CONTRIBUTIONS FROM THE MUSEUM OF PALEONTOLOGY
(Continuation of Contributions from the Museum of Geology)
UNIVERSITY OF MICHIGAN

VOL. III, No. 8, pp. 155–161 (5 pls., 2 text figs.) JULY 15, 1930

ON THE LOWER JAW OF *BRACHYSUCHUS MEGALODON*

BY
E. C. CASE

UNIVERSITY OF MICHIGAN PRESS
ANN ARBOR

AIIM SCANNER TEST CHART #2

Spectra

4 PT ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz;:'",./?$0123456789

6 PT ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz;:'",./?$0123456789

8 PT ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz;:'",./?$0123456789

10 PT ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz;:'",./?$0123456789

Times Roman

4 PT ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz;:'",./?$0123456789

6 PT ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz;:'",./?$0123456789

8 PT ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz;:'",./?$0123456789

10 PT ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz;:'",./?$0123456789

Century Schoolbook Bold

4 PT **ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz;:",./?$0123456789**

6 PT **ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz;:",./?$0123456789**

8 PT **ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz;:",./?$0123456789**

10 PT **ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz;:",./?$0123456789**

News Gothic Bold Reversed

4 PT ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz;:'",./?$0123456789

6 PT ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz;:'",./?$0123456789

8 PT ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz;:'",./?$0123456789

10 PT ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz;:'",./?$0123456789

Bodoni Italic

4 PT *ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz;:'",./?$0123456789*

6 PT *ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz;:'",./?$0123456789*

8 PT *ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz;:'",./?$0123456789*

10 PT *ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz;:'",./?$0123456789*

Greek and Math Symbols

4 PT ΑΒΓΔΕΞΘΗΙΚΛΜΝΟΠΦΡΣΤΥΩΧΨΖαβγδεξθηικλμνοπφρστυωχψζ≧∓'',./≦±=≠°><⊅⊄>⩽≡

6 PT ΑΒΓΔΕΞΘΗΙΚΛΜΝΟΠΦΡΣΤΥΩΧΨΖαβγδεξθηικλμνοπφρστυωχψζ≧∓'',./≦±=≠°><⊅⊄>⩽≡

8 PT ΑΒΓΔΕΞΘΗΙΚΛΜΝΟΠΦΡΣΤΥΩΧΨΖαβγδεξθηικλμνοπφρστυωχψζ≧∓'',./≦±=≠°><⊅⊄>⩽≡

10 PT ΑΒΓΔΕΞΘΗΙΚΛΜΝΟΠΦΡΣΤΥΩΧΨΖαβγδεξθηικλμνοπφρστυωχψζ≧∓'',./≦±=≠°><⊅⊄>⩽≡

White

Black

Isolated Characters

e	m	1	2	3	a
4	5	6	7	o	°
8	9	0	h	I	B

A4 Page 6543210

MESH HALFTONE WEDGES

65

85

100

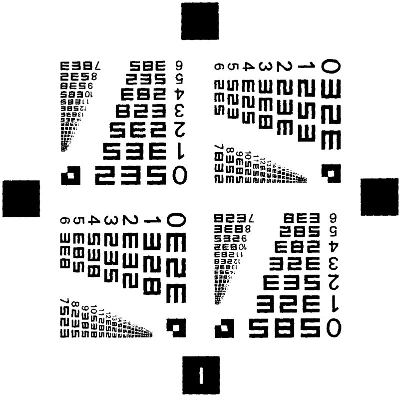
110

133

150

A4 Page 6543210

ROCHESTER INSTITUTE OF TECHNOLOGY, ONE LOMB MEMORIAL DRIVE, ROCHESTER, NEW YORK 14623



RIT ALPHANUMERIC RESOLUTION TEST OBJECT, RT-1-71

PRODUCED BY GRAPHIC ARTS RESEARCH CENTER

CONTRIBUTIONS FROM THE MUSEUM OF PALEONTOLOGY

(Continuation of Contributions from the Museum of Geology)

UNIVERSITY OF MICHIGAN

Editor: EUGENE S. MCCARTNEY

The series of contributions from the Museum of Paleontology was inaugurated to provide a medium for the publication of papers based entirely or principally upon the collections in the Museum. When the number of pages issued is sufficient to make a volume, a title-page and a table of contents will be sent to libraries on the mailing list, and also to individuals upon request. Communications with reference to exchange or purchase of copies should be directed to the Librarian, General Library, University of Michigan.

