these compound groupings which represent the earlier generation are rhombohedral in habit. In some instances this habit occurred sufficiently free from the superimposing secondary habit to admit of the determination of the modifying forms. The simple individual of this generation is shown in figure 1 and consists of the negative rhombohedrons δ. (01$\bar{1}$2) and *II.* (08$\bar{8}$1) modified by the forms a (11$\bar{2}$0), m.(40$\bar{4}$1), K:(21$\bar{3}$1), O:(8.5.$\bar{13}$.3) and s:(17.13.$\bar{30}$.4), the latter of which is new to the species. The crystals of this generation which are slightly more purplish in color and more transparent than those of the superposed second generation in several instances appear as phantoms within the latter. The superposed crystals of the second generation, which are transparent to translucent and slightly yellowish in color, are scalenohedral in habit. They are superimposed in parallel position upon the lateral solid angles of the rhombohedral habit of the s:(17.13.30.4), the latter of which is new to the species. The first generation in the manner shown in figures 2a and b. The dominant form is a new negative scalenohedron $-\frac{5}{4}R\frac{8}{5}$ = (3.13.$\bar{16}$.8)) to which the letter t has been assigned. The scalenohedral habit is terminated by the negative rhombohedron ν. (05$\bar{5}$4) = $-\frac{5}{4}$R the two forms lying in the zone [05$\bar{5}$4.11$\bar{2}$0]. In addition to the foregoing the new scalenohedron lies in zone with the planes 1$\bar{1}$02 = δ. and 08$\bar{8}$1 = *II.* both of which are present in considerable development on the rhombohedral crystals of the first generation. In general habit the superimposed crystals conform closely to that shown in figure 552B of Dana's *System of Mineralogy,* fifth edition, from Bergen Hill. The calculated angles for the negative scalenohedron $-\frac{7}{5}R\frac{3}{2}$ = (7.35.$\bar{42}$.20) assigned to this combination are X=87° 14′, Y=15° 52′ and Z=68° 14′. The measured values of the angles Y and Z for the negative scalenohedron $t = -\frac{5}{4}R\frac{8}{5}$ = (3.13.$\bar{16}$.8) are:

Y = 17° 46′; 17° 18′; 17° 48′ and 17° 11′.
Z = 69° 11′; 69° 20′; 68° 51′ and 69° 3′.

The following measurements served to identify the occurring forms:

LETTER	ANGLE	NUMBER OF READINGS	MEASURED		CALCULATED	
			°	'	°	'
δ.: δ.''	0112 : 1102	3	45	12	45	3
p''.: ν.	0111 : 0554	5	95	22	95	34
δ.: Π.	0112 : 0881	4	56	14	56	32
Π.: a	0881 : 1120	4	30	50	30	47
p.: *m.*	1011 : 4041	1	31	14	31	10½
p.: *K*:	1011 : 2131	4	29	4	29	2
K:: *K*:''	2131 : 3121	1	35	33	35	36
p.: *o*:	1011 : 8.5.13.3	5	35	57	35	47
o:: *o*:''	8.5.13.3 : 13.5.8.3	1	43	22	43	13
p.: *s*:	1011 : 17.13.30 4	5	42	43½	42	40
s:: *s*:''	17.13.30.4 : 30.13.17.4	1	50	27	50	33
t: t'	3.13.16.8 : 3.16.13.8	4	17	31	17	47
t: t''	3.13.16.8 : 13.3.16.8	4	69	6	69	1½

2 Calcite from Jersey City, N. J.

Among the minerals recently collected from the Erie railroad open cut which is being excavated through the Jura trias diabase at Jersey City are several specimens of calcite which present an interesting instance of parallel grouping somewhat similar to that previously noted from Plainfield. These specimens, which were collected by Mr James G. Manchester, have through the courtesy of Mr Manchester been made available for study. The calcite occurs in veins in the diabase associated with datolite, apophyllite, natrolite and stilbite all beautifully crystallized. The compound crystals, like those from Plainfield consist of two superposed habits corresponding to two generations of calcite deposition. The earlier generation is represented by crystals of a simple rhombohedral habit consisting of the negative rhombohedron π. ($07\bar{7}5$). In a number of instances these rhombohedral elements occur uncombined with the combination of the later generation and attain a size of 5 centimeters on edge. They have in these instances a markedly cubic aspect. Figure 3 shows the rhombohedron of this phase. The compound crystals which were noted on one specimen of the

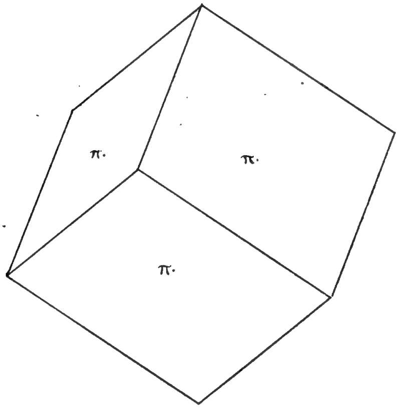


FIG. 3

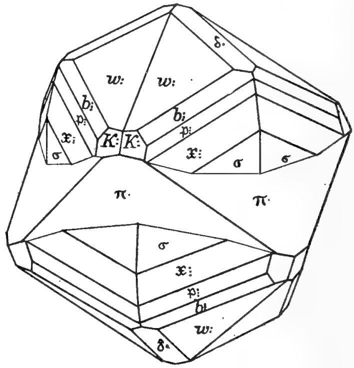


FIG. 4

series available, consist of the rhombohedral element noted above, upon the polar angles of which are superposed in parallel position the scalenohedral combination shown in figure 4. The compound crystals average 10 millimeters in vertical length. On the scalenohedral elements, which represent the later generation of calcite deposition, the following forms were observed: σ $(71\bar{8}0)$, δ. $(01\bar{1}2)$, w: $(3\bar{1}45)$, K: $(2\bar{1}31)$, p: (1341), b: (3584) and X: $(4.16.\overline{20}.3)$. The new dihexagonal prism $= \infty R \frac{4}{3} =$ (7180) is represented by brilliant, well developed planes which gave good reflections of the goniometer signal and lay well in the vertical zone. The following zones were also observed:

$[1\overline{78}0 : 1\bar{1}02 : 31\bar{4}5 : 35\bar{8}4 : 13\bar{4}1 : 4.16.\overline{20}.3 : 17\overline{80}]$

$[4\bar{3}11 : 3\overline{12}1 : 21\bar{3}1 : 13\bar{4}1]$

$[7\overline{70}5 : 41\overline{35} : 3145 : 0775]$

$[21\bar{3}1 : 35\bar{8}4 : 07\bar{7}5 : \bar{3}211]$

Calcite crystals of negative scalenohedral habit were noted on one specimen which yielded measurements approximating those for the scalenohedron $-\frac{11}{12} R \frac{7}{3} = (22.55.\overline{77}.36)$ described by vom Rath from Bergen Hill.[1] The measured angles obtained from the

[1] vom Rath, G. Der Kalkspath von Bergen Hill, N. J. Zeit. f. Kryst. 1877. 2:604.

crystals of this form correspond more closely to the form $-\frac{7}{8}R\frac{5}{2}$ $= (21.49.\overline{70}.32)$. These latter indexes are, however, too irrational to warrant the establishment of the form from the material at hand although the angles are given in the accompanying table for the sake of comparison.

LETTER	ANGLE	NUMBER OF READINGS	MEASURED °	MEASURED ′	CALCULATED °	CALCULATED ′
$\sigma : \sigma^{VII}$	$71\bar{8}0 : 81\bar{7}0$	6	13	11½	13	10½
$\pi. : \pi.^{IV}$	$07\bar{7}5 : 70\overline{75}$	6	90	47	90	55
$\omega :: \omega :^{I}$	$31\bar{4}5 : \bar{3}4\bar{1}5$	2	49	27	49	22½
$\omega :: \omega :^{V}$	$31\bar{4}5 : 4\overline{13}5$	2	15	52	16	0½
$K :: K :^{V}$	$21\bar{3}1 : 3\overline{12}1$	3	35	38	35	36
p: :p :^{I}	$13\bar{4}1 : 1\overline{43}1$	5	27	4½	26	44½
p: :p :^{V}	$13\bar{4}1 : 4\overline{31}1$	6	87	7	87	50½
b: :b :^{I}	$35\bar{8}4 : \bar{3}8\bar{5}4$	1	37	27	37	28
b: :b :^{V}	$35\bar{8}4 : 8\overline{53}4$	1	64	56	64	43
x: :x :^{I}	$4.16.\overline{20}.3 : \bar{4}.20.\overline{16}.3$	5	21	30	21	30
x: :x :^{V}	$4.16.\overline{20}.3 : 20.\overline{16}.\bar{4}.3$	5	96	20	96	26½
x: :x :^{VI}	$4.16.\overline{20}.3 : 16.4.\overline{20}.\bar{3}$	1	42	26	42	27
σ^{I} : x:	$17\bar{8}0 : 4.16.\overline{20}.3$	7	10	15	10	21
x: : p:	$4.16.\overline{20}.3 : 13\bar{4}1$	8	7	32½	6	57
x:: ω:	$4.16.\overline{20}.3 : 31\bar{4}5$	4	53	12	53	5
? : ?	$21.49.\overline{70}.32 : \overline{21}.70.\overline{49}.32$	6	74	7	74	25
? : ?	$21.49.\overline{70}.32 : 70.\overline{49}.\overline{21}.32$	7	30	10	30	3
? : ?	$21.49.\overline{70}.32 : 49.21.\overline{70}.\overline{32}$	7	60	34	60	28

THE LAST OF THE IROQUOIS POTTERS

BY M. R. HARRINGTON

The ceramic art of the New York Iroquois has long been obsolete. Although the knowledge that their ancestors manufactured vessels of clay still persists among them, none of the technical details remains, so far as I have been able to discover, even in tradition. For this reason I have long been interested in the reported survival of the potters' craft among the Eastern Cherokee[1] who are known to be Iroquoian in language and to have resembled in culture, to a certain extent, the Iroquois of the north. Here, thought I, may be an opportunity to throw light on questions which have long puzzled New York archeologists and to put on record a first-hand account of the art in which the Five Nations had developed such proficiency.

My opportunity came in July 1908, when in connection with my anthropological work for Mr George G. Heye of New York I visited the Cherokee settlements in western North Carolina for the purpose of collecting ethnological specimens.

Before starting I received many helpful hints from Mr James Mooney who has made the Eastern Cherokee an object of special study; thus I was enabled to know approximately what to expect before arriving on the ground. After securing an interpreter I began to make inquiries about pottery, and soon discovered that a number of families still kept a few pieces for their own use, or as mementoes of the old days. As a rule I was able to secure these, but in some cases neither money nor persuasion had any effect — the owners remained obdurate. Nevertheless a very fair collection was secured, comprising specimens of various ages, sizes and uses.

Three principal forms may be distinguished in modern Cherokee ware, as represented by the collection secured for Mr Heye: the large jar (ŭ^{n} tī^{n}), the pot (tū stī^{n}) and the bowl (de wa Lī^{n}). The jars are usually 12 to 16 inches high and average about 8 inches in diameter. Generally these are provided with a flat bottom from which the sides bulge slightly, contracting again toward the rim. Such vessels are usually covered with stamped designs applied with a carved paddle, but no free-hand incised decoration was seen. The name ŭ^{n} tī^{n} while specifically applied to these large

[1] Holmes. Aboriginal Pottery of Eastern U. S. p. 52.

jars, is often used as a generic term for any sort of pottery. Soup, cooked hominy and other foods are kept in such vessels. With the exception of the flat bottom which may be a comparatively recent adaptation to facilitate standing on shelves and tables, this form may well be of aboriginal origin, but bears a greater resemblance to what the New York archeologist would call the Algonquin rather than the Iroquoian type.

A distinct resemblance to Iroquois pottery may be observed in the pots, which often show, to a greater or less extent, a rounded bottom, spheroidal body and constricted neck sometimes surmounted by a projecting rim or collar, all of which features are characteristic of Iroquois ware. The rim is sometimes even decorated with notches, dots and simple incised lines, which add to the Iroquois effect as in the jars the body is frequently covered with stamped paddle patterns. Such pots were formerly employed for general cooking purposes but have been recently used more for stewing fruit than anything else. The hight of the modern specimens is generally under 8 inches; but in former times larger ones were made. One small vessel of this type was provided with handles of modern design.

Bowls are variable as to size and various as to use; some are round bottomed, some flat, some stamped, some plain; but the rims of all the bowls collected were invariably more or less flaring, not bent sharply inward as in many Muskhogean and some modern Catawba specimens. Similar flaring bowls are occasionally found on northern Iroquois sites. The only saucerlike form seen was made, the Indians told me, in imitation of white man's ware. When baking a batch of pottery the old Cherokees were accustomed to put in a lot of little toy vessels, dolls and animals modeled in clay, which were greatly appreciated by the children. Crude clay pipes were also made, and these too were reproduced in miniature as toys. Such toy vessels, figurines and pipes are not infrequently unearthed from ancient Iroquois sites in New York.

Mr Mooney had given me the name of one potter, Iwi Katâlsta, and I lost no time in making her acquaintance. Inquiry resulted in the discovery of but one more, an aged woman known as Jennie Arch, whose feeble hands had all but lost their skill. For this reason I confined myself almost entirely to Iwi's methods of pottery making. Fully half the pottery I secured from the Eastern Cherokees is said to be the work of her hand.

Her tools were few, and with one exception simple, consisting of a hammerstone for pounding the clay, a sharpened bit of stick for making lines and notches, and a fine grained, waterworn pebble for smoothing, showing the polish of long use. The exception is the carved paddle for stamping the pottery — a broad bladed wooden affair about 8 inches long, carefully carved to produce a checkerwork pattern when struck against soft clay. More paddles were later collected bearing different figures, some quite complex. Other accessories were a common axe, a bucket of water, a low sided wooden tray for kneading clay and a flat oval piece of wood used as a stand to build large jars upon and provided with a handle at either end for convenience in turning; some saucers of china or gourd, and some pieces of cotton sheeting.

After Iwi Katâlsta had dug her clay from a bed on Soco creek, the exact location of which she did not seem inclined to reveal, she was accustomed to mold it into a cake some 14 inches long, resembling in form a loaf of bread, in which shape it was dried and laid away for future use. When we visited her home at "Yellow Hill" [pl. 1] and requested her to make us some pottery she broke off the end of this cake and proceeded to pulverize it on her hearthstone, using the back of a common axe as a crushing instrument. In old times, she explained, a "long rock" was used for this purpose.

When sufficiently pulverized the clay was placed in a wooden tray, moistened and again thoroughly pounded [pl. 2]. This time Iwi used a hammerstone which she kept especially to crush hickory nuts, but which she often used in place of the axe in pounding the dampened clay. From time to time the mass was kneaded and a little more water or dry clay added as seemed necessary to obtain the required consistency. Sometimes, I was informed, a fine sand was added at this stage as a tempering material; but in this case it was omitted. Iwi had a vessel of the pot form in mind. Taking a large handful of the clay she patted it into a ball which she took in both hands and pressing her thumbs deeply into one side, began to turn it rapidly [pl. 3]. In a surprisingly short time a small bowl with fairly thin sides was produced to serve as a base for the future vessel. During this process she had taken care to keep her hands wet. Then supporting the inside of the bowl with the fingers of her left hand she struck it sharply on the outside with her carved paddle, slightly turning the embryo vessel before each stroke and moistening the paddle now and then in a vessel of water which stood near. The bowl-shaped base was then carefully laid upon a bit of cotton cloth resting on a common china saucer. When questioned as to what the Indians used before saucers were available, Iwi replied through the interpreter, that she had heard that for large vessels the base was set in a hole in the sand lined with some sort of cloth, the sand being often inclosed in a basket for convenience. For small vessels, she said, a saucer made of gourd was just as serviceable as one of china, and as I liked the old style, she would take care to use gourd supports hereafter in making pottery for me. It was her custom, she continued, when making the large, flat-bottomed hominy jars to set the base on the oval, flat utensil of wood before mentioned, especially made for the purpose and provided with a handle at either end to facilitate turning.

The bowl-shaped base having been safely ensconced in the saucer she pinched its edges thin with wet fingers; then, rapidly rolling out a lump of clay on a plank into a long thin cylinder [pl. 4] she applied it just inside the rim of the base and projecting above it about half its width, pinching it fast the while until the circuit was completed [pl. 5]. The coil proved a bit too long, so she broke the superfluous piece off and blended the two ends together with care. Then by careful pinching and smoothing with wet fingers and finger nails the coil was blended with the bowl-shaped base and thinned at the top to receive another coil which was also applied inside. The object of applying each coil inside instead of directly on top of the preceding was to produce strength by overlapping. Thus the coiling proceeded until the required form and hight were reached, when the rim coil was applied outside the one beneath. After being blended in the usual way this was pinched into lateral protuberances, and notched, dotted or marked with a sharpened stick to suit the fancy [pl. 8]. After each coil had been applied and blended the vessel was allowed to dry and harden a few minutes before the next one was added; and after the jar had received its shape it was allowed to become quite firm before the final stamping was applied.

It will be remembered that the base of the vessel had already been stamped before being placed in the saucer, so it was now only necessary to strike the body briskly with the wet paddle until the surface was covered with its imprints [pl. 6]. In one jar the stamping was complete before the rim was added. After stamping the vessel was set away to dry.

The fact that Iwi used no tools except the paddle, the marking stick and her fingers seemed remarkable to me, in view of the numerous smoothing tools of gourd, shell and wood employed by the Catawba.[1] Inquiry revealed the fact that while they had apparently never heard of gourd smoothers, the Cherokee formerly used mussel shells and a marine shell, probably some species of *cardium* for this purpose. Iwi herself sometimes used a chip of wood in making large vessels.

After drying — a process that takes from one to three days, depending on the weather — the vessel was carefully rubbed and polished on the inside, and on the outside whenever necessary [pl. 7] with the smoothing stone kept wet by continual dipping in water.

When a number of vessels had been made and dried the next step was to prop the vessels up on their sides around the fire, mouth toward the blaze, until a faint brown color, beginning near the fire crept over the whole of the vessels — a sign that they were hot enough for firing. Then the potter, with a long stick, rolled them over mouth down upon the embers [pl. 9] and covered them with pieces of dry bark to the depth of 2 or 3 inches. Making sure that the bark had caught fire all around [pl. 10] she left them to their fate. About an hour later the bark had burned away leaving the rounded bottoms of the pots protruding through the ashes. Then, taking her long hooked stick, Iwi rolled the vessels from the fire, tapping them sharply to detect cracks. If a vessel rang clear it was perfect.

" In order to be good for cooking, these pots should be smoked," she said. " If this is not done the water will soak through." So she dropped a handful of bran in each one while they were still almost red-hot, stirred it with her stick, tipped the pots this way and that, and finally, turning out the now blazing bran from each in turn, inverted the vessels upon it. In this way the inside was smoked black and rendered impervious and this without leaving any odor of smoke in the vessels when they became cold. Generally, Iwi told me, corncobs were employed for this purpose, but she always used bran when cobs were not available. This probably explains the black color of the inner surface so often seen in New York aboriginal pottery.

I was told that in later times the firing has been generally done indoors, because an absolutely still day was necessary for a successful burning in the open air, any breeze being liable to crack the vessels. The firing of my pottery was, however, done out of

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[1] Harrington. Catawba Potters and their Work. *Am. Anthropology*, Sept. 1908.

doors, the fire being built on a rude hearth of flat stones sunk level with the ground.

It seems probable from the evidence at my disposal[1] that similar methods were once used by the New York Iroquois in making pottery. As before mentioned the form of many Cherokee vessels is quite like the style we know as Iroquois. Similar rims are found in western and northern New York, as are potsherds showing the overlapped method of coiling, while from the ash pits on the early Mohawk site known as "Garoga" in Fulton county, New York I have unearthed with my own hands pottery bearing the impress of the checkerwork paddle.

But the ancient pottery of the Cherokee embraced forms still more like the Iroquois styles than are those of modern make, if we can judge by the specimens found near the "Town House Mound" at Yellow Hill on the Eastern Cherokee Reservation — a mound which the Cherokee claim was made by their ancestors. The pieces of rim and the single perfect vessel would not be considered intrusive or imported if found on an ancient Onondaga site in Jefferson county, New York. They show not only the spheroidal body, constricted mouth and projecting rim or collar, but also exhibit a well developed neck of true Iroquois style which is not clearly marked in the recent ware of the Cherokee.

The carved paddle for decorating pottery seems to have become obsolete among the Iroquois at an early date, for potsherds showing its use are rarely if ever found on their later sites so far as my knowledge goes. But such potsherds are not seen as a rule on New York sites once occupied by Algonquin tribes, so it is probable that here we have another link connecting the northern Iroquois with the Cherokee. The blowgun, the nearly universal possession of the southeastern tribes, seems also to have been peculiar to the Iroquois in the north. Possibly such apparent trifles may help us to trace the migrations of the Iroquois before they reached the region of Lake Erie and the St Lawrence.

It was perhaps fortunate that I was able to go to North Carolina when I did, for Iwa Katâlsta is old, and her health is failing, while Jennie Arch can no longer make pottery worthy of the name. The younger generation does not care, apparently, for pottery making, and the western Cherokees, from all I can learn, have abandoned the art. Hence it is probable that a few more years will see the last of the Iroquoian potters.

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[1] Iroquois Industries.

Plate I

Home of the Cherokee potter

Plate 2

Pounding clay for pottery

Plate 3

Molding the bottom of a vessel

Plate 4

Rolling the coil of clay preparatory to making a pottery vessel

Plate 5

Applying a coil to the pot base

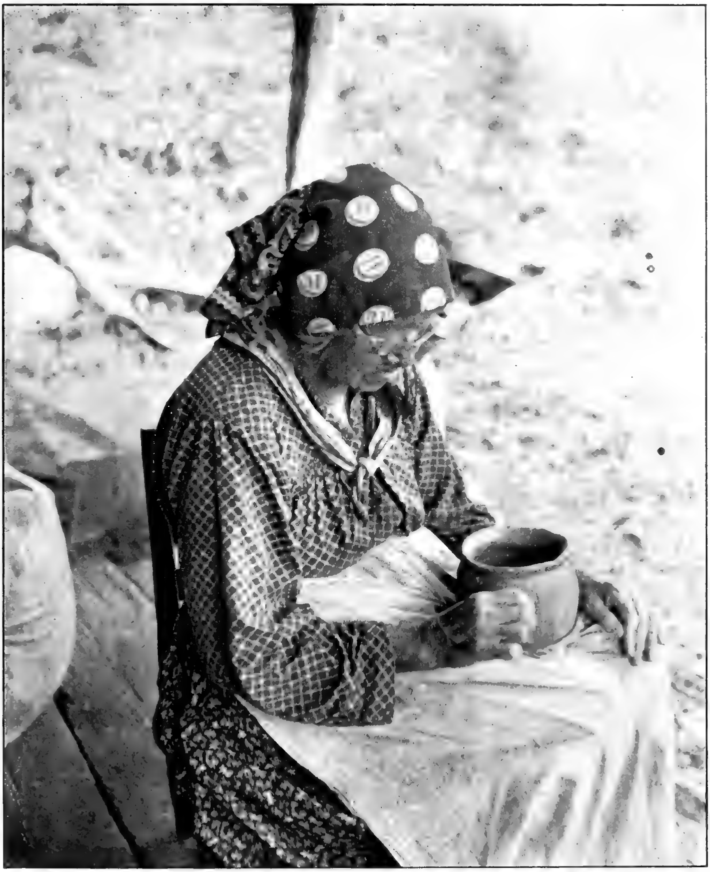
Plate 6

The use of the stamping paddle

Plate 7

The polishing stone in use

Plate 8



Decorating the vessel

Plate 9

Arranging the vessels for firing

Plate 10

Firing the clay vessels

INDEX

Education Department Bulletin

Published fortnightly by the University of the State of New York

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

No. 455 ALBANY, N. Y. SEPTEMBER 15, 1909

New York State Museum

JOHN M. CLARKE, Director
EPHRAIM PORTER FELT, State Entomologist

Museum bulletin 134

24th REPORT OF THE STATE ENTOMOLOGIST

ON

INJURIOUS AND OTHER INSECTS

OF THE

STATE OF NEW YORK

1908

PAGE

ALBANY

UNIVERSITY OF THE STATE OF NEW YORK

1909

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STATE OF NEW YORK

EDUCATION DEPARTMENT

New York State Education Department
Science Division, February 10, 1909

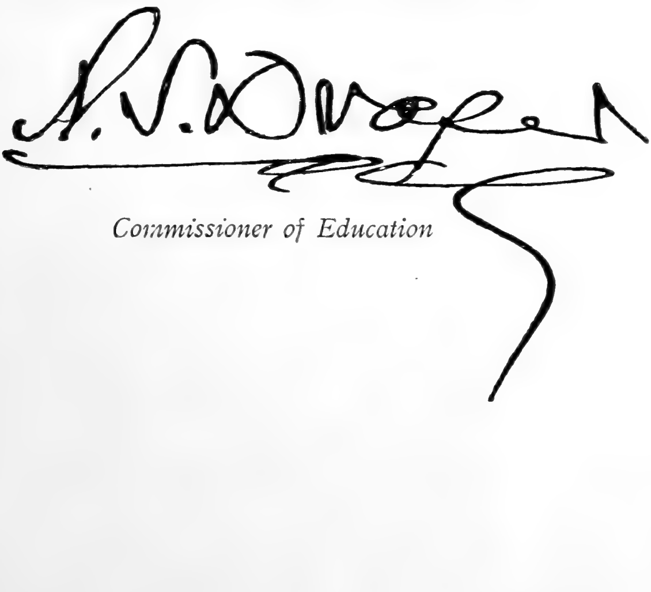
Hon. Andrew S. Draper LL.D.
Commissioner of Education

SIR: I have the honor to communicate herewith for publication as a bulletin of the State Museum, the annual report of the State Entomologist for the fiscal year ending September 30, 1908.

Very respectfully
JOHN M. CLARKE
Director

State of New York
Education Department
COMMISSIONER'S ROOM

Approved for publication this 11*th day of February* 1909



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24th REPORT OF THE STATE ENTOMOLOGIST 1908

To John M. Clarke, Director of Science Division

I have the honor of presenting herewith my report on the injurious and other insects of the State of New York for the year ending October 15, 1908.

A number of species have inflicted serious injuries upon both fruit and shade trees. A most interesting phenomenon was the widespread and abundant flight of the snow-white linden moth. An unusual feature was the capture, within the limits of the city of Albany, of two specimens of a small, green, subtropical cockroach.

Fruit tree insects. Fruit trees in the western part of the State were seriously injured in some sections by the cigar case bearer, a species which is very rarely abundant enough to cause material damage in the Hudson river valley. Depredations by the above mentioned case bearer were frequently associated with severe injury by a small plant mite known as the blister mite. Western fruit growers were also greatly exercised by the caterpillars of the white marked tussock moth eating into the young fruit, a troublesome departure from the normal habit. The fall canker worm was unusually abundant and destructive on eastern Long Island and in the vicinity of New York city. The San José scale is one of the most serious insect pests of the horticulturist. The warm, dry weather the latter part of the season has been favorable to the unrestricted multiplication of this insect, and in some cases infested orchards have become very badly affected. Our observations show that, as a rule, fruit growers are experiencing much less trouble in keeping this scale insect in check than was the case in earlier years. Early spring applications of a lime-sulfur wash are giving very good satisfaction. Some parties are meeting with excellent results from applications of a miscible or so called " soluble " oil. We have preferred, as a rule, to confine our recommendations to a material like the lime-sulfur wash, which is not only effective but safe and also valuable in controlling fungous diseases. Numerous observations have been made on the above mentioned and other insects.

It is gratifying to state that conditions in the Chautauqua grape belt have materially improved, so far as injury by the grape root worm is concerned. Though this insect is generally distributed throughout the grape belt, severe injuries by it have been confined to restricted areas. The grape blossom midge was responsible for an unprecedented outbreak, destroying from 50 to 75% of the blossoms on one acre of Moore's early grapes at Fredonia. It was generally present throughout the grape section and somewhat abundant in limited portions of certain vineyards. It is probable that this species has been responsible for failure to fruit in other cases where the losses were attributed to some unknown cause or possibly to unfavorable weather conditions. This insect is now under investigation. We hope to solve its life history next spring, a necessary preliminary to devising a practical method of preventing serious injury in the future.

Shade tree protection. Ravages by the elm leaf beetle have been very severe in many Hudson valley cities and villages and, as a result, popular interest in the welfare of our shade trees has increased greatly. This concern has been accentuated by extensive defoliations inflicted by the white marked tussock moth, a species which has been quite injurious in Buffalo for some years past.

Injuries by these and other shade tree pests have emphasized most strongly the recommendations of the Entomologist and, as a result, more than ever before is being done to protect our shade trees. The work of the city forester of Albany has been very beneficial, though owing to certain hindrances his work was not as effective as it might otherwise have been. The city of Buffalo has at last committed itself to a definite policy of shade tree protection. A forester was appointed and excellent work has already been accomplished in that municipality. The authorities of several villages have given careful consideration to shade tree protection and there is a good prospect that more will be accomplished another year. The work against the gipsy moth, noticed below, has resulted in a marked improvement in the spraying outfit. We believe that certain of this apparatus, modified to suit our conditions, could be adopted to advantage and would prove of much benefit, since it would, by making the spraying easier and quicker, afford great encouragement on account of the largely increased efficiency. Our work upon shade tree insects, consisting mostly of local examination and recommendation, has consumed much time and has been productive of marked improvement in the welfare of the trees.

Gipsy and brown tail moths. These two insects have continued their injurious work in Massachusetts, the first named being by far the more destructive. The gipsy moth has been found in small numbers at both Springfield and Greenfield, Mass., as recorded in our previous report. Points where this insect was likely to become established have been closely watched and as yet it has not been found in this State. A warning placard, illustrating this species and the brown tail moth, has been conspicuously posted in many post offices and other public places in the State. Prompt and efficient treatment of isolated colonies, should they be found in this State, is of utmost importance if extended injury is to be avoided.

The work against the gipsy moth, as revealed by a personal examination the past summer, is being prosecuted with great vigor. The residential sections are in excellent condition, though large woodland areas have been seriously damaged. The work with parasites, conducted by the state of Massachusetts in cooperation with the federal government, is most encouraging. The staff in charge of this work has been materially strengthened during the past year, and its efficiency greatly increased by the dispatch of a special agent to Japan. The latter secured some most promising parasites which already have been bred through one generation in this country, and lead us to hope that they may soon become important factors in controlling this species. The control of these introduced pests should be encouraged in every possible manner, since it is much more economical to check them in a restricted area than to allow the struggle to extend over a wide territory.

Forest insects. The extensive outbreaks by the green striped maple worm, recorded in our previous report, have been continued in southern Rensselaer county, and it is probable that this species was associated, as was the case last year, with the antlered maple caterpillar. The depredations by the snow-white linden moth, noticed in our preceding report, were continued in the Catskills and extensive injuries in the Adirondacks were also brought to our attention. The only hope of preventing damage of this character is by the encouragement of natural agents, prominent among which may be mentioned native birds. The efficiency of insectivorous birds has been repeatedly emphasized by the Entomologist.

The bark borers or Scolytidae comprise a large number of very destructive species. The literature relating to this group is greatly scattered and comparatively inaccessible, hence a bibliographic catalogue is a necessary preliminary to further work upon these insects. We submit for publication, as an appendix of this report, a catalogue of the described Scolytidae of America north of Mexico by Mr J. M. Swaine.

Gall midges. The studies upon this important group have progressed very successfully. We have already prepared preliminary keys for the separation of most forms into subfamilies, tribes, genera and species, together with tables giving the food habits of those which have been reared. Some idea of the magnitude of this work may be gained when it is remembered that we have studied over 300 bred species and now recognize 700 species, representing about 50 genera. The systematic arrangement alone of this large number of microscopic insects is an immense task. And in addition to the above, many descriptions have been drafted and numerous biological notes transcribed.

The later work upon these insects has of necessity been confined mostly to systematic study, owing to the fact that material was coming in faster than it could be worked up in a satisfactory manner. We have succeeded, in spite of the pressure of other matters, in rearing during the past season about 75 species, the biology of most of which was previously unknown. There is on hand a large series of galls from which some extremely desirable material may be expected another season. The work upon this group is so well in hand that there should be no difficulty in bringing it to a successful conclusion in the near future.

The rearing and care of breeding jars containing gall midges require much time. Assistant Entomologist D. B. Young had general charge of this work and was ably assisted by Miss Fanny

T. Hartman. In addition, Mr Young rendered material service in separating our large amount of material into the major groups, while Miss Hartman has made over 600 microscopic preparations.

Flies and mosquitos. The ubiquitous and well known house fly has been the recipient of much attention because recent investigations show it may be the responsible agent, under certain conditions, in the dissemination of typhoid fever and other grave intestinal disorders. Observations upon its life history and habits have established the practicability of largely reducing if not eliminating this menace to health and personal comfort. A press bulletin on this insect was issued and this will be supplemented by a more extended account.

There is much interest in the control of mosquitos. The Entomologist inspected the work in progress on the Flushing meadows and has kept in touch with similar operations in other localities. Attention has also been given to the control of freshwater species, especially the malaria-carrying form. The practicability of such work has been established and we look for a great extension of interest in the local suppression of these annoying pests.

Aquatic insects. The studies of insects inhabiting our fresh waters have been continued by Dr James G. Needham. His report on the work done at Old Forge was made public in the report of this office for 1907. Dr Needham is now engaged in completing his monographic account of the stone flies (Plecoptera), a work which should be ready for the printer some time during the coming winter. Dr Betten has made good progress in his studies of the caddis flies (Trichoptera), and it is expected that his work upon this group will be completed the coming spring. These two publications, when issued, will supply a most important want in our knowledge of aquatic forms and add much of value to the series of reports and bulletins on aquatic insects.

Publications. Many popular economic notices have been contributed by the Entomologist to the agricultural and local press, and a few accounts of more general interest have been widely disseminated through the agency of the Associated Press. The large number of Cecidomyiidae reared in 1907 rendered it advisable to publish preliminary descriptions of these, and a reprint from the report for that year, entitled *New Species of Cecidomyiidae II,* was issued October 26, 1907. Owing to numerous delays in printing, the report for last year did not appear during the fiscal year, although a large amount of time was necessarily expended upon the more technical part in carrying it through the press.

Collections. The additions to the collections have not been as numerous as in preceding years, owing to the necessity of giving more attention to the arrangement and classification of material on hand. A number of previously unknown Cecidomyiidae were reared and several important gaps in our knowledge respecting this group filled.

Several extremely desirable accessions, aside from those mentioned above, have been made to our biological collections. One of the most interesting was a complete series representing the egg, larva, pupa and adult of the remarkable Taeniorhynchus perturbans Walk., generously contributed by Mr J. Turner Brakeley of Hornerstown, N. J., the discoverer of the early stages and one of the most active in working out the life history of this previously very elusive species.

Two important additions have been made to our exhibit collections, namely, an enlarged model of the onion fly, showing the egg, maggot, puparium, adult fly and an onion infested by maggots; also an enlarged model of the cigar case bearer showing its work upon apple leaves. Both of these were executed by Mrs Otto Heidemann of Washington, D. C.

The arrangement and classification of the collection has received much attention. Assistant Entomologist D. B. Young has separated the Staphylinidae into their major groups and determined many species. He has also given considerable time to the arrangement of the Syrphidae. The completion of the catalogue of the Hill collection occupied much time during the past year. Miss Hartman also assisted in the preparation of the above mentioned catalogue and has done a great deal of general curatorial work, such as mounting, labeling and caring for insect specimens.

Office matters. The general work of the office has been conducted as in previous years, the Assistant Entomologist being responsible for the correspondence and other matters during the absence of the Entomologist. Assistant I. L. Nixon resigned October 12, 1907, and Miss Fanny T. Hartman was temporarily appointed to the vacancy October 26, with subsequent confirmation. Numerous specimens have been received for identification and many inquiries made concerning injurious forms. Owing to their having been no important bulletin or report issued during the season, there has been a decrease in the number of packages sent through the mails or by express. This latter has undoubtedly had some effect upon the correspondence. 1470 letters, 171 postals, 42 circulars, 408 packages were sent through the mails and 39 packages were shipped by express.

Nursery certificates. We have continued, as in past years, to indorse upon the request of the State Commissioner of Agriculture nursery certificates issued by his office and destined for points in the state of Virginia, since the Virginia authorities insist that all certificates accompanying shipments of nursery stock to that state shall be indorsed by an official entomologist. The following is a list of firms to whom these nursery certificates were issued during 1908:

Stark Bros. Nursery Co., George A. Sweet, Bryant Bros., all of Dansville; George S. Josselyn, T. S. Hubbard Co., F. E. Schifferli, Lewis Roesch, Foster & Griffith, all of Fredonia; The Chase Nurseries, Henry Sears & Co., The M. H. Harmon Co., H. E. Merrell, all of Geneva; E. Moody & Sons, Lockport; Jackson Perkins, Newark; Allen Nursery Co., Brown Bros. Co., Herrick Seed Co., Perry Nursery Co., First National Nurseries, Chase Bros. Co., Ellwanger & Barry, Western N. Y. Nursery Co., Rochester Nursery Co., H. S. Taylor Nursery Co., Glen Bros., all of Rochester; F. R. Pierson Co., Tarrytown.

General. We would acknowledge at this time our indebtedness to Dr L. O. Howard, Chief of the Bureau of Entomology, United States Department of Agriculture, and his associates for identifying a number of insects. Several correspondents have rendered valuable services in securing desirable material for the collection. There has been, as in previous years, a most helpful cooperation on the part of all interested in the work of this office.

The tacit limitations of earlier years confined the studies of the economic entomologist to insect enemies of well recognized farm crops, such as corn, potatoes, fruit, or to those forms annoying or injurious to domestic animals. The later extensive insect depredations upon shade and forest trees have served to emphasize the practical importance of this field. The more recent discoveries that malaria and yellow fever are transmitted by mosquitos, and that typhoid fever and other grave intestinal diseases may be conveyed by house flies, has made the entomologist a most welcome ally of the sanitarian. Furthermore, careful investigations of injurious and dangerous insects have repeatedly demonstrated the value of such studies as a necessary preliminary to practical control work on the farm or marsh, in the orchard or even about the home. Prophylactic measures against yellow fever, malaria and typhoid must depend in large measure upon an intimate knowledge of the habits of certain insects and their part in the dissemination of the dangerous germs. The study of injurious insects is by no means completed. There is great need of investigations that can not be adequately conducted with our present resources. The exhibit collections should be greatly strengthened by a large series of well executed, enlarged models of the smaller, more injurious insects. Such a departure would greatly increase the practical and educational value of the entomologic exhibits, particularly as the significance of some of the more recent discoveries can not be adequately portrayed without such aid. This latter would also do much to bring the larger exhibit necessary for the Education Building up to a high standard.

Respectfully submitted

EPHRAIM PORTER FELT

State Entomologist

Office of the State Entomologist, October 15, 1908

INJURIOUS INSECTS

Poplar sawfly

Trichiocampus viminalis Fallen

This sawfly, first observed in this country in 1888 by Dr J. A. Lintner, has become rather abundant upon Carolina poplars in the vicinity of Albany during recent years. Complaint of injuries by this species has also been received this season from Cambridge, N. Y. Dr Lintner stated in 1888 that this species was so abundant upon small poplars in his garden that it was necessary to pick and burn the infested leaves in order to prevent more serious injury.

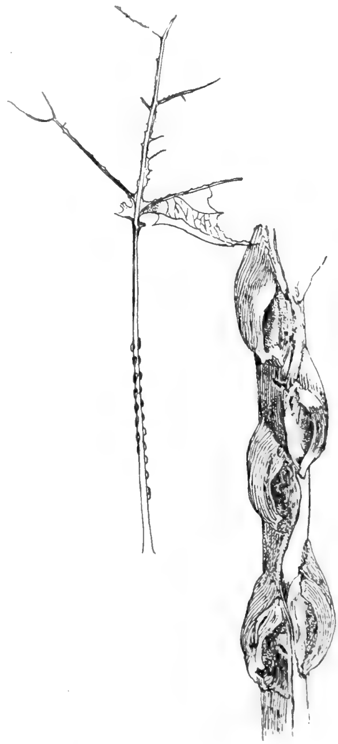

FIG. 1 Poplar sawfly, leaf stem showing oviposition and a portion of the stem greatly enlarged. (Original)

Life history and habits. The orange-yellow, black spotted, false caterpillars may be seen in early June. The young larvae feed in company on the under side of the foliage, skeletonizing most of the leaf. The larvae then break up into clusters of 6 to 8 or 10, migrate to other leaves and by this time are large enough so that everything is devoured except the larger veins, feeding invariably beginning at the tip of the leaf. The presence of leaves eaten in the above described ways is most characteristic of this species. The larvae attain full growth very quickly and some may be observed spinning up the latter part of June. The period of oviposition is quite extended and eggs, young larvae and full-grown larvae may frequently be observed upon the same tree the latter part of June and into July. A second generation of larvae occurs about the middle of August. The full-grown larvae of the first generation may spin their oval, brown cocoons in leaves or other debris. The second generation presumably hibernate in the cocoon, adults appearing the following spring and depositing their eggs in minute slits on either or both sides of the petiole in series of 10 to 15 or even more, since Dr Lintner records as many as 28 or 30 in one row.

Description. The egg is pearly white, oval and about 1 mm in length. Its position is indicated by a slight swelling about 1.5 mm long, the swellings being about 1 mm apart.

Larva. The young larvae are about 6 mm long, have dark brown or blackish heads and pale green or yellowish green bodies.

Partly grown larva. Length 1 cm. Head subglobose, jet-black, the most of the body being a very pale green with a conspicuous row of sublateral, subquadrate, black spots, a pair on each segment. The anterior portion of the body, namely the first thoracic segment and the lateral tubercles on the 2d, 3d and the 11th segments, particularly laterally, is variably tinged with pale orange, giving a very characteristic appearance. The larvae are rather thickly clothed with short, whitish setae arising from inconspicuous tubercles. True legs pale yellowish basally, yellowish transparent apically. The whitish transparent prolegs occur on the 2d to the 7th and 8th and 9th abdominal segments, each segment also with a small, black, lateral dot. Anal plate subcircular, black with whitish setose tubercles.

Full-grown larva. Length 1.5 cm. Head jet-black. Body a deep yellowish orange, sparsely covered with fine, whitish hairs and with a conspicuous row of irregular subquadrate lateral markings, a pair on each segment, and a substigmatal row of small triangular, black markings. The black anal plate bears several pairs of submedian white setae.

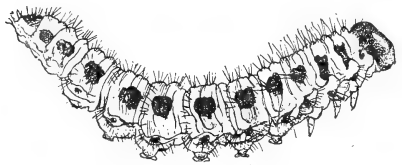

FIG. 2 Poplar sawfly, side view of larva, enlarged. (Original)

Adult. Length .8 cm. Wing spread 1.8 cm. Head shining black, short, broad. Antennae nearly as long as the body, composed of nine segments, the first two short, the others long, slender and tapering successively to the apex. Thorax black dorsally, the venter and the abdomen yellowish. Wings yellowish basally, the stigma large, distinct. Legs mostly pale yellowish, the pulvilli dark brown.

Remedial measures. This leaf feeder should be easily controlled by timely applications of an arsenical poison, preferably arsenate of lead.

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Grape blossom midge

Contarinia johnsoni Sling.

The work of this little midge has been observed here and there in Chautauqua vineyards for the last four years. The enlarged blossom buds, infested by maggots, have been found in small numbers each spring. Nothing was known as to the source of these little pests, aside from the fact that they were produced by some small fly. It was not till the spring of 1909 that we were enabled to rear this insect and show that it belonged to the genus Contarinia and has as allies several destructive species. One closely related form, Contarinia violicola Coq., has proved very injurious to the extensive violet-growing industry located at Rhinecliff, N. Y. Another member of this genus, Contarinia pyrivora Riley, is well known on account of its destroying young pears. A third form, Contarinia sorghicola Coq., infests sorghum in the South and causes a serious shrinkage in the production of seed, while a West Indian species, Contarinia gossypii Felt, is injurious to cotton. In addition, Contarinia viticola Rübs., which further study may show to be identical with the species attacking grape blossoms in the Chautauqua region, has been recorded as injurious to grape blossoms in Europe by Rübsaamen,[1] a noted authority upon this group.

Injuries. The grape blossom midge of the Chautauqua region was first observed in scattering numbers by the late Professor Slingerland and Fred Johnson in 1904, at which time it was recorded from the towns of Ripley, Westfield, Portland and Brocton. It has occurred in small numbers from year to year since then, and in 1908 aroused considerable apprehension among growers on ac-

[1] 1906 **Rübsaamen, E. H.** Zeitschrift für Wissenschaftliche Insektenbiologie, 2:194-98.

1909 ——— Die Wichtigsten deutschen Reben-Schädlinge und Reben-Nützlinge, p. 74-76.

count of injuries inflicted upon early Moore grapes. One acre of this variety, belonging to Mr H. L. Cumming of Fredonia, had 60 to 75% of the blossoms destroyed by this midge. Investigations by the writer last June showed that the insect was generally distributed, even in extensive vineyards, throughout the grape belt, being observed from Fredonia westward to Ripley, while Mr Fred Johnson recorded its occurrence at North East, Pa. The injury resulting from the attack of this insect simply causes the destruction of infested blossom buds. There was some complaint of grape clusters being unusually open and irregular during 1908, and as this midge was abnormally abundant, it was undoubtedly a factor in the production of light bunches. Furthermore, it is probable that some of the mysterious failures of the grape crop in restricted areas may be attributed to the work of this species. An examination of grapevines in the vicinity of Albany and at Nassau, N. Y. failed to reveal any signs of this insect's work.

Description. The presence of this enemy in a vineyard is easily recognized. The infested blossom buds remain closed and are conspicuous on account of their abnormal size. They are about ⅛ of an inch in length and usually longer than broad. They vary in color from the nearly normal green to a variable red tinted extremity. The actual presence of the destructive yellowish maggots is easily demonstrated by opening a bud. Seven to eight or ten larvae may occur in one blossom bud. The affected buds remain on the vines only a short time, dropping within a few days to a week after the injury becomes noticeable.

Larva. The pale yellowish or whitish maggot or larva is about 1/12 of an inch long and may be easily recognized by the presence of a somewhat characteristic, brownish, forked breastbone near the anterior extremity. The younger maggots are whitish, becoming lemon-yellow upon attaining full growth. The maggots, together with those of related species, have a peculiar method of locomotion. The extremities are brought together and then suddenly released. The movement frequently results in throwing the maggot a distance several times its own length.

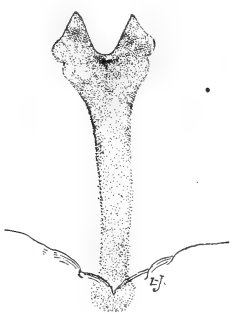

Fig. 3 Maggot of grape blossom midge, breastbone greatly enlarged. (Original)

Fly. The parent insect is an extremely delicate, pale yellowish fly only about 1/25 of an inch long. The male is easily recognized by the long, knobbed, hairy feelers or antennae one half longer than the body. The female is about 1/16 of an inch long and may be distinguished by the shorter, less densely haired feelers or antennae. This sex is provided with a long, slender ovipositor as long as the body, well adapted to placing the tiny eggs within the developing floral tissues.

Technical description. *Larva.* Length 1.5 to 2 mm. The smaller larvae are whitish, the larger ones pale yellowish. Head rather short, broad, with a length about equal to the diameter. Antennae short, stout, uniarticulate. Breastbone bidentate, the teeth rather broadly triangular and moderately chitinized, the basal

FIG. 4 Maggot of grape blossom midge, view of head, enlarged. (Original)

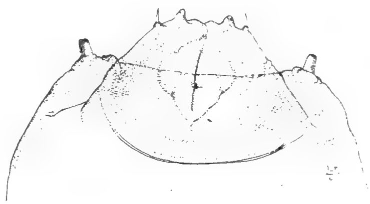

FIG. 5 Maggot of grape blossom midge posterior extremity, enlarged. (Original)

portion semitransparent and tapering posteriorly. The segmentation of the body rather distinct, the skin nearly smooth. The penultimate segment with a short, stout, cuticular process at the posterior lateral angles. Terminal segment broadly rounded, subtruncate distally, posteriorly with a pair of submedian acute dermal papillae, and just within, a pair of stouter, semitransparent, strongly curved pseudopods. Anus ventral, broadly oval.

Male. Length 1 mm. Antennae one half longer than the body, thickly haired, fuscous yellowish; 14 segments, the fifth with the basal portion of the stem with a length one half greater than its diameter, the distal part with a length three times its diameter, the enlargements subglobose, the basal one with a sparse subbasal whorl of setae, the circumfilum with the loops sparse, long and extending to or a little beyond the middle of the subglobular distal enlargement, which latter has a scattering subbasal whorl of curved setae and a similar circumfilum, the loops extending to the base of the following segment. Palpi; first segment short, subquadrate, the second stout, with a length over three times its diameter, the third a little longer, more slender, the fourth one fourth longer than the third. Mesonotum fuscous yellowish. Scutellum and postscutellum yellowish. Abdomen fuscous yellowish; genitalia darker. Wings hyaline, costa light brown, subcosta uniting therewith before the basal third, the third vein at the apex; fringe abundant. Halteres whitish transparent. Legs mostly pale yellowish; claws long, slender, evenly curved, the pulvilli as long as the claws. Genitalia; basal clasp segment stout, truncate; terminal clasp segment rather stout, slightly tapering; dorsal plate short, deeply and triangularly emarginate, the lobes diverging, obliquely truncate and sparsely setose; ventral plate long, very deeply and roundly emarginate, the lobes long, slender, with a few coarse setae at the narrowly rounded apex; style short, stout.

Female. Length 1.5 mm. Antennae nearly as long as the body, rather thickly haired, fuscous yellowish, yellowish basally; 14 segments, the third greatly produced, with a length six times its diameter, the fifth subsessile, cylindric, with a length two and one half times its diameter, slightly constricted near the basal third, subbasal and subapical whorls rather thick, short, strongly curved; terminal segment somewhat produced, the apical fourth forming a broadly rounded knob. Mesonotum fuscous yellowish, the submedian lines sparsely haired. Scutellum and postscutellum fuscous yellowish. Abdomen a little lighter, the distal segments slightly fuscous. Halteres pale yellowish. Coxae, femora and tibiae mostly pale straw, the anterior and midtarsi fuscous yellowish, the posterior tarsi apparently pale yellowish. Ovipositor nearly as long as the body, the terminal lobes with a length six times their width, very slender, subacute apically and with a few coarse setae.

Life history. The delicate parent midges undoubtedly appear with the unfolding of the blossom buds or soon after, and the female deposits 7 to 10 or more eggs. These hatch quickly, the maggots develop rapidly and become full grown at about blossoming time. Infested blossom buds were very abundant in vineyards June 11, 1908, while a week or 10 days later the insects had practically disappeared. This indicates clearly that the period of larval existence is very short. The maggots or larvae either drop from the infested bud or fall with it and seek shelter in the ground, remaining in an earthen cocoon during the rest of the season and transforming to pupae the following spring. The few adults reared by us under artificial conditions appeared April 30, 1909. It is probable that those hibernating in the field do not emerge till much later, namely, early in June before the grapes are in bloom. There appears to be no reason for believing that this insect can subsist upon other vines than grape, unless it be the allied Virginia creeper. The extent of injury is undoubtedly influenced greatly by the time the midges appear, since if they fly in large numbers just as the blossom buds appear and the latter are therefore in a favorable condition for infestation, there is likely to be much more serious injury. This is probably the explanation of the almost total destruction of the bloom in the acre of early Moore grapes noticed above. It is possible that this new American pest is an introduced species, brought to the Chautauqua region on recent importations of grape. It is to be hoped that it will not multiply greatly and become a serious menace to this important industry.

Remedial measures. Nothing very definite can be advised in the way of control measures. Clean culture, supplemented by liberal feeding, is the most hopeful method of avoiding serious injury, as we have yet to find this insect very abundant throughout large, well cultivated vineyards. Most of the infested clusters so far as our observation goes, occur near the outside of a vineyard in the vicinity of abundant natural shelters. The burning over of grassy headlands and margins of ditches in early spring could hardly cause much injury and might be of service in destroying the wandering maggots. The delicate parent insects would succumb readily to pyrethrum powder and presumably would be stupefied by heavy smoke. These insects fly mostly during the quieter part of the day and it might be practical, in the case of a badly infested vineyard, to watch for the appearance of the adults and then stupefy or destroy them by generating a heavy smudge throughout the vineyard. Attempts to control this midge by applications to the vines before the flies appear are very likely to result in failure.

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Gladioli aphid

Aphis gladioli n. sp.

The abundant occurrence of a plant louse upon gladioli bulbs is something unusual. No outbreak of the kind had been previously brought to our attention, and Dr L. O. Howard informs the writer that he is unable to find any record of an aphid occurring upon this showy plant. This new form of injury was first brought to our attention last July, by the reception of a number of gladioli bulbs badly infested with plant lice, although they had been previously fumigated with sulfur. The insect must be exceedingly prolific, since one small box containing about a dozen bulbs had the interstices almost filled with exuviae and plant lice. The presence of large numbers of these insects injures the salability of the bulbs, since it weakens them materially and frequently results in a failure to bloom. This species has caused more or less trouble to some of our growers for the past two or three years, particularly in late winter. Examples of this plant louse were submitted to Mr Pergande, through Dr L. O. Howard, and by him pronounced to be an unknown species of aphis.

Description. The very young plant louse is about .75 mm long, pale yellowish or whitish transparent with an obscure subapical orange band on the abdomen. The antennae are slightly fuscous apically, the tip of the beak, the distal tarsal segments and the cornicles being fuscous; the eyes are black. The antennal segments in this stage have the following measurements: Third .21 mm, fourth .06 mm, fifth .141 mm. The cornicles are subcylindric, being .09 x .045 mm.

The partly full grown wingless female has the following antennal measurements. Third segment .195 mm, fourth .12 mm, fifth .085 mm, the sixth .415 mm, the cornicles being subcylindric, .135 x .06 mm.

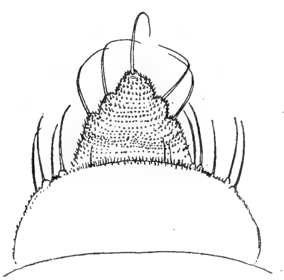

Fig. 6 Gladioli aphid, posterior extremity of wingless female, enlarged. (Original)

The full grown wingless female is rather stout, a pale yellowish white, the head dorsally, frequently having a distinct yellowish cast and the subapical abdominal segments a deeper yellowish cast on the venter. The apex of the third, fourth and fifth antennal segments and the apexes of the tibiae, tarsi and the beak are fuscous. The cornicles are light fuscous and the eyes black.

Winged female. Length 1.75 mm. This form is dark brown and yellowish, the antennae being mostly a fuscous yellowish, the head fuscous, the pronotal lobes a variable fuscous and separated from the mesonotum by a yellowish or deep orange area. The thorax has the median and two conspicuous submedian lobes fuscous. Scutellum fuscous, postscutellum light fuscous. Abdomen a variable yellowish orange and with a variable, oval, or subquadrangular, fuscous area on the dorsum of the fourth, fifth, sixth and seventh segments. Cornicles fuscous and tapering slightly. Wings with a yellowish white stigma. Legs mostly a pale

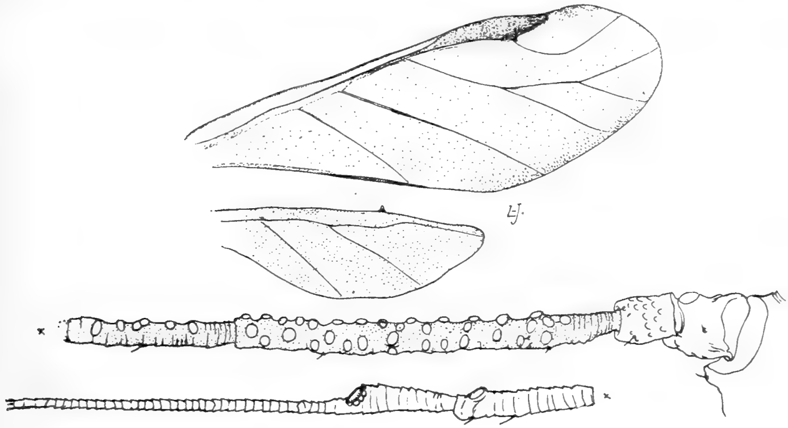

FIG. 7 Gladioli aphid, wings and antenna, much enlarged. (Original)

yellowish, the femora and tibiae apically and the tarsi fuscous. Venter of prothorax yellowish, the mesothorax with broad, angulate, fuscous sclerites ventrally. The abdomen ventrally yellowish and deep orange, the two apical segments narrowly margined mesially with fuscous. The antennal segments have the following measurements: The third .36 mm, the fourth .165 mm, the fifth .105 mm and the sixth .375 mm, the sensoria being very abundant on the third and fourth segments; cornicles .15 x .045 mm, tapering gradually.

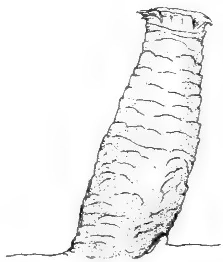

FIG. 8 Gladioli aphid, honey tube, enlarged. (Original)

Life history. Gladioli bulbs are kept by growers in large warehouses, the temperature being maintained at about 40 degrees throughout the winter. This insect is evidently unable to breed under these conditions. As spring advances and the house begins to warm up in March, the aphids appear in large numbers, reproducing so abundantly that the window frames and sills may become literally covered with wings and bodies of plant lice. It is comparatively easy, in a badly infested house, to sweep up a gill of wings and exuviae from under one window. This plant louse multiplies freely upon the bulbs, usually being massed around the origin of the roots and sometimes nearly covering the entire under surface. Breeding evidently continues from some time in March until into July, with the production of numerous winged individuals the latter part of July, at least in the case of bulbs submitted for examination, though winged females undoubtedly occur earlier in the season under warehouse conditions. By July 28th winged females had entirely disappeared in our breeding cages, though young were still numerous on the bulbs; later, all disappeared. An investigation about the middle of August resulted in finding no living aphids in the storage warehouse or upon the plants in the field. It is stated that when digging in October a few plant lice may be found upon the bulbs. These evidently remain in a dormant condition till the house warms up in the spring as described above.

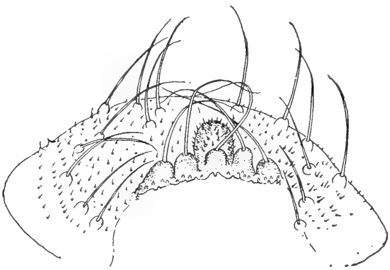

Fig. 9 Gladioli aphid, posterior extremity of young nymph, enlarged. (Original)

Remedies. Fumigation with sulfur has been found ineffective in controlling this species. It is more than probable that judicious fumigation with hydrocyanic acid gas would be entirely successful in controlling this pest. This might be accomplished by treating the entire house or by arranging for the fumigation of badly infested trays whenever necessary. The bulbs would probably not be injured by any strength of gas which would be harmless to ordinary growing plants, and it is probable that more gas could be used with safety. This point can be determined only by actual tests made preferably under warehouse conditions.

Green cockroach

Panchlora hyalina Saus.

Two specimens of this Central American form, kindly determined through the courtesy of Dr L. O. Howard, were brought to the office in March, each taken from a different section of Albany, N. Y. The occurrence of a single specimen would have little significance, as it might easily have been brought to the city upon fruit boats, but the finding of two in different sections is not so readily explained, particularly as we find records of this species having been taken in other parts of the country. The earliest record is that of a specimen being captured in a store in Boston

December 26, 1878, and is given on the authority of the late Dr Samuel Kneeland. Again in 1879 a female was found alive with numerous young in a house at Salem, Mass. In both of the above mentioned cases the insect was identified as Panchlora nivea Linn. A specimen was also taken by Dr Carl F. Gissler of Brooklyn, N. Y., September 21, 1890. It has also been recorded from Porto Rico.

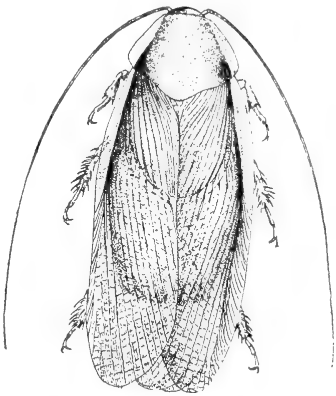

FIG. 10 Green cockroach, enlarged. (Original)

Description. This slender species is a rather fragile, light green, yellow margined form with the thinner portions of the wings transparent. It is nearly an inch long and has the long, slender, pale yellowish antennae characteristic of this group, the terminal segments of which are interesting, since they are strongly constricted at the base and thus subsessile. The legs and undersurface are pale yellowish green.

The young, as noted by Dr Howard, are light brown and are remarkable in that the body becomes broader posteriorly.

Life history and habits. This species, aside from being a tropical form, is particularly interesting because of its viviparous habits, most cockroaches producing large, characteristic oötheca. It is a tropical form and the abundance of constantly warm houses, not to mention greenhouses, should render it comparatively easy for this species to maintain itself in our climate, particularly when reinforced by frequent importations as appears to be the case at the present time. This or an allied form, according to Malcomb Burr, is occasionally found in Europe, being brought from South America.

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The typhoid or house fly and disease

Musca domestica Linn.

The house fly is such an extremely common species that description appears unnecessary. Dr Howard's investigations show that fully 98% of the flies in houses are ordinary house flies. A few others are associated with this dominant species. The stable fly, Stomoxys calcitrans Linn. may be rather abundant about houses in the fall and is responsible for the persistent belief that under certain conditions the house fly bites. Invariably the offender is this last named species, a form which presents an extremely close general resemblance to the house fly and may be distinguished therefrom at once by its bite. It occurs, as a rule, about the stable. Another fly liable to be abundant about houses in the fall is the cluster fly, Pollenia rudis Fabr., a species somewhat larger than the house fly and easily recognized by the yellowish hairs upon the thorax. The small, yellowish fruit fly, Drosophila ampelophia Loew, only about 1/8 inch long, is sometimes rather abundant in houses and is invariably found in association with overripe or decaying fruit. These

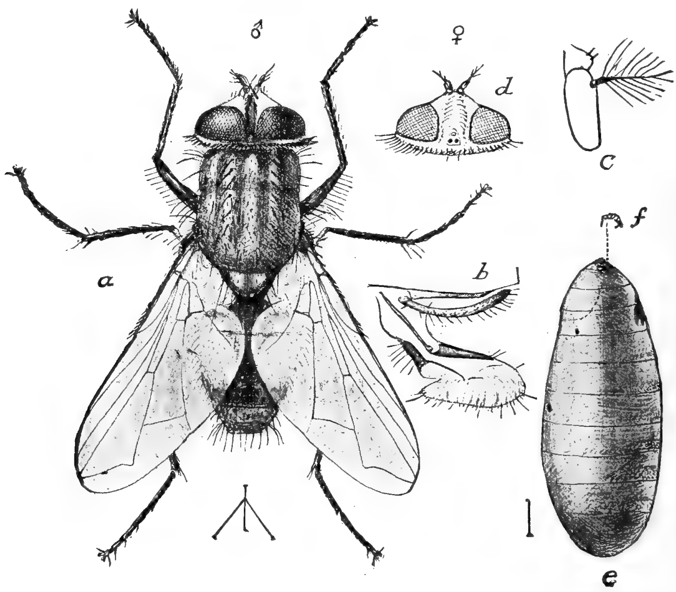

FIG. 11 Typhoid or house fly: *a*, male, seen from above; *b*, proboscis and palpus from the side; *c*, tip of the antenna; *d*, head of female; *e*, puparium; *f*, the anterior breathing-pore or spiracle, all enlarged. (After Howard & Marlatt, U. S. Dep't Agric. Div. Ent. Bul. 4. n. s. 1896)

various species, although annoying and under certain conditions dangerous, sink into insignificance compared with the common house fly.

Habits. The house fly subsists entirely upon fluids taken up by means of the fleshy tongue. It apparently feeds with equal gusto upon fresh manure, decaying vegetable matter or the daintiest culinary preparations. This catholicity of taste frequently results in flies feeding greedily upon exposed discharges, in open vessels or poorly constructed privies, from patients suffering from typhoid fever or other grave intestinal diseases. The hairy legs are thus fouled with thousands of deadly bacilli and countless numbers of germs are swallowed. Shortly thereafter the same flies may appear in the house and incidentally contaminate the food, to the great peril of the consumer, with the germs adhering to the limbs and those deposited with undiminished virulence in the familiar fly specks. This, while disgusting and abhorrent to every sense of decency, occurs repeatedly in nature and is apparently ignored by the masses, despite the deadly peril incurred.

There is abundant evidence to show that this insect breeds by preference in horse manure, though it also occurs to a limited extent in cow manure and in miscellaneous collections of filth and specially decaying vegetable matter. The parent insects deposit their eggs upon manure and similar materials, the young maggots hatching therefrom in less than 24 hours and, under favorable conditions, completing their growth in five to seven days later. The maggots then transform to the oval, brown, resting or pupal stage, remaining therein from five to seven days. The life cycle is thus completed in 10 to 14 days, the shorter period being true of the warmer parts of the year, particularly in the vicinity of Washington, D. C. One fly may deposit about 120 eggs, and as there may be 10 to 12 generations in one season, it is not surprising that this insect should become extremely abundant by midsummer. Calculations show that under favorable conditions the descendants from one fly might at the end of a season reach the stupendous number of over 190 quintillion. Dr Howard's studies show that as many as 1200 house flies, in various stages, might be found in one pound of manure. At this rate, one good load of manure might produce two and a half million flies. Fortunately, breeding is confined to the warm months, only a few flies wintering in houses in a more or less dormant condition.

Flight and dissemination. This is something of great importance in view of the part flies may play in the spread of disease. The experiments of Dr L. O. Howard, Government Entomologist, have shown conclusively that the major portion of the flies about a building breed in the immediate vicinity, probably within 300 to 500 feet. There is no denying the fact that this insect is capable of flying considerable distances but ordinarily this does not seem to occur. There is another phase of this question which has apparently received little consideration, namely, the conveyance of flies by vehicles of one kind or another. Only a little observation is necessary to show that the butcher cart of the country is a very efficient carrier of flies, presumably receiving accessions and leaving individuals at almost every stopping place, even though the route traversed may occupy an entire day. The same is true, though to a more limited extent, of trolley cars and express cars carrying sacked meat or other supplies equally attractive to flies. It is only necessary for these carriers to load where conditions are favorable for the infection of flies and we may have a mysterious outbreak of disease at some distance from the source of trouble.

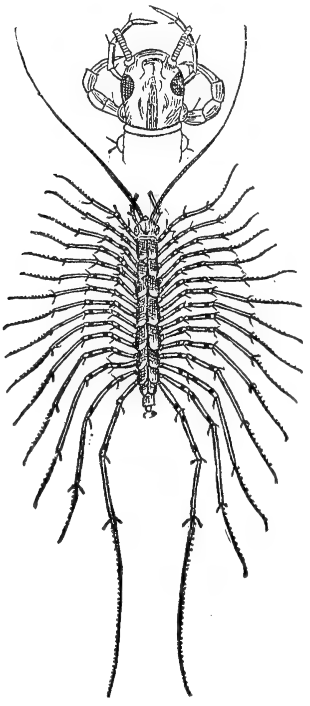

FIG. 12 House centipede; seen from above, enlarged, the head still more enlarged. (After Wood)

Natural enemies. The house fly, though so abundant, is subject to attack by various natural enemies. One of the most common is a fungous disease known as E m p u s a m u s c a e which is occasionally responsible for the death of many flies, particularly toward the end of the summer. It is not uncommon to find a few individuals affected by this disease every year. A small, reddish mite may be occasionally found attached to flies, seriously weakening the host. There are, in addition, wasps and spiders which prey upon flies and undoubtedly are of considerable service though they are very rarely sufficiently abundant to materially reduce the numbers of this pest. Another interesting enemy of the house fly is known as the house centipede, S c u t i g e r a f o r c e p s Raf., a harmless species which, in recent years, has become well established in many houses in New York State. It is credited with preying on house flies, cockroaches and presumably other insect inhabitants of dwellings.

The house fly as a carrier of disease. The house fly is such a common insect that altogether too much has been taken for granted. Up to recently it has been considered simply as an inevitable nuisance. Later developments have shown that this insect may be an important factor in the dissemination of certain diseases.

Typhoid fever is one of the most serious ailments to which man is subject. There are about 250,000 cases of this disease annually in America, about 35,000 proving fatal. 60% of the deaths in the Franco-Prussian War and 30% of the deaths in the Boer War were caused by this disease. Positive statements have been made to the effect that the house fly was an active agent in the dissemination of this disease, while certain reputable physicians consider this charge unproved. The Spanish-American War, if it accomplished nothing else, called attention in a most forcible manner to the part flies might play in the dissemination of typhoid bacilli. Dr M. A. Veeder of Lyons writing in 1898 was very strongly of the opinion that the house fly was largely responsible for the dissemination of this disease in camps. Dr Walter Reed writing of an outbreak near Porto Principe in the annual report of the War Department states that the outbreak "was clearly not due to water infection but was transferred from the infected stools of patients to the food by means of flies, the conditions being especially favorable for this manner of dissemination." Dr L. O. Howard, writing in 1900 on the fauna of human excrement, quotes from Dr Vaughan, a member of the army typhoid commission, as follows:

27 Flies undoubtedly served as carriers of the infection.

My reasons for believing that flies were active in the dissemination of typhoid may be stated as follows:

a Flies swarmed over infected fecal matter in the pits and then visited and fed upon the food prepared for the soldiers at the mess tents. In some instances where lime had recently been sprinkled over the contents of the pits, flies with their feet whitened with lime were seen walking over the food.

b Officers whose mess tents were protected by means of screens suffered proportionately less from typhoid fever than did those whose tents were not so protected.

c Typhoid fever gradually disappeared in the fall of 1898, with the approach of cold weather, and the consequent disabling of the fly.

It is possible for the fly to carry the typhoid bacillus in two ways. In the first place fecal matter containing the typhoid germ may adhere to the fly and be mechanically transported. In the second place, it is possible that the typhoid bacillus may be carried in the digestive organs of the fly and may be deposited with its excrement.

Dr Alice Hamilton in 1903, studying the part played by the house fly in a recent epidemic of typhoid fever in Chicago which could not be explained wholly by the water supply nor on the grounds of poverty or ignorance of the inhabitants, captured flies in undrained privies, on the fences of yards, on the walls of two houses and in the room of a typhoid patient and used them to inoculate 18 tubes, from five of which the typhoid bacillus was isolated. She further found that many discharges from typhoid patients were left exposed in privies or yards, and concluded that flies might be an important adjunct in the dissemination of this infection. More recently, Dr Daniel D. Jackson investigating in 1907 the pollution of New York harbor, found that by far the greater number of cases occurred within a few blocks of the water front, the outbreak being most severe in the immediate vicinity of sewer outlets. He gives a series of charts showing an almost exact coincidence between the abundance of house flies and the occurrence of typhoid fever, when the dates are set back two months to correspond to the time at which the disease was contracted. The bacilli of typhoid fever were found by Ficker in the dejecta of house flies 23 days after feeding, while Hamer records the presence of this bacillus in flies during a period of two weeks. Most significant of all, it should be noted that competent physicians in position to make extended observations upon this disease and the methods by which it may become disseminated, are most strongly of the opinion that under certain conditions at least, the fly is a most important factor. Epidemics spread by flies, according to Dr Veeder, tend to follow the directions of prevailing warm winds. He considers flies the chief medium of conveyance in villages and camps where shallow, open closets are used, thus affording the insects free access to infected material, and where it is possible to eliminate water and milk as the sources of infection. Drs Sedgwick and Winslow, writing in 1903 state that "the three great means for the transmission of typhoid fever are fingers, food and flies," the authors holding the last to be the most important.

The possibilities of transmitting typhoid fever are appalling to the layman when it is remembered that the germs of this disease may be in the system several weeks before diagnosis is possible, continue in numbers six to eight weeks after apparent recovery and in exceptional cases may be discharged from the system during a period of several years. There are authentic records of a patient distributing these germs for 17 years and being the incipient cause of 13 cases during 14 years of that period. Furthermore, Dr M. A. Veeder of Lyons cites a case where typhoid fever was perpetuated from year to year in a locality, ascribing it to a physician recommending the burial of all typhoid excreta and the execution of this direction by a favorite nurse. It is well known that soil infected by these germs may be the origin of new cases, and Dr Veeder significantly observes that the annual recurrence of typhoid fever in the above mentioned locality ceased with the death of the two parties mentioned above and a change in the method of disposing of typhoid discharges.

The evidence against this insect may therefore be summed up briefly as follows: Virulent typhoid bacilli have been found upon the legs and within the body of this insect, persisting in the latter case for 23 days. A number of serious outbreaks have been observed by competent physicians, where infection through a common water or food supply did not satisfactorily explain the outbreak. This positive evidence, while not establishing beyond all question the culpability of the fly, is further supported by the opinion of a number of reputable physicians who have had extensive experience with outbreaks of this character.

The evidence showing that flies may play an important part in the diffusion of cholera is, according to Dr Nuttall, absolutely convincing. He cites experiments showing that cholera bacilli may be found on flies in large numbers, while they may occur in the dejecta within 17 hours after feeding and as late as four days. Infected flies have been given access to milk and cholera cultures made therefrom.

Typhoid fever and cholera, while both serious infections, are by no means the only diseases which may be conveyed by flies. Certain forms of diarrhoea and enteritis are undoubtedly due to specific germs, and there is no reason why the bacilli causing these infections may not be carried as easily and in the same way as those responsible for typhoid fever. The monthly bulletin of the New York State Department of Health for October 1908, states that during 1907 there were in New York State 37,370 deaths of infants under 2 years of age, 9213 being due to diarrhoea and enteritis. Careful investigators, it is stated, have placed the proportion of deaths between bottle-fed and breast-fed babies as 25 to 1. Physicians recognize the necessity of providing pure milk for young children, and in most instances it is comparatively easy to see how flies might be responsible for the major portion of the infections, since they usually occur in numbers about stables, in the vicinity of milk houses, in the neighborhood of milk stations, on milk wagons and, in fact, are found in greater or less numbers wherever milk is stored, excepting in refrigerators and similar places. Martin states that each succeeding year confirms his observation of 1898 to the effect that the annual epidemic of diarrhoea and typhoid is connected with the appearance of the common house fly, while Nash, in the *Lancet,* records no mortality from diarrhoea among infants at Southend during July and August 1902, this immunity being accompanied by the almost complete absence of the house fly. This insect was abundant in that locality in September and coincidently epidemic diarrhoea developed. Sandilands, in the *Journal of Hygiene,* states that the great majority of cases of diarrhoea are due to the consumption of infected food, and suggests that the seasonal incidence of diarrhoea coincides with and results from the seasonal prevalence of flies. Dr Jackson records several epidemics of a malignant type of dysentery radiating from a single point and disappearing entirely when proper disinfection of closets was enforced.

