AMERICAN MUSEUM NOVITATES

Number 953 Published by THE AMERICAN MUSEUM OF NATURAL HISTORY New York City October 7, 1937

MORE COMPLETE REMAINS OF A CHELONIAN, *SYLLOMUS CRISPATUS* COPE, FROM THE MIOCENE OF VIRGINIA

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In 1896 Cope[1] described a new genus and species of Cheloniidae from the Miocene beds on the Pamunky River, Virginia. This new turtle, *Syllomus crispatus*, was based upon two fragments of carapace and part of a humerus. No additional material belonging to this species has been recognized until, on June 14, 1936, the present author collected a nearly complete specimen of *S. crispatus* from a Miocene exposure on the Virginia side of the Potomac River. This additional material greatly extends our knowledge of Cope's species although altering only slightly some of his generalized generic characters.

During the month of June the author visited Horsehead and Stratford Cliffs (better known under the collective name of Nomini Cliffs), Westmoreland County, Virginia. The purpose of the trip was to obtain additional remains, if possible, of *Peritresius virginianus* which had been obtained from Horsehead Cliffs the previous June.[2] Only scattered plates of this turtle were found while a nearly complete specimen of *S. crispatus* was collected about 50 feet south, and at an elevation of about 7 feet above beach level, from the type locality of *Peritresius virginianus*.

SPECIMEN.—The specimen consists of the nuchal, first to seventh neurals inclusive, and the second postneural; first suprapygal, and portions of all the costals of the carapace. The plastron is represented by a portion of the left hyoplastron, right and left hypoplastron, and right and left xiphiplastron. Also portions of first, second and eleventh right peripherals, first to sixth inclusive and eleventh left peripherals, and pygal, also portions of both right and left scapular, pubis, coracoid, ischium, a bone of the skull and several vertebrae.

LOCALITY.—The remains were collected in a bed about 7 feet above the beach at the southeastern end of Horsehead Cliffs, Westmoreland County, Virginia.

HORIZON.—The age of the beds exposed in these cliffs has been long

[1] Cope, E. D., 1896, 'Sixth Contribution to the Knowledge of the Marine Miocene Fauna of North America,' Proc. Amer. Philos. Soc., XXXV, pp. 139–140.

[2] Berry, C. T., and Lynn, W. G., 1936, 'A New Turtle, Peritresius virginianus, from the Miocene of Virginia,' Proc. Amer. Philos. Soc., LXXVI, No. 2, pp. 175–190.

Fig. 1.

A. Carapace of *Syllomus crispatus* (A. M. No. 1661). $\times 5/17$.
B. Ischium. $\times 1$.
C. Second right peripheral, inside view. $\times 5/7$.
D. First right peripheral, outside view. $\times 5/7$.
E. Centrum and neural arch of seventh cervical vertebra. $\times 1$.

disputed. The last work of Mansfield in 1932[3] states that there is exposed the upper part of the Calvert, all of the Choptank, and the lower part of the St. Mary's formations. The matrix in which the specimen was found is a blue-gray diatomaceous clay.

CARAPACE.—The outline of the carapace is oval being more blunt at the anterior than at the posterior end. The sculpturing on the carapace is very similar to that which is found on *P. virginianus* with the exception that on *S. crispatus* the grooves are wider at the expense of the ridges. Whether this difference is a generic one or due to age is uncertain. That S. *crispatus* is a somewhat older individual than *P. virginianus* is brought out by the several pitted areas on the carapace of the former. In general the sculpturing in the central portion of the costals parallels the plate while near the lateral edges it runs at right angles to the intercostal sutures. On the neurals the arrangement becomes very fine and irregular.

The carapace (Fig., A) is flatly arched transversely, while the curvature of the anterior end is greater than the flattened posterior portion. Crossing the first, second and third right and left costal plates is a very faint, low ridge about one and one-eighth inches from the neurocostal suture and parallel to it. This ridge which is more prominent on the first and third than on the second is lacking on the remaining costals. Running down the center of the first to fifth neurals is a low median keel which reaches its maximum on the posterior part of the nuchal plate and decreases posteriorly. The sulci can be easily traced in the median region of all the costal plates, but become indistinct near the lateral ends of the plates. The costoperipheral sulci can be observed crossing the distal ends of the fourth and sixth right costals and the second to sixth left costals.

