

EXPLANATION OF PLATES

Plate I.

- Fig. 1. *Diplodus striatus* Eastm. Upper Devonian; Elmhurst, Illinois. Detached tooth, anterior face. x 4-1. Page 105
- Fig. 2. Detached dorso-median plate of a small undetermined Arthrodire seen from the visceral aspect. Hydraulic limestone (Hamilton); Milwaukee, Wisconsin. x 2-1. Page.....207
- Fig. 3. *Onychodus hopkinsi* Newberry. Chemung beds; Franklin, Delaware county, New York. Series of five presymphysial teeth. x 3-4. Page.....241
- Fig. 4. *Onychodus* sp. (cf. *O. sigmoides* Newb.). Hydraulic limestone (Hamilton); Milwaukee, Wisconsin. Imperfect slightly arcuate presymphysial tooth seen partly in longitudinal section and displaying central pulp-cavity. x 2-1. Page.....240
- Fig. 5. *Diplodus priscus* Eastm. Upper Devonian; Elmhurst, Illinois. Detached tooth, anterior face. x 4-1. Page.....104
- Fig. 6. Detached dorso-median plate comparable to that shown in Fig. 2, and belonging to an unknown Arthrodiran genus. Hydraulic limestone (Hamilton); Milwaukee, Wisconsin. x 2-1. Page207
- Figs. 7, 8. Detached Thelodus-like scales from the "bonebed" of the Columbus limestone, near Columbus, Ohio. x 3-1. Page72
- Fig. 9. *Phoebodus politus* Newberry. Cleveland shale (Upper Devonian); Lorain county, Ohio. Detached tooth, anterior face. x 4-1. Page.....106
- Fig. 10. *Dinichthys pustulosus* Eastm. Hydraulic limestone (Hamilton); Milwaukee, Wisconsin. Left posterior palatopterygoid dental plate or "shear-tooth." x 1-1. Page.....194
- Fig. 11. *Onychodus* sp. (cf. *O. sigmoides* Newberry). Marcellus shale (Erian division of the Middle Devonian); Oran, Onondaga county, New York. x 1-1. Page.....241

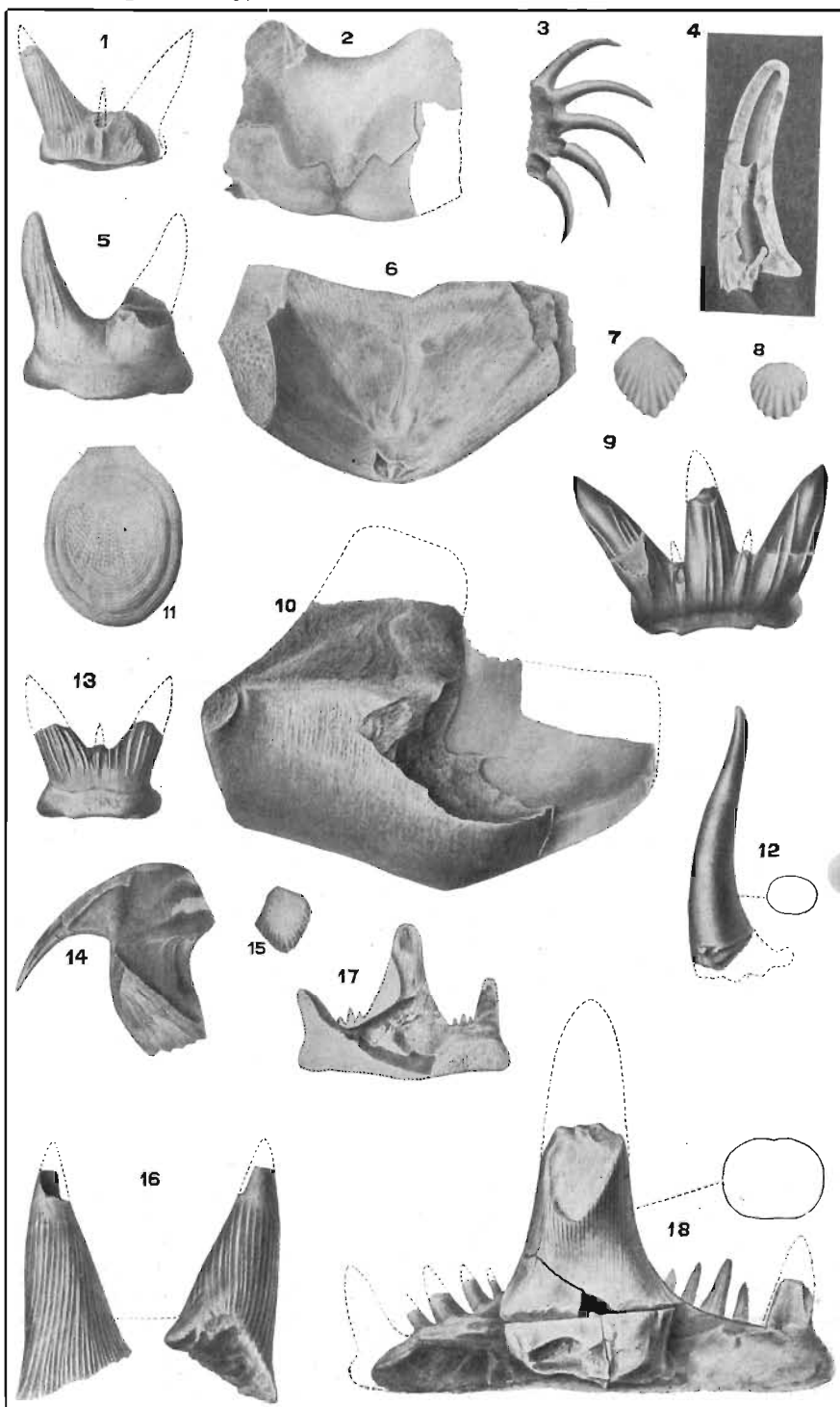


Plate I.—Continued.

Fig. 12. *Onychodus* sp. indes. Middle Devonian; Eifel District, Rhenish Prussia. Detached presymphysial tooth differing from the typical American species in its less pronounced curvature and more slender form. Cross-section of base of crown shown at the right. Original in the Museum of Comparative Zoology, Cambridge, Mass. x 3-4. Page.....240

Fig. 13. *Diplodus priscus* Eastm. Upper Devonian; Elmhurst, Illinois. Detached tooth, anterior face. x 4-1. Page.104

Fig. 14. *Acanthaspis armata* Newberry. Columbus limestone (Middle Devonian); Sandusky, Ohio. Dermal plate with segmented spinous process, the whole strictly homologous with the so-called "shoulder-girdle of Rhamphodus," as described by O. Jaekel from the Upper Devonian of Wildungen, Waldeck. An external dermal ossification formerly supposed to be of Arthrodiran nature, but now considered, in the light of Jaekel's discovery, to belong to Rhynchodus or some similar Palæozoic Chimæroid. x 5-7. Page.....145

Fig. 15. Detached Thelodus-like shagreen granule, of the same nature and from the same horizon and locality as those shows in Figs. 7 and 8. x 5-1. Page.....72

Fig. 16. *Diplodus striatus* Eastm. Upper Devonian; Elmhurst, Illinois. Anterior and posterior face of a single large detached cone. x 4-1. Page.....105

Fig. 17. *Cladodus monroei* Eastm. Hydraulic limestone (Hamilton); Milwaukee, Wisconsin. Detached tooth, coronal apex and portion of the base broken away. x 3-2. Page...108

Fig. 18. *Cladodus prototypus* Eastm. Columbus limestone (Middle Devonian); Columbus, Ohio. Detached tooth serving as holotype of the species, seen from the posterior face; coronal cross-section shown at the right. Original in American Museum of Natural History, New York. x 2-1. Page.....108

Plate II.

All specimens represented four-fifths natural size unless otherwise stated.

- Fig. 1. *Dipterus calvini* Eastm. Cedar Valley limestone (Middle Devonian); Fairport, Iowa. Right mandibular plate, holotype of the species. Page.....219
- Fig. 2. *Dipterus pectinatus*, sp. nov. State Quarry beds (Upper Devonian); North Liberty, Johnson county, Iowa. Left mandibular plate, cotype. A photograph of the same specimen is reproduced in Plate VII, fig. 13. Page.....222
- Fig. 3, 3a. *Dipterus uddeni* Eastm. Base of Cedar Valley limestone (Middle Devonian); Buffalo, Iowa. Left mandibular plate of holotype, shown from the oral and lateral aspects. Page218
- Fig. 4. *Dipterus mordax* Eastm. State Quarry beds (Upper Devonian); North Liberty, Johnson county, Iowa. Right mandibular dental plate; contour not entirely complete. Cotype. Page220
- Fig. 5. *Dipterus mordax* Eastm. A worn and somewhat fragmentary specimen from same horizon and locality as the last. Cotype. Page220
- Fig. 6. *Dipterus digitatus*, sp. nov. Left palatal dental plate of cotype from same locality and horizon as the preceding. A photograph of the same specimen is reproduced in Plate VII, fig. 20. Page.....221
- Fig. 7. *Dipterus pectinatus*, sp. nov. Palatal dental plate of cotype from same horizon and locality as the preceding. The concavity of the oral surface is in reality greater than the artist has here represented, and the lower right-hand margin is slightly deficient in the original. Other specimens illustrating the upper dentition of the same species are shown in Plate VII, figs. 11, 12 and 15. Page.....222
- Fig. 8. *Dipterus costatus* Eastm. Left mandibular dental plate selected as holotype of the species, from same horizon and locality as the preceding. Page.....220

