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NEW CROCODILIAN REMAINS FROM THE HORNERSTOWN MARLS OF NEW JERSEY

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INTRODUCTION

In March, 1929, fossil bones were found by men working in the marl pits of the Permutit Company at Birmingham, New Jersey. The discovery was reported by Mr. Vaugh, Manager of the Permutit Company's plant at Birmingham, to Dr. H. B. Kümmel, Director of the State Conservation Department and State Geologist. The matter was referred by him to Mrs. Katherine Greywacz, Curator of the State Museum at Trenton. Arrangements were made for the excavation of the bones, and a party headed by Mr. Charles Lang, of the American Museum of Natural History, proceeded with this work. They were provided with facilities by Mr. Vaugh and by Mr. McPherson, Superintendent of the plant. The bones were first exhibited in a partially prepared condition at the State Museum, and they were then sent to the American Museum, where they were completely prepared by Mr. Lang. The writer was given the opportunity of describing this material by Mrs. Greywacz.

The horizon in which the bones occurred is the lower fossiliferous level of the Hornerstown Marl. The Hornerstown was formerly considered uppermost Cretaceous. Recent investigation by the United States Geological Survey has determined the horizon to be Lower Tertiary. As the Hornerstown lies beneath known Lower Eocene formations, its age may be considered Paleocene.

The remains consist of portions of the skull and lower jaws, eighteen teeth, three cervical, one dorsal, one lumbar, two sacral, nine caudal vertebræ, right scapula, left coracoid, left humerus, right and left ulnæ, both ilia, both ischia, left pubis, both femora, both tibiæ, one metapodial, one tarsal, a partial sternal, ten ribs, and many dermal scutes.

A considerable number of genera and species of crocodilians have been described from the New Jersey Greensands. The type of one of these, *Gavialis fracterculus* Cope, occurred in the marl pits at Birmingham. It differs sufficiently in characters, however, from the specimen

[1]Contributions to the Osteology, Affinities, and Distribution of the Crocodilia, No. 20.

herein described to forbid its reference to that species. The resemblance is closest to *Holops pneumaticus* Cope, and the specimen is provisionally referred to that species.

SKULL

The skull is largely lacking in this specimen, only more or less fragmentary portions being preserved. From these fragments certain characters may be determined.

In the region of the cranial table the supratemporal fenestræ are large, being much larger than in *Holops brevispinis* Cope. The interfenestral bar is much narrower relative to the interorbital plate than in the latter species. In the specimen described, this bar is one-seventh as broad as the interorbital plate. In the *H. brevispinis* skull in the Rutgers Museum, it is about one-half the breadth of the interorbital plate. In the present specimen the interfenestral bar is deeply excavated, or rather its edges are rolled upward, and all the surficial pits have merged into one conspicuous depression. In the *H. brevispinis* skull the bar is flat and the pits on it are small and separate. In the present specimen the pits on the frontal, and on the parietal, both anterior and posterior to the interfenestral bar, are large and deep and close together. In the *H. brevispinis* skull they are small and shallow and far apart.

A considerable portion of the right maxillary is preserved. It is preserved from the alveolar border to the median line, and indicates that the rostrum was very slender. It was somewhat higher in proportion to its breadth than in the modern gavial or its Siwalik relatives. The inner border of the bone on its upper surface bends outward sharply a short distance from its anterior end. This indicates former contact with the premaxillary. A similar bending outward and backward at the posterior end indicates contact with the nasal. The straight portion along the median line indicates contact with the opposite maxillary. This portion is 105 mm. long, and lies opposite four maxillary teeth.

The alveoli of the teeth extend obliquely upward and backward in a regular curve, corresponding with a similar disposition in the modern gavial. These alveoli are larger than those of a modern gavial with a slightly larger skull. The curvature of the alveoli is somewhat greater than in the modern form. The alveolar border is slightly notched between the alveoli, but there is no suggestion of looping, either horizontal or vertical.

Measurements

Right supratemporal fenestra, antero-posterior	57 mm.
Right supratemporal fenestra, transverse	66 est.
Breadth of plate between supratemporal fenestræ	11.5
Width of snout, minimum, estimated	54.0
Length of maxillary over four alveoli	93
Vertical height of mandible near external fenestra	92
Length of longest tooth preserved	63

