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FOSSIL FISH REMAINS FROM THE LATE PALEOCENE TUSCAHOMA AND EARLY EOCENE BASHI FORMATIONS OF MERIDIAN, LAUDERDALE COUNTY, MISSISSIPPI

PART I. SELACHIANS

BY

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With 15 plates, 6 text-figures and 5 tables

Zusammenfassung

Die Entdeckung einer bisher nicht erforschten Fossillagerstätte im oberen Abschnitt der Tuscahoma-Formation (spätes Paleozän-Thanetium) im östlichen Zentral-Mississippi ermöglichte es uns, eine außerordentlich reiche und vielfältige Vertebratenfauna zu beschreiben. Diese besteht vor allem aus Fischresten, bei denen die Selachier und Teleosteer vorherrschen.

Der Verfasser stellt außerdem eine Faunengemeinschaft vor, die in den unverfestigten molluskenführenden Sanden unterhalb der Mergelkonkretionen der hangenden Bashi-Formation (frühes Eozän, möglicherweise Landenium) auftritt.

Die beiden Schichtglieder, die Tuscahoma- und die Bashi-Formation beinhalten ähnliche Faunen. Es gibt aber auch einige verschiedene Arten. Die folgenden Taxa werden beschrieben: *Odontaspis hynei* nov. sp., *Physogalus americanus* nov. sp. und *Mustelus rodgersi* nov. sp. aus der Tuscahoma-Formation sowie *Heterodontus sowasheense* nov. gen. et nov. sp., *Platyrhina dockeryi* nov. sp. und *Meridiania convexa* nov. gen. et nov. sp. aus der Bashi-Formation.

Die folgenden Taxa kommen in beiden Formationen vor: *Odontaspis borodini* nov. sp., *Pseudodontaspis lauderdalensis* nov. sp., and *P. mississippiensis* nov. sp.

Zusätzliche Faunenelemente, die sowohl in der Tuscahoma- als auch in der Bashi-Formation vorkommen, sind: *Ginglymostoma subafricanum* ARAMBOURG, *Nebrius thielensis* (WINKLER), *Jaekelotodus* sp., *Odontaspis speyeri* DARTEVELLE et CASIER, *O. substriatus* (STROMER), *O. winkleri* (LERICHE), *O.* sp., *Striatolamia macrota* (AGASSIZ), *Carcharias hopei* (AGASSIZ), *C. robustus* (LERICHE), *C. teretidens* (WHITE), *C. verticalis* (AGASSIZ), *Anomotodon* sp., *Cretolamna aschersoni* (STROMER), *C. lerichei* (CASIER), *Galeus* sp., *Scyliorhinus gilberti* CASIER, *Galeorhinus affinis* (PROBST), *G. lefevrei* (DAIMERIES), *G. minor* (AGASSIZ), *G. ypresiensis* CASIER, *Abdounia beaugei* (ARAMBOURG), *A. subulidens* (ARAMBOURG), *Physogaleus tertius* (WINKLER), *P.* sp., *Rhinobatis* sp., *Pristis* sp., *Eotorpedo jaekeli* WHITE, *Dasyatis jaekeli* (LERICHE), *D. tricuspidatus* CASIER, *Coupatezia woutersi* CAPPETTA, *Myliobatis dixoni* AGASSIZ, *M.* sp., *Rhinoptera* sp., *Archaeomanta melenhorsti* HERMAN, *Burnhamia daviesi* (WOODWARD), and *B. fetahi* CAPPETTA.

Die Gesamtfaunenzusammensetzung beider Schichtglieder zeigt kosmopolitische Beziehungen und ist am ehesten mit nordafrikanischen und europäischen Tertiärfaunen zu vergleichen. Die Exemplare aus der Bashi-Formation sind denen der "Sables de Mons-en-Pévèle" aus dem Unter Eozän (Paniselium) der Tongruben Ampé Tons von Egem in belgisch Flandern ähnlich.

Zusammenfassend kann gesagt werden, daß zehn Taxa für die Literatur des Ober-Paleozäns und des Unter-Eozäns neu sind. Dagegen sind 37 Arten mit gut bekannten und weltweit verbreiteten Faunen des Paläogen konspezifisch.

Schlüsselwörter: Selachier – Paläogen – Mississippi – U.S.A.

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Summary

The recent discovery of a heretofore unreported fossil zone within the upper part of the Tuscahoma Formation (Late Paleocene-Thanetian Stage), in east-central Mississippi, allows us a study of an extremely rich and varied vertebrate fauna comprised mainly of fish remains, with an abundance of selachians and teleosts.

The author is also presenting a faunal assemblage of selachians found within the unconsolidated shell-sands below the concretionary marlstones of the overlying Bashi Formation (Early Eocene-possible Landanian Stage).

The two formations, the Tuscahoma and the Bashi, have similar faunas, but there are a few distinct species found in each faunal assemblage. The following new taxa are described: *Odontaspis hynei* nov. sp., *Physogaleus americanus* nov. sp., and *Mustelus rodgersi* nov. sp. from the Tuscahoma Formation and *Heterodontus sowasheense* nov. sp., *Microscyliorhinus leggetti* nov. gen. et nov. sp., *Platyrhina dockeryi* nov. sp., and *Meridiania convexa* nov. gen. et nov. sp. from the Bashi Formation.

The following new taxa are found in both faunal assemblages: *Odontaspis borodini* nov. sp., *Pseudodontaspis lauderdalensis* nov. sp., and *P. mississippiensis* nov. sp.

Additional fauna recovered in both the Tuscahoma and Bashi Formations are as follows: *Ginglymostoma subafricanum* ARAMBOURG, *Nebrius thielensis* (WINKLER), *Jaekelotodus* sp., *Odontaspis speyeri* DARTEVELLE et CASIER, *O. substriatus* (STROMER), *O. winkleri* (LERICHE), *O.* sp., *Striatolamia macrota* (AGASSIZ), *Carcharias hopei* (AGASSIZ), *C. robustus* (LERICHE), *C. teretidens* (WHITE), *C. verticalis* (AGASSIZ), *Anomotodon* sp., *Cretolamna aschersoni* (STROMER), *C. lerichei* (CASIER), *Galeus* sp., *Scyliorhinus gilberti* CASIER, *Galeorhinus affinis* (PROBST), *G. lefevrei* (DAIMERIES), *G. minor* (AGASSIZ), *G. ypresiensis* CASIER, *Abdounia beaugei* (ARAMBOURG), *A. subulidens* (ARAMBOURG), *Physogaleus tertius* (WINKLER), *P.* sp., *Rhinobatis* sp., *Pristis* sp., *Eotorpedo jaekeli* WHITE, *Dasyatis jaekeli* (LERICHE), *D. tricuspidatus* CASIER, *Coupatezia woutersi* CAPPETTA, *Myliobatis dixoni* AGASSIZ, *M.* sp., *Rhinoptera* sp., *Archaeomanta melenhorsti* HERMAN, *Burnhamia daviesi* (WOODWARD), and *B. fetahi* CAPPETTA.

The total faunal assemblage of the two formations have cosmopolitan affinities and compare most favorably with many North African and European Tertiary faunas. The specimens of the Bashi Formation compare quite favorably with those of the "Sables de Mons-en-Pévèle" exposures of Early Eocene age, Paniselian Stage, at the Ampé Clay Pits, at Egem, Flanders, Belgium.

In summary, ten taxa are new to the literature of the Upper Paleocene and Early Eocene, while another thirty seven specimens are conspecific with most known and world-wide distributed faunas of the Paleogene.

Key words: Selachians – Paleogene – Mississippi – U.S.A.

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1. Introduction

This study details the selachians of two superimposed Paleogene formations in the Late Paleocene and Early Eocene of Mississippi; the Tuscahoma and Bashi Formations. The European Stage equivalents would be the Thanetian Stage and probable Landanian (but, also possibly, Paniselian) Stage for the Tuscahoma and Bashi Formations, respectively.

Besides the discovery of a "fish bed" in a supposedly non-fossiliferous formation, the most exciting item is

the nature of the vertebrate material recovered from both of the present formations. They compare favorably with fish faunas from fossil deposits in England, Belgium, and France in particular; as well as in North Africa, especially in the Paleogene deposits of Morocco.

The fish fauna of the Tuscahoma Formation at Meridian, Lauderdale County, Mississippi, is of Upper Paleocene age (Late Thanetian Stage), and possibly represents an estuarine paleoenvironment, while that of the overlying Bashi Formation of Early Eocene age represents an embayment or near-shore environment.

Certain species, i.e; *Otodus obliquus, Notorhynchus serratisimus*, and *Xenodolamia eocaena*, are littoral to offshore species that have not shown up in the Tuscahoma fauna assemblage. However, at least *Otodus obliquus* occurs occassionally in the overlying Bashi Formation (private collections) and formerly on display (now lost!) at the Meridian Community College, at Meridian, Mississippi.

Of interest in the Tuscahoma Formation is that many mammalian teeth (mostly rodents) and vertebrae of snakes (marine boas) are found in association with the selachian and teleostean teeth, scutes, and vertebrae, as well as abundant fish coprolites.

Dr. K. Christopher Beard, Assistant Curator, Carnegie Museum of Natural History, Pittsburgh, Pennsylvania, is studying the mammal teeth that I had collected in 1979, with my associate, Stan Hyne of Ann Arbor, Michigan, and in 1980, with my colleague, Paul D. Borodin of Whitestone, New York, and finally on a 9 day field trip by myself in the year 1982.

All of the material in this report, and the following report on the bony fishes was collected by the author on three field trips in the years: 1979, 1980, and 1982, and the three trips were sponsored by grants from the Griffis Foundation of the American Littoral Society, Atlantic Highlands, New Jersey.

Dr. J. Alan Holman, Professor of Geology, and Curator of Vertebrate Paleontology at Michigan State University, East Lansing, Michigan, is studying the reptile material from the Tuscahoma Formation, as well as some small amount of material from the overlying Bashi Formation. Holman has already published on this site (Holman 1982, and Holman et al. 1991). Dennis Parmley, Assistant Professor, Georgia College, reported on reptiles of this site (Parmley & Case 1988). The author has written about the fishes from this site (Case 1986), and K. Beard has also recently published an article on mammal teeth recovered by the author from this site (Beard & Tabrum 1991).

The age of the Bashi Formation may be equivalent to the Paniselian Stage of Europe, and lies above the Ypresian Stage. This is assumed by the author due to great similarity of species types and sizes between the fauna of Bashi at Meridian, Mississippi and that of the Sables de Mons-en-Pévèle (Plb of Herman) as recovered at the Ampé Clay Pits at Egem, Flanders in Belgium (Herman 1979, 1982a, 1982b, 1984, and 1986).

The recovery in various North American Cretaceous and Tertiary faunas of European and English species is not unusual, but, the recovery of North African species-types (particularly of the neoselachians) in the North American Cretaceo-Tertiary Formations is noteworthy and is becoming quite common of late. This author first reported the North African (Moroccan) species: *Cretolamna biauriculata* and *Rhombodus binkhorsti* in the Late Maastrichtian (Navarroan) of the Upper Cretaceous, Peedee Formation of Duplin County, North Carolina (Case 1979) and also recognized *Cretolamna appendiculata lata* which was first reported by Cappetta & Case (1975b) in their report on the selachians of the Monmouth Group (Early to Middle Maastrichtian) of New Jersey. Since then, the latter species has been found in most Atlantic Coastal Plain Cretaceous faunas, and has recently been listed from the fish fauna of the Blufftown Formation (Campanian) of Georgia (Case & Schwimmer 1988).

In a report on the selachian fauna of the Late Eocene of Georgia (Case 1981) listed *Propristis schweinfurthi* from the Twiggs Clay Member of the Barnwell Formation (Jacksonian) in Twiggs County, Georgia. The first occurrence in North America for that Egyptian species was reported from the Kaolin clay area near Dry Branch, Twiggs County, Georgia (Dunkle 1951).

This present paper lists for the first time in North American geological formations, the following North African species: *Cretolamna aschersoni* (Case & Leggett, in press); *Odontaspis speyeri; Abdounia beaugei; A. subulidens; Ginglymostoma subafricanum;* and *Burnhamia fetahi.*

European species are very numerous and are listed in Tables 2 and 3, along with their American counterparts.

2. History and geology

a. Historical geology – Tuscahoma Formation

It is necessary, first, to do a background perspective on the geology of the various units or divisions of the Wilcox Group (Paleogene), which comprise the Late Paleocene, Tuscahoma Formation, and the Early Eocene, Bashi Formation of this report, in the State of Mississippi (cf. Text-fig. 1).

As a natural process, the geological column of any given State or region is in constant flux over a long period of time, and as such, is subject to interpretation and revision by various authors (the present being no exception!). The following summary of terminology for the units in the Wilcox Group is the work of the author of this paper, with the valuable assistance of his colleague, Mr. JAMES J. LEGGETT of Elizabeth, New Jersey. For the present, the following material has been gathered from older publications (bulletins and reports) of the Geological Surveys of the States of Mississippi and Alabama. This author can not guarantee that this information is up-to-date.

Origin of the name Wilcox Group

LOWE (1933, p. 32) states: "It was first described in the year 1856 by Dr. JAMES M. SAFFORD, then the State Geologist of Tennessee, who called it 'Orange sand'". (Ed. note: The Holly Springs Sand Formation of LOWE (1913) is a part of the Orange Sand).

According to D.T. DOCKERY III (pers. commun.), the original reference to the Wilcox Group is by CRIDER & JOHNSON 1906, United States Geological Survey Water Supply Paper 159, p. 5,9.

Stratigraphic terms named in the Wilcox Group of Mississippi

LOWE (1933, p. 34) states: "The Wilcox Group in Mississippi is prevailingly fresh-water deposits with the exception of limited deposits of the Bashi and probably of the Naheola (Ed. note: the latter is of the Midway Group – Lower Paleocene) ... NO marine phases having been noted."

LOWE (1933, p. 34) further states: "There is a four-fold division of the Wilcox Group in Mississippi: 1. Ackerman (probably the lower part of the Tuscahoma and in part, the contact with the Nanafalia); 2. Holly Springs (the upper part of the Tuscahoma near the contact of the Bashi (Ed. note: This is the part of the study in the Tuscahoma fossil beds); 3. Bashi Formation; 4. Hatchetigbee Formation; and 5. Grenada Formation (Ed. note: For some unknown reason LOWE adds a 'fifth' formation to his 4-fold division of the Wilcox Group. This latter division may in fact be an equivalent to the Meridian Sand of the Claiborne Group).

LOWE (1913) named the "Ackerman Formation" based upon the basal clays of the Wilcox Group. He named it after the town of Ackerman in Choctaw County, Alabama. LOWE also indicates plant remains (1933, p. 39) found in the Ackerman Formation.

Overlying the Holly Springs Sand Formation (of LOWE) is the Bashi (Marl) Formation. FOSTER (1940, p. 32) lists five divisions of the Wilcox Group in Lauderdale County, Mississippi, they are: 1. Fern Springs (probably equivalent to the Nanafalia or the Lower Tuscahoma); 2. Ackerman; 3. Holly Springs; 4. Bashi; and 5. Hatchetigbee.

MELLEN (1939) described a section of sand, shale, and lignitic clay ... (which) he considered a distinct formation and named it from the characteristic development near Fern Springs, Winston County, Mississippi; MELLEN says: "The Fern Springs is possibly equivalent to the Ackerman Formation."

FOSTER (1940, p. 43) states: The Ackerman Formation includes those beds lying disconformably above the 'basal clays' or 'transition beds' of the older publications (here included in Naheola and Fern Springs) and disconformably below the basal sands of the Holly Springs Formation."

The term Holly Springs Sand was first applied by LOWE (1913, p. 25–27) to the middle division of the Wilcox Formation. (Ed. note: Either FOSTER's work (1940, p. 48) contains a typographical error, or in LOWE's original paper, he may have inadvertantly transposed the words 'division' with 'formation'). FOSTER further states (1940, p. 53) "No marine sediments were found in the Holly Springs of Lauderdale County, although within a few miles of the State line, the equivalent beds of Alabama (Tuscahoma) included glauconitic marls having a varied marine fauna."

Discussion on the origins of the Tuscahoma sand and reclassification as a formation

Note: According to D.T. DOCKERY, III (pers. commun.), the Tuscahoma is in the Wilcox Group. The Wilcox Group contains both Paleocene and Eocene units including the Nanafalia, Tuscahoma, Bashi, and Hatchetigbee Formations.

TOULMIN et al. (1951, p. 62) state that "The Tuscahoma Sand (in the State of Alabama) takes its present name from exposures at Tuscahoma Landing on the Tombigbee River – N.E. ¼, Sec. 31, T. 13 N., R. 1 W., Choctaw County, Alabama. It was first called the Bells Landing Series by SMITH & JOHNSON (1887), and later – the Tuscahoma ...".

TOULMIN et al. (1951, p. 65) talk about the "upper 120 feet" of the Tuscahoma Sand and describe "layers of pillow-shaped" sandstone concretions, from three to five feet in diameter. (Ed. note: TOULMIN and his associates are inadvertantly describing the lower part of the Bashi Marl Formation!).

TOULMIN et al. (1951, p. 66) further state that the most common invertebrate fossil found (in the Tuscahoma of Alabama) is *Turritella mortoni postmortoni* HARRIS. This is quite interesting, as the typical invertebrate fossil found in the Upper Aquia Formation (Late Paleocene) of Virginia and Maryland, is *Turritella mortoni* (CASE 1967).

HUGHES (1958, 166) states that the first reference for the use of the nomenclature, "Tuscahoma Sand" was by E.A. SMITH (1888). In his report, HUGHES further states that Bells Landing Series has one year's priority over Tuscahoma. (Ed. note: No one nowadays will accept this priority, and the name Tuscahoma is considered valid usage).

HUGHES also mentions that the Nanafalia Formation and its Fern Springs Member are Early Eocene (Wilcoxian) in age and is equivalent to part (the lower part) of the Ypresian substage (now considered a full stage) of the European classification system. Finally, HUGHES (1958, p. 177) says: "... the Tuscahoma Sand ... (in Mississippi) correlates with the Tuscahoma of Alabama."

KEADY (1962, p. 53) states: "The Tuscahoma Formation ... is composed chiefly of deltaic, fluviatile, and paludal sediments – a continuation of deposition similar to that of the Nanafalia. However, marine beds are absent in the Tuscahoma in Mississippi, with possible exceptions in the extreme eastern part of Lauderdale County."

RAINWATER et al. (1964, p. 26) state: "The Middle Wilcox (Tuscahoma) was a period of regression, when sedimentation was faster than subsidence."

In "The Geology of the Coastal Plain of Alabama" (ed. by D. E. JONES, 1967, p. 37), it is stated: "The Tuscahoma consists chiefly of non-fossiliferous sand and silt, containing three or more fossiliferous glauconitic sand and marl beds in the lower half of the formation. The fossiliferous beds of the Tuscahoma Sand are characterized by ... (only invertebrates are mentioned)."

TOULMIN (1977, p. 100) says: "The upper boundary of the Wilcox Group coincides with the upper boundary of the Sabine Stage, but the lower boundary is below that of the stage and is placed at the bottom of the Naheola Formation (Lower Paleocene, in the Midway Group) on lithologic criteria. The Sabine Stage has also been called the 'Lignitic Stage'."

TOULMIN (1977, p. 104) states that the Sabine Stage is now comprised of the Midway and Wilcox Groups of earlier reports.

DOCKERY et al. (1984, p. 15) state that in their opinion, the Tuscahoma Formation (in Mississippi) is devoid of fossils, and DOCKERY (1980, p. 25) says: "The Bashi Formation is the **only** Wilcox Unit in the State of Mississippi with an abundance of marine fossils."

The Tuscahoma fossiliferous zone

The author, with the assistance of STAN HYNE of Ann Arbor, Michigan, discovered the 'lag deposit' now known as the Tuscahoma Formation outcropping in the bluff back of the Red Hot Truck Stop, of the Frontage Road, in the environs of Meridian, Lauderdale County, Mississippi. This was in the year 1979. The following year, the author worked the fossiliferous zone with PAUL D. BORODIN of Malba (Whitestone), New York. The author finally worked the site by himself in the year 1982.

The fossils found by the author and his associates were as follows: Fish teeth (sharks, skates, rays, and sawfishes) as well as bony fish teeth and vertebrae; mammal teeth; snake vertebrae, and an occassional turtle bone and crocodilian teeth.

CASE (1986) reported this site known as the 'CASE estuary site 1' and discussed the above fauna in comparison with those of the overlying Bashi Boulder zone.

Recently, INGRAM (1991) published a paper dealing with the Tuscahoma Bashi section at Meridian, Mississippi. In this work, he states: "Several significant paleontologic findings have been made at this locality" and discusses the outcropping of the Tuscahoma Formation ("CASE's estuary site 1") and its geology. This outcropping is now known as "The T4 Channel Sand" and INGRAM states: "The T4 Channel Sand occurs just below the Tuscahoma-Bashi, Paleocene-Eocene boundary." He states in a description of the outcropping: "It is jade-green and composed of fine to very fine-grained quartz sand, fine grained glauconite, and mica" and further states: "At the base of the T4 Channel Sand is a lag deposit composed of vertebrate teeth and other fossil fragments."

b. Historical geology – Bashi Formation

Origin of the name Bashi

SMITH & JOHNSON (1887) established the name "Bashi" for the old "Woods Bluff" Formation, and named it after the Bashi Creek in Clarke County, Alabama.

LOWE (1933) states that as of the year 1907, E.A. SMITH adopted the name Bashi Formation and used Woods Bluff in parenthesis after it.

LOWE (1933, p. 100) further states that SMITH & JOHNSON in the year 1887 originally described the Bashi as the "Woods Bluff" or "Bashi Series", from the type exposures at Woods Bluff on the Tombigbee River, also just below JOHNSON's Island on the Alabama River, and on Bashi Creek and its tributaries in Clarke County, Alabama. Then in 1892 and 1894, they designated it as the Bashi or Woods Bluff Group (or Series).

c. Typical invertebrate fauna of the Bashi Formation (Wilcox Group) of Mississippi

Coelenterata:	*Madracis gregorioi* VAUGHAN
molluscans –	
Gastropoda:	*Solariella sylvaerupis* HARRIS
	Turritella rina PALMER
	Turritella gilberti BOWLES
	Euspira sabina (PALMER)
	Sinum declive (CONRAD)
	Sigativa clarkeana ALDRICH
	Pseudoliva santander GARDNER
	Cornulina minax compressa DOCKERY
	Nassarius exilis (CONRAD)
	Bullia calluspira DOCKERY
	Athleta tuomeyi (CONRAD)
	Coronia childreni (I. LEA) var. a
	Eopleurotoma cainei (HARRIS)
	Tornatellaea bella CONRAD
Scaphopoda:	*Cadulus* sp.
Bivalvia:	*Chlamys choctavensis* (ALDRICH)
	Crassotrea sp.
	Ostrea brevifronta DOCKERY
	Odontogryphaea sp.
	Lucina (Cavilinga) promila smithi (MEYER)
	Codakia? (Claibornites) sp.
	Felaniella sp.
	Venericardia (Leuroactis) horationa GARDNER
	Venericardia (Venericor) greggiana DALL
	Venericardia cf. *V. nanaplata nanna* GARDNER & BOWLES

Venericardia (Venericor) bashiplata GARDNER & BOWLES
Lirodiscus (Lirodiscus) smithvillensis (HARRIS) var.
Pitar (Pitar) nuttalliopsis (HEILPRIN)
Callista (Macrocallista) sylvaerupis (HARRIS)
Corbula subengonata DALL
List is from DOCKERY (1980).

Text-fig. 1. Map of the United States of America. Star in circle indicates approximate position of the Tuscahoma/Bashi fossil site at Meridian, Lauderdale County, Mississippi.

A note here regarding the list of invertebrate material as found in the Bashi Formation – with a comparison of the faunal lists of LOWE (1933) and DOCKERY (1980).

LOWE (1933, p. 103) has a faunal list of approximately 40 or 41 specimens recovered from "MCKAY's Marl Bed" at Sowashee Creek, 2 miles south of Meridian, Lauderdale County, Mississippi. (Ed. note: This may well be the "Boulder zone" of this report at the Red Hot Truck Stop, on the outskirts (south of) Meridian, Mississippi, and nearby to the Sowashee Creek).

DOCKERY (1980) studied the invertebrate fauna of the Bashi Formation at the Red Hot Truck Stop locality in Meridian, as well as other sites in Lauderdale County, Mississippi.

The differences in the two faunal lists may be due to an "updating" and/or re-identification of species-types. However, in all fairness to the earlier workers, with the invertebrates of the Bashi (i.e; C. WYTHE COOKE in particular, who identified the species types which are listed in LOWE's 1933 publication) – the LOWE list is included here for a comparison and in general, as a historical reference. There is no inference by the author of this paper (GRC) that either the previous list by DOCKERY (1980) or the following list by LOWE (1933), is or is not, in any way accurate or dependable as an aid in the identification of the invertebrate material of the Bashi Formation. The lists are included here as an item of interest to those who may be interested in the associated faunas within a given formation structure.

The Tuscahoma is not represented here by any invertebrate remains, due to the fact that **none** (with the exception of soft-sand steinkerns of indeterminate gastropods which were found in the estuarine paleoenvironments of this study) were found in the "fish bonebeds" at the Red Hot Truck Stop near Meridian, Lauderdale County, Mississippi.

The following listing is from LOWE (1933, p. 103): Bashi: *Tornaellaea bella* CONRAD, *Cyclichna aldrichi* LANGDON?, *Philine alabamensis* ALDRICH, *Cyclichna sylaerupis* HARRIS, *Pleurotoma cainei* HARRIS, *Pleurotoma teraralis* LAMARCK (plus 3 species and 1 variety of *Pleurotoma), Cancellaria tortiplica* CONRAD?, *Plejona petrosa* var. *tuomeyi* CONRAD, *Pseudolivia vetusta* (CONRAD), *Cornulina armigera* (CONRAD), *Calyptraphorus trinodiferus* (CONRAD)?, *Siphonalia subscalarina* (HEILPRIN), *Turritella clevelandia* HARRIS (var.),

Lunatia newtonensis (MEYER & ALDRICH), *Solariella louisiana* DALL, *Dentalium microrostria* HEILPRIN, *Dentalium* sp., *Cadulus abruptus* (MEYER & ALDRICH), *Nucula* sp., *Leda robusta* ALDRICH, *Leda pharcida* DALL, *Ostrea trigonalis* var. *sylvaerupis* HARRIS, *Ostrea sellaeformis* CONRAD, *Corbula aldrichi* MEYER, *Corbula alabamensis* LEA, *Corbula* cf. *C. engonata* CONRAD (this latter changed to: *Corbula subengonata* DALL), *Spisula* sp., *Tellina trumani* HARRIS, *Tellina virginiana* CLARK, *Meretrix nutaleiopsis* HEILPRIN, *Meretrix subimpressa* (CONRAD) var., *Lucina subvexa* CONRAD, *Phacoides (Parvilucina) smithi* MEYER, *Phaicoides (Miltha) pandatus* (CONRAD), *Diplodonta hopkinsensis* CLARK?, *Venericardia planicosta* (LAMARCK), and *Venericardia* cf. *V. rotunda* LEA.