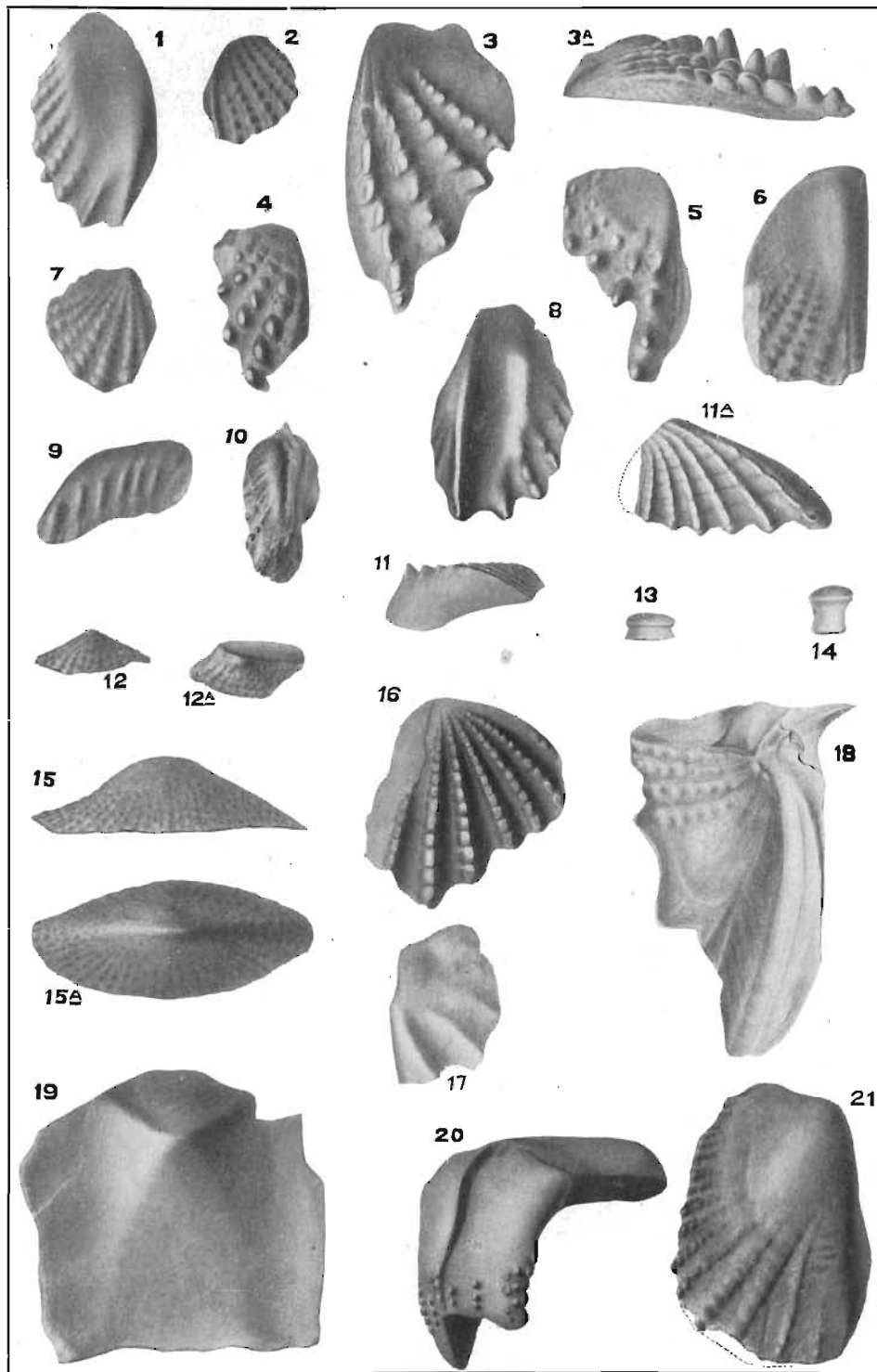


Plate II.—Continued.

Fig. 9. *Dipterus nelsoni* Newberry. Chemung beds; Warren, Pennsylvania. Oral surface of greatly abraded dental plate, worn so as to simulate the smooth forms usually referred to *Sagenodus*. Page223

Fig. 10. *Dipterus murchisoni* Pander. Middle Devonian; Berndorf, Eifel District. Right mandibular dental plate of a Russian and Eifelian species approximating closely to the *D. mordax* series of Dakotan seas (cf. Plate VII, figs. 5-9). Original in Museum of Comparative Zoology. Page.....226

Figs. 11, 11a. *Dipterus nelsoni* Newberry. Chemung beds; Warren, Pennsylvania. Right mandibular dental plate shown from the antero-lateral and oral aspects. The same specimen is shown in natural juxtaposition with its fellow of the left side in Plate VII, fig. 3. Page.....223

Figs. 12, 12a. Small dermal tubercle, supposed to be of Chimaeroid nature, from the Kinderhook limestone of Burlington, Iowa. Compare with Fig. 15. Page.....149

Figs. 13, 14. Thelodus-like scales from the Columbus limestone (Middle Devonian) of Columbus, Ohio. x 3-1. Page...72

Figs. 15, 15a. Large-sized Chimaeroid (?) dermal plate from the Kinderhook limestone of Burlington, Iowa. Page.....149

Fig. 16. *Dipterus fleischeri* Newberry. Oneonta beds; Franklin, Delaware county, New York. Right palatal dental plate. Page225

Fig. 17. *Dipterus* sp. ind. Worn example of palatal dental plate from the State Quarry beds (Upper Devonian) of Johnson county, Iowa. Page216

Fig. 18. Scale-like dermal plate supposed to be of Chimaeroid nature, and theoretically associated with *Rhynchodus*. Compare with the young example of *Acanthaspis armata* shown in Plate I, fig. 14, and with the so-called "shoulder-girdle of *Rhamphodus*" as described by O. Jaekel. Hydraulic limestone (Hamilton); Milwaukee, Wisconsin. Page.....126

Fig. 19. *Synthetodus calvini*, sp. nov. State Quarry beds (Upper Devonian); North Liberty, Johnson county, Iowa. Holotype. Original in Museum of Comparative Zoology, Cambridge, Mass. Page233

Plate II.—Continued.

Fig. 20. *Dinichthys lincolni* Claypole. Marcellus shale (Erian division of the Middle Devonian); Geneva, Ontario county, New York. Right vomerine tooth seen from the inner side and slightly from in front. Along the anterior face is seen a longitudinal fracture due to mechanical deformation; above and behind is the stout process serving for attachment of the tooth. Holotype in New York State Museum. Page.....193

Fig. 21. *Dipterus digitatus*, sp. nov. State Quarry beds (Upper Devonian); North Liberty, Johnson county, Iowa. Right mandibular plate of a fully grown individual. A photograph of the same specimen is reproduced in Plate VII, fig. 25. Compare with the series of palatal dental plates belonging to the same species, and shown in Plate VII, figs. 20-24. Page.....221

Plate III.

Fig. 1. *Gyracanthus sherwoodi* Newberry. Chemung beds; Ischua township, Cattaraugus county, New York. Drawn from squeeze of spine. x 3-4. Page.....114

Fig. 2. Detail of surface ornamentation of Arthrodiran (?) plates similar to those described by Newberry under the name of *Sphenophorus* (=“*Oestophorus*” S. A. Miller), from the Hamilton limestone of Milwaukee, Wisconsin. x 2-1. Page.207

Fig. 3. *Cladodus urbs-ludovici*, sp. nov. Genesee shale (=“New Albany black shale”); near Louisville, Kentucky. Holotype in Museum of Comparative Zoology, Cambridge, Mass. x 2-1, approximately. Page.....110

Fig. 4. *Machaeracanthus sulcatus* Newberry. Onondaga limestone; Victor, Ontario county, New York. Re-drawing of holotype figured by Hall; original in New York State Museum. x 3-4. Page114

Fig. 5, 5a. *Acantholepis* sp. Corniferous limestone; Falls of the Ohio. A small, probably immature and fragmentary spine, showing expanded nature of the pyramidal inserted portion. The lateral and anterior faces are shown in figs. 5 and 5a respectively. x 3-4. Page.....142

Fig. 6. *Ptyctodus punctatus* Eastm. Onondaga limestone (Ulsterian division of the Middle Devonian); LeRoy, New York. Functional surface of the detached tritor. x 3-4. Page.....133

Fig. 7. *Coelacanthus welleri*, sp. nov. Kinderhook limestone; Burlington, Iowa. Flank scales, slightly enlarged, showing spiniform ornamentation. Holotype in Walker Museum of University of Chicago. Page.....247

Fig. 8. *Rhynchodus major* Eastm. Upper Devonian; Wildungen, Waldeck. Left upper and lower dental plates (inner aspect) arranged in natural position. The outlines of these plates are copied from Jaekel, who figures them, however, in inverted position, and renames the species “*R[h]amphodus tetradon*.” x 3-4. Page.....127

Plate III.—Continued.

Fig. 9. *Onchus rectus* Eastm. Chemung group; Delaware county, New York. Dorsal fin-spine, lateral face. x 6-5. Page 150

Fig. 10. *Homacanthus acinaciformis* Eastm. Chemung group; Warren, Pennsylvania. Dorsal fin-spine, lateral face. x 4-3. Page151

Fig. 11. *Dinichthys pustulosus* Eastm. Oneonta sandstone (Portage group); Delhi, New York. External aspect of left mandibular ramus, partly restored. x 1-2, approximately. Page194

Fig. 12. *Dinichthys pustulosus* Eastm. Cedar Valley limestone; near Rock Island, Illinois. Incomplete mandible collected and drawn by Orestes H. St. John, and described in the American Naturalist for 1902, p. 657. x 3-4. Page.....194

