

SMITHSONIAN INSTITUTION  
UNITED STATES NATIONAL MUSEUM  
Bulletin 103

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CONTRIBUTIONS TO THE GEOLOGY AND PALEON-  
TOLOGY OF THE CANAL ZONE, PANAMA, AND  
GEOLOGICALLY RELATED AREAS IN CEN-  
TRAL AMERICA AND THE WEST INDIES

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DECAPOD CRUSTACEANS FROM THE  
PANAMA REGION

By MARY J. RATHBUN  
*Associate in Zoology, United States National Museum*

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Extract from Bulletin 103, pages 123-184, with Plates 54-6



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ISSUED JAN - 8 1919



WASHINGTON  
GOVERNMENT PRINTING OFFICE  
1918



# DECAPOD CRUSTACEANS FROM THE PANAMA REGION.

By MARY J. RATHBUN,

*Associate in Zoology, United States National Museum.*

## INTRODUCTION.

Fifty-eight species of Decapods are enumerated from the collections examined by the author. Three species described by other authors are inserted in systematic order, thus making the list complete to date for the Panama region. All the available material in the United States National Museum from Panama and Costa Rica is included; it ranges in age from the Oligocene (Culebra formation) to the Pleistocene.

In the list of stations and the table of distribution the data relating to Cirripedia from Dr. H. A. Pilsbry's report are included for convenience of reference.

The literature on Panama Tertiary Decapods is so scanty that it is not surprising that nearly all of the forms now examined prove to be new. Six species previously described from living forms are here recorded from the Pleistocene (4 species) or the Pliocene (2 species). Thirty-nine species are described as new, three are types of new genera, and one of these is the type of a new family, the Gattuniidae. This is an extremely large and massive crab and combines the characters of the well-known Recent families, the Cancridae and the Portunidae. The most remarkable occurrence is that of a member of the Hexapodinae, that subfamily of the Goneplacidae in which the legs of the last pair are wanting. This is a small group of Recent crabs containing 5 genera and 8 species and is strictly Indo-Pacific. The species from the Oligocene of Panama is the first one observed in a fossil state. Many other genera dealt with in this report have never before been found fossil. Such are *Pachycheles*, *Petrolisthes*, *Axius*, *Hepatus*, *Mursia*, *Leucosilia*, *Euphylax*, *Heteractaea*, *Eurytium*, *Euryplax*, and *Cardisoma*.

As in all large collections of fossil crustaceans there are a number of fragments whose position is problematic. Some of these can be determined as to genera, others as to family only.



## LITERATURE ON TERTIARY DECAPODS OF PANAMA.

BOUVIER, E. L. *Calappa Zurcheri*, Crabe nouveau des terrains miocènes de Panama. Bull. Mus. Hist. Nat. Paris, vol. 5, 1899, pp. 189-192, 1 text-fig.

*Calappa zurcheri* is not represented in the United States Geological Survey collections.

TOULA, FRANZ. Die jungtertiäre Fauna von Gatun am Panamakanal. II. Teil. Jahrbuch der k. k. Geolog. Reichsanstalt, Wien, vol. 61, 1911, pp. 487-530 (1-44), pls. 30, 31 (1, 2).

The hermit-crab (*Petrochirus*) noted and figured by Toula (p. 511, pl. 30, fig. 13) I have ventured to describe as a new species, combining as it does the characters of the two nearly related Recent species which inhabit opposite sides of the continent. The "Krabbenscheren" of Toula (p. 512, pl. 30, fig. 14) are described below as a species of *Callianassa*, *C. toulai*.

BROWN, AMOS P., and PILSBRY, HENRY A. Fauna of the Gatun Formation, Isthmus of Panama. II. Proc. Acad. Nat. Sci. Philadelphia, vol. 64, Dec. 1912 (publ. Jan. 30, 1913), pp. 500-519, pls. 22-26.

The author is indebted to Dr. H. A. Pilsbry for the loan of the specimens of *Callianassa* in the collection of the Philadelphia Academy of Natural Sciences which were described by Brown and Pilsbry. They have been critically compared with those collected by the United States Geological Survey.

LIST OF STATIONS FROM WHICH MATERIAL HAS BEEN EXAMINED, ARRANGED FROM THE EARLIEST TO THE LATEST, WITH THE SPECIES FOUND AT EACH.

*Station 6012a*.<sup>1</sup>—Panama Canal Zone. One-quarter mile south of Empire Bridge. From lower dark clay beneath lower conglomerate. Culebra formation (lower part). Oligocene series. Collectors, D. F. MacDonald and T. W. Vaughan; 1911. *Balanus* (*Hesperibalanus?*), species. *Callianassa lacunosa* Rathbun.

*Station 6010*.—Panama Canal Zone. Near Panama Canal Station "1910," north of Pedro Miguel locks. From dark clay. Culebra formation (lower part). Oligocene series. Collectors, D. F. MacDonald and T. W. Vaughan; 1911. *Mursia obscura* Rathbun.

*Specimens in Museum, Academy of Natural Sciences, Philadelphia*.—Panama Canal Zone. Las Cascadas section, Gaillard Cut. Lignitic layers about 65 feet below the base of *Pecten* bed at Tower N. Culebra formation (central part). Oligocene series. Collector, Prof. William B. Scott; 1911. *Callianassa scotti* Brown and Pilsbry. *Callianassa spinulosa* Rathbun. *Callianassa quadrata* Rathbun.

<sup>1</sup> The station numbers refer to the station book of Cenozoic Invertebrate fossils of the United States National Museum.



*Station 6019b.*—Panama Canal Zone. Las Cascadas section, Gaillard Cut. Four feet of dark, stratified tuff and clay immediately overlying the lower limestone bed. Culebra formation (upper part). Oligocene series. Collectors, D. F. MacDonald and T. W. Vaughan; 1911. *Callianassa scotti* Brown and Pilsbry. *Callinectes*, species, *Panopeus*, species.

*Specimen in Museum, Academy of Natural Sciences, Philadelphia.*—Costa Rica. Probably Culebra formation. Oligocene series; labeled "Miocene." Collector, W. M. Gabb. *Callianassa scotti* Brown and Pilsbry.

*Station 6019c.*—Panama Canal Zone. Las Cascadas section, Gaillard Cut. Lower part of lime-cemented soft gray to olive-colored limestone, with central parting of dark clay. The first hard, limy sandstone bed above the lower limestone and just above 6019b. Culebra formation (upper part). Oligocene series. Collectors, D. F. MacDonald and T. W. Vaughan; 1911. *Callianassa vaughani* Rathbun (probably). *Callianassa* ?, species. *Hepatus*, species.

*Station 6019e.*—Panama Canal Zone. Las Cascadas section, Gaillard Cut. Third hard sandstone bed from bottom. Culebra formation (upper part). Oligocene series. Collectors, D. F. MacDonald and T. W. Vaughan; 1911. *Callianassa stridens* Rathbun.

*Station 6012c.*—Panama Canal Zone. Gaillard Cut. Top part of limy sandstone below upper conglomerate, near foot of stairs. Culebra formation (upper part). Oligocene series. Collectors, D. F. MacDonald and T. W. Vaughan; 1911. *Natantia*, family, genus, and species indeterminate. *Callianassa*, species. *Callinectes*, species. *Euryplax culebrensis* Rathbun.

*Station 6020a.*—Panama Canal Zone. Las Cascadas section, Gaillard Cut. Lowest fossiliferous bed. Third bed below lowest limestone beds separated by rows of nodules. Culebra formation (lower part of upper half). Oligocene series. Collectors, D. F. MacDonald and T. W. Vaughan; 1911. *Balanus* (*Hesperibalanus*?), sp. *Axius reticulatus* Rathbun. *Callianassa ovalis* Rathbun. *Callianassa elongata* Rathbun. *Callianassa crassimana* Rathbun. *Callianassa spinulosa* Rathbun. *Callianassa quadrata* Rathbun. *Callianassa abbreviata* Rathbun. *Callianassa magna* Rathbun. *Goniochele* ? *armata* Rathbun. *Calappella quadrispina* Rathbun. *Callinectes reticulatus* Rathbun. *Thaumastoplax prima* Rathbun. *Brachyrhyncha*, family, genus, and two species indeterminate.

*Station 6025.*—Panama Canal Zone. About 200 yards south of southern end of switch at Bohio Ridge station, relocated line Panama Railroad. Foraminiferal marl and coarse sandstone. Culebra formation (upper part). Oligocene series. Collectors, D. F. MacDonald and T. W. Vaughan; 1911. *Carpilius*, species.