3. Systematics

Class: Chondrichthyes HUXLEY 1880

Subclass: Elasmobranchii BONAPARTE 1838

Subcohort: Neoselachii COMPAGNO 1977

Superorder: Galeomorphii COMPAGNO 1973

Order: Heterodontiformes BERG 1937

Family: Heterodontidae GRAY 1851

Genus: *Heterodontus* BLAINVILLE 1816

Heterodontus sowasheense nov. sp.

(Plate 2, Fig. 10–33)

Material: 6 specimens: 3 of which are anterior teeth, 1 lateral tooth and 2 posterior teeth of juvenile 'horn-sharks.'

Derivatio nominis: Named after the Sowashee Creek which runs nearby the fossil site in Mississippi.

Holotype: AMNH 13724. An anterior tooth of a juvenile.

Paratypoids: AMNH 13721. Anterior tooth; AMNH 13722. Lateral tooth, AMNH 13723. Lateral tooth; AMNH 13725. Lateral tooth; AMNH 13726. Anterior tooth.

Locality: Boulder zone, near the top of a bluff behind the Red Hot Truck Stop, off of Highway 20–59 (access road), Meridian, Lauderdale County, Mississippi;

Age: Bashi Formation, Early Eocene (Ypresian or Paniselian stage?).

Diagnosis: Anterior teeth, dimunitive in size, possessing from three to five cusps on their enamel crowns; lateral teeth with a ridge of cusps (approximately five or six), directed towards the commissure; and posterior teeth devoid of cusps, with flattened crowns, with slight coronal crestings.

Description: Anterior teeth averaging 2 mm across the width of the apron of the tooth in labial aspect (cf. Plate 2, Fig. 10, 19, and 29). Tooth crown of anterior teeth, highly elevated, with one central cusp (or blade) with from one to two side cusps on either side (cf. Plate 2, Fig. 19 and 29); apron of tooth extended posteriorly and on some specimens, there appears slight ornamentation in the form of conchoidal 'chips' and some rugose striae (cf. Plate 2, Fig. 10 and 11); the basal aspect shows a large foramen in its center, which traverses through the root and exits at the boss of the root in lingual aspect, through the apical foramen (cf. Plate 2, Fig. 12 and 13). Lateral teeth expand in their width and their coronal ridge is comprised of a series of 'stepped-down' multiple cusps, directed towards the commissure of the jaw. The roots contain (in lingual aspect), a certain number of foramina, at least of which are lateral facette foramina (cf. Plate 2, Fig. 26). Finally, the posterior teeth which are elongate and extremely low-crowned (stubby) in their appearance, with no traces of cusps, but a very slight indication of a coronal ridge (cf. Plate 2, Fig. 16 and 18), some foramina appear along the lingual apron area of the roots.

Discussion: The 'horn-shark' (Port Jackson shark) is extremely rare in the fossil record of the eastern seaboard of the United States, and until now, completely unknown in the Gulf coastal States.

CASE (1980 and 1981) described occurrences of the teeth of the horn-shark, *Heterodontus* in the Late Eocene and Early Miocene of the Eastern seaboard (Georgia and North Carolina, respectively). The present description now extends the occurrence in the fossil record for the horn shark, back to the Early Eocene. Although not as yet described, an anterior tooth of *Heterodontus* has been recovered from the Upper Cretaceous of New Jersey (Early to Middle Maastrichtian).

Modern day horn sharks are found along the west coast of North America, from Oregon to Baja California), and in many parts of the Pacific Ocean, as well as in the Sea of Japan.

Order: Orectolobiformes Applegate 1972

Family: Ginglymostomatidae Gill 1862

Genus: *Ginglymostoma* Müller et Henle 1837

Ginglymostoma subafricanum Arambourg

(Plate 10, Fig. 225–233, Plate 11, Fig. 234–242)

Material: Several hundreds of specimens.

Specimens: (AMNH 13727), (AMNH 13728), (AMNH 13729), and (AMNH 13730).

Localities: From both the Tuscahoma glauconitic sands and the overlying Bashi "Boulder zone," off of Highway 20–59 (access road), in a bluff situated behind the Red Hot Truck Stop, Meridian, Lauderdale County, Mississippi.

Ages: Tuscahoma Formation, Late Paleocene (Thanetian stage), and from the Bashi Formation, Early Eocene (Ypresian or Paniselian stage?).

Description: Teeth quite small, averaging 3 mm in their overall height, 5 mm in their greatest width; anterior teeth symmetrical (cf. Plate 10, Fig. 225–229); lateral teeth with coronal cusps directed towards the commissure (cf. Plate 10, Fig. 230–233). The base of *Ginglymostoma subafricanum* contains a large single foramen and is hemiaulacorhize in structure.

Discussion: This species was first described by Arambourg (1952: 135–137) from the Montian and Thanetian (Paleocene) of Morocco, North Africa.

The author has illustrated a specimen of *Ginglymostoma africanum* (cf. Plate 11, Fig. 238) for comparison, to show that *G. subafricanum* contains two cusps, while *G. africanum* has only one on each side of its central blade. Even though Arambourg also described *G. africanum* (Arambourg 1927) (also from Africa – Landana, Cabinda, western Congo), the comparative specimens in this report is from the Late Paleocene, Thanetian Stage, Lower Aquia Formation of Maryland. This specimen has not been officially described in a scientific publication, and is only shown here as a comparative specimen to those of *Ginglymostoma subafricanum.*

Genus: *Nebrius* Rüppel 1837

Nebrius thielensis (Winkler)

(Plate 11, Fig. 243–251)

Material: Numerous specimens.

Specimens: (AMNH 13731), (AMNH 13732), and (AMNH 13733).

Localities: From both the Tuscahoma glauconitic sands and the overlying Bashi "Boulder zone," in a bluff situated behind the Red Hot Truck Stop, off of Highway 20–59 (access road), Meridian, Lauderdale County, Mississippi.

Ages: Tuscahoma Formation, Late Paleocene (Thanetian stage), and from the Bashi Formation, Early Eocene (Ypresian or Paniselian stage?).

Description: Teeth small, averaging 2 mm in overall height and about 4 mm in their greatest width; anterior and lateral teeth have an asymmetry of the crown where the attached cusps (part of the entire outer margin of the crown-coronal ridge) lean towards the commissure of the jaw; and as with the previous description, the base of these teeth are in the hemiaulacorhize stage of root vascularisation.

Discussion: The teeth of *Nebrius* can be readily distinguished from the previous, *Ginglymostoma*, by the overhanging apron extension on the labial face of the tooth (cf. Plate 11, Fig. 243). *Nebrius thielensis* is fairly common in the Middle Eocene (Lutetian or Bruxellian) of Belgium, and is also found in the Late Eocene (Jacksonian stage) of Georgia, U.S.A. (Case 1975 and 1981).

Order: Lamniformes Berg 1958

Family: Odontaspididae MÜLLER et HENLE 1839

Genus: *Jaekelotodus* MENNER 1928

? *Jaekelotodus* sp.

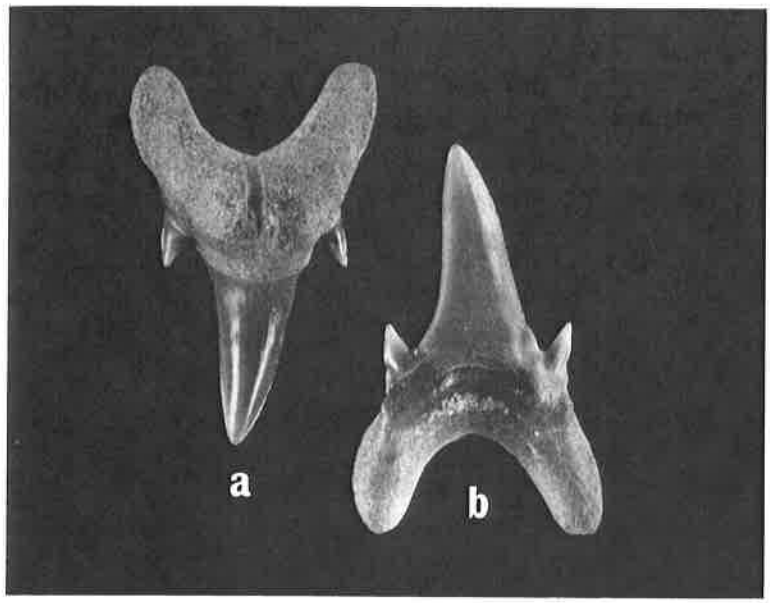
(Text-figure 2)

Material: Several dozens of specimens.
Specimen: (AMNH 13734).
Locality: CASE's estuary site 1 (Tuscahoma greensand), Meridian, Lauderdale County, Mississippi.
Age: Tuscahoma Formation, Late Paleocene (Thanetian stage).

Description: Teeth average 2 cm in total height, central blade is slender and devoid of striae; one sigmoidal side cusp on either side of the central blade. Tooth is robust with a large pronounced boss (cf. Text-fig. 5a). The boss also shows a distinctive furrow (groove).

Discussion: *Jaekelotodus*, as far as this author is aware, never has been reported in the Tertiary of North America.

According to CAPPETTA (1987: 88), specimens of *Jaekelotodus trigonalis* have so far only been found in the Upper Eocene and Lower Oligocene of the U.S.S.R, as well as in the Middle Eocene, Paris Basin of France. This author, along with four colleagues is currently preparing a manuscript on Middle Eocene selachians of the Kizylkum Desert, Uzbekistan Republic, in the Soviet Union. Among the large faunal assemblage are many representatives of *Jaekelotodus trigonalis.*



Text-fig. 2. An anterior tooth? of ?*Jaekelotodus* sp. a. Lingual view. b. Labial view.

Genus: *Odontaspis* AGASSIZ 1838

Odontaspis borodini nov. sp.

(Plate 5, Fig. 103, Plate 6, Fig. 104–105 and 112–113)

Material: Two dozen teeth, anterior and antero-lateral.
Derivatio nominis: Named after Mr. PAUL D. BORODIN, Malba, New York, who assisted the author in collecting at the site (1980).
Holotype: (AMNH 13736). [From the Bashi Formation, "Boulder Zone."]
Paratypoids: (AMNH 13735) and (AMNH 13737). [From both formations, Bashi and Tuscahoma.]

Localities: From both the Tuscahoma glauconitic sands and the overlying Bashi "Boulder zone", in a bluff situated behind the Red Hot Truck Stop, off of Highway 20–59 (access road), Meridian, Lauderdale County, Mississippi.

Ages: Tuscahoma Formation, Late Paleocene (Thanetian stage), and from the Bashi Formation, Early Eocene (Ypresian or Paniselian stage?).

Diagnosis: Teeth minute in size, with distinctive "flattened" and slightly triangular-shaped lateral (side) cusps, with striae on the lingual aspect of the central blade.

Description: Teeth average in size approximately 0.3 cm in their greatest height. The side cusps (two on either side of the central blade), the one nearest the central blade is longer than the outer one, which in turn possesses a vestigial cusplet (cf. Plate 6, Fig. 104). The lingual aspect of the tooth shows slight striae on the central cusp (blade) (cf. Plate 5, Fig. 103), and the root boss contains a distinctive furrow (groove).

Discussion: The teeth of *Odontaspis borodini* nov. sp. differ from other odontaspidid teeth in the most distinctive design of their lateral cusps. Although not very common, these teeth are recovered from both formations.

Despite the apparent similarity between *O. borodini* nov. sp. and *O. speyeri* (described following this), the side cusps of *O. borodini* nov. sp. differ dramatically from those of *O. speyeri* (cf. Plate 5, Fig. 101–102 and 103, for comparison). The shape of the overall teeth of *O. borodini* nov. sp. and *O. speyeri* differ as well, those of *O. borodini* nov. sp. being slightly concave and generally "flattened" (especially on the lateral cusps!), and triangular in shape, while those of *O. speyeri* are much more robust, with much more rounded (sigmoid) lateral cusps.

Odontaspis hynei nov. sp.

(Plate 6, Fig. 106–107 and Plate 7, Fig. 132–133)

Material: Less than one dozen teeth.

Derivatio nominis: Named for Stan Hyne, Ann Arbor, Michigan, who assisted the author in collecting at the site (1979).

Holotype: (AMNH 13739).

Paratypoid: (AMNH 13738).

Locality: Case's estuary site 1 (Tuscahoma greensand), Meridian, Lauderdale County, Mississippi.

Age: Tuscahoma Formation, Late Paleocene (Thanetian stage).

Diagnosis: Microscopic sized teeth, elongated, with a slender central cusp or blade, with from one to two side cusps, also tenous, although slightly sigmoidal in nature.

Description: The teeth of *Odontaspis hynei* nov. sp. average 3 mm in overall height and are extremely fragile in appearance (cf. Plate 6, Fig. 106–107 and Plate 7, Fig. 132–133). Some specimens show surficial wear on the root area in lingual aspect, while others (cf. Plate 7, Fig. 132) show a pronounced root furrow (groove). The lateral cusps of *O. hynei* nov. sp. are slightly divergent, as well as sigmoidal.

Discussion: Despite the lack of much study material for this species, the author feels confident that in comparing the teeth of *O. hynei* nov. sp. with those of other odontaspidid species in the present fauna, that he has discovered sufficient morphological features to satisfactorily erect a new species with confidence. *O. hynei* nov. sp. is only known from the Tuscahoma estuary site.

Odontaspis speyeri Dartevelle & Casier

(Plate 5, Fig. 99–102 and Plate 7, Fig. 140)

Material: Several dozens of specimens.

Specimens: (AMNH 13740), (AMNH 13741), and (AMNH 13742).

Localities: From both the Tuscahoma glauconitic sands and the overlying Bashi "Boulder zone," in a bluff situated behind the Red Hot Truck Stop, off of Highway 20–59 (access road), Meridian, Lauderdale County, Mississippi.

Ages: Tuscahoma Formation, Late Paleocene (Thanetian stage) and from the Bashi Formation, Early Eocene (Ypresian or Paniselian stage?).

Description: The teeth of *Odontaspis speyeri* average 5 mm to 1 cm in height. The anterior teeth are slender with double denticles, two on either side of the central cusp, with a robust root boss containing a furrow (groove) (cf. Plate 5, Fig. 99–102). Teeth are devoid of striae on both the labial and lingual faces.

Discussion: DARTEVELLE & CASIER (1943) described *Odontaspis speyeri* from the Paleocene of Landana (Cabinda), Western Africa. The teeth of *O. speyeri* are also known from the Paleocene of Morocco (ARAMBOURG 1952). In a previous description in this paper, *Odontaspis borodini* nov. sp., the author discussed the apparent similarities between *O. borodini* and *O. speyeri*.

Odontaspis substriatus (STROMER)

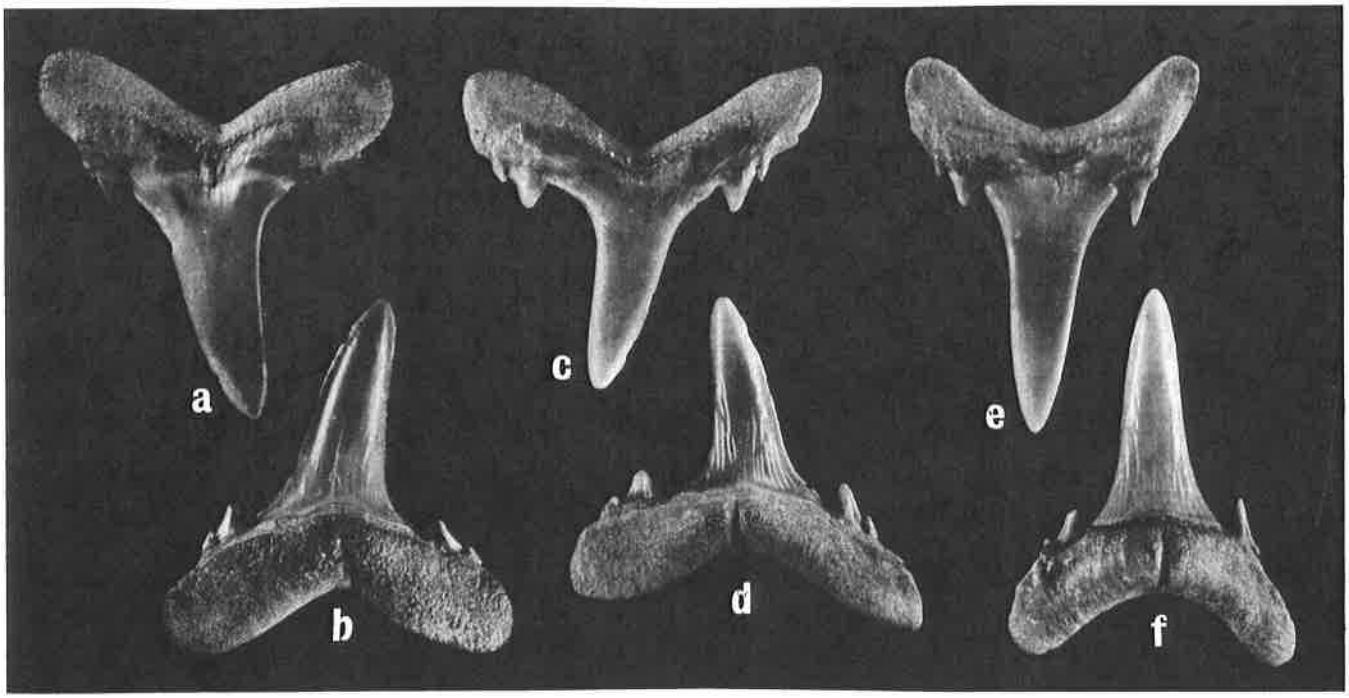
(Text-fig. 3a–f)

Material: Less than two dozen teeth.
Specimens: (AMNH 13743), (AMNH 13744), and (AMNH 13745).
Locality: CASE's estuary site 1 (Tuscahoma greensand), Meridian, Lauderdale County, Mississippi.
Age: Tuscahoma Formation, Late Paleocene (Thanetian stage).

Description: Teeth of small size, averaging 1 cm for anterior teeth (cf. Text-fig. 3e–f), and 7.5 mm for lateral teeth (cf. Text-fig. 3c–d). Teeth with two (one of which is vestigial) lateral denticles on either side of a central blade, which are approximately 1/6th the size of the central blade. Lingual faces may or may not have traces of rugose striae (cf. Text-fig. 3d), while the root boss (in lingual aspect) may or may not have a furrow (groove). Lateral teeth similar in appearance to those of *Cretolamna lerichei* (cf. Plate 4, Fig. 76), but the central blade is structured differently and *C. lerichei* has no striae ornamentation on its lingual face.

Discussion: ARAMBOURG (1952) has *Eugomphodus (Odontaspis) substriata* teeth ranging from the Montian on up into the Ypresian in Morocco, North Africa. In England, specimens of *E. substriata* are found in the following formations: Earnley, M. Farm, Elnore, Barton, and the Solent (KEMP 1982: 14).

Specimens of *Odontaspis substriatus* are only recovered from the CASE estuary site 1 (Tuscahoma Formation).



Text-fig. 3. Three teeth of *Odontaspis substriatus* (STROMER). Antero-lateral tooth. a. Labial view. b. Lingual view, lateral tooth? c. Labial view. d. Lingual view, and an anterior tooth. e. Labial view. f. Lingual view.

Odontaspis winkleri LERICHE

(Plate 7, Fig. 134–139)

Material: Less than two dozen specimens.

Specimens: (AMNH 13746), (AMNH 13747), and (AMNH 13748).

Localities: From both the Tuscahoma glauconitic sands and the overlying Bashi "Boulder zone," in a bluff situated behind the Red Hot Truck Stop, off of Highway 20–59 (access road), Meridian, Lauderdale County, Mississippi.

Ages: Tuscahoma Formation, Late Paleocene (Thanetian stage) and from the Bashi Formation, Early Eocene (Ypresian or Paniselian stage?).

Description: Teeth small, averaging 5 mm in their overall height. The teeth of *Odontaspis winkleri* are slender and arcuate, with slightly sigmoidal lateral denticles, extremely lengthy, one on either side of the central blade (cf. Plate 7, Fig. 134 and 135). The root boss in lingual aspect possesses a highly elevated structure with a pronounced nutritive furrow (groove).

Discussion: *Odontaspis winkleri* was originally described by LERICHE in 1905. It has retained its generic name to the present, with the exception of CASIER (1966: 72) using the synonym: *Synodontaspis*, but unlike WHITE (1931), CASIER did not place the author's name in parenthesis.

Odontaspis sp. indet.

(Plate 5, Fig. 88–90)

Material: Less than one dozen 'symphyseal' or 'intermediate' teeth.

Specimen: (AMNH 13749).

Locality: CASE's estuary site 1 (Tuscahoma greensand), Meridian, Lauderdale County, Mississippi.

Age: Tuscahoma Formation, Late Paleocene (Thanetian stage).

Description: Teeth of very small size, averaging 5 mm in their greatest height. The specimen illustrated (cf. Plate 5, Fig. 88–90), represents a symphyseal tooth from the lower jaw of a 'sand-shark'. The tooth is quite constricted (pinched) with no apparent lateral denticles (cusps) (probably dormant), with an elongated root, also pinched together, with the longest lobe directed towards the commissure of the jaw, and with a lengthy furrow (groove) on the root boss.

Discussion: These teeth are so small that they are usually overlooked in collecting and the illustration of either a symphyseal or intermediate tooth of a sandshark species is rarely presented in the literature.

It would be extremely difficult to ascertain from which species of sandshark that these symphyseal and intermediate teeth come from, therefore the present material is left indeterminate. The author indentifies the specimen illustrated as a symphyseal tooth from the center of the lower jaw of a sandshark (sandtiger) by direct comparison with the modern sandshark *Odontaspis (Carcharias) taurus* RAFINESQUE.

Genus: *Pseudodontaspis* CASE 1987

Pseudodontaspis lauderdalensis nov. sp.

(Plate 6, Fig. 108–11 and 114–125)

Material: Several dozens of specimens.

Derivatio nominis: Named for the County in which the specimens were recovered.

Holotype: AMNH 13750. Antero-lateral tooth of an adult. [From Tuscahoma Formation.]

Paratypoids: AMNH 13751, AMNH 13752, AMNH 13753, AMNH 13754, AMNH 13755, AMNH 13756, and AMNH 13757. [From both Formations, Bashi and Tuscahoma.]

Localities: From both the Tuscahoma glauconitic sands and the overlying Bashi "Boulder zone," in a bluff situated behind the Red Hot Truck Stop, off of Highway 20–59 (access road), Meridian, Lauderdale County, Mississippi.

Ages: Tuscahoma Formation, Late Paleocene (Thanetian stage) and from the Bashi Formation, Early Eocene (Ypresian or Paniselian stage?).

Diagnosis: An odontaspidid with distinctive heterodonty; teeth averaging in size 5 mm in slant height, with a prominent furrow or groove on a rather broad and irregularly shaped root structure in its lingual aspect.

Description: The teeth of *Pseudodontaspis lauderdalensis* nov. sp. are rather minute; anterior teeth being slender and elongate (cf. Plate 6, Fig. 118–119) with a somewhat distorted root structure. Lateral teeth (cf. Plate 6, Fig. 120–121) demonstrate the same root structure distortion, as well as having two side cusps (one on either side of the central blade), while anterior teeth appear to have a single vestigial side cusp on either side of the central blade. Plate 6, Fig. 116–117, probably represents either a symphyseal, parasymphyseal, or intermediate tooth. Its exact position in the jaw of this shark cannot be ascertained at the present time.

Discussion: CASE (1987) originally erected the genus *Pseudodontaspis* based upon Late Cretaceous material (Campanian) from Wyoming. The author feels that the present species, as well as the following one, belong to this genus, as the criteria are similar. The basic criteria is the prominent trenchant furrow (groove) situated on the lingual root boss of the tooth. In the case of *P. lauderdalensis* nov. sp., and *P. mississippiensis* nov. sp., their root structure is flattened (*P. Lauderdalensis* nov. sp.) and distorted (*P. mississippiensis* nov. sp.).

Pseudodontaspis mississippiensis nov. sp.

(Plate 6, Fig. 126–131)

Material: Several dozens of specimens.

Derivatio nominis: Named in honor of the State in which the fossil was recovered.

Holotype: AMNH 13759. Anterior tooth of an adult. [From Tuscahoma Formation.]

Paratypoids: AMNH 13758, AMNH 13760, and AMNH 13761. [From both formations, Bashi and Tuscahoma.]

Localities: From both the Tuscahoma glauconitic sands and the overlying Bashi "Boulder zone", in a bluff situated behind the Red Hot Truck Stop, off of Highway 20–59 (access road), Meridian, Lauderdale County, Mississippi.

Ages: Tuscahoma Formation, Late Paleocene (Thanetian stage) and from the Bashi Formation, Early Eocene (Ypresian or Paniselian stage?).

Diagnosis: Another odontaspidid with a distinctive heterodonty, teeth averaging in size, 5 mm in slant height with a prominent furrow (groove) on a robust root structure-differing from the previous species.

Description: The anterior teeth of *Pseudodontaspis mississippiensis* nov. sp. differ from the previous species description in that their overall tooth structure is more generally shark-like, closer to *Odontaspis*. The anterior teeth are elongate and slender with a robust root boss in lingual aspect, while it also contains a prominent trenchant furrow (groove) similar to the previous species. The teeth show less distortion in the root area than those of the previous description. The side cusps on *P. mississippiensis* nov. sp., one on either side of the central blade, are prominent and sigmoidal (cf. Plate 6, Fig. 130–131).