VOLUME I

The Stratigraphy and Fauna of the Hackberry Stage of the Upper Devonian, by Carroll Lane Fenton and Mildred Adams Fenton. Pages xi + 260, 45 plates, 9 text figures and 1 map. Cloth. $2.75 net.

VOLUME II

Consisting of 14 papers. With 41 plates, 39 text figures and 1 map Pp. ix + 240. Cloth $3.00. Postage extra.

Parts sold separately in paper covers

1. A Possible Explanation of Fenestration in the Primitive Reptilian Skull, with Notes on the Temporal Region of the Genus *Dimetrodon*, by E. C. Case. Pages 1–12, with 5 illustrations. Price $.30.
2. Occurrence of the Collingwood Formation in Michigan, by R. Ruedemann and G. M. Ehlers. Pages 13–18. Price, $.15.
3. Silurian Cephalopods of Northern Michigan, by Aug. F. Foerste. Pages 19–104, with 17 plates and 2 text figures. Price, $1.00.
4. A Specimen of *Stylemys nebrascensis* Leidy, with the Skull Preserved, by E. C. Case. Pages 87–91, with 7 text figures. Price, $.20.
5. Note on a New Species of the Eocene Crocodilian *Allognathosuchus, A. wartheni*, by E. C. Case. Pages 93–97, with 1 plate and 1 text figure. Price, $.20.
6. Two New Crinoids from the Devonian of Michigan, by G. M. Ehlers. Pages 99–104, with 1 plate. Price, $.20.
7. New Brachiopods from the Warsaw Formation of Wayne County, Kentucky, by G. M. Ehlers and M. S. Chang. Pages 105–111, with 1 plate. Price, $.20.

(Continued on inside of back cover)

Vol. III, No. 8, pp. 155–161 (5 pls., 2 text figs.) JULY 15, 1930

ON THE LOWER JAW OF *BRACHYSUCHUS MEGALODON*

By E. C. CASE

IN MAY of 1929 the author published the description of a very perfect skull (number 10336 of the Museum of Paleontology of the University of Michigan) of a large phytosaur under the name *Brachysuchus megalodon*.[1] In the summer of 1929 a collecting party from the Museum revisited the site of the discovery and Mr. Wm. H. Buettner, preparator in the Museum, recovered the nearly perfect lower jaws of a phytosaur within a hundred feet of the spot where the skull had been found two years before. The jaws accord so perfectly with the skull in characters and proportions that it may be safely assigned to the same genus and species, and with considerable confidence to the same individual; it carries the number 10336 A in the Museum (Plates I–II).

The jaw was found resting on the lower surface and is remarkable in the fact that nearly all the teeth are preserved entire and in position. This, so far as the author knows, is unique among the collected specimens of phytosaurs and permits a very satisfactory study of the dentition of the lower jaws.

The left ramus is perfect and the teeth also are perfect, with the exception of the tips of a few. The posterior part of the right ramus has suffered somewhat from decay and a few of the posterior teeth are incomplete, but are represented by their shattered bases. The anterior tusks, as described below, are in a somewhat anomalous condition.

As the individual was mature at the time of death, some of

[1] E. C. Case, *Description of the Skull of a New Form Phytosaur, with notes on the Characters of Described North America Phytosaurs*, Memoirs of the University of Michigan Museums (University of Michigan, Ann Arbor, 1929), Vol. 2.

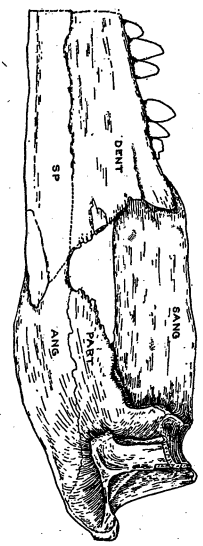


FIG. 1. Inner surface of the posterior portion of the right ramus of *Brachysuchus megalodon*