The visceral surface of the carapace is very incomplete having crumbled away upon collection and preparation of the specimen. The proximal rib ends are represented by only rounded knobs, as are the neural arches of the neural plates.

The greatest width of the carapace, taken in a straight line from the posterior corners of the right and left fourth costal is 288 mm., excluding the peripherals. The actual length including the nuchal and supygal is 428 mm. Greatest estimated width including the peripherals is 378 mm., estimated length including pygal is 540 mm.

The costoperipheral suture is present on the first to sixth right and left costals in all cases where the distal margin of the plates is preserved.

[3] Mansfield, Stephenson and Cooke, 1932, Int. Geol. Cong. 16, Guidedook No. 5, Excursion A-5, pp. 25–28.

Posterior of the sixth costal the distal ends do not possess any evidence of a suture. Whether this is due to the preservation of the specimen or the absence of such suture cannot be ascertained, but in all probability the peripherals did not contact the costals, for on the posterior portion of both the right and left eleventh peripherals a suture is present for only about 25 mm. The remaining portion forming a thin smooth edge. In order to maintain the marginal curvature of the carapace with that of the eleventh right and left peripherals and pygal it is necessary that the posterior costals not be united with the peripherals by a costopheral suture. The peripherals are also united to the costals by gomphoses of the rib ends with the exception of the first right and left peripherals.

Detailed description of the individual bones of the carapace will be omitted, Table I of their measurements being substituted. The epidermal sulci indicate that *S. crispatus* resembled the existing genus *Chelonia* in having five vertebral shields and four pairs of costal shields. Measurements of which are also included in Table I.

In addition to these carapace plates there was found an oval shaped plate (Fig. 2, D) whose exact location is uncertain. From the sculpturing upon the surface of this plate and its curvature it belongs to the posterior portion of the shell. This sculpturing is very similar to that which the pygal possesses. The interior surface is pitted with minute oval and circular holes irregularly arranged. Sutures are present on two of the diagonal corners in varying amounts. These sutures do not fit with any that have been found on the other carapace bones. In all probability this plate flanks the suprapygal. The longest axis of the plate is 60 mm. and the shortest 38 mm.

The pygal has the outline of a truncated triangle, the lateral sides joined by sutures to the eleventh right and left peripherals. The base of the triangle forms the posterior margin whose center is indented by a V-shaped sinus which is flanked on both sides by rounded lobes. The broken anterior margin possesses sutures. The dorsal surface, which is arched, is finely sculptured similarly to both eleventh peripherals, while the concave ventral surface is indefinitely sculptured. Near the margin on the posterior portion of the plate there are situated two semi-circular pitted areas which were probably caused by some infective organisms. The greatest width of the plate in a straight line across the posterior portion is 59.5 mm., greatest length 40 mm. and greatest thickness 9 mm.

PLASTRON.—The plastron was greatly crushed and the plates were very poorly preserved, so much so that only portion of these bones can be described. The reconstruction of these plates shows a curvature of ap-