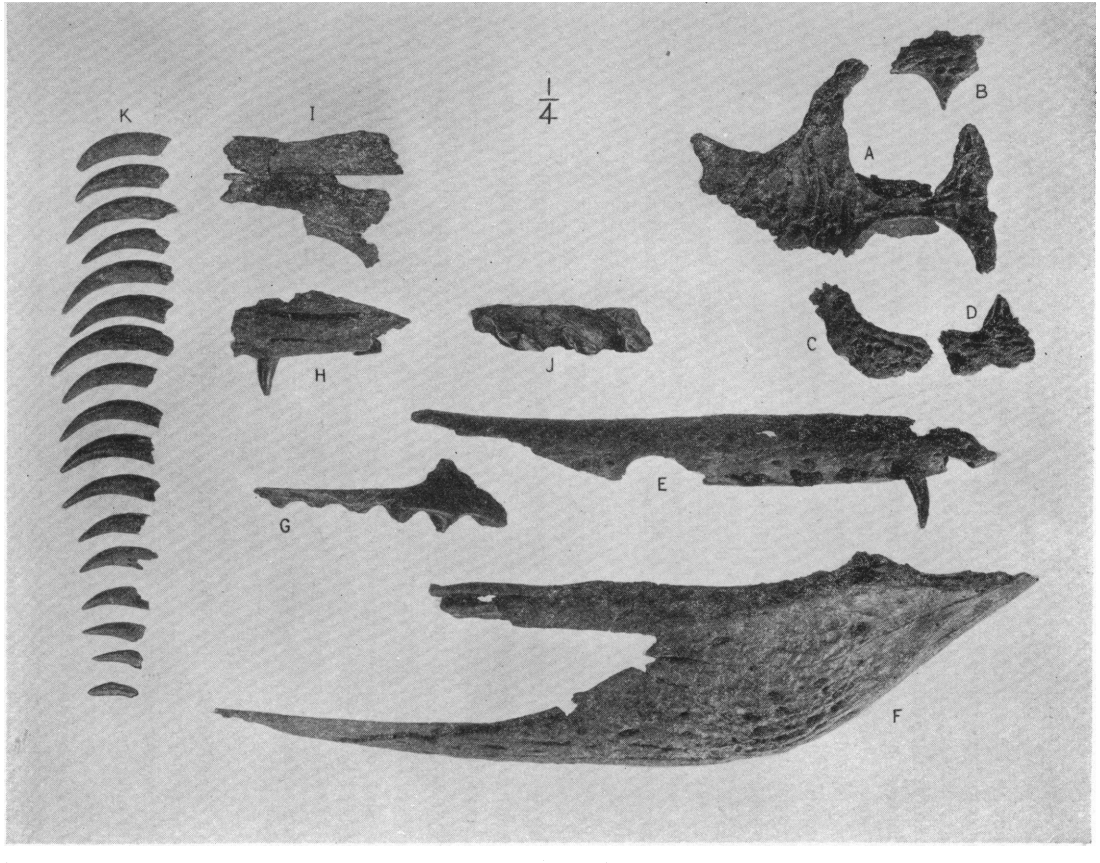

Fig. 1. *Holops pneumaticus* Cope. Specimen in New Jersey State Museum. All figures about one-fourth natural size.

A, cranial table, with parts of postorbital, frontal, and parietal bones, superior view; B, portion of right squamosal bone (?), superior view; C, portion of left postorbital bone (?), superior view; D, portion of left squamosal bone (?), superior view; E, portion of right maxillary bone, lateral view, right side; F, portion of left ramus of mandible, showing portions of angular, surangular, and articular bones; G, portion of left maxillary bone, inferior view; H, portion of left maxillary bone, external view; I, portions of nasal bones, superior view; J, fragment of maxillary, indeterminate as to position; K, isolated teeth.

Long, slender mandible with short symphysis. Amount of festooning very slight. Edges of alveoli of the first four mandibular teeth elevated somewhat above the alveolar border and are separated by considerable spaces from each other. The two first alveoli are near, but not at, the median line. Alveoli (1) are separated by a diastema of 9 mm. In order of diameter the alveoli are: 4–1–2–16–3–17–18. The rest of the alveoli are small. Each alveolus is complete, no two alveoli being confluent.

The symphysis extends backward to the level of the anterior borders of the fifth mandibular alveoli. On either side of the median line, anterior to the level of the fourth mandibular tooth, the superior surface of the dentary is somewhat depressed. In the depression are several pits, somewhat nearer to the alveolar line than to the median line. The shaft of each ramus is slender. There are 20 teeth in the lot. These vary considerably among themselves, yet show a certain amount of uniformity.

They are all relatively slender and are all considerably curved. They are circular or subcircular in section. None of the teeth has a very short crown, although the length is somewhat variable, along with the degree of curvature, probably in correlation with the position of the teeth in the dental row.

The teeth are all very slightly keeled. They exhibit varying degrees of striation, but in no case is striation prominent. Some of the striæ appear to be subparallel, converging toward the apex; other striæ are irregular and anastomosing rather than subparallel.

VERTEBRAL COLUMN

The vertebral column is represented by fifteen recognizable vertebræ, besides fragments of others. These consist of three cervicals, one dorsal, one lumbar, two sacrals, and nine caudals. These vertebræ present characters that are somewhat different from normal crocodilian vertebræ. The differences are minor in extent, however.

The first, or atlas vertebra, is represented by the centrum only. This, when viewed from above, is subrectangular in outline, contrasting with the subtriangular outline of *Crocodilus americanus*. The posterior surface is smaller than the corresponding surface in *C. americanus*, but the inferior surface is relatively larger.