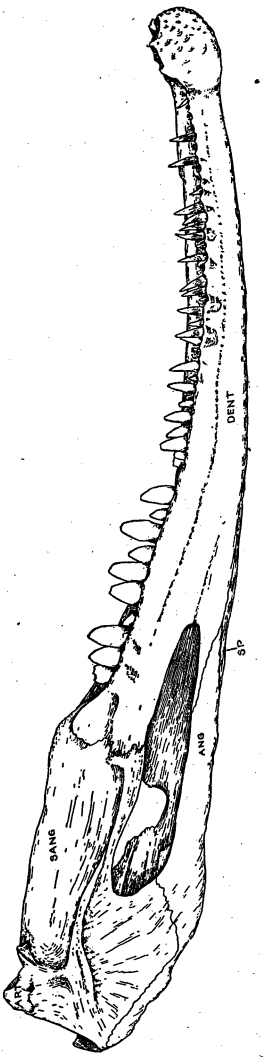


FIG. 2. Outer surface of the right ramus of *B. megalodon*

ANG, angular; ART, articular; DENT, dentary; PART, prearticular; SANG, surangular; SP, splenial

the sutures in the posterior portion of the jaws have closed in part, and it is not possible to make out the complete conformation of all the bones, but enough of each suture can be traced to show the general form and relationships of all the elements (Figs. 1–2).

Dentaries. — These form the major portion of the jaws and carry the teeth. The two, with the splenials, form a broad, heavy, relatively short symphasial region corresponding in size and proportions with the rostrum of the skull. The anterior ends of the two bones are expanded, forming together a large hemispherical prominence, rugose externally, which holds the large anterior tusks. This portion was somewhat shattered because of the thin walls, but all parts were held in position by the matrix and have been carefully replaced in their proper positions. The great anterior tusks are apparently not in a normal position. In the anterior swelling of the upper jaw there are two large sockets followed by two smaller ones on each side. In the lower jaw there are three large sockets on either side. The median socket of the left side is empty, but indicates the presence of a large upright tusk. The second socket is very irregular in form and holds two large tusks in the same stage of development; they are closely crowded together, with the apices just projecting from the opening; on the lower surface of the bone at this place, near the median line, there is the apex of a third tooth pointing obliquely outward and forward toward the opening. The third socket also carries two large teeth with their apices just below the edge of the opening; one of these teeth points backward and outward.

On the right side the median socket indicates an upright tusk; it is empty, but there is a replacing tusk just appearing at the bottom. The second socket carries two large teeth in the same stage of development, both pointing almost directly forward. One of these is projecting from the socket and the tip of the other is just below the edge of the opening. The opening of this socket is very irregular; it appears to have been occluded by a thin plate of bone and the two teeth are breaking through by a process of resorption. The third socket is nearly completely occluded; the covering plate of bone is perforated by one or two small holes.

This socket is occupied by the bases of the roots of the teeth appearing in the second socket and the wall between the two sockets has disappeared.

Besides the teeth described, the upper halves of four others and the tips of four more were found in the matrix filling the cavity of the anterior expansion, a total of sixteen for the six sockets. In all probability the tips and the incomplete teeth are parts of replacing teeth not yet fully formed. The displaced teeth and fragments of others and the disturbed position of the large tusks suggest two possibilities. Either the large tusks, normal in position in life, were forced back into the sockets in the process of maceration and fossilization, a suggestion supported by a slight transverse wrinkling of the roots of some, or the pulp of the living teeth was distorted by some injury to the jaw during life and the position of the teeth is pathological. This suggestion is supported by the partly occluded sockets of the right side and by the fact that the whole anterior end is slightly distorted, the right side being a little lower than the left. It is very easy to see how such an injury could result from a vigorous snap at some heavily armored prey (Plate III, Fig. 1).

