

WILLIAM
RATTONA
1871

THE NATIONAL ACADEMY OF SCIENCES
OF THE UNITED STATES OF AMERICA
REGENTS OF THE UNIVERSITY

STATE OF NEW YORK

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THIRTEENTH ANNUAL REPORT

Cover is the same
OF THE

REGENTS OF THE UNIVERSITY

OF THE

STATE OF NEW YORK,

ON THE CONDITION OF THE

STATE CABINET OF NATURAL HISTORY,

AND THE

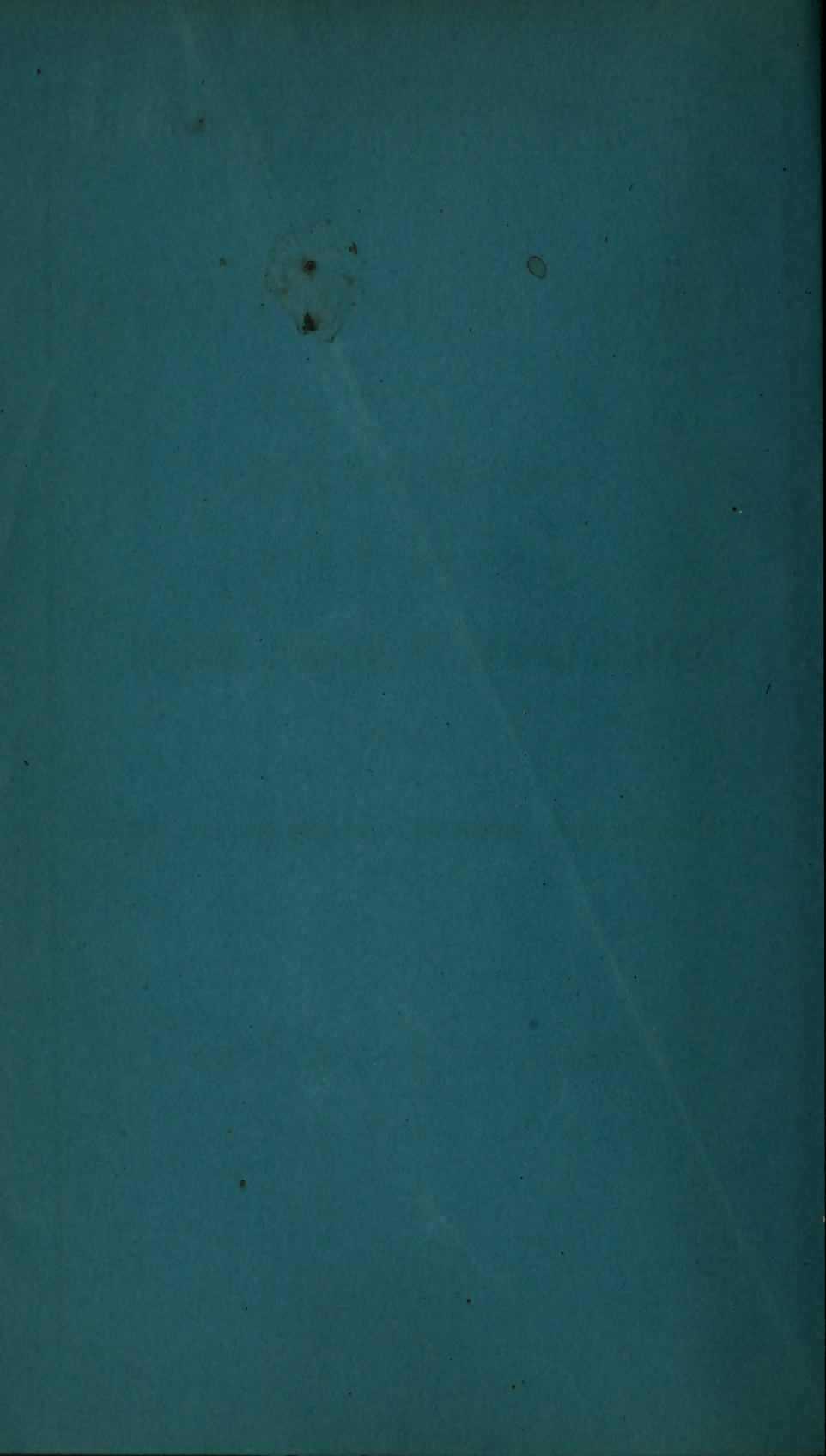
Historical and Antiquarian Collection annexed thereto.

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MADE TO THE SENATE, APRIL 10, 1860.
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ALBANY:

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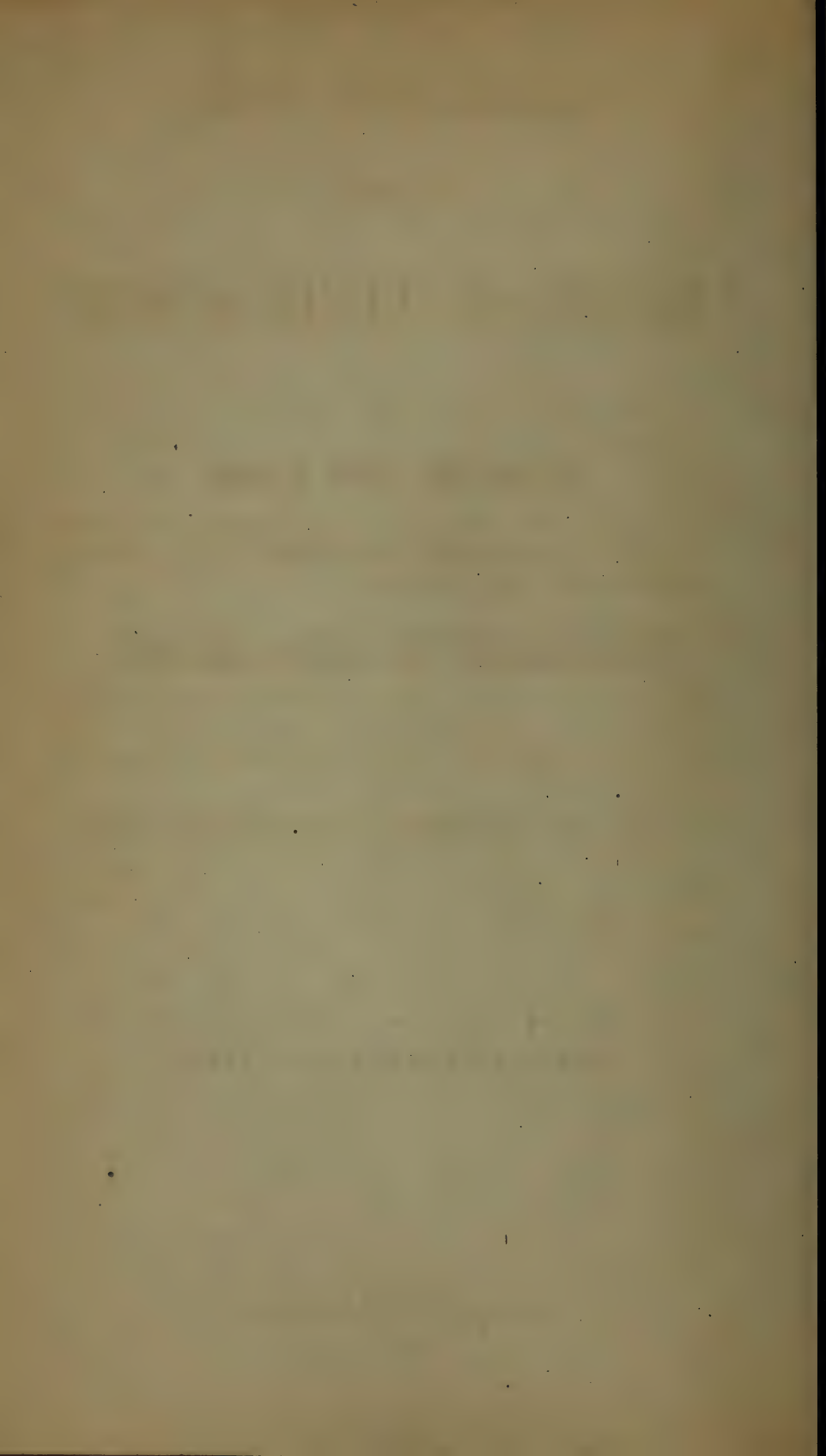
1860.



THIRTEENTH ANNUAL REPORT
OF THE
REGENTS OF THE UNIVERSITY
OF THE
STATE OF NEW YORK,
ON THE CONDITION OF THE
STATE CABINET OF NATURAL HISTORY,
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STATE OF NEW YORK.

No. 89.

IN SENATE, APRIL 10, 1860.

THIRTEENTH ANNUAL REPORT

Of the Regents of the University, on the condition of the State Cabinet of Natural History, and the Historical and Antiquarian Collection annexed thereto.

To the Hon. ROBERT CAMPBELL,

Lieutenant-Governor, and President of the Senate:

SIR—I have the honor to transmit the Thirteenth Annual Report of the Regents of the University, on the State Cabinet of Natural History, and the Historical and Antiquarian collection annexed thereto.

I remain, very respectfully,

Your obedient servant,

G. Y. LANSING,

Chancellor.

April 10, 1860.

• REGENTS OF THE UNIVERSITY, 1860.

GERRIT Y. LANSING, LL. D.,
Chancellor.

GULIAN C. VERPLANCK, LL. D.,
Vice-Chancellor.

EDWIN D. MORGAN,
Governor, ex officio.

D. R. FLOYD JONES,
Secretary of State, ex officio.

HENRY H. VAN DYCK,
Sup't Public Instruction, ex officio.

ERASTUS CORNING.

PROSPER M. WETMORE.

JOHN LORIMER GRAHAM.

GIDEON HAWLEY, LL. D.

DAVID BUEL.

JAMES S. WADSWORTH.

JOHN V. L. PRUYN, LL. D.

ROBERT CAMPBELL,

Rev. SAMUEL J. LUCKEY, D. D.

ROBERT G. RANKIN.

Rev. JOHN N. CAMPBELL, D. D.

ERASTUS C. BENEDICT.

GEORGE W. CLINTON.

Rev. ISAAC PARKS, D. D.

LORENZO BURROWS.

Rev. GEORGE B. CHEEVER, D. D.

ROBERT J. HALE.

S. B. WOOLWORTH, *Secretary.*

STANDING COMMITTEE OF THE REGENTS,

SPECIALLY CHARGED WITH THE CARE OF THE STATE CABINET.

1860.

EDWIN D. MORGAN,
ROBERT CAMPBELL,
JOHN LORIMER GRAHAM.

Rev. Dr. CAMPBELL,
DAVID R. F. JONES,

EZEKIEL JEWETT, *Curator.*

JAMES A. HURST, *Taxidermist.*

REPORT.

To the Legislature of the State of New York:

The Regents of the University

RESPECTFULLY REPORT :

That in prosecuting the objects referred to in their last report, "enlarging the collections, and making them a better exponent of the Natural History of the State," additions have been made to the Cabinet during the past year which render some of its departments nearly complete.

The details of these additions will be found in the appendix to this report.

A list of deficiencies in the department of Zoology, is also presented, that the attention of Naturalists may be called to the subject, in the hope that through their aid and advice they may be supplied. These deficiencies are principally of animals rarely found in the State, and contributions to supply them will therefore be the more highly prized.

The collection of fishes of the State made by Dr. De Kay, in connection with his report on that subject, was very imperfect. It has been to some extent supplied by the contributions of the Smithsonian Institution. The Regents have under consideration a proposition from an able ichthiologist, to prepare a full report on the subject, bringing the descriptions down to the present advanced state of this department of science.

The collection of shells of the State is incomplete. It is now under special review and examination, and it is hoped that during the present year it will be so enlarged as to represent, to a good extent, whatever properly belongs to the State.

The collection of Mazatlan shells presented by Mr. Philip P. Carpenter, of Warrington, England, and which was referred to in the last annual report, is fully arranged in the beautiful manner adopted by Mr. Carpenter in the set of which this is a duplicate, deposited in the British Museum. As the representation of the

molusca of a single locality, this collection is believed to be unequalled by any other in this country, and as presenting the types of the shells found on the western shores of the continent must be of great value to naturalists. The munificent gift has been duly acknowledged by the Regents, in behalf of the State, and the single condition that it be kept distinct, and forever open to the examination of students, fully admitted. A full catalogue, by genera and species, with numbers corresponding to the printed descriptive catalogue, and the tablets in the cases, will be found in the appendix.

The Regents have ever regarded it important to collect whatever may illustrate the history of the State. With this view, there is herewith submitted a report on the remains of Indian mounds, recently surveyed in the counties of Chautauqua, and Cattaraugus. These monuments of a race which has almost disappeared, are being rapidly obliterated, and any effort to perpetuate the memorials of their modes of life, in peace or in war, are worthy of encouragement. The descriptions of Mr. Morgan and of Dr. Hough have been printed in former reports. Those now submitted have been made with great labor and much apparent accuracy by T. Apoleon Cheney, and are communicated with the accompanying illustrative drawings of mounds and works of art, and their publication in the appendix of this work is recommended.

By order of the Regents.

G. Y. LANSING, *Chancellor.*

S. B. WOOLWORTH, *Secretary.*

ACCOUNT CURRENT.

The Secretary of the Regents of the University, in account current with the appropriation for preserving and increasing the "State Cabinet of Natural History, &c.

DR.

1858-'59. To Balance to new account, (see Assembly Doc., 1859, No. 186, p. 5,) -----	\$45 91
To amount received from the Comptroller, being the annual appropriation, 1858, '59,	800 00
To amount received from Comptroller for expenses of Mazatlan collection of shells, presented by P. B. Carpenter, Esq., ----	600 00
	\$1,445 91
	\$1,445 91

CR

	Voucher No.	
1858.		
Oct. 15. By cash paid J. A. Hurst, stands for birds,	1,	\$150 00
26. By cash paid J. C. Boynton, wages, &c.,	2,	18 20
Dec. 20. By cash paid sundry persons, -----	3,	28 03
27. By cash paid James Dodds, carpenter, -	4,	200 00
1859.		
Jan. 10. By cash paid Irving & Wiley, freight on Mazatlan collection, -----	5,	17 75
20. By cash paid J. Davis & Co., painting, &c.	6,	84 16
By cash paid J. C. Boynton, wages, ----	7,	10 00
24. By cash paid Wells & Co., express, ----	8,	7 63
31. By cash paid J. A. Hurst, mounting birds, &c., -----	9,	25 02
By cash paid J. W. Blackhall, locksmith,	10,	11 14
Mch. 31. By cash paid A. McClure & Co., camphor,	11,	40 93
By cash paid J. C. Boynton, wages, ----	12,	20 00
By cash paid Col. E. Jewett, expenses, -	13,	33 12
Apr. 26. By cash paid James Dodds, carpenter, --	14,	22 64

Voucher No.

Apr. 26.	By cash paid James Dodds, for cases for		
	Mazatlan collection,	15,	\$176 11
July 11.	By cash paid contingents,	16,	46 16
Sept. 5.	By cash paid J. C. Boynton, wages, &c.,	17,	22 55
Oct. 3.	By cash paid do do	18,	20 00
			<hr/>
			\$933 44
	By balance to new account,		512 47
			<hr/>
			\$1,445 91
			<hr/>

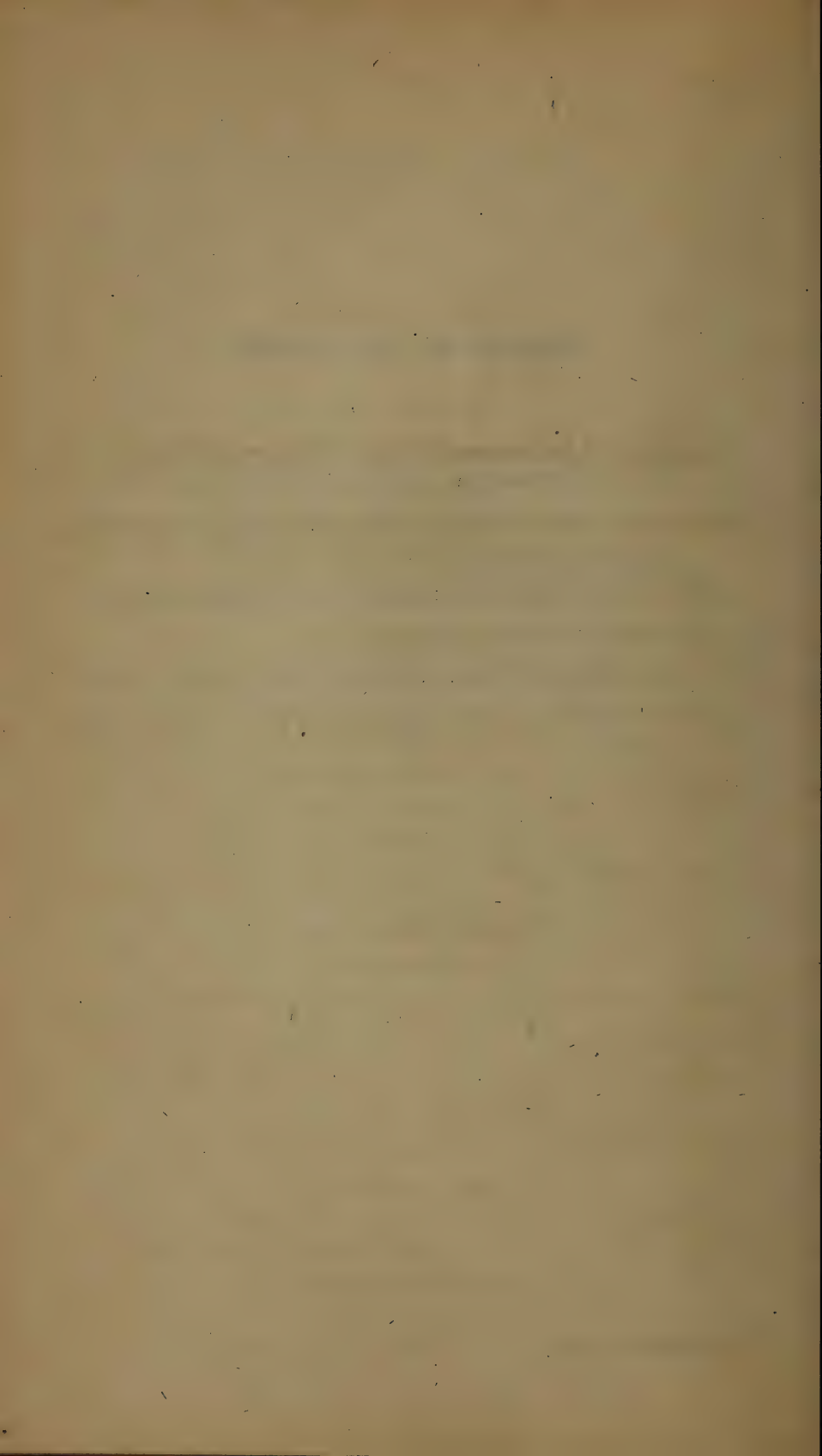
on behalf of the standing committee on the State Cabinet, I have examined the above account, and find it correct. The payments have been made by order of the standing committee, and are accompanied with proper vouchers.

E. D. MORGAN, *Chairman.*

March 26, 1860.

CONTENTS OF THE APPENDIX.

- A. Catalogue of the mammalia, birds, reptiles, and fishes, added to the State Cabinet from January 1, 1859, to January 1, 1860.
- B. List of Deficiencies in the mammalia, birds, reptiles and amphibia, inhabiting the State.
- C. Other additions to the Cabinet during the year, principally fossils.
- D. Catalogue of the Mazatlan mollusca.
- E. Ancient Monuments of Western New York. By T. APOLEON CHENEY.
- F. Contributions to the Paleontology of New York. By Prof. JAMES HALL.



APPENDIX.

(A.)

Catalogue of the Mammalia, Birds, Reptiles, and Fishes,

ADDED TO THE

STATE CABINET OF NATURAL HISTORY, FROM JANUARY
1, 1859, to JANUARY 1, 1860.

MAMMALIA.

ORDER CARNIVORA.

FAMILY VESPERTILIONIDÆ.

VESPERTILIO SUBULATUS, *Little Brown Bat* (male).

FAMILY MUSTELIDÆ.

PUTORIUS NOVEBORACENSIS, *New-York Ermine* (female and young).

ORDER RODENTIA.

FAMILY SCIURIDÆ.

SCIURUS VULPINUS, *Fox Squirrel* (albino, male).
SCIURUS NIGER, *Black Squirrel*.
SCIURUS NIGER, *Black Squirrel* (albino, pied, male).
SCIURUS LEUCOTIS, *Grey Squirrel* (albino, male).

FAMILY MURIDÆ.

ARVICOLA RUFESCENS, *Tawny Meadow-mouse* (albino).

FAMILY LEPORIDÆ.

LEPUS NANUS, *American Gray Rabbit* (male & fem.).
LEPUS AMERICANUS, *Northern Hare* (male and female).

ORDER UNGULATA.

FAMILY CERVIDÆ.

CERVUS VIRGINIANUS, *American Deer* (male).

BIRDS.

ORDER ACCIPITRES.

FAMILY FALCONIDÆ.

ASTUR FUSCUS,	<i>Slate-colored Hawk.</i>
ASTUR COOPERI	<i>Cooper's Hawk.</i>

FAMILY STRIGIDÆ.

BUBO VIRGINIANUS,	<i>Great-horned Owl.</i>
OTUS AMERICANUS,	<i>Long-eared Owl.</i>

ORDER PASSERES.

FAMILY CERCITIDÆ.

SITTA CAROLINENSIS,	<i>White-breasted Nuthatch.</i>
---------------------	---------------------------------

FAMILY MERULIDÆ.

ORPHEUS POLYGLOTTUS,	<i>Mockingbird.</i>
----------------------	---------------------

FAMILY SYLVICOLIDÆ.

TRICHAS PHILADELPHIA,	<i>Mourning Warbler.</i>
SYLVICOLA BLACKBURNIA,	<i>Blackburnian Warbler.</i>

FAMILY CORVIDÆ.

PICA CAUDATA,	<i>Magpie.</i>
---------------	----------------

FAMILY FRINGILLIDÆ.

COCCOBORUS CÆRULEUS,	<i>Blue Grosbeak (male and female).</i>
PLECTROPHANES NIVALIS,	<i>White Snowbird.</i>
PLECTROPHANES NIVALIS,	<i>White Snowbird.</i>
LOXIA AMERICANA,	<i>American Crossbill.</i>
LOXIA LEUCOPTERA,	<i>White-winged Crossbill.</i>

FAMILY PICIDÆ.

PICUS VILLOSUS,	<i>Hairy Woodpecker.</i>
PICUS ARCTICUS,	<i>Arctic Woodpecker.</i>

FAMILY CUCULIDÆ.

COCCYZUS AMERICANUS,	<i>Yellow-billed Cuckoo.</i>
----------------------	------------------------------

ORDER GALLINÆ.

FAMILY TETRAONIDÆ.

ORTYX VIRGINIANA,	<i>Quail.</i>
TETRAO UMBELLUS,	<i>Ruffed Grouse.</i>

ORDER GRALLÆ.

FAMILY SCOLOPACIDÆ.

- NUMENIUS HUDSONICUS, *Jack Curlew.*
 RUSTICOLA MINOR, *Woodcock.*

FAMILY RALLIDÆ.

- RALLUS ELEGANS, *Freshwater Meadow-hen.*

ORDER LOBIPEDES.

FAMILY PODICIPIDÆ.

- FULICA AMERICANA, *American Coot.*

ORDER NATATORES.

FAMILY COLYMBIDÆ.

- COLYMBUS GLACIALIS, *Great Loon, or Diver.*

FAMILY ANATIDÆ.

- FULIGULA ERYTHROCEPHALA, *Redhead.*
 FULIGULA MARILA, *Broadbill.*
 FULIGULA ALBEOLA, *Buffleheaded Duck.*
 FULIGULA CLANGULA, *Whistler.*
 FULIGULA AMERICANA, *Broadbilled Coot.*
 ANAS SPONSEA, *Wood Duck.*
 ANAS DISCORS, *Blue-winged Teal.*
 ANAS OBSCURA, *Black Duck.*
 ANAS AMERICANA, *American Widgeon.*

REPTILES.

ORDER TESTUDINATA.

FAMILY CHELONIDÆ.

- EMYS PALUSTRIS, *Saltwater Terrapin.*

ORDER OPHIDIA.

FAMILY COLUBERIDÆ.

- COLUBER VERNALIS, *Grass-snake.*
 TROPIDONOTUS DEKAYI, *Small Brown Snake.*
 TROPIDONOTUS TÆNIA, *Striped Snake.*

FISHES.

ORDER PECTINIBRANCHII.

FAMILY SALMONIDÆ.

SALMO FONTINALIS,

Brook Trout.

ORDER ELEUTHEROPOMI.

FAMILY STURIONIDÆ.

ACIPENSER BREVIROSTRIS,

Short-nosed Sturgeon.

(B.)

List of Deficiencies in the Mammalia, Birds, Reptiles and Amphibia, inhabiting the State.

MAMMALIA.

- | | |
|-----------------------------|-------------------------------------|
| 1. VESPERTILIO PRUINOSUS, | <i>Hoary Bat.</i> |
| 2. SOREX BREVICAUDUS, | <i>Short-tailed Shrew.</i> |
| 3. SOREX PARVUS, | <i>Small Shrew.</i> |
| 4. SOREX FOSTERI, | <i>Foster's Shrew.</i> |
| 5. SOREX CAROLINENSIS, | <i>Carolina Shrew.</i> |
| 6. OTISOREX PLATYRHINCUS, | <i>Broadnosed Shrew.</i> |
| 7. GULO LUSCUS, | <i>Wolverine.</i> |
| 8. MUSTELA MARTES, | <i>American Sable.</i> |
| 9. MUSTELA FUSCA, | <i>Brown Weasel.</i> |
| 10. STEMMATOPUS CRISTATUS, | <i>Hooded Seal.</i> |
| 11. MUS RATTUS, | <i>Black Rat.</i> |
| 12. ARVICOLA RIPARIUS, | <i>Marsh Meadow-mouse.</i> |
| 13. ARVICOLA ONEIDA, | <i>Oneida Meadow-mouse.</i> |
| 14. ARVICOLA ALBORUFESCENS, | <i>Light-colored Meadow-mouse.</i> |
| 15. ARVICOLA XANTHOGNATHUS, | <i>Yellow-cheeked Meadow-mouse.</i> |
| 16. RANGIFER TARANDUS, | <i>Reindeer.</i> |
-

BIRDS.

- | | |
|------------------------------|--------------------------------|
| 1. CATHARTES AURA, | <i>Turkey Buzzard.</i> |
| 2. NAUCLERUS FURCATUS, | <i>Swallow-tailed Hawk.</i> |
| 3. TROGLODYTES AMERICANUS, | <i>Wood Wren.</i> |
| 4. VERMIVORA SWAINSONI, | <i>Whistling Warbler.</i> |
| 5. VERMIVORA PEREGRINA, | <i>Tennessee Warbler.</i> |
| 6. SYLVICOLA PARUS, | <i>Hemlock Warbler.</i> |
| 7. MUSCICAPA FLAVIVENTRIS. | <i>Yellow-bellied Warbler.</i> |
| 8. GARRULUS CANADENSIS, | <i>Canada Jay.</i> |
| 9. EMBERIZA LINCOLNI, | <i>Blue-striped Bunting.</i> |
| 10. LINARIA ROREALIS, | <i>Mealy Redpoll.</i> |
| 11. PICUS HIRSUTUS, | <i>Banded Woodpecker.</i> |
| 12. ECTOPISTES CAROLINENSIS, | <i>Carolina Turtle-dove.</i> |

13. TRINGA CINCLUS,	<i>Black-breasted Sandpiper.</i>
14. PHALAROPUS FULICARIUS,	<i>Red Phalarope.</i>
15. HOLOPODIUS WILSONI,	<i>Wilson's Holopode.</i>
16. PHALACRACORAX CARBO,	<i>Cormorant.</i>
17. STERNA ARCTICA,	<i>Arctic Tern.</i>
18. STERNA CANTIACA,	<i>Sandwich Tern.</i>
19. STERNA DOUGALLII,	<i>Roseate Tern.</i>
20. LARUS SABINA,	<i>Fork-tailed Gull.</i>
21. LARUS TRIDACTYLUS,	<i>Kittiwake, or Three-toed Gull.</i>
22. LUTRIS BUFFONI,	<i>Arctic Hawk-gull.</i>
23. ANAS PENELOPE,	<i>European Widgeon.</i>
24. ANSER ALBIFRONS,	<i>White-fronted Goose.</i>
25. ANSER HUTCHINSI,	<i>Hutchins's Goose.</i>

REPTILES.

1. CHELONIA MYDAS,	<i>Green Turtle.</i>
2. SPHÆGIS CORIACEA,	<i>Leather Turtle.</i>
3. TRIONYX FEROX,	<i>Soft-shelled Turtle.</i>
4. EMYS RUBRIVENTRIS,	<i>Red-bellied Terrapin.</i>
5. EMYS MUHLENBERGII,	<i>Muhlenberg's Tortoise.</i>
6. EMYS GEOGRAPHICA,	<i>Geographic Tortoise.</i>
7. EMYS PSEUDOGEOGRAPHICA,	<i>Pseudogeographic Tortoise.</i>
8. KINOSTEMON PENNSYLVANICUM,	<i>Mud Tortoise.</i>
9. CISTUDA BLANDINGII,	<i>Blanding's Box-tortoise.</i>
10. SCINCUS FASCIATUS,	<i>Blue-tailed Skink.</i>
11. CLAMARIA AMÆNA,	<i>Red-snake.</i>
12. TRIGONOCEPHALUS CONTORTRIX,	<i>Copperhead.</i>

AMPHIBIA.

1. SCAPHIOPIUS SOLITARIUS,	<i>Hermit Spadefoot.</i>
2. HYLODES PICKERINGI,	<i>Pickering's Hylodes.</i>
3. HYLODES GRYLLUS,	<i>Cricket Hylodes.</i>
4. SALAMANDRA SALMONEA,	<i>Salmon-colored Salamander.</i>
5. SALAMANDRA FASCIATA,	<i>Blotched Salamander.</i>
6. SALAMANDRA LONGICAUDA,	<i>Long-tailed Salamander.</i>
7. SALAMANDRA BILINEATA,	<i>Striped-backed Salamander.</i>
8. SALAMANDRA COCCINEA,	<i>Scarlet Salamander.</i>
9. SALAMANDRA GLUTINOSA,	<i>Blue-spotted Salamander.</i>
10. TRITON TIGRINUS,	<i>Tiger Triton.</i>
11. MENOBRANCHUS LATERALIS,	<i>Banded Proteus.</i>
12. MENOPOMA ALLEGHANIENSIS,	<i>Allegany Hellbender.</i>

(C.)

ADDITIONS TO THE CABINET, PRINCIPALLY FOSSILS.

From Prof. E. F. B. ORTON, Albany.

FOSSILS from the Chemung group.

REMAINS OF FISHES, from Old Red sandstone.

From ROBERT HOWELL, Tioga County.

FOSSILS from the Chemung group.

INDIAN RELICS.

From LEDYARD LINCKLEAN, Cazenovia.

REMAINS OF FISHES, from Corniferous limestone.

From JOHN L. COON, Albany.

FOSSIL MOLLUSK, from Schenectady.

From Rev. S. H. CALHOUN, Syria.

FOSSIL FISHES, MOLLUSKS, ZOOPHITES, and CONES, of Cedars of Lebanon, from Mount Lebanon, Syria.

From WILLIAM DUNN, Utica.

SKELTON OF A PORCUPINE.

From BENJAMIN ALLEN, Utica.

SLATE OF PORTAGE ROCK, used for flag-stones, Covert, Seneca county.

BLOCK OF CORNIFEROUS LIMESTONE, Cassville, Oneida county.

From W. W. FROTHINGHAM, Albany.

COAL PLANTS, from Pennsylvania.

From HENRY A. GREEN, Mount Morris.

NATIVE ALUM, from the Portage slate rocks.

From HIRAM COLE, Albany.

A BANDED PROTEUS.

From GARRITT HARDICK, Waterford.

INDIAN ORNAMENT of stone, from Barry, Orleans county.

From the SMITHSONIAN INSTITUTION.

SKIN OF CYNOMIS LUDOCRIANUS, *Prairie Dog*, New Mexico.

" SCIURUS FOSSOR, *Great Ground Squirrel*, California.

" GEOMYS BURSARIUS, *Gopher*, Iowa.

" SPERMOPHYLUS 13-STRIATUS, *13-lined Squirrel*, California.

" SPERMOPHYLUS, *California Ground Squirrel*, California.

" HESPEROMYS LEUCOPUS, *Deer Mouse*, Massachusetts.

" SOREX DEKAYI, *Dekay's Shrew*, New York.

SKULL OF SOREX PLATYRHINCUS, *Eared Shrew*, New York.

" CASTOR CANADENSIS, *Beaver*.

From Miss HANNAH T. LAWRENCE, Bay Side, Long Island: By ROBERT TOWNSEND, Esq., Albany.

Seven specimens of GOLD-BEARING QUARTZ, from the mines of Colonel FREMONT, California.

UNIQUE FOSSIL, found by J. R. SIMS, in Plainfield, Otsego county, in 1836.

* METEORIC STONE. Bethlehem, Albany county.

From Prof. C. U. SHEPARD.

METEORIC IRON, from South Africa.

From B. P. JOHNSON, Albany.

NATIVE COPPER AND SILVER, from the Cliff mine, Lake Superior.

From J. P. BARNUM, Locke, N. Y.

CRINOID AND FOSSIL PLANT, Genesee slate, Moravia.

From JOHN STANTON GOULD, Esq., Hudson, N. Y.

AN INDIAN PESTLE, from a gravel pit twenty feet below the surface of the earth.

Deposited by Dr. F. B. HOUGH, of Albany.

COLPOCERAS VINGATUM, described by Prof. HALL, in Regents' Report for 1850.

* Found in the town of Bethlehem, seven miles below Albany. The finder was standing in the door of his house, between seven and eight o'clock in the morning of the 11th of August, 1859. Heard an explosion, which was loud, and which brought him to the door. Heard what he thought was a stone thrown against the house; saw this specimen fall and picked it up. The man is ignorant, but appears honest and truthful.

List of Geological and Mineralogical Specimens donated to the State Cabinet by T. Apoleon Cheney.

1. BLOCK, containing fossils: Locality, Cherry creek, N. Y. *Five specimens.*
 2. FOSSILS: Locality, Cherry creek, N. Y. *Five specimens.*
 3. CORALS: Locality, Cherry creek, N. Y. *Three specimens.*
 4. CONGLOMERATE formations: Locality, Elyria Falls, Ohio, and Cherry creek, N. Y. *Four specimens.*
 5. PLATYCERAS PLICATUM: Locality, Lexington, Ky. *One specimen.*
 6. LAPIS OLERIS: Locality, Leon, N. Y. *One specimen.*
 7. BLOCKS: Locality, Ohio. *Two specimens.*
 8. PETRIFIED MOSS: Locality, Sandusky, Ohio, (found crusting a large spring.) *One specimen.*
 9. CRYSTALIZATION: Locality, Mammoth cave, Ky. *One specimen.*
 10. ROCK: Locality, Georgia. *One specimen.*
 11. COPPER ORE: Locality, Lake Superior. *One specimen.*
 12. IRON ORE, ANTHRACITE COAL, &C.: Locality, Pennsylvania. *Three specimens.* Twenty-seven specimens in all. December 30, 1859.
-

DONATION FROM LOUIS CHENEY.

1. BLOCK, Chemung group, containing fossils. *One specimen.* January 20, 1860.
-

DONATION FROM JULIA E. CHENEY.

1. BARK-CLOTH, manufactured by the Indians. *One specimen.* January 20, 1860.

DONATIONS

*To the Historical and Antiquarian collections in the State Cabinet of
Natural History. From T. APOLEON CHENEY.*

1. ONE CRANIUM, nearly entire, from the entrenchment situated near Irving.
2. FRAGMENT OF CRANIUM, from same entrenchment, containing teeth.
3. FRAGMENTS OF CRANIA, from the Bone pits, Gerry. Nine specimens.
4. FRAGMENTS OF CRANIA, from the mound at Conewango. Two specimens.
5. FRAGMENTS OF THE OS FEMUR, superior and lower extremities, from the Conewango mound.
6. BONES,—femur, tibia, fibula, &c. Ten specimens. From the fortified enclosure and bone-pits, in Gerry.
7. ANCIENT POTTERY. Three specimens. From mounds, Cattaraugus Indian Reservation.
8. FRAGMENT OF AN AMULET, from Conewango mound.
9. FRAGMENT OF A TOMAHAWK, from Randolph mound.
10. ANCIENT SPADE OR PICKAXE, from enclosure near Randolph.
11. FISHING INSTRUMENTS. Two specimens.
12. STONE CHISELS, from various enclosures. Six specimens.
13. CORN-POUNDERS. Two specimens.
14. DISKS. Two specimens.
15. ROUND STONE BALLS. Two specimens.
16. FRAGMENTS OF PIPES. Two specimens.
17. OTHER ABORIGINAL RELICS, from various enclosures. Five specimens.
18. LARGE KNIFE OR SWORD, made in Canada, and used by the Indians in the Revolutionary war, and war of 1812. Obtained of JOHN SNIDER, Cattaraugus Reservation, Dec. 30, 1859.

(D.)

CATALOGUE

Of the Reigen Collection

OF

MAZATLAN MOLLUSCA,

PRESENTED TO THE STATE CABINET BY

PHILIP P. CARPENTER, Ph. D.,

OF WARRINGTON, ENGLAND;

BEING THE FIRST DUPLICATE OF THE COLLECTION PRESENTED
TO THE BRITISH MUSEUM.

1875

THE NEW YORK

LIBRARY

OF THE CITY OF NEW YORK

AND THE LIBRARY OF THE UNIVERSITY OF THE CITY OF NEW YORK

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EXTRACTS

From the Preface to the Descriptive Catalogue of the British Museum.

THE Collection, from which the shells described in the following pages have been carefully selected, was made at Mazatlan (*lat.* 23° N., *long.* 107° W.), during the years 1848 – 50, by a Belgian gentleman named FREDERICK REIGEN. The bulk of it was sent to Liverpool for sale in 1851, and circumstances enabled me to make a searching examination of it. Dr. GRAY having requested that the (comparatively) small selection which I had made for my own use should be deposited in the British Museum, I judged it conducive to the interests of science to obtain possession of the whole of the then-remaining stock, which was about to be dispersed; and to select as many specimens as might be required (1) to illustrate the local fauna of a known station at the mouth of the Gulf of California; and (2) to exhibit the amount of variation, whether great or little, observed in comparing together large numbers of individuals in the various species. The latter object appeared of no slight importance, especially for the sake of inland naturalists; who have usually to depend on the very limited number of specimens which are to be seen in public, still more so in private collections.

The series of shells here enumerated* is presented to the Trustees of the British Museum, and accepted by them, on the following conditions : (1) *That it be preserved separate and intact*, as a local collection; (2) *That it be always open to the use of students*, subject to the usual conditions; (3) *That the donor be allowed to arrange the collection in its permanent place of abode*; and (4) *That a Descriptive Catalogue of it be printed under the direction of the Trustees.*

The collection consists of about 8873 specimens (2505 Bivalves,

* The series presented to the New-York State Cabinet is an exact duplicate of that presented to the British Museum, and has been accepted on the same conditions, except the printing of the Descriptive Catalogue.

&c., and 6368 Univalves), mounted on 2529 glass tablets*. The number to the left refers to the *species*; that to the right, to the *tablet* in the Catalogue. Of the minute specimens, magnified sketches are given, drawn under the microscope with Chevallier's prism-disc. The principal part of the money required for the purchase of the shells has been generously and without solicitation provided by HERBERT THOMAS, esquire, of Bristol. For the remainder, and for all the work, from the first sorting and washing to the permanent allocation (including no inconsiderable share in the manual labor of printing), I am alone responsible.

The duty of writing the Catalogue was intrusted to me by Dr. GRAY. I was ill fitted for it, (1) by almost entire ignorance of conchological literature, and (2) by living in a country town, with extremely limited access to scientific books and collections. There did not appear, however, any competent naturalist who possessed the absolute essentials of time and full access to the Mazatlan materials. I therefore undertook the task, trusting that its acknowledged deficiencies might in some measure be compensated for by great patience and care in the faithful use of those means of information which were within my reach†. I have endeavoured to make it a

* The following are the advantages of this mode of preserving specimens, either in public or private collections : (1) Both sides of the shell can be seen, thus combining the advantages of mounting with those of leaving loose; (2) The drawers or cases can be lined with any coloured paper that happens best to display the particular series: very dark purple or black, glazed, will generally be found most suitable; (3) The tablets and shells can be cleaned as they stand, without remounting; (4) The tablets are extremely cheap, and can be rapidly cut to any required size. To write the names, white paint should be worked with a pestle in a little turpentine, till it is thin enough to pass through a fine steel pen. The strongest cement is common shell-lac dissolved in spirit; but the bleached liquid glue has a better appearance. The minute shells in the collection are cemented with canada balsam to strips of thin glass, which are fastened into the corks of test tubes.

† In the course of the inquiry, I have met with the greatest kindness from naturalists, most of whom were previously unknown to me, but to whom I applied for assistance. To HUGH CUMING, esquire, I am under extraordinary obligations for his singular urbanity, in allowing the unrestricted use of his invaluable collections, his library, and his original information to a complete stranger. Dr. A. A. GOULD, of Boston, U.S., intrusted to my care, and to the perils of the Atlantic, the whole of his collections and notes from the West American coast, for comparison with those known in this country. To Dr. GRAY and R. M'ANDREW, esquire, I am indebted for the long use of valuable works, and for advice and assistance throughout. Prof. Dr. DUNKER, of Marburg, gave me valuable aid in the Mytilidæ; J. D. GASKOIN, esquire, in the Cypræadæ and Columbelloidæ; L. REEVE, esquire, in the Patellidæ; W. CLARK, esquire, and W. BEAN, esquire, in the Cæcidæ; J. ALDER, esquire, in that family and in Jeffreysiadæ, and Miss STREE in the Olividæ. S. HANLEY, esquire, allowed me the use of his collection (representing the Havre division of M. REIGEN'S stores), and, along with R. D. DAREISHIRE, esquire, Dr. BAIRD, Messrs. H. & A. ADAMS, Rev. T. HINCKS, S. P. WOODWARD, esquire, and F. ARCHER, esquire, gave the benefit of critical judgment whenever solicited. I am also under great obligations to the officers of various public museums and libraries, for the kindness with which they have attended to my requests. One whose promised aid would have been of invaluable service, and whose friendly encouragement mainly induced me to undertake the work, was, at its commencement, suddenly removed from the field of labour which was opening before him with such promise in the Metropolitan University of Scotland.

companion to Prof. C. B. ADAMS's extremely valuable Catalogue of the Shells of Panama, which belong to the same great Tropical Fauna of Western America.

An estimate of the value of the Reigen Collection as a geographical authority, and a comparison of it with other neighbouring faunas, will be found in the "Report of the present state of our knowledge of the Mollusca of the West Coast of North America," presented to the British Association in September 1856, and published in its Transactions, pp. 159 *et seq.* The only account of the Shells of Mazatlan previously known, is Dr. MENKE's list of the species brought by Mr. H. MELCHERS, published in the *Zeitschrift für Malacozoologie*, 1847 - 51. An analysis of these is given in the Brit. Assoc. Reports, pp. 235 - 239.

The species of Bryozoa* (now first, I believe, included in a catalogue of Mollusca, although generally acknowledged by naturalists to belong to that Subkingdom), have been described by G. BUSK, esquire, with his usual kindness. The class is named as in Dr. W. B. CARPENTER's "Principles of Comparative Physiology, 1854." The name *Polyzoa* is believed to have precedence: but while the names of genera and species are *proper names*, and therefore ought to follow the law of priority, the arrangement of classes and orders is a matter of opinion; and it appears allowable to make use of those names, whenever given, which best express the leading characteristics of the division. For this reason, *Palliobranchiata* and *Lamellibranchiata* are used instead of the older names *Conchifera* and (or rather, including) *Brachiopoda*; *Proboscidifera*, for *Zoophaga*, &c. In the present case, when the names of a supposed order (of polypes) becomes entitled to rank as a class (of molluscs), and as such has to be learned in common schools, it appeared very important to select a name that could not easily be confounded with others of similar sound.

In the Bivalves, the order of Prof. E. FORBES, adopted by Mr. WOODWARD in his invaluable "Manual of the Mollusca," has been mainly followed; in the Univalves, that of Dr. GRAY, who obligingly lent me the proofsheets of his "Systematic Arrangement of the Mollusca," now passing through the press.

Having found considerable difficulty in the identification of species, when Lamarckian genera are retained without division, al-

* The Crustacea, Cirripedes, Annelids, Radiata, &c. found in the Reigen Collection, are deposited in the Warrington Museum; which has the honour of being the first Free Museum and Library established in the manufacturing districts. Duplicate series of the shells can be obtained through the Curator.

though now as numerous and diversified in recorded forms as were many of the Linnæan genera in the days of LAMARCK, I have freely adopted many of the generic names recently proposed, and have even, in some few cases, added to them. It is a matter of secondary importance, whether an accurately defined group takes rank as a mere section in a subgenus, or as a leading division in a family; but the binomial designation is much easier for reference, than that by sections. For ordinary purposes, it may be sufficient to cite the lower division, the genus (like the family, etc.) being implied. When the genus is required, it should have been always quoted, as it is in the later sheets, thus : (*Terebra*) *Myurella albocincta**.

In naming the genera and species, I have almost always followed (to the best of my knowledge) the law of priority, with the modifications authorized in the Brit. Assoc. Rep. 1842, pp. 109 *et seq.* In a few cases, however, in which different forms have been described as distinct species, which I have thought it necessary to unite, I have chosen that name (irrespective of priority) which represents the typical state of the species. By this means, those who are not satisfied with the union can keep the accustomed names for those forms which they regard as distinct, without adding to the confusion. Thus the name *Dione chionæa* of MENKE is chosen, being applicable to the whole species, of which *D. squalida* (SOWERBY), *D. biradiata* (GRAY), *D. chione* (SOWERBY, pars), and perhaps *D. elegans* (KOCH), had been previously described from peculiar forms.

To have dispensed with no fewer than 104 species constituted by naturalists of reputation (exclusive of synonyms), and at the same time burdened science with the names of 222 new ones, in a list numbering not quite 700 species, may seem extremely presumptuous in so inexperienced an author; as also may the opinions freely expressed on various recorded statements. But fresh sources of information must always be expected to modify judgments formed from insufficient materials; and, as a naturalist should desire truth above all things, and wish to save others the necessity of wading through the same labyrinth of errors from which he has with difficulty extricated himself, it appears a duty to lose no opportunity of correcting those statements in previous works which are liable to create confusion. The first person has been frequently used to show that the statement put forth is not necessarily a fact, but simply

* It would save much confusion, if those who divide genera would always make the subordinate names of the same gender with the original genus; also if authors, in describing new species in old genera, the modern divisions of which are not generally recognized, would avoid repeating a name already given in another of the sectional groups. *Vide* Brit. Assoc. Reports, *loc. cit.*

my interpretation of a fact; and for a similar reason I have freely employed the mark of uncertainty [?], which is to be understood as always referring to what *follows*, and not the word going before. Thus *Bulla ?nebulosa* (GOULD), signifies that it is uncertain whether the *Bulla* belongs to GOULD's species; while *?Alaba conica* signifies that the generic position of the species *conica* is doubtful.

As the proposed object was to exhibit all that was known of a local fauna, many species are described from more or less imperfect materials, which would not have been noticed if from a mixed collection. The same course is usually followed in describing fossils of any given formation, where objects are carefully noted that a mere collector of "good shells" would cast aside as worthless. There appears no reason for denying all knowledge of existing forms, merely because that knowledge is not as full as may be desired.

PHILIP P. CARPENTER.

Warrington : April 22, 1857.

CATALOGUE OF THE MAZATLAN MOLLUSCA.

CLASS BRYOZOA.

FAMILY MEMBRANIPORIDÆ.

- 1 Membranipora denticulata,
- 2 Membranipora góthica ;
- 3 Lepralia atrofusca,
- 4 Lepralia trispinosa,
- 5 Lepralia mazatlanica,
- 6 Lepralia rostrata,
- 7 Lepralia marginipora,
- 8 Lepralia hippocrepis,

- 9 Lepralia humilis,
- 10 Lepralia adpressa.

FAMILY CELLEPORIDÆ.

- 11 Cellepora papillæformis,
- 12 Cellepora cyclostoma.

FAMILY DISCOPORADÆ.

- 13 Defrancia intricata.

CLASS TUNICATA.

Omnia adhuc ignota.

CLASS PALLIOBRANCHIATA.

FAMILY DISCINIDÆ.

- 14 Discina cumingii.

CLASS LAMELLIBRANCHIATA.

FAMILY PHOLADIDÆ.

- 15 Pholadidea melanura,
- 16 Pholadidea ? curta ;
- 17 Parapholas calva,
- 18 Parapholas acuminata ;
- 19 Martesia intercalata ;
- 20 —————.

FAMILY GASTROCHÆNIDÆ.

- 21 Gastrochæna truncata,
- 22 Gastrochæna ovata.

FAMILY SAXICAVIDÆ.

- 23 Saxicava arctica.

FAMILY PETRICOLIDÆ.

- 24 Petricola robusta,
- 25 Petricola ventricosa,
- 26 Petricola ————— ;
- 27 Rupellaria lingua-felis,
- 28 Rupellaria exarata,
- 29 Rupellaria —————.

FAMILY CORBULIDÆ.

- 30 Corbula bicarinata,
- 31 Corbula biradiata,
- 32 Corbula pustulosa,
- 33 Corbula ? ovulata,
- 34 Corbula ————— ;
- 35 Sphænia fragilis.

FAMILY PANDORIDÆ.

- 36 Lyonsia picta.

FAMILY SOLECURTIDÆ.

- 37 Solecurtus affinis,
- 38 Solecurtus politus,
- 39 ? Solecurtus —————.

FAMILY TELLINIDÆ.

- 40 Semele flavescens,
- 41 Semele ? venusta ;
- 42 Cumingia lamellosa,
- 43 Cumingia trigonularis,
- 44 Cumingia californica,

- 45 *Cumingia* ————— ;
46 *Sanguinolaria miniata* ;
47 *Tellina rufescens*,
48 *Tellina broderipii*,
49 *Tellina* ? *mazatlanica*,
50 *Tellina dombei*,
51 *Tellina felix*,
52 *Tellina straminea*,
53 *Tellina donacilla*,
54 *Tellina punicea*,
55 *Tellina* ? *cumingii*,
56 *Tellina* ? *eburnea*,
57 ? *Tellina regularis*,
58 *Tellina lamellata*,
59 *Tellina* ? *puella*,
60 *Tellina* ? *delicatula*,
61 *Tellina brevirostris*,
62 *Tellina* ? *denticulata*,
63 *Tellina* ————— ,
64 *Tellina* ————— ;
65 *Tellidora burnettii* ;
66 *Strigilla* (*Tellina*) *carnaria*,
67 ? *Strigilla lenticulata* ;
68 ————— .

FAMILY DONACIDÆ.

- 69 *Iphigenia altior*,
70 *Iphigenia* ? *laevigata* ;
71 *Donax carinatus*,
72 *Donax rostratus*,
73 *Donax transversus*,
74 *Donax assimilis*,
75 *Donax puncto-striatus*,
75*b* *Donax puncto-striatus* *var.*
[*cælatus*,
76 *Donax conradi*,
77 *Donax navicula*.

FAMILY MACTRIDÆ.

- 78 *Maetra exoleta*,
79 *Maetra* (*Spissula*) *fragilis*,
80 *Maetra* (*Mulinia*) *angulata*;
81 *Gnathodon* (*Rangia*) *mendicus*.

FAMILY VENERIDÆ.

- 82 ? *Clementia gracillima* ;
83 *Trigona radiata*,
84 *Trigona humilis*,
85 *Trigona argentina*,
86 *Trigona* ? *crassatelloides*,
87 *Trigona planulata* ;
88 *Dosinia* ? *ponderosa*,
89 *Dosinia annæ*,
90 *Dosinia dunkeri* ;
91 *Cyclina subquadrata* ;

- 92 Dione aurantia,
93 Dione chionæa,
94 Dione rosea,
95 Dione lupinaria,
96 Dione ?vulnerata,
97 Dione ? brevispinosa,
98 Dione circinata,
99 Dione concinna ;
100 Cytherea petechialis ;
101 Venus (Chione) gnidia,
102 Venus (Chione) amathusia,
103 Venus (? Chione) ————,
104 Venus (? Chione) distans,
105 Venus (Chione) crenifera,
106 Venus (Chione) ? undatella,
107 Venus (Chione) columbiensis,
108 Venus (? Chione) ———— ;
109 Tapes histrionica,
110 Tapes grata,
111 Tapes squamosa ;
112 Anomalocardia subrugosa,
113 Anomalocardia subimbricata.

FAMILY ASTARTIDÆ.

- 114 *Circe margarita*,
115 ? *Circe subtrigona* ;
116 *Gouldia pacifica*,
117 *Gouldia varians* ;
118 *Cardita californica* ;
119 ? *Venericardia* _____ ;
120 ? *Trapezium* _____.

FAMILY CHAMIDÆ.

- 121 *Chama frondosa* var. *mexicana*,
121b *Chama* ?*frondosa* var. *fornicata*,
122 *Chama spinosa*,
123 *Chama* ?*exogyra*.

FAMILY CARDIADÆ.

- 124 *Cardium* (*Lævicardium*) *elatum*,
 125 *Cardium* *procerum*,
 126 *Cardium* ?*senticosum*,
 127 *Cardium* _____ (*a*),
 128 *Cardium* _____ (*b*),
 129 *Cardium* _____ (*c*),
 130 *Cardium* _____ (*d*),
 131 *Cardium* _____ (*e*),
 132 *Cardium* _____ (*f*),
 133 *Cardium* *alabastrum*,
 134 *Cardium* *graniferum*,
 135 ?*Cardium* _____ (*g*).

FAMILY LUCINIDÆ.

- 136 *Lucina* (*Codakia*) *tigerina*,
137 *Lucina* ? *punctata*,

CLASS PTEROPODA.

Omnia adhuc ignota.

CLASS GASTEROPODA.

FAMILY CYLICHNIDÆ.

- 221 *Cyllichna luticola* ;
 222 *Tornatina infrequens*,
 223 *Tornatina carinata*.

FAMILY BULLIDÆ.

- 224 *Bulla adamsi*,
 225 *Bulla* ? *nebulosa*,
 226 *Bulla* ? *quoyii*,
 227 *Bulla exarata*,
 228 *Bulla* ———— ;
 229 *Haminea cymbiformis*.

FAMILY TESTACELLIDÆ.

- 230 *Glandina albersi*,
 231 *Glandina turris*.

FAMILY HELICIDÆ.

- 232 *Orthalicus zebra*,
 233 *Orthalicus zieglerei*,
 234 *Orthalicus* ? *mexicanus*.

FAMILY AURICULIDÆ.

- 235 *Melampus olivaceus*.

FAMILY LIMNEIDÆ.

- 236 *Aplexa aurantia*,
 237 *Aplexa elata* :
 238 *Planorbis tumens*.

FAMILY SIPHONARIADÆ.

- 239 *Siphonaria lecanium*,
 240 *Siphonaria æquilirata*,
 241 *Siphonaria* ————.

FAMILY IANTHINIDÆ.

- 242 *Ianthina striulata*,
 242*b* *Ianthina striulata* *var. contorta*,
 243 *Ianthina decollata*.

FAMILY DENTALIADÆ.

- 244 *Dentalium liratum*,
 245 *Dentalium hyalinum*,
 246 *Dentalium corrugatum*,
 247 *Dentalium* ? *pretiosum*.

FAMILY CHITONIDÆ.

- 248 *Lophyrus articulatus*,
 249 *Lophyrus albolineatus*,

250 *Lophyrus striato-squamosus* ;251 ? *Tonicia forbesii* ;252 *Lepidopleurus sanguineus*,253 *Lepidopleurus clathratus*,254 *Lepidopleurus bullatus*,254*b* *Lepidopleurus bullatus* *var.*[*calciferus*,255 ? *Lepidopleurus macandrei*,256 ? *Lepidopleurus beanii* :257 *Chiton flavescens* ;258 *Acanthochites arragonites*.

FAMILY PATELLIDÆ.

259 *Patella mexicana*,260 *Patella pediculus*,261 *Patella discors* ;262 *Nacella* ————.

FAMILY ACMÆIDÆ.

263 *Acmaea mesoleuca*,264 *Acmaea fascicularis*,265 *Acmaea patina*,266 *Acmaea persona*,267 *Acmaea scabra*,268 *Acmaea mitella* ;269 *Scutellina navicelloides*.

FAMILY GADINIADÆ.

270 *Gadinia pentagoniostoma*.

FAMILY FISSURELLIDÆ.

271 *Fissurella virescens*,272 *Fissurella barbadensis*,273 *Fissurella rugosa*,274 *Fissurella nigrocincta*,275 *Fissurella* ————,276 *Fissurella alba*,277 *Fissurella peruviana*,278 *Fissurella spongiosa* ;279 *Glyphis inæqualis*,280 *Glyphis alta* ;281 *Rimula mazatlanica*.

FAMILY HALIOTIDÆ.

Nihil.

FAMILY TROCHIDÆ.

282 *Callopoma* (*Turbo*) *fluctuosum* ;283 *Phasianella perforata*,

283*b* Phasianella perforata var.

[striulatus,

284 Phasianella compta ;

285 Bankivia varians ;

286 Uvanilla (Imperator) olivacea,

287 Uvanilla inermis,

288 Uvanilla unguis ;

289 Trochus versicolor,

290 Trochus macandreae ;

291 Omphalius ? rugosus var.

[rufotinctus,

292 Omphalius viridulus,

293 Omphalius ligulatus,

294 Omphalius globulus ;

295 Vitrinella panamensis,

296 Vitrinella parva,

297 ? Vitrinella decussata,

298 Vitrinella monile,

299 Vitrinella monilifera,

300 Vitrinella lirulata,

301 Vitrinella subquadrata,

302 Vitrinella biflata,

303 Vitrinella bifrontia,

304 Vitrinella perparva var. nodosa,

305 Vitrinella exigua,

306 Vitrinella coronata,

307 ? Vitrinella annulata,

308 Vitrinella cineta,

309 Vitrinella carinulata,

310 ? Vitrinella naticoides,

311 ? Vitrinella planospirata,

312 ? Vitrinella orbis ;

313 ? Liotia carinata,

314 ? Liotia striulata,

315 ? Liotia c-b-adamsii,

316 ? Liotia ——— ;

317 ? Globulus tumens ;

318 Ethalia pyrallosa,

319 Ethalia lirulata,

320 Ethalia pallidula,

321 Ethalia carinata,

322 Ethalia amplexans ;

323 Teinostoma amplexans,

324 Teinostoma substriatum ;

325 Trochus ———.

FAMILY NERITIDÆ.

326 Nerita scabricosta,

327 Nerita bernhardi ;

328 Neritina cassiculum,

329 Neritina picta.

FAMILY VANICORIDÆ.

330 Vanicoro cryptophila.

FAMILY CALYPRÆIDÆ.

331 Trochita ventricosa ;

332 Galerus conicus,

333 Galerus mamillaris ;

334 Crepidula aculeata,

335 Crepidula dilatata,

336 Crepidula ? dorsata var. bilobata,

337 Crepidula excavata,

338 Crepidula adunca,

339 Crepidula incurva,

340 Crepidula onyx,

341 Crepidula nivea,

342 Crepidula ? unguiformis ;

343 Crucibulum imbricatum,

344 Crucibulum spinosum ;

345 Calyptrea cepacea.

FAMILY CAPULIDÆ.

346 Hipponyx serratus,

347 Hipponyx antiquatus,

348 Hipponyx planatus,

349 Hipponyx barbatus,

350 Hipponyx (Amalthea) grayanus ;

351 Capulus ———.

FAMILY VERMETIDÆ.

352 Aletes centiquadrus,

352*b* Aletes centiquadrus var.

[imbricatus,

353 Aletes margaritarum ;

354 Vermetus eburneus ;

355 ? Bivonia contorta,

355*b* ? Bivonia ? contorta var.

[indentata,

356 ? Bivonia albida,

357 ? Bivonia ——— (a),

358 ? Bivonia ——— (b) ;

359 Petaloconchus macrophragma.

FAMILY CÆCIDÆ.

360 Cæcum insculptum,

361 Cæcum subspirale,

362 Cæcum abnormale,

363 Cæcum obtusum,

364 Cæcum liratocinctum,

365 Cæcum heptagonum,

366 Cæcum elongatum,

367 Cæcum subimpressum,

368 Cæcum firmatum,

369 Cæcum clathratum,

370 Cæcum quadratum,

371 Cæcum undatum,

372 Cæcum læve,

373 Cæcum farcimen,

374 Cæcum glabriforme,

- 375 Cæcum corrugulatum,
376 Cæcum dextroversum,
377 Cæcum reversum,
378 Cæcum teres.

FAMILY TURRITELLIDÆ.

- 379 *Turritella goniostoma*,
380 *Turritella tigrina*.

FAMILY CERITHIADÆ.

- 381 *Cerithium maculosum*,
382 *Cerithium* ? *famelicum*,
383 *Cerithium* ? *uncinatum*,
384 *Cerithium* ——— (a),
385 *Cerithium alboliratum*,
386 *Cerithium* ——— (b),
387 *Cerithium stercus-muscarum*,
388 *Cerithium interruptum* ;
389 *Vertagus gemmatus*,
390 *Vertagus* ——— ;
391 *Triforis alternatus*,
392 *Triforis inconspicuus*,
393 *Triforis* ? *infrequens* ;
394 *Cerithidea montagnei*,
395 *Cerithidea* ? *varicosa var.*
[mazatlanica.]

FAMILY LITORINIDÆ.

- 396 *Litorina conspersa*,
397 *Litorina aspera*,
398 *Litorina philippii*,
399 *Litorina* ————,
400 *Litorina fasciata* ;
401 *Modulus catenulatus*,
402 *Modulus* ————,
403 *Modulus disculus* ;
404 *Fossarus tuberosus*,
405 *Fossarus angulatus* ;
406 *Isapis maculosa*,
407 ? *Isapis* ————.

FAMILY RISSOIDÆ.

- 408 *Rissoina stricta*,
409 *Rissoina* ————,
410 *Rissoina woodwardii*;
411 *Barleeia lirata*;
412 ? *Alvania excurvata*,
413 *Alvania effusa*,
414 *Alvania tumida*,
415 ? *Alvania* ————;
416 ? *Cingula* ————;
417 *Hydrobia ulvæ*,
418 ? *Hydrobia* ————.

FAMILY JEFFREYSIADÆ.

- 419
- Jeffreysia bifasciata*
- .

[Senate, No. 89.]

- 420 ? *Jeffreysia alderi*,
421 *Jeffreysia tumens*,
422 ? *Jeffreysia* —————

FAMILY TRUNCATELLIDÆ.

- 423 ? Truncatella ———.

FAMILY PLANAXIDÆ.

- 424 *Planaxis nigritella* ;
425 *Alaba supralirata*,
426 *Alaba violacea*,
427 *Alaba terebralis*,
428 *Alaba alabastrites*,
429 *Alaba scalata*,
430 ? *Alaba conica*,
431 ? *Alaba mutans*,
432 ? *Alaba lagundula*,
433 ? *Alaba* ————— (a),
434 ? *Alaba* ————— (b).

FAMILY OVULIDÆ.

- 435 *Ovula variabilis*.

FAMILY CYPRÆIDÆ.

- 436 *Cypræa exanthema* ;
437 *Luponia* ? *spurca* ;
438 *Aricia arabicula* ;
439 *Trivia pustulata*,
440 *Trivia radians*,
441 *Trivia solandri*,
442 *Trivia sanguinea*,
443 *Trivia pulla*,
444 *Trivia subrostrata*.

FAMILY CANCELLARIADÆ.

- 445 *Cancellaria urceolata*,
446 *Cancellaria goniostoma*.

FAMILY STROMBIDÆ.

- 447 *Strombus galeatus*,
448 *Strombus granulatus*,
449 *Strombus gracilior*.

FAMILY TEREBRIDÆ.

- 450 *Myurella albocincta*,
451 *Myurella hindsii*,
452 *Myurella subnodosa*,
453 *Myurella rufocinerea* ;
454 *Subula luetuosa* ;
455 *Euryta fulgurata*,
456 *Euryta aciculata*.

FAMILY PLEUROTOMIDÆ.

- 457 *Pleurotoma funiculata*,
458 *Pleurotoma maculosa*;
459 *Drillia incrassata*,

- 561 *Cerithiopsis convexa*,
562 *Cerithiopsis decussata*,
563 *Cerithiopsis assimilata*.

FAMILY SCALARIADÆ.

- 564 *Scalaria hexagona*,
565 *Scalaria suprastrata*,
566 *Scalaria* _____ (a),
567 *Scalaria* _____ (b),
568 *Scalaria raricostata*;
569 *Cirsotrema funiculata*.

FAMILY NATICIDÆ.

- 570 *Natica maroccana*,
571 *Natica* _____;
572 *Lunatia tenuilirata*,
573 *Lunatia* _____ (a),
574 *Lunatia* _____ (b),
575 *Lunatia* _____ (c);
576 *Polinices uber*.

FAMILY LAMELLARIADÆ.

- 577 *Lamellaria* _____ (a),
578 ? *Lamellaria* _____ (b).

FAMILY FICULIDÆ.

- 579 *Ficula ventricosa*.

FAMILY TRITONIDÆ.

- 580 Argobuccinum nodosum.

FAMILY. TURBINELLIDÆ.

- 581
- Turbinella caestus*
- .

FAMILY FASCIOLARIADÆ.

- 582 *Lathirus ceratus* ;
583 *Leucozonia cingulata* ;
584 *Fasciolaria princeps*.

SUBFAMILY MITRINÆ.

- 585 *Mitra lens* ;
586 *Strigatella tristis*.

FAMILY MARGINELLIDÆ.

- 587 *Marginella minor*,
588 *Marginella polita*,
589 *Marginella margaritula*.

FAMILY OLIVIDÆ.

- 590 *Oliva angulata*,
591 *Oliva melchersi*,
592 *Oliva intertincta*,
593 *Oliva* ? *venulata*,
594 *Oliva* *duclosi* ;
595 *Olivella undatella*.

- 596 *Olivella tergina*,
597 *Olivella anazera*,
598 *Olivella* ? *petiolita* *var.* *aureo-*
[*cincta*.

- 599 Olivella inconspicua,
600 Olivella dama, - - -
601 Olivella zonalis;
602 Agaronia testacea.

FAMILY PURPURIDÆ.

- 603 *Purpura patula*,
604 *Purpura columellaris*,
605 *Purpura muricata*,
606 *Purpura biserialis*,
607 *Purpura triserialis*,
608 *Purpura triangularis* ;
609 *Cuma kiosquiformis*,
610 *Cuma costata* ;
611 *Rhizocheilus nux* ;
612 *Vitularia salebrosa* ;
613 *Nitidaria cribraria*,
614 *Nitidella* ———.

FAMILY BUCCINIDÆ.

- 615 *Columbella major*,
616 *Columbella strombiformis*,
617 *Columbella fuscata*.
618 ? *Columbella cervinetta*,
618b ? *Columbella cervinetta var.*
[obsoleta ;
619 ? *Metula* _____ (a),
620 ? *Metula* _____ (b),
621 ? *Metula* _____ (c),
622 ? *Metula* _____ (d).

SUBFAMILY NASSINÆ.

- 623 *Nassa luteostoma*,
624 *Nassa tegula*,
624*b* *Nassa* ? *tegula* *var. nodulifera*,
625 *Nassa* (? *pagodus* *var.*) *acuta*,
626 *Nassa* ————— (*a*),
627 *Nassa* ————— (*b*),
628 *Nassa* ————— (*c*),
629 *Nassa* ————— (*d*),
630 *Nassa* ————— (*e*),
631 *Nassa* ? *gemma* *lusa*,
632 *Nasso* ? *versicolor*,
633 *Nassa* *crebristriata*,
634 *Nassa* ————— (*f*),
635 *Nassa* ————— (*g*),
636 *Nassa* ————— (*h*),
637 *Nassa* ————— (*i*).

FAMILY PYRULIDÆ.

- 638
- Pyrula patula*
- .

ILLUSTRATIONS

OF THE

ANCIENT MONUMENTS IN WESTERN NEW YORK,

T. APOLEON CHENEY,

DEL.

1859.

ILLUSTRATIONS

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ANCIENT MONUMENTS IN WESTERN NEW YORK

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NEW YORK

ERRATA TO ANCIENT MONUMENTS IN WESTERN NEW YORK.

Page 40—line 33, for *and* read or.

Page 40—line 40, for *Tuocalli* read Teocalli.

Page 41—line 9, for *Tea*-maize read Zea-maize.

Page 41—lines 41 and 42, for 'upon the other' read upon either flank.

Page 48—line 46, for *back* read beak.

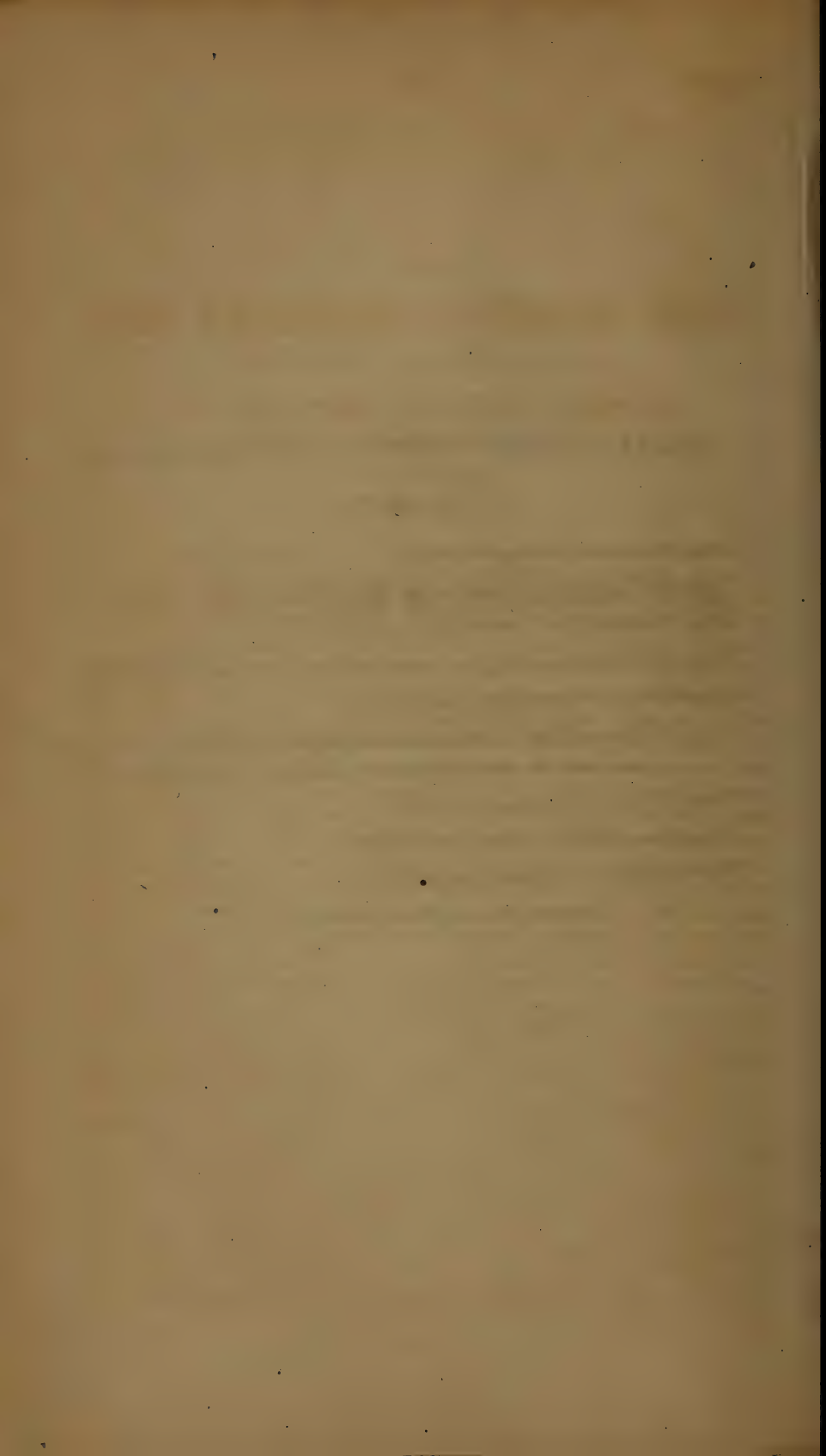
Page 51—lines 44 and 45, for *with numerous works which are said to exist*,
read with the fact that numerous works are reported to exist.

Page 52—line 1, for *these* read those.

Upon Plate VIII, for *Terry* read Gerry.

Upon the Map, for *Gowonda* read Gowanda.

do and for *Rutledge* read Rutledge.



(E.)

ANCIENT MONUMENTS IN WESTERN NEW YORK:

COMPRISING THE RESULTS OF EXPLORATIONS BY

T. APOLEON CHENEY, Civil Engineer, etc. 1859.

CHAPTER I.

INTRODUCTION.

THE Indian race, through an indefinite time, held undisputed empire over the continent. Now it has wasted away, and there is scarcely a region, save in the waning shadow of the western wilds, which they may call their own. Even there the Indian withers at the distant approach of civilization, and ere long his last footfall will die away. Another race, another empire now holds dominion.

Through the unknown centuries which marked the Aboriginal occupation of this hemisphere, there is not an annal to record the successive rise or fall of dynasties; but only the monuments, now crumbling in ruin, and dim in the twilight of ages long gone, to recall some vague and uncertain knowledge of their builders, to show their former status, or attest their former power. This subject, however, in the important connection which it holds in Archæological, as well as in Ethnological science, has called forth much investigation. Jefferson referred to these remains of ancient occupancy, in his "Notes;" extensive examinations of earthworks have been noticed in Silliman's Journal, in *Archæologia Americana*, &c.; and within a few years, Messrs. Squier and Davis have pursued their elaborate survey of the monuments of the Mississippi valley,—Messrs. Lapham and Whittlesey, respectively, have been engaged in interesting explorations,—while Schoolcraft has elaborately traced the history of the Indian race. In the State of New York, as early as 1817, De Witt Clinton, made examinations of various ancient works. Within a recent period, E. G. Squier has successfully pursued an extensive exploration of its aboriginal monuments; and the results of other surveys of earthworks in various sections of the State have been published in "Reports on the State Cabinet."

The section of Western New York bordering upon the waters of Lake Erie, only remained unexplored—though the opinion had formerly been entertained that no traces of ancient occupancy occurred upon the first and second terraces extending from the lake; and, as this formed intermediate ground between the territory of the Five Nations, or Iroquois confederacy, and that of the hostile Appalachian groups, it seemed reasonable to suppose that here would occur vestiges of military art in its most advanced state, as developed by Indian warfare, and interesting monumental remains,—the blending types of savage life,—not, indeed, like the pictorial mounds of the west, or the imposing temples reared by the Toltec and Aztec, in the sunny south,—but which would still add some contributions to our Archæological structure.

With the object of recovering some trace of these vestiges of the past—though but some shadowy outline of its history could be thus presented—I was induced to commence and pursue my humble labors, under the pressure of more than ordinary difficulties.

I have received encouragement in this survey from the Smithsonian Institution, the American Antiquarian Society, the Am. Ethnological Society, &c. My thanks are also due to Messrs. J. E. Weeden, D. J. Pratt, S. L. Ward, S. B. Elsworth, W. W. Henderson, and Nathaniel T. Strong, for information, assistance in surveys, &c.; and for the principal portion of the drawings of the relics, I have been indebted to Mrs. H. Fairbank, and Miss L. B. Brown.

CHAPTER II.

EARTHWORKS, MOUNDS, ETC.

The first earthwork embraced in this survey, (Plate 1, No. 1,) was perhaps among the latest erected to mark the ancient occupancy of the Aborigines; it also appears to form a connecting link with the era of civilization. It is situated upon the north bank of Cattaraugus creek, about a mile and a half from the village of Irving. The valley here forms a wide and beautiful expanse, the hills rising in shadowy outline upon either side, as if uncertain where to limit their boundaries, and the creek, a shallow but broad stream, glides away to mingle with the waters of Erie—which blend in their distant view with the over-arching skies and become lost in the far horizon. The work has all the appearance of ancient date, and consists of an embankment and trench of irregular form, with salient angles intersecting at each extremity with the banks of the creek. The wall has now become nearly obliterated; it was formerly some three feet in height, and can yet be distinctly traced, measuring about seventeen rods in length; from the course which the creek here assumes, the area embraced is some three-quarters of an acre. The principal interest, however, which attaches to this work, arises from the peculiar remains which have been observed within the inclosure. Numerous crania have here been exhumed, which were lying promiscuously as they may have fallen in battle. These cranial bones have been decided, from their physiological character, to have belonged both to the White and Red races: they were, on the whole, in a better state of preservation than those which elsewhere occur in the ancient works of this section. I received information that in one of the bones of the cervical vertebrae attached to a skeleton—I think from the description in the *Axis*—a leaden bullet or ball had been discovered to be imbedded. These facts show that an engagement had taken place upon this ground, in which representatives of the European race and the Aborigines, participated. No record of its history *here* remains, but only the silence of oblivion.

A group of interesting tumuli (Plate 1, No. 2) are also situated upon the north side of the Cattaraugus creek, within the limits of the Indian reservation. The first of these mounds occurs at the extreme point of a ridge, or rather terrace, which has an abrupt elevation of some fifteen feet, and then gradually ascends to the upper woods beyond, extending in either direction from the work in a semi-circular, picturesque form. This mound is of an oblong shape, fifteen feet in altitude, with a diameter near the apex, fifty-four feet in length by thirty-six in breadth. The tumulus is only separated from the crescent-shaped ridge by a narrow gorge, from

which it may reasonably be supposed the earth was removed in supplying material for the artificial mound. Still further back, some seventy-two rods, is situated another mound of circular form; it has an elevation of sixteen feet, with a diameter of forty-five feet. These tumuli, yet in possession of the Indian race, and overlooking their native forests and streams, appear to have once been the vast receptacles of the dead; but the Red men here, say that their fathers had wished them to remain undisturbed, and I at least could not ruthlessly assail the purest and most holy feelings of the human bosom, cherished wherever civilized or savage life prevails, by any violation of the sacred spot where the remains of their venerated dead were mouldering back to dust; here shall they sleep within the honored Mausoleum, and their remembrance be perpetuated by their monuments—not like the sculptured marble, in its unchanging and majestic and beautiful forms, as wrought by the skill of the old masters—but the year will come to garland the proud tomb where slumber the nation's brave, with its emerald beauty.

“How sleep the brave who sink to rest,
With all their country's wishes blest—
While Spring, with dewy fingers cold,
Returns to deck the hallow'd mould.”

Several miles still farther up this creek, which should be called a river, we find another sepulchral mound, (Plate 1, No. 3.) The valley at this point assumes an appearance not unlike that of the storied Rhine, with “its castled crags;” the waters of the creek hurry over the *falls* at a distance of a mile and a half above, murmuring swiftly by, and again are lost in the dim woods; while the majestic hills, in their sylvan loveliness and light, rising boldly upon the north, the east and the south, form an amphitheater. The tumulus is circular in form, one hundred and twenty feet in circumference, with an elevation of ten feet. Crania and other bones have been disclosed, upon slight examination, and large trees formerly grew upon the apex of the mound. Within a few rods, and located near the bed of a small creek, is an excavation of somewhat different shape, but nearly of the same dimensions of the mound. The tumuli which have now been mentioned, are all situated within the limits of Erie county, upon the Indian reservation. They all appear to be composed of distinct strata-layers, intermixed with charred remains, which had been owing, according to the Indian tradition, to the rites or ceremonies which prevailed—the sacred fires which were required to be kept burning over the dead interred within the orbicular tomb.

“’Tis said the form is now, as erst of old—
And the true reason may be well approved:
Vesta and earth are one. A ceaseless fire
Burns in them both, and both alike pervades.”

An ancient work (plate II, No. 1,) occupies the lofty promontory formed by the junction of a small stream with the Cattaraugus creek, upon the Indian Reservation, in the extreme north-western portion of Cattaraugus county. The view here presented, in its mingled beauty and sublimity, is one of the boldest and most romantic which well could be imagined; no situation could have been more admirably chosen for purposes of defense; it must, indeed, in the rude mode of Indian warfare, have been impregnable. The wall which intersects the rocky and precipitous shores of either creek, is twenty-four rods in length, and nearly four feet in height, and together with the wide trench, forms a complete barrier in the only direction from which an enemy would approach. Within the enclosure, guarded by parapet and natural mural escarpment, various implements of aboriginal military art have been found. The area embraced by this fortification, is still densely covered by the luxuriant wild-woods.

The remains of an extensive fortification had formerly been observed several miles farther up the creek, but the embankment can not now be easily traced.

In the township of Leon, lot 49, occur three remarkable excavations, rectangular in form; one of them has a circumference of a hundred and twelve rods, and an elevation from the interior surface of some twenty feet, and nearly in the centre there is a well or reservoir, in form of a semi-circle, ten feet across, by about six in depth. Similar depressions are elsewhere observed, and are believed to owe their peculiar formation to the drift. The principal fact which would indicate that these had been secondarily adopted by the Indians for security or defense, is furnished by the numerous remains of ancient art and workmanship, traces of fire-places, &c., which have been discovered here. Traces of ancient cultivation also yet remained.

The ancient work (plate II., No. 2,) is situated upon the low grounds bordering upon Elm creek, and the valley is flanked upon either side by a long range of hills. The work consists of an embankment and trench, of circular form, two hundred and eighty-seven feet in diameter. The wall is three feet in height, with ditch, two and one-half feet in depth; and upon the north-eastern side of the work, occurs a well-defined gateway, twelve feet in width, with bastions to guard the entrance. The unbroken forest still extends over the ground occupied by this ancient inclosure; the pine, *Pinus rigida*, *P. strobus*, and *P. balsamea* cast their shade, and the wild-flower blooms above its mouldering parapet. Traces of wind-falls, upon which large trees have grown, may be observed within the trench and upon the ancient wall; these successive growths of timber, at least, indicate a remote date to the construction of this work. Numerous *caches* have been observed here, containing remains of charred corn. This fortification being located in a central position of the valley, which is here some half a mile in width, its adaptation as a work for purposes of defense, is presented in the proximity of marshy lands, which might, to a considerable extent, interfere with the approach of hostile forces.

The Tumulus, represented upon plate III., from the peculiar construction of the work, and the character of its remains, appears to belong to a class of mounds different from any others embraced in this exploration. It is located upon the brow of a hill, still covered by the ancient forest, and overlooking the valley of the Cone-wango. This work has some appearance of being constructed with the ditch and vallum outside of the mound, as in the Druid Barrows, but perhaps more accurately belongs to the class composed of several stages, as the Trocalli of the valley of Anahuac. The form of the Tumulus is of intermediate character between an ellipse and the parallelogram; the interior mound, at its base, has a major axis of sixty-five feet, while the minor axis is sixty-one feet, with an altitude above the *first* platform or embankment of ten feet, or an entire elevation of some thirteen feet. This embankment, with an entrance or gateway upon the east side thirty feet in width, has an entire circumference of one hundred and seventy feet. As previously remarked, the work itself, as well as the eminence which it commands, and the ravines upon either side, are overshadowed by the dense forest. The remains of a fallen tree, imbedded in the surface of the mound and nearly decomposed, and which, from appearance, had grown upon the apex, measured nearly three feet in diameter, and heavy timber was growing above the rich mold it had formed. Thus we have some indicia of the age of this work. The mound, indeed, from the peculiar form of its construction, as well as from the character of its contents, has much resemblance to the Barrows of the earliest Celtic origin, in the Old World. In making an excavation, eight skeletons, buried in a sitting posture,

and at regular intervals of space, so as to form a circle within the mound, disinterred. Some slight appearance yet existed, to show that frame-work had enclosed the dead at the time of interment. These osteological remains were very large size, but were so much decomposed that they *mostly* crumbled to dust. The relics of art here disclosed, were also of a peculiar and interesting character,—amulets, chisels, &c., of elaborate workmanship,—resembling the Mexican and Peruvian antiquities.

The fields adjoining this work, at the period of the early settlement of this section, retained the trace of ancient cultivation; the Tea-maize and several other species of grain-shrubbery, were growing in wild luxuriance.

Vestiges of a series of ancient works are remaining in the section of the Conewango valley, where the waters of various tributaries unite in forming the Conewango, while lofty ranges of hills, clad with the luxuriant wild-woods, amid which nestle green and sunny slopes, rise upon the north, the east, the south, and the west, in their majestic grandeur, and still farther to the south are seen the hazy outlines of the distant Alleghanies. Plate IV.

The first work in this interesting group—situated upon low ground, with creeks upon either side—appears to have been constructed with geometrical accuracy. It forms a circle 1,000 feet in circumference; four gateways, each twelve feet in width, occur at equal distances in the wall, with slight bastions at the terminating points, to the north, the east, the south, and the west. The parapet has now an elevation of some two feet above the interior surface, and is perhaps six feet in width, with trench three and a half feet in depth. The work, however, has undoubtedly been much effaced, by long cultivation of the field where it is situated. The idea is suggested that this fortification was thrown up for purposes of attacking the entrenched position occupying the west bank of the creek. A *defensive* work would not have been erected in such a position, as it could afford no protection, even though guarded by palisades, against the showers of arrows with which an opposing force that might occupy the heights to the east, could sweep the entire work. Several rods in a northwestern direction from the fortification, are noticed remains of an ancient hearth, composed of flat stones cemented together; it is eight feet in diameter, and extends about a foot below the surrounding surface.

The entrenched work already referred to, upon the west side of the Conewango creek, consisting of a detached parallel sixty rods in length, extending across the level terrace, intersecting at each terminus with streams which were here bordered by impassable marshes. This redout, in its dimensions and manner of construction, must have been one of the strongest military works left by the Aborigines in Western New York. The position here chosen, as a defensive work, indeed, evinces much strategical skill; the inclosure, which is something in the form of a parallelogram, with the Conewango forming the boundary upon one side, and the inaccessible marshes bordering upon the creeks with which the wall intersected upon the other, constituted a complete barrier to successful attack. Connected with this work, numerous *caches* have been observed—thirty-two were at one time distinctly traced—and which would have been sufficient to contain the stores of a large force, even during a protracted siege.

In a western direction from the fortification just described, and at a distance of nearly forty rods, occurs a Tumulus. It has an altitude of ten feet, with a diameter of thirty-five feet. Within this mound were the remains of cranial and other bones, a plate of mica, and other interesting relics of ancient art.

A number of rods from the mound, and near a small stream, are found three
[Senate, No. 89.] 6

forms or hearths, consisting of boulder rock, which were burned and black, and extended some two feet below the surface; they were of circular form—the larger one thirty feet in diameter, while the others were only eight feet across. Near this stream, had also been noticed several pits, which were some five feet in depth by four in width.

Some indication of the antiquity of this series of works is presented in the fact that trees of the largest class, the monarchs of the forest, were found growing upon the embankments and upon the mounds. The site occupied by these works, of varying character, once was undoubtedly the seat of a dense population—the theatre of ensanguined conflict, where the rival chiefs of these rude nations gained or lost supremacy.

The ancient fortification, represented upon plate V., is located amid “the palaces of Nature.” The position of the work is admirably adapted for defensive purposes; it occupies an eminence, which rising precipitously at an angle of eighty degrees, to an altitude of two hundred feet, commands a view of the surrounding hills, and of the majestic Allegany. To the east and west of the work, are rapid streams, which, taking their rise in the deep ravines to the south, nearly encircle this fortified eminence, and mingle their currents with the Red House creek, which glides by in the valley, and at a distance of a mile below forms a junction with the Allegany river. This work embraces the level area of the summit of the hill; the wall is three feet in height, and the ditch two feet in depth. It is of circular form, with exception of the straight line, one hundred feet in length, which occurs in the northern portion of the work, and measures one thousand and sixty feet in circumference. Nearly in the centre of the inclosure is a copious spring. The forest, overshadowing the ancient parapet and the steep hill-sides, is as dense as when the Indian warrior glided amid its aisles; but in the long intervening period since, lofty trees have grown upon the embankment and within the wide trench.