The evil possibilities of the fly are by no means exhausted in the above recital. It is well known that flies feed upon sputum. Experiments by Lord recorded in the *Boston Medical and Surgical Journal* show that flies may ingest tubercular sputum and excrete tubercular bacilli, the virulence of which may last for at least 15 days. He considers the danger of human infection from this source to lie in the ingestion of fly specks on food, and suggests that during the fly season great attention should be paid to the screening of rooms and hospital wards containing patients with tuberculosis and laboratories where tubercular material is examined.

Nuttall considers that the evidence previously submitted proves that the house fly may carry about and deposit anthrax bacilli, though there may be a question as to how generally flies are responsible for the dissemination of this disease. Parke admits the possibilities of flies distributing, in addition to those mentioned above, plague, trachoma, septicemia, erysipelas and leprosy. Furthermore, there are those who would hold flies responsible for the more frequent new cases which occur in the zone immediately surrounding the smallpox hospital and which may be due either to the wafting out of infected particles or their carriage by flies. The latter is considered the more probable. Howe, according to the statement of Dr Howard, has demonstrated that the purulent conjunctivitis of the Egyptians is spread by the house fly. The experiments of Grassi show that the eggs of Taenia, Trichocephalus and Oxyuris pass uninjured through the alimentary tract of flies.

Sanitary and control measures. It is perhaps needless to add, in view of the foregoing, that the greatest care should be taken to exclude flies from the sick room, especially in the case of contagious diseases. The flies are not only annoying to the patient but may aid in carrying the disease to others. The proper disposal of infected discharges such as those from typhoid patients should never be neglected. Vessels which have contained any such material should be thoroughly cleaned and never left where flies may gain access to the infection.

All food, particularly that eaten without cooking, should be carefully protected from flies by the use of screens. This is especially true of milk, since it affords a favorable medium for the multiplication of certain disease germs. This applies to dealers in food supplies as well as to the home. An important step toward better sanitation would be taken if the public refused to patronize stores and eating places overrun by flies.

A large reduction in the number of house flies found in most places is thoroughly practical. This end can be best attained by doing away with conditions favorable to the unrestricted multiplication of this pest. The first step is to prevent flies from breeding in horse manure and other waste products from the stable. All manure should be placed in a fly proof receptacle or the accumulation treated daily with small quantities of chlorid of lime. If all manure is removed from the stable at intervals of three days and spread upon the field, there will be comparatively little breeding. Some one of these measures can be applied to every stable in cities and villages. The farmer, if unable to carry out any of the preceding suggestions, will find a large measure of relief from the fly nuisance, if the manure is stored in tight, practically fly proof cellars, such as can be easily constructed with the modern concrete foundation. Flies breed but little in darkness, and the writer has known of barns comparatively free from flies, simply because the manure was stored in the darker parts of a large barn cellar.

The treatment of manure described above should be supplemented by care in preventing the accumulation about the premises, of decaying organic matter such as fruit, table scraps, etc. Swill barrels should always be provided with tight covers and care exercised that there be no leakage or an accumulation of fly-breeding material about the barrel. The old-fashioned box privy should be abolished unless the same be conducted on the earth closet principle and the contents kept covered with lime or dry earth, so as to prevent both the breeding and infection of flies. The modern water-closet is by far the best and safest solution of this last named difficulty. The presence of numerous flies about the dwelling may be construed as indicating a nearby, usually easily eliminated breeding place.

It will be found in practice that some flies are very apt to exist in a neighborhood even after the adoption of rigid precautions. They should be kept out of houses, so far as possible, by the use of window and door screens, supplemented by the employment of Tanglefoot or other sticky fly paper. This, though somewhat disagreeable, is much to be preferred to the use of poisonous preparations which are likely to result in dead flies dropping into food. Prof. C. P. Lounsbury, Government Entomologist of South Africa, suggests, in addition to the above, putting fresh pyrethrum powder upon window sills and supplementing this by the judicious use of an insect net.

Bibliography

The following bibliography comprises most of the more important literature relating to the life history and habits of the house fly and its part in the dissemination of various diseases affecting man.

1869 **Packard, A. S.** Am. Nat. 2:638-40

Observations on the anatomy and life history.

1873 ——— On the Transformations of the Common House Fly, with Notes on Allied Forms. Bost. Soc. Nat. Hist. Proc. 16:136-50.

A detailed account of the life history and of the anatomy of the early stages, with brief notices of allied species.

1876 ——— The House Fly. Am. Nat. 10:476–80

Observations on the life history and habits.

1883 **Harrington, W. H.** House Flies. Ent. Soc. Ont. Rep't. 1882, p. 38–44

A somewhat extended discussion with quotations from Packard and other authorities.

1884 **E. P. W.** Dangers from Flies. Nature, 29:482–83

Abstract of a note by Dr B. Grassi in which he calls attention to flies occurring upon various pathogenic materials and conveying germs to receptive membranous surfaces. Ophthalmia is noted as an Egyptian complaint, very probably carried by flies. Grassi's experiments show that flies may ingest and pass unharmed, eggs of a human parasite (Trichocephalus) and probably of the tapeworm (Taenia solium).

1884 **Riley, C. V.** Am. Nat. 18:1267–68

Note on Grassi's experiments showing that flies are agents in the diffusion of infectious maladies, epidemics and even parasitic diseases and recording the ingestion and passage of Trichocephalus eggs and also of alcoholic eggs of Taenia solium.

1887 ——— The Plymouth Typhoid Epidemic. Science, 10:214

Gives the mortality figures of the outbreak in 1885 and cites an instance " in which the disease seems to have been transmitted through the air." The first case, that of a stranger, occurred in a hotel, the discharges being thrown without treatment into a water-closet which communicated with a room only 3 feet distant in which the landlord's daughters slept. The drinking water of the place was good and the three cases following the first were in all probability due to germs transmitted by flies.

1887 **Fyles, Thomas W.** Insects Troublesome in the Household and How to Deal with Them. Ent. Soc. Ont. 17th Rep't, p. 33-34

A summarized biologic account.

1890 **Aaron, C. B.** In Dragon Flies *vs.* Mosquitos, p. 37–42, 53–54

A brief discussion of the life history and habits with observations on the house fly as a carrier of disease.

1890 **Beutenmueller, William.** In Dragon Flies *vs.* Mosquitos, p. 123–24

Brief observations on the habits of the house fly and the possibility of controlling the insect.

1890 **Weeks, A. C.** In Dragon Flies *vs.* Mosquitos, p. 81–84

Brief notice of habits of the house fly with frequent references to associated species.

1891 **Marlatt, C. L.** Insect Life, 4:152–53

Records unusual mortality among flies in Washington caused by Empusa Americana Thax.

1892 **Power, Henry.** Conjunctivitis Set Up By Flies. Brit. Med. Jour. Nov. 19, p. 1114

Records the severe inflammation of the conjunctiva accompanied by extensive corneal ulceration within 24 hours after having been stung in the eye by a fly which had apparently risen from a dung hill. The case was marked by general prostration and feebleness for months after. Another case was recorded, diphtherial in nature, after a fly had gotten into a man's eye. [The first case can hardly be attributed to a house fly.]

1894 **Skinner, Henry.** Ent. News, 5:18

Surgeon General Sir William Moore is quoted as reporting an instance where anthrax was spread by flies from the unburied carcass of a dog. It is also noted that the greatest abundance of flies in India is coincident with cholera outbreaks. It is suggested that leprosy is often conveyed by flies. Ophthalmia is thus disseminated. [These notes may not all apply to the house fly.]

1896 **Aylett, W. R.** Am. Microscopical Jour. 18:288

Summary of Dr Aylett's experiments showing that flies ingest and pass tubercular bacilli.

1896 **Lugger, Otto.** Entomologist, Minn. State Exp. Sta. 2d Rep't, p. 145–55

A somewhat extended account of the life history and habits of the house fly. The opinion is expressed that the larvae may be beneficial because they breed in and destroy material which might produce pathogenic germs, though attention is called to the probability of flies carrying cholera and gangrene.

1896 **Howard, L. O. & Marlatt, C. L.** U. S. Dep't Agric. Div. Ent. Bul. 4. n. s. p. 43–47

A summarized gene ral account of the house fly with mention of several associated species Preventive measures are discussed briefly.

1896 **Osborn, Herbert.** U. S. Dep't Agric. Div. Ent. Bul. 5. n. s., p. 19–20

Refers to opinions in which flies are held to be the authors or probable carriers in epidemics of anthrax, cholera, typhoid fever, phthisis, leprosy and ophthalmia.

1896 **Sibthorpe, E. H.** Cholera and Flies. Brit. Med. Jour. Sept. p. 700

Flies are considered as scavengers not conveyers of cholera. An outbreak of disease occurred in a native regiment and on each occasion after leaving an old camp for a new, a recrudescence occurred. This was attributed to leaving flies behind; when they followed and mustered in force the disease abated.

1897 **Buchanan, W. J.** Cholera Diffusion by Flies. Indian Med. Gazette, 3:86–87

Gives details respecting a cholera outbreak in a jail, stating that all prisoners affected fed in the corner of the jail near infected huts, whereas those eating in the opposite hospital corner, diagonally across, escaped the malady. This data was considered sufficient to indicate the fly as a very probable carrier of the contagion.

1898 **Howard, L. O.** House Flies. U. S. Dep't Agric. Div. Ent. Cir. 35, ser. 2, p. 1–8

A summarized account of the life history of this insect, with a discussion of remedial measures.

1898 ———— Further Notes on the House Fly. U. S. Dept. Agric. Div. Ent. Bul. 10. n. s. p. 63–65

Gives details of experiments with applications of air-slaked lime, land plaster, gas lime, chlorid of lime and kerosene to horse manure, the treatment with kerosene and chlorid of lime being advised. Data on the abundance of larvae and puparia in manure are also given.

1898 **Veeder, M. A.** Flies as spreaders of sickness in camps. Med. Record, 54:429–30

Records flies feeding upon typhoid excreta and passing from that to food supplies. Bacterial cultures were made from both fly tracks and fly excreta.

1899 **Howard, L. O.** The Economic Status of Insects as a Class. Science, 32:233–47

It is stated on page 237 that purulent conjunctivitis of the Egyptians is spread by the house fly, while anthrax bacilli may be conveyed by the bite of Tabanus or Stomoxys. The house fly is mentioned as a probable carrier of typhoid fever.

1899 **Hutt, H. L.** Ent. Soc. Ont. 29th Rep't. 1898. p. 99–100

A summarized account of the life history and habits of the house fly, with mention of a few associated species

1899 **Nuttall, G. H. F.** On the Role of Insects, Arachnids and Myriapods as Carriers in the Spread of Bacterial and Parasitic Diseases of Man and Animals, a Critical and Historical Study. Johns Hopkins Hosp. Rep't, 8:1–152

Concludes that the evidence that flies transmit anthrax is not above question. Grants that flies are important agents in conveying cholera and assumes that the evidence relating to the dissemination of this disease could safely be applied to typhoid fever. Flies ingest and pass tubercular bacilli. An exhaustive examination of the evidence relating to the dissemination of a number of diseases. An extended bibliography is given.

1899 **Reed, Walter.** War Dep't An. Rep't, p. 627–33

Major Reed reporting on the local epidemics of typhoid fever in the 8th cavalry and 15th infantry encamped near Porto Principe in February and March 1899, after detailing the conditions existing in the camps, states that the outbreak " was clearly not due to water infection, but was transferred from the infected stools of patients to the food by means of flies, the conditions being especially favorable for this manner of dissemination."

1899 **Veeder, M. A.** The Relative Importance of Flies and Water Supply in Spreading Disease. Med. Record, 55:10–12

Flies are responsible for such typhoid and other intestinal diseases as occur in small neighborhood epidemics extending in short leaps from house to house, without reference to water supply or anything else in common. Epidemics spread by flies tend to follow the directions of prevailing warm winds. In villages and camps where shallow open closets are used, giving free access of flies to the chief source of infection, the flies are the most important carriers. These diseases are therefore usually fly-borne in villages and camps. The burial of typhoid infected matter in the ground is no protection against flies. On the contrary it actually perpetuates it in the locality from year to year.

1900 **Howard, L. O.** A Contribution to the Study of the Insect Fauna of Human Excrement. Wash. Acad. Sci. Proc. 2:541–600

A detailed study of the insects breeding in human excrement, with special reference to the house fly and its part in disseminating typhoid fever. Unquestioned evidence is submitted to show that this insect may breed in human excrement, and the following conclusions from a paper read by Dr Vaughan before the American Medical Association at Atlantic City, N. J. June 6, 1900, are quoted.

27 Flies undoubtedly served as carriers of the infection.

My reasons for believing that flies were active in the dissemination of typhoid may be stated as follows:

a Flies swarmed over infected fecal matter in the pits and then visited and fed upon the food prepared for the soldiers at the mess tents. In some instances where lime had recently been sprinkled over the contents of the pits, flies with their feet whitened with lime were seen walking over the food.

b Officers whose mess tents were protected by means of screens suffered proportionately less from typhoid fever than did those whose tents were not so protected.

c Typhoid fever gradually disappeared in the fall of 1898, with the approach of cold weather, and the consequent disabling of the fly.

It is possible for the fly to carry the typhoid bacillus in two ways. In the first place fecal matter containing the typhoid germ may adhere to the fly and be mechanically transported. In the second place, it is possible that the typhoid bacillus may be carried in the digestive organs of the fly and may be deposited with its excrement.

1900 **Reed, Walter, Vaughan, V. C., & Shakespeare, E. O.** Abstract of Report on the Origin and Spread of Typhoid Fever in the U. S. Military Camps During the Spanish War of 1898. Washington, Government Printing Office

1901 **Fletcher, James.** Can. Ent. 33:84–88

A review of Dr Howard's paper entitled: *A Contribution to the Study of the Insect Fauna of Human Fxcrement*, and giving the more important conclusions resulting from the investigation.

1901 **Howard, L. O.** The Carriage of Disease by Flies. U. S. Dep't Agric. Div. Ent. Bul. 30. n. s. p. 39–45

A discussion of the house fly and associated species as carriers of disease, with a consideration of protective measures. It is assumed that the fly was responsible in a large measure for the typhoid outbreak in the army camps during the late Spanish-American War.

1902 **Ehrhorn, Edward M.** Insects as Distributors of Human Diseases. Cal. State Bd Hort. 8th Biennial Rep't, 1901–2, p. 103–14

The life history and methods of controlling the house fly are briefly discussed on pages 111–12. It is considered an active agent in the dissemination of typhoid fever.

1902 **Firth, R. H. & Horrocks, W. H.** An Inquiry into the Influence of Soil, Fabrics and Flies in the Dissemination of Enteric Infection. Brit. Med. Jour. no. 2178, p. 936–43

An extended discussion with the conclusion that house flies, M u s c a d o m e s t i c a, can convey enteric infective matter from specific excreta or other polluted material to objects on which they may walk, rest or feed, and that enteric bacilli pass through the digestive tract of the fly.

1902 **Howard, L. O.** Insects as Carriers and Spreaders of Disease. U. S. Dep't Agric. Year Book, 1901, p. 177–92

The life history of the house fly and methods of controlling it and at the same time o preventing the dissemination of typhoid fever by means of flies is given on pages 185–88.

1902 **Lounsbury, C. P.** Agric. Jour. (South Africa) Jan. 30, repr. p. 1–10

A detailed account of the house fly with a discussion of repressive measures. It is stated that medical men in India firmly believe that cholera is very frequently transmitted by the house fly, though typhoid or enteric fever is considered the most important disease conveyed by this insect. It is stated that an American zoologist found that fly maggots, genus Musca (species not stated), will devour the common round worm eggs and that the eggs of the latter are passed off alive in the excreta of the winged adults.

1902 **Veeder, M. A.** Typhoid Fever From Sources Other Than Water Supply. Med. Record, 62:121–24

A case is cited where typhoid was perpetuated from year to year, the continuation of the trouble being ascribed to a physician recommending the burial of typhoid excreta and its execution by a nurse. The death of these two parties was followed by a change in the disposal of typhoid infected material and the practical disappearance of the disease. A typhoid outbreak in the Spanish-American War, occurring in a company of the best and most intelligent men, is charged to improper sanitary regulations, actuated by kindliness on the part of comrades. Data is also given respecting a picnic ground where unsanitary conditions prevailed and have undoubtedly been responsible for a number of typhoid cases, through the agency of the house fly.

1903 **Geddings, H. D.** The Fly and Mosquito as Carriers of Disease. Ohio Sanitary Bul. 7:31–39

Recommends the employment of every possible means to prevent the multiplication of flies and the infection by them of kitchens and messing places.

1903 **Hamilton, Alice.** The Fly as a Carrier of Typhoid. Am. Med. Ass'n Jour. 40:576–83

A detailed study of a typhoid outbreak in Chicago. She states that Majors Firth and Horrocks succeeded in proving that flies feeding on typhoid infected material could carry the same to suitable cultural mediums. The following are her conclusions:

1 The epidemic of typhoid fever in Chicago during July, August, September and October of 1902 was most severe in the 19th ward which, with 1-36 of the city's population, had over 1-7 of all the deaths from this disease.

2 A concentration of the epidemic in this locality can not be explained by contamination of the drinking water, or of food, or on the ground of ignorance and poverty of the inhabitants, for the 19th ward does not differ in these respects from several other parts of the city.

3 An investigation of the sanitary conditions of this region shows that many of the street sewers are too small and that only 48% of the houses have sanitary plumbing. Of the remaining 52%, 7% have defective plumbing, 22% water-closets with intermittent water supply, 11% have privies connected with the sewer but without water supply and 12% have privies with no sewer connection.

4 The streets in which the sanitary arrangements are the worst had the largest number of cases of typhoid fever during this epidemic, irrespective of poverty of the inhabitants.

5 Flies caught in two undrained privies, on the fences of two yards, on the walls of two houses and in the room of a typhoid patient, were used to inoculate 18 tubes and from five of these tubes the typhoid bacillus was isolated.

6 Many discharges from typhoid patients are left exposed in privies or yards and flies may be an important adjunct in the dissemination of the typhoid infection.

1903 **Martin, A. W.** Flies in Relation to Typhoid Fever and Summer Diarrhoea. Public Health, 15:652–53

Each succeeding year confirms my observation in 1898, that the annual epidemic of diarrhoea and of typhoid is connected with the appearance of the common house fly. . . The annual epidemic of these two diseases begins and ends with the appearance and disappearance of the domestic fly.

1903 **Nash, J. T. C.** The Etiology of Summer Diarrhoea. The Lancet, 164:330

Records no mortality from diarrhoea among infants at Southend during July and August 1902, this immunity being accompanied by the almost complete absence of the house fly. In September the fly made its appearance and coincidentally, epidemic diarrhoea. The year preceding had 23 deaths during this period.

1904 **Hayward, E. H.** The Fly as a Carrier of Tuberculosis Infection. N. Y. Med. Jour. 80:643–44

Flies feeding on tuberculous sputum in six hours passed tubercular bacilli unimpaired

1904 **Lord, F. T.** Flies and Tuberculosis. Bost. Med. & Surg. Jour. 151:651–54

The experiments show

1 Flies may ingest tubercular sputum and excrete tubercle bacilli, the virulence of which may last for at least 15 days.

2 The danger of human infection from tubercular fly specks is by the ingestion of the specks on food. Spontaneous liberation of tubercular bacilli from fly specks is unlikely (experiment B), if mechanically disturbed infection of the surrounding air may occur. As a corollary to these conclusions it is suggested that

3 Tubercular material (sputum, pus from discharging sinuses, fecal matter from patients with intestinal tuberculosis) should be carefully protected from flies lest they act as disseminators of the tubercular bacilli.

4 During the fly season greater attention should be paid to the screening of rooms and hospital wards containing patients with tuberculosis, and laboratories where tubercular material is examined.

5 As these precautions would not eliminate fly infection by patients at large, food stuffs should be protected from flies who may already have ingested tubercular material.

1905 **Cobb, J. O.** Is the Common House Fly a Factor in the Spread of Tuberculosis? Am. Med. 9:475–77

Refers to experiments by Hayward and Hoffman showing that tubercle bacilli can be ingested and discharged by the house fly with undiminished virulence. He holds that the bacilli may enter the system through the digestive tract rather than by the lungs. He calls attention to the universal prevalence of house flies about stores of all kinds dealing in human foods, and states that here we have a most prolific source of infection. He claims to have collected reliable data from all over the world on this point. He states that army medical officers from the Philippines find that cholera was continually spread by street venders and small shopkeepers.

1905 **Melander, A. L.** The Common House Fly a Dangerous Pest. Wash. Agric. Exp. Sta. Press Bul. p. 1–7

A summarized account of the life history, habits and methods of control.

1905 **Mays, Thomas J.** The Fly and Tuberculosis. N. Y. Med. Jour. & Phila. Med. Jour. 82:437–38

Unreservedly condemns the article of J. O. Cobb on the dissemination of tuberculosis by the house fly, claiming that his data is far from conclusive.

1905 **Ward, Henry B.** The Relations of Animals to Disease. Science, 45:194–95

The spread of typhoid germs by flies is accepted and the reported conveyance by this insect, of cholera, anthrax, septicemia, pyemia, erysipelas, tuberculosis and bubonic plague is noted, some being regarded as well proved and others as open to question. Mention is made of Grassi's experiments in which the eggs of both tapeworms and round worms, Taenia solium, Oxyuris and Trichuris were sucked up by flies and recovered unaltered from their dejecta.

1906 **Howard, L. O.** House Flies U. S. Dep't Agric. Bur. Ent. Cir. 7, p. 1–9

A summarized discussion of the house fly and other species associated therewith, with particular reference to remedial measures.

1906 **Sandilands, J. E.** Epidemic Diarrhoea and the Bacterial Content of Food. Jour. Hygiene, 6:77–92

Important conclusions:

4 The great majority of cases of diarrhoea are due to the consumption of food which has been infected in the district in which the cases have occurred.

5 The infected matter thus conveyed to food is generally the excrement of some person suffering from diarrhoea.

6 The life history of house flies and the facility with which they can convey the fecal excrement of infected infants to the food of the healthy, suggests that the seasonal incidence of diarrhoea coincides with, and results from the seasonal prevalence of flies.

1907 ——— Method of Transmission of Contagious Diseases. N. Y. State Dep't Health. Mo. Bul. August, p. 11–13

An abstract of a circular issued by the Public Health Department of France, flies being credited with disseminating typhoid fever, tuberculosis, cholera, etc.

1907 **Buchanan, R. A., Glasg, M. B. & Glasg, F. F. P. S.** The Carriage of Infection by Flies. Lancet, 173:216–18

An illustrated account with the following conclusions: The experiments conclusively show that flies alighting on any substances containing pathogenic organisms are capable of carrying away these organisms in large numbers on their feet and of depositing them in a gradually diminishing number on surface after surface with which they come in contact. They further serve to demonstrate the necessity for the exercise of stringent measures for preventing access of flies to all sources of infection and to protect food of all kinds against flies alighting on it.

1907 **Dickinson, G. K.** The House Fly and its Connection with Disease Dissemination. Med. Record, 71:134–39

An extended summarized statement with bibliography.

1907 **Hewitt, C. Gordon.** On the Bionomics of Certain Calyptrate Muscidae and their Economic Significance, with Special Reference to Flies Inhabiting Houses. Jour. Econ. Biol. 2:79–88

The house fly is briefly treated on pages 83–86.

1907 **M'Vail, John C.** The Prevention of Infectious Diseases, p. 61, 66–67

The part flies play in the spread of typhoid or enteric fever is assumed and preventive measures described.

1907 **Preston, C. H.** Insect Carriers of Infection. Pub. by Contemporary Club, Davenport, Ia. p. 20–21

The fly is charged with carrying germs of typhoid fever, tuberculosis, dysentery, etc.

1908 **Bruner, Lawrence.** The House Fly. [Neb.] State Ent. Cir. 10, p. 1–4

A summarized account.

1908 **Frost, W. & Vorhees, C. T.** The House Fly Nuisance. Country Life in America, May

1908 ——— Fighting the House Fly. North Carolina State Board of Health Bulletin. Reprint from Country Life in America

A general account.

1908 **Hamer, W. H.** Nuisance from Flies. London County Council Rep't, No. 1138, p. 1–10

Observations on flies, with special reference to their development in horse manure, their occurrence about stables and similar places, and their relation to diarrhoea.

1908 ——— Nuisance from Flies. London County Council Rep't, No. 1207, p. 1–6

Further observations, with remarks on behavior of Homalomyia, Musca and Stomoxys, and additional observations on flies and diarrhoea.

1908 ——— The Breeding of Flies. Summarized. Am. Med. 3:431

The breeding of flies in horse manure, collection of dust and other refuse confirmed. Children, dirty walls and ceilings and particles of food on the floor and in sinks are attractive to flies. Laboratory experiments demonstrate that flies may carry the typhoid bacillus in a living condition for over two weeks. They also disseminate the germs of zymotic diarrhoea and Asiatic cholera. Tubercle bacilli have been found alive in the intestinal tract of the house fly.

1908 **Hewitt, C. Gordon.** The Biology of House Flies in Relation to Public Health. Royal Inst. Public Health Jour. Oct. Separate p. 1–15

1908 **Howard, L. O.** How Insects Affect Health in Rural Districts. U. S. Dep't Agric. Farmers' Bul. 155, p. 1–19

The house fly is characterized as the principal insect agent in the spread of typhoid fever.

1908 **Jackson, Daniel D.** Pollution of New York Harbor as a Menace to Health by the Dissemination of Intestinal Diseases through the Agency of the Common House Fly. Pub. by the Merchants' Ass'n, p. 1–22

A detailed examination of local conditions showing that by far the greater number of cases of typhoid fever in 1907 occurred within a few blocks of the water front, the outbreaks being most severe in the immediate vicinity of sewer outlets. The same was also found true of deaths resulting from intestinal diseases. Charts are given showing an almost exact coincidence between deaths from the latter and the prevalence of the house fly. The same is shown to be true of typhoid fever when the dates are set back two months to correspond to the time at which the disease was contracted. Several epidemics of dysentery of a malignant type have been known to radiate from a single point and to entirely disappear when proper disinfection of closets was enforced. On several occasions local epidemics of typhoid fever were traced to transmission by flies.

1908 ——— Conveyance of Disease by Flies. Summarized. Bost. Med. & Surg. Jour. 159:451

Reports that he finds that the relation between the number of flies captured and the number of deaths reported are substantially the same as in 1907. A notable decrease in mortality this summer corresponded with catching a much smaller number of flies. Dr Jackson finds on 18 swill barrel flies 18,800,000 bacteria or over 1,000,000 to each fly.

1908 **N. Y. State Dep't Health.** Mo. Bul. October, p. 259–83

Summary of International Congress on Tuberculosis, page 284, Mortality Statistics of Infants.

1908 **The House Fly.** Cur. Med. Lit. 50:1656

Summary of Newstead's report. Flies breed in horse manure, a mixture of this with cow dung, fermenting hops, ash pits containing fermenting vegetable matter and all temporary collections of fermenting matter. They feed on most decaying vegetable matter, manure and particularly human, rotten flock beds, straw mattresses, old cotton garments and sacks and waste paper, bread, fruits and vegetables and excreta of animals generally.

1908 **Robertson, Alexander.** Flies as Carriers of Contagion in Yaws (Framboesia tropica). Trop. Med. & Hyg. Jour. 11:213

Experiments show that flies may carry the virus of yaws.

1908 **Smith, Theobald.** The House Fly as an Agent in the Dissemination of Infectious Diseases. Amer. Jour. of Public Hygiene, August, p. 312–17

Summary discussion.

1908 **Theiss, Mary B. & Louis E.** An Advance Agent of Death. Good Housekeeping, May

1908 **Wilcox, E. V.** Fighting the House Fly. Country Life in America, May

Discussion of repressive measures.

1908 ——— House Flies. Florida Health Notes, May

Brief general notice.

1909 **Davis, Dora.** Hops and Flies. The Christian Advocate, June 17, 1909, 84:954

Immunity from flies is believed to have been secured by shading porch and open windows with hop vines.

1909 **Felt, E. P.** The Economic Status of the House Fly. Econ. Ent. Jour. 2:39–44

A general discussion of the fly as a disease carrier.

1909 ——— Control of Household Insects. N. Y. State Mus. Bul. 129, p. 7–11

A summarized account.

1909 **Griffith, A.** The Life History of House Flies. Public Health, 21:122-27

Biologic studies and observations on the house fly.

1909 **Howard, L. O.** Economic Loss to the People of the United States through Insects that Carry Disease. U. S. Dep't. Agric. Bur. Ent. Bul. 78:23–36

A general summary of the losses caused by disease-carrying insects.

1909 **Metcalf, Z. P.** The House Fly. N. C. Dep't Agric. Ent. Cir. 25, p. 1–8

A summary account with special reference to control measures.

1909 **Smith, Theobald.** The House Fly as an Agent in the Dissemination of Infectious Diseases. Amer. Health Mag. May, 2:38–39

1909 ——— The House Fly at the Bar. Merchants Ass'n, New York, p. 1–48

A resumè of the evidence against the house fly, consisting of letters from health officers and others interested in sanitation, and with short articles or excerpts from publications by Dr D. D. Jackson, Dr L. O. Howard, Dr Alice Hamilton, Dr J. B. Huber, Prof. W. L. Underwood and others. There is also a brief bibliography.

NOTES FOR THE YEAR

A number of insects have been brought to attention during the past season. Some of the more important outbreaks are noticed in the following paragraph. The large, greenish caterpillar of the imperial moth, Basilona imperialis Drury, was unusually abundant during August and September, and on Staten Island it was credited with being somewhat injurious. Ordinarily this species is so rare as to attract no attention. The scurfy bark louse, Chionaspis furfura Fitch, has been abundant in several localities. This species has attracted more notice in recent years, partly because the presence of the San José scale has increased popular interest in the work of all Coccidae. The scurfy scale, however, appears to have been more destructive during the last five years than the equally common oyster scale, Lepidosaphes ulmi Linn.

Maple trees have been injured somewhat in various localities by the cottony maple scale, Pulvinaria innumerabilis Rathv., and also by the false maple scale, Phenacoccus acericola King. Both of these species are more likely to be injurious in the southern part of the State, though the false maple scale was sufficiently abundant to attract attention at Johnstown. The elm bark louse, Gossyparia spuria Mod., occurred in numbers on elms in both Brooklyn and Mt Vernon and also at Schenectady. This latter pest is rather generally distributed in the eastern portion of the State at least and, as pointed out by the writer earlier, the English sparrow is probably an important factor in carrying the pest from tree to tree in our cities.

Fruit tree insects

Gipsy moth (Porthetria dispar Linn.). This insect has not to our knowledge established itself in New York State, though a marked advance in our direction was discovered during the season, small colonies having been found at Springfield and Greenfield, Mass., both localities about 50 miles from our State line. The work against this insect in Massachusetts, as shown by our investigations in midsummer, is being most vigorously pushed, particular stress being laid upon preventing its further spread. This species, as has been repeatedly explained, spreads slowly, being dependent largely upon the activity of man and beast for conveyance from one locality to another. The continued exercise of vigilance by both state and national authorities may perhaps delay the invasion of this State for a decade or more. The warning placard illustrating both this species and the brown tail moth, has been conspicuously posted in many post offices and other public places located in portions of the State where the pest is most liable to appear. Additional copies are on hand and can be used to replace those broken or lost and also for sending to other localities should future developments warrant such procedure.

A better idea of what gipsy moth infestation means may be gained from the following notes made June 24, while examining conditions in the infested territory. Starting from Boston we passed through Cambridge and Brookline to Waltham, observing in particular conditions in Waltham park. This latter comprises over 100 acres of rocky land mostly covered with a dense growth of oaks some 20 to 40 feet high. No winter work such as creosoting egg masses on trees and clearing out underbrush was done, though the whole was rather badly infested. The entire park was sprayed with poison with one of the giant outfits described below, though the application was made rather late. The results were very gratifying, since practically no trees were seriously injured by caterpillars, though the park is surrounded by badly infested territory. The policy has been to safeguard such treated areas by clearing a strip about 100 feet wide around the entire border. This is done by cutting out and burning all underbrush and then applying tree Tanglefoot to the trunks of the remaining trees, so as to prevent caterpillars from ascending the trees. The latter do not, as a rule, pass this barrier, though at the time of our visit some were entering the park and supplementary spraying was necessary here and there in order to prevent further damage. Continuing from Waltham we passed through Arlington, Winchester and Stoneham to Melrose. Here and there along the entire route considerable woodland areas were stripped or nearly defoliated by gipsy moth caterpillars, and in one instance at least, the badly affected area was fully a mile and a quarter in length. These woodlands were all on hillsides and consisted mostly of oak ranging from 30 to 50 feet or more in hight. These stony hills are said to have very little agricultural value, being rated at $15 per acre. The cost of adequately controlling a pest like the gipsy moth in such situations is at once apparent. The general condition of the residential area was very gratifying, practically no trees either along the roads or on private estates were defoliated. Continuing, we passed from Melrose northward and eastward to Lynn, thence to Salem and across to Beverly. The same conditions prevailed as were observed in the vicinity of Arlington, except that the injury north of Salem appeared for the most part to be more recent and the woodland had not suffered so much, though limited tracts here and there were evidently badly infested. The street trees of Salem, though in very bad condition a few years ago, are now practically free from the pest.

The authorities are depending upon several methods for the control of the gipsy moth. Owing to the short season during which spraying is practical, an effort has been made to accomplish as much as possible by winter work, which latter consists in creosoting egg masses on trees throughout the infested area. This is supplemented, in the case of woodlands, by burning over the ground in order to destroy egg masses which may have been broken while climbing the trees or dislodged by birds or other natural agents. This burning is preferably deferred till early spring, after the eggs have hatched, and is usually preceded by cutting out the underbrush. The latter, if abundant, must be removed so that the trees will not be injured by fire. Then, by carefully controlling the flames, and especially by backfiring, it is possible to burn over a large area without materially injuring the forest. The extended area infested makes it impossible to treat all parts in an ideal manner, and a rather crude method of controlling the pest in woodlands has been adopted in some cases. This is accomplished by simply allowing the caterpillars to strip the woods and then burn over the ground just as the majority of them are leaving the trees and seeking food elsewhere. This method of procedure, while undoubtedly injurious to the trees, is much less harmful than were the insects allowed to propagate without restriction.

The work with parasites conducted by the state of Massachusetts in cooperation with the federal government is most encouraging. The work of 1907 has been considerably extended by providing larger quarters and a more adequate staff. Furthermore, special efforts have been made to secure larger sendings from European countries, and a special agent was dispatched to Japan. This latter undertaking has proved most encouraging, in that a large Apanteles and a new egg parasite of the gipsy moth have been received from Japan, and the Apanteles at least, has been bred through one generation in American caterpillars. The sendings from Japan have in addition resulted in the introduction of four species of Tachinidae which promise to be very efficient parasites of the brown tail moth. Marked improvements have been made in methods of handling and rearing parasites and other natural enemies. These latter justify the expectation that it will be practical to breed thousands of the more effective species prior to their being liberated under favorable conditions. This work with parasites may rightly be considered as most important, owing to the fact that the gipsy moth is now so widely established as to render any widespread method of control, aside from that by natural enemies, exceedingly costly.

Recent progress in wholesale spraying for the control of the gipsy moth has been most striking and should prove suggestive to the fruit grower and immensely helpful to all parties having charge of extensive spraying operations such as the control of insect pests upon shade trees. The capacity of the ordinary spraying outfit has been greatly increased by replacing the usual 6 horse power gasolene engine weighing some 1800 pounds, by a 10 horse power engine made especially for automobiles and weighing only 400 pounds. Furthermore, a heavier and more powerful pump has been employed, the whole weighing no more than the usual spraying outfit. The machinery is mounted upon a stout wagon with a 400 gallon tank, and a heavy inch and a half hose some 400 to 800 feet long, with a smooth one quarter inch nozzle is used for work in the woodlands. A pressure of 200 to 250 pounds is maintained. The hose is handled much as though a fire was in progress. Ten men, at intervals of 6 or 8 feet, carry the end of the hose, the nozzle being in charge of a superior man with instructions to keep it moving all the time. The pressure is sufficient to throw the insecticide 40 or 50 feet, and the resistance of the air breaks it into a fine spray. The foliage is well covered if the nozzle is handled intelligently. This giant outfit is particularly adapted to work in woodlands. It usually requires four horses and is capable of spraying 14 to 16 acres a day, much depending upon conditions. The cost of treatment in this manner is reduced to about $10.20 per acre where the woodland is fairly clear of underbrush. An interesting modification of this apparatus has been employed for spraying strips along the roadside. It simply consists of a giant extension nozzle mounted on a universal joint so that the tip may be lifted 40 or 50 feet from the ground. This last named apparatus, with a favorable wind, can cover a strip 400 feet wide. Contractors with apparatus such as that described above have been able to spray woodland where there was little or no underbrush and the trees ranging from 40 to 50 feet high at $17.50 per acre. This improved apparatus can also be employed in spraying street trees, a contractor being able to make money therewith at the rate of $1 to $1.25 per tree for spraying large elms. A responsible contractor stated that he could ship apparatus and men to a city at a considerable distance and treat a number of trees thoroughly at less than $2 per tree. The above is given since there are numerous inquiries as to the best method of spraying shade trees and the cost of doing such work.

Brown tail moth (Euproctis chrysorrhoea Linn.). The brown tail moth, though widely distributed in Massachusetts, seems to have become in the last year or so a pest of much less importance than the gipsy moth. Its nests are to be noted here and there but as a rule it is not very destructive. Part of the immunity from damage may be due to a fungous disease which has destroyed millions of the caterpillars, and also to the fact that many of the hibernating caterpillars were killed by the exceptionally cold weather of last winter. There is no record known to us of this insect having made its way nearer the New York State line than the Connecticut river valley.

Cankerworms. Reports of injuries by these looping caterpillars were received from several localities on the north shore of eastern Long Island and also from the vicinity of New York city. Specimens submitted upon examination showed that both the spring cankerworm, Anisopteryx vernata Peck, and the fall cankerworm, Alsophila pometaria Harr., were responsible for the injury, the last named species, however, being by far the more abundant on eastern Long Island and also in certain Connecticut localities. The caterpillars vary greatly in color, ranging from light green to almost black, and are usually ornamented with several narrow, white lines, some specimens frequently being adorned with a broad, dorsal, black stripe margined by white lines and with the sides light green, thus presenting an intermediate condition between the two extremes in color. The spring cankerworm may be recognized by the presence of but two pairs of legs at its posterior extremity, while the fall cankerworm has three pairs. The females of both species are wingless, grayish, grublike moths which are obliged to crawl up the tree if they deposit their eggs where the newly hatched caterpillars can find an abundance of sustenance. The spring form is so called because the females remain in the ground till some time after midwinter, crawling up the trees during warm weather, even in February though more usually in March. The fall cankerworm is thus designated because the females usually crawl up the trees and deposit their eggs in late fall or early winter. The eggs of both species hatch at about the same time, namely, when the young leaves begin to appear.

Cankerworms are exceedingly voracious and, when present in numbers, nothing but the most prompt action will be of service in mitigating the trouble. The larvae are somewhat resistant to insecticides and as a consequence it is advisable to spray at the inception of the outbreak with paris green used at the rate of 1 pound of poison with an equal amount, by weight, of lime, to 50 to 75 gallons of water. The lime is added to lessen the danger of injury by poison. Arsenate of lead can be employed at the rate of 1 pound to 7 gallons of water, though as it is a slower acting poison, it is usually advisable to apply paris green. The homemade arsenite of lime is equally effective. Ordinarily one application of poison is sufficient, but if this does not prove satisfactory, a second treatment should be given a few days or a week later.

Cankerworms spread very slowly, owing to the fact that the females are wingless, and as a result the species must depend largely for carriage upon winds and other natural agencies, consequently an orchard once freed of the pest is not likely to be attacked for some time. We have yet to hear of a serious outbreak in orchards systematically sprayed from year to year. The ordinary treatment for the control of the codling moth and other leaf feeding insects is usually sufficient to keep this pest under control. Advantage may also be taken of its limited means of locomotion and injury prevented by the use of sticky bands, such as Tree Tanglefoot, tar or printers ink. The Tree Tanglefoot is a new material which has come into high favor in eastern Massachusetts where it is used extensively in gipsy moth work. Experience has shown that it can be applied with practically no injury to most trees, and possesses a decided advantage in remaining adhesive for a considerable period. It is advisable, if either tar or printers ink is used, to apply these materials to a band of tarred paper wrapped around the trunk of the tree, rather than to make the application direct to the bark. We much prefer to advise the employment of arsenical poisons, since they are of service in checking other leaf feeders, rather than to recommend adhesive bands, because the latter have a very limited range of usefulness.

Cigar case bearer (Coleophora fletcherella Fern.). This insect was responsible last spring for very severe injuries to a number of orchards at South Byron and vicinity. An examination of conditions early in June showed that a considerable proportion of the foliage was badly damaged and would drop within a few weeks. The operations of this insect were so severe in some places as to give the trees a brownish appearance when viewed from a distance.

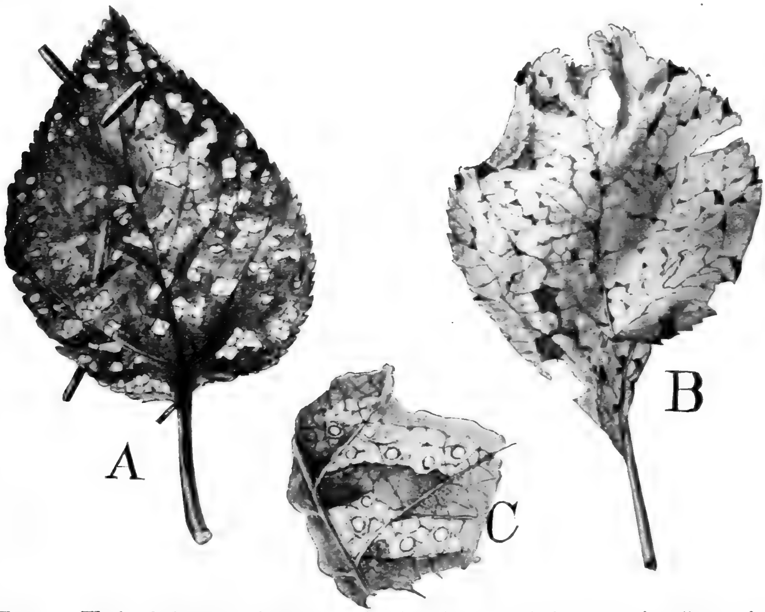

FIG. 13 Work of cigar case bearer. *a*, showing the spotted character of earlier work; *b*, leaf with the parenchyma entirely destroyed; *c*, a portion more enlarged. (Original)

An examination in the fall showed that this species was rather abundant at Albion and promises to cause considerable injury another spring unless controlled by timely spraying. The cigar case bearer was by far the more abundant though a few specimens of the pistol case bearer, Coleophora malivorella Riley, were also present in the orchard. Both of these insects are amenable to the same treatment, namely, thorough spraying with an arsenical poison at the time the young leaves appear in the spring. It is important that the application be made early, otherwise it may be difficult to destroy the voracious caterpillars before the buds have been seriously injured.

Blister mite (*Eriophyes pyri* Nal.). The blister mite is widely distributed in western New York and has also been found in several places in the Hudson valley. It has been especially destructive the past season to apple trees, being so abundant upon the foliage at South Byron early in June as to give many trees a brownish appearance when viewed from a distance. Many of the badly infested leaves dropped later and the same is true of orchards in the vicinity of Albion. In some instances at least half of the leaves must have been destroyed by the work of this pest. The characteristic blister of this form is easily distinguished by its peculiar, raised, spongy, brick-red appearance. The venation disappears in the affected area and furthermore, there is almost invariably a small, round hole near the center of the blister. These blisters may occur singly or in groups and frequently fuse to form irregular, reddish brown blotches which eventually may include a considerable proportion of the leaf. Inasmuch as the mites spend most of their time within the leaves, it is impractical to attempt any remedial measures during the summer. The pest winters under the bud scales and at such times it can be destroyed in large numbers by spraying with a lime-sulfur wash or one of the miscible or so called "soluble" oils. An application of a lime-sulfur wash is in our judgment preferable, since there is not the slightest danger of injuring the trees. Furthermore, reliable commercial preparations of this material can now be purchased, so that it is not necessary to bother with boiling if one feels that the delay incident to preparation is a serious hindrance. Orchards which have shown during the past season a more or less general infestation by this mite should be sprayed after the leaves drop and before they appear again in the spring with one of the contact insecticides named above, in order to prevent the chance of serious injury occurring another season.

Small fruit insects

Grape root worm (*Fidia viticida* Walsh). This insect is generally distributed throughout the Chautauqua grape belt. There has been a marked improvement in conditions over those obtaining last year, as there was comparatively little evidence of injury, though there were reports of severe local damage in vineyards in Sheridan or Fredonia. An examination of a number of vineyards failed to disclose any alarming conditions, and we are well satisfied that as a whole there has been a material betterment. Part of this is undoubtedly due to better cultivation, particularly the stirring of the soil when the majority of the insects are in the pupal stage. Furthermore, many growers have sprayed with an arsenical poison, and this treatment has undoubtedly been of great service in preventing the pest from becoming unusually abundant. Severe local injuries may be expected in the future, and all growers are advised to keep a close watch of their vineyards, remembering that the insect may be very destructive in one portion of the field and hardly be present in another.

Shade tree insects

Elm leaf miner (Kaliosysphinga ulmi Sund.). The injurious work of this European species was first observed by us in this country in 1895, and a brief notice was given thereof in the report of this office for the year 1898. This miner was at that time very injurious to Camperdown elms in Washington park, though its operations were also very apparent upon Scotch elms and were less extensive upon English elms in both Albany and Troy. The severe injuries of earlier years have been somewhat lessened though it has been reported from other sections of the State. A few years ago it was quite destructive to elms at Ithaca, N. Y. and last year it was reported as being very injurious to weeping elms at Syracuse. Complaints of its ravages were also received from Kenwood near Albany.

FIG. 14 Elm leaf miner (author's illustration)

There is no very satisfactory method of controlling this pest, since the larvae work exclusively between the upper and lower epidermis, devouring the tender parenchyma and making a rather characteristic, irregular blotched mine. The insect hibernates within a cocoon just below the surface. It has been suggested that the upper layer of soil might be removed and buried at some depth. Ordinarily the insect is not sufficiently destructive to warrant adopting such measures.

Elm leaf beetle (Galerucella luteola Mull.). This imported species continues to be a serious pest of elms, particularly in the Hudson valley, many of the elms of Yonkers, Poughkeepsie, Hudson, Albany, Troy, Schenectady, Schuylerville and Ithaca and probably other localities in the State being very badly injured. The work at Schuylerville and Schenectady was exceptionally severe and the same is also true of its operations at Ithaca. The major part of the injury in Albany at least was due to delay in appointing a city forester and getting the spray apparatus into operation. Furthermore, it is very difficult to secure men who can be relied upon to do thorough work. Experience has demonstrated beyond all question the practicability of keeping the elm foliage practically intact, even in localities where the pest is very abundant. It is for public spirited citizens in affected localities to insist upon the maintenance of such a standard.

The observations of the past season show in a most striking manner the extremely local character of this pest. The badly infested area in Albany has been restricted for the past decade to the older and more thickly settled fourth of the city. A study of conditions in Schenectady showed a similar restriction, the destructive work of the pest being limited almost exclusively to a small section of the older part of the city, in the vicinity of Church street and not extending in any direction more than 10 blocks from the center of the infestation. Furthermore, the most severe injury was noticed upon a group of elms near the open belfry of a church, clearly indicating that the insects winter most successfully where a structure of this kind affords abundant shelter.

Bag worm (Thyridopteryx ephemeraeformis Haw.). New York city and its vicinity represents about the northern extension of this species, as a rule. It was somewhat surprising, therefore, to receive healthy larvae from Germantown, only about 40 miles south of Albany. Mr T. F. Niles, who sent in the specimens, states that no young trees have been set in this locality within the past 2 years nearer than a quarter of a mile, consequently it would seem as though the species was able under certain conditions to maintain itself considerably farther north than has heretofore been supposed possible.

Fall webworm (Hyphantria textor Harr.). This common species has been unusually abundant in some portions of the

State, its webs on willow in particular forming conspicuous features in the landscape. In several instances small wild cherry trees were entirely defoliated by this pest. The promiscuous breeding of this insect on roadside and other trees, simply increases the danger of attack to more valuable trees, particularly when the latter are not sprayed systematically. Well cared for and systematically sprayed orchards suffer very little from injuries by this species.

White marked tussock moth (Hemerocampa leucostigma Sm. & Abb.). The white marked tussock moth continues to be a serious pest on horse-chestnuts and lindens in particular. It was extremely abundant and destructive in both Brooklyn and New York. It was numerous, though probably not quite so injurious in some other localities in the State. The impending destruction in Buffalo, we are pleased to state, was greatly mitigated by the activity and efficiency of the newly appointed city forester, Mr H. B. Filer. Buffalo has long held an unenviable reputation because of the poor condition of its shade trees, particularly horse-chestnuts, and we trust that the above mentioned appointment means a well supported and an advanced policy respecting shade tree protection.

The caterpillars of this notorious shade tree pest also occasioned considerable anxiety in the fruit section of the western part of the State. The partly grown caterpillars were found in considerable abundance in orchards, eating into the young fruit, the amount of damage being estimated at from 10 to 80%. This method of injury is by no means unknown, since similar work was observed in Nova Scotia in the summer of 1907. Though it is difficult to adequately control caterpillars which have developed the fruit-eating habit, it is very easy to keep this pest under control in commercial orchards. Systematic spraying with an arsenical poison will in the long run, at least, prove most efficacious in destroying the pest, though it may take a few years to bring about these results in badly infested orchards fruiting every season. It is comparatively easy to practically clear trees of this insect by collecting the conspicuous white egg masses any time during the winter. This work can be done thoroughly and at comparatively slight expense, then there is no occasion for worry as to the outcome another season, and an orchard once cleared is easily kept comparatively free from subsequent injury.

Snow-white linden moth (Ennomos subsignarius Hubn.). This species, at one time recognized as a most destructive enemy of lindens, has risen with phenomenal rapidity from the obscurity of recent years. The past season has been most remarkable for the extensive flights of the snow-white moths [pl. 1, fig. 2] in many cities and villages, not only in New York State but in other sections. The moths were so numerous about electric lights as to attract widespread attention. Their advent in New York city occurred about July 16 and the effect was aptly compared by various writers to a snowstorm. In the well lighted sections myriads could be seen circling about the electric lights and invading many brilliantly lighted places in such numbers as to be a veritable nuisance. The following morning the arc lights were found choked with the insects, and characteristic groups of snow-white wings here and there were mute evidences to the voracity of the English sparrow. This bird, despite its numerous failings, destroyed thousands of the moths, hunting them without mercy until there were comparatively few survivors from the night before. The abundance of the insects and the extended area where swarms were present is most remarkable. Aside from New York city, where the largest number of the moths seemed to be present, they were reported by the local press as swarming at Nyack, Ossining, Newburgh, Hudson, Albany, Troy, Cohoes, Ballston, Saratoga, Glens Falls, Schenectady, Amsterdam, Johnsonville, Gloversville, Little Falls, Herkimer, Ilion and Utica. It is interesting to note that the moths appeared in Albany and other northern localities about five days later than at New York city. Aside from the above mentioned records, the local press of numerous other cities and villages contained brief notices of the swarming of this species, though with no record as to local occurrence. The widespread character of the flight is well illustrated by authentic records of hosts occurring at Newark, N. J., Springfield, Mass. and Ottawa, Can., the latter flight occurring July 23d. This visitation is all the more striking when it is recalled that in recent years at least, this moth has been comparatively rare, hardly attracting notice for a generation, despite the fact that in earlier years it was considered an important enemy of lindens.

The remarkable local swarms recorded above are probably due to conditions being generally favorable for the multiplication of the species throughout the infested area. There is a possibility that some of the flights were due to swarms drifting with the wind from defoliated tracts lying at some distance. This is hardly an adequate explanation for the presence of many of the local swarms, particularly as observations in Albany show that the linden foliage in the western part of the city, where the trees are somewhat abundant, was badly injured by the insect, and it was in this section of the city where the moths were most numerous. It is probable that there were comparatively few extensive flights. The causes for this excessive abundance are probably to be found in the scarcity of bird life, in the temporary reduction of native parasites and possibly in part to unusually favorable climatic conditions.

The extensive defoliations by this species, recorded in our report for last year,[1] have been continued and large areas in the Catskills have suffered severely. Reports of injury in the towns of Hardenburg, Shandaken and Ladleton, Ulster co., indicated defoliation of extensive tracts of beech. There is also a record of severe injury by this pest from DeBruce, Sullivan co. This species was likewise destructive to beeches in the Adirondacks, Forester E. S.

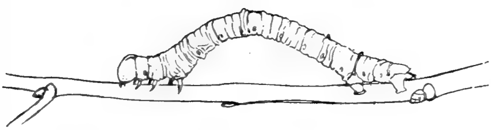

Fig. 15 Snow-white linden moth, larva on twig. (Original)

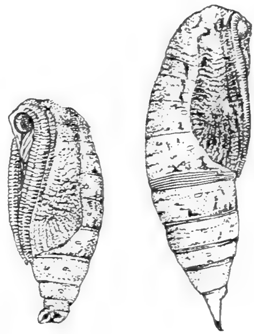

Fig. 16 Snow-white linden moth, pupae, enlarged. (Original)

Woodruff reporting that the beeches on the John Brown tract number 2, ranges 12 and 13, lots 3 to 8 were defoliated, the stripped area being about 3 miles long and having a width of ½ mile at one end and 1 mile at the other. The caterpillars fed at first upon young beeches, then stripped the older beeches, practically skeletonizing the foliage, and then turned to birches and maples, eating holes in the foliage of the latter. The lower limbs of the trees on the defoliated area bore numerous empty pupal cases in September, and irregular egg masses occurred in abundance upon the bark of beech, birch and maple. The eggs of this species are deposited at an oblique angle to the supporting surface, are about 1 mm in length, barrel-shaped and light brown, with a conspicuous dark salmon ring at the extremity. They occur in irregular

[1] N. Y. State Ent. 23d Rep't, 1907. N. Y. State Mus. Bul. 124, p. 23–28.

masses [pl. 1, fig. 1] about half an inch in diameter, each containing from 50 to over 100 eggs.

It is not expected that the above recorded flights in cities and villages will be followed by extensive injuries another season, since it is very probable that the English sparrows destroyed many of the adults before there was an opportunity for the deposition of eggs.

Spruce gall aphid (Chermes abietis Linn.). This introduced, widely distributed species has been the cause of an unusual number of complaints in New York State. Mr John Herliky, arboriculturist of Brooklyn, writing under the date of June 22d stated that many Norway spruce trees throughout Prospect park, and in fact in different parts of that section of the State, have been

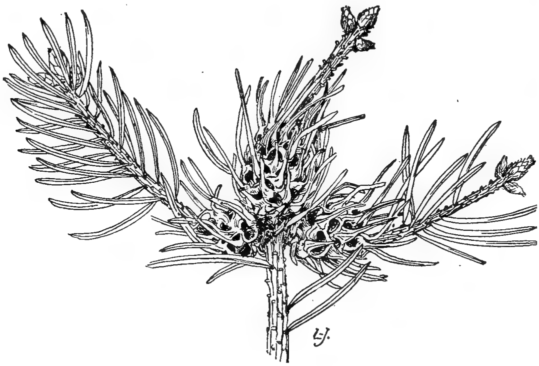

FIG. 17 Spruce gall aphid, normal type of gall. (Original)

dying of late. Specimens were submitted for examination and were found to contain a few of the characteristic galls of this insect and, in addition, an apparently undescribed injury. Numerous subglobular, aborted buds were found here and there at the base of the branches or at the base of new growth and on investigation were found to contain numerous small, light brown aphids. It is probable that these aphids entered the developing buds the preceding year and, on account of their abundance, prevented the usual growth and the development of the normal type of gall. An examination, at this time, of spruces in Albany showed that these trees likewise, in addition to the typical galls produced by this aphid, bore the subglobular dead buds inhabited by numerous aphids described above. An examination of infested trees in Albany the latter part of September showed that the dead buds described above had been deserted by the aphids and many of them contained numerous cast skins. Some showed evidence of having been invaded by parasites, which latter presumably preyed upon the young plant lice.

Complaint of this insect's work, accompanied by specimens, was received from Mr C. C. Laney, superintendent of parks, Rochester, N. Y. This gentleman stated that the galls were more abundant on white spruce than upon any other coniferous tree. Serious injuries were reported from Elizabethtown by Mr Seth Sprague Terry, who stated that 50 spruce trees, none over 25 feet high, have practically all the new growth affected by this insect. Mr John Nill sent from Star lake, in the southwestern part of St

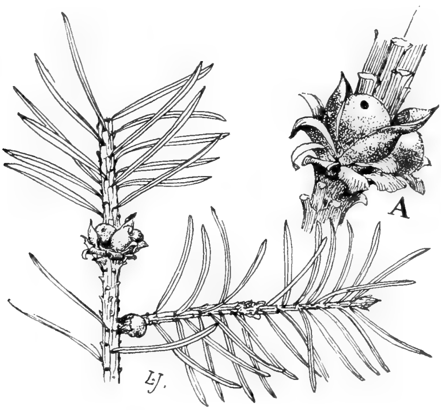

FIG. 18 Spruce gall aphid, destroyed buds; *a*, one enlarged. (Original)

Lawrence county, badly infested spruce twigs with an inquiry as to the cause of the trouble.

This insect, while rarely causing the death of the trees, frequently produces serious deformities, because twigs bearing galls are very likely to die, thus producing a very unsightly tree. Experiments conducted by Mr R. A. Cooley showed that thorough spraying in April with a whale oil soap solution, 1 pound to 2 gallons of water, is very effective in checking this insect. A more detailed discussion is given in New York State Museum memoir 8, volume 1, pages 189–91.

Miscellaneous

Corn worm (Heliothis armiger Hubn.). This species is much better known as the boll worm of the South, though it is frequently quite destructive in that section to corn. Occasionally it becomes somewhat abundant and injurious in New York State. Dr Lintner in his first report records this insect as being quite abundant and destructive to corn in Ontario county and its probable occurrence at the same time in the vicinity of Albany. Six years ago this insect was somewhat abundant in the vicinity of New York city, complaint of injuries having been received from Mt Vernon.

The operations of this species in the North are confined mostly to corn and tomatoes, the major portion of the damage being inflicted in the late summer or fall. This latter was true of injuries reported from Shelter Island, the caterpillars being brought to notice about the middle of October. The damage at Mt Vernon in 1902 did not occur until the latter part of August. The caterpillar of this species is extremely variable in color, ranging from a light green with reddish brown marks on the side to a darkish green, brown or even nearly black caterpillar with a variable whitish lateral line. It closely resembles in general appearance some of our common cutworms, being stout, and when full grown is an inch or more in length. The caterpillars begin their operations near the tip of the ear, eating down between the husks and making irregular frass-filled galleries over the face of the green cob, destroying a considerable proportion of the corn and defiling most of the remainder. Occasionally this species is quite destructive to tomatoes, on account of its eating rather large holes into the ripening fruit.

The pest can be controlled in the North only by recourse to hand picking. This measure will be particularly valuable at the incipiency of the attack, since ears which have been injured somewhat are more attractive to the insect than those protected by tightly folded husks. Care should also be exercised when removing caterpillars from recently infested ears to replace the husks so far as possible and thus reduce the chances of reinfestation.

White ants (Termes flavipes Koll.). It is not often that these insects are recorded as injurious in New York State, though they are undoubtedly present in many dwellings, particularly in the southern part of the State and occasionally inflict serious injury. Our attention was called last winter to the operations of white ants in the storage vaults of a New York city printing company. The vaults were filled with electrotypes and halftones mounted and unmounted, newspaper files and other material. The white ants fairly riddled the blocks upon which the electrotypes were mounted and ran galleries through files of back publications, thus causing heavy losses.

These insects can be easily recognized as white, wingless, ant-like forms. They are only seen, as a rule, when material in which they are boring has been disturbed as in the above mentioned

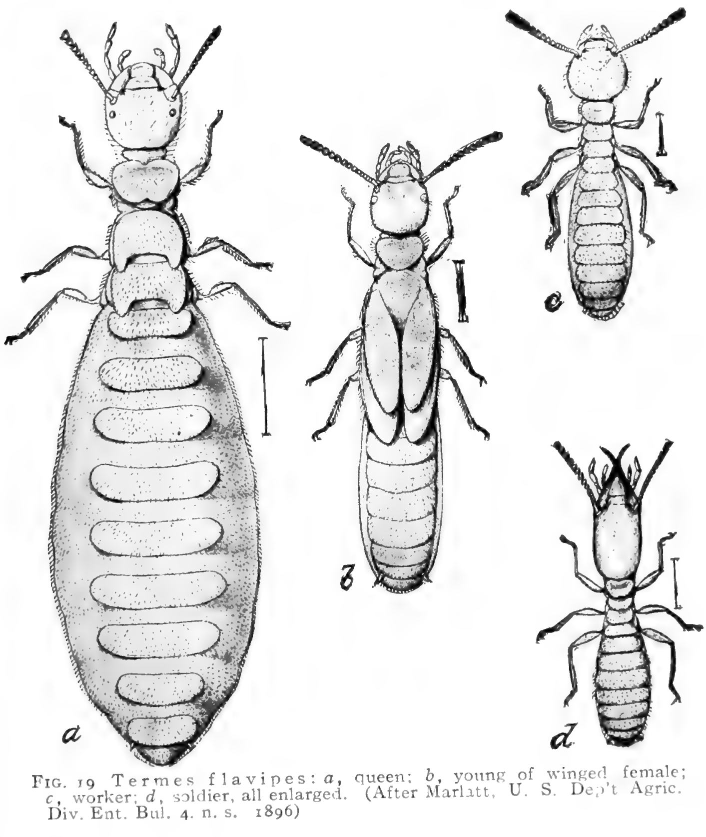

FIG. 19 *Termes flavipes*: *a*, queen; *b*, young of winged female; *c*, worker; *d*, soldier, all enlarged. (After Marlatt, U. S. Dep't Agric. Div. Ent. Bul. 4. n. s. 1896)

instance. This form remains active throughout the year in buildings that are kept warm during the winter. The ants excavate numerous irregular galleries through wood, paper and almost any material except stone or metal. They are communistic in habit and with a social organization similar to that of the honey bee. The only satisfactory method of preventing injury in vaults and similar places is first to thoroughly clean the infested chamber or chambers by removing everything in which the insects may be living. The door of the vault should be tight enough so that there would be no danger of subsequent entrance, and great care should be exercised to prevent reintroduction of the pest with material for storage. Fumigation with hydrocyanic acid gas would be of but limited value, since the fumes would hardly destroy all the insects in their galleries. The infested backing of electrotype blocks should be burned, while the insects in bulky papers or other material could be destroyed either by spreading the papers out loosely and drying thoroughly, or in some instances by subjecting to a gentle heat for a considerable period, since white ants succumb readily to both heat and excessive dryness. Storage boxes for valuable papers should be of metal or at least lined with tin and special care exercised to avoid any crevice which would allow the insects to enter.

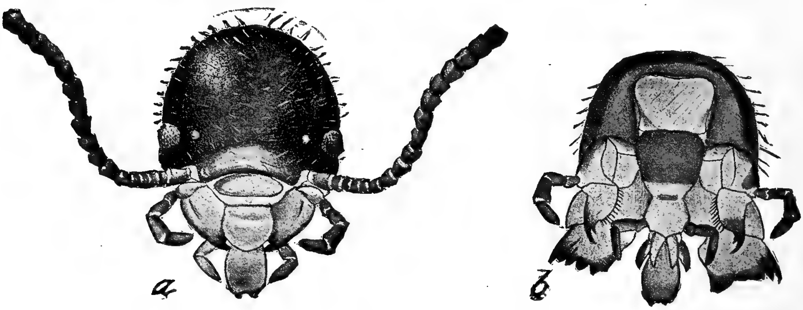

Fig. 20 Termes flavipes: *a*, dorsal view of head of winged female; *b*, ventral aspect of same, with mouth parts open, greatly enlarged. (After Marlatt, U. S. Dep't Agric. Div. Ent. Bul 4. n. s. 1896)

Mosquito notes. The season of 1908 was particularly interesting because a considerable proportion of New York city was invaded by large swarms of the salt marsh mosquito, Culex sollicitans Walk. Undoubtedly the insects came from adjacent marshes, possibly those of New Jersey and very likely some at least, from undrained areas on Long Island. The pests were so numerous in the city as to be a pronounced scourge for a few days, and did much to arouse popular interest in the problem of mosquito control.

The draining operations on Staten Island have been completed and the resultant change for the better has been most marked. Many places which were previously almost uninhabitable because of the swarms of mosquitos are now comparatively free. The work of draining marshes in other portions of Greater New York has been continued and during the summer a large proportion of the salt marsh areas in Flushing and its immediate vicinity has been ditched. Nine tenths of the Flushing meadows are now already drained, and it is probable that the work on the remaining tenth will be completed this fall. Operations have already been begun about Jamaica bay.

The antimosquito work at Orient, L. I., begun some two years ago, has been pushed to a successful completion and most gratifying results have been obtained. The indications are that operations of this kind will be continued until most of the salt marshes

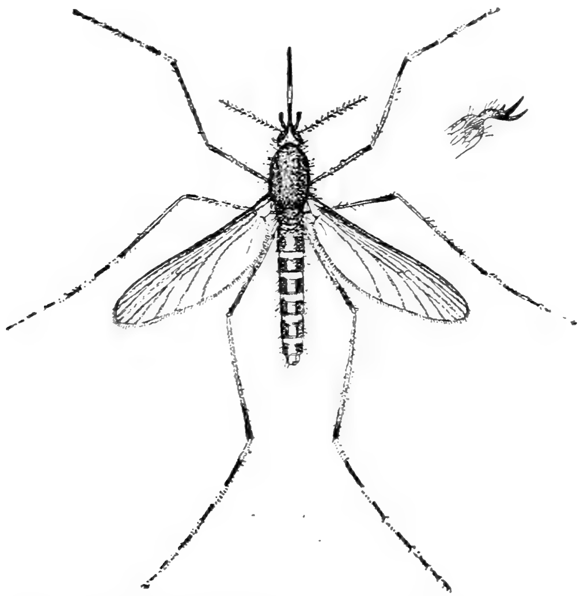

FIG. 21 Salt marsh mosquito from above, the toothed front claw more enlarged. (After Howard, U. S. Dep't Agric. Div. Ent. Bul. 25. n. s. 1900)

on Long Island will be practically free from these pests. The operations against the salt marsh mosquito naturally lead to some consideration being given to the fresh-water forms, particularly the common house mosquito, Culex pipiens Linn., and the malarial mosquito, Anopheles maculipennis Meig. Experience has demonstrated the practicability of controlling these two species, and it is only a question of time before this knowledge will be taken advantage of, and will lead to a great increase in comfort and practical freedom from malarial infections.

LIST OF PUBLICATIONS OF THE ENTOMOLOGIST

The following is a list of the principal publications of the Entomologist during the year 1908. Fifty-seven are given with title,[1] time of publication and a summary of the contents of each. Volume and page number are separated by a colon, the first superior figure gives the column and the second the exact place in the column in ninths: e. g. 71:969[27] means volume 71, page 969, column 2, in the seventh ninth, i. e. a little more than two thirds of the way down.

New Species of Cecidomyiidae II. N. Y. State Mus. Bul. 124, p. 285–304. Separate, p. 1–23 (Issued Oct. 26, 1907)

A number of new species are described.

A Caterpillar. Country Gentleman, Oct. 31, 1907, 72:1025[21]

A brief descriptive account of the red humped apple caterpillar, Schizura concinna Sm. & Abb.

Shade Tree Protection. Troy Record, Oct. 29, 1907

The elm leaf beetle, Galerucella luteola Mull.; the white marked tussock moth, Hemerocampa leucostigma Sm. & Abb. and several other injurious pests are discussed and a plea made for the better protection of shade trees.

Notes on the Insects of the Year 1906 in New York State. U. S. Dep't Agric. Bur. Ent. Bul. 67. 1907. p. 39–43

A number of insects are briefly noticed, the following being the more important: San José scale, Aspidiotus perniciosus Comst.; grape root worm, Fidia viticida Walsh; sugar maple borer, Plagionotus speciosus Say; white marked tussock moth, Hemerocampa leucostigma Sm. & Abb.; elm leaf bettle, Galerucella luteola Mull.; false maple scale, Phenacoccus acericola King; elm bark louse, Gossyparia Spuria Mod. and the violet gall midge, Contarinia (Mayetiola) violicola Coq.

Fighting the Scale. Suburban Life, 1908, 6:38–40

A summarized account of the San José scale, Aspidiotus perniciosus Comst.; and methods of control with brief notices of the oyster scale, Lepidosaphes ulmi Linn. and the scurfy scale, Chionaspis furfura Fitch.

The Insect Year. Country Gentleman, Jan. 30, 1908, 73:107[22]

A summary of insect injuries. The following species are noticed: San José scale, Aspidiotus perniciosus Comst.; grape root worm, Fidia viticida Walsh; apple leaf folder, Ancylus nubeculana Clem.; Epizeuxis denticularis Harv.; white marked

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

tussock moth, Hemerocampa leucostigma Sm. & Abb.; elm leaf beetle, Galerucella luteola Mull.; sugar maple borer, Plagionotus speciosus Say; green striped maple worm, Anisota rubicunda Fabr.; the antlered maple caterpillar, Heterocampa guttivitta Walk. and the snow-white linden moth, Ennomos subsignarius Hubn.

Hair Snake. Country Gentleman, Feb. 6, 1908, 73:128[42]

A summary account of the habits of hair snakes, Mermis sp. with a statement of their harmlessness.

Entomological Notes for 1907. American Fruits, 1908. 8:13

A summary account of injuries by the San José scale, Aspidiotus perniciosus Comst.; grape root worm, Fidia viticida Walsh; apple leaf folder, Ancylus nubeculana Clem.; Epizeuxis denticularis Harv., white marked tussock moth; Hemerocampa leucostigma Sm. & Abb., elm leaf beetle; Galerucella luteola Mull., green striped maple worm; Anisota rubicunda Fabr., antlered maple caterpillar; Heterocampa guttivitta Walk., snow-white linden moth, Ennomus subsignarius Hubn. and white grubs, Lachnosterna fusca Frohl.

Observations on the Biology and Food Habits of the Cecidomyiidae. Economic Entomology. Journal, Feb. 1908, 1:18–21

Summarized observations on the habits and life history of a number of forms.

Scale in an Apple Orchard. Country Gentleman, Mar. 26, 1908, 73:306[1]

A general discussion of remedial measures for San José scale, Aspidiotus pernicious Comst.

Gipsy and Brown Tail Moths and Miscellaneous Notes. Western New York Horticultural Society Proc. 53d An. Meeting 1908, p. 112–14

Notes on the progress made in controlling Porthetria dispar Linn. and Euproctis chrysorrhoea Linn., with special mention of the work with parasites. Also brief observations on a number of forms injurious in 1907.

Insect Control in its Larger Aspects. N. Y. State Fruit Growers Proc. 1908, p. 139–45. [Separate issued Apr. 11, 1908] In part in Country Gentleman, Mar. 5, 12, 1908, 73:229, 258

An address discussing briefly the present conditions and the methods most likely to be of service in the immediate future.

Entomological Notes for 1907. Economic Entomology. Journal, Apr. 1908, 1:148–50.

Brief notes are given on the San José scale, Aspidiotus perniciosus Comst.; grape root worm, Fidia viticida Walsh; apple leaf folder, Ancylus nubeculana Clem.; Epizeuxis denticularis Harv.; white marked tussock moth, Hemerocampa leucostigma Sm. & Abb.; elm leaf beetle, Galerucella luteola Mull.; sugar maple borer, Plagionotus speciosus Say; green striped maple worm, Anisota rubicunda Fabr.; antlered maple caterpillar, Heterocampa guttivitta Walk.; snow-white linden moth, Ennomos subsignarius Hubn. and Lachnosterna fusca Frohl.

Contarinia gossypii n. sp. Entomological News, 1908, 19:210-11

Original description of a species injuring cotton in the British West Indies.

Bark Louse. Country Gentleman, May 14, 1908, 73:488[43]

Brief economic account of the scurfy bark louse, Chionaspis furfura Fitch.

[Report on the Work of Importing Parasites of the Gipsy and Brown Tail Moths, Porthetria dispar Linn., Euproctis chrysorrhoea Linn.] Sup't for Suppressing the Gipsy and Brown Tail Moths, 3d An. Rep't, 1908, p. 210-13

A great improvement in the condition of infested territory is noted. The methods of importing parasites and the progress made are both most commendable. Careful biological studies of the parasites are advised, because of the importance of such knowledge in establishing species. The desirability of giving special attention to the rarer parasites is urged. Attention is called to the advisability of obtaining parasites from Japan, even though it involves considerable expense.

Currant Worm. Country Gentleman, May 28, 1908, 73:536-37

Brief economic account of the currant worm, Pteronus ribesii Scop.

Protect the Trees. Troy Times, May 28, 1908; Ithaca Journal, Schenectady Star, Poughkeepsie Eagle, May 29; Albany Argus, May 30; Daily Saratogian, June 1; Albany Times Union, June 2

Brief warning notice in regard to the elm leaf beetle, Galerucella luteola Mull.

Maple Pest in Johnstown. Johnstown Republican, June 2, 1908

Brief descriptive account, with remedies for the false maple scale, Phenacoccus acericola King.

Moth Work in Massachusetts. Country Gentleman, June 11, 1908, 73:598[42]-99

A review of the third annual report on the work against the gipsy and brown tail moths in Massachusetts.