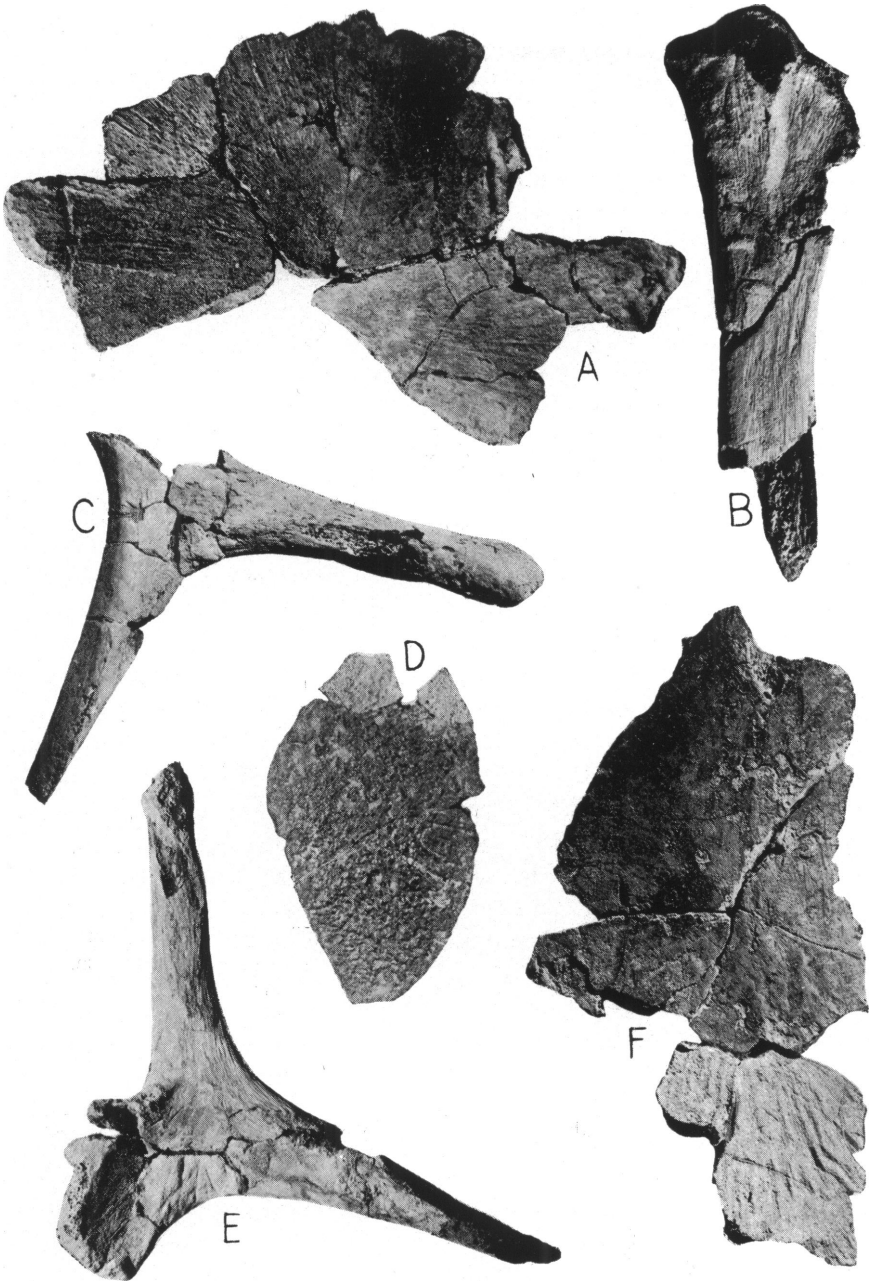

Fig. 2. *Syllomus crispatus* Cope.

A. Left hypoplastron, inside view. $\times^{9}/_{11}$.
B. Right coracoid. $\times 1$.
C. Left scapula. $\times^{3}/_{4}$.
D. Extra plate from posterior region of carapace. $\times^{3}/_{7}$.
E. Right scapula. $\times^{3}/_{4}$.
F. Right xiphiplastron. $\times 1$.