Assuming that there were normally three functional tusks in the anterior end of the jaw, there are forty-nine teeth and sockets in each ramus; there are forty-six on each side in the upper jaws. The arrangement and stage of development of the teeth are very irregular, showing that the replacement was without order and that the teeth were very loosely fixed in the jaw (Plate I, Fig. 2). As this is the first specimen which shows a complete dentition, it permits observations which clear up many hitherto uncertain points. The anterior tusks have the same form as the teeth of the median part of the whole series. They are convex on both the inner and outer faces, but the outer face is much more convex than the inner; the edge formed by the meeting of the two surfaces is crenulate; there is no fluting of the sides. The first teeth posterior to the anterior swelling are small and nearly or quite circular in section, with distinct flutings on the sides. This type of tooth when found isolated has been referred to the Stegocephalia. From the ninth tooth, backward, the section of the teeth becomes

progressively more unsymmetrical until they begin to broaden into the characteristic leaf-shaped teeth of the posterior part of the series. The outer side of the tooth is much more convex than the inner and the two sides meet in distinct ridges without crenulations; the sides of the teeth are fluted (Plate IV, Fig. 1). This condition continues to the twenty-ninth tooth. The thirtieth tooth is still high and sharp, but the edges show the first trace of crenulation and the sides are not fluted. With the thirty-second tooth the shape begins to change, the teeth are thinner and begin to broaden antero-posteriorly, a character which reaches its maximum in the posterior teeth. The crenulation upon the edges and the lack of fluting upon the sides continue to the posterior end of the whole series (Plate IV, Fig. 2). It is evident that types of teeth previously assigned to several different forms of phytosaurs and even to stegocephalians occur in this one jaw. The lower edge of the jaw is slightly curved downward, antero-posteriorly, but the median elevation between the teeth is nearly horizontal. In the anterior portion of the jaws the median elevation rises so high that the smaller teeth could have had but little function other than to help hold the captured prey and work it back toward the powerful cutting teeth behind. That this median elevation was functional in capturing prey is evidenced by two areas of injured bone, one in the space opposite the thirteenth–fifteenth teeth and one a little farther back (Plate III, Fig. 2).

The dentary is divided at the posterior end of the dental series and clasps the anterior end of the surangular. Below, the dentary extends on the outer surface as far back as the anterior third of the external opening; a tongue extends some distance back of this point on the floor of the Meckelian cavity.

Angular. — This reaches from the posterior end of the jaw as far forward as the anterior end of the external opening, joining the dentary and the splenial (Fig. 2). It forms the lower border of the posterior portion of the ramus and in both rami is bent inward at the lower edge; this is somewhat emphasized by the accidents of fossilization. The separation from the articular is not distinct in all places, but a suture on the posterior face of the jaw shows that the postangular process is formed by the angular alone.

Surangular. — The surangular is marked on its outer face by a strong rugose ridge, broadening posteriorly. Above and below the ridge are rugosities arranged somewhat radially. A vertical extension of the rugose ridge rises opposite the anterior edge of the articular face for the quadrate; it is marked on either side by foramina. These foramina open into canals which unite within the bone and end in a common foramen on the inner side. The surangular forms the whole of the outer side of the jaw above the external opening and ends in a slightly thickened process between the two projections formed by the bifurcation of the posterior end of the dentary. The sutures between the surangular and the articular are mostly obliterated, but one can be followed for a short distance on the posterior side of the jaw.

Coronoid. — This is not developed in the jaw.

Prearticular. — This is fused with the articular. The suture between it and the angular is clearly seen on the inner side of the jaw, but becomes obscure at the anterior end. The bone ends at the posterior end of the notch in the middle of the edge of the inner Meckelian opening. The posterior portion of the edge of the inner opening is formed by the thin edge of the prearticular, and the anterior portion is formed by the thin edges of the dentary and, possibly, the splenial (Fig. 1).

Articular. — This has a strong concave face for the quadrate. The posterior face is triangular and concave. The inner edge is extended into a pronounced vertical process before joining the prearticular.

Splenial. — This is visible for a short distance only on the outer surface of the jaw. The bones of the two sides form the inner portion of the broad, heavy posterior portion of the symphasis, but narrow anteriorly, ending in a point opposite the fourteenth tooth, leaving the portion of the jaws anterior to this to be formed by the dentaries alone (Plate V, Figs. 1–2). On the inner surface the splenial forms the lower portion of each ramus, but the course of the posterior portion of the suture between it and the dentary is not clear. In a fracture on the left ramus the suture can be seen extending back to the anterior edge of the notch in the lower border of the inner opening and continuing around the upper