Grape Blossom Midge. Grape Belt, June 12, 1908, p. 4; Buffalo News, June 13

Brief statement of injury and life history of the grape blossom midge, Cecidomyia johnsoni Sling.

Insecticides. Country Gentleman, June 18, 1908, 73:606[45]–7[12]

Brief discussion of the relative merits of paris green and arsenate of lead in bordeaux mixture.

Apple and Grape Pests. Country Gentleman, June 18, 1908, 73:607[23]

Brief accounts of injuries by the cigar case bearer, Coleophora fletcherella Fern.; the apple blister mite, Eriophyes pyri Nal., and the grape blossom midge, Cecidomyia johnsoni Sling.

Cutworms and Wireworms. Country Gentleman, June 18, 1908, 73:608[26]

Brief general accounts with discussion of remedies.

Apple Canker Worms. Country Gentleman, June 18, 1908, 73:608[11]

Brief economic account of the fall and spring canker worms, Alsophila pometaria Harr. and Anisopteryx vernata Peck.

Observations on the Genus Contarinia. Economic Entomology. Journal, 1908, 1:225–28

Brief notes are given on the following species: Contarinia pyrivora Riley, C. sorghicola Coq., C. liriodendri O. S., C. ananassi Riley, C. rumicis Loew, C. gossypii Felt, C. setigera Lint., C. negundifolia Felt, C. perfoliata Felt, C. quercifolia Felt, C. agrimoniae Felt, C. virginianiae Felt and C. clematidis Felt.

Some Problems in Nomenclature. Entomological Society of America. Annals, 1908, 1:102–4

A brief discussion of the validity of descriptions of insect galls with special reference to the Cecidomyiidae.

Wireworms. Country Gentleman, July 2, 1908, 73:646[47]

Brief discussion of remedies.

Elm Leaf Aphis. Country Gentleman, July 2, 1908, 73:647[17]

The life history and remedial measures for the elm leaf aphis, Schizoneura americana Riley are briefly discussed.

San José Scale. Country Gentleman, July 2, 1908, 73:647[23]

Brief general discussion of the San José scale, Aspidiotus perniciosus Comst., with a summary statement of the comparative value of the various sprays.

Shade Trees and the Elm Leaf Beetle. Ossining Citizen, July 6, 1908

Brief statement respecting the practicability of protecting elms from the elm leaf beetle, Galerucella luteola Mull.

Elm Leaf Beetle. Schenectady Union, July 7, 1908

A summary of local conditions with directions for controlling the elm leaf beetle, Galerucella luteola Mull.

Protect the Birds. American Humane Association. Leaflet. [Issued July 8] 1908. p. 1–4, 6–7

A brief popular discussion of the economic value of birds as natural checks upon injurious insects.

The Hop Merchant. Country Gentleman, July 9, 1908, 73:667[34]

A brief economic notice of the hop merchant, Polygonia comma Harris with special reference to currant.

Gipsy Moth Work. Country Gentleman, July 9, 1908, 73:667[42]

A brief account of recent developments in Massachusetts with special reference to progress made in spraying and the necessity of keeping watch for the appearance of Porthetria dispar Linn. in New York State.

Elm Leaf Beetle. Ithaca Journal, July 13; Amsterdam Recorder, Hudson Register, Poughkeepsie Eagle, July 14; Schuylerville Standard, July 16

General account of injuries by the elm leaf beetle, Galerucella luteola Mull., with a discussion of remedial measures.

Oyster Scale. Country Gentleman, July 16, 1908, 73:686[37]

Brief economic account of the oyster scale, Lepidosaphes ulmi Linn.

White Marked Tussock Moth. Grape Belt, July 17, 1908

Brief directions are given for controlling the white marked tussock moth, Hemerocampa leucostigma Sm. & Abb.

Shade Tree Pests. Dunkirk Observer, July 18, 1908; Grape Belt, July 28, p. 7

A reprint of a large portion of N. Y. State Museum bulletin 109 on the white marked tussock moth and the elm leaf beetle.

The Soldier Bug. Country Gentleman, July 23, 1908, 73:704[23]

Discusses briefly the habits of soldier bugs, Podisus sp., in connection with the finding of a nymph feeding on the grub of a potato beetle.

Blister Mites. Country Gentleman, July 23, 1908, 73:706[47]

A brief discussion of the character, extent of injuries and remedial measures for Eriophyes pyri Nal.

Giant Caterpillar. Country Gentleman, Aug. 6, 1908, 73:746[46]

Brief description of the larva of the giant caterpillar, *Samia cecropia* Linn. with observations on its life history.

Leaf Mites. Country Gentleman, Aug. 6, 1908, 73:747[22]

Remedial measures are given for the clover or brown mite, *Bryobia pratensis* Garm., and the red spider, *Tetranychus telarius* Linn.

Grain Moth. Country Gentleman, Aug. 13, 1907, 73:767[16]

Brief discussion of remedial measures for the grain moth, *Sitotroga cerealella* Oliv.

Flies as Carriers of Disease (Press Bulletin) Albany Evening Journal, Aug. 13; Brooklyn Eagle, Aug. 13; Utica Press, Aug. 14; Yonkers Statesman, Aug. 14; Boston Herald, Aug. 15; New York Farmer, Aug. 20, p. 7; Country Gentleman, Aug. 27, 1908, 73:830[15]–31[16]

A summary account of flies as carriers of disease, with directions for abating the nuisance.

[Scientific Notes] Economic Entomology. Journal, Aug. 15, 1908

Brief observations on the following: Grape blossom midge, *Cecidomyia johnsoni* Sling., page 243; white marked tussock moth, *Hemerocampa leucostigma* Sm. & Abb., page 276; bag worm, *Thyridopteryx ephemeraeformis* Haw., page 276; elm leaf beetle, *Galerucella luteola* Mull., page 280.

Notes on the Work Against the Gipsy Moth. Economic Entomology. Journal, Aug. 15, 1908, 1:275–76

A brief account with special reference to improved methods of spraying and the work with parasites.

Melon Aphis. Country Gentleman, Aug. 20, 1908, 73:786[47]

Remedial measures are given for the melon aphis, *Aphis gossypii* Glov.

Saddle Back. Country Gentleman, Aug. 27, 1908, 73:812[45]

Brief descriptive account of the saddle back caterpillar, *Sibine stimulea* Clem.

San José Scale. Country Gentleman, Sept. 17, 1908, 73:889[36]

Brief economic notice of the San José scale, *Aspidiotus perniciosus* Comst.

The Wheat Wire Worm. Country Gentleman, Sept. 24, 1908, 73:910[25]

A brief descriptive account of the wheat wire worm, *Agriotes mancus* Say, with a discussion of remedial measures.

Insect Bands. Country Gentleman, Oct. 8, 1908, 73:961[12]

Brief comments upon the use and value of sticky bands with special reference to "Tree Tanglefoot."

A Scale. Country Gentleman, Oct. 8, 1908, 73:961[15]

A brief descriptive account of Chionaspis euonymi Comst. with a discussion of remedies.

The Difficult Apple Maggot. Country Gentleman, Oct. 8, 1908, 73:962[32]

A general account of the apple maggot, Rhagoletis pomonella Walsh, with a discussion of remedies.

Katydid Eggs. Country Gentleman, Oct. 15, 1908, 73:984[36]

Brief descriptive account of the eggs of Microcentrum retinervis Burm. or M. laurifolium Linn.

Scientific Notes. Economic Entomology. Journal, 1908, 1:330

Record of injury by Ennomos subsignarius Hubn. and its unusual abundance. A new injury to gladioli bulbs by a species of Aphis is also recorded.

23d Report of the State Entomologist on Injurious and Other Insects of the State of New York, 1907. N. Y. State Mus. Bul. 124. Oct. 15, 1908. 542p. 44 pl.

Contents

ADDITIONS TO COLLECTIONS OCT. 16, 1907–OCT. 15, 1908

The following is a list of the more important additions to the collections.

DONATION

Hymenoptera

Amphibolips prunus Walsh, oak plum gall, Sept., Michigan, through **R. B. Hough,** Lowville.

Trichiocampus viminalis Fallen, poplar sawfly larvae, Aug. 21, **Daniel Harrington,** Cambridge.

Kaliosysphinga ulmi Sund., leaf miner on elm, June 16, **L. L. Woodford,** Pompey.

Urocerus edwardsii Brulle, Jan. 7, **Hermann Von Schrenk,** St Louis, Mo.

Coleoptera

Eccoptogaster rugulosus Ratz., fruit tree bark beetle on pear, through State Agricultural Department, Sept. 15, Rochester.

Cryptorhynchus lapathi Linn., mottled willow borer, larvae on balm-of-gilead, Aug. 10, Corning, through **C. H. Peck,** Albany.

Tyloderma fragariae Riley, strawberry crown borer, June 11, **D. B. Belden,** Fredonia.

Pissodes strobi Peck, white pine weevil, larvae on pine, July 6, **J. G. Newbury,** Coxsackie.

Chelymorpha argus Licht., argus tortoise beetle, larva on grape, June 25, **G. H. Barber,** Westfield.

Galerucella luteola Mull., elm leaf beetle, larvae and pupae, July 9, **A. E. Milligan,** Schuylerville.

Plagionotus speciosus Say, sugar maple borer, adult on maple, June 26, **J. C. Von Steenburgh,** Ballston.

Photinus? pyralis Linn., fire fly, serial, longitudinal and transverse sections, adult, Dr **S. G. Shanks,** Albany.

Diptera

Culex perturbans Walk., all stages, June and July, **J. T. Brakeley,** Hornerstown, N. J.

A number of Cecidomyiid galls from Miss **Cora H. Clarke,** Magnolia, Mass.

Siphonaptera

Pulex irritans Linn., common human flea, adult; Ctenocephalus canis Curt., cat and dog flea, adult, July 24, **Dudley R. Kathan,** Schenectady.

Lepidoptera

Basilona imperialis Dru., imperial moth, larva, Sept. 3, **M. J. Dutche,** Oakwood Heights. Same, larva on maple, Aug. 12, Dr. **A. B. Kelly,** Albany.

Hyphantria textor Harr., fall webworm, larvae on apple, July 7, **J. A. Thompson,** Rochester.

Halisidota caryae Harr., hickory tussock moth, larvae, July 8, **H. N. Otterson,** Bolton, Mass. Same, larva, July 6, **Irving T. Thornton,** Orchard Park.

Tolype velleda Stoll., lappet moth, larva, July 22, **George S. Graves,** Newport.

Alsophila pometaria Harr., fall cankerworm, young, June 5, **A. Mair,** Oakdale.

Ennomos subsignarius Hubn., snow-white linden moth, adult, July 23, **C. Gordon Reel,** Kingston, through Forest, Fish and Game Com'n. Same, pupae on oak, July 3, **W. O. Ensign,** Livingston Manor.

Ania limbata Haw., filament bearer or horned spanworm, larva, June 6, **H. W. Covert,** Waterford.

Memythrus tricinctus Harr., M. polistiformis Harr., M. simulans Grote, M. asilipennis Boisd., M. dolii Neum., Aegeria apiformis Clerck, Sesia bassiformis Walk., S. albicornis Hy. Edw., S. corni Hy. Edw., S. pyri Harr., S. scitula Harr., S. rubristigma Kellicott, and S. pyralidiformis Walk., Apr. 30, **G. P. Englehardt,** Brooklyn.

Thyridopteryx ephemeraeformis Haw., bag worm, larvae on red cedar, July 7, Germantown, through **T. F. Niles.** State Dep't Agric.

Sitotroga cerealella Oliv., adult in popcorn, Aug. 14, **F. B. Holmes,** Albany.

Tischeria malifoliella Clem., apple leaf miner, larvae on apple, July 7, **J. A. Thompson,** Rochester.

Odonata

Hetaerina americana Fabr., adult, Aug. 26, **Winifred Goldring,** Slingerland.

Hemiptera

Phylloxera caryaecaulis Fitch, hickory gall aphid, adults and young on hickory, June 8, **The American Nursery Co.,** New York city. Same, gall on hickory, Sept. 1, **Munson-Whitaker Co.,** New York city.

Colopha ulmicola Fitch, cockscomb elm gall, on elm, June 18, **L. L. Woodford,** Pompey. Same, young on elm, July 6, **Irving T. Thornton,** Orchard Park.

Pemphigus tessellata Fitch, nymphs on alder, Aug. 24, **George S. Downing.** Albany. Same on maple Sept. 19, Mrs **George H. Freeman,** Loudonville.

Chermes abietis Linn., spruce gall aphid, young on Norway spruce, June 22, **John Herliky,** Brooklyn. Same, galls, July 30, **Seth Sprague Terry,** Elizabethtown. Same, galls on spruce, Aug. 10, **C. C. Laney,** Rochester. Same, dead adults on spruce, Aug. 31, **John Nill,** Star Lake.

Aspidiotus perniciosus Comst., San José scale, adult on hornbeam, Oct. 13, **W. E. Kenney,** Brooklyn.

Eulecanium tulipiferae Cook, tulip tree scale, young on tulip tree, Apr. 6, **J. Aspinwall,** Newburgh.

Pulvinaria innumerabilis Rathv., cottony maple scale, adults on elm, June 2, **E. S. Brignall,** Schenectady. Same, on maple, June 12, Mrs **Stephen Niles,** Coeymans. Same, adults on maple, June 24, **E. R. Concklin,** Pomona.

Phenacoccus acericola King, false maple scale, young on maple, Oct. 12, **Frank H. Downer,** New Rochelle. Same, May 29, **G. F. Beakley,** Johnstown. Same, adult on maple, July 29, **S. B. Huested,** Blauvelt.

Gossyparia spuria Mod., elm bark louse, adults on elm, June 2, **E. S. Brignall,** Schenectady. Same, Aug. 3, **W. E. Kenney,** Brooklyn. Same, young on elm, Sept. 16, Mrs **W. C. Mains,** Mt Vernon.

Icerya purchasi Mask., cottony cushion scale, on Acacia, Feb. 25, **L. Menand,** Albany.

Orthoptera

Panchlora hyalina Stoll., on apples, Mar. 16, Mrs **Abraham Lansing,** Albany. Same, Mar. 26, **J. R. Gillett,** Albany.

Isoptera

Termes flavipes Koll., white ant, adult, Feb. 3, **A. T. De La Mare Co.,** New York city.

EXCHANGE

Diptera

Culicidae

Banks, C. S., Government Entomologist, Manila, P. I. Myzomyia ludlowii Theob., M. mangyana Banks, Myzorhynchus barbirostris V. d. W., M. vanus Walk., Stegomyia aurostriata Banks, S. persistans Banks, S. samarensis Ludl., Worcesteria grata Banks, Helecoetomyia pseudotaeniata Giles, Leucomyia cuneatus Theob., Culex fatigans Wied., C. microannulatus Theob., Mansonia uniformis Theob., Banksinella luteolateralis Theob., Finlaya aranetana Banks, F. poicilia Theob., Aedomyia squamipenna Arriz.

Dolichopodidae

Aldrich, J. M., Moscow, Idaho. Psilopodinus mundus Wied., Agonosoma filipes? Loew, A. scintillans Loew, Mesorhaga albiciliata Ald., Diaphorus mundus Loew, D. opacus Loew, Asyndetus syntormoides Wheel., Chrysotus barbatus Loew, C. discolor Loew, C. picticornis Loew, Argyra robusta Jno., Leucostola cingulata Loew, Porphyrops effilatus Wheel., Syntormon affine Wheel., Neurigona carbonifer Loew, Medeterus aurivittatus Wheel., Hydrophorus philombrius Wheel., Scellus vigil O. S., Aphrosyllus praedator Wheel., Dolichopus acuminatus Loew, D. albicoxa Ald., D. detersus Loew,

D. lobatus Loew, D. ovatus Loew, D. pugil Loew, D. setifer Loew, D. sexarticulatus Loew, D. setosus Loew, Gymnopternus crassicauda Loew, G. debilis Loew, G. frequens Loew, G. phyllophorus Loew, Hercostomus unicolor Loew, Tachytrechus vorax Loew, Pelastoneurus laetus Loew, P. lamellatus Loew, P. neglectus Wheel.

Tabanidae

Hine, J. S., Columbus, O. Chrysops vittatus Weid., Tabanus fronto O. S., T. tener O. S., T. trispilus Wied.

PURCHASE

Onion fly, Phorbia ceparum Meig., enlarged models representing the egg, maggot, puparium, adult and an infested onion.

Cigar case bearer, Coleophora fletcherella Fern., an enlarged model representing the larva and its operations on an apple leaf. Both from Mrs **Otto Heidemann**, Washington, D. C.

Honey bee, Apis mellifica Linn., life history group.

European hornet, Vespo crabo Linn., life history group.

Ground beetle, Calosoma sycophanta Linn., life history group.

Corn stalk fly, Chlorops taeniopus Curtis, life history (in alcohol).

Cabbage butterfly, Pieris rapae Linn., life history group.

4 insects in amber.

The above from **The Kny-Scheerer Co.**, New York city.

Appendix A

STUDIES OF AQUATIC INSECTS

A PECULIAR NEW MAY FLY FROM SACANDAGA PARK

BY JAMES G. NEEDHAM

Among a small lot of neuropteroid insects sent me by Dr Felt for determination, was a new May fly with a remarkable development of the adbomen. Five of the abdominal segments have their flaring lateral margins expanded broadly, forming a wide parachute or aeroplane. This peculiarity has its parallel among known May flies only in the New Zealand species Oniscigaster wakefieldi; a species that was described by McLachlan 36 years ago, and made the subject of a special report by him to the British Association for the Advancement of Science[1] and an announcement to the Entomological Society of London,[2] and of two special papers.[3] The last paper gave full descriptions of both nymphal and adult[4] stages. Eaton's *Monographic Revision of Recent Ephemeridae* pages 224-26 gives a description of the adult insect, and adds [pl. 21, fig. 36] an excellent figure of the venation. In Hutton's list of New Zealand Neuroptera[5] is found another description of the adult. In 1899 Eaton[6] added two additional New Zealand species to the genus, O. intermedius, with considerably less dilatation of the lateral margins of the abdominal segments, and O. distans, with hardly any lateral expansion at all. So Eaton dropped from his characterization of the genus all mention of the onisciform abdomen, that had brought the type species into such prominent notice. In 1904 Hudson described the three species in his New Zealand Neuroptera [p. 42-45] and added a much needed description of the nymph of O. distans [pl. 1, fig. 11; pl. 11, fig. 15], which appears to agree quite well with that of the typical species.

The New York May fly about to be described exhibits a more

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1 Report of 1873, p. 118 (1874).
2 Proceedings for 1874, p. vi.
3 Ent. Mo. Mag. 10:108-9, wood cut, 1873; Linn. Soc. Zool. Jour. 1874. 12:39-46, pl. 5, fig. 1-5.
4 The figure of the adult is copied by Sharpe in volume 5 of the Cambridge Natural History.
5 New Zeal. Inst. Trans. 1898. 31:218.
6 Ent. Soc. Lond. Trans. p. 292-93, pl. 10, fig. 6*a*, 6*b*, 6*c*.

marked dilatation of the lateral margins of the abdomen than even Oniscigaster wakefieldi. Its abdomen is more than onisciform: it is a veritable parachute. The expansion involves segments 5 to 9 of the abdomen (in O. wakefieldi, only 6 to 9), and begins and ends more abruptly than in the New Zealand species. Our insect distinguishes itself from Oniscigaster, however, by lacking a median caudal seta, and by a symmetrical forking of the median vein, that forking being very unsymmetrical in Oniscigaster. And since in these respects it agrees with the genus Siphlurus, which stands in the system next Oniscigaster, I was at first inclined, in spite of the parachute, which in Oniscigaster is certainly of no great systematic consequence, to refer it to Siphlurus. By my key in Bulletin 86, N. Y. State Museum, page 22, it would be traced to Siphlurus, with the discrepancy that there is no backward prolongation of the sternite of the 9th abdominal segment in the female. It differs from Siphlurus, also, in having the claws of the forefeet differentiated from those of the other feet, being obtuse and inflated and not at all clawlike in form: also, in having the radial sector in the hind wing twice dichotomously and symmetrically forked. I think therefore that this species represents a genus distinct from both Siphlurus and Oniscigaster, although closely allied to both, and as such I describe it below. Probably the male, and the nymph if known, would add other differential characters.

Siphlonisca gen. nov.

Caudal setae two, slightly longer than the body. Claws of the front tarsus inflated and obtuse; those on the other tarsi hooked and clawlike, and similar each to each. Hind tibia longer than its tarsus: last segment of tarsus longest, in all the feet. Median and cubital veins in the forewing symmetrically forked, and the radial sector in the hind wing equally twice forked: no humeral angulation of hind wing. Mesothorax with a prominent midventral spine. Abdomen with conspicuous lateral expansion of the middle segments.

Type the following species.

Siphlonisca aerodromia sp. nov.

Length (♀) 19 mm, setae 20 mm additional; expanse of wings 37 mm. Abdomen 13 mm long and 2 mm wide, expanded to 4 mm wide on the 5th to 9th segments.

Color brown varied with paler. Head fawn-yellow above, marked with blackish on the sides of the vertical facial carina, and around the ocelli internally, and bearing a mark shaped like the zodiacal sign for Aries along the middle of the head, the open end of the sign being in front. Antennae pale, about as long as the head Thorax brown more or less blackish on the sides, and in the rear above, the top of the mesothorax somewhat rufescent and shining. Between the bases of the middle legs a stout, thornlike spine, inclined slightly to rear, arises from the mesosternum. Legs pale, the front femora being slightly darkened, and the tips of all tarsi indistinctly so.

Wings hyaline with brown veins, cross veins more or less bordered with brown in the costoradial strip, especially a few approximated cross veins near the bulla, and a line of others, similarly approximated, extending from that point posteriorly across the wing [pl. 2, fig. 1].

Abdomen with a definite pattern of brown and paler yellow (possibly, greenish in life), subcylindric, the lateral margins of segments 5 to 9 suddenly dilated into wide, flat expansions, which double the width; each of these expansions obtusely rounded anteriorly, and produced posteriorly at its hind angle into a broad, flat, triangular tooth. These expansions are dark brown, paler basally, where they abut on a black line on the lateral margin of the abdomen. On the pale dorsum there are submedian blackish ( )- marks on each segment, the marks increasing in size posteriorly, becoming streaks on segments 9 and 10 [pl. 2, fig. 2]. On the ventral surface there are corresponding small and distant paired dots as far as the 7th segment, diffuse on the 8th, and becoming elongate dashes on the 9th, and absent on the 10th. The 10th segment is short and cylindric, hardly surpassing the tip of the lateral teeth of the 9th. There is no ventral prolongation of the 9th sternite. Setae white, or slightly brownish at the extreme base.

A single female imago from Sacandaga Park, collected by C. P. Alexander, Johnstown, N. Y.

As the above description is going through the press, additional specimens representing both sexes, are received from Mr Alexander. These he collected at Sacandaga Park on June 6, 1909. Mr Alexander writes that they were abundant, and that they kept high in air where they were conspicuous by reason of the wide abdomen.

The male is of about the same size as the female, with white, nearly bare setae 25 mm long, and brown fore legs whose tarsi are 9 mm long The enlarged and smoothly rounded eyes of the male just meet each other above the head. The face is black, with the vertical nasal carina yellow, and also a spot behind the ocelli and between the compound eyes. Otherwise the coloration is as in the female. The segments of the fore tarsus of the male are of nearly equal length, the 5th being perhaps a trifle shorter than the others: in middle and hind tarsi, the four basal segments are of approximately equal length, while the 5th is as long as any two other segments. Unlike the female, which has blunt and flabellate claws on the fore tarsi, those of the male are on all tarsi sharply hooked and similar. In several of the specimens the radial sector of the hind wing has its second forks less equal than in the female described above, the lower fork being deeper than the upper.

The appendages of the male abdomen are strongly chitinized, the forceps base is longer than the 9th segment, widened distally, broadly truncated on each hind angle to receive the much narrower base of the forceps, and angularly excavate on the wrinkled but strongly chitinized hind margin in a broadly triangular rear notch. The forceps limbs are long and strongly divaricate and conspicuous. Each consists of four segments, of which the first, third and fourth are short and of about equal length and are together about equal in length to the second segment. The apical half of the forceps is transversely wrinkled, and it is wholly dark brown in color.

After studying the male I conclude that the features which chiefly distinguish this genus from Siphlurus are in both sexes the onisciform abdomen, and the midventral thoracic spines.

While the foregoing is passing through the printer's hands another species of Mayfly of the genus Potamanthus has been sent me by Dr Felt, collected on June 29, 1909 at Schenectady. It is larger than P. diaphanus, described in the report of the State Entomologist for 1907 [p. 193–94, and pl. 10, fig. 5], and is readily distinguished therefrom by the abbreviated middle caudal seta and by the form of the appendages in the male.

Potamanthus inequalis sp. nov.

Length of body 11 mm, of fore leg about 10 mm, of lateral setae 26 mm, of middle seta 15 mm, expanse of wings 24 mm. Color white, with fuscous head, pale yellowish thorax and translucent white abdomen. Legs white except the slightly infuscated tips of fore tarsi and tibiae, and the joinings of the segments of the same tarsi. Wings whitish hyaline, with pinkish iridescence. End segments of the abdomen of a dull satiny whiteness on the dorsal side. Setae white, with the joinings very faintly darker in color, the middle seta but little more than half as long as the laterals.

The male forceps is not remarkably different from that of P. diaphanus [loc. cit. fig. 5], but the inner appendages are very differently formed as shown in the drawing herewith presented.

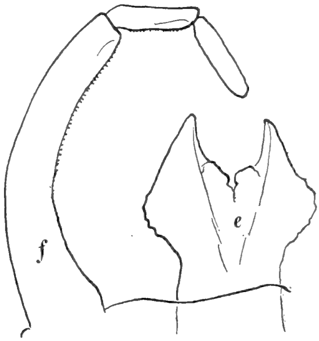

FIG. 22 Potamanthus inequalis n. sp.: *f*, forceps limb; *e*, inner appendages

The pinned submarginal skin of the same specimen is white: its fore femora are 10 mm long, and its setae (broken) are clothed with copious soft white pubescence.

Appendix B

CATALOGUE OF THE DESCRIBED SCOLYTIDAE OF AMERICA, NORTH OF MEXICO

BY J. M. SWAINE

The following catalogue is intended to include all names that have been proposed for species of Scolytidae occurring in America, north of Mexico, with citations of published articles referring thereto. The references were collected originally for our use, while working on the family Scolytidae. They include practically all the literature published on the North American species of the family.

Changes should, we believe, be made in the location of a few of the species here listed, and several of the genera may, with advantage, be divided. These changes require considerable discussion and illustration, and would perhaps be more effectively made in connection with the description of the large number of undescribed species of North American Scolytidae known to collectors. As a synonymic catalogue of the North American species of Scolytidae has been promised by the American authority on this family, I have reported the priority of the various genera and species just as found in the literature. The object of this paper is merely to present the references to that literature. The habitat and food plants have been compiled from the literature, the Cornell University collection and our own notes. References to several well known lists are not included. For convenience of reference the genera and species are arranged alphabetically.

As regards the conflicting names of Eichhoff, Zimmerman and Leconte, P. pullus Zimm., described in the Transactions of the American Entomological Society, 1868, volume 2, undoubtedly has precedence over P. cribripennis Eich., Berl. Ent. Zeit. March 1869. Though the contrary has been repeatedly stated, it seems perfectly clear to me that H. rufipes Eich. and H. salebrosus Eich. were described before H. opaculus Lec. and H. scabripennis Zimm., as will appear from the following: H. rufipes and H. tenuis were described by Eichhoff on page 147 of Berl. Ent. Zeit. for 1868, and H. salebrosus on page 146 of the same article. In the Transactions of the

American Entomological Society, 1868, volume 2, where the descriptions of H. opaculus and H. scabripennis appear, Dr Zimmerman begins his description of H. tenuis as follows: "H. tenuis [Hylastes tenuis Eich. Berl. Ent. Zeit. 1868, 147]." Also Leconte, in the same paper [*see* p. 169, 173] refers to pages 147 and 149 of Eichhoff's article just mentioned. There is therefore no question but that both Dr Zimmerman and Dr Leconte had Dr Eichhoff's pages 146 and 147 before them when their descriptions of H. opaculus and H. scabripennis were written.

In regard to the use of the names Ips, Tomicus, and Hylastes, perhaps a few words will be pardoned. The genus Ips was erected in 1775 by De Geer, Dermestes typographus Linné being the first species described. All the other species included by De Geer in the genus Ips have since been removed to other genera, therefore leaving typographus as type.

In 1802 Latreille described the genus Tomicus, including the single species, Hylesinus piniperda Fabr., which would therefore be the type.

In 1807 Latreille referred Dermestes typographus Linné to the genus Tomicus, and gave a description of the genus.

In 1836 Erichson erected the genus Hylastes with Bostrichus ater (= Hylesinus piniperd'a Fabr.) as the type.

Until recently Ips De Geer, 1775, seems to have been disregarded, and the name Ips has been applied to a genus of beetles of the family Nitidulidae. Tomicus Latr., 1802, has also been disregarded. Tomicus Latr., 1807, has been used for the allies of typographus and Hylastes Er., 1836, for the allies of ater. Ips De Geer, 1775, has therefore priority over Tomicus Latr., 1807, and Tomicus Latr., 1802, has priority over Hylastes Er., 1836.

The name Ips Fabricius, of the family Nitidulidae, dates from the year 1776 [Fabricius, Gen. Ins. p. 23].

If the above synonymy is correct, and I believe it to be, it is better to adopt it at once, even at the risk of temporary confusion.

Following Bedel [Faun. Col. Bassin Seine, Rhyn, 1888], Hylastes is dropped in this paper and the terms Ips and Tomicus are used as indicated above.

Geoffroy's name Scolytus dates from 1762, and therefore can not be accepted. In 1776, O. F. Muller [Zool. Dan. Prodr. 57], described Scolytus punctatus which is certainly not a scolytid: "Niger, thorace fossulato, elytris lineis quatuor elevatis, intervallo punctorum duplici serie." The name Scolytus should therefore give place to Eccoptogaster Herbst, 1793. The above is pointed out by C. L. Ganglbauer [Münch. Koleopt. Zeit. 1903, p. 311, footnote (sep.)] and has been followed by Trédl in his catalogue of the European Borkenkäfer. I have been unable to verify Dr Leconte's reference to Olivier, 1789 [Am. Phil. Soc. Proc. 1876. 15:371].

According to Gemminger and Harold, Cat. Col., the following names should be added to the synonymy:

Hylurgops glabratus *Zett.*
  crenatus *Panz.* Fn. Germ. 15, 7
  paykulli *Duftschm.* Fn Austr. 3:99
Hylastinus obscurus *Marsh*
  crenatulus *Duftschm.* Fn. Austr. 3:104
  fuscescens *Steph.* Ill. Brit. 3:365
  piceus *Steph.* Ill. Brit. 3:365
Crypturgus pusillus Gyll.
  aphodioides Villa. Col. Eur. duppl. Supl. 1833, p. 36
Hypothenemus eruditus West.
  ruficollis Fabr. Syst. El. 2:388. Ferr. Berl. Ent. Zeit. 1868. p. 255
Trypodendron lineatus Oliv.
  limbatum Payk. Fn. Suec. 3:144
  marginicolle Dahl.
  signatum Fabr. Ent. Syst. 1, 2:363
    Duftschm. Fn. Austr. 3:95
    Waringi Curtis, Ann. Nat. Hist. 1840. 5:279
Xyleborus dispar Fabr.
  rufipes Latr. Dej. Cat. ed. 3. p. 332
Dryocoetes autographus Ratz.
  var. micographus Oliv. Ent. 5, 78, p. 9, t. 2, f. 12
Ips pini Say.
  vicinus Dej. Cat. ed. 3, p. 332
Xylccleptes bispinus Duft.
  marginatus Megerle.
Eccoptogaster rugulosus Ratz.
  haemorrhous Schmidberger, Kollar. Naturg. schadl. Ins. 1837. p. 271.
    Meg. Sturm. Cat. 1826. p. 194
  flavicornis Géné. Dej. Cat. ed. 3, p. 332
  punctatus Mus. Berol.
Phloectribus frontalis Oliv.
  dubius Eich., Berl. Ent. Zeit. 1868. p. 150
  setulosus Eich. *loc. cit.* 149

Gemminger and Harold list the following:

Phloeotribus americanus Dej. Cat. ed. 3. p. 331, Amer. bor.

Cryphalus asperulus Eich., Berl. Ent. Zeit., 1871. p. 133, was renamed by Eichhoff in Rat. Tom., 1878, p. 153, as Stephanoderes cassiae; habitat given as "Asia (?)."

I wish to acknowledge my indebtedness to Prof. J. H. Comstock for the material he so kindly furnished, to Dr E. P. Felt for helpful criticism, and my especial obligation to Prof. A. D. McGillivray for his frequent assistance and advice.

Entomological Laboratory,
Cornell University, July 1, 1907

KEYS FOR DETERMINING THE GENERA OF THE IPIDAE (SCOLYTINAE) AND PLATYPODIDAE (PLATYPODINAE) OF AMERICA NORTH OF MEXICO

The arrangement of family and subfamily names in the following keys seems the most natural at present. Published keys have been freely used.

Cactopinus Schwz. (which has been omitted from the generic key) is distinguished from all other described North American Scolytidae by the sculpture of the pronotum: "Disk in both sexes, with a longitudinal, tuberculated, and distinctly elevated, median area which projects beyond the base of the thorax as a triangular lobe," forming a "hoodlike projection over the scutellum." [E. A. Schwarz. Psyche, v. 8, sup. 1, p. 11]

Families

a Head narrower than the prothorax; 1st tarsal segment shorter than the others united; eyes oblong or divided [*see* pl. 4, fig. 6; pl. 5, fig. 10, 11; pl. 8, fig. 21; pl. 9, fig. 25; pl. 11, fig. 36, 37] .... Ipidae[1]

aa Head broader than the prothorax; 1st tarsal segment as long as the others united; eyes round, subconvex [*see* pl. 3, fig. 1, 2] .... Platypodidae

The family Platypodidae is represented in America, north of Mexico, by one genus, Platypus Herbst.

Subfamilies of the Ipidae

a Anterior "tibiae produced at the upper apical angle beyond the tarsal insertion into a mucro or bifid process." (Blandford) [*see* pl. 3, fig. 5]

b Foretarsus with the 3d segment bilobed; upper or outer border of the foretibiae unarmed or with few very small teeth .... Eccoptogasterinae (Scolytini)

bb Foretarsus with the 3d segment not bilobed; the outer border of the foretibiae strongly dentate [*see* pl. 3, fig. 3] .... Erineophilinae

aa Foretibiae not produced at the upper or outer apical angle beyond the tarsal insertion into a mucro or bifid process [*see* pl. 4, fig. 6; pl. 5, fig. 10, 11]

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[1] Ganglbauer. Munchener Koleopterologische Zeitschrift. 1903, band 1, 311.

b Head suboblong and prominent; pronotum nearly equably punctured, not more strongly roughened in front; tarsi with the 4th segment much smaller than the 3d, which is usually dilated and heartshaped or bilobed [pl. 7, fig. 20, pl. 8, fig. 21; pl. 9, fig. 25; pl. 10, fig. 26; pl. 11, fig. 31, 32, 36, 37]................................Hylesininae

bb Head globose, not visible from above, deeply immersed in the pronotum, which is prolonged and usually strongly roughened with stout, backward pointing spines in front, and smooth or punctured behind; 3d tarsal segment simple, 4th segment distinct [pl. 4, fig. 6, pl. 5, fig. 10–12; pl. 7, fig. 19]....................Ipinae (Tomicini)

Genera of the Eccoptogasterinae

a Foretibiae with the outer apical angle produced into a curved spine, outer border unarmed

b Venter of abdomen with the caudal portion bent abruptly dorsad [pl. 3, fig. 4]..............Eccoptogaster Herbst. (Scolytus Geoff.)

bb Venter of abdomen regularly curved, nearly horizontal..Loganius Chap.

aa Foretibiae with the outer apical angle produced into a bifid spine, outer border near the base of the spine armed with a small tooth

b "Prothorax with a defined side margin."..........Bothrosternus Eich.

bb "Prothorax with no defined side margin, but usually with a fold above the femoral impression

c "Sutures of the club curved; rostrum narrower than the front; body oval." . . . .Pagiocerus Eich.

cc "Sutures of the club straight; rostrum scarcely narrower than the front; body oblong." (Blandford)................Cnesinus Lec.

The subfamily Erineophilinae contains one genus, Erineophilus Hopk.

Genera of the Hylesininae

a Antennal funicle with less than 4 segments

b Antennal funicle with 2 segments; club not distinctly annulated........ Crypturgus Erich.

bb Antennal funicle with 3 segments; club annulated.....Dolurgus Eich.

aa Antennal funicle with more than 4 segments

b Antennal club not annulated, pubescent on both sides [pl. 9, fig. 24]

c Eyes completely divided.........................Polygraphus Erich.

cc Eyes not divided [pl. 10, fig. 26].....................Chramesus Lec.

bb Antennal club annulated [pl. 9, fig. 27; pl. 10, fig. 28–30]

c Antennal club lamellate, of 3 loosely adjoined segments [pl. 10, fig. 30] . . . .Phloeotribus Latr.

cc Antennal club not lamellate, segments closely connate [pl. 9, fig. 27; pl. 10, fig. 28, 29]

d Antennal club strongly compressed

e Antennal funicle with 7 segments...............Hylesinus Fabr.

ee Antennal funicle with 5 segments

f Front coxae not contiguous

g Antennal funicle with outer segments distinctly broader; coxae moderately distant [pl. 9, fig. 27]................. Phloeosinus Chap.

gg Antennal funicle with outer segments scarcely broader; coxae very narrowly separated........Chaetophloeus Lec.

ff Front coxae contiguous

g Eyes emarginate or sinuate in front; prosternum in front of coxae very short or obsolete; antennal club oval-elongate

h Antennal club with 3 segments; eyes emarginate in front; foretibiae with very few teeth on the outer margin...... Carphoborus Eich.

hh Antennal club with 4 segments; eyes sinuate rather than emarginate in front; foretibiae with a row of stout teeth on the outer margin...............Renocis Casey

gg Eyes entire; prosternum distinct in front of the coxae; antennal club subcircular [pl. 7, fig. 20; pl. 10, fig. 28]...... Dendroctonus Erich.

dd Antennal club not strongly compressed, subglobular or conical

e 1st, 2d and 5th ventral segments of the abdomen subequal in length, 3d and 4th segments shorter; forecoxae widely separated [pl. 11, fig. 34]

f Antennal club with the 1st and 2d segments subequal in length, each as long as segments 3 and 4 united [pl. 12, fig. 39]...... Hylastinus Bedel

ff Antennal club with the 1st segment much longer than the 2d, nearly as long as segments 2, 3 and 4 united.....Scierus Lec.

ce 1st and 5th ventral segments distinctly longer than the others; forecoxae narrowly separated or contiguous [pl. 11, fig. 33]

f Mesosternum protuberant; 3d tarsal segment dilated and bilobed; elytra separately rounded at the base [pl. 8, fig. 23; pl. 11, fig. 31, 35, 36].......................Hylurgops Lec.

ff Mesosternum not protuberant; 3d tarsal segment subequal in width to the 2d, emarginate rather than bilobed; bases of elytra in a nearly straight line not separately rounded [pl. 9, fig. 22; pl. 11, fig. 32, 37] Tomicus Latr., 1802.............. (Hylastes Erich.)

Genera of the Ipinae

a Antennal funicle with less than 6 segments

b Antennal club pubescent on both sides

c Antennal club annulated on both sides; eyes not completely divided

d Antennal funicle with only one segment [pl. 4, fig. 8]

e Body robust; foretibiae without transverse ridges on outer side.. Corthylus Erich.

ee Body slender; foretibiae with transverse ridges on the outer side [pl. 5, fig. 11]............................Pterocyclon Eich.

dd Antennal funicle with more than 1 segment

e Prothorax wider than long.............Hypothenemus Westw.

ee Prothorax longer than wide

f Maxillary lobe pilose, without radiating spines on outer edge; woodborers [pl. 6, fig. 15]..............Gnathotrichus Eich.

ff Maxillary lobe, with radiating spines on the outer edge; bark borers [pl. 6, fig. 14] *g* Base of prothorax bordered by a fine, raised line; elytral declivity of the two sexes alike...... Pityophthorus Eich.

gg Base of prothorax without a raised border; teeth of elytral declivity much larger in the male than in the female...... Pityogenes Bedel

cc Antennal club not annulated; eyes completely divided; elytral declivity oblique, not excavated and not toothed [pl. 5, fig. 12, 13] Trypodendron Steph. (Xyloterus Erich.)

bb Antennal club not pubescent on both sides, almost entirely corneous and usually not at all annulated on the inner face; at most, the outer segments of the club show from the inner side but slightly at the distal extremity

c Antennal club obliquely truncate at the distal end of the outer surface, with the distal segments of the club confined to the truncate surface and telescoped so that the flat, pubescent, truncate surface appears concentrically annulated [pl. 6, fig. 18, ant.; pl. 13, fig. 42]

d Antennal funicle with 4 segments; elytral pubescence scalelike.... Cryphalus Erich.

dd Antennal funicle with 5 segments; elytral pubescence not scalelike

e Elytral declivity excavated and toothed........................ Ips DeG., in part (Tomicus Latr. 1807)

ee Elytral declivity not excavated, and without prominent teeth

f Caudal margin of prosternum extending into a long spinelike process which projects caudad between the forecoxae. Maxillary lobe with radiating spines on the outer edge, bark borers [pl. 6, fig. 14, 18].................Dryocoetes Eich.

ff Caudal margin of the extremely short prosternum at most but slightly produced on the median line; maxillary lobe pilose, without radiating spines on the outer edge, borers in wood and nuts [pl. 6, fig. 15, 17]

g Tibiae with the outer edge straight, spinose; dorsum of prothorax not more strongly roughened in front than behind.. Coccotrypes Eich.

gg Tibiae with the outer edge curved, finely serrate; dorsum of prothorax much more strongly roughened in front than behind ....Xyleborus Eich.

cc Antennal club with the distal segments not telescoped to form a flat, truncate surface, distinct, and not confined to the distal extremity of the outer surface [pl. 6, fig. 16]

d Elytral declivity not deeply excavated, at most only slightly concave; 2d segment of the antennal club surrounding the 1st, which is nearly oval [pl. 12, fig. 38].................Xylocleptes Ferr.

dd Elytral declivity deeply excavated and toothed; 2d segment of antennal club not nearly surrounding the 1st, the 1st suture being straight or angular [pl. 6, fig. 16]....................... Ips DeG., in part (Tomicus Latr. 1807)

aa Antennal funicle with 6 segments

b Antennal club distinctly annulated on both sides; elytra aculeate at the tip ....Micracis Lec.

bb Antennal club distinctly annulated on only 1 side; elytra not aculeate at the tip .... Thysanoes Lec.

MacDonald College, Quebec
October 15, 1908

Family SCOLYTIDAE

1837 Ratzeburg. Forstins. 1:156–68
1837 Kirby. Fauna. Am. Bor. p. 191
1856 Nordlinger. Nachtr. f. Ratzeb. Forstins. p. 17–45
1856 Perris. Ann. Ent. Soc. France, p. 173–245, pl. 5, fig. 299–323
1866 Lacordaire. Hist. Nat. Ins. Col. 7:349–55
1869 Chapuis. Syn. Scol.
1872 Gemminger & Harold. Cat. Col. bd. IX: 2669
1875 Lindermann, Beitr. Kentniss Borkenk. Russl. Bul. Mosc. 49, pt 1, p. 131–46
1876 Leconte. Am. Phil. Soc. Proc. 15:341–91
1876 Lindemann. Mon. Borkenk. Russl. Bul. Mosc. 52, pt 1, p. 158–87
1877 Perris. Larves des Coleopteres, p. 413
1877 Provancher. Faun. Ent. Can. 1:563–64
1878 Eichhoff. Rat. Tom. p. 6
1881 Eichhoff. Die Europ. Borkenk. p. 1–33
1883 Leconte & Horn. Col. N. A. p. 512–13
1888 Bedel. Faun. Col. Seine, p. 385
1889 Cholodkovsky. Gänge Borkenk. Hor. Ent. Ross. 22:262
1895 Reitter. Bestimmung. der Borkenk.
1895 Judeich-Nitsche. Forstins. 1:435–41
1895 Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 81–88
1898 Lowendal. De Danske Barkbiller
1899 Sharp. Camb. Nat. Hist. Insects. pt II, p. 294–95
1901 Barbey. Scol. l'Europ. Cent. 15, 33
1903 Ganglbauer. Munch. Koleopt. Zeit. 1:309, 310
1904 Comstock. Manual for the Study of Insects, p. 596–98
1905 Kellogg. American Insects, p. 298–300
1905 Nüsslin, Leitfaden der Forstinsectenkunde
1907 Trédl. Nahrungs. Verbreit. Borkenk. Europ. [Ent. Blätter, Nr. 1 mit 6]

Subfamily PLATYPODINAE

References are given under Platypus.

PLATYPUS Herbst

1793 Herbst. Die Kaefer. 5:128, gen. 34
1807 Latreille. Gen. Crust. et Ins. 3:277
1836 Erichson. Wieg. Archiv. 2:64
1839 Ratzeburg. Forstins. 1:230
1864 Eichhoff. Berl. Ent. Zeit. p. 17, 42, 43, 46
1866 Chapuis. Mon. Plat.
1866 Lacordaire. Hist. Nat. Ins. Col. 7:356, 357
1868 Leconte. Am. Ent. Soc. Trans. 2:150–51
1876 Leconte. Am. Phil. Soc. Proc. 15:342–43

1881 Eichhoff. Die Europ. Borkenk. 54, 305–7
1883 Leconte & Horn, Col. N. A. p. 513–14
1888 Bedel. Faun. Col. Seine, p. 385, 404, 421
1895 Judeich-Nitsche. Forstins. 1:441–42
1895 Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 89–95
1897 Hubbard. U. S. Div. Ent. Bul. 7. n. s. p. 14, 15
1901 Barbey. Scol. l'Europ. Cent. 15, 115

CYLINDRA Ill.

1825 Illiger. Duftschmidt. Faun. Aust. 3:87
1866 Chapuis. Mon. Plat. p. 97
1888 Bedel. Faun. Col. Seine, p. 404

1 **compositus** Say

1828 Platypus. Say. Acad. Nat. Sci. Phila. Jour. 3:324; ed. Lec. 2:182
1836 Platypus. Erichson. Wieg. Archiv. 2:65
1866 Platypus. Chapuis. Mon. Plat. p. 163, fig. 75
1876 Platypus. Leconte. Am. Phil. Soc. Proc. 15:344
1878 Platypus. Schwarz. Am. Phil. Soc. Proc. 17:468
1889 Platypus. Schwarz. Ent. Soc. Wash. Proc. 1:149
1891 Platypus. Riley & Howard. Ins. Life, 3:418
1892 Platypus. Riley. Ins. Life, 5:17
1893 Platypus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 127; Bul. 32, p. 207
1894 Platypus. Hopkins. Can. Ent. 26:277
1895 Platypus. Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 93, 94, 106
1897 Platypus. Hubbard. U. S. Div. Ent. Bul. 7 n. s., p. 14
1904 Platypus. Hopkins. U. S. Div. Ent. Bul. 48, p. 39, 45
1904 Platypus. Hopkins. U. S. Dep't Agric. Yearbook, p. 384
1907 Platypus. Pierce. Neb. Zool. Lab. Studies No. 78, p. 289

parallelus Fabr.

1792 Bostrichus. Fabr. Syst. El. 2:384
1866 Platypus. Chapuis. Mon. Plat. p. 164, fig. 76
1876 (?) = compositus Say. Leconte. Am. Phil. Soc. Proc. 15:344

tremiferus Chap.

1866 Platypus. Chapuis. Mon. Plat. p. 176, fig. 85
1876 (?) = compositus Say. Leconte. Am. Phil. Soc. Proc. 15:344

perfossus Chap.

1866 Platypus. Chapuis. Mon. Plat. p. 176, fig. 86
1876 (?) = compositus Say. Leconte. Am. Phil. Soc. Proc. 15:344

rugosus Chap.

1866 Platypus. Chapuis. Mon. Plat. p. 176, fig. 87
1876 (?) = compositus Say. Leconte. Am. Phil. Soc. Proc. 15:344

Habitat. United States south of Delaware bay and Illinois.

Food plants. Quercus, Acer, Fagus, Castanea, Ulmus, Tilia, Magnolia, Taxodium and many others.

2 **cylindrus** Fabr.

1793 Bostrichus. Fabr. Ent. Syst. 2:364
1801 Bostrichus. Fabr. Syst. El. 384, tab. II
1837 Platypus. Ratzeburg. Forstins. 1:188, t. X, fig. 13
1866[1] Platypus. Chapuis. Mon. Plat. p. 246, fig. 147
1881 Platypus. Eichhoff. Borkenk. p. 305, fig. 108, 109
1895 Platypus. Judeich-Nitsche. Forstins. 1:547
1901 Platypus. Barbey. Scol. l'Europ. Cent. 115
1907 Trédl. Nahrungs. Verbreit. Borkenk. Europ. 19

Habitat. Europe, Asia, America.

Food plants. Quercus, Castanea, Fagus, Fraxinus.

3 **flavicornis** Fabr.

1776 Bostrichus. Fabr. Gen. Ins. Mant. p. 212
1781 Bostrichus. Fabr. Spec. Ins. 1:67
1787 Bostrichus. Fabr. Mant. Ins. p. 36
1793 Bostrichus. Herbst. Kafer, 5:118
1793 Bostrichus. Fabr. Ent. Syst. 2:364
1801 Bostrichus. Fabr. Syst. El. 2:384
1808 Scolytus. Olivier. Ent. gen. 78, p. 4, t. 1, fig. 1.a, b
1866 Platypus. Chapuis. Mon. Plat. p. 154-56
1876 Platypus. Leconte. Am. Phil. Soc. Proc. 15:343
1878 Platypus. Schwarz. Am. Phil. Soc. Proc. 17:468
1886 Platypus. Lugger. Ent. Soc. Wash. Proc. 1:36
1894 Platypus. Hopkins. Can. Ent. 26:277
1895 Platypus. Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 93, 95, 104
1897 Platypus. Hubbard. U. S. Div. Ent. Bul. 7. n. s. p. 15
1900 Platypus. Smith. Cat. Ins. N. J. p. 361

bidentatus Dej.

1837 Platypus. Dej. Cat. ed. 3, p. 333
1866 =flavicornis Fabr. Chapuis. Mon. Plat. p. 155

disciporus Chap.

1865 Platypus. Chapuis. Mon. Plat. p. 219, fig. 123
1876 =flavicornis Fabr. Leconte. Am. Phil. Soc. Proc. 15:343

Habitat. Southern United States, Mexico.

Food plants. Many deciduous and coniferous trees.

4 **punctulatus** Chap.

1866 Platypus. Chapuis. Mon. Plat. p. 199, fig. 110
1876 Platypus. Leconte. Am. Phil. Soc. Proc. 15:345

Habitat. Texas.

Food plants. (?)

5 **quadridentatus** Oliv.

1795 Scolytus. Olivier. Ent. 78. 3, pl. 1, fig. 3
1866 Platypus. Chapuis. Mon. Plat. p. 337

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[1] For other references *see* Chapuis's Mon. Plat. p. 246.

1876 Platypus. Leconte. Am. Phil. Soc. Proc. 15:343, 344
1878 Platypus. Schwarz. Am. Phil. Soc. Proc. 17:468
1893 Platypus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 127; Bul. 32, p. 207
1894 Platypus. Hopkins. Can. Ent. 26:277
1897 Platypus. Hubbard. U. S. Div. Ent. Bul. 7. n. s. p. 15

blanchardi Chap.

1866 Platypus. Chapuis. Mon. Plat. p. 185, fig. 96
1876 = quadridentatus Oliv. Leconte. Am. Phil. Soc. Proc. 15:344
Habitat. West Virginia, Florida, Texas.
Food plants. Many deciduous and coniferous trees.

6 **rugulosus** Chap.

1866 Platypus. Chapuis. Mon. Plat. p. 192, fig. 103
1876 Platypus. Leconte. Am. Phil. Soc. Proc. 15:343, 344
1895 Platypus. Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 92, 95, 107
1905 Platypus. Hopkins. Ent. Soc. Wash. Proc. 7:71

reticulatus Chap.

1866 Platypus. Chapuis. Mon. Plat. p. 194, fig. 104
1896 = rugulosus Chap. Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 107

emarginatus Chap.

1866 Platypus. Chapuis. Mon. Plat. p. 199, fig. 109
1896 = rugulosus Chap. Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 107
Habitat. Lower California, Mexico, Guatemala, Panama.
Food plants. (?)

Subfamily SCOLYTINAE

1837 Ratzeburg. Forstins. 1:157-230
1866 Lacordaire. Hist. Nat. Ins. Col. 7:355, 356, 357
1868 Zimmerman. Am. Ent. Soc. Trans. 2:141
1869 Chapuis. Syn. Scol.
1876 Leconte. Am. Phil. Soc. Proc. 15:342, 345
1878 Eichhoff. Rat. Tom. p. 6
1881 Eichhoff. Die Europ. Borkenk. p. 33
1883 Leconte & Horn. Col. N. A. p. 513, 514, 515
1888 Bedel. Faun. Col. Seine, p. 385, 386
1895 Judeich-Nitsche Forstins. 1:442
1895 Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 81, 118-20

BOTHROSTERNUS Eich.

1868 Eichhoff. Berl. Ent. Zeit. p. 150
1869 Chapuis. Syn. Scol. p. 24
1873 Chapuis. Mem. Soc. Liège, p. 232
1883 Leconte & Horn. Col. N. A. p. 523
1895 Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 131, 132

7 **hubbardi** Sz.

1886 Bothrosternus. Schwarz. Ent. Am. 2:54
1896 (?) Bothrosternus. Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 131, 132

Habitat. Florida.

Food plant. (?) Hicoria.

CACTOPINUS Schwarz

1899 Schwarz. Psyche, vol. 8, sup. 1, p. 11

8 **hubbardi** Sz.

1899 Cactopinus. Schwarz. Psyche, vol. 8, sup. 1, p. 11
1899 Cactopinus. Schwarz. Ent. Soc. Wash. Proc. 4:368

Habitat. Arizona.

Food plant. Cereus giganteus.

CARPHOBORUS Eich.

1864 Eichhoff. Berl. Ent. Zeit. p. 27, 44, 46, tab. 1, fig. 8
1868 Leconte. Am. Ent. Soc. Trans. 2:172
1873 Chapuis. Mem. Soc. Liège, p. 248
1876 Leconte. Am. Phil. Soc. Proc. 15:383
1881 Eichhoff. Borkenk. p. 129
1883 Leconte & Horn. Col. N. A. p. 523
1895 Judeich-Nitsche. Forstins. 1:445, 446

9 **bicristatus** Chap.

1869 Carphoborus. Chapuis. Syn. Scol. p. 97
1873 Carphoborus. Chapuis. Mem. Soc. Liège, p. 249
1876 Carphoborus. Leconte. Am. Phil. Soc. Proc. 15:383, 384
1890 Carphoborus. Packard. U. S. Ent. Com'n, 5th Rep't, p. 726
1900 Carphoborus. Smith. Cat. Ins. N. J. p. 364

Habitat. Georgia ("Middle and Southern States," Chapuis).

Food plant. Pinus.

10 **bifurcus** Eich.

1868 Carphoborus. Eichhoff. Berl. Ent. Zeit. p. 147
1868 Dendroctonus. Zimmerman. Am. Ent. Soc. Trans. 2:148
1869 Dendroctonus. Chapuis. Syn. Scol. p. 97
1873 Carphoborus. Chapuis. Mem. Soc. Liège, p. 249
1876 Carphoborus. Leconte. Am. Phil. Soc. Proc. 15:383
1888 Carphoborus. Schwarz. Ent. Soc. Wash. Proc. 1:80
1890 Carphoborus. Packard. U. S. Ent. Com'n, 5th Rep't, p. 725, 726, fig. 255
1900 Carphoborus. Smith. Cat. Ins. N. J. p. 364

Habitat. District of Columbia, Tennessee, Gulf States.

Food plant. Pinus.

11 **simplex** Lec.

1876 Carphoborus. Leconte. Am. Phil. Soc. Proc. 15:383
1890 Carphoborus. Packard. U. S. Ent. Com'n, 5th Rep't, p. 725
Habitat. California.
Food plants. (?)

CHAETOPHLOEUS Leconte

1876 Leconte. Am. Phil. Soc. Proc. 15:382

12 **hystrix** Lec.

1858 Hylesinus. Leconte. Acad. Nat. Sci. Phila. Proc. p. 81
1868 Hylesinus. Leconte. Am. Ent. Soc. Trans. 2:171
1876 Chaetophloeus. Leconte. Am. Phil. Soc. Proc. 15:382
1892 Chaetophloeus. Blaisdell. Ins. Life, 5:36
Habitat. California.
Food plant. Rhus integrifolia.

CHRAMESUS Leconte

1868 Leconte. Am. Ent. Soc. Trans. 2:168
1876 Leconte. Am. Phil. Soc. Proc. 15:374
1883 Leconte & Horn. Col. N. A. p. 522
1895 Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 142, 169

RHOPALOPLEURUS Chapuis

1869 Chapuis. Syn. Scol. p. 46
1873 Chapuis. Mem. Soc. Liège, p. 254
1876 Leconte. Am. Phil. Soc. Proc. 15:374

13 **hicoriae** Lec.

1868 Chramesus. Leconte. Am. Ent. Soc. Trans. 2:168
1876 Chramesus. Leconte. Am. Phil. Soc. Proc. 15:375
1878 Chramesus. Hubbard & Schwarz. Am. Phil. Soc. Proc. 17:666
1886 Chramesus. Schwarz. Ent. Am. 2:54
1890 Chramesus. Packard. U. S. Ent. Com'n, 5th Rep't, p. 296
1890 Chramesus. Smith. Ent. Am. 6:53, fig.
1891 Chramesus. Hamilton. Can. Ent. 23:65
1892 Chramesus. Hamilton. Ins. Life, 4:268
1893 Chramesus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 140 etc.; Bul. 32, p. 212
1893 Chramesus. Smith. N. J. Agric. Rep't, p. 537, fig. 95
1894 Chramesus. Hopkins. Can. Ent. 26:280
1895 Chramesus. Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 170
1895 Chramesus. Hamilton. Am. Ent. Soc. Trans. 22:346, 378
1898 Chramesus. Chittenden. Ent. Soc. Wash. Proc. 4:78
1899 Chramesus. Lugger. Minn. Agric. Exp. Sta. Bul. 66, p. 316
1900 Chramesus. Smith. Cat. Ins. N. J. p. 364
1906 Chramesus. Felt. N. Y. State Mus. Mem. 8, 2:336, 448-49, 502

lecontei Chap.

1869 Rhopalopleurus. Chapuis. Syn. Scol. (?)
1873 Rhopalopleurus. Chapauis. Mem. Soc. Liège, p. 255
1876 = icoriae Lec. Leconte. Am. Phil. Soc. Proc. 15:375
Habitat. Canada, eastern, middle and western United States
Food plants. Hicoria, oak buds (?).

14 **chapuisii** Lec.

1876 Chramesus. Leconte. Am. Phil. Soc. Proc. 15:375
1886 Chramesus. Schwarz. Ent. Am. 2:54
Habitat. Louisiana.
Food plants. (?)

CNESINUS Leconte

1868 Leconte. Am. Ent. Soc. Trans. 2:171
1876 Leconte. Am. Phil. Soc. Proc. 15:378
1883 Leconte & Horn. Col. N. A. p. 523
1895 Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 132, 135

NEMOPHILUS Chapuis

1869 Chapuis. Syn. Scol. p. 27
1873 Chapuis. Mem. Soc. Liège, p. 235
1876 Leconte. Am. Phil. Soc. Proc. 15:378

15 **strigicollis** Lec.

1868 Cnesinus. Leconte. Am. Ent. Soc. Trans. 2:171
1876 Cnesinus. Leconte. Am. Phil. Soc. Proc. 15:378
1878 Cnesinus. Schwarz. Am. Phil. Soc. Proc. 17:468
1886 Cnesinus. Schwarz. Ent. Am. 2:54
1887 Cnesinus. Hamilton. Can. Ent. 19:66
1890 Cnesinus. Schwarz. Ins. Life, 3:87
1891 Cnesinus. Schwarz. Ent. Soc. Wash. Proc. 2:79
1895 Cnesinus. Hamilton. Am. Ent. Soc. Trans. 22:346, 378
1895 Cnesinus. Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 136, 139
1899 Cnesinus. Hopkins. Ent. Soc. Wash. Proc. 4:343
1900 Cnesinus. Smith. Cat. Ins. N. J. p. 365
1907 Cnesinus. Hopkins. Ent. Soc. Wash. Proc. 8:113

strigillatus Chap.

1869 Nemophilus. Chapuis. Syn. Scol. p. 27
1873 Nemophilus. Chapuis. Mem. Soc. Liège, p. 235
1878 = strigicollis Lec. Leconte. Am. Phil. Soc. Proc. 15:378
Habitat. Pennsylvania, Illinois, South Carolina, West Virginia, North Carolina, Texas, Mexico.
Food plants. Toxylon pomiferum, Liquidambar, Smilax, Hickoria (pith of twigs), Pyrus (?).

COCCOTRYPES Eich.

1878 Eichhoff. Rat. Tom. p. 57, 308
1881 Eichhoff. Borkenk. p. 52, 74, 267
1883 Leconte & Horn. Col. N. A. p. 518
1894 Blandford. Ent. Soc. Lond. Trans. p. 98

16 **dactyliperda** Fabr. (?)

1801 Bostrichus. Fabricius. Syst. El. 2:387, 14
(?) Bostrichus. Lucas. Expl. Alg. p. 464, tab. 39, fig. 1
1837 Bostrichus. Dej. Cat. p. 332
(?) Bostrichus. Duft. Fn. Aust. 3:95, 12
1842 Bostrichus. Hornung. Stett. Ent. Zeit. p. 116 (2)
1854 Bostrichus. Bach. Kaef. 2:123, 130
1862 Bostrichus. Doebner. Zool. 2:184
1866 Bostrichus. Eichhoff. Berl. Ent. Zeit. p. 277
1867 Anisandros. Ferrari. Borkenk. p. 26
1874 Dryocoetes. Redtenb. Fn. Aust. ed. 3. 2:381
1878 Coccotrypes. Eichhoff. Rat. Tom. p. 58, 309
1881 Coccotrypes. Eichhoff. Borkenk. p. 52, 74, 267
1886 Coccotrypes. Schwarz. Ent. Am. 2:42
1889 Coccotrypes. Hamilton. Am. Ent. Soc. Trans. 16:159
1894 Coccotrypes. Hamilton. Am. Ent. Soc. Trans. 21:406

palmicola Horn.

1846 Bostrichus. Hornung. Stett. Ent. Zeit. p. 116, (2)
1881 (?) = dactyliperda Fabr. Eichhoff. Borkenk. p. 268
Habitat. Europe, Africa, America (carried in nuts).
Food plants. Dates, betel.

CORTHYLUS Erichson

1836 Erichson. Wieg. Archiv. 1:64
1868 Eichhoff. Berl. Ent. Zeit. p. 279
1869 Eichhoff. Berl. Ent. Zeit. p. 297
1876 Leconte. Am. Phil. Soc. Proc. 15:347
1878 Eichhoff. Rat. Tom. p. 66, 421
1883 Leconte & Horn. Col. N. A. p. 517
1897 Hubbard. U. S. Div. Ent. Bul. 7. n. s. p. 16
1904 Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 251–54

MORIZUS Ferrari

1867 Ferrari. Borkenk. p. 59, 69
1904 Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 251

17 **columbianus** Hopk.

1894 Corthylus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 36, p. 313–36, fig. 27–30
1894 Corthylus. Hopkins. Can. Ent. 26:277
1894 Corthylus. Hopkins. Ins. Life, 6:281, 282; 7:146

1895 Corthylus. Hopkins. Ent. Soc. Wash. Proc. 3:104, 107
1897 Corthylus. Hubbard. U. S. Div. Ent. Bul. 7. n. s. p. 17–18
1904 Corthylus. Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 253, 254
1906 Corthylus. Felt. N. Y. State Mus. Mem. 8, 2:702

Habitat. Virginia, West Virginia, Michigan (?), Massachusetts.

Food plants. Quercus alba, Fagus americana, Tilia, Acer, Liriodendron tulipifera.

18 **punctatissimus** Zimm.

1868 Crypturgus. Zimmerman. Am Ent. Soc. Trans. 2:144
1868 Cryphalus. Leconte. Am. Ent. Soc. Trans. 2:154
1876 Corthylus. Leconte. Am. Phil. Soc. Proc. 15:347
1878 Crypturgus. Eichhoff. Rat. Tom. p. 460
1883 Corthylus. Merriam. Am. Nat. 17:84–86, fig. 1–5
1890 Corthylus. Packard. U. S. Ent. Com'n, 5th Rep't, p. 389, 390, fig. 144, 145
1890 Corthylus. Schwarz. Ins. Life, 3:178
1891 Corthylus. Schwarz. Ent. Soc. Wash. Proc. 2:109–15
1893 Corthylus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 127; Bul. 32, p. 207
1894 Corthylus. Hopkins. Ins. Life, 6:281; 7:145
1894 Corthylus. Hopkins. Can. Ent. 26:277
1895 Corthylus. Hamilton. Am. Ent. Soc. Trans. 22:346, 378
1895 Corthylus. Hopkins. Ent. Soc. Wash. Proc. 3:104
1897 Corthylus. Hubbard. U. S. Div. Ent. Bul. 7. n. s. p. 16–17
1900 Corthylus. Smith. Cat. Ins. N. J. p. 361
1904 Corthylus. Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 253, 254
1905 Corthylus. Felt. N. Y. State Mus. Mem. 8, 1:50, 65–67, fig. 7
1906 Corthylus. Felt. N. Y. State Mus. Mem. 8, 2:732

Habitat. Eastern, middle, southern and western United States.

Food plants. Acer saccharum, Sassafras, Cornus, Carpinus, Corylus, Ostrya, Gaylussacia resinosa.

19 **spinifer** Sz.

1891 Corthylus. Schwarz. Ent. Soc. Wash. Proc. 2:114
1895 Corthylus. Hopkins. Ent. Soc. Wash. Proc. 3:104

Habitat. South Florida.

Food plant. Quercus.

CRYPHALUS Erichson

1836 Erichson. Wieg. Archiv. 1:64
1864 Eichhoff. Berl. Ent. Zeit. p. 34, 45, 46
1868 Leconte. Am. Ent. Soc. Trans. 2:151, 153
1876 Leconte. Am. Phil. Soc. Proc. 15:361
1881 Eichhoff. Borkenk. p. 45, 172
1878 Eichhoff. Rat. Tom. p. 121
1883 Leconte & Horn. Col. N. A. p. 518
1885 Goz. Rev'd. Ent. 4:278
1888 Bedel. Faun. Col. Seine, 6:396, 397

1895 Judeich-Nitsche. Forstins. 1:448, 451, fig.
1901 Barbey. Scol. l'Europ. Cent. p. 69
1904 Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 225

ERNOPORUS Thomson

1866 Thomson. Skand. Col. i:147; vii:360
1904 Blandford. Biol. Centr. Am. Col. 4, pt 6. p. 226

20 jalappae Letz.

1844 Bostrichus. Letzner. Abh. Schles. Jahrb.
1848 Bostrichus. Letzner. Arb. Verand. Schles. Ges. p. 99
1867 Cryphalus (Ernoporus). Ferrari. Borkenk. p. 12, 14, 16, note 4
1878 Cryphalus. Eichhoff. Rat. Tom. p. 134
1881 Cryphalus. Eichhoff. Borkenk. p. 46, 74, 187
1883 Cryphalus. Schwarz. Ont. Ent. Soc. 14:30
1886 Cryphalus. Schwarz. Ent. Am. 2:42
1894 Cryphalus. Blandford. Ins. Life, 6:261
1894 Cryphalus. Hamilton. Am. Ent. Soc. Trans. 21:406
1901 Cryphalus. Schwarz. Ent. Soc. Wash. Proc. 4:432
Habitat. Mexico (?), exported to various countries, Europe, United States, etc.
Food plant. Jalap root.

21 miles Lec.

1878 Cryphalus. Leconte. Am. Phil. Soc. Proc. 17:433
1878 Cryphalus. Schwarz. Am. Phil. Soc. Proc. 17:468
Habitat. Florida.
Food plant. Pinus (?).

22 mucronatus Lec.

1879 Cryphalus. Leconte. U. S. Geol. Sur. Bul. 5:518
1886 Cryphalus. Schwarz. Ent. Am. 2:42
Habitat. Colorado.
Food plants.

23 piceae Ratz.

1837 Bostrichus. Ratzeburg. Forstins. 1:163
1854 Cryphalus. Bach. Kafer. 2:136
1862 Cryphalus. Doebner. Zool. 2:168
1874 Cryphalus. Redtb. Fn. Aust. ed. 3. 2:376
1878 Cryphalus. Eichhoff. Rat. Tom. p. 2, 122
1881 Cryphalus. Eichhoff. Borkenk. p. 45, 172–76, fig. 38, 39
1888 Cryphalus. Bedel. Faun. Col. Seine, 6:398, 414
1895 Tomicus. Judeich-Nitsche. Forstins. 1:492
1899 Cryphalus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 56, p. 444
1901 Cryphalus. Barbey. Scol. l'Europ. Cent. p. 69, pl. 2, fig. 15; pl. 8, fig. 5
1906 Cryphalus. Felt. N. Y. State Mus. Mem. 8, 2:753
1907 Cryphalus. Tredl. Nahrungs. Verbreit. Borkenk. Europ. p. 12

asperatus abietis Ferr.

1867 Cryphalus. Ferrari. Borkenk. p. 12, (7)
1878 = piceae Ratz. Eichhoff. Rat. Tom. p. 122
Habitat. France, Germany, Austria, Turkey, United States (West Virginia, New York), Canada.
Food plants. Pinaceae.

24 **rigidus** Lec.

1876 Cryphalus. Leconte. Am. Phil. Soc. Proc. 15:362
1878 Cryphalus. Hubbard & Schwarz. Am. Phil. Soc. Proc. 17:666
1886 Cryphalus. Schwarz. Ent. Am. 2:42
Habitat. Canada, Michigan.
Food plants.

25 **(?)robustus** Eich.

1871 Cryphalus. Eichhoff. Berl. Ent. Zeit. p. 131
1876 Cryphalus. Leconte. Am. Phil. Soc. Proc. 15:362
1878 Cryphalus. Eichhoff. Rat. Tom. p. 121
Habitat. "Am. Septent."
Food plants.

26 **striatulus** Mannh.

1853 Cryphalus. Mannerheim. Bul. Mosc. p. 235
1876 Cryphalus. Leconte. Am. Phil. Soc. Proc. 15:362
1878 Cryphalus. Eichhoff. Rat. Tom. p. 147
1894 Cryphalus. Schwarz. Ins. Life, 7:255
1894 Cryphalus. Hamilton. Am. Ent. Soc. Trans. 21:35
1901 Cryphalus. Felt. N. Y. Forest, Fish & Game Com'n Rept 7:516
1906 Cryphalus. Felt. N. Y. State Mus. Mem. 8, 2:376, 650, 673
Habitat. Alaska, Utah, New York.
Food plants. Picea engelmanni, Pinus, Abies, Tsuga.

27 **(?)terminalis** Mannh.

1843 Bostrichus. Mannerheim. Bul. Mosc. p. 298
1867 Ferrari. Borkenk. p. 75
1868 Bostrichus. Leconte. Am. Ent. Soc. Trans. 2:177
1885 Cryphalus (?) Henshaw. Col. N. A. p. 148
Habitat. California.
Food plants.

CRYPTURGUS Erichson

1836 Erichson. Wieg. Archiv. 1:60
1864 Eichhoff. Berl. Ent. Zeit. p. 33, 44, 46
1868 Zimmerman. Am. Ent. Soc. Trans. 2:142, 143
1876 Leconte. Am. Phil. Soc. Proc. 15:387
1877 Provancher. Faun. Ent. Can. 1:565
1878 Eichhoff. Rat. Tom. p. 72
1881 Eichhoff. Borkenk. p. 64, 165
1883 Leconte & Horn. Col. N. A. p. 523, 524
1888 Bedel. Faun. Col. Seine, 6:389, 395
1895 Judeich-Nitsche. Forstins. 1:448, 451
1901 Barbey. Scol. l'Europ. Cent. p. 68

28 **alutaceus** Sz.

1893 Crypturgus. Schwarz. Ins. Life. 5:288
1894 Crypturgus. Schwarz. Ent. Soc. Wash. Proc. 3:17
1899 Crypturgus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 56, p. 448
1906 Crypturgus. Felt. N. Y. State Mus. Mem. 8, 2:753
Habitat. Maryland, West Virginia, Florida.
Food plants. Picea, Pinus palustris, Pinus inops.

29 **atomus** Lec.

1868 Crypturgus. Leconte. Am. Ent. Soc. Trans. 2:152
1876 Crypturgus. Leconte. Am. Phil. Soc. Proc. 15:387
1877 Crypturgus. Provancher. Faun. Ent. Can. 1:565
1878 Crypturgus. Eichhoff. Rat. Tom. p. 75
1886 (?) =pusillus Gyll. Schwarz. Ent. Am. 2:56
1889 =pusillus Gyll. Hamilton. Am. Ent. Soc. Trans. 16:159
1889 Crypturgus. Hamilton. Am. Ent. Soc. Trans. 16:159
1890 Crypturgus. Packard. U. S. Ent. Com'n, 5th Rep't, p. 727, 825, 861, 872, fig. 256
1891 =pusillus Gyll. Hamilton. Ins. Life. 4:132
1894 =pusillus Gyll. Schwarz. Ent. Soc. Wash. Proc. 3:17
1898 Crypturgus. Blandford. Ent. News, 9:6
1900 =pusillus Gyll. Smith. Cat. Ins. N. J. p. 365
1904 Crypturgus. Hopkins. U. S. Div. Ent. Bul. 48, p. 26
1905 Crypturgus. Currie. U. S. Div. Ent. Bul. 53, p. 82
1906 Crypturgus. Felt. N. Y. State Mus. Mem. 8, 2:338, 359–60
Habitat. Canada, eastern United States.
Food plants. Pinus, Picea, Abies, Tsuga.