The remains of an ancient mound, situated several miles from the work last described, and upon the north side of Allegany river, can still be traced. It has an altitude of ten feet, with a diameter of thirty-nine feet. Within the mound, from the excavations which have been made, have been found several craniums, ornaments, and other articles of ancient workmanship. This work is surrounded by open woods; a tree some eleven feet in circumference had grown upon the summit of the tumulus, and directly beneath it, were exhumed the remains of a skeleton, although the bones were very much decayed.

An entrenched work, several miles below the mound last described, occupies a commanding position upon the east bank of the Allegany river. This work is circular, some three hundred feet in diameter, with parapet over four feet in height, and trench of corresponding dimensions. Within this inclosure have been observed interesting remains of art, and which indicate a higher civilization than any which elsewhere have come to my notice would denote.

The remains of ancient Indian workmanship, are extensively found throughout the entire Allegany valley; and several other earthworks, at some distance down the river, are reported to exist. All the monuments included in this survey, which are located in Cattaraugus county, have now been described.

The ancient work, plate VI., No. 1, appears to have been designed for a different purpose, and to belong to a different class of works from any previously examined. It is situated upon the first terrace, or gradual rise of hills from the waters of Clear creek; while further to the south the hills form a bolder outline, and upon

the opposite side of the creek loom in lofty ranges dimly away. This work is of elliptical form; the larger axis is two hundred and eighteen feet; the lesser axis one hundred and sixty-eight feet. The wall has an altitude above the anterior surface, of *nine* feet, and above the surface in the interior of the work, of only five feet; it is *thirty-two* feet in width. No appearance exists of any trench, either anterior or interior to the embankment; forming the only exception in this respect, it is believed, to the earthworks in Western New York. This work was undoubtedly a sacred enclosure, designed for religious and ceremonial purposes.

In a direction towards the creek from this inclosure, and at a distance of some seventy rods, was a stone mound, five feet in height by four feet across; the stones of which it was constructed must have been brought some distance, as none of similar size are found in the alluvial soil of the surrounding fields. Near this rude *Cromlech* have been found several curious remains of art. It is uncertain for what purpose this monument was erected; whether to mark the journeyings of the tribes, as the ancient *Thermulæ* or *Montjoyes* of the Middle Ages, or as a *cairn*, to denote the burial place of some noted personage.

Another work, (plate VI., No. 2,) forming nearly a true ellipse, occupies a lofty eminence amid the range of hills which rise precipitously, with narrow intervening terraces, upon the opposite bank of the creek from the inclosure last described. The direction of the ellipse, as well as its dimensions, appears to have been determined by the position which it occupied—the inclosure extending quite to the brow of the hill. The wall is three feet in height; the major axis is three hundred and twenty feet; the minor axis one hundred and seventy five feet. Two gateways, each six feet in width, can be traced in the embankment; one occupying a south-east position, the other upon the north, from which a narrow but level plateau extends several rods, and then widening into a broader area, but more uneven and broken, until it disappears in the open woods. Numerous remains of warlike implements, &c., have been noticed within the work. This fortification, now denominated the “Old Fort,” in regard both to its natural and artificial defenses, must have been almost impregnable in the ancient wars of the forest tribes.

Further up this creek, in the circuitous course it assumes, perhaps a mile and a half, occur two circular inclosures. They are only separated by a distance of some fifty-two rods. These works are nearly of equal dimensions—each being some six hundred and fifty feet in circumference. The embankments have become much obliterated, but can yet be distinctly traced. The *fosse* appears to have been located interior to the walls. The period when these works were erected must have been very remote; trees having a diameter of four and a half feet, were found growing upon its walls. Cranial bones, very much decomposed, have been disinterred at a depth of several feet below the surface, within the area inclosed. Both of these works were doubtless intended for ceremonial purposes—perhaps the mysterious worship of the Sun, of which their circular form is the symbol; and they will correctly come under the designation of Sacred Inclosures.

The ancient work represented in plate VII., occupies a rugged but picturesque eminence, which rises precipitously, with flanking terrace and mural escarpment of rock, to an elevation of a hundred and twenty-five feet, and in the bold outline which it presents, suggests to the imagination some half-decayed castle of the Feudal ages, with its indistinct and crumbling walls, crowned by overhanging parapet, and frowning buttress and turret—the ruins of an olden fortress, once held by chivalric knight, with his band of mailed retainers. Lesser hills, separated from this by deep ravines, rise upon either side. The entrenched work is in the

form of a parallelogram—six hundred and twenty-seven feet in length, by two hundred and ninety in width. The redout, constituting the line of defense across the isthmus which connects the summit of the hill with the plateau extending in a southern direction, has an elevation of some four feet, by five feet in width—with moat three feet in depth; the walls bordering upon the precipitous ravines are three feet in height, gradually assuming less elevation until reaching the northern side of the work, where the parapet, crowning the lofty brow of the hill, is only two feet above the interior surface. In a central position of the wall upon the southern side of the work, a wide gateway occurs, with elevated mounds upon each side, to guard the entrance. This enclosure possesses additional interest, arising from the numerous remains of art and implements of ancient warfare, which have been observed here; it was estimated that many bushels of these relics had been removed from the ground. Along the buttress extending upon the northern side of the hill, were vast masses of stones, which had been thus accumulated, undoubtedly for the purpose of projecting upon an approaching foe. I noticed upon a rock, which occurs nearly in the center of the inclosure, a block of blue granite from which a chisel was partially wrought, and probably just as it had been left by its rude artisan. Throughout the area embraced by this entrenchment, the plow had thrown up immense quantities of human bones; a more luxuriant vegetation, and a deeper verdure, still marks the ground where the tide of combat once rolled. The green woods now border the pleasant hill-side in quiet beauty; all is still save the faint murmur of the distant stream; the brave warrior has long since gone, and his war-whoop died away among the hills and in the dim retreats of these lonely glens.

Still further up this valley, about a mile and a half, occur two other works, situated upon opposite banks of the creek, and separated by a distance of some fifty-six rods.

One of these works appears to have been projected upon the same principles of military art, as the entrenched hill previously described. It occupies a peninsular eminence, which rises to an altitude of seventy-five feet; the waters of the stream which glides in the valley below, half encircle the hill, and its steep declivity, and the ravines upon either side, are covered by the forest and a luxuriant shrubbery; while upon the opposite side, to the east and the west, the green slopes of lesser hills, complete the picturesque view here presented. This work is in the general outline of a parallelogram, approaching to a rectangular form; the angles, however, are rounded upon a radius of about sixty feet. The parapet is now about three feet in height by four in width, and the vallum upon the southern line of fortification, is some three feet in depth. There exist some indications that bastions or towers had been erected upon the wall at its several angles, and also upon either side of the gateway, which occurs in the southern portion of the embankment. It embraces one acre and sixty-seven hundredths.

The other work is of circular form—some eight hundred feet in circumference; the embankment has an elevation of two feet, with ditch of corresponding dimensions. Various remains of ancient workmanship have been disclosed here.

The interesting work (plate VIII., No. 1,) is located upon a plateau which here has an altitude of a hundred and fifty feet above the level of the Cassadaga valley. The entrenched work forms an *enceinte* embankment, four hundred and ninety-five feet in circumference, having a *vertical* elevation of some four feet, with a wide ditch, two feet in depth. In the north-eastern section of the wall is a gateway, ten feet in width, and from which an old Indian trail, still quite visible, leads to the

small stream which flows through a ravine, which lies near by. In a central position of this inclosure, occurs a cauldron-shaped pit, fifteen feet in diameter, by eight feet in depth. The forest extends over this work—and trees, *Betula papyracea*, *Acer saccharinum*, *F. ferruginea*, several feet in diameter, were growing within the pit, and upon the ancient redout.

The vestiges of aboriginal occupancy, of which some outline is given, (plate VIII., No. 2,) are, in several respects, among the most interesting embraced in this exploration. The fortification is situated upon an eminence, or rather, range of hills, at a distance from the Cassadaga creek of some hundred and sixty rods; while only about thirteen rods, in a southern direction from the work, another stream flows by. The embankment is three feet in height, with trench, some two feet in depth; a portion of this work lies in the woods. Within this inclosure, and particularly near the circumvallations, numerous skeletons have been disclosed; they were buried in a horizontal position. In the north-eastern section of the work occurs an entrance or gateway, from which a well defined Indian trail leads to an ancient cemetery, situated at a distance of fifty rods from the fortification. These Indian graves—formerly three in number, but only two of which can now be found—are of rectangular form, some nine feet in diameter, with the surface of the pits depressed about a foot below the level of the surrounding field. These vaults were excavated, nearly forty years since, and it was variously estimated that from thirty to sixty skeletons were exhumed from each pit; they were buried in a sitting posture. These remains were of large size; one of the skeletons measured seven feet and five inches in length. Detached portions of crania disclosed here, which have come to my notice, are of unusual thickness. Thickness at superciliary ridges, one inch; and of the occipital bone at occipital protuberance, half an inch. It is known that a custom prevailed among the aborigines, of gathering their dead at stated intervals, and burying within their cemeteries; but here were evidences to denote that a sanguinary battle had once ensued. Within the redout, and in area surrounding its entrenchments, vast numbers of warlike implements have been observed; it was estimated that several bushels of arrow heads had been found here. Several very large *caches* also occur in the neighborhood of these works.

The most extensive work included in this survey—and perhaps the most extensive within the State—is represented upon plate IX. The redout is one hundred rods in length, and extends, in a slightly curved line, from the brow of lofty and precipitous bluffs, across a nearly level plateau, and intersects with the steep banks of a stream whose waters form a junction with the larger creek in the valley. The area thus inclosed is about one hundred rods in width, and flanked by the precipitous ravines, which answer every purpose of defense upon the north and the south; the banks of a wide stream forming the boundary upon the west, and the line of fortification intersecting with ravines referred to, successfully cut off approach in every direction. The parapet formerly had an elevation of eight feet, and a breadth of fifteen feet at its base, with trench of corresponding dimensions. Within the inclosure may be observed a large boulder, with a cavity in its surface, and which had from other indications, been used for the purpose of pounding corn, &c. Numerous remains of ancient workmanship, stone tomahawks, lance-heads, fragments of vases, have been found here. The site of this interesting fortification, which is not only the most extensive, and its position admirably chosen, but in its artificial defenses was the strongest in this section, is now occupied by the village of Sinclairville, and all traces of the work will soon be obliterated.

The vestiges of ancient works, of varied and interesting character, occur upon the shores of the beautiful Cassadaga lake, (plate X.) The remains of a circular Tumulus, now having a diameter of thirty feet, with an altitude of seven feet, are situated some forty rods from the eastern borders of the lake. This mound had been excavated in 1822; a number of skeletons, of very large size, were exhumed, and examined by medical gentlemen. One of the skeletons measured nearly *nine* feet. This mound is undoubtedly of great age. The osteological remains which it contained were very much decayed, and forest trees measuring two or three feet in diameter were growing upon its summit. A number of ancient hearths or platforms, having upon an average a diameter of thirty feet, and constructed of large stone, were observed in the vicinity of the mound; and the fires here had been so intense that the stones were burned to a depth of fourteen inches below the surface. Numerous *caches* are also found here, having a diameter of some four feet, and two feet in depth. In the vicinity of this Tumulus, formerly existed a line of fortification, extending across a peninsula upon the southern shores of the lake, and inclosing a very large area.

There also occurs the trace of an ancient road, or graded way, which commences at a point some ninety rods from the mound, upon the north-eastern shore of the lake, and running in north-west course to a distance of forty rods, across swampy lands. This road is constructed of coarse gravel, and has an elevation of several feet. The causeway had probably been formed for the purpose of establishing communication with some point upon the upper lake. It was formerly covered by the forest; large trees,—*Pinus strobus*, *Abies canadensis*, *L. americana*,—were growing upon the embankment; and wild-wood flowers, *Nymphæa odorata*, *Sarracenia purpurea*, *V. lanceolata*, and the *Anemone*, in their bloom, adorned the lonely way.

Vast numbers of relics have been found near these works; fragments of pottery, ornamented, and of elaborate workmanship, stone tomahawks and chisels, and also iron implements, such as "French axes," &c. Thus, within the area, not exceeding a hundred and sixty rods square, we find the trace of nearly every description of the remains of ancient aboriginal occupancy; the tumulus, the fortification, the ancient road, hearths, and caches; while the unparalleled size of the skeletons exhumed from the mound, and pronounced by medical gentlemen to "belong to human giants," renders this series of works also of the most interesting character.

An entrenched work occurs near the eastern boundary line of the corporation of Fredonia, and is known as "Fort Hill." The work occupies a strong defensive position; it is situated upon an eminence which rises abruptly to an altitude of thirty feet, while the embankment—one hundred and ninety-eight feet in length, intersects with the steep banks of the creeks upon either side. The wall, which is of semi-circular form, has been much obliterated by repeated ploughing, but was originally some five feet in height. The trace of a very large pit occurs in front of the embankment. The usual Indian relics, such as ancient pottery, &c., have been observed here. The Canadaway creek forms the southern boundary of the peninsula.

The remains of another fortification, in southern portion of Sheridan township, are situated upon elevated ground, and near a small stream, which flows in a north-western direction. This work incloses a circle, of four hundred and ninety-five feet in diameter. The embankment has been much obliterated, but a segment of about one-third of its circumference, upon the south-eastern limits, has still an elevation of two feet. Formerly several gateways were observed in the work, but they have now become effaced. Various relics have been found within the inclosure, such as remains of pottery, &c.

The interesting work represented upon plate XI., forms the most extensive circular fortification embraced in this exploration,—having a diameter of eight hundred and sixty feet, or inclosing an area of thirteen and one-fifth acres. It occupies a slight eminence, mainly descending in a northern and southern direction; while at the distance of a few rods to the south-west, occurs a large Beaver meadow.

The embankment has been much defaced by long cultivation; but about one-third of its circumference yet remains distinctly visible. The wall is here some two feet in height. Near the north-west terminus of the more elevated portion of the work, embracing some forty rods, are yet observed traces of two pits, one much larger than the other. These pits, in every instance two occurring together, were formerly quite numerous within the inclosure, and were also noticed outside of its circumvallations, but have now become mostly obliterated. Fragments of ancient pottery, and other remains of art, have been disclosed by cultivation, together with several entire crania. The ancient walls of this earth work have now nearly crumbled in ruin, and soon will be forever effaced.

The work last described is also the last among the series of ancient fortifications yet remaining which once extended along the Cassadaga and Canadaway creeks, and thence upon the hills bordering upon the waters of Lake Erie; all traces, even of the location, of many of them, by long cultivation of the soil, has been lost. They silently disappear, like the nearly extinct race by whom they were constructed. Two circular works, however, unconnected with this chain, and much obliterated, occur upon the first terrace from Lake Erie; and another group of tumuli now remains to be noticed.

The tumuli, whose relative position is given, plate XII., are located upon the shore of Chautauqua lake, nearly a hundred rods in an eastern direction from the "Narrows." These mounds are of circular form, and of nearly equal dimensions, having a diameter, respectively, of sixty-six feet, with an altitude now of about six feet, although they were formerly much more elevated; they are separated by a distance only of five rods. The tumuli are situated amid a fairie scene, which in its quiet beauty might rival an Arcadian landscape. The sylvan wild-woods, through whose dim retreats glides a murmuring stream, stretch down to the shore bordering upon the placid waters of this lake; and we might well imagine that these mounds were erected for a purpose similar to that described in the Iliad:

"The long-haired Greeks

To him, upon the *shores* of the Hellespont,
A mound shall heap; that those in aftertimes
Who sail along the darksome sea shall say,
This is the monument of one long since
Borne to his grave, by mighty Hector slain."

CHAPTER III.

REMAINS OF ANCIENT ART, ETC.

The remains of ancient workmanship, &c., which occur in connection with the mounds and earthworks, possess much interest in solving the problems relating to the migrations of the early occupants of the continent, and the distribution of the several groups of the aboriginal race, as well as in determining their civilization. These relics, together with osteological remains connected with the mounds, &c., will be noticed, in the connection as they were observed in the various earthworks.

Various specimens of *Terra-Cotta* were disclosed in one of the mounds upon the Cattaraugus Indian Reservation. Among these were fragments of pottery, composed of the pounded quartz mixed with clay, and baked quite hard. These articles are quaintly figured, and bear resemblance to the ancient pottery found on the Colorado Chiquito, and illustrated III volume "Pacific Railroad Reports."

Fig. 1. This represents a statuette or figure cut in relief, from a granite block; the features are remarkably well defined; the work evinces an advanced state of aboriginal art. Fig. 2 represents a vase—given from the restored fragments. It is elaborately wrought from the *Lapis ollaris*. This specimen of ancient workmanship is of the most beautiful design,—finely polished and ornamented. Many other articles—chisels, fleshing instruments, &c., were found, in connection with the relics first described, near the excavations in township of Leon. Here also occur those peculiar blocks of granite—such as referred to in "History of Indian tribes"—which from the *striae* or groves upon the surface, have a fanciful resemblance to birds. I consider their singular form to be entirely due to attrition.

In the tumulus at Conewango, the relics of art, together with osteological remains, were of the most interesting character. The several skeletons were very much decayed, crumbling upon exposure to the atmosphere, but were all of very large size. A cranium, as well as could be ascertained from the restored fragments, was of the following dimensions:

Occipito-frontal arch,.....	19 inches.
Longitudinal diameter,	9 "
Parietal diameter,.....	8 1-5 "
Zygomatic diameter,	7 2-5 "
Facial angle,.....	73°

The ethmoid, and both the superior and inferior maxillary bones were wanting. An *Os-femur* disclosed here, from accurate measurement, was found to have a length of twenty-eight inches. Fig. 3.—In this I have but imperfectly given a representation of an instrument, formed of dark variegated porphyry, elaborately wrought and polished; it is convex upon one side, while the upper portion is turned in concave form. The edge of this instrument is quite sharp, and it was undoubtedly used for the purpose of carving wood-work. It has a close resemblance to Peruvian antiquities, (as figured in second vol. Astl. Exp.) Fig. 4 represents another finely polished article, formed of the silicious slate. Fig. 5.—An amulet or ornament of *steatite*, and painted in deep red colors. Various other relics of ancient art—chisels, resembling those of the Mississippi valley—disks, similar to those found in the Carolinas—bone needles, fleshing instruments, which will compare favorably with the remains even in the proud Aztec capital of the south, were found deposited in the mound.

Fig. 6 represents one of the most interesting relics yet noticed. It was disclosed by the plough, near the tumulus at Randolph, at the time of my examination of the series of works at that place. The figure represents the head of a bird, resembling the toucan, and is wrought with most precise outline and elaborate design, from a block of white and nearly transparent stone, with sparkling crystallizations, and which is unlike any formation known in this section. This art specimen is finely polished—the contour, with the curved back, minutely traced; and it appears almost impossible that it could have been so well done with any other but metallic tools. This beautiful relic is undoubtedly a Totemic representation—the symbol of some tribe or clan. Fig. 7.—The fragment of a tomahawk. The material consists of dark and beautifully variegated stone, and is finely polished. Fig. 8 represents the fragment of a spear-head, formed of the white

chert-stone. Numerous other relics were also found in connection with the works here. A plate of mica, five by seven inches, was exhumed from the mound; stone chisels, axes, etc. One of these implements, which had perhaps been designed for a spade, had a hard sharp edge at each extremity, with an appearance of a groove around the central portion of the relic. Arrowheads were here found, four inches in width by five in length.

Within the circular enclosure upon the east bank of the Allegany river, various interesting relics have been noticed. Among these were spear-heads, some six inches in length, with double barbs upon each side, and formed from native masses of copper. Knives, which were probably used for the purpose of manufacturing fine fabrics, constructed of hard porphyry and elaborately polished and ornamented, were also found here, together with bone needles, amulets, etc. Fig. 9 represents a copper arrowhead, of fine finish, which was disclosed within the inclosure. It is stated that spearheads, hatchets, etc. of iron, much oxydized by exposure, had been observed within this ancient work. None came to my notice. They may have been obtained during the early intercourse with the Europeans.

Fig. 10. This gives a view of a *Meda*, the picture or song-writing of the aborigines, and is evidently of more recent date than the relics previously described: it had been in possession of the Indians. These pictographs, by which the medical, necromantic and military arts were expressed by ideagraphic signs or totemic symbols, formed a part of the ancient Indian mythology—the mystical lore of the priests. All the lines and shadings are drawn in this hieroglyphic writing with remarkable precision and minuteness: much of the elaborate tracery has had to be omitted in the plate. This inscription, or mnemonic writing, represents an advanced state of Indian art. A specimen of cloth, manufactured from the bark of trees, the fibres finely interwoven, and which appeared to have been colored and figured by block-prints, was obtained also from the Indians.

Fig. 11 represents an image, which had been found near the Allegany river, and is perhaps the most interesting among all the remains of ancient art observed during this exploration. The figure is chiseled from the compact grey sandstone, and is given life size; the facial outline having a length of seven and three-fourths inches, with breadth of six inches: it has a weight of twenty-four pounds. This statue-work certainly could not have been intended to give the physiognomy of any of the vesperic groups. All the features are given with but slight angular projection. It is entirely unlike any of the sculptures which are ascribed to the northern groups of the aboriginal race; far surpassing them in its artistic design, and in its elaborate workmanship. The head and all the features have a wide broad outline, well defined, with something of severity in artistic expression: the brow is encircled by a peculiar plaiting of hair like a head-dress, with fanciful knots, or rather raised flower-work, corresponding exactly with the style adopted by the Aztecs. This relic, indeed, has a close resemblance to the image-work of the Aztecs, as found in their ancient temples in the valley of the Anahuac, as figured in "Mexican Archaeology" and "History of the Indian Tribes." The image is much blackened, apparently from the action of fire. The work was undoubtedly an idol; one of the many gods in the Indian mythology, and worshipped in the mystical rites pertaining to their religion. I think, in artistic design and execution, it equals any of the ancient image-work even of Toltec and Aztec art, as figured in various works. The art-expression of any people affords an index of their culture or advancement, and this certainly denotes a state far removed from barbarism.

Mention should have been made that Governor Blacksnake, and other intelligent

Indians, upon a close examination of the image and other relics, as the figure of the bird, decided that they were *not* constructed by the ancestors of the Iroquois, but were *left* here by the nation with whom they had wars long since, and which passed far to the southwest beyond the Cherokee country.

Fig. 12. This beautiful article, formed of variegated stone, is polished with much skill.

Fig. 13 represents a relic which had probably been designed for a pipe-bowl : it is formed of the finest material, and in texture much resembles our modern stone-ware; a smooth hard polish has been given both to the inside and outside of the bowl, while upon the inside surface exist appearances of groovings. The two last articles described were found near the Stone mound in Ellington.

Fig. 14 represents a most beautiful specimen of Indian art; a pipe elaborately carved from steatite. It bears the figure of an Indian, cut in relief, and is otherwise tastefully ornamented. The bowl is two and a half inches in length.

Fig. 15 represents a singular shaped article, wrought from the blue granite, apparently for the purpose of being secured in a warclub. Large numbers of these were found. Besides these articles, which were disclosed in the fortified inclosure at Ellington (Plate VII), were found numerous chisels in this peculiar shape, corresponding with those of the Mississippi valley; concave discs, which appeared to have been used for the purpose of mixing paints, etc. etc.

In another fortified inclosure in Ellington were disclosed various ancient pipes, profusely ornamented, formed of *catlinite*; large disks; articles formed of stone, twenty-eight inches in length, perhaps intended for warclubs, and which in their peculiar shape resemble some of the pictorial mounds of Wisconsin : also stone hatchets, axes, chisels, etc.

In other earthworks in Chautauqua county, numerous remains of ancient workmanship have been disclosed for the last fifty years, but they do not differ materially from those already described.

CHAPTER IV.

CONCLUDING OBSERVATIONS.

Thus in the small area embraced in this survey, we find nearly every description of the Ancient Remains which mark the occupancy of this country; the tumuli of varied forms, entrenched works, sacred enclosures, stone mounds, ancient roads, artificial excavations, cemeteries, reservoirs or wells, ancient hearths, and traces of ancient cultivation, beside the interesting relics of ancient workmanship. The earthworks appear to correspond, in their general dimensions, nearly with those observed in other portions of the State and in Northern Ohio, but are more regular in outline, in this respect approaching the ancient monuments of the Mississippi valley. Evidence that this region was once occupied by a dense population, and that its possession was fiercely contested, is afforded by the number of these earthworks, particularly those of military character. It will be noticed that they form a distinct chain. At the period of the first settlements here, wide and deeply beaten Indian trails were observed passing through the Conewango valley, and also that of the Cassadaga and Canadaway creeks to Lake Erie, connecting fortifications which occurred at only short distances. It is estimated that nearly thirty of these earthworks, once existing upon the Cassadaga and Canadaway creeks in Chautauqua county, have now become entirely effaced. Many ancient works, formerly

known in Cattaraugus county, have also been too much obliterated to admit now of being satisfactorily traced; while undoubtedly other works of aboriginal origin are situated within the dense forests, and are yet unknown. Thus some estimate may be given of the number of these ancient works originally occupying this territorial area.

The annals of the past, if indeed they once existed, like the lost arts of the old world, have now become a blank, which no roll of time can ever restore. The history of these mountain ranges of the earth, through the long elapsing geological epochs, and even of the flora and fauna of the dim palæozoic period, is more legibly written than that of the successive races of men which we may suppose have held sway upon this continent. Another great cycle in human history, in the progress of civilization from the east to the west, is nearly fulfilled. The hunter race, in possession of this hemisphere at the Columbian period, will soon have passed away forever. The orb of their destiny is paling its light in the western heavens; slowly, but without delay, sinking from view :

*“Wie das Gestirn, ohne Hast,
Aber ohne Rast.”*

The question has now been reached : By whom and when were these earthworks erected ? I will preface any answer, by giving the information upon this point obtained in an interview with the distinguished sachem of the Senecas, Governor BLACKSNAKE. He related, as the tradition which had been transmitted by their fathers, that “Many hundred years ago, a long war occurred between the Iroquois and other powerful nations, during which, numerous fortifications, often stockaded and inclosing villages, were erected throughout all this region; but their enemies were finally repulsed, and passed far to the southwest,”—while the aged chief waved his hand towards the descending October sun. His eye had grown dim in the light of a hundred and seventeen summers, and his spirit, in its feeble hold on life, seemed floating out upon the boundaries of the invisible world; but as these reminiscences of their former power and glory again came thronging through his memory, his voice swelled in exultation, as in the hour when he led his braves to battle, and the war shout rang along these vallies. The aged chief, indeed, could only recal with uncertainty the events of their history, over whose dim legends had gathered an oblivious haze; groping in the dark amid the ruins of a long lost empire, the vestiges of the labor of forgotten nations. He had occupied a distinguished position in Iroquois history; had formed a treaty with WASHINGTON, during his second presidency.

Conclusions as to the phase which these works occupy in American Archæology have been reached during this exploration, entirely unanticipated at its commencement.

The first question presented is : Do *these* works belong to the system occupying other portions of the State, or are they connected with the series extending through the Mississippi region ? It is mentioned in Gov. Clinton’s Memoir, and again referred to in *Archæologia Americana*, that a chain of works commences at Cattaraugus creek, extending to the south; and this survey, with numerous works which are said to exist further down the Allegany valley, appears to sustain the assertion. It had, indeed, been supposed that the race of the mounds of the Mississippi valley did not extend beyond the Allegany mountains; but the tumuli form *nearly* half of the works embraced in the exploration of this section. From all the examinations which I have been able to institute, these earth-works appear to correspond nearly with those of the Mississippi valley; forming, with the exception of the intrenchment upon the *north* bank of Cattaraugus creek, geometrical lines of

embankment, parallel walls; and these of regular deflection, ellipses and circles, with other characteristics which mark the ancient remains of the west. If this inquiry shall lead to the conclusion that the range of works comprising the mound period of the west, *commenced* upon the upper waters of the Allegany, it may not be without interest in determining the distribution of the races which have held supremacy of the continent. These works certainly must have been reared at some ancient and indefinite era of time, and I have no doubt may rival in antiquity the barrows of Europe. We may suppose the western hemisphere to have been inhabited at as early a period as the eastern world: the Eocene deposits of the Mauvaises Terres, the Flysch beds, as shown by Dr. Owen's survey, demonstrate that it was occupied by the *Palæotherium*, *Oredon*, *Eucrotaphus*, while yet the Alps were submerged beneath the old Palæozoic ocean.

In our ethnographical researches, however, psychology and philology must also bring their aid. From a limited examination of the Indian dialects, their idioms appear to correspond with those of the earliest language known, of Turanian type. The remains of art connected with the mounds appear to be of different style; evincing more elaborate workmanship than the relics disclosed in defensive earth-works, while the osteological remains exhumed from these ancient barrows were far more decayed than those found within the inclosures. Thus I am led to the inference that these respective classes of works were reared by different groups of the aboriginal race, or even by separate races; or (and this conclusion seems more probable) that the tumuli were first erected, and afterwards, upon foreign and hostile immigrations, the earth-works were constructed for purposes of defence; and that all of these works, so far as our knowledge yet *certainly* indicates, were reared by some unknown nation of men, and in some far and unknown period of time, over which yet gathers the veil of obscurity. The last vestiges of fallen empire, which mark one of the strange inscrutable events in the progress of time, will soon be lost in oblivion, which has already swept beneath its tides the proud palaces of Ilium, and cast its shadow across the Acropolis of ancient Athens and the Coliseum of imperial Rome, as it may yet obscure the glory and grandeur of our own Republic—all the proudest monuments of the world's civilization. In the words of the great dramatist :

“ The cloud-capp'd towers, the gorgeous palaces,
The solemn temples, the great globe itself,
Yea, all which it inherit, shall dissolve,
And, like this unsubstantial pageant faded,
Leave not a rack behind.”

March 10, 1860.

No. 2.

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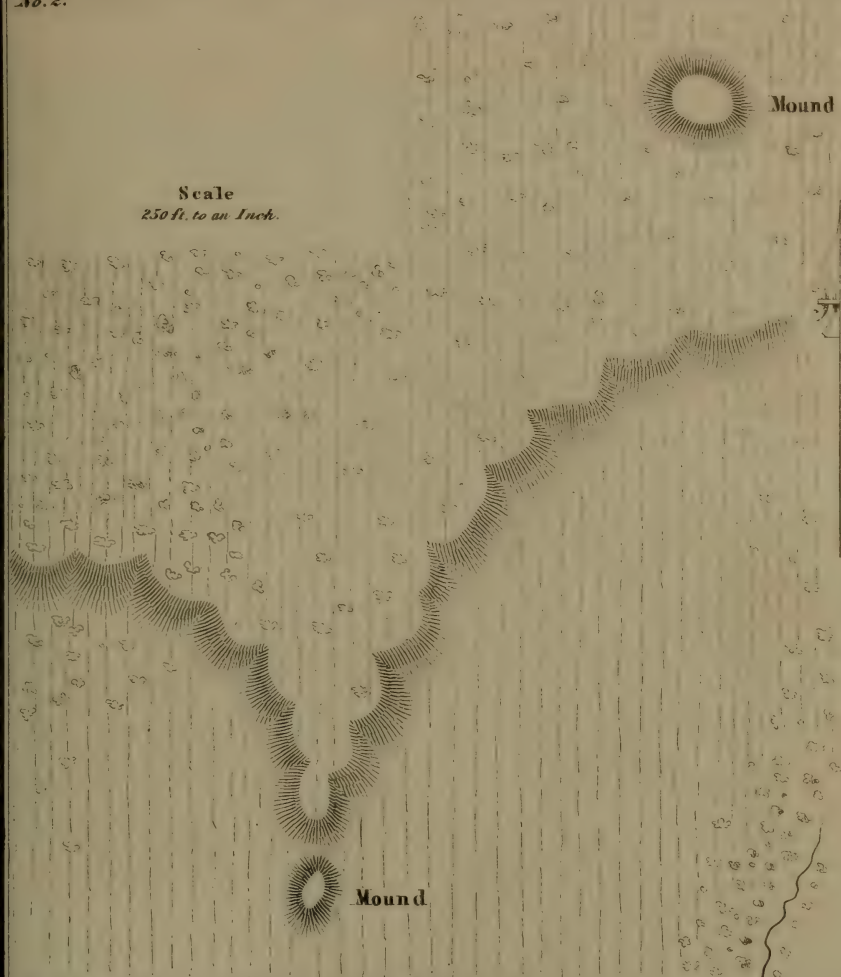


Plate I.

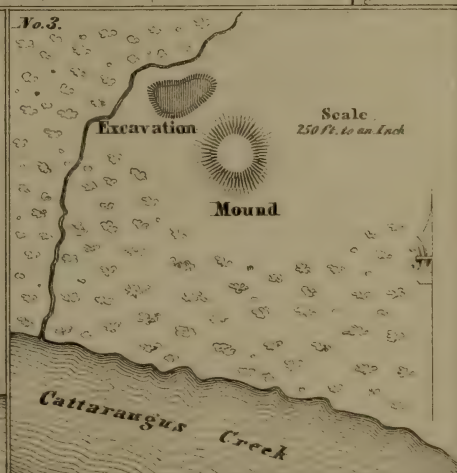
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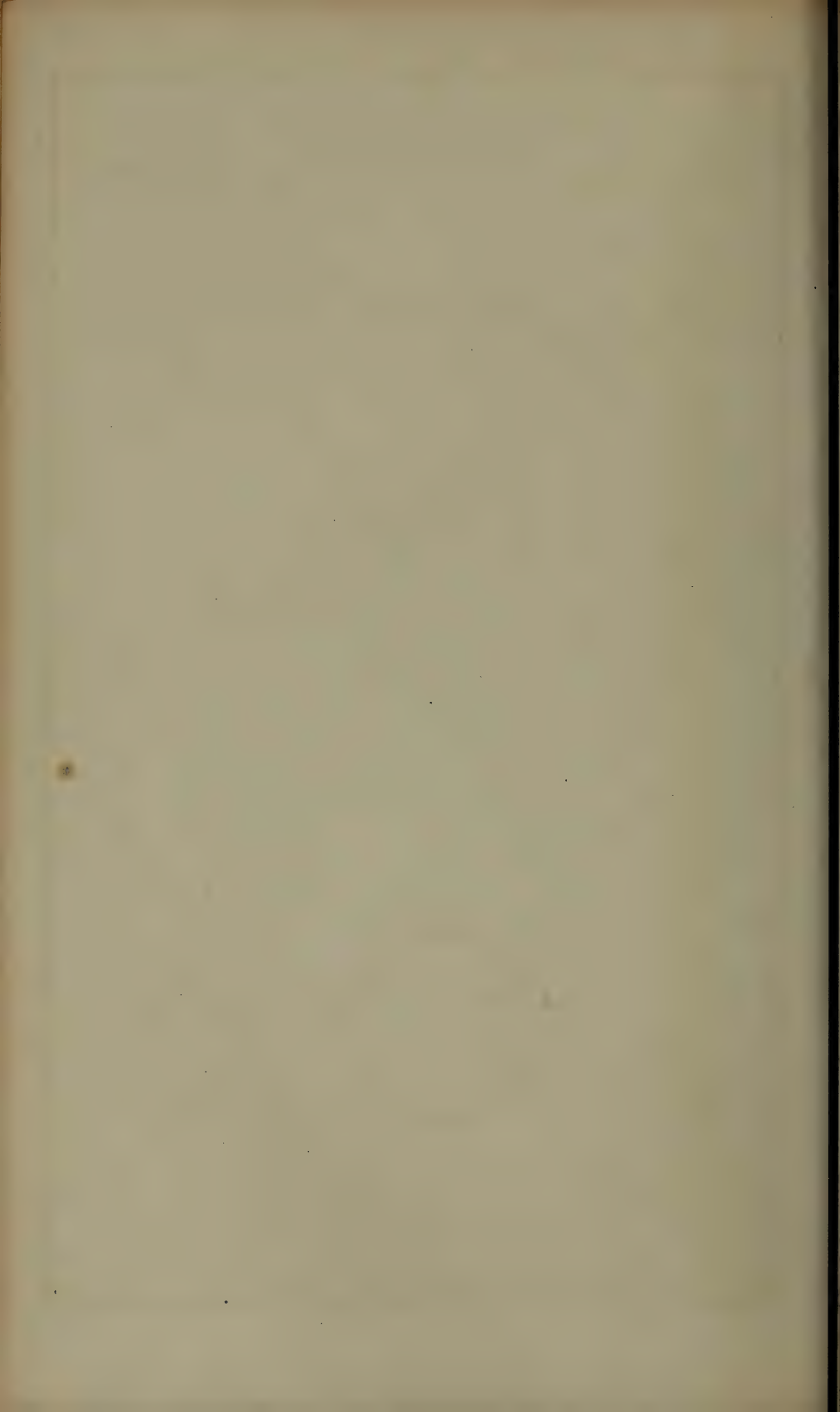
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No. 3.

Scale
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Scale
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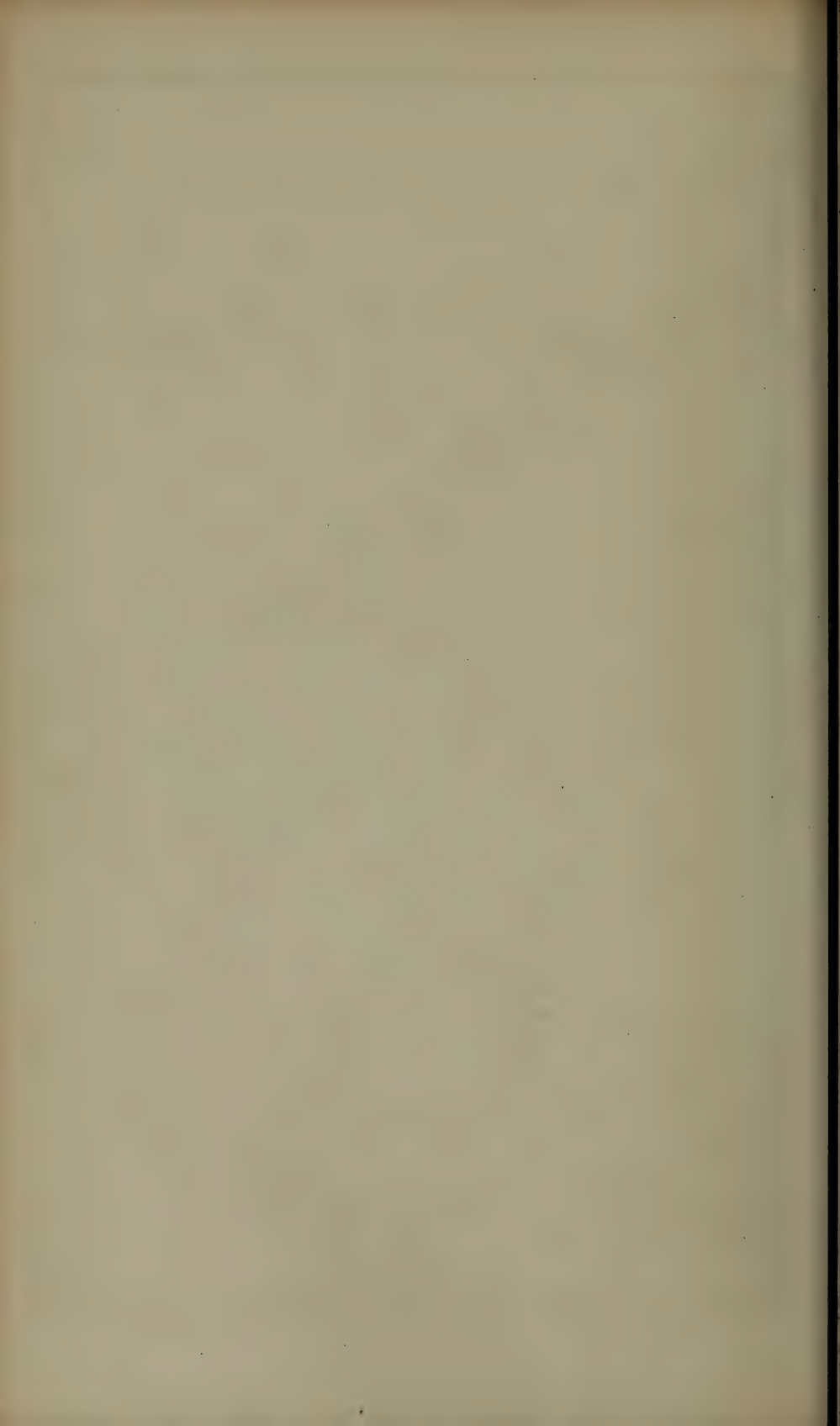
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Plate II.



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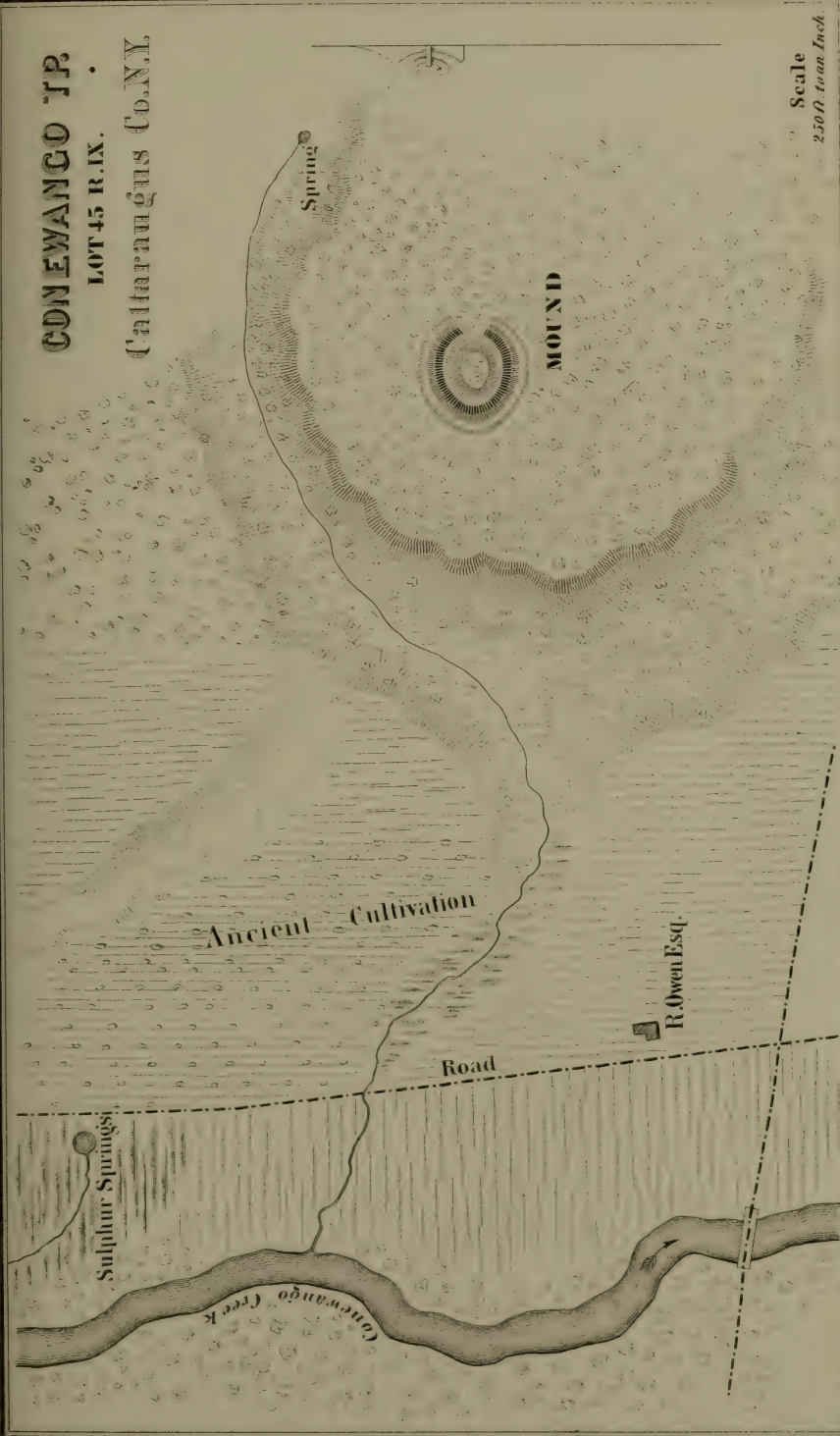
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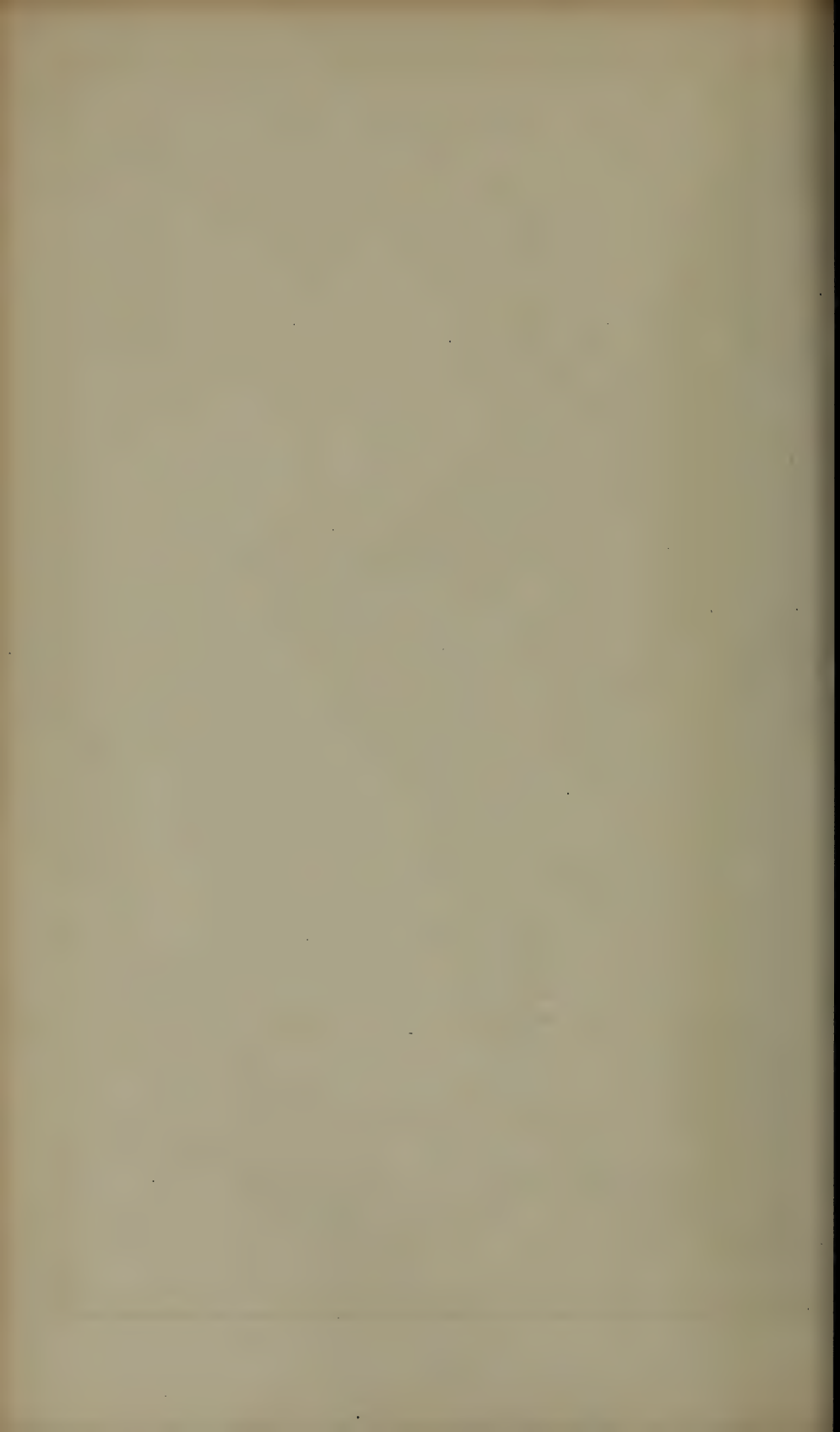
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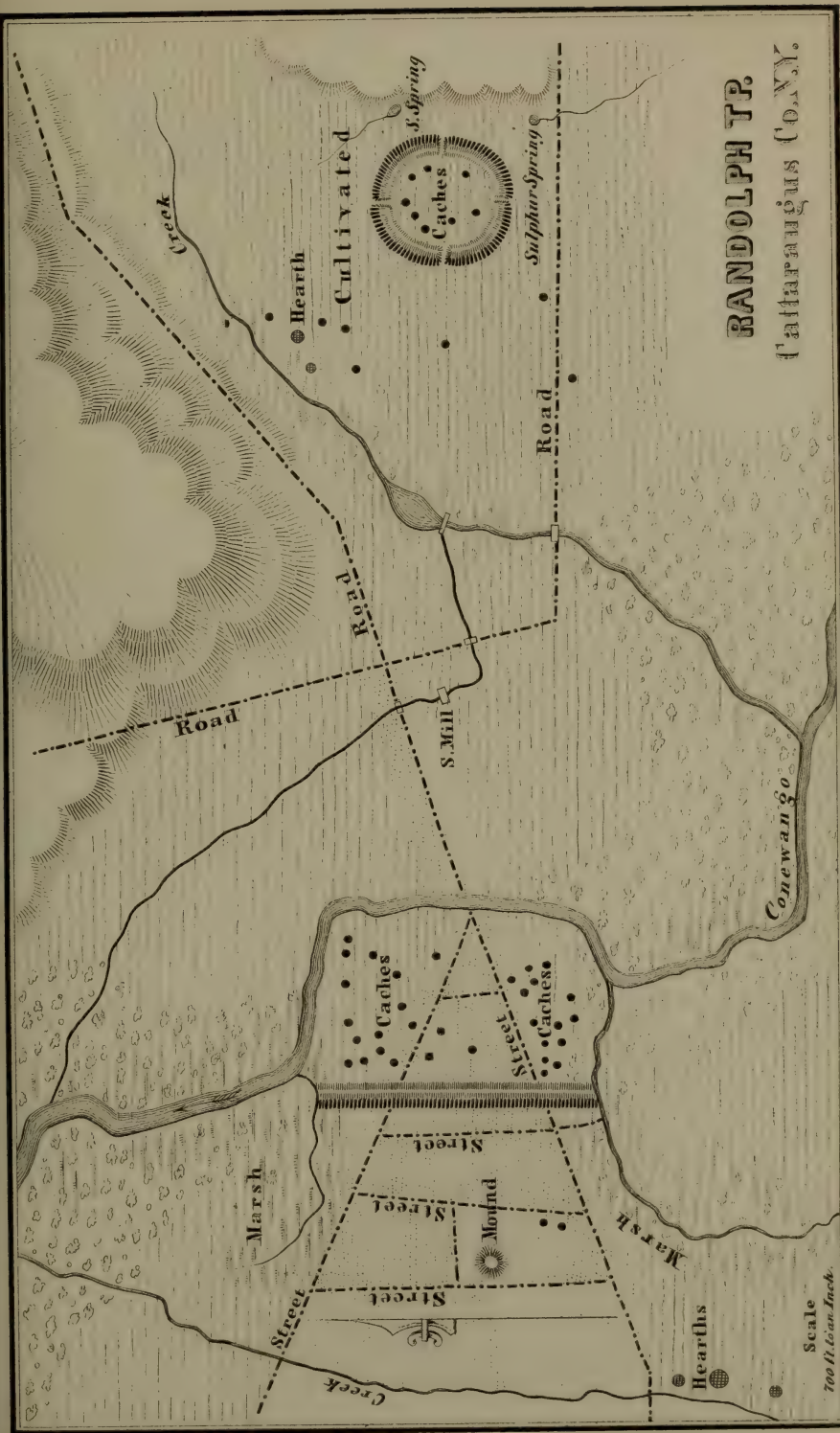
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CHATEAUGUS CO. N.Y.



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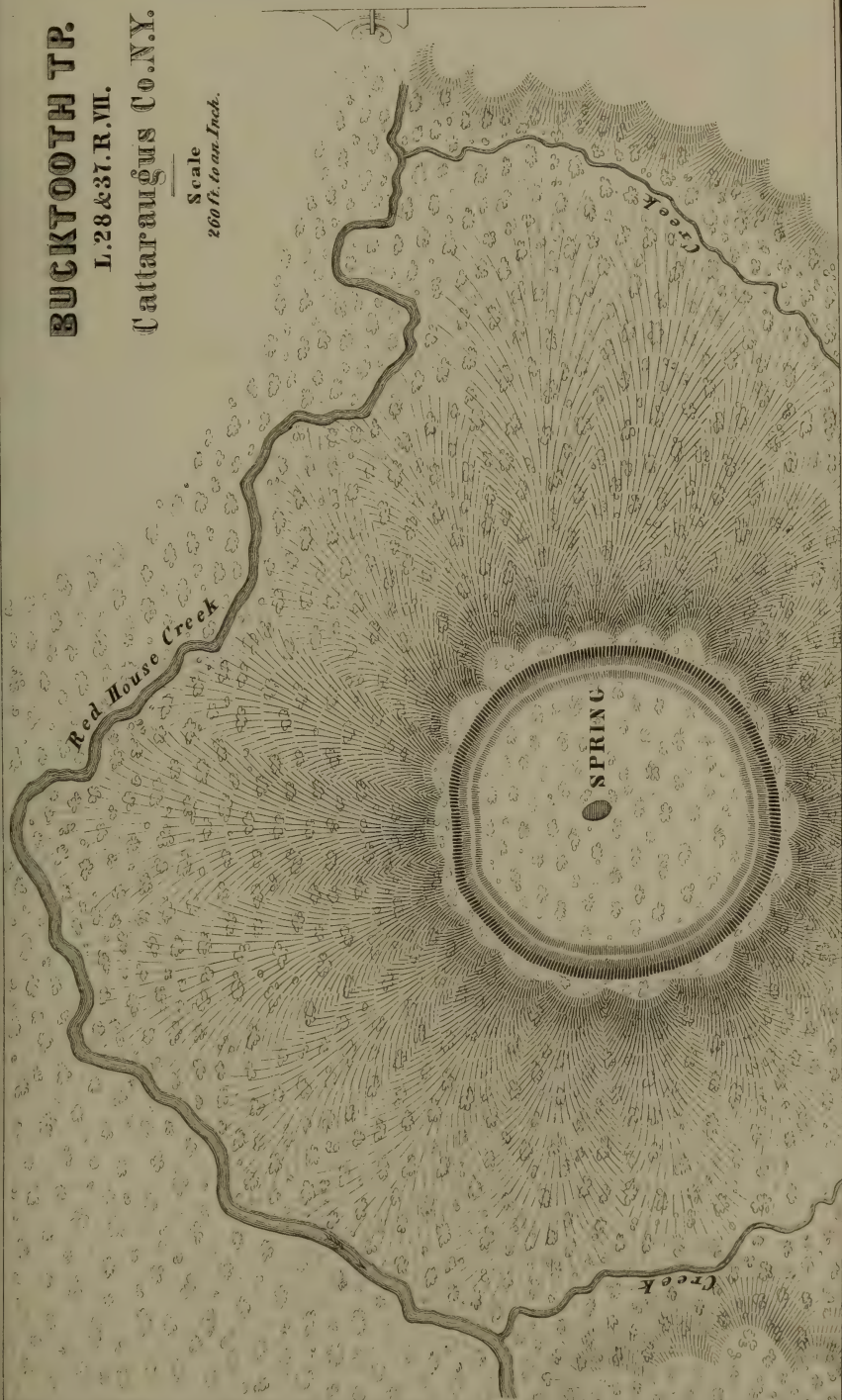


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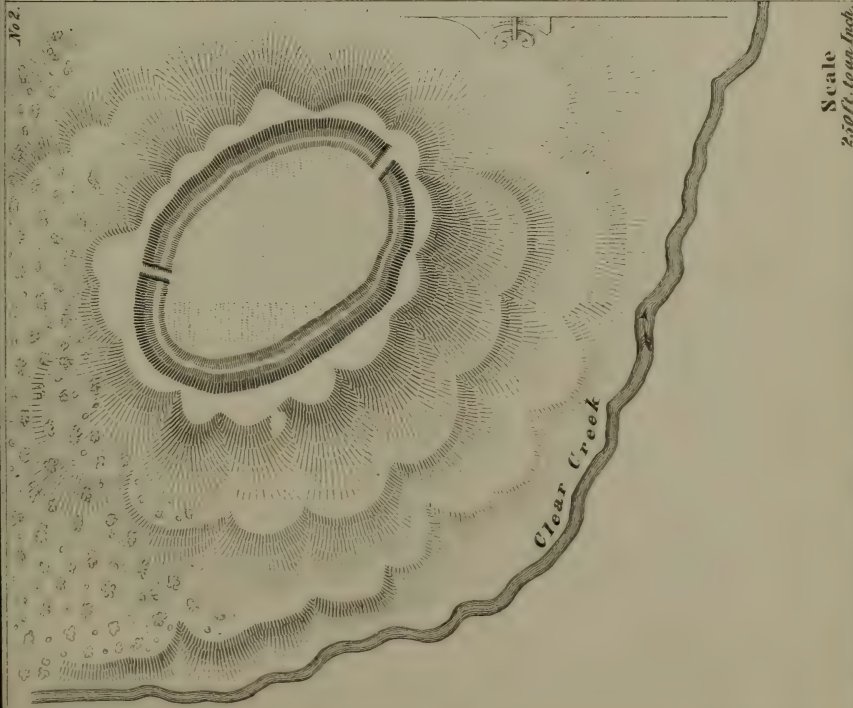
L. 28 & 37. R. VII.

Cattaraugus Co. N.Y.

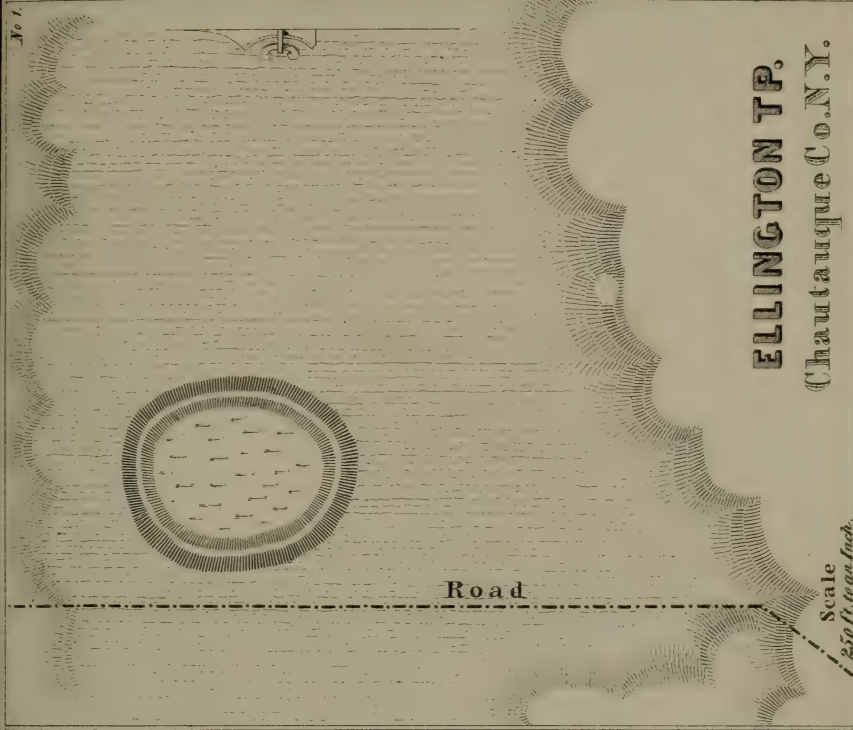
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No 2.



No 1.



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Chautauque Co. N.Y.

ELLINGTON TR.

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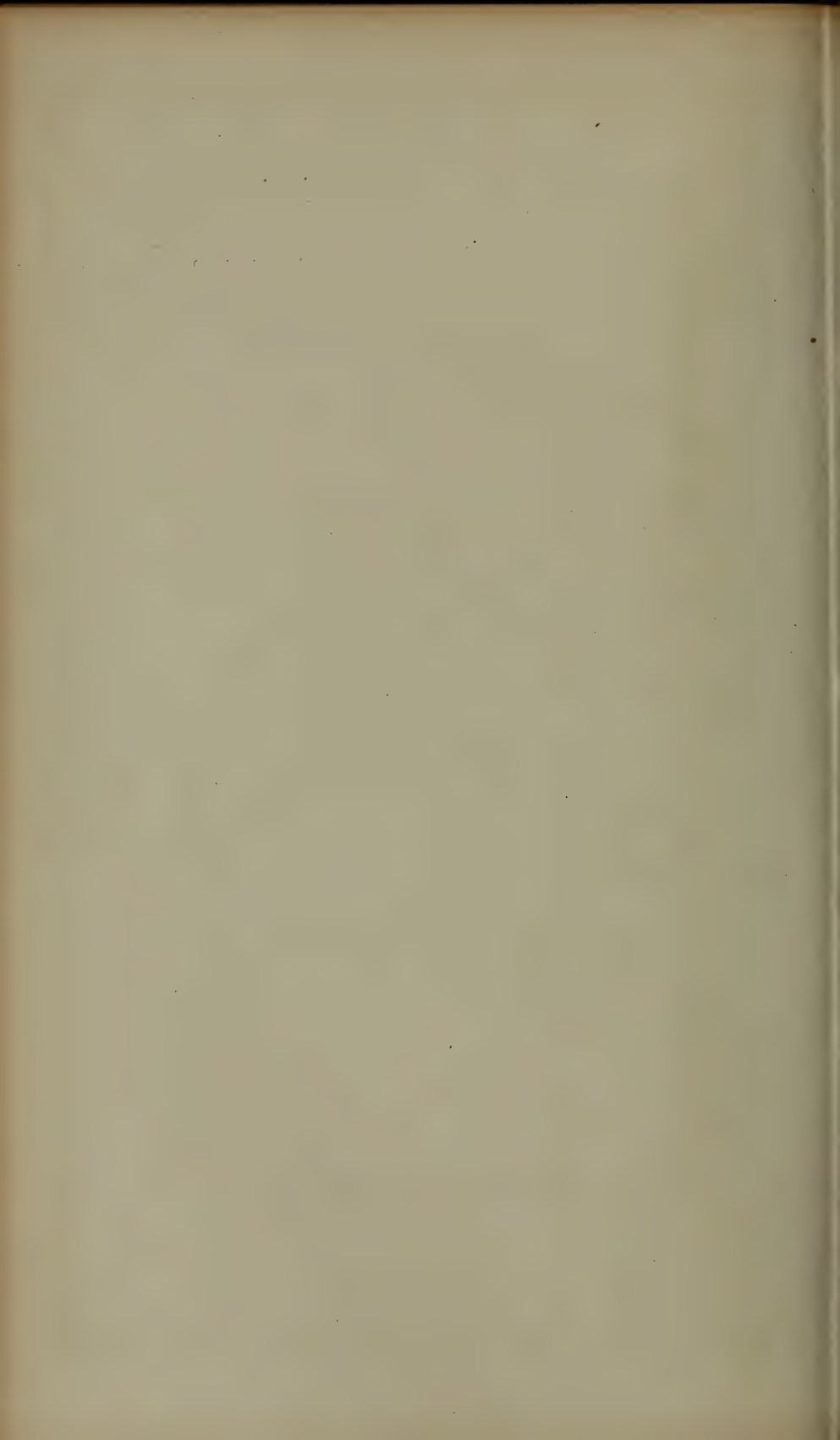
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Scale
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Clear Creek

Road

Cultivated



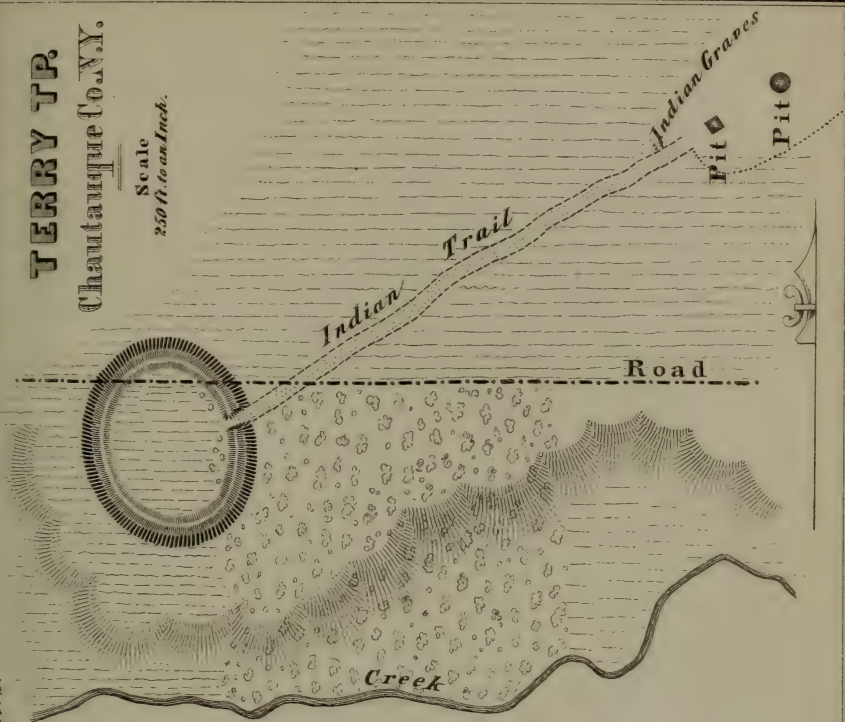
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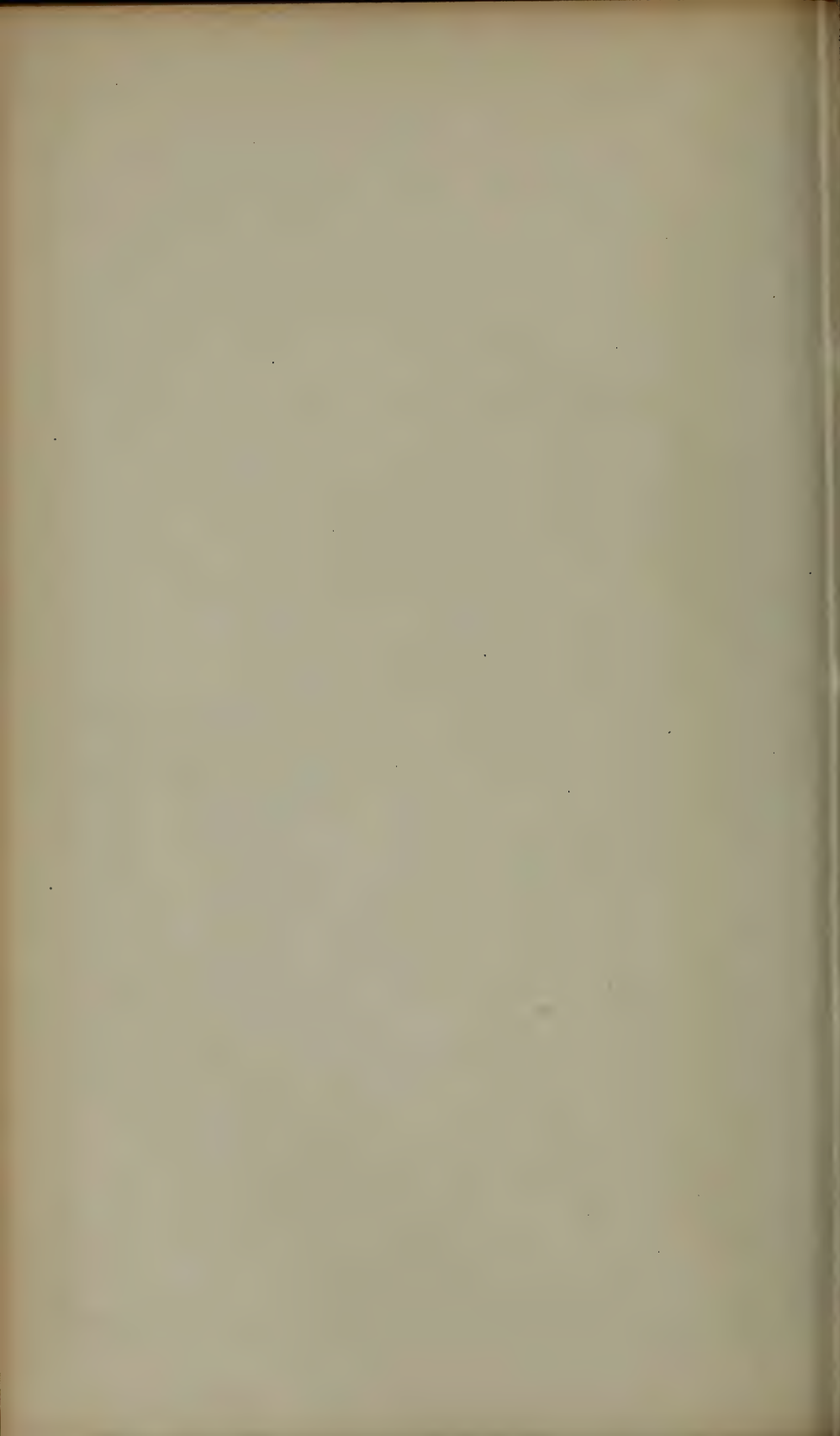
C. Van Benthuysen, Albany

No. 2.



TERRY TP.
Chautauque Co. N.Y.

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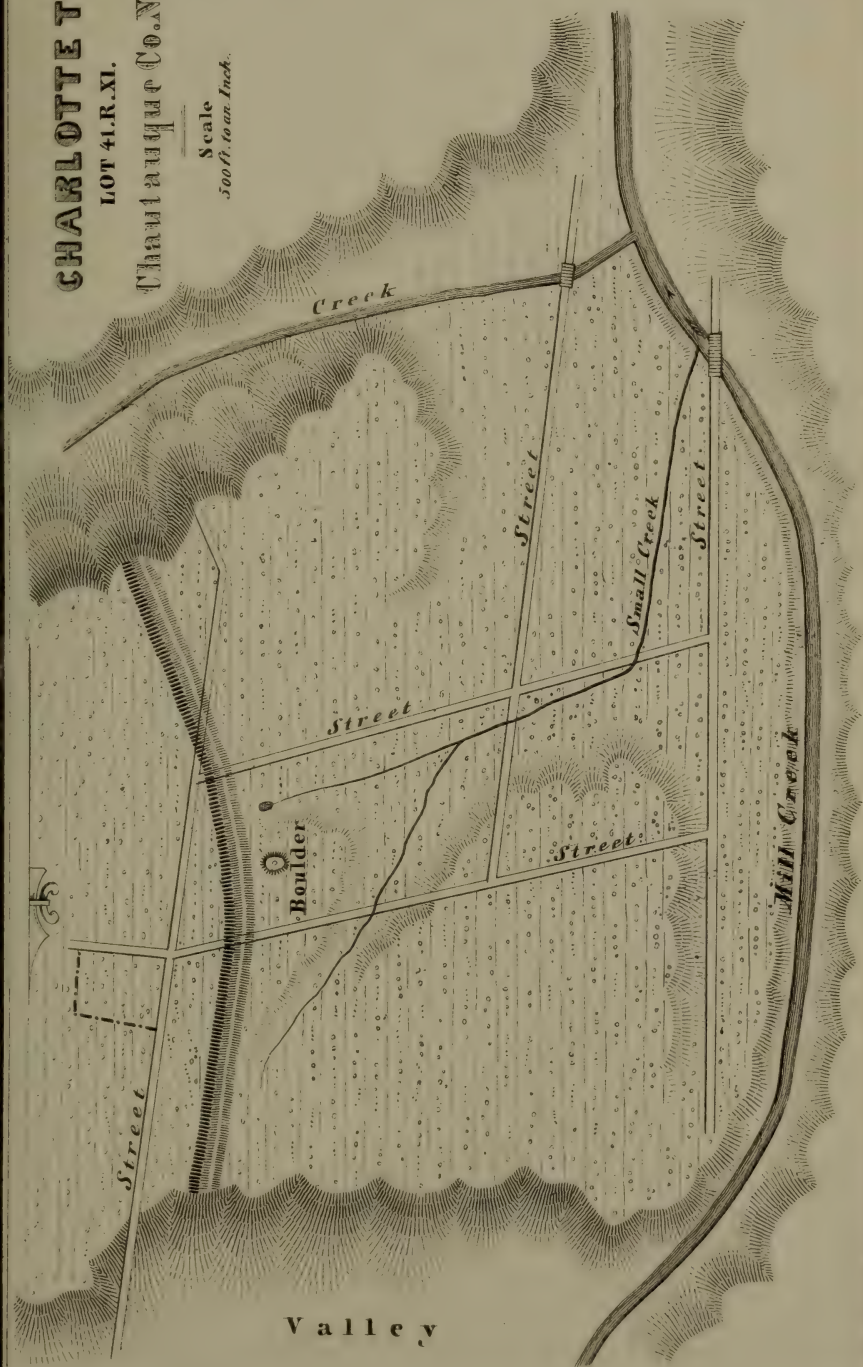


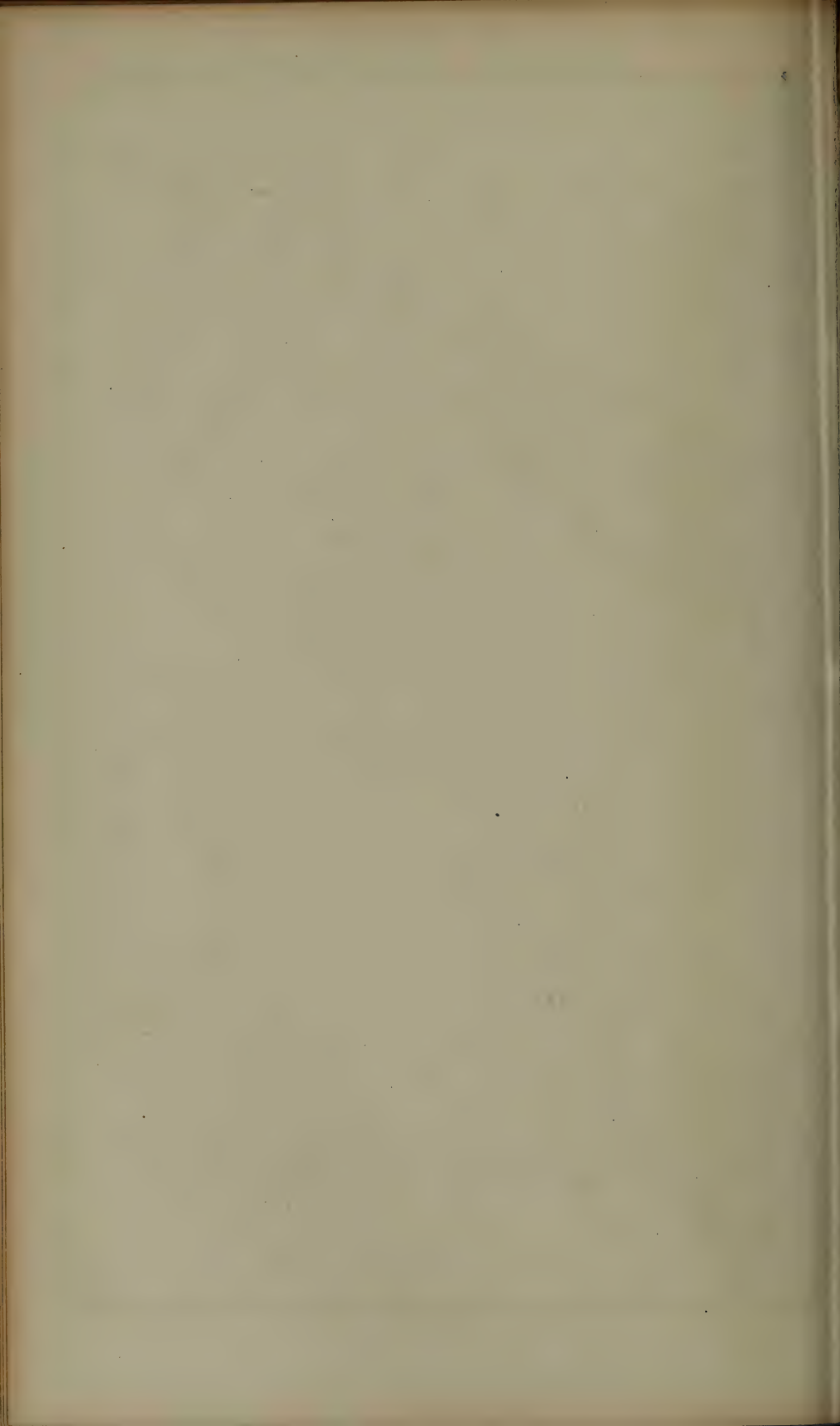
CHARLOTTE TP.

LOT 41.R.XI.

CHAUNIQUE CO.N.Y.

Scale
500 ft. to an Inch.





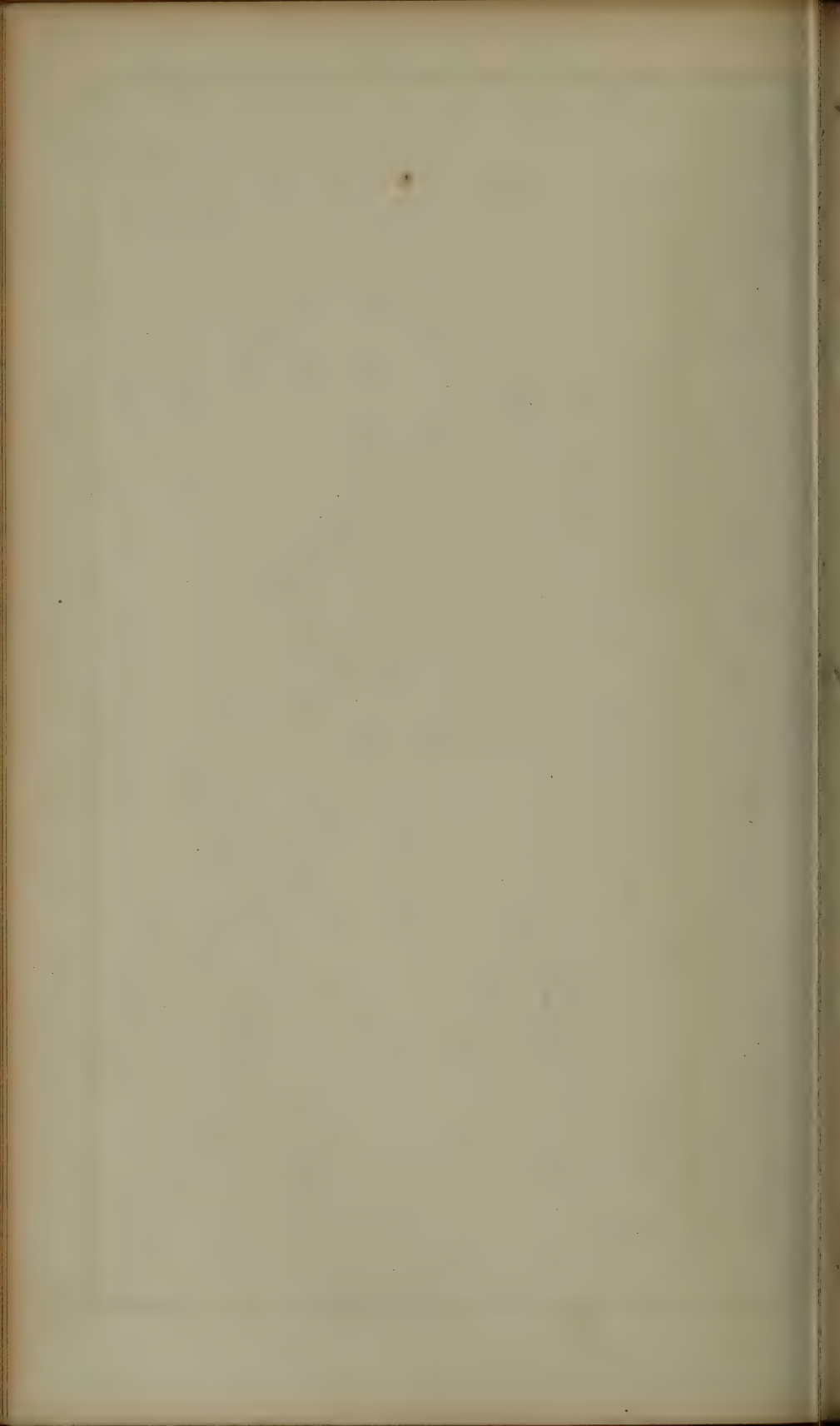
STOCKTON TP.

L. 8 & 16. R. XII.

Chautauque Co. N.Y.

Scale
250 ft. to an Inch.





SHERIDAN TP.

L. 35. R. XI.

Chautauque Co. N.Y.

Scale

250 ft. to an Inch.

Pits

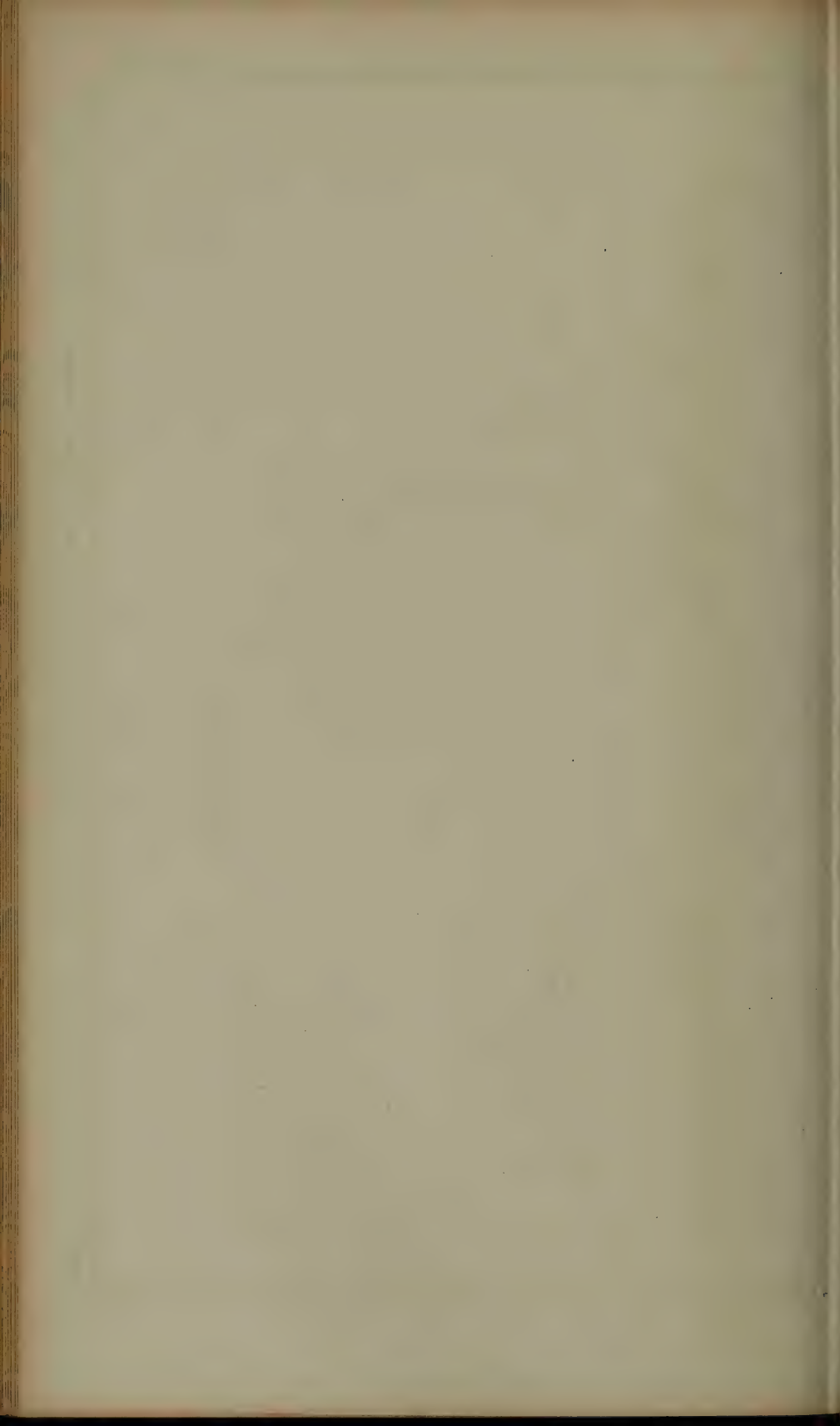
Section of Wall nearly obliterated

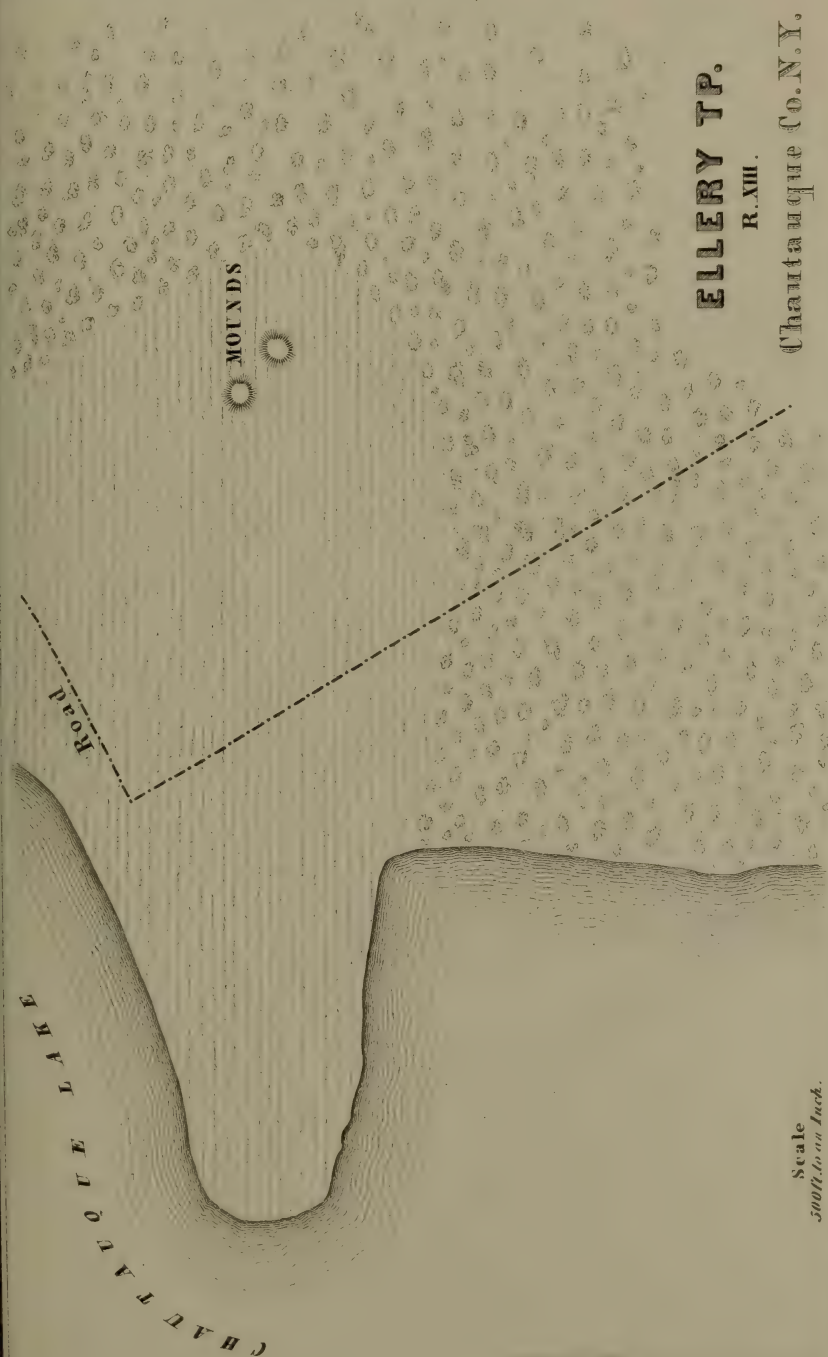
Road

Cultivated

Beaver Meadow

C. Van Benthuysen, Albany





ELLERY TP.

R. XIII.

Chautauque Co. N. Y.

Scale
500 ft. to an Inch.