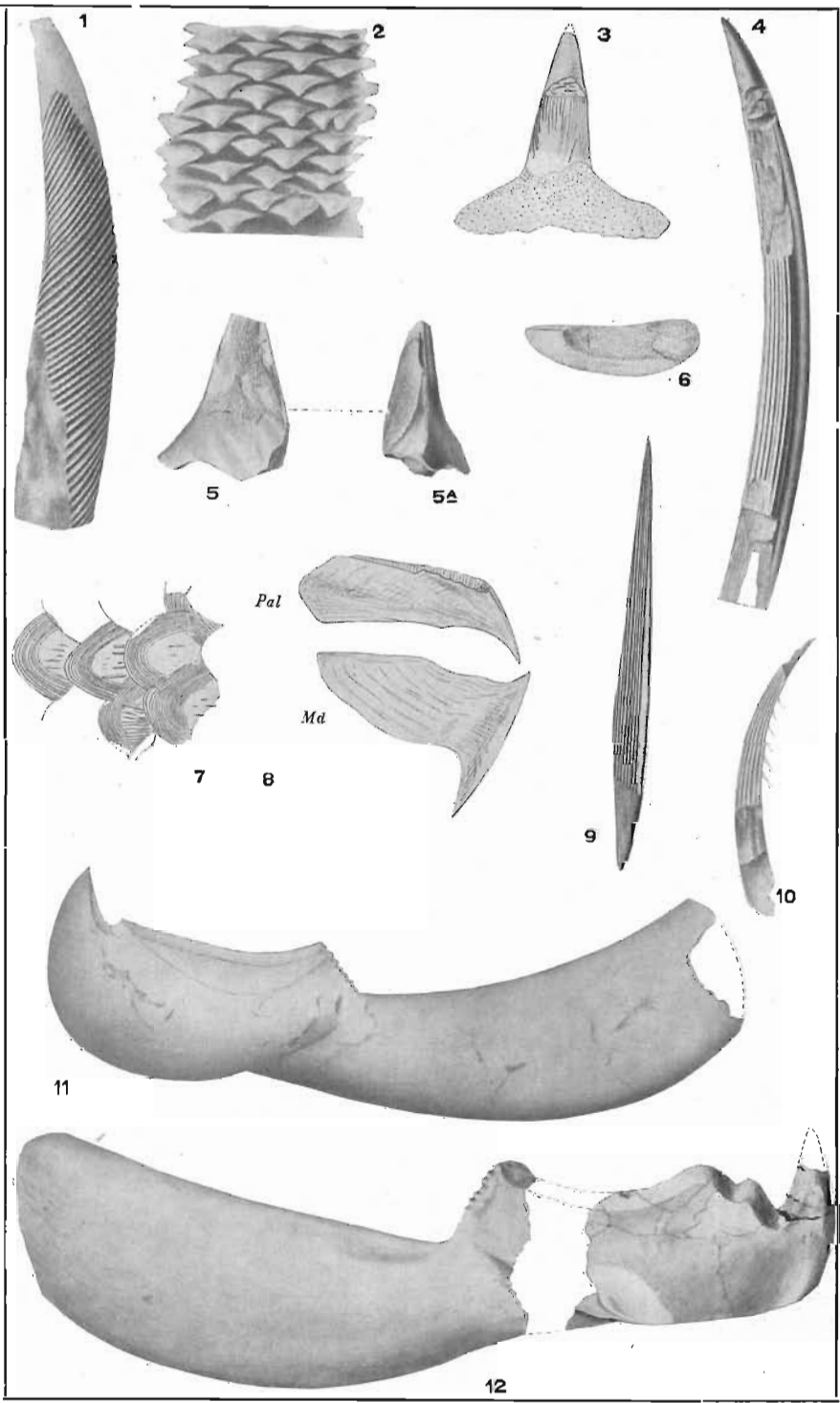


Plate IV.

Dinichthys pustulosus Eastm. Lower part of the Cedar Valley limestone (Middle Devonian); near Rock Island, Illinois. Dorsal aspect of moderate-sized headshield, showing cranial sutures, sensory canals and other features very distinctly. The median occipital plate is removable, showing conformation of the visceral surface, and median depression for the attachment of muscles, etc. Original collected by Mr. A. S. Tiffany, of Davenport, and now preserved in the Museum of Comparative Zoology, Cambridge. x 1-2. Page.....194

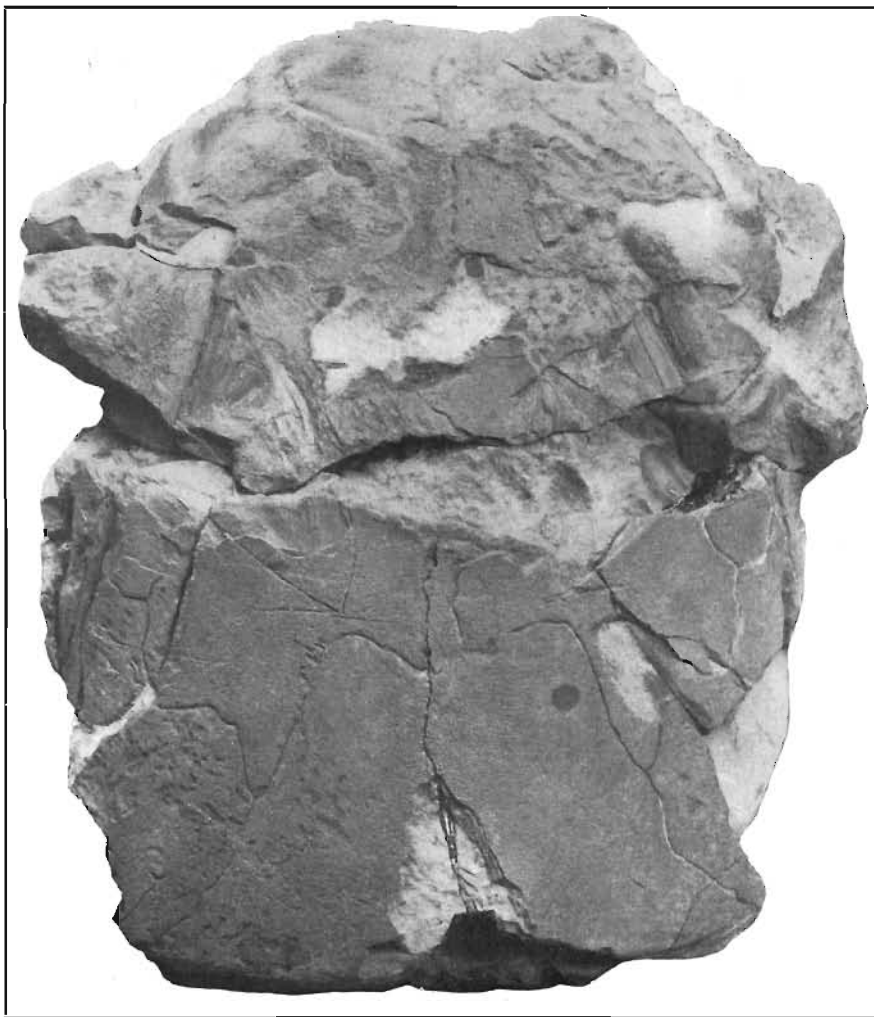


Plate V.

EXAMPLES OF PTYCTODONT DENTITION FROM VARIOUS DEVONIAN LOCALITIES.

All figures reduced a trifle less than natural size.
 Originals preserved in the Museum of Comparative Zoology.

Figs. 1-17. *Ptyctodus calceolus* Newb. and Worthen. State Quarry beds (Upper Devonian); Johnson county, Iowa. The distinction between upper and lower dental plates is apparent from the configuration of the symphysial portion, a prominent beak and obtuse descending process being developed in the lower, and the corresponding region of the superior being gently rounded. The lower beaks are preserved in the originals of Figs. 1, 5-9, 16, the last being a nearly complete specimen.
 Page133

Figs. 18-27. *Ptyctodus compressus* Eastman. State Quarry beds (Upper Devonian); Johnson county, Iowa. Symphysial beaks of the lower dentition well shown in Figs. 23-27. Page.135

Figs 28-30. *Ptyctodus molaris* Eastman. Middle Devonian; Eifel District, Rhenish Prussia. The holotype, shown in Fig. 28, is a nearly perfect example of the lower dental plate, and shows traces of sutural attachment with its fellow of the opposite side.

Figs. 31-34. *Ptyctodus panderi* Eastman. Middle Devonian; Eifel District, Rhenish Prussia. Figs. 31, 32 show collectively the greater portion of the Rhynchodus-like inferior dental plate, the oral surface of which, however, displays punctate tritoral areas. Detached examples of the tritors are shown in Figs. 33, 34.

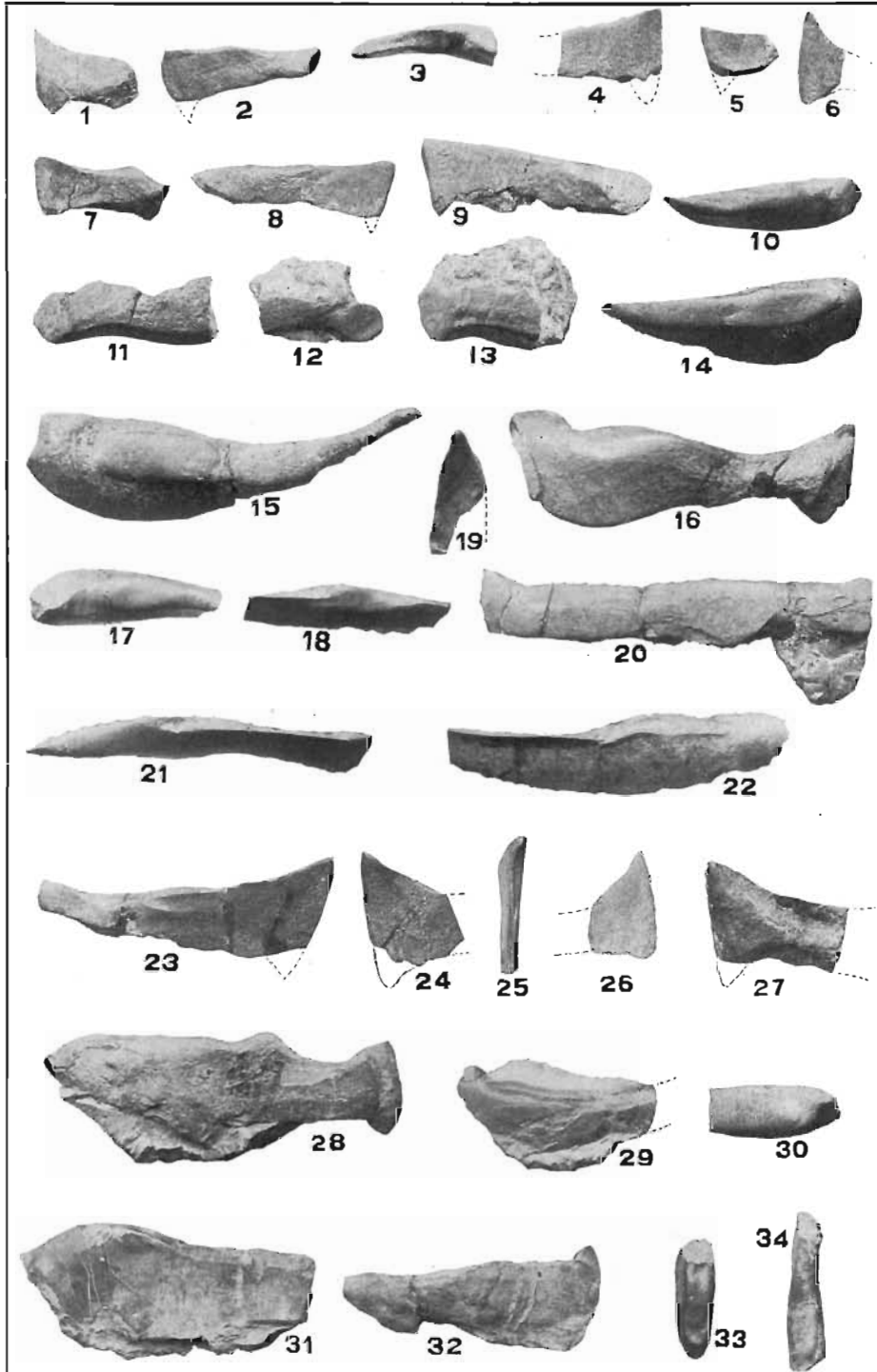


Plate VI.