30 **pusillus** Gyll.

1813 Bostrichus. Gyllenhal. In. Suec. 3:371, (16)
1834 Bostrichus. Hartig. Convers. Lex. p. 110–12
1837 Bostrichus. Ratzeburg. Forstins. 1:162, t. 13, fig. 16
1839 Bostrichus. Ratzeburg. Forstins. 1:196–98, t. 13, fig. 16
1854 Crypturgus. Bach. Kaefer, 2:137
1856 Perris. Ann. Fr. p. 202
1862 Crypturgus. Doebner. Zool. 2:167
1864 Crypturgus. Eichhoff. Berl. Ent. Zeit. t. 1, fig. 12, (Ant.)
1867 Crypturgus. Eichhoff. Berl. Ent. Zeit. p. 404
1878 Crypturgus. Eichhoff. Rat. Tom. p. 73
1881 Crypturgus. Eichhoff. Borkenk. p. 165
1888 Crypturgus. Bedel. Faun. Col. Seine, 6:395, 412
1889 Crypturgus. Hamilton. Am. Ent. Soc. Trans. 16:159
1893 Crypturgus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 143 etc.; Bul. 32, p. 213
1894 Crypturgus. Schwarz. Ent. Soc. Wash. Proc. 3:17
1894 Crypturgus. Hamilton. Am. Ent. Soc. Trans. 21:407
1894 Crypturgus. Blandford. Ent. Soc. Lond. p. 82
1895 Tomicus. Judeich-Nitsche. Forstins. 1:527
1897 Crypturgus. Johnson. Penn. Agric. Rep't, p. 78–79, fig. 3

1898 Crypturgus. Blandford. Ent. News, 9:6
1899 Crypturgus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 56, p. 346, 448, fig. 96
1900 Crypturgus. Smith. Cat. Ins. N. J. p. 365
1901 Crypturgus. Barbey. Scol. l'Europ. Cent. p. 68, pl. 2, fig. 13; pl. 7, fig. 5
1907 Crypturgus. Trèdl. Nahrungs. Verbreit. Borkenk. Europ., 11. [Entomol. Blätter, Nr. 1 mit 6]

Habitat. Europe, Japan, eastern United States.

Food plant. Pinaceae.

[1] DENDROCTONUS Erichson

1836 Erichson. Wieg. Archiv. 1:52
1864 Eichhoff. Berl. Ent. Zeit. p. 26, 44, 46
1866 Lacordaire. Ins. Col. 7:360
1868 Zimmerman. Am. Ent. Soc. Trans. 2:148, 149
1869 Chapuis. Syn. Scol. p. 34
1873 Chapuis. Mem. Soc. Liège, p. 242
1876 Leconte. Am. Phil. Soc. Proc. 15:384
1877 Provancher. Faun. Ent. Can. 1:572
1881 Eichhoff. Borkenk. p. 125
1883 Leconte & Horn. Col. N. A. p. 523
1890 Dietz. Am. Ent. Soc. Trans. 17:27
1895 Judeich-Nitsche. Forstins. 1:445, 446
1895 Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 143, 146
1901 Barbey. Scol. l'Europ. Cent. p. 55
1906 Felt. N. Y. State Mus. Mem. 8, 2:337

31 **approximatus** Dietz

1890 Dendroctonus. Dietz. Am. Ent. Soc. Trans. 17:28, 31
1902 Dendroctonus. Schwarz. Ent. Soc. Wash. Proc. 5:32
1902 Dendroctonus. Hopkins. U. S. Dep't Agric. Yearbook, p. 281
1903 Dendroctonus. Hopkins. Can. Ent. 35:61
1904 Dendroctonus. Hopkins. U. S. Div. Ent. Bul. 48, p. 44
1904 Dendroctonus. Hopkins. U. S. Dep't Agric. Yearbook, p. 281
1905 Dendroctonus. Hopkins. U. S. Div. Ent. Bul. 56, p. 11
1905 Dendroctonus. Hopkins. Ent. Soc. Wash. Proc. 7:81
1907 Dendroctonus. Fall & Cockerell. Am. Ent. Soc. Trans. 33:218
1908 Dendroctonus. Burke. Ent. Soc. Wash. Proc. 9:115

Habitat. Arizona.

Food plant. Pinus ponderosa.

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[1] The recent work on the genus Dendroctonus by Dr A. D. Hopkins, entitled *The Genus Dendroctonus*, and published by the Bureau of Entomology of the United States Department of Agriculture, as Technical series no. 17, part 1, has been received too late to be inserted in this list.

The treatise referred to discusses the structure of these beetles in detail, giving a long series of very fine plates. Besides describing a number of new species and putting the synonymy of the various names in final shape, many new food plants are given, and the distribution of the various species is more exactly defined. Excellent figures of the various species are given.

The following new species are described from America north of Mexico: barberi Hopk., convexifrons, Hopk., arizonicus Hopk., jeffreyi Hopk., pseudotsugae Hopk., engelmanni Hopk., borealis Hopk., murrayana Hopk.

32 brevicomis Lec.

1876 Dendroctonus. Leconte. Am. Phil. Soc. Proc. 15:384, 386
1890 =frontalis Zimm. Dietz. Am. Ent. Soc. Trans. 17:28
1890 Dendroctonus. Packard. U. S. Ent. Com'n, 5th Rep't, p. 722
1899 Dendroctonus. Hopkins. U. S. Div. Ent. Bul. 21, p. 13
1902 Dendroctonus. Hopkins. Ent. Soc. Wash. Proc. 5:3
1902 Dendroctonus. Hopkins. U. S. Dep't Agric. Yearbook, p. 281
1904 Dendroctonus. Hopkins. U. S. Div. Ent. Bul. 48, p. 18
1904 Dendroctonus. Hopkins. U. S. Dep't Agric. Yearbook, p. 281
1905 Dendroctonus. Hopkins. Ent. Soc. Wash. Proc. 7:147, pl. 4
1905 Dendroctonus. Currie. U. S. Div. Ent. Bul. 53, p. 74
1906 Dendroctonus. Webb. U. S. Div. Ent. Bul. 58, pt 2, p. 20–22, 9 fig.

Habitat. Cascade and Rocky mountain region of United States.

Food plants. Pinus ponderosa, Pinus lambertiana.

33 frontalis Fabr.

1801 (?), Fabricius. Syst. El. 2:389
1868 Dendroctonus. Zimmerman. Am. Ent. Soc. Trans. 2:149
1868 Dendroctonus. Leconte. Am. Ent. Soc. Trans. 2:173
1876 Dendroctonus. Leconte. Am. Phil. Soc. Proc. 15:384, 386
1890 Dendroctonus. Dietz. Am. Ent. Soc. Trans. 17:28, 32
1890 Dendroctonus. Packard. U. S. Ent. Com'n, 5th Rep't, p. 722
1892 Dendroctonus. Hopkins. Ent. Soc. Wash. Proc. 2:353
1892 Dendroctonus. Hopkins. Science, July 29, 20:64
1893 Dendroctonus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 143; Bul. 32, p. 213
1893 Dendroctonus. Hopkins. Ins. Life, 5:187–89
1893 Dendroctonus. Riley. Ins. Life, 6:140
1893 Dendroctonus. Hopkins. Ins. Life, 6:126
1894 Dendroctonus. Hopkins. Can. Ent. 26:280
1896 Dendroctonus. Hopkins. Can. Ent. 28:250
1897 Dendroctonus. Chittenden. U. S. Div. Ent. Bul. 7. n. s. p. 72–75, fig. 43
1898 Dendroctonus. Schwarz. Ent. Soc. Wash. Proc. 4:81
1899 Dendroctonus. Hopkins. Ent. Soc. Wash. Proc. 4:343
1899 Dendroctonus. Lugger. Minn. Agric. Exp. Sta. Bul. 66, p. 315, 317, fig. 246
1899 Dendroctonus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 56, p. 395
1899 Dendroctonus. Hopkins. U. S. Div. Ent. Bul. 21, p. 13, 14
1901 Dendroctonus. Hopkins. U. S. Div. Ent. Bul. 28, pl. XII
1902 Dendroctonus. Hopkins. U. S. Dep't Agric. Yearbook, p. 270–75
1903 Dendroctonus. Hopkins. Can. Ent. 35:59
1904 Dendroctonus. Hopkins. U. S. Div. Ent. Bul. 48, p. 41, 44, pl. 1, fig. 2; pl. VI, VII
1904 Dendroctonus. Hopkins. U. S. Dep't Agric. Yearbook, p. 270–75
1905 Dendroctonus. Hopkins. Ent. Soc. Wash. Proc. 7:80
1905 Dendroctonus. Currie. U. S. Div. Ent. Bul. 53, p. 100
1905 Dendroctonus. Felt. N. Y. State Mus. Mem. 8, 1:6

1908 Dendroctonus. Fiske. Ent. Soc. Wash. Proc. 9:24, 25, 26
1908 Dendroctonus. Hopkins. Ent. Soc. Wash. Proc. 9:131
Habitat. Eastern and southern United States.
Food plants. Pinus, Picea.

34 **monticola** Hopk.

1905 Dendroctonus. Hopkins. U. S. Div. Ent. Bul. 56, p. 11
1908 Dendroctonus. Burke. Ent. Soc. Wash. Proc. 9:12, 115
Habitat. Western United States.
Food plants. Pinus lambertiana, P. monticola, P. murrayana, P. ponderosa, Picea engelmanni.

35 **obesus** Mannh.

1843 Hylurgus. Mannerheim. Bul. Mosc. p. 296
1852 Hylurgus. Mannerheim. Bul. Mosc. p. 356
1868 Dendroctonus. Leconte. Am. Ent. Soc. Trans. 2:173
1873 Dendroctonus. Chapuis. Mem. Soc. Liège, p. 243
1876 = rufipennis Kirby. Leconte. Am. Phil. Soc. Proc. 15:385
1877 Dendroctonus. Provancher. Faun. Ent. Can. 1:573
1877 Dendroctonus. Provancher. Faun. Ent. Can. v. 1, Add. et Cor. p. 13
1894 = rufipennis Kirby. Hamilton. Am. Ent. Soc. Trans. 21:35
1899 Dendroctonus. Hopkins. U. S. Div. Ent. Bul. 21, p. 15
1902 Dendroctonus. Hopkins. Ent. Soc. Wash. Proc. 5:3
1903 Dendroctonus. Hopkins. Can. Ent. 35:60

similis Lec.

1860 Dendroctonus. Leconte. Pac. R. R. Explor. Ins. p. 59
1868 =obesus Mannh. Leconte. Am. Ent. Soc. Trans. 2:173
1876 Dendroctonus. Leconte. Am. Phil. Soc. Proc. 15:384, 385
1877 = obesus Mannh. Provancher. Faun. Ent. Can. 1:373
1878 Dendroctonus. Hubbard & Schwarz. Am. Phil. Soc. Proc. 17:666
1878 = rufipennis Kirby. Provancher. Faun. Ent. Can. v. 1, Add. p. 13
1890 Dendroctonus. Dietz. Am. Ent. Soc. Trans. 17:28, 30
1890 Dendroctonus. Packard. U. S. Ent. Com'n, 5th Rep't, p. 721, 722
1891 Dendroctonus. Cook & Davis. Mich. Agric. Exp. Sta. Bul. 73, p. 15
1894 = rufipennis Kirby. Hamilton. Am. Ent. Soc. Trans. 21:35
1903 = obesus Mannh. Hopkins. Can. Ent. 35:60
1907 Dendroctonus. Fall & Cockerell. Am. Ent. Soc. Trans. 33:218
Habitat. Canada, Oregon, Colorado, Virginia, Texas, New Mexico.
Food plants.

36 **piceaperda** Hopk.

1901 Dendroctonus. Hopkins. U. S. Div. Ent. Bul. 28, p. 16, pl. ii
1902 Dendroctonus. Hopkins. U. S. Dep't Agric. Yearbook, p. 266–70, fig. 23, 24
1904 Dendroctonus. Hopkins. U. S. Div. Ent. Bul. 48, p. 26
1904 Dendroctonus. Hopkins. U. S. Dep't Agric. Yearbook, p. 266–70
1905 Dendroctonus. Currie. U. S. Div. Ent. Bul. 53, p. 82

1905 Dendroctonus. Hopkins. U. S. Div. Ent. Bul. 56, p. 10–11
1906 Dendroctonus. Felt. N. Y. State Mus. Mem. 8, 2:338, 379–85, 693, fig. 85
1906 Dendroctonus. Burke. Ent. Soc. Wash. Proc. 8:4, 5
1907 Dendroctonus. Fall & Cockerell. Am. Ent. Soc. Trans. 33:218
Habitat. New Brunswick to New York, New Mexico.
Food plants. Picea canadensis, Picea mariana.

37 **ponderosae** Hopk.

1902 Dendroctonus. Hopkins. U. S. Div. Ent. Bul. 32, p. 10
1902 Dendroctonus. Hopkins. U. S. Dep't Agric. Yearbook, p. 275–81, fig. 1, 28, 29, 30
1903 Dendroctonus. Gillette. Col. Agric. Rep't, 24:118
1904 Dendroctonus. Hopkins. U. S. Dep't Agric. Yearbook, p. 275, 281
1904 Dendroctonus. Hopkins. U. S. Div. Ent. Bul. 48, p. 44, pl. 1, fig. 1, pl. III, VIII, IX
1905 Dendroctonus. Hopkins. Ent. Soc. Wash. Proc. 7:147, pl. IV
1905 Dendroctonus. Hopkins. U. S. Div. Ent. Bul. 56, p. 10–22, fig. 1, 5, 6
1905 Dendroctonus. Currie. U. S. Div. Ent. Bul. 53, p. 100
1906 Dendroctonus. Burke. Ent. Soc. Wash. Proc. 7:4
Habitat. Rocky mountain region.
Food plants. Pinus, Picea.

38 **punctatus** Lec.

1868 Dendroctonus. Leconte. Am. Ent. Soc. Trans. 2:173
1876 Dendroctonus. Leconte. Am. Phil. Soc. Proc. 15:384, 385
1886 Dendroctonus. Schwarz. Ent. Am. 2:56
1890 =rufipennis Kirby. Dietz. Am. Ent. Soc. Trans. 17:28
1890 Dendroctonus. Packard. U. S. Ent. Com'n, 5th Rep't, p. 722
1894 =rufipennis Kirby. Hamilton. Am. Ent. Soc. Trans. 21:35
1897 =rufipennis Kirby. Johnson. Penn. Dep't Agric. An. Rep't, p. 73–77, fig. 2
1902 Dendroctonus. Hopkins. Ent. Soc. Wash. Proc. 5:3
Habitat. New York, Quebec.
Food plants.

39 **rufipennis** Kirby

1837 Hylurgus. Kirby. Faun. Bor. Am. 4:195
1853 Hylurgus. Mannh. Bul. Mosc. p. 238, (217)
1876 Dendroctonus. Leconte. Am. Phil. Soc. Proc. 15:384, 385
1877 Dendroctonus. Provancher. Faun. Ent. Can. 1:573
1878 Dendroctonus. Provancher. Faun. Ent. Can. v. 1, Add. et Cor. p. 13, 14
1886 Dendroctonus. Schwarz. Ent. Am. 2:56
1890 Dendroctonus. Dietz. Am. Ent. Soc. Trans. 17:28
1890 Hylurgus. Packard. U. S. Ent. Com'n, 5th Rep't, p. 814
1894 Dendroctonus. Schwarz. Ins. Life, 7:255
1894 Dendroctonus. Hamilton. Am. Ent. Soc. Trans. 21:36

1897 Dendroctonus. Johnson. Penn. Agric. Rep't, p. 73-77, fig. 2
1899 Dendroctonus. Hopkins. Ent. Soc. Wash. Proc. 4:343
1899 Dendroctonus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 56, p. 349, 393
1900 Dendroctonus. Smith. Cat. Ins. N. J. p. 364
1906 Dendroctonus. Felt. N. Y. State Mus. Mem. 8, 2:753
1907 Tredl. Nahrungs. Verbreit. Borkenk. Europ. 11 [Entomol. Blätter, Nr. 1 mit 6]

Habitat. Alaska, Canada, northern United States.

Food plants. Picea, Pinus.

40 simplex Lec.

1868 Dendroctonus. Leconte. Am. Ent. Soc. Trans. 2:173
1876 Dendroctonus. Leconte. Am. Phil. Soc. Proc. 15:384, 385
1878 Dendroctonus. Provancher. Faun. Ent. Can. v. 1, Add. et Cor. p. 13, 14
1886 Dendroctonus. Schwarz. Ent. Am. 2:56
1888 Dendroctonus. Schwarz. Ins. Life, 1:162
1889 = rufipennis Kirby. Schwarz. Ent. Soc. Wash. Proc. 1:175
1890 Dendroctonus. Dietz. Am. Ent. Soc. Trans. 17:28, 31
1890 Dendroctonus. Packard. U. S. Ent. Com'n, 5th Rep't, p. 722
1899 Dendroctonus. Hopkins. Ent. Soc. Wash. Proc. 4:343
1899 Dendroctonus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 56, p. 394
1906 Dendroctonus. Felt. N. Y. State Mus. Mem. 8, 2:752
1907 Dendroctonus. Fall & Cockerell. Am. Ent. Soc. Trans. 33:218

Habitat. Canada to West Virginia, Colorado, California, New Mexico.

Food plants. Picea, Larix.

41 terebrans Oliv.

1795 Scolytus. Olivier. Ent. 4:78, p. 6, pl. 1, fig. 6, a-b
1841 Hylurgus. Harris. Inj. Ins. Mass. p. 72
1852 Hylurgus. Harris. Rep. Ins. Inj. Veg. p. 75-76
1858 Hylurgus. Fitch. Nox. Ins. N. Y. 4th Rep't, p. 728
1868 Dendroctonus. Lacordaire. Gen. Col. 7:361
1868 Dendroctonus. Zimmerman. Am. Ent. Soc. Trans. 2:149
1868 Dendroctonus. Leconte. Am. Ent. Soc. Trans. 2:173
1869 Dendroctonus. Chapuis. Syn. Scol. p. 35
1873 Dendroctonus. Chapuis. Mem. Soc. Liège, p. 243
1876 Dendroctonus. Leconte. Am. Phil. Soc. Proc. 15:384, 385
1876 Dendroctonus. Thomas. Nox. Ins. Ill. 1st Rep't, p. 146
1877 Dendroctonus. Provancher. Faun. Ent. Can. 1:572
1878 Dendroctonus. Provancher. Faun. Ent. Can. v. 1, Add. et Cor. p. 13, 14
1878 Dendroctonus. Schwarz. Am. Phil. Soc. Proc. 17:469
1880 Hylurgus. Saunders. Ont. Ent. Soc. 10:5
1883 Hylurgus. Saunders. Ont. Ent. Soc. 14:55
1886 Dendroctonus. Schwarz. Ent. Am. 2:56
1888 Dendroctonus. Schwarz. Ent. Soc. Wash. Proc. 1:80

1890 Dendroctonus. Dietz. Am. Ent. Soc. Trans. 17:28, 29
1890 Dendroctonus. Packard. U. S. Ent. Com'n, 5th Rep't, p. 721, 858, fig. 250
1893 Dendroctonus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 143 etc.; Bul. 32, p. 213
1894 Dendroctonus. Hopkins. Can. Ent. 26:280
1895 Dendroctonus. Hamilton. Am. Ent. Soc. Trans. 22:346, 378
1897 Dendroctonus. Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 146
1899 Dendroctonus. Hopkins. Ent. Soc. Wash. Proc. 4:343
1899 Dendroctonus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 56, p. 392, 415, 421
1899 Dendroctonus. Lugger. Minn. Agric. Exp. Sta. Bul. 66, p. 317, fig. 247
1900 Dendroctonus. Smith. Cat. Ins. N. J. p. 364
1901 Dendroctonus. Felt. Forest, Fish & Game Com'n Rep't, 7:480–81, fig. 1, 2, 3
1901 Dendroctonus. Hopkins. U. S. Div. Ent. Bul. 28, pl. XII
1902 Dendroctonus. Felt. U. S. Div. Ent. Bul. 31, p. 64
1904 Dendroctonus. Hopkins. U. S. Div. Ent. Bul. 48, pl. VII
1905 Dendroctonus. Hopkins. Ent. Soc. Wash. Proc. 7:81, 145, 147, pl. IV
1906 Dendroctonus. Felt. N. Y. State Mus. Mem. 8, 2:333, 338, 342–45, 357, fig. 64, 65, 66
1907 Dendroctonus. Snow. Kan. Acad. Sci. Trans. 20, pt 2, p. 64

Habitat. Canada, United States.

Food plants. Pinus, Picea.

42 valens Lec.

1860 Dendroctonus. Leconte. Pac. R. R. Explor. Ins. v. 12, pt 2, p. 59
1868 =terebrans Oliv. Leconte. Am. Ent. Soc. Trans. 2:173
1873 Dendroctonus. Chapuis. Mem. Soc. Liège, p. 243
1876 =terebrans Oliv. Leconte. Am. Phil. Soc. Proc. 15:385
1877 =terebrans Oliv. Provancher. Faun. Ent. Can. 1:572
1895 =terebrans Oliv. Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 146
1902 Dendroctonus. Hopkins. U. S. Div. Ent. Bul. 32, p. 12
1903 Dendroctonus. Gillette. Col. Agric. Rep't, 24:118–19
1903 Dendroctonus. Hopkins. Can. Ent. 35:61
1904 Dendroctonus. Hopkins. U. S. Div. Ent. Bul. 48, p. 19
1904 Dendroctonus. Powell. N. Y. Ent. Soc. Jour. 12:237–43
1905 Dendroctonus. Hopkins. Ent. Soc. Wash. Proc. 7:81, 147, pl. IV
1905 Dendroctonus. Currie. U. S. Div. Ent. Bul. 53, p. 74
1905 Dendroctonus. Hopkins. U. S. Div. Ent. Bul. 56, p. 11, 17
1908 Dendroctonus. Burke. Ent. Soc. Wash. Proc. 9:115

Habitat. Southern Canada, United States, Mexico.

Food plants. Pinus, Picea.

DOLURGUS Eichhoff

1868 Eichhoff. Berl. Ent. Zeit. p. 147
1873 Chapuis. Mem. Soc. Liège, p. 232

1876 Leconte. Am. Phil. Soc. Proc. 15:387
1878 Eichhoff. Rat. Tom. p. 83
1883 Leconte & Horn. Col. N. A. p. 524

43 **pumilus** Mannh.

1843 Hylastes. Mannerheim. Bul. Mosc. p. 297, (259)
1852 Hylastes. Mannerheim. Bul. Mosc. p. 356, (146)
1868 Dolurgus. Eichhoff. Berl. Ent. Zeit. p. 147
1868 Aphanarthrum. Leconte. Am. Ent. Soc. Trans. 2:152
1869 Dolurgus. Chapuis. Syn. Scol. p. 88
1873 Dolurgus. Chapuis. Mem. Soc. Liège, p. 232
1876 Dolurgus. Leconte. Am. Phil. Soc. Proc. 15:387, 437
1878 Dolurgus. Eichhoff. Rat. Tom. p. 83
1894 Dolurgus. Hamilton. Am. Ent. Soc. Trans. 21:35
1904 Dolurgus. Hopkins. U. S. Div. Ent. Bul. 48, p. 18
1905 Dolurgus. Currie. U. S. Div. Ent. Bul. 53, p. 73
Habitat. Alaska, Oregon.
Food plant. Picea sitchensis.

DRYOCOETES Eichhoff

1864 Eichhoff. Berl. Ent. Zeit. p. 38, 45, 46
1876 Leconte. Am. Phil. Soc. Proc. 15:358, 361
1877 Provancher. Faun. Ent. Can. 1:568
1878 Eichhoff. Rat. Tom. p. 283
1881 Eichhoff. Borkenk. p. 52, 261
1883 Leconte & Horn. Col. N. A. p. 518
1888 Bedel. Faun. Col. Seine, p. 396, 400
1895 Judeich-Nitsche. Forstins. 1:449, 451, fig.
1898 Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 186, 189
1901 Barbey. Scol. l'Europ. Cent. p. 100
1906 Felt. N. Y. State Mus. Mem. 8, 2:337

44 **affaber** Mannh.

1852 Bostrichus. Mannerheim. Bul. Mosc. p. 359, (151)
1853 Bostrichus. Mannerheim. Bul. Mosc. 3:235, (212)
1868 Xyleborus. Leconte. Am. Ent. Soc. Trans. 2:162
1876 Dryocoetes. Leconte. Am. Phil. Soc. Proc. 15:361
1878 Dryocoetes. Hubbard & Schwarz. Am. Phil. Soc. Proc. 17:666
1888 Dryocoetes. Schwarz. Ent. Soc. Wash. Proc. 1:80
1890 Dryocoetes. Packard. U. S. Ent. Com'n, 5th Rep't, p. 810, 857, fig. 291
1893 Dryocoetes. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 138; Bul. 32, p. 212
1895 Dryocoetes. Schwarz. Ent. Soc. Wash. Proc. 3:143
1906 Dryocoetes. Felt. N. Y. State Mus. Mem. 8, 2:752
Habitat. Alaska, British Columbia, Colorado, Lake Superior to Virginia, Quebec.
Food plants. Pinus, Picea, Abies.

45 **autographus** Ratz.

1837 Bostrichus. Ratzeburg. Forstins. 1:160, t. 13, fig. 6
1839 Bostrichus. Ratzeburg. Forstins. 1:194-95, t. 13, fig. 6
1848 Nördling. Stet. Ent. Zeit. p. 240
Ulrich. Dej. Cat. ed. 3. p. 332
1854 Bostrichus. Bach. Kaefer. p. 124, 130
1862 Bostrichus. Doebn. Zool. 2:179
1864 Dryocoetes. Eichhoff. Berl. Ent. Zeit. p. 39, t. i, fig. 18
1867 Dryocoetes. Ferrari. Borkenk. p. 27
1874 Dryocoetes. Redtenb. Fn. Aust. ed. 3, 2:380
1878 Dryocoetes. Eichhoff. Rat. Tom. p. 284
1881 Dryocoetes. Eichhoff. Borkenk. p. 261, 262
1888 Dryocoetes. Hamilton. Am. Ent. Soc. Trans. 16:159
1888 Dryocoetes. Bedel. Faun. Col. Seine, 6:400, 416
1890 Dryocoetes. Hamilton. Ent. Am. 6:44
1892 Dryocoetes. Hopkins. Ins. Life, 4:258
1893 Dryocoetes. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 137; Bul. 32, p. 211
1894 Dryocoetes. Hamilton. Am. Ent. Soc. Trans. 21:35, 406
1894 Dryocoetes. Hopkins. Can. Ent. 26:279
1895 Dryocoetes. Schwarz. Ent. Soc. Wash. Proc. 3:143
1895 Tomicus. Judeich-Nitsche. Forstins. 1:454
1899 Dryocoetes. Hopkins. W. Va. Agric. Exp. Sta. Bul. 56, p. 445
1900 Dryocoetes. Smith. Cat. Ins. N. J. p. 363
1901 Dryocoetes. Barbey. Scol. l'Europ. Cent. p. 101, pl. III, fig. 20; pl. 15, fig. 1
1904 Dryocoetes. Schwarz. Harriman Alaska Exp. 8, Ins. pt 1, p. 185
1906 Dryocoetes. Felt. N. Y. State Mus. Mem. 8, 2:336, 337, 469, 650, 672, fig. 118
1907 Dryocoetes. Trèdl. Nahrungs. Verbreit. Borkenk. Europ. p. 17 [Entomol. Blätter, Nr. 1 mit 6]

septentrionis Mannh.

1843 Bostrichus. Mannerheim. Bul. Mosc. p. 298, (261)
1853 Bostrichus. Mannerheim. Bul. Mosc. 3:325, (210)
1868 Xyleborus. Leconte. Am. Ent. Soc. Trans. 2: 161
1876 Dryocoetes. Leconte. Am. Phil. Soc. Proc. 15:361
1877 Dryocoetes. Provancher. Faun. Ent. Can. 1:568
1878 Dryocoetes. Hubbard & Schwarz. Am. Phil. Soc. Proc. 17:643
1878 = autographus Ratz. Eichhoff. Rat. Tom. p. 284
1881 = autographus Ratz. Eichhoff. Borkenk. p. 262
1886 = autographus Ratz. Schwarz. Ent. Am. 2:42
1888 = autographus Ratz. Bedel. Faun. Col. Seine, 6:416
1889 = autographus Ratz. Hamilton. Am. Ent. Soc. Trans. 16:159
1893 = autographus Ratz. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 137; Bul. 32, p. 211
1907 Dryocoetes. Fall & Cockerell. Am. Ent. Soc. Trans. 33:217

semicastaneus Mannh.

1852 Bostrichus. Mannerheim. Bul. Mosc. p. 358
1876 =septentrionis Mannh. Leconte. Am. Phil. Soc. Proc. 15:361
1878 =autographus Ratz. Eichhoff. Rat. Tom. p. 284
1888 =autographus Ratz. Hamilton. Am. Ent. Soc. Trans. 16:159
1888 =autographus Ratz. Bedel. Faun. Col. Seine, 6:416

villosus Herbst.

1793 Bostrichus. Herbst. Kaefer. 5:121 (?)
1813 Bostrichus. Gyllenhal. In. Suec. 3:361
1878 =autographus Ratz. Eichhoff. Rat. Tom. p. 284
1881 =autographus Ratz. Eichhoff. Borkenk. p. 262
Habitat. Alaska, Canada, northern United States, New Mexico, Europe, Japan.
Food plants. Pinus, Picea, Abies.

46 **eichhoffi** Hopk.

1894 Dryocoetes. Hopkins. Can. Ent. 26:279
1903 Dryocoetes. Hopkins. U. S. Dep't Agric. Yearbook, p. 320
1906 Dryocoetes. Felt. N. Y. State Mus. Mem. 8, 2:336, 337
Habitat. New York, Montreal Island.
Food plant. Betula lutea.

47 **granicollis** Lec.

1868 Xyleborus. Leconte. Am. Ent. Soc. Trans. 2:162
1876 Dryocoetes. Leconte. Am. Phil. Soc. Proc. 15:361
1878 Dryocoetes. Hubbard & Schwarz. Am. Phil. Soc. Proc. 17:643
1891 Dryocoetes. Schwarz. Ent. Soc. Wash. Proc. 2:79
1893 Dryocoetes. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 138; Bul. 32, p. 212
1894 Dryocoetes. Hopkins. Can. Ent. 26:279
1897 Dryocoetes. Chittenden. U. S. Div. Ent. Bul. 7. n. s. p. 72
1899 Dryocoetes. Hopkins. W. Va. Agric. Exp. Sta. Bul. 56, p. 251, 346, 445
1900 Dryocoetes. Smith. Cat. Ins. N. J. p. 363
1906 Dryocoetes. Felt. N. Y. State Mus. Mem. 8, 2:720, 753
Habitat. Pennsylvania, District of Columbia, Virginia, West Virginia, Colorado.
Food plants. Picea, Castanea, Juglans cinerea.

ECCOPTOGASTER Herbst.

1793 Herbst. Die Kafer. 5:124
1837 Ratzeburg. Forstins. 1:168
1839 Ratzeburg. Forstins. 1:225
1868 Zimmerman. Am. Ent. Soc. Trans. 2:142
1903 Ganglbauer. Munch. Koleopt. Zeit. 1:311, footnote
1907 Trèdl. Nahrungs. Verbreit. Borkenk. Europ. [Entomol. Blätter, Nr. 1 mit. 6:5]

COPTOGASTER Illiger

1807 Illiger. Mag. für Ins. 6:321
1888 Bedel. Faun. Col. Seine, 6:386

SCOLYTUS Geoffroy

1762 Scolytus. Geoffroy. Hist. Ins. Envir. Paris. 1:309
1864 Eichhoff. Berl. Ent. Zeit. p. 31, 44, 46
1866 Lacordaire. Col. 7:386, 387
1869 Chapuis. Syn. Scol. p. 53
1873 Chapuis. Mem. Soc. Liège, p. 261
1876 Leconte. Am. Phil. Soc. Proc. 15:370, 371
1881 Eichhoff. Borkenk. p. 39, 148
1883 Leconte & Horn. Col. N. A. p. 520
1888 Bedel. Faun. Col. Seine, 6:386
1895 Judeich–Nitsche. Forstins. 1:443
1895 Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 120
1901 Barbey. Scol. l'Europ. Cent. p. 34

48 **californicus** Lec.

1868 Scolytus. Leconte. Am. Ent. Soc. Trans. 2:165
1876 Scolytus. Leconte. Am. Phil. Soc. Proc. 15:371, 372
1886 Scolytus. Smith. Ent. Am. 2:127
1907 Scolytus. Fall & Cockerell. Am. Ent. Soc. Trans. 33:217
Habitat. California, New Mexico.
Food plants.

49 **fagi** Walsh

1867 Scolytus. Walsh. Pract. Ent. 2:58
1868 Scolytus. Leconte. Am. Ent. Soc. Trans. 2:166
1876 Scolytus. Leconte. Am. Phil. Soc. Proc. 15:371, 372
1886 Scolytus. Smith. Ent. Am. 2:127
1890 Scolytus. Packard. U. S. Ent. Com'n, 5th Rep't, p. 520, 611
1906 Scolytus. Felt. N. Y. State Mus. Mem. 8, 2:722
Habitat. Illinois, Texas.
Food plants. Celtis occidentalis, Fagus americana.

50 **muticus** Say

1826 Scolytus. Say. Acad. Nat. Sci. Phila. Jour. 3:323; ed. Lec. 2:182
1867 Scolytus. Walsh. Prac. Ent. 2:58
1868 Scolytus. Leconte. Am. Ent. Soc. Trans. 2:166
1873 Scolytus. Riley. Ins. Inj. Mo. 5th Rep't, p. 105, 108
1876 Scolytus. Leconte. Am. Phil. Soc. Proc. 15:371, 372
1886 Scolytus. Smith. Ent. Am. 2:127
1890 Scolytus. Packard. U. S. Ent. Com'n, 5th Rep't, p. 612
1892 Scolytus. Hopkins. Ins. Life. 4:257, 259
1893 Scolytus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 140 etc.; Bul. 32, p. 212
1894 Scolytus. Hopkins. Can. Ent. 26:280
1896 Scolytus. Klages. Ent. News, 7:11, 12, 282

1897 Scolytus. Klages. Ent. News, 8:90
1903 Scolytus. Hopkins. U. S. Dep't Agric. Yearbook, p. 320
1905 Scolytus. Hopkins. Ent. Soc. Wash. Proc. 7:145, pl. 4
1906 Scolytus. Felt. N. Y. State Mus. Mem. 8, 2:725

Habitat. Pennsylvania, Missouri.

Food plant. Celtis americana.

51 praeceps Lec.

1876 Scolytus. Leconte. Am. Phil. Soc. Proc. 15:371, 373
1899 Scolytus. Hopkins. U. S. Div. Ent. Bul. 21, p. 16
1904 Scolytus. Hopkins. U. S. Div. Ent. Bul. 48, p. 21
1905 Scolytus. Currie. U. S. Div. Ent. Bul. 53, p. 76
1907 Scolytus. Fall & Cockerell. Am. Ent. Soc. Trans. 33:217

Habitat. California, Idaho.

Food plant. Abies.

52 quadrispinosus Say

1826 Scolytus. Say. Acad. Nat. Sci. Phila. Jour. 3:323; ed. Lec. 2:182
1867 Scolytus. Walsh. Prac. Ent. 2:58
1868 Scolytus. Leconte. Am. Ent. Soc. Trans. 2:165
1873 Scolytus. Riley. Inj. Ins. Mo. 5th Rep't, p. 105–7, sup. p. 54
1874 Scolytus. Le Baron. Nox. Ins. Ill. Rep't, p. 146
1876 Scolytus. Thomas. Nox. Ins. Ill. Rep't, p. 145
1876 Scolytus. Leconte. Am. Phil. Soc. Proc. 15:371
1883 Scolytus. Saunders. Ont. Ent. Soc. 14:51
1886 Scolytus. Smith. Ent. Am. 2:127
1890 Scolytus. Packard. U. S. Ent. Com'n, 5th Rep't, p. 294, 860
1891 Scolytus. Hamilton. Ins. Life. 4:130
1892 Scolytus. Hopkins. Ins. Life, 4:258
1893 Scolytus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 139 etc.; Bul. 32, p. 212
1894 Scolytus. Hopkins. Can. Ent. 26:280
1894 Scolytus. Smith. Ent. News, 6:294
1895 Scolytus. Hamilton. Am. Ent. Soc. Trans. 22:346, 378
1895 Scolytus. Smith. N. J. Agric. Exp. Sta. Rep't, p. 465–74
1896 Scolytus. Klages. Ent. News, 7:12
1896 Scolytus. Osborn. Iowa Agric. Exp. Sta. Bul. 33, p. 594, fig. 1
1899 Scolytus. Hopkins. Ent. Soc. Wash. Proc. 4:344
1899 Scolytus. Lugger. Minn. Agric. Exp. Sta. Bul. 66, p. 304, 315, fig. 245
1900 Scolytus. Smith. Cat. Ins. N. J. p. 363
1901 Scolytus. Britton. Ct. Dep't Agric. Rep't, p. 267, pl. 8, fig. 2
1905 Scolytus. Gossard. Fla. Agric. Exp. Sta. Bul. 79, p. 309, 311
1905 Scolytus. Currie. U. S. Div. Ent. Bul. 53, p. 101
1905 Scolytus. Felt. N. Y. State Mus. Mem. 8, 1:257, 275–79
1906 Scolytus. Felt. N. Y. State Mus. Mem. 8, 2:336, 446, 502, 504, 505

caryae Riley

1867 Scolytus. Riley. Prairie Farmer, Feb. 2, Aug. 10, 1872
1867 Scolytus. Walsh. Prac. Ent. 2:58

1868 Scolytus. Leconte. Am. Ent. Soc. Trans. 2:166
1873 Scolytus. Riley. Nox. Ins. Mo. 5:103–7, 108, fig. 38, 371; sup. p. 54
1876 =quadrispinosus Say. Leconte. Am. Phil. Soc. Proc. 15:371
1881 =quadrispinosus Say. Riley. U. S. Ent. Com'n Bul. 6, p. 54

Habitat. New York to Georgia and Missouri, Quebec.

Food plant. Hicoria.

53 rugulosus Ratz.

1837 Eccoptogaster. Ratzeburg. Forstins. 1:187, t. X, fig. 10
1839 Eccoptogaster. Ratzeburg. Forstins. 1:230, t. X, fig. 10
1869 Scolytus. Chapuis. Syn. Scol. p. 60, 21
1878 Scolytus. Leconte. Am. Phil. Soc. Proc. 17:626
1880 Scolytus. Riley. Am. Ent. 3:298
1881 Scolytus. Eichhoff. Borkenk. p. 157–58
1882 Scolytus. Penhallow. Houghton Farm Exp. Sta. Pub. ser. 3. 5:38
1884 Scolytus. Hagen. Can. Ent. 16:161–63
1884 Scolytus. Garman. Georgia Crop. Rep't, Aug. 16
1885 Scolytus. Hamilton. Can. Ent. 17:48
1886 Scolytus. Scudder. Can. Ent. 18:195
1886 Scolytus. Smith. Ent. Am. 2:127
1888 Scolytus. Schwarz. Ent. Soc. Wash. Proc. 1:30
1888 Scolytus. Bedel. Faun. Col. Seine, 6:388, 406
1889 Scolytus. Atkinson. S. C. Exp. Sta. Bul. 4. n. s. p. 79, 80
1889 Scolytus. Howard. Ent. Soc. Wash. Proc. 1:129
1889 Scolytus. Forbes. Ill. Hort. Soc. Trans. 5:23, 245
1889 Scolytus. Lintner. 4th Rep't, p. 103–7, fig. 41
1889 Scolytus. Hamilton. Am. Ent. Soc. Trans. 16:159
1890 Scolytus. Packard. U. S. Ent. Com'n, 5th Rep't, p. 860
1891 Scolytus. Forbes. Ill. 6th Rep't, p. 1–20, pl. 1; Ill. Agric. Exp. Bul. 15, p. 469–78
1891 Scolytus. Riley & Howard. Ins. Life, 3:298
1893 Scolytus. Chittenden. Ins. Life, 5:250
1893 Scolytus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 140 etc.
1894 Scolytus. Hamilton. Am. Ent. Soc. Trans. 21:407
1894 Scolytus. Sturgis. Ct. Agric. Exp. Sta. Rep't, p. 142
1894 Scolytus. Murtfeldt. U. S. Div. Ent. Bul. 32. o. s. p. 40
1894 Scolytus. Smith. N. J. Agric. Exp. Sta. Rep't, p. 431, 565–72, fig. 43
1894 Scolytus. Troop. Ind. Agric. Exp. Sta. Bul. 53, p. 126–30, fig. 1–3
1894 Scolytus. Hopkins. Can. Ent. 26:280
1895 Scolytus. Ky. Dep't Agric. Rep't, p. 41
1895 Scolytus. Webster. Ohio Agric. Exp. Sta. Bul. 68, p. 23–25, fig. 3, 5, 6
1895 Scolytus. Sturgis. Ct. Dep't Agric. Rep't, p. 191
1895 Scolytus. Judeich–Nitsche. Forstins. 1:444, 486
1896 Scolytus. Klages. Ent. News, 7:12
1896 Scolytus. Lintner. 11th N. Y. Rep't, p. 270
1896 Scolytus. Ormerod. Rep't 1895, p. 76
1897 Scolytus. Britton. Ct. Exp. Rep't 1896, p. 240–44, 283, pl. 6
1897 Scolytus. Bogue. Okla. Agric. Exp. Sta. Bul. 26, p. 16–17, fig. 1–4
1897 Scolytus. Butz. Penn. Agric. Exp. Sta. Bul. 37, p. 26, fig. 6

1898 Scolytus. Ormerod. Hdbk. Ins. Orchard Fruits, p. 197–201, 2 fig.
1898 Scolytus. Chittenden. U. S. Div. Ent. Cir. 29
1898 Scolytus. Stedman. Mo. Agric. Exp. Sta. Bul. 44, p. 1–12, fig. 1–4
1898 Scolytus. Starnes. Ga. Agric. Exp. Sta. Bul. 42, p. 227, fig.
1898 Scolytus. Smith. N. J. Dep't Agric. Rep't, p. 385
1898 Scolytus. Baker. Ala. Agric. Exp. Sta. Bul. 90, p. 33–37, fig. 4–6
1899 Scolytus. Johnson. Ent. Soc. Wash. Proc. 4:344
1899 Scolytus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 56, p. 295
1899 Scolytus. Petit. Mich. Agric. Exp. Sta. Bul. 175, p. 363–65, fig. 19
1899 Scolytus. Fletcher. Ont. Ent. Soc. 30:110
1899 Scolytus. Chittenden. U. S. Div. Ent. Bul. 19, p. 96, 97
1899 Scolytus. Webster. Ohio Agric. Exp. Sta. Bul. 112, p. 143–49
1899 Scolytus. Hopkins. Ent. Soc. Wash. Proc. 4:344
1899 Scolytus. Lugger. Minn. Agric. Sta. Bul. 66, p. 313–15, fig. 243
1900 Scolytus. Smith. Cat. Ins. N. J. p. 364
1900 Scolytus. Sherman. N. C. Bd Agric. Rep't, p. 98
1900 Scolytus. Lochhead. Ont. Ent. Soc. 31:72
1900 Scolytus. Lowe. N. Y. Agric. Exp. Sta. Bul. 180, p. 122–28
1900 Scolytus. Johnson. N. Y. Agric. Exp. Sta. Bul. 195, p. 393
1901 Scolytus. Quaintance. Md. Agric. Exp. Sta. Rep't, p. 103, fig. 20
1901 Scolytus. Barbey. Scol. l'Europ. Cent. p. 39, pl. 1, fig. 14; pl. 3, fig. 2
1903 Scolytus. Sherman. N. C. Agric. Exp. Sta. Bul. 186, p. 5–6, 10, 21, fig. 1
1903 Scolytus. Washburn. Minn. Agric. Exp. Sta. Bul. 84, p. 57, 81, 91, fig. 30
1904 Scolytus. Titus & Pratt. U. S. Div. Ent. Bul. 47, p. 20.
1904 Scolytus. Petit. Mich. Agric. Exp. Sta. Bul. 24, p. 34, 53–55, 59, fig. 53
1904 Scolytus. Starnes. Ga. Agric. Exp. Sta. Bul. 67, p. 253–54, fig. 11
1905 Scolytus. Chittenden. U. S. Dep't Agric. Yearbook, p. 346, 347, fig. 88
1905 Scolytus. Smith. Ga. State Bd Ent. Bul. 17, p. 87–89, fig. 14
1905 Scolytus. Currie. U. S. Div. Ent. Bul. 53, p. 13, 19, 20
1905 Scolytus. Gossard. Ohio Agric. Exp. Sta. Bul. 164, p. 19, 22
1905 Scolytus. Symons. Md. Agric. Exp. Sta. Bul. 101, p. 129–30, 146, fig. 4
1906 Scolytus. Felt. N. Y. State Mus. Mem. 8, 2:336, 453, 503
1907 Eccoptogaster. Trèdl. Nahrungs. Verbreit. Borkenk. Europ. p. 6

Habitat. Europe, United States, Canada.

Food plants. Prunus, Pyrus, Crataegus.

54 **subscaber** Lec.

1876 Scolytus. Leconte. Am. Phil. Soc. Proc. 15:371, 373
1904 Scolytus. Hopkins. U. S. Div. Ent. Bul. 48, p. 21
1905 Scolytus. Currie. U. S. Div. Ent. Bul. 53, p. 76
1908 Scolytus. Burke. Ent. Soc. Wash. Proc. 9:115

Habitat. California to British Columbia, Utah.

Food plant. Abies.

55 **sulcatus** Lec.

1868 Scolytus. Leconte. Am. Ent. Soc. Trans. 2:167
1876 Scolytus. Leconte. Am. Phil. Soc. Proc. 15:371, 373

Habitat. New York.

Food plants.

56 unispinosus Lec.

1876 Scolytus. Leconte. Am. Phil. Soc. Proc. 15:371, 372
1878 Scolytus. Leconte. Am. Phil. Soc. Proc. 17:626
1886 Scolytus. Smith. Ent. Am. 2:125–27
1890 Scolytus. Packard. U. S. Ent. Com'n, 5th Rep't, p. 859, fig. 293
1894 Scolytus. Schwarz. Ins. Life, 7:255
1899 Scolytus. Hopkins. U. S. Div. Ent. Bul. 21, p. 16
1904 Scolytus. Hopkins. U. S. Div. Ent. Bul. 48, p. 20
1905 Scolytus. Currie. U. S. Div. Ent. Bul. 53, p. 76

Habitat. Pacific coast and Rocky mountain region of United States.

Food plants. Pseudotsuga mucronata, Larix occidentalis (?).

57 ventralis Lec.

1868 Scolytus. Leconte. Am. Ent. Soc. Trans. 2:167
1876 Scolytus. Leconte. Am. Phil. Soc. Proc. 15:371, 373

Habitat. Washington.

Food plants.

ERINEOPHILUS Hopkins

1902 Hopkins. Ent. Soc. Wash. Proc. 5:34

58 schwarzi Hopk.

1902 Erineophilus. Hopkins. Ent. Soc. Wash. Proc. 5:34–38, fig. 2

Habitat. Florida.

Food plant. Ficus.

GNATHOTRICHUS Eichhoff

1868 Eichhoff. Berl. Ent. Zeit. p. 275
1876 Leconte. Am. Phil. Soc. Proc. 15:350
1878 Eichhoff. Rat. Tom. p. 405
1883 Leconte & Horn. Col. N. A. p. 517
1904 Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 246

59 asperulus Lec.

1868 Cryphalus. Leconte. Am. Ent. Soc. Trans. 2:155
1876 Pityophthorus. Leconte. Am. Phil. Soc. Proc. 15:350
1878 Cryphalus. Eichhoff. Rat. Tom. p. 202
1886 Gnathotrichus. Schwarz. Ent. Am. 2:40
1888 Gnathotrichus. Schwarz. Ent. Soc. Wash. Proc. 1:80
1890 Gnathotrichus. Packard. U. S. Ent. Com'n, 5th Rep't, p. 720
1906 Gnathotrichus. Felt. N. Y. State Mus. Mem. 8, 2:726

Habitat. Washington, D. C., Virginia.

Food plant. Pinus.

60 materiarius Fitch

1858 Tomicus. Fitch. Nox. Ins. N. Y. 4th Rep't, p. 40–42
1868 Crypturgus. Zimmerman. Am. Ent. Soc. Trans. 2:143

1868 Gnathotrichus. Eichhoff. Berl. Ent. Zeit. p. 275
1876 Pityophthorus. Leconte. Am. Phil. Soc. Proc. 15:350
1877 Cryphalus. Provancher. Faun. Ent. Can. 1:566
1878 Gnathotrichus Eichhoff. Rat. Tom. p. 406
1886 Gnathotrichus. Schwarz. Ent. Am. 2:40
1888 Gnathotrichus. Schwarz. Ent. Soc. Wash. Proc. 1:44, 80
1890 Gnathotrichus. Packard. U. S. Ent. Com'n, 5th Rep't, p. 718–20, 816, fig. 249
1893 Gnathotrichus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 128; Bul. 32, p. 208
1894 Gnathotrichus. Hopkins. Can. Ent. 26:277
1895 Gnathotrichus. Hamilton. Am. Ent. Soc. Trans. 22:346, 378
1897 Gnathotrichus. Hubbard. U. S. Div. Ent. Bul. 7. n. s. p. 30
1899 Gnathotrichus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 56, p. 434, 442, fig. 11, 12
1901 Gnathotrichus. Felt. Forest, Fish & Game Com'n Rep't, 7:495–96
1904 Gnathotrichus. Hopkins. U. S. Div. Ent. Bul. 48, p. 15
1905 Gnathotrichus. Hopkins. Ent. Soc. Wash. Proc. 7:73
1905 Gnathotrichus. Garman. Ky. Agric. Exp. Sta. Bul. 120, p. 69
1905 Gnathotrichus. Currie. U. S. Div. Ent. Bul. 53, p. 70
1906 Gnathotrichus. Felt. N. Y. State Mus. Mem. 8, 2:339, 371–72, fig. 75
1907 Gnathotrichus. Fall & Cockerell. Am. Ent. Soc. Trans. 33:217

corthyloides Eich.

1868 Gnathotrichus. Eichhoff. Berl. Ent. Zeit. p. 273
1876 = materiarius Fitch. Leconte. Am. Phil. Soc. Proc. 15:350
1878 = materiarius Fitch. Eichhoff. Rat. Tom. p. 406

Habitat. Eastern United States and Canada to Texas.

Food plants. Pinus, Picea.

61 **retusus** Lec.

1868 Cryphalus. Leconte. Am. Ent. Soc. Trans. 2:155
1876 Pityophthorus. Leconte. Am. Phil. Soc. Proc. 15:350
1878 Gnathotrichus. Eichhoff. Rat. Tom. p. 406, 511
1893 Gnathotrichus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 128; Bul. 32, p. 208
1894 Gnathotrichus. Hopkins. Can. Ent. 26:277
1906 Gnathotrichus. Felt. N. Y. State Mus. Mem. 8, 2:752
1907 Gnathotrichus. Fall & Cockerell. Am. Ent. Soc. Trans. 33:217

Habitat. Nevada, Arizona, California.

Food plant. Pinus.

62 **sulcatus** Lec.

1868 Cryphalus. Leconte. Am. Ent. Soc. Trans. 2:155
1876 = retusus Lec. Leconte. Am. Phil. Soc. Proc. 15:350
1878 = retusus Lec. (?) Eichhoff. Rat. Tom. p. 408, 512
1904 Gnathotrichus. Hopkins. U. S. Div. Ent. Bul. 48, p. 15
1905 Gnathotrichus. Hopkins. Ent. Soc. Wash. Proc. 7:73

1905 Gnathotrichus. Currie. U. S. Div. Ent. Bul. 53, p. 70
1907 Gnathotrichus. Fall & Cockerell. Am. Ent. Soc. Trans. 33:217

Habitat. Pacific coast and Rocky mountain region, Mexico.

Food plants. Pinus, Tsuga, Pseudotsuga, Abies, Picea, Thuja, Sequoia.

HYLASTINUS Bedel

1888 Bedel. Faun. Col. Seine, 6:388

63 obscurus Marsh.

1802 Hylesinus. Marsham. Ent. Brit. p. 57
1869 Hylesinus. Chapman. Ent. M. Mag. 6:7
1888 Hylastinus. Bedel. Faun. Col. Seine, 6:388, 390, 408
1894 Hylastinus. Riley & Howard. Ins. Life, 7:273
1894 Hylastes. Davis. Mich. Agric. Exp. Sta. Bul. 116, p. 41, 47
1896 Hylastes. Hopk. & Rumsey. W. Va. Agric. Bul. 44, p. 264
1899 Hylastes. Webster. Ohio Agric. Exp. Sta. Bul. 112
1900 Hylastinus. Fletcher. Ont. Ent. Soc. 31:67
1901 Hylastes. Webster. Ont. Ent. Soc. 32:64
1907 Hylastinus. Webster. U. S. Div. Ent. Bul. 67
1907 =trifolii Müller. Trèdl. Nahrungs. Verbreit. Borkenk. Europ. p. 8, 20 [Entomol. Blätter, Nr 1 mit 6]

trifolii Müller

1807 Hylesinus. Müller. Mem. Soc. Deprtm. M. Tonerre, 1:47
1844 Hylastes. Schmitt. Stet. Ent. Zeit. p. 389–97
1864 Hylesinus. Taschenburg. Naturg. wirbell. Thiere, p. 272–73
1869 Hylastes. Chapuis. Syn. Scol. p. 22, 23, (79)
1873 Hylastes. Chapuis. Mem. Soc. Liege, p. 231
1878 Hylesinus. Riley. U. S. Dep't Agric. Rep't, p. 248
1880 Hylesinus. Riley. Am. Ent. 3:180
1881 Hylastes. Eichhoff. Borkenk. p. 97
1881 Hylastes. Saunders. Ont. Ent. Soc. p. 43–44, fig. 15
1881 Hylesinus. Lintner. N. Y. Agric. Soc. Rep't (1880), p. 16
1881 Hylesinus. Chase. Wis. Agric. Soc. Trans. 19:465
1882 Hylastes. Saunders. Ont. Ent. Soc. 12:43
1882 Hylastes. Lintner. 1st N. Y. Rep't, p. 247
1886 Hylesinus. Schwarz. Ent. Am. 2:55
1888 Hylesinus. Weed. Ohio Agric. Exp. Sta. Rep't, p. 133, fig. 1
1888 =obscurus Marsh. Bedel. Faun. Col. Seine, 6:391
1889 Hylastes. Hamilton. Am. Ent. Soc. Trans. 16:159
1889 Hylastes. Riley & Howard. Ins. Life, 1:218
1890 Hylesinus. Packard. U. S. Ent. Com'n, 5th Rep't, p. 227, fig. 72
1891 Hylastes. Weed. Ohio State Bul. 4, no. 2, ser. 2, p. 53–55
1891 Hylesinus. Fletcher. Can. Exp. Farm Rep't
1892 Hylesinus. Smith. Ins. Life, 5:99
1893 Hylesinus. Webster. Ohio Agric. Exp. Sta. Bul. 51, p. 120
1893 Hylesinus. Webster. Ind. Acad. Soc. Proc. p. 84
1894 Hylastes. McCarthy. N. C. State Bul. 98

1894 Hylesinus. Webster. Ohio An. Rep't, xxxi, xxxvii
1894 Hylastes. Hamilton. Am. Ent. Soc. Trans. 21:406
1895 Hylesinus. Judeich-Nitsche. Forstins. 1:454, 488
1896 Hylastes. Webster. Ohio Agric. Exp. Sta. Bul. 68, p. 31-33, pl. III, fig. 2
1899 Hylesinus. Lochhead. Ont. Ent. Soc. 30, p. 71
1899 Hylesinus. Lugger. Minn. Agric. Exp. Sta. Bul. 66, p. 317, fig. 248
1901 Hylastes. Barbey. Scol. l'Europ. Cent. p. 47, pl. 23, fig. 23
1907 = obscurus Marsh. Trèdl. Nahrungs. Verbreit. Borkenk. Europ. p. 8

Habitat. Europe, United States, Canada.

Food plants. Trifolium pratense, T. medium, T. hybridum, Spartium scoparium, Ononis natrix, Ulex europeus.

HYLESINUS Fabricius

1801 Fabricius. Syst. El. 2:390
1836 Erichson. Wieg. Archiv. 2:56
1864 Eichhoff. Berl. Ent. Zeit. p. 29, 44, 46
1866 Lacordaire. Col. 7:362
1868 Zimmermann. Am. Ent. Soc. Trans. 2:148
1869 Chapuis. Syn. Scol. p. 29
1873 Chapuis. Mem. Soc. Liège, p. 237
1876 Leconte. Am. Phil. Soc. Proc. 15:378
1877 Provancher. Faun. Ent. Can. 1:571
1881 Eichhoff. Borkenk. p. 133
1883 Leconte & Horn. Col. N. A. p. 523
1888 Bedel. Faun. Col. Seine, 6:389, 392. (Hylosinus)
1895 Judeich-Nitsche. Forstins. 1:444, 445, fig.
1895 Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 142, 154
1901 Barbey. Scol. l'Europ. Cent. p. 59

64 **aculeatus** Say

1826 Hylesinus. Say. Acad. Nat. Sci. Phila. Jour. 3:322; ed. Lec. 2:181
1868 Hylesinus. Zimmermann. Am. Ent. Soc. Trans. 2:148
1876 Hylesinus. Leconte. Am. Phil. Soc. Proc. 15:379, 437
1877 Hylesinus. Provancher. Faun. Ent. Can. 1:571
1878 Hylesinus. Hubbard & Schwarz. Am. Phil. Soc. Proc. 17:666
1886 Hylesinus. Knaus. Ent. Am. 2:76
1889 Hylesinus. Schwarz. Ent. Soc. Wash. Proc. 1:149
1890 Hylesinus. Packard. U. S. Ent. Com'n, 5th Rep't, p. 543
1891 Hylesinus. Davis. Ins. Life, 4:66
1893 Hylesinus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 142 etc.; Bul. 32, p. 213
1894 Hylesinus. Hopkins. Can. Ent. 26:280
1896 Hylesinus. Eichhoff & Schwarz. U. S. Nat. Mus. Proc. 18:607
1900 Hylesinus. Smith. Cat. Ins. N. J. p. 365
1903 Meliobius. Hopkins. U. S. Dep't Agric. Yearbook, p. 320
1904 Hylesinus. Hopkins. U. S. Div. Ent. Bul. 48, p. 20

1905 Hylesinus. Felt. N. Y. State Mus. Mem. 8, 1:257, 288
1905 Hylesinus. Currie. U. S. Div. Ent. Bul. 53, p. 75
1907 Hylesinus. Fall & Cockerell. Am. Ent. Soc. Trans. 33:218
1908 Hylesinus. Fiske. Ent. Soc. Wash. Proc. 9:24

pruinosus Eich.

1868 Hylesinus. Eichhoff. Berl. Ent. Zeit. p. 149
1868 (?) = aculeatus Say. Leconte. Am. Ent. Soc. Trans. 2:177
1869 Hylesinus. Chapuis. Syn. Scol. p. 32
1873 Hylesinus. Chapuis. Mem. Soc. Liege, p. 240
1876 = aculeatus Say. Leconte. Am. Phil. Soc. Proc. 15:379
1896 (?) = aculeatus Say. Eich. & Schwarz. U. S. Nat. Mus. Proc. 18:607

Habitat. Canada, United States (Atlantic to Pacific).
Food plant. Fraxinus.

65 **aspericollis** Lec.

1876 Hylesinus. Leconte. Am. Phil. Soc. Proc. 15:379, 380
1899 Hylesinus. Hopkins. U. S. Div. Ent. Bul. 21, p. 16
1904 Hylesinus. Hopkins. U. S. Div. Ent. Bul. 48, p. 20
1905 Hylesinus. Currie. U. S. Div. Ent. Bul. 53, p. 75

Habitat. California, Oregon, Washington.
Food plant. Alnus rhombifolia.

66 **fasciatus** Lec.

1868 Hylesinus. Leconte. Am. Ent. Soc. Trans. 2:170
1876 Hylesinus. Leconte. Am. Phil. Soc. Proc. 15:379, 380

Habitat. Pennsylvania.
Food plants.

67 **granulatus** Lec.

1868 Hylastes. Leconte. Am. Ent. Soc. Trans. 2:175
1876 Hylurgops. Leconte. Am. Phil. Soc. Proc. 15:390
1904 Hylesinus. Hopkins. U. S. Div. Ent. Bul. 48, p. 19
1905 Hylesinus. Currie. U. S. Div. Ent. Bul. 53, p. 75
1905 Hylesinus. Burke. Ent. Soc. Wash. Proc. 7:89

Habitat. Oregon, Washington, California.
Food plant. Grand fir (Abies grandis)?

68 **imperialis** Eich.

1868 Hylesinus. Eichhoff. Berl. Ent. Zeit. p. 149
1868 Hylesinus. Leconte. Am. Ent. Soc. Trans. 2:169
1869 Hylesinus. Chapuis. Syn. Scol. p. 32 (aculeatus)
1873 Hylesinus. Chapuis. Mem. Soc. Liege, p. 240
1876 Hylesinus. Leconte. Am. Phil. Soc. Proc. 15:379
1896 Hylesinus. Eich. & Schwarz. U. S. Nat. Mus. Proc. 18:607

Habitat. Dakota, Arizona, Wisconsin, Georgia, New York.
Food plants.

69 **nebulosus** Lec.

1859 Hylesinus. Leconte. Acad. Nat. Sci. Phila. Proc. p. 285
1876 Hylesinus. Leconte. Am. Phil. Soc. Proc. 15:380
1894 Hylesinus. Hamilton. Am. Ent. Soc. Trans. 21:35
1904 Hylesinus. Hopkins. U. S. Div. Ent. Bul. 48, p. 20
1905 Hylesinus. Currie. U. S. Div. Ent. Bul. 53, p. 75

Habitat. British Columbia to California, east to Idaho and Colorado.

Food plant. Pseudotsuga mucronata.

70 **sericeus** Mannh.

1843 Hylurgus. Mannerheim. Bul. Mosc. p. 296, (256)
1852 Hylurgus. Mannerheim. Bul. Mosc. p. 356, (144)
1852 Hylesinus. Mannerheim. Bul. Mosc. p. 385
1868 Hylesinus. Leconte. Am. Ent. Soc. Trans. 2:170
1876 Hylesinus. Leconte. Am. Phil. Soc. Proc. 15:379, 380
1892 Hylesinus. Schwarz. Ent. Soc. Wash. Proc. 2:239
1894 Hylesinus. Schwarz. Ins. Life, 7:254-56
1894 Hylesinus. Hamilton. Am. Ent. Soc. Trans. 21:35
1904 Hylesinus. Hopkins. U. S. Div. Ent. Bul. 48, p. 20
1905 Hylesinus. Currie. U. S. Div. Ent. Bul. 53, p. 75

Habitat. Alaska to California.

Food plant. Shore pine.

HYLURGOPS Leconte

1876 Leconte. Am. Phil. Soc. Proc. 15:389
1883 Leconte & Horn. Col. N. A. p. 525
1888 Bedel. Faun. Col. Seine, p. 389, 408

71 (?) **cristatus** Mannh.

1853 Hylastes. Mannerheim. Bul. Mosc. p. 239, (220)
1868 Hylastes. Leconte. Am. Ent. Soc. Trans. 2:177
1876 (?) Hylurgops. Leconte. Am. Phil. Soc. Proc. 15:390
1894 Hylastes. Hamilton. Am. Ent. Soc. Trans. 21:36

Habitat. Alaska.

Food plants.

72 (?) **glabratus** Zett.

1828 Hylurgus. Zetterstedt. Fn. Ins. Lapp. p. 343
1838 Hylurgus. Zetterstedt. Ins. Lapp. 192, 5
1871 Hylastes. Salb. Berl. Ent. Zeit. p. 206
1881 Hylastes. Eichhoff. Borkenk. p. 91
1886 Hylastes. Schwarz. Ent. Am. 2:56
1888 Hylurgops. Hamilton. Am. Ent. Soc. Trans. 16:159
1888 Tomicus. Bedel. Faun. Col. Bassin Seine, Rynch. p. 390
1891 Hylastes. Hamilton. Ins. Life, 4:132
1893 Hylurgops. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 144 etc.; Bul. 32, p. 213

1894 Hylastes. Hamilton. Am. Ent. Soc. Trans. 21:406
1894 Hylurgops. Hopkins. Can. Ent. 26:280
1894 Hylastes. Blandford. Ent. Soc. Lond. p. 58
1895 Hylastes. Judeich-Nitsche. Forstins. 1:447, 523
1899 Hylurgops. Hopkins. W. Va. Agric. Exp. Sta. Bul. 56, p. 449 etc.
1900 Hylurgops. Smith. Cat. Ins. N. J. p. 365
1901 = decumanus Er. Barbey. Scol. l'Europ. Cent. p. 45, pl. 1, fig. 21
1906 Hylurgops. Felt. N. Y. State Mus. Mem. 8, 2:649, 665-66, fig. 194
1907 Hylastes. Trèdl. Nahrungs. Verbreit. Borkenk. Europ. p. 9

decumanus Er.

1836 Hylastes. Erichson. Wieg. Archiv. 2:51, 10
1837 Hylesinus. Ratzeburg. Forstins. 1:182; 1839, p. 222
1869 Hylastes. Chapuis. Syn. Scol. p. 20, 14; 1873, p. 228
1881 = glabratus Zett. Eichhoff. Borkenk. p. 92
1894 = glabratus Zett. Hamilton. Am. Ent. Soc. Trans. 21:407
1901 Hylastes. Barbey. Scol. l'Europ. Cent. p. 45, pl. 1, fig. 21
Habitat. Europe, Siberia, United States (?).
Food plant. Picea.

73 **pinifex** Fitch

1851 Hylastes. Fitch. N. Y. Agric. Soc. Trans. p. 43
1858 Hylastes. Fitch. Nox. Ins. N. Y. p. 729
1868 Hylastes. Leconte. Am. Ent. Soc. Trans. 2:176
1876 Hylurgops. Leconte. Am. Phil. Soc. Proc. 15:390
1877 Hylastes. Provancher. Faun. Ent. Can. 1:574
1878 Hylurgops. Hubbard & Schwarz. Am. Phil. Soc. Proc. 17:643
1883 Hylurgops. Packard. U. S. Ent. Com'n, 3d Rep't, p. 280, pl. XXII
1886 = glabratus Zett. Schwarz. Ent. Am. 2:56
1888 Hylurgops. Schwarz. Ent. Soc. Wash. Proc. 1:80
1888 = glabratus Zett. Hamilton. Am. Ent. Soc. Trans. 16:159
1890 Hylurgops. Packard. U. S. Ent. Com'n, 5th Rep't, p. 709, 710, 722, 826, fig. 252, 254
1890 = glabratus Zett. Hamilton. Ent. Am. 6:44
1891 = glabratus Zett. Hamilton. Ins. Life, 4:132
1893 = glabratus Zett. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 144
1894 = glabratus Zett. Blandford. Ent. Soc. Lond. p. 58
1898 Hylastes. Blandford. Ent. News, 9:6
1900 Hylastes. Smith. Cat. Ins. N. J. p. 365
Habitat. Eastern United States and Canada.
Food plant. Pinus.

74 **rufipes** Eich.

1868 Hylastes. Eichhoff. Berl. Ent. Zeit. p. 147
1868 Hylastes. Leconte. Am. Ent. Soc. Trans. 2:177
1873 Hylastes. Chapuis. Mem. Soc. Liege, p. 231
1876 (?) Hylurgops. Leconte. Am. Phil. Soc. Proc. 15:390
1896 Hylastes. Eichhoff. U. S. Nat. Mus. Proc. 18:605, 606, 610

opaculus Lec.

1868 Hylesinus. Leconte. Am. Ent. Soc. Trans. 2:170
1876 Hylesinus. Leconte. Am. Phil. Soc. Proc. 15:379, 380
1878 Hylesinus. Hubbard & Schwarz. Am. Phil. Soc. Proc. 17:666
1879 Hylesinus. Riley. U. S. Dep't Agric. Ent. Rep't, p. 45
1884 Hylesinus. Harrington. Can. Ent. 16:218
1885 Hylesinus. Moffat. Ont. Ent. Soc. 15:23
1889 Hylesinus. Schwarz. Ent. Soc. Wash. Proc. 1:149, 176
1890 Hylesinus. Perkins. Vt. State Bd Agric. Rep't, p. 67, fig. 50
1890 Hylesinus. Packard. U. S. Ent. Com'n, 5th Rep't, p. 227, 544, fig. 2
1890 Hylesinus. Caulfield. Ont. Ent. Soc. 21:75
1893 Hylesinus. Hopkins. W. Va. Agric. Sta. Bul. 31, p. 142 etc.; Bul. 32, p. 213
1895 Hylesinus. Hamilton. Am. Ent. Soc. Trans. 22:346, 378
1896 = rufipes Eich. Eichhoff & Schwarz. U. S. Nat. Mus. Proc. 18:605, 606, 610
1898 Hylastes. Blandford. Ent. News, 9:5
1899 Hylesinus. Garman. Ky. Sta. Bul. 84, p. 60, 73-75
1900 Hylesinus. Smith. Cat. Ins. N. J. p. 365
1905 Hylesinus. Felt. N. Y. State Mus. Mem. 8, 1:257, 288

Habitat. New York, West Virginia and northward into Canada.
Food plants. Ulmus, Fraxinus.

75 **rugipennis** Mannh.

1843 Hylurgus. Mannerheim. Bul. Mosc. p. 297, (258)
1853 Hylastes. Mannerheim. Bul. Mosc. p. 238, (218)
1868 Hylastes. Leconte. Am. Ent. Soc. Trans. 2:176
1873 Hylastes. Chapuis. Mem. Soc. Liege, p. 228
1876 Hylurgops. Leconte. Am. Phil. Soc. Proc. 15:390
1894 Hylurgops. Am. Ent. Soc. Trans. 21:36
1904 Hylurgops. Schwarz. Harriman Rep't, Alaska Exp. pt 8; Insects, pt 1, p. 185
1904 Hylurgops. Hopkins. U. S. Div. Ent. Bul. 48, p. 19
1905 Hylurgops. Currie. U. S. Div. Ent. Bul. 53, p. 74
1905 Hylurgops. Hopkins. Ent. Soc. Wash. Proc. 7:81

Habitat. Alaska to California and New Mexico.
Food plants. Pinus, Picea, Abies, Pseudotsuga.

76 **subcostulatus** Mannh.

1853 Hylastes. Mannerheim. Bul. Mosc. p. 239, (219)
1868 Hylastes. Leconte. Am. Ent. Soc. Trans. 2:176
1876 Hylurgops. Leconte. Am. Phil. Soc. Proc. 15:390
1894 Hylurgops. Hamilton. Am. Ent. Soc. Trans. 21:36
1895 Hylastes. Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 144, 146
1896 Hylurgus. Eichhoff & Schwarz. U. S. Nat. Mus. Proc. 18:606
1902 Hylurgops. Hopkins. U. S. Div. Ent. Bul. 32, p. 13
1905 Hylurgops. Currie. U. S. Div. Ent. Bul. 53, p. 74

alternans Chap.

1869 Hylastes. Chapuis. Syn. Scol. p. 22
1873 Hylastes. Chapuis. Mem. Soc. Liège, p. 230
1895 =subcostulatus Mannh. Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 146
1896 =subcostulatus Mannh. Eichhoff & Schwarz. U. S. Nat. Mus. Proc. 18:606

Habitat. Alaska to New Mexico, Pacific coast and Rocky Mountain region.

Food plant. Western pines.

HYPOTHENEMUS Westw.

1836 Westwood. Ent. Soc. Lond. Trans. 1:36
1836 Erichson. Wieg. Archiv. 1:61
1864 Eichhoff. Berl. Ent. Zeit. p. 34, 45, 56
1876 Leconte. Am. Phil. Soc. Proc. 15:355
1883 Leconte & Horn. Col. N. A. p. 517
1885 Gozman. Rev. d'Ent. 4:278
1896 Eichhoff & Schwarz. U. S. Nat. Mus. Proc. 18:608
1904 Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 226

STEPHANODERES Eichhoff

1871 Eichhoff. Berl. Ent. Zeit. p. 132
1878 Eichhoff. Rat. Tom. p. 142
1881 Eichhoff. Borkenk. p. 46, 190
1896 Eichhoff & Schwarz. U. S. Nat. Mus. Proc. 18:608

HOMOEOCRYPHALUS Lindeman

1876 Lindeman. Bul. Mosc. 2:168
1904 Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 226

77 **dissimilis** Zimm.

1868 Crypturgus. Zimmerman. Am. Ent. Soc. Trans. 2:144
1876 Hypothenemus. Leconte. Am. Phil. Soc. Proc. 15:356
1878 Crypturgus. Eichhoff. Rat. Tom. p. 144
1878 Hypothenemus. Schwarz. Am. Phil. Soc. Proc. 17:468
1888 Hypothenemus. Schwarz. Ent. Soc. Wash. Proc. 1:80
1890 Hypothenemus. Smith. Ent. Am. 6:54
1890 Hypothenemus. Smith. Cat. Ins. N. J. p. 267
1893 Hypothenemus. Chittenden. Ent. Soc. Wash. Proc. 2:393
1893 Hypothenemus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 133; Bul. 32, p. 210
1895 Hypothenemus. Hamilton. Am. Ent. Soc. Trans. 22:346, 378
1895 Hypothenemus. Chittenden. Ins. Life, 7:385
1896 Hypothenemus. Lintner. 11th N. Y. Rep't, p. 270
1899 Hypothenemus. Hopkins. Ent. Soc. Wash. Proc. 4:343
1900 Stephanoderes. Smith. Cat. Ins. N. J. p. 362
1905 Hypothenemus. Wenzel. Ent. News, 16:124

chapuisii Eich.

1871 Stephanoderes. Eichhoff. Berl. Ent. Zeit. p. 132
1876 (?)= erectus Lec. Leconte. Am. Phil. Soc. Proc. 15:356
1878 Stephanoderes. Eichhoff. Rat. Tom. p. 143
1896 =dissimilis Zimm. Eichhoff & Schwarz. U. S. Nat. Mus. Proc. 18:608, 610

Habitat. Lake Superior and Quebec to Georgia, West Virginia, New York, New Jersey.