TABLE I

	Length (middle)		Width (greatest)	
	Bones	Scutes	Bones	Scutes
Nuchal	46 mm.		?	
Neurals				
1	43 mm.	80 mm.	27 mm.	60 mm.
2	47 mm.	92 mm.	26.5 mm.	55 mm.
3	48 mm.	92 mm.	27.5 mm.	53 mm.
4	46 mm.	?	26 mm.	47 mm.
5	44 mm.		25 mm.	
6	39 mm.		24 mm.	
7	25 mm.		22 mm.	
8	X		X	
Post neurals				
1	X		X	
2	17 mm.		20 mm.	
Suprapygal				
1	30 mm.		?	
Costals				
1 R	?	?	67 mm.	?
2 R	?	?	50 mm.	97 mm.
3 R	?	?	49 mm.	90 mm.
4 R	?	?	51 mm.	?
5 R	?		45 mm.	
6 R	?		50 mm.	
7 R	106 mm.		41 mm.	
8 R	?		?	
1 L	?	?	?	?
2 L	127 mm.	122 mm.	57 mm.	95 mm.
3 L	139 mm.	127 mm.	57 mm.	90 mm.
4 L	142 mm.	95 mm.	49 mm.	?
5 L	139 mm.		48 mm.	
6 L	126 mm.		41 mm.	
7 L	105 mm.		38 mm.	
8 L	?		49.5 mm.	

Measurements of individual bones and scutes of carapace (X indicates absence of plate; ? indicates complete measurement unobtainable).

proximately 126 degrees for the left hyoplastron. On none of the plates is there any evidence of sulci. None of the marginal processes were preserved intact, and the hyohypoplastral sutures have been destroyed.

The left hyoplastron (Fig. 3, A) is the best preserved of all the plastron plates. It is irregular in outline, somewhat rectangular; it varies in thickness being thickest near the center of the anterior margin, thinning near margins. Greatest length of plate is 105 mm., greatest width 95.5 mm. and greatest thickness 5 mm.

The right hypoplastron (Fig. 3, C) is represented by a small fragment from the posterior portion of the plate. This piece is only 45 mm. in length, 57.5 mm. in width and 6 mm. thick at greatest measurements. The left hypoplastron (Fig. 2, A) which is about twice the size of the right fragment represents the anterior portion of the plate. This fragment is 112 mm. broad, 76 mm. in length and 4 mm. thick at greatest measurements.

Only small portions of the right (Fig. 2, F) and left (Fig. 3, G) xiphiplastrons were preserved. These bones are very thin becoming thicker in posterior region where dorsal side of plate is arched. These plates are the only ones of the plastron which show any sculpturing, which is present on the posterior portion. The right xiphiplastron is 86 mm. long, 45 mm. broad and 4 mm. thick. The left xiphiplastron is 58.5 mm. long, 35.5 mm. broad and 4 mm. thick.

PERIPHERALS.—The peripherals preserved well enough for identification were the first, second and eleventh right and the first to sixth and eleventh left ones. Besides these numerous other incomplete pieces were found.

Only a small portion of the first right peripheral (Fig. 1, D) was preserved, consisting of a part of the outer margin and the posterior corner, possessing some suture. A similar fragment of the second right peripheral (Fig. 1, C) was found showing on the inside the open pit for the rib end.

The eleventh right peripheral is rectangular in outline except for the outer anterior corner which is lacking. Both anterior and posterior margins sutured while the outer margin forms a thin edge. The dorsal costal margin is uneven, the anterior portion is a thin straight edge for 21.5 mm. then there is an offset of about 2 mm. and the remaining 25 mm. is sutured. The sculpturing on the dorsal surface is pronouncedly finer than that which is found on the first two peripherals. Most of the ventral surface is lacking, exposing the sockets for the rib ends in cross section. The greatest length of the plate is 52 mm., greatest width 37 mm.

The first left peripheral is rectangular in outline and is flat. The anterior and posterior margins as well as the costal margins possess sutures, the outer margin rounded. The dorsal surface of the plate, which is twisted on the diagonal, is covered by irregular sculpturing. The interior surface is smooth being covered by numerous small holes with a radiating pattern from a place near the outer margin in the center of the plate. The plate thickens near costal margin. Greatest length of plate is 58.5 mm., greatest width 32.5 mm., greatest thickness 4.5 mm. and thinnest 2.5 mm.