**EXAMPLES OF PTYCTODONT DENTITION FROM THE
IOWA UPPER DEVONIAN.**

All figures are of the natural size.

A miscellaneous assortment of detached tritors, all more or less worn by use, and otherwise rolled and abraded, this being the usual condition in which remains of this sort are found in the Old State Quarry beds near North Liberty, in Johnson county, Iowa. The greater number of these tritors belong to *Ptyctodus calceolus* Newb. and Worthen, and are shown of the natural size. Originals in the Museum of Iowa State University. Page133

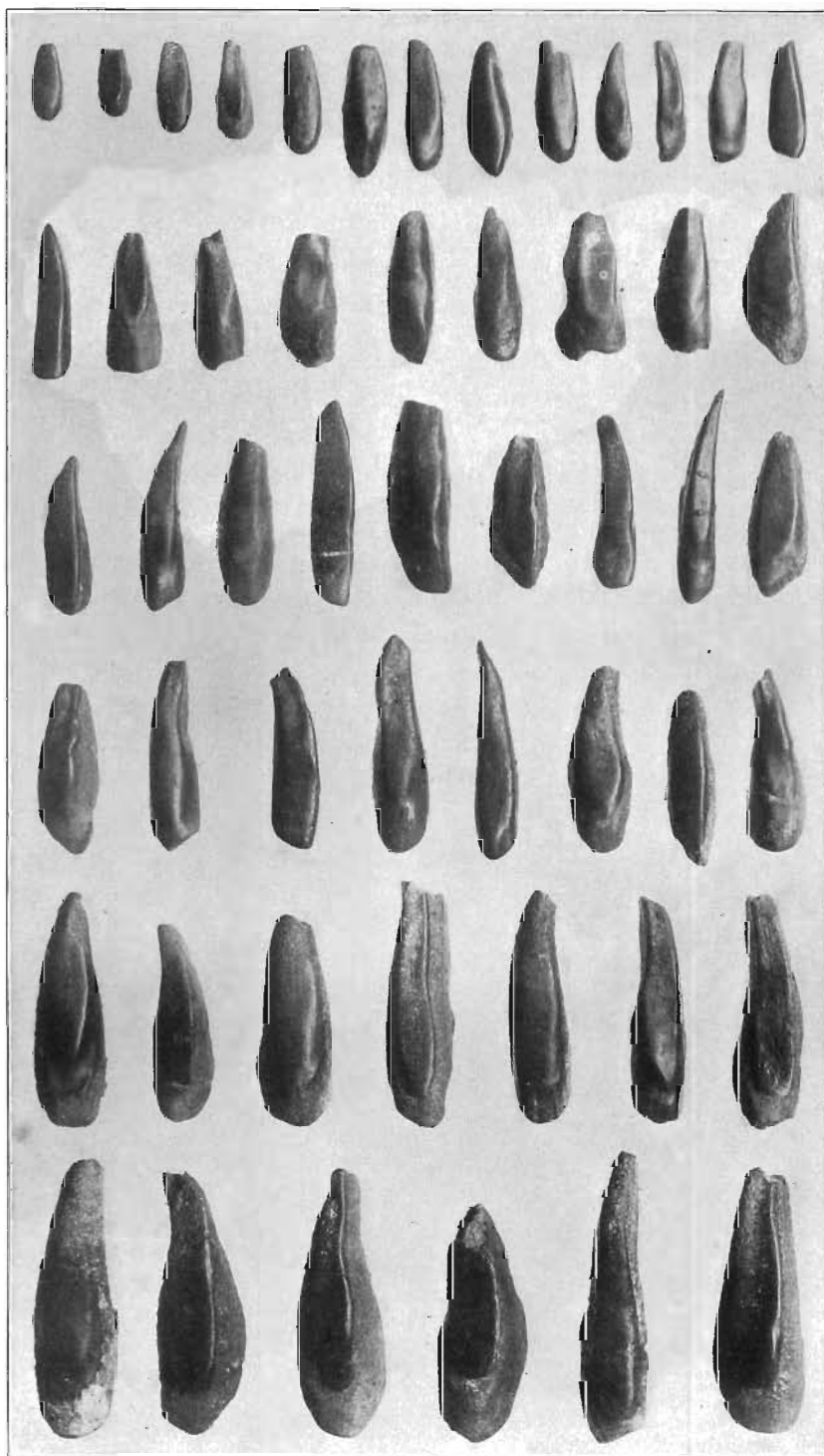


Plate VII.

EXAMPLES OF CTENODIPTERINE DENTITION, MOSTLY FROM THE IOWA UPPER DEVONIAN.

All figures are of the natural size.

Figs. 1-4. *Dipterus nelsoni* Newberry. Chemung; Warren. Pennsylvania. In Fig. 1 is shown a right upper dental plate of the so-called "*D. flabelliformis*" type, and in Figs. 2-4 the corresponding mandibular dental plates of both sides of the mouth. The original of Fig. 2 is one of Newberry's cotypes of this species, and is now preserved in the Peabody Museum at Yale University. The others are the property of the Museum of Comparative Zoology at Cambridge. The original of Fig. 3 is also shown in Plate II, Fig. 11, 11a. Page.....223

Figs. 5-9. *Dipterus mordax* Eastman. State Quarry beds (Upper Devonian); Johnson county, Iowa. Small sized examples of the inferior dental plates, to be compared with those shown in Plate II, Figs. 4, 5. Page.....220

Figs. 10-15. *Dipterus pectinatus*, sp. nov. State Quarry beds (Upper Devonian); Johnson county, Iowa. Lower dental plates represented in Figs. 10, 13, 14; upper in Figs. 11, 12, 15. The original of Fig. 13 is also shown in Plate II, Fig. 2. Page..222

Figs. 16-25. *Dipterus digitatus*, sp. nov. State Quarry beds (Upper Devonian); Johnson county, Iowa. Lower dental plates represented in Figs. 16-19, 25; upper in Figs. 20-24. The original of Fig. 20 is also shown in Plate II, Fig. 6. Page.....221

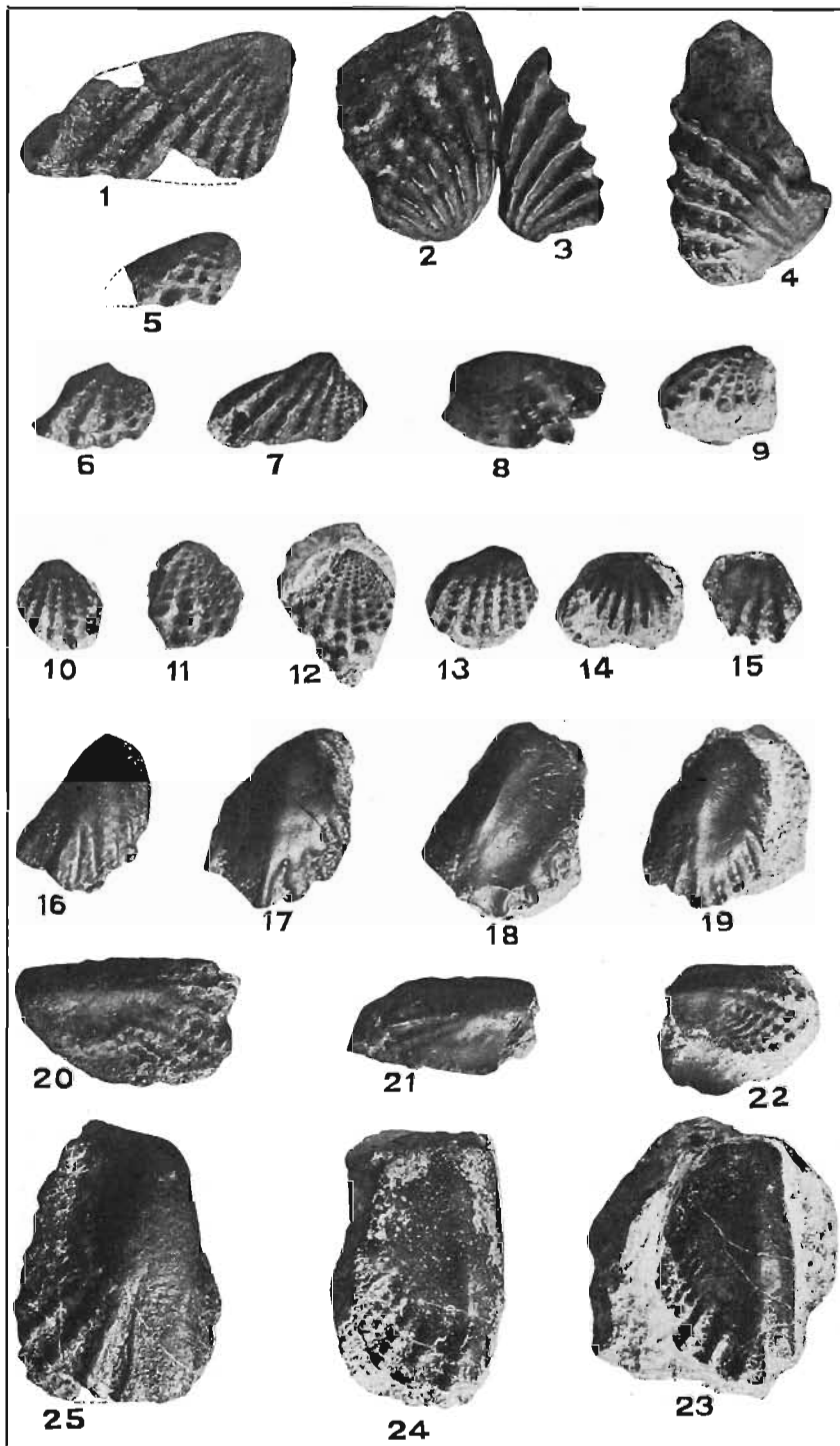


Plate VIII.

**EXAMPLES OF STATE QUARRY CTENODIPTERINE
DENTAL PLATES.**

All figures very nearly of the natural size.

The greater number of specimens selected for illustration in this Plate (all except Figs. 16, 20, 29, 34) are determined as belonging to *Conchodus variabilis*, sp. nov., and form a representative series, showing the wide range of variation exhibited by the detached dental structures, and with evanescent traces of coronal plications (seen especially at the bottom of Figs. 13, 15, 28, 33, etc.). The four exceptional figures are probably worn or otherwise imperfect specimens of *Synthetodus calvini*, all from the State Quarry beds near North Liberty in Johnson county, Iowa.

Originals preserved in the Museum of Iowa State University.