PLATE I

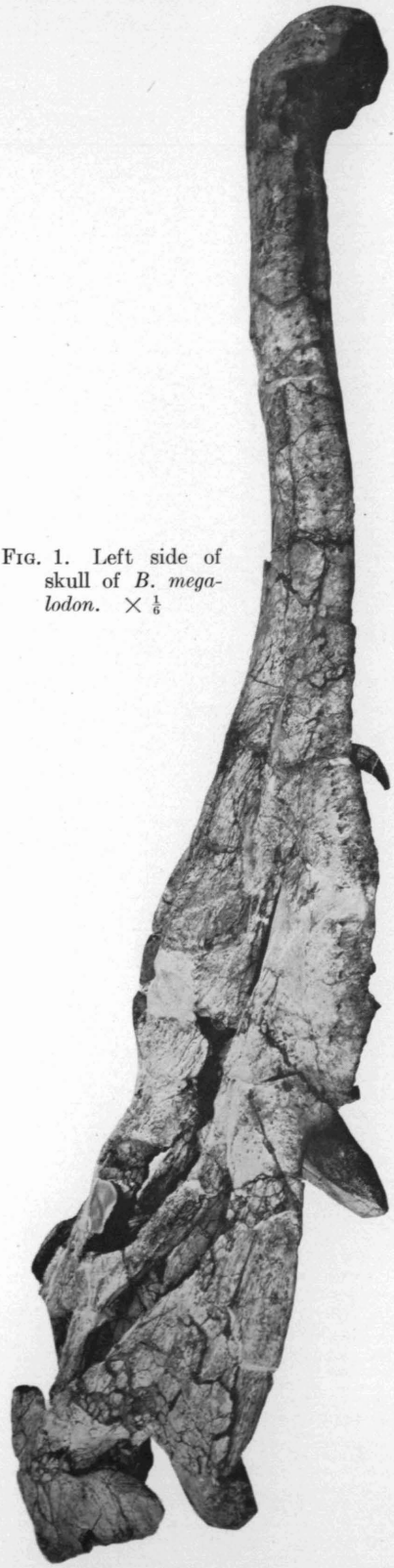


FIG. 1. Left side of skull of *B. megalodon*. $\times \frac{1}{6}$

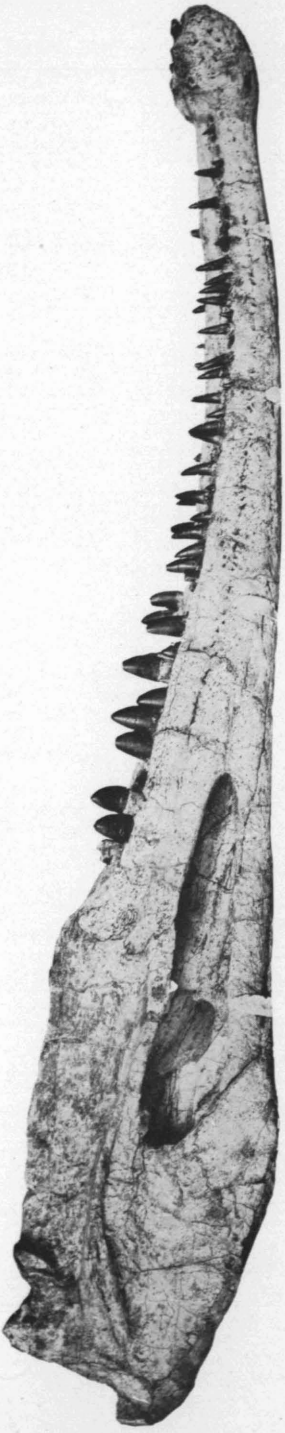
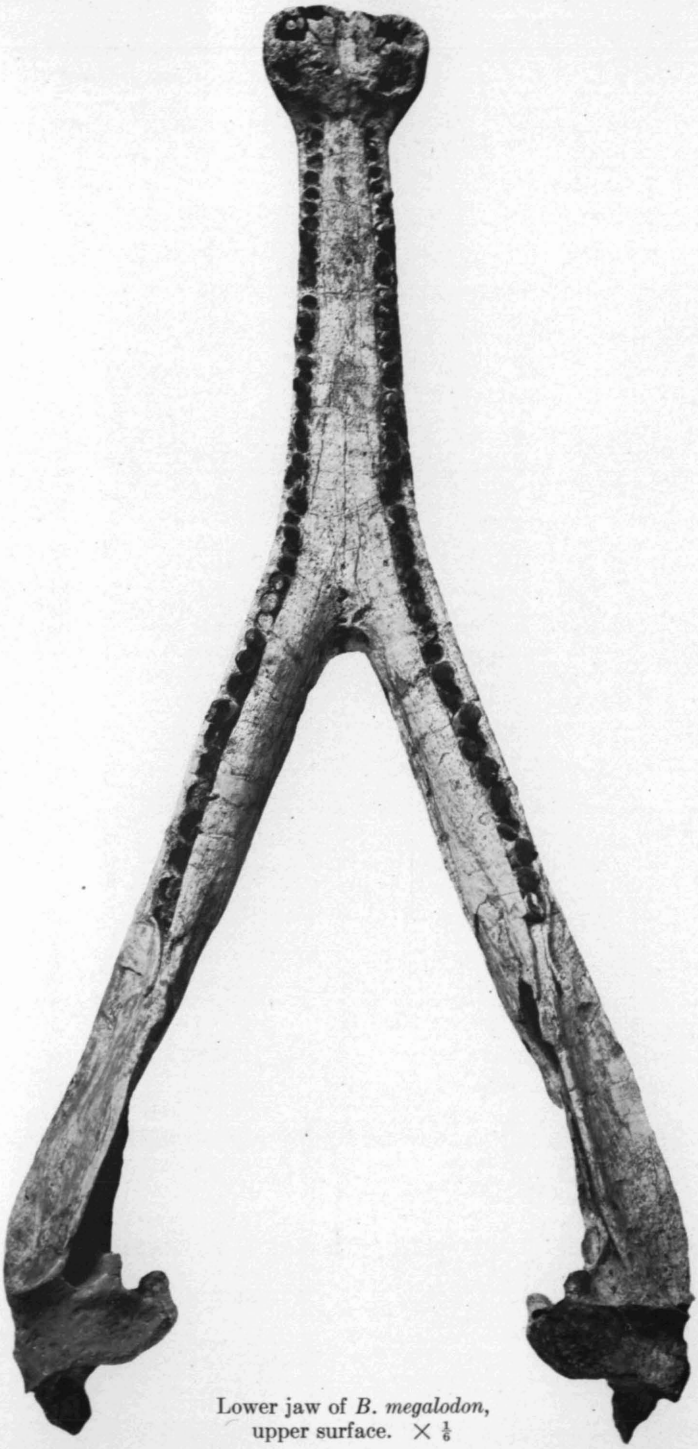


FIG. 2. Left ramus of *B. megalodon*. $\times \frac{1}{6}$

PLATE II



Lower jaw of *B. megalodon*,
upper surface. × $\frac{1}{6}$