*Station 6019g.*—Panama Canal Zone. Las Cascadas section, Gailard Cut. Fifth or topmost limestone. Emperador limestone. Oligocene series. Collectors, D. F. MacDonald and T. W. Vaughan; 1911. *Macrobrachium*, species. *Callianassa tenuis* Rathbun. *Mursia macdonaldi* Rathbun. *Parthenope panamensis* Rathbun.

*Station 6003.*—Panama Canal Zone. Gatun section A, bed A (bottom of section). Gatun formation (lower part). Miocene series. Collector, D. F. MacDonald. *Callianassa crassa* Rathbun.

*Station 6029a.*—Panama Canal Zone. One-fourth to one-half mile beyond Camp Cotton toward Monte Lirio. From lowest horizon in big cut. Gatun formation (lower part). Miocene series. Collectors, D. F. MacDonald and T. W. Vaughan; 1911. *Callianassa vaughani* Rathbun.

*Station 6033b.*—Panama Canal Zone. Gatun section. Upper part of lowest bed. Gatun formation. Miocene series. Collectors, D. F. MacDonald and T. W. Vaughan; 1911. *Lepas injudicata* Pilsbry. ? *Gatunia proavita* Rathbun.

*Station 6030.*—Panama Canal Zone. One and one-half to 2 miles beyond Camp Cotton toward Monte Lirio. From 85-foot cut on north side of big swamp on relocated line, P. R. R. Gatun formation. Miocene series. Collectors, D. F. MacDonald and T. W. Vaughan; 1911. *Balanus concavus rariseptatus* Pilsbry. *Callianassa vaughani* Rathbun *Gatunia proavita* Rathbun.

*Station 5900.*—Panama Canal Zone. Gatun Locks. Gatun formation. Miocene series. Collector, D. F. MacDonald; May, 1911. *Gatunia proavita* Rathbun.

*Catalogue No. 113706, U.S.N.M.*—Panama Canal Zone. Near Gatun. Gatun formation(?). Miocene series. Labeled "Miocene." Collector, Rev. J. Rowell. *Gatunia proavita* Rathbun.

*Station 5659.*—Panama Canal Zone. Near Gatun Dam. Gatun formation. Miocene series. Collector, one of the workmen; shipped by D. F. MacDonald; 1911. *Gatunia proavita* Rathbun.

*Catalogue No. 135218, U.S.N.M.*—Panama Canal Zone. Gatun beds. Gatun formation. Miocene series. Collector, R. T. Hill. *Callianassa hilli* Rathbun.

*Catalogue No. 135219, U.S.N.M.*—Panama Canal Zone. Gatun beds. Gatun formation. Miocene series. Collector, R. T. Hill. *Mursilia ecristata* Rathbun.

*Station 5882k.*—Costa Rica. Banana River; tenth fossiliferous zone below the uppermost one of the section. Probably equivalent to Gatun formation. Miocene series. Collector, D. F. MacDonald; 1911. *Euphyllax fortis* Rathbun.

*Station 5882j.*—Costa Rica. Banana River; ninth fossiliferous zone below the uppermost one of the section. Probably equivalent to Gatun formation. Miocene series. Collector, D. F. MacDonald; 1911. *Euphyllax callinectias* Rathbun.



*Station 5882i.*—Costa Rica. Banana River; eighth fossiliferous zone below the uppermost one of the section. Probably equivalent to Gatun formation. Miocene series. Collector, D. F. MacDonald; 1911. *Callinectes declivis* Rathbun.

*Station 5882h.*—Costa Rica. Banana River; seventh fossiliferous zone below the uppermost one of the section. Probably equivalent to Gatun formation. Miocene series. Collector, D. F. MacDonald; 1911. *Leucosilia bananensis* Rathbun.

*Station 5882g.*—Costa Rica. Banana River; sixth fossiliferous zone below the uppermost one of the section. Probably equivalent to Gatun formation. Miocene series. Collector, D. F. MacDonald; 1911. *Leucosilia bananensis* Rathbun.

*Station 5882f.*—Costa Rica. Banana River; fifth fossiliferous zone below the uppermost one of the section. Probably equivalent to Gatun formation. Miocene series. Collector, D. F. MacDonald; 1911. *Leucosilia bananensis* Rathbun.

*Catalogue No. 324287, U.S.N.M.*—Costa Rica. Moin Hill, near Limon. Probably equivalent to Gatun formation. Miocene series. Collector, H. Pittier. *Callianassa moinensis* Rathbun.

*Station 5884d.*—Costa Rica. Moin Hill; third fossiliferous zone below the uppermost; just above level of the rails in railway cut. Probably equivalent to Gatun formation. Miocene series. Collector, D. F. MacDonald; 1911. *Callianassa moinensis* Rathbun.

*Station 5906a.*—Panama Canal Zone. Chagres River, 50 to 75 feet below those of (17c) "5905" in lighter colored limestone according to incomplete evidence. Pliocene series. Collector, D. F. MacDonald; May, 1911. *Balanus glyptopoma* Pilsbry.

*Station 5903.*—Panama Canal Zone. From across Chagres River and probably 220 to 225 feet above level of river, top of hill opposite Alhajuela. Gray tufaceous limestone. Pliocene series. Collector, D. F. MacDonald; May, 1911. *Balanus glyptopoma* Pilsbry.

*Station 4269.*—Costa Rica. City of Port Limon. Port Limon formation. Pliocene series. Collector, Dr. L. A. Wailes. *Pachycheles latus* Rathbun. *Petrolisthes avitus* Rathbun. *Calappa costaricana* Rathbun. *Heteractaea lunata* (Milne Edwards and Lucas). *Cardisoma guanhumii* Latreille.

*Station 5886.*—Mexico. From the Sayula District of Chiapas. On the Arroyo Chapapoapam. Pliocene series. Collectors, Dr. C. W. Hayes and others, 1911. *Balanus glyptopoma* Pilsbry.

*Station 6038.*—Panama Canal Zone. From black mud from lower end of Gatun Locks. Pleistocene series. Collector, D. F. MacDonald; 1911. *Balanus eburneus* Gould.



*Station 5867.*—Panama Canal Zone. From dark mud formation, about 10 feet above present sea level, near lower end of Gatun Locks. Pleistocene series. Collector, D. F. MacDonald; April, 1911. *Balanus eburneus* Gould.

*Station 5868.*—Panama Canal Zone. From Mount Hope. Swamp ditch. Black mud formation. Pleistocene series. Collector, D. F. MacDonald; April, 1911. *Balanus eburneus* Gould.

*Station 5850.*—Panama Canal Zone. Near Mount Hope in ditch through swampy ground. About one-fourth mile from present sea beach and about 6 to 8 feet above high tide. Pleistocene series. Collector, D. F. MacDonald; April, 1911. *Macrobrachium?*, species. *Nephrops costatus* Rathbun. *Nephrops*, species. *Axius?*, species. *Hepatus chiliensis* Milne Edwards. *Calappa flammea* (Herbst). *Leucosilia jurinei* (Saussure). Leucosiidae, genus and species indeterminate. *Arenaeus*, species. *Panopeus antepurpureus* Rathbun. *Panopeus tridentatus* Rathbun. *Eurytium crenulatum* Rathbun. *Uca macrodactylus* (Milne Edwards and Lucas). *Parthenope pleistocenica* Rathbun.

In the following table the Cirripedia (see pp. 185–188) are included with the Decapoda. The letter “n” after a name in the first column indicates a new species or a new genus. The numerical headings refer to the same stations as in the above list but are arranged serially instead of chronologically.











## DESCRIPTIONS OF SPECIES.

## Subclass MALACOSTRACA.

## Order DECAPODA.

## Suborder NATANTIA.

Family, genus, and species indeterminate.

Plate 57, fig. 1.

*Locality.*—Panama Canal Zone. Top part of limy sandstone below upper conglomerate, near foot of stairs, Gaillard Cut. Upper part of Culebra formation. Oligocene series. D. F. MacDonald and T. W. Vaughan, collectors. 1911. Station 6012c. Cat. No. 324267, U.S.N.M.

*Material.*—One specimen showing three segments from the pleon of a shrimp. Pleon compressed laterally. Each of the two overlapping segments has the posterior angle produced backward in a rounded lobe of moderate size.

## Family PALAEMONIDAE.

## MACROBRACHIUM, species.

Plate 57, figs. 4 and 5.