Pages.....230 and 233

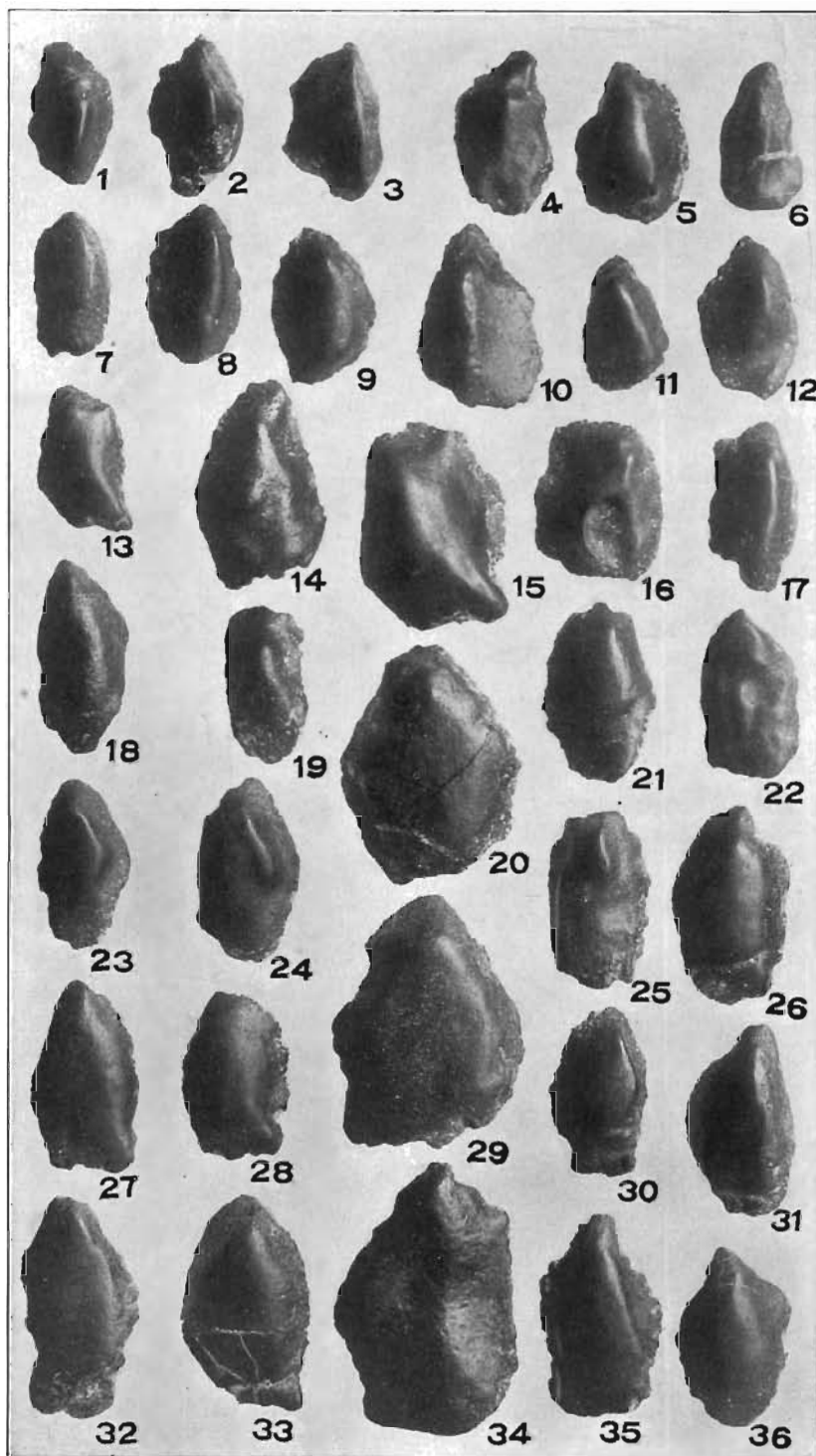


Plate IX.

EXAMPLES OF STATE QUARRY SYNTHETODONT DENTAL PLATES.

All figures reduced slightly less than the natural size.

In this plate is shown a representative assortment of the compound dental plates of *Synthetodus trisulcatus*, with perhaps one or two mutilated examples (Figs. 19, 32) of *S. calvini*, all from the State Quarry beds near North Liberty, in Johnson county, Iowa. The two upper rows represent the normal expression for the type species.

Originals preserved in the Museum of Iowa State University.
Pages.....231 and 233

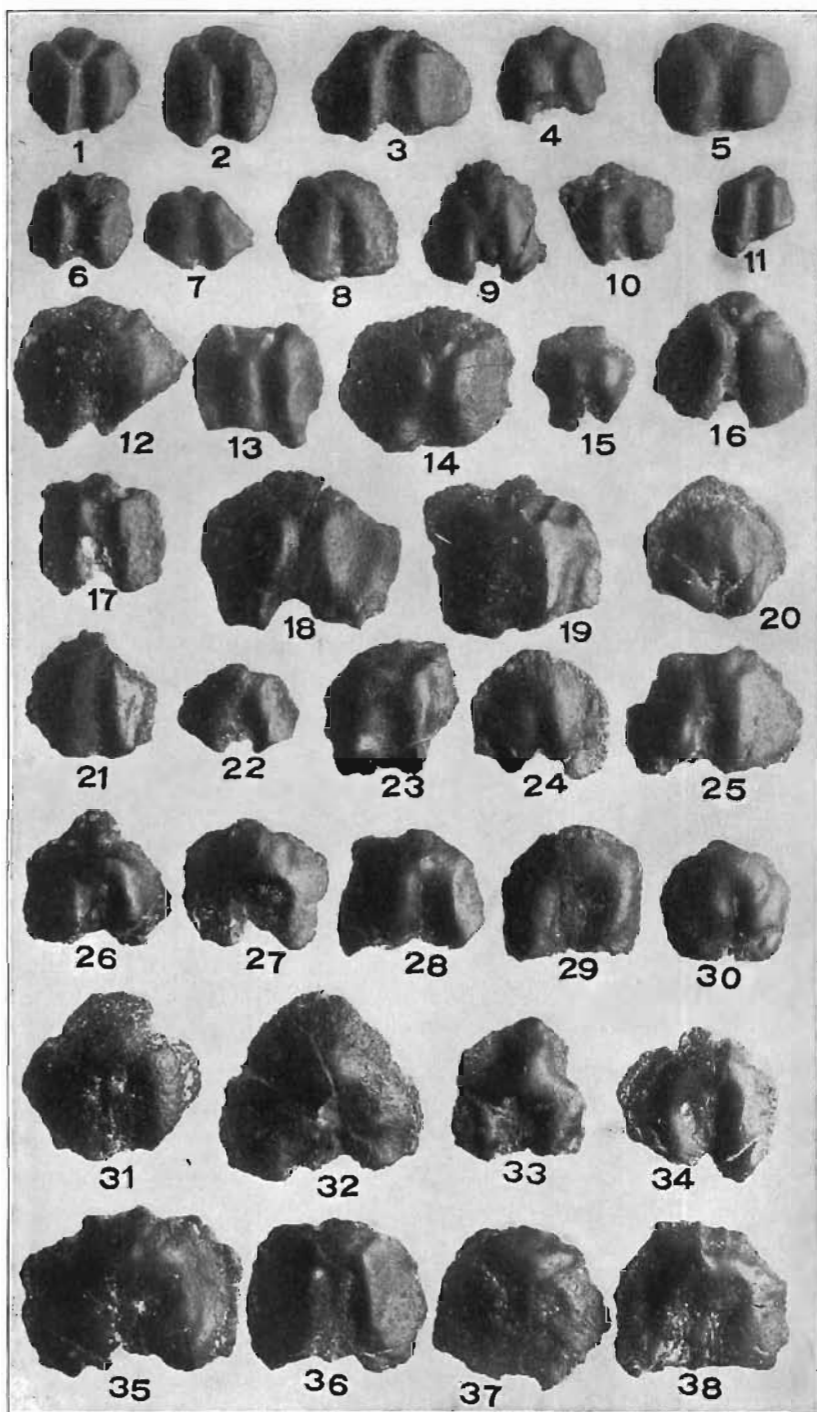


Plate X.

EXAMPLES OF STATE QUARRY SYNTHETODONT DENTAL PLATES.

All figures reduced slightly less than natural size.

The larger specimens in the middle row and at the bottom of the Plate are determinable as belonging to *Synthetodus calvini*, the remainder as imperfect examples of *S. trisulcatus*; all from the State Quarry beds near North Liberty, in Johnson county, Iowa.