	New Specimen	*C. americanus* A.M. 7139
Length of dorsal surface	38 mm.	27 mm.
Breadth of posterior surface	42	46
Height of posterior surface	24	25 (oblique)
Length of inferior surface	36	30

The seventh cervical is fairly well preserved, although the spine may not be complete. It was probably low. The prezygapophyses have moderately short, semioval articular surfaces, contrasting with long, subrectangular surfaces in the corresponding vertebra of *C. americanus*. The position of the articular surfaces is slightly nearer the horizontal than in the living form. The postzygapophysial surfaces are also rounder and flatter than in the recent species. The notch between the pre- and postzygapophysial processes is not so deep as in *C. americanus*. The anteroposterior diameter of the neural arch is greater than in the living species. The neural canal is decidedly larger than in the recent form.

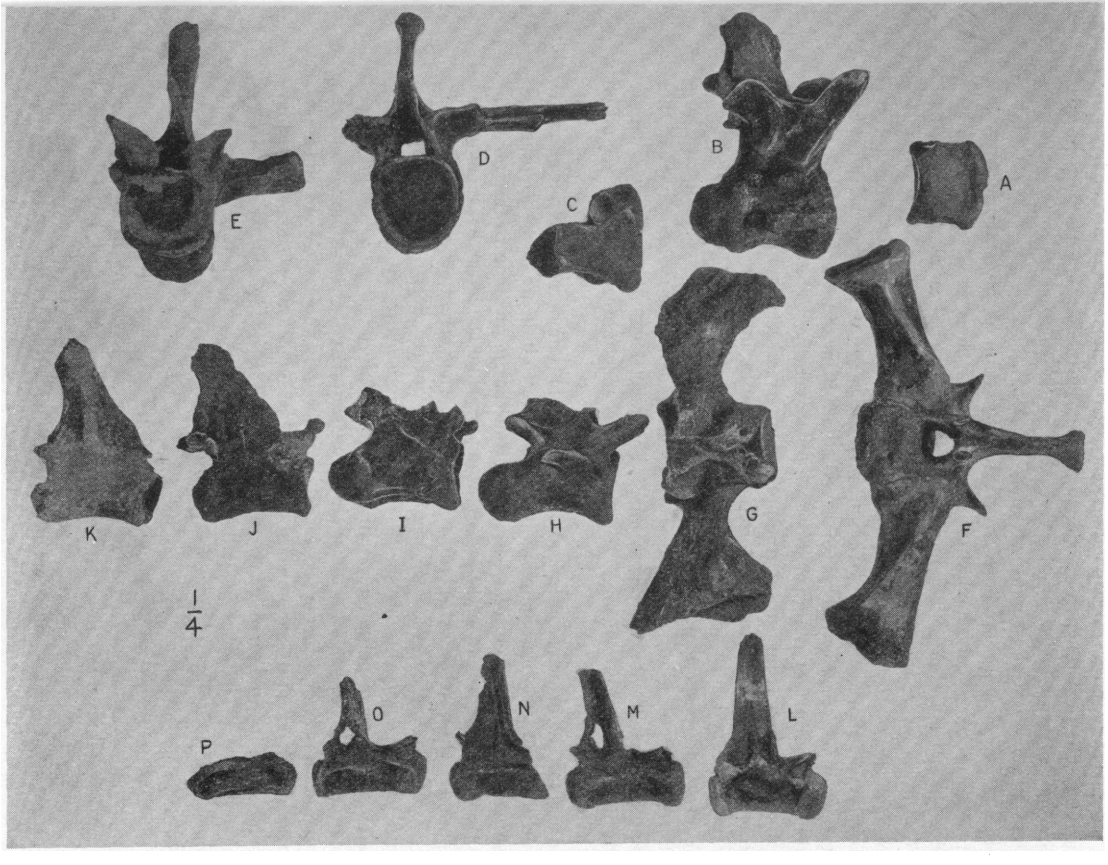

Fig. 2. *Holops pneumaticus* Cope. Specimen in New Jersey State Museum. All figures about one-fourth natural size.

A, atlas vertebra, inferior view; B, seventh cervical vertebra, lateral view, right side; C, eighth (?) cervical, lateral view, left side, inverted; D, fifth dorsal vertebra, anterior view; E, first lumbar vertebra, anterior view; F, first sacral vertebra, anterior view; G, second sacral vertebra, superior view; H, ninth caudal vertebra, lateral view, right side; I, eleventh caudal vertebra, lateral view, right side; J, thirteenth caudal vertebra, lateral view, right side; K, fourteenth caudal vertebra, lateral view, right side; L, sixteenth caudal vertebra, lateral view, right side; M, seventeenth caudal vertebra, lateral view, right side; N, eighteenth caudal vertebra, lateral view, right side; O, nineteenth caudal vertebra, lateral view, right side; P, twentieth caudal vertebra, lateral view, right side.