Food plants. Quercus, Pinus, Hicoria, Vitis, Prunus (wild), Ficus (dead twigs), Pyrus.

78 **erectus** Lec.

1876 Hypothenemus. Leconte. Am. Phil. Soc. Proc. 15:356
1890 Hypothenemus. Smith. Ent. Am. 6:54
1890 Hypothenemus. Smith. Cat. Ins. N. J. p. 267
1893 Hypothenemus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31:133
1896 Hypothenemus. Lintner. 11th N. Y. Rep't, p. 270
1896 Hypothenemus. Eichhoff & Schwarz. U. S. Nat. Mus. Proc. 18:608, 610
1900 Hypothenemus. Smith. Cat. Ins. N. J. p. 362

sculpturatus Eich.

1878 Stephanoderes. Eichhoff. Rat. Tom. p. 146
1896 =erectus Lec. Eichhoff & Schwarz. U. S. Nat. Mus. Proc. 18:608, 610

Habitat. New Jersey, West Virginia, Texas.

Food plants. Quercus, Hicoria, Vitis, Lonicera, Ficus, Pyrus.

79 **eruditus** Westw.

1836 Tomicus (Hypothenemus). Westwood. Ent. Soc. Lond. Trans. 2:34, t. 7, fig. 1, a, g
1836 Erichson. Wieg. Archiv. p. 61
1863 Fairm. Gen. Col. p. 4, t. 33, fig. 161
1865 Tomicus. Scudder. Bost. Soc. Nat. Hist. Proc. 10:13–14
1867 Ferrari. Borkenk. p. 7
1878 =areccae Horn. Eichhoff. Rat. Tom. p. 165
1879 Hypothenemus. Sharp. Ent. Soc. Lond. Trans. p. 102
1884 Hypothenemus. Fauvel. Rev. d' Ent. 3:315, 390
1887 Hypothenemus. Hubbard. Ins. Orange, p. 173, pl. 14, fig. 1
1889 Hypothenemus. Hamilton. Am. Ent. Soc. Trans. 16:158
1889 Hypothenemus. Schwarz. Ent. Soc. Wash. Proc. 1:139
1890 Hypothenemus. Smith. Ent. Am. 6:54
1891 Hypothenemus. Schwarz. Ent. Soc. Wash. Proc. 2:74
1893 Hypothenemus. Chittenden. Ins. Life, 5:250
1893 Hypothenemus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 132
1894 Hypothenemus. Blandford. Ins. Life, 6:261–63
1894 Hypothenemus. Reitter. Bestim. Tab. 75
1894 Hypothenemus. Hamilton. Am. Ent. Soc. Trans. 21:406
1895 Hypothenemus. Hamilton. Am. Ent. Soc. Trans. 22:346, 378
1896 =crudiae Pan. (?) Eichhoff. U. S. Nat. Mus. Proc. 18:608

1896 Hypothenemus. Lintner. 11th N. Y. Rep't, p. 270
1900 =aveccae Horn. Smith. Cat. Ins. N. J. p. 362
1904 Hypothenemus. Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 229, 230
1905 =hispidulus Lec. Currie. U. S. Div. Ent. Bul. 53, p. 7

(?) **areccae** Horn

1842 Bostrichus. Hornung. Stet. Ent. Zeit. p. 117
1878 Stephanoderes. Eichhoff. Rat. Tom. p. 165, 166
1884 =eruditus Westw. Fauvel. Rev. d'Ent. 3:315, 390
1896 =eruditus Westw. Eichhoff & Schwarz. U. S. Nat. Mus. Proc. 18:608
1900 Hypothenemus. Smith. Cat. Ins. N. J. p. 362
1904 =eruditus Westw. Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 229, 230

boieldieui Perroud

1864 Bostrichus. Perroud. Ann. Soc. Linn. Lyon. p. 188
1878 =areccae Horn.(?). Eichhoff. Rat. Tom. p. 166
1904 =eruditus Westw. Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 229, 230

Habitat. Mexico, United States, Canada, Panama, Nevis, Europe, Guinea, Sandwich Islands, New Caledonia.

Food plants. Oak, orange, fig, grape, sugar cane, nuts, Lonicera, Pyrus, Robinia.

80 **hispidulus** Lec.

1868 Cryphalus. Leconte. Am. Ent. Soc. Trans. 2:156
1876 Hypothenemus. Leconte. Am. Phil. Soc. Proc. 15:355
1878 Cryphalus. Eichhoff. Rat. Tom. p. 156
1878 Hypothenemus. Schwarz. Am. Phil. Soc. Proc. 17:468
1888 Hypothenemus. Hamilton. Am. Ent. Soc. Trans. 16:158
1890 (?) =dissimilis Zimm. Smith Ent. Am. 6:54
1894 Hypothenemus. Blandford. Ins. Life, 6:263
1894 =eruditus Westw. Hamilton. Am. Ent. Soc. Trans. 21:406
1896 =crudiae Pan. Eichhoff & Schwarz. U. S. Nat. Mus. Proc. 18:608, 610
1900 =crudiae Pan. Smith. Cat. Ins. N. J. p. 362
1904 Hypothenemus. Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 230
1905 Stephanoderes. Currie. U. S. Div. Ent. Bul. 53, p. 7, 13

seriatus Eich.

1871 Stephanoderes. Eichhoff. Berl. Ent. Zeit. p. 133
1876 (?) =hispidulus Lec. Am. Phil. Soc. Proc. 15:356
1878 Stephanoderes. Eichhoff. Rat. Tom. p. 158 (New Orleans)

Habitat. Eastern, Middle and Southern States.

Food plants. Quercus, Hicoria.

81 **rotundicollis Eich.**

1878 Stephanoderes. Eichhoff. Rat. Tom. p. 145
1896 Stephanoderes. Eichhoff & Schwarz. U. S. Nat. Mus. Proc. 18:608

Habitat. Amer. Septent (Tennessee).

Food plants.

82 striatus Lec.

1868 Cryphalus. Leconte. Am. Ent. Soc. Trans. 2:156
1876 Hypothenemus. Leconte. Am. Phil. Soc. Proc. 15:356
Habitat. Lower and Upper California; Illinois.
Food plants. (?)

Degeer

1775 DeGeer. Mem. Ins. 5:190
1884 Bergroth. Berl. Ent. Zeit. 28:230
1888 Bedel. Faun. Col. Seine, 6:396, 400
1895 Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 185, 188

BOSTRICHUS Fabr.

1777 Fabricius. Syst. Ent. p. 59
1836 Erichson. Wieg. Archiv. 1, p. 62
1868 Zimmerman. Am. Ent. Soc. Trans. 2:142, 146

TOMICUS Latreille (1807)

1807 Latreille. Gen. Crust & Ins. 2:276
1868 Leconte. Am. Ent. Soc. Trans. 2:162–64
1869 Lacordaire. Gen. Col. 9:382
1876 Leconte. Am. Phil. Soc. Proc. 15:346, 362
1877 Provancher. Faun. Ent. Can. 1:569
1879 Eichhoff. Rat. Tom. p. 220
1881 Eichhoff. Borkenk. p. 48, 211
1883 Leconte & Horn. Col. N. A. p. 518, 519
1895 Judeich-Nitsche. Forstins. 1:448, 449, 451, fig.
1895 Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 185, 186
1901 Barbey. Scol. l'Europ. Cent. p. 81

83 avulsus Eich.

1867 Tomicus. Eichhoff. Berl. Ent. Zeit. p. 402
1868 Bostrichus. Zimmerman. Am. Ent. Soc. Trans. 2:147
1876 Tomicus. Leconte. Am. Phil. Soc. Proc. 15:363, 366
1878 Tomicus. Eichhoff. Rat. Tom. p. 255
1878 Tomicus. Schwarz. Am. Phil. Soc. Proc. 17:469
1893 Tomicus Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 139; Bul. 32, p. 212
1899 Tomicus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 56, p. 344, 422, 445
1904 Tomicus. Hopkins. U. S. Div. Ent. Bul. 48, p. 44
1905 Tomicus. Currie. U. S. Div. Ent. Bul. 53, p. 100
1906 Tomicus. Felt. N. Y. State Mus. Mem. 8, 2:752
Habitat. Southern United States.
Food plant. Pinus.

84 balsameus Lec.

1878 Tomicus. Leconte. Am. Phil. Soc. Proc. 17:625
1896 =punctipennis Lec. Eichhoff & Schwarz. U. S. Nat Mus. Proc. 18:609, 610

1901 Tomicus. Felt. N. Y. Forest, Fish and Game Com'n Rep't, 7:519-22, fig. 20
1902 Tomicus. Felt. U. S. Div. Ent. Bul. 31, p. 65
1904 Tomicus. Hopkins. U. S. Div. Ent. Bul. 48, p. 25
1905 Tomicus. Currie. U. S. Div. Ent. Bul. 53, p. 81
1906 Tomicus. Felt. N. Y. State Mus. Mem. 8, 2:338, 354, 374, 375-79, 386, 389, 673, fig. 80-84

Habitat. Maine and Quebec to Michigan and West Virginia.

Food plants. Abies, Picea, Pinus.

85 **caelatus** Eich.

1867 Tomicus. Eichhoff. Berl. Ent. Zeit. p. 402
1868 Xyleborus. Zimmerman. Am. Ent. Soc. Trans. 2:146
1876 Xyleborus. Leconte. Am. Phil. Soc. Proc. 15:359, 360
1877 Xyleborus. Provancher. Faun. Ent. Can. 1:568
1878 Tomicus. Eichhoff. Rat. Tom. p. 274, 370
1878 Xyleborus. Schwarz. Am. Phil. Soc. Proc. 17:468, 666
1886 Xyleborus. Schwarz. Ent. Am. 2:41
1888 Xyleborus. Schwarz. Ent. Soc. Wash. Proc. 1:47, 80
1890 Xyleborus. Packard. U. S. Ent. Com'n 5th Rep't, p. 706, 710, 812, 825, fig. 277, 278
1893 Tomicus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 139; Bul. 32, p. 212
1894 Xyleborus. Blandford. Ins. Life, 6:261
1894 Tomicus. Hopkins. Can. Ent. 26:280
1894 Tomicus. Schwarz. Ent. Soc. Wash. Proc. 3:16, 27
1895 Xyleborus. Hamilton. Am. Ent. Soc. Trans. 22:346, 378
1899 Tomicus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 56, p. 258, 342, 446
1900 Ips. Smith. Cat. Ins. N. J. p. 363
1901 Tomicus. Felt. N. Y. Forest, Fish & Game Com'n Rep't, 7:488-90, fig. 8
1902 Tomicus. Hopkins. U. S. Div. Ent. Bul. 32, p. 12
1906 Tomicus. Felt. N. Y. State Mus. Mem. 8, 2:338, 354-56, 374, 376, fig. 72

vicinus Lec.

1874 Xyleborus. Leconte. Am. Ent. Soc. Trans. 5:72
1876 = caelatus Eich. Leconte. Am. Phil. Soc. Proc. 15:360

xylographus Fitch

1858 Tomicus. Fitch. Nox. Ins. N. Y. 4th Rep't, p. 716
1886 = caelatus Eich. Schwarz. Ent. Am. 2:41
1906 = caelatus Eich. Felt. N. Y. State Mus. Mem. 8, 2:355

Habitat. Canada; United States, south to West Virginia.

Food plants. Pinus, Picea, Abies.

86 **calligraphus** Ger.

1824 Bostrichus. Germar. Ins. Nov. p. 461
1858 Tomicus. Fitch. Nox. Ins. N. Y. 4th Rep't, p. 721

1868 Tomicus. Leconte. Am. Ent. Soc. Trans. 2:162
1876 Tomicus. Leconte. Am. Phil. Soc. Proc. 15:363
1877 Tomicus. Provancher. Faun. Ent. Can. 1:570
1878 Tomicus. Schwarz. Am. Phil. Soc. Proc. 17:469, 643
1888 Tomicus. Schwarz. Ent. Soc. Wash. Proc. 1:80
1890 Tomicus. Packard. U. S. Ent. Com'n 5th Rep't, p. 711, 712, fig. 244, 245
1893 Tomicus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 138; Bul 32, p. 212
1893 Tomicus. Garman. Ky. Agric. Exp. Sta. Bul. 47, p. 50–52
1894 Tomicus. Hopkins. Can. Ent. 26:279
1894 Tomicus. Garman. Ky. Agric. Rep't 1893, p. 127
1897 Tomicus. Johnson. Penn. Agric. Rep't, p. 109–10
1899 Tomicus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 56, p. 422
1900 Ips. Smith. Cat. Ins. N. J. p. 363
1901 Tomicus. Felt. N. Y. Forest, Fish & Game Com'n Rep't, 7:482–85, fig. 4, 5
1902 Tomicus. Felt. U. S. Div. Ent. Bul. 31, p. 64
1902 Tomicus. Hopkins. U. S. Div. Ent. Bul. 32, p. 11
1903 Tomicus. Gillette. Col. Agric. Exp. Sta. Rep't 15, p. 116–17
1906 Tomicus. Felt. N. Y. State Mus. Mem. 8, 2:334, 338, 342, 345–51, 354, 356, 358, fig. 67, 68, 69

chloroticus Dej.

1837 Bostrichus. Dej. Cat. p. 332
1878 = calligraphus Ger. Eichhoff. Rat. Tom. p. 224

conformis Dej.

1837 Bostrichus. Dej. Cat. p. 332
1878 = calligraphus Ger. Eichhoff. Rat. Tom. p. 224

exesus Say

1826 Bostrichus. Say. Acad. Nat. Sci. Phila. Jour. 5:255; ed. Lec. 2:317
1841 Bostrichus. Harris. Ins. Mass. p. 74
1868 Bostrichus. Zimmerman. Am. Ent. Soc. Trans. 2:147
1876 = calligraphus Ger. Leconte. Am. Phil. Soc. Proc. 15:363
1878 = calligraphus Ger. Eichhoff. Rat. Tom. p. 224

praemorsus Eich.

1867 Tomicus. Eichhoff. Berl. Ent. Zeit. p. 401
1876 (?) = calligraphus Ger. Leconte. Am. Phil. Soc. Proc. 15:363
1876 = calligraphus Ger. Eichhoff. Stett. Ent. Zeit. 37:378
1878 = calligraphus Ger. Eichhoff. Rat. Tom. p. 224

Habitat. Atlantic region of United States to New Mexico, Canada.

Food plant. Pinus.

87 **concinnus** Mannh.

1852 Bostrichus. Mannerheim. Bul. Mosc. 2:358, (149)
1853 Bostrichus. Mannerheim. Bul. Mosc. 3:234, (209)

1868 Tomicus. Leconte. Am. Ent. Soc. Trans. 2:164
1876 Tomicus. Leconte. Am. Phil. Soc. Proc. 15:363, 367
1878 Xylocleptes. Leconte. Am. Phil. Soc. Proc. 17:625
1878 Tomicus. Eichhoff. Rat. Tom. p. 232
1886 Xylocleptes. Schwarz. Ent. Am. 2:42
1894 Xylocleptes. Hamilton. Am. Ent. Soc. Trans. 21:35
1895 Tomicus. Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 186, 188
1898 Tomicus. Blandford. Ent. News, 9:6
1904 Tomicus. Hopkins. U. S. Div. Ent. Bul. 48, p. 17
1905 Tomicus. Currie. U. S. Div. Ent. Bul. 53, p. 73
1905 Tomicus. Hopkins. Ent. Soc. Wash. Proc. 7:75

hirsutus Eich.

1867 Tomicus. Eichhoff. Berl. Ent. Zeit. p. 402
1878 =concinnus Mannh. Eichhoff. Rat. Tom. p. 233
1895 =concinnus Mannh. Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 188
Habitat. Alaska to middle California.
Food plants. Pinus, Picea sitchensis.

88 confusus Lec.

1876 Tomicus. Leconte. Am. Phil. Soc. Proc. 15:362, 364
1886 Tomicus. Schwarz. Ent. Am. 2:42
1890 Tomicus. Packard. U. S. Ent. Com'n, 5th Rep't, p. 713
1904 Tomicus. Hopkins. U. S. Div. Ent. Bul. 48, p. 18
1905 Tomicus. Hopkins. Ent. Soc. Wash. Proc. 7:77
1905 Tomicus. Currie. U. S. Div. Ent. Bul. 53, p. 73

montanus Eich.

1881 Tomicus. Eichhoff. Borkenk. p. 219
1886 =confusus Lec. Schwarz. Ent. Am. 2:42
Habitat. Oregon, California, Arizona.
Food plants. Pinus edulis, P. monophylla.

89 decretus Eich.

1867 Tomicus. Eichhoff. Berl. Ent. Zeit. p. 402
1868 Tomicus. Leconte. Am. Ent. Soc. Trans. 2:177
1878 Tomicus. Eichhoff. Rat. Tom. p. 272
Habitat. America Borealis.
Food plants.

90 emarginatus Lec.

1876 Tomicus. Leconte. Am. Phil. Soc. Proc. 15:363, 364
Habitat. Oregon.
Food plants.

91 grandicollis Eich.

1867 Tomicus. Eichhoff. Berl. Ent. Zeit. p. 402
1878 Tomicus. Eichhoff. Rat. Tom. p. 231
1898 Tomicus. Blandford. Ent. News, 9:6
1905 Tomicus. Hopkins. Ent. Soc. Wash. Proc. 7:77

cacographus Lec.

1868 Tomicus. Leconte. Am. Ent. Soc. Trans. 2:162
1876 Tomicus. Leconte. Am. Phil. Soc. Proc. 15:362, 364
1878 =grandicollis Eich. (?) Eichhoff. Rat. Tom. p. 231
1878 Tomicus. Schwarz. Am. Phil. Soc. Proc. 17:469
1888 Tomicus. Schwarz. Ent. Soc. Wash. Proc. 1:80
1890 Tomicus. Packard. U. S. Ent. Com'n, 5th Rep't, p. 713, fig. 246
1893 Tomicus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 138; Bul. 32, p. 212
1893 Tomicus. Bruner. Neb. Hort. Rep't, p. 199, fig. 38
1893 Tomicus. Hopkins. Ins. Life, 6:129
1894 Tomicus. Bruner. Neb. Hort. Rep't, p. 187, fig. 38
1894 Tomicus. Hopkins. Can. Ent. 26:279
1894 Tomicus. Schwarz. Ent. Soc. Wash. Proc. 3:16, 27
1897 Tomicus. Johnson. Penn. Agric. Rep't, p. 79–80, 110
1898 =grandicollis Eich. Blandford. Ent. News, 9:6
1899 Tomicus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 56, p. 422
1900 Ips. Smith. Cat. Ins. N. J. p. 363
1901 Tomicus. Felt. N. Y. Forest, Fish & Game Com'n Rep't, 7:485
1906 Tomicus. Felt. N. Y. State Mus. Mem. 8, 2:334, 338, 342, 354, 356–359, 374, fig. 73

pini (Say) Zimm.

1868 Bostrichus. Zimmerman. Am. Ent. Soc. Trans. 2:147
1876 =cacographus Lec. Leconte. Am. Phil. Soc. Proc. 15:364
1878 =grandicollis Eich. Eichhoff. Rat. Tom. p. 231

Habitat. Middle Atlantic, Southern and Western States; Quebec.
Food plants. Pinus, Picea.

92 **hudsonicus** Lec.

1876 Tomicus. Leconte. Am. Phil. Soc. Proc. 15:363, 366
1878 Tomicus. Hubbard & Schwarz. Am. Phil. Soc. Proc. 17:643
1894 Tomicus. Schwarz. Ins. Life, 7:255

Habitat. Hudson Bay region, Utah.
Food plant. Picea.

93 **integer** Eich.

1869 Tomicus. Eichhoff. Berl. Ent. Zeit. p. 273
1878 Tomicus. Eichhoff. Rat. Tom. p. 226
1898 =plastographus Lec. Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 186, 187
1903 Tomicus. Gillette. Col. Agric. Exp. Sta. Rep't 15, p. 117
1904 Tomicus. Hopkins. U. S. Div. Ent. Bul. 48, p. 18
1905 Tomicus. Hopkins. Ent. Soc. Wash. Proc. 7:75, 76, 77
1905 Tomicus. Currie. U. S. Div. Ent. Bul. 53, p. 73

Habitat. Rocky mountain region of United States, Mexico.
Food plants. Pinus ponderosa, P. monticola.

94 **interruptus** Mannh.

1852 Bostrichus. Mannerheim. Bul. Mosc. p. 357, (147)
1853 Bostrichus. Mannerheim. Bul. Mosc. 234, (208)
1868 Tomicus. Leconte. Am. Ent. Soc. Trans. 2:164
1868 Tomicus. Eichhoff. Berl. Ent. Zeit. p. 274
1876 Tomicus. Leconte. Am. Phil. Soc. Proc. 15:363, 366
1878 Tomicus. Eichhoff. Rat. Tom. p. 238
1878 Tomicus. Hubbard & Schwarz. Am. Phil. Soc. Proc. 17:643
Habitat. Alaska, Hudson Bay region, Colorado.
Food plants.

95 (?) **interpunctus** Eich.

1878 Tomicus. Eichhoff. Rat. Tom. p. 241
1878 Tomicus. Eichhoff. Stett. Ent. Zeit. 39:390

tridens Eich.

1868 Tomicus. Eichhoff. Berl. Ent. Zeit. p. 274
1878 = interpunctus Eich. Eichhoff. Rat. Tom. p. 241
Habitat. American Borealis (Sitka).
Food plants.

96 **latidens** Lec.

1874 Tomicus. Leconte. Am. Ent. Soc. Trans. 5:72
1876 Tomicus. Leconte. Am. Phil. Soc. Proc. 15:363, 367
1904 Tomicus. Hopkins. U. S. Div. Ent. Bul. 48, p. 17
1905 Tomicus. Currie. U. S. Div. Ent. Bul. 53, p. 72
Habitat. Oregon, California, Colorado.
Food plant. Pinus lambertiana.

97 **oregoni** Eich.

1868 Tomicus. Eichhoff. Berl. Ent. Zeit. p. 274
1876 Tomicus. Leconte. Am. Phil. Soc. Proc. 15:435
1878 Tomicus. Eichhoff. Rat. Tom. p. 250
1903 Tomicus. Hopkins. U. S. Div. Ent. Bul. 32, p. 10
1903 Tomicus. Gillette. Col. Agric. Exp. Sta. Rep't 15, p. 117
1904 Tomicus. Hopkins. U. S. Div. Ent. Bul. 48, p. 17, 44
1905 Tomicus. Hopkins. Ent. Soc. Wash. Proc. 7:77
1905 Tomicus. Currie. U. S. Div. Ent. Bul. 53, p. 73, 100
Habitat. Western United States.
Food plant. Pinus.

98 **perturbatus** Eich.

1868 Tomicus. Eichhoff. Berl. Ent. Zeit. p. 274
1876 Tomicus. Leconte. Am. Phil. Soc. Proc. 15:435
1878 Tomicus. Eichhoff. Rat. Tom. p. 248
Habitat. American Borealis.
Food plants.

99 pini Say

1826 Bostrichus. Say. Acad. Nat. Sci. Phila. Jour. 5:257; ed. Lec. 2:319
1837 Tomicus. Kirby. Faun. Bor. Am. 4:191
1841 Tomicus. Harris. Ins. N. E. p. 74
1852 Tomicus. Harris. Rep't Ins. Inj. Veg. p. 78
1858 Tomicus. Fitch. Nox. Ins. N. Y. 4th Rep't, p. 722, 751
1868 Bostrichus. Zimmerman. Am. Ent. Soc. Trans. 2:147
1868 Tomicus. Leconte. Am. Ent. Soc. Trans. 2:163
1876 Tomicus. Leconte. Am. Phil. Soc. Proc. 15:363, 365
1877 Tomicus. Provancher. Faun. Ent. Can. 1:570
1878 Tomicus. Hubbard & Schwarz. Am. Phil. Soc. Proc. 17:666
1888 Tomicus. Schwarz. Ent. Soc. Wash. Proc. 1:80, 149, 175
1890 Tomicus. Packard. U. S. Ent. Com'n, 5th Rep't, p. 713-14, 858, fig. 247
1893 Tomicus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 139; Bul. 32, p. 212
1894 Tomicus. Hopkins. Can. Ent. 26:280
1899 Tomicus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 56, p. 342, 343, 422, 445
1899 Tomicus. Hopkins. U. S. Div. Ent. Bul. 21, p. 16
1900 Ips. Smith. Cat. Ins. N. J. p. 363
1901 Tomicus. Felt. N. Y. Forest, Fish & Game Com'n Rep't, 7:487-88, fig. 7
1903 Tomicus. Gillette. Col. Agric. Rep't, 24:117
1906 Tomicus. Felt. N. Y. State Mus. Mem. 8, 2:334, 338, 351-54, 359, 376, fig. 70, 71

dentatus Sturm.

1826 Tomicus. Sturm. Cat. p. 76, t. 4, fig. 30
1876 =pini Say. Leconte. Am. Phil. Soc. Proc. 15:426

pallipes Sturm.

1826 Tomicus. Sturm. Cat. p. 76
1876 =pini Say. Leconte. Am. Phil. Soc. Proc. 15:426

praefrictus Eich.

1867 Tomicus. Eichhoff. Berl. Ent. Zeit. p. 401
1876 =pini Say. Leconte. Am. Phil. Soc. Proc. 15:365

Habitat. Eastern United States and Canada, Montana (?), Colorado (?).

Food plants. Pinus, Picea, Larix.

100 plastographus Lec.

1868 Tomicus. Leconte. Am. Ent. Soc. Trans. 2:163
1876 Tomicus. Leconte. Am. Phil. Soc. Proc. 15:362, 364
1895 Tomicus. Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 186, 187
1898 Tomicus. Blandford. Ent. News, 9:6
1903 Tomicus. Gillette. Col. Agric. Exp. Sta. Rep't 15, p. 117
1904 Tomicus. Powell. N. Y. Ent. Soc. 12:237-43

1905 Tomicus. Hopkins. Ent. Soc. Wash. Proc. 7:75, 76
1907 Tomicus. Fall & Cockerell. Am. Ent. Soc. Trans. 33:217
Habitat. California, New Mexico.
Food plant. Pinus radiata.

101 rectus Lec.

1876 Tomicus. Leconte. Am. Phil. Soc. Proc. 15:363, 365
Habitat. Oregon, Arizona, New Mexico.
Food plants.

102 (?) spinifer Eich.

1878 Tomicus. Eichhoff. Rat. Tom. p. 499
1878 Tomicus. Eichhoff. Stet. Ent. Zeit. 39:390
Habitat. America Borealis (California) (?)
Food plants.

103 (?) terminatus Mannh.

1885 Tomicus (?). Henshaw. Col. N. A. p. 148

104 tridens Mannh.

1852 Bostrichus. Mannerheim. Bul. Mosc. p. 357, (148)
1853 Bostrichus. Mannerheim. Bul. Mosc. p. 273
1868 Tomicus. Leconte. Am. Ent. Soc. Trans. 2:164
1876 Tomicus. Leconte. Am. Phil. Soc. Proc. 15:363, 366
1878 Tomicus. Eichhoff. Rat. Tom. p. 240
1894 Tomicus. Hamilton. Am. Ent. Soc. Trans. 21:36
Habitat. Alaska.
Food plants.

LOGANIUS Chapuis

1869 Chapuis. Syn. Scol. p. 52
1873 Chapuis. Mem. Soc. Liège, p. 260
1894 Schwarz. Ent. Soc. Wash. Proc. 3:44
1896 Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 128

105 ficus Sz.

1894 Loganius. Schwarz. Ent. Soc. Wash. Proc. 3:44
1894 Loganius. Ashmead. Ent. Soc. Wash. Proc. 3:33
Habitat. Florida.
Food plant. Ficus aurea.

MICRACIS Leconte

1868 Leconte. Am. Ent. Soc. Trans. 2:164–65
1876 Leconte. Am. Phil. Soc. Proc. 15:367–68
1878 Eichhoff. Rat. Tom. p. 302
1883 Leconte & Horn. Col. N. A. p. 519

106 **asperulus** Lec.

1878 Micracis. Leconte. Am. Phil. Soc. Proc. 17:626
1878 Micracis. Hubbard & Schwarz. Am. Phil. Soc. Proc. 17:666
1900 Micracis. Smith. Cat. Ins. N. J. p. 363
Habitat. Pennsylvania, New York, Virginia.
Food plant. Quercus.

107 **hirtellus** Lec.

1876 Micracis. Leconte. Am. Phil. Soc. Proc. 15:368, 369
1890 Micracis. Packard. U. S. Ent. Com'n, 5th Rep't, p. 671
1892 Micracis. Blaisdell. Ins. Life, 5:36
Habitat. California.
Food plants. Umbellularia californica, Salix.

108 **nanula** Lec.

1876 Micracis. Leconte. Am. Phil. Soc. Proc. 15:368, 369
1878 Micracis. Schwarz. Am. Phil. Soc. Proc. 17:469
Habitat. Florida.
Food plants. (?).

109 **rudis** Lec.

1876 Micracis. Leconte. Am. Phil. Soc. Proc. 15:368, 369
1878 Micracis. Hubbard & Schwarz. Am. Phil. Soc. Proc. 17:666
1890 Micracis. Packard. U. S. Ent. Com'n, 5th Rep't, p. 612
1891 Micracis. Schwarz. Ent. Soc. Wash. Proc. 2:74
1895 Micracis. Hamilton. Am. Ent. Soc. Trans. 22:346, 378
1906 Micracis. Felt. N. Y. State Mus. Mem. 8, 2:725
Habitat. Michigan.
Food plants. Celtis occidentalis, Robinia pseudacacia, Hicoria.

110 **opacicollis** Lec.

1878 Micracis. Leconte. Am. Phil. Soc. Proc. 17:625
1878 Micracis. Hubbard & Schwarz. Am. Phil. Soc. Proc. 17:666
1900 (?) = asperula Lec. Smith. Cat. Ins. N. J. p. 363
1906 Micracis. Felt. N. Y. State Mus. Mem. 8, 2:702
Habitat. New Jersey, New York.
Food plants. Castanea dentata, Quercus, Hamamelis.

111 **suturalis** Lec.

1868 Micracis. Leconte. Am. Ent. Soc. Trans. 2:165
1868 Micracis. Shimer. Am. Ent. Soc. Trans. 2:viii
1876 Micracis. Leconte. Am. Phil. Soc. Proc. 15:368
1878 Micracis. Eichhoff. Rat. Tom. p. 303
1878 Micracis. Hubbard & Schwarz. Am. Phil. Soc. Proc. 17:666
1890 Micracis. Packard. U. S. Ent. Com'n, 5th Rep't, p. 660
1891 Micracis. Hamilton. Can. Ent. 23:65
1891 Micracis. Hamilton. Ins. Life, 4:131
1891 Micracis. Riley & Howard. Ins. Life, 4:94

1892 Micracis. Hamilton. Ins. Life, 4:268
1893 Micracis. Chittenden. Ent. Soc. Wash. Proc. 2:394
1895 Micracis. Hamilton. Am. Ent. Soc. Trans. 22:346, 378
1900 Micracis. Smith. Cat. Ins. N. J. p. 363
1906 Micracis. Felt. N. Y. State Mus. Mem. 8, 2:715

aculeatus Lec.

1868 Micracis. Leconte. Am. Ent. Soc. Trans. 2:165
1878 Micracis. Eichhoff. Rat. Tom. p. 304
1881 Micracis. Leconte. Am. Ent. Soc. Trans. 9:xxii
1891 Micracis. Hamilton. Can. Ent. 23:65
1891 Micracis. Riley. Ins. Life, 4:94
1892 Micracis. Hamilton. Ins. Life, 4:268
1893 = suturalis Lec. Chittenden. Ent. Soc. Wash. Proc. 2:394
1906 Micracis. Felt. N. Y. State Mus. Mem. 8, 2:715

Habitat. Massachusetts and New York to Michigan, Kansas and Louisiana.

Food plants. Zanthoxylum clava-herculis, Hicoria, Cercis canadensis, Fraxinus, Quercus, Juglans **nigra**, Benzoin aestivale, Salix Sassafras, Robinia, Corylus.

PAGIOCERUS Eich.

1868 Eichhoff. Berl. Ent. Zeit. p. 148
1869 Chapuis. Syn. Scol. p. 26
1873 Chapuis. Mem. Soc. Liège, p. 234
Blandford. Biol. Centr. Am. Col. pt 6, p. 49
1907 Hopkins. Ent. Soc. Wash. Proc. 8:112

112 **rimosus** Eich.

1868 Pagiocerus. Eichhoff. Berl. Ent. Zeit. p. 148
1869 Pagiocerus. Chapuis. Syn. Scol. p. 26
1873 Pagiocerus. Chapuis. Mem. Soc. Liège, p. 234
Pagiocerus. Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 49
1907 Pagiocerus. Hopkins. Ent. Soc. Wash. Proc. 8:113

Habitat. Cuba, Columbia, Brazil, Chile, Mexico, Guatemala, Panama, Florida.

Food plants. Anona glabra, A. cherimolia (Mexico), "coru" (Columbia, S. A.), Persea barbonia (Florida).

PHLOEOSINUS Chapuis

1869 Chapuis. Syn. Scol. p. 37
1873 Chapuis. Mem. Soc. Liege, p. 245
1876 Leconte. Am. Phil. Soc. Proc. 15:381
1881 Eichhoff. Borkenk. p. 131
1883 Leconte & Horn. Col. N. A. p. 523
1888 Bedel. Faun. Col. Seine, 6:389, 393
1894 Blandford. Ent. Soc. Lond. p. 68
1897 Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 143, 160
1901 Barbey. Scol. l'Europ. Cent. p. 58

113 **cristatus** Lec.

1868 Phloeosinus. Leconte. Am. Ent. Soc. Trans. 2:170
1876 Phloeosinus. Leconte. Am. Phil. Soc. Proc. 15:381
1893 Phloeosinus. Riley & Howard. Ins. Life, 5:262
1897 Phloeosinus. Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 160
1903 Phloeosinus. Hopkins. U. S. Bur. For. Bul. 38, p. 39, 40, fig. 4

Habitat. California.

Food plants. Cupressus, Sequoia sempervirens (?).

114 **cupressi** Hopk.

1903 Phloeosinus. Hopkins. U. S. Bur. For. Bul. 38, p. 35-38, fig. 2, 3
1904 Phloeosinus. Hopkins. U. S. Div. Ent. Bul. 48, p. 45
1905 Phloeosinus. Currie. U. S. Div. Ent. Bul. 53, p. 100

Habitat. California.

Food plants. Cupressus, Sequoia sempervirens.

115 **dentatus** Say

1825 Hylurgus. Say. Acad. Nat. Sci. Phila. Jour. 5:258; ed. Lec. 2:319
1852 Hylurgus. Harris. Rep't Ins. Inj. Veg. p. 77
1858 Fitch. Nox. Ins. 4th Rep't, p. 750; N. Y. Agric. Soc. Trans. 1857
1876 Phloeosinus. Leconte. Am. Phil. Soc. Proc. 15:381
1886 Phloeosinus. Knaus. Ent. Am. 2:77
1886 Phloeosinus. Schwarz. Ent. Am. 2:56
1890 Phloeosinus. Packard. U. S. Ent. Com'n, 5th Rep't, p. 904-6, fig. 299
1890 Phloeosinus. Riley & Howard. Ins. Life, 2:350
1893 Phloeosinus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 142; Bul. 32, p. 213
1894 Phloeosinus. Hopkins. Can. Ent. 26:280
1896 Phloeosinus. Eichhoff & Schwarz. U. S. Nat. Mus. Proc. 18:608, 610
1897 Phloeosinus. Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 160
1900 Phloeosinus. Smith. Cat. Ins. N. J. p. 365
1901 Phloeosinus. Felt. N. Y. Forest, Fish & Game Com'n Rep't, 7:522-23, fig. 25, 26
1904 Phloeosinus. Hopkins. U. S. Div. Ent. Bul. 48, p. 25
1905 Phloeosinus. Currie. U. S. Div. Ent. Bul. 53, p. 81
1906 Phloeosinus. Felt. N. Y. State Mus. Mem. 8, 2:336, 337, 338, 391-93, fig. 90, 91, 92

graniger Eich.

1868 (?) Dendroctonus. Eichhoff. Berl. Ent. Zeit. p. 147
1868 (?) Dendroctonus. Leconte. Am. Ent. Soc. Trans. 2:177
1869 Phloeosinus. Chapuis. Syn. Scol. p. 39, 95
1873 Phloeosinus. Chapuis. Mem. Soc. Liège, p. 247
1876 Phloeosinus. Leconte. Am. Phil. Soc. Proc. 15:382, 436, 437
1886 Phloeosinus. Schwarz. Ent. Am. 2:56
1892 Phloesosinus. Hopkins. Ins. Life, 4:258
1896 = dentatus Say. Eichhoff & Schwarz. U. S. Nat. Mus. Proc. 18:608, 610
1897 Phloeosinus. Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 160

haagii Eich.

1868 (?) Dendroctonus. Eichhoff. Berl. Ent. Zeit. p. 148
1868 (?) Dendroctonus. Leconte. Am. Ent. Soc. Trans. 2:177
1869 Phloeosinus. Chapuis. Syn. Scol. p. 38
1873 Phloeosinus. Chapuis. Mem. Soc. Liège, p. 247
1876 Phloeosinus. Leconte. Am. Phil. Soc. Proc. 15:382, 436, 437
1886 (?)=dentatus Say. Schwarz. Ent. Am. 2:56
1896 =dentatus Say. Eichhoff & Schwarz. U. S. Nat. Mus. Proc. 18:610
1896 (?) =punctatus Lec. Eichhoff & Schwarz. U. S. Nat. Mus. Proc. 18:608
1897 Phloeosinus. Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 160

serratus Lec.

1868 Phloeosinus. Leconte. Am. Ent. Soc. Trans. 2:170
1876 Phloeosinus. Leconte. Am. Phil. Soc. Proc. 15:381
1886 (?) =dentatus Say. Schwarz. Ent. Am. 2:56
1889 Phloeosinus. Schwarz. Ent. Soc. Wash. Proc. 1:176
1897 Phloeosinus. Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 160
1900 =dentatus Say. Smith. Cat. Ins. N. J. p. 365
1907 Phloeosinus. Fall & Cockerell. Am. Ent. Soc. Trans. 33:218

Habitat. Eastern and middle United States and Canada, New Mexico.

Food plants. Juniperus, Thuja.

116 **punctatus** Lec.

1876 Phloeosinus. Leconte. Am. Phil. Soc. Proc. 15:381, 382
1886 Phloeosinus. Schwarz. Ent. Am. 2:55
1902 Phloeosinus. Fowler. Cal. Rep't Agric. Exp. Sta. p. 80
1903 Phloeosinus. Hopkins. Can. Ent. 35:60
1903 Phloeosinus. Hopkins. U. S. Bur. For. Bul. 38, p. 35
1904 Phloeosinus. Hopkins. U. S. Div. Ent. Bul. 48, p. 18
1905 Phloeosinus. Currie. U. S. Div. Ent. Bul. 53, p. 73

Habitat. Lake Superior and Rocky mountain regions.

Food plants. Libocedrus decurrens, Chamaecyparis lawsoniana (Giant arbor-vitae).

117 **sequoiae** Hopk.

1903 Phloeosinus. Hopkins. U. S. Bur. For. Bul. 38, p. 33-35, fig. 1, pl. 12
1904 Phloeosinus. Hopkins. U. S. Div. Ent. Bul. 48, p. 18, 45
1905 Phloeosinus. Currie. U. S. Div. Ent. Bul. 53, p. 74

Habitat. California, Washington.

Food plants. Sequoia sempervirens, Giant arbor-vitae.

PHLOEOTRIBUS Latreille

1796 Latreille. Prec. car. gener. Ins. 50
1836 Erichson. Wieg. Archiv. 1:56
1864 Eichhoff. Berl. Ent. Zeit. p. 29, 44, 46

1868 Zimmerman. Am. Ent. Soc. Trans. 2: 147, 148
1868 Leconte. Am. Ent. Soc. Trans. 2:168
1869 Chapuis. Syn. Scol. p. 43
1873 Chapuis. Mem. Soc. Liège, p. 251
1876 Leconte. Am. Phil. Soc. Proc. 15:376
1881 Eichhoff. Borkenk. p. 39, 147
1883 Leconte & Horn. Col. N. A. p. 522
1888 Bedel. Faun. Col. Seine, 6:389, 394
1901 Barbey. Scol. l'Europ. Cent. p. 65

118 **frontalis** Oliv.

1795 Scolytus. Olivier. Ent. 4, no. 78, p. 13, pl. 2, fig. 20
1801 Bostrichus. Fabricius. Syst. El. 2:389
1868 Phloeotribus. Zimmerman. Am. Ent. Soc. Trans. 2:148
1876 Phloeotribus. Leconte. Am. Phil. Soc. Proc. 15:377
1890 Phloeotribus. Packard. U. S. Ent. Com'n 5th Rep't p. 612
1893 Phloeotribus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 142; Bul. 32, p. 213
1893 Phloeotribus. Chittenden. Ins. Life, 5:249
1894 Phloeotribus. Riley. Ins. Life, 6:227
1894 Phloeotribus. Hopkins. Can. Ent. 26:280
1895 Phloeotribus. Schwarz. Ent. Soc. Wash. Proc. 3:146
1896 Phloeotribus. Ashmead. Am. Ent. Soc. Trans. 23:233
1898 Phloeotribus. Chittenden. Ent. Soc. Wash. Proc. 4:78
1900 Phloeotribus. Smith. Cat. Ins. N. J. p. 364
1903 Phloeophthorus. Hopkins. U. S. Dep't Agric. Yearbook, p. 320
1905 Phloeophthorus. Hopkins. Ent. Soc. Wash. Proc. 7:78
1906 Phloeotribus. Felt. N. Y. State Mus. Mem. 8, 2:336, 725

granicollis Eich.

1868 Phloeophthorus. Eichhoff. Berl. Ent. Zeit. p. 149
1868 Phloeophthorus. Leconte. Am. Ent. Soc. Trans. 2:177
1873 Phloeotribus. Chapuis. Mem. Soc. Liège, p. 251
1876 =frontalis Fabr. Leconte. Am. Phil. Soc. Proc. 15:377

Habitat. Atlantic States to Iowa and Tennessee.

Food plants. Morus, Celtis occidentalis, Broussonetia papyrifera.

119 **liminaris** Harris

1852 Tomicus. Harris. Rep't Inj. Ins. Veg. p. 78
1863 Tomicus. Harris. Inj. Ins. ed. ult. 88
1868 Phloeotribus. Leconte. Am. Ent. Soc. Trans. 2:148
1873 Phloeosinus. Chapuis. Mem. Soc. Liège, p. 247
1876 Phloeotribus. Leconte. Am. Phil. Soc. Proc. 15:377
1878 Phloeotribus. Hubbard & Schwarz. Am. Phil. Soc. Proc. 17:666
1882 Phloeosinus. Linden. Buf. Soc. Bul. 4:61
1888 Phloeotribus. Schwarz. Ent. Soc. Wash. Proc. 1:113, 149
1890 Phloeotribus. Packard. U. S. Ent. Com'n, 5th Rep't, p. 227, 530

1890 Phloeotribus. Caulfield. Ont. Soc. Ent. 21:75
1891 Phloeotribus. Webster. Ins. Life, 3:452
1893 Phloeotribus. Lintner. 9th N. Y. Rep't, p. 365-68
1893 Phloeotribus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 141 etc.; Bul. 32, p. 213
1894 Phloeotribus. Fletcher. Ottawa House Com'n, p. 7
1895 Phloeotribus. Cockerell. N. M. Agric. Exp. Bul. 15, p. 69
1896 Phloeotribus. Lintner. 11th N. Y. Rep't, p. 270
1896 Phloeotribus. Fletcher. Ottawa House Com'n, p. 18
1900 Phloeotribus. Smith. Cat. Ins. N. J. p. 364
1903 Phloeophthorus. Hopkins. U. S. Dep't Agric. Yearbook, p. 320
1905 Phloeophthorus. Currie. U. S. Div. Ent. Bul. 53, p. 19
1906 Phloeotribus. Felt. N. Y. Mus. Mem. 8, 2:336, 428, 452
1907 Phloeotribus. Fall & Cockerell. Am. Ent. Soc. Trans. 33:217

Habitat. New York to Tennessee, eastern Canada, New Mexico.

Food plants. Prunus persica, P. armeniaca, P. cerasus, P. serotina, Pyrus malus.

120 **puberulus** Lec.

1879 Phloeotribus. Leconte. U. S. Geol. Sur. Bul. 5:519

Habitat.

Food plants.

PITYOGENES Bedel

1888 Bedel. Faun. Col. Seine, 6:397, 401

121 **carinulatus** Lec.

1874 Cryphalus Leconte. Am. Ent. Soc. Trans. 5:70
1876 Pityophthorus. Leconte. Am. Phil. Soc. Proc. 15:352
1878 Pityophthorus. Leconte. Am. Phil. Soc. Proc. 17:624
1892 Pityophthorus. Schwarz. Ent. Soc. Wash. Proc. 2:168
1894 Pityogenes. Schwarz. Ins. Life, 7:255
1904 Pityogenes. Hopkins. U. S. Div. Ent. Bul. 48, p. 17, 44

hamatus Lec.

1874 Xyleborus. Lec. Am. Ent. Soc. Trans. 5:72
1876 Xyleborus. Leconte. Am. Phil. Soc. Proc. 15:359, 361
1878 = carinulatus Lec. Leconte. Am. Phil. Soc. Proc. 17:624
1907 Pityophthorus. Fall & Cockerell. Am. Ent. Soc. Trans. 33:217

Habitat. California to Washington, South Dakota and Colorado.

Food plants. Pinus ponderosa, Picea engelmanni, (Jeffrey pine).

122 **fossifrons** Lec.

1876 Pityophthorus. Leconte. Am. Phil. Soc. Proc. 15:353
1896 Pityogenes. Schwarz. U. S. Nat. Mus. Proc. 18:609

Habitat. Vancouver island.

Food plants.

123 **plagiatus** Lec.

1868 Xyleborus. Leconte. Am. Ent. Soc. Trans. 2:161
1876 Xyleborus. Leconte. Am. Phil. Soc. Proc. 15:361
1878 Xyleborus. Eichhoff. Rat. Tom. p. 280
1878 Pityophthorus. Leconte. Am. Phil. Soc. Proc. 17:623
1892 Pityophthorus. Schwarz. Ent. Soc. Wash. Proc. 2:168
1893 Pityophthorus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 129; Bul. 32, p. 208
1894 Pityophthorus. Hopkins. Can. Ent. 26:278
1899 Pityogenes. Hopkins. W. Va. Agric. Exp. Sta. Bul. 56, p. 342, 427, 429
1906 Pityogenes. Felt. N. Y. State Mus. Mem. 8, 2:752
Habitat. Maryland, New York, West Virginia.
Food plant. Pinus.

124 **punctipennis** Lec.

1878 Xyleborus. Leconte. Am. Phil. Soc. Proc. 17:624, 666
1886 Xyleborus. Schwarz. Ent. Am. 2:42
1896 Pityogenes. Eichhoff & Schwarz. U. S. Nat. Mus. Proc. 18:609, 610
Habitat. Michigan.
Food plants.

125 **sparsus** Lec.

1868 Xyleborus. Leconte. Am. Ent. Soc. Trans. 2:160
1876 Xyleborus. Leconte. Am. Phil. Soc. Proc. 15:360
1878 Pityophthorus. Leconte. Am. Phil. Soc. Proc. 17:624
1878 Pityophthorus. Hubbard & Schwarz. Am. Phil. Soc. Proc. 17:643
1888 Pityophthorus. Schwarz. Ent. Soc. Wash. Proc. 1:80
1890 Pityophthorus. Packard. U. S. Ent. Com'n, 5th Rep't, p. 720
1891 Pityophthorus. Hamilton. Ins. Life, 4:132
1893 Pityophthorus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 130; Bul. 32, p. 208
1894 Pityophthorus. Hamilton. Am. Ent. Soc. Trans. 21:406
1895 Pityophthorus. Hamilton. Am. Ent. Soc. Trans. 22:346, 378
1896 Pityogenes. Eichhoff & Schwarz. U. S. Nat. Mus. Proc. 18:609
1899 Pityogenes. Hopkins. W. Va. Agric. Exp. Sta. Bul. 56, p. 446
1900 Pityophthorus. Smith. Cat. Ins. N. J. p. 362
1905 Pityogenes. Currie. U. S. Div. Ent. Bul. 53, p. 80
1906 Pityogenes. Felt. N. Y. State Mus. Mem. 8, 2:752
Habitat. Eastern United States and Canada.
Food plant. Pinus.

PITYOPHTHORUS Eich.

1864 Eichhoff. Berl. Ent. Zeit. 8:39, 45, 46
1871 Eichhoff. Berl. Ent. Zeit. 15:137
1876 Leconte. Am. Phil. Soc. Proc. 15:347, 349, 350
1878 Eichhoff. Rat. Tom. p. 173
1881 Eichhoff. Borkenk. p. 49, 192
1883 Leconte & Horn. Col. N. A. p. 517

1888 Bedel. Faun. Col. Seine, 6:396, 398
1891 Blandford. Ent. Mo. Mag. 2:15–17
1895 Judeich-Nitsche. Forstins. 1:448, 451, fig.
1901 Barbey. Scol. l'Europ. Cent. p. 74

126 **annectens** Lec.

1878 Pityophthorus. Leconte. Am. Phil. Soc. Proc. 17:622
1889 Pityophthorus. Schwarz. Ent. Soc. Wash. Proc. 1:164
1890 Pityophthorus. Packard. U. S. Ent. Com'n, 5th Rep't, p. 715
1892 Pityophthorus. Schwarz. Ent. Soc. Wash. Proc. 2:167
1906 Pityophthorus. Felt. N. Y. State Mus. Mem. 8, 2:751
Habitat. Florida.
Food plant. Pinus echinata.

127 **cariniceps** Lec.

1876 Pityophthorus. Leconte. Am. Phil. Soc. Proc. 15:353
1893 Pityophthorus. Chittenden. Ent. Soc. Wash. Proc. 2:393
1893 Pityophthorus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 130; Bul. 32, p. 209
1899 Pityophthorus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 56, p. 443
1901 Pityophthorus. Hopkins. U. S. Div. Ent. Bul. 28, pl. 8
1904 Pityophthorus. Hopkins. U. S. Div. Ent. Bul. 48, p. 24
1905 Pityophthorus. Currie. U. S. Div. Ent. Bul. 53, p. 80
1906 Pityophthorus. Felt. N. Y. State Mus. Mem. 8, 2:650, 674
Habitat. Maine to Michigan and West Virginia, Quebec.
Food plants. Picea, Pinus strobus.

128 **comatus** Zimm.

1868 Crypturgus. Zimmerman. Am. Ent. Soc. Trans. 2:143
1876 Pityophthorus. Leconte. Am. Phil. Soc. Proc. 15:355
1878 Cryphalus. Eichhoff. Rat. Tom. p. 136
Habitat. South Carolina.
Food plants.

129 **concentralis** Eich.

1878 Pityophthorus. Eichhoff. Rat. Tom. p. 188
1889 Pityophthorus. Schwarz. Ent. Soc. Wash. Proc. 1:163
1899 Pityophthorus. Henshaw. Ent. Am. 5:132
1891 Pityophthorus. Beutenmüller. N. Y. Micro. Soc. Jour. 7:50
Habitat. Florida, Cuba.
Food plant. Rhus metopium.

130 **coniperda** Sz.

1895 Pityophthorus. Schwarz. Ent. Soc. Wash. Proc. 3:144–45
1902 Pityophthorus. Harrington. Ont. Ent. Soc. 3:117
1906 Pityophthorus. Felt. N. Y. State Mus. Mem. 8, 2:751
Habitat. Ontario, Michigan, New York, Pennsylvania, Virginia.
Food plant. Pinus, in cones.

131 **confinus** Lec.

1876 Pityophthorus. Leconte. Am. Phil. Soc. Proc. 15:354
1893 Pityophthorus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 130; Bul. 32, p. 209
1894 Pityophthorus. Hopkins. Can. Ent. 26:278
1899 (?) = bisulcatus Eich. Hopkins. W. Va. Agric. Exp. Sta. Bul. 56, p. 284, 344, 443
1904 Pityophthorus. Hopkins. U. S. Div. Ent. Bul. 48, p. 16
1905 Pityophthorus. Currie. U. S. Div. Ent. Bul. 53, p. 71
1906 Pityophthorus. Felt. N. Y. State Mus. Mem. 8, 2:751

Habitat. California, Washington, Idaho, New Mexico, West Virginia.

Food plant. Pinus.

132 **consimilis** Lec.

1878 Pityophthorus. Leconte. Am. Phil. Soc. Proc. 17:622, 665
1889 Pityophthorus. Schwarz. Ent. Soc. Wash. Proc. 1:164
1891 Pityophthorus. Schwarz. Ins. Life, 3:357
1891 Pityophthorus. Riley & Howard. Ins. Life, 4:123
1891 Pityophthorus. Beutenmüller. N. Y. Micro. Soc. Jour. 7:50
1892 Pityophthorus. Schwarz. Ent. Soc. Wash. Proc. 2:167
1893 Pityophthorus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 130; Bul. 32, p. 209
1894 Pityophthorus. Ashmead. Ent. Soc. Wash. Proc. 3:33
1906 Pityophthorus. Felt. N. Y. State Mus. Mem. 8, 2:503, 737; Pityogenes, p. 482

Habitat. Florida; Washington, D. C.; New York (Ithaca); Michigan (Detroit, Marquette); Quebec.

Food plants. All species of the genus Rhus; Nyssa sylvatica.

133 **deletus** Lec.

1879 Pityophthorus. Leconte. U. S. Geol. Sur. Bul. 5:519

Habitat. Colorado.

Food plants.

134 **digestus** Lec.

1874 Cryphalus. Leconte. Am. Ent. Soc. Trans. 5:71
1876 Pityophthorus. Leconte. Am. Phil. Soc. Proc. 15:355
1892 Pityophthorus. Blaisdell. Ins. Life, 5:36

Habitat. California (Mojave desert).

Food plant. Rhus integrifolia.

135 **lautus** Eich.

1871 Pityophthorus. Eichhoff. Berl. Ent. Zeit. p. 135
1876 Pityophthorus. Leconte. Am. Phil. Soc. Proc. 15:354
1878 Pityophthorus. Eichhoff. Rat. Tom. p. 190
1893 Pityophthorus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 131; Bul. 32, p. 209

1898 Pityophthorus. Blandford. Ent. News, 9:6
1906 Pityophthorus. Felt. N. Y. State Mus. Mem. 8, 2:751
Habitat. Texas, West Virginia.
Food plant. Pinus.

136 **nitidulus** Mannh.

1843 Bostrichus. Mannh. Bul. Mosc. p. 298, (263)
1852 Bostrichus. Mannh. Bul. Mosc. p. 359, (152)
1853 Bostrichus. Mannh. Bul. Mosc. p. 273
1868 Cryphalus. Leconte. Am. Ent. Soc. Trans. 2:157
1876 Pityophthorus. Leconte. Am. Phil. Soc. Proc. 15:354
1878 Pityophthorus. Eichhoff. Rat. Tom. p. 173
1894 Pityophthorus. Schwarz. Ins. Life, 7:255
1894 Pityophthorus. Hamilton. Am. Ent. Soc. Trans. 21:35
1903 Pityophthorus. Gillette. Col. Exp. Sta. Rep't, 15:118
1904 Pityophthorus. Hopkins. U. S. Div. Ent. Bul. 48, p. 17
1905 Pityophthorus. Currie. U. S. Div. Ent. Bul. 53, p. 72
1905 Pityophthorus. Schwarz. Harriman Alaska Exped. Rep't, Insects, pt 1, p. 185
1907 Pityophthorus. Fall & Cockerell. Am. Ent. Soc. Trans. 33:217

atratulus Lec.

1868 Cryphalus. Leconte. Am. Ent. Soc. Trans. 2:156
1876 =nitidulus Mannh. Leconte. Am. Phil. Soc. Proc. 15:354
1878 =cribripennis Eich. Eichhoff. Rat. Tom. p. 175
Habitat. Coast and Cascade region, Alaska to California; Utah; New Mexico.
Food plants. Picea sitchensis, Pseudotsuga mucronata, Pinus flexilis (shore pine), Picea engelmanni.

137 **obliquus** Lec.

1878 Pityophthorus. Leconte. Am. Phil. Soc. Proc. 17:432–33, 468
Habitat. Michigan (Marquette).
Food plants.

138 **opaculus** Lec.

1878 Pityophthorus. Leconte. Am. Phil. Soc. Proc. 17:623
Habitat. Michigan.
Food plants.

139 **pilosus** Lec.

1868 Cryphalus. Leconte. Am. Ent. Soc. Trans. 2:154
1876 Pityophthorus. Leconte. Am. Phil. Soc. Proc. 15:351
1878 Pityophthorus. Eichhoff. Rat. Tom. p. 199

pilosulus Lec.

1868 Cryphalus. Leconte. Am. Ent. Soc. Trans. 2:156
Habitat. Middle California.
Food plants.

140 **pruinosus** Eich.

1878 Pityophthorus. Eichhoff. Stet. Ent. Zeit. 39:390
1878 Pityophthorus. Eichhoff. Rat. Tom. p. 198
1896 Pityophthorus. Eichhoff & Schwarz. U. S. Nat. Mus. Proc. 18:609, 610
1903 Pityophthorus. Hopkins. U. S. Dep't Agric. Yearbook, p. 318

querciperda Sz.

1888 Pityophthorus. Schwarz. Ent. Soc. Wash. Proc. 1:56
1890 Pityophthorus. Packard. U. S. Ent. Com'n, 5th Rep't, p. 93
1896 = pruinosus Eich. Eichhoff & Schwarz. U. S. Nat. Mus. Proc. 18:609, 610
1900 Pityophthorus. Smith. Cat. Ins. N. J. p. 362
1906 Pityophthorus. Felt. N. Y. State Mus. Mem. 8, 2:702

Habitat. New York to Florida.

Food plant. Quercus.

141 **puberulus** Lec.

1868 Cryphalus. Leconte. Am. Ent. Soc. Trans. 2:157
1876 Pityophthorus. Leconte. Am. Phil. Soc. Proc. 15:354
1878 Pityophthorus. Leconte. Am. Phil. Soc. Proc. 17:665
1878 Pityophthorus. Eichhoff. Rat. Tom. p. 202
1888 Pityophthorus. Schwarz. Ent. Soc. Wash. Proc. 1:80
1890 Pityophthorus. Packard. U. S. Ent. Com'n, 5th Rep't, p. 812
1890 Pityophthorus. Smith. Cat. Ins. N. J. p. 267
1891 Pityophthorus. Schwarz. Ent. Soc. Wash. Proc. 2:65
1893 Pityophthorus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 131; Bul. 32, p. 209
1895 Pityophthorus. Hamilton. Am. Ent. Soc. Trans. 22:346, 378
1896 Pityophthorus. Eichhoff & Schwarz. U. S. Nat. Mus. Proc. 18:609, 610
1899 Pityophthorus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 56, p. 443
1900 Pityophthorus. Smith. Cat. Ins. N. J. p. 362
1906 Pityophthorus. Felt. N. Y. State Mus. Mem. 8, 2:752

infans Eich.

1871 Pityophthorus. Eichhoff. Berl. Ent. Zeit. p. 135
1878 Pityophthorus. Eichhoff. Rat. Tom. p. 187
1896 = puberulus Lec. Eichhoff & Schwarz. U. S. Nat. Mus. Proc. 18:609, 610

Habitat. District of Columbia, Michigan, New York, West Virginia.

Food plant. Pinus.

142 **pubipennis Lec.**

1857 Tomicus. Leconte. Pac. R. R. Expl. Sur. Ins. p. 59
1868 Cryphalus. Leconte. Am. Ent. Soc. Trans. 2:154, 156
1876 Pityophthorus. Leconte. Am. Phil. Soc. Proc. 15:351
1878 Pityophthorus. Eichhoff. Rat. Tom. p. 197
1890 Pityophthorus. Packard. U. S. Ent. Com'n, 5th Rep't, p. 93

1904 Pityophthorus. Hopkins. U. S. Div. Ent. Bul. 48, p. 16
1904 Pityophthorus. Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 243
1905 Pityophthorus. Currie. U. S. Div. Ent. Bul. 53, p. 71

Habitat. Pacific coast, California to Oregon; Guatemala (San Geronimo).

Food plant. Quercus.

143 **pulchellus** Eich.

1868 Pityophthorus. Eichhoff. Berl. Ent. Zeit. p. 275
1876 Pityophthorus. Leconte. Am. Phil. Soc. Proc. 15:352, 435
1878 Pityophthorus. Eichhoff. Rat. Tom. p. 181
1896 Pityophthorus. Eichhoff & Schwarz. U. S. Nat. Mus. Proc. 18:609, 610
1899 Pityophthorus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 56, p. 442
1906 Pityophthorus. Felt. N. Y. State Mus. Mem. 8, 2:752

hirticeps Lec.

1878 Pityophthorus. Leconte. Am. Phil. Soc. Proc. 17:623, 665
1888 Pityophthorus. Schwarz. Ent. Soc. Wash. Proc. 1:80
1893 Pityophthorus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 131; Bul. 32, p. 209
1896 (?)=pulchellus. Eichhoff & Schwarz. U. S. Nat. Mus. Proc. 18:609, 610
1899 Pityophthorus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 56, p. 442
1906 Pityophthorus. Felt. N. Y. State Mus. Mem. 8, 2:751

Habitat. Michigan (Marquette), Pennsylvania, West Virginia, Virginia.

Food plants. Pinus, Picea mariana (?).

144 **pulicarius** Zimm.

1868 Crypturgus. Zimmerman. Am. Ent. Soc. Trans. 2:144
1868 Cryphalus. Leconte. Am. Ent. Soc. Trans. 2:155, 157
1876 Pityophthorus. Leconte. Am. Phil. Soc. Proc. 15:353
1878 Pityophthorus. Eichhoff. Rat. Tom. p. 195
1878 Pityophthorus. Schwarz. Am. Phil. Soc. Proc. 17:468
1889 Pityophthorus. Schwarz. Ent. Soc. Wash. Proc. 1:163
1890 Pityophthorus. Schwarz. Ent. Soc. Wash. Proc. 1:231
1890 Pityophthorus. Smith. Cat. Ins. N. J. p. 267
1899 Pityophthorus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 56, p. 442
1900 Pityophthorus. Smith. Cat. Ins. N. J. p. 362
1906 Pityophthorus. Felt. N. Y. State Mus. Mem. 8, 2:751

Habitat. New Jersey, West Virginia, South Carolina, Florida, Illinois.

Food plant. Pinus.

145 **pullus** Zimm.

1868 Crypturgus. Zimmerman. Am. Ent. Soc. Trans. 2:143
1868 Cryphalus. Leconte. Am. Ent. Soc. Trans. 2:155
1876 Pityophthorus. Leconte. Am. Phil. Soc. Proc. 15:352

1878 =bisulcatus Eich. Eichhoff. Rat. Tom. p. 186
1878 Pityophthorus. Hubbard & Schwarz. Am. Phil. Soc. Proc. 17:643
1887 Pityophthorus. Schwarz. Ent. Am. 3:20
1888 Pityophthorus. Schwarz. Ent. Soc. Wash. Proc. 1:80
1890 Pityophthorus. Smith. Cat. Ins. N. J. p. 267
1892 Pityophthorus. Schwarz. Ent. Soc. Wash. Proc. 2:168
1893 Pityophthorus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 129; Bul. 32, p. 208
1898 Pityophthorus. Blandford. Ent. News, 9:5
1899 Pityophthorus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 56, p. 344, 442
1900 Pityophthorus. Smith. Cat. Ins. N. J. p. 362
1906 Pityophthorus. Felt. N. Y. State Mus. Mem. 8, 2:751

bisulcatus Eich.

1868 Pityophthorus. Eichhoff. Berl. Ent. Zeit. p. 274
1876 (?)=pullus. Leconte. Am. Phil. Soc. Proc. 15:352, 435
1878 Pityophthorus. Eichhoff. Rat. Tom. p. 185

cribripennis Eich.

1868 Pityophthorus. Eichhoff. Berl. Ent. Zeit. p. 274
1871 Pityophthorus. Eichhoff. Berl. Ent. Zeit. p. 137
1876 =nitidulus Mannh. Leconte. Am. Phil. Soc. Proc. 15:354, 435
1878 Pityophthorus. Eichhoff. Rat. Tom. p. 175
1896 =pullus Zimm. Eichhoff & Schwarz. U. S. Nat. Mus. Proc. 18:609, 610
1899 Pityophthorus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 56, p. 437, 442
1906 Pityophthorus. Felt. N. Y. State Mus. Mem. 8, 2:751

Habitat. Michigan, West Virginia, New York.

Food plant. Pinus.

146 **puncticollis** Lec.

1874 Cryphalus. Leconte. Am. Ent. Soc. Trans. 5:71
1876 Pityophthorus. Leconte. Am. Phil. Soc. Proc. 15:354
1904 Pityophthorus. Hopkins. U. S. Div. Ent. Bul. 48, p. 16
1905 Pityophthorus. Currie. U. S. Div. Ent. Bul. 53, p. 72
1907 Pityophthorus. Fall & Cockerell. Am. Ent. Soc. Trans. 33:217

Habitat. New Mexico to northern Washington.

Food plants. Pinus, Picea sitchensis.

147 **minutissimus** Zimm.

1868 Crypturgus. Zimmerman. Am. Ent. Soc. Trans. 2:143
1868 Cryphalus. Leconte. Am. Ent. Soc. Trans. 2:154
1876 Pityophthorus. Leconte. Am. Phil. Soc. Proc. 15:351
1878 Pityophthorus. Leconte. Am. Phil. Soc. Proc. 17:665
1878 =pusillus Harr. Eichhoff. Rat. Tom. p. 200
1888 Pityophthorus. Schwarz. Ent. Soc. Wash. Proc. 1:56, 113
1890 Pityophthorus. Packard. U. S. Ent. Com'n, 5th Rep't, p. 93, 221
1892 Pityophthorus. Schwarz. Ent. Soc. Wash. Proc. 2:168

1893 Pityophthorus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 129; Bul. 32, p. 208
1894 Pityophthorus. Hopkins. Can. Ent. 26:277
1898 Pityophthorus. Chittenden. Ent. Soc. Wash. Proc. 4:78
1900 Pityophthorus. Smith. Cat. Ins. N. J. p. 362
1904 Pityophthorus. Hopkins. U. S. Div. Ent. Bul. 48, p. 24
1905 Pityophthorus. Felt. N. Y. State Mus. Mem. 8, 1:257, 295
1905 Pityophthorus. Currie. U. S. Div. Ent. Bul. 53, p. 80

pusillus Harris.

1837 Tomicus. Harris. Nat. Hist. Soc. Hartford Trans. p. 82
1876 = minutissimus Zimm. Leconte. Am. Phil. Soc. Proc. 15:351
1878 Pityophthorus. Eichhoff. Rat. Tom. p. 200
Habitat. New England, North Atlantic, Middle and Southern States, Quebec.
Food plants. Quercus, Cornus, Hamamelis virginiana.

148 **pusio** Lec.

1878 Pityophthorus. Leconte. Am. Phil. Soc. Proc. 17:623
1878 Pityophthorus. Hubbard & Schwarz. Am. Phil .Soc. Proc. 17:643
Habitat. Michigan.
Food plants.

149 **seriatus** Lec.

1878 Pityophthorus. Leconte. Am. Phil. Soc. Proc. 17:433
1878 Pityophthorus. Schwarz. Am. Phil. Soc. Proc. 17:468
Habitat. Florida.
Food plant. Pinus.

150 **tomentosus** Eich.

1878 Pityophthorus. Eichhoff. Rat. Tom. p. 201
1878 Pityophthorus. Eichhoff. Stet. Ent. Zeit. 39:390
Habitat. America Borealis.

151 **tuberculatus** Eich.

1878 Pityophthorus. Eichhoff. Mem. Soc. Liege, 8:498
1893 Pityophthorus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 132; Bul. 32, p. 209
1899 Pityophthorus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 56, p. 443
1906 Pityophthorus. Felt. N. Y. State Mus. Mem. 8, 2:753
Habitat. West Virginia (?), California.
Food plant. Picea mariana (?).

POLYGRAPHUS Erichson

1836 Erichson. Wieg. Archiv. 1:57
1864 Eichhoff. Berl. Ent. Zeit. p. 32, 45, 46
1866 Lacordaire. Hist. Nat. Ins. Col. 7:365
1868 Leconte. Am. Ent. Soc. Trans. 2:169
1876 Leconte. Am. Phil. Soc. Proc. 15:374, 375, 376
1877 Provancher. Faun. Ent. Can. 1:570

1881 Eichhoff. Borkenk. p. 37, 122
1883 Leconte & Horn. Col. N. A. p. 521
1895 Judeich-Nitsche. Forstins. 1:445, 446
1896 Blandford. Ent. Soc. Lond. p. 74
1901 Barbey. Scol. l'Europ. Cent. p. 55

152 (?) **brevicornis** Kirby

1837 Apate (Lepisomus). Kirby. Faun. Bor. Am. 4:194
1868 Apate (Lepisomus). Leconte. Am. Ent. Soc. Trans. 2:177
1876 Polygraphus (?). Leconte. Am. Phil. Soc. Proc. 15:376
1885 Polygraphus. Henshaw. Col. N. A. p. 149

Habitat. Hudson bay region.

Food plants.

153 **rufipennis** Kirby

1837 Apate (Lepisomus). Kirby. Faun. Bor. Am. 4:193, tab. 8, fig. 2
1853 Hylesinus. Mannerheim. Bul. Mosc. p. 237
1868 Polygraphus. Leconte. Am. Ent. Soc. Trans. 2:169
1876 Polygraphus. Leconte. Am. Phil. Soc. Proc. 15:376
1877 Polygraphus. Provancher. Faun. Ent. Can. 1:570
1889 Polygraphus. Schwarz. Ent. Soc. Wash. Proc. 1:149, 176
1890 Polygraphus. Packard. U. S. Ent. Com'n, 5th Rep't, p. 721–22, 814, fig. 251
1892 Polygraphus. Hopkins. Ins. Life, 4:257
1893 Polygraphus. Hopkins. Ins. Life, 5:188; 6:129
1893 Polygraphus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 141 etc.; Bul. 32, p. 212
1894 Polygraphus. Hamilton. Am. Ent. Soc. Trans. 21:35
1894 Polygraphus. Hopkins. Can. Ent. 26:280
1897 Polygraphus. Johnson. Penn. Agric. Rep't, pt 2, p. 72–73, fig. 1
1907 Polygraphus. Fall & Cockerell. Am. Ent. Soc. Trans. 33:217

nigriceps Kirby

1837 Apate (Lepisomus). Kirby. Faun. Bor. Am. 4:194
1876 = rufipennis Kirby. Leconte. Am. Phil. Soc. Proc. 15:376

saginatus Mannh.

1853 Polygraphus. Mannerheim. Bul. Mosc. p. 237
1876 = rufipennis Kirby. Leconte. Am. Phil. Soc. Proc. 15:376

Habitat. Northern and eastern United States, Canada.

Food plants. Pinus, Picea, Abies.

PTEROCYCLON Eich.

1868 Eichhoff. Berl. Ent. Zeit. 12:276, 277
1869 Eichhoff. Berl. Ent. Zeit. p. 299
1878 Eichhoff. Rat. Tom. p. 437
1898 Blandford. Ent. News, 9:6
1904 Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 270, 288

MONARTHRUM Kirsch

1866 Kirsch. Berl. Ent. Zeit. 9:213. (Description referred to Corthylus)
1868 Kirsch. Berl. Ent. Zeit. p. 214
1876 Leconte. Am. Phil. Soc. Proc. 15:347, 348
1883 Leconte & Horn. Col. N. A. p. 517

154 **dentiger** Lec.

1868 Cryphalus. Leconte. Am. Ent. Soc. Trans. 2:154
1876 Monarthrum. Leconte. Am. Phil. Soc. Proc. 15:348–49
1878 Cryphalus. Eichhoff. Rat. Tom. p. 449
1893 Monarthrum. Chittenden. Ent. Soc. Wash. Proc. 2:393
Habitat. Middle California.
Food plant. Quercus agrifolia

155 **fasciatus** Say

1825 Bostrichus. Say. Acad. Nat. Sci. Phila. Jour. 5:255, ed. Lec. 2:318
1836 Corthylus. Erichson. Wieg. Archiv. 2:64, 79
1867 Corthylominus. Ferrari. Tomicides, p. 48
1868 Crypturgus. Zimmerman. Am. Ent. Soc. Trans. 2:143
1869 Pterocyclon. Eichhoff. Berl. Ent. Zeit. p. 298, 299
1876 Monarthrum. Leconte. Am. Phil. Soc. Proc. 15:348
1878 Monarthrum. Leconte. Am. Phil. Soc. Proc. 17:665
1878 Pterocyclon. Eichhoff. Rat. Tom. p. 442
1880 Monarthrum. Comstock. U. S. Agric. Rep't, p. 274–75
1890 Monarthrum. Packard. U. S. Ent. Com'n, 5th Rep't, p. 328, 520
1893 Monarthrum. Chittenden. Ent. Soc. Wash. Proc. 2:391
1893 Monarthrum. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 128; Bul. 32, p. 208
1894 Monarthrum. Hopkins. Can. Ent. 26:277
1895 Monarthrum. Hamilton. Am. Ent. Soc. Trans. 22:346, 378
1897 Monarthrum. Howard. U. S. Div. Ent. Bul. 7, p. 85
1897 Monarthrum. Hubbard. U. S. Div. Ent. Bul. 7, p. 26–28
1899 Monarthrum. Lugger. Minn. Agric. Exp. Sta. Bul. 66, p. 308, fig. 238
1899 Monarthrum. Hopkins. W. Va. Agric. Exp. Sta. Bul. 56, p. 347, 442
1900 Monarthrum. Smith. Cat. Ins. N. J. p. 361
1904 Pterocyclon. Hopkins. U. S. Div. Ent. Bul. 48, p. 45
1905 Monarthrum. Garman. Ky. Agric. Exp. Sta. Bul. 120, p. 68–74, fig. 3
1906 Monarthrum. Felt. N. Y. State Mus. Mem. 8, 2:751

simile Eich.