Originals preserved in the Museum of Iowa State University.
Pages231 and 233

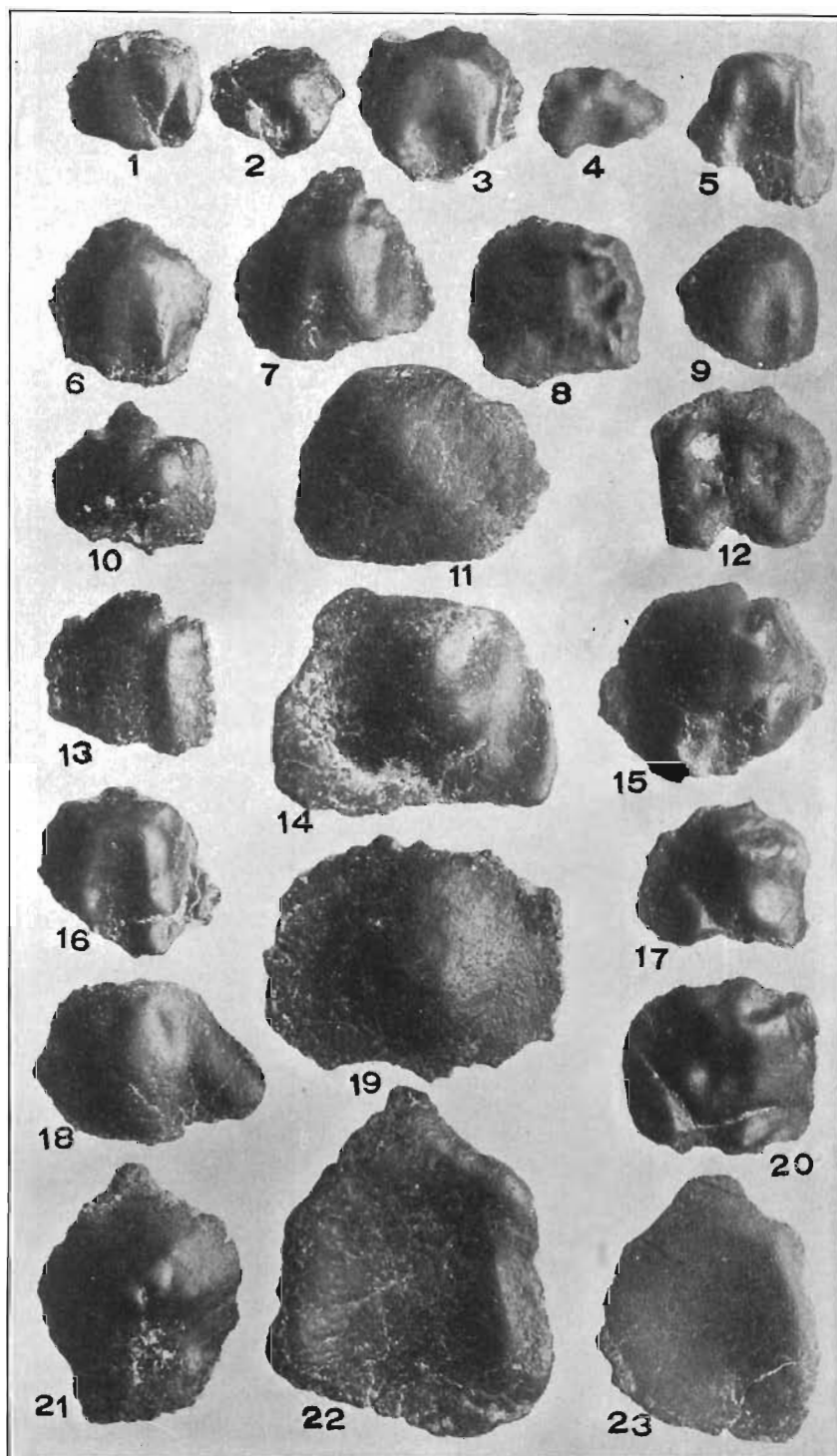


Plate XI.

EXAMPLES OF STATE QUARRY SYNTHETODONT DENTAL PLATES.

All figures reduced slightly less than the natural size.

The smaller plates with more or less distinct sulci, such as the originals of Figs. 6, 8, 10, 15, 22, 23, 25, etc., are determinable as belonging to *Synthetodus trisulcatus*, the larger ones, which are apparently simple, as somewhat imperfect examples of *S. calvini*; all from the State Quarry beds near North Liberty, in Johnson county, Iowa.

Originals preserved in the Museum of Iowa State University.
Pages231 and 233

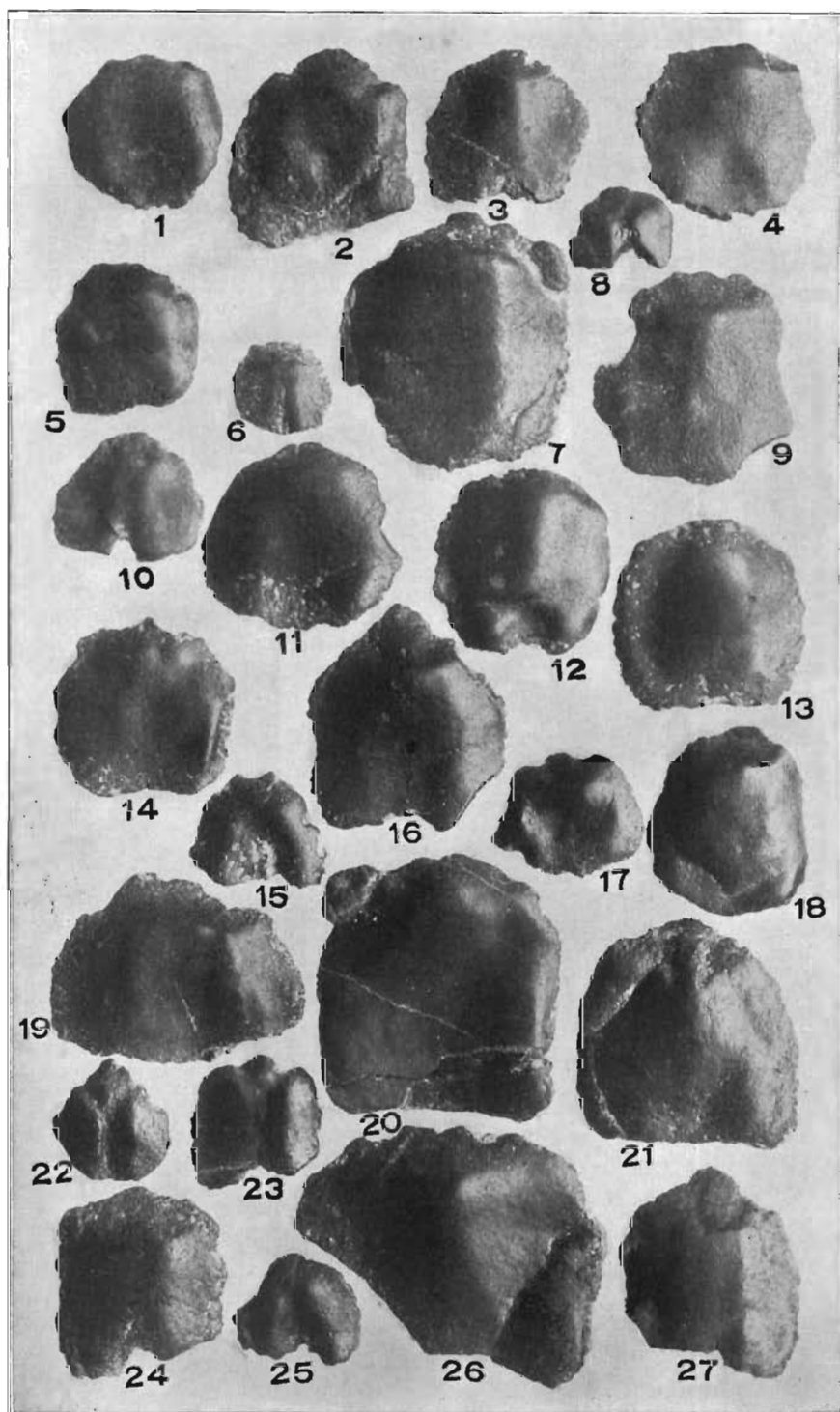




Plate XII.

EXAMPLES OF STATE QUARRY SYNTHETODONT DENTAL PLATES.

All figures reduced slightly less than the natural size.

In this Plate is shown a representative assortment of dental plates belonging to *Synthetodus calvini*. The originals of Figs. 7, 9, 12-15, are interpreted as constituting the lower, and the remainder, with the exception of Fig. 16, as the upper pavement dentition of this species. In Fig. 16 is seen a unique calcified vertebral body, also from the State Quarry "fish-beds," whose relations are considered problematical.

Originals preserved in the Museum of Comparative Zoology at Cambridge, Mass. Pages.....147 and 233

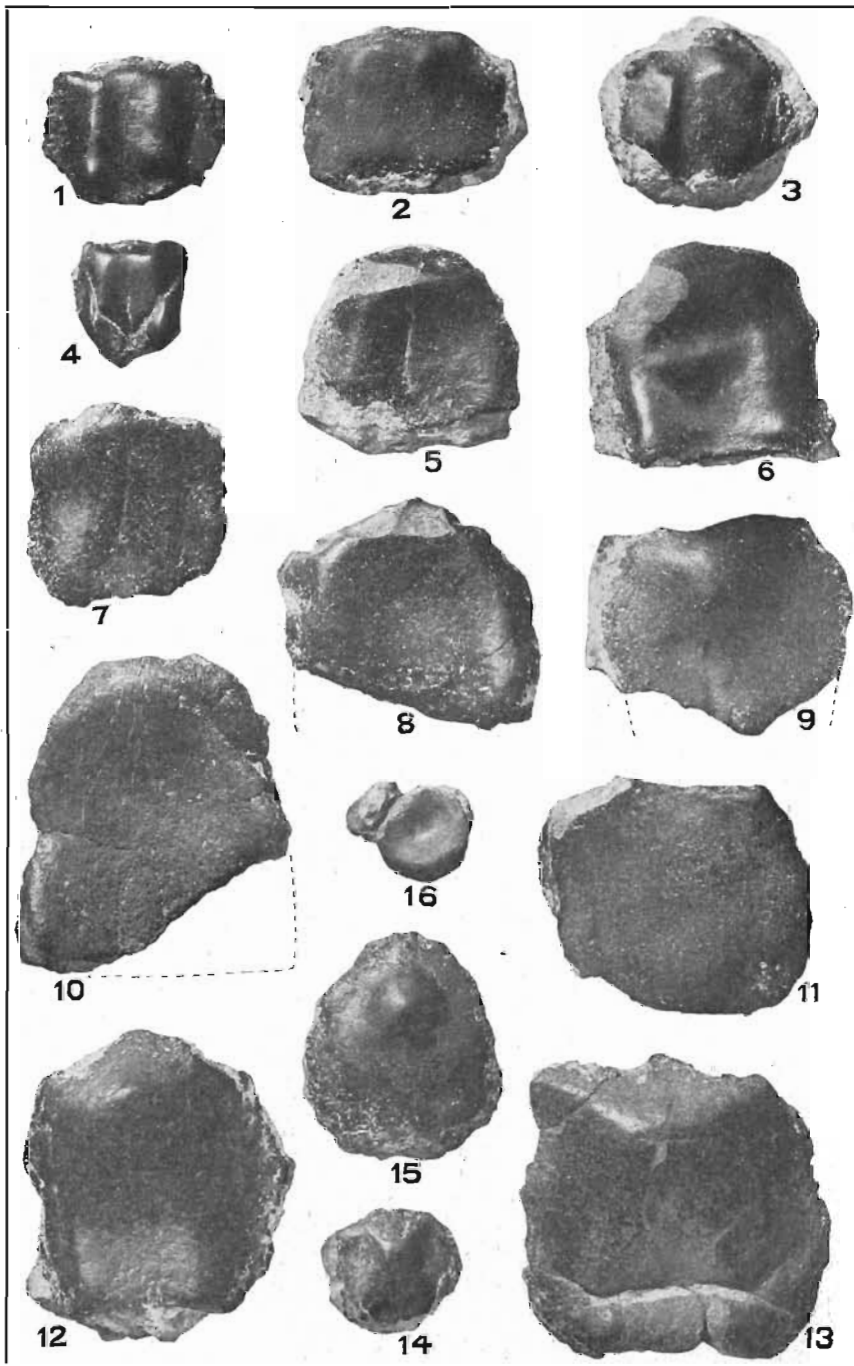


Plate XIII.

CRANIA OF *RHADINICHTHYS DEANI*, SP. NOV.

All figures are represented of the natural size.