*Locality.*—Panama Canal Zone. Las Cascadas section, Gaillard Cut. From fifth or topmost limestone. Emperador limestone. Oligocene series. D. F. MacDonald and T. W. Vaughan, collectors, 1911. Station 6019g. Cat. No. 324256, U.S.N.M.

*Material.*—One propodus of left cheliped, minus finger. Slightly compressed, subcylindrical. Some of the outer crust is lacking, but in general, the segment widens rapidly for the proximal two-fifths, then widens gradually at the middle, but not at all in the distal two-fifths. There is no shallow sinus in the lower margin behind the finger, as in *M. jamaicense*,<sup>1</sup> *M. acanthurus panamense*<sup>2</sup> and others; neither is the palm like that of *M. mexicanum*,<sup>3</sup> which is not at all convex below, and has subparallel margins.

The specimen resembles *Macrobrachium* more than it does any marine genus now existing in Panamian waters.

<sup>1</sup> *Cancer (Astacus) jamaicensis* Herbst, Natur. Krabben u. Krebse, vol. 2, 1792, p. 57, pl. 27, fig. 2.

<sup>2</sup> Rathbun, in Smithson. Misc. Coll., vol. 59, No. 13, 1912, p. 1.

<sup>3</sup> *Palaemon mexicanus* Saussure, Mém. Soc. Phys. Hist. Nat. Genève, vol. 14, 1858, p. 468 [52], pl. 4, figs. 27, 27a.



*Measurements.*—Length of palm, 13 mm.; width, 4.3 mm.; thickness, 3.7 mm.

MACROBRACHIUM?, species.

Plate 57, fig. 9.

*Locality.*—Panama Canal Zone. From near Mount Hope in ditch through swampy ground. About one-quarter mile from present sea beach, 6 to 8 feet above high tide. Pleistocene series. D. F. MacDonald, collector. April, 1911. Station 5850. Cat. No. 324248, U.S.N.M.

*Material.*—One segment (perhaps the carpus) of the second or large pair of chelipeds, probably the left one. Subcylindrical, enlarging gradually to the distal end, slightly curved, a longitudinal row of 5 low conical spines irregularly spaced.

*Measurements.*—Length, 9.5 mm.; diameter, 1.7 mm.

Suborder REPTANTIA.

Tribe ASTACURA.

Family HOMARIDAE.

NEPHROPS COSTATUS, new species.

Plate 57, figs. 13–17.

*Type-locality.*—Panama Canal Zone. From near Mount Hope in ditch through swampy ground. About one-quarter mile from present sea beach, 6 to 8 feet above high tide. Pleistocene series. D. F. MacDonald, collector. April, 1911. Station 5850.

*Types.*—Cat. No. 324246, U.S.N.M.

*Material.*—Three dactyli of left cheliped, one of which is fairly complete and is taken as the holotype; the other specimens show only the distal half or two-thirds. A fourth specimen (distal half only) represents a fixed finger perhaps and if so belongs on the left side.

*Holotype.*—Length 9.5 mm. In dorsal view the inner or right margin is sinuous, the tip curved strongly inward; viewed from the inside, both edges are sinuous, curving downward toward the tip. Upper and lower surfaces a little flattened. Five longitudinal costae, 2 dorsal, 2 ventral, 1 inner; each costa marked by a line of fine granules, with a row of punctae adjacent. On the proximal half



there is some intercostal granulation. Prehensile edge armed with fine teeth and divided into 3 sinuses separated by 2 large teeth; the distal of these has its distal edge normal and its proximal edge oblique to the margin of the dactylus; the top of the other large tooth is broken off; the terminal bay has a somewhat enlarged, but still small, tooth at its middle.

*Paratypes*.—(a) Distal half of dactylus, but with small tip lacking, same width as holotype; terminal sinus same length but more curved, so that the distal border of the boundary tooth is shorter; middle sinus half as long, nondentate, next boundary tooth broader than in holotype.

(b) Dactylus with proximal end lacking, same width as holotype, costae more rounded, terminal sinus a little shorter, boundary tooth with end missing, enlarged middle tooth better developed than in holotype, pointing obliquely distad; middle sinus longer, boundary tooth broken.

(c) Propodal (?) finger broader than the others, showing one sinus nearly equal to 2 sinuses of the holotype and limited by a large tooth with nearly equal sides.

I have placed this species in *Nephrops* on account of the ribbed fingers irregularly toothed. The variations in the dactyl may represent either individual or sexual variation.

#### NEPHROPS, species.

Plate 57, figs. 25 and 26.

*Locality*.—Panama Canal Zone. From near Mount Hope in ditch through swampy ground. About one-quarter mile from present sea beach, 6 to 8 feet above high tide. Pleistocene series. D. F. MacDonald, collector. April, 1911. Station 5850. Cat. No. 324249, U.S.N.M.

*Material*.—Dactylus of right cheliped, 12 mm. long; distal half moderately curved toward the propodal finger, but the whole finger strongly curved downward; 6 strong, longitudinal costae, 3 dorsal, 1 marginal, 2 ventral; about 9 lines of punctae; the prehensile teeth, 36 in all, are larger and more projecting in that two-fifths of the margin just posterior to the middle.

After the above description was written the proximal half of the specimen was accidentally crushed and destroyed.

Although the dactylus is much more curved than in any species of *Nephrops*, yet its ornamentation is so similar to that of the preceding species, *N. costatus*, that it is referred to the same genus.



## Tribe ANOMURA.

## Superfamily GALATHEIDEA.

## Family PORCELLANIDAE.

*PACHYCHELES LATUS*, new species.

Plate 57, figs. 21-23.

*Type-locality*.—Costa Rica; Port Limon. Pliocene series. Dr. L. A. Wailes, collector. Station 4269. Holotype, left manus with propodal finger; inner proximal corner of manus broken off. Paratype, left manus, with both fingers; proximal portion of manus broken off.

*Type*.—Cat. No. 324264, U.S.N.M.

*Measurements*.—Width of palm, 4.6 mm.; length of same to sinus, 5.1 mm.; length to end of finger, 6.7 mm.; greatest thickness, 2.3 mm.

*Holotype*.—Outer and inner margins thick and strongly curved in dorsal view; upper surface covered with granules crowded together and of varying size; the granules are continued on the outer surface and a little way on the under surface; they are then replaced by squamiform granules and short rugae which are continued over the inner surface. There are no marginal lines indicated. At the distal end, the width from the articulating condyle to the inner angle is nearly as great as to the outer margin. The fixed finger is short and stout, width subequal to length; a bit of the tip is, however, missing; a low tooth occupies the greater part of the basal half of the prehensile edge.

*Paratype*.—Smaller than the holotype and much worn so that the granulation is not well marked. Tooth at base of immovable finger minute. Movable finger very short and broad, granulate, with a basal prehensile tooth, its surface granulate.

In general shape and granulation, this form resembles the manus of the Recent *P. grossimanus* (Guérin) from Peru and Chile, but in the latter the outer margin is paved with larger granules forming a definite edge, and the propodal finger is longer and more curved.

*PETROLISTHES AVITUS*, new species.

Plate 57, figs. 18-20.

*Type-locality*.—Costa Rica; Port Limon. Pliocene series. Dr. L. A. Wailes, collector. Station 4269.

*Type*.—Cat. No. 324266, U.S.N.M.

*Holotype*.—Palm of left cheliped, showing the greater part of the upper and lower surfaces including the inner margin and the distal



articulating edge of the lower surface. Outer edge, proximal end, and finger missing. Upper surface covered with coarse granulated striae of very different lengths, varying from 1 to 10 or 12 granules, and arranged obliquely longitudinally. Lower surface covered with curved, wavy and punctate striae starting almost at right angles with the inner margin, curving slightly forward and then abruptly backward; so that the greater part is more longitudinal than transverse; the striae are somewhat subdivided and followed outwardly by shorter striae; at the inner end they terminate abruptly, so that from above they have the appearance of 13 truncated shallow teeth. Length 5.2 mm.

This manus resembles that of two common recent species, *P. armatus* (Gibbes)<sup>1</sup>, and *P. galathinus* (Bosc)<sup>2</sup>, both found on the Atlantic as well as on the Pacific side of the continent. The upper surface of the palm is similar in *P. armatus*, that is, it is ornamented with short, irregular striae, which are, however, parallel to the inner margin, while in the fossil form they diverge proximally from the margin. The lower surface of *P. avitus*, on the other hand, resembles more closely that of *P. galathinus*, but in the latter, the striae trend more strongly forward on leaving the inner margin, and that margin itself is not formed of such strongly marked teeth.