1868 Pterocyclon. Eichhoff. Berl. Ent. Zeit. p. 277
1876 = fasciatum Say. Leconte. Am. Phil. Soc. Proc. 15:348
Habitat. Lake Superior and Quebec to Florida.
Food plants. Many trees, both deciduous and coniferous. (Bores in wine casks.)

156 **gracile** Eich.

1878 Pterocyclon. Eichhoff. Rat. Tom. p. 444

fasciatus Say (var.)

1828 Bostrichus. Say. Acad. Nat. Sci. Phila. Jour. 5:253
1868 Cryphalus. Zimmerman, Am. Ent. Soc. Trans. 2:143
1878 = gracile Eich. Eichhoff. Rat. Tom. p. 444
Habitat. America Borealis (Tennessee, Pennsylvania, Carolina).
Food plants. (?)

157 **mali** Fitch

1855 Tomicus. Fitch. N. Y. Rep't Nox. Ins. 2: no. 5
1856 Tomicus. Fitch. N. Y. Rep't Nox. Ins. 3: no. 5, 8-9
1868 Crypturgus. Zimmerman. Am. Ent. Soc. Trans. 2:143
1876 Monarthrum. Leconte. Am. Phil. Soc. Proc. 15:349
1878 Monarthrum. Leconte. Am. Phil. Soc. Proc. 17:665
1878 Pterocyclon. Eichhoff. Rat. Tom. p. 447-49
1878 Monarthrum. Schwarz. Am. Phil. Soc. Proc. 17:468
1888 Monarthrum. Schwarz. Ent. Soc. Wash. Proc. 1:48
1888 Monarthrum. Fletcher. Ont. Ent. Soc. 18:15
1890 Monarthrum. Packard. U. S. Ent. Com'n, 5th Rep't, p. 94
1893 Monarthrum. Chittenden. Ent. Soc. Wash. Proc. 2:392
1893 Monarthrum. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 128; Bul. 32, p. 208
1894 Monarthrum. Hopkins. W. Va. Agric. Exp. Sta. Bul. 35, p. 295, fig. 8
1894 Monarthrum. Hopkins. Can. Ent. 26:277
1896 Monarthrum. Lintner. 11th N. Y. Rep't, p. 270
1897 Monarthrum. Howard. U. S. Div. Ent. Bul. 7. n. s. p. 85
1897 Monarthrum. Hubbard. U. S. Div. Ent. Bul. 7. n. s. p. 27, 28
1897 Monarthrum. Chittenden. U. S. Div. Ent. Bul. 7. n. s. p. 79
1899 Monarthrum. Hopkins. W. Va. Agric. Exp. Sta. Bul. 56, p. 347, 442
1899 Monarthrum. Lugger. Minn. Agric. Exp. Sta. Bul. 66, p. 306-10, fig. 239
1900 Monarthrum. Smith. Cat. Ins. N. J. p. 361
1901 Monarthrum. Felt. N. Y. Forest, Fish & Game Com'n Rep't, 7:517-18, fig. 17
1904 Pterocyclon. Hopkins. U. S. Div. Ent. Bul. 48, p. 45
1904 Monarthrum. Hopkins. U. S. Dep't Agric. Yearbook, p. 384
1905 Monarthrum. Felt. N. Y. State Mus. Mem. 8, 1:257, 289-92
1905 Monarthrum. Garman. Ky. Agric. Exp. Sta. Bul. 120, p. 68, fig. 4
1906 Monarthrum. Felt. N. Y. State Mus. Mem. 8, 2:336, pl. 67, fig. 1
1906 Pterocyclon. Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 269, 270, 271, 279

longulum Eich.

1868 Pterocyclon. Eichhoff. Berl. Ent. Zeit, p. 278
1876 = mali Fitch. Eichhoff. Stet. Ent. Zeit. 36:378
1876 = mali Fitch. Leconte. Am. Phil. Soc. Proc. 15:349
1878 = mali Fitch. Eichhoff. Rat. Tom. p. 448
1904 = mali Fitch. Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 279
Habitat. Eastern United States and Canada.
Food plants. Many trees, both deciduous and coniferous.

158 **scutellare** Lec.

1860 Corthylus. Leconte. Pac. R. R. Expl. & Sur. 12, pt 2, p. 59, (35)
1867 Corthylominus. Ferrari. Rat. Tom. p. 49
1876 Monarthrum. Leconte. Am. Phil. Soc. Proc. 15:348
1878 Corthylus. Eichhoff. Rat. Tom. p. 447
1893 Monarthrum. Chittenden. Ent. Soc. Wash. Proc. 2:392

cavus Lec.

1868 Cryphalus. Leconte. Am. Ent. Soc. Trans. 2:153
1876 = scutellare Lec. Leconte. Am. Phil. Soc. Proc. 15:348
1878 Cryphalus. Eichhoff. Rat. Tom. p. 451
Habitat. California.
Food plant. Quercus agrifolia.

RENOCIS Casey

1886 Casey. Cal. Acad. Sci. Bul. 2:257

159 **heterodoxus** Casey

1886 Renocis. Casey. Cal. Acad. Sci. Bul. 2, p. 258, pl. 7, fig. 20.

SCIERUS Leconte

1876 Leconte. Am. Phil. Soc. Proc. 15:390
1883 Leconte & Horn. Col. N. A. p. 525

160 **annectens** Lec.

1876 Leconte. Am. Phil. Soc. Proc. 15:390
1888 Scierus. Bedel. Faun. Col. Seine, 6:388
1901 Scierus. Hopkins. U. S. Div. Ent. Bul. 28, p. 33
Habitat. Anticosti, British Columbia, Maine.
Food plant. Picea.

TOMICUS Latr.

1802 Latreille. Hist. Nat. Crust. & Ins. 3:203
1887 Bedel. Faun. Col. Seine, 6:388, 389
1896 Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 143

HYLASTES Erichson

1836 Erichson. Wieg. Archiv. 2:47
1856 Perris. Ann. Soc. Ent. France, p. 223-30, pl. 5, fig. 321-23
1864 Eichhoff. Berl. Ent. Zeit. p. 23, 44, 46
1868 Leconte. Am. Ent. Soc. Trans. 2:174
1869 Chapuis. Syn. Scol. p. 16
1873 Chapuis. Mem. Soc. Liege, p. 224
1876 Leconte. Am. Phil. Soc. Proc. 15:387-88
1877 Provancher. Faun. Ent. Can. 1:574
1881 Eichhoff. Borkenk. p. 35, 76
1883 Leconte & Horn. Col. N. A. p. 521
1887 Bedel. Faun. Col. Seine, 6:388, 389, (Tomicus Latr.)

1895 Judeich-Nitsche. Forstins. 1:445, 446, fig.
1896 Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 143
1901 Barbey. Scol. l'Europ. Cent. p. 41

161 **exilis** Chap.

1869 Hylastes. Chapuis. Syn. Scol. p. 76
1873 Hylastes. Chapuis. Mem. Soc. Liège, p. 228
1876 Hylastes. Leconte. Am. Phil. Soc. Proc. 15:388, 389
Habitat. Florida.
Food plants. (?)

162 **longus** Lec.

1870 Hylastes. Leconte. Am. Phil. Soc. Proc. 15:388, 389
1907 Hylastes. Fall & Cockerell. Am. Ent. Soc. Trans. 33:218
Habitat. Colorado, New Mexico.
Food plants. (?)

163 **macer** Lec.

1868 Hylastes. Leconte. Am. Ent. Soc. Trans. 2:175
1876 Hylastes. Leconte. Am. Phil. Soc. Proc. 15:388
1894 Hylastes. Schwarz. Ins. Life, 7:255
Habitat. California, Utah, Nebraska.
Food plant. Picea engelmanni

164 **nigrinus** Mannh.

1852 Hylurgus. Mannerheim. Bul. Mosc. 356, 385. (143)
1868 Hylastes. Leconte. Am. Ent. Soc. Trans. 2:174
1873 Hylastes. Chapuis. Mem. Soc. Liège, p. 226
1876 Hylastes. Leconte. Am. Phil. Soc. Proc. 15:388
1894 Hylastes. Hamilton. Am. Ent. Soc. Trans. 21:36
Habitat. Alaska to California.
Food plants. (?)

165 **porculus** Er.

1836 Hylastes. Erichson. Wieg. Archiv. 2:49
1868 Hylastes. Leconte. Am. Ent. Soc. Trans. 2:149, 174
1876 Hylastes. Leconte. Am. Phil. Soc. Proc. 15:388, 389
1877 Hylastes. Provancher. Faun. Ent. Can. 1, Add. et cor. p. 28
1878 Hylastes. Hubbard & Schwarz. Am. Phil. Soc. Proc. 17:643
1878 Hylastes. Schwarz. Am. Phil. Soc. Proc. 17:469
1888 Hylastes. Schwarz. Ent. Soc. Wash. Proc. 1:80
1890 Hylastes. Packard. U. S. Ent. Com'n, 5th Rep't, p. 724
1896 Hylastes. Eichhoff & Schwarz. U. S. Nat. Mus. Proc. 18:605, 606, 610
1898 Hylastes. Blandford. Ent. News, 9:5
1899 Hylastes. Hopkins. W. Va. Agric. Exp. Sta. Bul. 56, p. 448
1900 Hylastes. Smith. Cat. Ins. N. J. p. 365
1905 Hylastes. Skinner. Ent. News, 16:248
1906 Hylastes. Felt. N. Y. State Mus. Mem. 8, 2:752

carbonarius Fitch

1851 Hylastes. Fitch. Nox. Ins. N. Y. 4th Rep't, p. 730
1876 =porculus Er. Leconte. Am. Phil. Soc. Proc. 15:389

cavernosus Zimm.

1868 Hylastes. Zimmerman. Am. Ent. Soc. Trans. 2:149, 174
1876 Hylastes. Leconte. Am. Phil. Soc. Proc. 15:388, 389
1877 Hylastes. Provancher. Faun. Ent. Can. 1:574, Add. et cor. p. 28
1878 Hylastes. Hubbard & Schwarz. Am. Phil. Soc. Proc. 17:643
1894 Hylastes. Hamilton. Am. Ent. Soc. Trans. 21:36
1896 =porculus Er. Eichhoff & Schwarz. U. S. Nat. Mus. Proc. 18:606, 610
1899 Hylastes. Hopkins. W. Va. Agric. Exp. Sta. Bul. 56, p. 345, 347, 356
1900 =porculus Er. Smith. Cat. Ins. N. J. p. 365

granosus Chap.

1869 Hylastes. Chapuis. Syn. Scol. p. 73
1873 Hylastes. Chapuis. Mem. Soc. Liège, p. 225
1876 =porculus Er. Leconte. Am. Phil. Soc. Proc. 15:389
1896 =porculus Er. Eichhoff & Schwarz. U. S. Nat. Mus. Proc. 18:606, 610

Habitat. Atlantic states, Colorado, Michigan, eastern Canada, Alaska.

Food plant. Pinus.

166 **porosus** Lec.

1868 Hylastes. Leconte. Am. Ent. Soc. Trans. 2:175
1876 Hylastes. Leconte. Am. Phil. Soc. Proc. 15:388
1902 Hylastes. Hopkins. U. S. Div. Ent. Bul. 32, p. 13

Habitat. Nevada, California.

Food plants. Roots of pines.

167 **salebrosus** Eich.

1868 Hylastes. Eichhoff. Berl. Ent. Zeit. p. 146
1868 Hylastes. Leconte. Am. Ent. Soc. Trans. 2:177
1876 (?) =porculus Er. Leconte. Am. Phil. Soc. Proc. 15:389
1896 Hylastes. Eichhoff & Schwarz. U. S. Nat. Mus. Proc. 18:606, 607, 610
1898 =scabripennis Zimm. Blandford. Ent. News, 9:5

scabripennis Zimm.

1868 Hylastes. Zimmerman. Am. Ent. Soc. Trans. 2:149
1876 =porculus Er. Leconte. Am. Phil. Soc. Proc. 15:389
1896 =salebrosus Eich. Eichhoff & Schwarz. U. S. Nat. Mus. Proc. 18:606, 607, 610
1898 Hylastes. Blandford. Ent. News, 9:5

Habitat. Atlantic states and eastern Canada.

Food plants.

168 scobinosus Eich.

1868 Hylastes. Eichhoff. Berl. Ent. Zeit. p. 146
1869 Hylastes. Chapuis. Syn. Scol. p. 73
1873 Hylastes. Chapuis. Mem. Soc. Liège, p. 225
1876 = cavernosus Zimm. Leconte. Am. Phil. Soc. Proc. 15:389
1896 Hylastes. Eichhoff & Schwarz. U. S. Nat. Mus. Proc. 18:606, 607, 610
Habitat. Carolina, Norfolk sound.
Food plants. (?)

169 tenuis Eich.

1868 Hylastes. Eichhoff. Berl. Ent. Zeit. p. 147
1868 Hylurgus. Zimmerman. Am. Ent. Soc. Trans. 2:149
1873 Hylastes. Chapuis. Mem. Soc. Liège, p. 227
1876 Hylastes. Leconte. Am. Phil. Soc. Proc. 15:388, 389
1878 Hylastes. Hubbard & Schwarz. Am. Phil. Soc. Proc. 15:469
1888 Hylastes. Schwarz. Ent. Soc. Wash. Proc. 1:80
1895 Hylastes. Hamilton. Am. Ent. Soc. Trans. 22:346, 378
1899 Hylastes. Hopkins. W. Va. Agric. Exp. Sta. Bul. 56, p. 345, 449
1906 Hylastes. Felt. N. Y. State Mus. Mem. 8, 2:752

gracilis Lec.

1868 Hylastes. Leconte. Am. Ent. Soc. Trans. 2:174
1876 Hylastes. Leconte. Am. Phil. Soc. Proc. 15:388
1899 = tenuis Zimm. Hopkins. W. Va. Agric. Exp. Sta. Bul. 56, p. 449
1907 Hylastes. Fall & Cockerell. Am. Ent. Soc. Trans. 33:218
Habitat. Atlantic states, California, Quebec.
Food plant. Pinus.

THYSANOES Leconte

1876 Leconte. Am. Phil. Soc. Proc. 15:369
1883 Leconte & Horn. Col. N. A. p. 519, 520

170 fimbricornis Lec.

1876 Thysanoes. Leconte. Am. Phil. Soc. Proc. 15:370
1889 Thysanoes. Schwarz. Ent. Soc. Wash. Proc. 1:165
1890 Thysanoes. Packard. U. S. Ent. Com'n, 5th Rep't, p. 293
1894 Thysanoes. Schwarz. Ent. Soc. Wash. Proc. 3:45
1906 Thysanoes. Felt. N. Y. State Mus. Mem. 8, 2:716
Habitat. Pennsylvania.
Food plant. Hicoria.

TRYPODENDRON Stephens

1830 Stephens. Ill. Brit. Ent. 3:353
1864 Eichhoff. Berl. Ent. Zeit. p. 36, 45, 46
1877 Provancher. Faun. Ent. Can. 1:566
1878 Eichhoff. Rat. Tom. p. 412
1881 Eichhoff. Borkenk. p. 291
1888 Bedel. Faun. Col. Seine, 6:396, 403
1895 Judeich-Nitsche. Forstins. 1:449-51
1901 Barbey. Scol. l'Europ. Cent. p. 110

XYLOTERUS Erichson

1836 Erichson. Wieg. Archiv. 1:60
1876 Leconte. Am. Phil. Soc. Proc. 15:357
1883 Leconte & Horn. Col. N. A. p. 517–18

171 **lineatus** Oliv.

1795 Bostrichus. Olivier. Ent. 4:77, p. 18, tab. 3, fig. 23, a, b
1813 Bostrichus. Gyllenhal. In. Suec. 3:367
1834 Bostrichus Hartig. Forstl. Convers. Lexicon, p. 13, 110
1839 Xyloterus. Ratzeburg. Forstins. 1:199–202, t. 13, fig. 11
1864 Xyloterus. Eichhoff. Berl. Ent. Zeit. tab. 1, fig. 11
1871 Xyloterus. Eichhoff. Berl. Ent. Zeit. p. 137
1876 Xyloterus. Eichhoff. Stet. Ent. Zeit. 36:378
1881 Trypodendron. Eichhoff. Borkenk. p. 298–305
1888 Trypodendron. Bedel. Faun. Col. Seine, 6:404, 421
1894 Xyloterus. Hamilton. Am. Ent. Soc. Trans. 21:36, 406
1899 Trypodendron. Ormerod. Rep't, 1898, p. 92
1901 Trypodendron. Barbey. Scol. l'Europ. Cent. p. 112, pl. 3, fig. 35; pl. 15, fig. 6
1907 Xyloterus. Fall & Cockerell. Am. Ent. Soc. Trans. 33:217
1907 Xyloterus Trèdl. Nahrungs. Verbreit. Borkenk. Europ. p. 19

bivittata Kirby

1837 Apate. Kirby. Faun. Bor. Am. 4:192, pl. 8, fig. 5
1853 Xyloterus. Mannerheim. Bul. Mosc. p. 236
1871 = lineatus Oliv. Eichhoff. Berl. Ent. Zeit. p. 137
1876 Xyloterus. Leconte. Am. Phil. Soc. Proc. 15:357, 426
1876 = lineatus Ratz. (?) Oliv. Eichhoff. Stet. Ent. Zeit. 36:378
1877 Trypodendron. Provancher. Faun. Ent. Can. 1:567
1878 Xyloterus. Hubbard & Schwarz. Am. Phil. Soc. Proc. 17:643
1881 = lineatus Ratz. (?) Oliv. Eichhoff. Borkenk. p. 299
1888 Xyloterus. Schwarz. Ent. Soc. Wash. Proc. 1:80
1889 Xyloterus. Hamilton. Am. Ent. Soc. Trans. 16:158
1890 Xyloterus. Packard. U. S. Ent. Com'n, 5th Rep't, p. 720, 812, 823, fig. 276
1891 Xyloterus. Riley & Howard. Ins. Life, 3:435.
1893 Xyloterus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 134; Bul. 32, p. 210
1894 Xyloterus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 35, p. 295, fig. 10
1894 Xyloterus. Hopkins. Can. Ent. 26:278
1894 = lineatus Oliv. Hamilton. Am. Ent. Soc. Trans. 21:35, 406
1895 = lineatus Oliv. Riley & Howard. Ins. Life, 7:419
1897 Xyloterus. Hubbard. U. S. Div. Ent. Bul. 7:28
1899 = lineatus Oliv. Hopkins. W. Va. Agric. Exp. Sta. Bul. 56, p. 444, 449
1901 Xyloterus. Felt. Forest, Fish & Game Com'n Rep't, 7:495, fig. 10
1904 Trypodendron. Hopkins. U. S. Div. Ent. Bul. 48, p. 16
1905 Trypodendron. Currie. U. S. Div. Ent. Bul. 53, p. 71

1905 Xyloterus. Schwarz. Harriman Alaska Exped. Rep't 8, Insects, pt 1, p. 185
1906 Xyloterus. Felt. N. Y. State Mus. Mem. 8, 2:335, 339, 369–70, pl. 70, fig. 2

cavifrons Mannh.

1843 Bostrichus. Mannerheim. Bul. Mosc. p. 297, (260)
1852 Bostrichus. Mannerheim. Bul. Mosc. p. 359, (153)
1852 Xyloterus. Mannerheim. Bul. Mosc. p. 385
1853 Xyloterus. Mannerheim. Bul. Mosc. p. 236
1868 =bivittatus Kirby. Leconte. Am. Ent. Soc. Trans. 2:158
1876 =bivittatus Kirby. Leconte. Am. Phil. Soc. Proc. 15:357
1878 =bivittatus Kirby. Eichhoff. Rat. Tom. p. 417
1881 =lineatus Oliv. Eichhoff. Borkenk. p. 299

melanocephalus Fabr.

1793 Bostrichus. Fabricius. Ent. Syst. 2:368
1801 Bostrichus. Fabricius. Syst. El. 2:21, 394
1881 =lineatus Oliv. Eichhoff. Borkenk. p. 299

rufitarsus Kirby

1837 Apate. Kirby. Faun. Bor. Am. 4:193
1868 Apate. Leconte. Am. Ent. Soc. Trans. 2:177
1876 =bivittatus. Kirby. Leconte. Am. Phil. Soc. Proc. 15:426
1878 (?) =lineatus Ratz. Eichhoff. Rat. Tom. p. 417
1888 =lineatus Oliv. Hamilton. Am. Ent. Soc. Trans. 16:158

vittiger Eich.

1881 Trypodendron. Eichhoff. Borkenk. p. 299
1886 =lineatus Oliv. Schwarz. Ent. Am. 2:41

Habitat. Central and Northern Europe, Siberia, Canada, Eastern, Northern and Western United States, New Mexico.

Food plants. Pinus, Picea, Abies, Tsuga, Juniperus, Larix, Betula.

172 politus Say

1828 Bostrichus. Say. Acad. Nat. Sci. Jour. 5:256; ed. Lec. 2:318
1868 Xyloterus. Leconte. Am. Ent. Soc. Trans. 2:159
1876 Xyloterus. Leconte. Am. Phil. Soc. Proc. 15:357, 358
1878 Xyloterus. Eichhoff. Rat. Tom. p. 420
1878 Xyloterus. Hubbard & Schwarz. Am. Phil. Soc. Proc. 17:666
1886 Xyloterus. Fletcher. Ont. Ent. Soc. 17:32
1889 Xyloterus. Schwarz. Ent. Soc. Wash. Proc. 1:149
1890 Xyloterus. Packard. U. S. Ent. Com'n, 5th Rep't, p. 387
1890 Xyloterus. Schwarz. Ins. Life, 3:87
1891 Xyloterus. Schwarz. Ent. Soc. Wash. Proc. 2:77
1893 Xyloperus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 134; Bul. 32, p. 210
1894 Xyloterus. Hopkins. Can. Ent. 26:278
1895 Xyloperus. Hamilton. Am. Ent. Soc. Trans. 22:346, 378

1897 Xyloterus. Hubbard. U. S. Div. Ent. Bul. 7, p. 28
1899 Xyloterus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 56, p. 444
1900 Xyloteres. Smith. Cat. Ins. N. J. p. 362.
1901 Xyloterus. Felt. N. Y. Forest, Fish & Game Com'n Rep't, 7:516–17, fig. 16
1905 Xyloterus. Felt. N. Y. State Mus. Mem. 8, 1:257, 292–293
1906 Xyloterus. Felt. N. Y. State Mus. Mem. 8, v. 2, pl. 70, fig. 4, 5
Habitat. Eastern United States and Canada.
Food plants. Quercus, Fagus, Acer, Betula, Hicoria, Fraxinus, Castanea, Magnolia, Alnus, Picea, Pinus.

173 **retusus** Lec.

1868 Xyloterus. Leconte. Am. Ent. Soc. Trans. 2:158
1876 Xyloterus. Leconte. Am. Phil. Soc. Proc. 15:357
1878 Xyloterus. Eichhoff. Rat. Tom. p. 420
1893 Xyloterus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 134; Bul. 32, p. 210
1894 Xyloterus. Hopkins. Can. Ent. 26:278
1897 Xyloterus. Hubbard. U. S. Div. Ent. Bul. 7, p. 29
Habitat. Canada, West Virginia.
Food plant. Populus grandidentata.

174 **scabricollis** Lec.

1868 Xyloterus. Leconte. Am. Ent. Soc. Trans. 2:158
1876 Xyloterus. Leconte. Am. Phil. Soc. Proc. 15:357, 358
1878 Trypodendron. Provancher. Faun. Ent. Can. 1, Add. et cor. p. 13
1878 =unicolor Eich. (?) Eichhoff. Rat. Tom. p. 419
1893 Xyloterus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 134; Bul. 32, p. 210
1897 Xyloterus. Hubbard. U. S. Div. Ent. Bul. 7, p. 29
1899 Xyloterus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 56, p. 444
1900 Xyloteres. Smith. Cat. Ins. N. J. p. 362
1905 Xyloterus. Skinner. Ent. News, 16:248
1906 Xyloterus. Felt. N. Y. Mus. Mem. 8, 2:752
1907 Xyloterus. Fall & Cockerell. Am. Ent. Soc. Trans. 33:217
Habitat. District of Columbia, West Virginia, New York, New Mexico, Quebec.
Food plants. Pinus, Hamamelis virginiana, Tsuga.

175 **unicolor** Eich.

1871 Xyloterus. Eichhoff. Berl. Ent. Zeit. p. 136
1876 Xyloterus. Leconte. Am. Phil. Soc. Proc. 15:358
1878 Trypodendron. Eichhoff. Rat. Tom. p. 419
1893 =politus Say. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 134; Bul. 32, p. 210
1894 (?) =politus Say. Hopkins. Can. Ent. 26:278
1900 Xyloteres. Smith. Cat. Ins. N. J. p. 362
Habitat.
Food plants.

XYLEBORUS Eich.

1864 Eichhoff. Berl. Ent. Zeit. p. 37, 45, 56
1868 Zimmerman. Am. Ent. Soc. Trans. 2:142, 144
1868 Leconte. Am. Ent. Soc. Trans. 2:151, 159–62
1876 Leconte. Am. Phil. Soc. Proc. 15:358
1877 Provancher. Faun. Ent. Can. 1:567
1878 Eichhoff. Rat. Tom. p. 315, 316
1881 Eichhoff. Borkenk. p. 53, 268
1883 Leconte & Horn. Col. N. A. p. 518
1888 Bedel. Faun. Col. Seine, 6:397, 402
1894 Blandford. Ent. Soc. Lond. p. 100
1895 Judeich-Nitsche. Forstins. 1:449, 451
1895 Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 192–97
1901 Barbey. Scol. l'Europ. Cent. p. 104

176 (?) affinis Eich.

1867 Xyleborus. Eichhoff. Berl. Ent. Zeit. p. 401
1878 Xyleborus. Eichhoff. Rat. Tom. p. 372–74
1893 Xyleborus. Blandford. Kew Bul. p. 1–46
1894 Xyleborus. Riley. Ins. Life, 6:227
1895 Xyleborus. Schwarz. Ent. Soc. Wash. Proc. 3:171
1895 Xyleborus. Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 195, 196, 216
1897 Xyleborus. Hubbard. U. S. Div. Ent. Bul. 7, p. 20, 21
1898 Xyleborus. Blandford. Ent. News, 9:3
1904 Xyleborus. Titus & Pratt. U. S. Div. Ent. Bul. 47, p. 7
1904 Xyleborus. Hopkins. U. S. Dep't Agric. Yearbook, p. 383
1905 Xyleborus. Currie. U. S. Div. Ent. Bul. 53, p. 7

Habitat. United States (?), Mexico, Guatemala, Nicaragua, Panama, West Indies, Columbia, Brazil, Peru, Argentina, Mauritius.

Food plants. Sugar cane (?), Liriodendron (?).

177 celsus Eich.

1867 Xyleborus. Eichhoff. Berl. Ent. Zeit. p. 400
1868 Xyleborus. Zimmerman. Am. Ent. Soc. Trans. 2:145
1876 Xyleborus. Leconte. Am. Phil. Soc. Proc. 15:359–60
1878 Xyleborus. Eichhoff. Rat. Tom. p. 399
1878 Xyleborus. Hubbard & Schwarz. Am. Phil. Soc. Proc. 17:666
1890 Xyleborus. Packard. U. S. Ent. Com'n, 5th Rep't, p. 92, 297
1893 Xyleborus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 135; Bul. 32, p. 211
1895 Xyleborus. Hamilton. Am. Ent. Soc. Trans. 22:346, 378
1896 Xyleborus. Hopkins. Can. Ent. 28:249, 250
1897 Xyleborus. Hubbard. U. S. Div. Ent. Bul. 7, p. 22, 24
1900 Xyleborus. Smith. Cat. Ins. N. J. p. 363
1904 Xyleborus. Hopkins. U. S. Dep't Agric. Yearbook, p. 384
1904 Xyleborus. Hopkins. U. S. Div. Ent. Bul. 48, p. 39
1906 Xyleborus. Felt. N Y. State Mus. Mem. 8, 2:427, 446–48, 504, fig. 102–5

biographus Lec.

1868 Xyleborus. Leconte. Am. Ent. Soc. Trans. 2:160
1876 Xyleborus. Leconte. Am. Phil. Soc. Proc. 15:359, 360 (♂)
1878 =celsus Eich. (?) Eichhoff. Rat. Tom. p. 399, 400
1878 Xyleborus. Schwarz. Am. Phil. Soc. Proc. 17:468, 666
1896 =celsus Eich. Hopkins. Can. Ent. 28:249
1906 Xyleborus. Felt. N. Y. State Mus. Mem. 8, 2:447
Habitat. Middle Atlantic, Central and Southern states.
Food plant. Hicoria.

178 dispar Fabr.

1792 Apate. Fabricius. Ent. Syst. 1:2, p. 363
1793 Bostrichus. Herbst. Col. 113, pl. 48, fig. 2, k
1801 Apate. Fabricius. Syst. Eleut. 2:382
1813 Bostrichus. Gyllenhal. Ins. Suec. 3:10, 363
1837 Bostrichus. Ratzeburg. Forstins. 1:169, taf. 13, fig. 13, 14
1839 Bostrichus. Ratzeburg. Forstins. 1:204-8, taf. 13, fig. 13, 14
1843 Bostrichus. Klingelh. Stet. Ent. Zeit. 4:78
1844 Bostrichus. Hartig. Allgemeine Forst. Jagdz. 13:73, 74
1848 Bostrichus. Noerdl. Stet. Ent. Zeit. p. 249
1854 Bostrichus. Bach. Kaef. 2:124, 131
1862 Bostrichus. Doeb. Zool. 2:183
1863 Fairm. Gen. Col. 4, t. 34, fig. 165, 166
1864 Bostrichus. Bach. Nat. u. Offenb. 10:52, fig. 7, 8
1864 Xyleborus. Eichhoff. Berl. Ent. Zeit. p. 38, t. 1, fig. 13-16
1867 Asinandrus. Ferrari. Borkenk, p. 26, (24)
1874 Asinandrus. Redtenb. Fn. Aust. ed. 3, 2:382
1878 Xyleborus. Eichhoff. Rat. Tom. p. 320-23
1878 Xyleborus. Schoch. M. T. schw. ent. Ges. 5:367
1881 Xyleborus. Eichhoff. Borkenk. p. 53, 67, 68, 73, 269
1887 Xyleborus. Fletcher. Ont. Ent. Soc. 17:14
1888 Xyleborus. Bedel. Faun. Col. Seine, 6:403, 420
1889 Xyleborus. Riley. Ins. Life, 2:145
1890 Xyleborus. Riley & Howard. Ins. Life, 2:279
1890 Xyleborus. Ormerod. Rep't 1889. p. 92
1890 Xyleborus. Ormerod. Man. Inj. Ins. p. 330-34, fig.
1890 Xyleborus. Schwarz. Ins. Life, 3:41
1891 Xyleborus. Schwarz. Ent. Soc. Wash. Proc. 2:64
1892 Xyleborus. Riley. Ins. Life, 5:17
1894 Xyleborus. Hopkins. Can. Ent. 26:278
1894 Xyleborus. Bellevoye. Soc. Rein. Bul. 3:89-111
1895 Xyleborus. Riley & Howard. Ins. Life, 7:419
1895 Tomicus. Judeich-Nitsche. Forstins. 1:549-51
1895 Xyleborus. Chittenden. Ins. Life, 7:385
1895 Xyleborus. Hamilton. Am. Ent. Soc. Trans. 22:346, 378
1897 Xyleborus. Hubbard. U. S. Div. Ent. Bul. 7, p. 22, 23
1898 Xyleborus. Ormerod. Ins. Orchard Fruits, Handbook, p. 185-92
1900 Xyleborus. Smith. Cat. Ins. N. J. p. 362
1901 Xyleborus. Barbey. Scol. l'Europ. Cent. p. 104, pl. 3, fig. 25, 26; pl. 15, fig. 5

1904 Xyleborus. Chapman. Ent. Soc. Lond. Trans. p. 100-2
1906 Xyleborus. Felt. N. Y. State Mus. Mem. 8, 2:446, fig. 103
1907 Asinandrus. Trèdl. Nahrungs. Verbreit. Borkenk. Europ. p. 18

brevis Panz. ♂

1793 Bostrichus. Panz. Fn. Germ. p. 34, fig. 20
Bostrichus. Panz. Crit. Rev. 1:118 (*var* pallida)
1878 =dispar Fabr. Eichhoff. Rat. Tom. p. 321

pyri Peck

1817 Scolytus. Peck. Mass. Agric. Jour. 4:205-7
1819 Scolytus. Peck. Mass. Agric. Jour. 5:307-13
1843 Tomicus. Mass. Ploughman. June 17, v. 2, no. 38
1843 Tomicus. New England Farmer, p. 21
Tomicus. Downing's Horticulturist, 2:365-67
1852 Tomicus. Harris. Ins. Inj. Veg. p. 80
1863 Tomicus. Harris. Inj. Ins. p. 91
1868 Xyleborus. Zimmerman. Am. Ent. Soc. Trans. 2:144
1876 Xyleborus. Leconte. Am. Phil. Soc. Proc. 15:358-60
1877 Xyleborus. Provancher. Faun. Ent. Can. 1:567
1878 Xyleborus. Eichhoff. Rat. Tom. p. 323
1886 Xyleborus. Schwarz. Ent. Am. 2:41
1887 Xyleborus. Schwarz. Ent. Am. 3:20
1889 Xyleborus. Schwarz. Ent. Soc. Wash. Proc. 1:138
1890 Xyleborus. Forbes. Psyche, 5:295
1890 =dispar. Riley & Howard. Ins. Life, 2:279
1891 Xyleborus. Cook. Mich. Agric. Exp. Sta. Rep't, p. 130-31, fig. 4
1893 Xyleborus. Harvey. Me. Agric. Exp. Sta. Rep't, p. 176-78
1893 Xyleborus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 135; Bul. 32, p. 210
1896 Xyleborus. Lintner. 11th N. Y. Rep't, p. 270
1897 =dispar. Hubbard. U. S. Div. Ent. Bul. 7, p. 22, 23
1898 =dispar Fabr. Ormerod. Ins. Orchard Fruits, Handbook, p. 185
1900 =dispar Fabr. Smith. Cat. Ins. N. J. p. 362
1902 Xyleborus. Lochhead. Ont. Ent. Soc. 33:109
1904 Xyleborus. Titus & Pratt. U. S. Div. Ent. Bul. 47, p. 20
1905 Xyleborus. Currie. U. S. Div. Ent. Bul. 53, p. 13, 20

tachygraphus Sahlb.

1834 Bostrichus. Sahlb. Diss. Ins. Fenn. p. 52
1878 =dispar Fabr. Eichhoff. Rat. Tom. p. 321, 323

thoracicus Panz ♀

1793 Bostrichus. Panz. Fn. Germ. p. 34, fig. 18
Bostrichus. Panz. Crit. Rev. 1:118
1878 =dispar Fabr. Eichhoff. Rat. Tom. p. 321

ratzeburgii Kolen. ♀

1846 Bostrichus. Kolenati. Mel. Ent. 3:39, 115, t. 14, fig. 11
1867 Bostrichus. Ferrari. Borkenk. p. 27, note 2
1878 =dispar Fabr. Eichhoff. Rat. Tom. p. 321, 323

Habitat. Canada, eastern and middle United States, Europe, Asia Minor, Siberia.

Food plants. Fruit trees, Betula, Fagus, Quercus, Tsuga, and, in Europe, many others.

179 **fuscatus** Eich.

1867 Xyleborus. Eichhoff. Berl. Ent. Zeit. p. 400
1868 Xyleborus. Zimmerman. Am. Ent. Soc. Trans. 2:145
1876 Xyleborus. Leconte. Am. Phil. Soc. Proc. 15:359, 360
1878 Xyleborus. Eichhoff. Rat. Tom. p. 386
1878 Xyleborus. Schwarz. Am. Phil. Soc. Proc. 17:468
1878 Xyleborus. Hubbard & Schwarz. Am. Phil. Soc. Proc. 17:666
1890 Xyleborus. Schwarz. Ins. Life, 3:87
1890 Xyleborus. Packard. U. S. Ent. Com'n, 5th Rep't, p. 93.
1891 Xyleborus. Schwarz. Ent. Soc. Wash. Proc. 2:78
1893 Xyleborus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 135; Bul. 32, p. 210
1894 Xyleborus. Schwarz. Ent. Soc. Wash. Proc. 3:16
1897 Xyleborus. Hubbard. U. S. Div. Ent. Bul. 7, p. 21, 22
1898 Xyleborus. Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 197, 217
1900 Xyleborus. Smith. Cat. Ins. N. J. p. 363
1906 Xyleborus. Felt. N. Y. State Mus. Mem. 8, 2:752

planicollis Zimm.

1868 Xyleborus. Zimmerman. Am. Ent. Soc. Trans. 2:145
1876 Xyleborus. Leconte. Am. Phil. Soc. Proc. 15:360, 361
1878 Xyleborus. Eichhoff. Rat. Tom. p. 391
1891 Xyleborus. Schwarz. Ent. Soc. Wash. Proc. 2:79
1897 (?) =fuscatus. Eich. Hubbard. U. S. Div. Ent. Bul. 7, p. 20, 22
1898 (?) =fuscatus Eich. Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 217

Habitat. New Jersey to Texas, Guatemala, Columbia.

Food plants. Quercus, Hicoria, Castanea, Juglans cinerea, Pinus, (wine and vinegar casks).

180 **impressus** Eich.

1867 Xyleborus. Eichhoff. Berl. Ent. Zeit. p. 400
1876 Xyleborus. Leconte. Am. Phil. Soc. Proc. 15:359, 360
1878 Xyleborus. Eichhoff. Rat. Tom. p. 389
1890 Xyleborus. Packard. U. S. Ent. Com'n, 5th Rep't, p. 718

Habitat. Georgia, New Jersey, Massachusetts.

Food plant. Pinus.

181 **inermis** Eich.

1867 Xyleborus. Eichhoff. Berl. Ent. Zeit. p. 401
1878 Xyleborus. Eichhoff. Rat. Tom. p. 370-72

1897 Xyleborus. Hubbard. U. S. Div. Ent. Bul. 7, p. 20
1898 Xyleborus. Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 217
1904 Xyleborus. Hopkins. U. S. Dep't Agric. Yearbook, p. 383
Habitat. Cuba, "Insula Americana, Civitates unitae, Tennessee, St Catharina."
Food plants. Probably those given for "pubescens."

182 **obesus** Lec.

1868 Xyleborus. Leconte. Am. Ent. Soc. Trans. 2:159
1876 Xyleborus. Leconte. Am. Phil. Soc. Proc. 15:359, 360
1878 Xyleborus. Eichhoff. Rat. Tom. p. 323, 324
1887 Xyleborus. Schwarz. Ent. Am. 3:20
1888 (?) = pyri Peck. Schwarz. Ent. Soc. Wash. Proc. 1:45
1890 Xyleborus. Packard. U. S. Ent. Com'n, 5th Rep't, p. 520
1893 Xyleborus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 135; Bul. 32, p. 211
1894 Xyleborus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 35, p. 295, fig. 12
1894 Xyleborus. Hopkins. Can. Ent. 26:278
1896 Xyleborus. Lintner. 11th N. Y. Rep't, p. 270
1897 Xyleborus. Hubbard. U. S. Div. Ent. Bul. 7, p. 23
1900 Xyleborus. Smith. Cat. Ins. N. J. p. 363
1904 Xyleborus. Hopkins. U. S. Dep't Agric. Yearbook, p. 383
1906 Xyleborus. Felt. N. Y. State Mus. Mem. 8, 2:722
Habitat. Canada to Virginia.
Food plants. Quercus, Fagus, Tsuga, Pyrus.

183 **pini** Eich.

1867 Xyleborus. Eichhoff. Berl. Ent. Zeit. p. 401
1876 = xylographus Say. Leconte. Am. Phil. Soc. Proc. 15:360
1878 = xylographus. Say. Eichhoff. Rat. Tom. p. 369, 370
1896 Xyleborus. Eichhoff & Schwarz. U. S. Nat. Musc. Proc. 18:609, 610
1897 Xyleborus. Hubbard. U. S. Div. Ent. Bul. 7, p. 20
Habitat. "Carolina."
Food plants.

184 (?) **propinquus** Eich.

1868 Xyleborus. Eichhoff. Berl. Ent. Zeit. p. 281
1878 Xyleborus. Eichhoff. Rat. Tom. p. 367
1897 Xyleborus. Hubbard. U. S. Div. Ent. Bul. 7, p. 20
1898 Xyleborus. Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 196, 213, 214
Habitat. Tennessee (?), Mexico, Guatemala, Nicaragua.
Food plants.

185 **pubescens** Zimm.

1868 Xyleborus. Zimmerman. Am. Ent. Soc. Trans. 2:145
1876 Xyleborus. Leconte. Am. Phil. Soc. Proc. 15:359, 360
1878 (?)= inermis Eich. Eichhoff. Rat. Tom. p. 371
1878 Xyleborus. Schwarz. Am. Phil. Soc. Proc. 17:468
1886 Xyleborus. Schwarz. Ent. Am. 2:41

1888 Xyleborus. Schwarz. Ent. Soc. Wash. Proc. 1:45
1890 Xyleborus. Packard. U. S. Ent. Com'n, 5th Rep't, p. 710–11
1890 Xyleborus. Schwarz. Ins. Life, 3:87
1890 Xyleborus. Riley & Howard. Ins. Life, 3:167
1891 Xyleborus. Schwarz. Ent. Soc. Wash. Proc. 2:78
1892 Xyleborus. Riley & Howard. Ins. Life, 4:402
1893 Xyleborus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 137; Bul. 32, p. 211
1894 Xyleborus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 35, p. 296, fig. 14
1894 Xyleborus. Hopkins. Can. Ent. 26:279
1894 (?)=perforans Woll. Hopkins. Ins. Life, 7:148
1894 Xyleborus. Schwarz. Ent. Soc. Wash. Proc. 3:16
1895 Xyleborus. Hamilton. Am. Ent. Soc. Trans. 22:346, 378
1896 Xyleborus. Hopkins. W. Va. Agric. Exp. Sta. Rep't, p. 133–35
1897 Xyleborus. Hubbard. U. S. Div. Ent. Bul. 7, p. 19–22
1897 Xyleborus. Howard. U. S. Div. Ent. Bul. 7, p. 85
1898 Xyleborus. Blandford. Ent. News, 9:4
1899 Xyleborus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 56, p. 445
1900 Xyleborus. Smith. Cat. Ins. N. J. p. 363
1904 Xyleborus. Titus & Pratt. U. S. Div. Ent. Bul. 47, p. 57
1905 Xyleborus. Wenzel. Ent. News, 16:124
1906 Xyleborus. Felt. N. Y. State Mus. Mem. 8, 2:396, 702, 720

Habitat. New York, West Virginia, Wisconsin and southward.

Food plants. Citrus aurantium, Quercus, Tilia americana, Prosopis juliflora, Populus, Juglans cinerea, Castanea, Magnolia, Pinus, Prunus cerasus.

186 retusicollis Zimm.

1868 Xyleborus. Zimmerman. Am. Ent. Soc. Trans. 2:146
1876 Xyleborus. Leconte. Am. Phil. Soc. Proc. 15:359, 360
1878 (?)=affinis Eich. Eichhoff. Rat. Tom. p. 372
1886 Xyleborus. Schwarz. Ent. Am. 2:41
1890 Xyleborus. Packard. U. S. Ent. Com'n, 5th Rep't, p. 93
1895 Xyleborus. Schwarz. Ent. Soc. Wash. Proc. 3:171
1897 Xyleborus. Hubbard. U. S. Div. Ent. Bul. 7, p. 20

Habitat. Maryland.

Food plant. Quercus.

187 tachygraphus Zimm.

1868 Xyleborus. Zimmerman. Am. Ent. Soc. Trans. 2:144
1876 Xyleborus. Leconte. Am. Phil. Soc. Proc. 15:358, 360
1878 Xyleborus. Eichhoff. Rat. Tom. p. 323
1891 Xyleborus. Schwarz. Ent. Soc. Wash. Proc. 2:62
1897 Xyleborus. Hubbard. U. S. Div. Ent. Bul. 7, p. 23
1897 Xyleborus. Chittenden. U. S. Div. Ent. Bul. 7, p. 79

Habitat. New York, middle and Southern states.

Food plants. Liriodendron tulipifera, Acer, Fagus, Cercis canadensis, Rhus.

188 xylographus Say

1826 Bostrichus. Say. Nat. Sci. Phila. Jour. 5:256; ed. Lec. 2:318
1857 Xyleborus. Fitch. Nox. Ins. 4th Rep't, p. 716–20
1868 Xyleborus. Zimmerman. Am. Ent. Soc. Trans. 2:145
1876 Xyleborus. Leconte. Am. Phil. Soc. Proc. 15:359, 360
1878 Xyleborus. Eichhoff. Rat. Tom. p. 369
1878 Xyleborus. Schwarz. Am. Phil. Soc. Proc. 17:468, 666
1883 Xyleborus. Saunders. Ont. Ent. Soc. 14:55
1886 Xyleborus. Schwarz. Ent. Am. 2:41
1889 Xyleborus. Schwarz. Ent. Soc. Wash. Proc. 1:149
1893 Xyleborus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 31, p. 136
1894 Xyleborus. Hopkins. Can. Ent. 26:278
1894 Xyleborus. Hamilton. Am. Ent. Soc. Trans. 21:406
1895 Xyleborus. Hamilton. Am. Ent. Soc. Trans. 22:346, 378
1896 Xyleborus. Hubbard. Ent. Soc. Wash. Proc. 3:318
1896 Xyleborus. Lintner. 11th N. Y. Rep't, p. 270
1897 Xyleborus. Hubbard. U. S. Div. Ent. Bul. 7, p. 24–26
1898 =saxeseni Ratz. Ormerod. Ins. Orchard Fruits, Handbook, p. 192
1898 Xyleborus. Hopkins. Can. Ent. 30:21–29, pl. 2, 3
1899 Xyleborus. Hopkins. W. Va. Agric. Exp. Sta. Bul. 56, p. 258, 347
1899 Xyleborus. Luggar. Minn. Agric. Exp. Sta. Bul. 66, p. 311–13, fig. 241
1900 Xyleborus. Smith. Cat. Ins. N. J. p. 363
1903 Xyleborus. Washburn. Minn. Agric. Exp. Sta. Bul. 84, p. 60, 82, 91, fig. 36
1905 Xyleborus. Skinner. Ent. News, 16:248
1907 Xyleborus. Bremner. Can. Ent. 39:195–96
1907 Xyleborus. Fall & Cockerell. Am. Ent. Soc. Trans. 33:217

aesculi Ferrari ♂

1867 Xyleborus. Ferrari. Borkenk. p. 22, note 2
1878 =saxeseni Ratz. Eichhoff. Rat. Tom. p. 362
1898 =xylographus Say. Hopkins. Can. Ent. 30:28

decolor Boield. ♂

1859 Bostrichus. Boieldieu. Ann. Soc. Ent. Fr. p. 473
1866 Bostrichus. Perris. Ann. Soc. Ent. Fr.
1867 Bostrichus. Ferrari. Borkenk. p. 21, 22, note 2
1876 =saxeseni Ratz. Eichhoff. Stet. Ent. Zeit. 36:378
1878 =saxesenii Ratz. Eichhoff. Rat. Tom. p. 362
1898 =xylographus Say. Hopkins. Can. Ent. 30:29

dohrnii Woll. ♀

1854 Tomicus. Wollaston. Ins. Mad. p. 290
(?) Tomicus. Wollaston. Cat. Col. Ins. Can. p. 253
1878 =saxeseni Ratz. Eichhoff. Rat. Tom. p. 362
1898 =xylographus Say. Hopkins. Can. Ent. 30:28

dryographus Ferrari

1867 Xyleborus. Ferrari. Borkenk. p. 20, 3 et 22, note 2 (ex parte ♀)
1878 =saxeseni Ratz. Eichhoff. Rat. Tom. p. 362, 363
1898 =xylographus Say. Hopkins. Can. Ent. 30:28

saxeseni Ratz.

1837 Bostrichus. Ratzeburg. Forstins. 1:167
1839 Bostrichus. Ratzeburg. Forstins. 1:204
1846 Bostrichus. Wiesmann. Stet. Ent. Zeit. p. 24
1848 Bostrichus. Noerdl. Stet. Ent. Zeit. p. 246. ♂
1854 Bostrichus. Bach. Kaefer, 2:126, 134
1862 Bostrichus. Doebn. Zool. 2:182
1867 Xyleborus. Ferrari. Borkenk. p. 21
(?) Tomicus. Thomson. Scand. Col. 7:370
1876 Xyleborus. Eichhoff. Stet. Ent. Zeit. 36:378
1878 Xyleborus. Schoch. M. T. schw. ent. Ges. 5:367
1878 Xyleborus. Eichhoff. Rat. Tom. p. 361
1881 Xyleborus. Eichhoff. Borkenk. p. 279–82
1886 Xyleborus. Schwarz. Ent. Am. 2:41
1888 Xyleborus. Bedel. Faun. Col. Seine, 6:402, 403, 419
1894 Xyleborus. Bellevoye. Soc. Reims Bul. 3:89–111
1895 Tomicus. Judeich-Nitsche. Forstins. 1:545
1896 =xylographus Say. Eichoff & Schwarz. U. S. Nat. Mus. Proc. 18:609
1897 =xylographus Say. Hubbard. U. S. Div. Ent. Bul. 7, p. 24
1898 Xyleborus Ormerod. Ins. Orchard Fruits, Handbook, p. 192, fig.
1898 =xylographus Say. Hopkins. Can. Ent. 30:21, 22
1901 Xyleborus. Barbey. Scol. l'Europ. Cent. p. 107, pl. 3, fig. 30
1904 Xyleborus. Titus & Pratt. U. S. Div. Ent. Bul. 47, p. 20
1904 Xyleborus. Hopkins. U. S. Div. Ent. Bul. 48, p. 16
1905 Xyleborus. Currie. U. S. Div. Ent. Bul. 53, p. 71
1907 Xyleborus. Trèdl. Nahrungs. Verbreit. Borkenk. Europ. p. 19

subdepressus Rey

1883 Xyleborus. Rey. Rev. d'Ent. 2:142
1898 =xylographus Say. Hopkins. Can. Ent. 30:28

Habitat. Eastern and western United States, Canada, Europe, Japan.

Food plants. Pinus, Hicoria, Quercus, Fagus, Acer, Tsuga, Picea, Prunus, Pyrus in America; Castanea, Betula, Tilia, Populus, Ulmus, Alnus, Sorbus, Aesculus, Abies, Larix, Prunus and Pyrus in Europe.

XYLOCLEPTES Ferrari

1867 Ferrari. Borkenk. p. 37
1878 Eichhoff. Rat. Tom. p. 216
1881 Eichhoff. Borkenk. p. 210
1883 Leconte & Horn. Col. N. A. p. 518

1888 Bedel. Faun. Col. Seine, 6:396, 399
1895 Judeich-Nitsche. Forstins. 1:449, 451
1898 Blandford. Biol. Centr. Am. Col. 4, pt 6, p. 185, 188
1901 Barbey. Scol. l'Europ. Cent. p. 80

189 (?) **bispinus** Duft

1825 Bostrichus. Duft. Fn. Aust. 3:92, 7
1837 Bostrichus. Ratzeburg. Forstins. 1:155, t. 13, fig. 5
1839 Bostrichus. Ratzeburg. Forstins. 1:189, t. 13, fig. 5
1849 Bostrichus. Bach. Verh. nat. Ver. Rheinl. p. 161
1849 Bostrichus. Bach. Stet. Ent. Zeit. p. 161, 200
1854 Bostrichus. Bach. Kaef. 2:129
1862 Bostrichus. Doebner. Zool. 2:178
1864 Bostrichus. Bach. Nat. u. Offenb. p. 51, fig. 6
1867 Xylocleptes. Ferrari. Borkenk. p. 40
1874 Xylocleptes. Redtenb. Fn. Aust. ed. 3. 2:378
1878 Xylocleptes. Eichhoff. Rat. Tom. p. 216, fig. 61
1881 Xylocleptes. Eichhoff. Borkenk. p. 210
1886 Xylocleptes. Schwarz. Ent. Am. 2:42
1888 Xylocleptes. Bedel. Faun. Col. Seine, 6:399, 415
1901 Xylocleptes. Barbey. Scol. l'Europ. Cent. p. 80, pl. 2, fig. 27; pl. 10, fig. 1

retusus Oliv.

1778 Scolytus. Olivier. Ent. 4:10, tab. 2, fig. 14, a, b
1878 =bispinus Duft. Eichhoff. Rat. Tom. p. 217

Habitat. Europe, United States (?).

Food plant. Clematis.

190 **cucurbitae** Lec.

1879 Xylocleptes. Leconte. U. S. Geol. Sur. Bul. 5:519
1886 Xylocleptes. Schwarz. Ent. Am. 2:42
1897 Xylocleptes. Cockerell. N. Y. Ent. Soc. Jour. 5:150
1907 Xylocleptes. Fall & Cockerell. Am. Ent. Soc. Trans. 33:217

Habitat. Utah, New Mexico.

Food plant. Cucurbita foetidissima.

191 **decipiens** Lec.

1878 Xylocleptes. Leconte. Am. Phil. Soc. Proc. 17:624
1878 Xylocleptes. Hubbard & Schwarz. Am. Phil. Soc. Proc. 17:666
1886 Xylocleptes. Schwarz. Ent. Am. 2:42
1893 Xylocleptes. Chittenden. Ent. Soc. Wash. Proc. 2:394
1896 Xylocleptes. Lintner. 11th N. Y. Rep't, p. 270
1906 Xylocleptes. Felt. N. Y. State Mus. Mem. 8, 2:715

Habitat. Virginia, Michigan, New York (Ithaca).

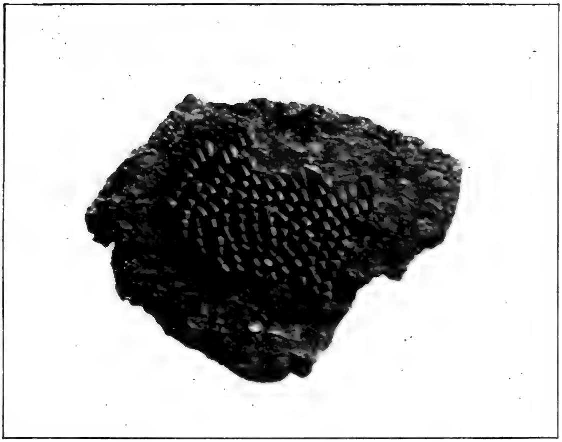
Food plants. Hicoria, Pyrus, Acer.

EXPLANATION OF PLATES

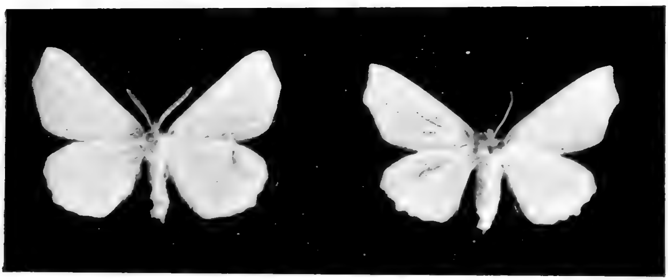
PLATE 1

1 Snow-white linden moth; eggs, slightly enlarged. (Original)
2 Adult moths. (Author's illustration)

Plate I



I



2

Snow-white linden moth

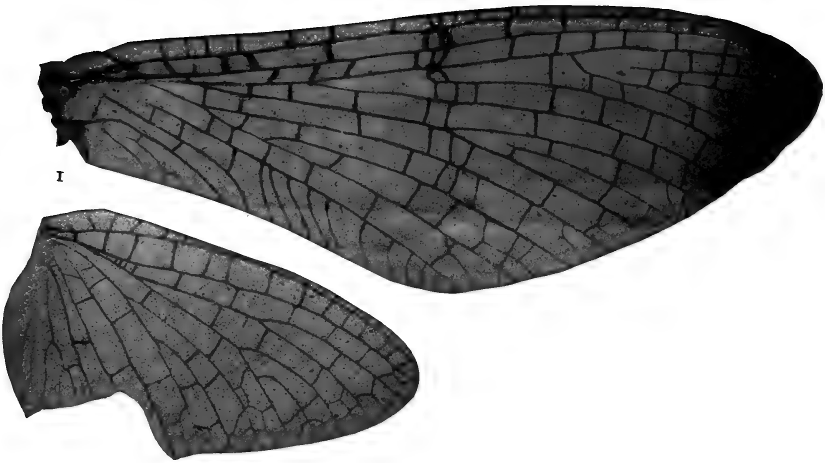
PLATE 2

Siphlonisca aerodromia Ndm.

1 Wings

2 Dorsal view of abdomen of female

Plate 2



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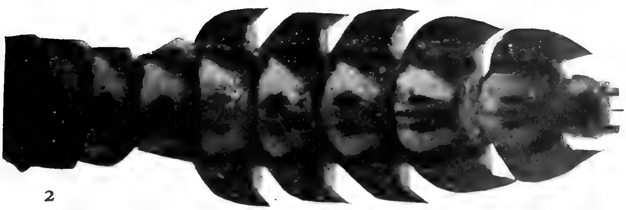


2

Siphlonisca aerodromia Ndm.

PLATE 3

1 Platypus compositus Say, dorsum of head and prothorax. (Enlarged)

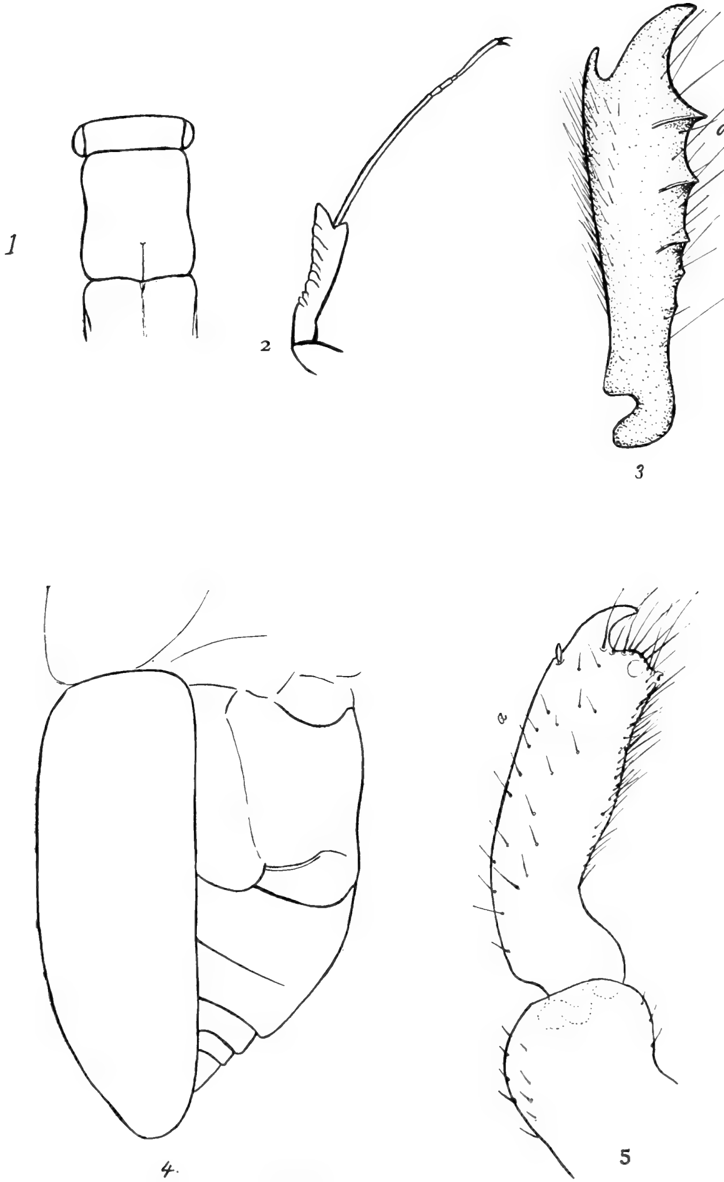
2 Platypus compositus Say, fore leg. (Greatly enlarged)

3 Erineophilus schwarzi Hopk., foretibia; *a*, outer border, after Hopkins. (Greatly enlarged)

4 Eccoptogaster rugulosus Ratz., side view of abdomen. (Enlarged)

5 Eccoptogaster rugulosus Ratz., foretibia; *a*, outer border. (Greatly enlarged)

Plate 3



Scolytid structures

PLATE 4

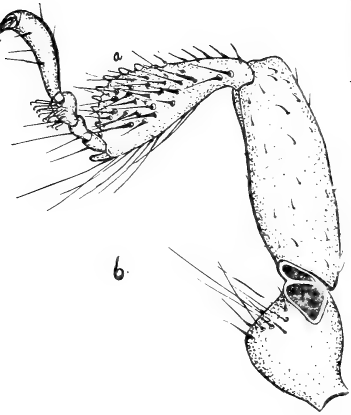
6 *Pityophthorus minutissimus* Zimm., fore leg; *a,* outer border. (Greatly enlarged)

7 Pityogenes undes. sp., antenna. (Greatly enlarged)

8 *Pterocyclon mali* Fitch, antenna. (Greatly enlarged)

9 *Pityophthorus minutissimus* Zimm., antenna. (Greatly enlarged)

Plate 4



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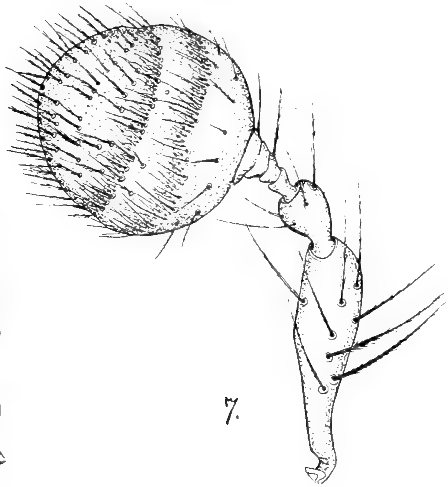

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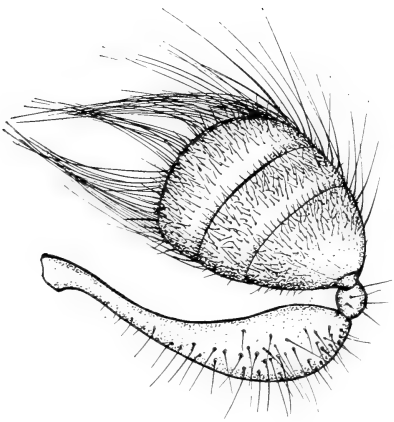

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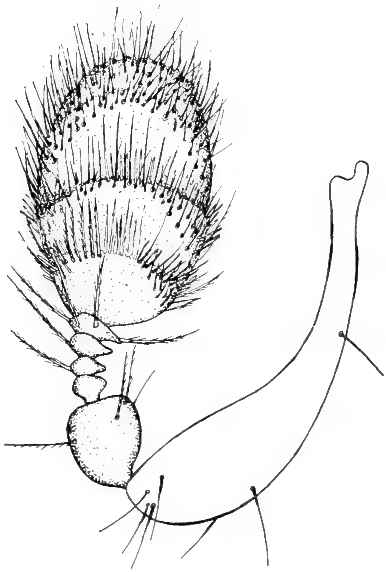


9

Scolytid structures

PLATE 5

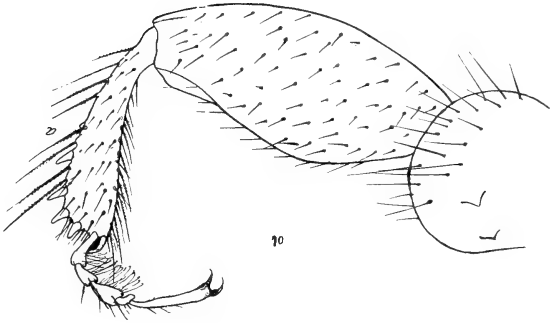
10 Pityogenes undes. sp., fore leg; *a,* outer border. (Greatly enlarged)

11 Pterocyclon mali Fitch, foretibia and tarsus; *a,* outer border. (Greatly enlarged)

12 Trypodendron politus Say, side view of head and prothorax, showing divided eye. (Enlarged)

13 Trypodendron politus Say, antenna. (Greatly enlarged)

Plate 5



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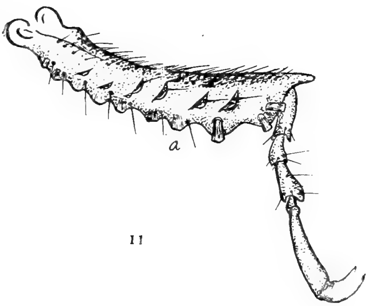

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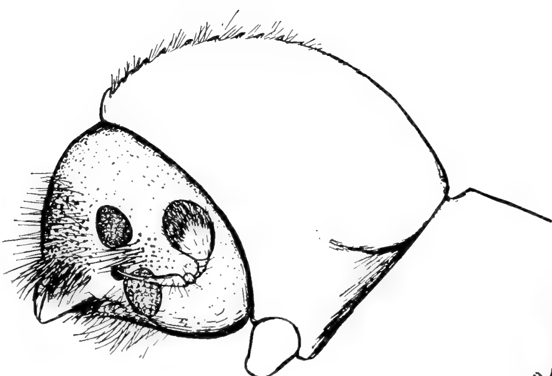

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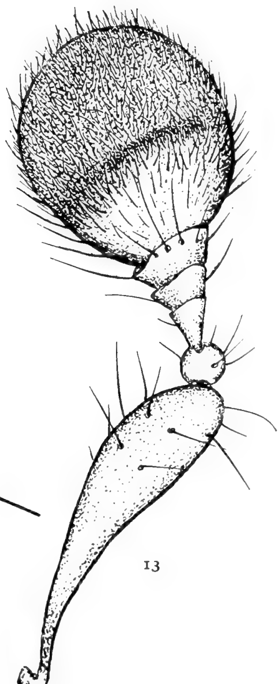


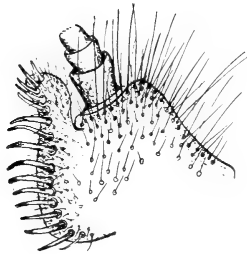
13

Scolytid structures

PLATE 6

14 Ips (Tomicus) pini Say, distal portion of maxilla. (Greatly enlarged)
15 Xyleborus undes. sp., *a*, distal portion of maxilla. (Greatly enlarged)
16 Ips pini Say, antenna (outer face). (Greatly enlarged)
17 Xyleborus undes. sp. *a*, ventral view of prosternum. (Enlarged)
18 Dryocoetes autographus Ratz., ventral view of prosternum; *Ant.*, antenna (outer face); *Gs.*, gular suture; *C.*, forecoxa; *Ps.*, prosternum. (Enlarged)

Plate 6



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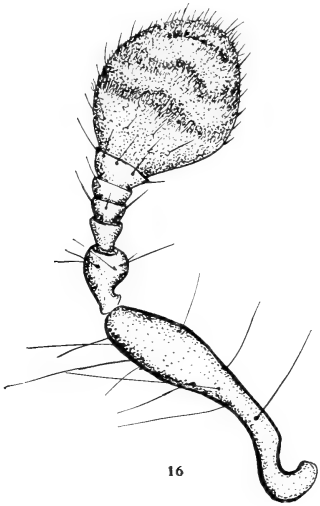

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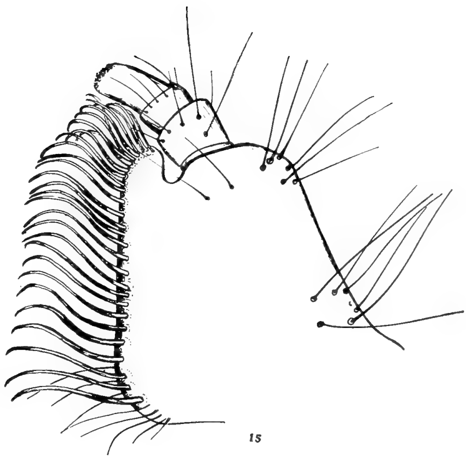

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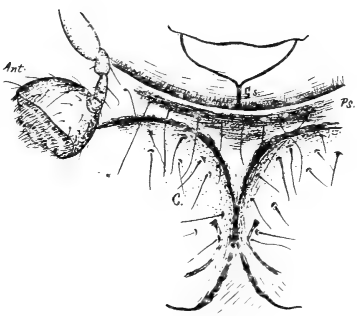

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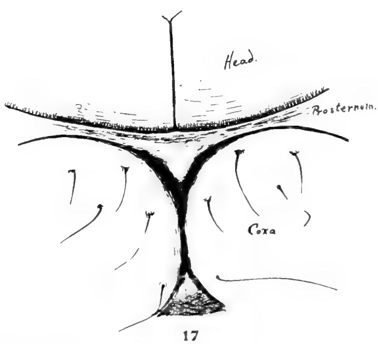


17

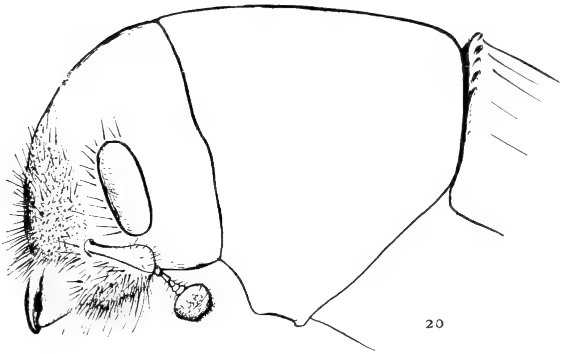
Scolytid structures

PLATE 7

19 Pityogenes undes. sp., dorsum of male. (Enlarged)

20 Dendroctonus terebrans Oliv., side view of head and prothorax. (Enlarged)

Plate 7



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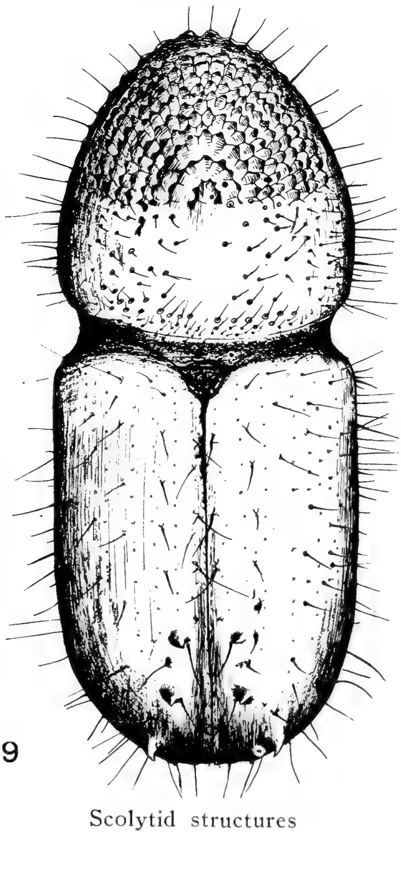


19

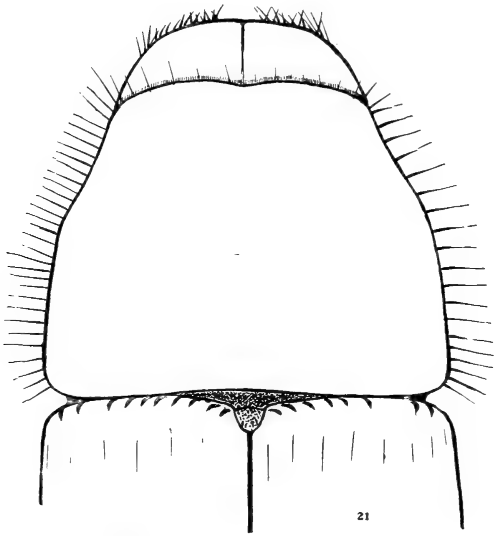
Scolytid structures

PLATE 8

21 Dendroctonus terebrans Oliv., dorsum of head and prothorax. (Enlarged)

23 Hylurgops glabratus Zett., cephalic aspect of mesosternum; *pro.*, protuberance of mesosternum. (Enlarged)

Plate 8



21

23

Scolytid structures

PLATE 9

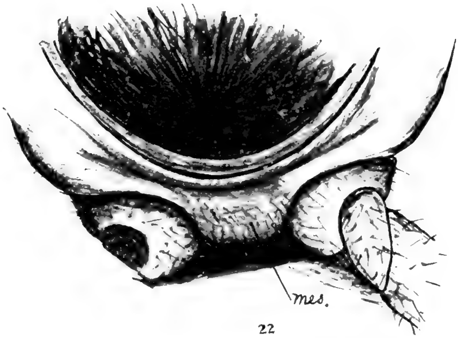
22 Hylastes undes. sp., cephalic view of mesosternum; *mes.,* mesosternum. (Enlarged)

24 Chramesus icoriae Lec., antenna. (Greatly enlarged)

25 Chramesus icoriae Lec., dorsum. (Enlarged)

27 Phloeosinus dentatus Say, antenna. (Greatly enlarged)

Plate 9



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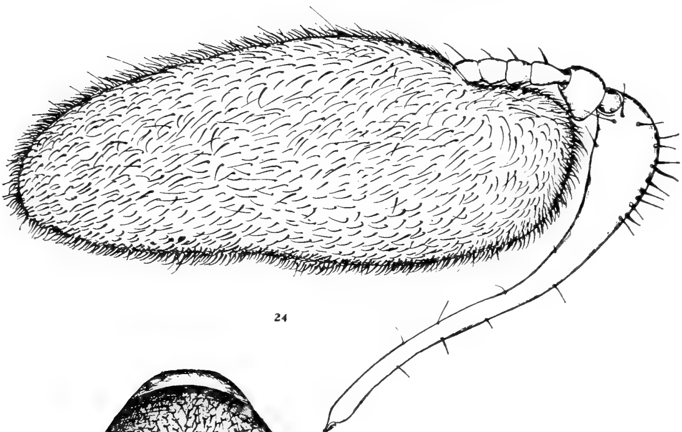

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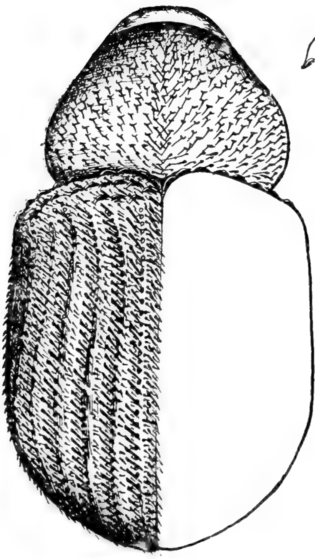