A series of phosphatic nodules from the base of the Waverly near Junction City, in Boyle county, Kentucky, which have been cleaved in such manner as to display their organic nuclei. In the case of each specimen here illustrated, this consists of the headshield, sometimes with other naturally associated parts of a new species of *Rhadinichthys*. The cranial roof may be exposed, with or without the superficial ornament, according to the position of the plane of fracture; and in a few fortunate instances, an example of which is furnished by Figs. 8, 9, the cranial roof has been lifted off so as to reveal the structure of the mineralized brain, auditory organs, and arterial blood-vessels. Most of these specimens, like the originals of Figs. 8 and 9, 14 and 15, are preserved in counterpart. The first of these pairs is also shown in text-figure 40, *A-B*.

Originals preserved in the Museum of Comparative Zoology at Cambridge, Mass. Page.....264

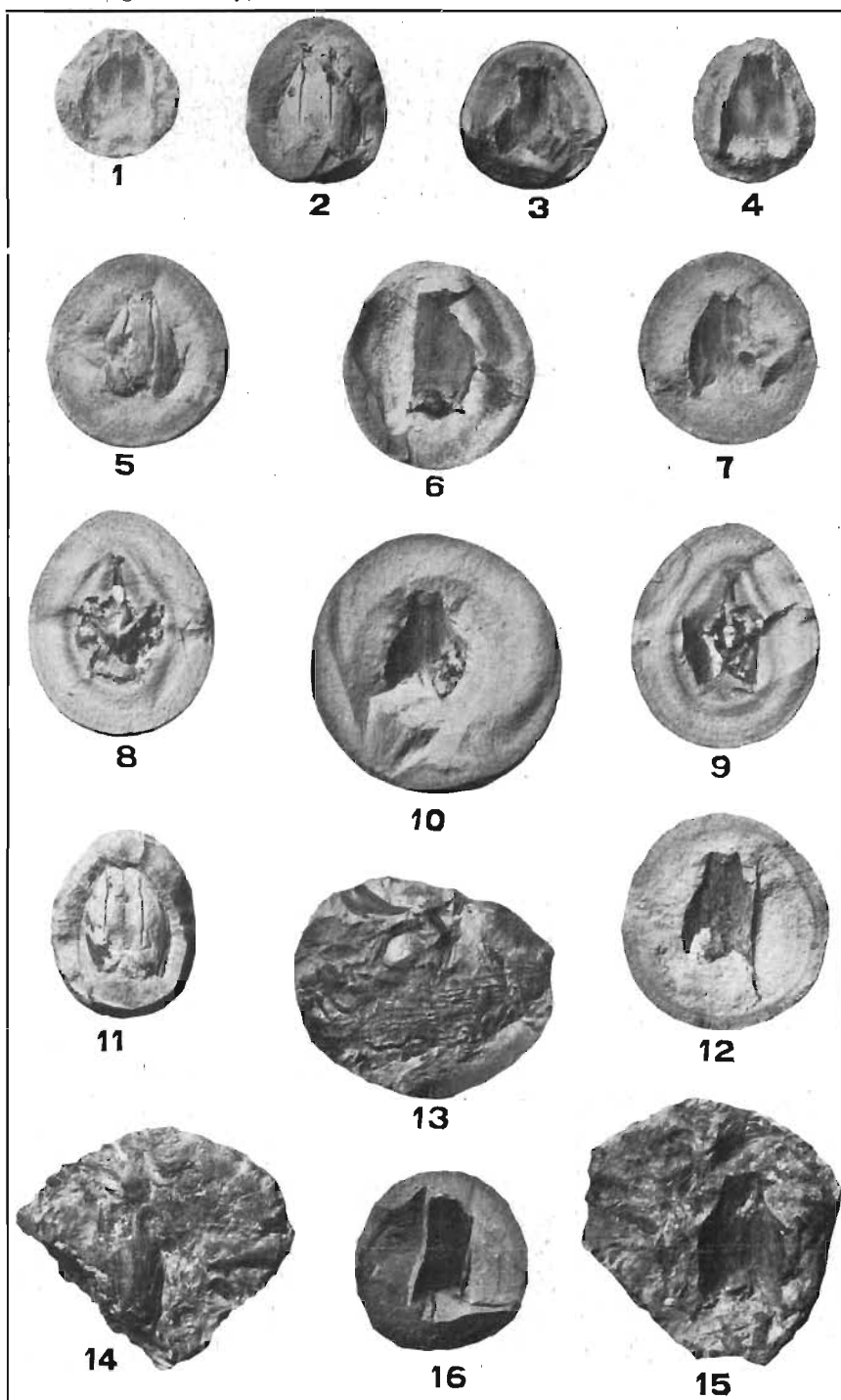


Plate XIV.

Areal Map of North American Middle Devonian

Professor Schuchert's reconstruction of Middle Devonian palæogeography at the close of Onondaga time. Noteworthy is the large extent of the interior continental area, the western borders of which are only conjecturally indicated.