The diapophysial and parapophysial processes are much less robust than in *C. americanus*. On the inferior surface the spread of the parapophysial processes is slightly greater than in the corresponding vertebra of *C. americanus*. The hypapophyses are much less prominently developed than in the modern species. In the last two characters the vertebra resembles very closely the centrum of a corresponding vertebra of *Holops obscurus* (Am. Mus. Cope Coll. 2025).

The eighth cervical is represented by the lower portion of the centrum only. Its parapophysial processes correspond in relative size with those in *C. americanus*, but are shaped slightly differently. The hypapophysis is somewhat more prominent than that of C.7, but is less so than in *C. americanus*.

The fifth dorsal is moderately well preserved. The spine is long antero-posteriorly, but is short vertically. It is inclined backward to a considerable degree. The left diapophysial process only is preserved, and it is incomplete. It is long in the fore-and-aft direction, but was probably short transversely. The capitular facet is located about one inch from the external prezygapophysial border, or about the same distance as from the mid-line to the external prezygapophysial border. The tubercular facet is not preserved.

The pre- and postzygapophysial surfaces are relatively very small, and are nearly horizontal in position, contrasting with the large oblique zygapophyses of the corresponding vertebræ of *C. americanus*. The neural canal is relatively large, especially in the lateral dimension. The centrum is short antero-posteriorly, and is higher than it is broad.

The vertebra identified as presacral 2 (or lumbar 1) is moderately well preserved. The spine is incomplete, but enough of it is preserved to indicate that the spine was taller than that of the vertebra last described, and that it was long in the fore-and-aft direction. The right transverse process is missing, and the left one is incomplete. It is extended in the antero-posterior direction. As in the vertebræ already described, the pre- and postzygapophyses are small and are nearly horizontal in position. The neural canal is comparatively small. The centrum is relatively long and narrow, compared with the corresponding vertebra of *C. americanus*.

The first sacral vertebra is decidedly different from that of *Crocodilus americanus*. The spread across the transverse process is approximately the same as in the specimen of *C. americanus* used for comparison (Am .Mus. No. 7139). Other dimensions can therefore be compared for similarity or contrast. The vertebra as a whole is very lightly constructed. The spine is slightly shorter vertically than in *C. americanus* and is considerably shorter in the antero-posterior direction. The summit, however, is considerably expanded.

The prezygapophysial processes are slender. The zygapophysial surfaces are small compared with those of *C. americanus*, but are consistent in size with those of the presacral vertebræ. The left postzygapophysis only is preserved, but it is complete. Both the process and the surface are extremely small. The spread across the two postzygapophyses must have been less than one-third the distance across the prezygapophyses. In the corresponding vertebra of *C. americanus*, the spread of the postzygapophyses is over half that of the prezygapophyses.

The transverse processes are extremely slender. Their distal expansions are relatively as great, compared with the shafts, as in *C. americanus*. The area of the distal expansions, however, in about one-third of that in the latter species.

The centrum is much shorter anteroposteriorly than in the living form.

The second sacral is less well preserved than the first. The spine is missing, except at the base. The prezygapophysial region is incomplete, but enough is preserved to indicate the small size of the prezygapophyses themselves. The right postzygapophysis is preserved. It is relatively larger than the prezygapophysis. The postzygapophysial surface is considerably smaller than in *C. americanus*, and is nearly horizontal in position. The spread of the two postzygapophyses was slightly less than that of *C. americanus*.

The transverse processes are approximately as long as in the recent form, but are extremely slender in comparison. The vertical diameter of the right process is scarcely one-half that of the recent species, and the distal surface, for articulation with the ilium, is less than one-half that of the latter. In both anteroposterior and transverse diameters the centrum is slightly smaller than in *C. americanus*.

The most anterior caudal preserved in the series appears to be Cd. 9. In it the spine is largely missing, but appears to have been long in the antero-posterior direction, judging from the base. The prezygapophysial processes are long and slender. They overhang the centrum farther than in *C. americanus*, and have a greater transverse spread. This may be partly due to the effects of pressure after burial, but not entirely so, as the base is but slightly asymmetrical, and shows no fracturing. The prezygapophysial surfaces are small in comparison with *C. americanus*, and are more nearly horizontal in position. The transverse processes are incomplete, and their bases are not distinctive.

The centrum is long and slender. Its vertical diameter is somewhat less than in *C. americanus*, especially at the posterior end. The border of the anterior cup is nearly vertical, compared with the oblique border in *C. americanus*. The posterior ball of the centrum is more decidedly convex than in the latter species, and the chevron facets are smaller.

The caudal identified as Cd. 11 is slightly smaller than Cd. 9. The spine is not preserved. The zygapophyses are incomplete, but indicate a narrower spread and smaller facets than in the modern form. The pit between the postzygapophyses is narrower than in Cd. 9. The transverse processes are represented by broken bases only; these are not distinctive.