The second left peripheral is irregular in outline, the outer surface curved inward. The anterior margin is partly broken and both costal and posterior margins possess sutures. The dorsal surface of the plate, which is irregularly sculptured, curves down forming the outer margin. Across the anterior portion of the plate is a shallow groove which indicates the intermarginal sulcus. The interior surface is irregularly pitted in the anterior portion near the outer margin where there is a shallow pit for the rib end. The plate is much thicker near the costal margin, being thinnest in the curvature of the plate. The greatest length of the plate is 51 mm., greatest width 42 mm., greatest thickness 5 mm. and thinnest 3 mm.

The third left peripheral, which is somewhat crushed, is irregular in outline. The anterior, posterior and costal margins sutured. The latter margin is sigmoid in shape. The outer margin curves under and forms the ventral surface. The dorsal surface is covered by irregularly arranged tubercles, the ventral surface being covered by shallow grooves and ridges. The inner surface of the plate is irregularly pitted with small holes, greater portion of surface covered by clay to strengthen plate. The plate is thickest near the posterior costal corner. Greatest length of plate is 51 mm., greatest width 40 mm., thickest 5 mm.

The fourth left peripheral is rectangular in outline. The anterior and costal margins are sutured, the posterior one imperfectly preserved. The costal margin has a broad shallow sinus in center. Outer margin curves under and forms ventral surface. The dorsal surface is irregularly sculptured having a radiating structure from a place near the center of the outer margin. Crossing anterior part of plate is faint intermarginal sulcus. Sculpturing on ventral surface destroyed. The remains of the inner surface, which is exposed, is pitted by small holes. Portion of rib end imbeded in clay. Greatest length of plate is 52 mm., and width 39 mm.

The fifth left peripheral is represented by a portion of the dorsal surface and a portion of the ventral surface held together by clay. The costal margin possesses sutures, other margins too badly preserved to distinguish. Dorsal surface is irregularly sculptured.

The sixth left peripheral is badly crushed and its identification depends upon a small portion of the costal margin, which is sutured, uniting to the fifth costal. The posterior margin is sutured. The dorsal surface is faintly sculptured as is the ventral surface.

The tenth left peripheral is represented only by a small posterior fragment whose sutures unit with the eleventh left peripheral.

The eleventh left peripheral is similar in outline to the right one, being however more complete. The costal margin is sutured for only 14 mm. of its 34 mm. length, the remaining portion forming a thin edge. The ventral surface of the plate still retains faint evidence of sculpturing. The inside surface possesses two conical sockets for the rib ends (the anterior socket is the deepest), both being in the posterior portion of the plate. Greatest length of plate 54 mm., greatest width 36 mm.

The fact that the first six left peripherals join the costals by a costal-peripheral suture as well as by gomphoses of the rib ends, and that the posterior portion of the eleventh right and left peripherals join the rest of the carapace by sutures while their anterior portions do not definitely excludes this specimen from the genus *Peritresius* as does the fact that two ribs unite by gomphosis to the eleventh peripherals. These facts which exclude the specimen from *Peritresius* place it without question under the genus *Syllomus* as partly characterized by Cope in 1896. Likewise the presence of the two rib sockets in the eleventh peripherals makes it differ from the living Loggerhead, *Caretta caretta* (Linnaeus) which possesses only one such socket.

Other Bones.—The centra of the sixth (Fig. 3, E) and seventh (Fig. 1, E) cervical vertebrae were preserved. The corners as well as the hypapophyses of both centra are broken off. Nearly all of the anterior end of the sixth centrum is lacking, however, enough still remains to show that this end was concave. The posterior end is flat. Attached to the anterior portion of the seventh centrum is half of the neural arch, which is badly preserved. The anterior end of this centrum is flat while the posterior end is convex. These two centra unite extremely well considering their condition.

Measurements of Centra

	Sixth	Seventh
Length	22 mm.	21 mm.
Width	21 mm.	18 mm.
Diameter of anterior concavity:		
Vertical	?	11 mm.
Horizontal	?	15 mm.
Diameter of posterior convexity:		
Vertical	10 mm.	?
Horizontal	17 mm.	?