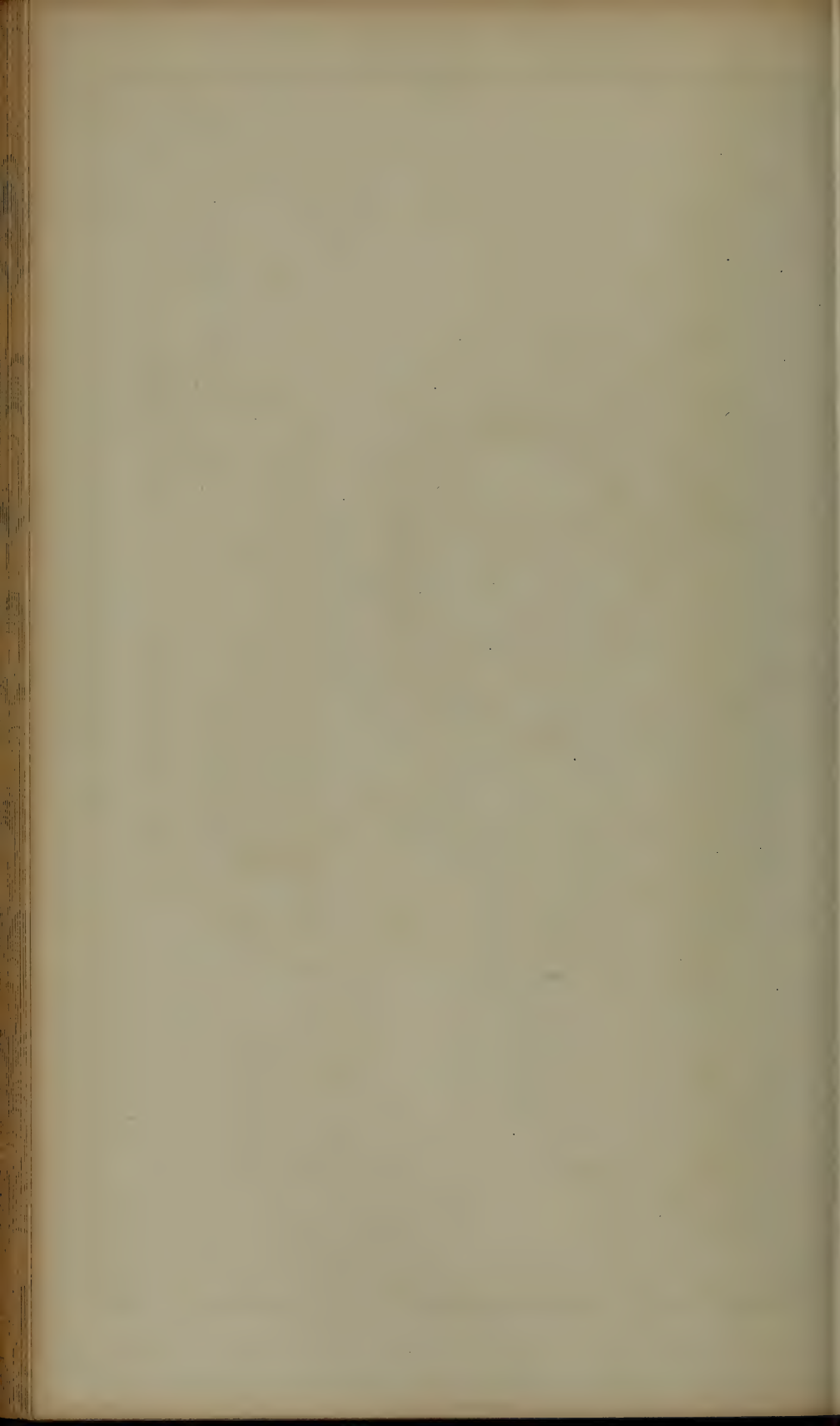
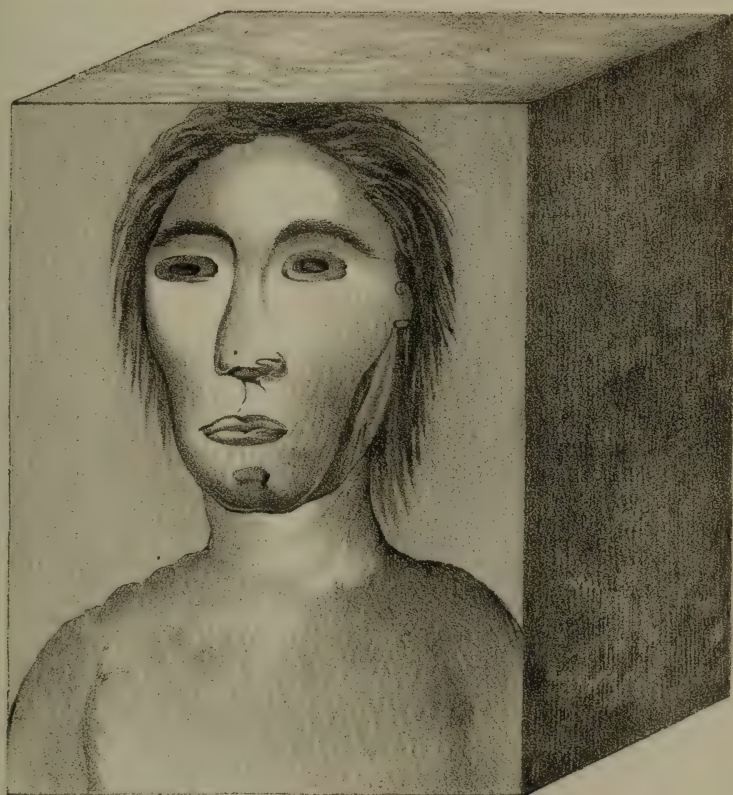
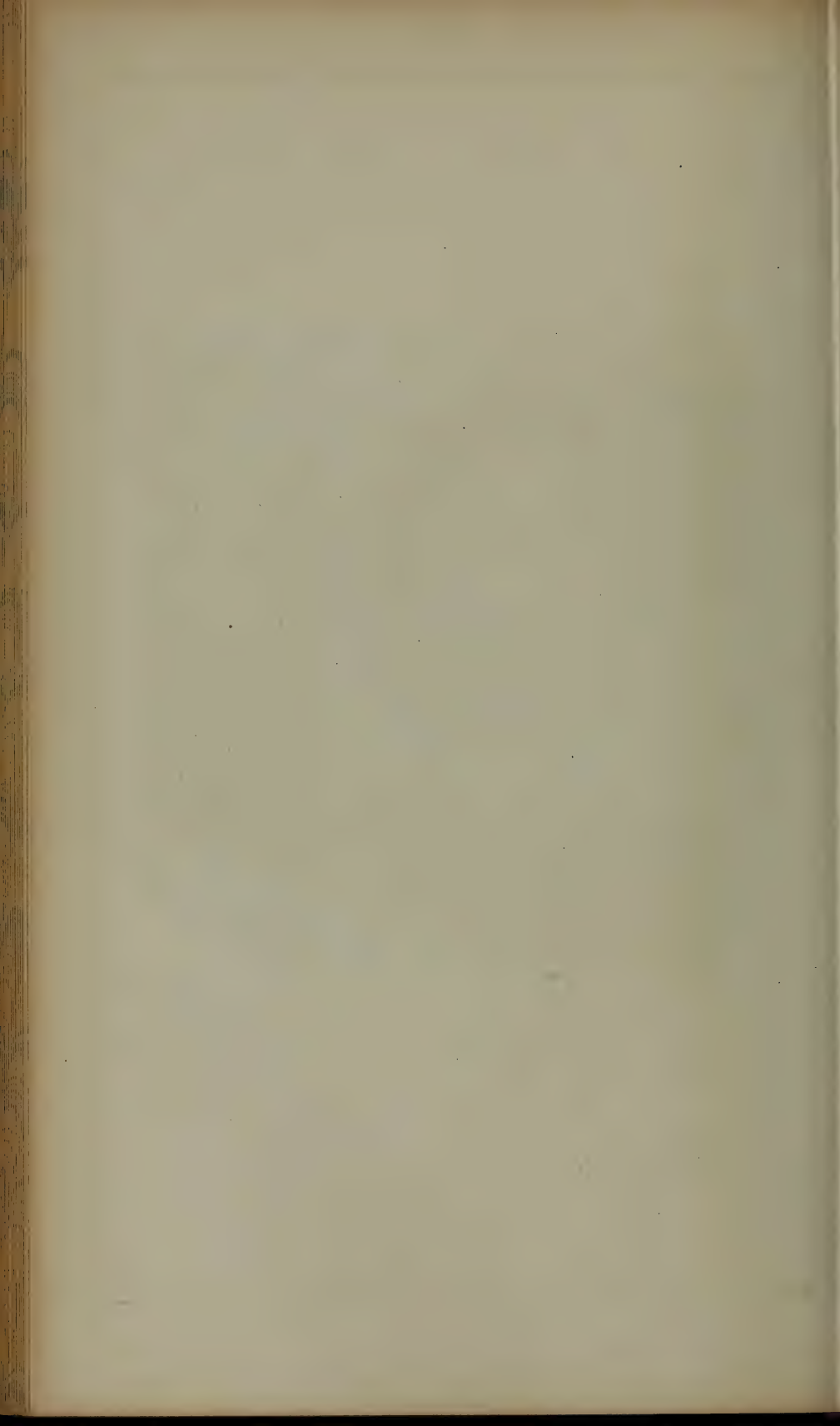


Fig. 1.





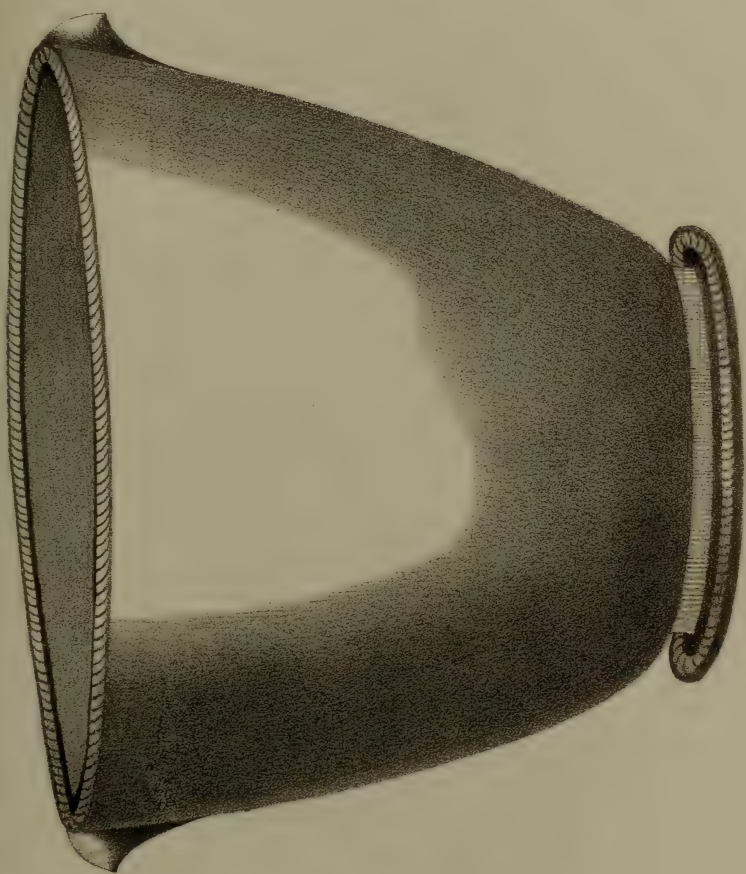


Fig. 2.

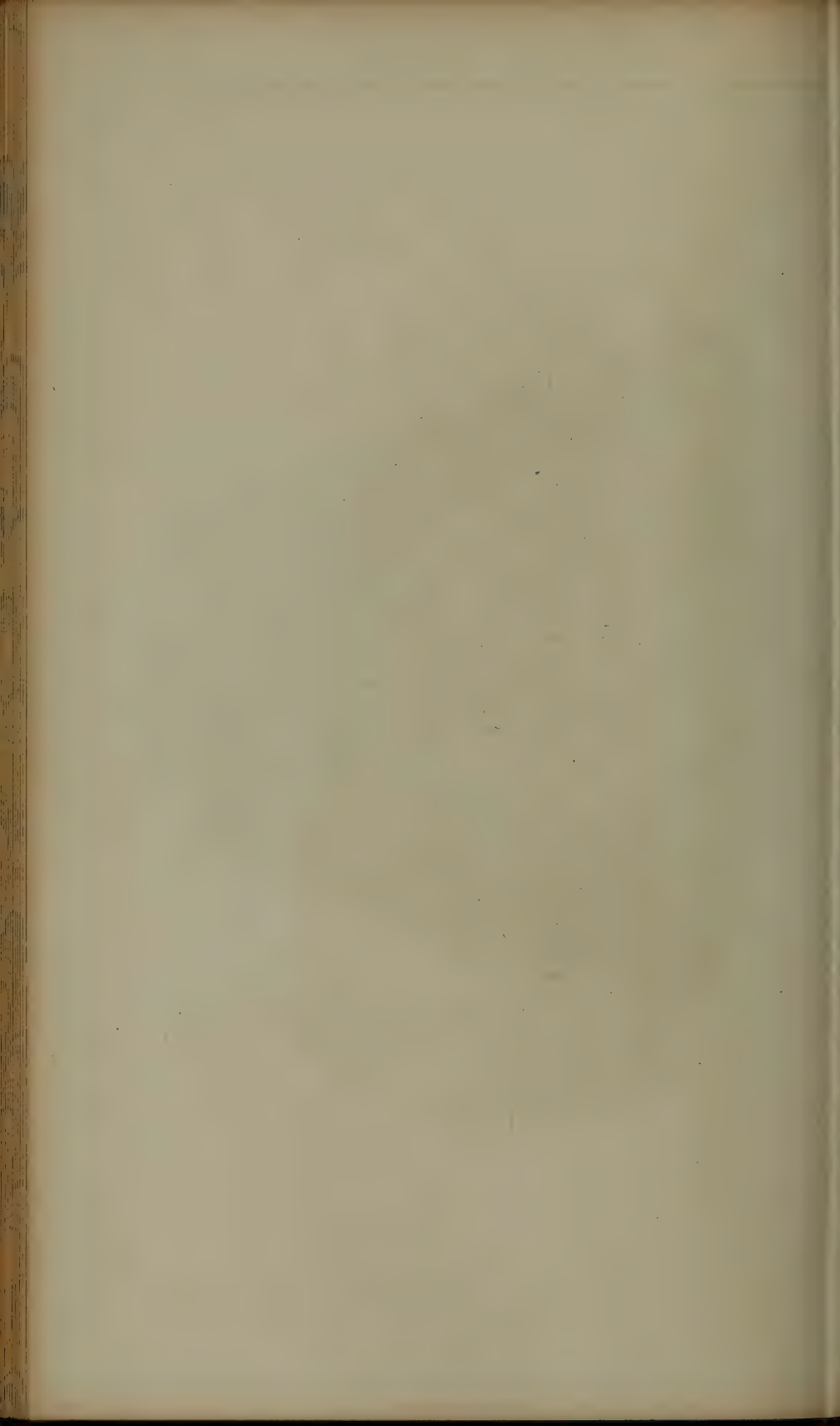


Fig. 5.



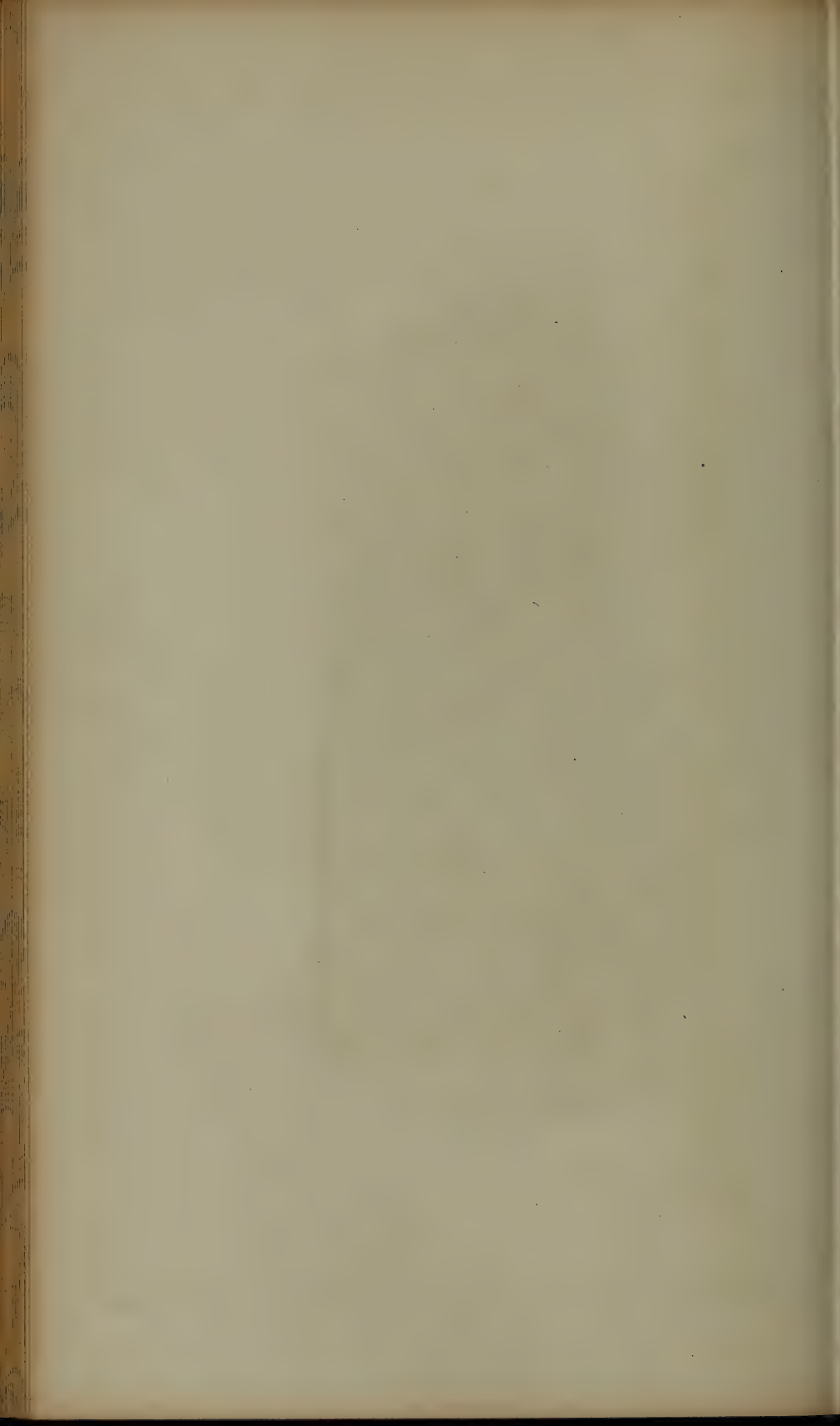
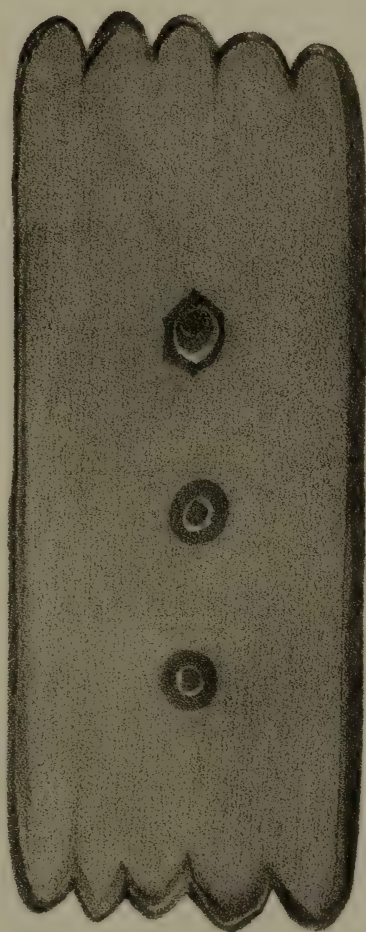


Fig. 4.



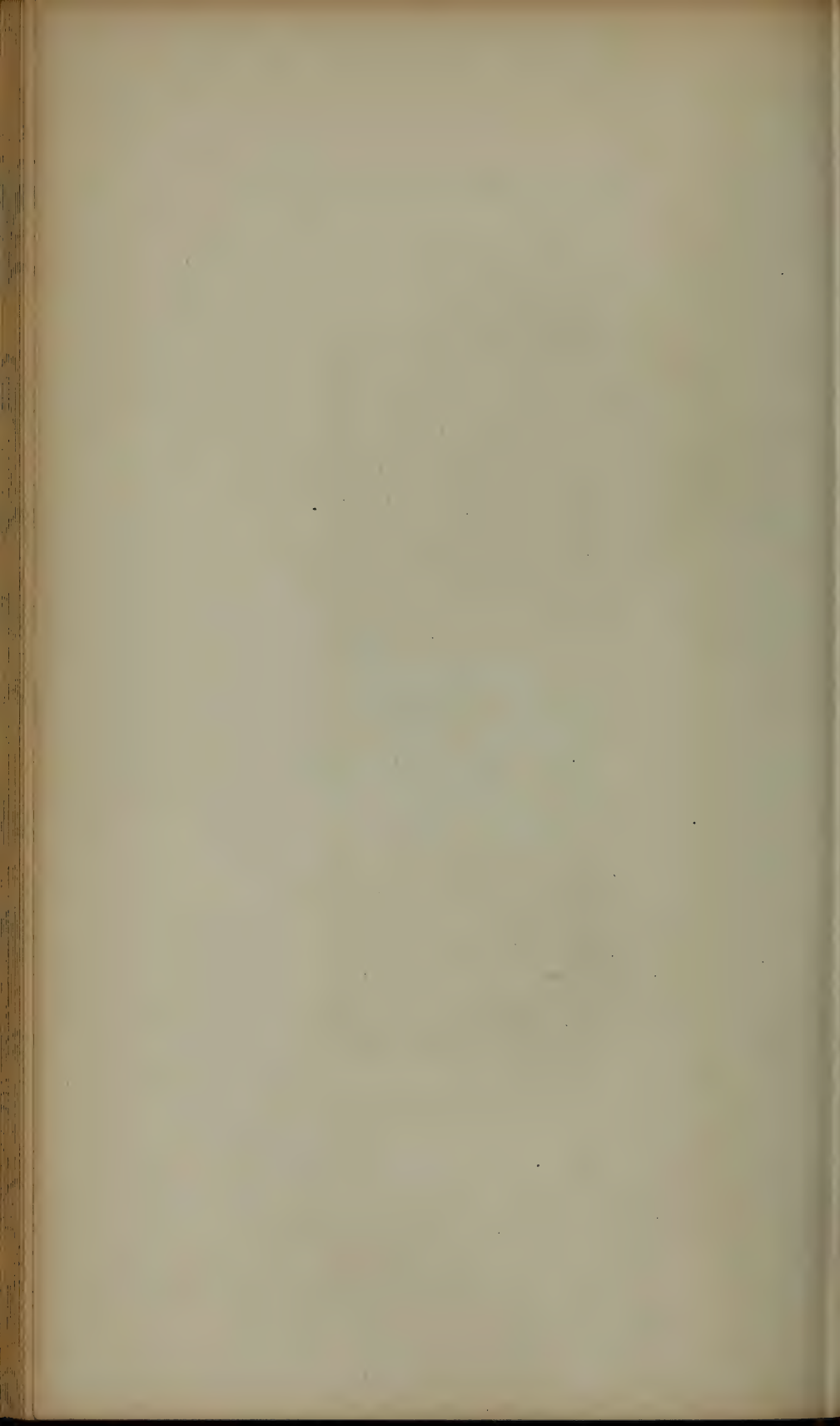


Fig. 15.

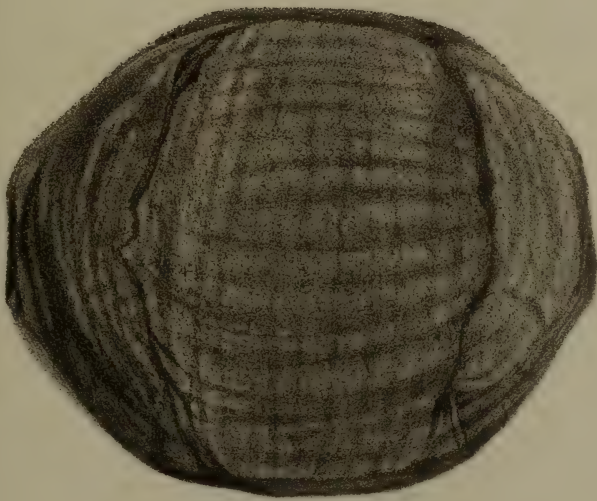


Fig. 5.



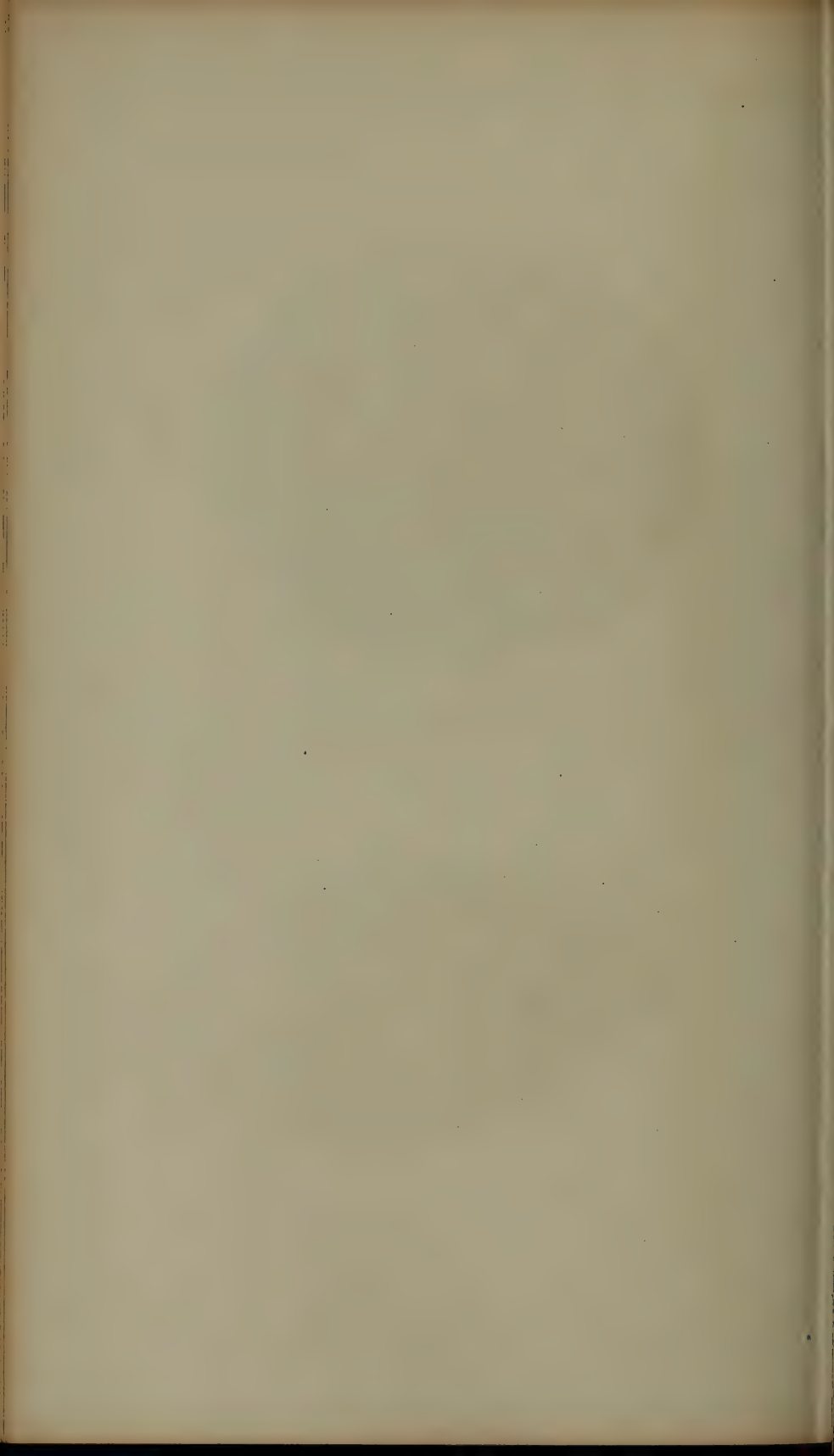


Fig. 6.

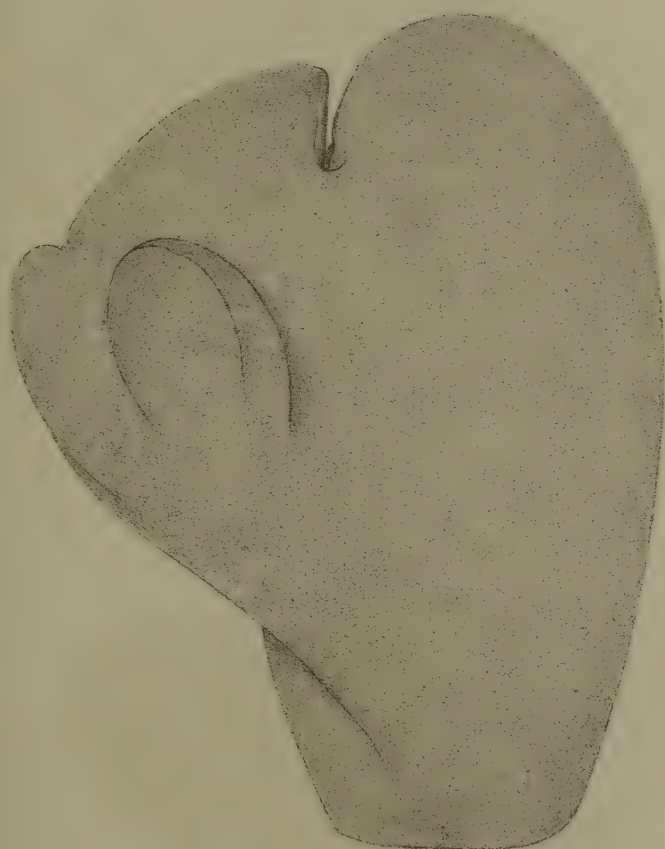




Fig. 13.

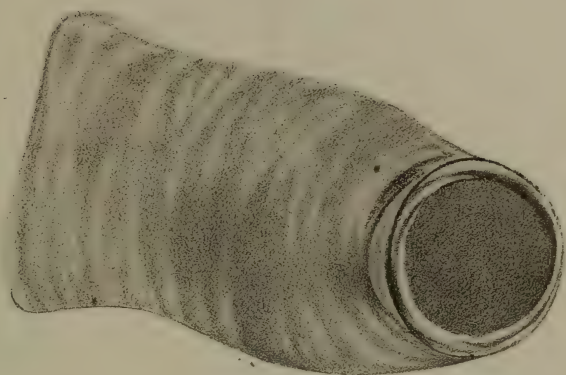


Fig. 7.



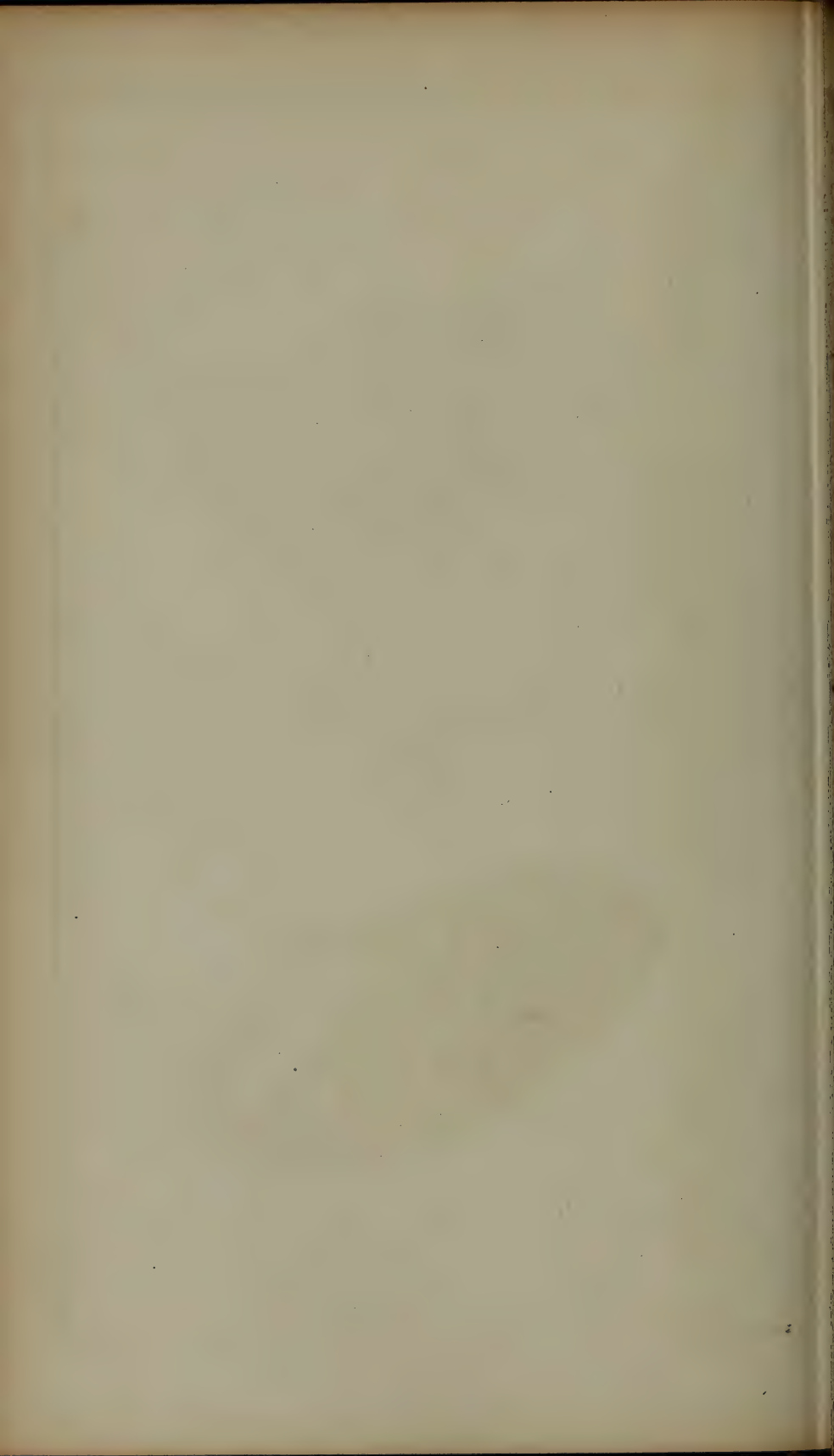
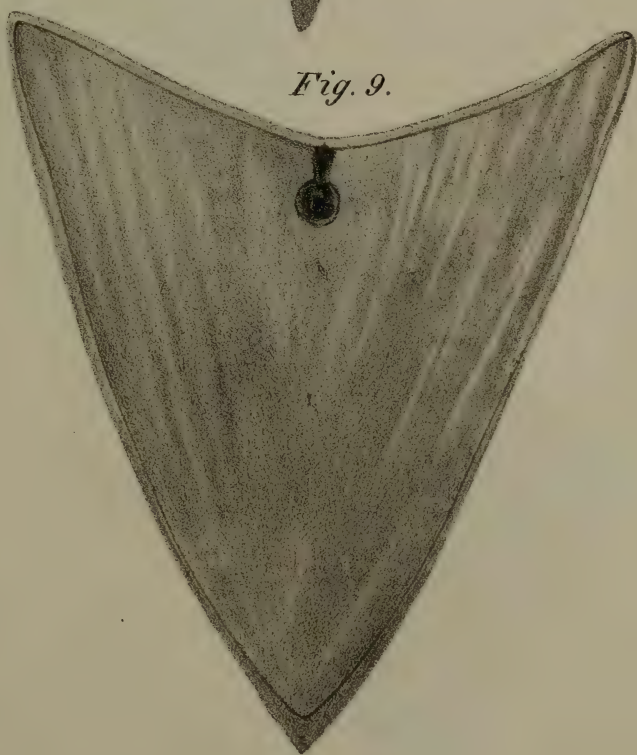


Fig. 8.



Fig. 9.



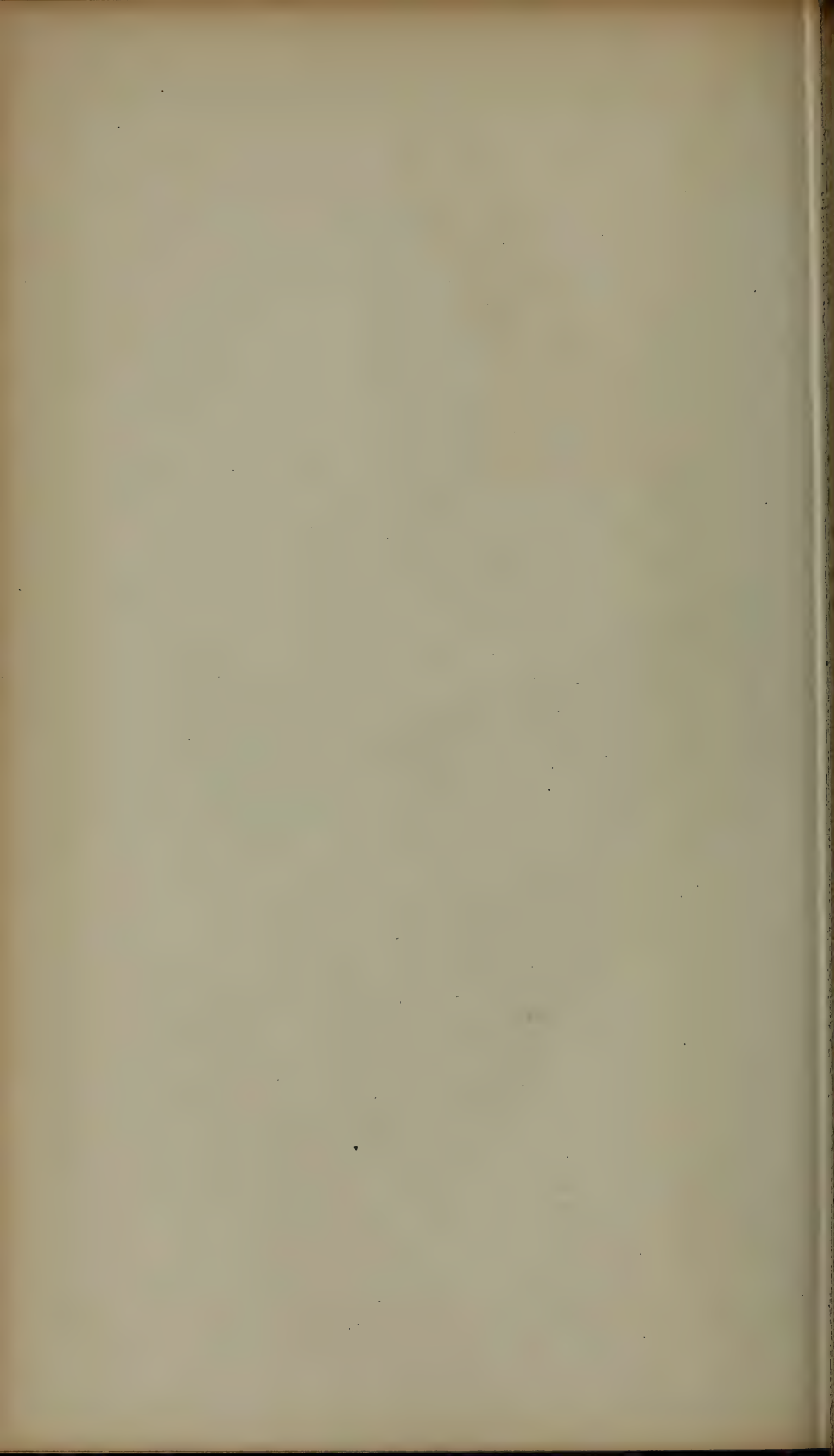


Fig. 10.



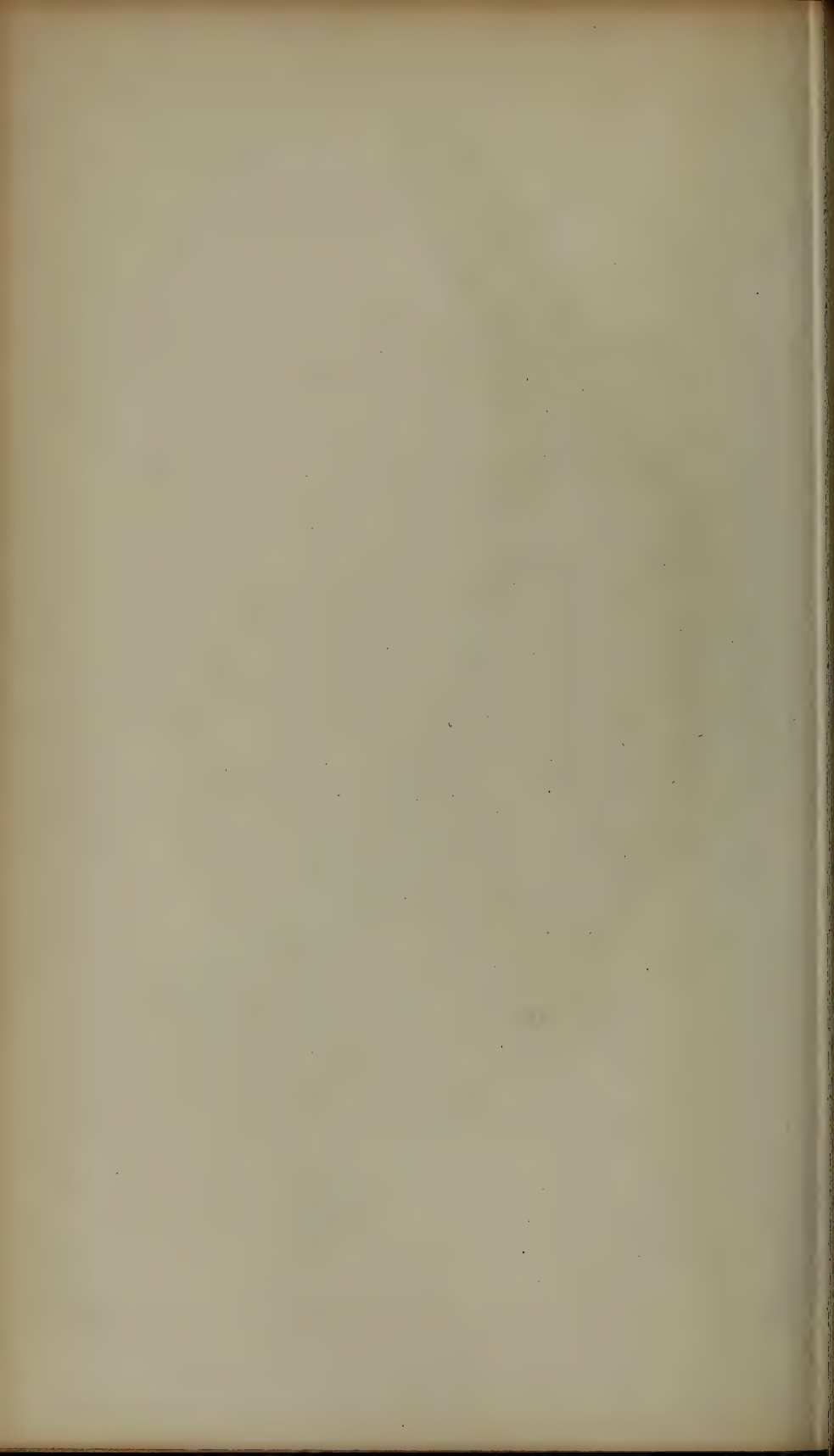


Fig. 11.



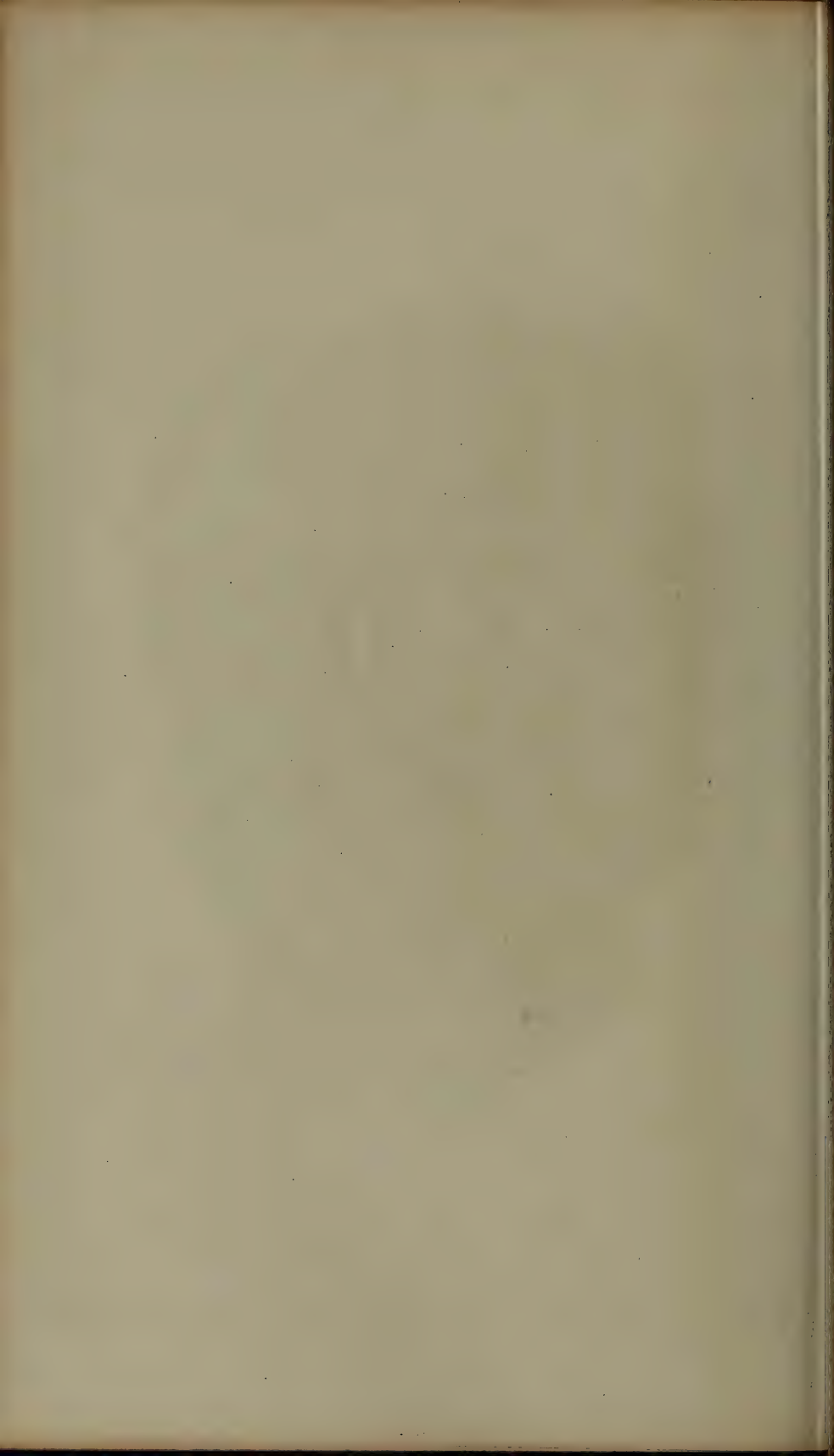
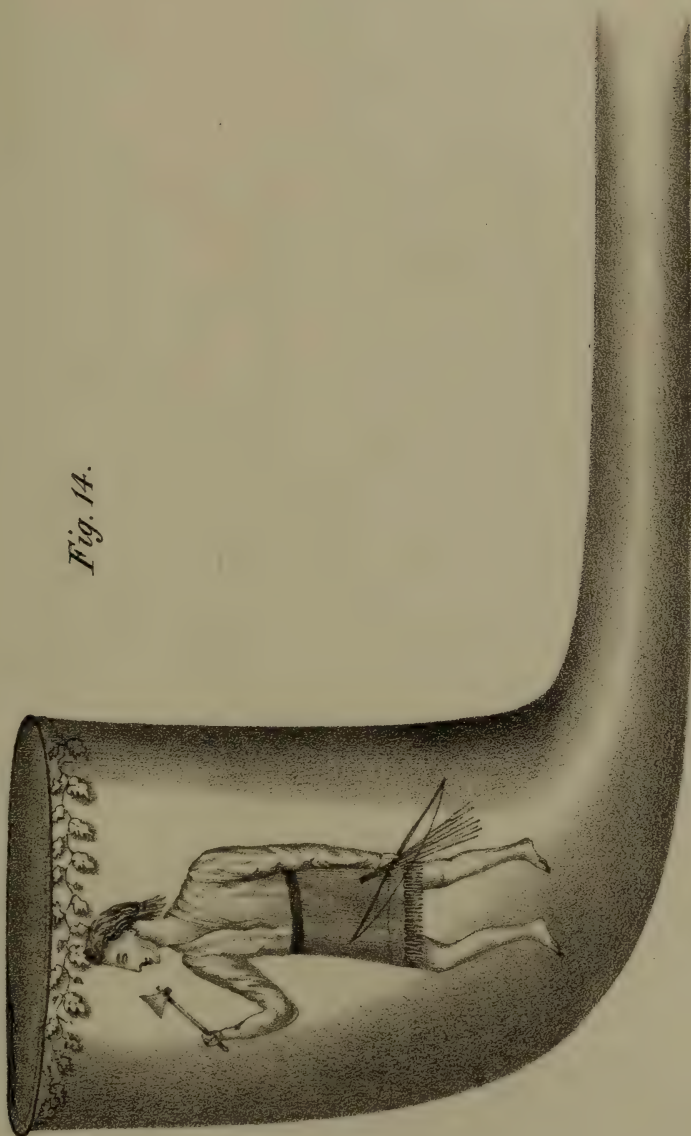


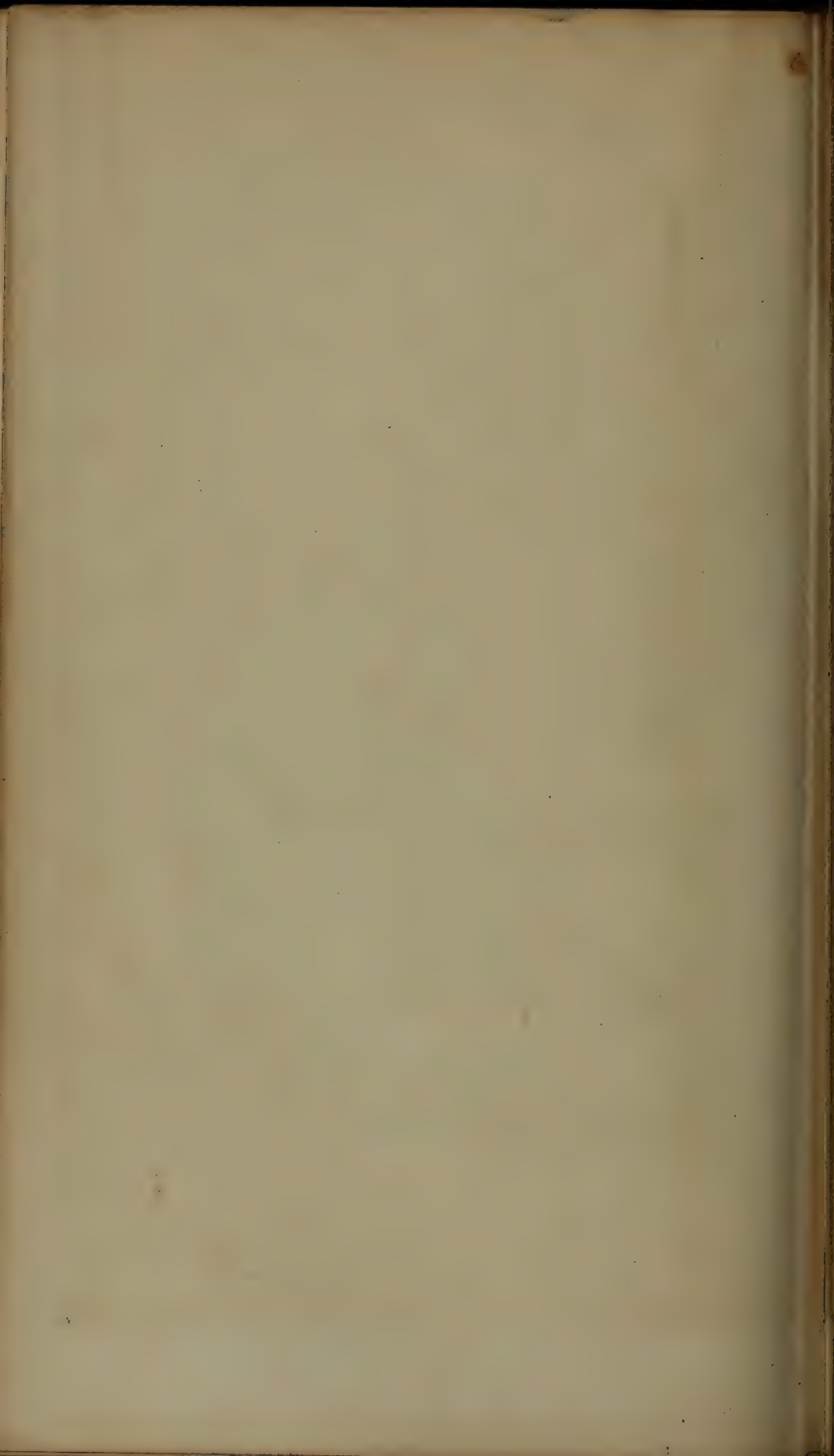
Fig. 12.



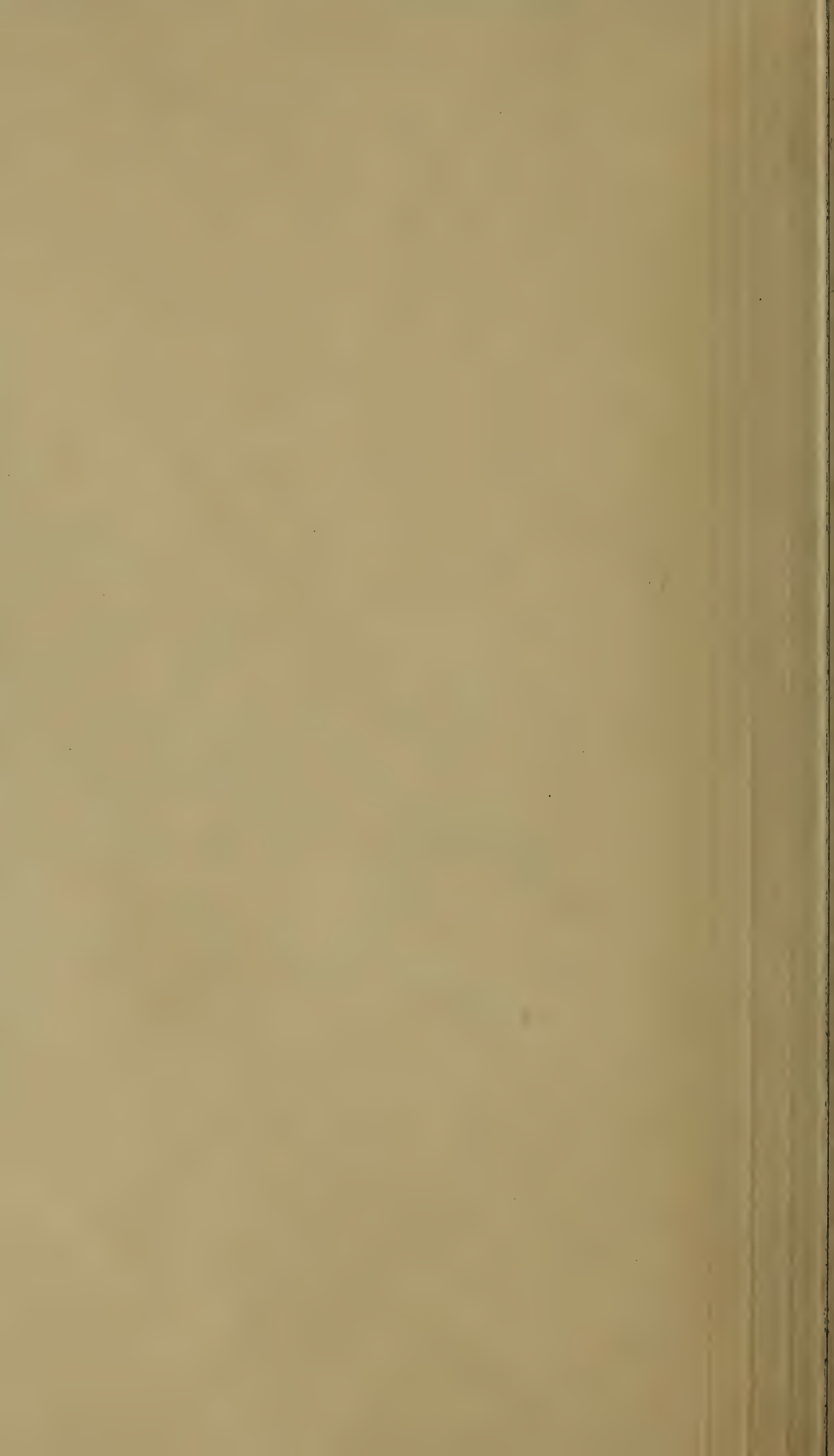


Fig. 14.





the
large



REFERENCES

- ☆ F. Fortifications
- M. Mounds
- En. Enclosures
- Ex. Excavations

MAP

Shewing the location
of the

ANCIENT MONUMENTS IN WESTERN NEW YORK,

by

T. Apoleon Cheney

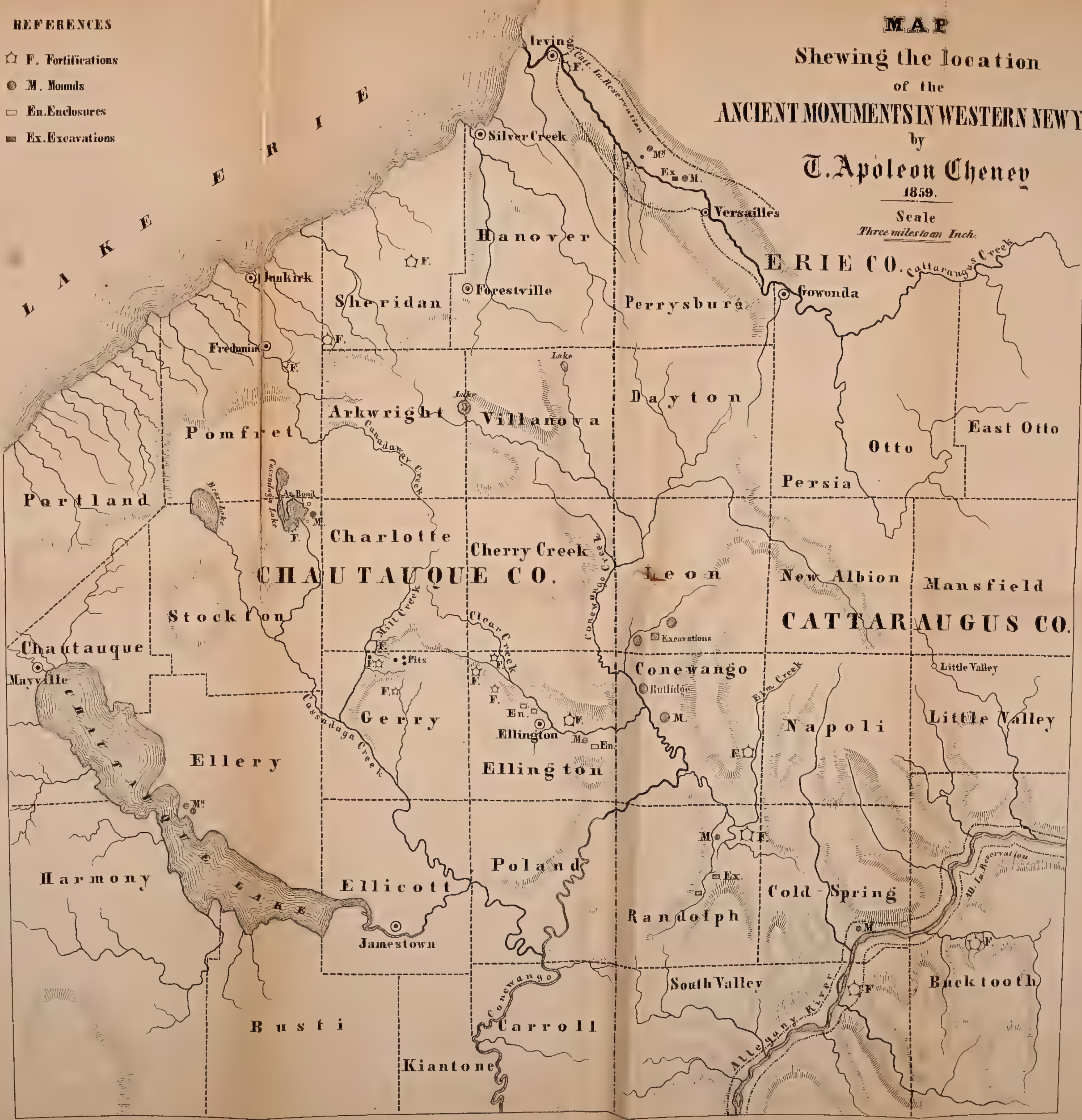
1859.

Scale

Three miles to an Inch.

PART OF CHAUTAUQUE CO.

PART OF CATTARAUGUS CO.



PENNSYLVANIA.

Range XIII.

Range XII.

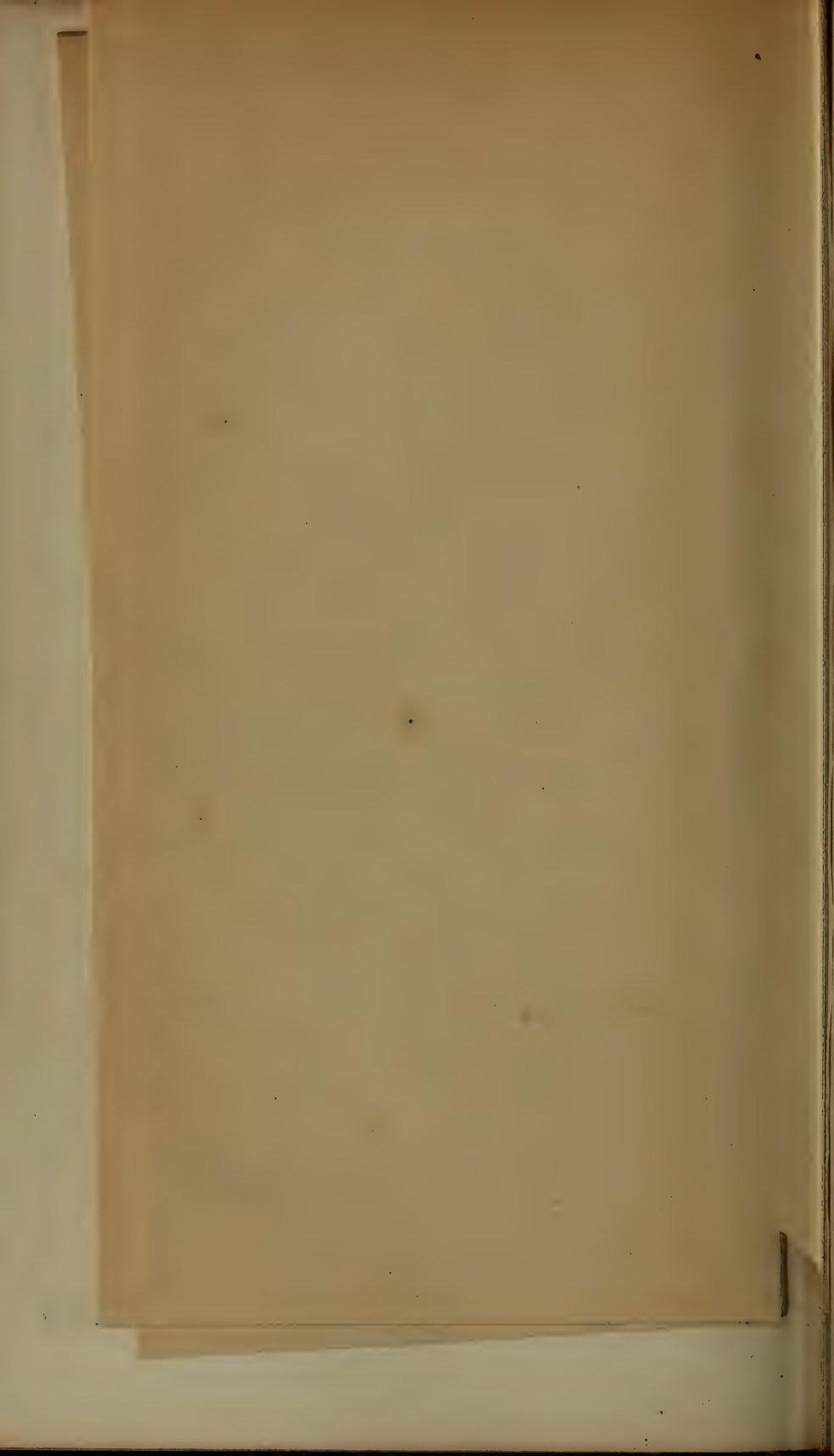
Range XI.

Range X.

Range IX.

Range VIII.

Range VII.



(F.)

CONTRIBUTIONS

TO

PALÆONTOLOGY,

1858 & 1859.

BY JAMES HALL,

GEOLOGIST AND PALÆONTOLOGIST, ETC.

Hand

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Notices of New Forms of the Genus *Graptolithus*, and Allied Genera.

[From the Supplement to Vol. I, published in Vol. III, Pal. N. York, p. 510 - 520.]

GRAPTOLITHUS GRACILIS.

This species was first described in the Palæontology of New York, Vol. i, p. 274. Its usual form is that of a slender sinuous stipe or rachis, from one side of which are diverging branches which are serrated on one margin only. I have lately farther illustrated this species in the Regents' Report upon the State Collections of Natural History. A subsequent examination of the specimens from the Normanskill, near Albany, has shown some modifications of its form and mode of occurrence, not before observed, which make it necessary to offer some farther illustrations in this place. The species may be described as follows:

Frond bipartite (or quadripartite?), consisting of two principal stipes: stipes diverging from a point of attachment, and ascending more or less vertically; slightly curved in the young state, and more curved in older forms. Branches originating on the outer or lower side of the rachis; the first ones diverging almost rectangularly, while the later ones are more ascending, as large at their origin as the rachis, and becoming wider in their extension. Young branches thickened and succulent with the serratures obscure, becoming flattened and distinctly serrate in the older forms. In the full grown specimens, the extremity of the stipe beyond the origin of the last branches is serrate.

The specimens of this species, in their mature condition, all present the peculiarity of having a slender sinuous rachis, approaching in form the letter S, from which the branchlets diverge always on the convex side of the curve, so that ordinarily one half the branchlets proceed in one direction and the other half in the opposite direction. In the young specimens, there is a distinct appearance of a slender process or radicle from which the stipes diverge; and a more critical examination of some of the specimens having the S form, since this fact has been ascertained, discloses the remains of a minute transverse filament; and others show a fracture or separation along the rachis between the two sets of branches, corresponding, as I had before suggested, with the centre or point of origin of the animal body.

It is barely possible that this apparent central radicle may be the remains of two other stipes, corresponding to the two usually preserved; but we have not thus far been able to discover any extension of these parts, or evidence of a third or fourth main branch or stipe. Although it is not possible at the present time to determine fully the mode of growth, and the original form of this species when entire, we are nevertheless able to offer some additional information which may be of interest.

In the minute forms which appear to be the young of this species, no lateral branches are developed, while the centre or base is marked by a transverse bar which extends almost equally on either side of the stipe or rachis. The accompanying figures 1-4 are illustrations of this form, which are enlarged to twice the natural size, fig. 1 presenting the animal in its earliest observed stage of development.

The second step in the progress of development, which has been observed, is shown in fig. 2, which is from a very beautiful specimen in the collection of Mr. R. P. Whitfield: in this one, the general form is similar to that of fig. 1, but it is

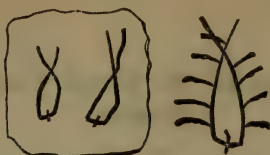


Fig. 1. Fig. 2.

somewhat larger, and there are five lateral branches on each side. Another individual, somewhat farther advanced, presents eight or nine branchlets on either side, as shown in fig. 3.

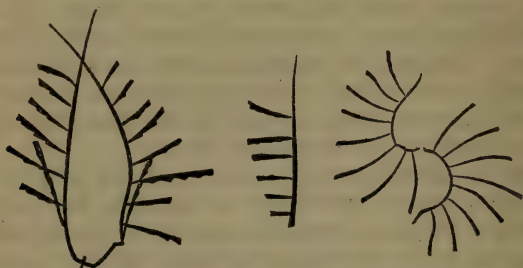


Fig. 3. Fig. 4. Fig. 5.

At the same time it is not easy to see at once how this form should assume the S-form so common in the specimens observed, and consequently it is difficult to illustrate every stage of the process. We do observe, however, that the main stipes become more curved as they progress; and it is only necessary to spread out, on a flat surface, these two stipes in opposite directions and rectangularly to the direction of the small branches, and we should have a form approaching that in which these fossils usually occur.

The small specimen which I had referred to *RASTRITES* in my communication to the Regents' Report, is simply one-half of one of those young individuals of *G. gracilis*, where the young branches are thickened and not distinctly serrate (fig. 4)*.

In the original specimen of *G. gracilis* there is a slight interruption in the continuity of the main stipe, as is observed in many individuals of that form; and there is likewise a small process which may be the radicle, as shown in the accompanying fig. 5, of a small specimen preserving the usual form of this species: this figure is of the natural size.

The accompanying fig. 6 (on the opposite page), of a very beautiful specimen of the *G. gracilis*, is from the same locality as all the others known to me, but shows a greater development of the branches and a more distinct serration than any others in the collection†.

* The specimen figured in EMMONS'S American Geology, Plate 1, fig. 6, and described as the type of a new Genus *NEMAGRAPTUS*, is evidently a fragment of *G. gracilis*.

† Although the main stipe was represented as continuous, it is nevertheless partially covered in the centre, or at the radicle-point by the overlapping of one of the bent branches and a little adhering stone.

This one and the preceding species are remarkably slender, and although serrated on one side only, present some marked peculiarities when compared with the singly serrated forms with central discs and a bilateral arrangement of the branches, as in *G. logani*, *G. flexilis*, and *G. multifasciatus*.

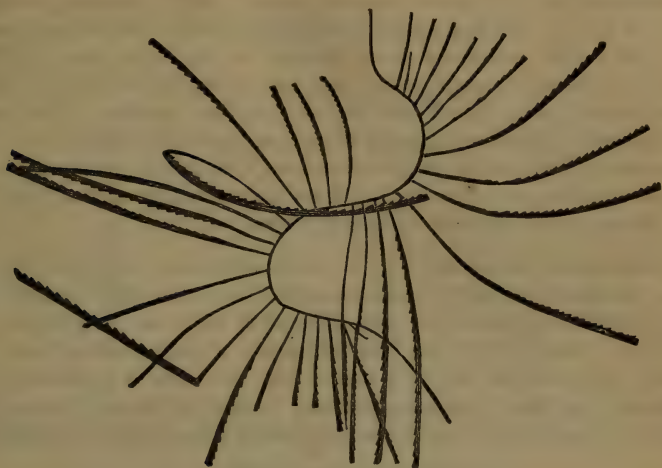


Fig. 6.—GRAPTOLITUS GRACILIS.

The specimens of this species, which have thus far come under observation, have still some points relative to the mode of growth undecided. It may have grown, in the young state, as shown in figures 1, 2, 3. If, however, the little transverse bar at the base indicates the original existence of two similar stipes or main branches in addition to those already known, the mode of growth may still have been similar, but having four instead of two main branches or stipes. If spread out, as the specimens usually are upon the surface, it may assume the form of the accompanying diagram, fig. 7.

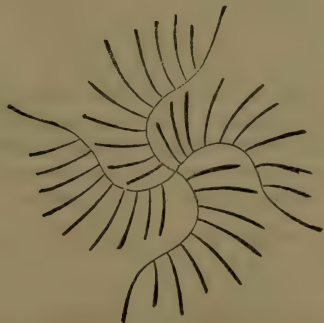


Fig. 7.

It is still possible that it may have assumed another form in its original mode of growth, and that these small bifurcate fronds are but the separated offshoots from a rhizoma which extended along the muddy bottom of the sea, giving off at intervals the ascending stipes in pairs, which in their progress became branched as before shown; and in this case, the little transverse bar in the bending of the frond is a part of the broken rhizoma.

Geological position and locality. In the shales of the Hudson-river group: Near Albany.

GRAPTOLITHUS DIVARICATUS (n. s.).

STIPE bifurcate from the radicle: branches slender, widely diverging, divergence from 90 to 120 degrees, very slightly increasing in width from the base, serrated on the lower side; serratures nearly straight on the outer margin, with the apices of the denticles somewhat rounded; the indentation rounded at the bottom, extending across one-half the width of the stipe; margins of the indentations thickened: the margin opposite the serratures is not thickened.

SURFACE marked by a row of small nodes placed obliquely to the direction of the axis, and situated just below and a little on one side of the bottom of the serrature. Serratures 22-26 in the space of an inch.

This species somewhat resembles in its general form, when the stipes are widely divergent, the *G. serratulus*; but the serratures are on the lower instead of the upper margin of the stipe, and are quite different in form and proportions. The small nodes or tubercles are, also, so far as known, a distinguishing feature. In this species these nodes are distinctly oval in form, and have a depression or slit in the summit; and from their appearance and relation to the serratures, I infer that they are of more importance in the organization than simply as ornament.

GRAPTOLITHUS DIVARICATUS.

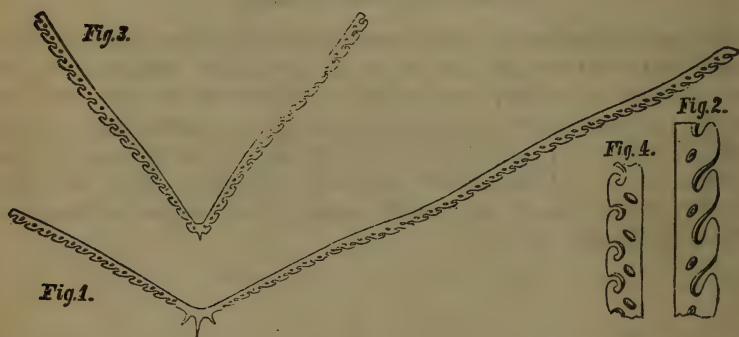


Fig. 1. A large individual, where the divergence of the parts is much greater than in figure 3.

The figures are twice the natural size of the specimens.

Fig. 2. A part of the stipe still further enlarged, showing the serratures and the small nodes.

Fig. 3. An individual, where the divergence is less than 90 degrees.

Fig. 4. A part of fig. 3 much enlarged, to show the form of the serrature.

Geological position and locality. In the shales of the Hudson-river group: Normanskill, near Albany.

GRAPTOLITHUS MARCIDUS (n. s.).

FROND simple biserrate: stipe short, rigid; midrib strong; serrations deep, the denticles small, triangular, subobtuse, arranged in the proportion of twenty-eight to thirty-two in the space of an inch, often somewhat alternating on opposite sides of the stipe, which is terminated below by two or three longer denticles which are of the same substance as the body of the stipe. The apex is marked by an extended fibre or continuation of the axis.

The specimens of this species which I have seen are usually not more than from one-half to seven-eighths of an inch in length. The axis is narrow; the points of the serrations separated, leaving a defined triangular indentation; and the aspect is that of a contracted or shrunken stipe, and by this character alone is very readily distinguished. It has been observed in considerable numbers, so that we can have no doubt as to the constancy of its characters.

GRAPTOLITHUS MARCIDUS.

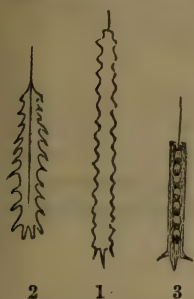


Fig. 1. A specimen more contracted than usual, with the serratures obtuse.

Fig. 2. An individual presenting a more expanded form, with distinct denticles at the lower extremity and a minute radicle below.

Fig. 3. A young form where the serratures are not developed, or are flattened in the line of their direction, and in which the minute fibres or radicles at the base are well preserved. The specific relations of these forms have not been fully determined; and I am, at present, unable to refer them to any other than this one.

Geological position and locality. In the shales of the Hudson-river group: Near Albany.

GRAPTOLITHUS ANGUSTIFOLIUS (n. s.).

STIPES simple, linear, slender, biserrate; serratures well defined, the denticles short ovate-acute, the extremities sometimes subobtuse; base marked by minute setiform radicles; midrib projecting beyond the serrated portion in a capilliform extension. Serratures arranged in the proportion of about twenty-eight to thirty in the space of an inch.

This species has a narrow stipe with very distinct denticles, which are usually closely arranged or apparently overlapping each other at the base, while sometimes they are separated more distinctly and the indentation deeper. The form and proportions of these denticles are different from those of any species of Graptolite in the collections from these shales, and often more resembling the minute denticulations on the fronds of fossil ferns than those of the graptolites. The denticles are often subalternate on the opposite sides of the stipe, and frequently variable in the same individual.

The accompanying figures illustrate the usual characters of this species.

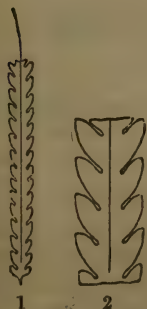


Fig. 1. A single stipe, twice the natural size.

Fig. 2. A portion still further enlarged.

This species is associated in the same laminæ of slate with *G. marcidus*, *G. whitfieldi*, *Reteograptus barrandi*.

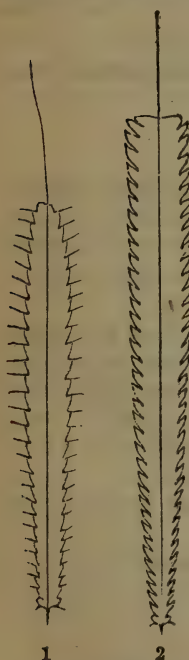
Geological position and locality. In the shales of the Hudson river group: Near Albany.

GRAPTOLITHUS WHITFIELDI (n. s.).

STIPE simple, flat, gradually expanding from the base to near the middle of its length, the upper part gradually narrowing in the direction of the apex, rarely continuing of the same width above the middle: serratures shallow, angular; the upper margin of the denticles short and nearly rectangular to the axis, the lower side twice as long as the upper, the tips furnished with mucronate or short setiform extensions which project in a line with the upper margin of the denticle. Serratures twenty-two to twenty-eight in the space of an inch.

LENGTH from one inch to an inch and a half.

This species has the general form and proportions of the *G. pristis* (HALL, Pal. New-York, Vol. i, pa. 265, pl. 72, f. 1); but that species does not contract its width towards the upper extremity, the denticles are concave above, and the points directed upwards. The form of the serratures and denticles is quite different in the two species, and the setiform processes are never observed on that species as in this one, where it is a constant feature.



The present form is not unlike the one described as *G. mucronatus* (HALL, Pal. New-York, Vol. i, pa. 268, pl. 73, f. 1); but that species has differently formed serratures and denticles, and the entire stipe is more lax. The upper margins of the denticles are traceable nearly to the midrib in well-marked specimens of that species, and the mucronate tips appear to be formed by the gradual narrowing and extension of the substance of the denticle; while in this one, it is an abrupt extension from the apex of the denticle.

For the purpose of comparison with the *G. pristis*, I have presented figures of the two species, which are enlarged to twice the natural size.

These specimens are from the same locality, and the differences are constant.

Fig. 1. *G. WHITFIELDI*.Fig. 2. *G. PRISTIS*.

Geological position and locality. In the shales of the Hudson river group: Near Albany.

GRAPTOLITUS SPINULOSUS (n. s.).

STIPE simple, flat; sides subparallel, gradually expanding from the base, which is furnished with several minute setiform radicles: serratures not distinct, the margin sinuous, the prominent parts extended into slender ascending spinuliform processes. These spinules are about one-sixteenth of an inch distant from each other.

This species presents no distinct serratures on the margin, which is simply undulating with the extension of the processes described, which probably mark the place of the serrature. It has been seen only in small individuals or fragments; but its great comparative width, the rigid distant spinules and absence of defined serratures are distinguishing characters.

The accompanying figure is of a fragment of this species, twice the natural size.

Geological position and locality. In the shales of the Hudson river group: Near Albany.



The Genus GLADIOLITES or RETIOLITES of BARRANDE was proposed for certain graptolitic forms having the general features of the biserrate Graptolites, as *G. pristis*, *G. mucronatus*, and others; but the structure of the entire substance of the stipe differs in being apparently minutely celluliferous or reticulate.

GENUS GLADIOLITES = RETIOLITES (BARRANDE).

"POLYPIER small, flat, triangular, elongate, formed of two series of symmetrical cellules arranged along the axis. These cellules extend from a single internal canal, which occupies the central part of the polypier: their orifices are disposed upon the sides of the triangle; they make an angle with the axis, and leave no spaces between them."

"The only known species has its surface covered with a film, which appears to envelope it."

I have recognized in the Clinton group of New York a species corresponding to this generic description, the *R. venosus* (Pal. New York, Vol. ii, pa. 40, pl. A 17, f. 2), which is there described as a GRAPTOLITHUS. In the Report on the Geological Survey of Canada for 1857, I have described two other species. An examination of some specimens of another similar form from the Hudson river shales near Albany (New York) has convinced me that one of these is sufficiently distinct to form the type of a new genus, for which I have proposed the name RETOGRAPTUS, from its reticulated structure, and from the absence of serratures of cellules reaching to the axis.

RETOGRAPTUS BARRANDI (n. s.).

STIPES small, sublinear; sides essentially parallel. Enveloping crust of the stipe finely veined, somewhat thickened: the skeleton reticulate with three or more rows or series of subquadrangular reticulations, without midrib or central axis: no defined cellules or serratures; margins with projecting mucronate or recurved spinules.

The specimens are nearly all deprived of their outer crust, leaving the skeleton alone.

The accompanying figure is from a specimen, twice enlarged.

Geological position and locality. In the shales of the Hudson-river group: Near Albany.

I am by no means certain that this fossil, in its perfect condition, or in all its stages of growth, consists of three rows of cells. The structure and mode of growth



in these forms indicates that the cells increase by lateral extension; and a single fragment in the collection gives some evidence of four rows of reticulations, as in other forms of the genus. It is not improbable, also, that in entire specimens we may find evidence of a central axis; since the implied mode of growth, in its similarity to that of the graptolites, indicates this structure.

GENUS THAMNOGRAPTUS (n.g.).

BODIES consisting of straight or flexuous stipes (simple or conjoined at the base?), with alternating and widely diverging branches : branches long, simple or ramose in the same manner as the stipe. Substance fibrous or striate; the main stipe and branches marked by a longitudinal central depressed line, indicating the axis. Cellules or serratures unknown.

These bodies are associated with the Graptolites; and from a general similarity in their substance, I suppose them to belong to the same family of fossils. In all the specimens the surface visible is smooth or striated without indentations, and marked by cross fractures or cleavage planes. The fragments of what appear to be carbonized plants, in the shales of the Hudson-river group, probably all belong to this genus, or to the DENDROGRAPTUS.

THAMNOGRAPTUS TYPUS (n.s.).

STIPE strong, flattened : branches alternating, about half as wide as the main stipe and expanding at their junction with it, simple, marked along the centre by a depressed line or axis. Surface marked by fine longitudinal striæ, with obliquely transverse fractures or lines of cleavage.

Fig. 1.



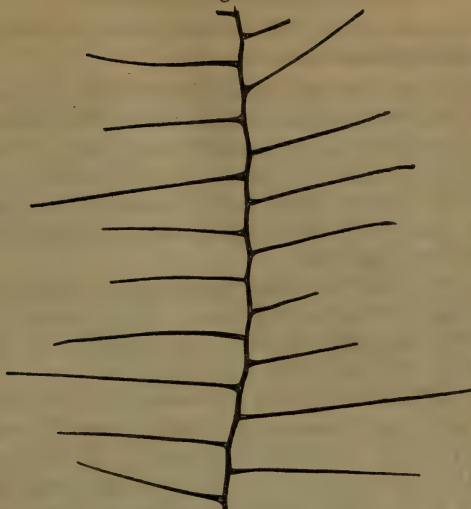
THAMNOGRAPTUS TYPUS.

The accompanying figure is from a fragment of this species, of the natural size.

Geological position and locality. In the shales of the Hudson-river group : Near Albany.

This genus was proposed by me in 1858, in a paper read before the American Association for the Advancement of Science; but no publication has been made of the name, so far as I know, except in a newspaper report at the time. At that time I had seen but a few fragments of the species, the first one having been discovered by Mr. J. B. ELLIS of Albany; and it is only since the descriptions were in type that the specimen, from which the accompanying figure 2 has been made, was discovered by Mr. WHITFIELD among the shales at Normanskill. The constancy of the generic characters in two distinct species, and in at least half a dozen specimens, affords satisfactory evidence for separating this from any described forms.

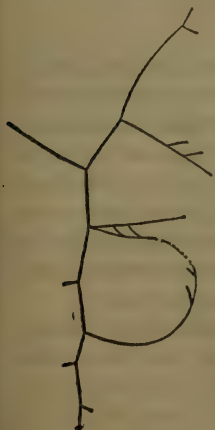
Fig. 2.



THAMNOGRAPTUS TYPUS.

THAMNOGRAPTUS CAPILLARIS (n.s.).

STIPE extremely slender, flexuose or slightly divergent at the junction of the branches : branches diverging nearly at right angles to the stipe, capillary; branchlets less divergent. Surface of stipe and branches marked by numerous indentations, which may indicate the place of cellules? Substance of the stipe, branches and branchlets, nearly cylindrical.



This species is an extremely slender form; the stipe, as preserved, being capillary, and the branches and branchlets still finer. It is not improbable that what appears in the fragment as the main stipe is a branch of a larger one, but its form and mode of branching preclude its identity with the preceding species.

The figure is from a fragment of this species, twice enlarged.

Geological position and locality. In the shales of the Hudson-river group : Near Albany.

THAMNOGRAPTUS CAPILLARIS.

GENUS RASTRITES (BARRANDE).

THIS genus was proposed by M. J. BARRANDE in 1850, to include certain graptolitic forms which he describes as follows :

" THIS polypier is composed of a small, almost linear, very long, and slightly curved stem, provided with an interior canal forming the communication between all the cellules. These are disposed upon the convex sides of the axis, and make with it a slightly acute angle : they are completely isolated from each other. The proportion between their length and their reciprocal distance varies according to the species. The diameter, in the known species, is always greater than that of the stem to which they are fixed.

" *Distribution of species.* The Genus RASTRITES has hitherto been represented only by four forms, all belonging to Bohemia : they characterize the mass of the Graptolite schists, constituting the base of our upper division. One of these four forms, *Rastrites peregrinus*, is also found in Saxony.

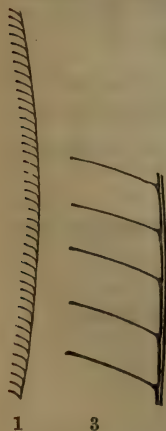
" *Relations and differences.* It must be observed that there is a very great analogy between the Genus RASTRITES and the Subgenus MONOPRION. The only characters which lead us to separate them are : 1, The isolation and the great space between the cells composing the polypier, which we call *Rastrites*; 2, The great tenuity of their filiform stems, always more slender than the alveoles which they support."

Notwithstanding some slight differences from the generic description here given, I have referred the following form to this genus :

RASTRITES BARRANDI (n.s.).

STIPE slender, filiform, rigid, slightly curved, and furnished on the concave side with numerous, nearly regularly disposed, minute, setiform processes or cellules, at the bases of which there is a slight thickening or expansion of the principal stipe. Stipe, and cellules or processes, rounded in their natural condition.

RASTRITES BARRANDI.



The fragment is about two and a quarter inches in length, and in its natural state has evidently been a nearly or quite cylindrical tube, a longitudinal depressed line indicating the place of the axis. In this length there are more than forty of these minute processes, the stipe just below each one swelling out a little on that side; the expansion terminating abruptly above, and, from its outer angle, the minute spine proceeds like the mucronate extension from the points of the serratures in some graptolites.

This form differs from the strict description of RASTRITES, in having the stipe much larger than the cellules. Whether these points or processes are the true cellules, or extensions from them, might admit of some doubt, were observations based upon this species alone.

Fig. 1. View of the specimen, nat. size. Fig. 2. A part enlarged.

Geological position and locality. In the shales of the Hudson-river group : Near Albany. Collected by Mr. R. P. WHITFIELD.

GENUS RHYNCHONELLA (FISCHER, 1809);

With Observations on the *R. (Atrypa) increbescens*.

THE shells of this genus have been for many years included under the Genus *ATRYPA* of DALMAN, and in part under *TEREBRATULA*, etc. by most American and many European palæontologists; and it is only recently that the name *Rhynchonella* has been fully understood in its application, and generally adopted by writers. At the same time we have already shown that some shells, usually referred to *RHYNCHONELLA*, possess internal characters incompatible with that genus; and I have separated *TREMATOSPIRA*, *RHYNCHOSPIRA* and *EATONIA* from among those species having externally the rhynchonelloid form. The two first possess internal spires, while the last has certain peculiarities separating it very clearly from *RHYNCHONELLA* proper.