## Superfamily THALASSINIDEA.

### Family AXIIDAE.

#### AXIUS RETICULATUS, new species.

Plate 57, figs. 2 and 3.

*Type-locality*.—Panama Canal Zone. Las Cascadas section, Gailard Cut. From lowest fossiliferous bed. Third bed below lowest limestone beds separated by rows of nodules. Lower part of upper half of Culebra formation. Oligocene series. D. F. MacDonald and T. W. Vaughan, collectors. 1911. Station 6020a.

*Holotype*.—Cat. No. 324260, U.S.N.M. Left propodus of first pereopod, embedded in a nodule and showing the finger and the greater part of the palm, except the proximal end and the distal upper corner. An impression of the same is shown in another piece of the nodule. The segment as uncovered is 14.3 mm. long, greatest height 5 mm., length of finger 7 mm. The palm is greatly swollen and at the top rounds over into a broad upper surface about 2.4 mm. in width. The shell is considerably cracked and in life may not have been as thick as it appears. The lower margin is sinuous, forming a bay at about the distal third of the palm; so far as the edge is preserved it is formed of small bead granules. The outer and upper surface is ornamented with granules irregular in size and disposi-

<sup>1</sup> *Porcellana armata* Gibbes, Proc. Amer. Assoc. Adv. Sci., vol. 3, 1850, p. 190.

<sup>2</sup> *Porcellana galathina* Bosc, Hist. Nat. Crust., vol. 1, 1802, p. 233, pl. 6, fig. 2.



tion, larger and thicker on the distal part midway between upper and lower margins, elsewhere smaller and to a large extent forming a reticulate pattern; proximally on the upper part of the outer surface the raised reticulate lines are smooth, or non-granulate.

The outer surface of the finger is rather regularly tapering, the lower margin directed slightly upward, the superior margin nearly straight; surface smooth; finger thick, the upper surface oblique or beveled; traces of fine teeth are visible on the prehensile edge.

AXIUS?, species.

Plate 57, fig. 10.

*Locality*.—Panama Canal Zone. From near Mount Hope, in ditch through swampy ground. About one-quarter mile from present sea beach, 6 to 8 feet above high tide. Pleistocene series. D. F. MacDonald, collector. April, 1911. Station 5850. Cat. No. 324250, U.S.N.M.

*Material*.—A single movable spine, 6.7 mm. long, with the tip broken off, resembles the styloid scaphocerite or movable acicle of the outer antenna of some species of *Axius*. The spine is somewhat 3-angled, the most acute edge being dorsal, the two blunt edges being nearer together and ventral. There are a few punctae: 4 large ones in a row on the ventral surface; 2 large, external, far apart, just below the upper margin; 4 small ones, internal, 3 of which form a triangle near the middle, while the other is nearer the distal end.

### Family CALLIANASSIDAE.

#### KEY TO THE SPECIES OF CALLIANASSA HERE DESCRIBED.

The material is insufficient to distinguish between the larger and the smaller chela of the same pair, which also may vary in shape and size in the two sexes.

A<sup>1</sup>. Manus and carpus meeting in an oblique line.

B<sup>1</sup>. Lower margin of manus serrated.....*ovalis*, p. 137

B<sup>2</sup>. Lower margin of manus smooth.....*lacunosa*, p. 138

A<sup>2</sup>. Manus and carpus meeting in a vertical line.

B<sup>1</sup>. Lower margin of manus directed forward and upward, at least in part.

C<sup>1</sup>. Palmar portion of manus distinctly longer than high.

D<sup>1</sup>. Palm compressed.

E<sup>1</sup>. Palm elongate; margins strongly convergent.....*elongata*, p. 139

E<sup>2</sup>. Palm less elongate; margins moderately convergent.....*scotti*, p. 140

D<sup>2</sup>. Palm swollen.....*moinensis*, p. 142

C<sup>2</sup>. Palmar portion of manus about as long as high, or shorter. Upper margin of manus directed forward and downward toward the lower margin.

D<sup>1</sup>. Immobile finger very thin, a cross-section near its base being more than twice as long as wide. A strong tooth in the sinus between the fingers or on the base of the immobile finger.....*spinulosa*, p. 143

D<sup>2</sup>. Immobile finger thicker, a cross section near its base being less than twice as long as wide. A tooth in the sinus between the fingers but near the base of the dactylus.....*tenuis*, p. 144



A<sup>2</sup>. Manus and carpus meeting in a vertical line—Continued.

B<sup>2</sup>. Lower margin of manus directed straight forward or nearly so; that is, at right angles to its proximal margin.

C<sup>1</sup>. Upper margin of manus subparallel to lower margin. No tooth in sinus between fingers. Carpus much higher than long.

D<sup>1</sup>. Lower margin serrulate.....*quadrata*, p. 145

D<sup>2</sup>. Lower margin granulate.....*toulai*, p. 146

C<sup>2</sup>. Upper margin of manus directed forward and downward toward lower margin.

D<sup>1</sup>. A large tooth in sinus between fingers and situated on base of immovable finger.....*abbreviata*, p. 147

D<sup>2</sup>. A small tooth in sinus between fingers, and situated near movable finger. Carpus very little, if at all, higher than long...*hilli*, p. 148

D<sup>3</sup>. No tooth in sinus between fingers. Fingers long and strong.  
*vaughani*, p. 148

B<sup>3</sup>. Lower margin of manus unknown. A stridulating ridge near the horizontal upper margin.....*stridens*, p. 151

A<sup>3</sup>. Meeting of manus and carpus unknown.

B<sup>1</sup>. Immobile finger slender. Distal articulating edge of manus crenulate and very oblique.....*crassimana*, p. 141

B<sup>2</sup>. Only the dactylus known.

C<sup>1</sup>. Dactylus of large size. Cross section at base subcylindrical. Prehensile edge thin.....*magna*, p. 151

C<sup>2</sup>. Dactylus half as long as preceding, more compressed. Prehensile edge thicker.....*crassa*, p. 152

The 2 *Callianassas* to which specific names are not given are excluded from the above key.

#### CALLIANASSA OVALIS, new species.

Plate 59, figs. 1-4.

*Type-locality*.—Panama Canal Zone. Las Cascadas section, Gaillard Cut. From lowest fossiliferous bed, third bed below lowest limestone beds separated by rows of nodules. Lower part of upper half of Culebra formation. Oligocene series. D. F. MacDonald and T. W. Vaughan, collectors. 1911. Station 6020a. Holotype and one paratype. Cat. No. 324269, U.S.N.M.

*Holotype*.—A left chela with wrist and arm attached, and enclosed in a nodule which is split in two. The specimen had been crushed, and the half nodule containing the impression shows also small pieces of the cheliped itself. Wrist and manus together oblong-oval; line between them oblique; upper and lower margins of manus slightly convex; greatest width about equal to the upper length; from the widest point, the lower margin of the propodus slants upward. Fingers directed straight forward and of subequal length. Immobile finger an isosceles triangle, the base of which is two-thirds as long as either side; end blunt; cutting edge with a shallow triangular tooth at the proximal two-fifths. Movable finger sub-oblong, end broad, cutting edge with a broad, shallow, rounded tooth



near the base. The merus appears to be about twice as long as high and is dilated at the middle.

*Measurements.*—Length of carpus and propodus, measured from lowest point of articulation with merus to end of propodal finger, 20.5 mm.; proximal width of propodus (approx.), 9.4 mm.; greatest width of same, 10 mm.; distal width of same, 8.7 mm.; superior length of same, 10.2 mm.; inferior length of same, 13.2 mm.; length of propodal finger measured on cutting edge, 5.7 mm.; length of dactylus, 5.7 mm.

*Paratype.*—(a) Left manus with part of the fixed finger, embedded in a nodule and exposing the outer surface. Larger than holotype. The lower margin of the manus has blunt serrations resembling the stumps of spines; above the margin is a row of five distant punctae; at the distal end there are two rows of granules leading toward the upper part of the fixed finger.

*Paratype.*—(b) Carpus of left cheliped embedded in a nodule and imprint of same, showing the distal and upper margins and a large part of the outer surface. The distal margin is oblique and concave and has a little rounded lobe at each end; the upper margin is arcuate and has a submarginal groove.

CALLIANASSA LACUNOSA, new species.

Plate 59, figs. 6–11.