(? indicates complete measurement unobtainable)

The sacral vertebrae (Fig. 3, F) are represented by two crushed centra and the right pair of short ribs, all embedded in clay. It seemed advis-

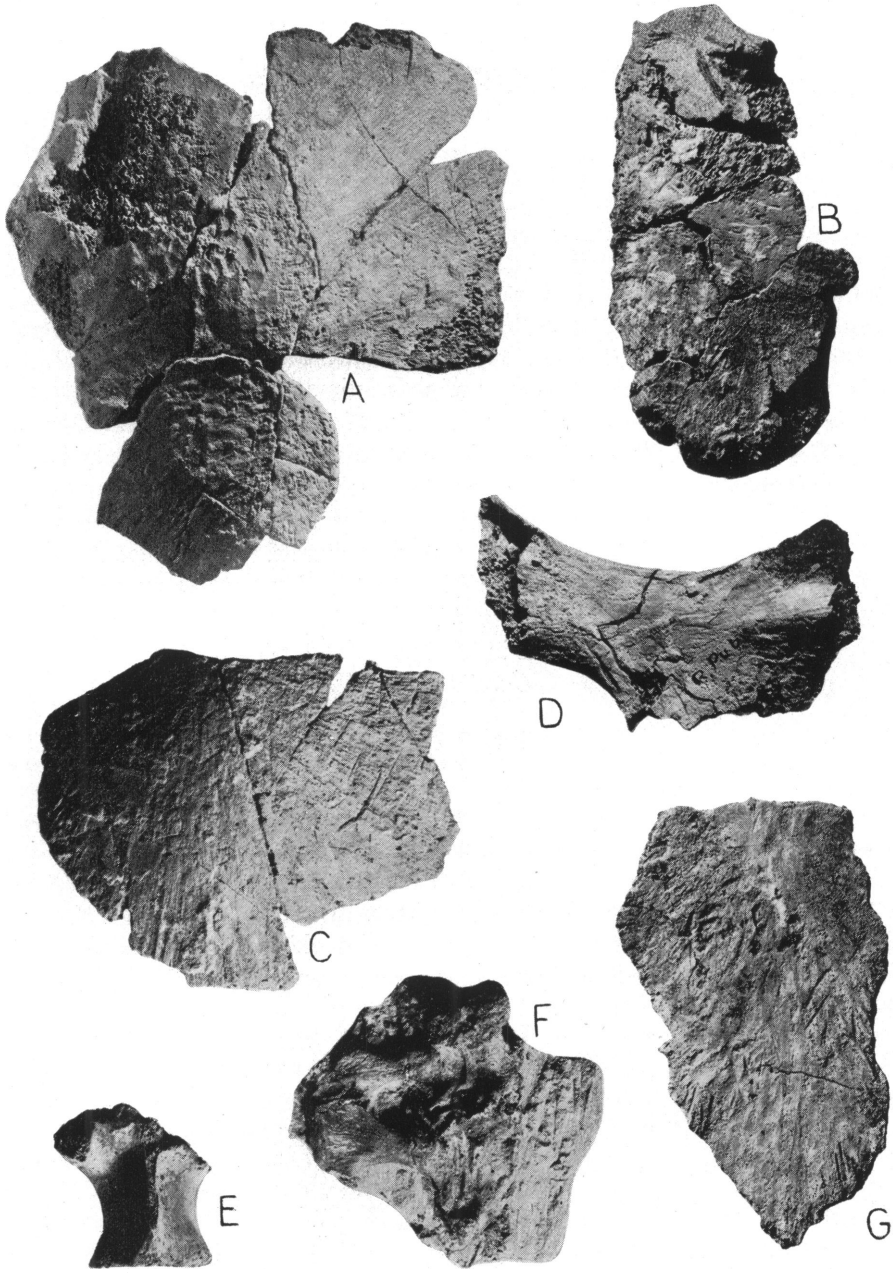

Fig. 3. *Syllomus crispatus* Cope.