Discussion: The author has considered that *Pseudodontaspis mississippiensis* nov. sp. follows his basic criteria for his genus, *Pseudodontaspis*. The teeth of *P. mississippiensis* nov. sp. lack the generalized distortion of the roots of the previous species, but retain the characteristic lengthy furrow or groove of *P. lauderdalensis* nov. sp. The author has been unable to locate any lateral teeth of *P. mississippiensis* nov. sp.

Genus: *Striatolamia* GLIKMAN 1964

Striatolamia macrota (AGASSIZ)

(Plate 5, Fig. 78–87)

Species-type: *Odontaspis macrota* AGASSIZ, 1843

Most recent synonym: 1981, *Striatolamia macrota* (AGASSIZ) – CAPPETTA & NOLF, p. 90, pl. 1, fig. 4–7.

Material: Hundreds of specimens, teeth from all positions in the jaws: anterior, antero-lateral, lateral, postero-lateral, and posterior.

Specimens: (AMNH 13762), (AMNH 13763), (AMNH 13764), (AMNH 13765), and (AMNH 13766).

Localities: From both the Tuscahoma glauconitic sands and the overlying Bashi "Boulder zone", in a bluff situated behind the Red Hot Truck Stop, off of Highway 20–59 (access road), Meridian, Lauderdale County, Mississippi.

Ages: Tuscahoma Formation, Late Paleocene (Thanetian stage) and from the Bashi Formation, Early Eocene (Ypresian or Paniselian stage?).

Description: Ubiquitous sand-shark teeth, the anterior teeth of which range in size from 2.5 cm to 4 cm; and their lateral teeth averaging about 2.5 cm (length). Both the anterior and lateral teeth possess fine striae covering approximately 50 % of the blade surface (in lingual aspect, cf. Plate 5, Fig. 78 and 84). All teeth possess lateral (side) denticles, short and stubby on the anterior teeth, while broader and somewhat spade-like (triangular) on the lateral and antero-lateral teeth.

Nutritive furrows (grooves) are present, but not very conspicuous (cf. Plate 5, Fig. 82 and 86).

Discussion: This species-type has had several generic names at various times, such as: *Odontaspis, Synodontaspis,* and more recently, *Eugomphodus* and *Striatolamia.*

The original description by AGASSIZ in the year 1843, was *Odontaspis macrota.* WHITE (1931: 58) retained the name, but placed the generic name '*Synodontaspis*' in synonomy within the title description (in parenthesis,

after *Odontaspis*!), and furthermore created a variety (praemut.) called '*striata*'. He based his variation on the fact that his tooth specimens (from the Late Paleocene/Early Eocene) are much smaller than those originally described by AGASSIZ some 88 years previously.

CAPPETTA & NOLF (1981), adopt the genus *Striatolamia*, erected by GLIKMAN in 1964, based upon the characteristics for the tooth already pertained to in the above description of this present paper.

KEMP (1982), in his popular work on the selachians of the Eocene of England, uses the generic name *Eugomphodus* (erected by GILL in the year 1861), but gives no history of the usage of the name.

This author does not fully understand the reason behind the usage of *Eugomphodus* vs. *Striatolamia*, but he will accept *Striatolamia* as used by CAPPETTA & NOLF (1981), as being the most up-to-date descriptive generic name of the species-type.

Genus: *Carcharias* RAFINESQUE 1810

Carcharias hopei (AGASSIZ)

(Plate 4, Fig. 58–61)

Material: Several dozens of teeth from anterior and lateral jaw positions.
Specimens: (AMNH 13767) and (AMNH 13768).
Locality: CASE's estuary site 1 (Tuscahoma greensand), Meridian, Lauderdale County, Mississippi.
Age: Tuscahoma Formation, Late Paleocene (Thanetian stage).

Description: Teeth of medium size, averaging from 1.5 to 2.5 cm in overall height, with a lengthy central blade and two lateral denticles (side cusps), one on either side of the central cusp, small, recurved and slightly sigmoidal in shape, and approximately 1/5th the size of the central cusp (cf. Plate 4, Fig. 60–61). There is a furrow (groove) on the boss of the tooth in lingual aspect, with slight traces of striae (cf. Plate 4, Fig. 60). No ornamentation on the labial face of the teeth.

Discussion: A fairly common tooth of a 'sand-shark' found in the Oldhaven beds (Thanetian) up into the London Clay (Ypresian) of England (WHITE 1931 and CASIER 1966), and in parts of western Europe, while larger specimens of this species have been recovered in fairly large numbers from the Ypresian of Ouled Abdoun, Morocco (ARAMBOURG 1952).

According to WARD (1988), *Hypotodus robustus* LERICHE, and *H. verticalis* (AGASSIZ), as well as *H. heinzelini* (CASIER) have been reassigned to *Carcharias hopei* (AGASSIZ) as junior synonyms.

This author has presented the following *C. robustus* (LERICHE) and *C. verticalis* as separate species in this report, but agrees that WARD may possibly be right in his thesis. However, it seems to this present author that for the moment, these species should be separated in order to create less confusion until the entire matter is resolved to the satisfaction of all concerned.

So far, specimens of *Carcharias hopei*, *C. robustus*, and *C. verticalis*, have only been recovered from the CASE estuary site 1 (Tuscahoma Formation) at Meridian. None have been recovered from the overlying Bashi Marls.

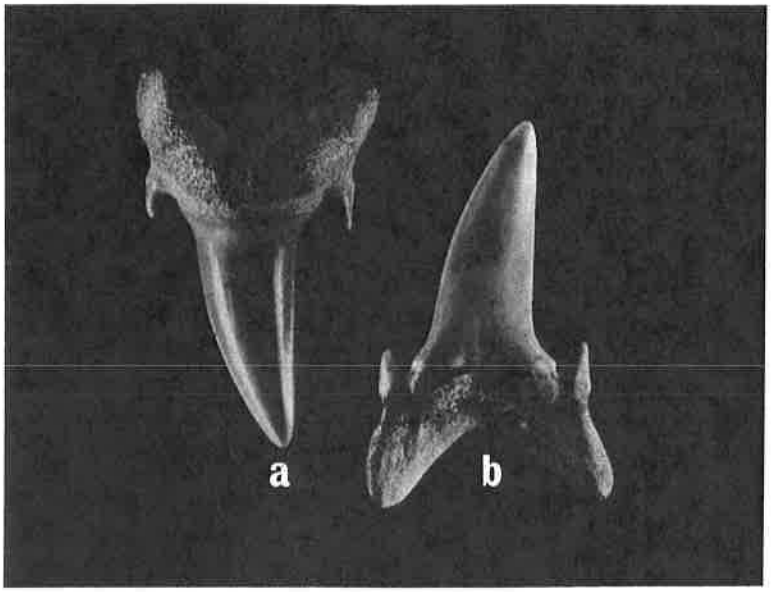
Carcharias robustus (LERICHE)

(Text-fig. 4)

Material: Less than two dozen specimens.
Specimen: (AMNH 13769).
Locality: CASE's estuary site 1 (Tuscahoma greensand), Meridian, Lauderdale County, Mississippi.
Age: Tuscahoma Formation, Late Paleocene (Thanetian stage).

Description: Teeth averaging 1.5 cm with a robust root structure and prominent side cusps, one on either side of the central blade (cf. Text-fig. 4a and b). There is a pronounced furrow (groove) in lingual aspect on the root boss (cf. Text-fig. 4a and b). Root lobes are symmetrical and form and arch.

Discussion: WARD (1988) places *Hypotodus robustus* and *H. verticalis*, as well as *H. heinzelini*, together to form *Carcharias hopei*, thus creating junior synonyms for the 3 previously described *Hypotodus* species. Ward based this synonomy upon the finding of a large piece of matrix containing what appears to be the remains of a single shark showing all three species types together.

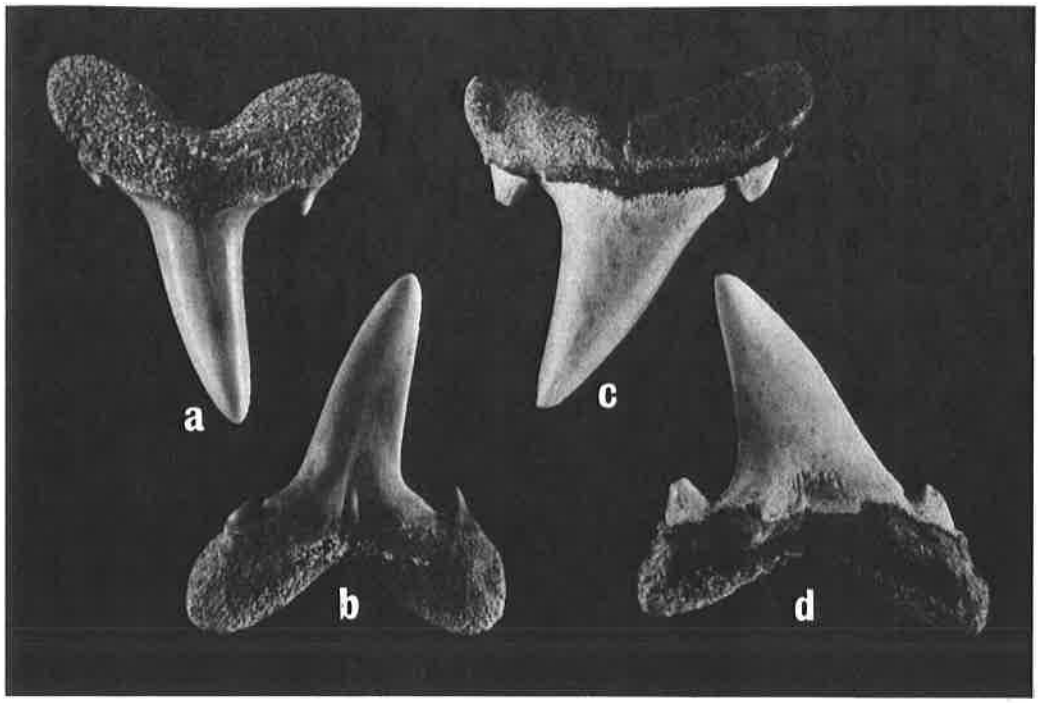


Text-fig. 4. Tooth of *Carcharias robustus* (LERICHE). a. Lingual view. b. Labial view, antero-lateral tooth.

Carcharias teretidens (WHITE)

(Text-fig. 5a–d)

Material: Less than one dozen specimens.
Specimens: (AMNH 13770) and (AMNH 13771).
Locality: CASE's estuary site 1 (Tuscahoma greensand), Meridian, Lauderdale County, Mississippi.
Age: Tuscahoma Formation, Late Paleocene (Thanetian stage).



Text-fig. 5. Two teeth of *Carcharias teretidens* (WHITE). Anterior tooth. a. Lingual view. b. Labial view, and lateral tooth. c. Lingual view. d. Labial view.

Description: Teeth of small size, averaging 12 mm in size for anterior teeth (cf. Text-fig. 5a–b), and approximately 8 mm for lateral teeth (cf. Text-fig. 5c–d). Central blade broader than *Odontaspis substriatus* (cf. Text-fig. 3a–f), and slightly reminiscent of the central blades of *Cretolamna lerichei* (cf. Plate 4, Fig. 64), but, with vestigial striae along the tooth enamel apron (lingual face), not fully erupted as with *Striatolamia macrota* (described elsewhere in this paper). Lateral cusplets 'spade-like' (cf. Text-fig. 5d) on lateral teeth, and slightly sigmoidal on the anterior teeth (cf. Text-fig. 5a). Teeth with traces of medial furrow (groove) on their root's boss (cf. Text-fig. 5c).

Discussion: WHITE (1931: 53) assigns a variation (praemut.) to AGASSIZ's *Odontaspis cuspidata* – as *teretidens*, with *Synodontaspis* in generic synonomy along with AGASSIZ's original name. The teeth WHITE described were from the Upper Paleocene Blackheath Beds (Thanetian stage) at Abbey Wood (Lesness Park), Kent, which is just on the outskirts of London. The teeth of *Carcharias teretidens* from the Early Eocene (Landanian and Ypresian stages) are much larger, but carry the same characteristics as WHITE's earlier description. As with previous descriptions in this paper, the teeth of *C. teretidens* are only recovered from CASE's estuary site 1 (Tuscahoma Formation).

Carcharias verticalis (AGASSIZ)

Plate 5, Fig. 91–96)

Material: Less than two dozen specimens.
Specimens: (AMNH 13772), (AMNH 13773), and (AMNH 13774).
Locality: CASE's estuary site 1 (Tuscahoma greensand), Meridian, Lauderdale County, Mississippi.
Age: Tuscahoma Formation, Late Paleocene (Thanetian stage).

Description: Teeth averaging up to 2 cm in slant height with the central blade being arcuate, having small, slightly sigmoidal side cusps, one on either side of the central blade (cf. Plate 5, Fig. 91–92). The tooth contains a standard furrow (groove) for the nutritive pit, on the root boss in lingual aspect and the root itself is robust in general.

Discussion: See previous discussion for WARD's (1988) reclassification of *Hypotodus robustus, H. verticalis*, and *H. heinzelini* as junior synonyms of *Carcharias hopei.*

Family: Mitsukurinidae JORDAN 1898

Genus: *Anomotodon* ARAMBOURG 1952

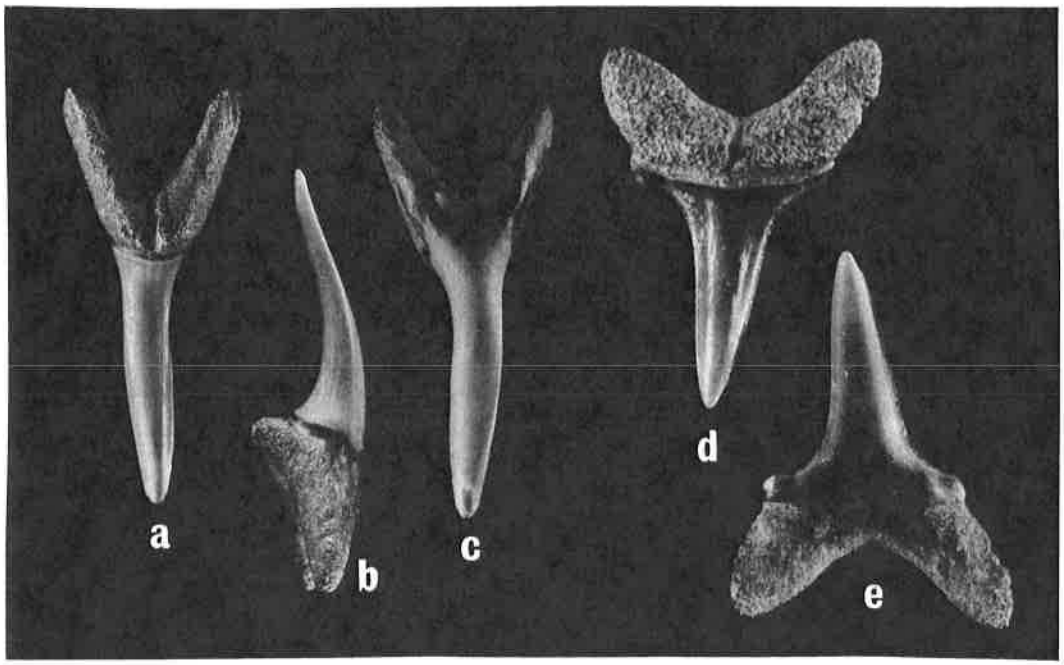
Anomotodon sp.

(Plate 7, Fig. 141–147 and Text-fig. 6)

Material: Several dozens of specimens.
Specimens: (AMNH 13775), (AMNH 13776), (AMNH 13777), (AMNH 13778–1), (AMNH 13778–2), and (AMNH 13778–3).
Localities: From both the Tuscahoma glauconitic sands and the overlying Bashi "Boulder zone", in a bluff situated behind the Red Hot Truck Stop, off of Highway 20–59 (access road), Meridian, Lauderdale County, Mississippi.
Ages: Tuscahoma Formation, Late Paleocene (Thanetian stage) and from the Bashi Formation, Early Eocene (Ypresian or Paniselian stage?).

Description: Teeth averaging 1 cm in slant height, anterior teeth rather symmetrical (cf. Plate 7, Fig. 142–143), while lateral teeth are slightly arcuate (cf. Plate 7, Fig. 141). None of the teeth of *Anomotodon* sp. have lateral cusps, rather they have a distinctive and quite pronounced "heel" (of CASE & CAPPETTA 1990) or shoulders at the point where the apron enamel meets the bony root structure.

Discussion: The teeth of *Anomotodon* sp. are similar to *Parananomotodon* of the Late Cretaceous, although they are probably not related. CASIER (1966) described *A. sheppeyensis* (originally called: *Oxyrhina sheppeyensis*) which appears to be closer to *A. cravenensis* of the Early Miocene (CASE 1980). Therefore, this species of *Anomotodon* presented here has no relationship to *A. sheppeyensis* and may be in fact, a possible new species.



Text-fig. 6. Two teeth of *Anomotodon* sp. Anterior tooth. a. Lingual view. b. Profile view. c. Labial view. Antero-lateral tooth. d. Lingual view. e. Labial view.

Family: Lamnidae Müller & Henle 1838

Genus: *Cretolamna* Glikman 1958

Cretolamna aschersoni (Stromer)

(Plate 3, Fig. 34–53, Plate 4, Fig. 54–57, 72–73, and Plate 5, Fig. 97–98)

Material: Numerous teeth, from all positions in the upper and lower jaws.

Specimens: (AMNH 13779–1), (AMNH 13779–2), (AMNH 13779–3), (AMNH 13779–4), (AMNH 13779–5), (AMNH 13779–6), (AMNH 13779–7), (AMNH 13779–8), (AMNH 13779-9), (AMNH 13779–10), (AMNH 13779–11), (AMNH 13779–12), (AMNH 13779–13), and (AMNH 13779–14).

Localities: From both the Tuscahoma glauconitic sands and the overlying Bashi "Boulder zone", in a bluff situated behind the Red Hot Truck Stop, off of Highway 20–59 (access road), Meridian, Lauderdale County, Mississippi.

Ages: Tuscahoma Formation, Late Paleocene (Thanetian stage) and from the Bashi Formation, Early Eocene (Ypresian or Paniselian stage?).

Description: Anterior teeth, erect and symmetrical, averaging 2.5 cm in overall height, with divergent side cusps, one on either side of a central blade (cf. Plate 3, Fig. 40 and 41). Lateral teeth with a central blade that is arcuate, possessing multiple, divergent side cusps (cf. Plate 3, Fig. 46, 47, 52, and 53). Average size of the lateral teeth, approximately 2 cm in slant height.

The teeth of *Cretolamna aschersoni* have either a single foramen (hole) or a vestigial furrow (groove) on the boss of the root in lingual aspect (cf. Plate 3, Fig. 34 and 36).

Discussion: The teeth of *Cretolamna aschersoni* are well documented from Africa (Arambourg 1952), and are very commonly distributed in the Early Eocene 'Ypresian' Stage in Morocco, in particular, and are less evident in the adjoining countries of Algeria and Tunisia.

Case & Capetta (1990: 9) have resolved the confusing status of *Cretolamna aschersoni* concerning its occurrence in literature in the Middle and Late (Upper) Eocene of Egypt. They have shown that the teeth which Stromer (1905, pl. 15, fig. 13) first assigned to the genus, *Otodus*, based upon two teeth from Birket-el-Qurun in the Fayum Depression of Egypt, and which were named *aschersoni*, are in fact the teeth of *Cretolamna*

twiggsensis (CASE 1981), and that the teeth described from Morocco by ARAMBOURG (1952) were in fact, truly the teeth of *Cretolamna aschersoni* (STROMER).

CASE & LEGGETT (in press) have presented *Cretolamna aschersoni* in its first occurrence in North America. The teeth of this latter report were collected during a National Geographic Society sponsored field trip to the CASE estuary site (the Tuscahoma Formation, CASE 1986), from the Carnegie Museum of Natural History, Pittsburgh, Pennsylvania, under the leadership of Dr. K. CHRISTOPHER BEARD. The date of this field trip, during which the specimens were collected, was: April 23–28, 1990. All the specimens of the present report were collected by the author during the years, 1979, 1980, and 1982, and this study started in 1983, was sponsored by a grant from the Griffis Fund of the American Littoral Society, Highlands, New Jersey.

Cretolamna lerichei (CASIER)

(Plate 4, Fig. 62–71 and 74–77)

For a complete synonomy see CASIER, 1966: 74.

Material: Numerous teeth from all positions in the jaw.

Specimens: (AMNH 13780–1), (AMNH 13780–2), (AMNH 13780–3), (AMNH 13780–4), (AMNH 13780–5), (AMNH 13780–6), and (AMNH 13780–7).

Localities: From both the Tuscahoma glauconitic sands and the overlying Bashi "Boulder zone", in a bluff situated behind the Red Hot Truck Stop, off of Highway 20–59 (access road), Meridian, Lauderdale County, Mississippi.

Ages: Tuscahoma Formation, Late Paleocene (Thanetian stage) and from the Bashi Formation, Early Eocene (Ypresian or Paniselian stage?).

Description: Teeth small in size as compared to those of the previous description, averaging 15 mm in height. Teeth are more symmetrical than those of the previous. Anterior teeth possessing up to two side cusps, one on either side of the central cusp (cf. Plate 4, Fig. 68–69). Anterior teeth are erect and slightly robust, particularly in the root area. The antero-lateral and lateral teeth are more flattened-out, and possess from one to two side cusps on either side of the central blade.

As with the previous specimens (see description for *Cretolamna aschersoni*), certain specimens of *C. lerichei* possess a vestigial furrow (groove), while others have only a single foramen or hole on the boss of the root in lingual aspect (cf. Plate 4, Fig. 68 and 76).

Discussion: The teeth of *Cretolamna lerichei* are common in the Early Eocene of the Island of Great Britain, and in some formations in parts of western Europe (particularly in Belgium), and in Morocco, North Africa. The presently described material of this study represents the first occurrence of this species in North American fossil deposits.

Order: Carcharhiniformes COMPAGNO 1973

Family: Scyliorhinidae GILL 1862

Genus: *Galeus* RAFINESQUE 1810

Galeus sp.

(Plate 8, Fig. 184–185)

Material: Less than one dozen specimens.

Specimen: (AMNH 13781).

Locality: From the Bashi "Boulder zone", in a bluff situated behind the Red Hot Truck Stop, off of Highway 20–59 (access road), Meridian, Lauderdale County, Mississippi.

Age: Bashi Formation, Early Eocene (Ypresian or Paniselian stage?).

Description: A microscopic tooth measuring less than 1 mm; a lateral tooth with pronounced side cusps, one on either side of the central blade, taking up almost one half the length of the central blade, triangular shaped with strong rugose striae along the entire margin of the enameled apron (from cusp to cusp) at the contact with the root in labial aspect (cf. Plate 8, Fig. 184–185).

Discussion: The specimens of *Galeus* sp. are extremely rare, and were found only in the Bashi Formation.

Genus *Microscyliorhinus* nov.

Type-species: *Microscyliorhinus leggetti* nov. gen. et nov. sp.
Derivatio nominis: Micro=tiny, scyliorhinus=named for its similarity to *Scyliorhinus.*

Diagnosis: Microscopic teeth measuring 2.5 mm slant height on average; possible oral teeth of a previously unknown shark species; teeth are probably functional.

Microscyliorhinus leggetti nov. gen. et nov. sp.

(Plate 9, Fig. 195–207)

Material: Less than one dozen specimens.
Derivatio nominis: Species named in honor of my colleague, JAMES J. LEGGETT, Elizabeth, New Jersey.
Locality: From the Bashi "Boulder zone", in a bluff situated behind the Red Hot Truck Stop, off of Highway 20–59 (access road), Meridian, Lauderdale County, Mississippi.
Age: Bashi Formation, Early Eocene (Ypresian or Paniselian stage?).
Holotype: (AMNH 13784).
Paratypoids: (AMNH 13782) and (AMNH 13783).

Diagnosis: See the genus diagnosis.
Description: Minute teeth, slender in structure with a pronounced boss on the root in lingual aspect (cf. Plate 9, Fig. 195–199, and 206). Teeth have one central cusp (with no side cusps), sigmoidal in style. There are strong rugose striae on the heels of the enamel surface in labial aspect (cf. Plate 9, Fig. 207). The basal view of this tooth exhibits a holaulacorhize effect, being completely bilobed (cf. Plate 9, Fig. 196).
Discussion: The author has assigned *Microscyliorhinus leggetti* nov. gen. et nov. sp. provisionally to the Family Scyliorhinidae due to the basal structure of the tooth and its holaulacorhize design. If this new genus turns out to be related to *Scyliorhinus*, it would be the second species in this family to be devoid of lateral (side) denticles. The first being: *Megascyliorhinus cooperi* CAPPETTA & WARD (1977).
At the present time, *Microscyliorhinus leggetti* nov. gen. et nov. sp. appears to be restricted to the Early Eocene Bashi Formation.
The teeth are microscopic in size, and their closest species would be *Megascyliorhinus cooperi* CAPPETTA & WARD (1977), which is a much larger species, with similar characteristics to *Microscyliorhinus*, i.e; lack of lateral denticles (side cusps), and rugose striae on both the lingual and labial face of the teeth in *Megascyliorhinus*, while, *Microscyliorhinus leggetti* nov. gen. et nov. sp., has only rugose striae on the labial aspect of the tooth apron. The root structure differs slightly between the two species. It is possible that the species: *Megascyliorhinus* and *Microscyliorhinus* are related.

Genus: *Scyliorhinus* BLAINVILLE 1816

Scyliorhinus gilberti CASIER

(Plate 7, Fig. 148–152)

Material: Less than one dozen specimens.
Specimens: (AMNH 13785) and (AMNH) 13786).
Locality: From the Bashi "Boulder zone", in a bluff situated behind the Red Hot Truck Stop, off of Highway 20–59 (access road), Meridian, Lauderdale County, Mississippi.
Age: Bashi Formation, Early Eocene (Ypresian or Paniselian stage?).