PLATE III

FIG. 1. Anterior view of the jaw, showing the distorted tusks. $\times\frac{1}{2}$

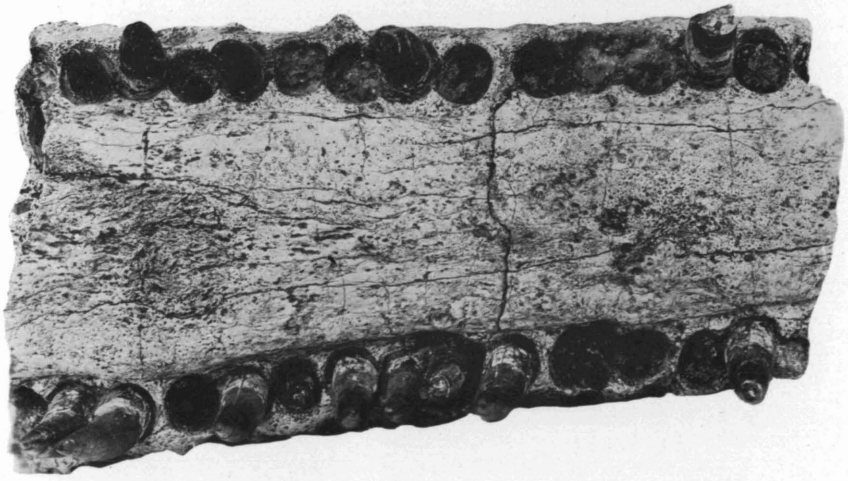


FIG. 2. Upper surface of the median elevation between the thirteenth and twenty-sixth teeth, showing injuries. Visible also in Plate IV, Figure 1. $\times\frac{1}{2}$