*Type-locality.*—One-quarter mile south of Empire Bridge, Canal Zone, Panama; from lower dark clay beneath lower conglomerate. Lower part of Culebra formation. Oligocene series. D. F. MacDonald and T. W. Vaughan, collectors. 1911. Station 6012a. Two specimens, each a left propodus of the first cheliped. Cat. No. 324278, U.S.N.M.

*Holotype.*—The palmar portion of a propodus, the fixed finger broken off near its base; the propodus is incomplete near the dactylus and also at the proximal end; this end is, however, fairly complete on the inner surface, so that the measurements may be stated with approximate accuracy. Length, at the level of the sinus between the fingers, 16 mm.; greatest height, 15.6 mm.; least height, 15.2 mm.; thickness, 6.6 mm. The upper margin is a little arched, the lower nearly straight; they converge a little distally; they are very thin; the top of this thin edge along the upper margin is set with oblong tubercles, dorsal in position; the lower edge is smooth. The outer surface has a row of 6 pits a little above the edge and fairly evenly spaced; they have a raised edge and are distally inclined, indicating that they were sockets for hairs or bristles; 3 similar pits far apart are close up under the upper margin; of the few scattered pits, 3 form a triangle at the distal end, the one near the base of the fixed



finger being the largest; there is also a medium-sized pit a little below the middle, while 3 small ones are visible near the proximal end. A prominent blunt ridge runs from near the top of the fixed finger obliquely backward and upward for a short distance on the palm; near this ridge, but chiefly above it, and partly behind it, there is a patch of low tubercles, mostly oblong but very irregular in shape and size. On the inner surface there is a row of 8 sockets a little distance below the thin, upper, marginal rim; these sockets, while of good size, have very narrow, perpendicular openings. Above the lower margin there is a row of 12 sockets; this row distally approaches close to the edge, while the sockets themselves become larger and farther apart; they are very oblique to the margin and are almost more distal than lateral in their inclination. These 2 rows of sockets on the inner surface are more prominent than any others; below the middle there are 10 or 12 scattered sockets mostly small; near the middle there is a patch of tubercles, somewhat masked by a thin layer of adhering matrix. On the inner surface there is a blunt ridge leading back from the finger similarly placed to that on the outer surface, but lower and wider. The finger is slender, judging from the section at its base.

*Paratype*.—This propodus shows the outline of the proximal end, but the distal end is broken off and not a vestige of the finger remains. The size is less than in the holotype: length, at the level of the sinus between the fingers, 10.3 mm.; greatest height, 11.4 mm.; least height, 10 mm.; thickness, 5.2 mm. The margins are more convergent than in the holotype and the palm is relatively shorter. The upper as well as the lower edge is almost smooth. On the outer surface the sockets in the upper submarginal row are 4, as there is an additional one visible at the proximal end; the sockets of the lower row are fewer and more distant than in the larger specimen, as only 5 can be detected; of the scattered sockets, 3 form a distal triangle, while 10 or 12 small ones are disposed transversely near the proximal end; the protuberances above the oblique ridge leading from the fixed finger consist of a few small granules. On the inner surface, a row of 8 submarginal sockets above, as in the holotype; near the lower margin only 10 sockets can be counted, because the distal corner is broken away; scattered sockets 16 or 18, below the middle; a few granules close to the sinus between the digits.

**CALLIANASSA ELONGATA, new species.**

Plate 60, figs. 4-6.

*Type-locality*.—Panama Canal Zone. Las Cascadas section, Gaillard Cut. From lowest fossiliferous bed, third bed below lowest limestone beds separated by rows of nodules. Lower part of upper



half of Culebra formation. Oligocene series. D. F. MacDonald and T. W. Vaughan, collectors. 1911. Station 6020a.

*Holotype*.—Cat. No. 324271, U.S.N.M. A left manus, with base of immovable finger attached; this shows all of the outer surface, except the margin bordering the dactylus; nearly the whole of the inner surface is concealed by the matrix. The upper margin is nearly straight throughout its length, and is bluntly angled; lower margin very sinuous, the manus being very much deeper in its proximal than its distal half, edge serrulate or spinulose throughout its length; proximal edge vertical, nearly as long as upper margin. On the outer surface there is a group of granules at the distal two-sevenths and just below the middle; there is a curved row of granules near the sinus, which is continued upon the propodal finger near its upper edge; 6 granules in all are visible. Finger very slender, inclined downward. The dactylus must have been very stout, and the adjacent edge of the manus very oblique, but it is now incomplete.

*Measurements*.—Superior length of manus (approx.), 15.7 mm.; length to sinus, 20.4 mm.; greatest height, 16.2 mm.; proximal height (approx.), 15.1 mm.; distal height, 12.4 mm.

CALLIANASSA SCOTTI Brown and Pilsbry.

Plate 60, figs. 9–12.

*Callianassa scotti* BROWN and PILSBRY (part), Proc. Acad. Nat. Sci. Phila., vol. 64, 1913, p. 503, pl. 22, figs. 1 and 3 (not fig. 2).

*Locality*.—Panama Canal Zone. From the 4 feet of dark stratified tuff and clay immediately overlying the lower limestone bed. Las Cascadas section. Upper part of Culebra formation. Oligocene series. D. F. MacDonald and T. W. Vaughan, collectors. 1911. Station 6019b. Cat. No. 324279, U.S.N.M.

*Material*.—A left manus, removed from the matrix, and incomplete at the proximal end. Outer surface very convex from upper to lower margin; upper margin straight, with a blunt marginal line; lower edge acute and serrulate with fine appressed teeth or spines, inclined upward toward the base of the finger, then downward; three granules or tubercles in a curved row just outside the edge of the sinus between the fingers. The cross section of the finger near its base is very small, in relation to the manus. Inner surface slightly convex, from upper to lower edge, and with a depression on either side of the base of the fixed finger; numerous granules near the distal end, some arranged in a curved band between the two fingers.

*Measurements*.—Greatest height of manus, 25.2 mm.; least height of same, 23.3 mm.; length of same to digital sinus, 24.6 mm.; thickness



of same, 10.9 mm.; greatest diameter of fixed finger near its base, 6.5 mm.; least diameter of same, 4.2 mm.

*Holotype and paratypes.*—In the material included by Mr. Brown and Dr. Pilsbry under *C. scotti* are specimens of three species; two of these species were figured with the original description; the larger species illustrated<sup>1</sup> by figures 1 and 3, plate 22, is chosen to bear the name *scotti*, and the original of figure 1 may be designated as the type-specimen, as it is free from the matrix and shows more of the characteristic granulation than does the original of figure 3, which is furnished with a propodal finger, but is half embedded in a matrix. It also shows, although roughly, a row of 5 pits on the upper margin; this row, however, slopes downward a little distally on to the inner surface. The greatest height of the type is 27 mm., length at level of sinus between fingers, 28 mm.

Still a third specimen, also a left manus, was taken at the same place; the surface is much worn, but the proximal angles are well defined. The type-locality is in the lignitic layers, about 65 feet below the base of the *Pecten* bed at Tower N., Las Cascadas section, Gailard Cut; Prof. W. B. Scott, collector, 1911. Type, Cat. No. 2259, Mus. Acad. Nat. Sci., Philadelphia.

The hand mentioned by Brown and Pilsbry,<sup>2</sup> as collected by W. M. Gabb in Costa Rica, apparently belongs to *C. scotti*. It shows well the upper marginal row of pits, numbering 7, which drops distally on to the inner surface. The specimen is labeled "Miocene." Cat. No. 2255, Mus. Acad. Nat. Sci., Philadelphia.

CALLIANASSA CRASSIMANA, new species.

Plate 61, figs. 15-17.

*Type-locality.*—Panama Canal Zone. Las Cascadas section, Gailard Cut. From lowest fossiliferous bed, third bed below lowest limestone beds separated by rows of nodules. Lower part of upper half of Culebra formation. Oligocene series. D. F. MacDonald and T. W. Vaughan, collectors. 1911. Station 6020a.

*Measurements.*—Distal height of palm, 22 mm.; thickness of palm, at least 7.7 mm.; length of crenulated lobe bordering dactylus, 10.2 mm.; upper length of dactylus (tip broken off), 18 mm.; greater diameter at the break near the tip, 1.7 mm.; lesser diameter at same point, 1.3 mm.; greater diameter at a break about middle of finger, 3.8 mm.; lesser diameter at same point, 2.8 mm.