Description: Teeth minute, averaging 1.5 mm in their overall height. Anterior and antero-lateral teeth (cf. Plate 7, Fig. 148–152) have a slightly sigmoidal central blade, with two side cusps (one on either side of the central blade); some specimens having an additional vestigial cusp attached to either side of the lateral cusps (cf. Plate 7, Fig. 148–149). There appears to be a prominent rugose striae on the enamel apron in labial aspect, extending across the entire width of the tooth from cusp to cusp. The tooth's basal structure is typically holaulacorhize.
Discussion: CASIER (1946) first described *Scyliorhinus gilberti* from the Lower Eocene (Ypresian) of Forest-les-Bruxelles, Belgium. CAPPETTA & NOLF (1981) have also reported *S. gilberti* from the Upper Eocene Paris Basin of France. This indicates a rather lengthy range for this species.

CAPPETTA (1987) states that *Scyliorhinus* appears in the Upper Albian (Lower Cretaceous) and ranges up to recent times.

Scyliorhinus gilberti is the only true Scyliorhinidae recovered in this fauna and seems to be restricted to the Bashi Formation.

Family: Triakidae GRAY 1851

Genus: *Galeorhinus* BLAINVILLE 1816

Galeorhinus affinis (PROBST)

(Plate 9, Fig. 186–194)

Material: Less than two dozen specimens.

Specimens: (AMNH 13787–1), (AMNH 13787–2), (AMNH 13787–3), and (AMNH 13787–4).

Localities: From both the Tuscahoma glauconitic sands and the overlying Bashi "Boulder zone", in a bluff situated behind the Red Hot Truck Stop, off of Highway 20–59 (access road), Meridian, Lauderdale County, Mississippi.

Age: Tuscahoma Formation, Late Paleocene (Thanetian stage), and from the Bashi Formation, Early Eocene (Ypresian or Paniselian stage?).

Description: Teeth averaging 3 mm in slant height. Teeth of this species have a central blade which slants towards the commissure, with an average of three cusps on one side of the central blade, while the other side of the central blade shows an unerupted slight ridge (which can not be called cusps) (cf. Plate 9, Fig. 190–191).

There is a slight rugose striae running across traversing the enamel apron margin in labial aspect (cf. Plate 9, Fig. 194). The lingual aspect of the tooth is completely devoid of striae. The basal aspect of the tooth is typically Carcharhiniforme.

Discussion: CAPPETTA (1987) gives a geological range of Lower Turonian (Upper Cretaceous) to recent times for *Galeorhinus* species in general.

Galeorhinus affinis is one of four species of *Galeorhinus* recognized in the total fauna (both Tuscahoma and Bashi). It seems that the liver oil sharks (topes) are well represented in both formations.

Galeorhinus lefevrei (DAIMERIES)

(Plate 8, Fig. 165–166)

Material: Less than one dozen specimens.

Specimen: (AMNH 13788).

Locality: CASE estuary site 1 (Tuscahoma greensand), Meridian, Lauderdale County, Mississippi.

Age: Tuscahoma Formation, Late Paleocene (Thanetian stage).

Description: Small teeth, averaging 3 mm in slant height. Lateral teeth have a slightly arcuate blade directed towards the commissure with an average of two ridgelike cusplets on one side of the central blade, while the arcuate side of the central blade is devoid of any traces of ridges or cusplets. There are traces of rugose striae on the enamel apron margin in labial aspect (cf. Plate 8, Fig. 165). The basal structure of the tooth is typically Carcharhiniforme.

Discussion: *Galeorhinus lefevrei* was first described by DAIMERIES (1891) from the Lutetian (Middle Eocene) of Brussels, Belgium. CASIER (1946) described *G. lefevrei* from the Ypresian (Lower Eocene) of Belgium, as well as from the Lower Eocene of England (CASIER 1966).

Galeorhinus minor (AGASSIZ)

(Plate 8, Fig. 167–174)

Material: Several hundreds of specimens.

Specimens: (AMNH 13789–1), (AMNH 13789–2), (AMNH 13789–3), and (AMNH 13789–4).

Localities: From both the Tuscahoma glauconitic sands and the overlying Bashi "Boulder zone", in a bluff situated behind the Red Hot Truck Stop, off of Highway 20–59 (access road), Meridian, Lauderdale County, Mississippi.

Age: Tuscahoma Formation, Late Paleocene (Thanetian stage), and from the Bashi Formation, Early Eocene (Ypresian or Paniselian stage?).

Description: Teeth averaging 4 mm in slant height. Teeth curve towards the commissure with an average of from two to three cusplets on one side of the central tooth blade, while there may or may not be vestigial denticulations on the arcuate side (cf. Plate 8, Fig. 167–170). Slight striae may or may not be present in labial aspect. Basal structure of the tooth is typically Carcharhiniforme (cf. Plate 8, Fig. 169).

Discussion: A rather ubiquitous shark species, dominant in both the Tuscahoma (estuarine) and the littoral (offshore) exposures of the Bashi Formation. First described by AGASSIZ (1843). LERICHE (1905 and 1906) as well as CASIER (1966) described *Galeorhinus minor* from the Early to Late Eocene of Great Britain, Belgium and France. ARAMBOURG (1952) described *G. minor* from the Lutetian (Middle Eocene) of Morocco, North Africa.

Galeorhinus ypresiensis CASIER

(Plate 8, Fig. 181–183)

Material: Less than one dozen teeth.
Specimen: (AMNH 13790).
Locality: CASE estuary site 1 (Tuscahoma greensand), Meridian, Lauderdale County, Mississippi.
Age: Tuscahoma Formation, Late Paleocene (Thanetian stage).

Description: Teeth averaging 3 mm in total height. Figured specimen (cf. Plate 8, Fig. 181–183), is probably an anterior tooth near symphysis of the shark's jaw, lacking side cusps, striae or any other denticulation. In profile (cf. Plate 8, Fig. 182), the tooth has a "hood-like" structure. An interesting feature of this tooth, is that there is a ring of foramina following along the base of the root in labial aspect (cf. Plate 8, Fig. 183). The basal structure of the tooth is Carcharhiniforme.

Discussion: CASIER (1946) first described *Galeorhinus ypresiensis* from the Lower Eocene (Ypresian) of Belgium.

A further note of interest regarding the genus *Galeorhinus* is that it also appears in the Upper Cretaceous (Lower Turonian) of Poland, according to CAPPETTA (1987: 115), and was so described by MARCINOWSKY & RADWANSKI (1983); and was personally observed by CAPPETTA in the Upper Cretaceous (Campanian) of Agadir, Morocco, North Africa. CAPPETTA (1987) also sites the occurrence of *Galeorhinus* (in general) in the Miocene, Pliocene as well as the Pleistocene.

This author has observed the genus, *Galeorhinus* in a yet to be published fauna from the Upper Cretaceous (Late Maastrichtian) of Texas (CASE & CAPPETTA, in prep.).

Genus: *Mustelus* LINCK 1730

Mustelus Rodgersi nov. sp.

(Plate 13, Fig. 276–281)

Material: Less than one dozen specimens.
Derivatio nominis: Named after "JIMMIE RODGERS", Meridian's late "Singing Brakeman".
Holotype: (AMNH 13791).
Locality: CASE estuary site 1 (Tuscahoma greensand), Meridian, Lauderdale County, Mississippi.
Age: Tuscahoma Formation, Late Paleocene (Thanetian stage).

Diagnosis: Lateral teeth, dimunitive in size, and asymmetrical; crown is devoid cusps, but there is a coronal ridge with slight crenulations (cf. Plate 13, Fig. 277 and 280). The entire tooth is directed towards the commissure.

Description: Teeth minute, 3 mm in width and 1 mm in overall height, on the average. Enameled portion of the tooth is proportionately 50 % of the overall volume of the tooth (i.e; a 50/50 ratio of enamel to root). Basal aspect of the teeth exhibit the root vascularisation refered to as holaulacorhize.

Discussion: According to CAPPETTA (1987: 116), the genus *Mustelus* ranges from the Early Eocene (Ypresian stage) all the way up to recent times in Europe. The present author has now pushed back the appearance of a fossil *Mustelus* in North America to the Late Paleocene (Thanetian stage).

Family: Carcharhinidae JORDAN & EVERMANN 1896

Genus: *Abdounia* CAPPETTA 1980

Abdounia beaugei (ARAMBOURG)

(Plate 8, Fig. 161–162 and 175–180)

Material: Several hundreds of specimens.

Specimens: (AMNH 13792–1), (AMNH 13792–2), (AMNH 13792–3) and (AMNH 13792–4).

Localities: From both the Tuscahoma glauconitic sands and the overlying Bashi "Boulder zone", in a bluff situated behind the Red Hot Truck Stop, off of Highway 20–59 (access road), Meridian, Lauderdale County, Mississippi.

Ages: Tuscahoma Formation, Late Paleocene (Thanetian stage), and from the Bashi Formation, Early Eocene (Ypresian or Paniselian stage?).

Description: Small teeth measuring 4 mm to 5 mm in height on the average, anterior and antero-lateral teeth having between 1 to 2 cusps on either side of the central blade (sometimes 3, not to be confused with *A. recticona*); enlarged median furrow (groove) situated on the root boss of the tooth in lingual aspect (cf. Plate 8, Fig. 161, 176 and 179). The furrow bisects the root lobes, halving the entire root, however, this does not make the tooth bi-lobed, but, rather that it is typically carcharhiniform.

The lateral teeth are slightly different from the anterior and antero-lateral teeth, having no lateral cusps on one side of the tooth, but averaging 2 lateral cusps on the side of the tooth leaning towards the commissure (lateral teeth not illustrated).

Discussion: *Abdounia beaugei* was first described by ARAMBOURG (1935), from the Lower Eocene (Ypresian) of Morocco, North Africa, as *Eugaleus beaugei*. However, ARAMBOURG (1952: 123) cites it as *Scyliorhinus beaugei*.

CAPPETTA (1980) further changes the generic name to *Abdounia*. The tooth is now know as *Abdounia beaugei* (ARAMBOURG).

Abdounia subulidens (ARAMBOURG)

(Plate 7, Fig. 153–160)

Material: Several hundreds of specimens.

Specimens: (AMNH 13793–1), (AMNH 13793–2), (AMNH 13793–3), (AMNH 13793–4) and (AMNH 13793–5).

Localities: From both the Tuscahoma glauconitic sands and the overlying Bashi "Boulder zone", in a bluff situated behind the Red Hot Truck Stop, off of Highway 20–59 (access road), Meridian, Lauderdale County, Mississippi.

Ages: Tuscahoma Formation, Late Paleocene (Thanetian stage), and from the Bashi Formation, Early Eocene (Ypresian or Paniselian stage?).

Description: Teeth measure on the average 4 mm to 5 mm in slant height, anterior and antero-lateral teeth, unlike the previous description, possess only one large, slightly divergent side cusp on either side of the central blade. The central blade is elongated and slender, and in profile, there is a strong sigmoidal shape to the tooth, leaning lingually (cf. Plate 7, Fig. 157).

Lateral teeth (cf. Plate 7, Fig. 158) show only one lateral cusp on one side of the central blade, while the other side is devoid of any cusps. As with the previous description, there is a transverse vertical furrow (groove) across the entire root face in lingual aspect (cf. Plate 7, Fig. 153, 156 and 160).

Discussion: ARAMBOURG (1952: 121) describes *Scyliorhinus subulidens* as a new species, and relegates *Scyllium minutissimum* and *Scyliorhinus minutissimus*, to synonymy.

According to CAPPETTA (1987: 120), *Abdounia minutissima* is a valid species, therefore this contradicts ARAMBOURG's description of *Scyliorhinus subulidens*. It is obvious that CAPPETTA does not accept *subulidens* as a valid species. The present author prefers to recognize ARAMBOURG's *S. subulidens*, which is now known as *Abdounia subulidens*.

CAPPETTA & NOLF (1981) describe as a new species from the Upper Eocene of the Paris Basin, *Abdounia lapierrei*. In many ways, *A. lapierrei* resembles *A. subulidens*. It also resembles, on a smaller scale, *A. enniskilleni*, which is a much larger tooth from the Upper Eocene of Georgia, USA (CASE 1981). CASE & CAPPETTA (1990) described *Abdounia* sp. from the Middle and Late (Upper) Eocene of the Fayum Depression of Egypt. This tooth is probably *A. enniskilleni*.

Genus: *Physogaleus* CAPPETTA 1980

Physogaleus americanus nov. sp.

(Plate 10, Fig. 214–218)

Material: Several dozens of specimens.

Derivatio nominis: Named after the country in which it was found.

Holotype: (AMNH 13796). [From the Tuscahoma Formation.]

Paratypoids: (AMNH 13794) and (AMNH 13795). [From both formations, Bashi and Tuscahoma.]

Localities: From both the Tuscahoma glauconitic sands and the overlying Bashi "Boulder zone", in a bluff situated behind the Red Hot Truck Stop, off of Highway 20–59 (access road), Meridian, Lauderdale County, Mississippi.

Ages: Tuscahoma Formation, Late Paleocene (Thanetian stage), and from the Bashi Formation, Early Eocene (Ypresian or Paniselian stage?).

Diagnosis: Teeth small in size, with lateral cusps on both sides of the central blade. The side opposite the central blade that points towards the commissure, possesses a rather distinctive cusp. The lateral cusps are divergent.

Description: Teeth average 3 mm in size, with an abberant lateral cusp on one side of the central blade (cf. Plate 10, Fig. 214, 216 and 218). There is a trenchant furrow (groove) running vertically through the root area in lingual aspect (cf. Plate 19, Fig. 215, 217 and 218) – typical of the carcharhiniformes.

Discussion: The present author considers this to be a new species, differing from *Physogaleus secundus* which does not seem to have lateral cusps on both sides of its central blade (KEMP, KEMP & WARD 1990). *P. secundus* has vague unerupted ridges on one side of its central blade (CAPPETTA 1987: 124, Fig. 105I and J). These "ridges" seem to predate denticulation (i.e; *Galeocerdo aduncas*), rather than a pronounced or defined lateral (side) cusp or cusplets.

Physogaleus tertius (WINKLER)

(Plate 10, Fig. 219–224)

Material: Several dozens of specimens.

Specimens: (AMNH 13797–1), (AMNH 13797–2) and (AMNH 13797–3).

Localities: From both the Tuscahoma glauconitic sands and the overlying Bashi "Boulder zone", in a bluff situated behind the Red Hot Truck Stop, off of Highway 20–59 (access road), Meridian, Lauderdale County, Mississippi.

Ages: Tuscahoma Formation, Late Paleocene (Thanetian stage), and from the Bashi Formation, Early Eocene (Ypresian or Paniselian stage?).

Description: Small to medium sized teeth, ranging between 4 mm to 8 mm in slant height, and averaging 5 mm. Anterior and antero-lateral teeth (cf. Plate 10, Fig. 219–222) possess a lengthy, slanted central blade with from 1 to 2 side cusps on only one side of the central blade directed towards the commissure, while the opposing side is devoid of cusps. Lateral teeth do not possess side cusps, rather they have a small unerupted ridge on the side of the central blade directed towards the commissure (cf. Plate 10, Fig. 223 and 224).

The root of the tooth contains a trenchant furrow (groove) traversing vertically through the root in lingual aspect (cf. Plate 10, Fig. 220, 221 and 224).

Discussion: ARAMBOURG (1952) illustrates in his Plate 26, *Physodon tertius.* It is apparent to this author that ARAMBOURG was probably describing two different species as one: *P. secundus* and *P. tertius.*

CAPPETTA (1980) changed the generic name to *Physogaleus.* According to KEMP, KEMP & WARD (1990) and CAPPETTA (1987), there is sexual dimorphism in *P. secundus*, represented by the male having teeth like *P. tertius*, and the female having teeth like *P. secundus.*

The problem of *Physogaleus secundus* and *P. tertius* is an old one, and probably won't be resolved to the satisfaction of everyone in the near future. This author however, has decided to stick with his interpretation of *P. tertius* as the legitimate taxon of the present study.

Physogaleus sp.

(Plate 8, Fig. 163–164, Plate 9, Fig. 208–211 and Plate 10, Fig. 212–213)

Material: Less than two dozen specimens.

Specimens: (AMNH 13798–1), (AMNH 13798–2), (AMNH 13798–3), and (AMNH 13798–4).
Locality: Case's estuary site 1 (Tuscahoma greensand), Meridian, Lauderdale County, Mississippi.
Age: Tuscahoma Formation, Late Paleocene (Thanetian stage).

Description: Small teeth measuring 4 mm on average in slant height, postero-lateral or lateral teeth with slender central blade; 1 to 2 side cusps on one side of the central blade directed towards the commissure, while the other side of the central blade is devoid of any cusps. Root is bisected by a rather trenchant furrow (groove) traversing vertically through the entire root in lingual aspect (cf. Plate 8, Fig. 164).

The teeth illustrated in Plate 9, Fig. 208–211, as well as the one specimen illustrated in Plate 10, Fig. 212–213, show vestigial denticulation on the side of the central blade, and differ from *P. tertius* (cf. Plate 10, Fig. 219–224).

Discussion: The tooth illustrated in Plate 8, Fig. 163–164, may be related to *Physogaleus tertius*, while those illustrated in Plates 9 and 10, may be closer to *P. americanus* nov. sp.

Superorder: Batomorphii Cappetta 1980

Order: Rajiformes Berg 1940

Suborder: Rhinobatoidei Fowler 1941

Family: Rhinobatidae Müller & Henle 1838

Genus: *Rhinobatos* Linck 1790

Rhinobatos sp.

(Plate 12, Fig. 252–256)

Material: Less than two dozen specimens.
Specimens: (AMNH 13799–1) and (AMNH 13799–2).
Localities: From both the Tuscahoma glauconitic sands and the overlying Bashi "Boulder zone", in a bluff situated behind the Red Hot Truck Stop, off of Highway 20–59 (access road), Meridian, Lauderdale County, Mississippi.
Ages: Tuscahoma Formation, Late Paleocene (Thanetian stage), and from the Bashi Formation, Early Eocene (Ypresian or Paniselian stage?).

Description: Teeth minute, averaging 2 mm in their greatest width, in lingual aspect, the central uvula, on the average, is short and thick, with a slight coronal crest or ridge above the central uvula, with two smaller-slightly divergent uvula, one on either side of the central uvula; the crown of the tooth is high and massive; the central uvula extends over the root area (cf. Plate 12, Fig. 252, 255 and 256).

The root structure is typically holaulacorhize, with a median furrow (groove) containing a distinctive foramen (cf. Plate 12, Fig. 254).

Discussion: *Rhinobatos* is a rather ubiquitous guitarfish skate with a range in the fossil record from the Lower Cretaceous (Aptian) all the way up to recent.

This author feels that *Rhinobatos* sp. compares favorably with *R. bruxelliensis*, but he lacks comparative material for a positive identification.

Family: Platyrhinidae Jordan 1923

Genus: *Platyrhina* Müller & Henle 1831

Platyrhina dockeryi nov. sp.

(Plate 12, Fig. 257–261)

Material: Less than one dozen specimens.
Specimen: (AMNH 13800).
Derivatio nominis: Named for Dr. David T. Dockery, III, Jackson, Mississippi.
Locality: From the Bashi "Boulder zone", in a bluff situated behind the Red Hot Truck Stop, off of Highway 20–59 (access road), Meridian, Lauderdale County, Mississippi.
Age: Bashi Formation, Early Eocene (Ypresian or Paniselian stage?).

Diagnosis: Teeth minute in size; flat, unornamented crown; enamel portion of tooth and the root section occupy a 50/50 ratio in volume; occlusal aspect ovaloid, but quite rhomboid; tooth rests upon a bi-lobed root structure.

Description: Small teeth averaging 2 mm in width, and 1 mm in height. In lingual aspect, there is a small protuberance (a slight uvula) (cf. Plate 12, Fig. 257 and 259). There are lateral facette foramina in the root structure in lingual aspect (cf. Plate 12, Fig. 257 and 259). Even though one root lobe tip is missing, we can discern that this species is typically bi-lobed (holaulocorhize) (cf. Plate 12, Fig. 260 and 261).

Discussion: The teeth of *Platyrhina dockeryi* nov. sp. are similar in some respect to those of *Pseudohypolophus* (Cappetta & Case 1975a), but they are probably closer to those of *Protoplatyrhina* of the Upper Cretaceous (Case 1978 and 1987). In appearance, they have more similarities to *Protoplatyrhina*.

This is the first reported occurrence of the genus *Platyrhina* in the fossil record of North America.

According to Cappetta (1987: 140), the only *Platyrhina* known in the fossil record to date is from the Lower Eocene of Monte Bolca, Italy. These specimens were fossilized cartilaginous skeletons.

Suborder: Pristiodei Cappetta 1980

Family: Pristidae Bonaparte 1838

Genus: *Pristis* Linck 1790

Pristis sp.

(Plate 15, Fig. 319–325)

Material: Several dozens of specimens.
Specimens: (AMNH 13801–1) and (AMNH 13801–2).
Locality: Case's estuary site 1 (Tuscahoma greensand), Meridian, Lauderdale County, Mississippi.
Age: Tuscahoma Formation, Late Paleocene (Thanetian stage).

Description: Rostral spines averaging about 2.5 cm in total length. These are lengthy, oblong structures showing strong growth rings in profile (cf. Plate 15, Fig. 319, 322, 323 and 325). The anterior bord view, these same growth rings are quite evident, while the posterior bord view shows a trenchant furrow traversing the entire length of the spine (cf. Plate 15, Figs. 320 and 321).

Discussion: This author feels that *Pristis* sp. may possibly be a new species, as it does not compare favorably with other known species of *Pristis*, including *P. lathami*, which is a much larger and robust species.

The oral teeth of *Pristis* (in general) appear to resemble the teeth of the skate, *Rhynchobatus*, but this author has not been able to recover any oral teeth of P. sp. in either the Tuscahoma or Bashi, for a more thorough description.

Order: Torpediniformes Buen 1926

Family: Torpedinidae Bonaparte 1838

Genus: *Eotorpedo* White 1934

Eotorpedo jaekeli White

(Plate 12, Fig. 262–266)

Material: Several dozen specimens.
Specimens: (AMNH 13802–1) and (AMNH 13802–2).
Localities: From both the Tuscahoma glauconitic sands and the overlying Bashi "Boulder zone", in a bluff situated behind the Red Hot Truck Stop, off of Highway 20–59 (access road), Meridian, Lauderdale County, Mississippi.
Ages: Tuscahoma Formation, Late Paleocene (Thanetian stage), and from the Bashi Formation, Early Eocene (Ypresian or Paniselian stage?).

Description: Minute teeth measuring 2.5 mm in height. Anterior teeth quite slender with an elongated

central cusp (no side cusps) (cf. Plate 12, Fig. 262–264 and 266). The basal aspect of the teeth show a root that is typically holaulacorhize in structure. Where the boss of the root in lingual aspect is located, there is a bifurcated ring-like enameled apron (cf. Plate 12, Fig. 262).

Discussion: According to CAPPETTA (1987: 160), the geological range in Europe, North and West Africa of *Eotorpedo jaekeli* in the fossil record is from the Danian/Montian of the Lower Paleocene, up to the Lower Eocene (Ypresian stage).

As far as this author can determine, this is the first occurrence in the fossil record of North America for *E. jaekeli.*

Order: Myliobatiformes COMPAGNO 1973

Superfamily: Dasyatoidea WHITLEY 1940

Family: Dasyatidae JORDAN 1888

Genus: *Dasyatis* RAFINESQUE 1810

Dasyatis jaekeli (LERICHE)

(Plate 13, Fig. 275)

Material: Less than one dozen specimens.
Specimen: (AMNH 13804).
Locality: CASE estuary site 1 (Tuscahoma greensand), Meridian, Lauderdale County, Mississippi.
Age: Tuscahoma Formation, Late Paleocene (Thanetian stage).

Description: Teeth minute, measuring 2 mm in height. Possible antero-lateral tooth with a short crown, lacking ornamentation (specimen illustrated is slightly damaged in its occlusal aspect), with a definitive holaulacorhize basal aspect.

Discussion: LERICHE (1905), in his original description, illustrated *Dasyatis jaekeli* as *Trygon jaekeli. D. jaekeli* is known from the Lower Eocene (Ypresian stage) of Brussels, Belgium.

CAPPETTA (1987: 163) gives a geological range for the general genus *Dasyatis*, from the Upper Cretaceous (Cenomanian stage) to recent.

Dasyatis tricuspidatus CASIER

(Plate 13, Fig. 272–274)

Material: Three dozen specimens.
Specimen: (AMNH 13803).
Localities: From both the Tuscahoma glauconitic sands and the overlying Bashi "Boulder zone", in a bluff situated behind the Red Hot Truck Stop, off of Highway 20–59 (access road), Meridian, Lauderdale County, Mississippi.
Ages: Tuscahoma Formation, Late Paleocene (Thanetian stage), and from the Bashi Formation, Early Eocene (Ypresian or Paniselian stage?).

Description: Small teeth measuring on average, 3 mm in total height; a lengthy crown overhanging the root area. The crown has two definitive depressions, giving the tooth a tri-cusped effect (cf. Plate 13, Fig. 272). In profile, one can see in detail, a good example of the length of the crown or tooth cap, with its lateral depression (cf. Plate 13, Fig. 273). The basal aspect shows a typical holaulacorhize root vascularisation (cf. Plate 13, Fig. 274).

Discussion: CASIER (1946) originally described *Dasyatis tricuspidatus* from the Lower Eocene (Ypresian stage) of Forest-les-Bruxelles, Belgium.

This is the first occurrence in the fossil record of North America for this species.

Genus: *Meridiania* nov.

Type-species: *Meridiania convexa* nov. gen. et nov. sp.
Derivatio nominis: Named after the City of Meridian, in Lauderdale County, Mississippi.

Diagnosis: Small teeth measuring 3 mm on the average; possible oral tooth of an unknown batoid species; teeth probably functional in a mosaic pattern similar to that of the Dasyatidae Family.

Meridiania convexa nov. gen. et nov. sp.

(Plate 13, Fig. 282–291 and Plate 14, Fig. 292–306)

Material: Several dozens of specimens.

Derivatio nominis: Species named for its convexity.

Locality: From the Bashi "Boulder zone", in a bluff situated behind the Red Hot Truck Stop, off of Highway 20–59 (access road), Meridian, Lauderdale County, Mississippi.

Age: Bashi Formation, Early Eocene (Ypresian or Paniselian stage?).

Holotype: (AMNH 13805).