Since some of the species having the external form and plicated surface of the genus are proved to be distinct, we may reasonably look for others among the great number of species now referred to that genus from the different geological periods, as it is recognized from the Lower Silurian epoch to the present time.

Leaving out of view in this place the structure of the animal, the following description will convey an idea of the character of these shells in their fossil condition. The animal, in its living state, is free, or attached to submarine objects by a pedicle which protrudes from a foramen beneath the apex of the beak.

GENERIC CHARACTERS. "Shell inequivalve, variable in shape, transverse or elongated, circular or trigonal : valves more or less convex, with or without a mesial fold or sinus; beak entire, acute, prominent, or so much incurved as to leave no free space for the passage of pedicle-muscles; foramen variable in its dimensions and form, placed under the beak, exposed or concealed, entirely or partially surrounded by a deltidium, the aperture being sometimes completed by a portion of the umbo of the smaller valve; deltidium in two pieces, at times extending in the form of a tubular expansion, or rudimentary; surface striated or plaited, rarely smooth; structure fibrous, impunctate. Valves articulating by means of two teeth in the larger (ventral) and corresponding sockets in the imperforate dorsal valve; apophysary system, in the smaller or dorsal valve, composed of two short flattened and grooved lamellæ, separate and moderately curved upwards, attached to the deeply divided hinge plate. In the socket valve the quadruple impression of the adductor muscle is clearly defined, and separated by a short medio-longitudinal ridge s. The pedicle scars occupy the small cardinal plates, between which is the small and narrow cardinal process. In the perforated valve the two strong diverging cardinal teeth are supported by dental plates extending to the bottom of the valve, and at the base of these a semi-circular ridge curves on each side, forming a more or less defined saucers shaped depression into which were affixed the shell and pedicle muscles : these last leave two narrow elongated scars close to the inner base of the dental laminæ; the remaining and largest portion being chiefly occupied by the cardinal muscles, which are longitudinally divided by a small raised ridge; above these again is seen a small oval scar due to the adductors."*

* DAVIDSON'S Introduction to the Study of the Brachiopoda.

The accompanying figures illustrate the generic character as above.

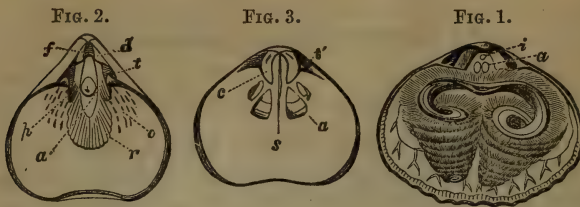


FIG. 1. The dorsal valve of *R. nigricans*, a living species, showing the spiral appendages (or labial arms) : *a*, the adductor muscles; *i*, the intestine.

FIG. 2. *R. psittacea*, ventral valve : *f*, foramen; *d*, deltidium; *t*, teeth; *a*, adductor; *p*, pedicle muscles; *r*, cardinal muscles; *o*, ovarian spaces.

FIG. 3. Dorsal valve : *c*, crural processes; *t'*, sockets; *a*, adductor; *s*, septum.

Figures 4 and 5 are illustrations of the ordinary form and appearance of *Rhynchonella psittacea*, as it occurs in the modern tertiary deposits of the St. Lawrence valley.

FIG. 4.

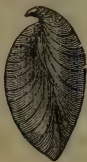
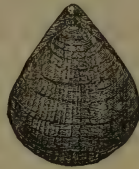


FIG. 5.



Species of this genus are common in the rocks of New-York, from the Chazy limestone to the Chemung group inclusive. Among the most common forms in the Lower Silurian rocks are the *R. altilis* of the Chazy limestone, *R. increbescens* and *R. dentatus** of the Trenton limestone and the Hudson-river group. In the Niagara group of New-York the *R. cuneatus* is usually the most conspicuous form, while other species are of frequent occurrence. In the Lower Helderberg group the more common forms are of the type of *R. wilsoni*, while *R. concinna* and others represent the type of *R. dentatus*. The globose forms, with rounded or flattened plications, attain their greatest development in the Lower Helderberg group, while the higher rocks are usually marked by the presence of the more nearly triangular forms with angular plications.

RHYNCHONELLA INCREBESCENS.

This species is very abundant and widely distributed : it occurs in the Trenton limestone of New-York and the Western States. In the higher beds of the calcareous shales of the Hudson-river group in Kentucky, Ohio, Indiana, Illinois, Michigan and Wisconsin, it everywhere abounds, often attaining a large size and very gibbous and ventricose proportions.

* These were described under the generic name of *ATRYPA*, in the first volume of the Palæontology of New-York, and subsequently (Regents' Report for 1859) placed under the Genus *RHYNCHONELLA*.

The accompanying figures illustrate the ordinary forms of the species.



Fig. 6. A young specimen, front view. 7. An older specimen. 8. Front view of fig. 2.

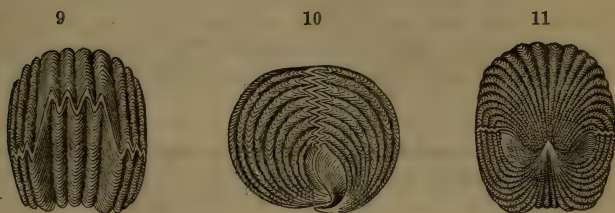


Fig. 9, 10 & 11 are front, profile and cardinal views of a full-grown individual which has become very ventricose.

Its wide geographical distribution and considerable vertical range make it an interesting species. In its external features it presents no variation or difference of importance from other *Rhynchonellæ*; but the interior structure of specimens recently examined shows some peculiarities, which, if constant, are incompatible with the characters of that genus as determined from existing and some well-marked fossil species.

This species, like some others of the genus, becomes extremely gibbous or ventricose with age, and the apex of the ventral valve is closely incurved over the beak of the opposite valve. Nor is this all; for the beak is perforate, and in many specimens we are able to discover a distinct foramen in the substance of the shell: indeed sometimes this foramen is above or exterior to the apex of the beak, but it is rarely possible to distinguish the continuity of the substance of the shell between this foramen and the beak of the opposite valve. Externally, therefore, this feature might not be considered incompatible with *RYNCHONELLA*, where the base of the foramen is often formed by the beak of the dorsal valve; and it might be supposed that as the shell increased, and the incurvation became too great to permit the protrusion of the pedicle at the ordinary foramen, the notch in the beak might be deepened until it would reach beyond the apex. Sometimes, however, this foramen is seen to be surrounded by the substance of the shell; thus becoming a simple perforation, without the appearance of deltidial plates.

The real condition and relations of this foramen I have recently been able to determine satisfactorily, from an examination of some separated valves and imperfect specimens collected by Mr. WOOLSON, of Iron Ridge, Wisconsin, from the green shales beneath the iron ore. The interior of the dorsal valve has the usual aspect of this valve of other *Rhynchonellæ*, except that in the centre of the apophysary process, at the base of the crura, there is a narrow central process which is more distinct than usual. In the ventral valve there are two strong teeth, which fit into deep sockets in the opposite valve; and above these, the triangular space is partially or entirely occupied by a concave solid area; beneath which, extending

from the interior of the shell, there is a distinct foramen which passes out at the apex or above the apex of the valve, a groove on the lower side always extending thence to the apex. This area sometimes shows a longitudinal suture line, but this feature is not always visible. In three well-preserved specimens, this area and the foramen beneath have been very satisfactorily determined, while in others the existence of the area has been ascertained. In older specimens the shell is often much thickened, and the cavity partially filled by the substance of the valve.

It has not been possible, with the specimens in my possession, to determine whether this feature is characteristic in all stages of growth; but since it occurs in some half-grown specimens which are but moderately gibbous, and where the beak is but moderately incurved, I infer that this character is assumed at an early period of growth. In the *R. altilis* of the Chazy limestone, there are some evidences of the feature here described, but the specimens I have do not afford sufficient proof. At the same time, after an examination of the gibbous and ventricose forms of the Lower Helderberg group, I have been unable to detect any feature of this kind.

The accompanying figures are of the dorsal and ventral valve of a specimen of this species, where the shell is much thickened.

FIG. 12. FIG. 14. FIG. 13.



FIG. 12 & 13. Ventral and dorsal valves of the natural size.

The letters refer to the same parts as in the figures 1 and 2 of a preceding page. I have used the letter *d* to designate the area, its use being to indicate in shells of this kind the deltidial plates.

Fig. 14 is a figure of a smaller individual, enlarged, where the beak is but little incurved, the foramen well defined, and the solid area well preserved, showing longitudinal striæ.

It may be suggested that the cardinal area results from the bending inwards and coalescing of the deltidial plates, but its appearance scarcely corresponds with such a change in these parts. The area is distinctly defined, making an angle with the outer shell at its lateral margins, which limits it as strongly as the cardinal area in *SPIRIFER*, while the course of the foramen beneath it is distinctly defined.

Should the characters here described prove constant in this and other species, it may be convenient to separate them under the subgeneric designation of *Rhynchotrema*, in allusion to the apical foramen.*

* Since the preceding pages were prepared for the press, I have seen several valves of this species from the shales of the Hudson-river group in Ohio. In one of four only was there any area preserved; the specimens, however, had been somewhat waterworn.

ATRYPA MODESTA.

Paleontology of New-York, Vol. i, pa. 141, pl. 33.

This species, which was described under the name of *Atrypa modesta* (*Producta modesta* of SAY), was subsequently (Regents' Report of 1859, p. 66) left with hesitation under the same designation, with a doubt expressed as to its generic relations, and a suggestion that it might be related to LEPTOCÆLIA. At the same time, I suggested that *Atrypa plicatula* of the Clinton group might be of the same genus.

Since that time, I have made careful examinations of some specimens of *A. modesta*; and though they are all solid, they nevertheless show, on cutting through them or grinding down and polishing the surface, the existence of internal spires, which appear to be arranged as in ATRYPA. In regard to this fact, however, I have still some hesitation, and farther examination is necessary to the full determination of the generic relations of this species.

Although having externally the form of RHYNCHONELLA, and the plicated surface common to many species of this genus, it will be observed that the *Atrypa? modesta* has the sinus on the dorsal valve, and a mesial lobe or elevation on the ventral valve. It likewise bears some resemblance in its beak and foramen to TREMATOSPIRA, but there are still differences which are scarcely reconcilable with that genus.

Thus far, I have been quite unable to obtain separated valves of this species. Solid specimens of the *Atrypa plicatula*, when cut through, have shown no internal appendages. My collection of these, however, is not large, and I have not the means of making satisfactory examinations. The sinus of this species is in the ventral valve, and the elevation on the dorsal valve is less like RHYNCHONELLA than it is like TREMATOSPIRA or RHYNCHOSPIRA. These, and a few other of the rhynchonelloid forms, are subjects worthy of farther investigation by those who have large numbers of specimens of the species.

NOTE. Being engaged in the study of this and some analogous forms, with a view to their illustration in the next Report of the Regents upon the State Cabinet of Natural History, the writer will be greatly obliged for any information or specimens that may aid in the elucidation of the structure of these fossils, and will be glad to give liberal returns of other fossils for any specimens of separated valves, or those showing the interior structure.

OBSERVATIONS

Upon *Orthis insignis* of the Lower Helderberg group (Pal. New-York, Vol. iii, pa. 173, pl. 13, f. 13 - 15); *Orthis pyramidalis* of the Niagara group (Pal. New-York, Vol. ii, pa. 251, pl. 52, f. 2), and a similar species from Tennessee.

AN examination of the separated valves of *Orthis insignis* has shown that the internal structure is so extremely different from that of ORTHIS, that the species cannot with propriety remain under that generic designation. In the separated dorsal valve there is a slender cardinal process, which, continued as a longitudinal septum, extends from the beak towards the front of the shell where it is bifurcated, and, expanding in width, reaches the inner margin of the ventral valve. The hinge-plates or brachial plates are extremely thin and flattened, spreading laterally, and having scarcely perceptible dental sockets: the inner margins are produced towards the centre of the cavity, as if for the attachment of crura. In the ventral valve, I have not been able to determine the form of the muscular impression. The angles of the

foramen at the base of the area are but slightly thickened, but little produced, and have scarcely the appearance of the teeth of *ORTHIS*.

In *Orthis pyramidalis*, I have not been able to obtain separated valves; but so far as can be ascertained, we have a similar internal structure. In the species from Tennessee the same characteristics appear, except, perhaps, that the specimens seen do not exhibit the bifurcation of the median septum of the dorsal valve.

For these forms I propose the generic designation of *SKENIDIUM*, in allusion to the form of the ventral valve.

GENUS SKENIDIUM (n.g.).

[Gr. Σκενιδιον, *tentoriolum*, a little tent.]

SHELL subpyramidal, somewhat semicircular, with or without median sinus and elevation. Area large, triangular, divided by a narrow deltoidal foramen which is sometimes closed at the summit by a concave deltidium. Valves articulating by teeth and sockets, which are often obscure or obsolete. Dorsal valve flat, or varying from depressed convex to concave; beak entire, or indented by the foramen. Cardinal line straight, and usually equalling the width of the shell: cardinal plates broad and well developed, marked by the imprints of the peduncular muscles, and produced in the middle in a pointed process. The cardinal process extends as a median septum through the length of the shell, and may be simple or divided at its extremity. Ventral valve elevated, subpyramidal; beak straight or slightly arched. Muscular impressions undetermined. Exterior surface covered with radiating striæ.

The species which I propose to include under this genus have the general aspect of *ORTHIS*, except in the extreme elevation of the ventral valve, which gives a pyramidal aspect to the shell when resting upon the dorsal valve. In one species, *S. insignis*, the median septum is clearly bifurcated near the extremity, and expanded in width so much that it divides the interior cavity. In a species from Tennessee, for which I am indebted to the kindness of Prof. SAFFORD, the septum appears to be simple, and extends to the anterior margin of the shell. The interior of *S. pyramidalis* of the Niagara group has not been determined, and it is united with the others from its exterior form and surface markings.

Geological distribution of the species. Of the three species known, one occurs in the Lower Silurian strata of Tennessee, one in the Niagara group, and one in the Lower Helderberg group.

The accompanying figures illustrate the characters given in the descriptions above.



FIG. 1. Front view of a specimen of *Skenidium insignis*, enlarged.

FIG. 2. Cardinal view, still farther enlarged.

FIG. 3. Exterior of the dorsal valve.

FIG. 4. Interior of the ventral valve.

FIG. 5. Interior of the dorsal valve, showing the wide hinge-plates and the bifurcating median septum*.

* As this description is going to the press, my attention is called to the Genus *RHYNCHORA* of DALMAN, as illustrated by DAVIDSON in the species *R. spatulata* of DALMAN. The interior of the dorsal valve of that species, particularly in the median septum, bears much resemblance to the dorsal valve of *SKENIDIUM*; but I cannot suppose there will prove to be generic identity.

OBSERVATIONS ON THE GENUS AMBOCÆLIA.

IN the Journal of the Academy of Natural Sciences of Philadelphia, Vol. viii, 1842, Mr. CONRAD described, under the name *Orthis umbonata*, a fossil shell from the shales of the Hamilton group at Moscow in New-York. This species is common in the same group from Seneca lake to the shores of Lake Erie. There are likewise other similar forms less abundant in the Hamilton group of New-York, and one species in the Chemung group, and we know a single species from the Coal measures. The species all have the ventral valve extremely convex, arcuate and ventricose; while the dorsal valve is nearly flat, or sometimes slightly concave or convex. These species differ essentially from *ORTHIS* in external appearance and internal structure; and from the ventricose form of the ventral valve, I have proposed the generic designation *AMBOCÆLIA*.

GENUS AMBOCÆLIA (n.g.).

[Gr. ἀμβων, *umbo*; and κοιλία, *venter*.]

Generic characters. Shells bivalve, inequivalve, equilateral, plano-convex or concavo-convex: valves articulating by teeth and sockets; cardinal line equaling the greatest width of the shell; area common to both valves; foramen triangular, extending also to the area of the dorsal valve. Dorsal valve flat, depressed convex or concave; cardinal process bifurcate. The foveal plates are straight, longitudinal, pointed at their inner extremities; and from their centre on the outside extends a callosity curving around the dental sockets, which open towards the cardinal line. Muscular impressions four, and distinctly marked in the middle of the valve or below. Ventral valve arcuate, with or without a distinct sinus: beak arching over the area; dental lamellæ strong, extending in short obtuse teeth. The impressions of the cardinal muscles form two semioval spots near the middle of the concavity between the beak and base of the shell. Surface very finely cancellated by obscure radiating striæ and fine concentric lines of growth. Shell-structure fibrous (or fibro-punctate): lustre pearly.

The typical species of this genus is the *Orthis umbonata* of CONRAD. The *Spirifer unguiculus* of SOWERBY may likewise be included in this genus; and also *Orthis subumbonata*, *O. preumbona* and *O. nucleus*, as well as another species in the Chemung group which I have heretofore referred to *O. unguiculus* (*S. unguiculus* of SOWERBY). There is likewise a Carboniferous species, *A. gemmula*; making five known American species, and one European. These together constitute a very natural group, readily determined by external characters, and easily separable by these alone from *ORTHIS* or any other genus of Brachiopods in the American strata.

In several of the species there is a distinct mesial sinus upon the ventral valve, a feature strongly marked in *A. umbonata*, while in the other Hamilton species this character is less conspicuous; but it is seen in the Chemung species, and in the European form *A. unguiculus* as figured by PHILLIPS in his Palæozoic Fossils.



FIG. 1, 2, 3. Dorsal, ventral and profile views of *Ambocælia umbonata*, natural size, from the shales of the Hamilton group.

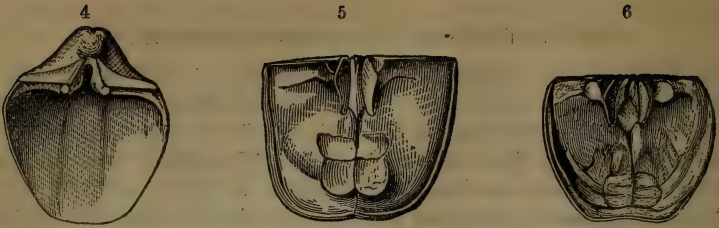


FIG. 4. The interior of the ventral valve, showing foramen, area, etc. enlarged.

FIG. 5. Interior of the dorsal valve enlarged, showing the foveal plates, dental sockets, and the quadripartite muscular impression; the valve slightly distorted.

FIG. 6. A similarly enlarged dorsal valve, showing some variations from the preceding.

Geological relations. The lowest position in which this genus is known is in the Marcellus shale, where we have a single species. There are three species in the Hamilton group, one in the Chemung group, and one in the Coal measures.

GENUS VITULINA (n.g.).

[Lat. *Vitula*, a goddess.]

Generic description. Shell plano-convex, semielliptical, marked by four or five simple rounded plications on either side of the mesial fold and sinus. Ventral valve very convex, gibbous in old specimens; the mesial fold consisting of two larger plications, with a shallow depression between them. Dorsal valve depressed convex or nearly flat, with a defined mesial sinus, in the bottom of which there is a flattened or slightly elevated fold. Area large, confined to the ventral valve; its length occupying two-thirds the length of the cardinal line, and sometimes nearly the entire length. Foramen very large, broadly triangular, reaching to the apex of the ventral valve, and its base half the length of the area. The cardinal processes and foveal plates of the dorsal valve are conspicuous in the foramen. Surface minutely pustulose; the pustules arranged in radiating lines, those of each line alternating with those of the next.

The interior of the ventral valve has the dental lamellæ well developed, and terminating at the lower angles of the foramen in strong somewhat rounded dental processes. Within the foramen, at the apex of the shell, a strong callosity extends across the rostral cavity, but does not reach to the exterior margins. From this callosity, a slender mesial septum extends half way to the base of the shell: on each side of this are the muscular impressions. The interior of the dorsal valve shows the cardinal process extending in a low rounded mesial septum which reaches below the middle of the shell, each side marked by a distinct groove. The foveal plates are narrow and very divergent.

This genus possesses characters somewhat intermediate to *TROPIDOLEPTUS* and *LEPTOCÆLIA*, when we consider the general form of the shell, but differs from both in internal structure. The strong dental lamellæ and dental processes extend from the lower angles of the area; while in *TROPIDOLEPTUS*, the teeth are oblique, crenulate, and distinctly separate from the area.

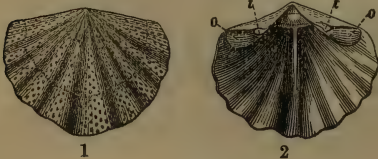


FIG. 1. Exterior of the dorsal valve, showing the pustulose surface: enlarged.

FIG. 2. Interior of the ventral valve, enlarged: *tt*, teeth; *oo*, the thickened dental lamellæ.

Geological relations. The single species known occurs in the Hamilton group, associated with other Brachiopoda, but extremely restricted in its vertical range.

OBSERVATIONS ON THE GENERA *ATHYRIS* (= *SPIRIGERA*),
MERISTA (= *CAMARIUM*), *MERISTELLA* AND *LEIORHYN-*
CHUS.

AMONG the fossils referred for many years to *TEREBRATULA*, *ATRYPA*, etc., European authors have separated the Genera *ATHYRIS* and *MERISTA*; shells which have many characters in common, and which were indeed at first united under *SPIRIGERA* or *ATHYRIS*, until in 1851 the Genus *MERISTA* was proposed by Prof. SUESS. In my later studies of the Brachiopoda of the American palæozoic strata, I have referred to the Genus *ATHYRIS* certain species which have a subglobose or ovoid form, with lamellose surfaces, and without, or with scarcely perceptible radiating striæ; while other forms, which are less distinctly lamellose and always more or less distinctly radiatingly striate with fine concentric lines of growth, I have referred to the Genus *MERISTA*. Many of the latter have the general form and surface characters of *Merista* (*Atrypa*) *tumida*, DALMAN, but are less ventricose: they all have internal spires, and, when perfect, the beaks appear to be imperforate. The radiating striæ, though visible in well-preserved specimens, are still more conspicuous in the partially exfoliated shell. *Atrypa tumida* of DALMAN is cited by DAVIDSON as one of the types of the Genus *MERISTA*.

I proposed last year* a separation of certain *Merista*-like forms, under the name *CAMARIUM*, on account of the presence of an arching transverse septum in the ventral valve. Subsequently, a more careful consideration of the characters of *MERISTA* as given by Mr. DAVIDSON, and an inspection of his figures, have shown me that this arching septum, in its attenuation towards the beak, is identical with the shoelifter process described as belonging to the Genus *MERISTA*. An examination of numerous specimens of different species of those which I have referred to the Genus *MERISTA*, shows no evidence of this process or septum; and the deep muscular impression below the rostral cavity, and the thickening of this part of the shell, are characters incompatible with the existence of the septum. Moreover I conceive that this arching septum, or the extension of the shoelifter process into the cavity of the valve, would produce such a modification of the soft parts of the animal, that the inhabitants of these shells were generically distinct from the inhabitants of the large uninterrupted cavity of the shells which heretofore I have referred to *MERISTA*.

In order, if possible, to reach a solution of the question, I have had the shell removed from a solid specimen of *M. tumida*†, which is one of the types of the genus, and there is certainly no evidence of the septum or shoelifter process, but, on the contrary, the presence of all the characters marking the American species which I have referred to *MERISTA* in Vol. iii, Pal. New-York. At the same time, the *Merista* (*Terebratula*) *scalprum* of BARRANDE, in the most solid of the specimens which I possess, readily reveals the presence of the septum.

Since this shoelifter process, or septum, was originally described by Prof. SUESS as characteristic of his Genus *MERISTA*, and the species designated by him as the types of this genus (the *M. scalprum* and *M. herculea* of BARRANDE) "do

* In the twelfth Report of the Regents on the State Cabinet : Also Supplement to Vol. iii, Pal. N. York.

† A specimen from Dudley, England, which does not differ materially from the authentic Swedish specimen; and Prof. M'Cor has pronounced the Swedish and Dudley species identical.

"possess this feature, the genus must be retained for the species with the shoelifter process."*

It would appear, therefore, that the Genus CAMARIUM, proposed by me in the preceding Report, possesses characters identical with MERISTA as originally described by SUESS, but which have been overlooked to some extent in consequence of the reference to *M. tumida* as a typical form of the genus. This point will undoubtedly be best determined by Prof. SUESS himself, and I shall not hesitate to follow his views.

At the same time, as the *M. tumida* of DALMAN, an English and Swedish species, in common with numerous well-marked forms in our Silurian and Devonian strata, do not possess this feature, we can no longer, with propriety, refer them to that genus.

With this restriction, the MERISTÆ proper consist of smooth, ovoid, circular or transverse shells, with usually a conspicuous sinus upon the ventral valve, and a corresponding wide, often undefined, mesial fold or elevation upon the dorsal valve; the hinge articulation being not very different from that of ATHYRIS, to which they are allied.

The interior of the ventral valve, however, is strongly distinctive; and the septum or shoelifter process is not unfrequently shown in the cleavage of the beak of that valve, in solid specimens, where the interior is inaccessible.

The forms which I have regarded as MERISTA are similar to those above; but instead of this septum, or shoelifter process, they have a deeply marked triangular muscular area just below the rostral cavity of the ventral valve, which is bordered on the anterior side by a callosity of the shell, and on the two other sides by the strong dental lamellæ. This feature is not conspicuous in ATHYRIS: the dental lamellæ in that genus are shorter and less strong, and the form of the muscular impression is different. The dorsal valve of those shells now under consideration has a longitudinal median septum; a feature which is obsolete, or partially obsolete, in the species of ATHYRIS. In the CAMARIUM, or MERISTA proper, the exterior of the ventral valve sometimes shows what appear to be two diverging septa, somewhat similar to those in the dorsal valve of PENTAMERUS, which are the margins of the shoelifter process.

The Meristidæ begin their existence, so far as we know, in the rocks of the Clinton group; and in this and the Niagara group there are several species, while they are more numerous in the Lower Helderberg group: they occur likewise in the Upper Helderberg rocks, and in the Hamilton group. MERISTA proper, so far as we know, appears first in the Lower Helderberg period, while ATHYRIS is known in two species for the first time in the Hamilton group.

Restricting, therefore, the signification of the Genus MERISTA to such forms as were originally included by Prof. SUESS under that name, it becomes necessary to designate those species of similar form, but without the peculiar appendage of the ventral valve, by another generic term; and I would therefore suggest the name MERISTELLA, proposed by me last year†.

GENUS MERISTELLA (n. g.).

SHELLS variable in form, oval, ovoid, orbicular or transverse. Valves unequally convex, with or without a median fold and sinus; beak of the ventral valve apparently imperforate, incurved over the beak of the smaller valve; area none: valves articulating by teeth and sockets. Surface smooth, or with fine concentric

* DAVIDSON, in letter to the writer.

† Regents' Report on the State Cabinet, page 78.

lines of growth and fine obsolete radiating striæ, which are usually more conspicuous in the exfoliated shell. The interior of the dorsal valve is marked by the presence of a longitudinal septum, and the upper part of the ventral valve by a deep sub-triangular muscular impression which unites with the rostral cavity.

EXAMPLES : *Meristella lavis*, *M. bella* and *M. arcuata* of the Lower Helderberg group; *M. cylindrica*, and *M. oblata* of the Niagara and Clinton groups.

Geological range of the species. In the Clinton and Niagara groups, the Lower and Upper Helderberg and Hamilton groups, and probably in the Chemung group. The carboniferous species of similar form, which I have examined, have a bilobed muscular impression in the ventral valve, and correspond with those I have referred to *ATHYRIS*.

In the period of the Hamilton group, other new forms appear, apparently allied to *MERISTELLA*, but marked by plications on the mesial fold and sinus, and sometimes with obscure or distinct plications on the lateral portions of the shell.

The internal structure appears to be the same as in *MERISTELLA*, and the fine obscure radiating striæ and fine cancellating concentric lines appear both upon the surface and upon the exfoliated shell. In these forms the substance of the shell is always thin, and the individuals are never so gibbous as in the species of the three allied genera.

Some of these forms approach *RHYNCHONELLA*; but the plications are more rounded, and rarely or never continued to the lateral margins, which are more compressed than in *RHYNCHONELLA* proper. The internal structure appears, so far as ascertained, to be the same as in *MERISTELLA*.

For these forms, I propose the generic name *LEIORHYNCHUS*.

GENUS *LEIORHYNCHUS* (n. g.).

SHELLS variable in form, ovoid, circular or transverse : valves more or less unequally convex, with a median sinus upon the ventral valve and a corresponding elevation upon the dorsal valve; beaks imperforate, that of the ventral valve curving over the smaller valve. Surface more or less strongly plicated; the mesial fold and sinus always plicated, the lateral portions being sometimes nearly or quite free from plications; concentrically marked by fine lines of growth and some stronger imbricating lamellæ. Substance of shell thin : structure distinctly fibrous. Valves articulating by teeth and sockets. Interior of ventral valve with two short diverging dental lamellæ, which extend into and are affixed to the sides or bottom of the rostral cavity. The muscular impressions occupy a narrow triangular cavity below the bases of the lamellæ, and usually extend about one-third the length of the shell. Dorsal valve with a well-defined medium septum, which extends half the length of the shell : the hinge-plates are narrow, strong processes, embraced by the curving teeth of the opposite valve. In numerous specimens examined, there is no evidence of internal spires; and it is only the similarity of these forms to *MERISTELLA* and *ATHYRIS*, that affords an argument in favor of the existence of these appendages.

The types of the genus are *Atrypa quadricosta* and *A. mesacostalis* (HALL, Geol. Report of the Fourth District of New York) = *Leiorhynchus quadricosta* and *L. multicosta* described in this paper, from the shales of the Hamilton group.

For illustration of these genera, see end of descriptions of species of the Hamilton group.

DESCRIPTIONS OF NEW SPECIES OF FOSSILS,

FROM THE HAMILTON GROUP OF WESTERN NEW-YORK, WITH NOTICES OF OTHERS
FROM THE SAME HORIZON IN IOWA AND INDIANA.

LINGULA LIGEA (n. s.).

SHELL narrow elliptical; length equal to twice the width; sides regularly curving; extremities subequal; margins of the valves thickened. Surface marked by fine concentric striæ, and by a few obscure or obsolete radiating striæ. The more convex valve shows, along the inner margin, a narrow shallow groove as if the edge of the opposite valve closed just within its margin.

The shell is of more equal width throughout and more symmetrically oval, and is much larger than the *L. spatulata* of the Genesee slate.

Geological formation and locality. In the shales of the upper part of the Hamilton group, on the shore of Seneca lake; and near the base of the Portage group, at the falls below Trumansburgh, N.York.

LINGULA PALÆFORMIS (n. s.).

SHELL broadly subovate, convex at the umbo and depressed below, the length a little greater than the greatest width, rapidly expanding for about two-thirds the length of the shell, below which it is abruptly rounded: shell thick. Surface marked by strong concentric lamellose striæ, and, in the exfoliated surface, by fine radiating striæ.

Geological formation and locality. In the shales of the Hamilton group, associated with numerous known fossils, in a loose fragment of rock in the valley south of Cayuga lake.

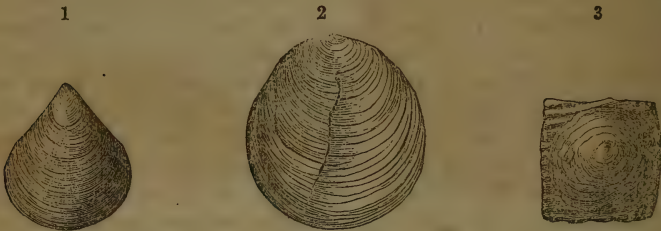


FIG. 1. *Lingula palæformis*.

FIG. 2. *Lingula exilis*.

FIG. 3. *Crania hamiltonia*; the dorsal valve adhering to *Tropidolepus carinatus*.

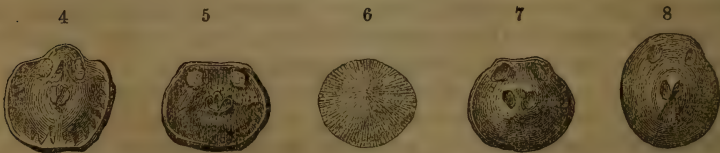


FIG. 4 & 5. *Crania hamiltonensis*; the interiors of ventral valves, showing some difference of form, and fig. 5 showing more distinctly the vascular impressions.

FIG. 6. *Crania crenistria*; the exterior of the dorsal valve.

FIG. 7. *Crania leoni*; the interior of the ventral valve in its natural proportions.

FIG. 8. *Crania leoni*; the interior of the ventral valve of a distorted specimen.

LINGULA EXILIS (n.s.).

SHELL broad ovate, moderately convex, length little greater than width; apex obtuse; cardinal margin obtusely rounded; sides regularly curving; base broadly rounded. Surface lamellose with irregular rugæ or lines of growth.

This species is very broad; and the great width at the apex, and broadly rounded cardinal extremity, distinguish it among all the other forms of the Hamilton group or of the rocks of New-York.

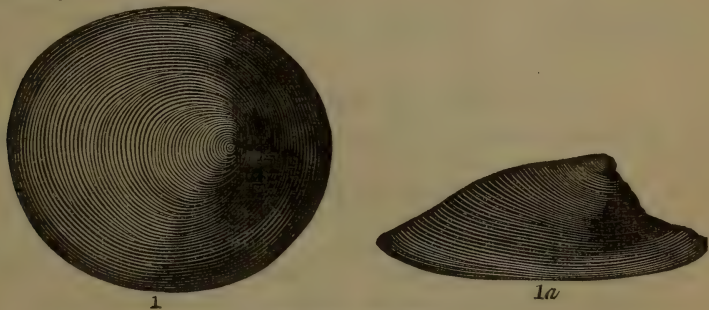
Geological formation and locality. In the Marcellus shale, near Bridgewater, New-York.

DISCINA ALLEGHANIA (n.s.).

SHELL broadly elliptical or nearly circular. Dorsal valve depressed conical; anterior side broadly and equally convex; apex placed at a little more than one-third the length from the posterior end of the shell, slightly inclined backwards; the posterior slope concave, and the shell flattened towards the margin. Surface marked by fine regular concentric lamellæ, which are distant from each other two or three times their width.

This large species is one of the finest and most beautiful of the genus, nearly equal in size to the *Discina grandis* of the Oriskany sandstone, and differing from that one in the posterior position of the apex and the more abrupt sloping on the posterior side, while the concentric striæ are much finer and more closely arranged. It differs from the large circular form *Discina discus* of the Lower Helderberg group, in the greater elevation of the dorsal valve, and absence of radiating striæ.

Geological formation and locality. In the Chemung group, Hobbieville, Alleghany county, N.York.



DISCINA ALLEGHANIA..

CRANIA HAMILTONIÆ (n.s.).

SHELL subconical, subcircular; apex subcentral, pointed in well-preserved specimens, often worn or decorticated. Exterior surface of the dorsal or upper valve lamellose. Ventral or lower valve marked by four strong muscular impressions, which are variable in form: the two lateral ones are distant, and each apparently double; the central impressions approximate, diverging above and assuming a somewhat cordiform appearance; vascular impressions strongly digitate.

This species is found adhering to valves of *Tropidoleptus*, *Strophodonta*, *Spirifer*, *Spirigera*, *Avicula*, *Orthoceras*; and the separated valves are free in the shales.

Geological formation and localities. In the shales of the Hamilton group: Western New-York, Maryland, and Virginia.

CRANIA CRENISTRIATA (n.s.).

VENTRAL or upper valve very depressed conical, subcircular in outline; apex central or subcentral, a little inclined. Surface marked by sharp elevated crenulate striæ reaching almost to the apex (which is quite smooth), and increasing by interstitial additions.

This species is quite rare, and two specimens only of the ventral valve are known at this time. The sharp elevated striæ give the fossil, when partially obscured by adhering shale, the appearance of the exterior of the small funnelshaped fronds of FENESTELLA.

Geological formation and locality. In shales of the Hamilton group, Ontario county, N.York.

CRANIA LEONI (n.s.).

SHELL subcircular, transverse or slightly elongate. Dorsal valve convex : ventral valve concave, variable in form. The shell, towards the margin, is more abruptly recurved : hinge-line straight, equal to a little more than one-third the width of the shell. Muscular impressions of the posterior adductors in the dorsal valve near the cardinal angles; the anterior ones near together and a little behind the centre, with two minute impressions a little anterior to the centre, marking the place of the retractor muscles. Ventral valve with the posterior adductors corresponding to those of the dorsal valve; the anterior adductors occupying a subcircular area, and barely separated by an elevation marking the place of the protractor muscle.

This species is known only in the condition of casts of the interior. The dorsal side is moderately convex; the apex apparently a little excentric on the posterior side.

Geological formation and locality. In the Chemung group : Leon, Cattaraugus county, N.York.

ORTHIS LEPIDUS (n.s.).

SHELL small, transversely subelliptical, somewhat ventricose : cardinal line little less than the greatest width of the shell; area proportionally large; beaks distant. Ventral valve very convex, regularly curved from beak to base : beak prominent, pointed, slightly incurved. Dorsal valve depressed convex, marked by a distinct mesial depression, which, in some specimens, extends nearly to the beak : beak small, pointed, and but little incurved. Surface marked by fine radiating striæ, crossed by concentric striæ and a few lines of growth.

This is the smallest species of ORTHIS yet known in the Hamilton rocks of this country, and is easily characterized by the great transverse diameter, the proportionally large area, the prominent beak of the ventral valve, and the distinct sinus of the dorsal valve.

Geological formation and locality. In shales of the Hamilton group : Ontario county, N.York.

ORTHIS CYCLAS (n.s.).

SHELL small, varying from subcircular to transversely subelliptical, moderately convex : beaks appressed, not distant; cardinal line rather less than one-half the greatest width of the shell. Ventral valve convex, most gibbous near the umbo : beak small, slightly incurved; area rather low. Dorsal valve the less convex, sometimes marked by a shallow depression : beak very small, slightly projecting beyond the cardinal line; area small. Surface marked by strong sharp

prominent striæ, which are both bifurcated and implanted, often appearing fasciculate near the margin of the shell.

The largest specimens known of this species measure not more than three-eighths of an inch in the greatest diameter. The distinguishing features are the coarse prominent striæ and the length of the cardinal line.

Geological formation and locality. Shales of the Hamilton group : Western New-York.

ORTHIS PENELOPE (n.s.).

SHELL large, oblate, the proportions of length and breadth usually as four to five, plano-convex : hinge-line about two-fifths of the breadth of the shell. Ventral valve flat or slightly convex : beak somewhat elevated; foramen broad, triangular. Dorsal valve regularly convex, with a very slight depression : beak small, rising but little beyond the general outline of the shell; area smaller than that of the opposite valve.

Surface marked by fine radiating bifurcating striæ, which are strongly arched upwards near the cardinal extremities, and crossed by fine concentric striæ, giving a slightly rugose appearance in well-preserved specimens; and, besides these, are closely arranged lamellose lines of growth. The radiating striæ have the appearance of being broken, from the peculiar manner in which the pores open upon the surface.

Interior of the ventral valve marked by a subcircular foliate muscular impression, which occupies more than half the length and breadth of the valve, and, in old specimens, is extremely thickened from its anterior margin nearly to the border of the pallæal impression. Interior of the dorsal valve marked, in old specimens, by a similar imprint, but smaller and less distinctly defined. The cardinal and brachial processes are strong and prominent, directed downwards into the opposite valve : the cardinal process fills the broad foramen of the ventral valve, and appears as an angular ridge on the exterior of the area.

This species is much larger than *O. vanuxemi*, with which it is associated; often measuring more than one and three-quarters inches in transverse diameter, while the largest specimens of *O. vanuxemi* seldom measure more than one inch. It differs also in the character and strength of the radiating striæ; the muscular imprint of the ventral valve is usually broader and more strongly marked; the cardinal and brachial processes of the dorsal valve are stronger, and directed towards the opposite valve, while those of *O. vanuxemi* are inclined forward or into the cavity of the dorsal valve.

Geological formation and locality. Shales of the Hamilton group : Western New-York.

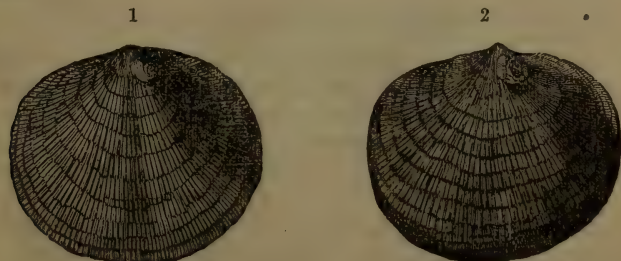


FIG. 1 & 2. Dorsal and ventral views of *Orthis penelope*. One of these figures was used in the Regents' Report of 1847, to illustrate *Orthis vanuxemi*, with which this species was at that time included.

ORTHIS LEUCOSIA (n.s.).

SHELL broad ovate, greatest breadth below the middle, obtusely pointed at the beaks. Valves moderately convex : cardinal area short and small; beaks approximate, pointed and incurved. Ventral valve depressed convex, most gibbous at the umbo and flattened towards the front, without a distinct mesial sinus, but sometimes having a broad shallow curve at the anterior margin of the shell : foramen broad triangular. Dorsal valve much the more gibbous, the greatest convexity above the middle, marked along the middle by a very slight depression which is sometimes obsolete : area smaller than that of the opposite valve, curved and slightly overhanging. Surface marked by fine radiating bifurcating striæ, crossed by strong distant lamellose lines of growth, and interrupted by the openings of the pores. Interior of ventral valve marked by a strong, foliate, somewhat elongate muscular impression.

This species is allied to *O. vanuxemi*, but differs in the cardinal margin being nearly straight from the beaks to nearly one-third the length of the shell, while in that species it is usually regularly curved : it differs also in the area being much smaller, and the beaks incurved and closely approximate.

Geological formation and locality. Shales of the Hamilton group : Ontario county, N.York.

ORTHIS SOLITARIA (n.s.).

SHELL small, subcircular or broadly ovate : valves unequally convex; hinge-line somewhat more than one-half the greatest width of the shell. Ventral valve highly convex : beak small, prominent, slightly incurved; area low and well defined. Dorsal valve depressed convex, most prominent near the umbo; a broad shallow mesial sinus at the anterior margin, which does not extend beyond the middle of the shell : beak small, not prominent; area linear. Surface marked by fine radiating bifurcating striæ and strong concentric lines of growth.

This shell is of the type of *O. elegantula*. It differs from any other in the Hamilton group, except *O. lepidus*, in having the ventral valve more convex than the dorsal, the sinus being on the dorsal valve. From *O. lepidus* it differs in being longer than wide, with less prominent beak and smaller area : it is also a larger species, being more than half an inch in diameter.

Geological formation and locality. Shales of the Hamilton group : Livingston county, N.York.

ORTHISINA ARCTOSTRIATA (n.s.).

SHELL small, semicircular or semielliptical : hinge-line straight, nearly equal to the greatest width of the shell. Ventral valve irregularly gibbous : beak small, pointed, and truncate from its adhesion to foreign substances; area moderate, slightly arcuate, and somewhat irregular on the two sides; pseudo-deltidium broadly triangular, closed. Dorsal valve depressed convex; area narrow linear. Surface marked by strong sharp close radiating crenulated striæ, which increase by interstitial addition, and crossed by strong concentric lines of growth.

Geological formation and locality. Shales of the Hamilton group : Ontario county, N.York.



ORTHOSINA ARCTOSTRIATA.

FIG. 1. Ventral view of a medium-sized specimen.

FIG. 2. Enlarged cardinal view of another specimen, showing the closed rounded pseudo-deltidium.

ORTHOSINA ALTERNATA (n.s.).

SHELL of medium size, semielliptical : hinge-line shorter than the greatest width of the shell; cardinal extremities rounded. Ventral valve most gibbous near the umbo and depressed near the front : area moderate, somewhat arcuate; pseudo-deltidium large, broad at base, imperforate, marked along the middle by a deeply impressed line. Dorsal valve regularly convex, apparently without sinus; area linear or obsolete. Surface marked by fine radiating striæ, alternating in size, usually three smaller between the larger ones near the margin of the shell; distinctly undulating concentric striæ. The margin of the shell is extremely thin.

This species differs from the last in the proportionally shorter hinge-line and the alternating larger and smaller striæ, which are also less prominent and less closely arranged.

Geological formation and locality. Shales of the Hamilton group : Genesee county, N.York.



ORTHOSINA ALTERNATA.

FIG. 1. Dorsal valve of a small individual.

FIG. 2. Dorsal valve of a larger individual.

AMBOCÆLIA GREGARIA (n.s.).

Compare with *Atrypa unguiculus*, SOWERBY, Geol. Transactions, Vol. v, pl. 54, f. 8.

Spirifer unguiculus, PHILLIPS, Pal. Fossils, pl. 28, f. 119.

Orthis unguiculus, HALL, Geol. Report Fourth District of New-York, p. 268, f. 5 a, b, c, d; p. 267.

SHELL subhemispherical, wider than long : hinge-line straight; cardinal angles rounded. Ventral valve gibbous, marked by a shallow mesial sinus, which extends from near the beak to the base of the shell : beak obtuse, strongly incurved. Dorsal valve semielliptical, depressed convex, with/sometimes a slight longitudinal central depression; foveal plates slender and parallel.

This species differs from *A. umbonata* in the less regular convexity of the ventral valve, the greater convexity of the dorsal valve, and the proportionally greater transverse diameter.

I had originally considered this shell as identical with *Atrypa unguicula* (SOWERBY), *Spirifer unguiculus* (PHILLIPS), placing it under the Genus ORTHIS; but farther comparison of figures and descriptions has convinced me that it is quite distinct.

A variety (*A. crassa*), which has not thus far afforded the means of separation as a distinct species, has the bases of the dental lamellæ thickened, and extended in strong ridges across the valve on each side obliquely to the anterior lateral margins, leaving the central part of the shell of the ordinary thickness.

Geological formation and locality. In shaly sandstone of the Chemung group, crowded together in great numbers in some beds : Paintedpost, Jasper, Steuben county; near Ithaca in Tompkins county, and in Chautauque county.

VITULINA PUSTULOSA (n.s.).

SHELL plano-convex, semicircular : hinge-line equal or nearly equal to the greatest width of the shell; area large triangular, reaching to the extremities of the cardinal line. Ventral valve highly convex, the greatest convexity at the umbo : beak small, pointed, somewhat incurved over the area; foramen very broad, equalling half the length of the cardinal line. Dorsal valve flat or slightly convex, having a broad shallow sinus, flat or with an incipient fold in the bottom. Surface marked by about ten moderately strong simple rounded radiating plications, two of which are slightly elevated in the middle of the ventral valve, in form of a mesial fold corresponding to the sinus of the dorsal valve; the entire surface beautifully covered with minute pustules resembling spine-bases.

Geological formation and locality. In the limestone of the upper part of the Hamilton group : Genesee county, N.York.

SPIRIFER VENUSTUS (n.s.).

SHELL subrhomboidal, ventricose, length about two-thirds the greatest width : hinge-line scarcely equalling the greatest width of the shell; cardinal extremities rounded. Dorsal valve very convex; mesial fold narrow above and expanded in front. Ventral valve less convex than the opposite, broadly arching from the extremities, the greatest convexity a little above the middle : beak arched; area short, rounded, and not defined at the margins; foramen high, the height equal to the width at the base; mesial sinus narrow and well defined near the beak, broader below the middle and expanded in front, terminating in a broad triangular extension. Surface marked by numerous fine bifurcating plications, the mesial sinus margined by a stronger plication; at the beak there is a single one in the centre which sometimes continues simple to the base, while the accessions take place from the lateral ones, till there are 10, 11, or 12 within the limits of the sinus near the base : plications crossed by arching lamellose striæ, which are granulose or fimbriate on their margins.

This is one of the finest species of *SPIRIFER* in the Hamilton group, and equal or superior in size and beauty to *S. granulifera*. It is the only species in this group which has bifurcated plications, or plications on the mesial fold and sinus. The largest specimen is about three inches wide, by nearly two inches long. In general aspect and surface characters, this species resembles the finer specimens of *S. cameratus*.

Geological formation and locality. Shales of the Hamilton group : Livingston county, N.York.

TREMATOSPIRA GIBBOSA (n.s.).

SHELL transversely subelliptical, once and a half as wide as long, ventricose, the anterior margin thickened in old specimens; valves subequally convex. Beak of

ventral valve strongly arcuate, and truncated by a circular perforation which is completed on the inner side by the outer ends of the small deltidial plates; false area small, broad triangular. Beak of the dorsal valve abruptly incurved, and concealed by passing within the concavity of the area of the opposite valve. Surface marked by nine strong angular elevated plications; three in the centre of the dorsal valve more approximate, giving the appearance of a mesial elevation, and three correspondingly depressed on the ventral valve : concentric lamellæ of growth at irregular distances, undulated in crossing the plications, giving a series of zigzag lines. Entire surface finely granulose. Shell-structure strongly punctate. This species differs from every other described, in its extreme gibbosity and highly elevated angular plications.

Geological formation and locality. Shales of the Hamilton group : Western New-York.

RHYNCHOSPIRA NOBILIS (n. s.).

SHELL large, broadly subovoid, ventricose. Dorsal valve the more gibbous, with a broad moderately elevated mesial lobe. Ventral valve with a broad mesial sinus; the beak large and truncated by a large round foramen, the lower side of which is bounded by the summits of the deltidial plates : margins of the valve sub-ulate a little below the beak. Surface marked by numerous angular elevated plications; which are sharply crenulated on the summits; the sides and intermediate spaces finely and evenly striated. In the mesial fold there are from nine to eleven plications elevated, and a corresponding number in the sinus of the opposite valve.

The dorsal valve shows strong crural processes extending from the hinge-line for a short distance, when they become slender and flattened, and below this they curve and send off a process towards the centre of the shell, as in others of the genus, and similar to that of *TEREBRATULA*.

This is the largest species of *RHYNCHOSPIRA* now known. It differs conspicuously from the other species, in the defined mesial fold and sinus, and sharply elevated plications.

Geological formation and locality. Hamilton group : Livingston and Erie counties.

RHYNCHOSPIRA LEPIDA (n. s.).

SHELL small, broadly suboval. Ventral valve depressed convex, regularly arched from beak to base : beak prominent, pointed, slightly incurved; foramen triangular, closed by two convex deltidial plates which are excavated on their inner and upper margins, forming an elongate or oval perforation. Dorsal valve the less convex, most gibbous above the centre. Surface marked by about twenty-four fine simple radiating plications; five in the middle of the valves stronger, distinctly elevated on the ventral valve. These stronger plications extend, giving a protruding form to the front of the shell.

This species differs from the others of this genus, in the flatness of the valves, fineness of the plications, and general form.

Geological formation and locality. Shales of the Hamilton group : Ontario county.

ATRYPA PSEUDOMARGINALIS (n.s.).

SHELL trilobate, subcircular, with the beak of the ventral valve extended. Dorsal valve with mesial fold strongly defined below the first third of the shell, and elevated in front. The mesial sinus does not extend to the beak. Plications rounded, irregularly bifurcating.

This species resembles *Atrypa marginalis* of DALMAN, but is larger and more robust, the beak less attenuate, the mesial fold and sinus broader and not extending to the beak, and the striæ coarser and not as much recurved. From the Bohemian specimens under the same name, it differs in the greater elevation and rounded form of the mesial lobe, and the less angular plications.

Geological formation and locality. Upper Helderberg limestone : Schoharie.

MERISTELLA HASKINSI (n.s.).

SHELL broadly ovate, more or less gibbous, length and breadth nearly equal, the greatest width anterior to the middle. Dorsal valve often a little wider than long. Ventral valve slightly the more convex, the greatest depth being a little anterior to the umbones : beak extended and slightly incurved, and, in all the specimens examined, truncated by a broad rounded foramen, impressed near the front by a short shallow sinus which produces an arcuation of the dorsal valve in front. Surface marked by close concentric lines of growth, which are crowded into wrinkles on the sides of the shell. Interior substance of the shell fibrous, with an exterior covering which appears to be punctate.

This shell bears many features of *TEREBRATULA*. It differs from *M. barrisi* in the broader form, short and little defined sinus, and in its surface characters.

Geological formation and locality. Shales of the Hamilton group, in Western New-York.

MERISTELLA BARRISI (n.s.).

SHELL ovoid, more or less elongate or sometimes broadly ovate; proportions variable. Ventral valve extremely arcuate : beak incurved; mesial depression sometimes beginning about one-third the length below the beak, and becoming on the front of the shell a broad flattened sinus produced in a short linguiform extension. Dorsal valve little longer than wide, regularly convex, abruptly elevated near the anterior margin from the extension of the mesial sinus of the opposite valve. Surface smooth, or marked by regular concentric lines of growth; some at the margins crowded into wrinkles. The exfoliated shells show obscure radiating striæ.

This species presents considerable variety of form; due, in the specimens examined, both to stages of growth and to accidents of compression, and also to the degree of development of the mesial sinus.

Geological formation and locality. In limestone of the Marcellus shale, near Leroy, N.York. From Rev. W. H. BARRIS.

MERISTELLA DORIS (n.s.).

SHELL subovate, elongate, compressed below the middle and the margins thin and sharp, gibbous on the umbones. Ventral valve with the beak elongate, attenuate and incurved; the sides below the beak abruptly compressed, making a concave area; regularly convex from the beak to below the middle of the valve, where it

is depressed into a shallow undefined sinus which is produced in front, and in old shells becomes a linguiform extension. Dorsal valve oval, narrowed towards the beak, a little more gibbous on the umbo than the opposite valve, depressed below the middle, and becoming in old shells abruptly bent upwards. Surface marked by close concentric lines of growth, and fine radiating striæ are visible upon the surface in the exfoliated shell, and upon the cast. Shell-structure punctate.

This species is readily distinguished by its greater proportional length and attenuation. Some half-grown shells show no evidence of a sinus, while in other individuals it becomes earlier distinct. One specimen measures an inch and three quarters in length, by an inch and a quarter in width : the usual length is from one and a quarter to one and a half inches, with a width of about one inch.

Geological formation and locality. In loose masses of limestone, south of YOUNG's farm, Williamsville, Erie county.

LEIORHYNCHUS MULTICOSTA (n.s.).

SHELL ovate, subcircular or transverse, moderately gibbous : beak small, pointed, somewhat incurved. Ventral valve with a broad well-defined mesial sinus, reaching nearly to the beak; in elongated specimens, extended in front. Dorsal valve the most convex; mesial elevation most distinct in the upper part of the valve. Surface marked by strong angular plications, generally bifurcating; from six to ten on the mesial elevation, the lateral ones of which have their outer faces broad, forming the entire height of the elevation; the plications on each lateral portion of the shell about six or eight, variable in number. Numerous concentric wrinkles cross the striæ, giving a broken aspect to the surface. Substance of the shell extremely thin.

This species differs from *L. quadricostata* of the upper black shales, in being much larger and more robust. The mesial lobe is always distinctly marked; the plications are strong, angular, and cover the whole shell.

Geological formation and locality. Shales of the Hamilton group, in numerous localities in Western New-York.

The following species, originally described under the Genera ORTHIS and ATRYPA, belong to the Genus LEIORHYNCHUS.

LEIORHYNCHUS LIMITARIS.

Orthis limitaris : VANUXEM, Rep. 3d Geol. Dist. New-York, 1843, p. 146, f. 3.

Atrypa limitaris : HALL, Rep. 4th Geol. Dist. New-York, p. 182, f. 11.

SHELL moderately gibbous, subcircular or transverse. Dorsal valve with a broad mesial elevation. Ventral valve with sinus only on the anterior portion. Surface covered by numerous fine plications, mostly simple.

When found in limestone, it is full and well formed; but in the thinly laminated shales it is usually compressed, and occurs in great numbers.

Geological formation and locality. In the black shales at the base of the Hamilton group, at Leroy and Avon, N.York.

LEIORHYNCHUS QUADRICOSTATA.

Orthis quadricostata : VANUXEM, Report on 3d Geol. Dist. New-York, 1843, p. 168.

Atrypa quadricostata : HALL, Report on 4th Geol. Dist. New-York, p. 223, f. 2.

SHELL thin, flattened, transverse, marked by distinct rounded plications in the middle of the valves; lateral portions plain, or with faintly marked plications; without distinct mesial fold or sinus.

This species is smaller than the preceding, with fewer radiating plications. It differs from *L. multicosta* in the absence of a mesial fold, and smaller number of ribs.

Geological formation and locality. Upper black shales of the Hamilton group: Bigstream point, Seneca county; and other places in Western New-York.

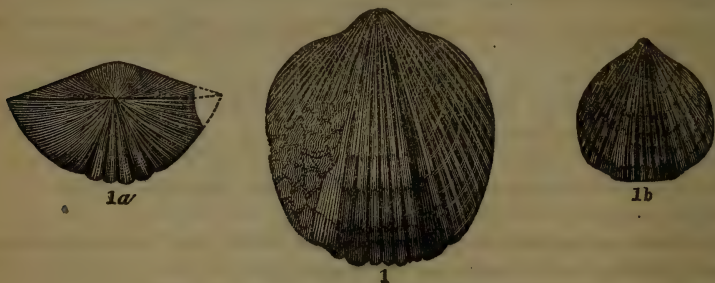
LEIORHYNCHUS MESACOSTALIS.

Atrypa mesacostalis : HALL, Report on 4th Geol. Dist. New-York. Illustrations of Fossils of the Chemung group, 64, ff. 1 a, 1 b.

SHELL somewhat elongated, with moderately prominent beak. Valves convex, with well-defined mesial lobe and sinus, which are covered with plications; those bordering the sinus are the largest. Lateral portions of the shell smooth, or with obscure ribs.

This species is usually larger than any of the preceding, and is characterized by its elongate form and plain or obscurely marked lateral portions of the shell.

Geological formation and locality. In rocks of the Chemung group: Steuben county, and other parts of Western New-York.



LEIORHYNCHUS MESACOSTALIS.

FIG. 1, 1 a. Ventral and cardinal views of full-grown individuals of *L. mesacostalis*.

FIG. 1 b. Ventral view of a young individual of the same species.

PENTAMERUS PAPILIONENSIS.

Pentamerus papilionensis, cited in Geol. Report of Iowa, 1858, p. 514.

SHELL ventricose, broadly ovate. Ventral valve the most convex: beak obtuse, incurved; a broad mesial sinus reaching nearly to the beak, and produced in front in a linguiform extension; surface marked by few or many rounded or subangular unequal plications, of which, three, four, or five occupy the sinus, with sometimes five, six or seven on each side. Dorsal valve gibbous, with a prominent mesial elevation which is marked by several plications. The triangular foramen, or opening to the V-shaped process of the ventral valve, is visible above

the beak of the dorsal valve. The interior of the ventral valve shows a short V-shaped process attached to the median septum for a distance of one-third the length of the shell from the beak, the septum continuing below the middle of the shell. Surface punctate : substance of the shell lamellose, prismatic, brittle.

This species resembles *P. occidentalis* of the Iowa Geological Report; but the plications are more numerous and conspicuous, and extend farther towards the beak. The texture and surface markings are similar.

Geological formation and locality. Shales of the Hamilton group, in numerous places in Western New-York.

RHYNCHONELLA SAPPHO (n. s.).

SHELL transverse, gibbous or ventricose; cardinal slopes nearly straight or a little concave, and regularly rounded below. Dorsal valve very gibbous, regularly convex transversely; about six to eight plications elevated upon the mesial fold, which is distinctly but not prominently raised towards the front. Ventral valve flabelliform, depressed convex, a little gibbous near the beak, flattened in the middle near the front, and abruptly bent up at the margin for the width of the sinus; the margins on each side of the sinus a little recurved. Surface marked by twenty to twenty-four plications, of which, in old shells, usually six or seven mark the mesial fold and sinus. The middle plications are flattened or grooved towards the margin, while the lateral ones are more angular, and become obsolete on the cardinal line. Surface crossed by fine close undulating concentric lines.

This is a very beautiful and symmetrical species, and, in full-grown individuals, has the length and width as seven to eight. In young shells, there are not more than four plications on the sinus and fold.

Geological formation and locality. In limestone of the Marcellus shale : Near Leroy, N.York.

RHYNCHONELLA HORSFORDI (n. s.).

SHELL, in full-grown specimens, transverse, gibbous, length and width about as five to six or six to seven; front nearly straight, abruptly and shortly pointed at the beak; cardinal slopes concave; sides rounded. Dorsal valve very gibbous, sloping abruptly to the beak; mesial elevation defined below the middle of the valve. Ventral valve moderately convex, flattened and incurved in front, forming a distinct mesial sinus; lateral portions gently curving to the margins. Surface marked by twenty to twenty-four well-defined angular plications, about five of which mark the mesial sinus and fold. The plications limiting the sinus are more sharply elevated than the others, concentrically marked by fine undulating striæ.

This species differs from *R. sappho*, in the stronger and more angular plications which characterize all stages of growth : it is also smaller at maturity, and more straight in front.

Geological formation and locality. In shales of the Hamilton group, at numerous places in Western New-York.

RHYNCHONELLA ORBICULARIS (n.s.).

SHELL circular, ventricose. Dorsal valve subhemispherical; mesial elevation extending from near the beak to the base, and gradually expanding : beak small, compressed, not rising above the general outline of the shell. Surface marked by about twenty-four strong, rounded, highly elevated plications; four occupying the middle of the valve, more prominent, forming the mesial elevation; the plications on the lateral cardinal slopes slightly arched at the outer extremities. In some parts of the specimen are indications of regular concentric striae.

This description is drawn from a single dorsal valve, but so characteristic as to leave no doubt of the specific distinction. The circular form, full rounded cardinal slopes, the four strong plications of the mesial fold and recurved plications of the sides, are decided characters.

Geological formation and locality. In rocks of the Chemung group : Steuben county, N.York.

TEREBRATULA LINCKLÆNI (n.s.).

Atrypa — : Geol. Report 4th Dist. New-York, p. 202.

SHELL oval, ovate or subelliptical, generally broadest below the middle, varying from moderately convex to very gibbous, sometimes subcylindrical; cardinal slopes of the ventral valve somewhat angular. Ventral valve usually the most gibbous, somewhat flattened in the middle and toward the anterior margin, and sometimes marked by a faint narrow mesial depression. Dorsal valve with umbo narrow and prominent. Surface smooth, or marked by a few concentric lines of growth : these are sometimes strong, and cause an abrupt thickening of the shell near the anterior margin. Shell-structure distinctly and beautifully punctate.

Geological formation and locality. In limestone of the Hamilton group : Delphi, N.York.

TEREBRATULA RECTIROSTRA (n.s.).

SHELL elongato-ovate, subovate or subelliptical, the greatest width anterior to the middle. Valves subequally convex, somewhat truncate at base : beak of ventral valve strong, little incurved; deltidial plates long and narrow; shell abruptly inflected along the umbonal slopes : beak of the dorsal valve incurved, passing within the cavity of the opposite valve; umbo prominent. Surface marked by strong concentric lines of growth. Shell-structure distinctly punctate.

This species differs from the last in being less ventricose and arcuate, with beak longer and more incurved : it is also larger, and the base truncate.

Geological formation and locality. Shales of the Hamilton group : Western New-York.

TEREBRATULA LENS (n.s.).

SHELL ovate, broadly elliptical or lenticular below, and abruptly tapering towards the beak, the greatest width a little below the middle, moderately gibbous : valves subequally convex, the width about four-fifths as great as the length, and the depth equal to about half the length. Ventral valve less convex than the dorsal, the beak moderately incurved and broadly truncated, the lateral slopes subangular; without visible sinus or elevation. Dorsal valve broadly elliptical or subcircular, a little more convex than the opposite. Surface marked by indistinct lines of growth : shell structure punctate. Length nearly seven-tenths, and breadth six-tenths of an inch.

This species is proportionally shorter and broader, and more abruptly tapering to the beak, than either of the preceding species. It varies little in length from the larger specimens of *T. lincklani*; but that species is narrower, and the valves more gibbous. The *T. rectirostra* is a more elongate shell, attains a length of an inch or more, and has nearly straight sides from the middle to the beak.

Geological formation and locality. In the Upper Helderberg limestone : at Clarence hollow, Erie county. Collected by Col. JEWETT.

TEREBRATULA PLANIROSTRA (n.s.).

SHELL subangularly ovate, unequally subquadrilateral: the front often truncate, giving a subpentagonal outline; greatest width near the middle of the shell; width and length about as six to seven: the thickness at the greatest convexity of the two valves is more than half the length. Ventral valve with the greatest convexity above the middle, the lower part flattened or depressed along the centre : beak moderately incurved and truncate at the extremity, depressed or flattened on the umbo; lateral slopes angular; deltidial pieces large. Dorsal valve shorter than the opposite, very convex and often extremely gibbous above the middle, more or less flattened towards the front. Surface (in old shells) marked by strong lines of growth, which are sometimes regularly and evenly disposed as concentric laminæ, often roughened : shell structure punctate. Length of full-grown individuals about one inch.

This fossil, in full-grown specimens, is distinguished by a subangular form and a truncation in front : an incipient sinus marks the ventral valve. The flattening of the umbo, and angular margins of the lateral slopes of the ventral valve, are distinctive features.

Geological formation and locality. In the shales of the Hamilton group : at York, Moscow and Geneseo in Livingston county, and in Ontario county, N.York.

For the finest specimen which I have seen, I am indebted to Prof. E. N. HORSFORD of Cambridge, who collected it many years since at Moscow.

The preceding species are referred to *TEREBRATULA*, from their general form and punctate structure. The internal arrangement is unknown; and it is possible that they may prove distinct from that genus, when we become acquainted with the interior structure.

ATHYRIS VITTATA (n.s.).

SHELL subquadrilateral, usually a little transverse, trilobate from the strong mesial sinus and elevation : hinge-line extending more than half the width of the shell; cardinal extremities rounded; length and breadth as five to six. Ventral valve most convex above the middle, the sinus often reaching to the beak and becoming sharply defined below the middle of the valve, elevating the front in a defined semicircular arch; sides of the valve regularly curving to the margins. Dorsal valve usually a little more gibbous, the greatest convexity above

the middle; the mesial elevation becoming defined below the middle of the valve, and often margined by a defined groove which is distinctly marked on the front of the shell. Surface marked by regular equal concentric laminae of growth, which often, towards the front of the shell, become lamellose expansions. These lamellae are often abruptly bent at the margins of the mesial fold and sinus.

The greatest length of the specimens examined is about six-tenths of an inch. This shell bears some resemblance to small individuals of *A. concentrica*; but is more distinctly trilobate, and never acquires the same dimensions.

Geological formation and locality. In rocks of the age of the Hamilton group, near Iowa city. My specimens were received from Rev. W. H. BARRIS.

This species, in the Hamilton group of the West, is a representative of the *Athyris spiriferoides* of the same group in New-York, and is associated with *Spirifer submucronatus*, *S. inutilis*, *S. aspera*, and others which have been noticed as similar to our Hamilton species. The *Athyris spiriferoides* is a much larger shell, with much less strongly developed mesial fold and sinus; while in all stages of growth it has a more orbicular form, and the surface is less regularly laminated.

SPIRIFER DUBIUS (n.s.).

SHELL ovoid, ventricose; cardinal extremities rounded: proportions varying from length and breadth equal, to length greater than breadth; the thickness of both valves about equal to two-thirds the width. Dorsal valve the less convex; mesial fold defined towards the anterior margin, and marked by four or five plications which coalesce and die out before reaching the apex: beak incurved. Ventral valve more gibbous, becoming ventricose in old shells, highly arcuate above: beak incurved, with summit extending above the opposite valve from one-fifth to one-fourth the entire length of the shell. Area short, with margins undefined: foramen high. Surface marked by fourteen to twenty or more plications, which show a tendency to bifurcate near the margin, and, in old shells, are entirely obsolete on the upper part of the valves: plications crossed by imbricating lamellae.

This species, though having a foramen and other characteristics of SPIRIFER, has nevertheless a median septum in the ventral valve; which, however, does not join the dental lamellae, as in CYSTINA. There is likewise a short median septum in the dorsal valve. The longitudinal median septum of the ventral valve is not an unusual feature, being shown in some Lower Helderberg species, particularly in *S. octocostatus* (Vol. iii, Pal. New-York). In some species referred to CYSTINA, the dental plates join this septum, not at its summit, but below, leaving it projecting within the triangular cavity.

Among these various modifications of SPIRIFER, we find, in some of the Devonian and Carboniferous forms, a less distinctly fibrous structure, or a punctostriate texture, while the interior organization is apparently that of true SPIRIFER.

I am indebted for this species to the Rev. W. H. BARRIS of Burlington, Iowa.

Geological formation and locality. In the shaly limestones of the age of the Hamilton group, near Iowa city, Iowa.

STROPHODONTA PLICATA (n.s.).

SHELL semielliptical, length and width nearly equal, cardinal angles scarcely extending beyond the width of the shell. Ventral valve regularly convex: beak extending beyond the cardinal line; area sublinear, vertically striate, and the inner margin strongly crenulate; foramen closed. Dorsal valve concave, the depression slightly less than the interior of the opposite valve. Surface marked by strong rounded plications, which bifurcate on the dorsal valve, and are in-

creased by implantation on the ventral valve : entire surface radiatingly striate.

The specimen described is a little more than half an inch in length, and has the appearance of a mature shell. It is readily distinguished from other STROPHODONTÆ described, by the strong rounded plications of the surface.

Geological formation and locality. In the rocks of the age of the Hamilton group, near Iowa city. From Rev. W. H. BARRIS.

TROPIDOLEPTUS? OCCIDENS (n.s.).

SHELL semielliptical, longer than wide, concavo-convex; cardinal area very narrow and linear : beak of ventral valve extending a little beyond the hinge-line. Surface marked by twelve elevated angular plications, of which two central ones on the ventral valve are a little stronger and more elevated, while a single central one on the dorsal valve is a little depressed. The substance of the shell is silicified : it appears to have been originally punctate.

I refer the species with some hesitation to the Genus TROPIDOLEPTUS, since the condition of the only specimen known does not admit of satisfactory determination. It is a matter of interest to discover other species of this peculiar genus.

Geological formation and locality. In strata of the Hamilton group, near Iowa city. From Rev. W. H. BARRIS.

CONOCARDIUM EBORACEUM (n.s.).

SHELL subovate, gibbous; anterior end obliquely truncate, the umbonial slopes angular and flattened or concave within, the joining edges of the shell produced; posterior end conical, scarcely constricted behind the beaks; umbones angular; hiatus rounded anteriorly, narrow and elongate, reaching nearly the whole length of the shell, and strongly denticulate on the inner margins. Surfaces cancellated by radiating and concentric striæ, which are nearly equal upon the upper part of the shell; while on the lower part the concentric striæ become strongly lamellose, and the radiating striæ are obsolete.

This shell is somewhat equilateral, in having the anterior end on the base extending as far beyond the beaks, as the distance from the beaks to the posterior extremities. The cancellated structure above and strong lamellose concentric striæ below, with the extreme hiatus, are distinguishing features.

Geological formation and locality. In shales of the Hamilton group: in York, Livingston county, New-York.

CONOCARDIUM VENTRICOSUM (n.s.).

SHELL extremely ventricose, the width and thickness of the two valves being equal to or greater than the height from base to beak, while the length is about equal to the thickness. Beaks rising above the hinge-line, incurved : hinge-line straight; anterior end almost vertically truncate, and sometimes abruptly and obtusely rounded, usually slightly concave between the umbonial slope and the edges of the shell, posteriorly constricted just behind the beaks, and produced in a short subconical extension : the hiatus on the lower side is narrow and short, rounded at the posterior extremity. Surface of the body of the shell, and a part of the posterior slope, marked by slender radiating ribs, which become double below their origin, and again coalesce at or near the edge of the shell; or the ribs may be described as simple, with a sharp deep groove throughout the greater part of their length : ribs on the anterior slope simple.

This is a pretty little species, remarkable for its great ventricosity and for the character of its ribs.

Geological formation and locality. In limestone of the age of the Hamilton group : near Iowa city, Iowa. From Rev. W. H. BARRIS.

GENUS PHOLIDOPS (HALL, 1859).

Pholidops : Palæontology of New-York, Vol. iii, p. 498.

SHELL small, patelliform; apex anterior, subcentral, excentric or terminal. Surface marked by concentric lamellæ of growth, which are more expanded on the posterior side. Interior a shallow oval cavity, with a bilobed or horseshoe-shaped muscular impression; the margin flattened or slightly deflected, and entire.

These fossils are not unlike, in form and general aspect, to DISCINA (ORBICULA of authors); and I had originally thus referred a species in the Niagara group, under the name *Orbicula squamiformis* (Pal. New-York, Vol. ii, p. 250). It is only recently that we have ascertained that these little scale-like fossils are really univalve, like PATELLA; since in numerous examples there is no evidence of any other valve, and the muscular imprint is unlike any of the brachiopods of the DISCINA or CRANIA forms.

In some of the specimens from the Hamilton group, the casts are beautifully preserved, and show the impression of the muscular callosity in a good degree of perfection. We have now four well-defined species of the genus, each one holding a different geological position, viz: *Pholidops squamiformis*, of the Niagara group; *P. ovatus*, of the Lower Helderberg group; *P. terminalis*, of the Oriskany sandstone; and *P. hamiltoniæ*, of the Hamilton group. The species are therefore of Silurian and Devonian age, and will probably be found in the Carboniferous strata.

PHOLIDOPS HAMILTONIÆ (n.s.).

SHELL ovate, broader near the anterior end; apex excentric, little elevated and slightly inclining forwards, thin and flattened towards the margins. Surface marked by fine closely arranged lamellose striæ. Interior smooth, except an ovate somewhat bilobed prominence beneath the apex, which marks the muscular impression.

The casts of the interior show very distinctly a double indentation at the apex. The surface, when magnified, shows some indications of minute interrupted radiating striæ. It is the smallest of the species described, having a length of fourteen hundredths of an inch, and a width of twelve hundredths in the widest part.

Geological formation and locality. In the shales of the Hamilton group, from the shores of Lake Erie to the Genesee river.

LEPERDITA PUNCTULIFERA (n.s.).

TEST minute, subcylindrical; the two extremities subequal, rounded; a scarcely elevated point or tubercle near one extremity: the ventral margin of one valve distinctly overlapping the other, and rising in a distinct ridge along the border. Surface marked by minute puncta or pits, which are much more distinct and regular than usual in the species of this genus.

Geological formation and locality. In shales of the Hamilton group, often very abundant on the shaly laminæ; from the shores of Lake Erie, to Canandaigua lake.

The following figures will serve to illustrate more fully the characters described in the observations upon the Genera ATHYRIS, MERISTA, MERISTELLA, and LEIORHYNCHUS.

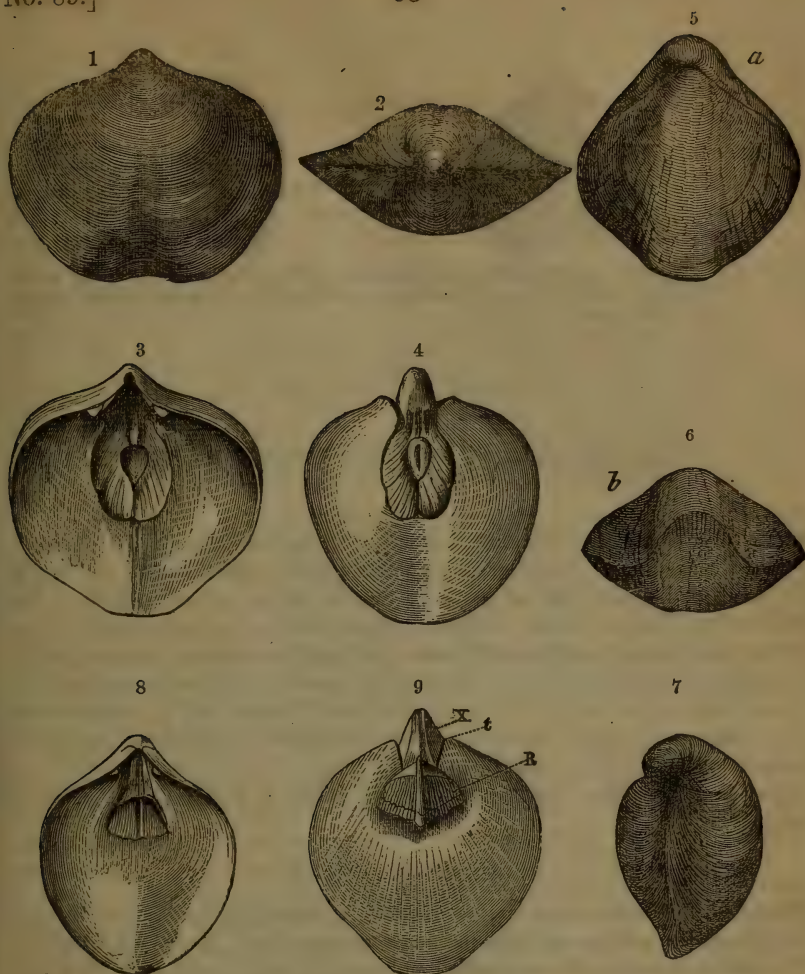


FIG. 1 & 2 are of the exterior, and 3, 4 the interior and cast of *Athyris spiriferoides* of the Hamilton group, N. York.

FIG. 5, 6 & 7 : Dorsal, front and profile views of *Meristella princeps* of the Lower Helderberg. 8, 9 are the interior and cast of the ventral valve as shown in *M. nasuta* (*Atrypa nasuta*, CONRAD) of the Upper Helderberg limestones of New-York and Ohio. The letter x refers to the filling of the rostral cavity; t, the cavities of the dental lamellæ; R, the triangular muscular impression.



FIG. 10 & 11. Dorsal and profile views of *Merista typa* (*Camarium typum*) : 12, interior of the ventral valve; 13, longitudinal section; a, rostral cavity; s, transverse arching septum, or "shoelifter" process of Kine; t, teeth.



FIG. 14 & 15 illustrate the exterior form and characters of *Leiorhynchus multicosta* of the Hamilton shales, and may be considered as illustrating the general external characters of the genus.

ADDITIONAL SPECIES FROM THE HAMILTON GROUP.

ATHYRIS CORA (n.s.).

SHELL depressed suborbicular or transversely elliptical, moderately gibbous : valves, in specimens of ordinary size, nearly equally convex; length and width of the dorsal valve about as eleven to fifteen, the proportional length of the ventral valve being twelve or thirteen. Surface marked by concentric lamellose striæ or lamellæ of growth, which have apparently been fimbriate in their perfect condition. There are likewise a few stronger concentric ridges or grooves; and there is a shallow longitudinal sinus in the ventral valve, and a corresponding elevation or flattening of the centre of the dorsal valve. In the casts, this mesial elevation is marked by a narrow depressed line.

Geological formation and locality. In the shales of the Hamilton group at Delphi.

SPIRIFER CLIO (n.s.).

SHELL subrhomboidal, more or less gibbous or ventricose; extremities usually salient, and sometimes extended into mucronate processes. Dorsal valve regularly convex, becoming gibbous; mesial fold strongly defined, simple at its origin, and becoming flattened and grooved below the first third, or for a greater proportion of its length : cardinal line showing a narrow area. Ventral valve more gibbous than the dorsal; medial sinus deep and strongly defined, with a slight elevation in the centre, giving an undulation in the direction of the lamellæ; beak incurved; area strongly defined; length more than twice the height, and extending to the cardinal extremities : foramen somewhat narrow, sometimes twice as high as the width at base, open to the beak. Valves marked by from six to ten or twelve regular plications on each side of the mesial fold and sinus, more than half of which run out upon the margins of the area. Entire surface marked by regular imbricating lamellæ, which are sharply arched at the summit of the plications and in the groove between them.

This species has sometimes been confounded with *S. zigzag*; but the plications are more numerous, while the mesial fold and sinus are marked by a groove and elevation not shown in that one. The imbricating lamellæ are coarser and stronger in the *S. zigzag*.

Geological formation and locality. In shales of the Hamilton group : at Moscow, York and Genesee, Livingston county; and at Darien, Genesee county, N.Y.

NOTES AND OBSERVATIONS

Upon the fossils of the Goniatile limestone in the Marcellus shale of the Hamilton group, in the eastern and central parts of the State of New-York, and those of the Goniatile beds of Rockford, Indiana; with some analagous forms from the Hamilton group proper.

At the base of, or forming the lower member of the Hamilton group, there is a mass of black shale or slate known as the Marcellus shale. In the midst of this black slate there is a band of limestone which is more or less continuous, and which, over a considerable area, divides the Marcellus shales into two parts, a lower and upper member. The lower one is more strictly a slate; while the upper one, from a black slaty mass, passes to an olive or bluish shale, gradually losing its slaty cleavage. As this limestone dies out in a westerly direction, this line of division is not marked, and the Marcellus shale is recognized only as a single member of the group.

This limestone is charged with GONIATITES, and other chambered shells, with comparatively few fossils of any other character. Among the fossils of this rock, I have recognized two species of GONIATITES, one of which occurs in great numbers; one of NAUTILUS or DISCITES, one of CYRTOCERAS, two of GYROCERAS, three of GOMPHOCERAS or APIOCERAS, one of ONCOCERAS, one of ORTHOCERAS, one of PLEUROTOMARIA, one or two of EUOMPHALUS, one DENTALIUM, one acephalous shell allied to EDMONDIA?, one LEIORHYNCHUS (the *L. limitaris*, page 85 of this paper), and a species of PROETUS.

There are probably other fossils not yet ascertained in this limestone, which, however, has rarely a thickness of more than three or four feet, and often less than two feet. In the western part of the State we know two or three other species of GONIATITES, ORTHOCERATITES, etc. in the shales of the Hamilton group in a higher position than those of the limestone.

In the Report of the Third Geological District of New-York, Mr. VANUXEM gave figures and descriptions of two of these GONIATITES, the originals of which were placed in the State Collection. Since that period, I am not aware that any published notice has been made of these fossils.

At Rockford, Indiana, in what appears to be nearly the same geological horizon, we find a stratum charged with GONIATITES, ORTHOCERATITES, etc. Of the former there are at least three species, one of which is regarded by palæontologists as identical with the European *G. rotatorius*, a Carboniferous species, while the others are apparently of undescribed forms. In the same association we find GYROCERAS, BELLEROPHON, PLEUROTOMARIA, EUOMPHALUS, etc., with a few brachiopodous and lamellibranchiate shells. A comparison of these fossils with those of New-York becomes a matter of interest; and to facilitate this object, I have presented the following descriptions and illustrations. In the New-York localities we have one species of GONIATITES and one ORTHOCERATITE, occurring in large numbers. In the Rockford locality, we have two species of GONIATITES and one of ORTHOCERATITES, likewise occurring in great numbers; while in both localities the other fossils are comparatively rare, or far less abundant.

The parallelism of these localities is inferred from the fact that the stratum containing the GONIATITES is clearly above the limestone of the age of the Upper Helderberg group, and below the sandstones which are recognized as of the age of the Chemung group of New-York. The exposures at the immediate locality are ob-

scure; but the Black slate, which I regard as the continuation of the Marcellus shale, occurs in the immediate neighborhood. The fossils are all found loose in the bed of a stream, washed out by the water from the rock. The fossils themselves are silicified to a great extent, and the adhering stone is an impure or siliceous limestone of light color and compact texture. In the vicinity of New-Albany and Jeffersonville, Indiana, the Marcellus shale rests upon the limestone of the Falls of the Ohio, which is a continuation of the Upper Helderberg limestone. In this neighborhood, the Black shale (Marcellus shale) is succeeded by a band of compact fine-grained, and in some parts crystalline light-colored limestone, undistinguishable, in fragments, from that accompanying the GONIATITES and other fossils from Rockford. From all these facts, I have been inclined to regard the evidence as favoring the view that these Goniatite beds of Rockford are near the horizon of the upper part of the Black slate, the position of which may be regarded as determined with reference to the Marcellus shale of New-York.

With these preliminary remarks, I will proceed to enumerate the fossils at present known to me from these localities.

GONIATITES EXPANSUS (VANUXEM).

Geological Report, Third District, 1842, page 146, fig. 1.

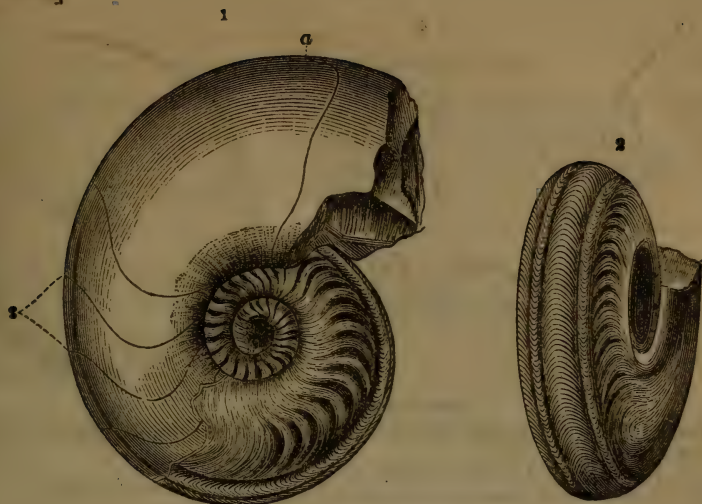
Goniatites expansus and *Goniatites marcellensis* : VANUXEM, Geol. Report, Third District, 1842, p. 146, f. 2.

Of the latter or *Marcellus Goniatite* (page 147), Mr. VANUXEM remarks : "This species is more abundant, and some are of great size. A fragment of one "was found, which, when perfect, must have been nearly a foot in diameter. "Both specimens are in the State Collection."

Having been familiar with the original specimens figured by Mr. VANUXEM, and with the later collections from the same neighborhood and from Schoharie, I am compelled to regard them as one species, which, in all conditions, presents some variety; but between the young and the old specimens, there are differences which might well be mistaken for specific characters. The young are more rotund, and are rounded on the dorsum, with a double groove and ridge between, along the dorsal margins; the sides are strongly striate, with arching ridges. As the shell becomes older, the back is less rotund, the grooves and rounded carinæ along the dorsal angles disappear, and the ridges on the sides become obsolete; the dorsum is flat, and the angles are quite plain. So different indeed do they become, that it is only when we dismember the parts and find the interior to correspond with the *G. expansum*, that we feel satisfied that this species is only the young of the *G. marcellensis*, which attains to such large dimensions and occurs very abundantly; much more abundantly than the smaller one, the young, which is in some localities comparatively rare. It is from the investigation of a large number of individuals. and from having seen and collected them in the localities mentioned, that I have arrived at this conclusion, and therefore feel compelled to unite these two described species under the name of *Goniatites expansus*.

The septa in this species are comparatively simple, and scarcely departing from the nautiloid type. They are, however, very distinctly lobed upon the back, and have a dorsal siphuncle.

The accompanying diagrams will illustrate the characters described.



GONIATITES EXPANSUS.

FIG. 1. Lateral view of a young, or specimen of medium size. The surface marking is shown upon a part of the figure, while the outer chamber is left plain : *s*, the septa; *a*, line parallel to the aperture. This is of the type of *G. expansus* (VANUXEM).

FIG. 2. Dorsal view of fig. 1, showing the grooves and carina on the dorso-lateral angles.

Geological formation and locality. In the Goniatite limestone of Marcellus, Manlius, and near Schoharie, New-York.

There is a fine collection of specimens of this species in the State Cabinet, in part purchased of Mr. GEBHARD; and a greater number, particularly of large individuals, presented by LEDYARD LINCKLAEN, esq., of Cazenovia.

GONIATITES DISCOIDEUS (n. s.).

SHELL orbicular : volutions all embraced within the outer one; aperture subelliptical, narrower anteriorly, widening towards the base, and slightly auriculate at its junction with the axis; sides convex, gently curving towards the back, and rounded upon the periphery.

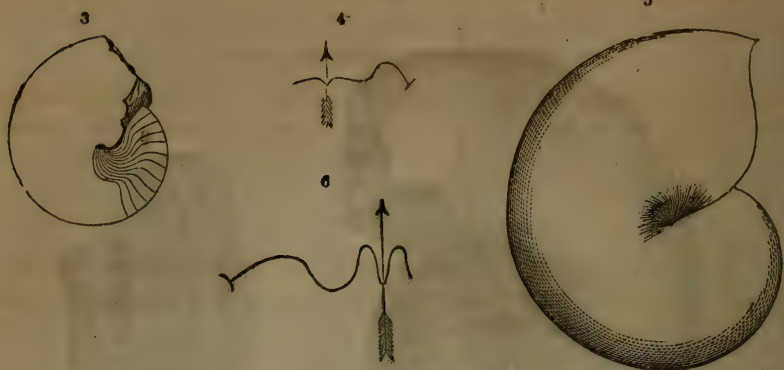
A specimen, which is apparently an adult, measures from the umbilicus to the periphery one and one-eighth inches; across the volution at the ventral side, not including the expansion of the mouth, five-eighths of an inch; and across the volution at the back, three-eighths of an inch. Another specimen, smaller but a little more rotund, measures, at the same points respectively, five, three and two-eighths of an inch.