*Holotype.*—Cat. No. 324273, U.S.N.M. A portion of the distal end of the left manus with the propodal finger attached; embedded in a nodule. This must have been a very large specimen. The oblique

<sup>1</sup> Proc. Acad. Nat. Sic., Phila., vol. 64, 1913, p. 503

<sup>2</sup> Idem, p. 504.



margin of the lobe of the manus which overlapped the dactylus is very oblique and is straight and deeply crenulated with about 16 crenules; the length of the lobe is as great as the distance across the adjoining sinus and the propodal finger. This sinus is very deep and proximally subtruncate. The immovable finger is very narrow in relation to the size of the palm; it is slightly compressed, and bends upward; on the inner surface just within the lower margin there is a row of punctae; on the outer face there are 3 larger spots, 2 near the lower margin and one near the sinus, which may be sockets for setae. A tubercle on the outer surface just behind the sinus. The inner surface of the manus is deeply channeled out near the sinus between the fingers.

The holotype is in two pieces, as the immovable finger is broken in two, the distal portion embedded in that half of the nodule which bears the imprint of the remainder of the holotype.

This species is very near *C. scotti*, but has a larger sinus between the fingers, a longer propodal finger, and a shallower sinus in the lower margin of the manus just behind the finger.

CALLIANASSA MOINENSIS, new species.

Plate 60, figs. 1-3.

*Type-locality*.—Moin Hill, near Limon, Costa Rica. Probably equivalent to Gatun formation. Miocene series. H. Pittier, collector. Propodus of right cheliped, and an impression of half a finger.

*Measurements*.—Length (approx.) of manus, to sinus between fingers, 9 mm.; height of same, 7 mm.; thickness of same, 4.7 mm.; length of immovable finger (tip broken off), 8.6 mm.

*Holotype*.—Cat. No. 324287, U.S.N.M. Palm much swollen, cross section ovate, lower margin viewed from the side very arcuate, upper margin slightly so. The surface has almost entirely lost the outer white layer, but the next layer is gray and is crossed transversely by many very short rugae, which are strongest on the lowest part of the outer surface. There is a distinct line below dividing the inner from the outer surface and marked by an irregular row of very fine punctae. On the inner surface considerably below the upper margin there is a row of large punctae.

The immovable finger is slender, bent downward and curved inward. It has 7 more or less defined ridges, the bluntest of which is the most inferior; either side of the ridge representing the prehensile edge there is a granular ridge, the outer of which is less elevated; in addition, there are 2 ridges on the outer surface and one on the inner; near each ridge there is a row of fine punctae. Prehensile edge armed with small irregular teeth. There is an unusually deep furrow above the principal ridge on the inner surface.



*Paratype (a)*.—Cat. No. 324287, U.S.N.M. On a small piece of crumbling rock there is an impression of the distal half of a finger, but not the finger of the holotype. The impression has a similar curvature and 3 rows of punctae are present.

*Paratype (b)*.—Cat. No. 324288, U.S.N.M. Moin Hill, Costa Rica; third fossiliferous zone below the uppermost; just below level of rails in railway cut. Probably equivalent to Gatun formation. Oligocene period. D. F. MacDonald, 1911. Station 5884*d*. A right propodus without finger, similar in size to the holotype and corresponding in its characters.

CALLIANASSA SPINULOSA, new species.

Plate 61, figs. 6–9.

*Callianassa scotti* PILSBRY (part), Proc. Acad. Nat. Sci. Phila., vol. 64, 1913, p. 503 (not pl. 22, figs. 1–3).

*Type-locality*.—Panama Canal Zone. Las Cascadas section, Gailard Cut. From lowest fossiliferous bed, third bed below lowest limestone beds separated by rows of nodules. Lower part of upper half of Culebra formation. Oligocene series. D. F. MacDonald and T. W. Vaughan, collectors. 1911. Station 6020*a*.

*Holotype*.—Cat. No. 324272, U.S.N.M. Left propodus which was encased in a nodule; the manus has been removed except the proximal part of the outer surface; of the propodal finger only the impression remains. Length of manus less than greatest height; the upper and lower margins converge distally, the upper margin convex, the lower sinuous. Outer surface very convex in a vertical direction, having a few scattered granules, also a short vertical line of 3 granules near the upper distal corner, a row of 6 distant granules just above the lower margin, and a sharp granule near the sinus. The lower margin is very thin and serrated; between the serrations are the truncated bases of movable spines; 9 such spines remain. Upper edge bluntly margined. Inner surface convex except near the inferior and distal margins; a row of 3 granules on the middle line, 2 above the base of the propodus, 2 parallel to the lower margin, and many small granules just above that margin. An obliquely longitudinal line of pits below the upper margin.

The propodal finger is very much smaller than the dactylus and thin; a cross section near its base is somewhat diamond-shaped, the impression of the thumb (viewed sideways) is subtriangular, end curved upward; prehensile edge concave; at its base in the sinus between the fingers there is a short but strong curved tooth; on both outer and inner surfaces of the thumb, leading down from the palm, there is an oblique ridge.

*Measurements*.—Length of propodus to end of finger (approx.), 22.4 mm.; length of manus, measured on the inner side, to sinus, 14.7



mm.; greatest height (proximally), 15.3 mm.; least height (distally), 13.3 mm.

*Paratypes.*—(a) One left propodus with about half of the fixed finger attached was taken in the lignitic layers, about 65 feet below the base of the *Pecten* bed at Tower N., Las Cascadas section, Gailard Cut; central part of Culebra formation, Oligocene series; Prof. W. B. Scott, collector; 1911 (Mus. Acad. Nat. Sci. Philadelphia). The specimen is half embedded in a nodule which conceals the inner surface and the upper part of the outer surface. It is nearly as large as the type. It shows the large tooth at the proximal end of the prehensile edge of the fixed finger, the tubercle on the outer surface near the sinus between the fingers, and roughly, the ornamentation on the lower edge of the palm.

(b) From the same source, a similar left propodus half embedded in a nodule but so as to expose the inner surface and the upper edge; it shows the characteristic row of pits on the inner surface just below the upper edge, the row sloping downward distally.

(c) Also a third specimen, free from the matrix but with the edges broken; it shows the palmar ridge leading to the fixed finger and the basal tooth on the edge of the latter.

CALLIANASSA TENUIS, new species.

Plate 60, figs. 13 and 14.

*Type-locality.*—Panama Canal Zone. Las Cascadas section, Gailard Cut. From fifth or topmost limestone. Emperador limestone. Oligocene series. D. F. MacDonald and T. W. Vaughan, collectors, 1911. Station 6019g.

*Holotype.*—Cat. No. 324282, U.S.N.M. Left manus with propodal finger broken off, segment shorter than its greatest height, in general subrectangular, with upper and lower margins converging distally; outer surface very convex from top to bottom; upper and lower edges marginate, the lower one very thin; inner surface convex except near the bottom where it is flat, at the proximal end where there is a furrow parallel with the articulation, and near the distal sinus where there is a depression. The propodal finger is very much smaller than the dactylus, and its cross section is suboval with pointed ends; the sinus is about as wide as the thumb; it bears, close up to the insertion of the dactylus and on the edge of the outer surface, pointing forward, a short, broadly triangular spine. Surfaces much worn, so that it is difficult to tell whether unevennesses are natural or not.

*Measurements.*—Length of manus, measured to sinus, 11.4 mm.; greatest height, 13 mm.; distal height, 10.3 mm.; thickness, 5.3 mm.



## CALLIANASSA QUADRATA, new species.

Plate 62, figs. 4-14.

*Callianassa scotti* BROWN and PILSBRY (part), Proc. Acad. Nat. Sci. Phila., vol. 64, 1913, p. 503, pl. 22, fig. 2 (not figs. 1 and 3).

Represented by 2 specimens of the left manus from which the propodal finger has been broken off. The smaller one is used as the type, as it is the better preserved.

*Type-locality*.—Panama Canal Zone. Las Cascadas section, Gailard Cut. From lowest fossiliferous bed, third bed below lowest limestone beds separated by rows of nodules. Lower part of upper half of Culebra formation. Oligocene series. D. F. MacDonald and T. W. Vaughan, collectors. 1911. Station 6020a. Holotype and paratype. Cat. No. 324275, U.S.N.M.