Paratypoids: (AMNH 13806), (AMNH 13807), (AMNH 13808), (AMNH 13809), (AMNH 13810), (AMNH 13811), and (AMNH 13812).

Diagnosis: See the genus diagnosis.

Description: Anterior teeth are somewhat larger than lateral ones, averaging 4 mm, while the lateral teeth average between 2 and 3 mm. Anterior teeth are rhomboid in design, the tooth crown is extremely convex with an identation along the enamel apron in lingual aspect, a form of depression laterally displaced leaving a boss in the central portion of the enameled apron (cf. Plate 13, Fig. 287 and Plate 14, Fig. 293).

Lateral teeth (cf. Plate 13, Fig. 282–286) show similar characteristics to the anterior teeth, however the example shown does not appear to have a complete convexity in occlusal aspect.

This lateral tooth displays a unique coronal peak, extending the full width of the tooth, not forming the typical convexity (rounded crown) shown in anterior teeth (cf. Plate 13, Fig. 282–284).

In basal aspect, the root vascularisation of *Meridiania convexa* nov. gen. et nov. sp. is probably polyaulacorhize. The root averages from between two to three lobes (cf. Plate 13, Fig. 286 and 291, and also Plate 14, Fig. 244, 300, 303, and 306).

Discussion: This author has placed *Meridiania convexa* nov. gen. et nov. sp. in the Family Dasyatidae with confidence. This species is unique to the Early Eocene (Ypresian or Paniselian stage) of North America and has only been found in the Bashi Formation of Mississippi to date.

The closest species to *Meridiania convexa* nov. gen. et nov. sp., is ARAMBOURG's *Dasyatis globidens* (ARAMBOURG, 1952: 206–207, and Pl. 31). *Meridiania convexa* nov. gen. et nov. sp. differs from *Dasyatis globidens* ARAMBOURG by the lack of rugose striae or sculpturing on the lingual face of the crown, and the teeth of *D. globidens* are larger than the microscopic teeth of *Meridiania convexa* nov. gen. et nov. sp. The basal root structure differs somewhat between the two species.

It seems likely that ARAMBOURG should have erected a new genus and this author suggests that *Dasyatis globidens* should be considered as *Meridiania globidens* (ARAMBOURG).

Dasyatoidea incertae familiae

Genus: *Coupatezia* CAPPETTA 1982

Coupatezia woutersi CAPPETTA

(Plate 12, Fig. 267–271)

Material: Several dozens of specimens.

Figured specimen: (AMNH 13813).

Localities: From both the Tuscahoma glauconitic sands and the overlying Bashi "Boulder zone", in a bluff situated behind the Red Hot Truck Stop, off of Highway 20–59 (access road), Meridian, Lauderdale County, Mississippi.

Ages: Tuscahoma Formation, Late Paleocene (Thanetian stage), and from the Bashi Formation, Early Eocene (Ypresian or Paniselian stage?).

Description: Small teeth measuring 3 mm wide on average, strongly ornamented labial face of the crown (occlusal aspect) showing multiple irregular "pock marks" (cf. Plate 12, Fig. 267 and 269). Figured specimen is probably an antero-lateral tooth, and in profile it shows the occlusal face leaning posteriorly – to form a labial face (cf. Plate 12, Fig. 271). The root vascularisation is typically holaulacorhize.

Discussion: CAPPETTA (1982) revised *Cestracion duponti* (WINKLER, 1874), forming two new genera, *Jacquhermania* and *Coupatezia*. *Coupatezia woutersi* has been erected by CAPPETTA from *Raja duponti*.

This author herewith presents the first occurrence in the fossil record of North America of *Coupatezia woutersi.* Until now, *C. woutersi* has only been reported from the Middle Eocene (Bruxellian stage) in the Brussels region of Belgium (CAPPETTA 1987: 168).

Coupatezia woutersi is found in both the Tuscahoma and Bashi formations of Mississippi, extending back in geological time to the Early Eocene (either Ypresian or Paniselian stages) and most interesting and importantly of all, to the Late Paleocene (Thanetian stage).

Superfamily: Myliobatoidea COMPAGNO 1973

Family: Myliobatidae BONAPARTE 1838

Genus: *Myliobatis* CUVIER 1817

Myliobatis dixoni AGASSIZ

(Plate 15, Fig. 348–350)

Material: Several dozens of isolated chevrons.
Specimen: (AMNH 13814).
Localities: From both the Tuscahoma glauconitic sands and the overlying Bashi "Boulder zone", in a bluff situated behind the Red Hot Truck Stop, off of Highway 20–59 (access road), Meridian, Lauderdale County, Mississippi.
Ages: Tuscahoma Formation, Late Paleocene (Thanetian stage), and from the Bashi Formation, Early Eocene (Ypresian or Paniselian stage?).

Description: A section of the lower jaw of an Eagle ray, with five chevrons (median pavement teeth) connected to each other (cf. Plate 15, Fig. 348–350). No lateral (side) denticles present on this specimen. The five median chevrons (entire specimen) measures approximately 18 mm (vertically) and approximately 1 cm in width (horizontally).

Discussion: According to CAPPETTA (1987: 172), *Myliobatis dixoni* has been reported from the Early Eocene (Ypresian stage) London Clay of England, and has been reported by DARTEVELLE & CASIER (1943) in the Paleocene and Eocene at Cabinda, West Africa. It has also been reported by ARAMBOURG (1952) in the Early Eocene (Ypresian) of Morocco, North Africa.

Myliobatis sp.

(Plate 15, Fig. 341–343 and 351–352)

Material: Several hundreds of isolated chevrons (medial as well as lateral), and fragments of stingray barbs.
Specimens: (AMNH 13815–1), (AMNH 13815–2), (AMNH 13815–3), and (AMNH 13815–4).
Locality: CASE's estuary site 1 (Tuscahoma greensand), Meridian, Lauderdale County, Mississippi.
Age: Tuscahoma Formation, Late Paleocene (Thanetian stage).

Description: Isolated medial chevrons averaging 3 cm in length (cf. Plate 15, Fig. 341–343). The root vascularisation is typically polyaulacorhize, having numerous, closely spaced root lobes in basal aspect.

Lateral denticles of *Myliobatis* sp. measure an average of 5 mm in overall size. In basal aspect, there are on the average, 3 distinctive irregularly shaped lobes, also polyaulacorhize (cf. Plate 15, Fig. 352).

Finally, a description of an anterior fragment of a stingray barb of *Myliobatis* sp. If the barb were complete, the entire barb would have been from 3 to 4 times longer (cf. Plate 15, Fig. 351).

Discussion: According to CAPPETTA (1987: 172), the geological range the genus *Myliobatis* is from the Danian/Montian of the Lower Paleocene to recent times.

Family: Rhinopteridae JORDAN & EVERMANN 1896

Genus: *Rhinoptera* CUVIER 1829

Rhinoptera sp.

(Plate 15, Fig. 332–340 and 346–347)

Material: Less than two dozen specimens.
Specimens: (AMNH 13816–1), (AMNH 13816–2), (AMNH 13816–3) and (AMNH 13816–4).
Locality: CASE's estuary site 1 (Tuscahoma greensand), Meridian, Lauderdale County, Mississippi.
Age: Tuscahoma Formation, Late Paleocene (Thanetian stage).

Description: Isolated tooth plate chevrons averaging 6 mm in total width; one specimen over 1 cm in width. Pavement crusher teeth (chevrons) in basal aspect, contain large, irregularly shaped and widely spaced root lobes, differing from those of the previous description of *Myliobatis dixoni* and *M.* sp., the latter two have numerous and closely spaced root lobes (cf. Plate 15, Fig. 333, 334, 337 and 338). The chevrons of *Rhinoptera* (in general) have smooth, unornamented surfaces (cf. Plate 15, Fig. 332 and 335).

Discussion: This material may represent at least three distinct species of *Rhinoptera*. Species 1 (cf. Plate 15, Fig. 332–334) may represent a true rhinopterid species. Species 2 (cf. Plate 15, Fig. 335–337) may represent yet another type of rhinopterid. Species 3, however, appears to be closer to *Aetobatus* by virtue of its semi-circular or crescent-shaped chevron (cf. Plate 15, Fig. 338–340), and may not be a rhinopterid, after all.

Superfamily: Mobuloidea WHITLEY 1936

Family: Mobuloidae GILL 1893

Genus: *Archaeomanta* HERMAN 1979

Archaeomanta melenhorsti HERMAN

(Plate 14, Fig. 307–318)

Material: Less than two dozen specimens.
Specimens: (AMNH 13817–1), (AMNH 13817–2), and (AMNH 13817–3).
Locality: From the Bashi "Boulder Zone", in a bluff situated behind the Red Hot Truck Stop, off of Highway 20–59 (access road), Meridian, Lauderdale County, Mississippi.
Age: Bashi Formation, Early Eocene (Ypresian or Paniselian stage?).

Description: Small teeth measuring up to 3.5 mm in overall height; central cusp slender, sigmoidal or bent anteriorly, and flattened laterally with no apparent side cusps; central cusp extends from a robust bifurcated root structure. The teeth are devoid of ornamentation or striae. Teeth are probably non-functional in a manta ray.

Discussion: HERMAN (1979) places *Archaeomanta* in the Family Ceratopteridae (WHITLEY 1936), while CAPPETTA (1987: 175) places it in the Family Mobuloidae (GILL 1893).

This author, in association with one American and three Russian colleagues, is working up a Middle Eocene selachian fauna from the Republic of Uzbekistan in the U.S.S.R., which includes among its taxa, *Archaeomanta melenhorsti*.

Genus: *Burnhamia* CAPPETTA 1976

Burnhamia daviesi (WOODWARD)

(Plate 15, Fig. 329–331)

Material: Less than one dozen specimens.
Specimen: (AMNH 13818).
Locality: From the Bashi "Boulder zone", in a bluff situated behind the Red Hot Truck Stop, off of Highway 20–59 (access road), Meridian, Lauderdale County, Mississippi.
Age: Bashi Formation, Early Eocene (Ypresian or Paniselian stage?).

Description: Illustrated specimen is 3 mm in width with a broad hollowed-out depression containing ornamentation situated within the hexagonal shape of the entire tooth in occlusal aspect (cf. Plate 15, Fig. 329). In lateral view, there is an identation surrounding the apron of the enameled area running transversally, which forms the "collar" situated in the middle of the hexagonal silhouette of the tooth in occlusal aspect (cf. Plate 15,

Fig. 330). The basal aspect of the tooth shows 4 distinctive and rather larger root lobes, and therefore its root vascularisation is polyaulacorhize (cf. Plate 15, Fig. 331).

Discussion: Originally WOODWARD (1889) described this species as *Rhinoptera daviesi*, the tooth being similar in some respects to that ray. CAPPETTA (1976) revised the genus and named it after the town of Burnham on Crouch, in Kent, England, not far from London. *Burnhamia daviesi* has been recovered from the Early Eocene (Ypresian stage) of England. It has also been reported from Belgium, and has even turned up in the Thanetian as well. It is also known from the Lower Eocene (Ypresian stage) of the Ouled Abdoun Basin, Morocco, North Africa.

Burnhamia fetahi CAPPETTA

(Plate 15, Fig. 326–328)

Material: Less than one dozen specimens.

Specimen: (AMNH 13819).

Locality: From the Bashi "Boulder zone", in a bluff situated behind the Red Hot Truck Stop, off of Highway 20–59 (access road), Meridian, Lauderdale County, Mississippi.

Age: Bashi Formation, Early Eocene (Ypresian or Paniselian stage?).

Description: Illustrated specimen measures 3 mm in width; the occlusal aspect of this tooth shows an entire depression transversally across the entire width of the hexagonally shaped tooth, as opposed to the previous description (cf. Plate 15, Fig. 326). Within this depression area of the tooth is a "pock-marked" type of ornamentation, throughout the entire depressed area. In profile view, there is no identation on the enamel apron region as there was in *Burnhamia daviesi*. In basal aspect, the root vascularisation is still polyaulacorhize (even though there are 3 root lobes present, badly worn and abraded) (cf. Plate 15, Fig. 327 and 328).

Discussion: CAPPETTA (1985) described *Burnhamia fetahi* from the Early Eocene (Ypresian stage) of Ouled Abdoun, Morocco, North Africa.

This is the first report in the fossil record of the "new world", not only of *Burnhamia daviesi*, but also for *B. fetahi*.

4. Results and conclusions

The material studied in this report comprises 47 selachian species belonging to 28 genera (33 shark species attributable to 17 genera and 14 batoid species attributable to 11 genera).

The fossils are from 2 formations located in City limits of Meridian, Lauderdale County, Mississippi: the Tuscahoma Formation of Late Paleocene age and the Bashi Formation of Early Eocene age.

Paleontological results

Several taxa are new: *Heterodontus sowasheense* nov. sp.; *Odontaspis borodini* nov. sp.; *O. hynei* nov. sp.; *Pseudodontaspis lauderdalensis* nov. sp.; *P. mississippiensis* nov. sp.; *Microscyliorhinus leggetti* nov. gen. et nov. sp.; *Mustelus rodgersi* nov. sp.; *Physogaleus americanus* nov. sp.; *Platyrhina dockeryi* nov. sp.; and *Meridiania convexa* nov. gen. et nov. sp.

In this report, the lamniformes are the most abundant (17 species), followed by the carcharhiniformes (13 species). The rajiformes are represented by three species; the orectolobiformes are comprised of 2 species, while the heterodontiformes and torpediniformes are represented by 1 species each.

Composition of the fauna

Table 1 represents a distribution of the fossil species found in both formations.

Table 2 presents an interesting correlation between the species found in the Tuscahoma Formation and a similar fauna found in the British Isles (probably also in western Europe, which includes France, Belgium, and The Netherlands (Holland)) and the northern part of the African continent (particularly, Morocco).

Table 3 demonstrates a further correlation between the Bashi Formation and the fauna of the Sables de Mons-en-Pévèle, found in Europe (Belgium).

The following tables (Table 4 and Table 5) list the 47 species of selachians in this report with respect to their abundance (recovered specimens).

Table 1. Distribution of species within the two formations.

Status	Genus and species	Tuscahoma Fm	Bashi Fm
n. sp.	*Heterodontus sowasheense*		×
	Ginglymostoma subafricanum	×	×
	Nebrius thielensis	×	×
	Jaekelotodus sp.	×	×
n. sp.	*Odontaspis borodini*	×	×
n. sp.	*Odontaspis hynei*	×	
	Odontaspis speyeri	×	×
	Odontaspis substriatus	×	
	Odontaspis winkleri	×	×
	Odontaspis sp.	×	
n. sp.	*Pseudodontaspis lauderdalensis*	×	×
n. sp.	*Pseudodontaspis mississippiensis*	×	×
	Striatolamia macrota	×	×
	Carcharias hopei	×	
	Carcharias robustus	×	
	Carcharias teretidens	×	
	Carcharias verticalis	×	
	Anomotodon sp.	×	×
	Cretolamna aschersoni	×	×
	Cretolamna lerichei	×	×
	Galeus sp.		×
n. gen. & sp.	*Microscyliorhinus leggetti*		×
	Scyliorhinus gilberti		×
	Galeorhinus affinis	×	×
	Galeorhinus lefevrei	×	
	Galeorhinus minor	×	×
	Galeorhinus ypresiensis	×	
n. sp.	*Mustelus rodgersi*	×	
	Abdounia beaugei	×	×
	Abdounia subulidens	×	×
n. sp.	*Physogaleus americanus*	×	×
	Physogaleus tertius	×	×
	Physogaleus sp.	×	
	Rhinobatos sp.	×	×
n. sp.	*Platyrhina dockeryi*		×
	Pristis sp.	×	
	Eotorpedo jaekeli	×	×
	Dasyatis jaekeli	×	
	Dasyatis tricuspidatus	×	×

Table 1. Continued.

Status	Genus and species	Tuscahoma Fm	Bashi Fm
n. gen. & sp.	*Meridiania convexa*		×
	Coupatezia woutersi	×	×
	Myliobatis dixoni	×	×
	Myliobatis sp.	×	
	Rhinoptera sp.	×	
	Archaeomanta melenhorsti		×
	Burnhamia daviesi		×
	Burnhamia fetahi		×

Table 2. Comparison of species from the Tuscahoma Formation of Mississippi, U.S.A., with the London Clay of England and its equivalent in the Oulad Abdoun Basin of Morocco, North Africa (both of which are Ypresian stage).

Genus and species	Tuscahoma Fm of Mississippi	London Clay of England	Oulad-Abdoun Basin-Morocco
Cretolamna aschersoni	×		×
Cretolamna lerichei	×	×	×
Carcharias hopei	×	×	×
Carcharias teretidens	×	×	
Carcharias robustus	×	×	
Odontaspis substriatus	×	×	×
Odontaspis winkleri	×	×	×
Odontaspis speyeri	×		×
Striatolamia macrota	×	×	×
Jaekelotodus sp.	×	×	
Anomotodon sp.	×		
Abdounia beaugei	×	×	×
Abdounia subulidens	×		×
Galeorhinus affinis	×		
Galeorhinus lefevrei	×	×	
Galeorhinus minor	×		×
Galeorhinus ypresiensis	×	×	
Physogaleus tertius	×		×
Ginglymostoma subafricanum	×		×*
Nebrius thielensis	×	×	
Dasyatis jaekeli	×	×	
Coupatezia woutersi	×	×	×
Eotorpedo jaekeli	×		×
Myliobatis dixoni	×	×	×
	TUSCAHOMA	LONDON CLAY	MOROCCO

* Recorded in the Montian and Thanetian of Morocco (Arambourg 1952: 336–338), but, may also have been recovered from the Ypresian as well.

Note: London Clay equivalents in Belgium and France and their faunas, not completely known to this author, and as such, are left off this comparison of species table.

Table 3. Comparison of species from the Bashi Formation of Mississippi, U.S.A., with the Sables de Mons-en-Pévèle (Paniselian) at the Ampé Clay Pits, Egem, Flanders, Belgium (P1b of HERMAN).

Genus and species	Bashi Formation (Wilcox Group) of Mississippi	Egem, Belgium loc. (Paniselian)
Nebrius thielensis	×	×
Odontaspis speyeri	×	×
Striatolamia macrota	×	×
Cretolamna lerichei	×	×
Scyliorhinus gilberti	×	×
Galeorhinus minor	×	×
Abdounia subulidens	×	×
Physogaleus tertius	×	×
Dasyatis jaekeli	×	×
Coupatezia woutersi	×	×
Myliobatis dixoni	×	×
Burnhamia daviesi	×	×
Archaeomanta melenhorsti	×	×

Table 4. Occurrence of species in the Tuscahoma Formation – abundant to extremely rare.

Striatolamia macrota	abundant	*Coupatezia woutersi*	rare
Cretolamna aschersoni	abundant	*Jaekelotodus* sp.	rare
Cretolamna lerichei	abundant	*Carcharias teretidens*	rare
Ginglymostoma subafricanum	abundant	*Galeorhinus ypresiensis*	rare
Abdounia beaugei	abundant	*Odontaspis winkleri*	rare
Abdounia subulidens	abundant	*Eotorpedo jaekeli*	rare
Galeorhinus affinis	abundant	*Carcharias robustus*	rare
Galeorhinus minor	abundant	*Dasyatis jaekeli*	rare
Myliobatis dixoni	abundant	*Dasyatis tricuspidatus*	rare
Myliobatis sp.	abundant	*Odontaspis hynei*	extremely rare
Carcharias hopei	uncommon	*Physogaleus americanus*	extremely rare
Odontaspis speyeri	uncommon	*Odontaspis borodini*	extremely rare
Odontaspis substriatus	uncommon	*Physogaleus* sp.	extremely rare
Nebrius thielensis	uncommon	*Galeorhinus lefevrei*	extremely rare
Pristis sp.	uncommon	*Mustelus rodgersi*	extremely rare
Pseudodontaspis lauderdalensis	uncommon	*Rhinobatos* sp.	extremely rare
Pseudodontaspis mississippiensis	uncommon	*Rhinoptera* sp.	extremely rare
Physogaleus tertius	uncommon	*Anomotodon* sp.	extremely rare
Odontaspis sp.	uncommon		

Table 5. Occurrence of species in the Bashi Formation – abundant to extremely rare.

Abdounia beaugei	abundant	*Heterodontus sowasheensis*	rare
Abdounia subulidens	abundant	*Odontaspis speyeri*	rare
Galeorhinus affinis	abundant	*Anomotodon* sp.	rare
Galeorhinus minor	abundant	*Microscyliorhinus leggetti*	rare
Striatolamia macrota	abundant	*Physogaleus americanus*	rare
Physogaleus tertius	abundant	*Nebrius thielensis*	rare
Myliobatis dixoni	abundant	*Coupatezia woutersi*	rare
Cretolamna aschersoni	uncommon	*Scyliorhinus gilberti*	extremely rare
Cretolamna lerichei	uncommon	*Galeus* sp.	extremely rare
Pseudodontaspis lauderdalensis	uncommon	*Platyrhina dockeryi*	extremely rare
Pseudodontaspis mississippiensis	uncommon	*Rhinobatos* sp.	extremely rare
Odontaspis winkleri	uncommon	*Burnhamia daviesi*	extremely rare
Ginglymostoma subafricanum	uncommon	*Burnhamia fetahi*	extremely rare
Meridiania convexa	uncommon	*Eotorpedo jaekeli*	extremely rare
Archaeomanta melenhorsti	uncommon	*Dasyatis tricuspidatus*	extremely rare

Paleoecology

The Tuscahoma Formation probably represents an estuarine paleoenvironment, while the Bashi Formation probably represents an embayment or near-shore (littoral) paleoenvironment.

Evolutionary discussion

Many of the species in this report had their origins in the Late Cretaceous. Species such as: *Heterodontus, Ginglymostoma, Odontaspis, Pseudodontaspis, Carcharias, Cretolamna, Scyliorhinus, Galeorhinus,* and *Rhinobatos.* These have all been recovered in the various Maastrichtian exposures in the States of New Jersey, Delaware, Maryland, and in Texas. These species-types have successfully breached the KT (Cretaceo-Tertiary) boundary, and many of them have had a long history during Tertiary times, and some, up to the present time in the oceans and seas of the world.

Cretolamna as a generic type was first brought fourth into the Tertiary times by CASE & CAPPETTA (1990) with *Cretolamna twiggsensis* of the middle to late Eocene. The present report uses *Cretolamna* for two species: *Cretolamna aschersoni* and *C. lerichei.*

This report presents for the first time in North American Tertiary fossil deposits, the following taxa: *Jaekelotodus, Abdounia, Platyrhina, Coupatezia, Archaeomanta,* and *Burnhamia.*

The following species are the earliest occurrence in the fossil record of North America: *Striatolamia, Anomotodon, Galeus, Physogaleus, Pristis, Eotopedo, Dasyatis, Myliobatis*, and *Rhinoptera.*

Finally, the following new genera are completely new to the fossil record of North America: *Microscyliorhinus leggetti* nov. gen. et nov. sp.; and *Meridiania convexa* nov. gen. et nov. sp.

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The material as described herein (types, paratypes, and figured specimens) will be housed in the collections of the American Museum of Natural History, in New York City, New York. Acronym: AMNH.

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Explanations of the Plates

Plate 1

Fig. 1. Exposure of Bashi Formation at Bashi Creek (type locality), Clarke County, Alabama.
Fig. 2. Closeup of the "Boulder zone"" of the Bashi Formation. Fossils are recovered from below the boulders. Meridian, Mississippi. Boulder is in situ in a 14.7′ high bluff back of the Red Hot Truck Stop, Frontage road.
Fig. 3. Bashi "Boulders"" situated along the berm of 31st Avenue, in Meridian, Mississippi. These boulders were removed from overhanging blufffs near the highway-as a safety precaution to vehicular traffic.
Fig. 4. A closeup of a *Venericardia* specimen on top of one of the boulders situated at 31st Avenue, Meridian, Mississippi. *Venericardia (Venericor)* is a "type"" pelecypod (clamshell) found in the late early Eocene, and as such is Paniselian in age, just slightly younger than basic London Clay (Ypresian).
Fig. 5. Another view of the removed Bashi boulders at 31st Avenue in Meridian, Lauderdale County, Mississippi.
Fig. 6. Closeup of the "waterfall"" area in the Tuscahoma Formation exposed back of the Red Hot Truck stop, in a bluff that is approximately 10.7 feet in height from the base (Nannafalia Formation) exposed in Crawdaddy Creek, a tributary of Sowashee Creek.
Fig. 7. Quarry (April 1982) exposing the fossiliferous "fish-bed"" zone (Thanetian stage) of the Tuscahoma Formation, back of the Red Hot Truck stop, Meridian, Mississippi.
Fig. 8. Bashi Formation boulder exposed in situ at roadcut near Whynot, Mississippi, on route 19, close to the Alabama border.
Fig. 9. An overall view of the Bashi Formation exposure in the roadcut near Whynot, Lauderdale County, Mississippi, near to the Alabama border, along Rt. 19.

Plate 2

Fig. 10–33. *Heterodontus sowasheense* nov. sp.
Fig. 10–14. Paratypoid. (AMNH 13721), × 18. Anterior tooth of an adult individual. 10. Labial view; 11. Profile view; 12. Basal view; 13. Lingual-basal view; 14. Occlusal view. (SEM).
Fig. 15–17. Paratypoid. (AMNH 13722), ×11.5. Lateral battery tooth of an adult individual. 15. Occlusal view; 16. Labial view; 17. Basal view. (SEM).
Fig. 18. Paratypoid. (AMNH 13723), ×11. Lateral battery tooth of an adult individual. 18. Occluso-lingual view. (SEM).
Fig. 19–23. Holotype. (AMNH 13724), ×16. Anterior tooth of a juvenile individual. 19. Labial view; 20. Profile view; 21. Basal view; 22. Occluso-lingual view; 23. Labial view. (SEM).
Fig. 24–28. Paratypoid. (AMNH 13725), ×19. Lateral tooth in the anterior region of the jaw of an adult individual. 24. Occlusal view; 25. Profile view; 26. Lingual view; 27. Basal view or occluso-labial view; 28. Labial view. (SEM).
Fig. 29–33. Paratypoid. (AMNH 13726), ×17. Anterior tooth of a juvenile individual. 29. Labial view; 30. Labial view; 31. Basal-labial view; 32. Profile view; 33. Lingual view. (SEM).