The septa are marked on the back by a short narrow lobe, and, thence extending laterally with a gentle curve halfway across the volution, bend suddenly backwards, and make a sharp curve to the ventral side. They can scarcely be described as lobed, and the sinuosity approaches more the character of *CLYMENIA*.

The surface is marked by fine undulating striæ, which follow the direction of the septa.

Geological formation and locality. In the Goniatite limestone, at Manlius and Schoharie. Specimens of similar form, and extremely compressed, occur in the shales of the Hamilton group, at Cazenovia and elsewhere. They are probably identical.

The figure illustrates the form of the shell and the direction of the septa.



GONIATITES DISCOIDEUS.

FIG. 3. A young individual, showing form of shell and direction of septa.

FIG. 4. Diagram of septa.

FIG. 5. A larger and nearly full-grown individual.

FIG. 6. Diagram of septa, showing a greater sinuosity in the older specimens.

GONIATITES UNIANGULARIS.

G. uniangularis : CONRAD, Jour. Acad. Nat. Sci. Phil'a, Vol. viii, pa. 268, pl. 16. fig. 4.

This is a small species, showing an increased sinuosity in the septa, a small dorsal lobe, with shallow dorsal saddle and a defined dorso-lateral lobe. A larger specimen shows more sinuous septa.

The figure gives the form and proportions, with the direction of the septa in the original of Mr. CONRAD's description.

Geological formation and locality. In the shales of the Hamilton group : at Moscow and Paterson's creek, Livingston co.

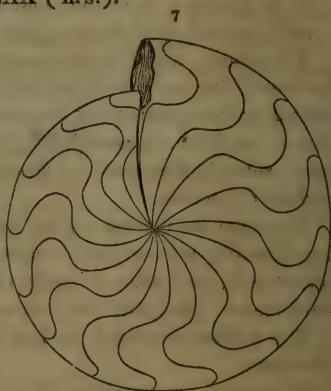
Reproduction from original illustration in the collection of the U.S. National Academy of Sciences. GONIATITES UNIANGULARIS.



GONIATITES MITHRAX (n.s.).

This species is discoid and but moderately gibbous in the middle of the volutions, and regularly curving towards the back. There is no perceptible umbilicus, the interior volutions being entirely included. It has twice the diameter of the figure, and the last chamber and the aperture are unknown. Its similarity to *G. uniangularis*, in the direction of the septa, is remarkable; but that species is proportionally more expanded towards the ventral side of the volutions, and a little flattened on the sides towards the back. The outer volution in that one is not so deeply occupied by the preceding ones, and the aperture is more elongated.

Geological formation and locality. In limestone of the age of the Upper Helderberg limestone, near Columbus (Ohio), received from Dr. MANN. The notice and illustration of this species are introduced here, for the purpose of comparison with those of the Hamilton group.



GONIATITES MITHRAX.

GONIATITES ORBICELLA (n.s.).

SHELL small, depressed orbicular, without distinct umbilicus, the volutions deeply embraced in the succeeding ones; aperture comparatively large. Dorsal lobe unknown; dorso-lateral lobe narrow and deep, with a wider lateral saddle, and a slight undulation towards the centre.

8



The specimen is compressed, so that its original form is not fully known. It is readily distinguished from *G. uniaangularis* by the undulations of the septa.

GONIATITES ORBICELLA.

Geological formation and locality. In shales of the Hamilton group; at Ludlowville.

GONIATITES PATERSONI (n.s.).

The specimen is a fragment, consisting of a part of one of the outer volutions, with some portions of the inner volutions still attached. This is a cast of about two and a half inches in length: the distance from the centre or umbilicus to the dorsal side, at the widest part, is one inch and five-eighths; the depth of the volution, from the dorsal to the ventral side, is one and a quarter inches; and the greatest transverse diameter, at the commencement of the umbilical depression, is seven-eighths of an inch, while the diameter near the dorsal edge is but three-eighths of an inch. The umbilicus has been moderately large; showing, however, less than half the vertical diameter of the inner volutions, since the next within the outer one of this fragment has nearly three-fourths embraced within the ventral concavity of the latter. The dorsal lobe is angular, and scarcely pointed except in the younger portions: the dorso-lateral lobe is extremely narrow and acute, the septum rising in a narrow arch, and again descending to form a more obtusely angular lateral lobe.

This species shows a greater extreme in the sinuosities, or complexity of the septa, than any other in the group at present known to me.

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GONIATITES PATERSONI.

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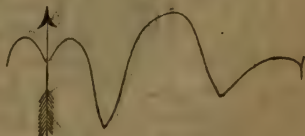


FIG. 9. A fragment of the natural size.

FIG. 10. Diagram of the septa.

Geological formation and locality. In shales of the Hamilton group: at Paterson's creek, Livingston county, N. York.

GONIATITES OWENI (n.s.).

SHELL depressed suborbicular; umbilicus moderately large (varying in different individuals). Volutions five, six, or more; about one-sixth to one-fourth the width of the volution showing in the umbilicus, three-fourths or more being embraced in each succeeding volution. Aperture sublunate or semielliptical, with the angles auriculate: sides of the volutions flattened towards the ventral margin, and gradually curving to the dorsal side; the back regularly curved. Surface (as preserved in the specimens examined) without markings. Dorsal lobe elongate, a little wider above than below, and narrower in the middle; extremity bifid: dorsal saddle highly arched, with a height equal to or greater than its width at base; dorso-lateral lobe elongate, triangular, with a low arching lateral saddle and a narrow triangular ventral lobe.

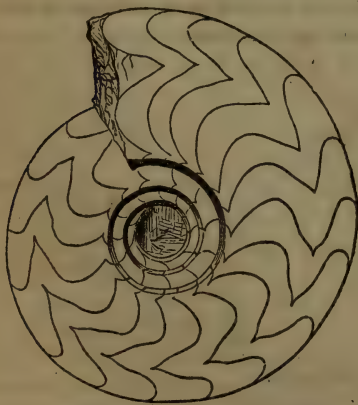
In the young state, and sometimes in older specimens, this species is marked by transverse grooves or constrictions, extending around the outer volution and giving a trinucleate aspect.

This species is more rotund than the *G. patersoni* of the Hamilton group, and the septa are less complex in their sinuosities. It is also more rotund and broader on the dorsum, with a larger umbilicus, than *G. rotatorius*, with which it is associated.

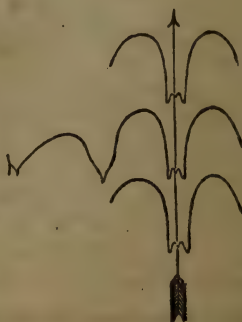
The species appears to be variable in some of its characters, and we find two somewhat constant varieties. The difference in proportional size of umbilicus is accompanied by other characteristics. In a specimen with a large umbilicus, the dorsal lobe has the form described, and the extremity does not reach so low as the arch of the saddle in the second septum behind; while in specimens with a small umbilicus, the sides of the dorsal lobes are quite parallel, and the periphery of the shell is marked by a pair of continuous grooves parallel with the sides of these lobes; and the extremities reach beyond the arch of the saddle in the second septum behind. This feature indicates a closer arrangement of the septa throughout, which does not appear to be due to age.

For this variety I would propose the name of *G. parallela*, from the lineal grooves on the periphery bordering the dorsal lobes.

11



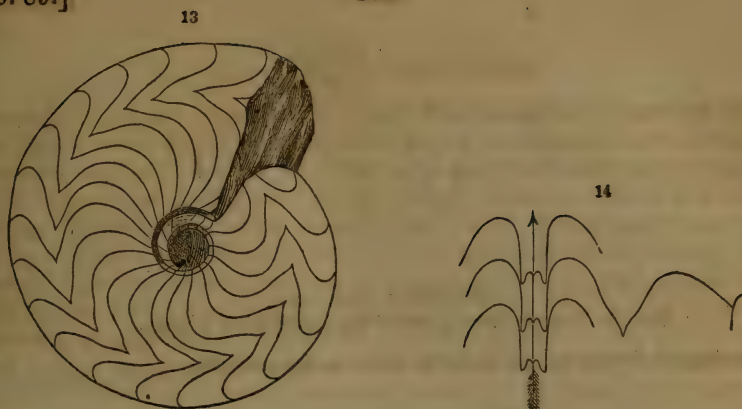
12



GONIATITES OWENI.

FIG. 11. View of a specimen with the larger umbilicus.

FIG. 12. Septa of the same produced, in their natural relations.



GONIATITES OWENI, var. PARALLELA.

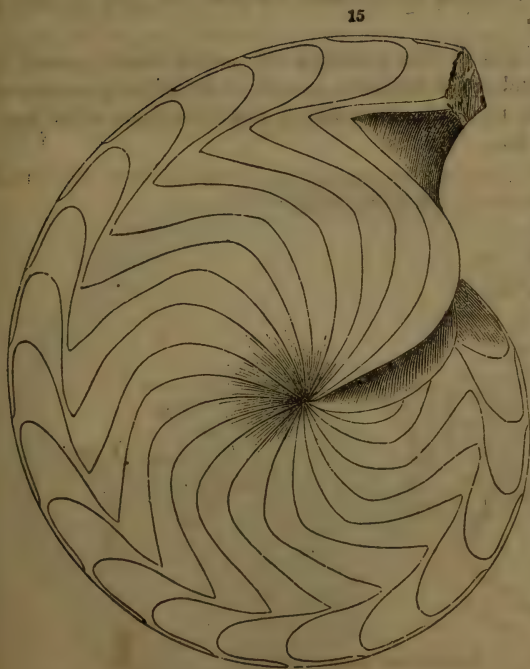
FIG. 13, 14. Specimen showing the smaller umbilicus, and the septa produced.

Geological formation and locality. In strata of the age of the Hamilton group of New-York; at Rockford, Indiana.

GONIATITES ROTATORIUS?

G. rotatorius : DE KONINCK, Carb. Fossiles de Belgique, page 565, plate 50, fig. 1.

[See Note at the end of this paper.]

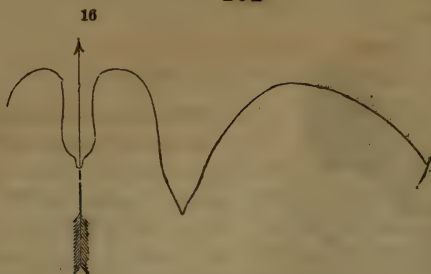


GONIATITES ROTATORIUS.

FIG. 15. Outline of the shell and direction of the septa.

This species, from the same locality as the preceding, has been identified with the European form. In the absence of European specimens, I have only means of comparison with figures, and am unable to point out specific differences. In general form of shell, and proportions of volutions, this fossil does not greatly differ from *G. pater-soni*; but the presence of a large umbilicus, and more complicated septa in that one, are distinguishing features.

The accompanying diagram will suffice for comparison with the preceding species.



GONIATITES ROTATORIUS.

FIG. 16. Diagram showing form of septa produced in a plane.

Geological formation and locality. Same as the preceding.

GONIATITES HYAS (n. s.).

SHELL discoid : volutions five, six or more, slender and flattened laterally, and rounded upon the back; umbilicus very wide and shallow, showing two-thirds or three-quarters of the width of each volution, a very small portion only being embraced in each succeeding one. Siphuncle very small. Dorsal lobe narrow and acute, reaching about as low as the first lateral lobe; dorsal saddle elongate, broader than the dorso-lateral lobe or lateral saddle; dorso-lateral lobe narrow, elongate, sublinguiform, and pointed below; lateral saddle of the form of the dorsal saddle, but narrower, the apex midway between the dorsal and ventral side of the volution; ventro-lateral lobe of the form of the dorso-lateral lobe, but a little shorter : ventral saddle broader and shorter than the dorsal saddle.

This species is associated with the two preceding ones, and is readily known by the more slender volutions and broad umbilicus, as well as the abruptly undulated septa. It bears some relation to *G. chemungensis* of VANUXEM (Report 3d Geol. District N. York, p. 182, f. 1).

17

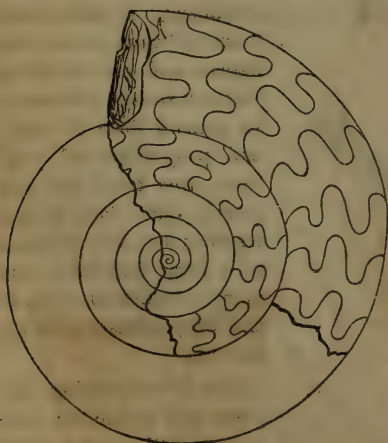
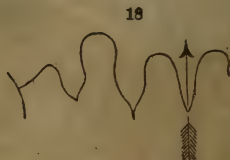


FIG. 17. Form of the shell.

GONIATITES HYAS.

FIG. 18. Diagram showing direction of septa.



Geological formation and locality. In strata of the age of the Hamilton group of N. York; at Rockford, Indiana.

GONIATITES BICOSTATUS.



GONIATITES BICOSTATUS.



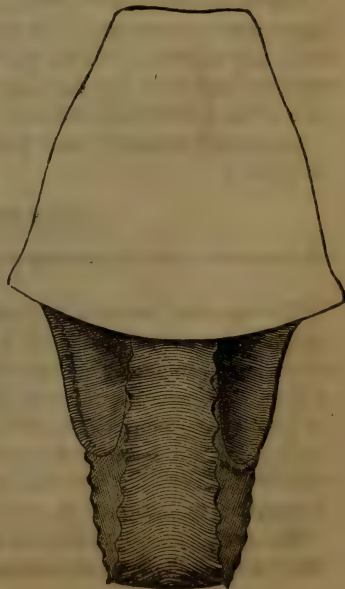
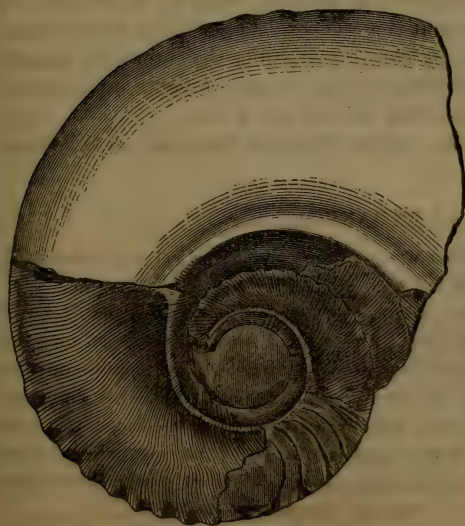
The *Goniatites bicostatus* of the Portage group (Report 4th Geol. District, page 245, f. 8) differs from all the preceding species in the character of its septa, which are abruptly bent along the dorso-lateral groove; making, however, a much less angle than in *G. oweni* or *G. patersoni*.

NAUTILUS (DISCITES) ORNATUS (n. s.).

SHELL discoid; umbilicus broad : volutions, three, four or more, not embracing, rapidly expanding, flattened upon the dorsum and ventrum; sides moderately convex; section and aperture quadrangular, with the ventral side the broader : dorsal angles subcarinate, nodose; nodes elongate, sometimes regularly alternating, having one upon one division and two upon the next. Septa simple; outer chamber very large. Siphuncle dorsal.

This is a strongly marked species, and readily distinguished from the GONIATITES by the flattened dorsum and great width of the ventral side; and also by the nodose angles, which are partially preserved even in the casts. A large specimen measures about six inches across the disc, and of this the aperture measures one-half. There seems no sufficient reason for separating the species from NAUTILUS, unless it be the position of the siphuncle. In this respect it corresponds with DISCITES of M'Coy; but as this name has been anticipated by DE HAAN for a genus of Cephalopoda, there is an impropriety in following the latter name.

Geological formation and locality. In the Goniatite limestone of the Marcellus shale : near Manlius, and at Schoharie.



DISCITES ORNATUS.

FIG. 21. Lateral view.

FIG. 22. Profile and form of septa.

CYRTOCERAS TRANSVERSUM (n. s.).

SHELL moderately curving, somewhat flattened upon the ventral side, making the ventral and transverse diameters near the last septa about as five to eight, somewhat obtusely angular on the sides : septa moderately concave, distant on the dorsal side about one-seventh of the transverse diameter, and, on the ventral side, one-seventh of the vertical diameter. Outer chamber short, very gradually expanding. Aperture transverse, subelliptical.

All the specimens examined are imperfect casts of the interior; and the only evidence of external markings consists of nodes upon the lateral angles, of which there is one to about every third septum, with some appearance of arching ridges extending from these to the centre of the dorsum.

This species differs from any other in the Hamilton group, or the Upper Helderberg limestones, by the transversely oval form and closely arranged septa.

Geological formation and locality. In the Goniatite limestone of the Marcellus shale, near Manlius, New-York.

GYROCERAS LIRATUM (n. s.).

SHELL obliquely subovate; volutions disunited, number unknown, rapidly expanding on the last volution. Aperture and outer chamber unknown, the former apparently subcircular. Septa numerous, a little more straight on the back of the shell, distant from one-fifth to one-fourth the diameter of the shell. Surface marked by strong longitudinal ridges, which, slowly increasing in number, become widely divergent towards the aperture, leaving flattened or concave interspaces twice or thrice as wide as the ridges. The longitudinal ridges, in the earlier formed portions of the shell, are crossed by strong concentric ridges, which, at their junction, produce nodes. The transverse or concentric ridges likewise diminish, and become nearly obsolete towards the aperture. There are finer intermediate longitudinal striæ, and lamellose striæ parallel to the lines of growth.

The species is described from a fragment of the fossil, with an impression of a larger portion of the same. The fragment is a cast consisting of about twenty chambers; and thirteen of these, including what appears to be the outer one, measure upon the back three and one-quarter inches; while the same number, on the curvature of the ventral side, measure less than one inch and a half.

Geological formation and locality. In the Goniatite limestone; at Schoharie, New-York.

GYROCERAS EXPANSUM? var.

G. expansum : SEMANN, DUNKER and VON MEYER, Palæontographica, Vol. iv, 1853, pa. 167, pl. 21, f. a, b, c.

The specimen resembles, in some points, the figure given by SEMANN; but it expands more rapidly, and the volution, in its second turn, is in contact on a few of the last chambers. The ventral side is somewhat flattened, and concave only for a short distance at the junction of the second volution. The transverse diameter, at the ninth septum from the outer one, measures in direct line one inch; while the vertical diameter is a little more than five-eighths of an inch; the septum being about two-fifths of the whole diameter from the ventral side, which is much farther than represented by SEMANN in a section of greater diameter.

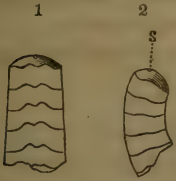
The surface is cancellated by fine elevated diverging longitudinal striæ, which are crossed by finer closely arranged concentric striæ.

Geological formation and locality. In the Goniatite limestone; at Manlius, N.Y.

The locality cited by Mr. SEMANN for his species is Cazenovia; but the Goniatite limestone does not occur there, and I presume the specimens were from Mr. LINCKLAEN of Cazenovia, who derived them from the Goniatite limestone at Manlius.

GYROCERAS GRACILE (n.s.).

SHELL slender, curving, very gradually enlarging; vertical and transverse diameters about as four to five; septa undulated on the back, distant about one-third the greater diameter: on the ventral side there are, in the same measurement, a little more than five septa. Siphuncle excentric, and near the dorsal side. Surface longitudinally striated.



1. Dorsal view of fragment. 2. Lateral view of same: s, siphuncle.

The specimen is a fragment, and the true form and number of volutions is unknown. The occurrence of a species of this genus in the same association as the GONIATITES, etc. is interesting, and therefore it is enumerated in this place.

Geological formation and locality. In the same beds with *Goniatites rotatorius* and *G. oweni*; at Rockford, Indiana.

ONCOCERAS DILATATUM (n.s.).

SHELL very rapidly expanding towards the aperture; outer septa very moderately convex, distant about one-eighth of an inch; section oval, a little wider on the dorsal side of the transverse diameter: vertical and transverse diameters about as 17 to 13. The expansion at the sides, in the length of five septa, is from seven-eighths to one inch and three-eighths; and from the dorsal to the ventral side, the expansion in the same length is from one inch and one-eighth to one inch and six-eighths, the expansion being mainly on the dorsal side.

The specimen is imperfect, and the apex and outer chamber unknown. The general form, shallow chambers, and other characters, refer it to the Genus ONCOCERAS. The curvature in the body of the shell has been very moderate, as usual with the shells of this genus.

Geological formation and locality. In the Goniatite limestone; at Schoharie.

GOMPHOCERAS (APIOCERAS) OVIFORME (n.s.).

SHELL, in its outer chamber and upper part, rotund, subovate or oviform, abruptly contracted towards the aperture, which is large and well defined; length of the outer chamber but little greater than the greatest width. From the base of the outer chamber to an equal distance below, it has nearly the same size and form, embracing four or five septa; and from this point the tube is very abruptly contracted. Section circular or broadly oval. Surface marked by fine concentric striæ.

Fragments of this species are not uncommon, though I have seen but a single individual which preserves the entire form.

Geological formation and locality. In the Goniatite limestone: at Manlius and Schoharie.

GOMPHOCERAS (APIOCERAS) FISCHERI (n.s.).

SHELL large, broadly clavate or elongate subovoid, attenuate below and ventricose above, somewhat abruptly contracted at the aperture. Septa closely arranged. Surface finely striated concentrically.

The length of one specimen is seven inches, with a diameter of four inches in its widest part, which is at a point three-fourths of an inch above the last septum : from the last septum it tapers gradually to the apex, measuring eleven septa in the space of three inches. It is a much larger and more ventricose shell than the preceding, but not so rotund or abruptly contracted at the aperture. It is a remarkably large and fine species.

Geological formation and locality. In the Goniatile limestone : at Manlius, Onondaga county, N.Y.

GOMPHOCERAS (APIOCERAS) CONRADI (n.s.).

SHELL small, clavate or fusiform, gradually enlarging from the apex to a little below the aperture, where it is greatly constricted, or becomes gradually smaller to the contraction of the aperture proper, the shell being folded abruptly inwards. Aperture transverse, occupying the greater part of the width of the cavity at the summit; the sinus extending below the summit, and marked by a few concentric wrinkles. Septa simple, rather deeply concave, about nine in the space of five-eighths of an inch, the last one narrower than the others. The diameters below the outer chamber measure respectively eight- and nine-sixteenths of an inch, and the length of the outer chamber is half an inch. The surface appears to have been longitudinally striated.

From the same rock and same locality I have a fragment of a chambered shell, which is marked by strong longitudinal rounded and somewhat distant striæ; which I am inclined to refer to the same genus, but which can scarcely be the same species.

In several species of this genus, I have observed that those with longitudinal striæ are but little expanded at the outer chamber, and sometimes contracted towards the extremity, and truncate rather than rounded at the aperture; while the concentrically striate species are more ventricose in the outer chamber. Should these characters be found constant, it may be necessary to refer the species to two genera, and reduce the present generic synonymy.

Geological formation and locality. In the Goniatile limestone at Manlius, N.Y.

ORTHOCERAS MARCELLENSIS (VANUXEM).

(*Orthoceras typus* : SEMANN, loc. cit.)

SHELL extremely elongate, straight; section circular, gradually tapering to an extremely minute apex, and, in its greatest width at the aperture, measuring about two inches : the diameter is about equal to the extent of three septa next below the point of measurement. Septa deeply concave, the concavity equal to three-fourths their distance apart, slightly bending downward on the dorsal side, and a little arched on the opposite side. Siphuncle small, subcentral. Surface marked by fine closely arranged concentric striæ, with a longitudinal suture line on the ventral side.

Geological formation and locality. This species is abundant in the Goniatile limestone, at Manlius and Marcellus, and less common at Schoharie.

ORTHOCERAS INDIANENSIS (n.s.).

SHELL extremely elongate, very gradually tapering; section circular. Septa somewhat deeply concave, the concavity equal to one-third the diameter, distant from each other from one-fourth to one-third the diameter. Siphuncle central or sub-central, small; outer chamber subfusiform and constricted towards the aperture. Surface unknown.

The specimens are numerous, occurring in fragments with diameters varying from one-tenth of an inch to nearly two inches. The condition of the specimens is precisely the same as that of the *GONIAITES* at the same locality.

This species very closely resembles *O. marcellensis*, but tapers less abruptly. In specimens of the same size, the number of septa does not differ in the two species.

Geological formation and locality. In the same strata with *Goniatites oweni* and *G. rotatorius*; at Rockford, Indiana.

PUGIUNCULUS? (THECA) ACULEATUS (n.s.).

Elongated obtusely triangular bodies, having one side nearly flat, and the other two sides meeting at a very obtuse angle, and slightly incurved towards that angle, the flat side being convex in the direction of the length. Aperture obtusely triangular, and a little thickened on the straight side at the lateral angles.

It is with hesitation that I refer these bodies to any known genus.

Geological formation and locality. In the Goniatite limestone at Rockford, Indiana.

DENTALIUM ACICULATUM (n.s.).

Small, slender, cylindrical, gently tapering and slightly incurved tubes, with striated surfaces. In general appearance these tubes resemble minute Orthoceratites; but they are destitute of septa, and incurved towards the upper extremity.

Geological formation and locality. In the Goniatite limestone: Manlius, N.Y.

BELLEROPHON LINEOLATUS (n.s.).

SHELL subglobose: volutions broadly rounded on the back, not carinate, the last one much expanded; aperture somewhat semicircular, and extended at the lateral angles; umbilicus small and neatly rounded. Surface marked by longitudinal elevated and rounded striæ which are somewhat alternate in size, and crossed by similar finer striæ, giving a beautifully cancellated structure.

There is a slight depression and an arching of the striæ along a narrow dorsal line. Length about half an inch, with a width of one quarter of an inch at the junction of the labrum with the volution.

This species bears a close resemblance to a species in the Hamilton group in N. York.

Geological formation and locality. In the Goniatite limestone at Rockford, Ind.

BELLEROPHON CYRTOLITES (n.s.).

SHELL subcuneiform; the first volutions narrow, expanding more suddenly towards the aperture: volutions contiguous, but slightly embracing, somewhat acute, angular upon the back, and the outer half of the last one obtusely angular at the umbilical margin. Aperture rhomboidal, with a deep notch at the dorsal

angle. Surface marked by undulations parallel to the margins of the aperture, and apparently by finer striæ in the same direction : surface characters not fully known.

Geological formation and locality. In the same strata with *Goniatis oweni* and *G. rotatorius* : Rockford, Indiana.

PLEUROTOMARIA VADOSA (n.s.).

SHELL depressed subconical or ovoid : volutions about four, rapidly expanding; the last one marked by several revolving ridges, and a more prominent one along the back. In the cast the upper volutions are regularly rounded on the exterior, and the last one subangular from the prominence of the carina and the characters of the exterior shell : width from half to three-fourths of an inch, with equal height.

Geological formation and locality. The same as the preceding.

PLEUROTOMARIA RUGULATA (n.s.).

SHELL depressed conical or ovoid : volutions four or five, very rapidly expanding, the body volution forming almost the entire bulk of the shell; volutions rounded exteriorly, the last one showing a carination (upon the cast) towards the aperture. Aperture broadly expanded, and the lip somewhat reflexed on the lower side. Surface marked near the aperture by strong folds parallel to the margin, which are preserved in the cast; while regular and sharply elevated striæ, parallel to the lines of growth, which are distant about twice the diameter, mark the surface of the shell : also some extremely faint revolving lines are visible.

This shell has the form of the preceding, but is larger, with the last volution more ventricose; and the sharp vertical striæ, with or without faint revolving ones, are characters not observed in the preceding.

Geological formation and locality. In the Goniatite limestone, associated with *G. expansus*, *Discites*, *Orthoceras*, etc., at Schoharie. N.Y.

PLEUROTOMARIA? MITIGATA (n.s.).

SHELL small, ovate : volutions four or five, gradually enlarging above; the body volution becoming ventricose, and constituting much the larger part of the bulk of the shell. Aperture ovate.

The back of the volutions in the cast are marked by an obscure revolving band, but the surface markings are otherwise unknown.

The specimens are casts, and consequently their reference to *PLEUROTOMARIA* is with hesitation.

Geological formation and locality. In the Goniatite limestone, at Rockford, Indiana.

MURCHISONIA (PLEUROTOMARIA?) LIMITARIS (n.s.).

SHELL teretely conical : volutions five, six or more, rapidly ascending and increasing moderately in size, angular on the periphery in the cast, flattened on the upper side and rounded below; the last one flattened on the back towards the aperture, which is somewhat rounded. Surface characters not fully known; the lower side of the last volution marked by strong revolving striæ below the central revolving band.

Geological formation and locality. In the same strata, associated with the preceding.

LOXONEMA TURRITIFORMIS (n.s.).

SHELL elongate, slender : volutions six or more, very gradually enlarging to the aperture, rounded upon the back. Aperture oval or ovate.

Geological formation and locality. In the same association as the preceding.

EUOMPHALUS PLANODISCUS (n.s.).

SHELL planorbicular : spire depressed, composed of about three volutions which are barely contiguous, the whole in the same plane on the upper side. Volutions slender and very gradually enlarging from the apex, regularly rounded; the last one near the aperture a little flattened above, and the margin of the aperture slightly expanded.



This species has a more depressed spire than any other known to me in the rocks of New-York.

Geological formation and locality. In the Goniatite limestone at Manlius, New-York.

EUOMPHALUS PLANODISCUS.

EUOMPHALUS LENS (n.s.).

SHELL small, planorbiform or lenticular : spire composed of about four volutions (three to four or more), the inner ones revolving almost in the same plane, while the last one is slightly depressed. Volutions gradually expanding, the last one angular on the periphery; the upper side flattened and declining, and the lower side somewhat rounded : umbilicus broad and moderately deep, the width about equal to the width of the last volution.

The specimens are casts, or with silicified shells, and the surface markings are obliterated or obscure. There are evidences of oblique striae from the umbilicus to the angular periphery, and a revolving undulation on the lower surface.

The form of the shell is similar to *Pleurotomaria (Raphistoma) lenticularis*; but is a little more depressed on the summit, while the inner volutions are more rounded.

Geological formation and locality. In strata associated with *Goniatites oweni*, *G. rotatorius*, etc. : Rockford, Indiana.

EUOMPHALUS SPIROBIS (n.s.).

SHELL extremely depressed, discoid : spire composed of three or four volutions which, on the upper side, are revolved in the same plane. Volutions slender, very gradually enlarging and not expanding at the aperture; aperture rounded : umbilicus wide and shallow, and sometimes with the outer edge subangular. Surface marked by strong elevated striae parallel to the lines of growth : striae sometimes crenulate.

Geological formation and locality. In the same strata with the preceding species.

MEGAMBONIA LYONI (n.s.).

SHELL obliquely subovoid, broadly rounded in front and on the base, sloping posteriorly and rounded on the postero-basal margin : beak incurved and pointing forward. Surface marked by flattened radiating striae, which are sometimes dichotomized.

The right valve shows two strong teeth just anterior to the beak, but the character of the hinge-line is not ascertained.

The shell has the form of *AMBONYCHIA*; being more robust than *A. carinata*, and with finer radiating striae, in this respect approaching *A. bellastrata*. The presence of teeth in the hinge removes this fossil from *EDMONDIA*, to which genus I should otherwise have referred it.

Geological formation and locality. In the compact limestone of the Goniatile beds; at Rockford, Indiana.

CYPRICARDIA VENTRICOSA (n.s.).

SHELL subovoid, ventricose, inequilateral; hinge-line equalling little more than half the entire width of the shell; umbones much elevated; beaks incurved; anterior end short and abruptly rounded, lunule cordiform; ligamental area strongly marked; posterior end subtruncate; umbonial slope angulated, and extending to the postero-basal margin : the surface between this ridge and the anterior end marked by strong concentric ridges, while the posterior concave slope is nearly smooth.

This is a small strong shell, about three-fourths of an inch long and half an inch high. The depressed posterior slope occupies one-third the superficies of each valve.

Geological formation and locality. In the limestone with *Goniatites rotatorius* and other fossils, at Rockford, Indiana.

Besides the preceding, there are a few other lamellibranchiate shells : one of these is a *NUCULA*, resembling *N. bellatula* of the Hamilton group, but smaller, and with more angular beaks.

ANATINA LEDA (n.s.).

SHELL oblong, ovate, subcuneate, scarcely gibbous : anterior end rather sharply rounded; posterior end produced. Anterior cardinal slope short and slightly curving; posterior slope straight; basal margin curving from the anterior end regularly to the posterior extremity of the cardinal line. Beak thin, pointed, and but little elevated above the hinge-line.

This shell resembles *A. attenuata* of McCoy, but is a narrower shell, and has the general form and expression of *LEDA*, but the hinge-line is not crenulated.

Geological formation and locality. In the Goniatile limestone : at Rockford, Indiana.

NUCULA HIANIS (n.s.).

SHELL ovate, gibbous, subcuneate; anterior end somewhat obliquely truncate; posterior side twice as long as the anterior, subacutely rounded and gaping at the extremity; beaks elevated, a little compressed.

In the cast there is a depression on each side at the shorter end of the valves, extending from just above the muscular imprint towards the beaks. The (posterior) anterior muscular impression is almost terminal, with a small secondary muscular pit near the cardinal line : hinge crenulate.

Geological formation and locality. In the Goniatile limestone; at Rockford, Indiana.

ORTHIS OCCASUS (n.s.).

SHELL suborbicular, the transverse greater than the longitudinal diameter; hinge-line greater than half the entire width of the shell. Surface marked by numerous fine tubular radiating striæ, and a few imbricating lines of growth. The length and width of the dorsal valve are about as seven to nine.

This species resembles *O. vanuxemi* and *O. penelope* of the Hamilton group of New-York; but the dorsal valve is more gibbous, and the hinge-line proportionally longer.

Geological formation and locality. In the Goniatic limestone; at Rockford, Indiana.

RHYNCHONELLA (EATONIA) OBSOLESCENS (n.s.).

SHELL short, subpyramidal, ventricose; anterior end truncated by a broad shallow sinus; sides rounded in the middle. Dorsal valve much the more gibbous, regularly rounded in the middle, and somewhat abruptly elevated towards the point. Ventral valve depressed convex towards the beak, becoming flattened and concave in the middle, and abruptly bent upwards on the anterior half of the shell; beak short and rounded, with the apex truncate. Surface of the upper part of the shell smooth or finely striated: a few short obsolete folds upon the mesial fold and sinus, while the margins of the shell appear to be crenulate on the inner edge.

The shell has much the aspect of *EATONIA*; but the muscular impression, so far as can be ascertained from an imperfect cast, is that of *RHYNCHONELLA*.

SPIRIFER SEMIPLICATA (n.s.).

SHELL pyramidal: dorsal valve moderately convex, the mesial fold affecting only the anterior half: ventral valve much elevated; beak incurved over the foramen; area short, undefined at the margins; mesial sinus well defined. Surface marked by rounded slightly elevated plications, reaching about half way to the beaks: entire surface marked by undulating lines of growth. Length from one-quarter to one-half an inch or more.

In the young state, this shell resembles an *AMBOCÆLIA*; but the semiplicate character is a distinguishing feature. The form approaches *CYRTIA*; but the beak is rounded and incurved over the area, which, having no defined margins, differs conspicuously from the species of that genus.

Geological formation and locality. In the Goniatic limestone; Rockford, Indiana.

SYNBATHOCRINUS OWENI (n.s.).

BODY calyculate, rounded below and gradually enlarging to the summit of the radial plates: base short, truncated below by the large round column, distinctly pentangular above by five radial plates which are wider than high. Surface granulose.

The base of this species is larger and more rotund than any of the Carboniferous species described.

Geological formation and locality. In the Goniatic limestone at Rockford, Indiana.

PROETUS DORIS (n. s.).

The caudal shields of a species of this genus are not rare in the same association with the preceding fossils.

CAUDAL shield semielliptical, convex; the axis gibbous, rounded and very prominent in old specimens, obtuse posteriorly. The plain border of the pygidium is about half as wide as the lateral lobe, and defined by a shallow depression on the inner side, marked by about eight ribs, while the axis is marked by thirteen or fourteen in full grown specimens. Surface granulose.

This species is larger than the one in the Goniatile limestone in New-York.

Geological formation and locality. In the Goniatile limestone at Rockford, Indiana.

I am aware that this enumeration of species shows a large preponderance of numbers in the Indiana locality; and that viewed together, these might be regarded as evidences of the existence of a Carboniferous fauna in that region during the period of the deposition of these beds. On the other hand, the GONIATITES of the New-York rocks, including those of the Hamilton group, offer too close an analogy to be referred to a different system of strata.

The absence of GOMPHOCERAS in the Indiana locality is a striking fact, while GYROCERAS is barely represented in the collections. It is not improbable that further examinations may reveal these and other fossils in the same beds. It should not be forgotten, also, that the same limestone, in the Marcellus shale of New-York, in localities where the GONIATITES do not occur, yields numerous fossils not here enumerated. Even admitting that the fauna of the Goniatile limestone of Indiana has a more carboniferous aspect, it is only in accordance with what we observe in other strata above the Upper Helderberg limestones as we trace them in a westerly direction. This subject, however, will be resumed in a future report.

I have been indebted, for specimens from Rockford, to Mr. H. C. GROSVENOR, and Mr. S. T. CARLEY of Cincinnati, Ohio, and to Mr. S. S. LYON of Jeffersonville, Indiana. The most numerous collection of species, however, was made by Mr. A. H. WORTHEM during his connection with the Iowa Geological Survey, while making a section across the country from the Mississippi river to the outcrops of the lower strata bordering the Cincinnati axis.

CORRECTION.

The reader will please alter the names *Orthosina arctostriata* and *O. alternata*, on pages 80 and 81, to *Streptorhynchus arctostriata* and *S. alternata*; the species having been inadvertently left under the former genus to which they were originally referred.

NOTE UPON THE TRILOBITES OF THE SHALES OF THE HUDSON-RIVER GROUP IN THE TOWN OF GEORGIA, VERMONT.

IN the Regents' Twelfth Annual Report on the New-York State Cabinet of Natural History, I described three species of TRILOBITES from the shales of the upper part of the Hudson-river group in Georgia, Vermont. I then referred two of these, with some hesitation, to the Genus *OLENUS* (DALMAN), and one to *PELTURA* (MILNE-EDWARDS); following the reference to *Peltura* (*Olenus*) *scarabæoides*, as the type. A further examination of these specimens, and some others, has satisfied me of the impropriety of this reference. Although in many respects approaching to *OLENUS*, these forms differ in some important features; and, in order to avoid confusion, they require a distinct designation. In their general aspect, and in some of the details, these fossils bear a resemblance to *PARADOXIDES*; from which they are at once distinguished by the less proportional elongation of the body, the smaller number of articulations of the thorax, the direction of the groove or furrow in the lateral segments, and by the form of the glabella. In the first point they also differ from *OLENUS*, which, though having fewer articulations of the thorax, has a larger number than in our fossils. In their general aspect and expression, these fossils are of what might be termed a "primordial type;" but yet differ from any of the TRILOBITES in our extreme lower formations sufficiently to be readily distinguished from them.

The genus *PARADOXIDES* was established by BRONGNIART in 1822 (*Crust. foss.* p. 30); and the fossil described by LINNE under the name of *Entomolitus paradoxus*, as figured and described by WAHLENBERG (*Act. Soc. Upsal.* 1821, pa. 31, pl. 1, f. 16), was made the type of the genus under the name *Paradoxides tessini*. Under the same genus were included *P. spinulosus*, *P. scarabæoides* and *P. laciniatus*; species described by WAHLENBERG, reproducing the figures of that author, and giving an additional illustration of *P. spinulosus*.

In 1826, DALMAN, admitting the Genus *PARADOXIDES* of BRONGNIART, nevertheless proposed the name *OLENUS* to include the four first named species; placing *P. tessini* and *P. spinulosus* in the first section, and the others in the second section of the new genus, proposing the generic name of *LICHAS* for the *P. laciniatus* of BRONGNIART. Subsequently the three species *P. spinulosus*, *P. gibbosus* and *P. scarabæoides* have been regarded as distinct from *PARADOXIDES*, and made the foundation of the Genus *OLENUS*; while the latter of these has more recently been placed under the Genus *PELTURA*.

In *PARADOXIDES*, as now established, we have species with broad lunate cephalic shields, with the glabella wider in front: the body or thorax has from sixteen to twenty articulations; the pygidium is narrow, with two to three and even five and eight segments, while the lateral lobes are little developed.

In *OLENUS*, the cephalic shield is comparatively broader and shorter, the glabella narrowing (or not broader) anteriorly: the number of thoracic segments is from fourteen to sixteen; the caudal shield is broader than long and semicircular, the lateral lobes being more developed than in *PARADOXIDES*, and both marked by transverse rings or ridges.

M. BARRANDE makes the following comparisons between *PARADOXIDES* and *OLENUS*:

"In establishing the family for which we have given *PARADOXIDES* as the type,
[Senate, No. 89.]

we have indicated the characters common to the genera which constitute it. Notwithstanding their affinities, it is easy to recognize at a glance that the PARADOXIDES are distinguished by the large number of segments, the form of ribs, the hypostoma, the great prolongation of the cephalic limb, the very elongated eyes, and the general appearance. The only type where it is difficult to establish a strong line of demarkation is OLENUS; particularly when we consider *P. spinulosus*, which approaches nearest to PARADOXIDES, and which BURMEISTER has classed with them. Not having at our disposal the materials necessary to show fully the distinction between these two genera, we will confine our remarks to, 1, That in OLENUS, the glabella has a form constantly narrowing towards the front, and which contrasts with those of the PARADOXIDES; 2, the lateral furrows of OLENUS are very much inclined, and rarely unite in pairs on the axis, while in PARADOXIDES they are almost horizontal, and the two last pairs generally form two parallel branches traversing the glabella; 3, the number of thoracic segments in the first genus appears not to exceed fifteen or sixteen, which is the least number observed in the second; 4, the pygidium of OLENUS usually differs from that of PARADOXIDES by a greater relative development of the lateral lobes. We hope that the Swedish savants will be able to define the limits between the two genera. The discovery of the hypostoma of OLENUS would contribute much to attain this end.*

In comparing our own species with OLENUS, we find some differences in the form of the cephalic shield, but more particularly in the form of the glabella; which, however, from imperfection in the specimens, does not admit of minute comparisons. Our specimens have no more than thirteen or fourteen segments of the thorax (and the one referred to PELTURA has eleven), instead of fifteen or sixteen, and the direction of the lateral furrow is different. The greater development and extension of the third segment of the thorax is a remarkably distinctive character, and the same feature is shown in the posterior segments of one species. The form and development of the pygidium also differs from that of OLENUS, in the lesser lateral expansion, and absence of segments on the lateral lobes.

When we compare with PARADOXIDES, we find the cephalic shield proportionally broader and shorter, while there is no expansion of the glabella towards the front; nor do the transverse furrows extend entirely across this part, except at its base. This feature and the facial suture, though indistinct, correspond more nearly with OLENUS.

The smaller number of thoracic segments is a distinguishing feature, and the direction of the segment-furrow differs essentially. In one feature, that of the greater development of the *third* segment, it corresponds with PARADOXIDES, where the *second* segment has a greater development than the others. In the extreme development of the posterior segments, in one species, there is likewise a similarity with PARADOXIDES. In the slight development of the pygidium, our fossil corresponds in some degree with PARADOXIDES.

In the perfect condition, one species appears to have been furnished with a row of nodes or spines along the dorsal ridge.

We have, therefore, although the material is imperfect, the means of showing well-marked distinctions between these forms and the allied Genera OLENUS and PARADOXIDES.

The species referred to PELTURA has the cheeks separated, and therefore there is some obscurity about the suture margins. The expansion of the lateral lobes of the thorax is imperfect in the specimen figured; but, from examination of this and other specimens, the third segment does not appear to have been prolonged as in

* BARRANDE, *Système Silurien du centre de la Bohême*, Vol. i, p. 367.

the two others. The pygidium has four or five rings on the axis, and the latera lobes are expanded and the extremity rounded; moreover I am able to count but eleven articulations in the thorax : these, with other characters enumerated, seem to exclude it from generic association with the two species referred to *OLENUS*. For these, excluding the one referred to *Peltura*, I would propose the generic designation *BARRANDIA*.

GENUS *BARRANDIA** (n.g.).

GENERAL form broadly ovate or elongate ovate, distinctly trilobate. Cephalic shield broad, somewhat semicircular; the width more or less than twice the length, with the posterior angles projecting in long spiniform points : the posterior margin is nearly straight or slightly concave, with a slight sinuosity at the outer angle just within the cephalic limb; the anterior and lateral margins have a thickened or elevated border, within which is a well marked groove or depression of the crust. The glabella is well pronounced, of nearly equal width throughout, or slightly narrowing and rounded in front; marked by three pairs of furrows (perhaps from two to four), the posterior one of which is nearly or quite continuous across from the posterior angles of the eyes. The facial suture has not been fully determined, but appears to extend in a curving line from the front margin to the anterior angle of the eye, and from the posterior angle of the eye it turns abruptly outwards towards the postero-lateral angle of the cephalic shield.

EYES large and well developed, elongate semilunate, extending from near the base of the shield more than halfway to the anterior margin. Hypostoma broadly ovate, little longer than wide.

THORAX composed of thirteen or fourteen articulations; the axis being moderately convex, and usually much narrower than the lateral lobes (and sometimes apparently marked by a row of nodes or short spines along the summit). Lateral lobes nearly flat; the ribs, to about the eighth or ninth, extending almost rectangularly, or slightly inclined from the axis for one-third to one-half their length, where they are bent abruptly backwards. The third segment is stronger, and much more prolonged than the others. The last segments of the lateral lobes are produced directly backwards, or sometimes a little convergent below. The segments of the lateral lobes are marked by a broad longitudinal furrow nearly parallel to the anterior margin; leaving an abruptly elevated ridge or border upon that side as far as the geniculation of the segment, where the groove runs along the centre, dying out on the recurved extremities.

PYGIDIUM distinct, narrow, elongated, the axis narrow and acutely pointed; without rings? Lateral lobes narrow or obsolete, and free from transverse ridges or furrows.

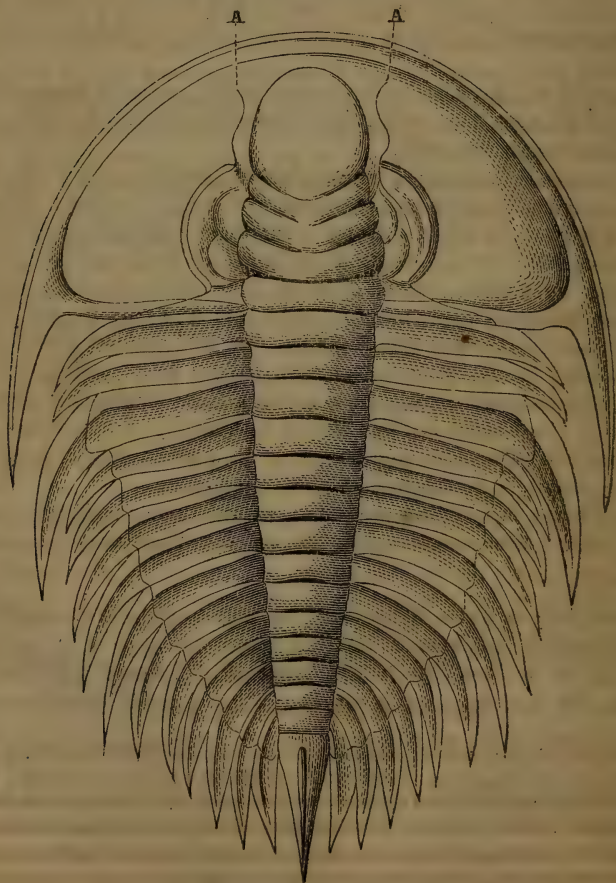
The accompanying figure, illustrating this genus, combines characters observed in several imperfect specimens of the same species. The form of the cephalic shield is shown in two or three individuals : the glabella is crushed in all the specimens examined; but the form is made out, as nearly as possible, from the materials in

* In honor of M. J. BARRANDE, author of *Système Silurien de Bohême*. I can only regret that I have not something of greater importance to offer as a tribute to the name, and in commemoration of the rare merits and eminent services in the cause of science, of this distinguished palæontologist. I believe, however, that these forms will hereafter be found to mark an important horizon in our geological series; associated as they are with other forms that indicate the last appearance and final dying out of the types of that ancient crustacean fauna, which marked, so far as we now know, the dawn of life upon our planet.

our possession, and cannot vary much from the truth. There are three pairs of glabellar furrows anterior to the occipital furrow. In the area between the extremities of the glabella lobes and the eyes, there are on each side, in the species figured, two low oblong tubercles; but I cannot be sure that these are of generic importance, and it might be supposed possible that this appearance is due to the crushing of a prominent part of the crust, were it not that the feature is symmetrical and correspondent on the two sides.

The facial suture can be traced a little forward of the eye, but its direction on the anterior margin has not been ascertained: on the posterior margin, its direction is shown as accurately as it can be from crushed and distorted specimens. The body, or thorax and pygidium, is drawn essentially from a single individual. The line just within the free extremities of the pleura is shown in this and other specimens, and indicates the limits of the crust on the lower side. The caudal shield shows no more than the axis which is prolonged into a slender pointed spine, strengthened by a sharp elevated ridge beginning near the anterior margin, and extending to the extremity.

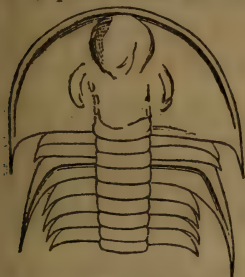
The entire absence, so far as can be seen, of lateral lobes of the pygidium, is a marked feature; and this especially is in strong distinction with *OLENUS*.



BARRANDIA THOMPSONI.

BARRANDIA VERMONTANA*.

The accompanying figure of *B. vermontana* illustrates also the character of the cephalic shield, and the greater strength and extension of the third articulation of the thorax. The fragment of thorax and pygidium, heretofore referred to this species (Twelfth Annual Report of the Regents), prove, on farther examination, to be parts of the following or a similar species there referred to PELTURA.



BARRANDIA VERMONTANA.

The head and part of the thorax. The remaining parts of the animal are unknown.

In my examinations of these TRILOBITES, I had hoped to unite the three forms heretofore described, under a single genus; but on more careful comparisons, I find that the one before referred to PELTURA is so dissimilar, that I am unable, by any proper extension of the generic characters of BARRANDIA, to include it in the same genus. In the specimen figured, and in two others which appear to possess the thorax and pygidium entire, there are but eleven thoracic segments; the third segment is not enlarged and produced as in BARRANDIA, but, on the other hand, the anterior segments, to the number of five or six, are little prolonged at their extremities: the prolongation increases in the posterior segments, while the last one of the thorax is enlarged as it recedes from the axis, and at its broadest part makes an abrupt geniculation, turning almost rectangularly backwards, is prolonged into sharp spines in a direction parallel to the axis and extending beyond the pygidium. The axis of the pygidium is marked by three rings, while the lateral lobes are apparently smooth (in one specimen), and the entire form is semielliptical, the axis obtuse at its posterior extremity, and bordered by a smooth extension of the crust from the lateral lobes; which is in strong contrast with the preceding genus. Nor can it be properly placed under PELTURA, which has twelve segments of the thorax, the cephalic shield not extended in the posterior limb, nor the last segment of the thorax produced as in the present form; while the pygidium is emarginate at the extremity, and dentate on the margins.

While the glabella has the form of OLENUS, and the general form of the cephalic shield corresponds to that genus, the extension of the last segment of the body in spines parallel to the axis is a character of the typical species of PARADOXIDES (see *P. bohemiensis*): the pygidium is also much more nearly of the type of PARADOXIDES, than of OLENUS or PELTURA.

I propose therefore to designate this form by the generic name BATHYNOTUS.

GENUS BATHYNOTUS (n. g.).

[Gr. *βαθύς*, *amplus*, and *νωτός*, *dorsum*; in allusion to the ample central lobe or axis of the typical species.]

GENERAL form elongate ovate, distinctly trilobate. Cephalic shield somewhat semielliptical, with the posterior angles prolonged in spiniform processes: po-

* This and the preceding species were published as *Olenus thompsoni* and *O. vermontana*, in the Twelfth Annual Report of the Regents of the University on the State Cabinet of Natural History, pp. 59 & 60.

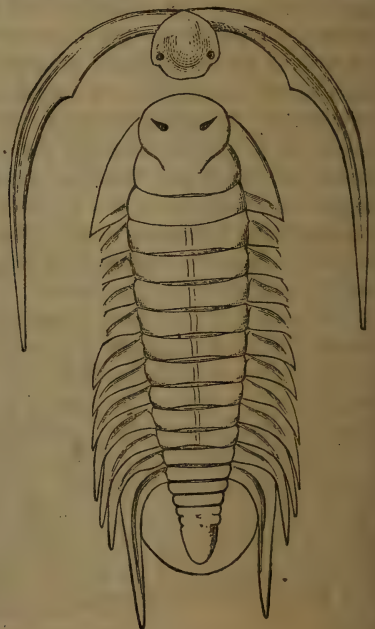
sterior margin nearly straight across the centre, and a little concave at the sides; anterior and lateral margins somewhat thickened. The facial suture (to judge from the separated parts) is very simple, extending in a slightly curving line from the front of the shield backwards, and coming to the posterior margin within the limb. The glabella is prominent and well defined, ovate in form and gradually narrowing towards the front: the occipital furrow extends directly across the glabella; the first pair of furrows above this are oblique and only slightly connected across the middle of the glabella, while anterior to these are two slight indentations. Hypostoma subcircular, with the posterior end a little wider. Eyes unknown.

THORAX composed of eleven articulations; the axis broad and prominent, wider than the lateral lobes. Lateral lobes nearly flat, narrow: the first five or six ribs short and narrow, inclining gently backwards; the posterior ones becoming more abruptly bent and prolonged at the extremities, while the last pair are wider and stronger, bent almost rectangularly, and produced in spiniform extensions much beyond the others.

PYGIDIUM distinct, semioval, the axis marked by several annulations, the lower part plain. Lateral lobes plain or marked by ridges, and extending beyond the axis in a continuous flattened expansion.

BATHYNOTUS HOLOPYGA*.

There are but three distinct rings in the axis of the pygidium, though there is a fourth indistinct depression, which may or may not indicate a fourth ring.



BATHYNOTUS HOLOPYGA.

The single species described in the last Report is illustrated in the accompanying figure. The specimen is a mould or impression from which most of the crust has been removed, and we have the relief from a cast made in this mould. The cheeks are separated and turned on one side; but in the drawing, they are placed in symmetrical relation with the other parts of the animal. The rings of the axis are marked

* *Olenus (Peltura) holopyga*: Twelfth Annual Report of the Regents of the University, on the State Cabinet of Natural History, p. 61.

by a row of small spines. The great length of the spines or processes, from the posterior angles of the cephalic shield, is a remarkable feature : in this individual, their extremities must have reached as far as the eighth or ninth segment of the thorax; and in another individual, these separated parts have similar proportions.

In one imperfect specimen of this species, with narrower axis, we have eleven body rings, including the elongated posterior one; but behind this there are three annulations of the axis, the two anterior of which have somewhat the appearance of free segments, and are likewise marked upon the lateral lobes; while the pygidium below has apparently a single annulation, extending into the lateral lobe.

This one appears to be specifically distinct from the preceding, in its narrower axis : nevertheless this feature may be due to distortion, as also some other points of apparent difference.

It is to be regretted that the materials at my disposal are so imperfect as to leave some points yet in doubt; but I conceive that there can be no hesitation in admitting the generic distinction of these fossils, from those of any established genus of TRILOBITES; and however much, therefore, we may desire to avoid the multiplication of genera, it seems to be unavoidable in the present instance.

The geological horizon of the shales in which these trilobites occur having been made a matter of discussion among geologists, I shall refer those interested in the subject to the forthcoming Report upon the Geology of the State of Vermont by Prof. E. HITCHCOCK.

NOTE. I may remark, in this place, that the disposition of these three species does not include two which I have designated as *OLENUS* in the first volume of the Palæontology of New-York (p. 256 - 258, pl. 67, f. 2, 3). One, the *O. asaphoides*, showing six of the lateral ribs of the thorax, has no ribs larger or longer than the others, though the form of the cephalic shield and the glabella are very similar to *BARRANDIA* : in that one there are four pairs of glabellar furrows, the two posterior ones of which are slightly indented across the centre of the glabella. The eyes are elongated, and more curved than in *Barrandia thompsoni*. We have, therefore, yet other undetermined material in these slates.

NEW SPECIES OF FOSSILS FROM THE HUDSON-RIVER GROUP OF OHIO, AND OTHER WESTERN STATES.

CALYMENE CHRISTYI (n.s.).

GENERAL form elongate ovate, symmetrical: body gibbous, the pygidium equalling the length of the head. Head semicircular, the frontal border expanded, and gradually narrowing on the sides; the posterior angles terminating in a short sharp spine. Glabella wide, slightly narrowing towards the front, regularly convex, strongly defined by the dorsal furrows, a little concave in the middle of the base : occipital furrow well defined, nearly straight, and in right line with the cheek furrows; posterior furrow oblique, defined but not deep; the middle one nearly rectangular to the axis, while the anterior one is but slightly indented. The posterior lobe is much wider than the middle one, and about the same width as the anterior one. Cheeks small. Eyes very prominent.

THORAX with thirteen segments; the axis salient, and a little wider in the middle than the lateral lobes; the articulations of the latter flat, or slightly curving for a little more than one-third their length, when they are suddenly bent downwards.

The **PYGIDIUM** is gibbous, semielliptical, with the axis very prominent and marked by seven or eight rings, the last one being longer and more prominent, with a minute scarcely defined node at the extremity : lateral lobes marked by six flattened ribs, the last one of which is minute, the expansion being continued in a narrow flattened border around the posterior extremity.

This beautiful species of *CALYMENE* will be recognized by the form of the glabella and the shallow furrows, which leave the lobes flattened, and not convex and rounded as in the other American species of the genus. The minute spine at the posterior angle is a well-marked and peculiar feature.

Geological formation and locality. In the calcareous shales of the age of the Hudson-river group near Oxford, Ohio. The specimens were received from DAVID CHRISTY, esq., of Cincinnati, to whom I have been indebted for many other fossils from the same and other formations.

PROETUS PARVIUSCULUS (n. s.).

BODY small, ovate, the head broader and the thorax narrowing behind : cephalic shield margined in front and at the sides by a distinct border, and the posterior angles produced in small spiniform processes which reach to the fourth or fifth articulation of the body. Glabella short, ovate, gibbous, a little concave at the base, without visible lobes : dorsal furrow narrow. Eyes close to the glabella, and prominent.

THORAX with ten segments; the axis narrow and prominent : lateral lobes but moderately convex.

PYGIDIUM semicircular; the axis prominent and marked by several rings, while the lateral lobes are flat and marked on the upper part by about four ribs on each side, with a plain expanded border around the posterior margin.

The length of this fossil is about one-third of an inch; and having seen several specimens varying little in their dimensions, and none larger than the one described, I am inclined to regard them as mature individuals.

Geological formation and locality. In the calcareous shales of the Hudson-river group at Cincinnati, Ohio. The specimens were received from Mr. S. T. CARLEY.

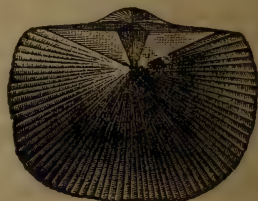
ORTHIS CARLEYI (n. s.).

SHELL transversely subelliptical or subquadrate, resupinate : hinge-line less than the greatest width of the shell, usually from two-thirds to three-fourths as long; extremely compressed towards the cardinal extremities, and the angles rounded; front margin often subtruncate; sides nearly straight, or more or less rounded. Dorsal valve gibbous, arcuate and incurved at the umbo, and flattened in the middle towards the front; area narrow. Ventral valve flattened near the cardinal angles, elevated and obtusely pointed at the beak, and concave in the middle and towards the front : beak straight, the plane of the area inclined forwards; area large, triangular, with a large open foramen which reaches to the beak.

SURFACE strongly striate, the margin of each valve being marked by from fifty to seventy rounded or subangular striæ. Some of the striæ are simple and continuous from the beak, the increase taking place chiefly by implantation; while a small number are bifurcate.

The length of the shells of this species is sometimes an inch and a quarter or more. The specimen figured has a length of an inch, by a width of one inch and four-tenths.

The accompanying figure is an illustration of this species, looking upon the ventral valve, and, though only in outline, will be sufficient to distinguish the fossil.



ORTHIS CARLEYI.

Geological formation and locality. In the shales of the Hudson-river group near Cincinnati, where it was originally discovered by Mr. S. T. CARLEY.

ORTHIS EMACERATA (n.s.).

SHELL semielliptical, length and width about as five to seven; hinge-line nearly equalling the width of the shell. Dorsal valve flat, with a slight depression down the centre; area extremely narrow. Ventral valve depressed convex, slightly elevated at the beak, which is inclined over the area, but scarcely incurved; an undefined elevation extending from the umbo towards the front, and sometimes quite to the margin of the shell: area narrow, almost linear.

SURFACE finely striated: striæ bifurcating, curving upwards, and running out on the hinge-line. Interior of the dorsal valve with two small teeth and a small cardinal process: valves thin.

This species has the form and general characters of *Orthis testudinaria*; but the shell is much thinner than that species ordinarily is in the same formation, and the striæ are finer, there being at least twenty more on the margin in shells of equal size. The depression in the centre of the dorsal valve, and elevation in the centre of the ventral valve, are far less conspicuous or scarcely marked in some specimens, while the hinge-line is always proportionally longer than in *O. testudinaria*.

Geological formation and locality. In the shales of the Hudson-river group near Cincinnati, Ohio. Received from Mr. CARLEY, and also collected in Iowa and Wisconsin.

ORTHIS ELLA (n.s.).

SHELL small, ovate: valves nearly equally convex; hinge-line extremely short, being scarcely more and sometimes less than one-third the width of the shell, and scarcely affecting the contour of the cardinal margin, which slopes from the beak of the ventral to the lateral margins a little above the middle of the valve. Dorsal valve gibbous, subcircular; the beak extending a little above the hinge-line, and the area extremely short. Ventral valve broadly ovate, sloping from the beak: beak produced beyond the line of the opposite valve, and pointed, not incurved; area twice as long as high; foramen narrow and extending to the apex of the beak, and sometimes truncating the extremity.

SURFACE marked by from fifteen to twenty simple, abruptly rounded or subangular plications.

This small *ORTHIS* is so peculiar, as not to be readily mistaken for any other known in our strata. The short hinge-line and area, and the produced beak of the ventral valve, are characteristic features. In some specimens the area is obscure or undefined, and the shell has much the aspect of *Trematospira*. It is a rare species, and I have not seen more than twenty individuals, all of which preserve the characters given above, the variation being mainly in the number of striæ: those with fewer striæ are frequently more gibbous than the others. Length about one-third of an inch; the width a little more.

Geological formation and locality. In the calcareous shales of the Hudson-river group near Cincinnati, Ohio. From the collections of Mr. S. T. CARLEY and Mr. U. P. JAMES.

OBSERVATIONS UPON A NEW GENUS OF CRINOIDEA:

CHEIROCRINUS.

I HAVE had in my collections, for the past ten years or longer, some separated plates of a Crinoid so peculiar in character as to convince me that it must be a form very distinct from any thing heretofore described; but I was still unable to arrange

these parts in any satisfactory manner to produce a symmetrical body. During this period, I have obtained some, and seen other plates of similar character; till I came to know the existence of such forms from the Niagara group to the Carboniferous limestone inclusive. These plates are so peculiar in shape, proportions and convexity, that, when once attention is directed to them, a single one is sufficient for the determination of its relations.

It has been only during the past year, that I have obtained the means for a proper description of the genus; and it is now easy to see why all our previous knowledge of these fossils would not suffice for a reconstruction of the body from the separated plates. The body is unsymmetrical; the column is not attached to the centre in a line with the axis in its ordinary position, but on one side; and the body has not grown erect upon the column.

From the unsymmetrical form, the peculiar arrangement of plates, the position of the column, etc., I have found myself obliged to employ some different terms from those in ordinary use; and to designate one side of the fossil as the dorsal, and the opposite as the ventral side. The dorsal side is covered by several plates of peculiar shape, some of them closely anchylosed, and presenting the characters of the back of a jacket or tunic in the arrangement of the parts. These plates bend over at the sides, and unite with a few smaller plates, which form the ventral wall. The ventral side consists of one plate, and sometimes of two anchylosed plates, forming an arch over the space below. This arch is filled by the single triangular or semioval basal plate, which is attached to the dorsal plates by a free joint, and was capable of a great degree of motion when the animal was in a living state. The arms are peculiar, and are as well marked as are the plates of the body by the generic characteristics.

The whole fossil has so much the appearance of a skeleton hand, that I propose the name CHEIROCRINUS; of which genus I already know at least five or six species.

GENUS CHEIROCRINUS (n.g.).

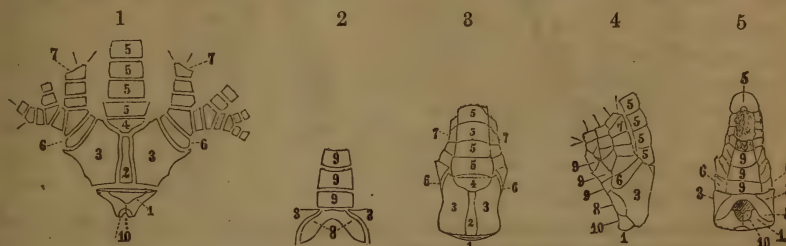
BASE consisting of a single subtriangular or semioval plate, which is composed of three anchylosed pieces (perhaps sometimes of five pieces). The column is attached at the lower angle of the basal piece, sometimes within the margin, and sometimes extending to the limit of the plate. Body above the base composed of five or seven pieces, of which two are much the largest. The lower dorsal plate, or first plate above the base, is usually triangular (sometimes narrow or linear), supporting on its upper sloping edges two large plates, which I designate the dorso-lateral plates; and upon the concave line made by the upper margins of these two plates rests the upper dorsal plate, which supports the plates of the dorsal arm.

These two dorso-lateral, and the upper and lower dorsal plates, are often so firmly anchylosed together as to present the appearance of a single plate, the surface indicating more or less distinctly the lines of suture. The dorso-lateral plates form the dorsal and lateral walls of the body; and their central angles, on the ventral face, are sometimes extended for a little distance between the ventral arch and the succeeding plate. The ventral side consists of an arch, which may be of one or two pieces, joining above, and leaving an arched opening below which is filled by the reversed basal plate. Above the dorsal arch, there may be one or more simple plates. The lower sloping faces of the dorso-lateral plates border the two sides of the arched ventral area or opening; while the upper sloping sides support brachial plates and the lateral arms, which may be simple or subdivided. The dorsal arm extends directly in line with the axis; while the lateral arms,

in their first extension, are more or less rectangular to the axis and extended towards the ventral side, thus enclosing the upper part of the cavity; while, either from the bifurcating plates, or from the upper margins of the simple plates, these arms, or some of their subdivisions, are extended in a longitudinal direction.

The surface is either granulose or striate, and the arms nodose or lamellose.

The accompanying diagrams will serve to illustrate the parts of the fossil, as described above.



DIAGRAMS OF CHEIROCRINUS CHRYSALIS.

FIG. 1. Diagram showing the relations of the parts, from the dorsal side. The small figures refer to the parts of the fossil, and are correspondent with the succeeding diagrams.

1. The basal plate, as seen when extended. 2. Lower dorsal plate, which in this species is narrow and elongate. 3. Dorso-lateral plates. 4. Upper dorsal or dorso-radial plate. 5, 5. Plates of the dorsal arm. 6, 6. Lateral brachial plates. 7. Lateral arms and their subdivisions. 10. Point of column of attachment.

FIG. 2. Diagram of the ventral side : 8. The ventral arching plate. The arching cavity below is filled by the recurved basal plate. 9, 9. Plates of the ventral side. 3, 3, are the extended ventral angles of the dorso-lateral plates.

FIG. 3. A ventral view of specimen in outline : 1, shows the incurved basal plate in its usual position, filling the cavity below the ventral arch.

FIG. 4. Lateral view of the same.

FIG. 5. Dorsal view of the same specimen : 1, is the edge of the incurved basal plate, showing below the dorso-lateral plates.

CHEIROCRINUS CHRYSALIS (n.s.).

Body small, subquadrangular; the plates arranged as shown in the diagrams above. Lateral arms bifurcating. From the Niagara group.

CHEIROCRINUS VENTRICOSUS (n.s.).

Body ventricose; the interior cavity semielliptical below and circular above. Basal plate broadly semielliptical; the first dorsal plate, the dorso-lateral plates, and the ventral arch, all anchylosed together. The upper dorsal plate is deeply inserted between the dorso-lateral plates, and is longer than in any other species. From the Burlington limestone.

CHEIROCRINUS LAMELLOSUS (n.s.).

Body unknown. Arms with strong lamellose extensions at the joints. Burlington limestone.

CHEIROCRINUS DACTYLUS (n.s.).

Body small, subcylindrical, flattened on the back. Plates of the body anchylosed. Dorsal arm cylindrical nodose, bifurcating : lateral arms five on each side, rising from the upper margins of five plates which proceed rectangularly from the brachial plate on the upper lateral face of the dorso-lateral plates. These arms bifurcate twice, the bifurcating joint being nodose. From the Burlington limestone.

The accompanying figure is of this species.

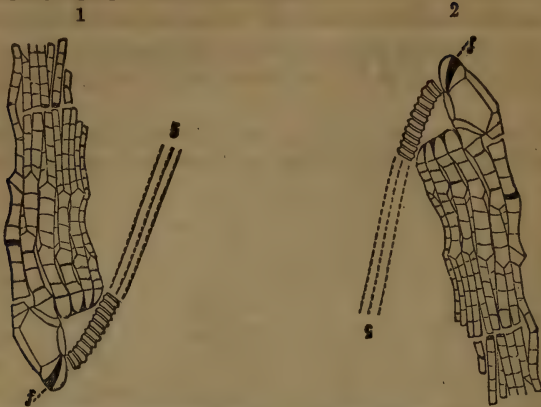


FIG. 1, is in a position with the body erect, as we usually view crinoids; but the direction of the column shows this to be unnatural.

FIG. 2, is in a position the body would take with the column in its natural direction.

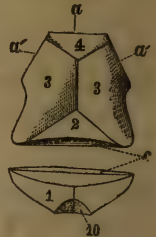
The animal doubtless had the power of erecting its body; and by elevating itself so that the edges of the basal and lower dorsal plates would meet, the basal plate would be nearly in line with the plates above, and the body nearly erect.

CHEIROCRINUS TUNICATUS (n.s.).

Body strong, the dorsal side flattened, narrowing above, the cavity shallow. Basal plate wide and short; first dorsal plate triangular; dorso-lateral plates wide, five-sided, supporting a small upper dorsal plate above: ventral arch of two narrow pieces. The plates of the dorsal side, and those of the ventral arch, are all anchylosed together as shown in the diagram.

CHEIROCRINUS TUNICATUS.

1. Basal plate, showing the point of attachment for column. The figures indicate the plates, as given in the preceding diagram: *c*, the cicatrix, for a strong tendon which connects the dorsal with the basal plate; *a* shows the direction of the dorsal arm; *a'* *a'*, faces of attachment for the lateral arms.



From the Keokuk limestone.

CHEIROCRINUS NODOSUS (n.s.).

Body robust; form of plates similar to the preceding, with the basal plate longer, and the upper sides of the dorso-lateral plates and the upper dorsal plate nodose. Dorsal arm strongly nodose between the joints: lateral arms consisting of a series of simple nodose plates, extended laterally from the brachial plate; and from the upper faces of these the lateral arms extend longitudinally or parallel to the dorsal arm, some of them bifurcating above, and strongly nodose at the junction of every third plate. From the Keokuk limestone.

I have been indebted to the Collections of Messrs. E. JEWETT, A. H. WORTHEN, B. J. HALL and C. A. WHITE, and of the Crawfordsville College through Mr. E. O. HOVEY. Full descriptions and figures will be given in a future Report.

NOTE REFERRED TO ON PAGE 101.

SINCE the preceding pages were printed, I have again compared the figure of the *Goniatites rotatorius* of DE KONINCK with the species from Indiana; and notwithstanding the deference I have for the European authorities who pronounce the two identical, I still feel that there is room for doubt. The direction of the septa in the figure of DE KONINCK differs from that of ours; the arch of the lateral saddle in the latter is nearly central, while in the former it is near the umbilicus. The form and proportions of the section of a volution differ; for while in the European specimen the greatest diameter is near the middle, or nearly in a line with the back of the embraced volution, the greatest diameter in ours is much within this line, and near the ventral side of the volution. The depression formed by the dorso-lateral lobe is nearer to the back of the embraced volution in our species, than is shown in the figure of DE KONINCK; while the summit of the dorsal saddle is longer than in our species. The figure cited is represented with an umbilicus, which ours does not show; while the profile view shows a rotundity of the volutions, and a depression towards the centre, not seen in the American specimens.

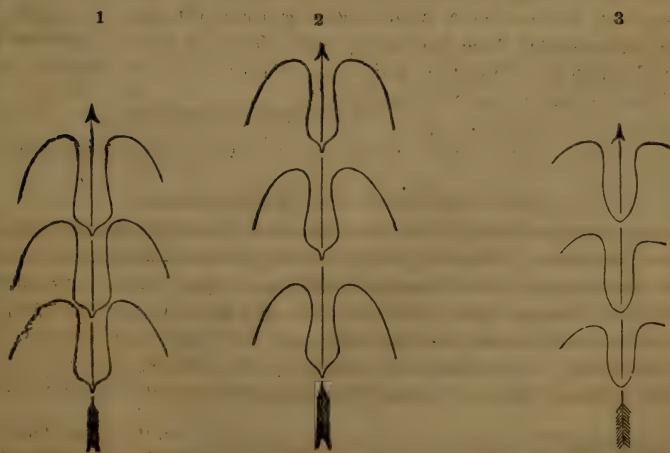
On comparing the dorsal view given by DE KONINCK, with our specimens, we find the dorsal lobe in the latter proportionally longer and more constricted above; while its retrol extremity is suddenly constricted, and then continued in a narrow acute point.

In consideration of these differences in the European and American forms, I think it proper to propose a distinct name for the Rockford species.

GONIATITES IXION.

Goniatites rotatorius of authors; *G. rotatorius?* page 101 of this Report.

SHELL depressed orbicular: volutions entirely embracing; the greatest width of the volutions near the ventral side, gradually curving or flattened on the sides, the back rounded; width on the back, from the points of the dorso-lateral lobes, a little more than half the greatest width of the volution. Septa as in figure 15, page 101. The dorsal side shown in the accompanying diagram.



GONIATITES ROTATORIUS.

FIG. 1 & 2. These diagrams show the extremes of variation in the distance of the septa, form of lobe, etc. on the dorsal side of *Goniatites ixion*.

FIG. 3. Dorsal side of *Goniatites rotatorius*, after DE KONINCK.

SUPPLEMENTARY NOTE,

BY THE

SECRETARY OF THE REGENTS OF THE UNIVERSITY.

PALÆONTOLOGY OF NEW-YORK. Vol. III, by JAMES HALL. pp. 532, with intercalated pages 401* to 424*. Published by Legislative Authority. Charles Van Benthuyssen, Albany, N.Y. 1859.

THIS volume contains descriptions of more than three hundred and forty species of fossils, from the Waterlime group, the Lower Helderberg group and the Oriskany sandstone. The volume of text, amounting altogether to more than five hundred and fifty pages, has been for some time printed; and the index, except that of the addenda, has already appeared in the Regents' Report on the State Cabinet for the last year. The plates, amounting to one hundred and forty-five, making a separate volume, are nearly finished, and will be ready for delivery as soon as the binding is completed, of which due notice will be given.

The fossils described in this volume are distributed as follows :

Under the Crinoidea, there are twenty-five species of the Genera *ASPIDOCRINUS**, *BRACHIOCRINUS**, *CORONOCRINUS**, *DICTYOCRINUS* [the latter a crinoidean?], *EDRIOCRINUS**, *HOMOCRINUS*, *MARIACRINUS**, *PLATYCRINUS* and *TECHNOCRINUS**.

Among the Cystidea, there are four species under the following genera : *ANOMALOCYSTITES**, *LEPADOCRINUS*, and *SPHEROCYSTITES**.

Of the Asteridæ, there is a single species under the Genus *PROTASTER* of FORBES.

Of the Brachiopoda, there are one hundred and thirty-nine species, of the Genera *ATRYPA*, *CHONETES*, *CYRTIA*, *DISCINA*, *EATONIA**, *LEPTÆNA*, *LEPTOCHELIA**, *LINGULA*, *MERISTA*, *NUCLEOSPIRA**, *ORTHIS*, *PENTAMERUS*, *RENSSELERIA**, *RHYNCHONELLA*, *RHYNCHOSPIRA**, *SPIRIFER*, *STROPHODONTA**, *STROPHOMENA*, and *TREMATOSPIRA**.

Of the Lamellibranchiata, there are forty-one species described under the Genera *CYPRICARDINIA*, *MEGAMBONIA**, *MODIOLOPSIS*, *PALEARCA*†*, and *TELLINOMYA*.

Of the Gasteropoda, there are seventy-eight species described under the Genera *BUCANIA*, *EUOMPHALUS*, *HOLOPEA*, *LOXONEMA*, *MURCHISONIA*, *PLATYCERAS*, *PLATYSTOMA*, *PLEUROTOMARIA*, and *STROPHOSTYLUS**.

Of Pteropoda, there are four species under the Genus *CONULARIA*.

Of Cephalopoda, there are twelve species under the Genera *CYRTOCERAS*, *ONCOCERAS* and *ORTHOCERAS*.

Of the Articulata, there is one species of the Genus *SPIROBIS*.

Of Crustacea of the Family of Trilobites, there are thirteen species under the Genera *ACIDASPIS*, *BRONTEUS*, *DALMANIA*, *HOMALONOTUS*, *LICHAS*, *PHACOPS* and *PROETUS*.

Of the Entomostraca, under *BEYRICHTIA* and *LEPERDITIA* there are nine species.

Of the Order Eurypteridæ, there are seven species of *EURYPTERUS* proper, one species under the Subgenus *DOLICHOPTERUS*, and three species of *PTERYGOTUS*; and under the Order Phyllopoda, there are described three or four species of *CERATIOCARIS*.

The descriptions of the Corals and Bryozoa are postponed to a future volume.

* Those marked with an asterisk are new genera proposed by Mr. HALL, and first published by him in this volume and the preceding Report of the Regents of the University on the State Cabinet of Natural History.

† The Genus *CYRTODON* of BILLINGS is synonymous with this genus, and both are synonymous with *CYPRICARDITES* of CONRAD.

Among the new genera of Crinoidea, the most remarkable is the *EDRIOCRINUS*; which, although fixed and without pedicel in the young state, is quite free in its mature condition.

The illustrations of the Genus *PLATYCERAS* of CONRAD present a wide variation of form and manner of growth, graduating in the different species from closely enrolled spires to a single volution at the apex; and others are entirely free from volutions, and present a slightly arching conical form.

There are few species among the Cephalopoda, and the paucity of these forms is in striking contrast to the same in the first volume.

The species of Trilobites each represent (some of them more extravagant in form) those previously described from the Niagara group.

PTERYGOTUS is, for the first time, recognized among American fossils; while *CERATIOCARIS*, heretofore known by a few of the caudal spines, and referred to another genus, is recognized in three species in the Waterlime group.

Of *EURYPTERUS*, two American species were previously known, the *E. remipes* of DEKAY and the *E. lacustris* of HARLAN. Mr. HALL has brought together all the collections known to him in the State of New-York, and has been enabled to add (principally from the State Collection and from that of Mr. C. COBB of Buffalo*) six new species; one of them presenting some remarkable variations, which induce him to refer it to a distinct subgenus. He has also discovered and combined all the parts of the animal, which has never before been done; so that we now know the entire number of articulations of the body, the number and character of the organs of locomotion, together with their appendages (consisting of straight or curving spines), and the form and position of the mouth. The feet, of which the exterior parts serve for locomotion, have their bases expanded and serrate to perform the office of manducation.

These discoveries in the peculiar Genus *EURYPTERUS* are of the greatest interest; and their publication at this time will doubtless excite attention among all amateurs, and others who may be engaged in the collection of such remarkable fossils as this and its associated Genera *PTERYGOTUS* and *CERATIOCARIS*. The subject of these large crustaceans has recently engaged the attention of the palæontologists of the Geological Survey of Great Britain; but their results, as published at this time, do not afford the positive information regarding structure, that is here given in the Palæontology of New-York.

These remarkable crustaceans are regarded by Sir RODERICK MURCHISON as marking, in Europe, the age of the uppermost Silurian strata; and by Mr. SALTER, as entering into strata of well-marked Devonian age; while Mr. HALL has here shown that they lie at the base of, or below, the Lower Helderberg group of rocks (which are of acknowledged Silurian age), and are separated from the earliest known Devonian or fish-bearing beds by a considerable thickness of well-marked Silurian strata. In England, the beds bearing *EURYPTERUS* and *PTERYGOTUS* are directly below the beds containing fishes, and the fossils of the two are sometimes described as mingled together. In this volume it is shown how, in the absence of the Lower Helderberg group and Oriskany sandstone, the beds with remains of *EURYPTERUS* and *PTERYGOTUS* may lie directly beneath the limestones containing remains of fishes; while in this country, along an outcrop of hundreds of miles, the two are never known to be mingled together.

* The author has likewise, in the preface to the volume, made his acknowledgments to O. OSBORN, esq., and Mr. TOWER, of Waterville, for specimens of *Eurypterus remipes*; and to Col. JEWETT, for the use of similar specimens.

The volume contains an Introduction of nearly one hundred pages, in which the author has given a resumé of the later discoveries in the strata preceding those under immediate consideration, and a description of the principal geological formations known in the State of New-York, their origin and geographical distribution. From his observations upon the Appalachian chain, the author has deduced a new theory of the cause of mountain elevation and the folding of strata, the associated and consequent metamorphism resulting from the great accumulation of sediments, and the different results produced by gradual or rapid deposition, etc.

In some Notes following the body of the Introduction, some arguments are discussed which heretofore have been brought forward by HERSHEY, BABBAGE, LYELL, and others, which, so far as they go, sustain the views of the author. The question of the supposed paucity or absence of calcareous matter in metamorphic strata is taken up in one of these notes; and although this is shown to be in general, a necessity from the conditions under which the sediments were originally accumulated, the absence of calcareous matter is by no means universal in metamorphic rocks.

This Introduction is in fact a reproduction of Mr. HALL'S Address before the American Association for the Advancement of Science, in Montreal, in 1857; or, indeed, we may say that the Introduction preceded the Address, since a considerable part of it was printed before that time.

NOTICE.

WHEN the Appendix F (Contributions to Palæontology) was originally reported, it was intended to embrace only the new forms of GRAPTOLIDÆ; the observations on RHYNCHONELLA; the new Genera SKENIDIUM, AMBOCELIA, and the observations on ATHYRIS, MERISTA, etc., with descriptions of some new species of BRACHIOPODA, subjects which had been determined some time previously. The delay in publishing the Report has enabled the author to add other matter since its date. To the titlepage, therefore, should be added "*with additions during 1860.*"

FOURTEENTH ANNUAL REPORT
OF THE
REGENTS OF THE UNIVERSITY
OF THE
STATE OF NEW YORK
ON THE CONDITION OF THE
STATE CABINET OF NATURAL HISTORY,
AND THE
Historical and Antiquarian Collection annexed thereto.

Made to the Assembly, April 10, 1861.

ALBANY:
CHARLES VAN BENTHUYSEN, PRINTER.
1861.

FOURTEENTH ANNUAL REPORT
OF THE
REGENTS OF THE UNIVERSITY
OF THE
STATE OF NEW YORK.

NOTE.

A question having arisen with respect to the date of publication of the Regent's Report on the State Cabinet, it is deemed proper to state that the date on the title page is that on which the report is made to the Legislature. The printing and publication are necessarily subsequent to that time. The thirteenth report was published on or about December 17, 1860.

The fourteenth report is published August, 1861. Some copies of the descriptions of new species by Prof. Hall, were distributed in July.

Historical and Antiquarian Collection annexed thereto.

Made to the Assembly, April 10, 1861.

ALBANY:
PRINTED BY C. VAN BENTHUYSEN.
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STATE OF NEW YORK.

No. 136.

IN ASSEMBLY,

April 10, 1861.

FOURTEENTH ANNUAL REPORT

Of the Regents of the University, on the condition of the State Cabinet of Natural History, and the Historical and Antiquarian Collection annexed thereto.

To Hon. D. W. C. LITTLEJOHN, *Speaker of the Assembly* :

SIR—I have the honor to transmit the Fourteenth Annual Report of the Regents of the University, on the State Cabinet of Natural History, and the Historical and Antiquarian collection annexed thereto.

I remain, very respectfully,

Your obedient servant,

G. Y. LANSING,

Chancellor.

April 10, 1860.

REGENTS OF THE UNIVERSITY, 1861.

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1861.

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JOHN W. VAN DYKE

JOHN W. VAN DYKE

REPORT.

To the Legislature of the State of New York :

The Regents of the University respectfully report that among the additions made to the Cabinet during the last year, are remains of the Mastodon, found at Ellenville, in the county of Ulster. While these wonderful animals, the giants of former days, have become entirely extinct, they have left the evidences of their former existence in various parts of the United States; but in no places in more perfect preservation than in the counties of Orange and Ulster, in this State. A skeleton nearly perfect was many years since found near Newburgh; and in digging the drains of a swamp more recently, in Ellenville, a large tusk, parts of the skull and several detached bones were obtained. During the last summer, other remains in the same locality were found; and, in the hope of obtaining an entire skeleton, the Secretary of the Board, and the Curator of the Cabinet were directed to make a thorough examination of the grounds. Every facility for doing this was granted by John McElhorn, Esq., the owner. A tusk more than seven feet long, from which some three feet had been broken, evidently during the life of the animal, parts of the upper and lower jaws, in which are several teeth, and the principal parts of the skull, from all of which it is confidently expected that an entire skeleton of the head can be constructed, were obtained. A heavy rain, which occurred soon after these excavations, arrested the work.

The swamp in which the bones were found is composed of about two feet of peat and three of marl, resting on a base of clay. The bones are in the marl, and those found were near the outlet of the swamp, which is several acres in extent. Should the ensuing season be favorable, further examinations may be made.

A valuable collection of shells, principally from the Pacific, has been received from the Smithsonian Institution. They are not catalogued, because few of them are yet described or named.

It is proposed to keep them as a distinct collection, to be labeled "From the Smithsonian Institution."

The specimens representing the Palæontology of the Geological department have been labeled, as named and described in the first and second volumes of Prof. Hall's work on that subject. The completion of the third volume will furnish the means of extending the labeling through its descriptions.

It is proposed to occupy the entire second floor of the Geological building with collections from this State; admitting only those from other States, which, by comparison, will illustrate our own formations.

It is the purpose of the Regents to renew their efforts for forming a department of Economic Geology, and to gather representatives of all the natural productions of the State which are applied to the purposes of life.

A popular view of the Geology of the State, with special reference to its exhibition in the Cabinet, has been prepared by Ledyard Lincklaen, Esq., and is herewith submitted as an appendix to the report. It will be of great use to persons visiting the Cabinet, and who are not fully instructed in the subject, and as a guide to the arrangement and study of the collections.

Prof. Hall's contributions are continued, and are regarded as very valuable; anticipating as they do the descriptions of the fourth and fifth volumes of the Palæontology, and thus presenting at an early day to the scientific world what would otherwise be long delayed.

By order of the Regents.

G. Y. LANSING, *Chancellor.*

S. B. WOOLWORTH, *Secretary.*

ACCOUNT CURRENT.

The Secretary of the Regents of the University, in account current with the appropriation for preserving and increasing the State Cabinet of Natural History.

DR.

To balance to new account, (see Senate document No. 89, 1860, page 8,)	\$512 47
To amount received from the Comptroller, being the annual appropriation for 1859-60,	800 00
	\$1,312 47

CR.