*Measurements* (in mm.).—

	Holotype.	Paratype.
Height of manus near middle.....	13.3	15.3
Length of manus measured to sinus.....	12.8	15.7
Thickness of manus.....	6.2	7.5

*Holotype*.—Hand squarish, with the corners rounded off. The upper and lower margins are subparallel, the upper slightly arched, the lower with a shallow distal sinus. Distal margin, at the articulation with the dactylus, nearly vertical. Outer surface slightly convex in a longitudinal direction, strongly convex vertically, furrowed at the distal end across the middle third; inner surface moderately convex except at the distal and lower portions, where it is concave; there is a groove just above the lower margin which widens as it approaches the finger. Lower margin serrulate; upper margin bluntly angled except in the distal third, where it is rounded; just within this margin there is a row of sockets of which 3 can be made out. On the outer surface near the sinus between the fingers there is a tubercle and near the carpus 3 granules far apart in a vertical row; on the inner surface there is a row of granules, running almost longitudinally near the middle and thence downwards toward the sulcus between the fingers; 2 tubercles near the articulation with the dactylus. Propodal finger narrow, much compressed, subtriangular at the base in cross section, with the small end of the triangle down. Base of dactylus very large.

*Paratype (a)*.—Larger than the type; upper margin straighter; the tubercle on the outer surface near the sinus is of good size; on the inner surface near the middle there are numerous granules instead of the single row in the holotype; 2 tubercles near the dactylus.

*Doubtful specimen*.—A single specimen of a left carpus, from the same locality as the types may belong to the same species. The inner surface is mostly concealed by the matrix. Outer surface



very convex from the upper to the lower margin; convexity akin to that of the manus of this species, which is the reason for placing the carpus here rather than with *Callianassa elongata* or any other species occurring at the same locality. Carpus about  $1\frac{2}{3}$  times as high as its greatest width, which is in the upper part; the angle formed by the superior and the distal margins is a little less than a right angle; superior margin straight; distal angle projecting above the articulation with the manus. The inferior distal angle projects even more below the articulation; the angle is obtuse; from it the margin rounds downward and then upward in a single curve; the lowermost part is finely serrate.

*Measurements.*—Height of carpus, between distal angles, 18.3 mm.; greatest height, 18.8 mm.; greatest width, 12.8 mm.; width on upper margin, 12 mm.; greatest width below the articulation with the merus, 11.8 mm.

Four specimens before me from the collection of the Academy of Natural Sciences of Philadelphia belong to this species; they are one right and three left chelae and form part of the material referred by Brown and Pilsbry to their *C. scotti*. (Paratype *b*) One left chela is that figured on plate 22, fig. 2.<sup>1</sup> All are larger than the type material described above, but so far as their characters are preserved they agree in essentials with the type. (Paratype *c*) The right chela (the largest specimen) is about 23 mm. long by 21.2 mm. wide, and possesses a longer piece of the propodal finger than the other specimens; the exposed cross section of the finger is oval. (Paratype *d*) The shortest of the left chelae has a large part of the outer layer preserved on the infero-distal and inferior surface, where it is covered with granules, arranged without regularity except for a row on the outer surface parallel and close to the lower edge. This row is not visible in my figure 14, plate 62. The longest of the left chelae (Paratype *e*) is about 24 mm. by 19 mm., that is, considerably narrower than (*c*).

CALLIANASSA TOULAI, new species.

“ Krabbenscheren ” TOULA, Jahrb. der k. k. Geolog. Reichsanstalt, vol. 61, 1911, p. 512 [26], pl. 30 [1], fig. 14.

Founded on two chelae, one with palm 20.6 mm. long, 16.5 mm. wide, the other (without movable finger) with palm 9.4 mm. long, 5.5 mm. wide.

Outer surface of palm arched, inner surface almost flat and with a flat depression close to the lower margin and extending from the fixed finger. The upper and lower margins are sharp, the former bears 3 spinelike projections directed forward, the lowest spine ends

<sup>1</sup> Proc. Acad. Nat. Sci. Phila., vol. 64, 1913, p. 503



in a sharp margin; lower margin very finely and sharply granulate to the finger tip. Outer surface smooth and glossy, thickly covered near the lower margin with fine granules. Inner surface covered with very small, oblong punctae. A stout tooth on the prehensile margin of the immovable finger visible from the outside; another tooth on the movable finger, visible from the inside.

*Type-locality*.—Gatun. Miocene series.

CALLIANASSA ABBREVIATA, new species.

Plate 63, figs. 1-6.

*Type-locality*.—Panama Canal Zone. Las Cascadas section, Gailard Cut. From lowest fossiliferous bed; third bed below lowest limestone beds separated by rows of nodules. Lower part of upper half of Culebra formation. Oligocene series. D. F. MacDonald and T. W. Vaughan, collectors. 1911. Station 6020a. 4 specimens.

*Types*.—Cat. No. 324274, U.S.N.M.

*Measurements*.—Length of manus to sinus, 10.3 mm.; greatest height, 10 mm.; distal height, 8.4 mm.

*Holotype*.—Specimen of right manus partially embedded, showing inner surface and half of outer surface; an imprint of the inner surface of the holotype is seen on a separate piece of rock. Length and height subequal; infero-proximal angle a right angle, upper margin convex. Outer surface slightly convex from end to end, more so from top to bottom. Inner surface equally convex in both directions, with a furrow close to the proximal end; an oblique furrow near the lower edge, directed slightly upward distally, and a depression leading to the sinus between the fingers and to the adjacent part of the immovable finger; on the oblique raised line below this depression, there is a row of 4 granules. Upper and lower edges margined; the lower edge shows, in the impression, about 18 dots, but whether these are punctae or spinules on the outer surface can not be told. There is a line of 6 punctae just within the upper margin. A few scattered punctae on inner surface. An oblique cross section of the thumb is small and somewhat diamond-shaped; above this section there is a blunt tooth; sinus between the 2 fingers V-shaped. The impression shows a little more of the length of the thumb than remains in the type, but represents neither the full length nor width.

*Paratype (a)*.—Left manus, larger than the holotype, and free from the matrix; immovable finger broken off; edges worn; interdigital tooth present, and near by on the outer surface, a granule.

*Paratype (b)*.—A fragment, comprising the distal lower end of the propodus with broken finger attached; interdigital tooth present.



## CALLIANASSA HILLI, new species.

Plate 58, figs. 18-20.

*Type-locality*.—Gatun beds, Panama Canal Zone. Gatun formation. Miocene series. Robert T. Hill, collector; Station 18.

*Types*.—Cat. No. 135218, U.S.N.M.

*Measurements*.—Greatest height of carpus of right cheliped, 10.2 mm.; superior length of same, 10.3 mm.

*Material*.—3 pieces of rock from the same place contain fragments of *Callianassa* which belonged to at least 2 specimens and probably represent a single species. The largest piece contains 2 fragments, each consisting of a right merus and carpus (the better preserved of these may be considered the holotype); the imprint of a right wrist and hand; the distal half of a right propodus and a portion of the dactylus. The second piece of rock has been broken from the first and contains the continuation of the right propodus, with carpus and merus attached (paratype *a*), also the first 4 segments of the third right leg. The third piece of rock contains the sixth joint of the tail (paratype *b*). The following description is compiled from all the specimens:

The merus of the right cheliped has the outer margin prominently carinate with a smooth rounded carina; upper margin granulated. In both instances the merus is so flexed beneath the carpus that the lower margin is not visible. The carpus is about equally long and high; its upper margin is slightly convex to a point near the articulation with the merus; distal margin slightly concave, but nearly vertical; margin from the infero-distal angle to the merus strongly arcuate. Manus about as long as high, moderately convex, outer surface more so than inner; lower margin nearly straight; just above it on inner surface a row of many fine punctae from which setae may have sprung; this row is continued on the propodal finger; the latter is only partly uncovered; it is flat on the inner side, at least half as long as the manus and its lower margin is a straight line continuous with that of the manus.

The right leg of the third pair is very much like the corresponding member in *C. stimpsoni* Smith, the *Callianassa* of the Atlantic coast of the United States.

The sixth segment of abdomen or tail is subrhomboidal, with a constriction behind the middle; the segment is much wider in front than behind; the depressed portion at the anterior middle was hidden in life under the fifth segment.

## CALLIANASSA VAUGHANI, new species.

Plate 63, figs. 10-13.

*Type-locality*.—Panama Canal Zone. From 85-foot cut on north side of big swamp on relocated line, Panama Railroad; 1½ to 2 miles



beyond Camp Cotton toward Monte Lirio. Gatun formation. Miocene series. D. F. MacDonald and T. W. Vaughan, collectors. 1911. Station 6030. Holotype and 2 paratypes. Cat. No. 324285, U.S.N.M.