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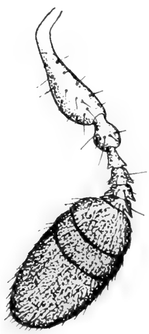


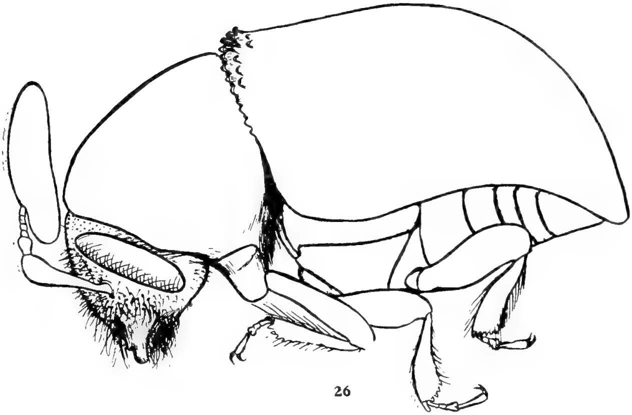
27

Scolytid structures

PLATE 10

26 *Chramesus icoriae* Lec., lateral view. (Enlarged)
28 *Dendroctonus terebrans* Oliv., antenna. (Greatly enlarged)
29 *Hylurgops glabratus* Zett., antenna. (Greatly enlarged)
30 *Phloeotribus liminaris* Harris, antennal funicle and club. (Greatly enlarged)

Plate 10



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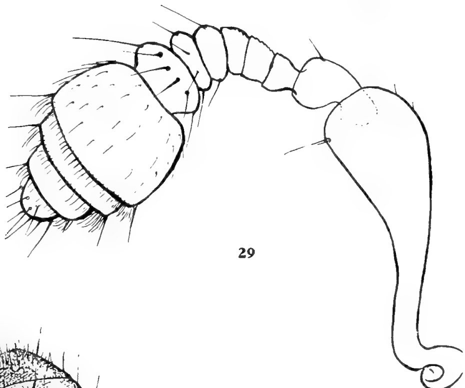

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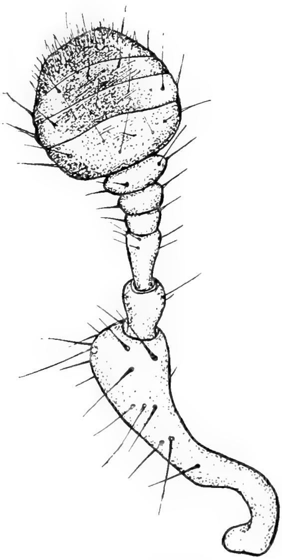

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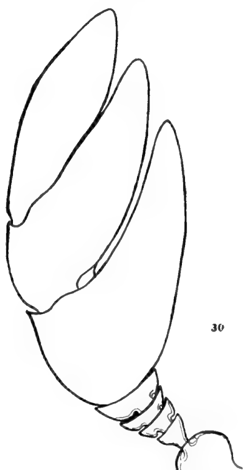


30

Scolytid structures

PLATE 11

31 H y l u r g o p s g l a b r a t u s Zett., foretarsus. (Greatly enlarged)

32 Hylastes undes. sp., first three segments of foretarsus. (Greatly enlarged)

33 H y l u r g o p s g l a b r a t u s Zett., venter of abdomen. (Enlarged)

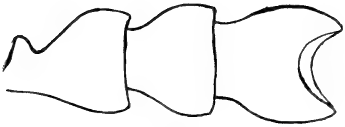
34 H y l e s i n u s a c u l e a t u s Say, venter of abdomen. (Enlarged)

35 H y l u r g o p s g l a b r a t u s Zett., mesosternum; *C.*, coxal cavity; *pro.*, protuberance of mesosternum. (Enlarged)

36 H y l u r g o p s g l a b r a t u s Zett., pronotum and base of elytra. (Enlarged)

37 Hylastes undes. sp., pronotum and base of elytra. (Enlarged)

Plate 11



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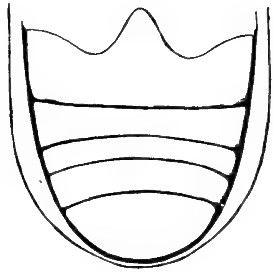

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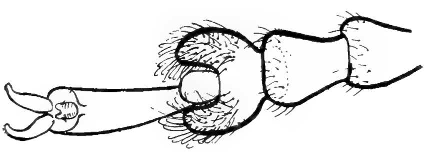

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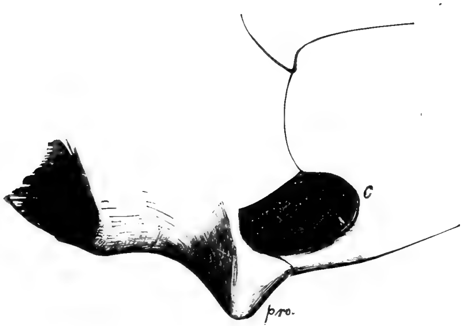

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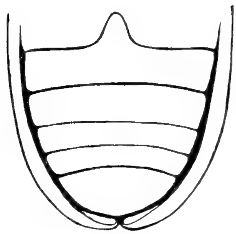

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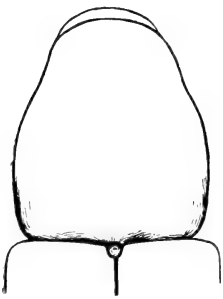

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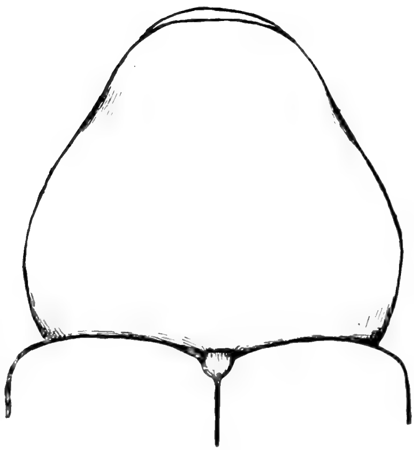

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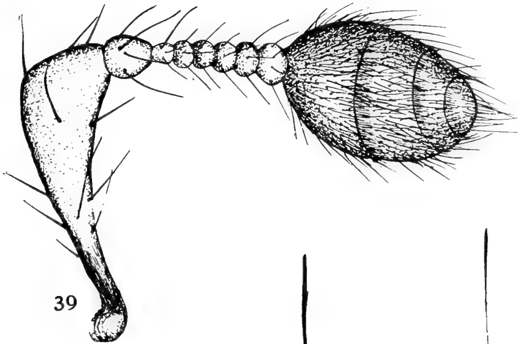
Scolytid structures

PLATE 12

38 *Xylocleptes* undes. sp., antenna. (Greatly enlarged)
39 *Hylastinus obscurus* Marsh, antenna. (Greatly enlarged)
40 *Ips pini* Say, declivity of elytra. (Enlarged)
41 *Micracis opacicollis* Lec., declivity of elytra. (Enlarged)

Plate 12



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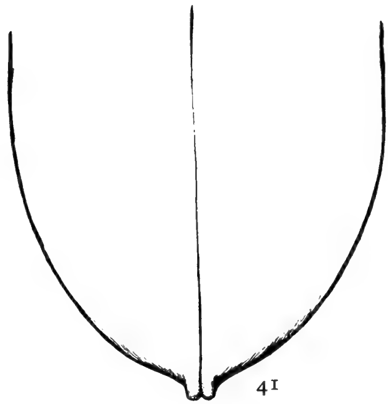

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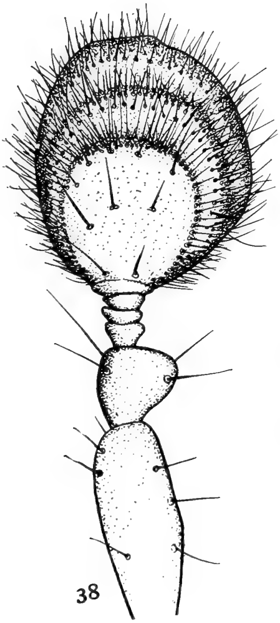

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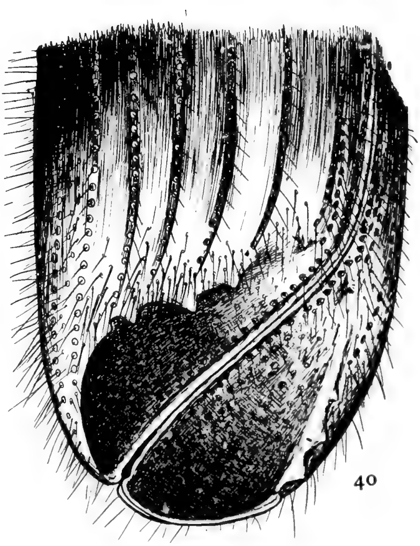


40

Scolytid structures

PLATE 13

42 Xyleborus undes. sp., *a,* antennal funicle and club. (Greatly enlarged)

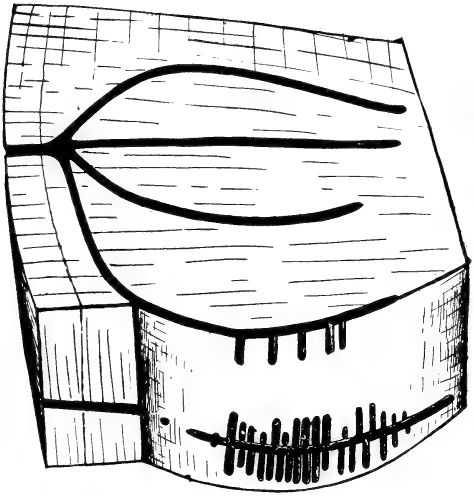
43 Polygraphus rufipennis Kirby, left aspect of head showing divided eye. (Enlarged)

44 Xyleborus undes. sp., *a,* foretibia. (Greatly enlarged)

45 Pterocyclon mali Fitch, work in oak

46 Micracis opacicollis Lec., work in chestnut twig

Plate 13



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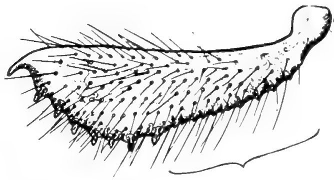

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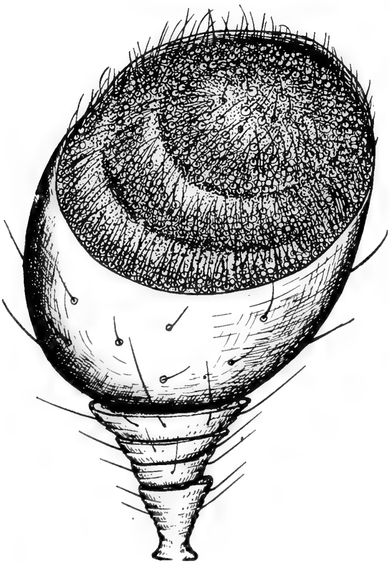

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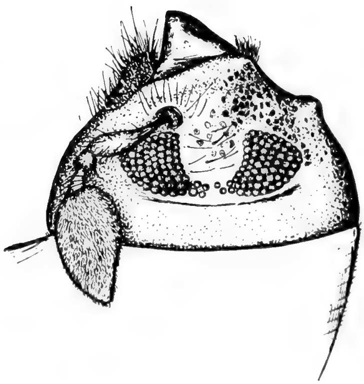

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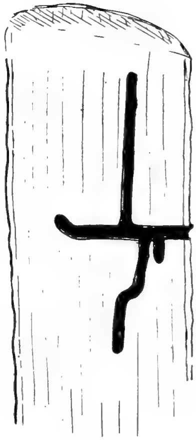
Scolytid work and structures

PLATE 14

47, 48 Xyleborus undes. sp., *a,* work in maple branch
50 Pityogenes undes. sp., work in white pine

Plate 14

48



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47

Scolytid work

PLATE 15

49 P i t y o p h t h o r u s m i n u t i s s i m u s Zimm., work in oak

Plate 15

49

Pityophthorus work in oak

PLATE 16

51 C h r a m e s u s i c o r i a e Lec., work in hickory

Plate 16

51

Chramesus work in hickory

PLATE 17

52 Hylesinus aculeatus Say, work in ash

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Plate 17

52

Hylesinus work in ash

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ERRATA

Page 24, line 3 from bottom, for ampelophia, read ampelophila.

Education Department Bulletin

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No. 463 ALBANY, N. Y. JANUARY 15, 1910

New York State Museum

JOHN M. CLARKE, Director

Museum bulletin 135

GEOLOGY OF THE PORT LEYDEN QUADRANGLE, LEWIS COUNTY, N. Y.

BY

W. J. MILLER

ALBANY

UNIVERSITY OF THE STATE OF NEW YORK

1910

M221r-S9-1500

New York State Education Department

Science Division, September 24, 1909

Hon. Andrew S. Draper LL.D.

Commissioner of Education

SIR: I have the honor to transmit herewith for publication as a bulletin of the State Museum, the manuscript of a report on the *Geology of the Port Leyden Quadrangle, Lewis county,* prepared by Prof. W. J. Miller, a member of the staff of this division.

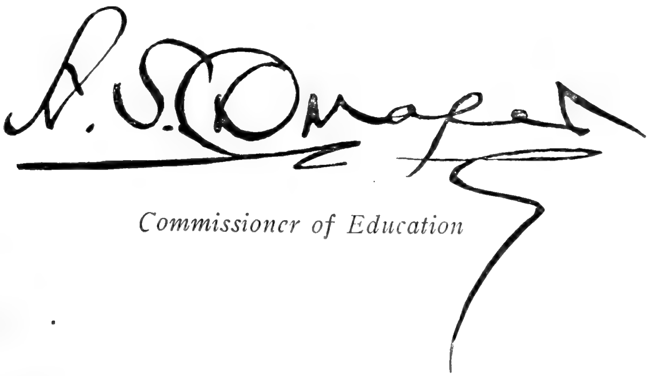
Very respectfully

JOHN M. CLARKE

Director

State of New York
Education Department
COMMISSIONER'S ROOM

Approved for publication this 24th day of September 1909



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GEOLOGY OF THE PORT LEYDEN QUADRANGLE, LEWIS COUNTY, N. Y.

BY

W. J. MILLER

INTRODUCTION

The Port Leyden, New York, quadrangle of the United States Geological Survey comprises the region lying along the western border of the Adirondack mountains and is included between latitude lines 43° 30′ and 43° 45′ north and between longitude lines 75° 15′ and 75° 30′ west. The map covers 1/16 square degree or about 215 square miles of territory, all of which lies in Lewis county except a few square miles extending into Oneida county at the extreme southeast. The Rome, Watertown and Ogdensburg Division of the New York Central Railroad traverses the region from north to south through the Black river valley. Port Leyden, Lyons Falls, Glenfield, Martinsburg, Turin and Constableville are the principal villages.

This region, like most others along the border of the Adirondacks, was at one time a dense forest which has nearly all been cut away, leaving only small wooded areas of second growth. Next to agriculture, the chief industry is the manufacture of wood pulp and paper, the largest mills being located at Lyons Falls, Goulds Mill, Kosterville, Shuetown, Lyonsdale and Port Leyden. The logs used are driven down Moose river. A number of small sawmills are still in operation.

On the east side of Black river the soil is nearly always sandy and rather unproductive, while on the west side of the river the soil is usually rich and supports a prosperous farming community. The principal products are milk and cheese.

GENERAL GEOLOGIC FEATURES

Under this heading it is proposed to briefly outline the geologic history of the whole Adirondack region so that the detailed study presented in this report may be made more intelligible to the reader. This outline is based largely upon the admirable treatises of Prof. H. P. Cushing.

So far as known the oldest rocks of the Adirondacks are those of Grenville (Precambric) age. They are sedimentary rocks, originally shales, sandstones and limestones, which have been highly metamorphosed into gneisses and crystalline limestone. These rocks are of unknown but great thickness, and are widely scattered throughout the Adirondacks, thus showing that the whole region was under water at the time of their deposition.

After the deposition of the Grenville sediments the region was raised above the ocean level and the rocks began to decompose and suffer erosion. Either just before, during, or after the uplift, great masses of igneous rocks were intruded. The Grenville rocks were for the most part engulfed by the intrusion so that only occasional patches of them were left intact.

After the igneous activity the rocks became thoroughly metamorphosed by being squeezed, highly folded and converted into gneisses. Such changes can take place only at great depths (several thousand feet) and hence we are led to the belief that a vast erosion of the original land masses must have taken place. This in turn signifies that the land masses must have remained above sea level for an immense length of time.

At or toward the close of this long period of erosion, igneous activity of a minor character took place. The basic igneous rocks erupted at this time are especially well shown in the northeastern Adirondacks, where they were squeezed up between joint planes in the older rocks. That these rocks are much younger than the igneous rocks first mentioned is clearly shown by their mode of occurrence and their general lack of metamorphism.

Toward the close of the erosion period the region of the Adirondacks was nearer the sea level and of slighter relief than at present. Then the whole region began to sink slowly, allowing the sea to encroach upon the land until only an island was left or probably even until the whole region was under water. During the subsidence, deposition of Paleozoic sediments went on, one layer above another, the younger deposits overlapping each other and encroaching upon the sinking land surface. Since the subsidence was not entirely uniform on all sides certain local variations in deposition occurred.

The first of the deposits to form upon the sinking floor was the Potsdam (Cambric) sandstone now found exposed nearly everywhere except along the southwest border. After this the sediments changed in character and the limestones of the Beekmantown (Lower Siluric) were laid down. Then followed the deposition of the highly fossiliferous Trenton (Lower Siluric) limestones including the Lowville and the Black River limestones. The fairly clear waters full of animal life then gave way to the muddy waters of the Utica, when the Utica shales (Lower Siluric) were deposited. At this time the Adirondack region was probably all under water. Next came an uplift on the east and northeast where depositions ceased. On the south and southwest, however, deposition continued and the successive formations of the Siluric and Devonic above the Utica shale were laid down. These Paleozoic formations may now be seen as one passes from the Adirondacks southward to the southern border of the State.

The last period of igneous activity in the Adirondacks occurred some time after the close of the Lower Siluric. This activity was of minor extent and showed itself in the form of dikes.

At some time after the deposition of the Utica shale the rocks, especially along the southern border, were deformed chiefly by faulting. A series of these faults extends across the Mohawk valley. The western Adirondacks, including the Port Leyden quadrangle, have been subjected to erosion for a vast length of time, certainly since the close of the Paleozoic and more than likely since the Devonic. During this great lapse of time a large amount of material has been removed. Doubtless the whole Port Leyden quadrangle was at one time covered by the Utica and Lorraine shales, which have all been removed except along the western side.

The superficial deposits, such as the sands and gravels which are so prominent in the Port Leyden district, were formed by, or along the border of, the great ice sheet of the Glacial age. From the geological standpoint this ice sheet was present only quite recently and covered most of New York State.

TOPOGRAPHY AND DRAINAGE

The Black river valley may be looked upon as the principal topographic feature along the western border of the Adirondacks, and the Port Leyden quadrangle represents a considerable portion of this valley where it is deepest. Black river enters the quadrangle at the southeast corner at an elevation of 1000 feet and, after following a northwest-north course, leaves it near the middle of the northern boundary at an elevation of about 740 feet. From the river eastward there is a general upward slope toward the Adirondacks. Facing the river there is a steep slope, which within 2½ miles, passing eastward, gives way to a generally level sand-flat area lying at an elevation of from 1200 to 1300. Along the eastern edge of the map several points reach altitudes of from 1300 to 1340 feet.

Passing westward from the river the general rise is much more rapid. Two terraces are here well developed from the latitude of Port Leyden northward. The lowermost terrace is from 2½ to 4 miles wide and has a steep front rising from 300 to 400 feet just west of the river. The upper terrace is known as Tug hill whose very steep eastern front rises from 400 to 450 feet and makes up the western portion of the quadrangle. The highest point on this side of the river is Gomery hill, near the western edge of the map, which shows an elevation of nearly 2100 feet, while altitudes of 1800 to 1900 feet are common. This high ground to the west of the river is a part of the broad high land area which lies between Black river and Lake Ontario. It is interesting to note that the elevations of the western portion of the quadrangle are much greater than those of the eastern or Adirondack portion. In order to reach elevations of 2100 feet or over it is necessary to pass 20 or 25 miles east of Black river into the Adirondacks to the high points around the Fulton chain of lakes.

Within the map limits Black river descends 200 feet, through a series of still waters and rapids, before reaching Lyons Falls. At Lyons Falls there is a sudden drop of 60 feet, but from this point northward to the map limit the river flows by a winding course through an old lake bottom [*see* p. 54] and the gradient is almost imperceptible. The largest tributaries to Black river from the east are Fall brook, Moose river, Fish creek, Otter creek and Independence river. By far the largest of these is Moose river, one branch of which drains the Fulton chain of lakes. Chief among the tributaries from the west are Sugar river, Mill creek, House creek, Whetstone creek and Roaring brook. All the larger streams which have cut across the steep eastern front of Tug hill have there cut out deep narrow gorges locally called "gulfs." More special physiographic features will be described later.

PRECAMBRIC ROCKS

The Precambric rocks of the quadrangle represent a portion of the great Adirondack crystalline mass along its extreme western border. They occupy the eastern side of the quadrangle and make up a little less than one half its area. Except at the extreme south the Paleozoic-Precambric boundary line is everywhere to the west of Black river, but it keeps close to the river bottom. These crystalline rocks continue westward, under cover of the Paleozoics, for many miles. Considerable portions of the Precambric area are so deeply buried under glacial drift deposits that it is impossible to gain even the slightest clue as to the character of the rocks in those places.

Grenville gneiss

The Grenville formation takes its name from Grenville, Canada. It comprises a series of gneisses representing very ancient sedimentary rocks which have been so profoundly metamorphosed that the original sedimentary features have been largely obliterated. So far as can be definitely proved they are the oldest exposed rocks in the whole Adirondack region. That they are not actually the oldest rocks is evident from the fact that these sediments must have been deposited upon a still older floor. This very ancient rock floor, which may or may not represent a portion of the earth's primitive crust, has thus far not been proved to exist in the present exposures of the Adirondacks. It is barely possible that some of the gneisses still of doubtful age and origin may represent that ancient sea-floor.

Within the map limits the Grenville has been mapped in only three small areas, one at Kosterville, another at Lyonsdale, and a third to the east of Fowlersville. Grenville rocks are unquestionably present in much greater force than these small areas seem to indicate but they are always so thoroughly involved with other gneisses that they can not be represented on the geologic map as such. Occurrences of this kind will be described later.

One of the strongest proofs of the sedimentary origin of the Grenville is the presence of limestone beds in the formation. Such limestones have been described by Smyth[1] in the Diana-Pitcairn area some 30 miles northward and also at the Fulton chain of lakes some 25 miles eastward. A little has been found by Mr D. H. Newland in the Little Falls district and also on Moose river a few miles east of the Port Leyden quadrangle. The latter occurrence is the closest to the Port Leyden quadrangle so far known. The writer has found no actual limestone on either the Remsen or the Port Leyden sheet although certain gneisses usually associated with the limestone are present. The statement may be repeated that, whereas Grenville limestone is common along the northwestern Adirondacks, it is only sparingly represented along the southwestern border.

The fact that commonly the Grenville rocks here and elsewhere are in alternating layers which stand out in sharp contrast because of marked differences in composition and color leads to the belief that these bands are due to differences in original sedimentation. At times the gneiss is composed of almost pure quartz and could scarcely be of igneous origin.

Graphite is a form of crystallized carbon and of organic origin. Its presence as flakes in certain of the Grenville gneisses, including some within this quadrangle, affords a strong argument in favor of the sedimentary origin of those gneisses. Garnet is frequently present, often in great abundance, and it is rather more common in metamorphosed sediments.

Of the three areas above mentioned, each has certain distinctive features and hence they will be separately described. Thus in the Kosterville area the rocks are mostly quartz-sillimanite gneisses in thin layers and weathering to a rusty brown. They are not sharply separated from the neighboring rocks and some feldspar-garnet gneisses appear near the northern border of the area and along the river below Shuetown. The dip of the foliation is northward while the strike is about n. 60° e. which is the same as for the surrounding rocks. The specimens here described were taken from the fine exposures just below the bridge across Moose river. Microscopic study shows one

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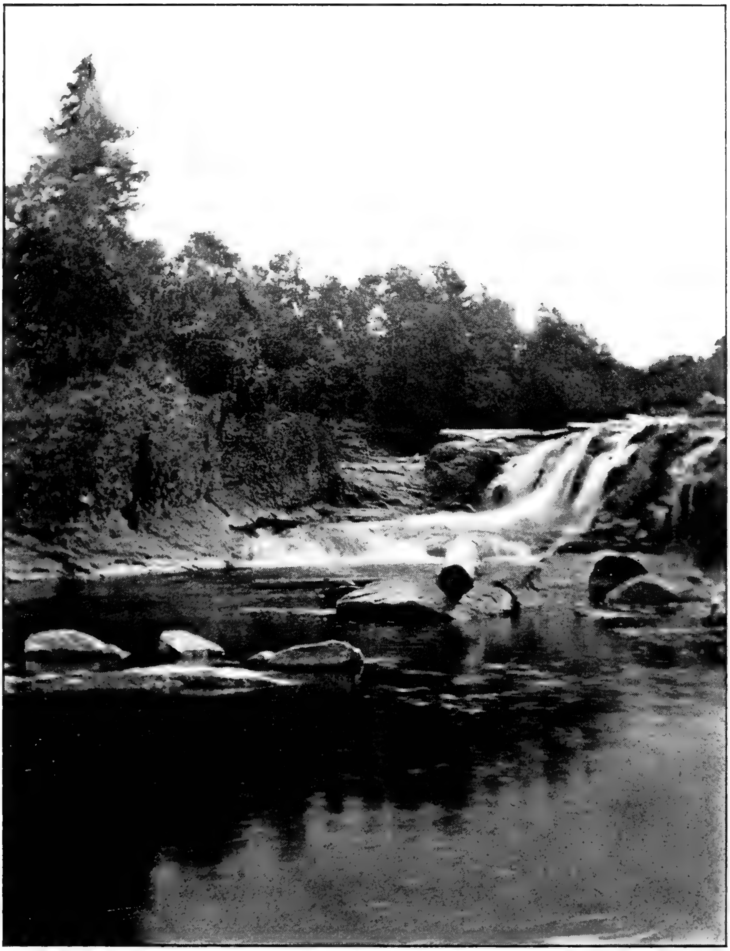
[1] Crystalline Rocks of the Western Adirondack Region. N. Y. State Mus. 51st An. Rep't. 1897. 2:469–97.

Plate 1



W. J. Miller, photo

Grenville gneiss just below the Moose river bridge at Goulds Mill. The rock is here practically a thin bedded quartzite.

specimen to be made up as follows: quartz 75%; sillimanite 12%; and with the long axes of the glistening needles parallel to the rock bands; enstatite 5%; magnetite 3%, and changing to leucoxene; pyrite 2%; garnet 2%, and often completely enveloping the magnetite; together with a little zircon and badly decomposed biotite. Another specimen shows from 85 to 90% of badly cracked quartz; 1 or 2% each of hornblende, pyrite and sillimanite with a little zircon; while the rest of the rock is made up of gray, uncrystallized, yellow-stained, decomposition products of hornblende and biotite. Certain other layers are slightly feldspathic. The most striking features in the composition are the very high quartz content, the almost complete absence of feldspar, and the dearth of dark colored minerals. The rock thus appears to have been an almost pure sandstone which has been metamorphosed to a quartzite. The rock is highly cataclastic and that the mass has been subjected to a great pressure is proved by the local folds and by the general crushed appearance of the exposures [*see* pl. 1]. In the field the rock has a decidedly sedimentary look and we have here a fine example of the Grenville which does not appear to have been very profoundly changed from the original sediment. Where these gneisses grade into the surrounding mixed gneisses some feldspar and a larger percentage of dark colored minerals are present.

The Grenville rocks in the Lyonsdale area are chiefly feldspar-garnet-mica gneisses. The gneissic structure is here greatly accentuated by the alternation of light and very dark gray layers which are usually from a few inches to a foot or more in thickness. A thin section of the light gneiss shows quartz 75%; feldspar 15 to 18%, mostly oligoclase to labradorite, but with a little microperthite; biotite 5%, and garnet 2 or 3%. In the dark gneisses the quartz is proportionately less prominent while the biotite may run as high as 35 or 40%. Both the light and dark rocks are often very garnetiferous. In some specimens a few small flakes of graphite were noted. The original sediments here were probably somewhat carbonaceous shales and shaly sandstones.

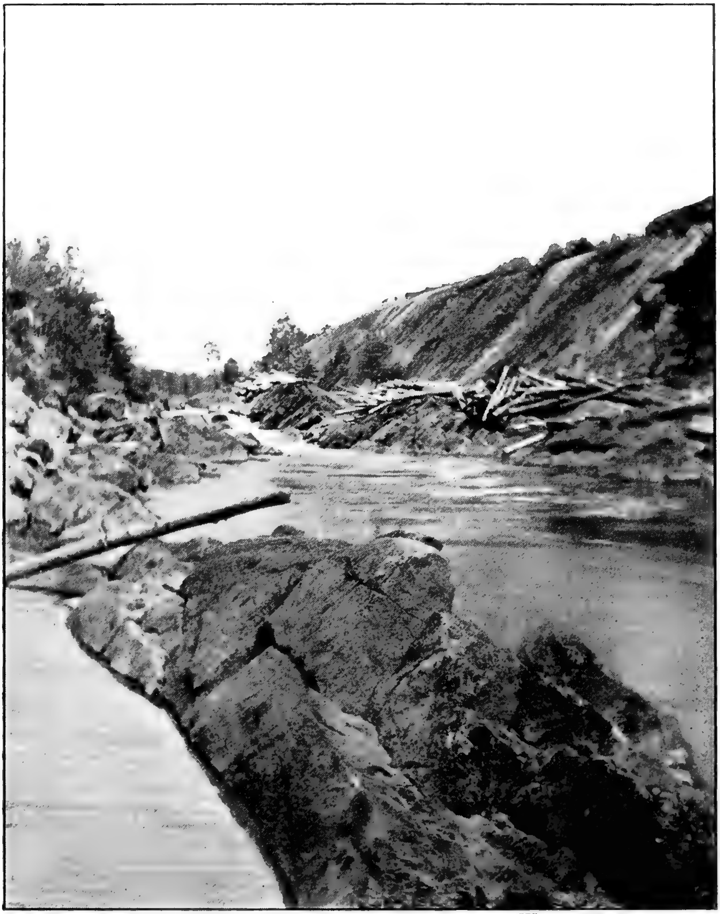
The rock bands show a northward dip at a high angle and a strike of n. 40° e. On the north side the exposures are not good but the Grenville does not seem to be sharply separated from the surrounding rocks, while on the south side, along Moose river, there is exhibited a very sharp contact between the Grenville and the syenite. The more resistant syenite here forms a high, steep rock-wall on the south side of the river, while the less resistant Grenville gneisses have been deeply trenched by the river [*see* pl. 2]. Moose river really bears about n. 40° e. here and parallel to the foliation instead of nearly east and west as shown on the map.

In the area east of Fowlersville the Grenville rocks are chiefly pyroxene gneisses. The gneissic structure is highly developed and accentuated by the alternations of light and dark colored bands although none of the rocks are very dark colored. The bands are seldom more than a few inches thick. Microscopic investigation shows the common rock to be made up as follows: 40 to 50% of quartz; 25 to 30% of large, bright green, pyroxene crystals, sometimes slightly pleochroic; about 25% of feldspar, mostly orthoclase together with a little acid plagioclase; 3 to 5% each of hypersthene and enstatite; and a little bronzite and white pyroxene. Judging by the composition the sediments from which these rocks were derived were probably shales or shaly sandstones possibly somewhat calcareous. These gneisses are very similar to those referred to by Smyth as being directly associated with limestone. Although no limestone is here seen in outcrop, it is possible that some does occur along the east side of the area which may thus account for the distinct depression (now drift-filled) along that side and from which some softer or less resistant material has certainly been removed by erosion. Associated with these gneisses are a few layers rich in basic plagioclase feldspar and poor in pyroxenes and which have the appearance of igneous rocks. This Grenville area forms a long, narrow ridge which stands out as a distinct topographic feature. Moose river has cut a channel across this ridge. The rocks dip at an angle of 40° or 50° westward and strike almost due north and south. Outcrops of syenite have been found on all sides of, and pretty close to the Grenville mass. There are no sharp contacts visible but it seems certain that we are here dealing with a long, narrow inclusion of the Grenville in the syenite. This matter will be further discussed below under the heading "Syenite gneiss."

Syenite gneiss

As indicated on the geologic map, syenite gneiss makes up a considerable portion of the known Precambric area. From the standpoint of both composition and structure it is very uniform

Plate 2



W. J. Miller, photo

Moose river gorge just east of Lyonsdale. The rocks in the bed of the river are garnetiferous gneisses belonging to the Grenville. The high, steep rock on the right side is syenite which is in sharp contact with the Grenville.

over pretty large areas and it is clearly the most homogeneous rock mass among the Precambrics. The typical rock is a quartz-hornblende syenite always showing the granitoid texture. The quartz content varies a good deal but apparently without otherwise affecting the rock. The dark colored minerals are always very subordinate in amount. On weathered surfaces the color of the rock varies from a light brown to a reddish brown, while the color of the fresh rock varies from a sort of greenish gray to a light gray. The rock is nearly always medium grained although somewhat variable in this respect. In the field the rock always clearly exhibits a gneissic structure which usually can not be made out in the hand specimen. A distinct banding is seldom shown except at times near the borders where the syenite grades into the surrounding rocks. The minerals are roughly arranged with their long axes parallel to the strike of the foliation which ranges from n. 30° to 70° e. Such an arrangement of the dark colored minerals causes the foliation to be more evident, but they appear like wavy streaks which are seldom continuous for more than a few inches or a foot. The homogeneity of this syenite and its lack of distinct banding serve to separate it from the other Precambric rocks in the field.

The only noteworthy departure from homogeneity is to be found in the presence of occasional small dark basic patches in the syenite. These patches nearly always show abrupt terminations and to all appearances they are true inclusions. They are rich in hornblende and biotite and are invariably arranged with their long axes parallel to the gneissic bands of the syenite. Such inclusions may be seen in the field southeast of Denley; near where Miller brook enters the quadrangle; and probably best in the large exposures southwest of Partridgeville. Most of the syenite outcrops are, however, entirely free from such inclusions.

A number of syenite areas are shown on the accompanying geologic map. Of these the southernmost one extends from Denley southeastward to Hawkinsville and represents probably the purest and most typical syenite of the region. Fine exposures occur in the fields southeast of Denley and in the vicinity of Hawkinsville. A large area extends from Miller brook northward to Moose river with good outcrops along Fall and Miller brooks; at Fowlersville and for 2 miles southward; and just east of Lyonsdale. Another large area occupies the northeastern portion of the quadrangle with fine exposures between Brantingham lake and Partridgeville and also where the road leaves the map east of Brantingham post office. The area between Greig and Donnattsburg shows many large outcrops of rock which here as well as around Partridgeville are more quartzose than usual. Smaller patches of rather quartzose syenite are shown at Lyons Falls and in the river bottom east of Glenfield.

The rock exposed in the quarry southeast of Denley may be taken as typical of the best syenite of the quadrangle and a detailed description of this type will now be given. In thin section fresh feldspar is seen to be the most common mineral which makes up 75 to 80% of the rock. Much of the feldspar is present as microperthite usually in large crystals and with the microperthitic structure beautifully exhibited. There is also a considerable percentage of another feldspar, presumably anorthoclase, which is characterized by a sort of moire or clouded appearance. There is a small amount of plagioclase feldspar ranging from oligoclase to andesin. The second most common mineral is quartz of which there is 12 or 15%. The quartz grains are very variable in shape and size and are frequently broken as a result of pressure. Of the dark colored minerals hornblende and biotite make up about 5% of the rock. The hornblende is the common green variety with usual pleochroism and shows frequent alterations to chlorite. 1 or 2% of magnetite, sometimes with leucoxene borders, is also present. Beside these a few small crystals of zircon, apatite, and zoisite may be seen nearly always as inclusions.

A study of the thin sections from the different syenite localities shows a range of minerals as follows: Feldspar 60 to 80% — microperthite always abundant, anorthoclase none to 20%, oligoclase none to 10%; quartz 15 to 30%; hornblende none to 5%; biotite none to 3%; magnetite none to 3%, and zircon, apatite and zoisite are nearly always present in very small amounts. In one or two cases a little garnet has been noted. The cataclastic structure is always more or less well developed in the syenite, sometimes being very prominent, which shows that the rock must have been subjected to a pretty severe dynamic metamorphism.

In Cushing's[1] typical syenite at Loon lake and Smyth's[2] typi-

[1] Geol. Soc. Am. Bul. 1899. 10:177-92.

[2] *loc. cit.* p. 473.

cal rock in the Diana-Pitcairn area, the dark minerals, especially pyroxene, are prominent constituents, while in the Port Leyden district the pyroxene is always absent and the dark minerals never amount to more than 7 or 8%. Otherwise the rocks are very similar. In passing northwestward from Little Falls to Port Leyden the syenite loses its pyroxene and the microperthite becomes more prominent than the anorthoclase.

It is now well established, especially by the excellent work of Smyth,[1] that the syenite is a plutonic igneous rock which has been intruded into and is therefore younger than the Grenville. The evidences from the Port Leyden region are clearly in harmony with this view. Thus the Grenville area east of Fowlersville is surrounded by pure syenite and the writer is convinced that we have here a good example of a large Grenville inclusion in the syenite. Significant in this connection is the fact that the strike of the foliation in the Grenville is north and south while that of the nearby syenite is about n. 30° e. This would be expected especially where large sedimentary masses were caught up in the molten syenite. Near Lyonsdale, on the south side of the river, the syenite and Grenville are in sharp contact while north of the river they appear to blend into each other. Around Kosterville no sharp contacts are seen but the syenite and Grenville seem to be mixed around the borders of the Grenville. Referring to similar phenomena farther northward Smyth[2] says: "Some of these inclusions are clearly defined with sharp boundaries but others are somewhat blended with the surrounding syenite as though they had undergone a partial melting." The small basic inclusions above mentioned and the very intimate mixture of syenite and Grenville on a large scale as described below also argue for the intrusive character of the syenite.

Granitic syenite gneiss

In the northern portion of the quadrangle, and on either side of Black river, two areas of granitic syenite gneiss are shown on the geologic map. These areas are probably continuous under the broad drift-filled valley bottom. This rock is almost certainly a granitic phase of the normal syenite above described, and, since the one rock grades into the other, the drawing of a boundary line must of necessity be an arbitrary matter. In

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[1] *loc. cit.*

[2] *loc. cit.* p. 477.

order to distinguish the granitic syenite from the normal syenite several features, given in the following description, must be considered.

The rock is not only clearly gneissoid but also distinctly banded. The rock bands are straight and rather persistent and the minerals are commonly arranged with their long axes parallel to the foliation. Frequently the "leaf gneiss" effect is beautifully shown because of the flattening out of the quartz and feldspar crystals. The color of the typical rock is red although at times gray bands are present. The size of the grain is rather variable but mostly pretty coarse. At times the quartz and feldspar crystals are almost porphyritic. The average quartz content is noticeably higher than in the normal syenite and commonly the more weathered surfaces show numerous projecting quartz crystals; often the rock might well be called granite. The granitic syenite also lacks the homogeneity of the ordinary syenite. In the larger exposures of the typical red quartzose gneisses there are occasional bands of gray, less quartzose gneisses very similar to the normal syenite.

Another noteworthy feature is the presence of long, narrow patches or inclusions much like those sparingly present in the ordinary syenite, but they are here much larger and more numerous. They are always drawn out perfectly parallel to the foliation planes but they are seldom more than 30 or 40 feet in length. They are composed of about equal parts of badly decomposed basic plagioclase and brown hornblende with which are associated thin layers of almost pure biotite. These biotite layers often give the rock a decidedly schistose appearance. The presence of these basic patches has doubtless aided in the production of the distinct banding of the granitic gneiss during the process of dynamic metamorphism. In this connection the writer has read the recent paper[1] by Professor Adams which deals with the origin of the amphibolites in the Glamorgan granite of Ontario, Canada. He says: "Here the limestone (Grenville), toward the granitic contact, passes gradually over into amphibolite, the latter being undoubtedly produced by the alteration of the former. . . The granite, furthermore, not only penetrates the (limestone) series, but floats off masses of the altered rock which in the form of bands, streaks, and isolated shreds are seen thickly scattered through the granite in the

[1] Jour. Geol. 1909. 17:8.

vicinity of the contact and which while less abundant, are found throughout practically the whole extent of the bathylith." Judging from his descriptions of the amphibolites, the inclusions in the Port Leyden region are very similar to them and, although we have here no such positive evidence for their origin, the explanation above given by Professor Adams becomes very suggestive at least.

In a general way at least, another distinction from the syenite is the more complete granulation of the granitic gneisses. Under the microscope the cataclastic structure is always well exhibited, sometimes to a remarkable degree. The quartzes were most badly broken by the grinding action and strain shadows are common.

In thin section the typical red granitic syenite from near the lower road crossing on Otter creek is seen to consist of about 60% of feldspar; 35% of quartz; 3% of hornblende; 2% of magnetite, and a very little zircon and apatite. The feldspar is chiefly microperthite accompanied by some anorthoclase and a little oligoclase. Red hematite stains are common in the sections. Closely associated with this typical rock, but always in subordinate amount, is a gray, less quartzose and more truly syenitic rock. In all of the sections of the granitic syenite examined the feldspar ranges from 60 to 70%. Microperthite is the chief feldspar, while anorthoclase ranges from absence to 20%, and oligoclase never exceeds 5%. The quartz range is from 25 to 40%. Hornblende is always present but never above 5%. Biotite is often absent and never exceeds 2%. From 1 to 4% of magnetite always occurs. Small crystals of apatite and zircon are common.

It seems certain that this red granitic gneiss is a differentiation phase of the normal syenite gneiss. Except for the greater granulation and somewhat higher quartz content, microscopic study shows no difference between the rocks. In the field no sharp line of separation can be drawn. The normal syenite in general seems to become more quartzose toward the north so that in this respect, at least, the syenite around Partridgeville closely approaches the granitic syenite. The writer is inclined to the belief that the passage from one rock to the other is much like that described by Smyth in the Diana area some 20 or 25 miles northward. He says:[1] "Passing southward from the latter (limestone formation) the syenite at first slowly and irreg-

[1] *loc. cit.* p. 481–82.

ularly then more rapidly increases in gneissoid structure till at a distance of from 3 to 5 miles from the limestone a region of red hornblende gneiss is reached. . . West of Natural Bridge in Jefferson county the syenite unquestionably passes over into a very perfect red gneiss. . . Both in the field and under the microscope the gradual change of the rock can be followed through every step." The same sort of a change has been observed by Cushing in the Tupper Lake syenite.[1]

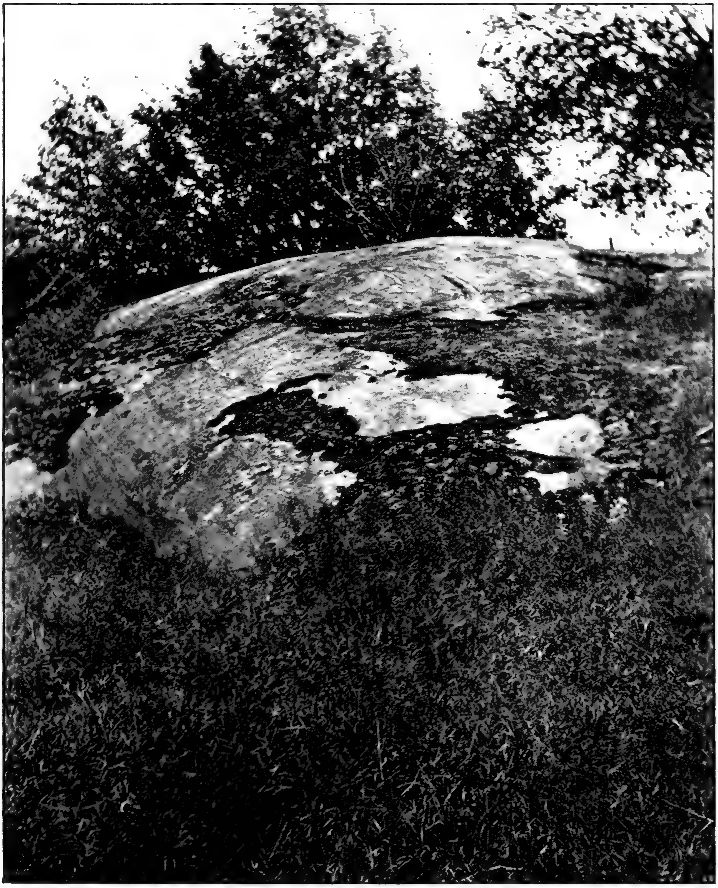
Syenite-Grenville mixed gneisses

A considerable portion of the known Precambric rock area has been represented upon the geologic map as being made up of various mixed gneisses. These gneisses include a great many rock varieties which make up a heterogeneous mass. After a careful study of these gneisses the writer is fully convinced that, for most part at least, they represent a more or less intricate mixture of the syenite and Grenville rocks. Some of these gneisses are admittedly of uncertain origin. Certain small patches within these areas are undoubtedly rather pure Grenville, while others seem to be pure syenite, but the small scale of the map does not permit these to be separately shown. Sometimes the syenitic and sometimes the Grenville facies predominate. These rocks are everywhere thoroughly gneissoid and they are generally well banded except in some of the more syenitic masses. The " leaf gneiss " structure is at times well developed.

It has already been stated that the syenite is intrusive into and younger than the Grenville and that the Grenville areas must be regarded as large inclusions. A study of the syenite-Grenville mixed gneisses furnishes convincing evidence of the same kind. Actual inclusions of undoubted Grenville may occasionally be seen within the syenitic masses. Such inclusions may be seen in the vicinity of Lyons Falls; ½ mile north and 1 mile east of Port Leyden; 1½ miles above the mouth of Miller brook; 1 mile above the mouth of Fall brook, etc. As already suggested, the writer is of the opinion that the Grenville was often either partially or wholly incorporated into the syenite by fusion when the latter came up in a molten condition. Various rock types formed in this way would depend partly upon the degree of metamorphism and partly upon the character of the Grenville. The masses of rather syenitic looking rocks which

[1] N. Y. State Mus. Bul. 95, p.323.

Plate 3



W. J. Miller, photo

A typical Precambric exposure ½ mile north of Lyons Falls station showing the smoothed, glaciated character of the surface. The rock is a syenitic facies of the syenite-Grenville mixed gneisses.

are quartzose and garnetiferous may be accounted for by some such process.

Three syenite-Grenville areas are shown on the map. The largest of these extends from Denley station to north of Greig, a distance of nearly 12 miles, while the width averages something like 3 miles. In the southern portion of this area the Grenville is present in greater force than the syenitic or granitic rocks, while in the northern the reverse is true except possibly in the vicinity of Greig. Within this area there seems to be good evidence for the former existence of very ancient Grenville rock belts or structure lines which extended in a northeast-southwest direction. Thus pyroxene gneisses are found in the area east of Fowlersville; in small outcrops 1½ miles east of Port Leyden; and 1½ miles north of Denley, and these are all arranged along a northeast-southwest line. A belt of feldspar-garnet gneisses shows a similar strike and extends from Lyonsdale to Port Leyden. Quartz-sillimanite rocks much like those at Kosterville have been noted in small exposures from ½ to ¾ of a mile north of Port Leyden and this suggests another northeast-southwest belt. A less well defined belt is garnetiferous and passes through Lyons Falls. Still another belt, in which garnet-sillimanite gneisses are commonly found, passes northeast and southwest through Greig. It seems pretty certain that before the intrusion of the syenite, these Grenville belts were continuous and well defined and that as a result of the intrusion they were all cut up leaving only here and there masses of the pure Grenville.

Of the two smaller syenite-Grenville areas, one lies about 2 miles north of Fowlersville and the other around East Martinsburg. These rocks are quartzose syenites often containing garnets and more or less intermingled with Grenville.

The great variety of rock types making up this complex and their gradations from one type to another make it difficult to give a proper idea of them by description. Microscopic study of numerous thin sections shows the presence of all the minerals of both the Grenville and the syenite and in addition to them microcline which often occurs as a prominent feldspar. The following brief descriptions include most of the leading types:

1 Syenitic facies. These are often practically indistinguishable from the normal syenite. They are usually, however, pretty fine grained and under the microscope nearly always show a highly cataclastic structure. They frequently contain microcline

feldspar and a large proportion of quartz and the dark colored minerals. Thus a specimen from along the railroad 2½ miles north of Lyons Falls contains 75% of microperthite; 20% of quartz; 5% of magnetite, biotite and hornblende, together with a little zircon. Another from ⅔ of a mile southwest of Goulds Mill contains 65%, in about equal amounts, of microcline, microperthite and plagioclase (oligoclase to labradorite); 25% of quartz; and 10% of biotite and magnetite. North of Lyons Falls, along the railroad, similar rocks often carry 30 to 40% of quartz with sometimes a little anorthoclase and they greatly resemble the granitic syenite.

2 Grenville facies. Small exposures often show very pure Grenville as for example at the river dam ½ mile north of Port Leyden. A thin section from here shows 80% quartz; 10% sillimanite; 8% magnetite and 2% biotite, together with a little zircon. Again, a typical pyroxene, quartz gneiss is associated with syenitic rocks 1½ miles above the mouth of Miller brook. A Grenville facies carrying garnets occurs in the vicinity of the paper mill at Lyons Falls.

3 Garnetiferous gneisses with a general igneous appearance are very common. Such a rock 2 miles east of Port Leyden shows 65% of microcline and microperthite; 20% of quartz; 5% of hornblende and biotite and 10% of augite, magnetite, garnet and zircon. A similar type much richer in garnet and almost free from dark minerals occurs in the river bed at Port Leyden. Another type from 2½ miles east-southeast of Greig shows 65% of plagioclase (oligoclase to labradorite); 30% of quartz and 5% of biotite, garnet, magnetite and zircon. The origin of these gneisses is doubtful but they may have been formed by a thorough mixing of Grenville masses with the molten syenite. The garnets in these rocks are frequently an inch or more across.

4 A very gneissoid, rather dark rock, which is fairly common, is rich in plagioclase, quartz and biotite. An example from ½ mile south of Lyons Falls contains 45% of plagioclase (oligoclase to andesin); 40% of quartz; 10% of biotite; 2% of hornblende and 3% of magnetite, zircon and pyrite.

5 A very gneissoid, dark rock from 1½ miles east of Port Leyden contains 50% of microcline and plagioclase (oligoclase to labradorite); 20% of quartz and 10% each of green augite, biotite, magnetite and a very little garnet.

6 A type of dark, quartzless, gabbroic rock such as that at Lyons Falls dam contains 55% of plagioclase (oligoclase to labrador-

Plate 4

Falls of Black river at Lyons Falls. The rock here is a dark, gabbroic mass which has been mapped with the syenite-Grenville mixed gneisses.

ite); 40% of green hornblende and green augite and 5% of hypersthene, magnetite, biotite, zircon and apatite. This type is in contact with another gabbroic rock which has a considerable percentage of quartz and hypersthene and some microperthite.

7 Very dark, long, narrow patches which are probably inclusions are common. They usually consist mostly of decomposed hornblende and basic plagioclase together with some quartz, magnetite and biotite.

Undetermined Precambric areas

Unfortunately several large Precambric areas are so deeply buried under Pleistocene deposits that the character of the underlying rocks is entirely unknown. These areas have been so indicated upon the geologic map.

PALEOZOIC ROCKS

The Paleozoic rocks occupy a little over one half the area of the quadrangle on the west side. Except at the extreme south they always lie to the west of Black river. The maximum thickness of the Paleozoic formations is approximately 1500 feet.

Potsdam sandstone

The Potsdam sandstone is of upper Cambric age and is the most ancient sedimentary formation bordering the Adirondacks. It is not present in outcrop in the Port Leyden quadrangle nor in fact along the whole southwestern border of the Adirondacks, although it is most likely present beneath the later formations. South of Port Leyden the deep wells at Utica and at Rome show a basal sandstone which is more than likely the Potsdam. West of Port Leyden the Potsdam, according to Orton,[1] is most certainly present in the deep wells of Oswego county at Central Square, Parish, Pulaski and Stillwater. The nearest outcrops of the sandstone are something like 20 miles north-northwest of the Port Leyden quadrangle and from there northward to the St Lawrence it is a common surface rock.

Pamelia limestone

The Pamelia limestone was named by Professor Cushing from a town in Jefferson county where he recently recognized it as a distinct formation.[2] Between the Potsdam and the Pamelia,

[1] Petroleum and Natural Gas in New York. N. Y. State Mus. Bul. 30. 1899.

[2] Geol. Soc. Am. Bul. 1908. 19:155-76.

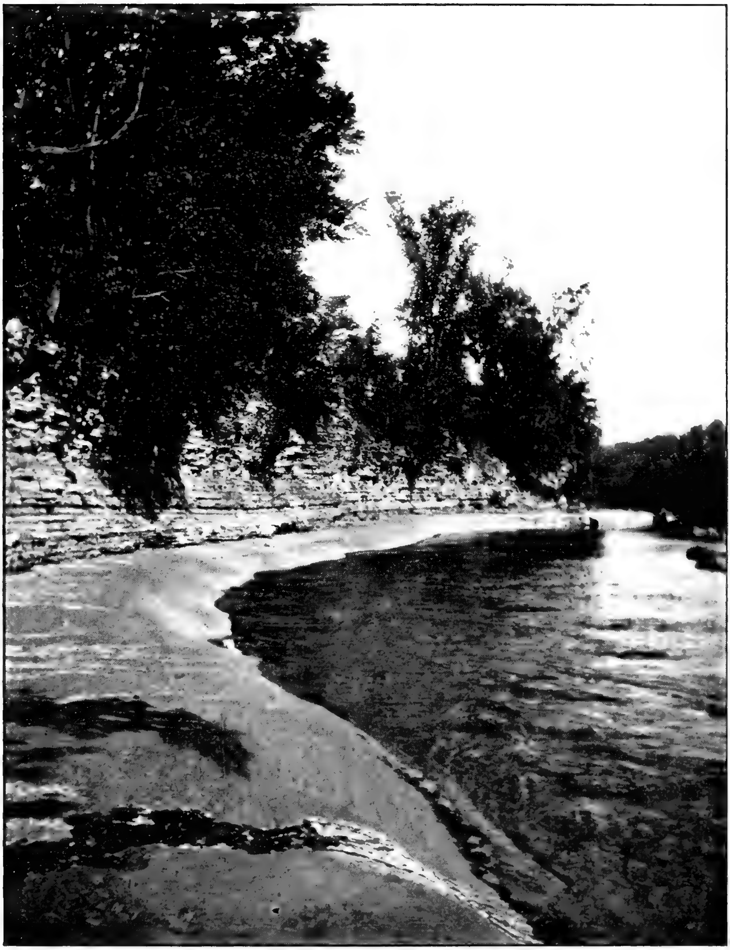
in the St Lawrence and Champlain valleys, other formations come in whose exact relationships have not yet been made out. According to Ulrich the Pamelia is to be correlated with a part of the Chazy of the Champlain valley. For a long time the Pamelia had been described and mapped as Beekmantown limestone, but it now seems to be pretty well established that the true Beekmantown is not present along the northwestern Adirondacks.

The Pamelia formation (Lower Siluric) is the oldest sedimentary mass exposed within the limits of the quadrangle. Its outcropping edge, which extends from north to south across the district, everywhere rests directly upon the Precambric rocks. Since it outcrops at the base of the steep slope facing Black river its surface exposure is small. The actual contact with the Precambric may be seen in at least three places as follows: Where the railroad crosses Roaring brook near Martinsburg station; along the creek 1⅓ miles northwest-north of Lyons Falls; and along the railroad ¾ of a mile north of Port Leyden. At a number of other places the contact is almost visible. The bed in actual contact with the Precambric is always a sandy conglomerate above which occur several feet of calcareous sandstones, then a few feet of bluish black, fossiliferous limestone, and finally thin to thick bedded, whitish gray to bluish gray, rather impure limestones which latter make up more than half the section. Many of the upper, gray beds are really magnesian limestones which may be burned for waterlime as has been done at Lowville. The conglomerate and sandstone at the base of the Pamelia represent the materials derived from the Precambric land surface as the sea encroached upon it. According to the observations of Professor Cushing on the Theresa quadrangle (northward), which are corroborated by the writer on the Port Leyden quadrangle, the basal conglomerate and sandstone represents a shifting upward horizon, due to overlap, as the sea encroached upon the land from west to east. These basal beds are more than likely to be correlated with the Rideau sandstone as described by Ami in Ontario, Canada.

Following is a detailed section made by Professor Cushing along Roaring brook (near Martinsburg station) and kindly furnished to the writer:

	Feet	Inches
4 inches of blue gray calcareous shale above and 9 inches of same beneath with a 4-inch layer of mottled blue limestone like that beneath	1	5

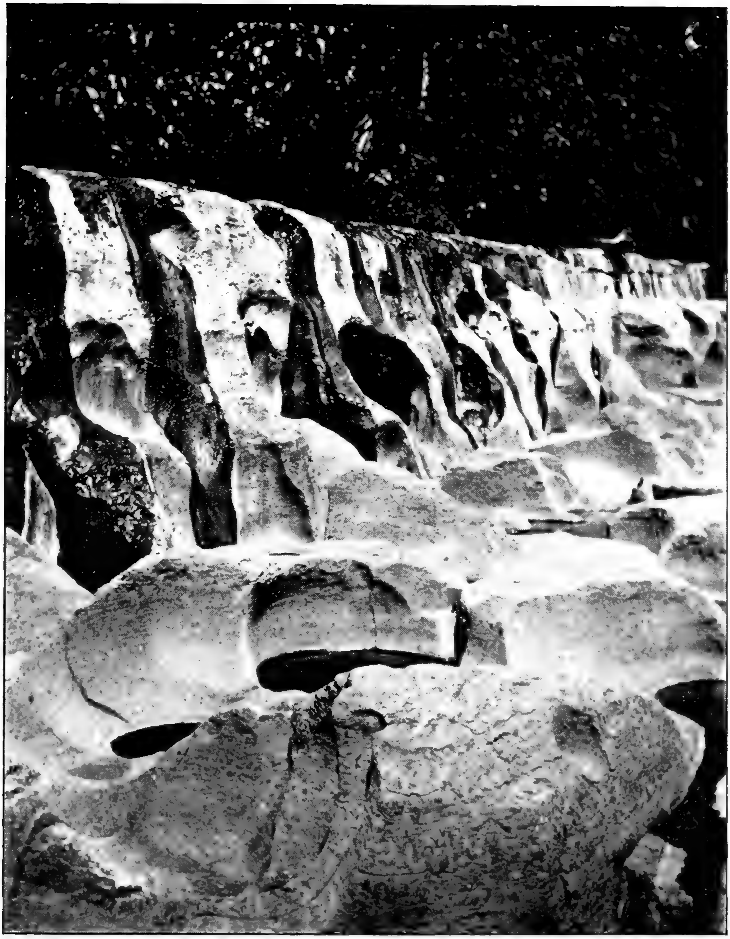
Plate 5



W. J. Miller, photo

View along Black river, 1¼ miles above the mouth of Sugar river, taken to show the sharp contact between the Trenton and the Black River limestones. During high water the thin bedded Trenton limestones have been worn back to leave exposed a distinct platform of the underlying massive Black River limestone.

Plate 6



W. J. Miller, photo

A group of "potholes" in the bed of Sugar river ½ mile below the railroad crossing. The rock is Black River limestone.

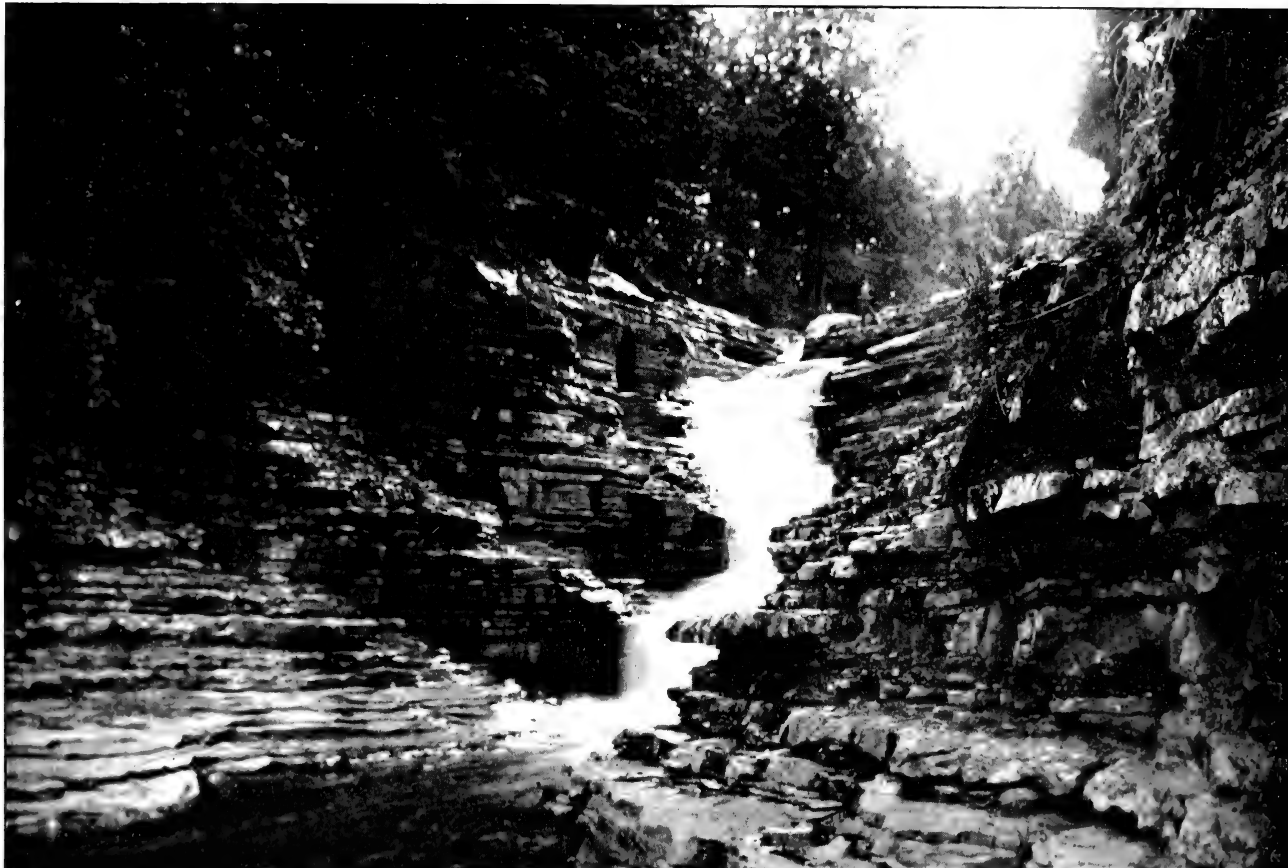
	Feet	Inches
A massive bed of blue granular limestone, mottled and laminated and with pebbles of blue dove limestone	1	6
Hard, gray white limestone with spots of crystallized calcite	....	9
Bluish gray, thin bedded limestone, with ripple marks and ostracods	2	2
Shaly, dirty white mud limestone beds, mud cracked	1	6
Bluish subgranular, thin bedded limestone	....	9
Blue dove, hard, mottled limestone, shaly below, traces of fossils	1	4
Hard, gray granular limestone, pinkish tinge, much calcite	....	6
Thin, ripple marked, dirty white, mud limestone beds	1	......
Hard, blue gray subgranular limestone, sand grains and ostracods above	2	6
Hard, gray white limestone, less earthy than usual; calcite spots	....	9
Subgranular, blue, laminated limestone; welded contact with above	2	5
Very massive, gray white, earthy limestone, irregular splitting.	5	9
Massive blue dove limestone in two layers; laminated; styliolites and traces of fossils	1	9
Thin and thick bedded, blue subgranular limestone; massive basal layer; laminated; much mud cracked	7	9
Earthy, impure, gray white beds; massive and irregular splitting; lower 12–18 inches hard, gray white, calcite spotted, bunchy surfaced	3	11
Gray white, impure, earthy, blocky beds	1	8
Impure, gray white, reddish tinged, earthy limestone, with purer layer of reddish limestone at base; quite massive; summit less red	7	8
Bluish black, fine, hard limestone, like 2d beneath but unfossil.	1	......
Gray to blue gray, magnesian looking limestone in 3–6-inch beds	2	9
3 heavy layers of hard, bluish black limestone; ringing; multitude of small fossils, lamellibranchs, cephalopods, one-celled Tetradium, etc	4	7
Red and green, impure, calcareous, sandy mudstone, large sand grains; upper 6 inches thin bedded, rest massive	7	......
Very sandy firm green limestone, full of quartz grains	1	3
Hard, gray white, somewhat sandy limestone or dolomite; calcite spots	1	2
Hard, ringing, green, calcareous sandstone	....	10
Red, sandy, rotten shale	1	6
More solid, red and green calcareous sandstone; rots easily	4	......
Red and green, rotten, calcareous sandstone	....	9
Green and red arkose; perhaps calcareous	....	11
Conglomerate resting on Precambric	....	10
Total	71	8

Eight miles south of the above section and 1¼ miles north-west-north of Lyons Falls station another excellent section is shown along Mill creek where all the beds from the Precambric to the Trenton are exposed. Mill creek is not properly placed on the map here. Its true course is close to the town line between Turin and West Turin. By means of the hand level the writer has determined the thickness of the Pamelia here to be about 56 feet. The basal conglomerate, 1 foot thick, is followed by 10 feet of gray, calcareous sandstones and very sandy limestones with some sandy shale partings. Next come 4½ feet of bluish black limestones. Above this the beds are much like those along Roaring brook and their summit is here also capped by a limestone conglomerate.

Some 7 miles south of the Mill creek section and in the vicinity of Denley there are good exposures of the Pamelia. No complete section is visible but a study of all the outcrops makes it certain that the formation is here not over 20 feet thick. The basal conglomerate and sandstone underlies grayish, sandy, thick bedded limestones, while the whole is capped by the usual limestone conglomerate. The most southerly outcrops of Pamelia occur along Mile creek from ½ to 1 mile above its mouth, where the formation is apparently not over 10 or 12 feet thick. It disappears before the Remsen quadrangle is reached.

The thinning out to disappearance of the Pamelia in passing southeasterly may be entirely explained as due to overlap, since the formation came in from the west, as above shown, and rapidly thins out eastward. Its place of disappearance, most likely in the northeastern corner of the Boonville quadrangle, is some 9 or 10 miles east of a north-south line passing through the Roaring brook section where the Pamelia is over 71 feet thick. This represents an eastward thinning of 7 or 8 feet per mile which compares favorably with the rate of thinning noted by Cushing over the Theresa quadrangle. Of course, some of the thinning may quite possibly be due to a lack of deposition of so much material in the southern portion of the basin. It seems certain that the Pamelia is present in considerable force, under cover of later rocks, in the western part of the Port Leyden quadrangle and to some extent, at least, in the northern part of the Boonville quadrangle. In a letter Cushing says that what has heretofore been referred to as Beekmantown-Lowville passage beds in the region around Little Falls may in reality be a touch of the Pamelia there.

Plate 7



Falls of Sugar river just above the railroad bridge. The rock is rather heavy bedded crystalline Trenton limestone.

Lowville limestone

The Lowville limestone formation takes its name from the type locality at Lowville a few miles beyond the map limits to the northward. It was formerly called the Birdseye limestone because of the spotted character of the surfaces due to the emergence of the calcite-filled tubes so characteristic of the formation. These calcite-filled tubes stand perpendicular to the stratification planes and were first thought to have been caused by a seaweed of the Fucoid type, but they are now referred to the genus Tetradium of the branching corals. Not all of the Lowville beds contain the Tetradium.

In the old State report by Vanuxem everything below the Trenton, in this region, was described under the heading "Black River limestone," but the following quotation shows that, on lithologic grounds, he recognized three divisions of the formation: "The cliff shows several distinct kinds of limestone, not being a homogeneous mass. The upper part is mixed irregularly with black shale. . . The second division is of a lighter color, with less shale or impurities, more brittle, and contains the Fucoides demissus (Tetradium), etc. . . The third division, and which therefore forms the base of the cliff . . . is light colored, and the surface of some of the layers present mud cracks, showing the presence of shale. It is in these layers that the stone exists which is burnt for waterlime at Lowville."[1] His upper division corresponds to our Black River limestone, the middle one nearly to our Lowville, and the lower one nearly to our Pamelia.

Within the map limits the Lowville, together with the Pamelia, is present, except at the extreme south, as an almost continuous surface exposure or ledge facing the railroad. In spite of its considerable thickness its areal extent is small because of its outcrop along this steep slope. The Lowville beds are mostly bluish dove-colored, pure limestones in beds varying from a few inches to 2 feet thick. Some of the beds are mud cracked, others are shaly, while still others are fossiliferous commonly with the Tetradium. A notable feature is the presence of limestone conglomerate at several horizons. In passing downward this conglomerate is prominent where the pure dove limestones give way to the more impure bluish gray to whitish gray limestones and it is here where the line between the Lowville and Pamelia has been drawn. Within the quadrangle this line is a difficult one to draw with any great degree of accuracy.

[1] Geol. N. Y. 3d Dist. 1842. p. 42.

According to the work of Cushing and Ulrich farther northward, there is an unconformity separating the two formations, the time gap being represented by the upper portion of the Chazy of the Champlain valley. In the Port Leyden district, the change from the conglomeratic bluish dove limestones to the more impure whitish, sandy beds seems significant and may be due to an unconformity at this horizon. Certainly, however, the writer has found no evidence of any well defined or large unconformity between the Lowville and Pamelia.

In the Roaring brook section as measured by Cushing the Lowville is made up as follows:

	Feet	Inches
6-foot layer of Black River limestone; upper 3 feet full of chert	....	......
Mostly thin bedded blue dove limestone in 6-inch to 1-foot layers, full of Tetradium and other fossils, to base of Black River	7	8
Massive beds of blue dove limestone in 18-inch to 2-foot layers; only sparingly fossiliferous, but more or less Tetradium everywhere	17	4
Shaly, blue dove limestone	1	8
Blue, granular limestone full of fossils and much crystallized calcite	1	2
Ordinary blue dove limestone; lower portion full of gastropods; upper portion a limestone conglomerate with bunchy surface and Stromatocerium look; filling in above are 2–10 inches of shaly limestone	2	10
Thin bedded blue dove limestone	1	1
Massive blue dove limestone; few fossils and little calcite	2	......
Blue black dove limestone; full of fossils and crystallized calcite; thin bedded; shaly above	1	5
Gray, oolitic beds	2	2
Shaly, impure limestone beds blue dove color	1	4
Gray blue, subgranular limestone; calcite specks and spots	1	4
Massive, blue dove limestone; very fossiliferous; Tetradium abundant	2	10
Thin bedded to shaly blue dove limestone; mud cracked; many fossil fragments	3	6
Two massive blue dove beds with shale parting; conglomeratic; many fossils and calcite spots; not sure about Tetradium	2	8
Blue black dove limestone, notably conglomeratic; lots of fossil fragments and many calcite spots; irregular surface	....	9
Thin bedded, mud cracked, dove limestone	1	4
Blue dove limestone spotted with calcite; conglomeratic; many fossils; no Tetradium seen; abundant quartz sand grains on lower surface; probable base of Lowville	3	6
Total	54	7

A section measured by the writer 1½ miles north-northwest of Lyons Falls, and along Mill creek, shows about 54 feet of Lowville. This section is continuous with that of the Pamelia already referred to. Near Denley the section contains about 57 feet of the Lowville.

A comparison of the sections at these widely separated localities brings out some interesting facts, the chief one probably being that the formation shows almost exactly the same thickness throughout the whole distance. This is especially significant in view of the rapid thinning of the underlying Pamelia. Another fact is the great similarity of the beds in the different sections. Thus the basal conglomerate always lies from 54 to 57 feet below the summit, while another conglomerate apparently always lies about 26 or 28 feet below the summit and is associated with a heavy bed of pure dove limestone full of gastropods.

Near the west edge of the Remsen quadrangle, along Black river, there is no complete section, but the Lowville is probably not over 40 feet thick. On the Little Falls sheet the Lowville varies in thickness from 5 to 21 feet, while at Canajoharie it is absent altogether. Thus the outcropping Lowville along the southwestern Adirondacks shows a steady increase in thickness in passing from Canajoharie to Port Leyden.

Black River limestone

The Black River limestone is so named because of its typical occurrence along Black river. It is a hard, fine grained, dark colored to almost black, limestone which breaks with a smooth fracture. Interspersed through the limestone, in a very irregular manner, are small patches of black shale which causes the rock, on weathering, to break into lumpy masses. The appearance of the rock is pretty well shown in plate 6. After long exposure to the weather the surface color changes to a light gray. The rock is generally massive although two or three layers can usually be fairly well made out. Another distinctive feature of the rock, particularly the upper portion, is the presence in it of many irregular shaped black chert nodules. Among the abundant fossils are fine large specimens of orthoceratites and columnar corals especially well exhibited on the upper waterworn surfaces. Hall[1] says of the formation " from being characterized by a large number of peculiar fossils, though mainly belonging to a single family, it is regarded as worthy of separate notice. The principal and most prominent

[1] Palaeontology of N. Y. 1847. 1:46.

organic bodies in this rock are Orthocerata, some of which attain the length of more than 10 feet, and have a diameter of 1 foot or more. Associated with these are several species of Cephalopoda belonging to other genera, and some species of Gastropoda which subsequently appear in the succeeding limestone." These distinctive features cause the formation to stand out as a clearly defined horizon and there are many excellent exposures within the quadrangle.

Within the map limits the Black River limestone varies in thickness from 6 or 8 to 15 or 16 feet and although it is so thin it is persistently present. It is nowhere seen in outcrop on the Remsen quadrangle although it does most likely occur. In the vicinity of Little Falls it is occasionally present but only a few feet thick, while at Canajoharie it is absent altogether.