PLATE IV

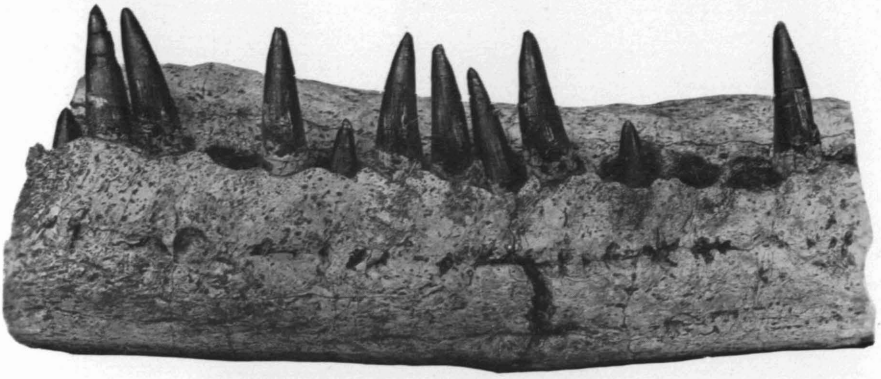


FIG. 1. Lateral surface of the right ramus of the jaw between the thirteenth and twenty-sixth teeth, showing the conical form, the lack of crenulations and the fluted sides. × ½

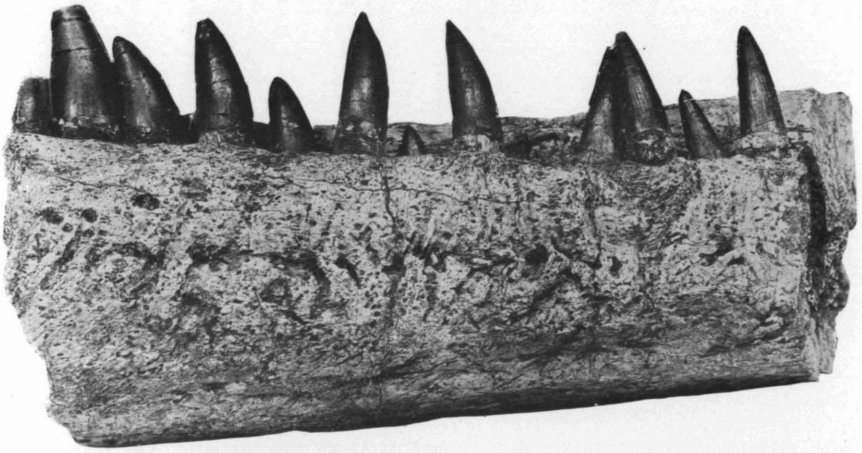


FIG. 2. Lateral surface of the right ramus of the jaw between the twenty-seventh and thirty-ninth teeth, showing the lack of flutings and the beginning of the broader form of tooth. The crenulations do not show in the photograph. × ½

PLATE V

FIG. 1. Section of right ramus of the jaw opposite the thirteenth tooth; anterior face of section shown in Plate IV, Figure 1. The symphasial region is formed by the dentaries only. × $\frac{2}{3}$

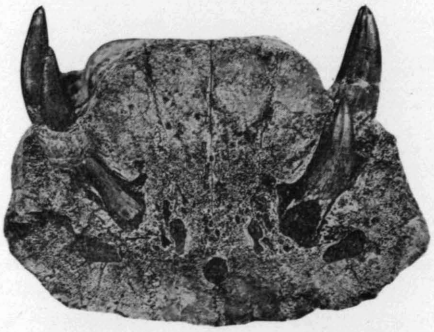


FIG. 2. Section of the right ramus of the jaw; posterior face of the section shown in Plate IV, Figure 1. The splenial takes part in the symphasis. × $\frac{2}{3}$

edge of the angular. The splenial apparently ends at this point by overlap on the inner (within the Meckelian cavity) side of the angular. Certainly the splenial does not, in this specimen, expand posteriorly and form the inner wall of the alveolar edge, as it is shown to do by Huene in his figures of the jaw of *Mystriosuchus pleiningeri*.