A. Left hyoplastron. $\times^{9}/_{13}$.
B. Left parietal. $\times 1$.
C. Right hypoplastron. $\times 1$.
D. Right pubis. $\times 1$.
E. Centrum of sixth cervical vertebra. $\times 1$.
F. Centra of sacral vertebra embedded in matrix. $\times 1$.
G. Left xiphiplastron. $\times 1$.

able to leave these bones in the clay due to their state of preservation, thus only their dorsal surface is exposed. The anterior end of the centrum of the first sacral vertebra is lacking. The posterior end of the second centrum is flat, being irregularly pitted. The dorsal surface of the centra is uneven with a low, sharp, narrow ridge crossing both bones. The first right rib which is only 5 mm. broad at its proximal end increases to over 11 mm. at its distal end. The second right rib is much smaller than the first, being only 4 mm. broad at proximal end and increasing to a little over 6 mm. at its distal end. The surface of the ribs is, in general, smooth being slightly depressed in central region. At the anterior end of the specimen is part of neural arch exposed in cross section.

The pectoral girdle is represented by portions of the right (Fig. 2, E) and left (Fig. 2, C) scapula and the anterior portion of the right coracoid (Fig. 2, B). The right scapula, the most complete, has the ends of the distal rod and the proscapular lacking while the glenoid fossa is too crushed to distinguish. On the portion of the left scapula the proscapular end is better preserved and shows region where the fibro-cartilagenous plate unites with the bone. At the end of the distal rod the fine grooves and ridges which parallel the bone are preserved. The right coracoid is represented by only a portion of the anterior head. Conditions of preservation of the glenoid articulating surface prevents measurements. Entire length of fragment of coracoid is 77 mm.

The pelvic girdle is represented by fragments of the pubis (Fig. 3, D) and ischium (Fig. 1, B). The pectineal process and a portion of the proximal part of the right pubis are preserved. The bone is thin, in general thickening in the proximal portion. The smallest distance across the pectineal process is 15 mm. The fragment of the right ischium is too broken to distinguish any of its features. Its longest measurement is 29 mm.

The skull is represented by a portion of the left parietal (Fig. 3, B). This identification is based upon the suture along one edge, the curvature of the inner surface, and the thinness of the bone. This fragment is so badly crushed that portions of the clay were left adhering to strengthen the specimen. The suture along the median edge is 37 mm. long and 7 mm. thick at greatest measurement. The greatest length of the bone is approximately 60 mm. while its width is about 34 mm.

Discussion.—In Cope's original description he placed more emphasis upon the humerus than upon the pieces of the carapace, but it is remarkable that the present find complements his conception of this species and the genus which he set up for it. The author had the privilege of study-

ing Cope's type last year and it is regrettable that in the present find that the humerus was lacking, so that no comparison could be made. Cope draws the conclusion that there are two lateral keels upon the carapace of *S. crispatus*. In this he seems to be right but these keels do not traverse the entire length of the carapace. Instead they die out posterior to the third costals. As to the median keel he cannot say because of the absence of the "vertebral bone." In the present specimen there is a low median keel crossing the first five neurals. Both of these keels are not prominent in the recent find. In regard to the contact of all the peripherals with the costals, Cope apparently went beyond the facts at hand and entered the field of conjecture. In the recent find there is evidence that the first six peripherals joined the costals by a costalperipheral suture as did part of the eleventh. However the anterior portion of the eleventh peripherals do not possess any suture, thus proving that some of the plates from the sixth to eleventh did not unite with the costals. Unfortunately just which ones did or did not cannot be stated for the plates in question were not preserved.

This lack of a costalperipheral suture in the posterior portion of the carapace raises the question as to whether the presence of this suture is an indication of the age of the individual. This could only be proved by a great number of specimens which as yet have not been found. If this suture is indicative of age, then the genera *Syllomus* and *Peritresius* are the same. It is concluded that the present specimen of *S. crispatus* is of an old turtle as indicated by the condition of its carapace, whereas the specimen of *P. virginianus* originally described is that of a very young individual. A similarity between these two genera appears in all features except the costalperipheral suture and the arrangement of the pygal plates.

The present specimen of *Syllomus crispatus* has been deposited in The American Museum of Natural History along with Cope's type, and has received the Cat. No. 1661.