Caudal 13 has a moderately tall spine, that is long in the anteroposterior direction at the base. The right prezygapophysis only is preserved. The process is slender, and the surface is small. The left postzygapophysis and part of the right one are preserved. The articular surfaces are small and close together. The centrum is short in the anteroposterior direction, being about two-thirds the length of the corresponding vertebra in *C. americanus*. The transverse processes are not preserved. The anterior articular surface of the centrum is relatively large, and moderately concave. Its vertical dimension is slightly greater than in *C. americanus*. The upper part of this surface is narrower than in the living species, but the lower part is broader. The whole surface is less triangular. The posterior surface is very convex. This convexity occupies the entire end of the centrum, and not merely part of it as in *C. americanus*. The inferior surface of the centrum is relatively much broader than in the American crocodile. The ridges that bound it laterally are higher, and the depression between them is deeper.

Caudal 14 has a tall spine that tapers more rapidly than that of Cd. 13. The zygapophyses are not preserved sufficiently well to permit description. The trans-

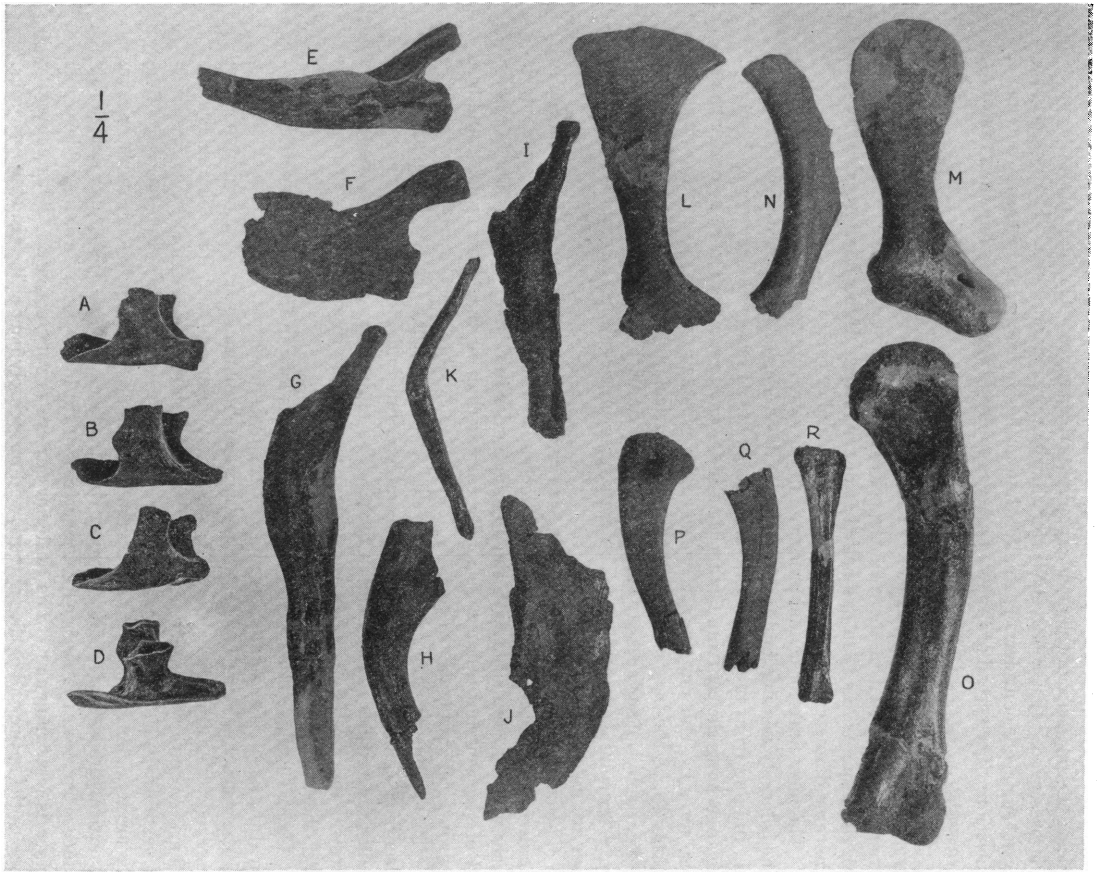

Fig. 3. *Holops pneumaticus* Cope. Specimen in New Jersey State Museum. All figures about one-fourth natural size.

A, right fourth cervical rib; B, right seventh cervical rib; C, left fourth cervical rib; D, left seventh cervical rib; E, left first dorsal rib; F, left third dorsal rib; G, right fifth dorsal rib; H, right third dorsal rib; I, right sixth dorsal rib; J, right fourth dorsal rib; K, sternal rib; L, right scapula; M, left coracoid, N, left scapula; O, left humerus; P, right ulna; Q, left ulna; R, metapodial.

verse processes are not preserved. The length of the centrum is the same as in Cd. 13. The anterior surface of the centrum resembles that of Cd. 13, except that it is not so high. The inferior surface of the centrum resembles that of Cd. 13, except that the lateral ridges are not quite so high, and are somewhat closer together.