By cash paid James A. Hurst, Taxidermist, for a large deer and other animals, catalogued in the last report,	\$300 00
By cash paid Philip P. Carpenter, for expenses of arranging the Mazatlan shells,	288 00
By cash paid J. C. Boynton, for assisting the Curator,	110 00
By cash paid J. Davis, for painting and glazing,	26 65
By cash paid A. McClure & Co., for alcohol, camphor and bottles,	32 25
By cash paid W. C. Little, for subscription to Silliman's Journal, for 1858 and 1859,	10 00
By cash paid for Gazetteer and Map of New York, ..	10 00
By cash paid for Express charges and cartage,	41 47
By cash paid to carpenter,	16 64
By cash paid for stationery,	7 75
By cash paid for bones of the Mastodon,	74 88
By cash paid to C. Mull and H. A. Danker, for birds, ..	2 00
By cash paid to S. F. Baird, for paper trays for shells,	4 81
	\$924 45
By balance to new account,	388 02
	\$1,312 47

In behalf of the standing committee on the State Cabinet, I have examined the above account and find it correct. The payments have been made by order of the standing committee, and are accompanied with proper vouchers.

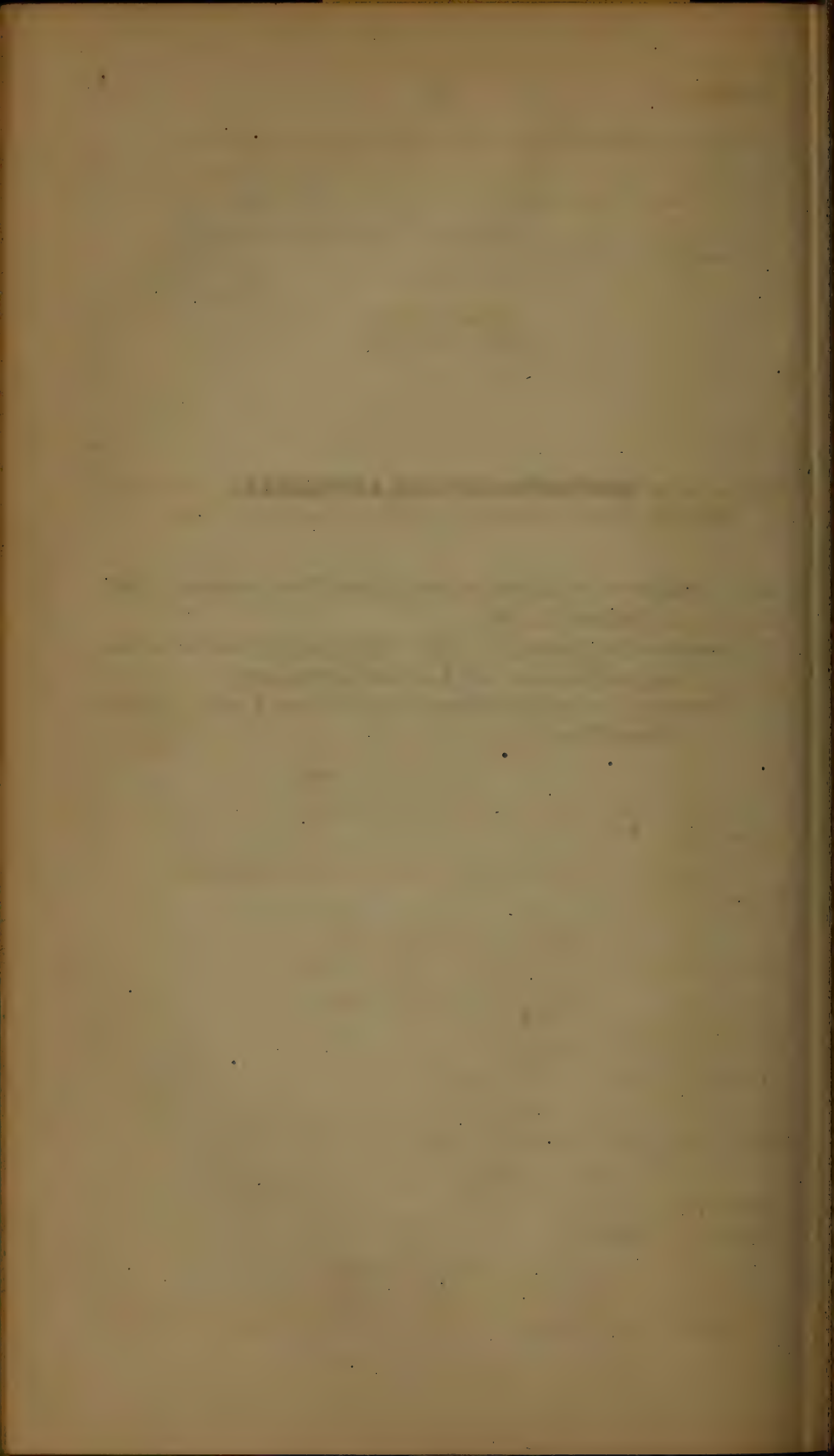
(Signed,)

E. D. MORGAN, *Chairman.*

April 9, 1861.

CONTENTS OF THE APPENDIX.

- A. Catalogue of additions to the Cabinet from January 1, 1860, to January 1, 1861.
- B. Guide to the Geology of New York, and to the State Geological Cabinet. By LEDYARD LINCKLAEN.
- C. Contributions to the Palæontology of New York. By Prof. JAMES HALL.



APPENDIX.

(A.)

Catalogue of additions made to the State Cabinet of Natural History, from January 1, 1860, to January 1, 1861.

Dr. A. SMITH, Little Falls.

COAL PLANT, Beaver County, Pa.

THEODORE KERNER, East Greenbush.

Skins of Serpents from the East Indies, collected by Major William Taylor, British Army: 2 Cobre di capello; 1 Cobre di manilla; 1 Whip Snake; 2 Carpet Snakes; 1 Boa (species?); 7, Species (not stated).

JOHN BIRMINGHAM, San Francisco, Cal.

SULPHURET OF SILVER, Washoe mines.

Hon. AUGUSTUS BEARDSLEE, East Creek, Herkimer county.

BANDED PROTEUS.

Prof. R. W. HASKINS, Buffalo.

PETROLEUM, native and clarified, Pennsylvania.

HORACE AVERILL, Albany.

BROWN HEMATITE, several specimens.

LOGEA PUNCTATA. (Squid.)

LUMPUS ANGLORUM. (Lump-fish.)

Hon. GEORGE W. PRATT, Esopus.

BOTTLE OF WATER FROM THE DEAD SEA.

JAMES McARTHUR, Clyde, Wayne county.

SKULL OF A WOLF.

SKULL OF A MINK.

Dr. E. EMMONS, Albany.

CAST of the head of a Rutodon, North Carolina.

CAST of the tooth of extinct Whale, North Carolina (both fossil).

A. H. WORTHEN, State Geologist, Springfield, Illinois.

POTERIOCRINUS MISSOURIENSIS.

MELONITES PORIFORMIS. Carboniferous limestone, St. Louis, Mo.

C. P. STAATS, Albany.

BANDED PROTEUS.

LEDYARD LINCKLAEN, Cazenovia (deposited).

GONIATITES EXPANSUS. Marcellus shales.

GONIATITES, species? Marcellus shales.

PHRAGMOCERAS, species? Marcellus shales.

PLEUROTOMARIA, species? (two specimens).

PROETUS CRASSIMARGINATA (two). Corniferous limestone, Stafford.

HOMALONOTUS DEKAYII, Hamilton group, Cazenovia.

NUCULA (two specimens), Hamilton group, Cazenovia.

FRAGMENT of a large trilobite, Corniferous limestone.

AMMONITES BUCKLANDI, Lias, Germany.

AMMONITES COLUBRENNI, Oolite, Bavaria.

CYPRINA* HESSII, Wealden clay, Hanover.

PALUDINA FLUVIORUM, Wealden clay, Hanover.

POLIMÆDES CARBONARIA, Wealden clay, Hanover.

ORBITULITES CONCAVA, Upper Greensand, France.

APTYPCHUS LÆVIS, Oolite, Lithographic slate, Germany.

NATICA INFLATA, Devonian, Hartz mountain.

CARDIUM ACARDO, Myacine, Crimea.

CALYPTINE BLUMENBACHII, Upper Silurian, Dudley, England.

AMMONITE, species? Oxford clay, France.

MELANIA, species? Oxford clay, France.

H. A. HOMES, Albany.

SILVER ORE, Stevenson's mine, Arizona.

E. W. COOK, Lockport, Niagara county.

SKULL OF BEAVER.

ISAAC COLES and others, Glen Cove, L. I.

UNDESCRIBED FISH.

LIBINA CANICULATA.

POLYPHEMUS OCCIDENTALIS.

PANOPSI HERBERTI (10 specimens).

SQUILLA EMPURA.

GELASIMUS VOCANS (10 specimens).

PARGURUS PALLICARIS.

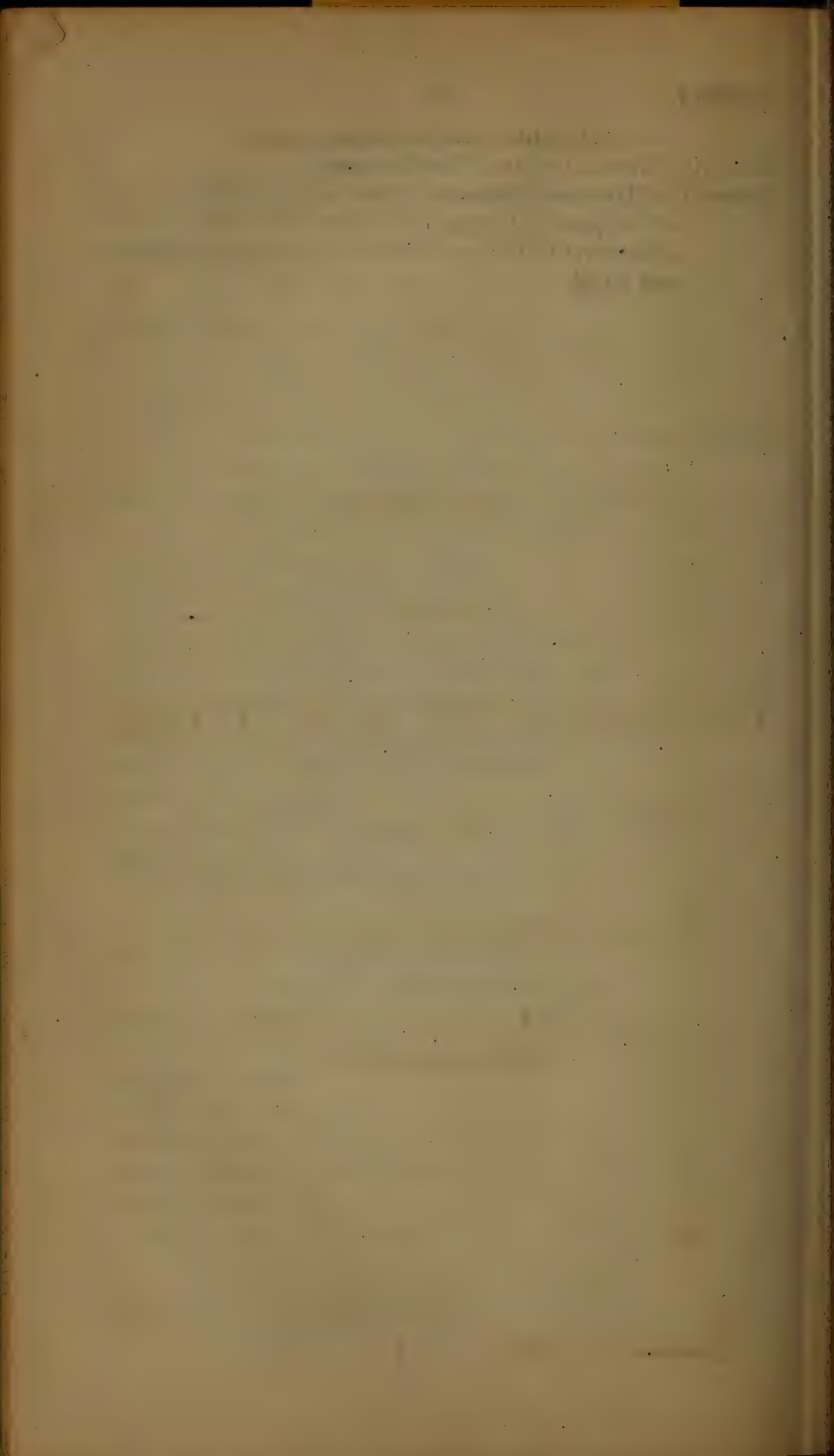
LUPA DICANTHA (2).

PLATYCARCINUS IRRORATUS (10).

G. L. RIDER, Norwich, Chenango county.

SLAB with Crinoidal column, Hamilton group.

BONES of a MASTODON, Ellenville, Ulster county. These consist of the principal parts of the skull; the jaws, in which are several teeth; a pelvic and thigh bone; vertebræ, and a tusk.



(B.)

GUIDE

TO THE

GEOLOGY OF NEW YORK,

AND TO THE

STATE GEOLOGICAL CABINET.

PREPARED BY DIRECTION OF THE REGENTS,

By LEDYARD LINCKLAEN, Esq.



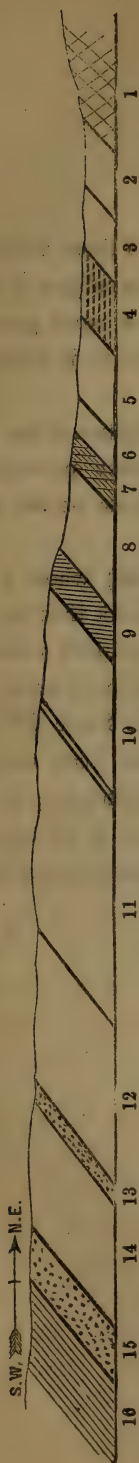
THIS pamphlet is prepared chiefly for the guidance of those visitors to the State Museum who have given little attention to the subject of which it treats; in hopes that it may render the collections more generally instructive, and aid to awaken a more general interest in geological observation.

It has therefore not been strictly confined to a description of the rocks of New-York; but a short sketch of the elementary principles of geology, and some account of formations later than those known in this State, have been introduced.

Those visitors (comparatively very few in number) whose special studies have made all this familiar to them, will not think that too much pains have been used to simplify and explain the subject, when they remember how little clear understanding of it prevails even among persons of liberal education. It is to aid in making the State Collection an educational institution that this little epitome has been compiled, mainly from the State Reports on Geology and Palæontology; and persons already acquainted with the science, or who wish to become critically so, will find in those large volumes the most accurate and abundant information.

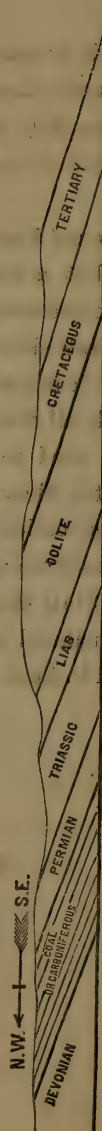
L. L.

February, 1861.



1. Hypogene.
2. Metamorphic.
3. Potsdam and Calceiferous sandstones.
4. Chazy, Birdseye, Black-river, and Trenton limestones.
5. Utica slate and Hudson-river group.
6. Medina sandstone.
7. Clinton and Niagara groups.
8. Onondaga-salt group.
9. Helderberg rocks.
10. Hamilton group, ending with Tully limestone.
11. Portage and Chemung groups.
12. Catskill group.
13. Conglomerate.
14. Carboniferous red shale.
15. Great conglomerate.
16. Coal measures.

Section showing the succession of the strata from N.E. to S.W. across Central New-York.



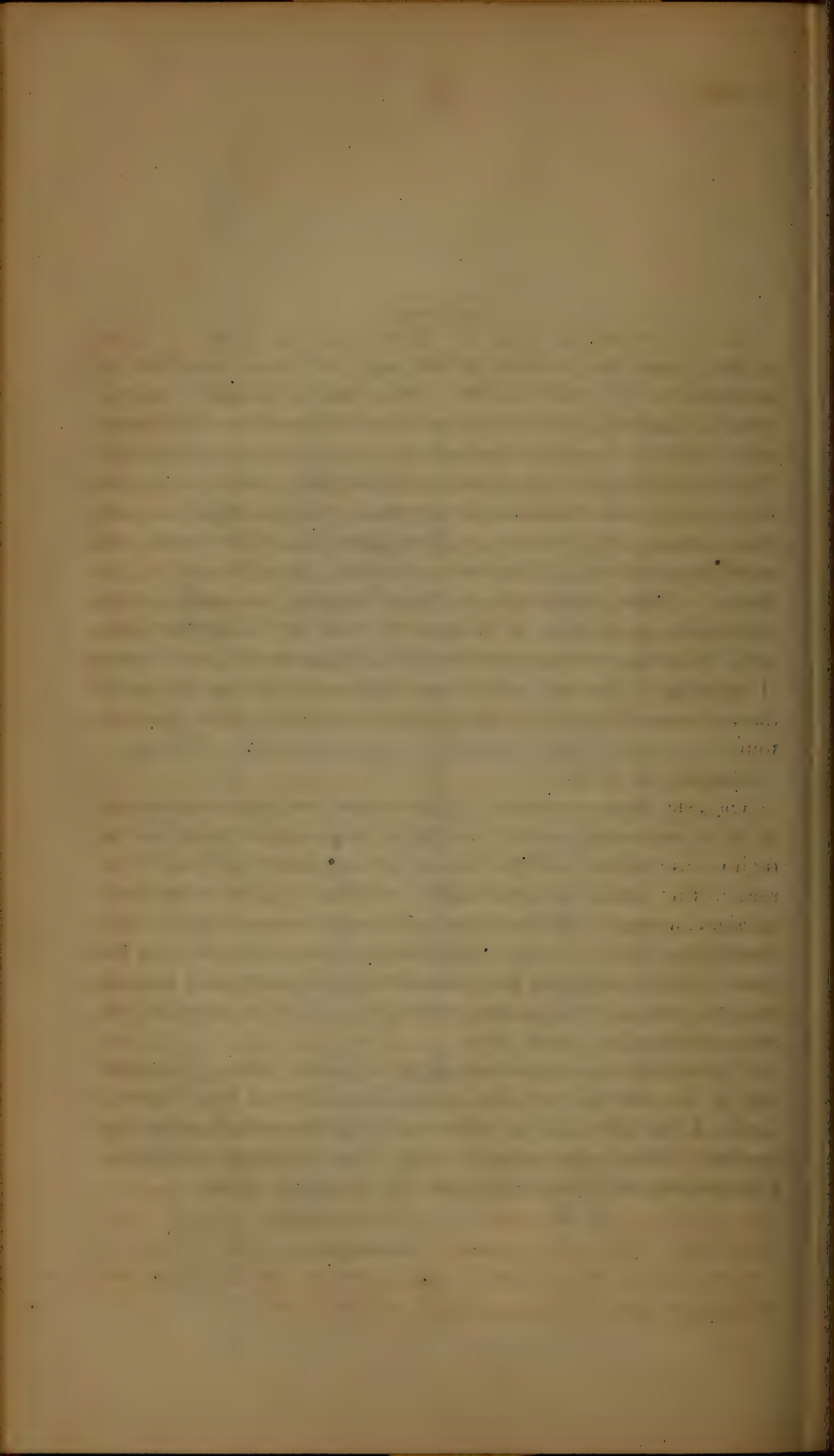
Section showing the succession of the strata from N.W. to S.E., from Derbyshire to Sussex.

NOTE.

The "sections" on the opposite page are intended to show the succession of the rocks of New-York, and also of higher rocks as seen in England. The first or upper section presents the successive rocks in the same manner and order in which their edge would be seen, if a deep excavation reaching down to the sea-level were made from near Gouverneur or Edwards in St. Lawrence county, to Blossburg in Pennsylvania, and we could look at its western wall. The strata are found through most of the State to slope downward, or "dip" toward the south about thirty feet in a mile; so that as we pass on the surface from north to south, we come continually to higher and higher layers. It is owing to this fact, much more than to the greater elevation above the sea level of the more southern counties, that they are found to contain higher and newer strata than those of Middle or Northern New-York.

The relative proportions of this section are greatly distorted: for it is necessary to draw it with a height of at least half an inch on the paper, in order to allow its separate divisions to be seen at all; and if its length had been drawn on the same scale of about a mile to the inch, the entire section would have been twenty feet long. It has therefore been shortened so that the scale of distances is but about one-fortieth of the scale of heights, and this has necessarily exaggerated the "dip" or slope of the strata in an equal proportion.

The second or lower section gives a general view in the same way of the succession of the higher formations of strata across England, from Derbyshire to Sussex. It is drawn in the simplest manner, without attention to proportion; omitting all details, and showing only the main features of the great series.



ALL the stratified rocks of New-York, like those of other countries, are the product of the sea. All these vast beds of sandstone, slate, and limestone, were once deposited from the waters of an ocean, which bore their materials either in chemical solution, or mechanically suspended in the form of fine sediment. The petrified shells, fishes, plants and similar objects which are so commonly found in the rocky layers, are the remains of organic things which either lived in the waters from which the rocks were deposited, or which were washed into them from adjoining shores. Therefore, we have in these remains specimens of the animated population or of the vegetation of earth and sea, which lived when these rocks were deposited. This is the great lesson of all historic geology; and to make it more clear, let us look at the processes which are daily going on under our own observation.

The rain which falls on our hills or plains, slowly, but surely wears away their substance. The waters run from every slope, or rise from every spring, loaded with particles of the earth; either dissolved in a limpid stream, or suspended in a turbid torrent. The process is slow indeed; so slow, that our brief observation can detect its steps only in a few instances; but it is not the less real and certain. The work of wear or abrasion has never stopped since the first shower fell on the dry land, and the first river began to run; and it must ever continue while the elements remain as now. Every exposed inch of the earth's surface is wearing away more or less rapidly, and sending its minute tribute of solid matter through the rivers to the sea. As this waste of the dry land is swept out from the river-mouths into the ocean, it becomes mingled with other sediments worn from exposed coasts by the tides and the waves, or by sea-currents, and all are borne together to the stiller waters beyond these influences. There they gradually settle down to the bottom, the coarser and heavier sediments falling nearest the land, the finer and lighter particles being carried farther to sea.

In these ocean-depths there is thus always in progress a process the reverse of what takes place on land: in the one, there is perpetual wearing away; in the other, perpetual accumulation. In the sea bottom are constantly forming layers upon layers of sand, fine slime, or calcareous mud. In a few places, such as near the mouths of great rivers, these accumulations go on rapidly, but on the average their increase must be exceedingly slow; for the sea deposits can be formed no faster than the waste of the dry land furnishes material, and the average filling up of the ocean's bed must be as slow as the average wearing down of the continents. Slow as it is, however, it is uninterrupted. Year after year, century after century, cycle after cycle it continues, and new layers are added to the increasing pile in every age. The deposits formed during this century overlies and conceal those of the last; beneath the latter, lie those of preceding ages; and at the base of all must be buried those of the first periods of creation.

But it is not only the inanimate dust of earth which is thus carried into the great storehouse of the sea: there lie millions of shells of a thousand kinds; there the remains of innumerable fishes and other forms of life which inhabit the waters, fall, to settle into the oozy bottom; thither float leaves and reeds and tree trunks, drifted from many shores; there sink the skeletons of sea fowl and exhausted land birds, and the remains of drowned quadrupeds swept out to sea by rivers. All these relics are there slowly buried by the ever-settling sediment; every layer containing the remains of such things as lived at the time it was formed beneath the waters. Thus the bottom of the sea becomes a Great Cemetery, in which are buried, by natural agencies, more or less of the relics of every age of earth's history; the deepest and oldest layer of all containing the remains of the living things of its primeval period, those higher in place containing relics of proportionately later centuries, and the highest of all containing the animal or vegetable forms which exist on earth at the present day.

If we could gain access to this sea-bottom, and examine its successive layers, gaining knowledge of the remains of greater and greater antiquity as we penetrated deeper and deeper from its surface, it is easily seen what perfect evidence we should have of the past progress of the world, and how interesting would be the revelations as to whether the living things of early ages were

like those of the present, or whether a variety of plans and different forms of animated existence had maintained a long series of changes, of which the present inhabitants of earth are only the latest arrangement.

Now this is precisely what we have in the stratified rocks, and this study of the order of organic creation, as displayed in their buried contents, is the chief object of Geology; the reading of the history of earth from its own natural records, formed in the way we have noticed.

That these stratified rocks are really old sea-deposits, is perfectly proved by their form corresponding to that produced by deposition from water, by their buried relics of shells and fishes and other remains, by the ripple-marks so plainly visible on the surfaces of many layers, and other evidences. Their present hardness is chiefly the effect of chemical action among their particles, or of consolidation by their own weight and the pressure of higher layers. Their present elevated position is due either to their having been uplifted by subterranean forces above their parent sea, or to the recession of its waters to deeper basins formed by the subsidence of other parts of the earth's surface, both causes having doubtless combined to produce the result.

The broken and abrupt form in which we often find these strata now to exist, projecting their edges from the banks of ravines or slopes of high hills, is explained by the consideration that during their slow emergence from the sea, they were subjected to the wearing action of waves and marine currents which must have removed considerable portions of them; and that ever since then the action of rains and streams during enormous periods have carried on the wearing (or, as geologists call it, the "denuding") process to the point at which it now stands; the whole series of strata, many thousand feet in thickness, being deeply worn and furrowed into hills and valleys. These processes are difficult to trace, for their effect has been always to obscure in one period what was done in a previous one; but the evidences of enormous wear are visible to every observer who studies the face of the country.

These stratified rocks (as might be presumed from this view of their origin) lie, not as many unobservant persons think, in shapeless masses, left confusedly here and there, but in vast sheets or widely extended layers. Many of these, though only a few feet in thickness, extend from one extremity of the State to the other,

and spread far beyond into adjoining regions. Some of them are plainly traceable far southward along the Alleghanies through Virginia, southwestward to Tennessee, northeastward to the Lower St. Lawrence, or northwestward beyond the Upper Mississippi. Thus far, at least, spread the ancient sea on the floor of which these successive sheets of sediment were deposited; and over all this vast extent the same groups of fossil forms prevail, proving that the living population of that old ocean was much the same over its whole extent at each successive period.

We say its living population was *much* the same in all parts at the same period: it was so, but not *entirely* the same. In existing oceans the living population varies more or less in different parts: for instance, out of an hundred shells gathered on the shores of Massachusetts, and an hundred gathered on the coast of Great Britain, only about thirty-five per cent will be found identical; while of the remainder, a large proportion are very similar on both sides of the ocean, so that they may be called "geographical representatives" of each other: a small number, beside, will be found quite peculiar to one coast or the other. We may therefore reasonably expect to find a similar degree of correspondence among the organic relics from different parts of any of the rocks so widely spread; and this is exactly the fact, as proved by observation. A particular bed of limestone, for example, will be found in Ohio to contain not entirely the same fossils found in it in New-York, but a great proportion of them; while in each of these distant localities, some will be discovered which are not known in the other. This is even true where the character of the rock itself changes in different districts. A certain series of strata may in New-York be slates or sandstones: when examined further west, it is found that they become more and more calcareous, until in Kentucky they may be almost pure limestones, varying from their New-York aspect not only in texture, but perhaps in color also. Yet the imbedded fossils will be found so much the same, that a practised observer will at once recognise the rock by them; and having thus found one portion of the series of strata to be identical with a particular set of layers known here, he is able to guide himself with great certainty in the search for other parts of the series which it may be desirable to discover. This principle is often applied with great advantage in searching for such minerals as may be known to

occur in a certain position in the series, such as coal, or some beds of iron ore.

Yet the chief interest of fossils is in their historic value, as giving us records of the condition of earth and sea and their inhabitants at the different periods of the vast succession of ages during which all the stratified rocks known were deposited; of which, much will appear in the detailed account hereafter given of the separate rocky strata.

These relics are found in a great variety of conditions. Shells are found with both valves united as when living, either open or closed; but more frequently with the hinge broken and the valves separated. Sometimes they are hardly changed from their original texture; at other times, quite "petrified," or replaced by stone like the surrounding rock: in some cases they are converted into iron pyrites; in others, into white calcareous spar, with crystals of which their cavities are often lined or filled. Often the shell has decomposed, leaving in the rock only a hollow marked with its external impression: sometimes we find a cast or mould of its interior, showing the forms of the teeth of the hinge, and the pits or other marks where the inhabiting animal was attached to it. Often they are distorted or compressed even to flatness, by the consolidating or settling of the material in which they were imbedded. (This is especially common in slaty rocks; while in limestones, which would seem to have hardened at once when first deposited, shells are usually not compressed.)

Other fossils occur in various conditions. Fishes are rarely perfect, the skeleton being generally separated and the bones and scales more or less scattered. Crustaceans, or animals with jointed coverings like the lobsters or crabs, are also usually found to have been disjoined by decay before they were buried in the sediment, so that specimens in an entire state are not common, though detached plates are abundant. The stems of plants are usually much flattened, and often converted into coally matter; while leaves generally show as mere imprints in the stone, blackened by the carbonaceous remains of their substance.

From this brief notice of the origin of the stratified fossil-bearing rocks and the nature of their organic relics, we may be prepared to appreciate the value to the cause of science (which is only another name for accurate knowledge) of a thorough investigation of a series of these rocks and of their fossil con-

tents. Such a series of all the rocks older in date than the great Coal formation exists in New-York, much better exhibited than in any other region yet known.

The same series exists in great thickness along the range of the Alleghanies; but they are in that region so much upheaved, displaced and contorted that it is very difficult to trace their edges so as to learn their true position and succession. In that range, also, fossils are few; either from their original scarcity in that part of the ancient sea, or because subsequent changes in the rock have obliterated their remains, so that the all-important aid which they afford in studying the strata can be but sparingly obtained.

In New-England it is still worse; for there the rocks are not only broken up and distorted in position, but so changed or metamorphosed by the action of heat and other causes, that all fossils are obliterated except in a few rare instances, and the rocks are recognizable in their true character with great difficulty.

In the Western States the case is different: there these strata are almost as level as when originally formed, and they contain many well preserved fossils. But in that direction many of them "thin out," or diminish in thickness; so that while some important groups of strata quite disappear before reaching Ohio, others, which in New York are many hundred feet thick, are in the West but a few yards;* and the level and unbroken character of most of that region, covered with gravels or alluvial soil, prevents the rocks from being well examined in many districts.

*The thinning out of the rocks westward is very remarkable. Tracing them from New-York and Pennsylvania to Iowa, we find the Hudson river group and Oneida conglomerate diminish from 2000 to 100 feet; the Medina sandstone runs out entirely; the Onondaga-salt group diminishes from 1000 to 150 feet; the Hamilton, Portage and Chemung groups, from 4000 to 200 feet; the Catskill group, from 3000 feet in New-York, disappears entirely in the West; and the Carboniferous, 6000 feet thick in Pennsylvania, is only 600 in Iowa. And it is also true that all, or nearly all, the coarser sandy rocks, traced westward from New-York, are found to become finer-grained and more calcareous, as well as thinner; while the limestones generally keep their thickness from east to west, with little or no diminution.

These facts lead to the belief that the source whence the materials of these rocks were derived was at the East; and that while the old marine currents spread the sediments very freely and heavily in this region, only a small portion of them, and that of the finest and lightest kind, was carried into the western part of the old ocean to form the thin and fine-grained strata of Iowa, Wisconsin and Minnesota.

The same strata above mentioned as so thick in New-York, are far thicker still in the range of the Alleghanies, and also in the continuation of their range through the Green mountains and the White mountains (where they have been much changed, as will be hereafter shown);

But in New-York, almost all facilities for their study exist. Its territory lies between the broken and metamorphosed Eastern part of the formations, and the thinner though level strata of the West: it contains these rocks in thick masses, full of fossils, and well exposed in numerous ledges and quarries; while it has this remarkable feature, that the outcropping edges of the strata chiefly run across the State in successive belts extending from East to West, while the streams which drain the country generally run North and South, thus cutting across the edges of the strata, and exposing in their bordering precipices and ravines excellent natural sections, where almost every layer can be examined. Such instances are well known on the Niagara, the Genesee, and the West-Canada; and hundreds of less conspicuous examples can be seen between the Hudson and Lake Erie. The eminent English geologist, Mr. LYELL, in his first book on America, remarks, after speaking of his journey through this part of New-York:

“In the course of this short tour I became convinced that we must turn to the *New World* if we wish to see in perfection the oldest monuments of the earth’s history, so far at least as relates to its earliest inhabitants. Certainly in no other country are these ancient strata developed on a larger scale, or more plentifully charged with fossils; and as they are nearly horizontal, the order of their relative succession is always clear and unequivocal.” This is no more than the truth; for though rocks of similar age are found on a large scale in England and other parts of Europe, there is nowhere else to be seen so complete, undisturbed and accessible a series as here.

It was therefore most fortunate that the munificence of New-York provided for an early and complete survey of her territory; the facts discovered in the course of which gave at once a stand-

and indeed it seems proved by Mr. HALL that the height of these mountain ranges is mainly due, not so much to the uplifting or folding of the strata by subterranean forces of elevation, as to the enormous depth or thickness in which the materials of these rocks were originally deposited in this region.

The causes of such great inequalities in the thickness of the ancient sea deposits may be easily imagined, though we cannot prove them. We may believe that a great sea-current, like the modern Gulf stream, may have swept over or near this long N.E. and S.W. range, carrying with it and depositing in the vicinity of its course vast quantities of heavy sediment, while to other parts of the sea but little found its way; or that the ancient or primeval land from which the sediments may have been derived, lay to the eastward. These, however, are mere speculations: all we can be assured of at present, are the facts as above stated.

ard by which to study and compare the strata of all the Northern, Eastern, and Western States, and by which to unravel all the main features of American palæozoic* geology. The New-York Reports have been text-books for observers elsewhere, and the same local names given in them to the various strata are known and used over almost half the continent.

This Geological Cabinet is intended, when completed, to exhibit specimens of all these rocks, and especially of their organic relics; which will be made accessible also to the scientific world at large, by being fully figured and described in Professor HALL's work on the Palæontology† of New-York, now in its third volume.

* PALÆOZOIC, from the Greek *palaïos*, ancient, and *zoe*, life; a term applied to all the strata containing remains of living forms from the top of the Carboniferous system down.

† PALÆONTOLOGY, from the Greek *palaïos*, ancient, *ontos*, existence, and *logos*, discourse or science, signifying the science or knowledge of ancient existences; a term applied to the study of all fossil remains.

The stratified fossil-bearing rocks, of which alone we have hitherto spoken, cover all the State of New-York, except the southeastern corner from Newburgh and Fishkill to the sea, and the Adirondack region comprising most of the country lying between Lake Champlain and the Black river. These two portions of the State exhibit rocks of a different character.

Next below the lowest of the fossil-bearing rocks are generally found a series of hard, semi-crystalline strata, of which gneiss is the most common and conspicuous form; though they embrace many other varieties, such as the coarse gritty rock known as mica-slate, and the coarse-grained crystalline white marble of Westchester county. These rocks are believed to have been originally in most, if not all cases, sandstones, limestones and slates, much like the fossil-bearing strata before described (though generally older in age and lower in position), and to have been exposed to the influence of subterranean heat and great pressure in such intensity that their whole appearance has been changed, and their materials so affected as to suffer chemical changes which have produced the coarse crystalline structure which most of them present. The same cause must have obliterated their fossils, if they ever contained any. Instances are known in many places where the outbreak of a vein of lava, trap, or some other melted mass from below, has cut through stratified rocks, and the heat has changed them at the place of contact so that black limestone becomes white crystalline marble, sandstone becomes a close grained jaspery rock, and the fossils of both are obliterated; though at a short distance both these rocks retain their usual appearance, and their fossils are distinct. Such facts seem to prove fully that the class of rocks of which we speak have been changed by heat from their original character, and they are therefore known as METAMORPHIC rocks, a term derived from Greek words signifying "changed in form."

These rocks seem almost everywhere to underlie the older fossil-bearing strata, and appear where uplifts from below have

broken through the latter. Such an instance occurs at Little-Falls, where the hard red and gray gneiss has been lifted up in a ridge across the Mohawk, and appears in the gorge protruding through the fossil-bearing slates and limestones. Most of New-England is covered by rocks of this character; their broken, bent, and upheaved position bearing witness to their having been subjected to enormous pressure in every direction. Even there, in some localities there are portions of these rocks which show traces of fossils, to prove that they are only altered or changed masses of the same strata which in Western New-York appear in horizontal and unchanged layers of limestone; and it is believed that the coarse crystalline rocks of the White and Green mountains are in fact extensions of the same masses, which have undergone a similar transformation.

Still below these metamorphic rocks are found what are known as *HYPOGENE* or *PLUTONIC** rocks. These include granite,† trap, greenstone, porphyry, and many other varieties of hard crystalline rocks, the great peculiarity of which is that they are not found in layers or strata, but in shapeless masses, and appear, instead of having been formed by deposition from water, to have been upheaved from below. They bear evidences of having been intensely heated, and in many instances have calcined or *baked* other rocks with which they come in contact as before mentioned. Though in their original position the lowest of all rocks, they have in many places been upheaved far above others; and in most high mountain ranges, the cone or central ridge is formed of these rocks, which have been thrust upward, splitting through and tilting up all which lay above them. They form the central mass of the Adirondacks, and masses of them are found in the Highlands and in many parts of New-England, the well known Quincy sienite being one form of hypogene rock. They were once generally called "primary" or "primitive," as it was

* *HYPOGENE*, signifying born from below. *PLUTONIC*, from *Pluto*, king of the infernal regions in Pagan mythology.

† *GRANITE* is a hard crystalline rock, made up of crystals of quartz, felspar and mica. There are many varieties of rocks of similar nature, varying by having some other minerals replacing or added to these, such as hornblende, garnet, steatite, etc. etc. The rock varies much in color, being often red, but not uncommonly grey or dark. The frequent use of the term "granite" in popular speech to signify any hard and massive rock, is entirely incorrect. *SIENITE*, which is quarried at Quincy (Mass.) in great quantities, and has been so extensively used in building in Boston and for the Exchange in New-York, is granite with the mica replaced by hornblende.

believed that they were the original crust of the earth, first formed by the cooling of its melted mass,† but these names are now replaced by those we have given; for it is doubted whether, if such a crust exists, we can identify it, and many able geologists think that most of the granite and other hypogene masses are only re-melted and altered forms of stratified rocks. That many such masses are so, is certain; whether we can find any which are portions of an original crust of the globe, is at least very doubtful.

Containing no fossils, these rocks have their chief interest from their value for economic uses in building and other purposes, and in the remarkable minerals which they so often contain. Most of the beautiful crystals which form the collections of the mineralogist are from these rocks, or from the metamorphic masses which overlie them; and the latter, where they are seamed with veins or dykes of melted hypogene rock, are often depositories of the metallic ores.

To recapitulate the order of these three great classes of rocks, beginning *from below*, we find:

1. The **HYPOGENE** or **PLUTONIC** masses, seen in this State in the Adirondack region and the mountainous and hilly southeastern part of the State.
2. The **METAMORPHIC**, generally lying next above and adjoining to the former.

† The "nebular hypothesis" in astronomy leads us to think it probable that the earth first existed as a hot gaseous or "nebular" body; that it afterwards slowly condensed by loss of heat into a liquid or melted globe, and that still further cooling during the lapse of ages brought it to a state in which it was covered with a thick rocky crust, and so far cooled that water condensed upon it, when the great series of changes began which have been before explained, growing out of the action of rain and rivers and sea, and leading to the formation of the stratified rocks. Many phenomena seem to confirm this opinion: such are the many volcanoes yet in activity; the innumerable instances where trap, lava, porphyry, granite, and other similar rocks appear to have risen in a melted state from below through fissures or crevices of the higher rocks; the generally changed or "metamorphic" condition of many of the deepest and oldest stratified rocks; and the universal increase of heat found in deep mines or borings, being on the average a degree for every fifty or sixty feet in depth; a rate of increase which, continued to thirty or forty miles below the surface, would melt granite or basalt. The form of the earth, also, slightly flattened at the poles and bulging at the equator, is precisely that which a fluid globe rotating on its axis would assume. It thus seems probable that the globe of our earth is, at a moderate depth, in a state of fusion or intense heat, covered only by a crust thick enough to prevent further radiation of heat to any sensible degree. Yet there are some reasons for doubting this theory; and it can yet be regarded only as an unproved, though very probable hypothesis. It is so often mentioned or alluded to, and seems to afford so good an explanation of some phenomena in geology, that this brief mention of it is deemed proper.

3. The STRATIFIED fossil-bearing rocks, covering all the State except the two districts above mentioned.

We will now describe them more in detail, beginning at the lowest and proceeding upward.

Of the HYPOGENE and METAMORPHIC rocks, however, we shall add to what has been said but very little. They cover, as has been before remarked, two separate tracts of country in this State, one in its southeastern part; the other lying in the central portion of the great triangular area bounded by the Mohawk, the Champlain and the St. Lawrence valleys. On the geological map of the State, the territory which they occupy is marked by a coloring of deep pink.

The various kinds or varieties of these rocks are mingled in great confusion over most of these tracts, seeming often to change or gradually pass into each other. The metamorphic masses of gneiss, mica-slate, crystalline limestone, etc., are more fully exposed (as a general rule) around the edges of the tracts, where they pass under the higher strata of fossiliferous rocks; while the granite, hypersthene, and other hypogene masses are more fully developed near the centres of these areas, and among the highest of their mountains.

In the southeastern part of New-York these rocks occur generally in small areas, seeming to be interposed among the gneiss and other metamorphic masses, as if they had broken up here and there through fissures or clefts. A very remarkable instance of this is on the lower Hudson. The rock at the level of the river is a horizontally stratified red sandstone; but through some fissures or rents now concealed, vast volumes of melted rock have formerly been forced up, which have overflowed the sandstones to a great depth, and in cooling have assumed the rudely crystalline or columnar structure so common in basaltic or trap rocks. The broken or worn edges of this enormous pile of trap, fronting on the river, forms the precipice so well known as "the Palisades." Veins of granite are seen in many places on the island of New-York, penetrating in every direction the gneiss rock which forms the mass of its territory.

In the hypogene and metamorphic region of Northern New-York, the higher mountains seem to be chiefly composed of gray "hypersthene" rock, made up chiefly of felspar. Granite, trap, serpentine, and many other varieties of similar rocks of igneous origin, are found in all parts of the district, and so intermingled

that no separation of their areas is practicable. The great route of travel by Lakes George and Champlain is bordered by cliffs and precipices, in which these rocks are seen in great variety. In this northern region, as well as in the southeastern part of the State, gneiss is exceedingly abundant; and in some places it appears to change into, or rather to be formed from, sandstone strata, thus exemplifying the belief of most geologists that this is only a changed or metamorphosed condition of other rocks.

All through these hypogene and metamorphic districts there are many *dykes*, or perpendicular veins of trap or other igneous rock standing among masses of a different appearance. Not uncommonly a mountain or hill range will show such dykes cutting across or through it, miles in distance, and to an unknown depth. These seem to have been merely cracks or clefts by which the country has been riven in many directions, which have been filled by the rise of melted matter from below, just as a crack in a sheet of ice is filled by the underlying waters. They are of all sizes, from half an inch to an hundred feet or more in thickness.

Except the two great districts above described, the metamorphic rocks appear only in two or three localities in the Mohawk valley, where they have been uplifted through higher and newer strata. The most conspicuous of these instances has been already mentioned as occurring at Little-falls: it is a ridge which, commencing some miles south of the river and crossing it at that point, extends on to the northeastward until it reaches and terminates on Lake Champlain near Port Kent, the loftiest of the Adirondack mountains being formed by its highest summits.

The hypogene and metamorphic rocks generally decompose slowly, and give origin to a poor or barren soil; and the districts which the coloring on the geological map indicates as formed of these rocks are the least fertile of all our State.

From the hypogene and metamorphic rocks, we pass to the consideration of the stratified fossilbearing rocks. These, in New-York, are among the most ancient of their class, called by the earlier geologists "transition" strata, from the idea that they marked a period of gradual change or progress from what they called the "primary" rocks to what were known as "secondary," the latter term including all strata newer than the Coal. By more modern observers they have been named "palæozoic," a term signifying "ancient life," from the fact that they comprise the

earliest and oldest fossil remains of once-living things. These palæozoic rocks have been again subdivided into four systems, the lowest being called the SILURIAN, the next the DEVONIAN; the CARBONIFEROUS or Coal formation succeeding, and the PERMIAN being the uppermost.

The fossiliferous rocks of New-York (with very limited exceptions which will be noticed) belong to the lower subdivisions of the Palæozoic strata, the Silurian and Devonian systems. The oldest and lowest of them,* which is found in many places to rest directly upon the gneiss, is a hard sandstone or quartz rock, usually brownish in color, though sometimes of other shades, and attaining in some places the thickness of 300 feet. Its edge can be traced nearly all around the great hypogene and metamorphic region of the Adirondacks, and is especially well seen near Keeseville in Clinton county, where the deep ravine of the Ausable river is cut through it; also at POTSDAM, St. Lawrence county, from which place it is called the

POTSDAM SANDSTONE.

It is an excellent building material. Its fossils are very few, the only distinct forms are a couple of species of minute shells of the Genus LINGULA, which are the oldest of our fossils. Specimens of them may be seen in the case marked "Potsdam sandstone;" in looking at which, the observer may be confident that he sees some of the very earliest forms of animal life which were introduced on our earth † (Fig. 1). This rock shows, on many of its layers, waved surfaces, precisely resembling the ripple-marks seen on sandy bottoms over which waters are agitated by waves or currents. They are believed to have been formed in the same

* Professor EMMONS maintains that there exists in Eastern New-York a series of fossiliferous strata older and lower than the Potsdam sandstone; which he calls the TACONIC system, but this is a controverted point. See some remarks on it hereafter in describing the "Hudson-river group."

† We quote from HUGH MILLER his popular description of this shell. "The LINGULA still exists in some two or three species in the distant Moluccas. There was but one of these known in the time of CUVIER; and so unlike was it deemed to any of its cotemporary mollusca, that of the single species he formed not only a distinct genus, but also an independent class. The existing, like the fossil shell, resembles the blade of a shovel; but the shovel has also a handle, and in this mainly consists its dissimilarity to any other bivalve. A cylindrical cartilaginous stem or footstalk elevates it some inches over the rocky base to which it is attached, just as the handle of a shovel stuck into the earth would elevate the blade over the surface, or as the stem of a tulip elevates the flower over the soil. I am not aware that any trace of the cartilaginous footstalk has yet been detected in fossil Lingulæ; but in all that survives of them, or could be expected to survive, the calcareous shell, they are identical in type with the living mollusc of the Moluccas."

way, by movements of those waters under which were deposited the sands which we see hardened into the Potsdam sandstone. Similar markings are frequent in almost all rocks of sandy texture.

The Potsdam sandstone, though not seen distinctly in the Mohawk valley (where its place between the gneiss and the Calcareous sandstone appears to be vacant), is a thick mass in Pennsylvania, and is known northeastward and northwestward over a great area. It is seen on the Lower St. Lawrence, and can be traced westward by the north shore of Lake Huron, and the south shore of Lake Superior, through Wisconsin, Minnesota and Northern Iowa, and has even been recognized in the "Black Hills" near the Rocky mountains. In this extension it often varies in color and hardness, being in some places so soft as to crumble with very little difficulty; but it is always mainly a siliceous rock, though with some bands which contain a portion of lime. The little *Lingula* is found in the far northwest as here (specimens being in the cases from the Falls of the St. Croix, Wisconsin), and in that region it contains a few remains of trilobites.

Next above this sandstone lies another, which, however, contains a considerable portion of lime mingled with it, and thence has received the name of the

CALCIFEROUS SANDSTONE.

It may be described as a siliceous or gritty limestone, generally of a brownish color, lying in straight thin layers, and attaining an entire thickness of two or three hundred feet. It is well seen at the "Noses" about Fonda on the Mohawk, and also at Little-falls; in each of which places it has been raised to light by an uplift which has brought it from its originally lower position. It may also be examined near Middleville on the West-Canada creek (where it contains in its cavities many beautiful quartz crystals), and in many places in the vicinity of Lake Champlain and the St. Lawrence river, in which latter region it has some layers so purely calcareous as to be profitably burnt for lime. Toward the west and northwest it extends about equally with the Potsdam sandstone, seeming in some localities so much like it as not to be easily distinguished from it, though in most places it is highly calcareous, forming the "Lower Magnesian limestone" of the Upper Mississippi as described by Dr. OWEN; and it is seen in moderate thickness in Pennsylvania. (In Missouri, a limestone belonging at the junction of this rock with

the next above affords lead ore; but the great depositories of this mineral in Wisconsin belong to a higher rock.)

The Calciferos sandstone contains a considerable number of fossils, which are described and figured in the first volume of Professor HALL's Palæontology of New-York (the same volume embracing the fossils of all the strata up to and including the Hudson-river group). Among them are many obscure forms, which are thought to be the remains or impressions of fuci or marine plants (though their true nature is not always clear), and which go under the general name of *fucoids*. There are also a few shells, nearly all of coiled forms, but they are rare in most localities. It is interesting to know the earliest forms in which this class of animal life appeared: they were those known to scientific men as *EUOMPHALUS*, a shell coiled nearly in a horizontal plane; *OPHILETA*, a very similar but obscure form; and *MACLUREA*, the characters of which are mentioned in describing the next rock. This rock also contains a few generally imperfect shells of the peculiar family to which the name of *Orthoceras** has been given. Their character and structure will be explained in speaking of the Black-river limestone.

The variety of living things which existed in the sea from which this rock was deposited, does not appear to have been large; and so far as we yet know, it embraced no type of higher order in the scale of life than the inhabitants of the coiled or bivalve shells, or the animal inhabiting the shell of the *Orthoceras*, which was a mollusc† of higher organization, something like the cuttlefish of the present day.

Next above the Calciferos sandstone, we find a dark, irregular, thick-bedded limestone, called, from the locality where it is best seen (in Clinton county), the

CHAZY LIMESTONE.

Dr. EMMONS states its thickness at 130 feet on Lake Champlain; but, in striking contrast with the wide extent of many other rocks, it is known only in the Champlain valley, and does not appear to extend in any considerable thickness into those parts of the State west or south of the Adirondack region; and it is

* *ORTHO CERAS*, from the Greek *orthos*, straight, and *keras*, a horn; referring to the straight and tapering form of the shell.

† *MOLLUSCS* are soft-bodied animals, most of which, like the oyster, inhabit shells; though many are naked, such as some snails, slugs, and the common cuttlefish or *sepia*.

not seen as a distinct or separable mass in the Mohawk valley, though the rocks above and below it are there well known. In the far West, in Iowa, the place of this rock in the series is occupied by what is called the St. Peters sandstone, there 60 or 80 feet in thickness; and this sandstone forms the lower part of the precipice at the Falls of St. Anthony, being there covered by the Trenton limestone, the lower part of which forms the brink of the fall and the floor of the rapids above. Southward this limestone (together with the succeeding Black-river limestone) becomes enormously developed by the thickening of its parts and the addition of other strata; so that, if we may rely on the measurements of the Pennsylvania geologists, it becomes in that state from 2500 to 5500 feet in thickness! * Like most of the rocks of that region, it is there not very prolific of fossil remains.

The Chazy limestone contains a considerable variety of fossils, among which the most conspicuous is the *Maclurea magna* (Fig. 2), a remarkable coiled shell; in which the coil, though close and having a nearly flat surface on the top, is open and forms a deep central hollow below. Some layers of this limestone, which are worked extensively as a dark gray marble for hall pavements, frequently show white spiral coils, which are merely sections of this shell, split through the middle by the saw of the stone-cutter. Such specimens are to be seen in the halls of the Delavan House in Albany.

There are also in this rock several kinds of bivalve shells belonging to the great class of "BRACHIOPODA;" the name of which, derived from the Greek *brachys*, an arm, and *pous*, a foot, refers to a very peculiar internal arrangement of these molluscs, which consists mainly in the presence within the shells of two spiral coils or arms, which bear "cilia" or minute vibratory filaments, by the motion of which the animals are believed to create currents in the water to enable them to gather their food. Mollusca of this class are rare among living shells, but were enormously abundant in the earlier periods of earth's history. They are arranged in many genera, among which are SPIRIFER, in which the shell is straight in the hinge-line, and often pro-

* Many of the groups of strata, as has been heretofore mentioned, show similar variations in thickness in different parts of their extent; the sediment from which they were formed appearing to have been deposited in great thickness at some points, while at others it was very thin or entirely wanting.

longed in two sharp lateral points; ORTHIS, which has also a straight hinge-line, but is rounded on the other sides into a form approaching a semicircle; ATRYPA or RHYNCHONELLA, in which the shell approaches a globular form; STROPHOMENA or LEPTÆNA, in which the shell is thin, nearly semicircular in outline, and bent so as to be convex on one surface and concave on the other; and various other forms. The characters here given relate merely to general external appearances; but the distinctions on which the divisions of the various genera more strictly depend, are made from peculiarities of the inner organization of the shells and their tenants. In most of the genera there is an aperture near the hinge of the shell, whence a muscular cord or "byssus" proceeded, by which the shell was attached or anchored to rocks or other substances.

In the Chazy limestone are also found several kinds of fossil corals, but they are not abundant in comparison with those of higher strata; and a few remains of crinoids and trilobites, of both which remarkable forms some account will be given in speaking of the Trenton limestone, page . There are also found in it some species of ORTHOCERAS; for a general notice of which family of shells, see the Black-river limestone.

The woodcut (Fig. 3), taken from Dr. EMMONS's Report on the Third or Northern district, shows a few of the more remarkable fossil shells from the Chazy limestone. No. 1 is the *Scalites angulatus**; No. 2, *Raphistoma staminea*; No. 3, *Raphistoma striata*; No. 4, *Bucania sulcatina*; No. 5, *Discina deformis*; No. 6, an unnamed *Atrypa*.†

The rock which succeeds the Chazy limestone is one well

* The names given to fossils are taken from the Greek and Latin, and are always intended to be descriptive of them: thus, *Scalites angulatus* alludes to the spiral form of the shell like a winding stair, and to its sharp external corner or angle; *Bucania* refers to the trumpet-formed aperture of the shell; *Discina*, to the circular form of another; *Leptæna*, to the thin form of another still. So among the trilobites, *Isotelus* implies "equal-ended," alluding to the form of the fossil; *Trinucleus* refers to the three knobs or elevations on the buckler of the trilobite bearing the name, etc. etc. Much fault is found by many readers with these hard words; but the task of the scientific describer is not easy, when he has to find names for hundreds of new objects, and he may be excused for inventing some which are not euphonious. The frequent *alteration* of such names, growing out of the descriptions of their subjects by different writers, and out of new arrangements and systems, is, however, a serious evil, and tends to no little confusion in this as well as other branches of natural science.

† But a very small part of the many hundred fossils of the New York rocks can be mentioned in this brief article. The reader is referred to the cases in the collection, where he will find labeled specimens of most of the species; and also to Prof. HALL's Palæontology of New York, which gives careful and full descriptions and figures of every known relic from these old sea-sediments.

known in the Mohawk valley, as also along the Black river and Lake Champlain: it is a fine-grained gray brittle limestone, thirty feet in its greatest thickness; and the most conspicuous of its fossils is one the nature of which is somewhat obscure, but which is believed to have been the stems of some marine plant. Standing in an upright position, perpendicular to the strata, the ends of the stems are seen on the surfaces of the layers, to which they give a peculiar dotted appearance, from which the rock has derived its name

BIRDSEYE LIMESTONE,

and by which, as well as by its characteristic color and fracture, it is easily recognized.* It is a valuable rock for economical uses, as it is a good building stone, and dresses well under the chisel; and it is quarried to a considerable extent at various points in the Mohawk valley.

The only fossils of this rock, beside the peculiar plant above mentioned, are an *Orthoceras* (Fig. 5) and a few species of coiled and spiral shells, not common, and generally obtained only in bad preservation.

To the Birdseye limestone succeeds a thin mass, amounting in all to only ten or twelve feet, but classed as a distinct rock from being marked by having a somewhat peculiar mineral character, and containing a peculiar set of fossils. It is a dark, thick-bedded, compact, hard limestone, fine-grained and taking a high polish, and is worked as a black marble at Glen's Falls on the Hudson, and at Isle La Motte on Lake Champlain. It is also well seen at Watertown, Jefferson County, in the river banks, from which locality it has been named the

BLACK-RIVER LIMESTONE.

In the last named place it is lumpy and irregular in texture, and not fit for good masonry or marble; and is known among the quarrymen as "the seven-foot tier." In the Mohawk valley it seems not to have been deposited except in a few places, the Birdseye being generally covered directly by the Trenton limestone.

The most abundant and remarkable fossils of this rock are

* Fig. 4 represents the general appearance of this fossil as seen on the broken edges of the layers, where its upright stems are visible.

different species of ORTHOCERAS, and other shells of similar character. This family of shells is a very peculiar one, found only in the older or palæozoic rocks, and thus are characteristic fossils of the earlier periods of geologic history. They are, and have long been, entirely extinct, and their structure is only understood by comparing them with the NAUTILUS* now found living in the seas of warm climates. The *Nautilus* is a coiled shell, which, instead of being open within in one long spiral cavity like a snail-shell, is divided into many chambers by a great number of shelly partitions. These are formed by the inhabiting animal, which is a mollusc of high organization, much like the cuttlefish or squid. As it increases in size, and requires larger room for its accommodation, it constantly adds to its shell at the enlarging mouth, and cuts off the inner spaces from which it withdraws by walls of shell. Thus in time, a long series of chambers, scores in number, is formed, each larger than its predecessor as we examine them in order from the centre through the enlarging coil. The whole series are perforated by small apertures near the centres of the partitions, through which there passes a long membranous pipe or tube (known as the "siphuncle"), extending from the animal living in the outer chamber to the innermost apartment at the centre of the coil. It is believed that this series of empty chambers acts as a buoy, by which the tenant is enabled to float at will at the surface of the sea.

(A recent shell of a *Nautilus* of the umbilicated species, nearly allied to the Pearly *Nautilus*, lies in a case with some fossil shells of similar nature in a window on the north side of the Hall; one of its sides being partly removed, to allow the internal structure to be plainly seen.)

The *Orthoceras* resembles the *Nautilus*, except that instead of being coiled up in a circular form or disc, the shell is extended in a straight line, forming a long and tapering cone. In many specimens, when broken, the separate chambers and the mark of the connecting siphuncle are plainly seen. They are very various; some being plain, or marked only with fine lines either running circularly round the shell, or crossing each other at right angles; others being covered, as if for ornament, with protuberant knobs or rings: some are very long and slender, others are

* The *Pearly Nautilus* is the shell spoken of: the thin "Paper *Nautilus*" is an entirely different form.

short; some have a narrowed or contracted portion of the outer chamber, others are swelling or pear-shaped. Other species of allied genera are curved into hooked or crescent-shaped forms; others still into circles or discs, thus approaching the form of *Nautilus*. The partitions of the chambers also vary; some having only a simple curve, others a waved or sinuous form: in some, as in the discoid genus called *GONIATITES*, the edges of the partitions have an indented or zigzag outline. In rocks newer than the coal, forms of straight and coiled shells allied to *Orthoceras* and *Nautilus* ("*Baculites* and *Ammonites*") are very abundant, but in them the edges of the interior partitions are curved and plicated into every degree of intricacy; and looking at the whole series of variations, it would seem as if there had been a purpose to show every possible change in the arrangement of one general plan or type. The siphuncle, or tube connecting the chambers, is sometimes central, and sometimes lies against the inner or outer wall of the shell.

Of all these many varieties of one leading form, the straight *ORTHO CERATA* with simple partitions characterize the Palæozoic rocks, as few or none are found above the Coal. The *GONIATITES*, with zigzag partitions, are found in the upper palæozoic rocks and in some higher strata; the *AMMONITES*, and other forms with plicated partitions, are found only in rocks between the Carboniferous and Tertiary. The simpler coiled forms, like *Nautilus*, are found in rocks of almost all periods. Less than half a dozen existing species of chambered shells are now known, all of them inhabiting tropical seas; but the extinct species of the rocks are numbered by thousands, and are found in every latitude (one of many facts which seem to prove that the temperate and arctic zones were once far warmer than they are now). Some of the *ORTHO CERATA* are no larger than a pencil, while others are found in the Birdseye and Black-river limestones ten feet in length; one of which size lies in the Curator's room. *Ammonites* are also found in the English chalk rock, as large as a wagon-wheel.

The nature of these shells has been explained thus at length, as they are among the most abundant and conspicuous fossils of all the rocks of New York. Fig. 5 represents an *Orthoceras* from the Birdseye limestone: others are figured in woodcuts illustrating fossils of the higher rocks. The Black-river limestone contains, as has been said, a large variety of these shells, not only of the straight *Orthocerata*, but one or two coiled forms. Speci-

mens of both are in the cases, but it is not necessary to describe particularly the peculiarities of each species.

Above the Black-river limestone (or, where this is absent, lying upon the Birdseye), we find one of the most interesting repositories of organic remains in the State; a thick series of limestones, usually black and fine-grained with thin seams of slate toward the lower part, but grey and crystalline near the top. They attain to an entire thickness of more than three hundred feet, and, succeeding the lower rocks as already described, their edges surround the great Adirondack region in an almost unbroken circuit, traceable (in connection with the lower limestones) on the State Geological Map by a belt of blue. Seen along the Mohawk at Fort Plain and elsewhere, at Glen's Falls on the Hudson, on the west shore of Lake Champlain, at the Thousand Islands and Kingston on the St. Lawrence, they also extend up the valley of the Black River, and are crossed by the West-Canada Creek at Trenton Falls, from which place they take the name of the

TRENTON LIMESTONE.

In many places, they furnish building stone of excellent quality. The State Lunatic Asylum at Utica, and the Cathedral of Montreal, are built of the grey variety of this rock.

The same series of limestone strata are seen at many points on the Lower St. Lawrence, one of which is at the Falls of Montmorenci near Quebec. Westward, they may be traced near the Bay of Quinte and onward by Lake Huron, Green Bay, and across Wisconsin to the Mississippi. There they are increased by an upper set of strata (not known at the east), called the GALENA LIMESTONE, from the large caverns and crevices of which the lead ore of Iowa, Wisconsin and Illinois is obtained. Strata of the same age with the Trenton limestone, probably a continuation of them, are known west of Lake Winnipeg. Southwestward the Trenton limestone and the succeeding Hudson-river group are known in Tennessee, Missouri, and even Texas: they appear in Kentucky and Ohio, covering the country round Cincinnati (where they are known as the "BLUE LIMESTONE"); and their edges may be traced along the great Alleghany chain from Pennsylvania southward to Alabama, in all which region, however, they are much broken up and distorted in position, while their fossils are less numerous and distinct than in New-York.

The Trenton limestones contain enormous quantities of organic remains, which may be collected in more or less perfection wherever the rock is exposed in ravines or cliffs. Many of them, however, are much broken and imperfect. This is especially true of the TRILOBITES, of which this rock contains about a dozen species, varying in size from the TRINUCLEUS, no larger than one's finger nail, to the large ISOTELUS or ASAPHUS, which sometimes attains the length of a foot.

These TRILOBITES, which are among the most numerous and characteristic fossils of the palæozoic rocks, and which, from their peculiar appearance, so unlike any still living form, have been the object of so much curiosity and study, were creatures belonging to the great class of CRUSTACEA, or animals covered, insect-like, with a jointed crust or armor. Of this class the common crab and lobster are familiar examples, and the *Limulus* or "Horsefoot" of the Jersey shore is another, which bears a closer analogy to the trilobites.

The various species (of which several hundred are known) possess essentially the same prominent features, but differ widely in the proportion and arrangement of their parts. These consist, first, of a broad arched plate or shield covering the head, not unlike the buckler of the "horse-foot crab." This buckler is divided by several joints or "sutures" in directions which vary in different genera, the most marked being those which separate its lateral portions or "cheeks" from the central part. Though these are not often visible, and appear in any case only as faint lines running across the buckler, we very frequently find specimens in which they have separated, leaving the parts detached.

On this "head" or "buckler" are often found prominences of various forms, the main features being usually a central and two lateral elevations; though in some species, such as the large ISOTELUS or ASAPHUS of the Trenton limestone, these are obscure, and the head forms almost a single flat arch. On the lateral elevations are placed the eyes, which are generally very conspicuous. In some genera, these are simply smooth prominences, without perceptible markings; but in others, especially the Genus PHACOPS, they show most distinctly a large number of lenses arranged on a crescent-shaped elevation, being in fact a compound eye, such as is found on many Crustacea at the present day, and resembling that of such insects as the dragon-fly. This

structure is plainly shown in one of the cases of the Hamilton group, where a *Phacops bufo* is placed under a magnifier which distinctly exhibits the eye and its lenses.

The middle portion or back of the trilobite is covered by a series of jointed armor-like scales or ribs, extending from side to side, and so articulated as to allow of great flexibility; many species having had the power to roll themselves up into a globular form, in which condition they are often found fossil. These ribs or articulations vary in number from six to fifteen or even more.

The posterior extremity is covered by a single plate, sometimes small, at other times nearly equaling in size that covering the head. It is in some species nearly smooth, but is more generally marked with transverse furrows like those separating the ribs of the body. It sometimes terminates in one or more sharp spines; and such indeed in a few species are found at the corners of the bucklers, at the ends of the articulations, and even over the whole surface of the shelly covering.

All the Trilobites are marked by two furrows running from front to back, dividing them apparently into three lobes, whence they have their general name. The whole family have been extinct since the Carboniferous period, and from that time few forms are found bearing any resemblance to them. One of the living CRUSTACEA most analogous to them is the *Limulus* or "Horse-foot;" a specimen of which lies in the case with the trilobites of the Trenton limestone to illustrate their structure. They appear to have possessed but very slight and perishable feet or paddles; as among all the thousands of specimens which have been found, no trace of these organs has been discovered. The readiness with which the ligaments connecting their different plates decayed, allowing these fragments to fall asunder before being fairly buried in the sediment, explains the fact that we find so few of them in a perfect and un mutilated form; and it is not improbable that many of the pieces we find belonged to cast shells, which may have been annually shed by the growing trilobites, as the coverings of the lobster and limulus are now thrown off and renewed every year.

The most abundant species in the Trenton limestone are the *Isotelus gigas*, a remarkably large form; and the *Calymene senaria*, a small one, fragments of which are seen in almost every block at Trenton Falls. Another very peculiar species is the *Trinu-*

cleus concentricus, a little trilobite which has a semicircular buckler marked with three bold prominences or swellings, and a large number of dots or depressions around the border, with a spine on each corner; its body being less in size than the buckler itself (Fig. 10, No. 1).

In Fig. 6 is a woodcut (No. 1) of the large *Isotelus gigas*. In Fig. 7 are illustrations of several forms: No. 1 is a very rare one, *Illæus trentonensis*; No. 2, a very common species, *Calymene senaria*; No. 3, a small and rare species, *Illæus latidorsata*; No. 4, a small living crustacean from the Antarctic seas at Cape Horn, introduced as somewhat similar to the trilobites; Nos. 5 and 6, parts of the heads of two rare species, No. 5 having lost all but the central part, and No. 6 having lost the margins or "cheeks;" No. 7 is the head only of the little *Trinucleus*, common in many localities, (shown in a perfect condition in Fig. 10.)

This rock also contains many species of ORTHOCERATA, which in some places almost cover the worn surfaces of the strata; and a very handsome coiled chambered shell about two inches across, the *Trocholites ammonius* (Fig. 8, No. 1). There are also several species of BELLEROPHON, a small coiled shell with a flaring or trumpet-shaped mouth; one of which has the mouth curved or deeply indented at the middle, dividing the edge of the shell in two projections, whence it is called the *Bellerophon bilobatus*. It is one of the commonest and most characteristic fossils of the rock. We find in it also other varieties of coiled shells of other genera: MURCHISONIA, coiled in a spiral form; and PLEUROTOMARIA, coiled more flatly, like a snail-shell (Fig. 8, No. 2). A very large number of small bivalves also occur, the most abundant of which are different kinds of BRACHIOPODA, the general nature of which class was explained in speaking of the Chazy limestone. They are of various genera: LEPTÆNA, ATRYPA, RHYNCHONELLA, ORTHIS, STROPHOMENA, etc. etc. (*Leptæna deltoidea* is shown in Fig. 6, No. 3).

The Trenton limestone also contains several CRINOIDS, which are exceedingly rare in a state approaching perfection, though short pieces of their stems are common, and their separate discs most abundant. The "CRINOIDS" are animated forms of a very remarkable character, organized in many respects like an Echinus or "Sea-egg," or like a Star-fish; but generally bearing clusters of arms or jointed appendages at the summit, and attached at the base by a long jointed column or stem to the ground. This

gives them a general resemblance to a lily, whence they were often called stone-lilies; but it is very rare that a specimen is found in a complete state. Short pieces and separate joints of the stems and arms are very common: the body is not often preserved in a perfect condition. The most perfect specimens in the collection are from the Lower Helderberg limestones, and are in the cases belonging to those rocks. A figure of a beautiful and characteristic species is given hereafter in describing the Portage group (Fig. 39.) A fragment of a single starfish has been found and figured; its name *Palæaster matutina*, being given in reference to its being the earliest of its race yet known.

CORALS are numerous, generally of small size. One species (*Chatetes lycoperdon*) is very abundant (Fig. 6, No. 2). It is a low rounded form with a flat base, and would not be suspected as a coral by a casual observer; but when broken, the columns of which it is composed are plainly seen radiating from the centre of the base to the convex side. A few branching corals are found also, and several species of another form, conical and slightly curved like a horn. In these last, a single animated inhabitant or zoophite lived in the cup-shaped cavity of the larger end; while in the other forms, each coral was inhabited and formed by a large community of tenants. (Corals of the single-celled forms, not unlike those here referred to, are illustrated in figure 31.*)

Next in upward succession lies the

HUDSON-RIVER GROUP,

an enormous mass of sandstone, slate and shale,† in the eastern part of the State 1500 feet thick or more. It is well seen in the north of Oswego, south of Lewis, and middle of Oneida; also through the Mohawk valley, and on the Hudson river, from which it takes its name. West of Schenectady it is generally level and undisturbed; but near the Hudson its strata are upheaved, broken, and crushed in every conceivable manner, as

* These "Corals," as they are commonly called, include forms of very various nature; most of them being like the "Reef-coral" of the present day, built by "radiated" animals which live in the separate cells; but the animals which inhabit many of the smaller forms are more nearly allied to Mollusca, and are termed BRYOZOA.

† A SHALE is a soft slaty rock, but of less fissile and thin-bedded character than a pure SLATE; generally breaking with a rough fracture, and often approaching in character to a hardened clay.

is well seen in many places near the Cohoes, and along the Hudson-river Railroad. In much of this disturbed region the rock has been changed in texture by the forces to which it has been subjected, and fossils are very rare.

The same formation may be traced, overlying the Trenton limestone, northwestward to the Mississippi (where, however, it is thin and not conspicuous), northeastward to the Lower St. Lawrence, and southward along the Appalachian ranges as far as Eastern Tennessee and Alabama. It is in its western extension very calcareous, forming most of the great series of the "BLUE LIMESTONE," so called, near Cincinnati.

The lower part of this formation is a fissile black slate about 75 feet thick, called in the State reports the

UTICA SLATE.

Its most marked fossil is the *Tricrithrus beekii*, a small trilobite, which in many localities is very abundant. It is usually found in fragments, and crushed flat by the settling or consolidation of the deposits in which it lies buried (Fig. 9, No. 1).

The higher strata, to which the name of the HUDSON-RIVER GROUP is more usually restricted, are brownish slaty masses, with some coarse sandstones especially toward the top, and in some places, near the summit of the group, a coarse sparry limestone. The fossils are in great part bivalve shells, including a number of elongated forms not very unlike the "freshwater muscles" of our lakes (Fig. 11).

Some ORTHOCERATA also occur; and some of the same Trilobites known in the Trenton limestone are found occasionally in this group also, among them the *Isotelus* and *Trinucleus* before described. The coiled shell TROCHOLITES is also found here, but is not common. There are many indistinct remains of seaweed, and a great variety of GRAPTOLITES, which are a very peculiar and as yet little understood family of animals, apparently related in some way to the modern "Sea-pen," or to some of the Bryozoa. They are peculiar in their appearance, usually occurring in fragments as straight black stems about one-tenth of an inch wide, having serrated edges; but Prof. HALL has found in the northern extension of this group of rocks near Quebec, more perfect specimens showing that these stems branched or radiated from a com-

mon centre, and were connected like the ribs of an umbrella by a membranous or horny film. The whole family of Graptolites is extinct, and their fossil remains characterise the older formations, to which they are confined with few or no exceptions.

(The eastern part of New York and the western part of most of New-England are formed of an enormous mass of upheaved and bent strata of slates, sandstones and limestones, which Dr. EMMONS has always maintained to be of lower position and older date than the Potsdam sandstone; and he has described them in his reports as the TACONIC SYSTEM. This range of rocks contains very few or no fossils in most localities, and geologists have been obliged to examine it without the aid which fossils would have given in explaining the relation and true position of its confused and contorted strata. The general conclusion has been that this series of strata is not a separate and distinct one, but merely the eastward extension of the rocks older than the Medina and Clinton groups, changed in character or "metamorphosed" by the effect of heat and pressure. But some recent discoveries, in a few localities of this "Taconic" range, have brought to notice fossils from them, so differing from forms previously known, as to indicate that these strata are indeed a distinct and separate series. The opinions of some of the most competent geologists seem therefore inclining to the views of Dr. EMMONS; and there seems to be a probability that it may be yet recognized as an older series of rocks, lying beneath the Potsdam sandstone, and preserving in its fossils the relics of the earliest period of living things. Others, however, adhere to the belief that these fossils show merely a local development of a portion of the Hudson-river group, with a peculiar set of fossils. There are great difficulties as yet in reconciling the apparently contradictory appearances which these rocks present; and the question is so obscure, that differences of opinion may well exist till further observations are made.)

The Hudson-river group is covered in many places by a bed of conglomerate rock, made up chiefly of coarse sand and worn and rounded pebbles of quartz. Being well developed in Oneida county south of Utica, it has received the name of the

ONEIDA CONGLOMERATE.

In Central New York it is but a few feet in thickness, and indeed seems to be entirely wanting in many places; but on the Hudson it swells to a thickness of several hundred feet, and forms the Shawangunk mountain near Rondout. From this place its upheaved edges may be traced in the range of hills southeast of the Delaware and Hudson Canal, and the same rock forms most of the mountain range of the Kittatinny or Blue Ridge, along which the Delaware flows from where it leaves New-York to where it breaks through the barrier at the famous Water Gap. From this point, its edge ranges southward to Virginia. No fossils have yet been discovered in it: indeed the rolled and worn condition of its materials would indicate that it was formed under agitated waters, which would not allow the growth or preservation of organic forms.

The source from which such enormous quantities of rolled pebbles of quartz could have been derived, and the mode by which they could have been spread so widely on the ocean bed, is a very obscure question in geology. (Several other such formations of conglomerate are known, two of which occur at the lower and middle parts of the great CARBONIFEROUS SYSTEM, of which we shall speak hereafter.)

The next succeeding series of strata are those known, from a locality in Orleans county where they are well seen, as the

MEDINA SANDSTONES.

They are a huge mass of sandy and shaly rock, of very variable hardness from soft marl to hard sandstone, and varying in color from deep red to olive and light gray. They are not known in the far West, seeming to thin out and disappear before reaching Wisconsin, but are well seen on the Niagara river, where they form most of the precipice near Lewiston. At this point the lower part is a soft red shale, with harder and lighter-colored layers above, to one heavy bed of which the cables of the Lewiston suspension bridge are fastened. These sandstones may also be seen in the lower part of the river cliffs, extending as far up as the upper Suspension Bridge. The same rocks are quarried near the lower town of Lockport for building and flagging stone, and they form the lower falls of the Genesee at Rochester, at the top of which the uppermost hard layer, called the "GRAY BAND,"

is very conspicuous from its light color. Further east, the same rock forms the falls of the Oswego river at Fulton; but in the Mohawk Valley it thins out, and becomes wanting. In South-eastern New-York, however, it re-appears; is very thick at the Delaware water gap in New-Jersey and Pennsylvania, reaching, in the latter State, the thickness of 1000 feet; and it may be recognized as far south as Alabama.

The fossils of this rock are few, the most abundant and curious are FUCOIDS, or Seaweeds, one of which, the *Arthrophycus harlani*, is known from the Niagara frontier to Virginia, and easily recognized from its conspicuous and peculiar form (Fig. 13). There are also a few small shells (Fig. 14).

Above the Medina sandstone lies a series of sandstones, limestones and shales, called the

CLINTON GROUP,

from one of the localities where they are well seen, the vicinity of Clinton, Oneida county. This group of strata is hardly distinguishable east of Fulton county, appearing to thin out in the eastern part of the State, where it is all sandstone and greenish shale. At the west, however, it contains two distinct layers of limestone and two of greenish shale, which can be well examined above the lower fall of the Genesee. Two thin strata of iron ore are found in this group, and are extensively quarried in the vicinity of Clinton: the ore is of a peculiar granular appearance almost like small shot, and contains many fossils of small size.

On the Niagara river, the upper limestone of this group is about twenty feet thick, and a very solid, massive rock; projecting conspicuously from the eastern precipice somewhat more than half way down from the top at the Suspension Bridge. At the Falls, this layer is near the level of the water.

This group of rocks extends westward through Canada, but does not appear beyond Wisconsin as a distinct mass. As has been said, it is not found in Eastern New-York, but re-appears in Pennsylvania in enormously increased thickness, amounting to nearly 2000 feet, and extends southward along the Appalachian chain even to Eastern Tennessee. It seems everywhere to contain beds of iron ore of the same character with those in New-York, which are known in Pennsylvania as the Catawissa ore, and are worked for the Montour iron furnaces; though in the far

western extension of these strata in Wisconsin, this mineral is perceptible only in very small quantity.

Some very curious and interesting markings have been found on the surfaces of sandy layers of this rock in Oneida and Herkimer counties; appearing to be the tracks or trails of shellfish or some other humble form of life, which crawled over these sands, perhaps while exposed just above the water level by the reflux of the tide, which on its return washed over them another film of sediment which preserved them through all subsequent changes until now. Specimens of these trails are in the cases, and are figured in the second volume of the Palæontology. It is one of the strangest of facts, that what we consider the most striking symbol of evanescence, a track upon the tidewashed sand, should thus become an imperishable record. (Other instances of the same nature are known, one of which is the existence in strata of the Connecticut sandstone, a rock of far more modern age, of tracks of wading birds like snipes or herons, some of them being of great size; doubtless imprinted on the beach laid bare by the tide, or in shallow waters, where this rock then existed as a soft bed of sand. Large slabs of this rock, with such impressions, are in the upper story of the Museum.)

The fossils of the Clinton group are quite numerous, but not generally so marked as to be described with interest in a general sketch like the present. Many of them much resemble those of the succeeding rocks; the most characteristic being a large bivalve brachiopodous shell, the *Pentamerus oblongus*, common below Rochester. It is oval and somewhat flattened in form: the internal structure, which can be seen in some specimens, is peculiar, but not explainable without plates. This shell is a peculiarly interesting fossil, as it is known to spread, in strata of similar age, from Europe to the west of the Mississippi; a marked instance of the wide extension of a single form in the ancient ocean. Its general form is shown by the figures in the woodcut 14a.

To the Clinton group succeeds the

NIAGARA GROUP.

The observer, standing on the upper Suspension Bridge, sees in the precipice, above the Clinton limestone, a sloping bank of soft grey shale about eighty feet thick, above which follows a thick

series of layers of limestone forming the brink of the rocky wall: these are the Niagara shale and the Niagara limestone. The great cataract pours over their edges; and its peculiar form, so like a huge dam, is owing to the fact that the soft shale below wears away more rapidly than the hard limestone which forms the top of the fall, thus maintaining a hollow space behind the descending sheet.

These rocks are perfectly exhibited in the ravine of the Niagara, especially along the Niagara and Lewiston railroad. The shale decomposes rapidly where exposed to the air, until it resembles a bank of grey clay. It contains thin layers of limestone in many places, the surfaces of which are often covered with beautiful small corals of several species, and the shale itself contains them in great numbers. The best locality for fossils has been at Lockport, where they are more numerous than on the Niagara, and where, during the construction of the double locks, great quantities of the shale were excavated. The "deep cut" of the canal above Lockport is through the Niagara limestone, some layers of which there form a massive and beautiful building stone. The same limestone and shale form the upper falls of the Genesee at Rochester; and in the precipices below, fossils are common.

The limestone is at Niagara about 160 feet thick (of which only the lower part is seen just at the Falls); at Rochester, about 70 feet only. It forms the summit terrace of that remarkable range of hill known as the Mountain Ridge or Queenston Heights, extending from New-York through Canada West: it can be seen in the Manitoulin islands on Lake Huron; also south of Green Bay, and across Wisconsin and Iowa. (On the Upper Mississippi, the Medina sandstone does not exist, and the Hudson-river group is thin and so inconspicuous as to have been overlooked by the earlier observers. They thus found the Galena or Upper Trenton limestone apparently joining the Niagara limestone, and both were described as one rock under the name of the UPPER MAGNESIAN LIMESTONE, an error which has been corrected by more careful examination.) It exists also in Ohio and Kentucky, where it forms the lower part of what is there called the CLIFF LIMESTONE. Eastward from Rochester, the Niagara group gradually thins out, its limestone being traceable to the Mohawk valley, and a few of its layers even farther: it is not distinctly seen in Pennsylvania.

The fossils of this group are numerous and very marked. Corals are in great numbers, many beautiful small branched forms being found in the soft shale; some of which, showing merely in dark films like pressed plants, would hardly be thought corals by an ordinary observer (Fig. 15): others, in the limestone, are in flattened columnar masses like honeycomb; others still in rounded forms, and the structure is often so minutely preserved as to be visible only with a magnifier. One very peculiar coral is the *CATENIPORA*, the name of which implies "chain-like cavities." Its cells or tubes are oblong, and are arranged in rows, so that when broken across, their section resembles the series of links in a chain. This species of coral is found in the same rock as far west as Louisville, Ohio; and the same, or a closely similar form, is found in strata of similar age in Northern Europe.

Half a dozen species of trilobites are found in the Niagara shale; the small *Calymene senaria* (Fig. 16, No. 3) being scarcely distinguishable from the similar form in the Trenton limestone: indeed, it is not certain but that they are the same; if so, it is a very remarkable instance of the long endurance of a single species. A large elongated trilobite, with the lobes of the back so obscure as to be hardly perceptible, is also found (the *Homalotus delphinocephalus* (Fig. 17); likewise the *Lichas boltoni*, a very large and handsome species, broad in proportion to its length, and with the ends of the ribs extended into points.

Some of the most perfect crinoids known are found in this rock, which (as well as its other fossils) are beautifully figured in the State Palæontology of Prof. HALL. A very common one is the *Caryocrinus ornatus*; the globular head, or body, made up of many angular plates, being the part usually found, having lost its stem and the jointed arms which stood on its summit (Fig. 18, No. 1, 2).

A small but perfect star-fish has been found in this rock, and a great variety of small brachiopodous shells abound in many of its localities. All are figured in the State Palæontology.

The next series of strata in upward succession are very deep beds of shale, slate, and thin limestones, the whole of which in Central and Western New-York attain the thickness of nearly a thousand feet. Its lower part in Central New-York is composed for several hundred feet of a soft red shale or hardened clay, especially conspicuous along the canal in Madison county. Its

upper portion is generally a gray slaty rock, with layers of impure limestone, well seen along the Auburn and Syracuse railroad. The important Salt Springs of Salina being situated in these rocks, they have received the name of the

ONONDAGA-SALT GROUP.

The salt has not hitherto been found in solid masses, though the gray part of the rock in some places shows impressions of the peculiar "hopper-formed" crystals of this mineral, proving that it once existed there in small quantities. It is probable that it is diffused in small proportion through large extents of these strata, through which (as they are very permeable to water) the rains percolate, and bear the salt in solution to the deep basin at Salina. This is found by boring to be several hundred feet in depth, filled with gravel and sand, in which the salt water seems to lie as in a reservoir, and from which it is raised by the pumps for the supply of the evaporating works. The Onondaga lake, which is a comparatively shallow body of fresh water, lies over this deep mass of gravel, but has a water-tight bottom of marl which keeps its waters separate from those below. Such is the generally accepted explanation of the Onondaga salines; yet the question as to their sources is somewhat obscure.

The upper drab or gray slates of this group contain great quantities of gypsum, which is quarried extensively from Madison county westward. The rock over the masses of gypsum often seems arched, as if this mineral, in forming, had exerted an upward pressure, lifting the overlying masses.

The whole group is remarkably destitute of organic remains; not a single fossil having been found in the lower part or red shale, and but a small number in a few localities of the upper portion. The most remarkable of these is the *EURYPTERUS*, a very curious crustacean, with a semicircular head, a long jointed body and spinous tail; having several antennæ or "feelers" about the mouth, and one of its pairs of feet flattened into broad blades like oars or paddles, doubtless used in swimming. It is a rare fossil, found as yet only at Williamsville in Erie county, and near Waterville in Oneida county and Litchfield in Herkimer county; but there is no doubt that more general search will yet discover specimens in many other places. It is found in the upper part of the Salt group, in the thin layers not far below the base of the succeeding Waterlime group.

In Canada West, near Galt, there is a limestone believed to belong to this group, but which seems not to have been formed in New-York, which contains some remarkable fossils, especially some large bivalve shells named by Prof. HALL, MEGALOMUS, specimens of which are in the cases.

The Onondaga-salt group is hardly seen east of Herkimer county, though in Pennsylvania it seems to re-appear, but without saline springs. Westward it extends to Iowa, but there contains no useful minerals and few fossils.

Above the Salt group succeeds a thick series of strata, chiefly limestone, but with one or two sandstones among them, known under the general name of the HELDERBERG ROCKS, as they form the great escarpment of the Helderberg hills in Albany county. From this place their edges may be followed in the hills lying back from the Hudson, along the base of the Catskill mountains, and through Ulster county as far as Kingston and Rondout; whence they bend southward and extend along the hills west of the valley of the Delaware and Hudson Canal, passing out of the State near the northwest corner of New-Jersey. They run still farther southeastward, are seen above the Delaware water-gap; and their lower strata are traceable in the Appalachians as far as Tennessee, though their upper limestones do not extend beyond the Susquehanna. In following them westward, we find their lower limestones and sandstones thin out rapidly, not extending beyond the Niagara in any considerable thickness, while their upper limestones are found spreading into the far west.

This series of rocks may be divided into four portions; the WATERLIME GROUP, the LOWER HELDERBERG LIMESTONES, the HELDERBERG SANDSTONES, and the UPPER HELDERBERG LIMESTONES. Lowest lies.

THE WATERLIME GROUP

of Central New-York, a succession of dark-colored, usually fine-grained and straight-bedded limestones, attaining in Madison county the thickness of over 100 feet. They lie immediately over the grey and drab limestones of the upper part of the Salt group, and are not divided from them by any very distinct or sudden change in the appearance of the strata. Their name is given from the water-lime or hydraulic cement which is extensively manufactured from two of the layers toward their upper

part : these are generally of a drab color, and separated from each other by a thin mass of blue limestone. They are quarried, burnt and ground on a very large scale near Manlius in Onondaga county, and the hydraulic cement of Rosendale and Rondout is probably made from the same beds. (That manufactured at Williamsville, Erie county, is from the upper limestones of the Salt group below; and in Niagara and Orleans counties, a similar cement is made from some layers of the Niagara group.)

The fossils of the Waterlime group are but few : the most abundant is the *Spirifer plicata*, a little brachiopodous shell which often occurs in great numbers in some grey slaty layers of the rock (Fig. 19, No. 1); CYTHERINÆ, which are shells of a minute crustacean, appearing as smooth black oblong shells, very common in many places (Fig. 19, No. 6); and TENTACULITES, small conical bodies like spines, ornamented with rings the nature of which is not well understood, though they are believed to be shells once inhabited either by floating marine mollusca, or by marine worms allied to the SERPULA (Fig. 19, No. 3). A LEPTÆNA, a thin brachiopodous shell marked with fine radiating lines, is abundant in many localities.

The Waterlime group is succeeded by what are called the

LOWER HELDERBERG LIMESTONES,

described in the District reports as the Pentamerus limestone and Catskill shaly limestone, the former mass being the lower : it is a coarse-grained, thick-bedded and often concretionary limestone; while the Catskill limestone is in thin layers, with much shaly or slaty matter interstratified with it. Both of these limestones thin out rapidly to the west, and are not recognisable west of Madison county, though at the Helderberg they are eighty or an hundred feet in thickness. They may (with the Waterlime group) be traced through Pennsylvania and Virginia, but are very thin and not found in all places, seeming to be interrupted, and were probably deposited only here and there, in areas of no great extent.

The fossils of the Lower Helderberg limestones are very numerous and interesting, and, with those of the Waterlime group below and the Oriskany sandstone above, fill the third volume of the State Palæontology. A few of the most common and characteristic are *Rhynchonella ventricosa* (Fig. 20), *Pentamerus galeatus* (Fig. 21, No. 1), *Lepocrinites gebhardi* the stem of a crinoid

(Fig. 21, No. 4), *Delthyris macroleura* (Fig. 22, No. 1), *Merista laevis* (Fig. 22, No. 2), *Eatonina medialis* (Fig. 22, No. 4), and the two *Strophomenæ* (Fig. 23). There are several trilobites, and some very beautiful and perfect encrinites have been found in these strata in Schoharie and Herkimer counties.