In connection with the Black River limestone certain erosion features are noteworthy. Directly overlying the hard, massive Black River beds are thin beds of Trenton with pronounced shale partings. The latter beds are more readily worn back than the former, the result being that the Black River nearly always stands out as a terrace or platform back of which the Trenton rises rather abruptly. This platform is of sufficient topographic importance to be shown on the contour map. At times of high water the Trenton is now being stripped off the Black River along Dry Sugar river and along Black river a little over a mile above the mouth of Sugar river. At the latter place the high water has cut back the Trenton limestone so as to leave a distinct and remarkably regular platform of Black River limestone which extends for several hundred yards. During low water the river occupies a channel which has been worn into the Black River limestone [*see* pl. 5].

The composition, texture, and massive character of the rock are favorable for the development of "potholes." A magnificent display of "potholes" may be seen along Sugar river (Dry Sugar river) from the canal crossing to near its mouth. The bed of the stream, which is here dry except during high water, is literally honeycombed with hundreds of "potholes," some of them attaining a depth of 6 or 8 feet and a diameter of several feet [*see* pl. 6].

Trenton limestone

The Trenton limestone has its type locality at Trenton Falls some 20 miles southward. From the standpoint of areal extent and thickness this formation is the second most important one within the quadrangle. In a general way the Trenton here shows most of the features of the type locality. At Trenton Falls the formation is about 300 feet thick and the rocks are mostly thin bedded, impure, dark limestones with pronounced shale partings, except the upper 30 feet which are thicker bedded, gray, crystalline limestones. The following section shows that a marked lithologic change has taken place in passing from Trenton Falls to Port Leyden.

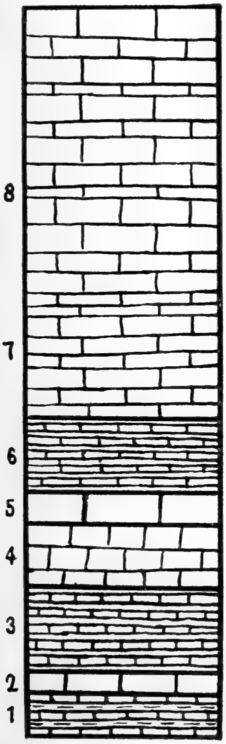


FIG. 1 Columnar section from base to summit of the Trenton limestone formation along Sugar river and Moose creek. The section is 350 feet thick.

More than half of the section is here made up of the gray, crystalline, heavy beds as opposed to only about 30 feet of such beds at Trenton Falls. Within the Little Falls quadrangle the heavy, crystalline beds are absent altogether, the upper Trenton being represented by the Dolgeville shales which are in reality alternating thin beds of impure limestone and shales. These and other facts may be studied to best advantage by comparing the type section here with those of the Little Falls and Trenton Falls districts. The two last named sections may be found on page 38 of the Remsen quadrangle bulletin.[1] It is evident, therefore, that the upper Trenton sea in the Port Leyden district was much clearer water than the same sea in the Little Falls region. Also the change from the upper Trenton to the Utica was much more gradual at Little Falls as shown by the deposition there of the Dolgeville shales as a transition series. In passing northward from Sugar river to Martinsburg the pure, heavy bedded, crystalline limestones assume even greater importance.

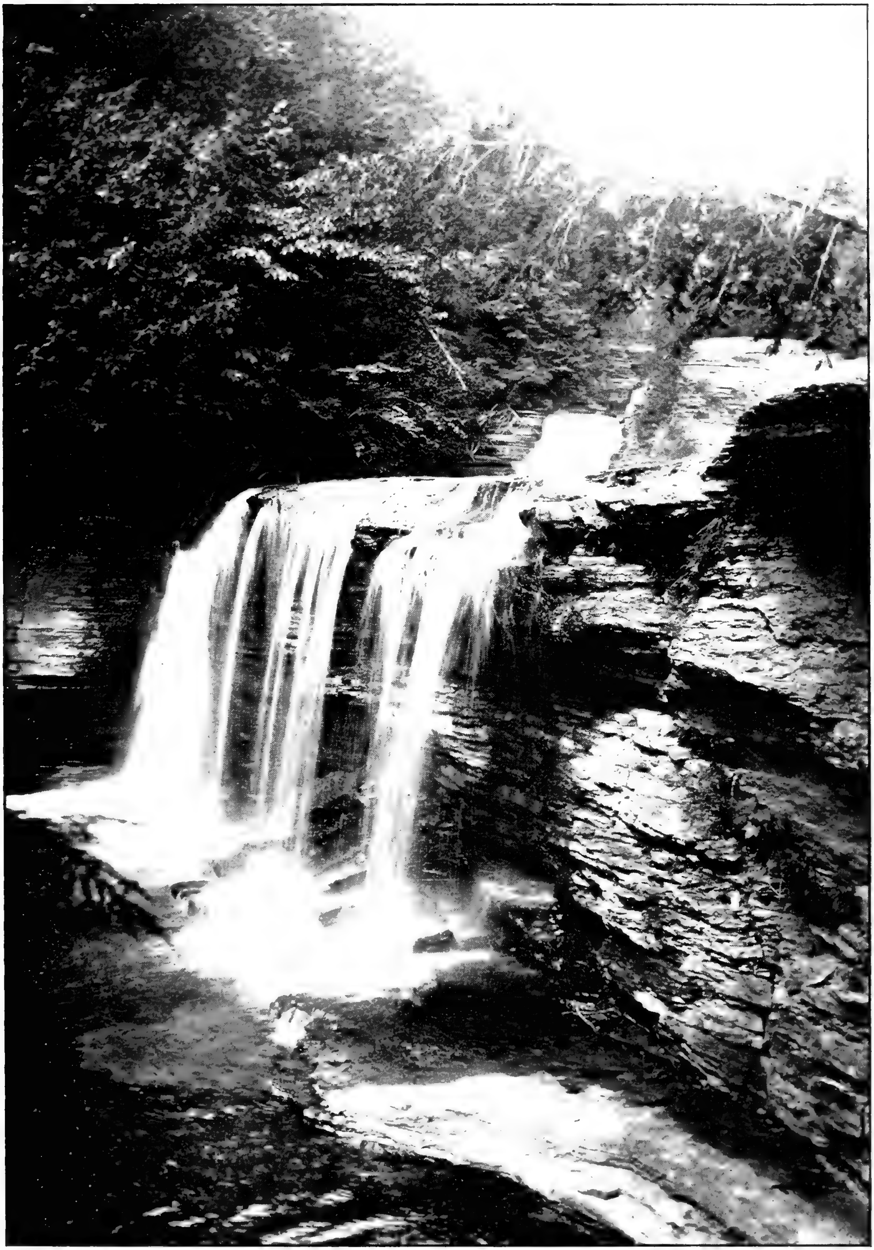
The lowermost 20 feet of the Trenton are highly fossiliferous, thin bedded, alternating shales and limestones. These beds are in sharp contact with the underlying massive Black River limestone as may be seen along Sugar river; along Black river 1 mile above the mouth of Sugar river; along Mill, Douglass, and House creeks and Roaring brook.

Except for the shale area at Locust Grove, the Trenton limestone extends from south to north across the map as an unbroken belt whose width is from 2 to 3 miles. It forms the summit of the lower great terrace so plainly shown on the topographic map. Minor terraces are developed along the lines of outcrop of certain harder and more resistant strata within the formation. The villages of Talcottville, Collinsville, Turin, Houseville and Martinsburg all rest upon the Trenton. The larger streams have cut picturesque gorges through this limestone as for example on Sugar river, Mill creek, House creek and Roaring brook. The last named gorge is locally called " Whitaker's gulf."

Throughout all of Trenton time the ocean was fairly teeming with animal forms, especially brachiopods, trilobites, cephalopods, corals and crinoids. Many of the limestone beds are practically made up of fossil shells. The writer has made no detailed study of the fossils, but the forms are mostly the same as those decribed by Prosser and Cumings from the type locality at Trenton Falls. Hall has described and figured many of the forms from this limestone along the Black river valley. In the lowest Trenton beds the writer has seen specimens of orthoceras several feet long and 5 or 6 inches in diameter.

[1] N. Y. State Mus. Bul. 126. p. 38.

Plate 8



Whitaker falls on Roaring brook 1 mile southwest of East Martinsburg station. The rock is Trenton limestone.

The thickness of the Trenton has been approximately determined in a number of places as follows:

	Feet
Along Moose creek and Sugar river	350
Between Port Leyden and Locust Grove	370
Along Mill creek	400
Along House creek	450
Along Roaring brook and Atwater creek	475

Thus, in a distance of 20 miles across the map, from south to north, the Trenton shows an increase in thickness of something like 125 feet or at the rate of about 6 feet per mile. Passing southeastwardly along the line of outcrop, the Trenton shows a progressive thinning. Thus at Remsen it is about 300 feet; near Middleville 200 feet; at Ingham Mills 100 feet; and at Canajoharie only 17 feet. Westward in Oswego county deep wells at Stillwater and Central Square show respective thicknesses of 670 and 747 feet.

Utica shale

The Utica shale formation shows practically the same characteristic features here as it does at its type locality at Utica. It is a very fine grained, dark gray to black, thin bedded shale. The black color is due to the presence of carbonaceous matter which may be readily burnt out, although, contrary to a current popular idea, nothing like a workable coal seam occurs within the formation Occasionally some of the layers are rather sandy especially toward the top. Toward the base of the formation some of the layers are several inches thick and are frequently calcareous and except for this the contact between the Utica and the Trenton is a sharp one. Because of the softness of the rock and the character of the outcrop, favorable to the development of talus slopes, the actual contact between the shale and limestone was nowhere observed. Many times, however, Trenton beds have been noted in such close proximity to the shale that the boundary line can be pretty accurately drawn. Such observations may be made along Atwater creek or Moose creek.

In spite of a considerable thickness its areal extent is rather small because it outcrops along the base of the steep slope forming the eastern fronts of Tug and Mohawk hills. Excellent sections are to be found along all of the larger streams which cut across this steep slope. Its broadest surface exposure is from Constableville southward where the shale is thickest and the slope is not so great. An interesting erosion remnant, or outlier, separated from the main mass covers several square miles in the vicinity of Locust Grove.

The Utica shale is here not highly fossiliferous although certain fossils so common to the formation may be found in nearly every exposure. Among these are the Endoceras proteiforme of the chambered cephalopods, Triarthrus becki of the trilobites, and some graptolites. Animal life in the Trenton ocean was very prolific, but with the advent of the muddy Utica sea there was a great diminution in both the number of species and individuals.

Along the line of outcrop the shale shows a notable and steady decrease in thickness toward the north. Following are approximate determinations of the thickness within the quadrangle from south to north.

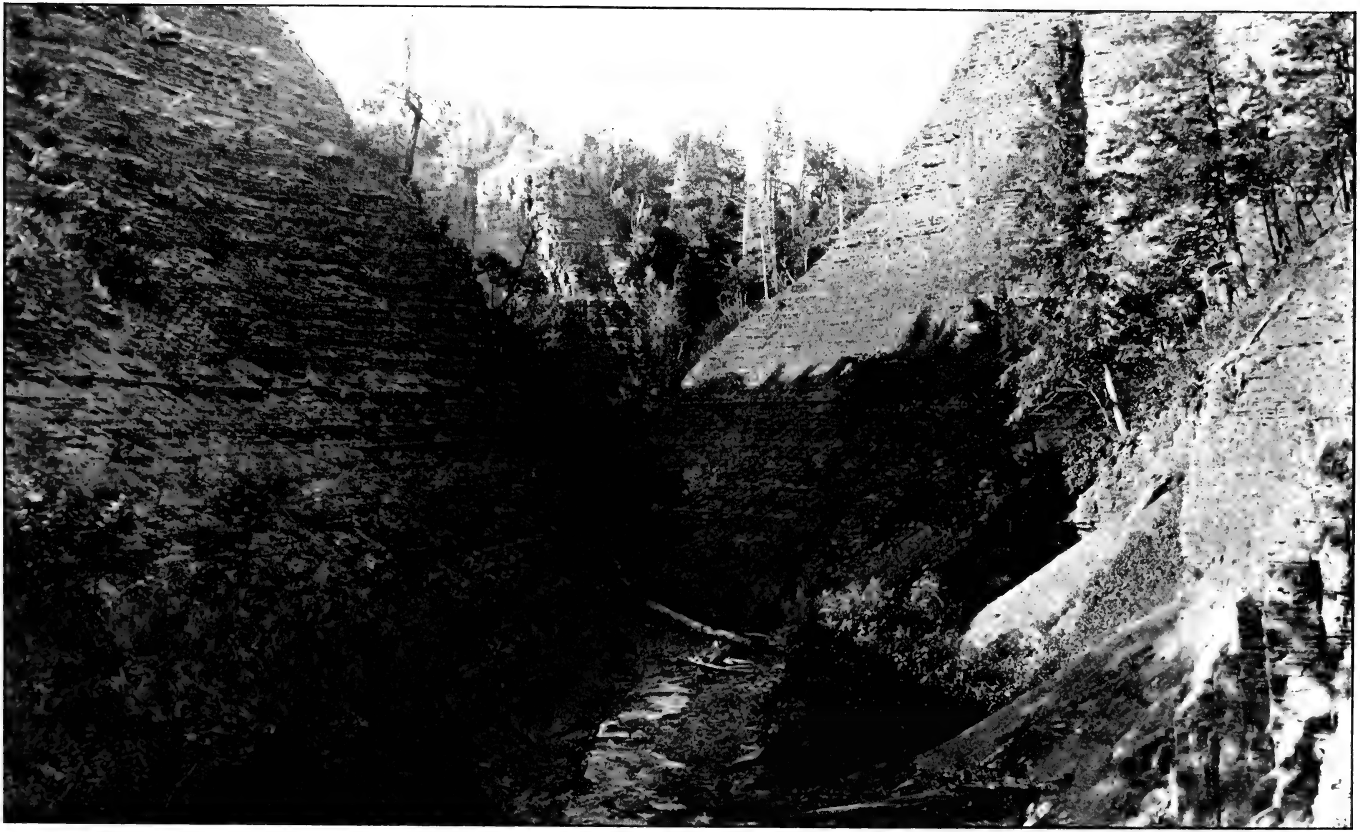
	Feet
Along Moose creek	300
At Constableville	260
At Turin	230
At Houseville	200
Along Atwater creek	180

Southeasterly along the line of outcrop the Utica increases in thickness. Near Remsen it is over 300 feet and near Little Falls about 600 feet. Westward in Oswego county it shows a thickness of 180 feet at Central Square; 120 feet at Fulton and 113 feet at Stillwater in the deep wells. Thus it is evident, in a general way along the southwestern Adirondacks, that the Utica is thinnest where the Trenton is thickest and vice versa, the two formations having nearly the same thickness on the Remsen quadrangle.

Lorraine shales and sandstones

The Lorraine formation received its name from the town of Lorraine in Jefferson county, some 30 miles northwest of Port Leyden. The rocks included under this heading are the same as those of the old "Hudson River group" of Vanuxem's report.[1] In the future the Lorraine beds will doubtless be subdivided, but more detailed work over a wider territory must be done before such subdivision is attempted. In the meantime, all the strata lying between the

[1] Geol. N. Y. 3d Dist. 1842. p. 60.



A view in Whetstone gulf. A short distance above this the gulf is much narrower. The depth is nearly 300 feet and the exposed rocks are the alternating shales and sandstones of the Lorraine.

Utica shale and the Oswego sandstone, two well marked horizons, are described and mapped in this report as Lorraine.

The formation consists chiefly of alternating thin bedded shales and sandstones together with some thin layers of limestone. There is no sharp line of separation between the Utica and the Lorraine, the lowermost shale beds of the Lorraine being in every way like those of the Utica. The lower Lorraine, comprising a thickness of approximately 200 feet of shales, is not very fossiliferous and contains occasional thin beds of fine grained sandstone. Among the fossils the Endoceras proteiforme and Triarthrus becki, so common in the Utica shale, are also found here. The lower Lorraine as thus described corresponds in a general way at least to Vanuxem's Frankfort slate and sandstone.[1]

The upper Lorraine, showing a thickness of something over 400 feet, is made up of gray, fine grained sandstone beds alternating with black to dark gray shales and occasional thin beds of impure limestone. Passing upward the sandstone content increases greatly and the thin partings of shale become rather sandy and light colored. The upper Lorraine sandstones and limestones are highly fossiliferous and fragments of sandstone full of fossils are strewn over the Tug hill region in great quantities. Among the many fossils some of the more noteworthy forms are: Pentacrinites hamptonii of the echinoderms, Leptaena sericea and Orthis testudinaria of the brachiopods, Ambonchyia radiata and Modiolopsis modiolaris of the lamellibranchs and Cyrtolites ornatus of the gastropods. A more complete list of fossils for this general region may be found in a paper by Walcott.[2] The upper Lorraine as here described corresponds roughly to the sandstone shale of Pulaski as used in Vanuxem's report.

From the standpoint of both areal extent and thickness the Lorraine is the principal Paleozoic formation of the quadrangle. Except for the small Oswego sandstone area, the Lorraine occupies all of Tug and Mohawk hills. Fine sections are exposed along the larger streams which cut across the eastern front of Tug hill, the best one probably being in Whetstone gulf [*see* pl. 9]. The whole thickness of the formation is shown in the township of Turin where it is estimated at 630 feet. About 600 feet are shown in Mohawk hill with the top not present. Well records to the west and south

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[1] *loc. cit.* p. 61.

[2] Geol. Soc. Am. Bul. 1890. 1:348-49.

show the Lorraine to be 600 feet thick at Lorraine (Jefferson co.); 530 feet at Stillwater (Oswego co.); 549 feet at Central Square (Oswego co.); 640 feet at Chittenango (Madison co.) and 720 feet at Vernon (Oneida co.). According to these figures there is somewhat of variation in thickness but not in any particular direction.

Oswego sandstone

This formation is so named because of its prominence in Oswego county. It is the only representative of the Upper Siluric within the quadrangle, and corresponds to the gray sandstone of Oswego as used in Vanuxem's report. But one small area occurs within the map limits and this forms the capping of the highest part of Tug hill. This area represents the easternmost extension of the formation which occupies many square miles in the southern part of Lewis county. The Highmarket quadrangle, immediately to the west, is literally strewn with slabs of this sandstone and the region is characterized by numerous swamps and a sluggish drainage.

Within the map limits the Oswego sandstone is a gray, fine grained, thin bedded rock. The stratification is not very regular and practically no shale is present. Fine examples of cross-bedding on a small scale are common. A characteristic feature is the presence of occasional yellowish spots of limonite, which are no doubt due to the alteration of original iron pyrite. In marked contrast to the underlying formation, the rock examined appeared to be barren of fossils. The sandstone lies between the 2000 and 2100 foot contours, thus showing a thickness of about 100 feet but with the top not reached.

STRUCTURAL GEOLOGY

Dip of the Paleozoic formations

Movements since the deposition of the Paleozoic strata have given them a very perceptible dip toward the southwest. This dip may be determined, in a general way at least, by comparing the altitudes of given horizons within the Port Leyden quadrangle and south and west. For this purpose the top of the Trenton is chosen because it is so clearly recognized in well sections.

The top of the Trenton in the Rome well, as reported by Prosser,[1] is 205 feet below sea level, while 2 miles west of Port Leyden it is

[1] Am. Geol. 1900. 25:137.

1280 feet above sea level. Thus in a distance of 25 miles the top of the Trenton drops 1485 feet or shows a southerly dip of nearly 60 feet per mile.

According to Orton,[1] the top of the Trenton in the Central Square (Oswego co.) well was struck at 1209 feet below sea level. The same horizon 2 miles west of Port Leyden is at an altitude of 1280 feet above the sea which thus shows an increased elevation of 2489 feet within 44 miles or a southwesterly dip of over 56 feet per mile.

In the Stillwater (Oswego co.) well Orton[2] reports the surface of the Trenton at 25 feet below sea level and this is 1305 feet below the same horizon 2 miles west of Port Leyden. The distance is 30 miles and the westward dip is over 43 feet per mile.

Within the map limits, near Locust Grove, the Trenton-Utica contact is at an elevation of nearly 1300 feet, while 2 miles to the southwest it is a little over 1100 feet, thus indicating a southwestward dip here of about 50 feet per mile.

An exceptional dip of 3 or 4 degrees toward the southwest may be seen in the Trenton limestone in the vicinity of Martinsburg. This is probably due to the updrag effect of the fault below described.

Faults and folds

No fault of sufficient extent to be mapped has been found within the limits of the quadrangle. A few places have been noted where there have been slight movements of 1 or 2 feet as for example in the Trenton of the Black river gorge 2½ miles northeast of Boonville.

Just beyond the edge of the map and in a ravine ¾ of a mile northwest of East Martinsburg station a fault with considerable displacement is well shown. No detailed study of this fault has been made, but it is of the normal type and strikes approximately northwest-southeast. Its length was not determined. The fault plane stands nearly vertical and the limestone beds are highly inclined on the south side as a result of the updrag during the process of faulting. On the north side of the ravine the Precambric lies fully 40 or 50 feet higher than on the south side and this represents the amount of the throw. The Pamelia beds have been faulted against the Precambric. The unusually rapid downward slope of

[1] N. Y. State Mus. Bul. 30. 1899. p. 455.

[2] *loc. cit.* p. 448.

the Precambric surface between Glenfield and East Martinsburg is due to the settling of the mass on the south side of the fault.

Extensive folding of the Paleozoic rocks nowhere occurs. Local folds are sometimes developed but even these are rare. Such small folds are best seen ½ mile above the mouth of Mill creek (north of Boonville); near Denley; and where the railroad crosses Sugar river. At the latter place a syncline in the Trenton is perhaps the best example of folding in the district.

The folded structure of the Precambric rocks will be dealt with under the heading "Gneissic structure."

Ripple marks

Small ripple marks are frequently present in the Paleozoic formations. Thus at several horizons within the Pamelia, Lowville and Trenton limestones there are ripple marks which measure 1 or 2 inches from crest to crest and about ½ inch from trough to crest. Special attention, however, is called to certain ripple marks of unusual interest in the Trenton. They are of unusual interest both because of their large size and their occurrence in limestone. These marks occur about 25 or 30 feet above the base of the Trenton and are finely shown in the south bank of Sugar river a short distance above the railroad bridge. The ripples measure from 24 to 56 inches from crest to crest, and 4 to 7 inches from trough to crest. They strike about n. 30° e. The ripple marked layer varies in thickness from 2 to 9 inches and is a crystalline and very fossiliferous limestone. Shale occurs immediately above and below the marked stratum and the shale above thickens or thins according to whether it rests upon the troughs or crests of the ripples. The limestone layers both above and below rapidly thicken and thin and are certainly of shallow water origin.

Gneissic structure

The precambric rocks, which are metamorphosed, igneous and sedimentary masses, all exhibit the gneissic structure. This structure is best developed in the old Grenville sediments and least in the syenite. In the areas of mixed gneisses it is also clearly shown. The strike of the gneissic bands varies from north-south to almost east-west, but the most common range is from n. 40° to 70° e. The direction of dip of the foliation planes is either northward or southward but prevailingly northward. The angle of dip is usually high, varying from 50 to 80 degrees although just north of Lyons

Falls it is as low as 20 or 25 degrees. From south of Denley to 3 miles north of Lyons Falls the dip is northward; thence northward to just south of Glenfield it is southward; thence northward to the map limit it is northward. Thus we have good evidence of distinct folding of the Precambric rocks on a large scale. Certain other Precambric rock structures will be discussed later.

Structure sections

The structure sections shown in figures 2–4, page 38, have been carefully chosen with the idea of giving the best general notion of the various rock formations and their relationships to each other.

PALEOZOIC OVERLAP

It is well known that during the general subsidence (barring certain minor oscillations of level) of the Adirondack region in early Paleozoic times, sediments were being deposited on the Precambric surface and that these sediments gradually encroached upon the sinking land mass until nearly all, if not all, of the Adirondack region was covered by them. The younger formations extended farther in than the older ones upon the sinking surface, thus constituting an overlap of the Paleozoic sediments upon the Precambric crystallines. The stripping off of this Paleozoic cover has been going on since the close of the Paleozoic era, at least, and the exposed surface of the Precambric rocks is still being enlarged by this same process. A glance at the structure sections [fig. 2–4] will show the eroded edges of about 1500 feet of sediments which formerly must have extended farther eastward upon the Precambric surface. In the Port Leyden district we have positive evidence to prove the Paleozoic overlap.

On the western side of the Adirondacks the oldest overlapping formation is the Potsdam sandstone. It is not present in outcrop within the Port Leyden quadrangle, the nearest exposures being about 20 miles northward in the vicinity of Carthage. According to Orton [1] the Potsdam, resting upon the Precambrics, occurs in Oswego county to the west and southwest of Port Leyden as shown in deep well sections. Thus the deep well at Central Square shows 156 feet of sandstone; the well at Parish 50 feet of sandstone and the well at Stillwater (southeast of Orwell) at least 49

[1] N. Y. State Mus. Bul. 30.

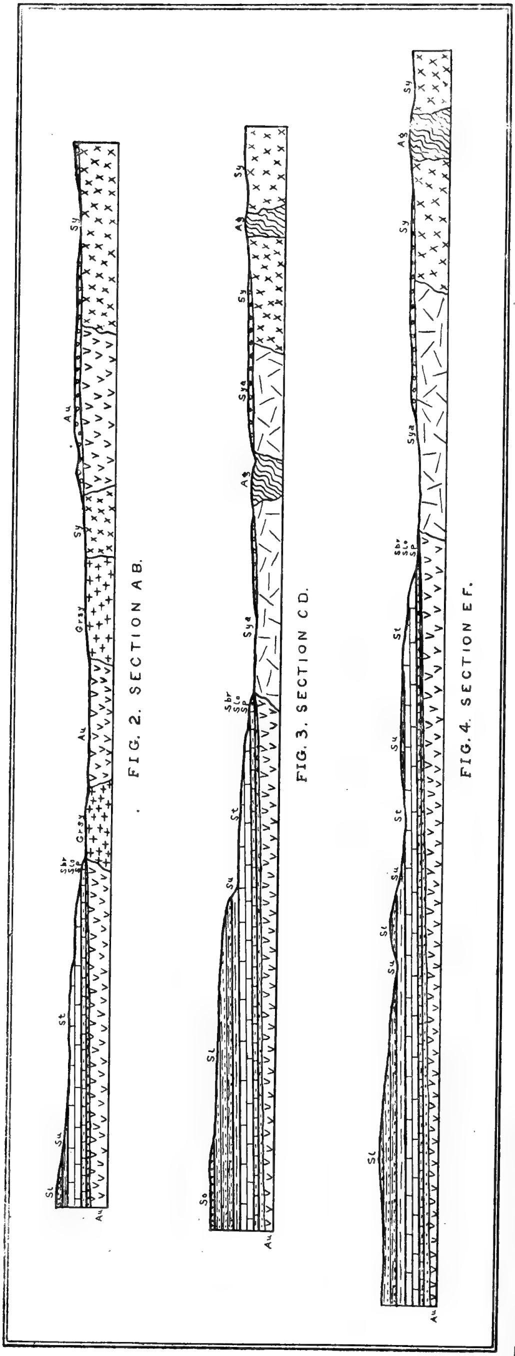

FIG. 2–4 Structure sections across the Port Leyden quadrangle. The section lines are indicated on the geologic map. The symbols are the same as those on the geologic map. Vertical scale is twice the horizontal.

feet of mostly sandstone. Orton refers all of these sandstones to the Potsdam. The bottom of the section at Stillwater is:

	Feet
Dark Trenton	370
Sand and shales	40
Sand, green and white	25
Black limestone	6
Red and white sandstone, calcareous	18
Precambric struck at	1697

Fossils in the black limestone layer prove the Upper Cambric (Potsdam) age of the deposit. The presence of this Potsdam in Oswego county and its absence along the Paleozoic-Precambric boundary to the eastward on the Port Leyden sheet, affords conclusive evidence of overlap.

Again, we have a strong argument in favor of overlap if we consider the whole thickness of sediments between the top of the Trenton and the Precambric. Details will be presented later, but suffice it to say now that a comparison of the thickness of these sediments in Oswego county with those near Port Leyden shows a thinning of several hundred feet in passing toward the latter place. Such a marked diminution in thickness toward the northeast and east is just what would be expected in the case of overlap.

SURFACE OF THE PRECAMBRIC ROCKS

Smoothness of the surface which received Paleozoic deposition

A study of the Paleozoic-Precambric line of contact gives strong evidence in favor of the statement that the sinking surface which received Paleozoic sedimentation must have been worn down to a remarkably smooth condition (peneplain). Except for a few miles near the southern edge of the map, the Paleozoic-Precambric boundary line can be drawn with a considerable degree of accuracy. A glance at the geologic map will show that this boundary line is a very regular one which at no point shows any rapid elevation or depression. Such a regular line of contact is precisely what one would expect where sediments have been laid down upon a smooth floor and then, after elevation, have been stripped off rather regularly by erosion. Even a comparatively small elevation or depression along the contact line could be recognized. At several points where the actual contact is exposed, the Precambric floor appears to be smooth.

Because of the deep mantle of sand and gravel which now covers the Precambric surface east of Black river, the configuration of that surface can not be studied to the best advantage. But so far as can be judged, if the stream channels in the Precambric surface were filled up the resulting surface would be comparatively smooth and even which strongly argues for that sort of a surface before the stripping off of the sediments and later erosion. Any prominent elevations on the old floor ought now to be recognizable, especially in the valley bottom and near the Paleozoic boundary, but none occur there. The distinct rock ridge southeast of Fowlersville seems to be the only example of such an elevation. This ridge rises about 80 feet above the general level but its hight is thought to have been somewhat accentuated by ice action. Again, if there had been any marked depressions in the old floor they would have been filled up with Paleozoic sediments and we might well expect to find such protected sediments as isolated patches or outliers within the general Precambric area as, indeed, the Potsdam sandstone does occur some 30 or 40 miles farther northward. The available evidence, however, points to a complete removal of the sediments.

The conclusion for the Port Leyden quadrangle is that the Precambric floor upon which the sediments were laid down was comparatively smooth and even, with only one known elevation rising above the general level. This is substantially the conclusion reached by Professor Cushing and the writer for the Little Falls and Remsen quadrangles respectively and it is true of the southern and southwestern border of the Adirondacks. This result as Cushing says "seems specially important in view of the fact that Professors Kemp and Smyth, and the writer (Cushing) also, have found evidence to show that, in the St Lawrence and Champlain valleys and vicinity, the surface on which the Potsdam was deposited was considerably more uneven than this. In other words, the surface to the south was worn down to a nearer approach to base level than was the case farther north."

Slope of the Precambric surface where now exposed

We have just shown that the Paleozoic sediments were deposited upon a very smooth Precambric surface. The uneven and dissected character of that surface where now exposed is due almost entirely to erosion since the stripping away of the sediments. A fairly good idea of the present general slope of this surface may be obtained by comparing altitudes at various points.

Near Partridgeville the Precambric lies at about 1300 feet above the sea level, while at Hawkinsville (Boonville sheet), 16 miles southward, it lies at 1060 feet. The difference in elevation is 240 feet or the slope per mile southward is 15 feet between these places.

One mile south of Donnattsburg the Precambric is at 1020 feet, while at Port Leyden, 10½ miles southward, its elevation is 900 feet. The difference in elevation of 120 feet shows a southward slope of over 11 feet per mile in this direction.

The Precambric near Partridgeville is at 1300 feet, while just west of Glenfield, 7½ miles westward, it lies at 840 feet. Thus we get a difference in elevation of 460 feet or a slope per mile of 61 feet toward the west. In a similar way we may find a slope, between Lyons Falls and a point east of Fowlersville, of 67 feet per mile westward.

In the vicinity of Woodhull lake, at the western edge of the Old Forge sheet, the Precambric elevation is 2000 feet while at Port Leyden, 17 miles westward, it is 900 feet. The difference in altitude is 1100 feet which means a westward slope of nearly 65 feet per mile.

These comparisons clearly demonstrate that the Precambric surface now slopes both southward and westward, but that the westward slope is much steeper. The writer has compared Precambric altitudes at many points over the Port Leyden, Remsen, Wilmurt and Little Falls quadrangles. The conclusion reached is that the exposed Precambric surface along the southwestern Adirondacks slopes both westward and southward; that the slope toward the west is steeper (being from 60 to 100 feet) than the slope toward the south (being from 11 to 50 feet); and that the general southwestward slope is greater in the Little Falls than in the Port Leyden region.

Slope of the Precambric surface where Paleozoics now cover

Having acquired some idea regarding the slope of the exposed Precambric surface it will now be of interest to determine the slope of the Precambric surface where Paleozoics now cover. This may be done by comparing altitudes of the Precambric within the Port Leyden quadrangle with the Precambric altitudes as found in certain deep wells to the south, southwest and west.

In the Campbell well 3 miles west of Utica, according to Prosser,[1] the Precambric was struck at 1500 feet below sea level, while at

[1] Geol. Soc. Am. Bul. 1893. 4:101.

Port Leyden it lies at 900 feet above sea level. The distance is 33 miles and the difference in elevation 2400 feet which shows a slope of over 72 feet per mile southward.

According to Orton,[1] the Central Square (Oswego co.) well shows Precambric at 2015 feet below sea level, while at Port Leyden its altitude is 900 feet. This shows a drop of 2915 feet in passing 46 miles southwestward or a slope of over 63 feet per mile toward the southwest.

In a deep well at Pulaski the Precambric was struck at 1048 feet below sea level, according to Orton.[2] Its altitude at Port Leyden is 900 feet, which indicates a drop of 1948 feet in a distance of 38 miles or a slope of over 51 feet per mile toward the west.

These results show that the Precambric slope under the Paleozoics is somewhat greater southward than westward and that the general southwestward slope is clearly less than it is in the Little Falls and the Remsen districts. Also the slope under the Paleozoics is greater than where no sedimentaries now cover, which is always true along the southwestern border of the Adirondacks. This is what would be expected because the general surface over the Precambric area has been reduced by erosion since the removal of the sediments. By referring to the above figures we find that if we consider a due east-west line through the Port Leyden district, the Precambric slope under the Paleozoics is actually a little less than it is east of them. This certainly means that the slope of the Precambric surface, before the removal of the sediments, must have been steeper eastward from Port Leyden than westward, and that it is still steeper in spite of the later erosion.

Slope of the Precambric surface during Paleozoic deposition

It is possible to get some idea regarding the slope of the surface upon which the older Paleozoics were being deposited by comparing the thickness of these formations with the same ones to the west and southwest in Oswego county. This comparison may be most satisfactorily made by considering together all of the deposits from the top of the Trenton to the Precambric, because in the well sections the different formations are not clearly distinguished.

In the well at Pulaski[3] the thickness of the strata from the top of the Trenton to the Precambric is 900 feet, while the corresponding

[1] *loc. cit.* p. 455.
[2] *loc. cit.* p. 489.
[3] *loc. cit.* p. 489.

thickness just west of Port Leyden is only 500 feet. Between these places, which are 39 miles apart, the thickness has diminished 400 feet or at the rate of over 10 feet per mile toward the east.

At Central Square it is 806 feet from the top of the Trenton to the Precambric, while at Port Leyden it is 500 feet. Thus in a distance of 45 miles the thickness has diminished 306 feet or at the rate of nearly 7 feet per mile toward the northeast.

In the Stillwater well the top of the Trenton lies 772 feet above the Precambric, while at Martinsburg it is about 600 feet. This shows a decreased thickness in 27 miles of 172 feet or at the rate of over 6 feet per mile toward the northeast.

Thus we see that there is an increasing thickness of these formations toward the southwest and west at from 6 to 10 feet per mile, and these figures may, in a general way at least, be taken to indicate the slope of the surface upon which the Paleozoic deposits were being laid down.

These results are significant when compared with the results similarly obtained by Cushing for the Little Falls district and by the writer for the Remsen quadrangle. In the Little Falls region the slope receiving Beekmantown deposition was about 30 feet per mile southward; while in the Remsen district the slope receiving Trenton deposition was from 6 to 20 feet per mile southwestward, the greatest slope being in the southeastern portion of the district. Thus it is pretty well established that the slope of the surface receiving Paleozoic deposition was very considerably greater in the vicinity of Little Falls than in the vicinity of Port Leyden and that there was a gradual change from the steeper to the more nearly level surface.

The results obtained for the Port Leyden quadrangle are also significant in another way. The thickness of the formations here, from the top of the Lorraine to the Precambric, is approximately 1400 feet. This thickness is great enough so that even after allowing for decreased thickness due to overlap and a possibly increased slope (receiving sediments) as the heart of the Adirondacks was approached, we seem to have here a strong argument in favor of the submergence of the region for many miles to the east and northeast of Port Leyden, so that by the close of the Lower Siluric the submergence extended to, or close to, the heart of the Adirondacks. This conclusion is quite different from that reached by Cushing by similar reasoning for the southern Adirondacks. He says:[1] "This line of evidence would therefore, so far as it may be worth anything,

[1] N. Y. State Mus. Bul. 77. 1905. p. 61-62.

seem to indicate that the southern Adirondack region could not have been completely submerged at the close of the Lower Silurian, much less so at the close of the Trenton."

PLEISTOCENE (GLACIAL) GEOLOGY

From the standpoint of its glacial history the Port Leyden district is unusually interesting and instructive. When the great ice sheet, which covered most of New York State, reached its maximum development the Black river valley must have been buried under several thousand feet of ice. We know this because the whole Adirondack region is glaciated and was covered by the ice. The advance and retreat of the ice across the Port Leyden quadrangle has left most of the ordinary marks of glaciation, while certain of them are developed to a remarkable degree. So far as the writer knows nothing has been published regarding the Pleistocene history of this immediate region, although a report by Chamberlin[1] published some 27 years ago has an indirect bearing.[2]

Direction of ice flow

Chamberlin, in the report above referred to, makes the tentative statement "that massive ice currents having their ulterior channels in the Champlain valley, on the one hand, and the St Lawrence on the other, swept around the Adirondacks and entered the Mohawk valley at either extremity, while a feebler current, at the hight of glaciation, probably passed over the Adirondacks and gave to the whole a southerly trend." Observations by later investigators have tended to bear out this view and the evidences from the Port Leyden quadrangle herewith presented have an important bearing upon the proposition.

The direction of flow is best shown by the glacial striae which have been observed at a number of different places through the district. The striae are best preserved upon the hard Precambric rocks, but these are mostly drift covered except along the chief stream courses. The limestones are next most favorable while upon the shales none have been found. Striae are present only upon those surfaces from which the drift has been recently removed, because

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[1] U. S. Geol. Sur. 3d An. Rep't 1881–82. p. 360–65.

[2] Since the above was written Prof. H. L. Fairchild has presented several papers, bearing on the glacial history of northern and central New York, before the 1908 meeting of the Geological Society of America. These papers will be published in the bulletin of the society.

even the hardest rocks, exposed during all of postglacial time, have been weathered enough to cause an obliteration of the glacial marks.

Striae pointing from s. 25° to 40° e. have been located as follows: On Trenton limestone 1 mile south of Martinsburg and also ⅓ mile to the east of that village (s. 25° e.); on Black River limestone just west of Lyons Falls; on Precambric near the mouth of Roaring brook, 1½ miles northeast-north of Glenfield and also ⅓ mile southwest and ¾ mile southeast-south of the same village; on Precambric 1 mile northeast of Denley and ⅓ mile northeast of Hawkinsville. Striae bearing nearly south occur on the Precambric 1 mile east of Port Leyden. The southeasterly movement, shown by these marks, changed to a more nearly easterly movement in the Mohawk valley region, and this is just what would be expected according to the statement of Chamberlin. It should be noted that the Black river valley, which is the chief topographic feature on the western side of the Adirondacks, had much to do with determining the direction of flow of the ice. This valley existed in preglacial time and the close parallelism between the directions of the striae and the direction of the valley shows the influence of the latter in determining the ice movement. Along the northwestern border of the Adirondacks the ice undoubtedly moved southwestwardly. Along the eastern border of the Adirondacks the general southerly movement of the ice has been well established, as has also the westerly movement up the Mohawk valley toward Little Falls. Thus the statement of Chamberlin, regarding ice flow around the Adirondacks, harmonizes almost perfectly with the observed striae.

But the question still arises, what was the direction of the current during the hight of glaciation? We have abundant evidence to prove that, during the hight of glaciation, the main current was a southeasterly one. On the Long Lake quadrangle in the midst of the Adirondacks Professor Cushing has recorded a number of striae all of which point toward the southwest.[1] Over the region south of the Adirondacks and the Mohawk valley the observations of both Brigham[2] and Chamberlin[3] show that the ice moved in a general southwesterly direction. Another strong evidence favoring the southwesterly current is the distribution of glacial boulders over the

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[1] N. Y. State Mus. Bul. 115. 1906. p. 495.

[2] Amer. Jour. Sci. 1895. 49:216.

[3] *loc. cit.* p. 365.

region southwest of the Adirondacks. Most of the common Adirondack rock types are strewn over the region and they gradually diminish in number as the distance from the mountains becomes greater. This subject has been discussed in a paper by Brigham.[1]

Thus, bearing in mind all the facts, the writer is strongly of the opinion that when the ice in its southward movement struck the Adirondacks, it was divided into two currents flowing around the mountains and meeting in the Mohawk valley; that during the time of maximum glaciation there was a strong general southwesterly current, but that the border currents continued as under currents (more or less checked in velocity); and that after the disappearance of the ice sheet from the central Adirondacks, border currents were maintained. According to this the Port Leyden quadrangle was first invaded by a tongue of ice which flowed southeastward up the Black river valley. When the general ice sheet had here reached a thickness of several thousand feet the main current was southwesterly, but with a southeasterly under current in the valley bottom. The ice first melted from the highlands and left a tongue of ice in the valley which gradually melted and retreated northward.

ICE EROSION

Erosion of the Precambric rocks

As the ice moved across the quadrangle, the preglacial rock surface was more or less scratched, polished and eroded. In the case of the Precambric rocks it is doubtful if the ice did any very deep cutting. Its work of erosion involved mostly the removal of masses of decayed and weathered rock material near the surface. The evidence is conclusive that the weathered materials were rather thoroughly scraped off the Precambrics as shown by the remarkable freshness of the rocks wherever exposed and by the smoothed and rounded character of the outcrops [*see* pl. 3]. The highly jointed character of these rocks no doubt greatly aided the ice in its work of erosion. Mention should be made of the great number of erratics of Precambric rock material strewn over much of the region, especially toward the south. One of these erratics measures about 17 feet high and 27 feet across [*see* pl. 11]. The larger ones are mostly of the hard, homogeneous syenite or granite. Probably the greatest amount of erosion of the Precambrics occurred along Black river between Lyons Falls and Lowville, but this matter will be referred to below.

[1] *loc. cit.* p. 213–28.

Erosion of the sedimentaries

Turning our attention to the sedimentaries, we find that ice erosion was much more effective upon them. In fact the writer believes that in the Black river valley we have one of the best examples of ice erosion in northern New York. One factor favoring the ice work here was the comparative softness and highly jointed character of the rocks, while another factor was their position with reference to the ice current.

The figure on page 48 shows the profile and geologic structure across the Black river valley 2½ miles north of Lyons Falls. One of the striking features is the terraced character of the sedimentaries, particularly from Port Leyden northward [*see* topographic map]. Along the river course there is a slight notch in the Precambrics and just west of this, on the northern part of the Port Leyden sheet, there is a steep slope rising 300 feet above the Precambrics. The formations outcropping on this slope are shown in the section. Resting upon the Precambrics are several feet of weak sandstones which are followed by the sandy limestones of the Pamelia; then come the hard Lowville and Black River limestones; while the summit is capped by hard, crystalline limestones. The streams passing over this slope are characterized by gorges with waterfalls and rapids. From the summit of this slope and extending for several miles westward there is a well defined terrace developed upon the limestone.

Rising from the western side of the above named terrace there is a second slope higher and much steeper than the first. The rise is commonly about 450 feet within ⅓ mile. The soft Utica shales outcrop at the base of this slope and they are followed by the Lorraine shales with an upward increasing sandstone content. The summit of this terrace, known as Tug hill, is more irregular and stream dissected than the limestone terrace below. All streams flowing across the steep slope of this terrace have high gradients and have cut deep, narrow gorges locally called "gulfs."

At first these terraces, in their present form, were thought to have been due entirely to water action, but an examination of the region shows that some other explanation must be sought. The steep fronts of the terraces are certainly young topographic features, which precludes the possibility of their having been formed during the long preglacial period of erosion in this ancient region. On the other hand, Black river has done very little work of erosion, between Lyons Falls and Lowville, in postglacial times as proved by the fact

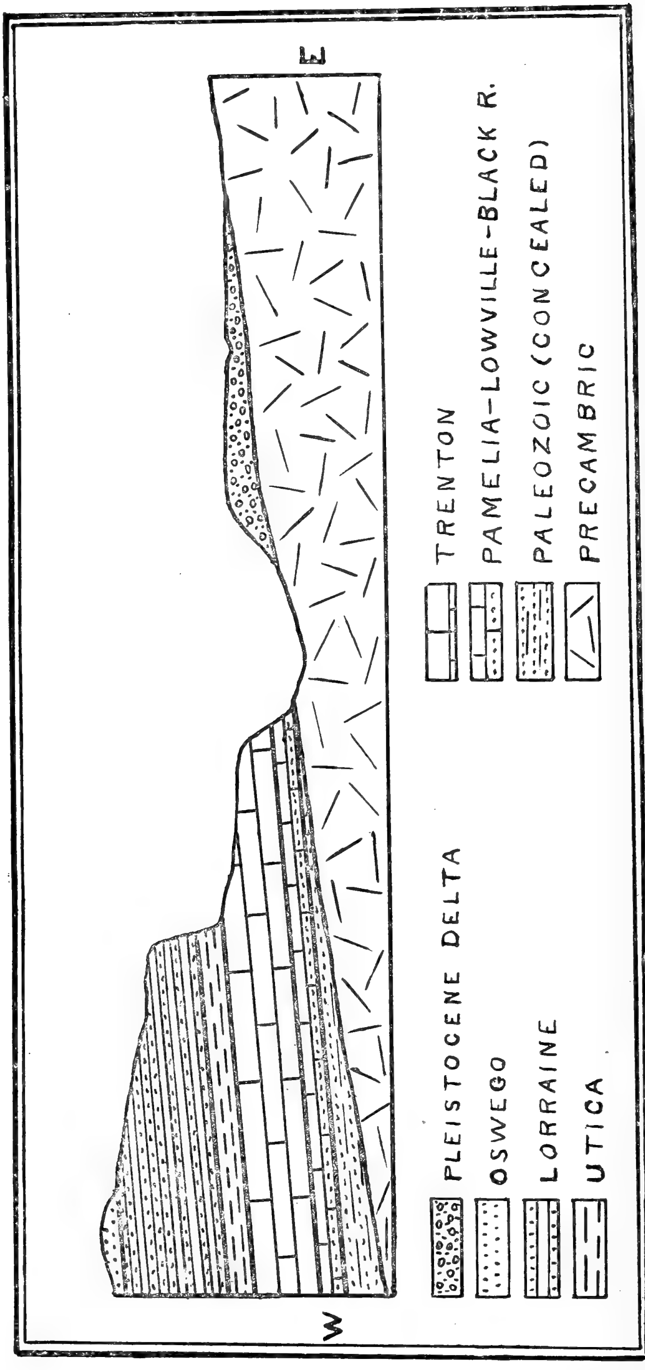


Fig. 5 East-west section across the "Port" Leyden quadrangle 2½ miles north of Lyons Falls, showing the position of the delta deposits and the terraced character of the Paleozoic sediments. Vertical scale 8.8 times the longitudinal.

that the stream has not yet cut its way through the alluvium and reworked drift filling the valley bottom, and also because glacial striae and kames near the river level have not been disturbed. Thus also the slight trench cut into the Precambrics along here could not have been postglacial in origin.

There is still the possibility that glacial waters might have developed the terraces, but there is no evidence of any such vigorous water action especially along the higher part of the limestone terrace where records would surely be left. Even if a large stream had flowed along the ice edge and under the steep front of Tug hill its gradient would have been too low to be compatible with much cutting power. No doubt there was movement of water along the waning Black river ice lobe, but the only current of any importance was a northerly one between the eastern edge of the limestone terrace and the ice margin [*see* below]. The limestones here are somewhat water-worn, but the stream was about 200 feet below the top of the terrace and thus clearly could not have done the work of erosion over the whole terrace. Also the presence of glacial striae on the terrace shows that no great amount of erosion could have taken place there since the ice retreat.

It seems certain that the lowermost Paleozoic layers must have extended farther eastward, by overlap on the Precambrics, immediately preceding the glacial period. This means that Black river was some distance farther eastward and that the western tributaries from Tug hill entered it with lower gradients. As above shown, the lowest sedimentary beds could not have been cut back to form the steep slope now facing Black river in pre- or postglacial times nor were they cut back by glacial waters. Evidently they were cut back by the ice to develop the steep slope. This allowed Black river to shift westward to its present position. Thus the slight trench in the Precambrics here could not have been preglacial. As already shown it is clearly not postglacial and apparently it was formed by ice cutting. The concave character of this inner portion of the valley is brought out in the figure and strongly suggests ice work.

The fact should also be considered that we are here dealing with unaltered sedimentaries, with slightly upturned edges, resting upon a rather smooth surface of igneous and metamorphic rocks, and that the lowest sediments are weak sandstones and sandy limestones, which greatly favored the stripping off power of the ice. Robert

Bell[1] has noted similar conditions in Canada and he says that when the ice sheet moved from the crystallines against the edges of the unaltered sedimentaries "great erosion has always taken place and valleys and basins are formed whose width depends upon the angle of dip and the softness of the strata which have been scooped out. The strata are presented in the most favorable attitude for abrasion. The wearing down would go on till the resisting rock front had attained a hight and weight sufficient to counterbalance those of the glacier." In the Black river valley the ice moved from the crystallines against the slightly upturned edges of the sediments.

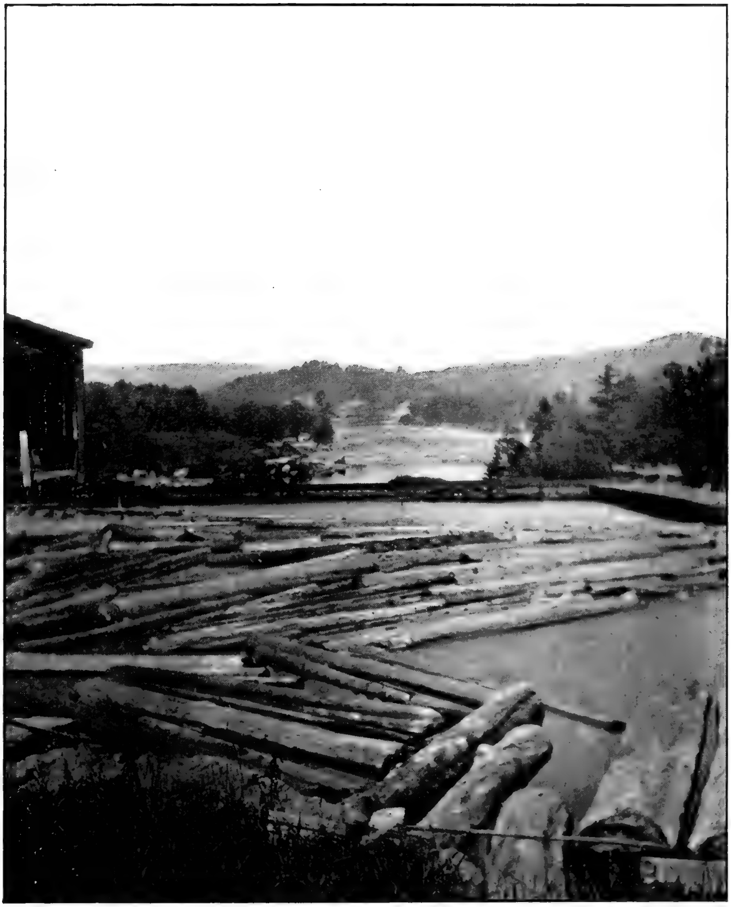
In much the same way the soft shales were stripped off the surface of the hard limestones to form the broad terrace and the steep front of Tug hill. Such a stripping off of the shales occurred, but to a less extent, over the southern part of the Port Leyden quadrangle and the western part of the Remsen quadrangle. The maximum thickness of shale thus removed was probably several hundred feet, but not over a wide area. The total amount of shale removed was not nearly as much as may at first sight be supposed. Then too the shales were soft and highly jointed even to a considerable depth as may now be seen in the Whetstone gulf section.

Two other factors which greatly aided the work of the ice in the Tug hill region must not be overlooked. One of these is the fact that the ice moved up hill as it advanced southward along the valley and so had its cutting power increased. On reaching the divide between Black river and West Canada creek the cutting power was lessened and till and other drift materials were deposited in great quantities as the ice moved down hill toward the Mohawk river. Another factor which the writer regards as important in this connection is the angle at which the ice current entered the Black river valley in its sweep around the Adirondacks. The greatest amount of erosion was along the eastern side of Tug hill, and it is just here where the ice current must have struck with greatest force as it crowded into the valley. In harmony with this idea is the fact that the glacial striae near Martinsburg bear more toward the south than does the steep front of Tug hill.

It may be fairly asked, what became of the materials thus removed? The very resistent Precambrics ought to be present in considerable force somewhere in the region as erratics and this is the case southward especially in the townships of Boonville and Remsen where vast numbers of such erratics may be seen. Shale

[1] Geol. Soc. Am. Bul. 1890. 1:296.

Plate 10



W. J. Miller, photo

Looking down Moose river from Goulds Mill. The river here, between Goulds Mill and Lyons Falls, flows through a drift-filled channel.

and limestone are also present in great abundance in the till and other drift of the Remsen quadrangle. However, much of the shale must have been ground up and carried away by glacial waters.

Glacial sand plains or terraces

A remarkable development of glacial sand plains or terraces is to be found within the Port Leyden quadrangle. Here, on the east side of the river, most of the region is occupied by these terraces, which taken together may be looked upon as a single great terrace with steep front facing Black river [*see* fig. 5]. On the Port Leyden sheet alone they cover fully 75 square miles and continue both northward and southward from this area. They are clearly shown upon the topographic map. The sands and gravels of these terraces show a depth of from 200 to 250 feet along the western edge, and there is a gradual thinning out to disappearance several miles eastward.

Except in a few cases the flat-topped surfaces are practically destitute of large boulders. A characteristic feature is the presence of pitlike or kettlelike depressions over the surfaces [*see* map]. These depressions are of various sizes and shapes and are sometimes occupied by lakes or ponds, as for example Brantingham, Little Otter and Catspaw lakes and Sand pond. They are often very steep-sided and range in depth from a few feet to 50 or 60 feet. The terraces are dissected by many streams so that enough good sections are exposed to make it certain that the materials are crudely stratified and cross-bedded, and occasionally interstratified with clay, thus proving that they were water laid. The western margin of this great terrace is distinctly lobate in character and is strongly suggestive of delta origin as for example in the southeastern part of the quadrangle. Another very notable feature is the concordance of altitudes at about the same distance back from the margin. The altitudes vary from about 1150 to 1260 feet, the higher altitudes being on the east, thus giving a gradual slope of the terrace surface toward Black river.

A study of the character and distribution of these terraces as well as their relation to the other drift deposits, leaves no doubt as to their origin as delta deposits in a marginal lake along the waning ice tongue during its retreat from the Black river valley. The immense amount of material thus deposited was readily obtained by the streams, especially Black and Moose rivers and Otter creek, as they emerged from the newly drift-strewn Adirondack highlands.

That they were deposited along the ice margin is clearly established by the presence of kames and large drift boulders along the western edge which prove an ice contact front here. The gradual downward slope of the sand plains toward the west is to be accounted for by the gradual lowering of the marginal lake level as the ice retreated.

The depressions within the sand plains may be explained in either one of two ways. They may have been due to isolation of ice masses from the ice margin (possibly sometimes as icebergs) which were partially or completely buried under the delta sand to be melted later thus causing the development of the depressions, or they may have been due to unequal deposition of the delta materials whereby some places were not brought up to the general level. The depth, steepness of sides and irregular shapes of the depressions cause the writer to favor the first view to account for most of them.

Kames

Kames, which are hillocks of crudely stratified materials deposited at the ice edge, are rather abundantly represented except on the east side over the sand plain area. There is no group of large kames such as those of Park and Sperry hills within the Boonville quadrangle, or like those of the Remsen quadrangle described in a former report. Probably the best example of a single kame is the one ¾ of a mile southeast-south of Greig. It is remarkable for its steepness and symmetry of form and shows a hight of at least 150 feet. Many kames are located along the steep western front of the great sand terrace above described, especially from Lyons Falls northward. Other good examples may be found from south of Port Leyden to north of Lyons Falls along the railroad; south and west of Talcottville; along the road from Turin to Houseville; south and east of Martinsburg; and even on the highland southwest of Mohawk hill. Frequently, as in the locality last mentioned, there are long low ridges of stratified materials called eskers associated with the kames.

No doubt kames were also formed over the region now covered by the sand plains, but as the ice gradually retreated from the valley the kames formed along the ice edge were buried under the deep delta deposits. Only those along the western margin of the great delta deposit were left uncovered. Partially buried kames in the midst of a sand plain are finely exhibited around Forestport on the Remsen quadrangle. The sands are there comparatively

Plate 11

W. J. Miller, photo

An erratic or glacial boulder of syenite in the bed of Black river 2 miles northeast of Boonville. The boulder is about 27 feet across and 17 feet high and rests upon Black River limestone.

thin and after the formation of the kames and withdrawal of the ice edge, the delta sands were deposited around them but not with sufficient depth to cover them.

Erratics

Like the kames, glacial boulders or erratics are scattered over all parts of the quadrangle except the typical sand plains. Their absence from the sand plain belt is to be explained in much the same way as the absence of the kames, that is after the boulders were dropped by the melting ice they were covered by the delta deposits so that they are scarcely ever seen except along the larger stream courses where they have again been exposed by erosion. A good many are present along the western front of the delta terrace particularly in the vicinity of Greig. They are also strewn over the Paleozoic rock area, even on the high land of Tug and Mohawk hills.

The erratics are mostly from the hard, resistant Precambric formations and, as above pointed out, their presence on the high western portion of the quadrangle strongly argues for a southerly or southwesterly ice current at one time. The largest erratic observed by the writer is one of quartzose syenite, already referred to, which rests upon the Black River limestone about 2 miles northeast of Boonville. This boulder measures about 27 feet across and 17 feet high. Another large one may be seen in the field about ¾ of a mile east-northeast of Denley station.

Glacial lakes

A very interesting and extensive glacial lake occupied all of the sand-flat country on the east side of Black river between Forestport and Lowville. It also extended somewhat west of Black river in the vicinity of Boonville, and to an unknown distance north of Lowville. The former presence of this large lake is conclusively shown by the great development of unquestioned delta deposits, associated with clays, and the remarkably concordant altitudes of the sand plains [*see* above]. These waters were impounded by the waning lobe of ice in the Black river valley. The kames and drift boulders along the western edge of the great delta deposit show an ice contact from there; also the absence of delta deposits on the west side of the valley, under Tug hill, shows that the lake did not extend that far west. Again the failure of any delta deposits to reach out to or across the valley bottom also argues for ice occupancy of the deepest part of the valley during the existence of the large lake. In his description of the deposits along the Connecticut river, Gulliver has noted similar features and argues that those deposits must have formed before the ice had completely melted from the valley.[1]

The highest water level in this lake was apparently something over 1300 feet at which time an outlet probably crossed the Black river-West Canada creek divide[2] near Honnedaga (Remsen sheet) and flowed southward toward Trenton Falls. Possibly the extensive sand deposits near the latter place were formed by this outlet, although West Canada creek may have contributed to their formation. Further retreat of the ice lobe down the Black river valley certainly opened an outlet southwestward past Boonville and down Lansing kill toward Rome causing deposition of the great delta deposits north of the latter place. This delta no doubt formed in Lake Iroquois or rather its broad outlet in the Mohawk valley. This outlet from the glacial lake affords a fine example of a " through valley " to use the term suggested by Davis. The preglacial divide was doubtless near Hurlbutville as shown by the widening of the channel both northward and southward from that place; by the existence there of a deep inner gorge; by the aggraded stream bottom north of Hurlbutville; by the fact that the present stream could not have cut the deep narrow channel north of Hurlbutville and by the right elevation of an outlet there. The lake stood at approximately the 1250 foot level when it started over this divide and it cut down the divide rapidly until the 1140 foot level in the lake was reached. By this time the ice tongue had so far melted as to allow an escape of the water northerly and northwesterly along the west side of the ice tongue and into Lake Iroquois near Watertown. These north moving waters have left the limestones just west of the river more or less waterworn and possibly some of the minor terraces were formed by them.

Another lower and very distinct lake level was a little below 800 feet and caused by still further ice retreat to allow an accumulation of water back of a barrier at Carthage. The river is still engaged in cutting through this barrier. This lake extended southward to Lyons Falls where it was very narrow. Between Lyons Falls and Carthage the river now shows a very low gradient and the winding

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[1] Am. Geol. Soc. Proc. 1907. 18:640.

[2] The rather recent land movements in the region are not considered. Thus the elevations given are comparative only, but they are not far from the actual lake levels which were doubtless lower.

stream is developing terraces through the old lake deposits of the valley bottom.

Drainage

Black river and its tributaries. From Hawkinsville to opposite Denley, Black river is certainly out of its preglacial channel as shown by the gorge cut into the limestones. Its former course was probably about 2 miles eastward along the Paleozoic-Precambric boundary. Between Denley and Port Leyden it is practically in its old channel. Thence to east of Lowville the stream is somewhat west of the preglacial course due to the westward shifting of the Paleozoic-Precambric boundary by erosion during glacial times. It is doubtful if any of the tributaries of Black river, which cut through the delta deposits and into the Precambrics, follow their old channels because they have been superimposed upon the Precambric surface. Thus Moose river has cut through the deep sands and is now engaged in eroding a channel, with gorges and waterfalls, into the Precambrics.

Origin of the "gulfs." The deep gorges which have been cut through the steep eastern front of Tug hill, by tributaries of Black river, are locally known as "gulfs." The chief gorges are occupied by Mill, House, Whetstone and Atwater creeks and Roaring brook. Whetstone gulf which is perhaps the most interesting, is about 2 miles long and shows a depth of 300 feet [*see* pl. 9]. Its walls are very steep sided to almost vertical, especially in the upper end (narrows) where there is just room enough for the stream at the bottom and where erosion is now proceeding most rapidly. A section showing something like 700 feet of Lorraine and Utica shales is finely exposed in this gorge. The stream emerges from the "gulf" upon the broad limestone terrace.

During glacial times the shales were eroded back over the limestone for a considerable distance, and this caused the development of the steep eastern front of Tug hill. After the disappearance of the ice from the region, all of the east bound streams from Tug hill rushed over this steep slope and began to erode notches into its summit. These notches were rapidly deepened in the soft shales to develop the "gulfs," whose heads have since been cut back to their present positions. South of Tug hill the "gulfs" are not so well developed because the shales, with their preglacial channels, were not cut back by erosion to such a great extent.

ECONOMIC PRODUCTS

Soils

The principal industry of the region is farming and the success of that industry here, as elsewhere, depends not only upon the character and energy of the people, but also, to a large extent upon the nature of the soil. The Port Leyden quadrangle affords us a fine example of the dependence of agriculture upon the geologic formations. From the standpoint of fertility of soil, Black river divides the district into two portions which present a remarkable contrast. Eastward from the river the territory is mostly covered with deep sands and gravels which are generally unproductive. Occasionally along the stream bottoms or where some clay is mixed with the sand, the soil is of fairly good quality. The potato crop is best suited to this sandy soil. There are many deserted farms on this side of the river and apparently this section was most prosperous when lumbering was the chief occupation of the people and farming a secondary matter.

On the west side of the river where the geologic formations are chiefly limestones and shales, and where sands and gravels are sparingly present, there is a prosperous farming community. Here the surface is mostly strewn with glacial debris which is largely composed of ground up shale, sandstone, and more or less limestone, which is thus a rich and easily worked soil.

Building stone

Building stone of fine quality occurs in immense quantities within the map limits. The rocks most quarried for this purpose are the limestones of the Pamelia, Lowville and Black River formations, but especially the Lowville. Many large quarries have been opened up in these formations, the principal ones being located on the geologic map. Such stone was used in building the numerous locks of the Black river canal and then later by the railroad for bridge abutments. It now has a considerable local use, especially for foundations. The highly jointed and stratified character of the Lowville and Pamelia beds cause it to be readily accessible in layers of almost any desired thickness up to about 2 feet. The Lowville is a bluish gray, very fine grained, pure limestone, while the Pamelia is usually a whitish gray to pink, more or less sandy and impure limestone. The gray Black River limestone quarries out as a more massive stone. The most extensive quarries are between the mouth of Sugar river and Denley station.

Other good building stone is found in the Trenton limestone, especially the upper portion. This rock is gray, coarse grained, crystalline, and pretty pure and may be quarried in layers from a few inches to a foot thick. The stone is much used locally and was formerly burnt in great quantities for the production of lime. The chief quarries are at Talcottville, Turin and Martinsburg. The sandstones of the upper Lorraine are strewn over the highlands on the west and are of considerable local use.

Of the Precambric rocks, the syenite is an excellent building material. It is a very hard, greenish to reddish, rather granitic syenite which takes a high polish. The expense of quarrying and transportation have almost entirely prevented its exploitation. A quarry from which syenite of fine quality has been taken is located about a mile east of Denley station.

Road materials

Most of the Precambric rocks, but especially the syenite, because of its great durability, when crushed would yield excellent road materials. Most of the stone now used for road work comes from the Lowville and upper Trenton limestones because this stone is cheaply quarried and crushed and is fairly durable.

Sand and gravel

As above explained much of the country east of the river is deeply covered with sand and gravel, often of good quality for all sorts of uses. The increasing demand for such materials will, in the future, doubtless cause the exploitation of these immense deposits.

Iron ore

In the above descriptions of the Precambric rocks, magnetite, in small grains, is seen to be very commonly present. Many times patches of magnetite 1 or 2 inches across have been observed in the mixed gneisses and in the more acid phases of the syenite and they have every appearance of being segregation masses. An ore body several feet across has been found on the Murtaugh farm 2 miles east of Glenfield. It is magnetite mixed with much pyrite and is closely associated with pegmatitic material in the granitic syenite. The pegmatite and ore seem to grade into the country rock and probably represent a segregation mass.

The most interesting and important magnetite deposits occur in the village of Port Leyden and on the west side of the river below the bridge. Many years ago several attempts were made to mine the ore here. An ore pit, now filled with water, was run down some 50 or 60 feet and a furnace was erected, but the mine was never a paying proposition. Ore was later brought to the furnace from other places. The ore is magnetite associated with much iron pyrites and often with quartz. A thin section of the ore from the pit shows 50% of quartz; 45% of magnetite and pyrite and 5% of badly decomposed ferro-magnesian minerals. The wall rock from the pit shows 35% of feldspar, chiefly microperthite and some oligogclase; 45% of quartz and 20% of biotite, pyrite, sillimanite, zircon and garnet. Thirty feet from the ore pit, the feldspar content is somewhat higher and the dark minerals not so prominent. Still farther away the rock is much like a quartzose syenite. A few rods from this pit and at the water's edge, an irregular shaped ore body several feet across may be seen. It is nearly pure magnetite and entirely surrounded by syenite. The ore is in no sense sharply separated from the country rock. A rapid but perfect gradation of the ore into the syenite may be seen and the evidence seems conclusive that this small ore body, at least, is a segregation mass in the syenite. The ore in the pit is thought to have a similar origin, although the evidence is not there quite so conclusive. This ore is closely associated with syenite and garnetiferous gneisses in a syenite-Grenville area and it is interesting to note that the Salisbury Iron Mine described by Cushing on the Little Falls quadrangle, and the occurrences noted by the writer on the Remsen quadrangle, all show similar relationships to the country rock. It would seem that when the molten syenite was passing through the Grenville the conditions were somehow made favorable for the segregation of the magnetite.

Lead ore

Before the middle of the last century lead ore was discovered in the Trenton limestone about a mile a little west of north of Martinsburg. The early attempts to mine the ore and extract the metal failed because of the small quantity of ore available. The ore is galena (sulphid of lead) which occurs in true vein deposits and associated with calcite as a gangue material. The calcite is frequently crystallized in six-sided prisms capped by three-sided pyramids. The vein-stuff fills joints in the limestone and the galena has doubtless been dissolved out of the surrounding rock and deposited in the veins.

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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. Checks or money orders should be addressed and payable to New York State Education Department.

Museum annual reports 1847–date. *All in print to* 1894, 50c *a volume,* 75c *in cloth;* 1894*–date, sold in sets only;* 75c *each for octavo volumes; price of quarto volumes on application.*

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.

1904. 138p. 20c.
1905. 102p. 23pl. 30c.
1906. 186p. 41pl. 35c.
1907. 212p. 63pl. 50c.
1908. 234p. 39pl. map. 40c.

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.

Geologist's annual reports 1881–date. Rep'ts 1, 3–13, 17–date, 8vo; 2, 14–16, 4to.

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	10	$.35	18 (Bul. 64)	$.20
2	.30	11	.25	19 (" 76)	.15
5	.25	12	.25	20 (" 97)	.40
6	.15	13	*Free*	21 (" 104)	.25
7	.20	14 (Bul. 23)	.20	22 (" 110)	.25
8	.25	15 (" 31)	.15	23 (" 124)	.75
9	.25	16 (" 36)	.25	24 (" 134)	.35

Reports 2, 8–12 may also be obtained bound in cloth at 25c each 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.

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), 58th (1904), 59th (1905), 60th (1906), in volume 2 of the 61st (1907) and 62d (1908) 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. 8vo. *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 grouped in the list on the following pages according to divisions.

The divisions to which bulletins belong are as follows:

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12	“	57	Entomology	102	Economic Geology
13	Entomology	58	Mineralogy	103	Entomology
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Geology. 14 Kemp, J. F. Geology of Moriah and Westport Townships, Essex Co. N. Y., with notes on the iron mines. 38p. il. 7pl. 2 maps. Sept. 1895. Free.

19 Merrill, F. J. H. Guide to the Study of the Geological Collections of the New York State Museum. 164p. 119pl. map. Nov. 1898. *Out of print.*

21 Kemp, J. F. Geology of the Lake Placid Region. 24p. 1pl. map. Sept. 1898. Free.

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Cushing, H. P.; Fairchild, H. L.; Ruedemann, Rudolf; Smyth, C. H. Geology of the Thousand Island Region. *In press.*

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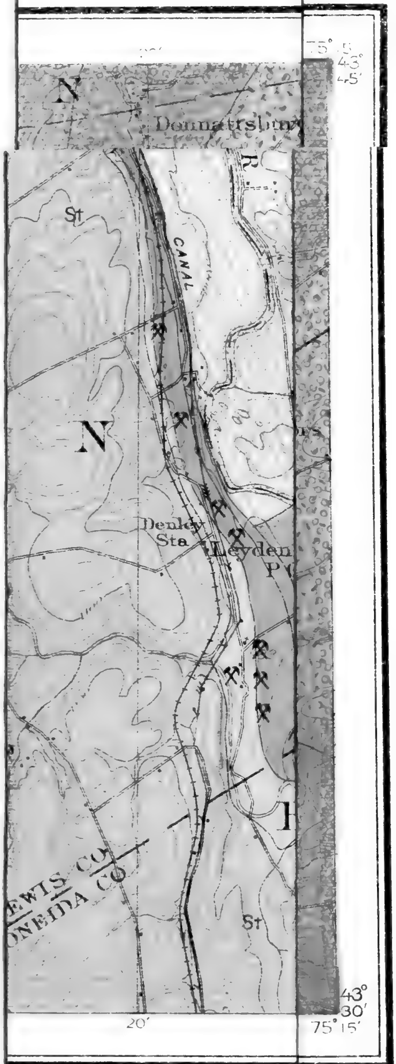

LEGEND

amphibolite inclusions.

PRECAMBI

Ag

Grenville gneisses. Highly metamorphosed, sedimentary rocks, showing a distinct gneissic structure.

Sya

Syenite-Grenville mixed gneisses. Clearly gneissoid rocks of various types, but mostly Grenville, much cut up by intrusions of syenite.

Au

Precambric rocks, but of unknown character because buried under heavy Glacial drift.

⚒ Stone Quarries.

A B, C D, and E F are structure section lines. See text page 38.

Miller,

3 4 Miles

5 Kilometers

LEGEND

Sedimentary Rocks

Pl — Modern valley alluvium together with much Glacial drift

Sand and gravels, mostly delta deposits, and largely concealing boundaries

PLEISTOCENE

So — Oswego sandstone. Gray, fine-grained, thin-bedded sandstone.

UPPER SILURIC

Sl — Lorraine shales and sandstones. Alternating thin beds of gray to black shales and gray, fine-grained sandstones

Su — Utica black shale. Somewhat calcareous toward base

St — Trenton limestone. Mostly impure and thin bedded in lower portion and crystalline and heavy-bedded in upper portion

Sbr — Black river limestone. Pure, bluish gray massive limestone with chert nodules and a little shale

Sl — Lowville limestone. Pure, bluish, dove colored, thin to thick bedded limestones, containing calcite-filled tubes

Sp — Pamelia limestone. Impure, whitish gray to bluish-gray, earthy limestones. Sandstone and conglomerate at the base

Metamorphic Rocks

Sy — Syenite. A rather quartzose rock, showing a gneissic structure, and of undoubted igneous origin. Younger than the Grenville

Granite-syenite. A very quartzose phase of the normal syenite gneiss. The rock is usually red, straight-banded, and contains long, narrow or pencil-like inclusions

Ag — Grenville gneisses. Highly metamorphosed, sedimentary rocks, showing a distinct gneissic structure

Sya — Syenite-Grenville mixed gneisses. Clearly gneissoid rocks of various types, but mostly Grenville, much cut up by intrusions of syenite

A — Precambric rocks but of unknown character because buried under heavy Glacial drift.

⚒ Stone Quarries

A B, C D, and E F are structure section lines. See text page 38

Topography by U. S. Geological Survey in cooperation with the State of New York 1904-1906

Scale 1/62500

Miles

Kilometers

Contour interval 20 feet
Datum is mean sea level

Geology by W. J. Miller, 1908