Plate 3

Fig. 34–53. *Cretolamna aschersoni* (Stromer)
Fig. 34–35. (AMNH 13779-1), ×2. Lateral tooth. 34. Lingual view. 35. Labial view.
Fig. 36–37. (AMNH 13779-2), ×2. Antero-lateral tooth. 36. Lingual view. 37. Labial view.
Fig. 38–39. (AMNH 13779-3), ×2. Antero-lateral tooth. 38. Lingual view. 39. Labial view.
Fig. 40–41. (AMNH 13779-4), ×2. Lower anterior tooth. 40. Lingual view. 41. Labial view.
Fig. 42–43. (AMNH 13779-5), ×2. Upper lateral tooth. 42. Lingual view. 43. Labial view.
Fig. 44–45. (AMNH 13779-6), ×2. Lateral tooth. 44. Lingual view. 45. Labial view.
Fig. 46–47. (AMNH 13779-7), ×2.5. Lateral tooth. 46. Lingual view. 47. Labial view.
Fig. 48–49. (AMNH 13779-8), ×2. Lateral tooth. 48. Lingual view. 49. Labial view.
Fig. 50–51. (AMNH 13779-9), ×1.5. Anterior tooth. 50. Lingual view. 51. Labial view.
Fig. 52–53. (AMNH 13779-10), ×3. Postero-lateral tooth. 52. Labial view. 53. Lingual view.

Plate 4

Fig. 54–57. *Cretolamna aschersoni* (Stromer)
Fig. 54–55. (AMNH 13779-11), ×1.5. Anterior tooth. 54. Lingual view. 55. Labial view.
Fig. 56–57. (AMNH 13779-12), ×2. Lateral tooth. 56. Labial view. 57. Lingual view.
Fig. 58–61. *Carcharias hopei* (Agassiz)
Fig. 58–59. (AMNH 13767), ×2. Anterior tooth. 58. Labial view. 59. Lingual view.

Fig. 60–61. (AMNH 13768), ×3. Anterior tooth. 60. Lingual view. 61. Labial view.
Fig. 62–71. *Cretolamna lerichei* (Casier)
Fig. 62–63. (AMNH 13780-1), ×2.5. Lateral tooth. 62. Lingual view. 63. Labial view.
Fig. 64–65. (AMNH 13780-2), ×2.5. Lateral tooth. 64. Lingual view. 65. Labial view.
Fig. 66–67. (AMNH 13780-3), ×2.5. Lateral tooth. 66. Lingual view. 67. Labial view.
Fig. 68–69. (AMNH 13780-4), ×2.5. Antero-lateral tooth. 68. Lingual view. 69. Labial view.
Fig. 70–71. (AMNH 13780-5), ×4. Antero-lateral tooth. 70. Lingual view. 71. Labial view.
Fig. 72–73. *Cretolamna aschersoni* (Stromer)
Fig. 72–73. (AMNH 13779-14), ×2. Anterior tooth. 72. Lingual view. 73. Labial view.
Fig. 74–77. *Cretolamna lerichei* (Casier)
Fig. 74–75. (AMNH 13780-6), ×2.5. Lower lateral tooth. 74. Lingual view. 75. Labial view.
Fig. 76–77. (AMNH 13780-7), ×3.5. Lateral tooth. 76. Lingual view. 77. Labial view.

Plate 5

Fig. 78–87. *Striatolamia macrota* (Agassiz)
Fig. 78–79. (AMNH 13762), ×2. Lateral tooth. 78. Lingual view. 79. Labial view.
Fig. 80-81. (AMNH 13763), ×2. Antero-lateral tooth. 80. Labial view. 81. Lingual view.
Fig. 82–83. (AMNH 13764), ×2. Antero-lateral tooth. 82. Lingual view. 83. Labial view.
Fig. 84–85. (AMNH 13765), ×1. Anterior tooth. 84. Lingual view. 85. Labial view.
Fig. 86–87. (AMNH 13766), ×1.5. Lower anterior tooth. 86. Lingual view. 87. Labial view.
Fig. 88–90. *Odontaspis* sp.
Fig. 88–90. (AMNH 13749), ×10. Symphyseal tooth (species indeterminate). 88. Left profile. 89. Lingual view. 90. Right profile view.
Fig. 91–96. *Carcharias verticalis* (Agassiz)
Fig. 91–92. (AMNH 13772), ×2.5. Lateral tooth. 91. Labial view. 92. Lingual view.
Fig. 93–94. (AMNH 13773), ×2. Antero-lateral tooth. 93. Lingual view. 94. Labial view.
Fig. 95–96. (AMNH 13774), ×2. Antero-lateral tooth. 95. Lingual view. 96. Labial view.
Fig. 97–98. *Cretolamna aschersoni* (Stromer)
Fig. 97–98. (AMNH 13779-13), ×2. Anterior tooth. 97. Lingual view. 98. Labial view.
Fig. 99–102. *Odontaspis speyeri* Dartevelle & Casier
Fig. 99–100. (AMNH 13740), ×4. Antero-lateral tooth. 99. Lingual view. 100. Labial view.
Fig. 101–102. (AMNH 13741), ×12. Antero-lateral tooth. 101. Lingual view. 102. Labial view.
Fig. 103. *Odontaspis borodini* nov. sp.
Fig. 103. Paratypoid. (AMNH 13735), ×10. Anterior tooth. 103. Lingual view. (SEM).

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Fig. 104–105. *Odontaspis borodini* nov. sp.
Fig. 104–105. Holotype. (AMNH 13736), ×10. Anterior tooth. 104. Lingual view. 105. Labial view. (SEM).
Fig. 106–107. *Odontaspis hynei* nov. sp.
Fig. 106–107. Paratypoid. (AMNH 13738), ×12. Anterior tooth. 106. Lingual view. Labial view. (SEM).
Fig. 108–111. *Pseudodontaspis lauderdalensis* nov. sp.
Fig. 108–109. Holotype. (AMNH 13750), ×7. Antero-lateral tooth. 108. Lingual view. 109. Labial view.
Fig. 110–111. Paratypoid. (AMNH 13751), ×8. Anterior tooth? 110. Lingual view. 111. Labial view.
Fig. 112–113. *Odontaspis borodini* nov. sp.
Fig. 112–113. Paratypoid. (AMNH 13737), ×12. Lateral tooth. 112. Lingual view. 113. Labial view. (SEM).
Fig. 114–125. *Pseudodontaspis lauderdalensis* nov. sp.
Fig. 114–115. Paratypoid. (AMNH 13752), ×7. Anterior tooth. 114. Labial view. 115. Lingual view.
Fig. 116–117. Paratypoid. (AMNH 13753), ×10. Antero-lateral tooth? 116. Labial view. 117. Lingual view.
Fig. 118–119. Paratypoid. (AMNH 13754), ×8. Anterior tooth. 118. Labial view. 119. Lingual view.
Fig. 120–121. Paratypoid. (AMNH 13755), ×8. Lateral tooth. 120. Lingual view. 121. Labial view.
Fig. 122–123. Paratypoid. (AMNH 13756), ×10. Anterior tooth. 122. Labial view. 123. Lingual view.
Fig. 124–125. Paratypoid. (AMNH 13757), ×8. Anterior tooth. 124. Labial view. 125. Lingual view.
Fig. 126–131. *Pseudodontaspis mississippiensis* nov. sp.
Fig. 126–127. Paratypoid. (AMNH 13758), ×15. Anterior tooth. 126. Lingual view. 127. Labial view.
Fig. 128. Holotype. (AMNH 13759), ×7. Anterior tooth. 128. Lingual view. (SEM).
Fig. 129. Paratypoid. (AMNH 13760), ×10. Anterior tooth. 129. Lingual view. (SEM).
Fig. 130–131. Paratypoid. (AMNH 13761), ×12. Anterior tooth. 130. Lingual view. 131. Labial view. (SEM).

Plate 7

Fig. 132–133. *Odontaspis hynei* nov. sp.
Fig. 132–133. Holotype. (AMNH 13739), ×10. Antero-lateral tooth. 132. Lingual view. 133. Labial view.
Fig. 134–139. *Odontaspis winkleri* (LERICHE)
Fig. 134–135. (AMNH 13746), ×7. Anterior tooth. 134. Lingual view. 135. Labial view.
Fig. 136–137. (AMNH 13747), ×10. Lateral tooth. 136. Lingual view. 137. Labial view.
Fig. 138–139. (AMNH 13748), ×9. Lateral tooth (incomplete, missing a side cusp). 138. Lingual view. 139. Labial view.
Fig. 140. ?*Odontaspis speyeri* DARTEVELLE & CASIER
Fig. 140. (AMNH 13742), ×10. Anterior tooth. 140. Labial view. (SEM).
Fig. 141–147. *Anomotodon* sp.
Fig. 141. (AMNH 13775), ×7. Lateral tooth. 141. Lingual view. (SEM).
Fig. 142–143. (AMNH 13776), ×4. Anterior tooth. 142. Lingual view. 143. Labial view.
Fig. 144–145. (AMNH 13777), ×8. Antero-lateral tooth. 144. Lingual view. 145. Labial view.
Fig. 146–147. (AMNH 13778), ×5. Lateral tooth. 146. Labial view. 147. Lingual view.
Fig. 148–152. *Scyliorhinus gilberti* CASIER
Fig. 148–149. (AMNH 13785), ×20. Anterior tooth. 148. Labial view. 149. Lingual view.
Fig. 150–152. (AMNH 13786), ×30. Antero-lateral tooth. 150. Lingual view. 151. Profile view. 152. Labial view. (SEM).
Fig. 153–160. *Abdounia subulidens* (ARAMBOURG)
Fig. 153–154. (AMNH 13793-1), ×8. Antero-lateral tooth. 153. Lingual view. 154. Labial view.
Fig. 155–157. (AMNH 13793-2), ×8. Anterior tooth. 155. Labial view. 156. Lingual view. 157. Profile view.
Fig. 158. (AMNH 13793-3), ×10. Lateral tooth. 158. Lingual view. (SEM).
Fig. 159. (AMNH 13793-4), ×10. Antero-lateral tooth. 159. Labial view. (SEM).
Fig. 160. (AMNH 13793-5), ×10. Antero-lateral tooth. 160. Lingual view. (SEM).

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Fig. 161–162. *Abdounia beaugei* (ARAMBOURG)
Fig. 161–162. (AMNH 13792-1), ×8. Anterior tooth. 161. Lingual view. 162. Labial view.
Fig. 163–164. *Physogaleus* sp.
Fig. 163–164. (AMNH 13798-1), ×10. Lateral tooth. 163. Labial view. 164. Lingual view.
Fig. 165–166. *Galeorhinus lefevrei* (DAIMERIES)
Fig. 165–166. (AMNH 13788), ×12. Lateral tooth. 165. Labial view. 166. Lingual view.
Fig. 167–174. *Galeorhinus minor* (AGASSIZ)
Fig. 167–168. (AMNH 13789-1), ×10. Lateral tooth. 167. Lingual view. 168. Labial view.
Fig. 169–170. (AMNH 13789-2), ×8. Antero-lateral tooth. 169. Lingual view. 170. Labial view.
Fig. 171–172. (AMNH 13789-3), ×8. Anterior tooth. 171. Lingual view. 172. Labial view.
Fig. 173–174. (AMNH 13789-4), ×7. Antero-lateral tooth. 173. Lingual view. 174. Labial view.
Fig. 175–180. *Abdounia beaugei* (ARAMBOURG)
Fig. 175–176. (AMNH 13792-2), ×8. Anterior tooth. 175. Labial view. 176. Lingual view.
Fig. 177–178. (AMNH 13792-3), ×10. Anterior tooth. 177. Lingual view. 178. Labial view.
Fig. 179–180. (AMNH 13792-4), ×7. Lateral tooth. 179. Lingual view. 180. Labial view.
Fig. 181–183. *Galeorhinus ypresiensis* CASIER
Fig. 181–183. (AMNH 13790), ×12. Anterior tooth. 181. Lingual view. 182. Profile view. 183. Labial view.
Fig. 184–185. *Galeus* sp.
Fig. 184–185. (AMNH 13781), ×20. Antero-lateral tooth. 184. Lingual view. 185. Labial view.

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Fig. 186–194. *Galeorhinus affinis* (PROBST)
Fig. 186–187. (AMNH 13787-1), ×15. Antero-lateral tooth. 186. Labial view. 187. Lingual view.
Fig. 188–189. (AMNH 13787-2), ×10. Lateral tooth. 188. Lingual view. 189. Labial view.
Fig. 190–191. (AMNH 13787-3), ×12. Antero-lateral tooth. 190. Lingual view. 191. Labial view. (SEM).
Fig. 192–194. (AMNH 13787-4), ×10. Anterior tooth. 192. Lingual view. 193. Basal-lingual view. 194. Labial view.
Fig. 195–207. *Microscyliorhinus leggetti* nov. gen. et nov. sp.
Fig. 195–198. Paratypoid. (AMNH 13782), ×13. Anterior tooth. 195. Profile view. 196. Basal view. 197. Lingual view. 198. Labial view. (SEM).
Fig. 199–202. Paratypoid. (AMNH 13783), ×10. Anterior tooth. 199. Profile view. 200. Basal view. 201. Labial view. 202. Lingual view. (SEM).

Fig. 203–207. Holotype. (AMNH 13784), ×17. Anterior tooth. 203. Lingual view. 204. Basal-lingual view. 205. 3/4 view-labial. 206. Lingual-profile. 207. Labial view. (SEM).
Fig. 208–211. *Physogaleus* sp.
Fig. 208–209. (AMNH 13798-2), ×7. Anterior tooth. 208. Lingual view. 209. Labial view.
Fig. 210–211. (AMNH 13798-3), ×7. Antero-lateral tooth. 210. Lingual view. 211. Labial view.

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Fig. 212–213. *Physogaleus* sp.
Fig. 212–213. (AMNH 13798-4), ×8. Antero-lateral tooth. 212. Labial view. 213. Lingual view.
Fig. 214–218. *Physogaleus americanus* nov. sp.
Fig. 214–215. Paratypoid. (AMNH 13794), ×10. Lateral tooth. 214. Labial view. 215. Lingual view.
Fig. 216–217. Paratypoid. (AMNH 13795), ×12. Anterior tooth. 216. Labial view. 217. Lingual view.
Fig. 218. Holotype. (AMNH 13796), ×15. Antero-lateral tooth. 218. Lingual view. (SEM).
Fig. 219–224. *Physogaleus tertius* (WINKLER)
Fig. 219–220. (AMNH 13797-1), ×10. Antero-lateral tooth. 219. Labial view. 220. Lingual view.
Fig. 221–222. (AMNH 13797-2), ×12. Anterior tooth. 221. Lingual view. 222. Labial view.
Fig. 223–224. (AMNH 13797-3), ×6. Antero-lateral tooth. 223. Labial view. 224. Lingual view.
Fig. 225–233. *Ginglymostoma subafricanum* ARAMBOURG
Fig. 225–229. (AMNH 13727), ×8. Anterior tooth. 225. Labial view. 226. Profile view. 227. Lingual view. 228. Basal-lingual view. 229. Basal view.
Fig. 230–233. (AMNH 13728), ×7. Lateral tooth. 230. Labial view. 231. Profile view. 232. Lingual view. 233. Basal view.

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Fig. 232–242. *Ginglymostoma subafricanum* ARAMBOURG
Fig. 234–237. (AMNH 13729), ×10. Antero-lateral tooth. 234. Labial view. 235. Profile view. 236. Lingual view. 237. Basal view.
Fig. 238. *Ginglymostoma africanum* LERICHE
Fig. 238. Comparative specimen (in author's collection).
Fig. 239–242. *Ginglymostoma subafricanum* ARAMBOURG
Fig. 239–242. (AMNH 13730), ×20. Antero-lateral tooth. 239. Occlusal view. 240. Lingual-occlusal view. 241. Profile view. 242. Lingual view.
Fig. 243–251. *Nebrius thielensis* (WINKLER)
Fig. 243–246. (AMNH 13731), ×3. Antero-lateral tooth. 243. Labial view. 244. Profile view. 245. Basal-lingual view. 246. Basal view.
Fig. 247–249. (AMNH 13732), ×12. Lateral tooth. 247. Lingual view. 248. Basal-lingual view. 249. Basal view. (SEM).
Fig. 250–251. (AMNH 13733), ×12. Antero-lateral tooth. 250. Lingual view. 251. Labial view. (SEM).

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Fig. 252–256. *Rhinobatos* sp.
Fig. 252–254. (AMNH 13799-1), ×15. Anterior tooth. 252. Lingual view. 253. Profile view. 254. Basal view. (SEM).
Fig. 255–256. (AMNH 13799-2), ×15. Anterior tooth. 255. Occlusal view. 256. Lingual view. (SEM).
Fig. 257–261. *Platyrhina dockeryi* nov. sp.
Fig. 257–261. Holotype. (AMNH 13800), ×20. Lateral tooth. 257. Lingual view. 258. Occlusal view. 259. Profile view. 260. Labial view. 261. Basal view. (SEM).
Fig. 262–266. *Eotorpedo jaekeli* WHITE
Fig. 262–265. (AMNH 13802-1), ×40. Anterior tooth. 262. Lingual view. 263. Profile view. 264. Labial view. 265. Basal view. (SEM).
Fig. 266. (AMNH 13802-2), ×35. Anterior tooth. 266. Lingual view. (SEM).
Fig. 267–271. *Coupatezia woutersi* CAPPETTA
Fig. 267–271. (AMNH 13813), ×20. Antero-lateral tooth. 267. Lingual view. 268. Right profile view. 269. Occlusal view. 270. Left profile view. 271. Basal-labial view. (SEM).

Plate 13

Fig. 272–274. *Dasyatis tricuspidatus* CASIER
Fig. 272–274. (AMNH 13803), ×15. Anterior tooth. 272. Lingual view. 273. Profile view. 274. Basal-labial view. (SEM).
Fig. 275. *Dasyatis jaekeli* (LERICHE)
Fig. 275. (AMNH 13804), ×15. Antero-lateral tooth. 275. Lingual view.

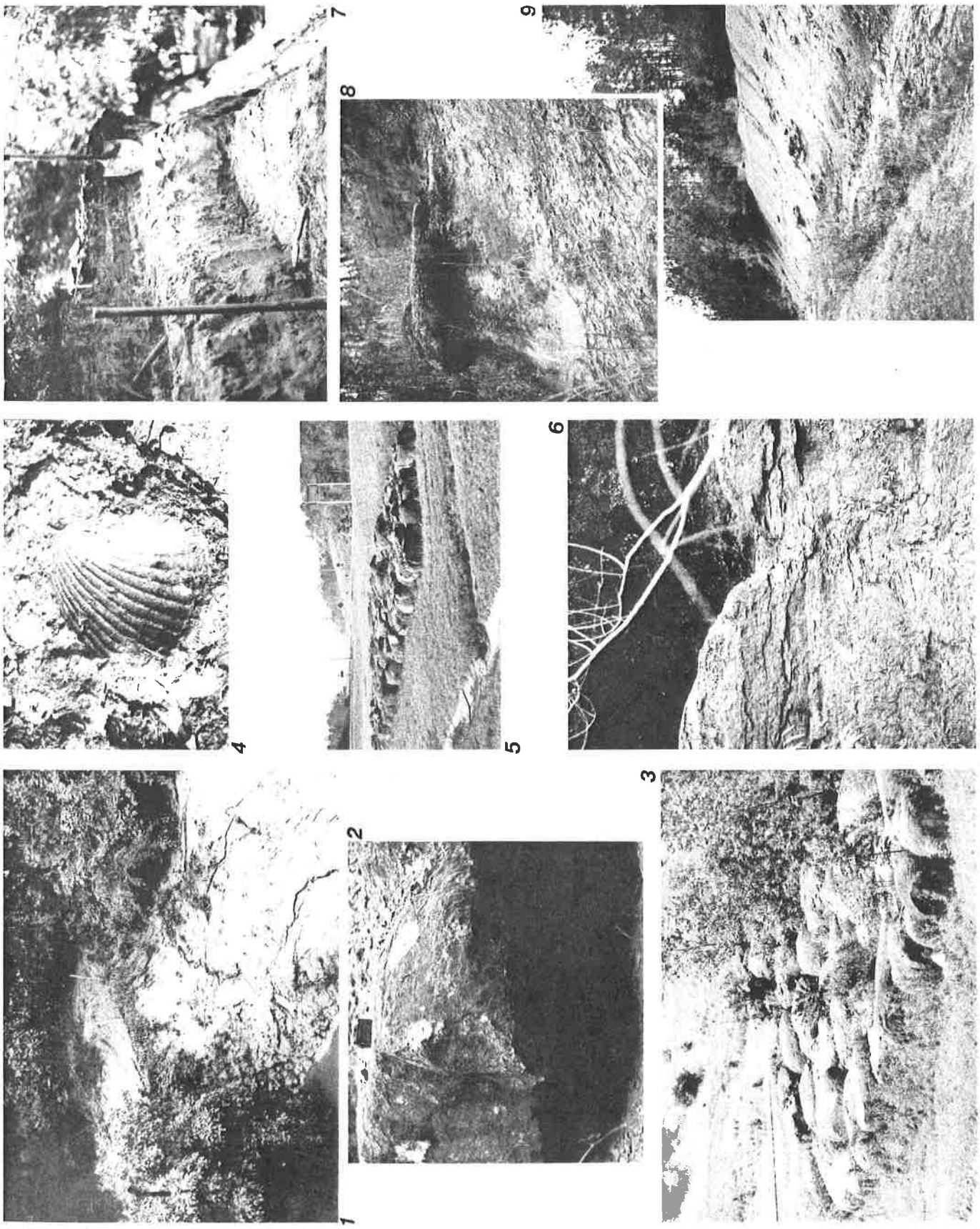
Fig. 276–281. *Mustelus rodgersi* nov. sp.
Fig. 276–281. Holotype. (AMNH 13791), ×20. Antero-lateral tooth. 276. Occlusal view. 277. Profile view. 278. Labial view. 279. Lingual-occlusal view. 280. Lingual view. 281. Basal view. (SEM).
Fig. 282–291. *Meridiania convexa* nov. gen. et nov. sp.
Fig. 282–286. Holotype. (AMNH 13805), ×12. Lateral tooth. 282. Lingual view. 283. Profile view. 284. Labial view. 285. Occlusal view. 286. Basal view. (SEM).
Fig. 287–291. Paratypoid. (AMNH 13806), ×10. Antero-lateral tooth. 287. Lingual view. 288. Profile view. 289. Occlusal-lingual view. 290. Occlusal view. 291. Basal view. (SEM).

Plate 14

Fig. 292–306. *Meridiania convexa* nov. gen. et nov. sp.
Fig. 292–294. Paratypoid. (AMNH 13807), ×13. Anterior tooth? 292. Occlusal view. 293. Profile view. 294. Basal view.
Fig. 295–296. (AMNH 13808), ×8. Isolated dermal denticle (scute). 295. Dorsal view. 296. Ventral view.
Fig. 297. (AMNH 13809), ×5. Isolated dermal denticle (scute). 297. Dorsal view.
Fig. 298–300. Paratypoid. (AMNH 13810), ×10. Anterior tooth? 298. Occlusal view. 299. Profile view. Basal view.
Fig. 301–303. Paratypoid. (AMNH 13811), ×7. Anterior tooth? 301. Occlusal view. 302 Profile view. 303. Basal view.
Fig. 304–306. Paratypoid. (AMNH 13812), ×12. Anterior tooth? 304. Occlusal view. 305. Profile view. 306. Basal view.
Fig. 307–318. *Archaeomanta melenhorsti* HERMAN
Fig. 307–312. (AMNH 13817-1), ×12. Anterior tooth? 307. Labial view. 308. Basal view. 309. Occlusal view. 310. Right profile view. 311. Left profile view. 312. Lingual view. (SEM).
Fig. 313–315. (AMNH 13817-2), ×12. Anterior tooth? 313. Lingual view. 314. Basal view. 315. Profile view. (SEM).
Fig. 316–318. (AMNH 13817-3), ×10. Anterior tooth? 316. Left profile view. 317. Labial view. 318. Right profile view. (SEM).

Plate 15

Fig. 319–325. *Pristis* sp.
Fig. 319–322. (AMNH 13801-1), ×2. Isolated rostral spine (denticle). 319. Right profile view. 320. Ventral bord view. 321. Dorsal bord view. 322. Left profile.
Fig. 323–325. (AMNH 13801-2), ×1.5. Isolated rostral spine (denticle). 323. Right profile view. 324. Ventral bord view. 325. Left profile view.
Fig. 326–328. *Burnhamia fetahi* CAPPETTA
Fig. 326–328. (AMNH 13818), ×12. Isolated chevron. 326. Occlusal view. 327. Profile view. 328. Basal view. (SEM).
Fig. 329–331. *Burnhamia daviesi* (WOODWARD)
Fig. 329–331. (AMNH 13819), ×15. Isolated chevron. 329. Occlusal view. 330. Profile view. 331. Basal view. (SEM).
Fig. 332–340. *Rhinoptera* sp.
Fig. 332–334. (AMNH 13816-1), ×8. Isolated chevron. 332. Occlusal view. 333. Profile view. 334. Basal view. (SEM).
Fig. 335–337. (AMNH 13816-2), ×7. Isolated chevron. 335. Occlusal view. 336. Profile view. 337. Basal view.
Fig. 338–340. *Rhinoptera* sp.?
Fig. 338–340. (AMNH 13816-3), ×4.5. Isolated chevron. 338. Basal view. 339. Profile view. 340. Occlusal view.
Fig. 341–345. *Myliobatis* sp.
Fig. 341–343- (AMNH 13815-1), ×2. Isolated chevron. 341. Occlusal view. 342. Profile view. 343. Basal view.
Fig. 344–345. (AMNH 13815-2), ×2. Isolated chevron. 344. Right profile view. 345. Left profile view.
Fig. 346–347. *Rhinoptera* sp.?
Fig. 346–347. (AMNH 13816-4), ×7. Isolated fragment of a chevron. 346. Right profile view. 347. Left profile view.
Fig. 348–350. *Myliobatis dixoni* AGASSIZ
Fig. 348–350. (AMNH 13814), ×2. A partial plate (comprised of five chevrons). 348. Profile or cross-section view. 349. Occlusal view. 350. Basal view.
Fig. 351. *Myliobatis* sp.
Fig. 351. (AMNH 13815-3), ×9. Distal portion of a sting-ray barb. 351. Dorsal view.
Fig. 352. (AMNH 13815-4), ×8. Isolated corner chevron (or anterior chevron). 352. Ventral view (or basal view).