The caudal identified as 16 is incomplete. It has a tall, slender spine, which is supported laterally by a pair of laminar braces; and it has no transverse processes, but smooth bone at the point usually occupied by the bases of these processes. The zygapophyses are not preserved. The centrum is poorly preserved. It appears to be about three-fourths the length of the corresponding vertebra in *C. americanus*, and somewhat narrower and lower. The lateral ridges of the inferior surface are close together.

Caudal 17 is fairly complete. The spine is high and slender. The prezygapophyses and postzygapophyses are not preserved. The centrum is of moderate length, and the ridges of its inferior surface are close together.

The caudal identified as 18 has a high slender spine with lateral braces The zygapophyses are not preserved. The centrum is narrow, and the two ridges of the inferior surface are close together. This vertebra is considerably smaller than the corresponding one in *C. americanus*.

Caudal 19 has a very slender spine, whose summit is incomplete. The zygapophyses are not preserved. The centrum is very slender.

Caudal 20 is represented by the centrum only.

A centrum represents what is probably Caudal 20. It resembles the centrum of Cd. 19, but it is slightly smaller.

LIMB AND GIRDLE BONES

The right scapula is preserved, though its proximal, or lower, border is incomplete; a portion of the left is also present. The distal blade differs considerably in shape from that of the Recent American crocodile. The superior border of the blade is long, as in *Crocodilus americanus*, but the blade narrows rapidly, while in *C. americanus* it narrows gradually. The anterior border is straighter than in the compared Recent species, and the posterior border is more regularly concave. The shaft is thicker than in the American crocodile. The lower, or proximal, end of the bone is not complete, but enough of it is preserved to exhibit the bases of the processes strengthening the glenoid articulation.

The left coracoid is present, though its borders are incomplete. Its preservation does not permit accurate determination of its characters, excepting that it is clear that the shaft of the bone is flatter and less thick than in the American crocodile.

The left humerus is nearly complete. It is curved slightly more than the humerus of *C. americanus* and exhibits some different proportions. The outline of the head, viewed from above, is suboval, rather than irregularly pentagonal. The upper portion of the anterior aspect of the bone, between the head and the deltoid crest, consists of one surface, contrasting with two distinct surfaces making an oblique angle with each other, as in *C. americanus*.

Measurements

	Height of vertebra, entire.	Breadth across prezygapophyses.	Breadth across postzygapophyses.	Length, right prezygapophysis to right postzygapophysis, inclusive.	Breadth across diapophyses.	Breadth across parapophyses.	Length of centrum.	Breadth of centrum, anterior end.	Height of centrum, anterior end.	Breadth of centrum, posterior end.	Height of centrum, posterior end.
Cervical 7	....	59	55	70	68e	64	68	48	43	43	36
Cervical 8	....	....	....	....	....	....	....	51	42	....	....
Dorsal 5	....	70e	70e	65e	212e	130e	64	44	47	38	35
Lumbar 1	132	60	57	82	124	....	68	46e	44	38	34
Sacral 1	110	73	20e	60e	215	....	51	58	37	42	31
Sacral 2	....	....	51	55e	181	....	55	41	27	52	33
Caudal 9	....	42	34	71	....	....	62	37	38	31	30
Caudal 11	....	....	23	69e	....	....	66	33	34	29	28
Caudal 13	92e	28e	19e	67e	....	....	63	29	30	26	26
Caudal 14	100e	....	19e	61e	....	....	63	29	27	29	20
Caudal 16	90e	....	....	....	....	....	60e	23	23	....	....
Caudal 17	....	....	....	....	....	....	60	21	21	21	19
Caudal 18	....	....	....	....	....	....	....	....	....	20	17
Caudal 19	....	....	....	....	....	....	57	17	19	18	18
Caudal 20	....	....	....	....	....	....	54e	....	....	....	....

The head is relatively narrower in proportion to the length of the bone, compared with the modern form. The crest is somewhat less robust than in the American crocodile, and is relatively farther from the proximal end. The shaft is somewhat flatter in section than in the living American crocodile. The portion of the shaft below the crest is proportionately shorter than in *C. americanus*. The distal end is not completely preserved, but enough of it remains to enable one to note that it was comparatively narrow. The whole bone exhibits a much greater degree of curvature than is characteristic of the American crocodile.

MEASUREMENTS

	C. americanus Am. Mus. No. 7139, left	New specimen
Length	28.1 cm.	24.9 cm.
Circumference of shaft	10.1	9.1
Index	359	365
Breadth across proximal end	7.0	5.8
Index	249	232
Breadth across distal end	6.5	5.4 est.
Index	231	176
Distance from tip of crest to center of head	70	70
Distance from tip of crest to distal end	226	193 est.
Ratio, superior portion over inferior portion	309	362 est.

Both right and left ulnæ are preserved but are not sufficiently complete to permit description of characters.

Both ilia are preserved; neither ilium is complete, but the left one is nearly so. It is not especially noteworthy in form, although the following items may be noted: it appears to be higher in proportion to its length than in *C. americanus*, though this cannot be proven definitely owing to the incomplete character of the posterior process. It is definitely higher in proportion to the distance across the pubic and ischiadic peduncles than in the living American crocodile. The excavations, on the internal side, for articulation with sacral ribs, are not so deeply excavated nor so rugose as in *C. americanus*. This may be partly due to the abrasion of the specimen.