The inner Meckelian opening is largely formed by a lack of the inner wall of the jaw due to the wastage of the edges of the dentary and prearticular, but at the bottom there is a distinct notch with thick, rounded edges almost entirely within the angular. It appears probable that there was originally a small but complete fenestra, but that the upper edges have disappeared through the wastage of the bones as described above. The wastage was probably caused by the pressure of strongly developed biting muscles. In the much more slender jaw of *Leptosuchus crosbyensis* the inner fenestra is completed by a thin upper border formed from the dentary and prearticular bones.

It is apparent that the form described as *Brachysuchus megalodon* was of notably different feeding habits from such forms as *Leptosuchus* and *Mystriosuchus carolinensis*. The extremely heavy bones and the relatively short symphasial region in *Brachysuchus*, with the powerful anterior tusks and the large posterior cutting teeth and with the evidence of greatly developed jaw muscles, are in strong contrast to the longer, lighter jaws, the weaker teeth and the less well developed jaw muscles of the other forms. The light phytosaurs with elongate jaws which permitted a very quick snap probably fed upon fish and the more softly bodied forms, while the phytosaurs of the *Brachysuchus* type were well equipped to capture and devour the heavily armored forms, such as other phytosaurs and the giant stegocephalians. That even such powerful jaws and strong teeth as were possessed by *Brachysuchus* suffered from the force necessary to crush the defensive armor of the prey, is amply attested by the deformed anterior end of the specimen described and by the injuries to the median elevation between the teeth.

(*Continued from inside of front cover*)

8. The Richmond Formation of Michigan, by R. C. Hussey. Pages 113–187 with 11 plates, 12 text figures and 1 map. Price, $.75.
9. Devonian Cephalopods from Alpena in Michigan, by Aug. F. Foerste. Pages 189–208, with 5 plates. Price, $.35.
10. The Vertebral Column of *Coelophysis* Cope, by E. C. Case. Pages 209–222, with 1 plate and 9 text figures. Price, $.25.
11. A New Species of Trionychid Turtle, *Amyda nelsoni*, from the Eocene Beds of Southwestern Wyoming, by E. C. Case. Pages 223–226, with 1 plate and 3 text figures. Price, $.20.
12. A Complete Phytosaur Pelvis from the Triassic Beds of Western Texas, by E. C. Case. Pages 227–229, with 1 plate. Price, $.20.
13. Discovery of a Hamilton Fauna in Southeastern Michigan, by G. M. Ehlers and Mary E. Cooley. Pages 231–236. Price, $.15.
14. *Anisotrypa waynensis*, a New Bryozoan from the Warsaw Formation of Kentucky, by Charles F. Deiss, Jr. Pages 237–239, with 2 plates. Price, $.20.

VOLUME III

1. Indications of a Cotylosaur and of a New Form of Fish from the Triassic Beds of Texas, with Remarks on the Shinarump Conglomerate, by E. C. Case. Pages 1–14, with 1 plate. Price, $.25.
2. Fossil Fishes from the Triassic of Texas, by Aldred S. Warthin, Jr. Pages 15–18, with 1 plate. Price, $.20.
3. Contributions to the Geology of Foxe Land, Baffin Island, by Laurence M. Gould, Aug. F. Foerste and Russell C. Hussey. Pages 19–76, with 17 plates, 1 text figure and 1 map. Price, $.75.
4. Cystoids from the Trenton Rocks of Michigan, by Russell C. Hussey. Pages 77–79, with 1 plate. Price, $.20.
5. Description of a Nearly Complete Skeleton of *Ostodolepis brevispinatus* Williston, by E. C. Case. Pages 81–107, with 3 plates and 12 text figures. Price, $.35.
6. The Color Patterns of Fossil Cephalopods and Brachiopods, with Notes on Gasteropods and Pelecypods, by Aug. F. Foerste. Pages 109–150, with 5 plates. Price, $.50.
7. Additional Notes on Nephriticerina, by Aug. F. Foerste. Pages 151–154, with 1 plate and 1 text figure. Price, $.15.
8. On the Lower Jaw of *Brachysuchus megalodon*, by E. C. Case. Pages 155–161, with 5 plates and 2 text figures. Price, $.30.