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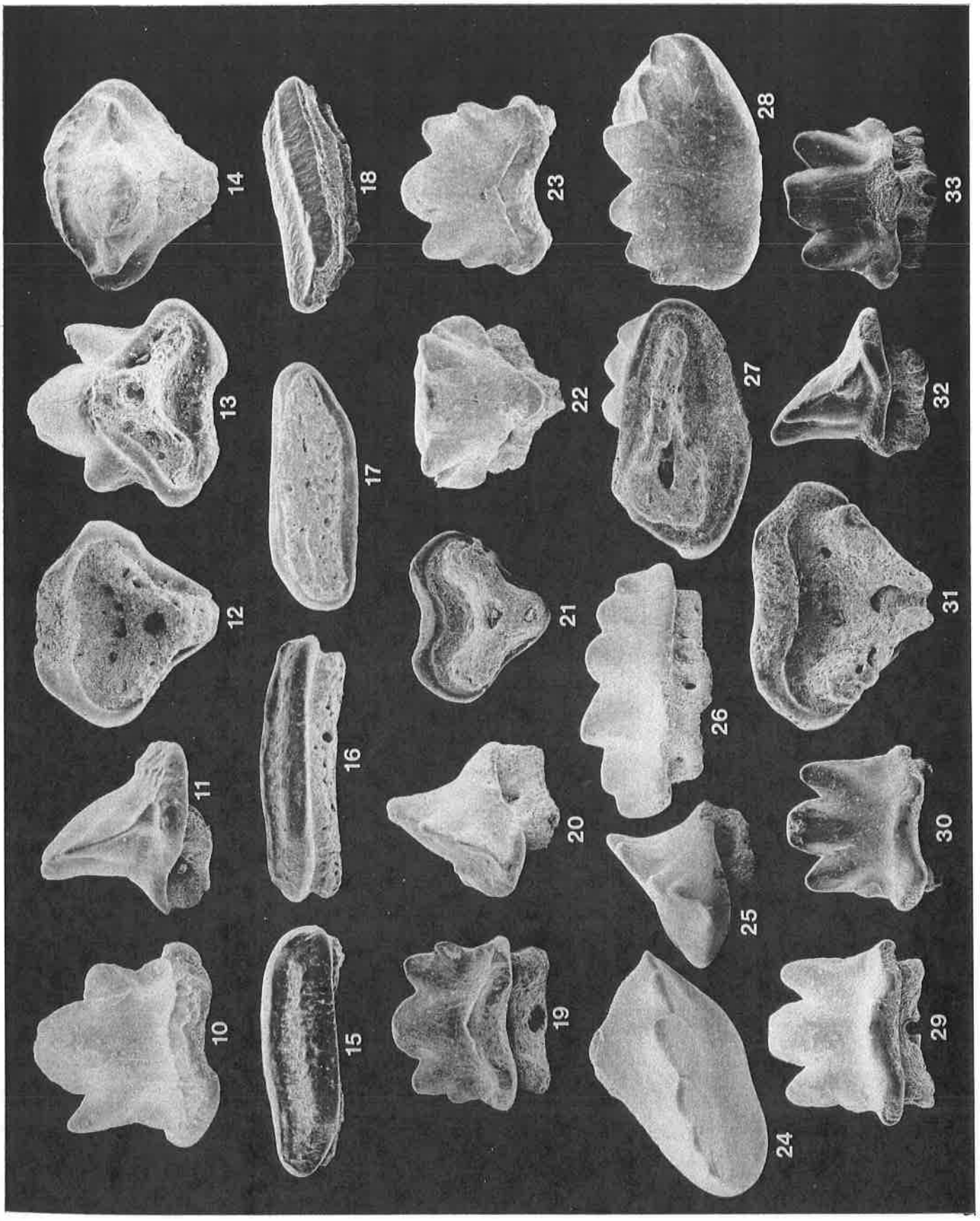

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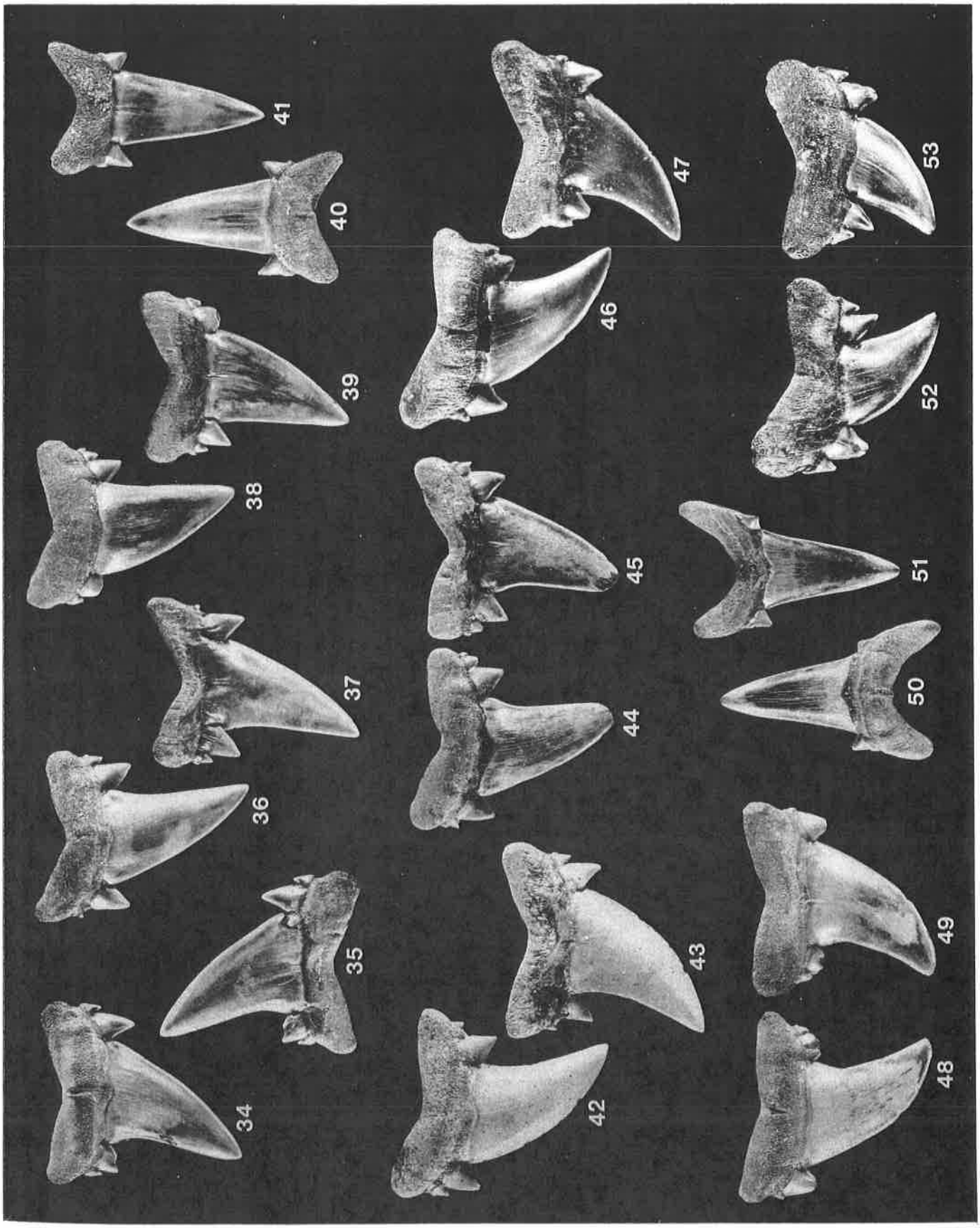

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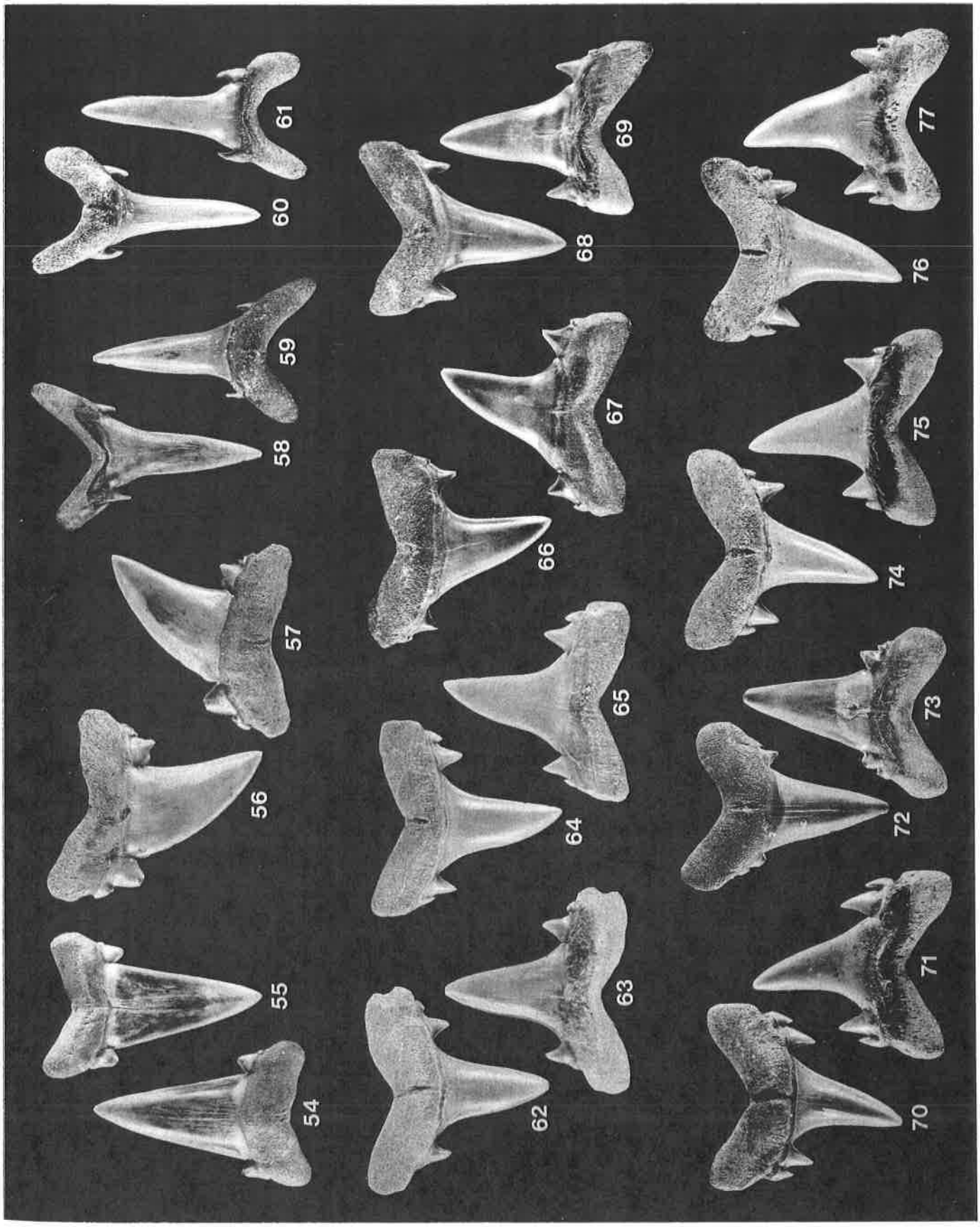

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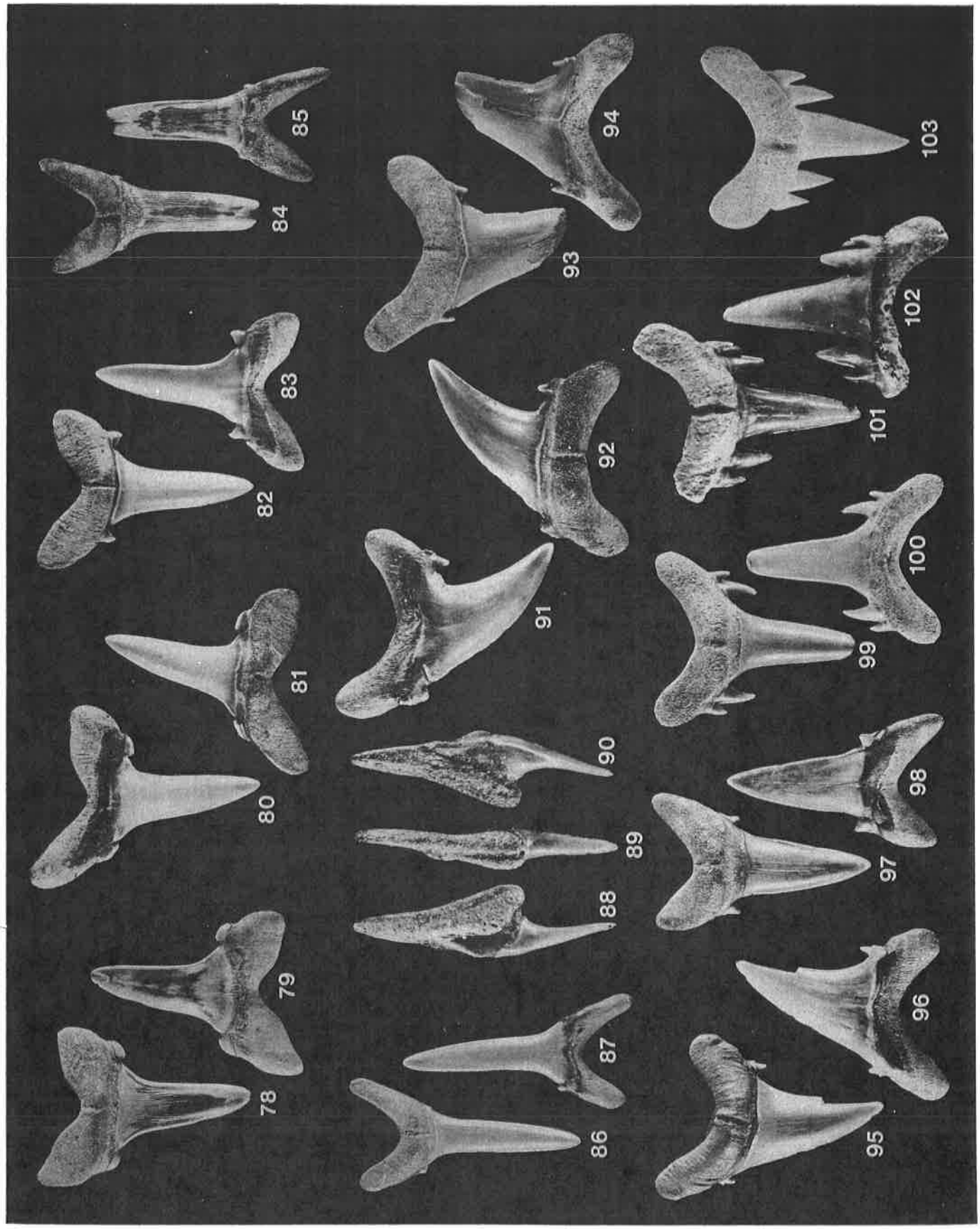

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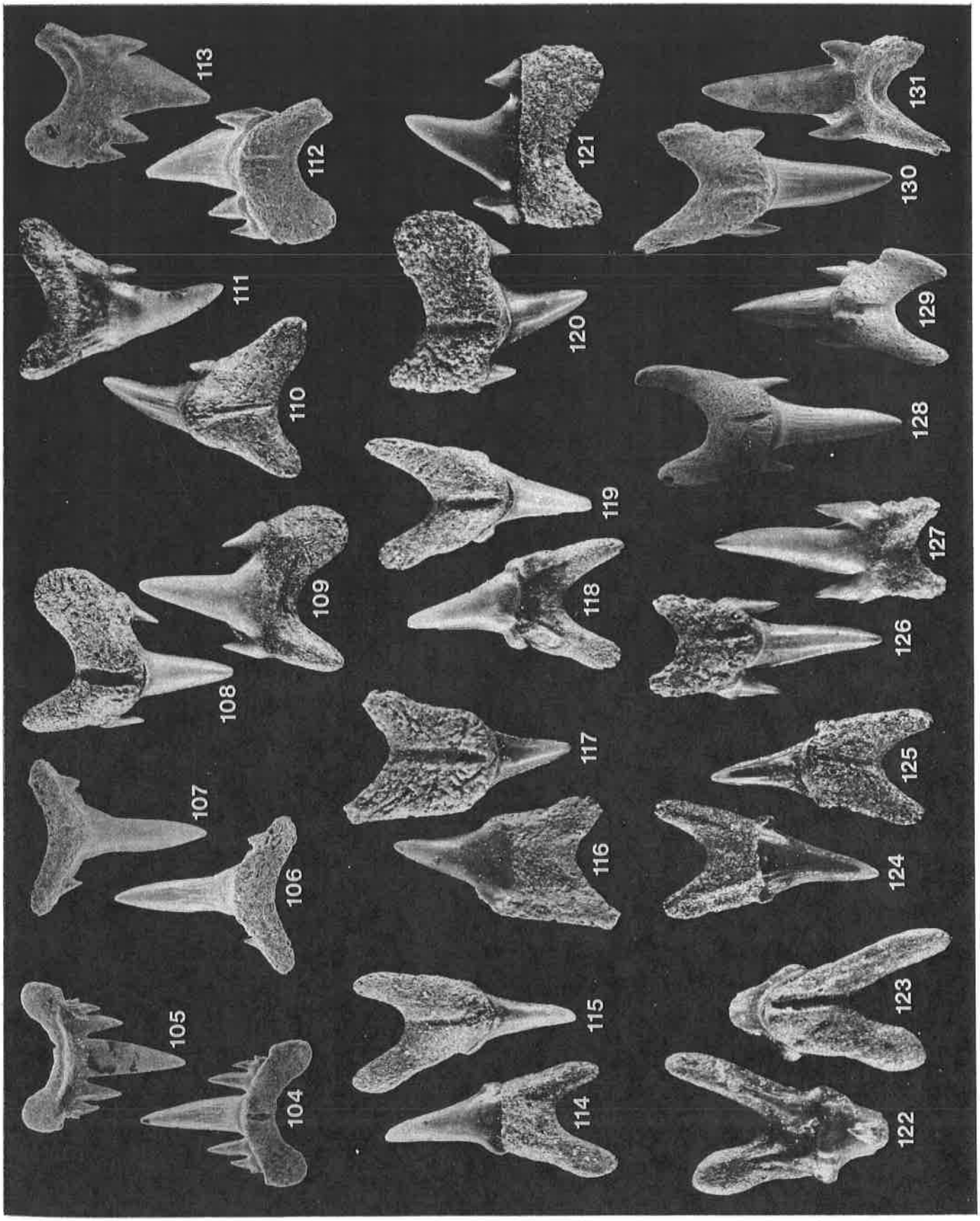

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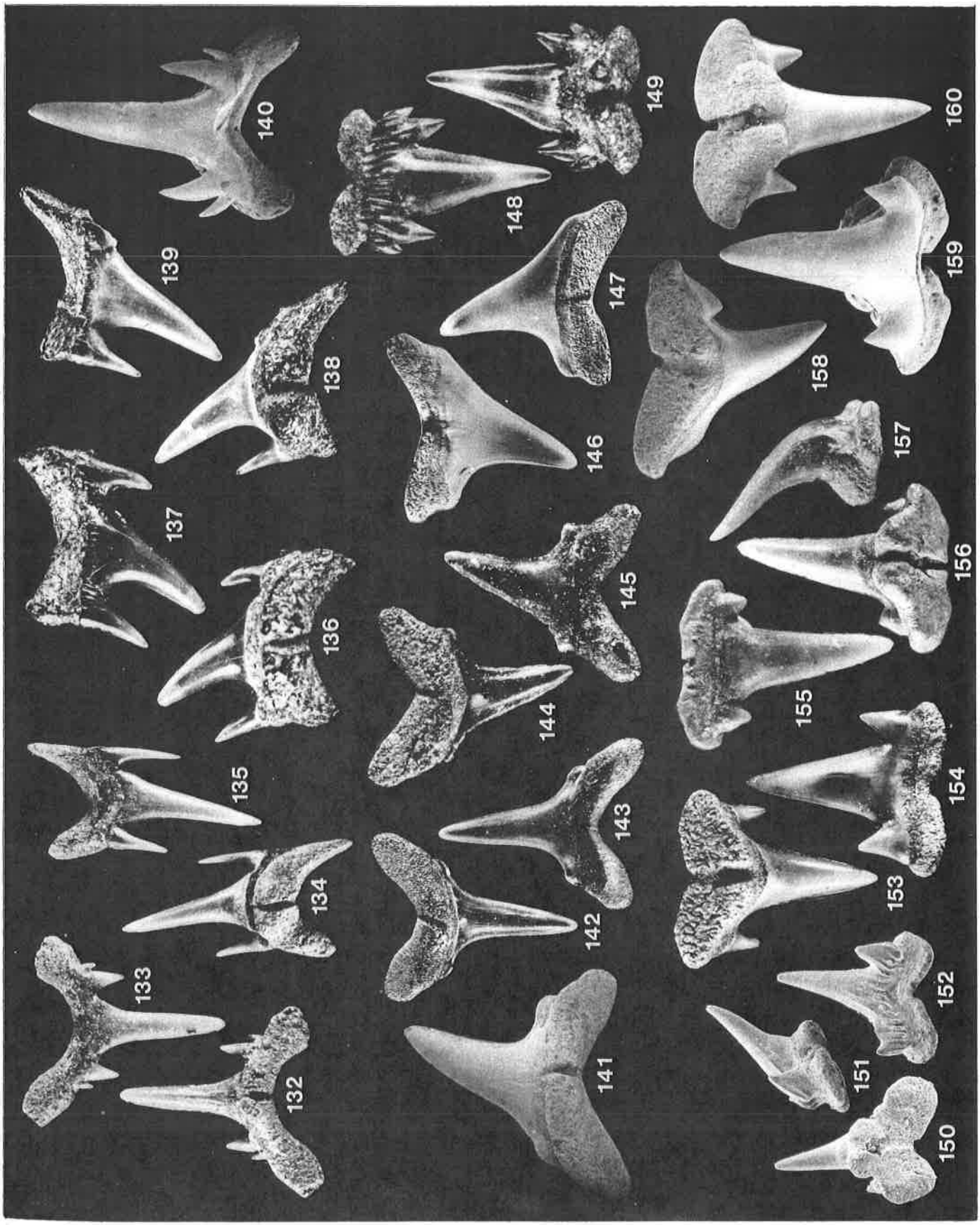

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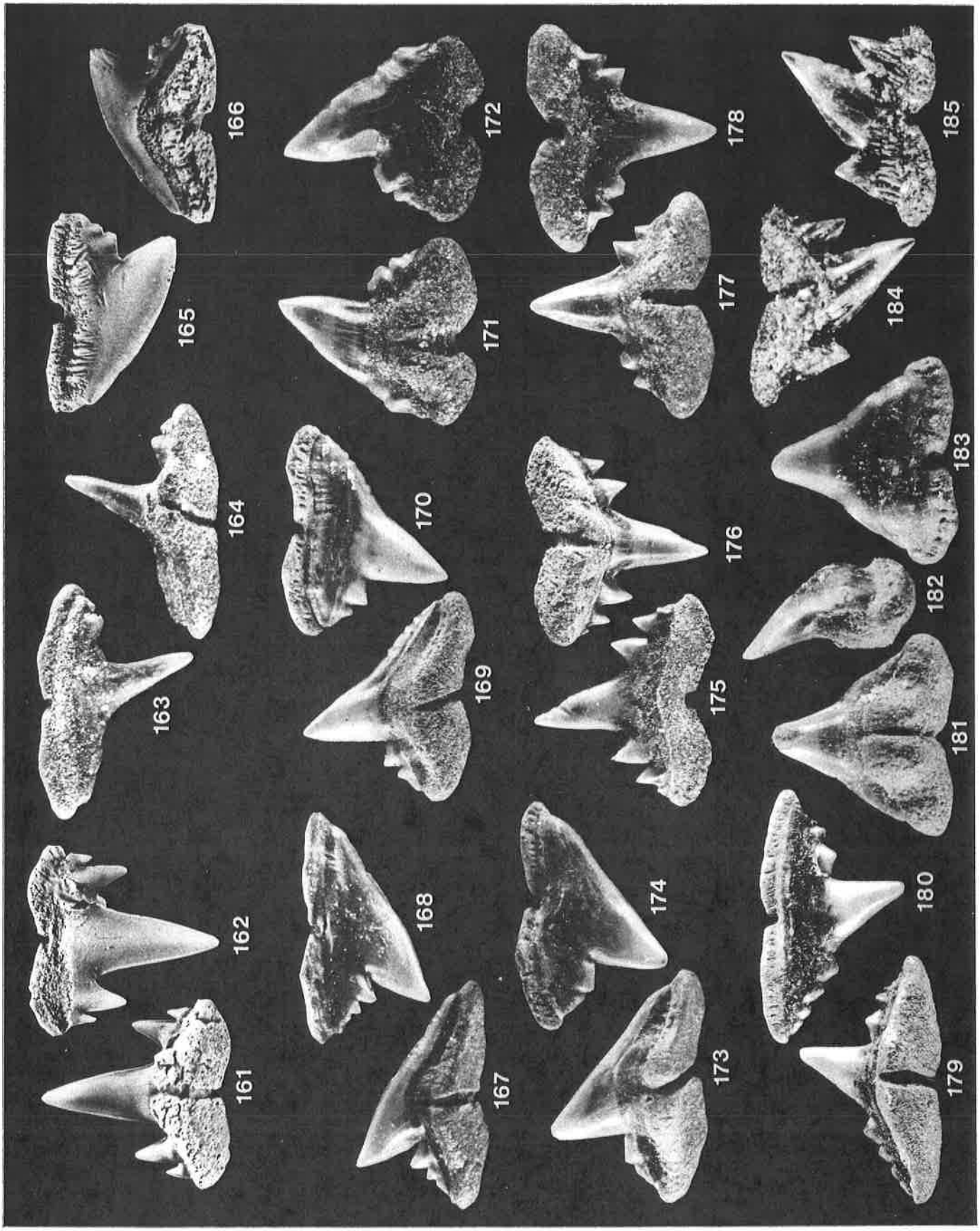