They also differ somewhat in shape.

Both ischia are represented, but the right ischium is incomplete. The left ischium is practically perfect; the following description is based on this bone. The most noticeable characteristics of the ischium are the relatively short length of the bone, and the great width of the neck below the superior articular processes. The inferior flange is relatively wide, the thickness of the neck and of the posterior iliac process

is not great. The inferior border appears to have been regularly rounded, and not composed of two straight lines making an angle with each other, as in *C. americanus*.

	7139	
Length posterior iliac process to inferior border	174	129
Breadth across flange	109	103
Ratio, br. of flange over length	626	798
Breadth across both iliac processes	94	75
Ratio, breadth across iliac processes over length	546	581
Breadth of neck	31	41
Ratio, breadth of neck over length	672	318
Thickness of neck	19	16
Ratio, thickness of neck over length	109	124
Ratio, thickness of neck over breadth of neck	623	390

A pubic bone, apparently that of the left side, is included in the material, but it is not sufficiently well preserved to permit description.

Both femora are present in the specimen, but the distal end is lacking in each femur. This prevents the computations of accurate ratios depending upon the length of the bone. The left femur is the better preserved of the two, and the description is largely based on it.

The curvature of the bone is somewhat greater than in the femur of *C. americanus*, and the degree of twisting of the shaft is also somewhat greater. The head is much broader in proportion to its thickness than in the living American crocodile. The shaft appears to be smaller in proportion to its length than in the Florida crocodile.

	sp.	A.M. 7139
Length	300 mm. est.	330
Head to 4th trochanter	86	123
Breadth of head	63	65
Thickness of head	36	42
Circumference of shaft	103	115

The tibia is represented by both sides, but both specimens are too incomplete to permit accurate description.

The fibula is not preserved. One metapodial, without distinctive characters, is present.

RIBS

A number of ribs are present in various degrees of preservation. Some of them can be identified as to their place in the series, while others are indeterminate. Some of the ribs exhibit characters of considerable morphologic significance.

Four complete cervical ribs and part of a fifth are preserved. One pair evidently belonged to Cervical 4. The capitular facets are much