The chief of the Helderberg sandstones is

THE ORISKANY SANDSTONE,

which overlies the Lower Helderberg group, is, at Oriskany Falls, whence it derives its name, a light coarse sandstone about twenty feet thick. In localities further west, it is sometimes, as at the falls of the Chittenango creek and at Split Rock near Syracuse, either wanting or represented only by a few inches of dark sandy rock; sometimes, as between Elbridge and Skaneateles, thirty feet thick; and in other localities, of various intermediate thicknesses. Near Schoharie, it contains some lime with its sand, and is light colored; in some parts of the Helderberg, as near Clarksville and Knoxville, it is only a foot or two thick, a hard black stratum full of fossils. In Pennsylvania, it is from 150 to 300 feet in thickness, and contains the same organic remains which are found in it in New-York. But the finest fossils yet discovered in it are near Cumberland in Maryland, where the crumbling texture of the rock causes it to decompose, often leaving the shells as perfectly free from adhering matter as those of the seashore; so that every detail of internal structure, as well as external form, is perfectly seen.

The fossils of this rock are numerous, some sixty species being described in Professor HALL's third volume. Among the most characteristic are those shown in figures 24-25. The forms in Fig. 25 are *internal casts*, or moulds of the interior of the shells, formed by the sand which filled them; the substance of the shell itself having decomposed. These "casts" are very abundant, and give rise in the mind of unlearned observers to many fanciful resemblances, such as "butterflies," "colts-tracks," etc. etc.

Above the Oriskany sandstone, in the Helderberg region, is a mass of sandy slate or shale, often more than fifty feet thick; but it is not known west of Herkimer county. In Pennsylvania, it is seen from the State line to the Water-gap. It forms, by decomposing, a poor soil; and is equally barren in fossils, the only form known being what is called the *Cocktail fucoid*, supposed to be the remains of a marine plant, the form of which re-

sembles the peculiar plumage from which it is named. The abundance of this fossil has given the rock in which it lies the name of "COCKTAIL GRIT."

Upon it lies the SCHOHARIE GRIT, a thin mass, being usually only four or five feet of hard calcareous sandstone, which, when freshly quarried, looks like a grey limestone, but when long weathered, loses its carbonate of lime and becomes a gritty yellowish sandstone. It is found only from Cherry-valley eastward, extending round the front of the Helderbergs and along the hills west of the Hudson, but does not appear to be known in Pennsylvania. Its fossils are numerous and conspicuous: among them may be noticed one or two Trilobites, several Orthocerata, and many smaller shells; of which we cannot furnish illustrations. They are figured in the third volume of the State Palæontology, and many of them are in the cases in the Cabinet.

THE UPPER HELDERBERG LIMESTONES

(which lie above the Schoharie grit, Cocktail grit and Oriskany sandstone, and where these are wanting, as in Western New-York, lie immediately on the Waterlime group), are some of the most widely known and useful limestones of the State. The lower portion (usually varying from 10 to 20 feet in thickness) is generally a coarse-grained crystalline gray rock, lying in solid layers, and, when free from flint, working well under the hammer and chisel, and often taking a good polish as a marble; called, from being very extensively quarried in Onondaga county, the ONONDAGA LIMESTONE. It is easily traced from near Rondout on the Hudson to the Helderbergs, where its outcropping edge turns westward, and runs by Schoharie, Cherry-valley, Bridgewater, Oriskany falls, the falls of the Chittenango below Cazenovia, Onondaga Hill at Split Rock, Auburn, Phelps, Le Roy, and Williamsville to Black Rock. Through nearly all this distance it preserves its well marked character, and is extensively used in building.

The upper portion of the group is what was originally called the CORNIFEROUS LIMESTONE, from its containing beds and nodules of hornstone or flint: it is usually from 30 to 50 feet thick, a bluish or grayish rock, lying in straight courses, often having some shale interstratified with it. Though these two portions of the Upper Helderberg limestone are in most places very distinct, yet in others, especially in the West, they seem to run together or

blend in one mass; so that they are now regarded only as local varieties of a single rock. They are known in Northeastern Pennsylvania, but are not very distinct there. Westward, however, they spread over a vast extent, along Northern Ohio, where they are seen at Sandusky; through Northern Indiana and Illinois, where they are quarried near Chicago; and across Wisconsin to the Mississippi, where they may be seen at and above Davenport. They also emerge from beneath newer rocks on the Ohio, where they form the Falls at Louisville, and are known in that country as the upper part of the Cliff limestone (the lower part being the western extension of the Niagara limestone; all the rocks which intervene in New-York, the Onondaga-salt group, the Lower Helderberg group, the Oriskany sandstone, and the succeeding grits, being almost or entirely wanting in that region).

The fossils of these limestones are very well marked, generally peculiar to them, and abundant. A large shell, *Meganteris ovoides*, is shown in figure 26: it is from the lower part of this rock, or the grey "Onondaga limestone." Fig. 27 shows some fossils of its upper portion, the "Corniferous limestone." No. 1 is a common trilobite, easily recognized by the "notched" edge of the head and the forked tail. No. 2 is a common coiled chambered shell. No. 7 is a fragment of a fish-bone: such are not uncommon, being more abundant at the West. The fishes from which they came were allied to the remarkable forms of which HUGH MILLER wrote in his "Footprints of the Creator."*

In the Upper Helderberg group, we have the last or highest formation of limestones of any considerable extent or thickness in the State. All the southern counties, lying above or south of the line of outcrop of the Onondaga and Corniferous limestones as before described, are nearly destitute of this useful mineral; being formed of vast piles of slaty, shaly, and sandy strata, several thousand feet in thickness, whose surfaces extend from a few miles south of the Erie Canal to and beyond the Pennsylvania line.

These rocks give rise to peculiarities in the topographical

* These limestones contain several trilobites, and many corals both of the columnar and branching forms; and a large number of the one-celled conical genera, shaped like horns of cattle; each of which was made by a single animal tenant, living in the larger cup-shaped end.

features of the country which they underlie, and in its soil and vegetable productions. Containing little lime, we find the culture of wheat does not generally succeed well upon them; nor does the central wheat-growing district extend upon them more than a few miles south of the limestone range, except in a few alluvial valleys, or places where calcareous materials from the limestone belts have been strewed over the southern slates by the DRIFT, of which we shall speak hereafter. Grazing and dairying are almost exclusively the pursuits of the farmer.

The most marked physical features of all this great extent of country consist in its deep valleys and long ridgy hills, usually extending in a north and south direction, as an inspection on any map of the rivers which follow the valleys will show. Some of these long north and south valleys having been excavated so deeply below their outlets as to retain the accumulated waters of the rains and streams, form that remarkable series of lakes beginning with the Otsego, and comprising the Canaderaga, Cazenovia, Otisco, Skaneateles, Owasco, Cayuga, Seneca, Crooked, Canandaigua, Honeoye, Canadice, Hemlock, and Conesus lakes; all so similar in their general form and direction, and in the shape and geological formation of their enclosing hills. Over the whole extent of these rocks, the country is "rolling" or broken into ridges generally running north and south, and rising from one to eight hundred feet above their main dividing valleys; and it is rarely that we find among them a plain half a mile in width, excepting in a few of the "bottom-flats" or alluvial lands along the larger rivers.

These rocks are generally quite uniform in their character, especially in the eastern part of the State near the Hudson valley, and might be grouped into one enormous formation five thousand feet or more in thickness, except for a few variations in texture, and some more marked differences in the fossils of their lower, middle, and higher portions, from which they have been separated and described under the successive divisions of the MARCELLUS SLATES, the HAMILTON GROUP, GENESEE SLATE, PORTAGE, CHEMUNG and CATSKILL MOUNTAIN groups; under which names their strata and fossils have been described in the State Reports and arranged in the State Collection.

Lowest of these divisions, resting immediately on the Upper Helderberg limestone, is the MARCELLUS SLATE, named from the village of Marcellus, near which it is well seen; a mass of dark,

fissile, short-fractured slate, one or two hundred feet in thickness, in most places containing layers of impure limestone and rounded concretions of similar material in its lower part.* These slates closely resemble those of the Coal formation, and sometimes contain thin seams of coaly or bituminous matter, which have misled many persons to spend considerable sums in digging and boring in them, with the ill-founded expectation of finding useful layers of coal: an idle hope, for they lie (as will be seen hereafter) thousands of feet below that true Carboniferous system, beneath which no valuable coal strata have ever been found.

Their fossils are usually few, those most common in the slate itself being figured in the annexed wood cut (Fig. 28). They all belong to genera which have been heretofore noticed, except the *DISCINA* and *AVICULA*. The former was a flat circular brachiopodous shell, the valves not articulated by a hinge, and with a slit or hole in the lower valve through which passed a "pedicle" or muscular appendage by which the animal attached itself to stones or other objects on the sea bottom. The *AVICULÆ* are bivalve shells having the lower valve much smaller than, and often quite unlike the upper, and with a wing or prolongation of the hinge-line on one or both sides. They are very numerous as fossils in the older rocks, but comparatively few are known now living. The "Pearl oyster" is one of this family.

But the limestone layers near the base of the slate contain a very peculiar group of fossils, met with in no other stratum.† They are chiefly large chambered shells, *Orthocerata* and *Goniatites*, though the latter are much like *Nautilus* in general form. The larger species is sometimes a foot in diameter, its outer surface beautifully marked with waving lines of growth; and broken specimens show perfectly the sinuous form of the partitions between the chambers, and the siphuncle or connecting tube

* These concretions (found also in other slaty formations) are generally cut in various directions by veins of spar, the edges of which show on the surface in intersecting lines. The common oval form of the concretions, and a frequent approach to regularity in the veins, give them a curious resemblance to large tortoises; though they are simply concretions without any fossil character, except that fossils are sometimes contained in them. Such masses are called by the general name of *Septaria*.

† This should be understood of the layers east of Marcellus. At Le Roy and elsewhere in Western New-York, there are one or two thin layers of compact limestone, containing a few *Brachiopoda* and *Trilobites*, the latter appearing to be like the smaller forms of the *Hamilton* group. These layers are different from those above described.

lying close to the outside or back of the shell. Another form has partitions curved in a simple convex form, and a siphuncle placed in the interior, separate from the shell. In this species the successive volutions simply touch each other, while in the former each outer volution covers half the width of the inner one; and there is a third species, only about as broad as a half dollar, in which the inner coils are entirely covered by the outer ones.

The *Orthocerata* are very perfect, the more common form being a long tapering species, about two feet in its greatest length; others being pear-shaped; and there are one or two shells which seem between *Orthoceras* and *Goniatites*, being bent into a sort of crescent. These have knobs or bosses on every second or third chamber.

These fossils are found most abundantly in the lower part of the upper layer, in which they sometimes lie very thickly. A mass of this layer is placed in a separate case in one of the north windows, which contains four perfect *goniatites* of the species first mentioned, two or three broken ones, and several other fossils. A recent *Nautilus umbilicatus*, from the tropical seas, lies beside them, and the close resemblance in their general form is very striking.

The top of the upper layer often contains small coiled shells, probably of the Genus *PLEUROTOMARIA*; and a tiny trilobite of the Genus *PROETUS* or *ÆONIA* is sometimes found in the base of the lower layer. This rock also contains bones, plates and spines of fishes, which are of great interest. A few specimens are in the cases, appearing to belong chiefly to species of *ASTEROLEPIS* (or "Star-scale"), a thick-plated fish, nearly allied to that described in HUGH MILLER'S "Footprints of the Creator." An examination of these specimens will enable the student to recognize such remains wherever he may find them; and such will be gladly received by the Curator of the Collection.

The *Marcellus* slate is a rock of very wide extent, being traceable through Pennsylvania, Virginia, and even Tennessee; and it is a remarkable fact, stated by Prof. ROGERS in his State Report on the Geology of Pennsylvania, that through all this distance it seems to contain near its bottom a thin argillaceous limestone; and that *goniatites*, of some variety, are found in this slate in Pennsylvania and the West. This limestone and its remarkable fossils have been clearly traced and examined in New-

York, as yet, only from Marcellus to Schoharie; but it is probable that they may be found well developed through the Helderbergs and along the hills west of the Hudson river and Delaware and Hudson canal to Pennsylvania. The layer is easily found, generally projecting in ravines worn in the shale not far from its base; and it is hoped that this pamphlet may stimulate some readers residing in that district to look for it, and collect its many fossils.

The Marcellus shales change gradually, at their higher part, into the

HAMILTON GROUP,

which is a harder, lighter-colored mass, often becoming a sandstone, and, in Central New-York and as far east as the Catskill range, is a thousand feet or even more in thickness. Like the Marcellus shale, many parts of it show very little marks of stratification; but it is divided perpendicularly by joints, which, where it is excavated, often show as upright and smooth as the walls or angles of a plastered building. In the more eastern part of the State, it is generally coarse-grained and sandy: in Western New-York, it is fine grained, soft, and more calcareous, forming by its decomposition a rich soil.

Taken as a whole, it is exceedingly prolific in fossils, though in some of its beds they are few. They are very various in their nature, comprising univalve, bivalve and chambered shells, corals, trilobites, crinoids, fish-bones, and distinct remains of *land plants*; being the lowest and oldest rock in New-York in which any traces of terrestrial vegetation have been found, except a few indistinct stems in the Marcellus slate (a fragment of this kind is shown in Fig. 34a).

Four or five species of TRILOBITES are known: the largest (which is common in Central New-York, but rare further west) is the *Homalonotus dekayi*; which, in general appearance as well as size, resembles the *Homalonotus* from the Niagara shale (Fig. 29). It differs, however, in the form of the head; and the plate covering the other extremity, instead of being furrowed transversely and pointed at the end, is smooth and rounded. The *Phacops bufo* (Fig. 30, No. 6) is a small trilobite abundant in many places, especially near Moscow in Livingston county, and near Eighteen-mile creek in Erie county: many specimens show

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the lenses of the eyes very perfectly. The *Dalmania calliteles* is another small species (Fig. 30, No. 7): its tail is fringed with small pointed projections. Other species are exceedingly rare. Among the chambered shells is one very large coiled species, the *Phragmoceras maximus*, found near Madison in Lewis's quarry and elsewhere in Central New-York, fifteen inches in diameter. Smaller species are also found; and there are many ORTHOCERATA, one small species of which, common in Central New-York, is surrounded with rings or swellings which have caused it to be compared to the tail of the rattlesnake, to which, in the eyes of some beginners in geological observation, its jointed structure, separating at the partitions, seems a striking feature of resemblance.

A few ASTERIE, or starfishes, have been found in this rock, but they are as yet very rare; and there is in the Collection a slab of stone containing several badly preserved specimens of something very like an ECHINUS, or modern "Sea-egg." These are animals bearing some relationship to the starfish, but generally of a circular or flattened-oval form, and covered with projecting spines, which are articulated to the body, and by the movement of which they walk or crawl on the sea-bottom. A specimen of a recent Echinus is laid in the case, to explain the nature of the fossil. Many more specimens of such forms will probably be discovered, when observers are so numerous as to examine all parts of the State above the limestones.

The appearance of *Terrestrial Plants* is a very interesting feature of the Hamilton group. Specimens may be seen in the cases: they are of several kinds; one is a large flattened stem; another a long stalk, marked with scale-like protuberances (Fig. 34 *a*); others are branched, like that in the figure, No. 34 *b*. Their appearance seems to mark a step in the great progress of creation, when the earth, previously bare of trees or land-plants, began to produce its first vegetable growths. The attention of observers is urged to this class of fossil remains, which may be expected to be found in considerable abundance in the Hamilton and higher groups, especially east of Seneca and Tompkins counties, west of which they seem to be less common.

The fish-bones of the Hamilton group seem generally to belong to species of ASTEROLEPIS, allied to those of the limestone of the Marcellus slate. They are as yet rare.

The CRINOIDS are not common in a perfect state, but scattered joints and short stems are common. (There is in Western New-

York a thin layer of limestone in the shale, which is almost made up of encrinal columns, often of large size; and is known as the ENCRINAL LIMESTONE. It does not extend far to the east, however.)

The CORALS of the Hamilton group are chiefly of forms allied to the columnar and horn-shaped Corals of the Upper Helderberg limestones. The figure given (Fig. 31) explains their more common character. There are, however, many beautiful small forms belonging to the BRYOZOA, which are found adhering to the inner or outer surfaces of shells on which they seem to have been parasitic.

The bivalve shells of this rock are exceedingly numerous. There are many species of AVICULA (Fig. 32, No. 3); and many of oblong forms bearing some general resemblance to the "fresh-water muscles" of our lakes and streams, though all are of marine origin (Fig. 33). There are great numbers of brachiopodous shells, of which some of the most marked are the great DISCINA (Fig. 32, No. 4), and the *Atrypa concentrica* (Fig. 34, No. 5), an exceedingly common species. The *Atrypa reticularis* (Fig. 34, No. 4) is another common form, which is known through a great thickness of strata; being found in rocks far below the Hamilton group, even as low as the Clinton, (if indeed the species be identical throughout.) A beautiful bivalve shell is the GRAMMYSIA, which has its knobs or umbones curved into two coiled spires which approach each other at the hinge, with a broad furrow running from each umbo diagonally across each valve to the margin at its other end. The NUCULÆ (Fig. 33, Nos. 4, 5) are small, short and thick bivalves, with the hinges marked with a long line of teeth almost like a saw, seen (like all such details of structure) best in broken or weatherworn specimens. Among the univalve shells are species of BELLEROPHON (Fig. 34, No. 1), explained under the head of the Trenton limestone; PLEUROTOMARIA, small and often beautifully marked snail-like shells with a band on the outer edge; LOXONEMA (Fig. 30, No. 8), a long spiral form with lines crossing each whorl or coil; and NATICA, a coiled shell formed much like a large snail, but wanting the marginal band found in Pleurotomaria. We may add some of the SPIRIFERS, very long or rather wide and pointed brachiopodous shells; of which several are shown in the woodcuts (Fig. 29, No. 3; Fig. 34, Nos. 2, 3; Fig. 30, No. 5).

The Hamilton group terminates in Central New-York with a very impure dark limestone, about ten feet thick, called the TULLY LIMESTONE. In the eastern and western parts of the State this rock does not exist, and the Genesee slate lies directly on the Hamilton group. The Tully limestone contains some fossils which are common to it and lower shales, among which are the *Phacops bufo* and *Dalmania calliteles* (see page 65); and some peculiar to itself, the most marked of which is a beautiful brachiopodous shell, the *Rhynchonella cuboides*, shown in Fig. 35, No. 1. Beside the fossils in this cut, there are others; among them, a very pretty small LEPTÆNA.

The next rock in upward order is the GENESEE SLATE, a series of layers of thin-bedded fissile black slate, in some places 150 feet thick, but diminishing westward so that it is only about 25 feet on Lake Erie. It is, however, distinctly recognized in Pennsylvania, where it is some 300 feet thick, and, with the Marcellus slate and Hamilton group, forms the "CADENT GROUP" of Prof. ROGERS' Report. It derives its name from one of its best localities in this State, the gorge of the Genesee below Portage. It is generally easily recognized by its black soft slaty texture, but its fossils are very few; the more common forms being shown in the woodcut Fig. 36.

The name of

PORTAGE GROUP

has been given to the next upward portion of the great slaty and shaly masses, which form the deep gorge of the Genesee at Portage, and everywhere cover the southern edges of the Hamilton group and Genesee slates. This enormous pile of sandy, slaty, and shaly strata is in some parts of the State 1000 feet in thickness: it is divided, in Prof. HALL's Report on the Fourth District, into a lower mass called the Cashaqua shale, a middle mass called the Gardeau shale and flagstones, and a terminal mass of sandstones seen at Portage; but in Middle and Eastern New-York, these divisions are not distinct.

Much of this group is a soft olive-colored shale; but its most useful portions are its layers of flagstone, which are largely quarried near Norwich and Ithaca, on the hills back of the Helderbergs, and on those west of the Hudson river as far down as Rondout. Layers of the same character exist in this group in Pennsylvania, where it attains an enormous development, being

estimated by Prof. ROGERS at seventeen hundred feet. The group extends westward through Ohio (where it, with the succeeding Chemung group, forms what are called the Waverly sandstones); but while in Indiana it and the Chemung group together are not more than 400 feet, where it reaches the Mississippi and passes into Iowa, it and its associated rocks have so thinned out, that the whole vast series from the Hamilton to the Chemung groups (inclusive of both) are reduced from the 3000 feet of thickness which they have in Middle and Eastern New-York, to less than 200 feet.

It is generally very poor in fossils; so that in some places a whole day, spent in searching for them, is rewarded with but a few obscurely preserved shells or even none. Those described in the Report on the Fourth District are shown in Fig. 37, 38 and 39. The crinoid in Fig. 39 is one of the most perfect and beautiful which are known from the rocks of any age, and is a good example to show the general form and structure of this curious and interesting family. It has been found in perfection only in the shore bluffs of Lake Erie, in the town of Portland, Chautauque county.

The soft slates of the Portage group contain many of the concretions known as *Septaria*, described in our notice of the Marcellus shales.

To the Portage group succeeds the

CHEMUNG GROUP,

so called from being well exhibited at the "Narrows" of the Chemung river. Its thickness of 1000 or 1500 feet is made up of a series of thin-bedded sandstones with intervening shales, and occasionally beds of impure limestone mainly formed by the materials of fossil shells. It, in many places, abounds with fossils. Trilobites are very rare, as they are in all strata above the Tully limestone; and the few found in this group (apparently the same with *Phacops bufo* of the Hamilton group) are the last of their race known in America, the whole family having been extinct since before the commencement of the Carboniferous period. Plants are not uncommon, and some specimens of fern-like character plainly indicate a gradual approach to the forms so abundant in the Coal formation. The shells are chiefly bivalves, of which several illustrations are here given (Fig. 40, 41). It will be seen that they resemble in considerable degree

some forms of the Hamilton group. Many species of *AVICULA* occur, and brachiopodous shells of the Genera *SPIRIFER*, *ORTHIS*, *ATRYPA* and *STROPHOMENA* are abundant and beautiful.

This group of strata contains many remains of plants : most of them are very ill-preserved, but one quite perfect imprint of a fern-like leaf is shown on Fig. 41. The original specimen was found at Pine valley, Chemung county.

The Chemung group passes or changes upward into the

CATSKILL GROUP,

an enormous series of shaly and sandy strata, which cover all the upper range of the Catskills, and many of the higher tracts of the southern counties as far west as Steuben. In the latter county it is only a thin mass of calcareous sandstone, and farther west it thins out and disappears entirely ; but in the Catskill region it is probably 2500 feet thick, and twice as much in Pennsylvania ; whence it is found southward along the mountain ridges, but in thinner volume, as far as Tennessee.

The beds of this series are various in color, being greenish grey sandstones ; fine-grained reddish sandstones, slates and shales ; grindstone grits, and an accretionary mass appearing like fragments of hard slate cemented in calcareous rock. The hard sandstone often weathers in a peculiar way, dividing into thin layers almost like piles of boards.

The fossils of this rock are very few : the shells figured (Fig. 42) were found by Prof. VANUXEM in a locality near Mount Upton on the Unadilla. Remains of plants are numerous, forming occasionally tiny seams of coal ; and there are in some localities many teeth, bones and scales of fishes. The latter are often conspicuous objects, as they are usually white or bluish in color, and contrast strongly with the red rock. A few specimens are shown in Fig. 43.

Above these "Catskill mountain strata," lies the rock which is considered as the base of the great CARBONIFEROUS SYSTEM of Pennsylvania. It is mainly a mass of hard CONGLOMERATE, of rolled and rounded quartz pebbles cemented with sand into a solid mass. Some of its finer or more sandy layers often show a singular lamination in a diagonal or slanting direction. It is remarkably massive and ponderous in its general appearance, the ledges often separating into huge blocks with wide

fissures between, which have been fancifully compared to ruined cities.

This conglomerate rock is found on the summits of the Catskills, and it is also known in a few places in Southwestern New-York, where, in the absence of the Catskill group, it lies on the top of the Chemung. Such are to be seen six miles south of Olean, seven miles south of Ellicottville, and near Wellsville, where they are popularly called "rock-cities." They lie on high points not far from the Pennsylvania line, and are simply remaining spots of the conglomerate left far north of the main body of the rock, by the wear of the elements, which, going on through ages of ages, has worn away this massive stratum over great extents of country. They are thus most impressive monuments to show the vastness of that wear or erosion, which has left them in this insulated position, and which may in the course of future centuries demolish them entirely.

The fossils of this rock are very few, and are found only in the finer sandy layers. Those shown in Fig. 44 were found near Panama, Chautauqua county.

This conglomerate is the highest and latest formed of all rocks known within the limits of New-York. It is possible that a few strata of later origin, belonging to the Carboniferous formation, may exist on the Catskill summits, but probably none of any considerable amount. The whole Carboniferous system, with its valuable beds of coal, appears, in its present extent, to terminate south of our State Line; and it is in the highest degree improbable that useful layers of coal can ever be found within our borders. To obtain a knowledge of the Coal formations, we must go into Pennsylvania. The following statement of the succession of its different rocks in that State is taken from the Report of Prof. ROGERS.

The great CONGLOMERATE, of which we have spoken as existing in Southern New-York, attains a thickness of more than 2500 feet in Pennsylvania on the Susquehanna. It contains no fossils, except fragments of plants.

It is succeeded by what is called, in the Pennsylvania Report, the UMBRAL RED SHALE, which in that State is about 3000 feet in its greatest thickness, though far less in some districts. It is in Pennsylvania almost entirely composed of soft red shales and

argillaceous red sandstones, seen in the northern counties, and generally around the edges of the different coal-fields (especially in the Sharp mountain south of Pottsville, where it has been so uplifted that its layers stand perpendicular in the walls of the valley); but when traced southward through Virginia, is there found to embrace near its middle several hundred feet of grey and brownish limestone, which also extends far to the west, and is known as the CARBONIFEROUS LIMESTONE. The St. Louis and Keokuk limestones of Missouri and Iowa are part of the western extension of these rocks. These limestones abound in fossils; but the formation in Pennsylvania (where it is all red shale and sandstone), contains scarcely a shell or other fragment of any living form. It, however, bears traces of life of a different nature; for there have been found on the surfaces of some of its layers, which doubtless once formed a beach left bare by the tide, tracks or footprints made by some fourfooted animal which had walked over them while yet soft. The animal which left these prints was in all probability a large lizard, or some similar reptile; and there are, between the right and left lines of the tracks, obscure furrows, as if made by its tail dragging on the soft mud or sand. These tracks are two or three inches in diameter, and show five toes upon each foot. The layers on which they are found often show little dots or pits scattered thickly over them, which appear to have been the marks of heavy rain-drops falling on the slimy sand when fresh and soft; and in some instances they are intersected in all directions by small cracks, just such as are at this day formed on muddy shores by the drying action of sun and wind. These footprints are of the greatest interest; for they are the oldest vestiges to show the existence of any form of life higher in degree than fishes—and thus the oldest relics of air-breathing animals.

This "Umbral Red shale" is covered by another thick series of conglomerate strata, called by Prof. ROGERS the "SERAL CONGLOMERATE." It is a gray and whitish conglomerate, in massive beds alternating with gray sandstones. It is 1100 feet thick in the Sharp mountain south of Pottsville, and often contains one or more thin seams of coal; being the lowest position in which any considerable quantities of that mineral have yet been found.

This is the base of the "Productive Coal-measures," as the strata containing workable layers of coal are called. These are made up of thick beds of sandstones and black slate, with which

the coal layers are interstratified. These strata of coal are of all thicknesses, from a few inches up to twenty or even forty feet, and are separated from each other by masses of rock of from ten or twenty to two or three hundred feet thick, and they are mined in various ways according to their situation : in a few places, where they are covered by but little rock, being quarried in open daylight; in others, mined by galleries or tunnels driven into the hillsides on a level; in others, by deep pits.

Geological investigation in all coal countries has led to the conclusion that these strata of coal are vegetable matter, which during the Carboniferous epoch appears to have reached an enormous and luxuriant growth, and formed vast accumulations, which, after being buried under the marine sediments of sand and clay which now form the slates and sandstones over them, underwent the chemical changes which transformed them to their present condition.* The proofs of this are found in the facts that the rocks above and below the coal seams are filled with vegetable remains, leaves, stems, roots, etc.; the trunks of the trees being in some places found still erect and standing upon their roots, but converted into coal; and that even the coal itself, though in most cases it is solidified into one mass so as to show no organic structure, displays in other instances, under the microscope, all the texture of wood, the cells, the ducts through which the sap once circulated, and even minute markings by which it can be determined whether the wood belonged to one or another general class of trees; for instance, whether it was a cone-bearing tree like the pine, or one of another family.

This vegetable origin of all the coal seems well-established; but the mode in which such great accumulations of it were made over such vast areas,* is yet an obscure question. The prevailing opinion is that it grew in enormous morasses or swampy tracts, resembling on a larger scale the Great Dismal swamp, or the Okefenoke swamp of Georgia; in which the annual fall of leaves, branches, and trunks at last formed thick peaty masses, which, being submerged under the sea and covered with sediments, became the vast piles of fossil fuel which are now of so great importance to our race.

* A single bed of coal, that called the Pittsburgh seam, is known to extend over no less than 14000 square miles, with a usual thickness of from four to ten feet. Other layers, though less in extent, are much greater in thickness, reaching even forty feet.

The fossils of the Coal measures are almost entirely vegetable. In the slates above the coal seams, most perfect and beautiful impressions of leaves occur in profusion; and large trunks or stems are found, almost always compressed to a thickness of only an inch or two, though two feet or more in width. The greater part of these trees seem to have been allied to the tree-ferns of tropical climates, though there are remains of cone-bearing trees and several other vegetable families. The character of this fossil vegetation would seem to indicate that at the time it grew, a far milder climate than that now known prevailed over the temperate and arctic zones; and the tropical forms of many fossils of the older rocks (such as the nautilus-like shells), confirm us in this opinion.

A small collection of the vegetable fossils of the Coal formations is displayed in a case at the end of the New-York Collections, next to that containing the Catskill and Conglomerate fossils. They are few, but serve to give the inexperienced observer a general idea of the character of these relics.

The belief that the coal is of vegetable origin, seems to explain why the lower rocks which form the State of New-York contain no coal. They appear to have been formed before terrestrial vegetation flourished to an extent sufficient to form accumulations of this substance. The first relics of land plants are found in the Hamilton group; above which they become more numerous, and in the Catskill group are quite abundant, forming occasionally miniature coal seams an inch thick. In the great Carboniferous formation, they increase suddenly to an enormous quantity, and in later formations are found in considerable, but generally in less abundance; and though coal is found in smaller quantities in newer rocks, such as the Jurassic and Tertiary, it seems never to have been formed in such profusion as in what is called the Carboniferous period.*

* The Coal or Lignite beds of the central part of the continent near the Rocky mountains, appear to be of a much later date, and to belong to the Tertiary rocks. The same is true of the coal of Vancouver's island on the Pacific. The coal beds near Richmond, Virginia, are of an intermediate age. The conclusions to be drawn from our present knowledge are, that good coal may be *sometimes found above* the Great Carboniferous system, but *never below it*.

We have thus traced the great series of stratified rocks from their Hypogene Granite foundation up through the Carboniferous. But this—though forming all that is distinctly shown in and near New-York—is only the earliest and oldest portion of the geological formations which are known, and embraces, in a historical view, only the development on earth of the lower and older forms of animal life. We may be permitted very briefly and rapidly to glance at the succession of the newer formations and the character of their fossil relics, as shown by explorations in other regions. Of all these formations and fossils, it is intended to show hereafter some small collections in this State Museum; which may thus not only afford the student a very full and complete exhibition of our own Palæozoic rocks and fossils, but a general representation of those of that later part of the whole grand series, which, beginning at the era of the Coal, reaches to the period of man's existence and civilization.

Though these formations exist in many parts of the world, the best connected series of them is that of England. There, as here, are found the hypogene or granite rocks, succeeded by gneiss and other metamorphic strata; and these are followed by vast piles of rocks similar in general texture to, and closely corresponding in fossils with, the rocks of New-York. The lower part are there called Silurian; the upper, Devonian: the former corresponding, as far as we can judge, with our strata below the Oriskany sandstone; the latter, with those between it and the Carboniferous.* Shells, trilobites, and remains of fishes are found in those rocks, of forms sometimes identical with those of New-York, sometimes only having a general resemblance; but these strata are there so broken, upheaved, and distorted, and

* The Devonian includes the OLD RED SANDSTONE, made so famous by the attractive geological writings of HUGH MILLER; and the American counterparts of its strata are probably to be found from the Hamilton group to the Catskill group. They contain similar fish-remains; but in their other fossils, differ very materially from the Old Red sandstone of Scotland.

are comparatively so poor in fossils, that they are as a series far less perfect and instructive than those of this State.

These Silurian and Devonian strata are there, as here, succeeded by a Carboniferous formation, with its beds of coal and abundant vegetable remains, but far less in breadth of extent than the enormous coalfields of America. But above the Carboniferous, they have the newer formations, which succeed each other from west to east, as our older ones do from north to south. This is because the dip or downward slope of the strata is there to the east or southeast, not as here, to the south. The section at the beginning of this pamphlet (No. 2) gives a general idea of their succession across England from Derbyshire to Sussex, though it is far from accurate in either proportion or smaller details.

First above the Carboniferous, lies what is called the PERMIAN SYSTEM : several hundred feet of limestone, marls, slates and sandstones ; containing many fossils, shells, corals, fishes, and the bones of several kinds of reptiles.

Next lies the TRIASSIC SYSTEM, or NEW RED SANDSTONE, which contains the great mines and springs from which most of the salt used in and exported from England is manufactured. It is a thousand or two feet thick ; and though generally not abounding in fossils, some very remarkable forms of reptiles have been discovered in it, and many fish.

It is believed that the Red sandstone of the Connecticut valley, which is also found crossing New-Jersey, Pennsylvania and Virginia, is of the same age with the Triassic system of Europe. This opinion is mainly founded on the similar character of the fossil fish in the two formations. It will be remembered that it is in this rock that the footprints of birds mentioned on page 53 occur. Specimens of these are in one of the rooms, and are of great interest, for they mark, so far as is yet known, the period when the great class of BIRDS first appeared on earth. (They bear also other tracks, considered as being those of various kinds of reptiles.) Specimens of the fish of this formation, from the Connecticut valley and New-Jersey, are in a case in one of the rooms of the collection.

Next above the Triassic system, succeeds what is called (from constituting the greater part of the Jura mountains in Switzerland) the JURASSIC SYSTEM. The whole formation is several thousand feet in thickness : its lower part, known as the LIAS, is several hundred feet of dark marly shales and straight thin

layers of black limestone; the upper part, often called the OOLITE, is generally yellowish or drab limestones and shales. The Lias abounds in shells of numerous genera: among the most abundant are the AMMONITES, or nautilus-like chambered shells with curiously plicated partitions. Of these, there are in the Lias and Oolite, and the Chalk which overlies them, more than a thousand species, many of them very beautiful and graceful in form, and varying in size from that of a dime to four feet diameter. Many kinds of fishes are found in the LIAS, some of them so well preserved that hardly a scale is out of place; but instead of the strange heavily-plated fish of the Devonian system, they approach in form more nearly to existing fishes. There are fossil plants, all differing from those of the Coal formation. The most remarkable of the remains in the Lias, however, are those of reptiles; many of which are larger than any now known, and of very strange forms, seeming to blend the characters of reptiles with those of fishes; and there is one very remarkable family of small reptiles (the PTERODACTYLES), which had bat-like wings, seeming to realize the fables of flying dragons.

The Oolites, or upper Jurassic strata, contain many beautiful ECHINI, or Sea-eggs and reptiles, fish and shells in great numbers; but the most important relics found in them are those of the earliest known MAMMALIA.* These seem to have been small quadrupeds allied to the OPOSSUM, and belonging to the lowest orders of the Mammalia; but they mark, so far as is yet known, the first appearance of any terrestrial or warmblooded animals except birds. Remains of Insects are also found in some Jurassic layers, the fine texture of which (in the Lithographic limestone of Bavaria) admitted of the perfect preservation of such fragile things.

The Jurassic is succeeded by the CRETACEOUS SYSTEM, of which the WHITE CHALK forms in England and France a considerable portion, being several hundred feet thick where seen in the sea-side precipices of Beachy Head and Dover. The whole system abounds in fossils, consisting of fish, reptiles, shells of many families, echini, crinoids, etc. etc. One of the most remarkable evidences of the quantity of the smallest forms of life which have existed, is found in the fact that a great part of this enor-

* Mammalia are animals which nurse their young; a great class, comprehending all the more highly-organized animals.

mous bed of White chalk is made up of the skeletons or shells of minute living things ordinarily spoken of as animalcules, so small that they are not to be detected without the aid of the microscope. The oldest now living forms of earth belong to these tiny beings, for it is believed that some of those found fossil in the Chalk are identical with some which live in the ocean to-day. Every shell, every fish or other relic found in the Cretaceous strata, is of an extinct species; of many, no analogous or closely similar form now exists, but these minute organisms still survive without change.

The lower beds of rock which overlie the Cretaceous system, called the TERTIARY FORMATIONS, exhibit in their fossils a close resemblance to now-existing forms, and some of them are the same. As we examine the fossils of higher and higher strata of the Tertiary, we find the proportion of extinct species gradually diminishing, and that of still extant species increasing, until in the Upper Tertiary they show a set of animal inhabitants and plants almost precisely the same with those which now exist; the same trees; the same quadrupeds, the same shells buried in the newest tertiary strata being still found living. Thus, through the enormous succession of strata which we have traced, we have found a gradual advance in their fossil relics: the first shells beginning in the Lower Silurian, or Potsdam sandstone; the first fishes, in the Lower Devonian, or Oriskany sandstone; the first land-plants, in the Middle Devonian, or Hamilton group; the first reptiles, in the Carboniferous; the first birds, in the Triassic, or New Red sandstone; the first warm-blooded quadrupeds, in the Jurassic; while the more modern mammalia, the ox, horse, deer, the canine and feline tribes and others now abundant, as well as the modern trees, such as oaks, beeches, maples, palms, etc., first appear in the Tertiary.

The remains of MAN and his works are found only in the newest of all the Tertiary beds, which appear to have an age of not many thousand years. Man thus appears to be the latest introduced on earth of all its living tenants, or at least to have appeared only among the latest creations. The earliest relics of him appear to be some rude knives and arrow-heads of flint,—such as are universal among savage hunter-tribes;—which have been found in association with bones of extinct animals, buried in gravel beds in France and England. There is yet some doubt and uncertainty hanging about these evidences of human anti-

quity; and it is possible that they are not as old as the animal relics with which they occur.

A few fossils from the Lower or Older Tertiary strata around Paris in France, are in a case on the second floor. They are chiefly shells, and all or nearly all, of extinct species, though strongly resembling those now found in the seas of mild or warm climates.

Of the various formations newer than the Carboniferous which we have passed in review, many are represented in different parts of North America, but not in so unbroken a succession as in Europe. Thus the PERMIAN formation is believed to exist in Kansas: the Connecticut sandstone, so largely quarried for the New-York market, is regarded as having been formed during the same period with the European TRIASSIC or LOWER JURASSIC strata; marls and clays of CRETACEOUS age, and containing many fossils similar to those of the European CHALK lie all along the Atlantic coast from New-Jersey to the Gulf of Mexico; and TERTIARY strata are found in all the Southern States. A very remarkable series of Tertiary strata exists also near the Upper Missouri, on White river, called the "Mauvais Terres" or "Bad Lands," from which many remarkable fossils were recently collected for the Smithsonian Institution. They consist of skulls and bones of several extinct quadrupeds, some carnivorous; others herbivorous, some of them of aquatic habits; and shells of fossil turtles. These "Mauvais Terre" strata appear to be of freshwater formation.

The natural monuments of geology since the Tertiary period are few: the most remarkable being the enormous accumulations of gravel, sand and clay which are found so widely spread, and which are known as the

DRIFT.

This is well seen in almost all parts of this State, in almost every gravel-bank: it consists of waterworn fragments of the old rocky strata; pebbles of limestone, sandstone and slate, with some of gneiss and granite, which universally appear to have been trans-

ported from north to south. From a bushel of pebbles taken from any gravelbank south of the Erie Canal, the geologist can pick out specimens of almost every stratum which is exposed north of the bed whence they were taken. South of the line of outcrop of the Helderberg limestones, the gravel banks are full of fragments of their different layers; and among them lie worn pieces of the red Medina sandstone, others of the Hudson-river group, and others of still more northern strata; while some are granite pebbles, which must in many instances have come from Canada. They have evidently been transported from north to south in vast quantities: they are smooth-worn, and are smaller the farther they are found from their original strata; they are generally found in irregular layers with sand and clay, as if left so by the action of rapid currents of water. One of the most puzzling facts connected with them is, that they have been in many cases transported from lower to higher levels, even up steep declivities and over high hills.

There are spread with them also (but generally lying on the surface of the ground) many large and heavy masses of loose rock, called boulders. Some of these are limestones or sandstones, the origin of which can easily be traced to thin native strata within the State; others are granitic masses, which must have come from beyond Lake Ontario, in the same manner that the peculiar granitic rocks of the Adirondack mountains are found to have been carried south beyond the Mohawk valley. And the surfaces of the rocky strata in all the country over which these "drift beds" have passed, are in many places found to be worn smooth, and scratched or furrowed in a general north and south, or northwest and southeast direction, as if such heavy materials had been dragged or driven over them.

Some geologists refer these facts to the operation of glaciers moving from the north over the country, during some supposed epoch of arctic cold; others think the scratches were made by stones pushed over the bottom by grounding icebergs floating from the north, while the country was submerged; others believe the gravel and boulders were transported, and the rocks smoothed and worn, by violent currents which were thrown over the land from the north by some convulsion, such as the uplifting of a great tract of northern sea-bottom, which might have poured its waters towards the south in great depth and with enormous force. It must be admitted that none of these theories fully

meet the difficulties of the case, and that the facts of the Drift form one of the most obscure and perplexing questions in all geological investigation.

Above the gravel beds, near the St. Lawrence and Lake Champlain, are some beds of clay, two hundred feet thick or more, which contain marine shells of species now existing on the coast of New-England and Canada. These prove that since such shells were living, those valleys must have been depressed below the sea-level, long enough for these deposits of clay to be formed. They are known as the *PLEISTOCENE** clays. (The Albany clays are their southern extension, but contain no fossils.) Specimens of the shells of this *Pleistocene* are in case.

* *PLEISTOCENE*, from two Greek words signifying "the most recent," because they are the newest of all marine deposits known in the State.

We may add in conclusion a few remarks on the causes which have brought the rocky strata of New-York from the original level and unbroken condition in which they were formed, to the waving and broken surface of hills and valleys which we now see. It is probable, as we have before stated, that during the slow process of their emergence above their native sea, the action of waves and currents wore them deeply and extensively; and since they were fairly uplifted to their present elevation, the elements have been unremittingly acting upon them until now.

We know that, in all probability, no rocks newer than the Carboniferous were ever deposited within the area of our State. It seems therefore, that this region has been above water since the Carboniferous period; during all the countless ages while the Permian, Triassic, Jurassic, Cretaceous and Tertiary formations were formed; during the deposition of which the animated population of earth has been changed many times. All of these must have been made of sediments worn from pre-existing dry land. We should expect, therefore, that this ancient land would show the marks of vast erosion or wear. Such marks are found in the long and deep river-valleys which cross the State, all of which have evidently been worn out of the solid strata, the remaining portions of which form their bounding hills. They are still being worn deeper and wider by rains and streams; but how far the action of these, continued through an indefinite though vast period of past time, may be deemed adequate to produce such enormous excavations, may be questioned. And there are some valleys which have been excavated much below the level of their outlets, so that they retain the waters and form the remarkable series of lakes of which we have before spoken. Such instances seem to require a different explanation, which it is not easy to give.

However inexplicable it may be, with our present knowledge, the fact is plain that not only these valleys have been worn out, but hundreds of feet of rocky strata have been removed from the

summits of the hills themselves, and from large tracts of plain country. The whole vast basin of Lake Ontario is an excavation in rocks, which still lie nearly as level as when first deposited; and there seems no reason to doubt that the northern edges of the enormous piles of slate rocks above the Helderberg limestones once overspread what are now the level plains of the countries bordering on that inland sea.

Such long lines of bluffs as the Niagara "mountain ridge," or the steep escarpments of the Helderberg limestones, seem to indicate the action at some period of waves from a broad expanse of sea, to which they stood as coast-precipices. The existence of old beaches, such as the Lake Ridge near Rochester, seems to prove that the waters of the lakes once stood far higher than now: perhaps the land may have stood much lower, and they were inland bays or gulfs of the ocean.

This whole subject is obscure, and we have mentioned it only from a desire to embrace in this sketch a glance at every point of interest connected with the surface of the State, as well as with the strata of which it is built up; and to direct wider and more general study and observation to the Natural Monuments of the Past.

Among the most recent of geological monuments, which seem to link together the vanished forms of the past with the conditions of the present, are the bones of the MASTODON and FOSSIL ELEPHANT, which are occasionally disinterred in various parts of the State, found buried only in recent accumulations of muck, peat, or other earthy materials. They appear to be relics of a very modern period of geological history, and their owners seem to have lived since the existence in this region of many of our still-remaining wild animals; possibly even since it was inhabited by man. Specimens of these are in the Collection; and there is also a plaster cast of the skull of the *Castoroides ohioensis*, a gigantic extinct species of beaver, which was probably of the same period with the mastodon. It was found near the village of Clyde, in earth, during the excavation of a canal.

The petrified wood, leaves, moss, etc., which are so common in our limestone districts, are of modern date, and are being formed at the present time. The rainwater which percolates through

the crevices of the limestone rocks, by the carbonic acid which it contains, dissolves the lime ; and on coming again to the light and air in springs, re-deposits it in the form of tufa, a drab-colored mass which is nearly pure lime. This, as it gradually forms, incrusts the leaves, sticks, etc., with which it comes in contact ; and often, as they decay, replaces them in such a manner as to present the same form and structure ; pieces of wood being thus replaced or substituted by a stony mass closely resembling the original substance.

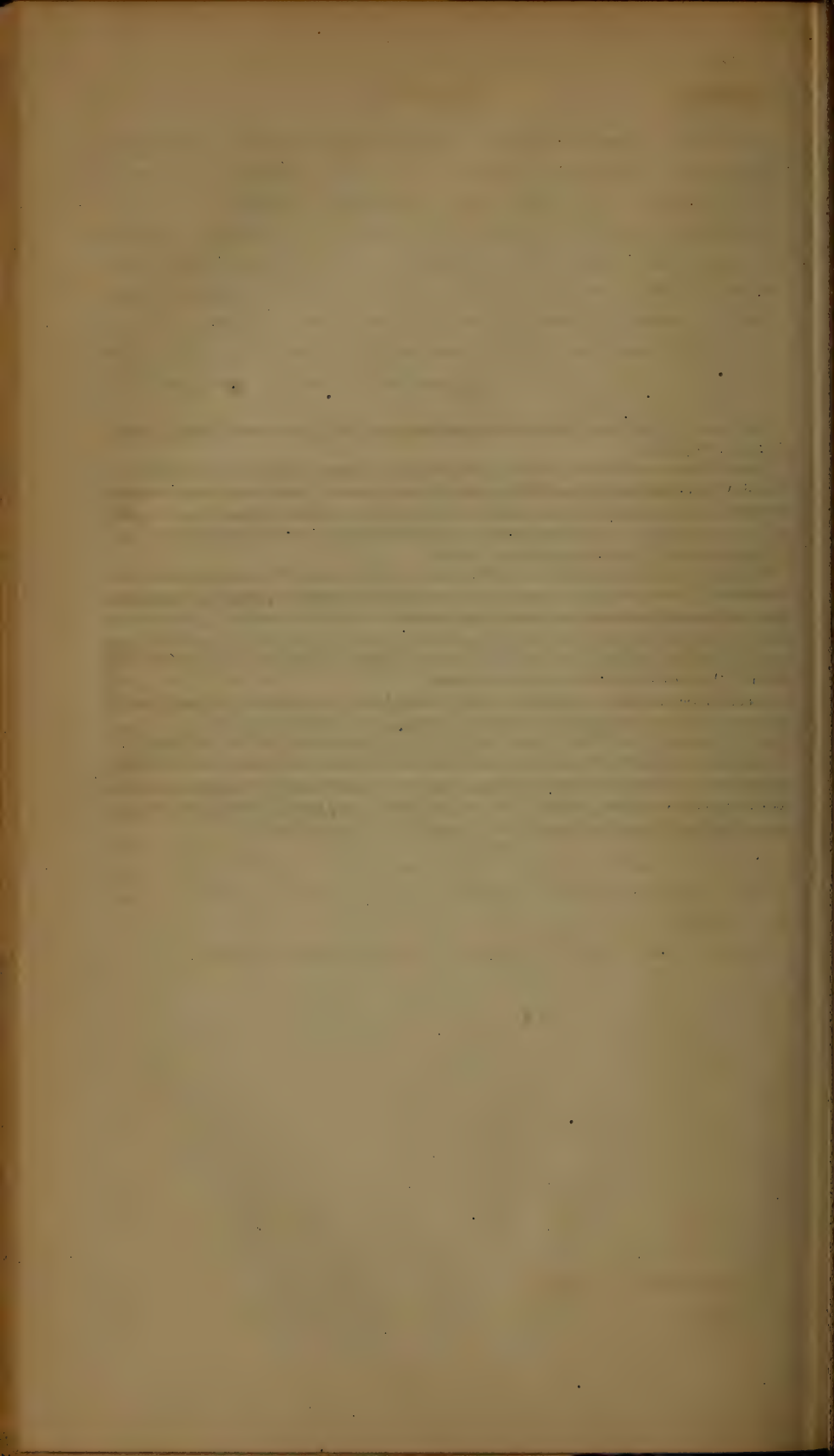
NOTE.

The Curator of the State Collection will gladly receive for it specimens of rare, or especially of new fossils.

The attention of collectors is especially directed to the remains of Crinoids, Star-fishes and Echini, which exist through nearly the whole series of rocks of New-York, but are hitherto very rare; and any distinct relics of Fossil Fishes, such as scales, plates, bones or teeth, will be very welcome. Good specimens of the Trilobites and other Crustaceans are also desired, and shells of the larger and rarer forms.

The more perfect specimens of such relics come under the eyes of observing persons only occasionally, when favorable opportunities, such as excavations or quarrying operations, offer; and cannot be collected at once by any amount of labor or exploration. To make the State Geological Museum as complete and useful as possible, the Regents rely confidently on contributions from students and friends of natural science, to whose aid they already owe much of the most valuable part of the collection.

It should be remembered that the useful value of any such specimen depends almost entirely on accurate knowledge of its locality; that is, the particular formation, and, if possible, the stratum from which it came; for, as has been before shown, it is on the presence of certain fossil remains *in certain formations* that the whole historical conclusions of Geology are founded. Care should always be taken that the correct origin of every fossil from its rock be accurately known, and that it be not attributed to any other position than its true one; otherwise it becomes a *cause of error*, instead of evidence of truth.



CORRIGENDA.

In arranging the woodcuts of fossils, it has been found necessary to affix to them different numbers from those by which they were originally denoted, and by which they have been referred to in Appendix B. The reader will, therefore, to avoid confusion, *disregard entirely* the references by numbers scattered through the pages of such appendix, and find the illustrations by the lists printed opposite the engravings.

In regard to the newly discovered fossils mentioned on p. 50 as indicating the existence of fossiliferous strata older than the Potsdam sandstone (such as has been supposed to exist in the controverted "Taconic System"), a probable opinion seems to be that these fossil-bearing strata are not really of such a lower series; neither of the Hudson-river group; but that they belong to an intermediate position, and are equivalent in age to the Cal-ciferous sandstone and Chazy limestone. These rocks may, in the Green Mountain chain, be much more largely developed than in New-York, and may contain many more fossils, while their disturbed condition in the upheaved hill-ranges renders it extremely difficult to trace out their true age and relations.

On p. 61, for *Meganteris ovoides*, read *Meganteris elongata*.

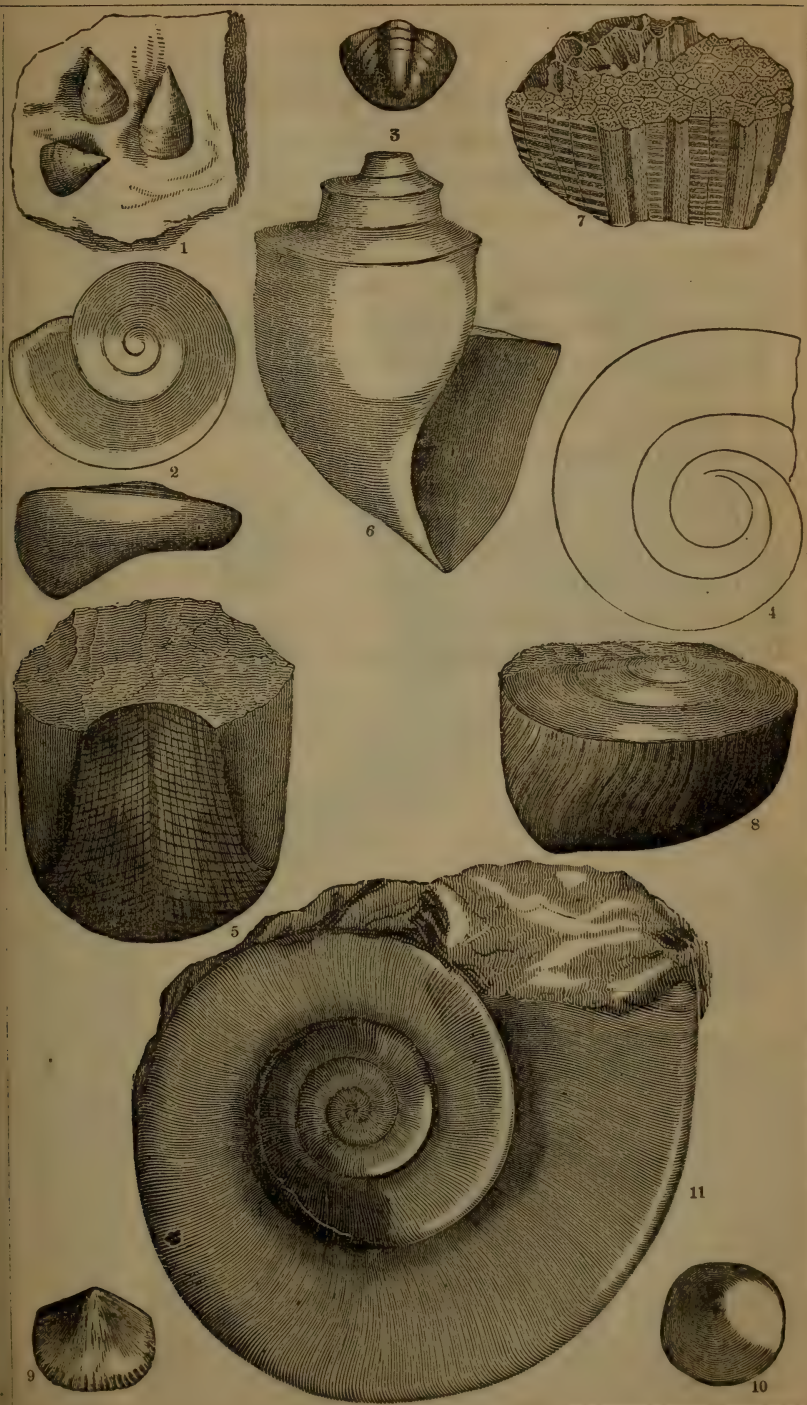
Fossils of the Potsdam sandstone.

1. LINGULA ANTIQUA (page 36).

Fossils of the Chazy limestone.

2. RAPHISTOMA STAMINEA, upper surface and profile.
3. ASAPHUS (the caudal portion of the animal).
4. BUCANIA SULCATINA, profile outline.
5. — — front view.
6. SCALITES ANGULATUS (p. 40).
- *7. COLUMNARIA ALVEOLATA (of the Black-river limestone).
8. RAPHISTOMA STRIATA.
9. ORTHIS.
10. DISCINA DEFORMIS.
11. MACLUREA MAGNA, upper surface (p. 30).

* This "COLUMNARIA" is one of the Corals which grow in crowded masses, like the cells of honeycomb. It is sometimes found in masses of a ton or more in weight.

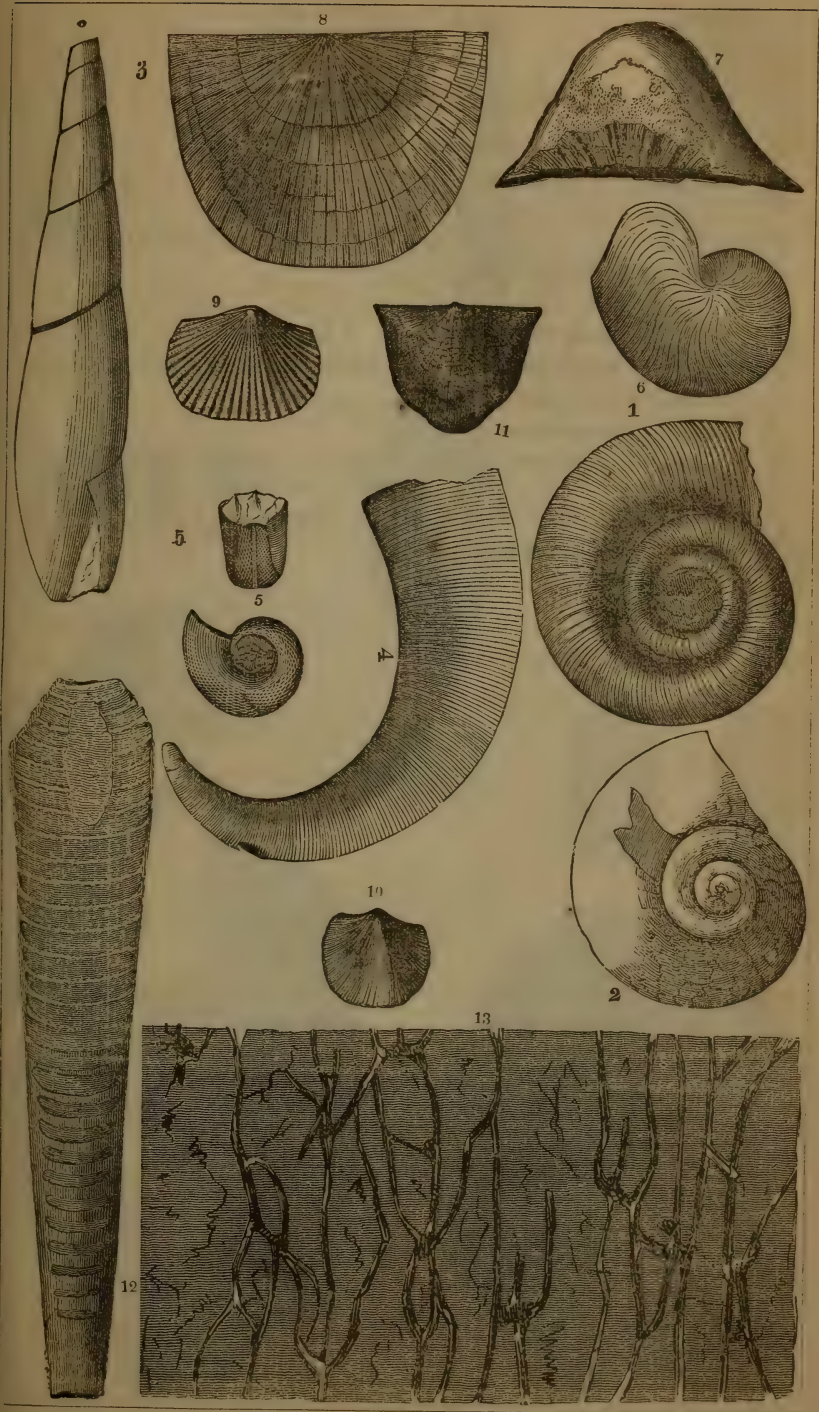


Fossils of the Birdseye limestone.

12. ORTHOCERAS MULTICAMERATUM (p. 41).
13. PHYTOPSIS TUBULOSUM (as seen in the broken edge of the strata).
This is the plant described on page 41.

Fossils of the Trenton limestone.

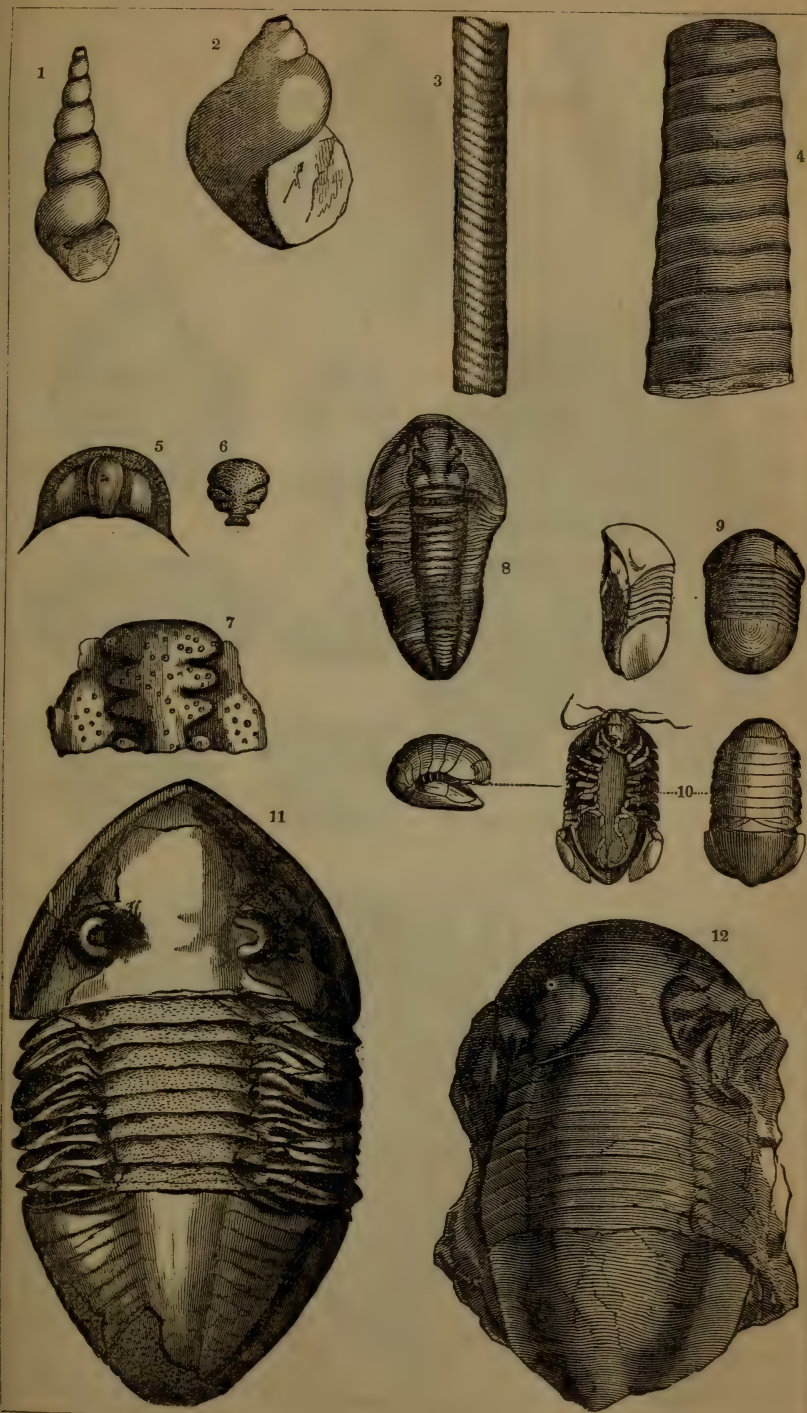
1. TROCHOLITES AMMONIUS (p. 47).
2. PLEUROTOMARIA LENTICULARIS (p. 47).
3. SUBULITES ELONGATA.
4. CYRTOCERAS (a curved form of ORTHOCERAS).
5. BUCANIA PUNCTATA.
6. BELLEROPHON BILOBATUS (p. 47).
7. CHÆTETES LYCOPERDON (p. 48).
8. STROPHOMENA ALTERNATA.
9. ORTHIS PECTINELLA.
10. O. TESTUDINARIA.
11. STROPHOMENA DELTOIDEA.



Fossils of the Trenton limestone.

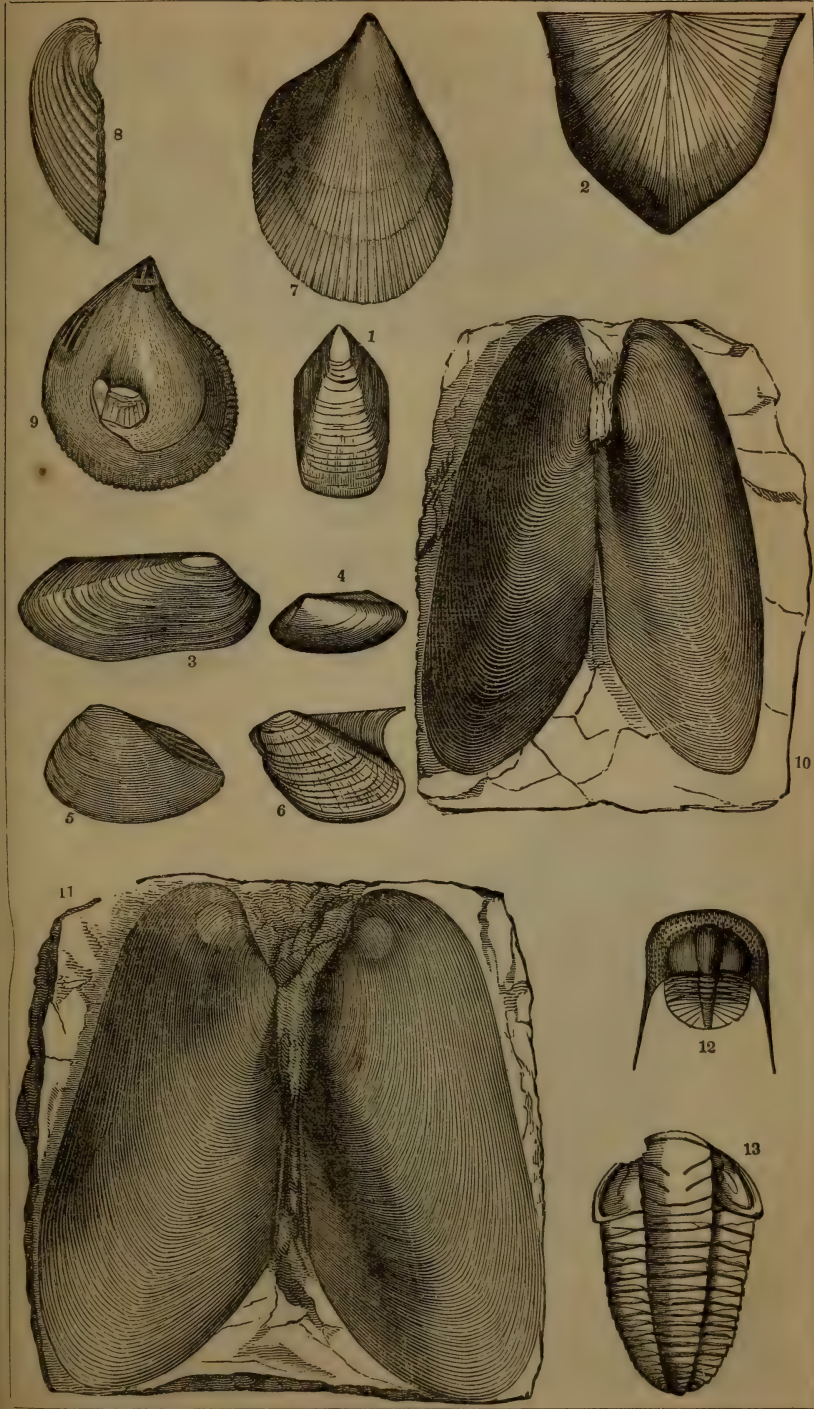
TRILOBITES.

1. MURCHISONIA GRACILIS.
2. HOLOPEA PALUDINÆFORMIS.
3. CAMEROCERAS TRENTONENSE (ORTHOCERAS ARCUOLIRATUM).
4. ORTHOCERAS VERTEBRALE.
5. TRINUCLEUS CONCENTRICUS, detached head (p. 47).
6. DALMANIA, detached central part of head.
7. CERAURUS PLEUREXANTHEMUS, detached head ; "cheeks" gone.
8. CALYMENE SENARIA, entire, but distorted.
9. ILLÆNUS CRASSICAUDA.
10. SPHÆROMA BUMASTIFORMIS : a living crustacean from the South seas, somewhat resembling the trilobites.
11. ISOTELUS GIGAS, or ASAPHUS PLATYCEPHALUS, perfect.
12. ILLÆNUS TRENTONENSIS, perfect.



Fossils of the Hudson-river group.

1. LINGULA QUADRATA.
2. STROPHOMENA ALTERNATA.
3. MODIOLOPSIS ANODONTOIDES.
4. NUCULA.
5. NUCULA POSTSTRIATA.
6. AVICULA INSUETA.
7. AMBONYCHIA RADIATA.
8. Same, profile view.
9. Cast of the same.
10. MODIOLOPSIS MODIOLARIS.
11. Same.
12. TRINUCLEUS CONCENTRICUS, perfect specimen.
13. TAIARTHURUS BECKII (p. 49).



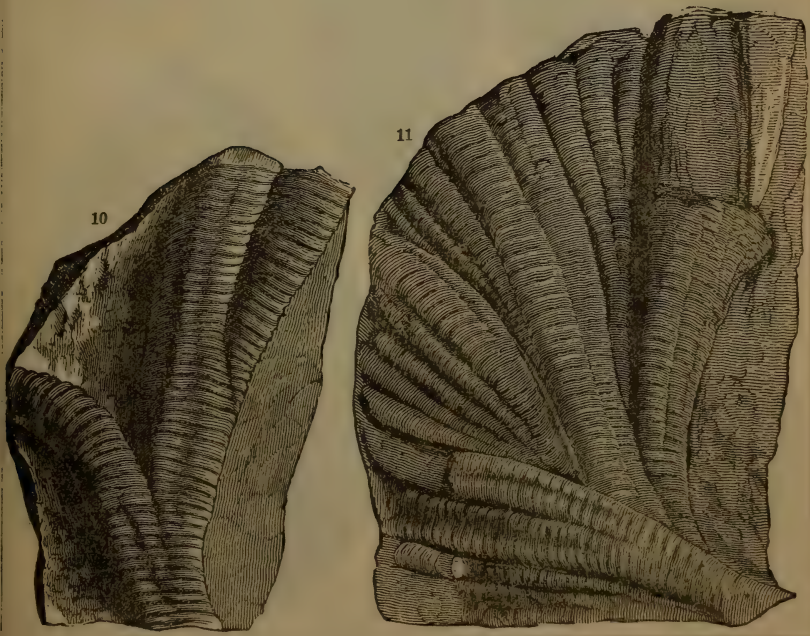
[Assembly, No. 136.]

B

Fossils of the Medina sandstone.

- A. *LINGULA CUNEATA* : Three specimens, as found on the surface of a layer. Ripplemarks are visible on the rock ; and a little ridge of hardened sand extends from each shell, doubtless formed by the tide-current when the shells lay on the sandy sea-bottom, now hardened to rock (See HALL's Report, 3d Dist., p. 52).
1. *PLEUROTOMARIA PARVETUSTA*, base.
 2. Same, side view.
 3. *MODIOLOPSIS PRIMIGENIUS*.
 4. *DISCINA PARMULATA*.
 5. *LINGULA CUNEATA*.
 6. *BUCANIA TRILOBATUS*, back.
 7. Same, profile.
 8. *MODIOLOPSIS ORTHONOTA*, side.
 9. Same, back.
 - 10 & 11. *ARTHROPHYCUS HARLANI* (p. 52).

A



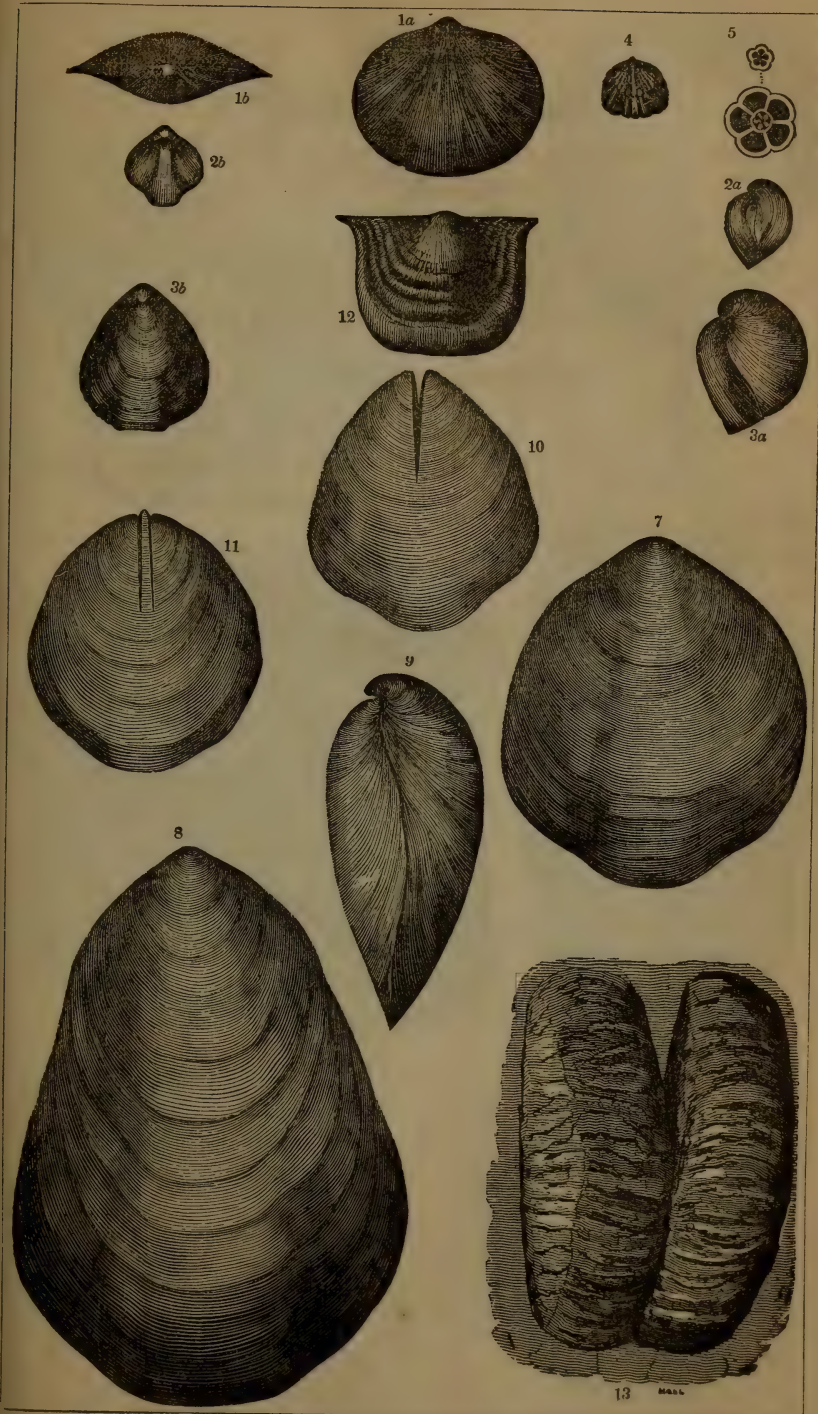
Fossils of the Clinton group.

1. ORTHIS CIRCULUS, side and end views.
2. ATRYPA CONGESTA, side and front views.
3. A. NAVIFORMIS, do. do.
4. A. PLICATULA.
5. Joint of crinoidal stem, natural size and magnified.
7. PENTAMERUS OBLONGUS, young shell (p. 53).
8. Same, old shell.
9. Same, profile view.
10. Same, internal cast* of lower valve.
11. Same, do. do. of upper valve.

The dark cavities in the last two figures show where the peculiar internal plates of the shell were placed.

12. STROPHOMENA RUGOSA.
13. FUCOIDES BILOBA.

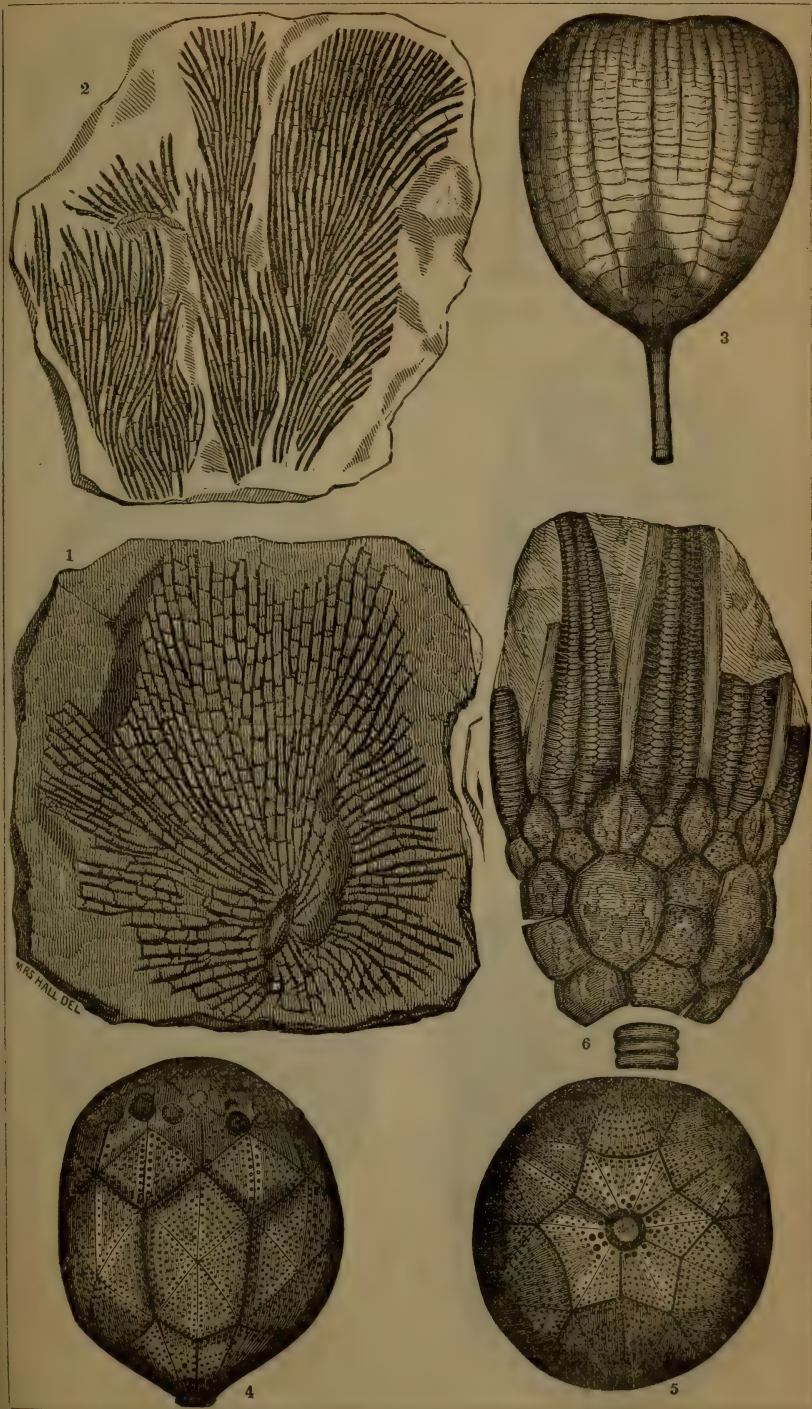
* For explanation of a "cast", see p. 27.



Fossils of the Niagara group.

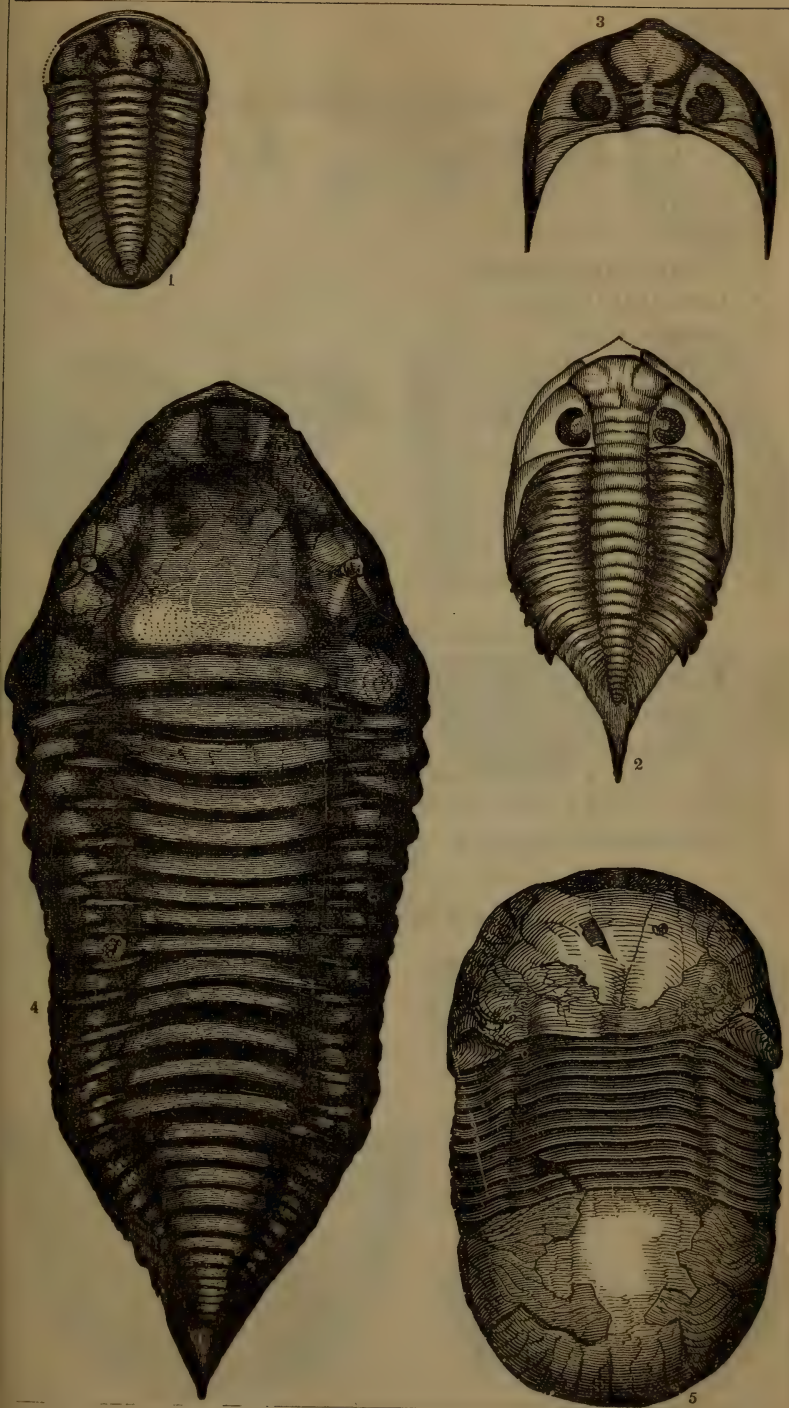
1. Coral : *DICTYONEMA RETIFORMIS* (p. 55).
2. Do. : *D. GRACILIS*.
3. Crinoid : *ICHTHYOCRINUS LÆVIS*.
4. Do. : *CARYOCRINUS ORNATUS*, side (arms gone).
5. Do. : Same, base.
6. Do. : *EUCALYPTOCRINUS DECORUS* (entire specimen ; arms folded or closed).

For Crinoids, see pp. 45, 47.



Trilobites of the Niagara group.

1. CALYMENE BLUMENBACHII [or SENARIA?] (p. 55).
2. DALMANIA LIMULURUS.
3. Same, detached head only.
4. HOMALONOTUS DELPHINOCEPHALUS.
5. ILLÆNUS BARRIENSIS.



[Assembly, No. 136.]

c

Fossils of the Lower Helderberg group.*

A. *From the Waterlime series* (p. 58).

1. SPIRIFER PLICATUS.
2. AVICULA RUGOSA.
3. TENTACULITES ORNATUS.
4. LITTORINA ANTIQUA.
5. ATRYPA SULCATA.
6. CYTHERINA ALTA.

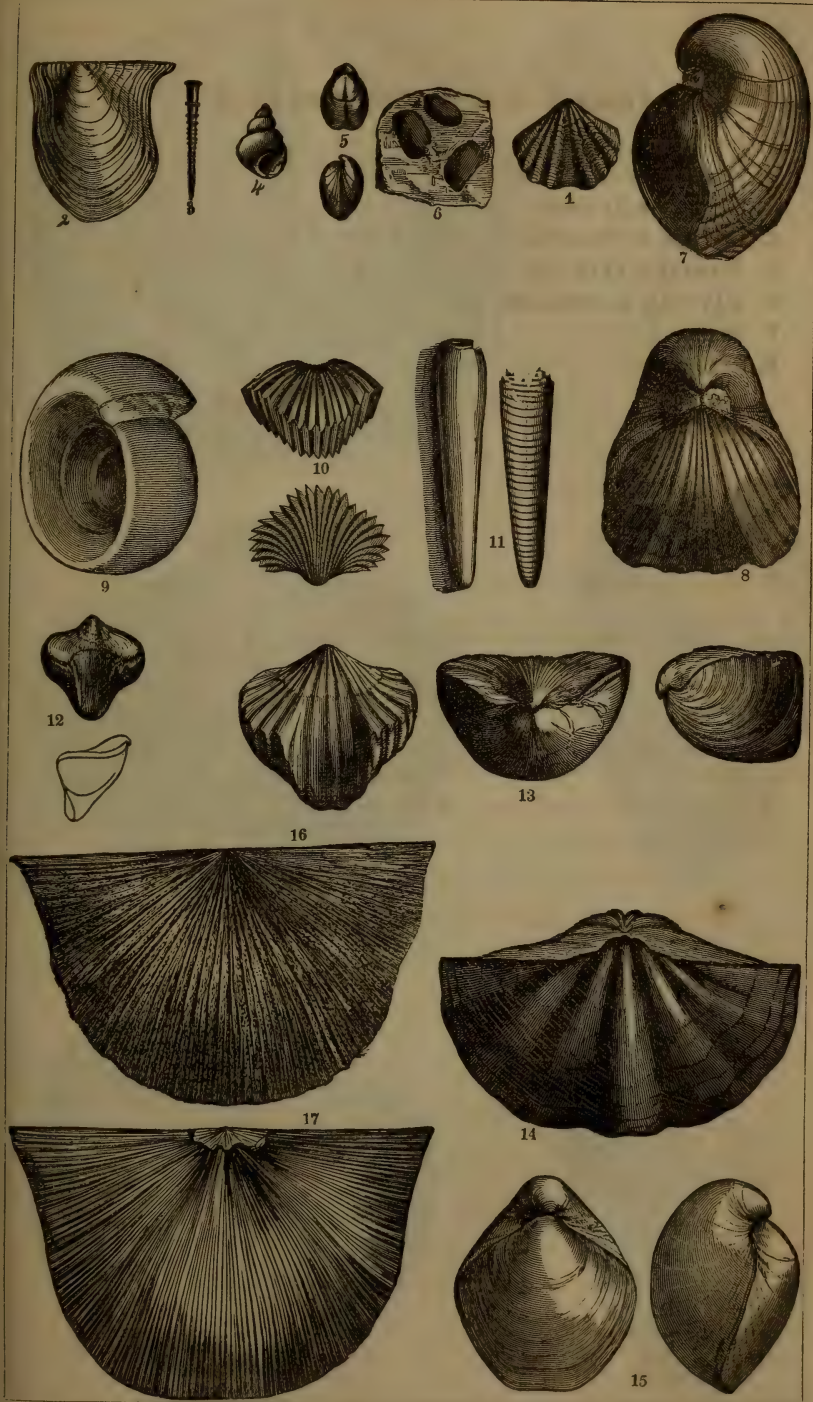
B. *From the Pentamerus limestone* (p. 58).