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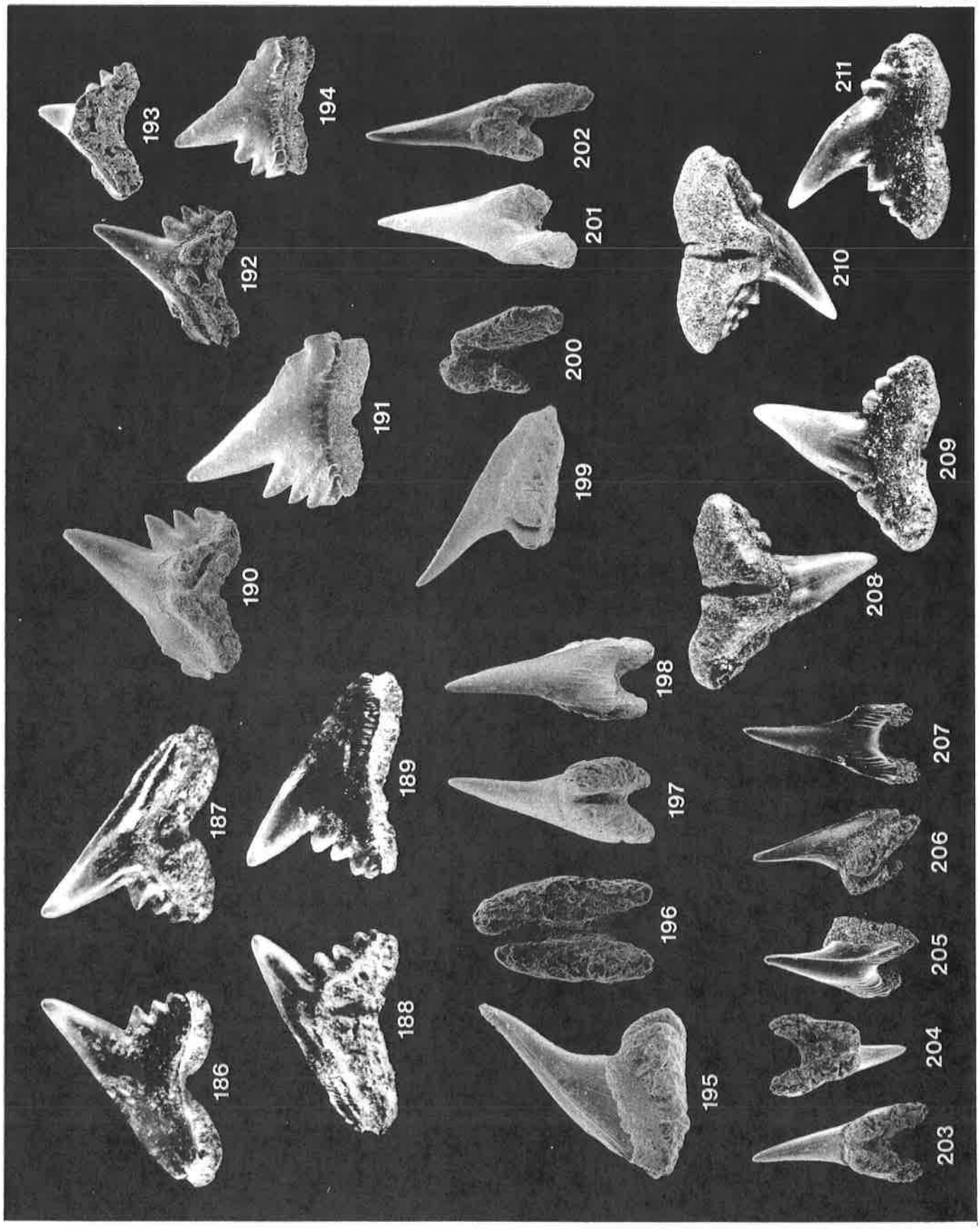

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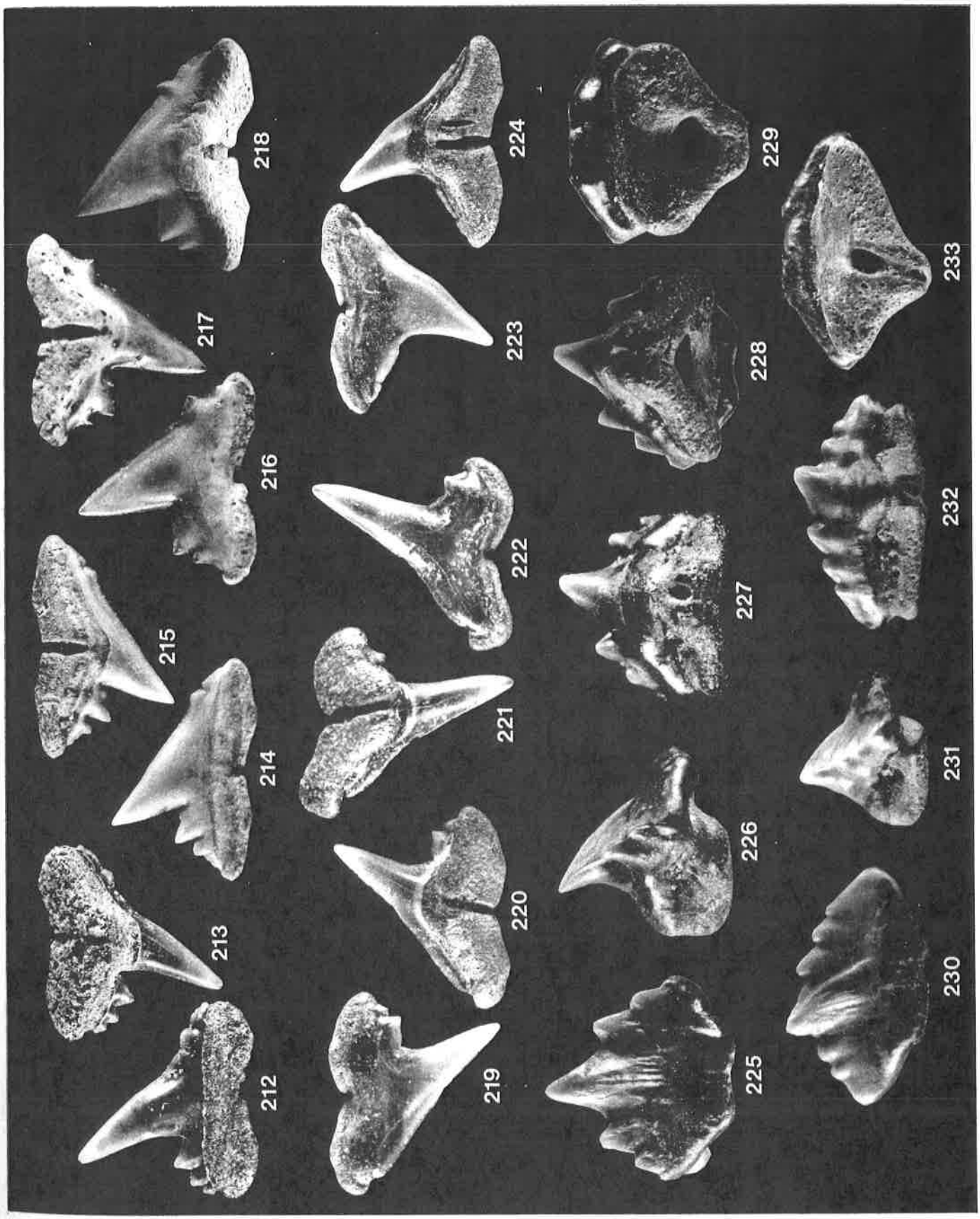

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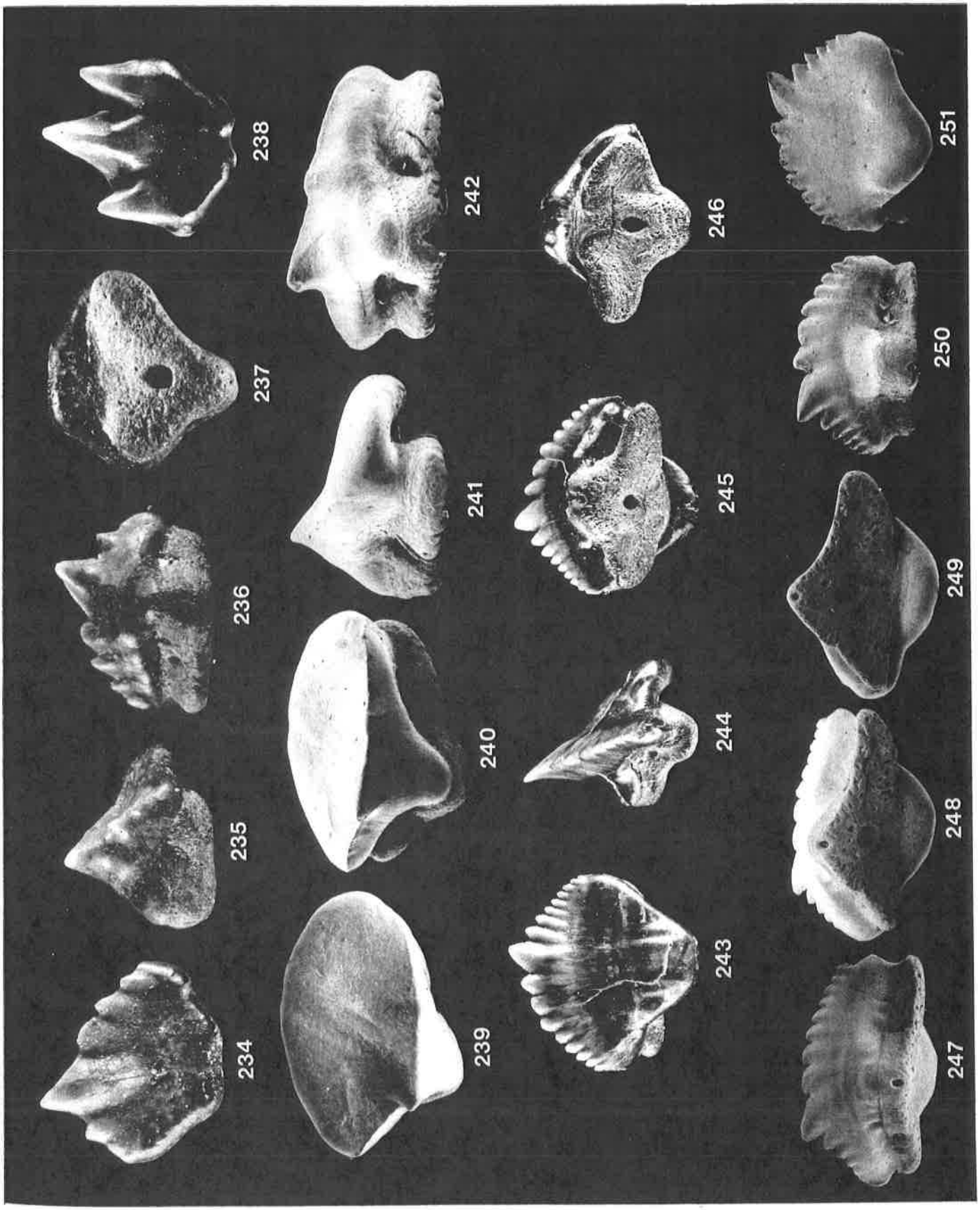

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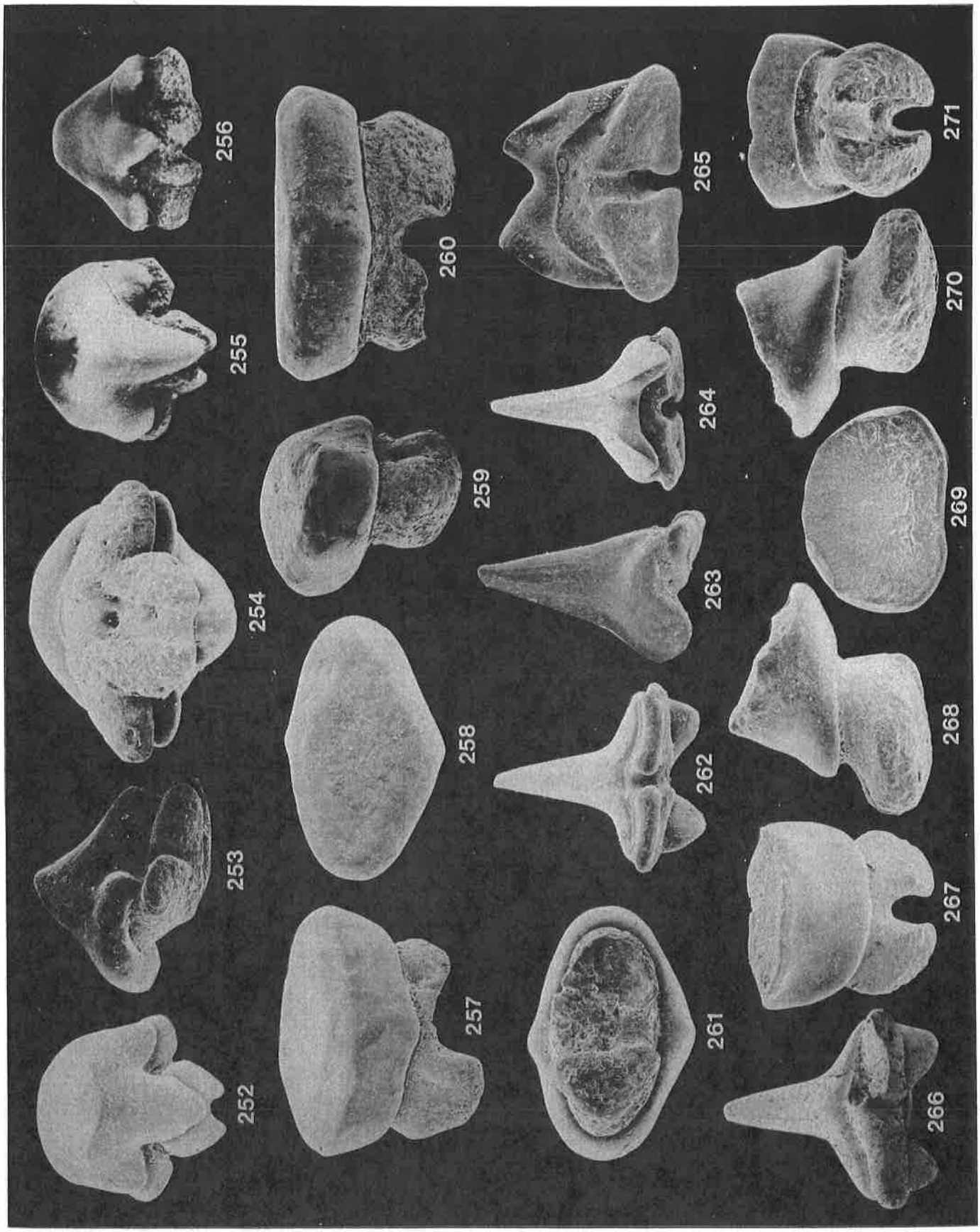

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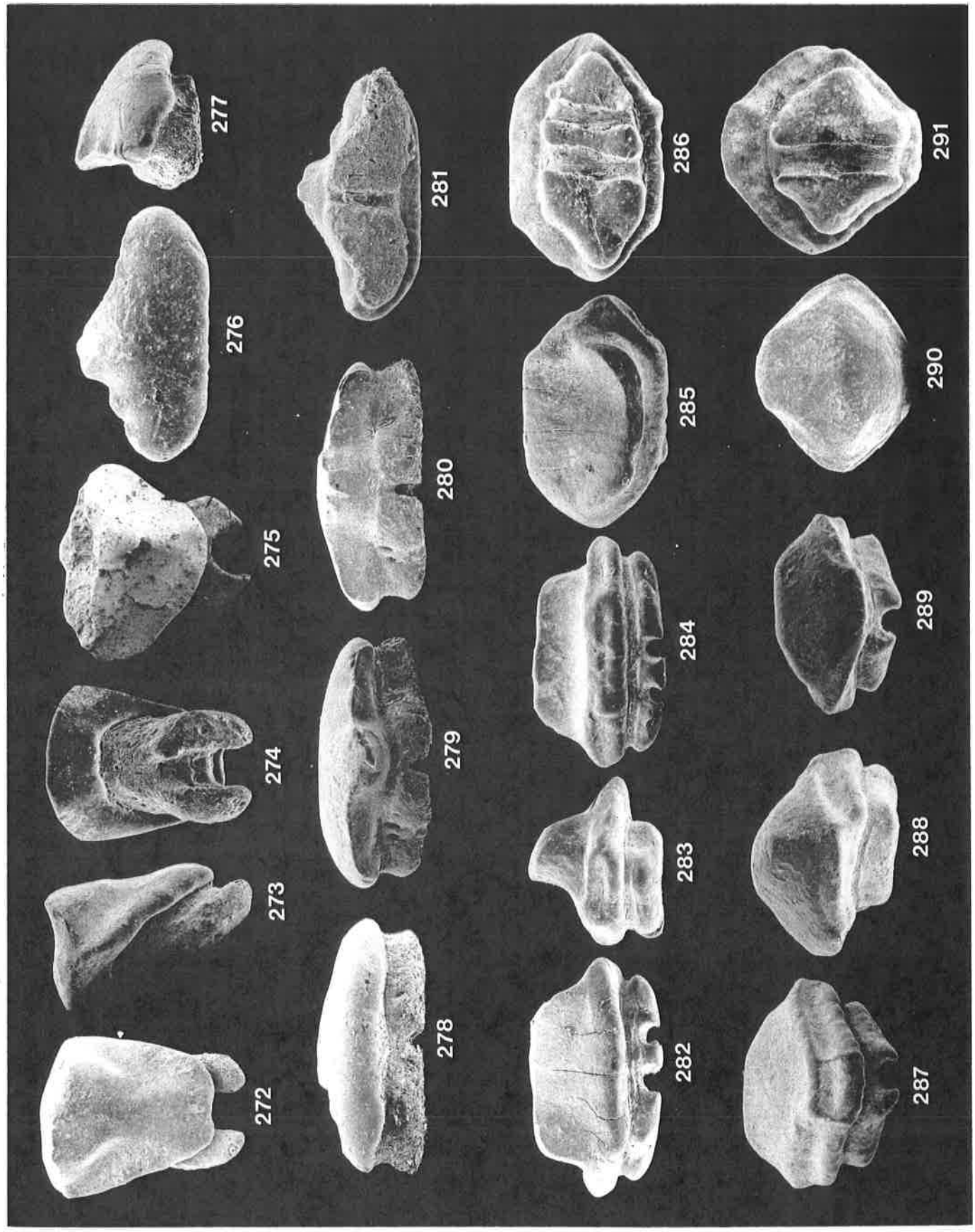

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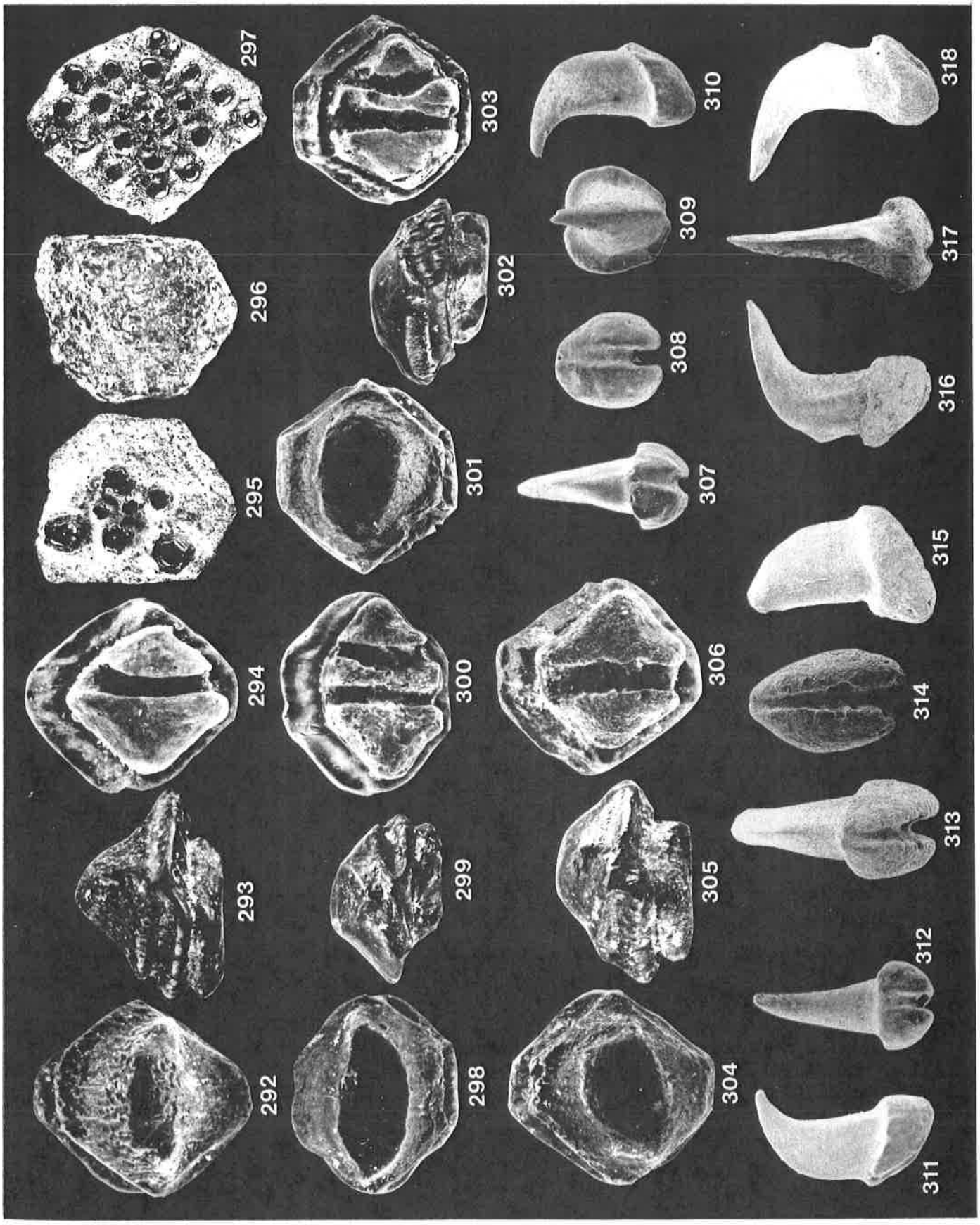

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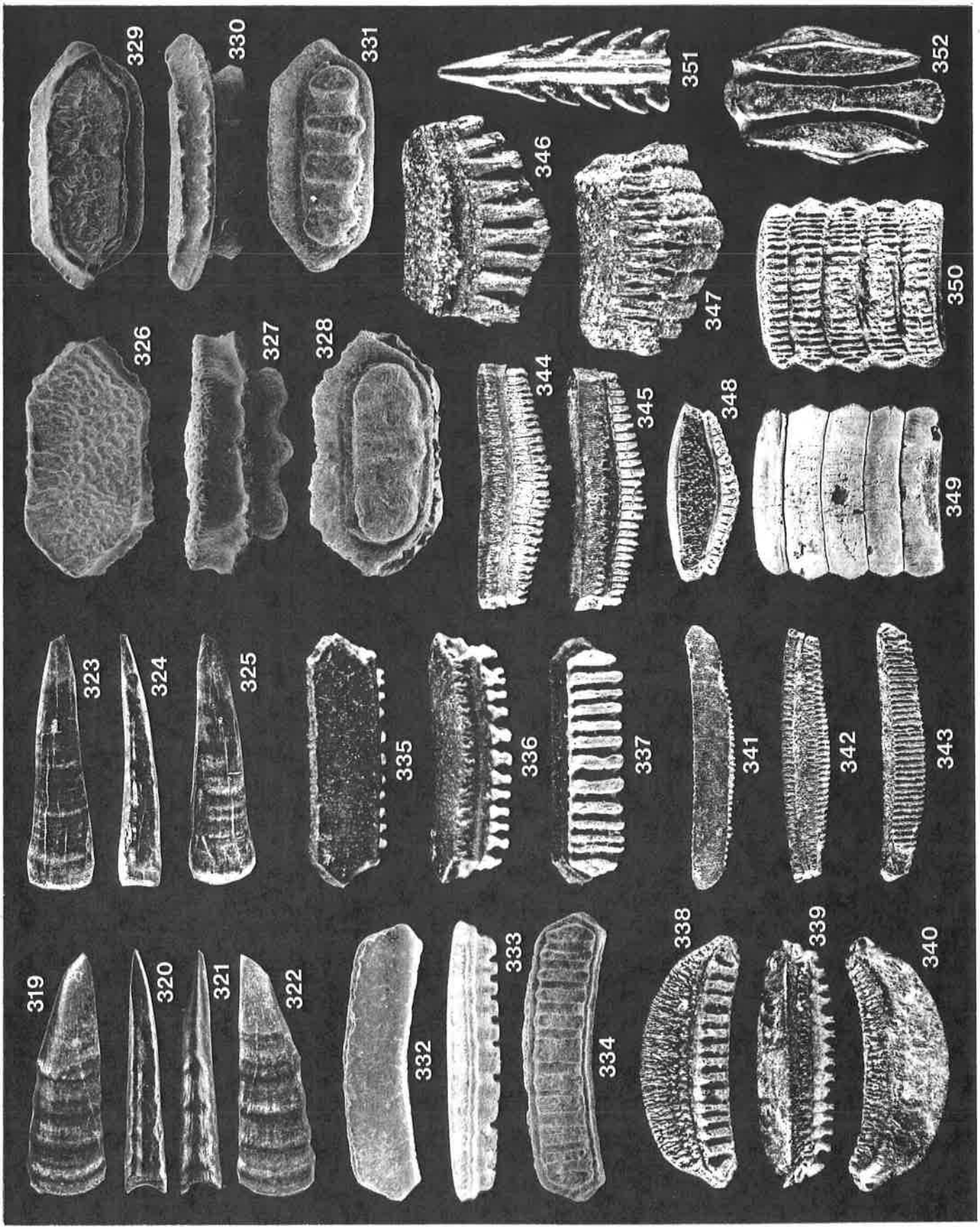

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