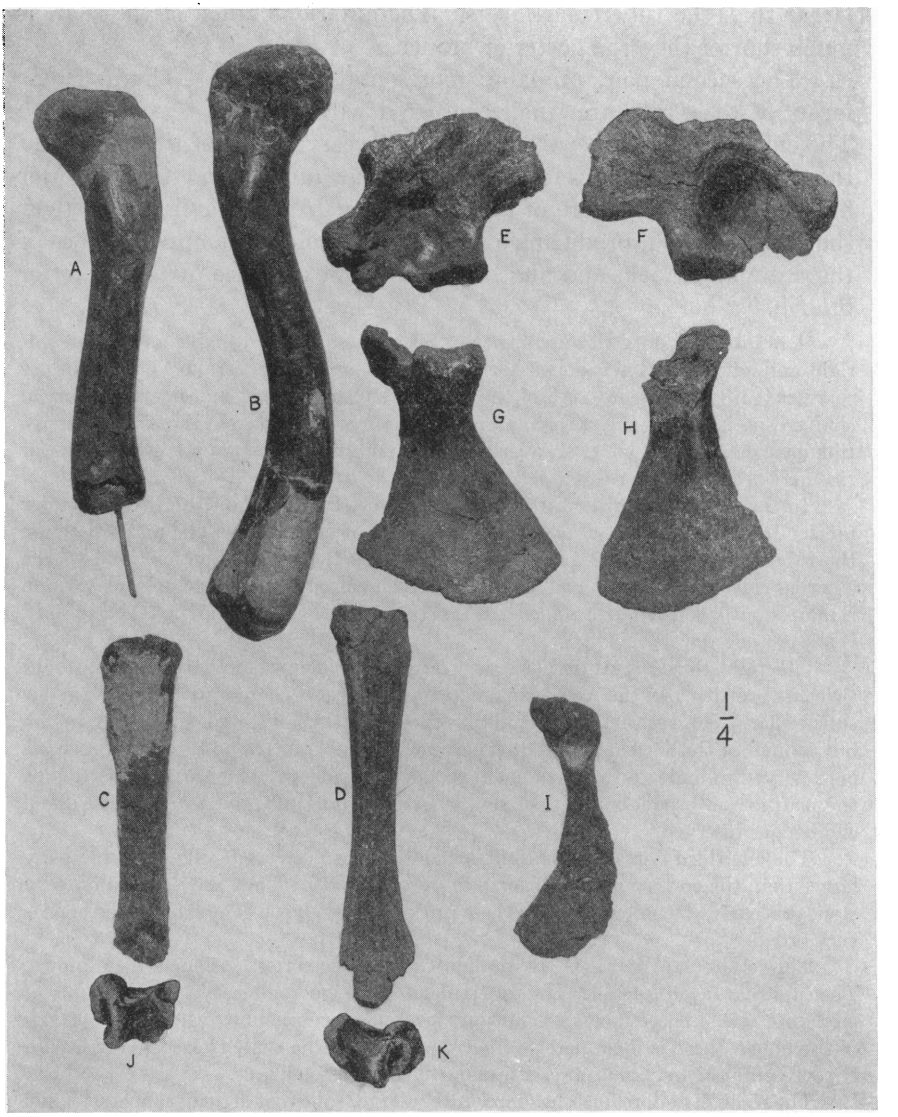

Fig. 4. *Holops pneumaticus* Cope. Specimen in New Jersey State Museum. All figures about one-fourth natural size.

A, right femur; B, left femur; C, left tibia; D, right tibia; E, left ilium; F, right ilium; G, right ischium; H, left ischium; I, left pubis; J, right calcaneum; K, left calcaneum.

larger than the tubercular facets. The anterior branch of the shaft is much shorter than the posterior branch.

The second pair, probably represents Cervical 7. The articular facets of these ribs are small compared with those in *C. americanus*. The chief distinction between the seventh cervical rib of the latter and those described is the fact that both the anterior and the posterior branches of the shaft are of equal length in *H. pneumaticus*, and their shafts are twisted, producing a deep excavation on the upper surface of the anterior branch, and another on the lower surface of the posterior branch.

A number of dorsal ribs are present. Six of these are identifiable as left dorsal 1, right and left dorsal 3, left dorsal 4, right dorsal 5, and right dorsal 6. Other ribs are represented by fragments. All of these ribs are characterized by remarkably broad shafts, especially near their proximal ends. This breadth is so great that the successive ribs must have approached an overlapping condition. In fact some of the anterior ribs may actually have overlapped each other.

In the left first dorsal rib the tubercular facet is twice the size of the capitular facet. In *Crocodilus americanus* these facets are of equal size. The notch between the tubercular and capitular processes is less deep than in the living species. The external ridge appears to have been more prominent, and the whole proximal region is more stoutly constructed. The shaft tapers toward the distal end, but the end itself is not preserved.

The right third dorsal rib has a very large tubercular facet. Its length is about twice its breadth. In the American crocodile this facet is comparatively small, and is subcircular. The capitular facet, and the process on which it rested, are not preserved, but enough of the border of the notch between the tubercular and capitular processes is preserved to indicate that this notch was not very deep. The proximal portion of the shaft is very broad, but its thickness is not as great as in *C. americanus*. The distal end is not preserved.

The left third dorsal has both articular surfaces preserved. These surfaces are larger than the corresponding surfaces in *C. americanus*. They are situated on very stout processes; the notch between these processes is shallow. The shaft of the bone is very broad.

The left fourth dorsal is the broadest rib in the series, so far as it is known. The capitular facet is small. The tubercular facet is incomplete, but was probably of moderate size. These facets are not on elevated processes but rather on the shafts of the bone; there is little notching between them. The shaft is excessively broad. It represents the maximum breadth known among crocodilians.

The right fifth dorsal rib has moderately large, subequal articular facets. They differ from those of the American crocodile in being oval instead of circular. The capitular facet is situated directly on the shaft, and not on a process of its own. The tubercular facet is situated on a process that may be considered as an extension of the main shaft of the bone. This process is in direct line with the long axis of the shaft, and not oblique to it as in *C. americanus*. The shaft of the bone is very broad; but it is also rather thin. The tapering toward the distal end is very gradual. The end itself is not preserved.

The right sixth dorsal rib is more slender. The facets are of moderate size. The tubercular facet is concave. The shaft is broad, but not extremely so. It turns upward slightly on the posterior border.

MEASUREMENTS

Left Cervical 2.	
Length of both branches of shaft	73 mm.
Center of shaft to tubercular facet	44
Right Cervical 7 (The left Cervical 7 is distorted).	
Length of both branches of shaft	80
Center of shaft to tubercular facet	44
Left Dorsal 1.	
Breadth across both articular facets	56
Breadth of shaft at proximal end of external crest	32
Thickness	10
Right Dorsal 3.	
Maximum breadth of shaft incomplete as preserved	43
Thickness, maximum	17
Left Dorsal 3.	
Breadth across both articular processes	77
Maximum thickness of shaft	53
Thickness, maximum	17
Right Dorsal 5.	
Distance across both articular facets	70
Breadth of shaft, maximum	44
Thickness	10
Left Dorsal 4.	
Breadth across articular facets	62 preserved 75 estimated when complete
Breadth of shaft	55
Right Dorsal 6.	
Breadth across both articular facets	61
Breadth of shaft	37

DERMAL SCUTES

Sixty-two fairly complete dermal scutes are preserved, besides fragments of others. These vary in outline from subcircular to square to rectangular. They are all moderately thin, they all lack median keels, and their pitting is deep and irregular.