7. PENTAMERUS GALEATUS.
8. Same, front view.
9. EUOMPHALUS PROFUNDUS.
10. ATRYPA LACUNOSA.
11. LEPOCRINITES GEBHARDI.

C. *From the Catskill shaly limestone* (p. 58).

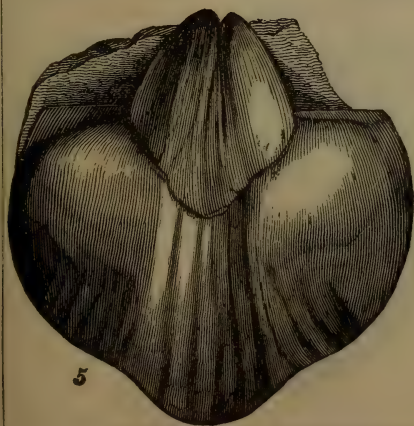
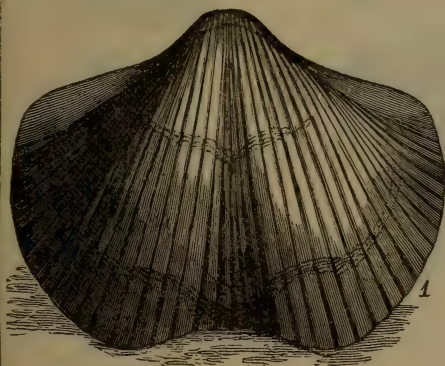
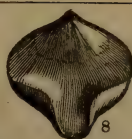
12. ATRYPA SINGULARIS, side and rear views.
13. EATONIA MEDIALIS.
14. SPIRIFER MACROPLEURA.
15. MERISTELLA LÆVIS, front and side views.
16. STROPHOMENA PUNCTULIFERA.
17. STROPHOMENA RADIATA.

* This group is made up of the three limestones above specified.



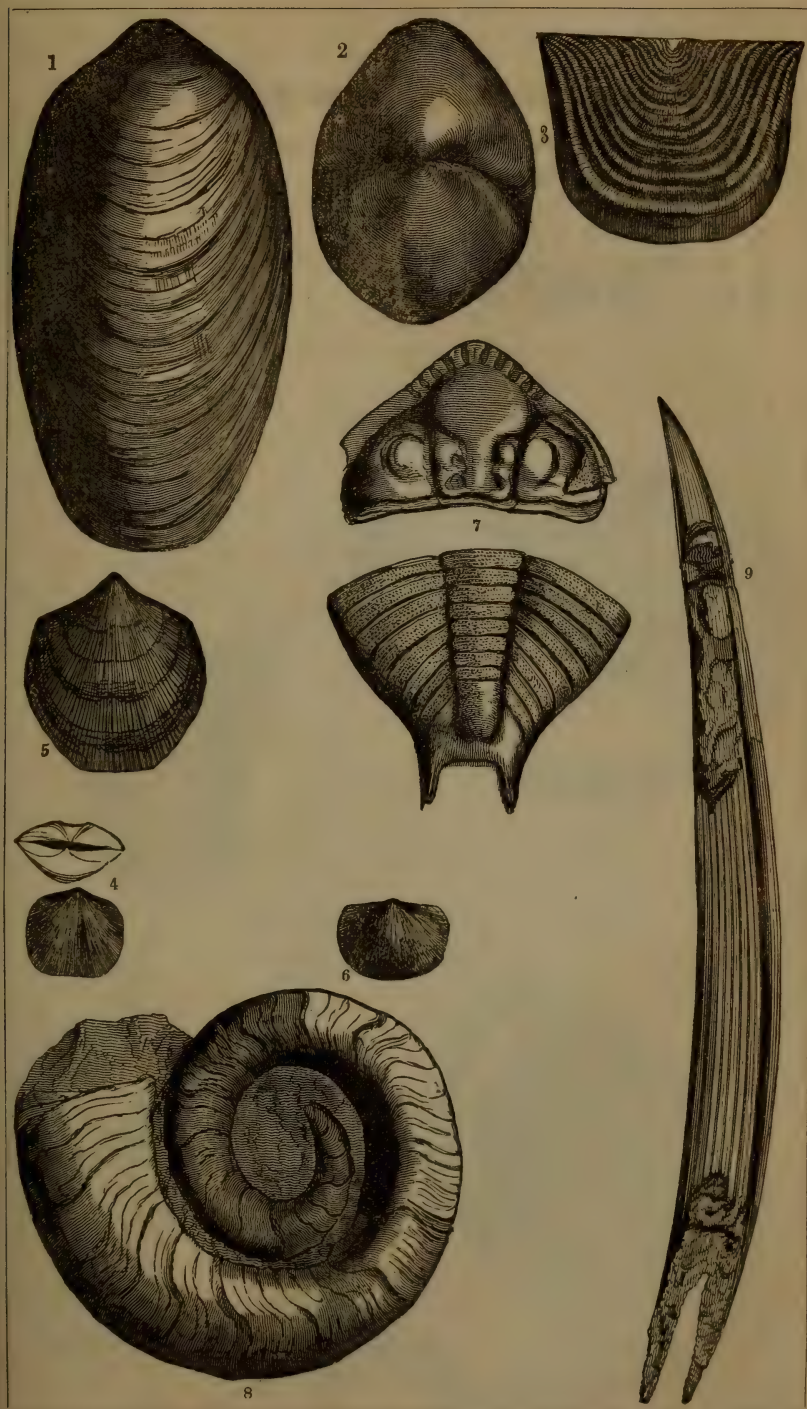
Fossils of the Oriskany sandstone (p. 59).

1. *SPIRIFER ARENOSA*.
2. *RENSSELÆRIA OVOIDES*.
3. Same, profile view.
4. *ORTHIS HIPPARIONYX*, internal cast of upper valve.
5. *SPIRIFER ARENOSA*, do do of lower valve.
6. *EATONIA PECULIARIS*, side.
7. Same, hinge.
8. Same, front.



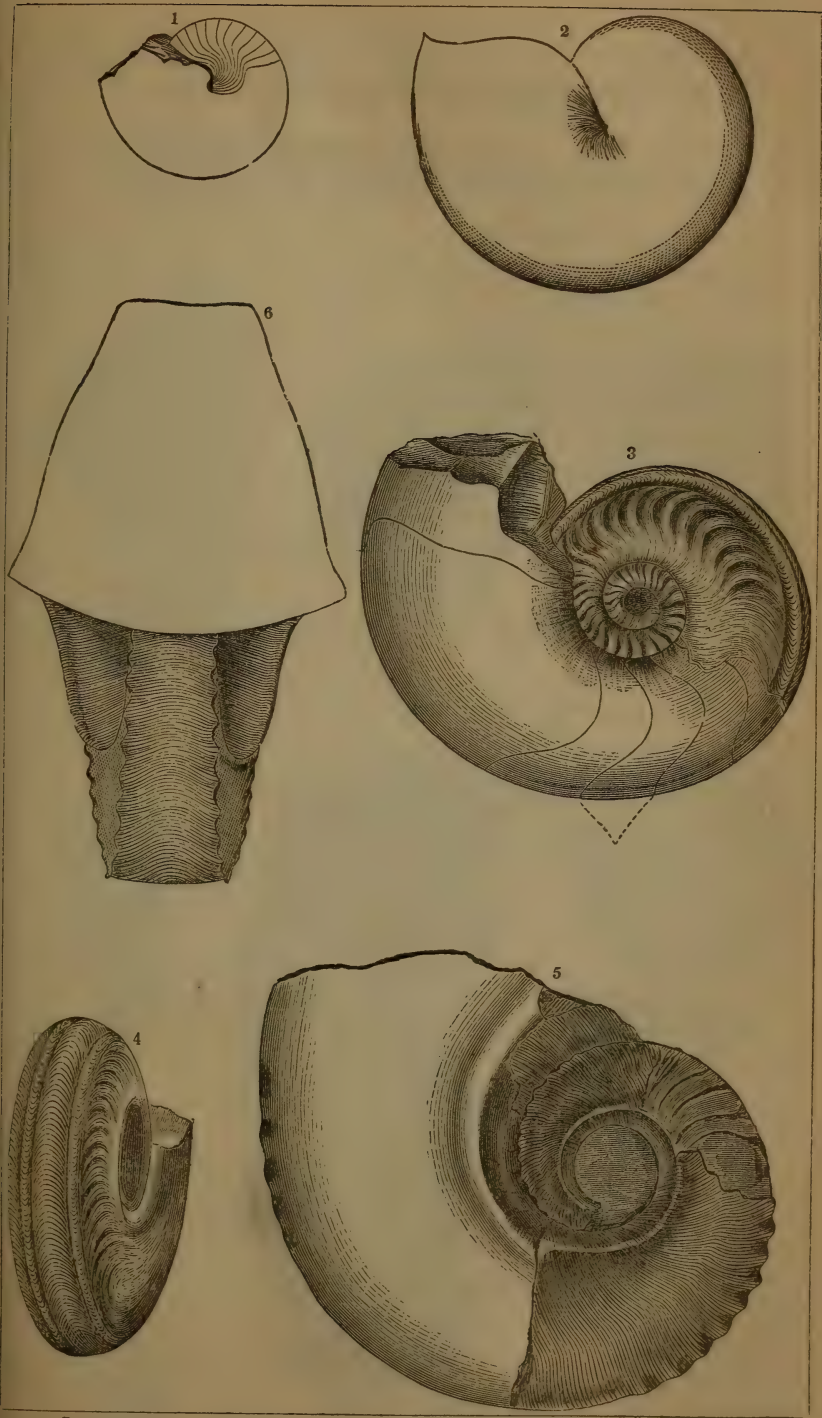
Fossils of the Upper Helderberg group.

1. RENSSSELÆRIA (MEGANTERIS) ELONGATUS (wrongly called *M. ovoides* on p. 61).
2. Same, end view.
3. STROPHOMENA UNDULATA.
4. ORTHIS LENTICULARIS, lower valve and front outline.
5. ATRYPA RETICULARIS.
6. STROPHOMENA LINEATA, enlarged.
7. DALMANIA SELENURUS : separate fragments, head and tail.
8. CYRTOCERAS UNDULATUS.
9. ICHTHYODORULITE, a defensive fin-bone of a devonian fish.



Fossils of the limestone layers in the Marcellus shale.

1. GONIATITES DISCOIDEUS, showing the septa.
2. The same, showing the exterior form.
3. GONIATITES EXPANSUS.
4. Same, back view (p. 63).
5. NAUTILUS ORNATUS.
6. Same, back view (p. 64).



Fossils of the Marcellus shale.

1. ORTHOCERAS SUBULATUM.
2. STROPHOMENA SETIGERA.
3. S. MUCRONATA.
4. S. PUSTULOSA.
5. AVICULA MUCRONATA.
6. A. LÆVIS.
7. A. EQUILATERA.
8. ORTHIS NUCLEUS.
9. DISCINA MINUTA.
10. TENTACULITES FISSURELLA.
11. ATRYPA LIMITARIS.

Fossils of the Hamilton group (p. 67).

CORALS.

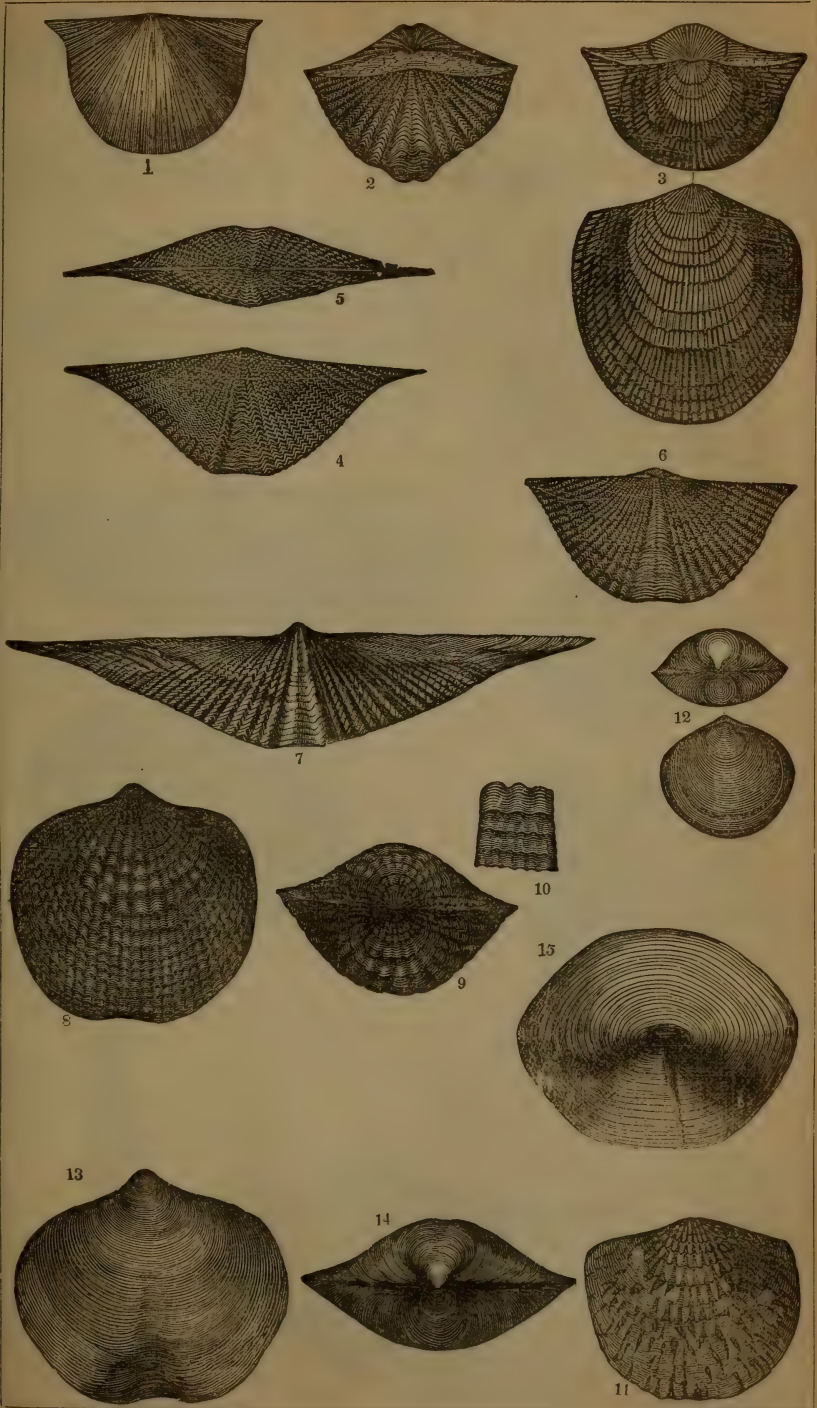
12. STROMBODES SIMPLEX (a small parasitic coral or bryozoon is attached on it).
13. Same, end or cup.
14. STROMBODES HELIANTHOIDES.
15. S. DISTORTUS.
16. S. RECTUS.
17. CYSTIPHYLLUM CYLINDRICUM.
18. Same? with another kind of coral (AULOPORA) attached.



Shells of the Hamilton group.

BRACHIOPODA.

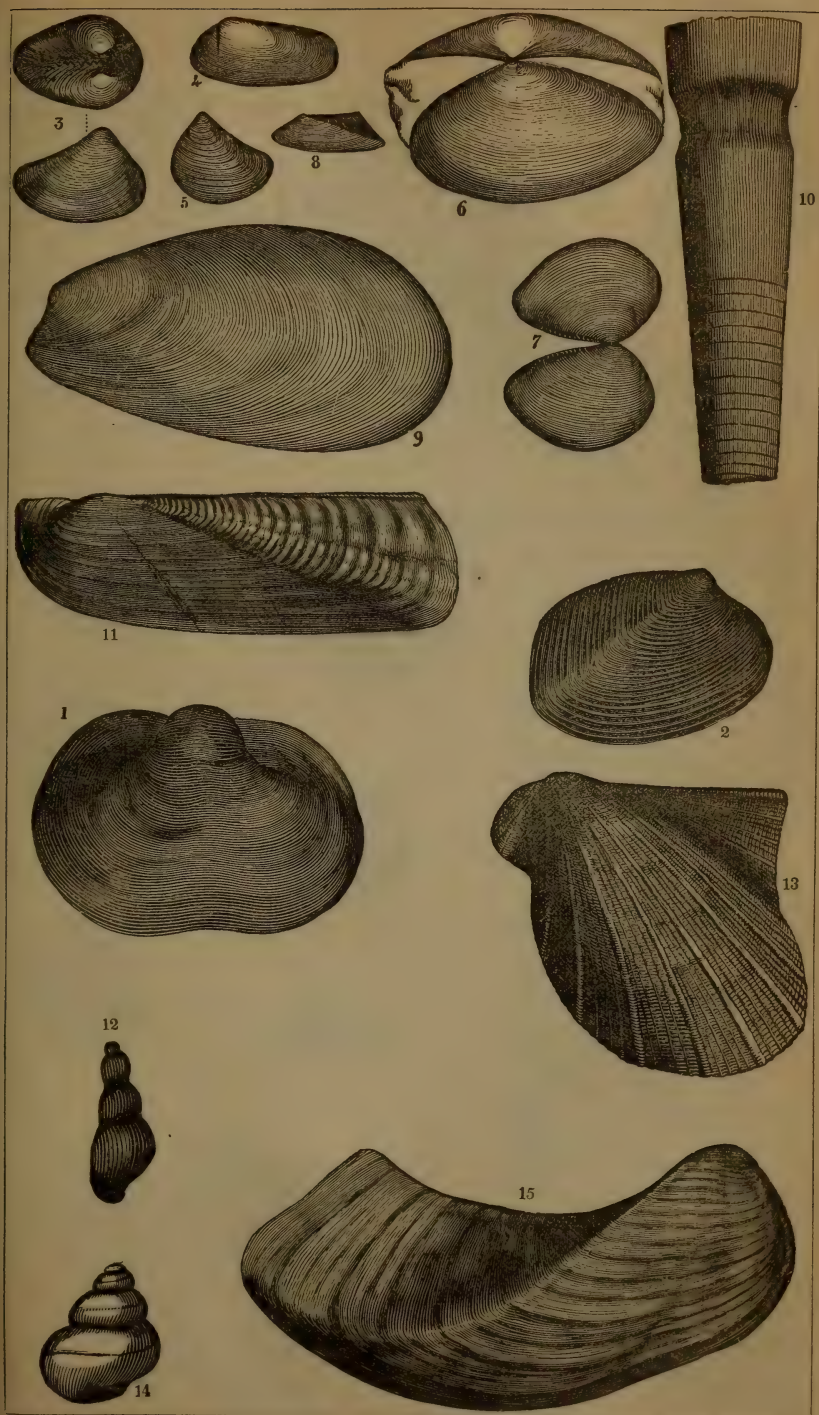
1. STROPHOMENA INEQUISTRIATA.
2. SPIRIFER ZIGZAG.
3. ATRYPA RETICULARIS (p. 67).
4. SPIRIFER MUCRONATUS, lower valve (p. 67).
5. Same, front view.
6. Same, shorter variety.
7. Same, very elongated variety.
8. ATRYPA ASPERA.
9. Same, front view.
10. Same, magnified portion of surface.
11. Same, with the spines still adhering in parts.
12. ATRYPA CONCINNA.
13. A. CONCENTRICA, lower valve (p. 67).
14. Same, front view.
15. DISCINA GRANDIS (p. 67).



Fossils of the Hamilton group.

SHELLS.

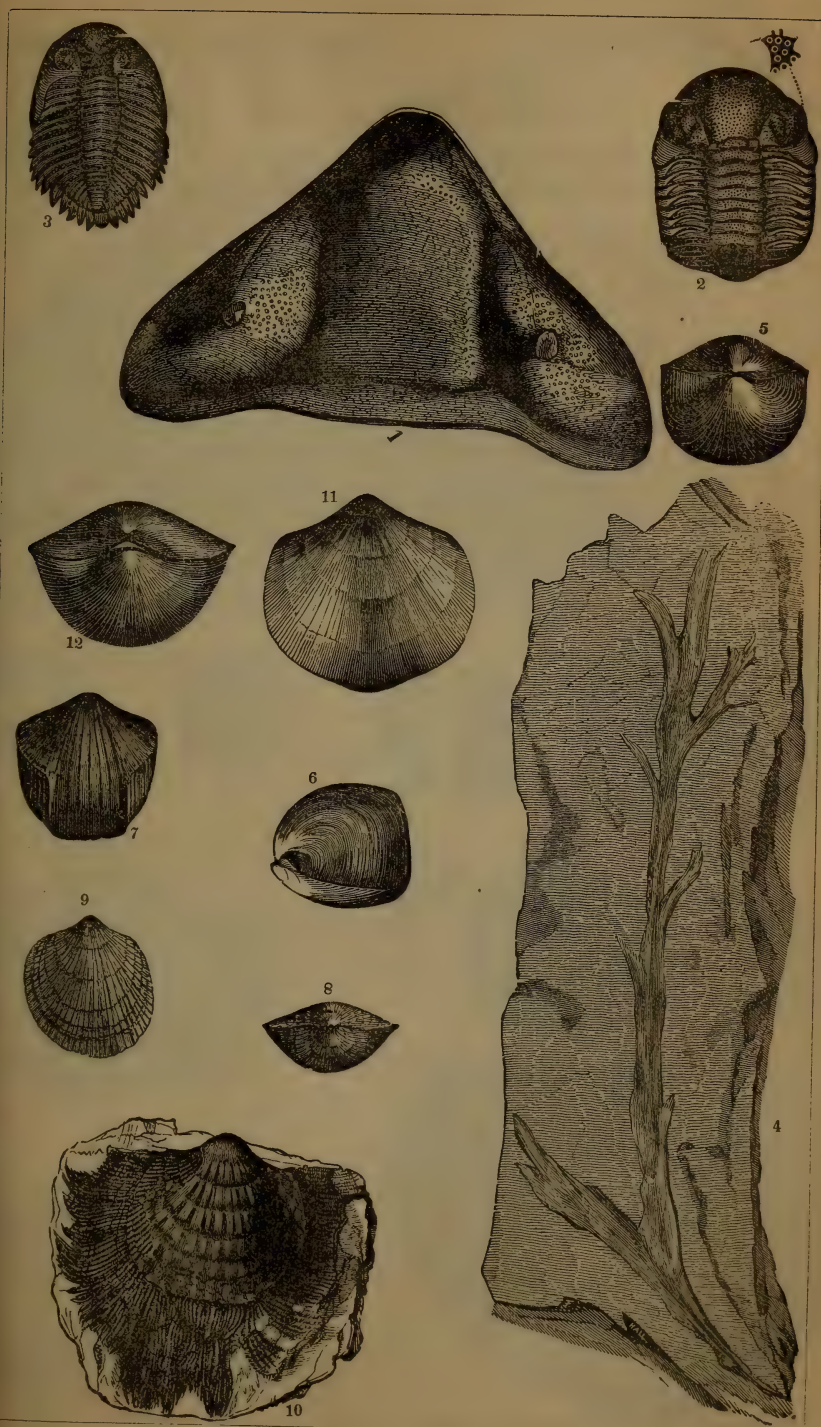
1. BELLEROPHON PATULUS.
2. MICRODON BELLASTRIATA.
3. CUCULLÆA OPIMA.
4. NUCULA OBLONGA (p. 67).
5. NUCULA LINEATA.
6. TELLINA OVATA.
7. NUCULA BELLATULA.
8. N. TRUNCATA.
9. MODIOLA CONCENTRICA.
10. ORTHOCERAS CONSTRICTUM.
11. ORTHONOTA UNDULATUM.
12. LOXONEMA NEXILIS.
13. AVICULA FLABELLA.
14. TURBO LINEATUS.
15. CYPRICARDITES RECURVA.



Fossils of the Hamilton group and Tully limestone.

1. Head of HOMALONOTUS DEKAYI.
2. PHACOPS BUFO, partly coiled or contracted. (A magnified representation of the lenses of the eye is given.)
3. DALMANIA CALLITELES.
4. Stem of plant, undescribed (p. 66).
(*The above are from the Hamilton group.*)
5. RHYNCHONELLA SUBCUBOIDES, front view (p. 68).
6. Same, side view.
7. Same, rear view.
8. ATRYPA LENTIFORMIS, front.
9. Same, lower valve.
10. ATRYPA AFFINIS (the fringe-like margin is the edge of the shell compressed).
11. ORTHIS RESUPINATA, lower valve.
12. Same, front view.

(5 to 12 are from the Tully limestone.)

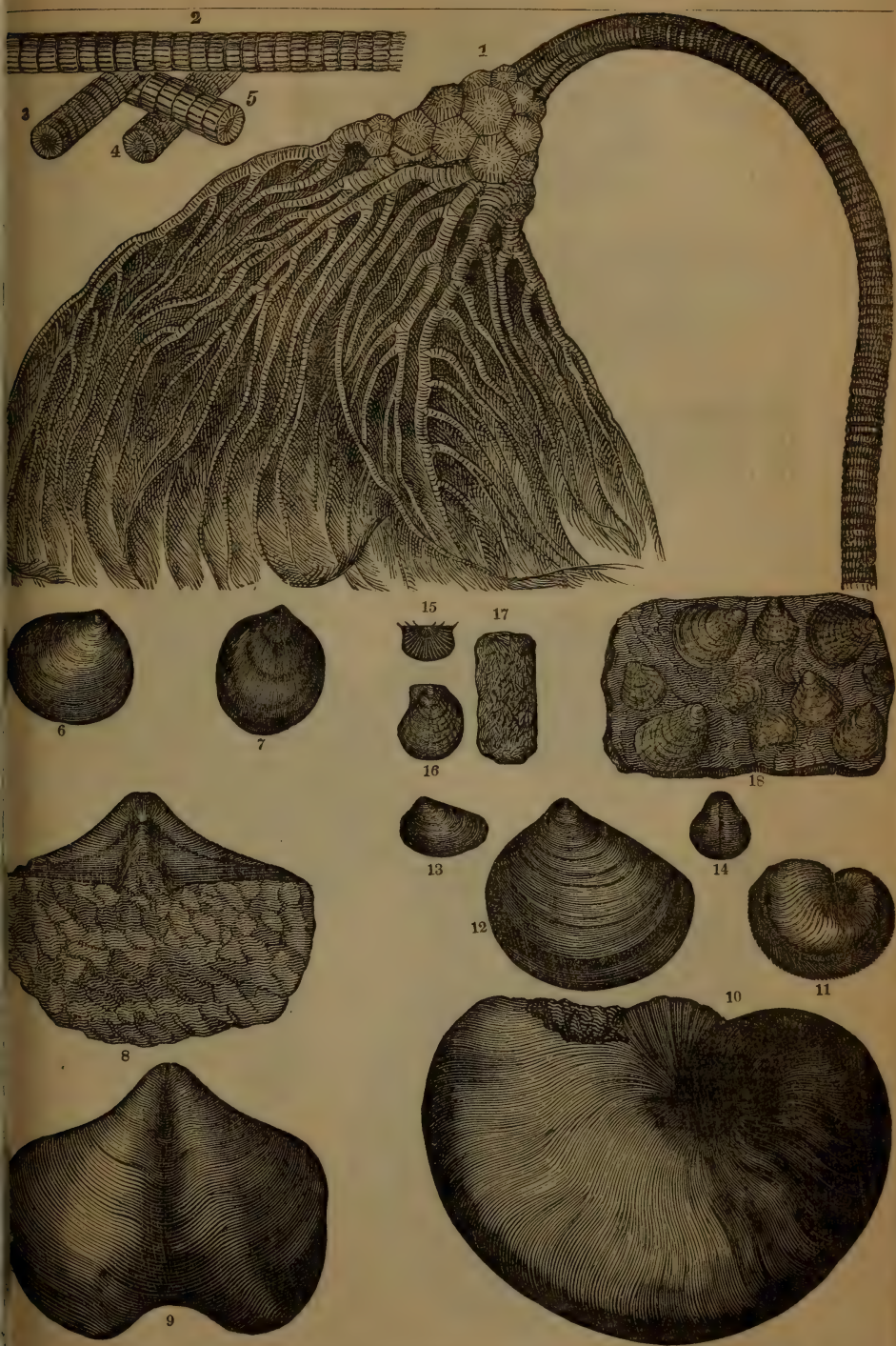


Fossils of the Portage group.

1. Crinoid : CYATHOCRINUS ORNATISSIMUS (p. 69, 47).
- 2, 3, 4, 5. Fragments of its stalk or column.
6. LUCINA RETUSA.
7. ORTHIS TENUISTRIATA.
8. SPIRIFER LÆVIS : beak, hinge, and triangular opening for the
byssus (p. 40).
9. Same, outside of lower valve.
10. GONIATITES SINUOSUS.
11. G. BICOSTATUS.
12. ASTARTE SUBTEXTILIS.
13. NUCULA LINEOLATA.
14. BELLEROPHON STRIATUS.

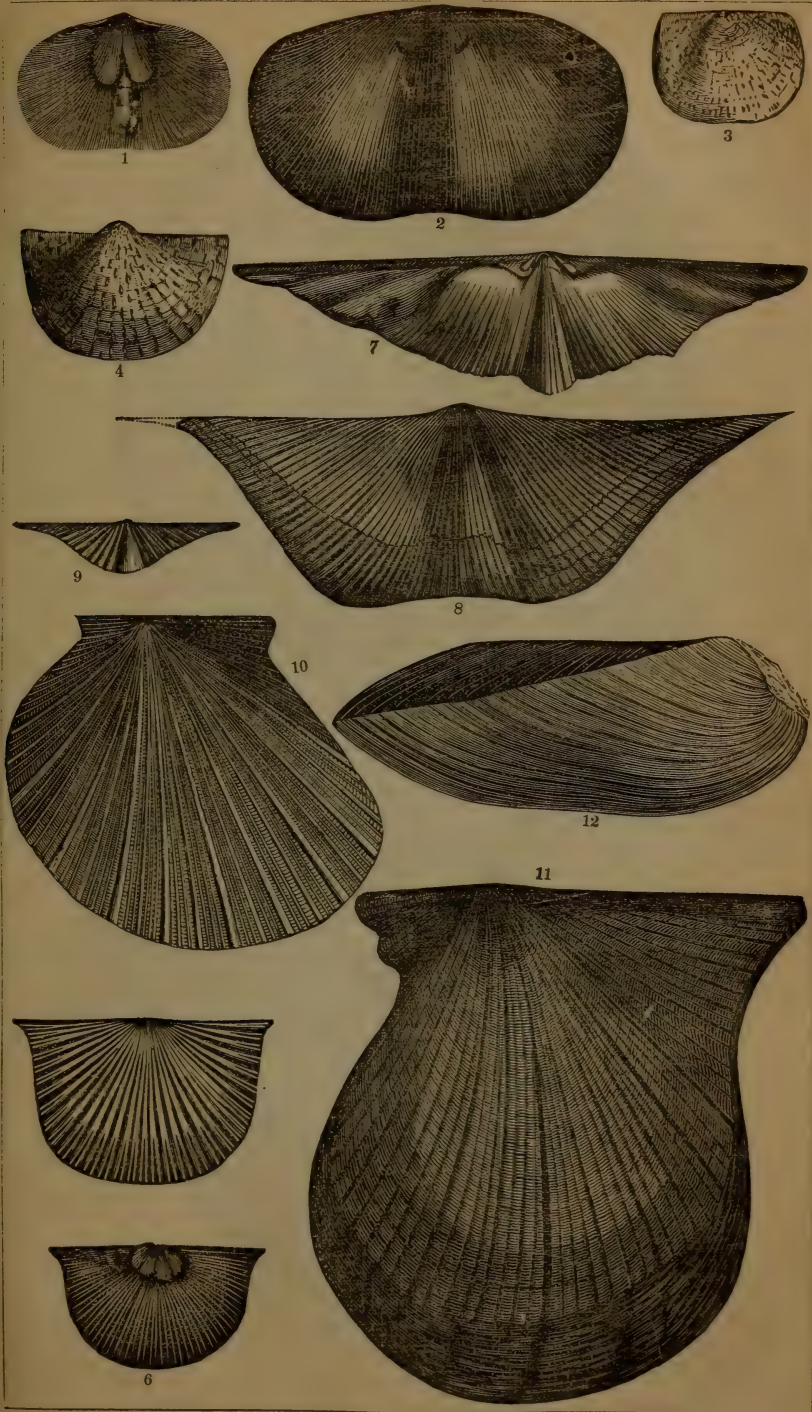
Fossils of the Genesee slate.

15. CHONETES SETIGERA.
16. AVICULA FRAGILIS.
17. TENTACULITES.
18. Fragment, with AVICULA FRAGILIS.



Fossils of the Chemung group.

1. ORTHIS INTERLINEATA?
2. O. CARINATA.
3. PRODUCTUS (STROPHOMENA) MEMBRANACEA.
4. Same, upper valve.
5. STROPHODONTA BIFURCATA.
6. S. INTERSTRIALIS?
7. SPIRIFER PROLATUS.
8. S. CUSPIDATUS.
9. S. ACUMINATUS. .
10. AVICULA TRICOSTATA.
11. A. PECTENIFORMIS.
12. CYPRICARDITES CHEMUNGENSIS.



Fossils of the Chemung group.

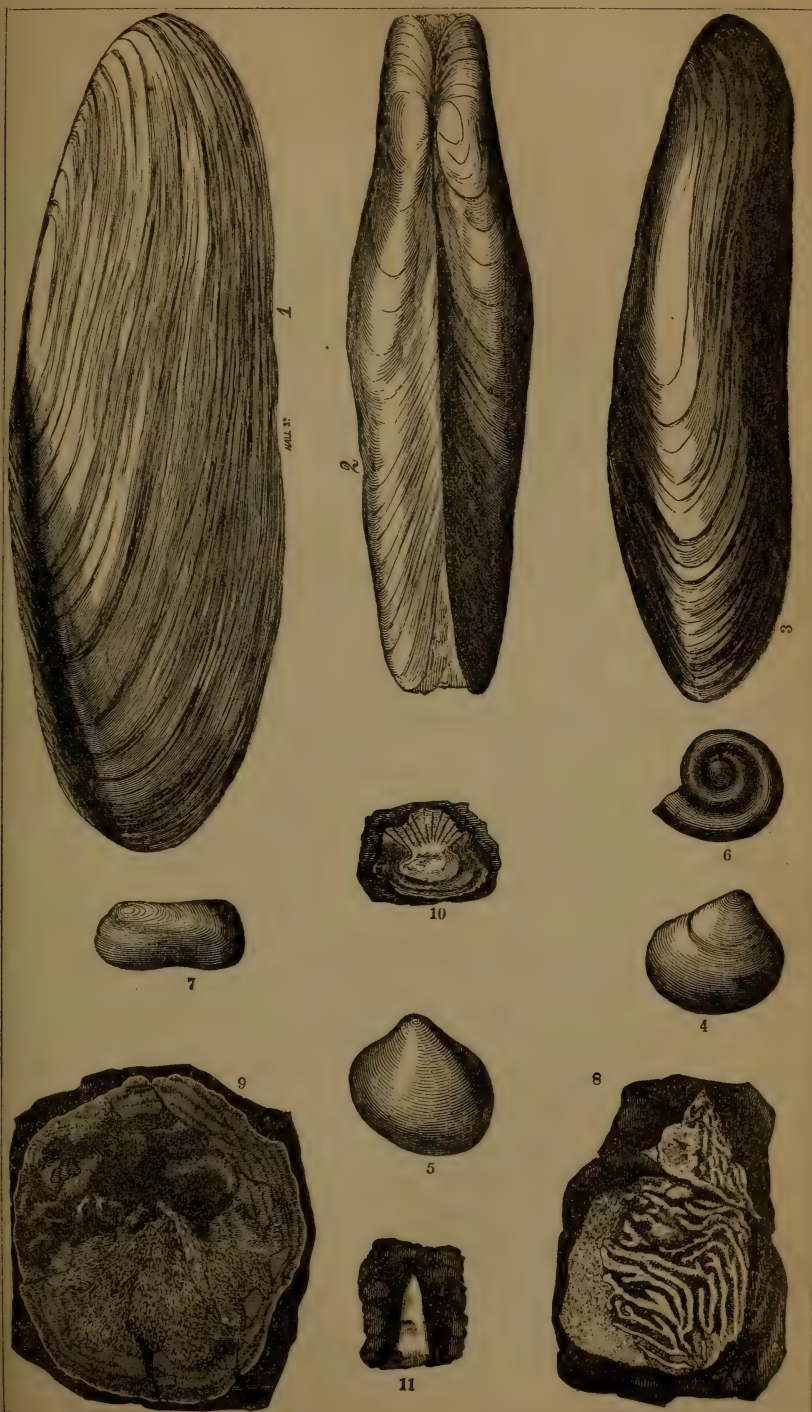
FERN.

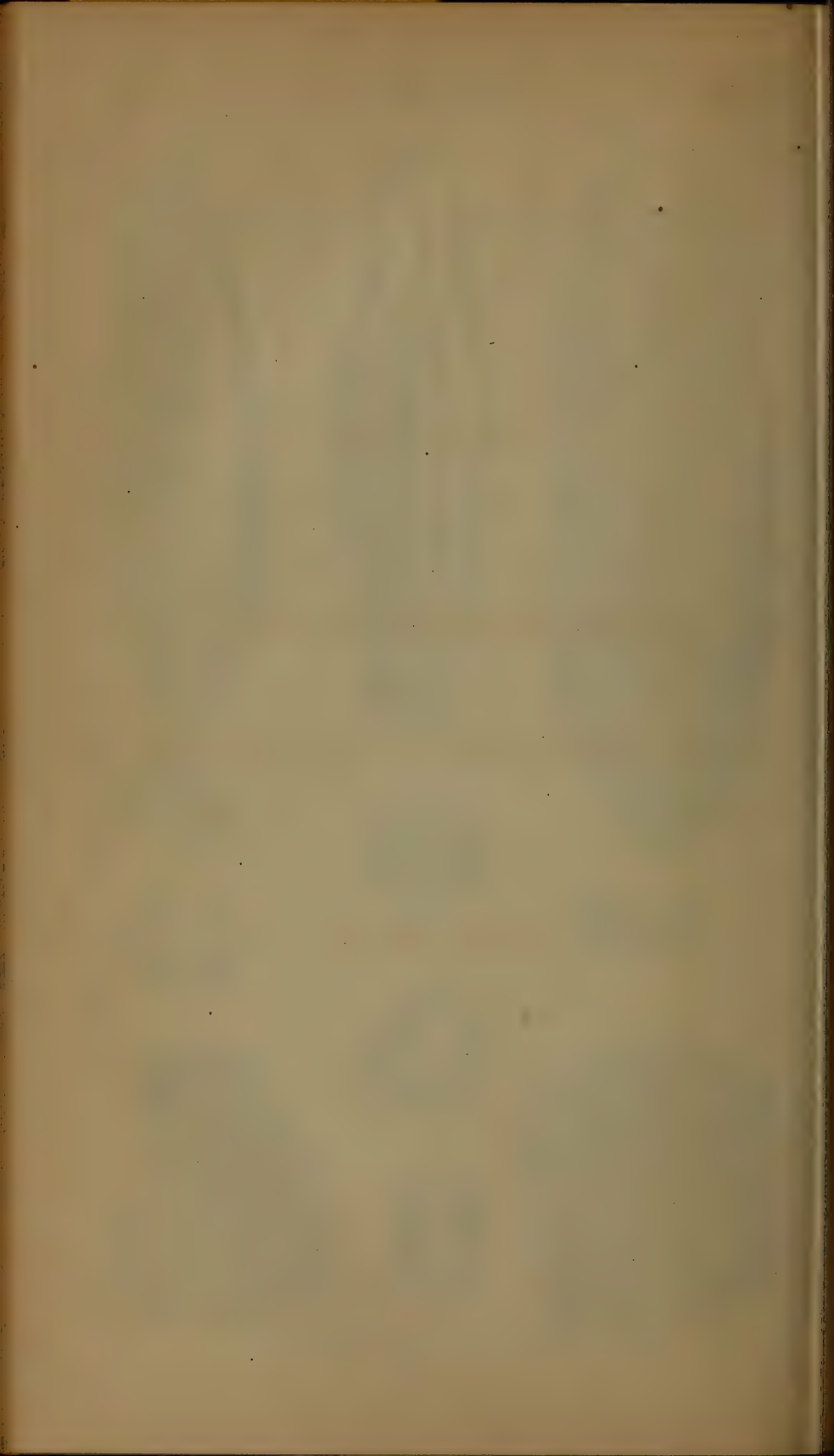
SPHENOPTERIS LAXUS (p. 76).



Fossils of the Catskill group and Carboniferous conglomerate.

1. MODIOLA? CATSKILLENSIS.
2. MODIOLA? ANGUSTA.
3. Same, back of shell.
4. CYPRICARDITES? RHOMBEA.
5. Same.
8. Scale of fish (HOLOPTYCHIUS).
- 9 Do. (HOLOPTYCHIUS TAYLORI).
10. Do. do.
11. Tooth of fish.
(*The above from the Catskill group, p. 70.*)
6. EUOMPHALUS DEPRESSUS.
7. CYPRICARDITES CONTRACTA.
(*From the Conglomerate, p. 71*)





(C.)

CONTRIBUTIONS
TO
PALÆONTOLOGY.

Being some of the Results of Investigations made during the years 1859 and 1860,

BY
JAMES HALL.



OBSERVATIONS

Upon some new and other species of Fossils, from the rocks of Hudson-river group of Ohio and the Western States ; with descriptions.

[Continued from page 121 of the 13th Annual Report of the Regents of the University on the State Collections of Natural History.]

ORTHIS JAMESI (new species).

SHELL transversely semielliptical : hinge-line equalling, or a little greater than the width of the shell below ; the length a little more than half the width, and sometimes nearly two-thirds. Cardinal extremities compressed, and usually truncate or rounded. Dorsal valve convex, becoming gibbous, with a shallow often scarcely defined sinuosity in the middle : hinge-line slightly rising towards the beak, which is not incurved ; area narrow, but distinctly defined : foramen broad, and showing a narrow process which rises as high as the plane of the area. Ventral valve much elevated towards the beak ; the sides somewhat flattened, and the middle sometimes a little depressed towards the front ; the beak slightly arcuate, and the wide area nearly flat and moderately inclined backwards : foramen large, and extending to the apex.

SURFACE marked by twenty to twenty-four simple, strongly rounded, slightly arching primary striæ, which, by intercalations of secondary striæ, are often increased to twice that number on the margin.

Often the striæ are simple throughout, and, when well preserved, are always marked by fine thread-like concentric striæ, and towards the margin by a few lamellæ of growth.

This species, in general form, resembles *O. plicatella* ; but the area is much larger, and extends to the salient cardinal extremities ; while in

that species the extremities are usually rounded, and the shell a little rounded below.

Geological formation and locality. In the calcareous shales of the age of the Hudson-river group : near Cincinnati, Ohio. Collection of S. T. CARLY.

ORTHIS CLYTIE (n. s.).

SHELL larger than medium size, semielliptical, the length and breadth about as 4 to 5, or as 7 to 9, plano-convex or concavo-convex : hinge-line less than the greatest width of the shell ; cardinal extremities rounded. Dorsal valve flat or concave, with a longitudinal depression along the centre ; cardinal area linear, not incurved. Ventral valve moderately convex, sometimes more elevated or subangular along the middle towards the beak : area narrow, longitudinally striated, and extending little more than two-thirds the width of the shell ; foramen wide ; beak scarcely incurved. Muscular impression deeply divided ; in the middle of the inner division of each lobe, more deeply impressed, and extending two-thirds the length of the shell from the beak ; the outer portions flabellate, and margined by an elevated ridge ; the whole interior surface granulose, and the visceral area margined by a thickened elevation, which becomes, in old shells, a defined ridge. The striæ are shown along the inner margin.

In the dorsal valve the inner surface is finely striato-granulose, and outside of the submarginal ridge the striæ are stronger. The muscular impression is comparatively small, distinctly circumscribed, with central ridge, thin prominent cardinal process, and strongly defined dental fossets and corresponding crural processes.

The surface is finely and somewhat evenly striated ; the striæ on the ventral valve often more prominent than those on the dorsal valve.

This is a very well-marked and distinct species, which, in the deeply bifid muscular impression, differs from any other species known to me in this group of strata ; while in other features, it is readily distinguished.

Geological formation and locality. In strata of the age of the Hudson-river group; in Kentucky. Received from DAVID CHRISTY, Esq., of Cincinnati.

I have under consideration several species of *ORTHIS* from the shales of the Hudson-river group, which have been placed in my hands by Mr. CARLY of Cincinnati. Two of these are of the type of *O. occidentalis* and *O. sinuata*, etc.; and since the entire characters and degree of variation of these forms have not been fully determined, I hesitate to designate other species until I have a larger collection for comparison. I take this occasion, however, to say to those palæontologists who have regarded the three species of this type described in Vol. I, Pal. N. Y., as one species, and identical with *O. porcata* of Europe, that in my collections may be found specimens of the type which can only be referred to three distinct species; for the illustration of which, I hope to procure the separated valves to show the interior markings. In the mean time, I shall feel under obligations to any persons who can aid me in obtaining other specimens for the more satisfactory determination of this question.

CYCLONEMA VENTRICOSA (H. S.).

SHELL turbinate; height and greatest breadth about equal.

Spire consisting of about four volutions, which increase rapidly in size, the last one extremely ventricose; the lower side somewhat flattened near the upper part of the columella, which is straight and thickened. Aperture as wide as high, transversely semioval.

SURFACE marked by strong revolving striæ, about three of which on the upper volutions, and four or more on the last volution, become more strongly developed, and give a subcarinate form to the volutions; between these, the striæ are fewer and unequal. The revolving striæ are crossed by finer lines of growth, which on the upper volutions are nearly uniform, but towards the aperture become crowded, unequal and sublamellose.

This species resembles the *Pleurotomaria* (*Cyclonema*) *percarinata* of the Trenton limestone, but is more ventricose, with different surface

markings. It is large, more ventricose, and very differently marked from *C. bilix*, which occurs in the same formation.

Geological formation and locality. In the shales of the Hudson-river group : in Ohio and Tennessee.

CYCLONEMA BILIX (CONRAD).

Since the preceding description was written, Mr. S. T. CARLY of Cincinnati has placed in my hands a series of specimens of the above species; or, more properly, specimens which are usually referred to *C. bilix*. These were collected at various altitudes in the shaly limestone from the river level at Cincinnati, to beds which are 700 feet above that horizon. Although I am able to indicate differences in the individuals, and those from the greatest altitude present some marked peculiarities, still I am at this time unable to point out characters which can be relied upon for specific distinction. More extensive collections may prove that there are three species within the vertical range of 700 feet. A careful collection of these forms, whether they may prove to be of distinct species or only varieties, will be of great interest in showing the influence of time, and the gradual changes which the ocean bed may have undergone during the long period of quiet accumulation of seven hundred feet of fine sediments, every foot of which is filled with the remains of these former creations. We are already aware that in the upper beds of this extensive group, there is an accession of several species of Brachiopoda which are unknown in the lower beds.

NOTE ON THE GENERA BELLEROPHON, BUCANIA, CARINAROPSIS, AND CYRTOLITES.

(See Vol. I, Pal. N. York.)

PICTET, in his very valuable work "*Traité de Paléontologie*," has united, under the Genus BELLEROPHON (Montfort), the typical form of that genus, together with BUCANIA, CARINAROPSIS and CYRTOLITES. It is true that the principal distinctive feature of the *Bucania* is the open umbilicus, showing the volutions together with an exterior carina along the dorsal line, corresponding to a channel on the inner side; and the lip terminating in a deep sinuosity, and usually abruptly expanded; while the lateral and posterior parts of the lip are often much thickened, as is shown in nearly all the good specimens of *B. troosti* of D'ORBIGNY, a lower silurian form from Tennessee. Since this type is well known, I shall not at present contend for the generic distinction, believing that it will ultimately be found a useful designation.

The Genus CARINAROPSIS was founded upon the external characters, presented by a few specimens. These are, the usually attenuated spire, the abruptly expanding body volution, and shallow cavity, giving the shell a patelloid aspect. To this may be added the character (perhaps not constant) of an attenuated carina upon the dorsum. The shells are usually thin.

The interior of the established species has not been determined, and I do not know whether or not they present differences from the ordinary *Bellerophon*.

Among some collections presented to me some time since by Prof. SAFFORD, State Geologist of Tennessee, and many others more recently received (Oct. 1860) from Mr. S. S. LYON of Jeffersonville, Indiana, are several specimens having the form and exterior character of those specimens referred to CARINAROPSIS. The outer or body whorl beyond the columella for nearly half a volution is extremely expanded, the first volutions contracted and forming a very inconsiderable proportion of the whole. In these specimens the cavity presents a kind of septum as in CREPI-

DULA, extending from the posterior side one-third the distance across the cavity. This septum is marked on the lower side by a strong carina, and is concave above; the margin a little thickened as if from the folding over of the shelly laminæ, and posteriorly spreading over the volution behind in a callosity, like many of the *BELLEROPHON*. This septum is a very peculiar feature, and, taken together with other characters, I conceive to be of sufficient importance to warrant the separation from *BELLEROPHON*. Should this prove to be identical with those which I have designated as *CARINAROPSIS*, that generic term will have precedence; but should this important character not be found in those forms, I propose for those now under consideration the generic name of *PHRAGMOSTOMA*, from the septum within the aperture.

CARINAROPSIS (PHRAGMOSTOMA) CYMBULA (n. s.).

VOLUTIONS about two, enrolled in the same plane, very abruptly expanding beyond the first volution, which is minute: width of the aperture more than twice as great as the depth of the cavity; length of the septum about half as great as the width, longitudinally carinate on the lower side and plane concave above, the posterior lip not reflected over the spire. The dorsum is marked with an elevated band, scarcely carinate, having sometimes a faint groove in the centre and one on each side. Striæ of growth well defined, indicating a deep sinus at the anterior margin.

This species is sometimes distorted and the small spire broken or eroded, when it very much resembles a *CREPIDULA*. One specimen, when entire, has had an aperture at least an inch and a half in diameter.

Geological formation and locality. In strata associated with *Cyrtolites ornatus*, and other fossils of the Hudson-river group, on the Ohio river below Louisville. From Mr. S. S. LYON.

CARINAROPSIS (PHRAGMOSTOMA) CUNULÆ (n. s.).

VOLUTIONS two or more, the last one abruptly expanding, the greatest expansion being two or three times as great as the

depth of the cavity : depth of cavity, directly below the anterior margin of the septum, about equal to half the width of the septum ; septum sharply carinate on the lower side, with a slight continuation of the same feature on the upper side, which is concave ; posterior lip reflected, often somewhat abruptly truncated in the middle behind, and extending over the back of the volution. Dorsum angular, not distinctly carinated behind, and gradually flattening towards the anterior margin, which is deeply sinuate. Surface finely striate in the direction of the lines of growth.

This species differs from the preceding in having the first volution and the first part of the second volution proportionally larger, the lip more abruptly deflected ; while the carination of the lower side of the septum marks the anterior edge, and dies out upon the upper surface. The exterior striæ are less lamellose, and the cavity of the outer volution somewhat deeper.

In some specimens of this species, the aperture has been from three-fourths of an inch to an inch in diameter.

Geological formation and locality. In strata of the age of the Hudson-river group, near Nashville, Ten. From Prof. SAFFORD.

Related apparently to the forms just noticed, but still farther removed from the true *BELLEROPHON*, are those shells which have sometimes been referred to *CLIO* or *CLEODORA*. These forms, so far as I know, are all from the Lower Silurian rocks, occurring in the Trenton limestone and associated strata in New-York, Canada and the Western States. These shells have usually a somewhat triangular form, with a rounded sinuate base, or more rarely a subcircular outline. From their external form and appearance, as they usually adhere to the stone by the inner or aperture side, one might fancy them to be expanded carinate *Bellerophontides* with small apices, which had been vertically compressed. There is usually a strong sharp carination on the back, extending from the apex to the aperture. The apex is incurved and pointed, but I have not been able to discover any volutions.

The shell is composed of two plates ; the inner one a plane concave expansion extending the entire width of the shell, and, joining the lateral margins of the outer or carinate portion,

extending usually more than half the entire length, and leaving a shallow cavity between the outer shell and the partition which sometimes extends nearly to the margins on either side, but is occasionally contracted by the junction of the septum with the outer shell at a distance from the margin.

I conceive that these forms are quite distinct from the *BELLEROPHON*; while, in the character and substance of the shell, I can see no reason to unite them with the *CLEODORA*. I therefore prefer for them the generic name of *CLIODERMA*.

CLIODERMA (new genus).

SHELLS more or less arcuate, somewhat calyptraeform, subtriangular or oval, with the apex marginal and incurved in the same plane, not known to be convolute, carinate upon the back, abruptly and broadly expanding, with the anterior margin sinuate; interior concave, much wider than deep. A concave shelly partition covers the posterior half or more of the cavity. Substance of the shell of moderate thickness, lamellose, with surface lamellose-striate parallel to the exterior margins or lines of growth. Shells heretofore referred to *CLEODORA*, *SPIRIFER*, &c.

CLIODERMA SAFFORDI (n. s.).

SHELL arcuate; apex much incurved: exterior form ovate-triangular; the sides, from the apex to the middle, somewhat straight or slightly concave, rounded below, with a deep sinuosity in front. Dorsum strongly carinate; the substance of the shell being bent abruptly outward, so that the carination affects the form of the internal cavity. Shell-partition extending from the apex two-thirds the length of the shell, regularly concave on the exterior side, and without apparent carina on the lower side. Surface strongly lamellose-striate. Width about one inch and a half; nearly the same length.

Geological formation and locality. In Lower Silurian strata: Lebanon, Tenn. From Prof. J. M. SAFFORD.

CLIODERMA CANALICULATA (n. s.).

SHELL subovate, triangular, subarcuate; the sides nearly straight, or sometimes a little concave from the apex to the middle of the shell or below: apex moderately incurved. Dorsum abruptly and strongly carinate from the apex; the carina gradually expanding towards the front, which is deeply sinuate: ventral partition extending more than halfway from the apex to the front. Interior cavity shallow, modified by the form of the carina. Surface marked by flattened lamellose striæ, which are parallel to the margin and abruptly arching backwards on the carina.

In the best preserved specimens there is a shallow groove or depression parallel to the lateral margins, and apparently along the line of junction between the outer shell and the partition; but as none of the specimens are entire, the relations of this feature are not fully determined.

CLIODERMA UNDULATA (n. s.).

SHELL subcircular or broadly subelliptical, moderately and equally convex; length and width about as eleven to twelve; margin curved from the apex, and broadly rounded in front; apex short, and but moderately incurved; central carina unknown; the ventral partition extending more than half way from the apex to the front of the shell, but apparently uniting with the shell considerably within the lateral margins; visceral cavity very shallow. Surface marked by strong concentric undulations, with finer parallel striæ.

This species is distinguished from the two preceding by its nearly orbicular form, little extension of apex, rounded postero-lateral margins, and broad undulations of surface.

Geological formation and locality. In Trenton limestone: at Watertown, N. Y.

CLIODERMA ANATIFORMIS.

Tellinomya anatiformis : Pal. New York, Vol. I, pa. 154, pl. 34, f. 7.

This specimen is essentially a cast, with little of the shell remaining, and has the appearance of a bivalve shell. The inequilateral character is due to distortion from pressure, and partly to the imperfect separation of the specimen from the adhering rock. The divergent grooves are apparently caused by the thickening at the junction of the ventral partition with the outer shell. The species is extremely broad, and the postero-lateral margins are much expanded. A small portion of the shell towards the apex shows a sharp dorsal carina.

Geological formation and locality. In Trenton limestone : Watertown, N. Y.

CLIODERMA EXPANSA.

Delthyris expansus : EMMONS, Geol. Report Second District, p. 397, f. 2.

This fossil belongs to the Genus CLIODERMA, having a great lateral expansion and a very strong dorsal carina.

I have before me an imperfect specimen apparently of this species, which has a length of more than an inch and three-fourths on the carina.

Geological formation and locality. Same as the preceding.

CLIODERMA ATTENUATA.

Clioderma attenuata : Geol. Report of Wisconsin.

This species, of the Trenton limestone in Wisconsin, is ovate-triangular in form, the dorsum abruptly and prominently carinate, the cavity very shallow, and the apex attenuate.

The casts of this species show a feature which is apparently of generic importance. The apex of the cast is trifold, from two parallel short vertical septa which divide this portion of the shell into three divisions for a short distance below the summit.

This species resembles the *C. canaliculata* in form, but has no depressions of the shell parallel to the sides, and the surface is apparently less distinctly striated.

Geological formation and locality. In Trenton limestone of Wisconsin.

DESCRIPTIONS

Of New Species of Fossils from the Upper Helderberg, Hamilton and Chemung groups; with observations upon previously described species.

[Continued from page 94 of the preceding Report.]

PRODUCTUS DUMOSUS (n. s.).

SHELL subovoid, arcuate. Ventral valve broadly gibbous, with beak incurved. Surface marked by strong radiating ridges, which gradually become stronger, and terminate abruptly in long tubular spines rising almost vertically from the surface: interstitial ridges of the same character mark the surface in successive ranges, so as to give a tolerably regular series of spines, of which there are as many as ten ranges. The surface is otherwise marked by fine concentric undulating striæ. Dorsal valve unknown.

This species has a length of one inch, with a width of three-fourths of an inch: the height or depth of the ventral valve is more than half an inch. It is quite distinct from any other species known to me in strata of this age.

Geological formation and locality. In shales of the Hamilton group: near Canandaigua lake.

ATHYRIS ANGELICA (n. s.).

SHELL ovoid, gibbous, elongate; width and length about as six to seven, or twelve to fifteen. Ventral valve most convex above the middle, marked throughout its length by a strongly defined and abruptly depressed mesial sinus, which becomes somewhat suddenly expanded on the lower third of the shell: sides of the shell gibbous, and abruptly curving to the margins; beak extended and incurved. Dorsal valve much shorter

than the opposite, gibbous, transverse, or as wide as long: mesial fold usually not defined above the lower third of the shell; its place above this being indicated by the straightness of the striæ and sometimes by a little greater gibbosity: hinge line short; the cardinal extremities rounded.

SURFACE marked by fine regular lamellose striæ, the edges of which are sometimes projected.

The distinguishing feature of this species, when compared with the three species known in the Hamilton group, is the great inequality of the valves. The band-like or lamellose striæ are not unlike the *A. vittata*, but the elongate ventral valve and angular sinus are very distinctive features. Internal casts of the species are strongly marked by the generic characters of *ATHYRIS*.

Geological formation and locality. In the Chemung group: Philipsburgh, Alleghany county, and elsewhere.

MERISTELLA ELISSA (n. s.).

SHELL subovoid; length and width of the body of the shell subequal, with a linguiform extension in front. Ventral valve gibbous and extremely arcuate, the umbo much elevated, and the beak incurved over the dorsal valve: the greatest gibbosity of the valve is a little below the beak of the dorsal valve; the base extended in front, with scarcely a sinus. Dorsal valve depressed-convex below the middle, a little gibbous above, broadly expanded laterally, and extended in front into a broad linguiform process.

SURFACE marked by fine concentric striæ, with stronger lamellose elevations at intervals, and obscure radiating striæ crossing these.

The specimen described has a length of one inch and eight-tenths, and, below the beak of the ventral valve, is about one inch and four-tenths; while the greatest width across the middle of the shell is more than one inch and five-tenths. The width of the linguiform process, in the middle of its extension, is about seven-tenths of an inch.

This species is distinguished from *M. nasuta* of CONRAD by its larger size, comparative flatness of dorsal valve, and broad extension in front; while in that species it is narrow, and more incurved and elevated in front.

Geological formation and locality. In the Schoharie grit: Helderberg mountains.

TREMATOSPIRA HIRSUTA.

Atrypa hirsuta : HALL, Tenth Annual Report of the Regents, p. 123.

This species, which I referred to the Genus *ATRYPA* on account of its general form and finely plicated surface, proves to belong to the Genus *TREMATOSPIRA*; the interior showing spiral appendages, as in the already described species of that genus. This then makes two species of the genus in the Hamilton group.

The *Atrypa uniangulata* of CONRAD has heretofore remained without the means of determining its structure; but during the present year, 1860, I have, through the kindness of Mr. S. S. LYON, been furnished with the separated valves of a well-preserved individual. The ventral valve bears essentially the character of *MERISTELLA*; while the cardinal process in the opposite valve is quite peculiar, rising above the level of the hinge-line, and approaching in form the corresponding part of *RHYNCHOSPIRA*, preserving at its base the commencement of the crural processes. Another specimen shows the presence of internal spires arranged as in *SPIRIFER*. These characters ally it with *TREMATOSPIRA*, but the structure of the shell is distinctly fibrous; and in this respect, and in the character of the muscular impression, it is more nearly allied to *MERISTELLA*; while in the cardinal process, muscular impression, and absence of lamellose structure, it differs from *ATHYRIS*.

Should farther examination prove these differences to be of generic importance, it may form a subgenus, for which I suggest the name *GONIOCELIA*.

In the preceding Report, I have described as *TEREBRATULA*, *T. lincklæni*, *T. rectirostra*, *T. lens*, and *T. planirostra*; suggesting at the same time that, since the internal structure is unknown, they may prove distinct from that genus. Even before the Report was published, I had satisfied myself that these forms were not true *TEREBRATULA*. The muscular impressions left upon the shell so nearly resemble those of *RENSSELÆRIA*, that it might be inferred from the cast that the species belonged to this genus. The exterior form and the extension of the beak give them a different aspect; and the absence of longitudinal or radiating striæ is likewise opposed to the known forms of that genus, with one exception.

These forms begin their existence in the Lower Helderberg group, where I know a single species, while the type becomes farther developed in the Upper Helderberg and Hamilton groups. For these fossils, I propose the name of *CRYPTONELLA*.

CRYPTONELLA (n. g.).

SHELLS equilateral, inequivalve, elongate, oval or ovoid; valves unequally convex, without median fold or sinus, or with this character moderately developed and principally towards the base of the shell. Ventral valve with beak extended or incurved, perforate; foramen terminal, the lower side formed by two small triangular deltidial pieces, or, in their absence, by the umbo of the opposite valve. Shell-structure finely punctate. Surface smooth, or with concentric striæ. Valves articulating by teeth and sockets, the dental lamellæ of the ventral valve extending downwards into the cavity of the shell. The muscular impressions in the dorsal valve are strongly marked above, and extend in two narrow separated impressions more than halfway to the front of the shell: the ventral sinus shows elongated muscular and vascular impressions.

The species of this genus are more elongate than MERISTA and MERISTELLA, and those now known are less distinctly marked by mesial fold and sinus; while the beak is more attenuate, often a little flattened, and rarely so closely incurved, as in the genera cited. The punctate structure of the shell is a distinguishing character.

CENTRONELLA IMPRESSA (n. s.).

SHELL subtriangularly ovoid, elongate; width and length about as seven to nine. Ventral valve convex, much elevated or subangular in the middle, with sides abruptly sloping to the margins, sinuate in front; beak extended and nearly straight. Dorsal valve slightly concave in the upper and middle portions, with usually an impressed line down the centre, abruptly inflected at the sides and less abruptly in the front, which is produced in a short process filling the sinus of the opposite valve. Surface finely striate concentrically, with faint remains of extremely fine radiating striæ, which are visible only under a lens: entire surface finely punctate.

The interior of the ventral valve shows two strong teeth much below the beak, with an elongate triangular foramen reach-

ing to the beak. The dorsal valve shows the dental sockets, with a strong thickened process which is deeply concave in the centre from which proceeds the crural processes.

I refer this to the Genus *CENTRONELLA* of BILLINGS, from its similarity to *C. glansfaga*; but it is to be regretted that the figures given to illustrate the generic character are extremely unsatisfactory.

Of the Lamellibranchiata of these groups, Mr. CONRAD has described about eighty species; and, including those described by others, we have nearly one hundred known species of these fossils. A considerable number of these remain to be identified. Several species of Gasteropoda have been described, among which are *Platyceras sulcatus*, *P. cirriformis*, *P. subundata*, *P. erecta*; *Platyostoma lineata*; *Pleurotomaria poulsoni*, *P. unisulcata*, *P. capillaria*, *P. sulcomarginata*, *P. rotunda*; *Bellerophon unisulcata*, *B. brevilineatus*.

The following species have not been described:

MURCHISONIA MAIA (n. s.).

SHELL elongate, turritiform: spire consisting of seven or eight (or more) volutions, which are regularly convex and gradually expanding from the apex, the last volution somewhat more ventricose than the preceding; aperture broadly oval, a little longer than wide, the columella extended below. Surface marked by transverse threadlike striæ, bent backwards on the centre of the volution by an elevated revolving band, which is tricarinate, with depressed lines between. Summit of the volutions canaliculate just below the suture; the striæ bending forward from the suture, and backward as they pass the limit of the groove. Length from one to two inches or more.

Geological formation. Upper Helderberg limestones.

MURCHISONIA LEDA (n. s.).

SHELL elongate, terete or subfusiform: volutions somewhat rapidly expanding, convex, the last two a little more expanded; aperture elliptical. Surface of volutions marked by elevated

threadlike striæ, which, on the upper side of the volution, are vertical, but turn gently backwards towards the centre, which is marked by a flat revolving band. Length from one to two inches.

This species resembles the preceding, a variety of which I had formerly considered it; but the absence of the canaliculation at the summit of the volution, the more depressed convexity and greater attenuation of the volutions, giving a more elongate aperture, are characters which appear sufficient for specific distinction.

Geological formation. Upper Helderberg limestones.

LOXONEMA PEXATA (n. s.).

SHELL elongate, terete or subfusiform: volutions six or more, gradually expanding from the apex, somewhat flattened towards the upper side, or a little concave just below the suture, and most convex below the middle, last one ventricose; aperture elliptical. Surface marked by regular elevated transverse striæ, which, at the summit of the volution, bend a little backwards, and again curve forwards above the greatest convexity of the volution.

Geological formation and localities. In limestone of the Upper Helderberg group: throughout New-York and in Ohio. This species of LOXONEMA, and the two preceding species of MURCHISONIA, are not unfrequently associated together; and as the specimens are usually in the condition of casts of the interior, it becomes very difficult to distinguish the one from the other, more particularly where they have suffered pressure and distortion.

LOXONEMA BELLATULA (n. s.).

SHELL moderately elongated, somewhat conical: volutions few, rapidly expanding from the apex; last volution ventricose, obtusely angular a little below the middle; aperture transverse. Surface of volutions marked by transverse undulating striæ, which have their greatest retral curve just above the

suture in the first volutions, and a little above the obtuse angle on the last volution.

This species, occurring with the preceding, is readily known by its shorter spire and obtuse angularity of the last volution.

Geological formation and locality. Upper Helderberg limestone, Ohio.

PLEUROTOMARIA KEARNYI (n. s.).

SHELL large, trochiform. Spire short, consisting of three or four volutions, which rapidly increase in size from the apex: upper volutions depressed-convex on the sides; the suture somewhat canaliculate, and carinate above by the base of the volution; the last volution flattened on the upper third, prominent above the middle and flattened on the lower half, marked just above the base by a strong simple angular carina: lower side of the volution prominent in the middle, depressed towards the umbilicus; aperture transverse, somewhat semioval. Surface marked by strong unequal striæ, which bend slightly backwards from the suture, and, in passing the upper more prominent part of the volution, curve a little forward, but do not become vertical; bending abruptly forward on the carina, again curve a little forward, and then backward into the umbilicus.

This shell reaches the dimensions of more than two inches in height by three inches in diameter on the base, while some individuals are four inches across the base.

Geological formation. Upper Helderberg limestone.

PLEUROTOMARIA HEBE (n. s.).

SHELL conical, hemispheric, rounded upon the lower side; the volutions above flattened, and nearly in the same plane from the apex to the outer edge of the last volution; the spire above the aperture about equal to the height of the aperture. Volutions about four, very gradually expanding to the last one, which is ventricose and angular on the outer margin;

aperture transversely elliptical. Surface marked by strong revolving striæ and finer transverse striæ, which are strongly bent backward on the carina of the outer volution.

This species is larger and more rotund than *P. sulcomarginata* of the Hamilton group. The specimens examined are all imperfect, and the shell crystalline, so that the surface markings are indistinctly seen.

Geological formation and locality. In limestone of the Upper Helderberg group : Western New-York.

PLATYOSTOMA TURBINATA (n. s.).

SHELL depressed subturbinata, sometimes approaching to globose. Spire depressed, little elevated above the outer volution, and sometimes nearly on a plane with it. Volutions three or four, very rapidly expanding; the last one extremely ventricose, and the lower part projected downwards in the direction of the columella, which is unusually extended : aperture ovate, broader above. Surface marked by five somewhat unequal striæ, parallel to the aperture, and crossed by finer and less conspicuous revolving striæ.

This species, which seems clearly referable to the Genus PLATYOSTOMA, is remarkable for the attenuation of the last volution and the contraction of the aperture below.

Geological formation and locality. In the Upper Helderberg limestone: Helderberg mountains, and places in Western New-York.

PLATYOSTOMA LICHAS (n. s.).

SHELL obliquely subglobose. Spire moderately elevated : volutions about four, rounded, the earlier ones very gradually expanding, and the last one becoming extremely ventricose; aperture nearly circular. Surface marked by fine striæ of growth.

This species resembles *P. ventricosa* of the Oriskany sandstone; but the spire is more elevated, and the specimens examined do not attain a

size equal to that one. The specimens measure from an inch to one and a half inches in diameter, with a length about one-fifth greater.

Geological formation and locality. In the Upper Helderberg limestone: Clarence Hollow, Stafford, and other places in Western New-York.

EUOMPHALUS CONRADI (n. s.).

SHELL discoid. Volutions three or four (rarely preserving more than two or three), gradually enlarging from the apex, which is depressed below the plane of the outer volution: inner volutions rounded above, gradually becoming depressed, and the outer one flattened and sloping towards the ventral side, the upper or dorso-lateral edge obtusely angular; periphery moderately convex, sometimes flattened and gradually contracting to the lower side, which is obtusely angular with the base abruptly depressed, forming a wide umbilicus. Aperture somewhat quadrilateral; a short, nearly straight side against the inner volution; the upper side making a little more than a right angle, while the outer edge makes nearly a right angle with the upper side: the lower side conforms to the upward, bending at the lower outer angle, and, thence following the curve of the umbilicus, is longer than the other sides.

Shell thin. Surface marked by fine elevated striæ of growth, without cancellating striæ.

The fossil has a diameter of two to four inches; but as it usually occurs in the form of casts, the inner volutions are not well preserved: these, at first rounded, gradually become flattened above as they extend from the apex, and the last one slopes from the periphery, giving a concave upper surface. In rare instances, the apex of the spire rises nearly to the plane of the outer volutions.

This species resembles the *Euomphalus disjunctus* of the Lower Helderberg group, but is distinguished by the flattening of the upper side, and the obtuse angles above and below upon the outer volution. It also resembles more nearly the *E. trigonalis* of GOLDFUSS; but the outer volution is never so much dilated, nor does our shell exhibit the revolving striæ represented in the figure of GOLDFUSS.

Geological formation and locality. In limestone of the Upper Helderberg group: in numerous localities in Central and Western New-York.

Of the Cephalopoda of the Upper Helderberg group, four species of CYRTOCERAS and one PHRAGMOCERAS have been described, viz : *C. paradoxum*, *C. trivolvis*, *C. matheri*, *C. undulatum*, and *Phragmoceras spinosum*. Several species of ORTHOCERATITES and GOMPHOCERAS are known, and two of TROCHOCERAS.

TROCHOCERAS CLIO (n.s.).

SHELL discoid or depressed, suborbicular, convex above and broadly umbilicate beneath : volutions about three, gradually expanding, the last one becoming ventricose ; the outer chamber large. On the lower side of the outer volution, where the diameter is half an inch, the septa have a distance of about one-tenth of an inch ; while in the margin of the umbilicus at the same part, they have not more than half this distance, and upon the dorsum about one-eighth of an inch. Siphuncle central.

SURFACE strongly annulated upon the upper and dorsal portions of the volution, the ridges dying out in the umbilicus : entire surface evenly cancellated by transverse and revolving striæ.

This species attains a diameter of two or three inches, and can be known in its fragmentary condition by the annulated surface.

Geological formation and locality. In the Schoharie grit : Helderberg mountains and Schoharie.

TROCHOCERAS EUGENIUM (n.s.).

SHELL subhemispherically discoid : volutions strong, gradually increasing from above to the last one, which becomes more rapidly expanded and ventricose ; outer chamber large. Septa, where the shell is one inch in diameter, one-fifth of an inch distant on the lower side, and about half the same distance at the margin of the umbilicus : volutions a little flattened upon the lower side, and abruptly curving into the deep umbilicus. Siphuncle dorsal : dorsal surface of casts showing no annulations ; character of shell unknown.

This is a more robust species than the *T. annulatum*: it is readily distinguishable in the absence of annulations, and in the dorsal position of the siphuncle, while the umbilicus is proportionately narrower and deeper.

Geological formation and locality. In the Schoharie grit: Helderberg mountains and Schoharie.

GOMPHOCERAS EXIMIUM (n.s.).

SHELL large, the outer chamber gradually contracting from the last septum, and tapering in about the same degree in the opposite direction: section elliptical. The twelve chambers preceding the outer one measure three inches in length; the greatest diameter at the outer section being three and a half inches, and, at the distal section, two and a half inches.

There are about three inches of the outer chamber preserved in the specimen. The entire length of the specimen is more than six inches, the greater diameter about three inches, and the lesser diameter two inches. It may have suffered accidental pressure in some degree; but it is evident, from the prevalent form, that the shell has been originally elliptical in section.

Geological formation and locality. In the Upper Helderberg limestone: Black Rock, New-York.

CORRECTION.

Page 91, for CYCLONEMA VENTRICOSA read Cyclonema varicosa.

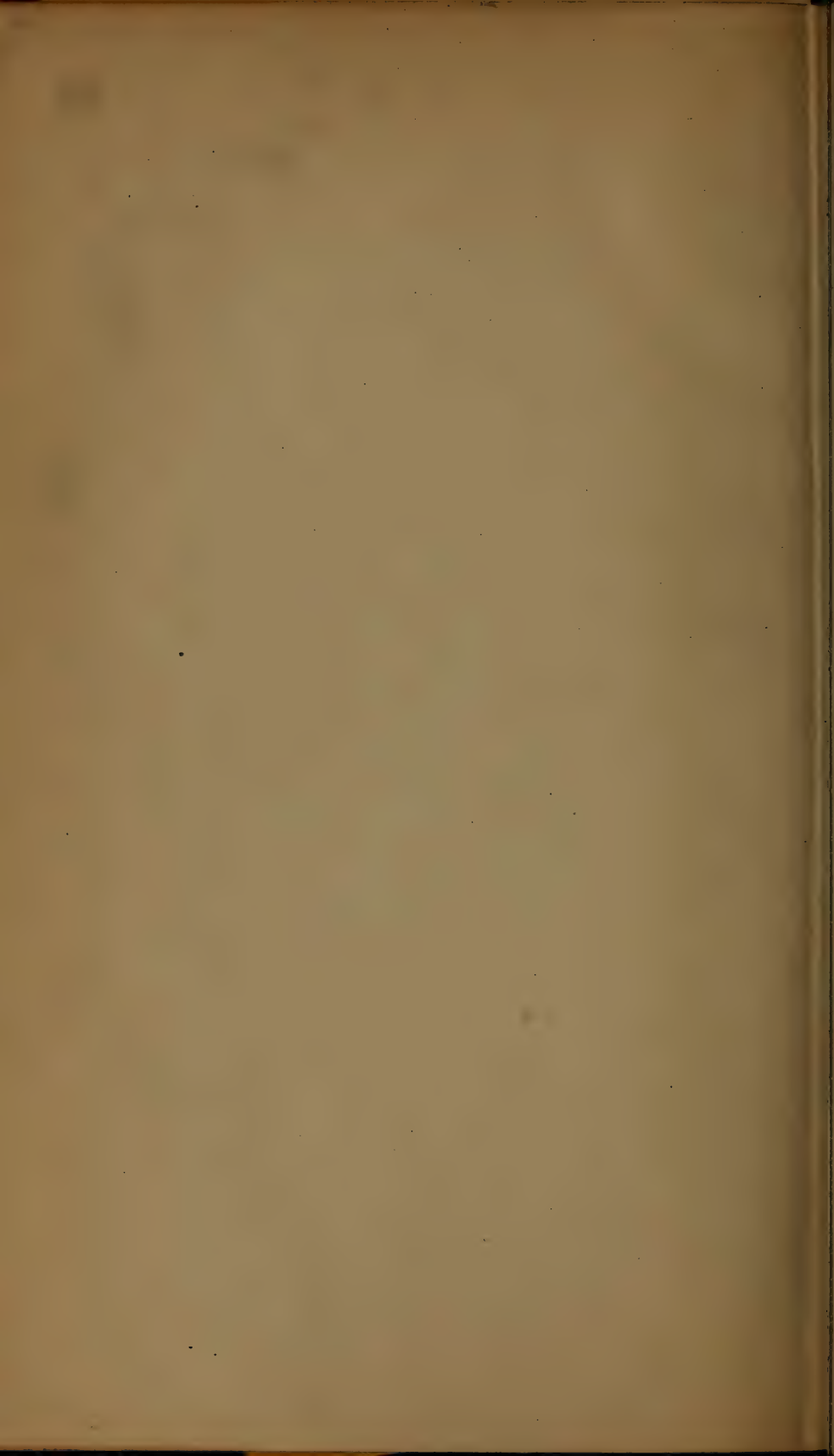
Page 92, for *large*, read larger.

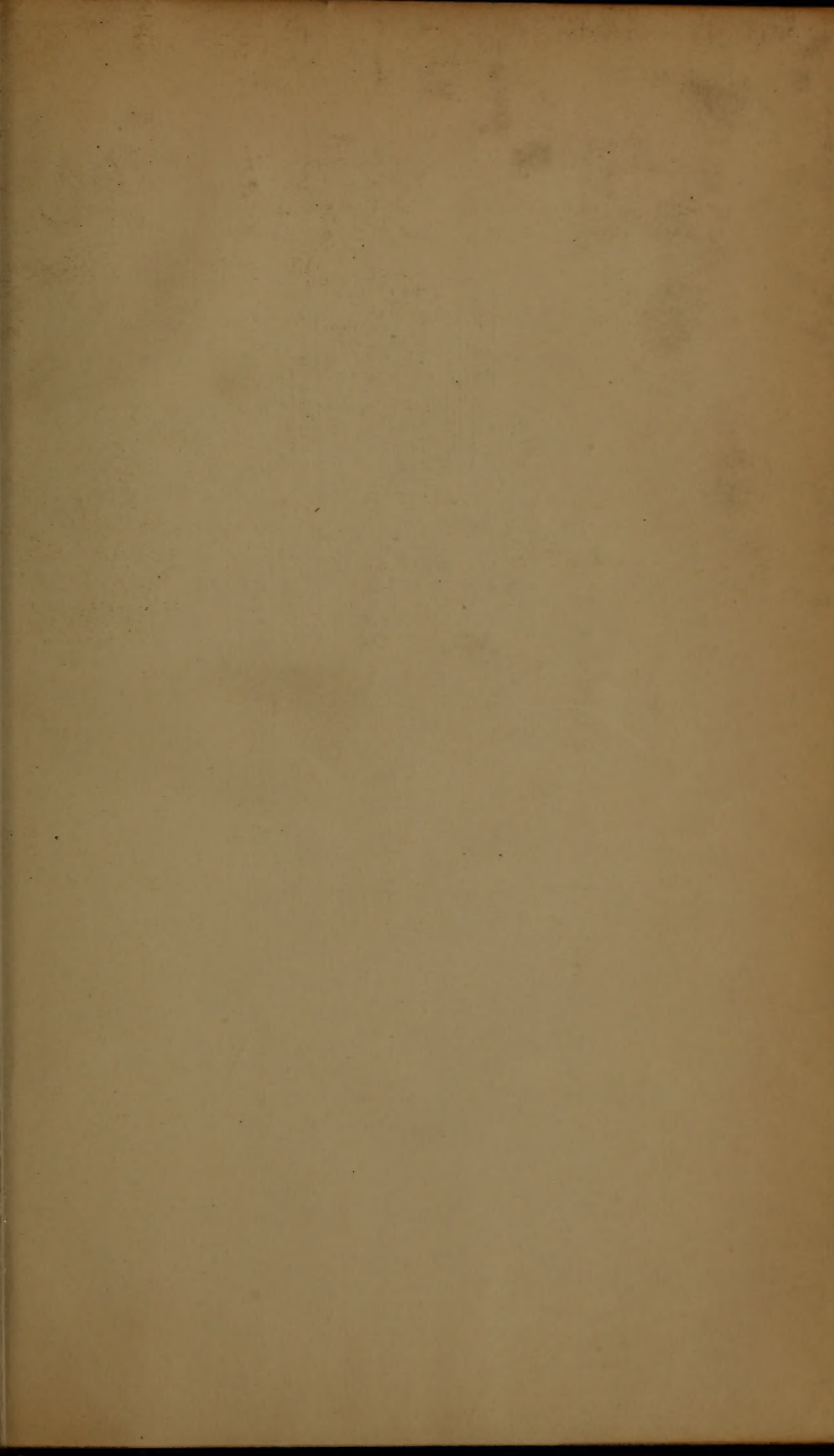
CORRECTION FOR THE THIRTEENTH ANNUAL REPORT.

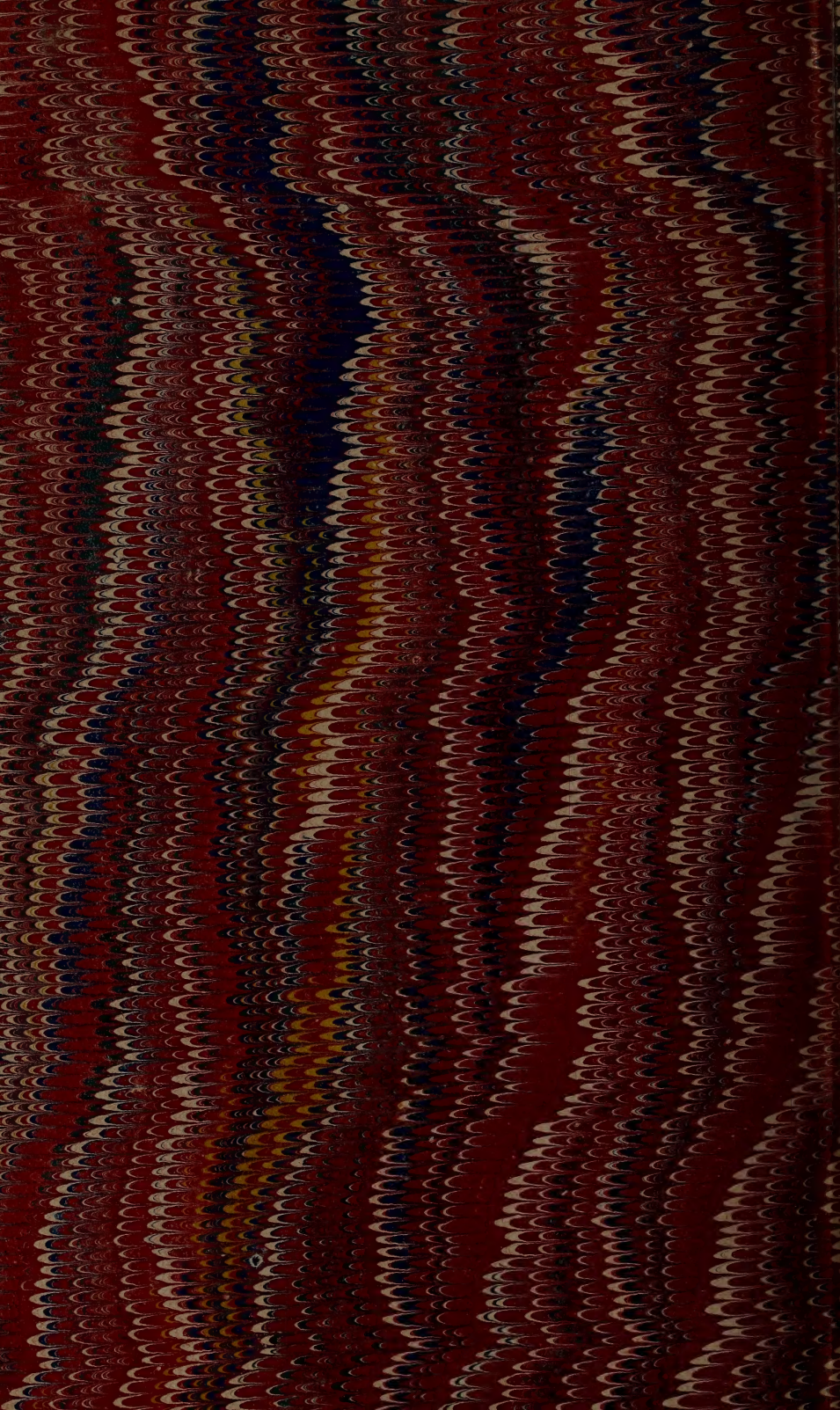
Page 113. In the title of the article for "Hudson-river group," read QUEBEC GROUP.

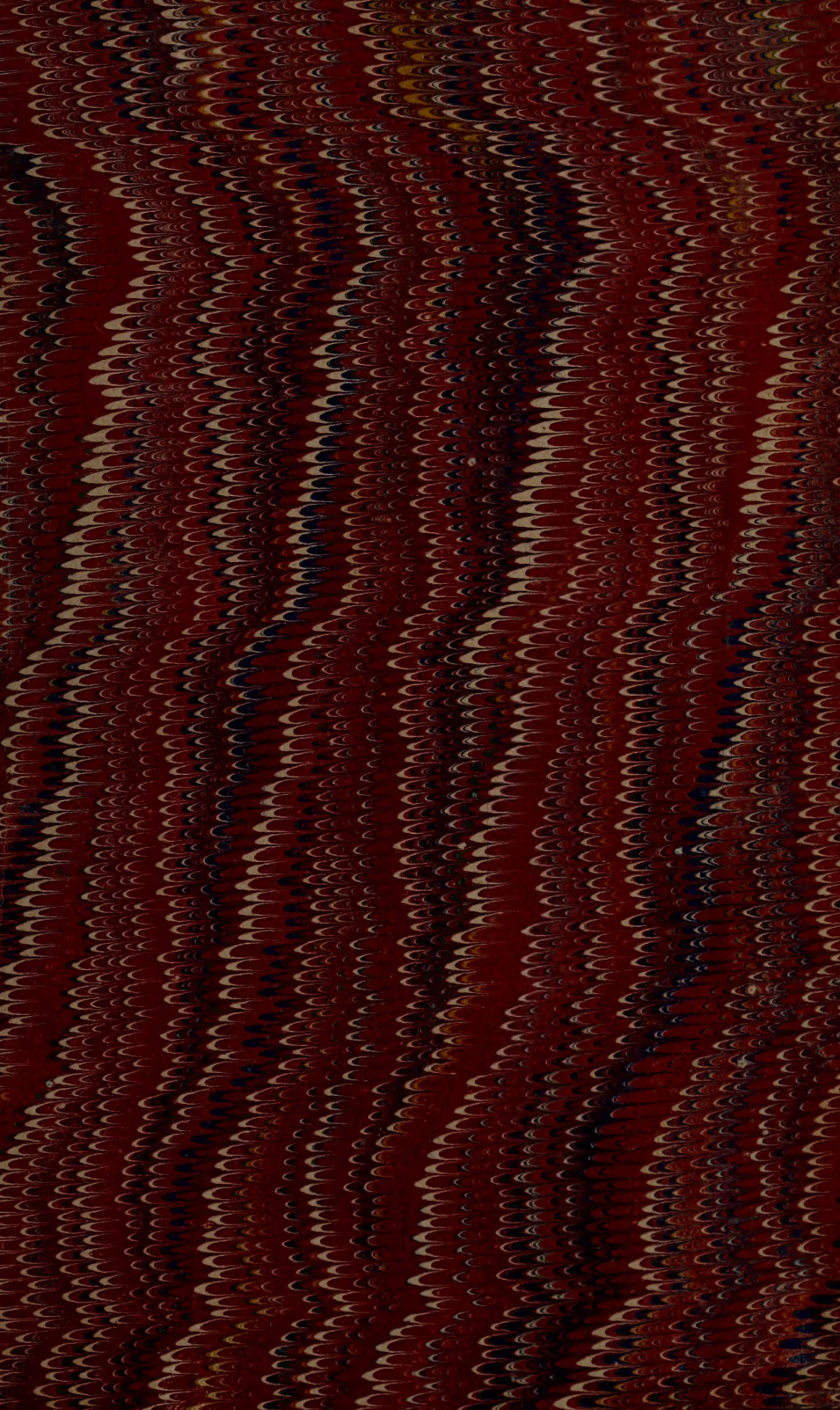
This correction was made in a part of the edition.

The NOTICE on page 128 did not reach the printer till the form was on the press, and consequently some of the first copies printed are without this notice.









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