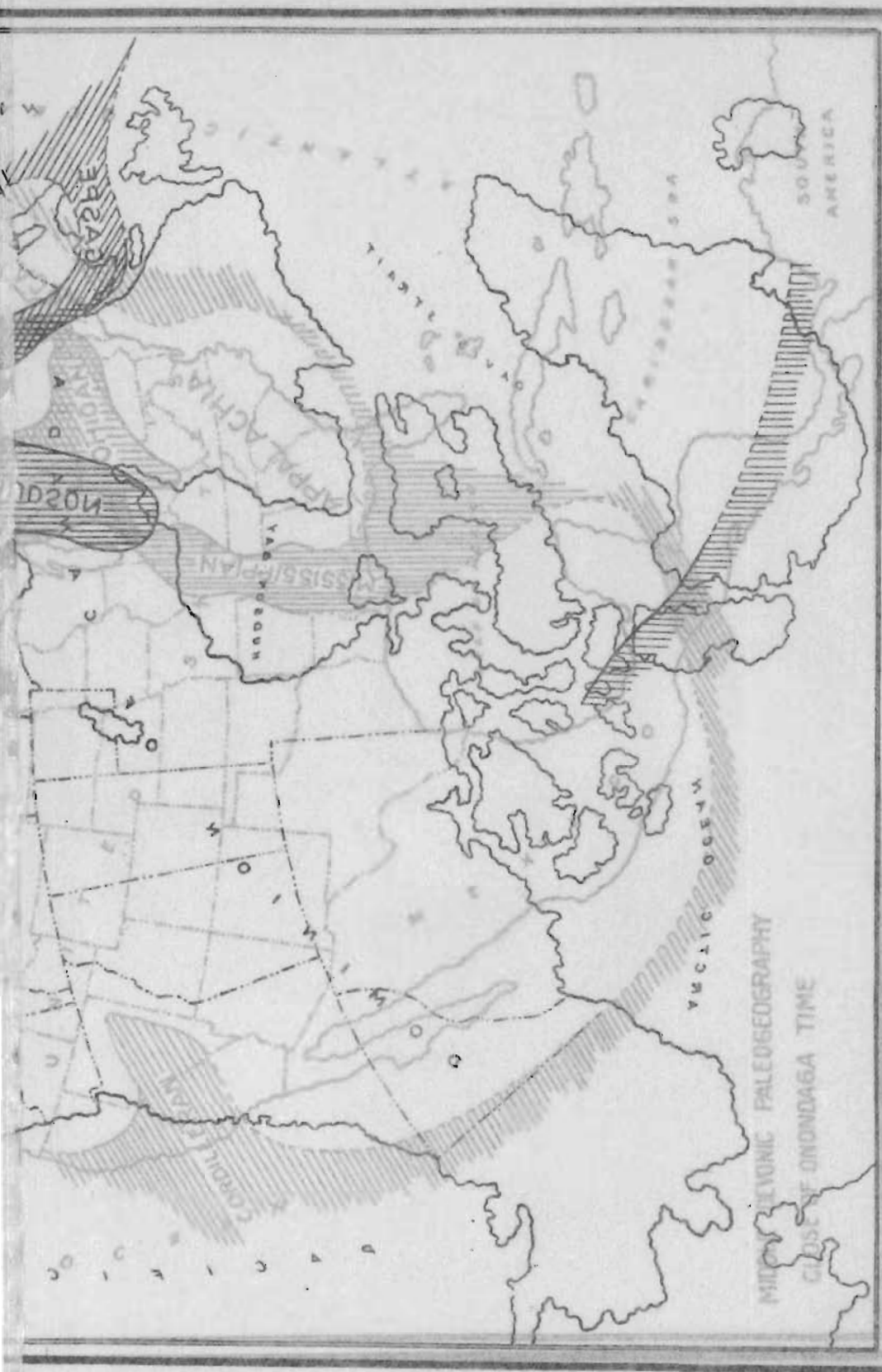


PLATE XLIII
Geological Survey of the Atlantic

PLATE XLII



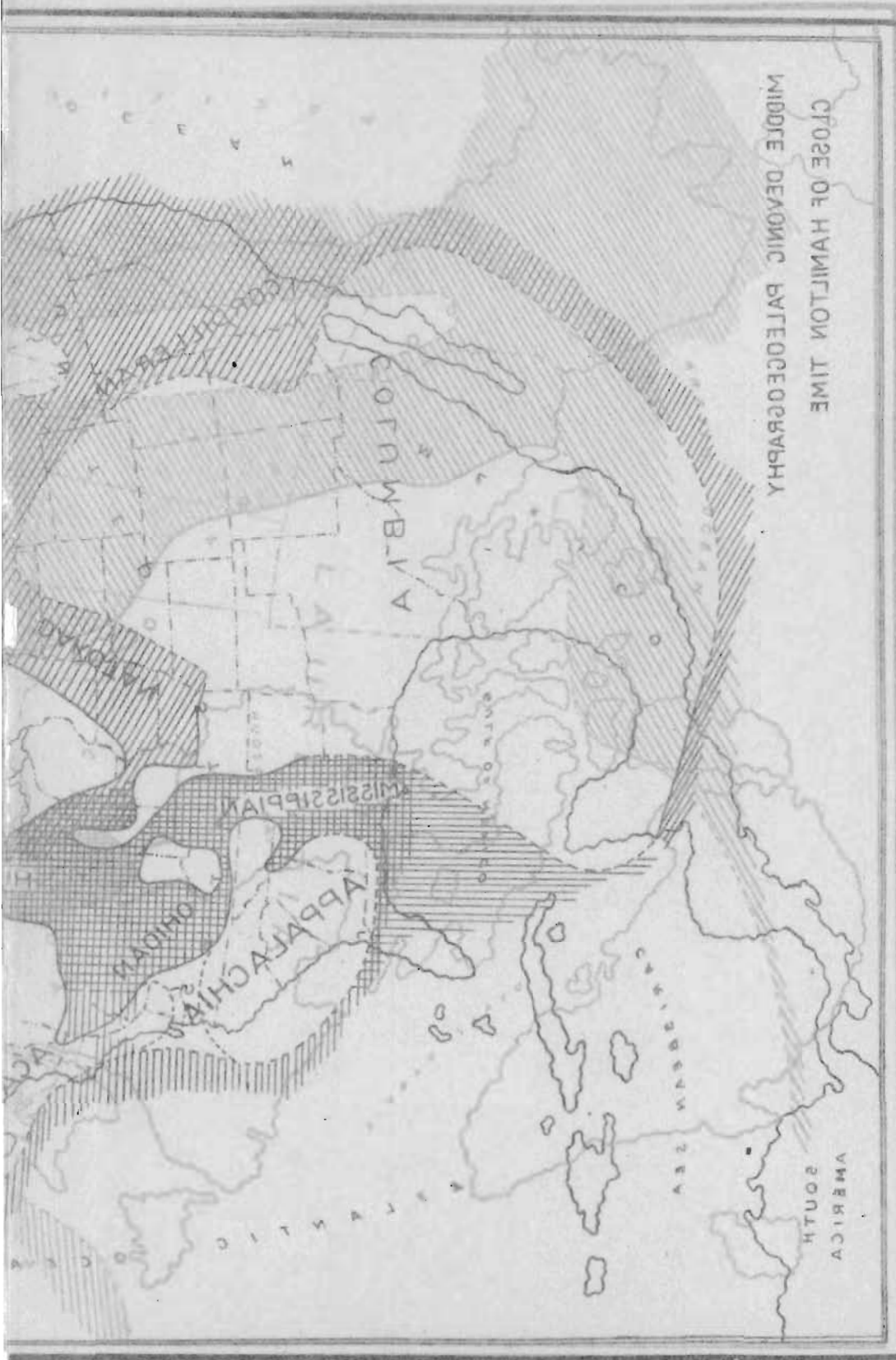


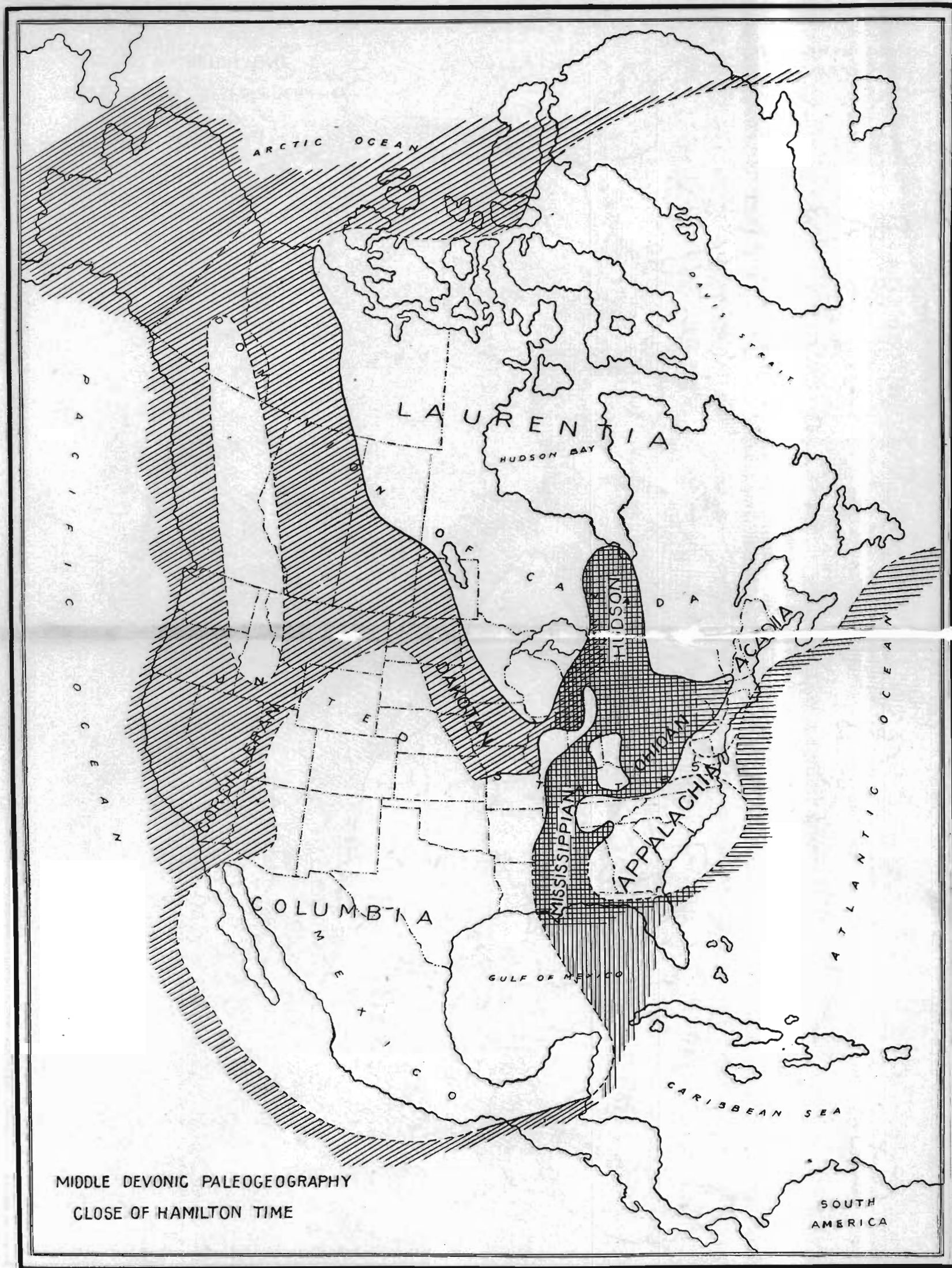
Plate XV.

Areal Map of North American Middle Devonian.

Professor Schuchert's reconstruction of Middle Devonian palæogeography at the close of Hamilton time. Partial submergence is indicated for the interior continental area, the two principal land-masses (designated as "Laurentia" and "Columbia") being separated by the encroachment of the "Dakotan sea." The "Ohioan sea" is represented as being in less open communication with oceanic bodies on the east and south than during the period immediately preceding.

CLOSE OF HAMILTON TIME
MIDDLE DEVONIC PALEOGEOGRAPHY





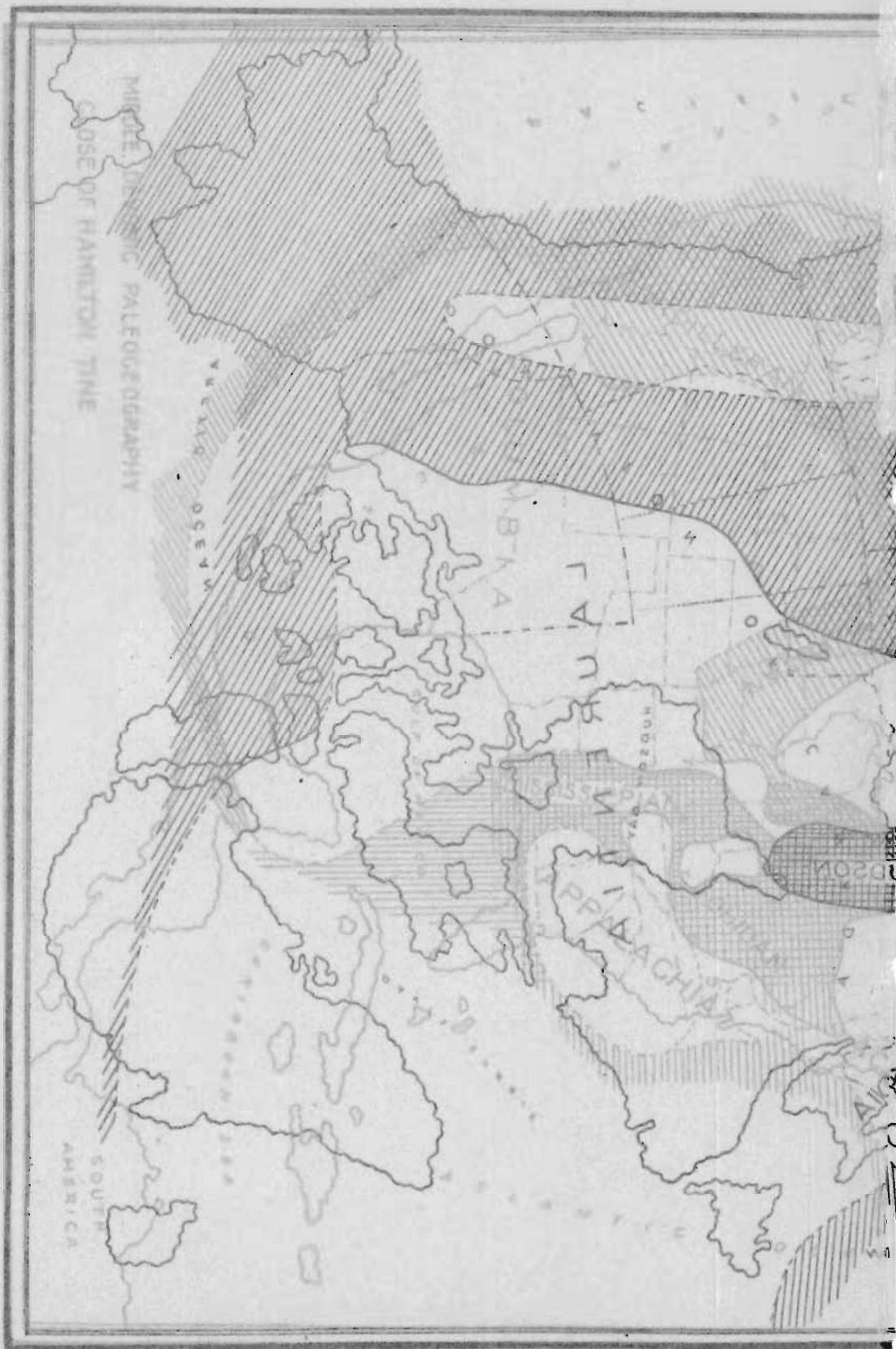


Plate XVI.

Areal Map of North American Upper Devonian.

Professor Schuchert's reconstruction of Upper Devonian palæogeography. The Appalachian and Columbian land-masses are represented as more shrunken in area than during earlier periods of the Devonian, and a westward extension of the Mississippian sea receives the name of Oklahoman. In the Cordilleran region it is probable that a larger land-mass was elevated above sea level than is here conjecturally represented.