*Holotype*.—Portion of the right claw, comprising the distal end of the manus and both fingers; outer surface only. Height of manus at distal end equal to length of dactylus measured on the chord from the tip to the middle of its articulating edge; surface convex from upper to lower edge. Fixed finger wide in its proximal half, then abruptly narrowed; distal half directed slightly upward; length twice as great as basal width. The ends of the fingers are somewhat crushed; the movable finger curves strongly downward and appears to overreach the tip of the immovable finger, being at right angles to it; its lower edge has two teeth, one near the articulation squarish, broader than long, the other smaller, separated by a rounded sinus. At the sinus distal to this tooth is the widest interdigital gape; a little further on the fingers would meet for a ways, if they were closed, while the tips would cross each other. The greatest width of the dactylus is a little more than a third of its greatest length, measured in a straight line.

The oblique edge of the propodus which projects over the dactylus is crenulate. On the manus near the gape of the fingers there are 3 tubercles in a curve parallel with the edge. Behind the crenulation there are 2 scale-like sockets from which setae probably arose, and behind these a vertical thumb-nail impression. Near the supero-distal angle of the manus there is another socket. On the proximal half of the dactylus there are 9 sockets of larger size than those on the manus and irregularly disposed; 2 are on the larger prehensile tooth and one on the smaller.

*Paratype (a)*.—Left manus; both sides visible. A smaller specimen than the holotype. Upper and lower margins distally converging. Length a little more than greatest width. Outer surface convex in both directions, but more so from top to bottom. Surface for the most part smooth and shining. The ornamentation is like that of the type, that is, a crenulated edge on the lobe which overlaps the dactylus, a row of tubercles just behind the gape—the lower of the 3 tubercles is broken off—above this 2 sockets, and then a very short thumb-nail impression, followed by a socket near the upper angle. The upper margin is subacute in its proximal half, becoming gradually blunt toward the distal end; on either side is a row of sockets; 3 are visible on the outer surface and 5 on the inner; lower margin sharp, also with a row of sockets on either side; 5 are visible on the outer side and about 10 on the inner side in the distal half; the proximal half is broken. There are a few punctae scattered about the outer surface; while on the inner surface near the depression



leading to the gape there is a double row of granules, 8 of which can be made out. The edge overlapping the dactylus is crenulate on the inner surface.

*Paratype (b)*.—Portion of left propodus showing part of finger and a small part of the manus. Surface shining. Three tubercles near gape, and continuing the same curve along the upper part of the outer surface of the finger, there is a granule followed by 2 sockets.

*Measurements*.—(Approximate only.) *Holotype*: Distal height of manus, 19.3 mm.; length of dactylus from tip to proximal end of upper margin, 23.5 mm.; height of dactylus, measured straight up from the edge of the basal tooth, 8.6 mm.; length of immovable finger measured along the prehensile edge, 15 mm.; height of same at base, 7 mm. *Paratype (a)*: Length of manus across middle, 19.5 mm.; proximal height, 16.7 mm.; distal height, 15 mm.; greatest thickness, 6.6 mm. *Paratype (b)*: Height of immovable finger at base, 5.8 mm.

*Additional localities*.—Panama Canal Zone. Las Cascadas section. From lower part of lime-cemented soft gray to olive-colored limestone with central parting of dark clay. The first hard, limy sandstone bed above the lower limestone just above Station 6019*b*. Upper part of Culebra formation. Oligocene series. D. F. MacDonald and T. W. Vaughan, collectors. 1911. Station 6019*c*. One left propodus with most of the fixed finger attached. The specimen is so bruised and crushed that its identity can not be determined with certainty. Cat. No. 324283, U.S.N.M.

Also, from the same place, a right dactylus from a cheliped of much smaller size. Its identity is uncertain. It lacks the large teeth on the cutting edge, but it may belong to the feebler of the two chelipeds, or to a female. There is evidently a shallow sinus at the base, followed by a low broad tooth. Six sockets for setae can be made out. The thick outer crust has nearly all broken away. Cat. No. 324283, U.S.N.M.

Panama Canal Zone. From lowest horizon in big cut from  $\frac{1}{4}$  to  $\frac{1}{2}$  mile beyond Camp Cotton toward Monte Lirio. Lower part of Gatun formation. Miocene series. D. F. MacDonald and T. W. Vaughan, collectors. 1911. Station 6029*a*. Left manus, about 9.6 mm. long, measured at the level of the articulating condyle of the dactylus; edges mostly broken and obscured. Identification based (1) on the general contour of the surface, (2) the color, a light drab, (3) the margin adjacent to the articulating condyle of the dactylus, and (4) 2 sockets just below the upper margin on the inner surface. Cat. No. 324284, U.S.N.M.



## CALLIANASSA STRIDENS, new species.

Plate 61, figs. 12-14.

*Type-locality*.—Panama Canal Zone. From third hard sandstone bed from bottom. Las Cascadas section. Upper part of Culebra formation. Oligocene series. D. F. MacDonald and T. W. Vaughan, collectors. 1911. Station 6019*e*. Cat. No. 324281, U.S.N.M.

*Holotype*.—Manus of a left cheliped. Only the upper two-thirds is visible, the lower third is embedded in rock. Upper margin horizontal, distal and proximal margins vertical, supero-posterior corner rounded. Upper edge thin, a little sinuous, viewed from the top. On the inner surface a little below the upper edge there is a row of 8 short vertical ridges, which occupies the whole length of the segment. This may have been a stridulating mechanism.

*Measurements*.—Superior length of manus, 11 mm.; thickness, 3.1 mm.

## CALLIANASSA MAGNA, new species.

Plate 62, figs. 1-3.

*Type-locality*.—Panama Canal Zone. Las Cascadas section, Gailard Cut. From lowest fossiliferous bed. Third bed below lowest limestone beds separated by rows of nodules. Lower part of upper half of Culebra formation. Oligocene series. D. F. MacDonald and T. W. Vaughan, collectors. 1911. Station 6020*a*. Cat. No. 324270, U.S.N.M.

*Measurements*.—Greatest length of movable finger (tip broken off), 33 mm.; greatest height, 13.2 mm.; thickness, 0.8 mm.; length of basal sinus, 6 mm.

*Holotype*.—The only specimen is a movable finger or dactylus of the right cheliped. It is very much worn and a considerable portion of the tip is lacking. The lower border is thin, but the remainder is thick and in cross section subcircular, and tapers gradually toward the distal end. At the proximal end below there is a broad sinus; the thin prehensile edge is slightly concave, viewed from outside, and feebly denticulate, especially when viewed from inside; there is a somewhat larger and better preserved tooth just within the margin at the widest part of the finger. Upper margin in outer view straight in its proximal half, gently curved distally. In dorsal view the finger is much curved and in the middle of its upper surface there is a longitudinal row of four large punctæ.

In its general shape, including the basal sinus, this dactylus resembles that of *C. pellucida* Rathbun, from the Leeward Islands, a description of which is about to be published by the Carnegie Institution, but the prehensile edge is thinner and more laminate and the inner outline more concave in dorsal view instead of almost straight as in that species.



## CALLIANASSA CRASSA, new species.

Plate 61, figs. 1-3.

*Type-locality*.—Gatun section A, bed A (bottom of section). Lower part of Gatun formation. Miocene series. D. F. MacDonald, collector. Station 6003. Two dactyli of the left cheliped.

*Types*.—Cat. No. 324276, U.S.N.M.

*Measurements*.—Length of dactylus, 16.3 mm.; height, 6.2 mm.

*Holotype*.—Outer and upper surfaces exposed, outline of tip obscure. Viewed from the outside the upper outline is arcuate and the tip bent down below the prehensile edge, which is nearly horizontal. Viewed from above, the outer line is much curved and the inner line nearly straight. On the prehensile edge there is a shallow basal sinus, followed by a very low, broad tooth; rest of margin faintly sinuous. The surface shows a number of granules, some large, others small; the large ones are about 7 on the outer surface and 5 on the upper surface; of the former, 2 are submarginal, one of them being above the lobe, the other half way to the tip; the other 5 external granules are disposed on the distal half; the 5 superior granules are arranged in 2 rows, one row of 3 toward the inner surface, and the other row of 2 granules toward the outer surface; the proximal of these is double. On the middle of the outer surface there is a patch of about 50 small granules. The chalky-white outer layer of the shell has crumbled away except near the edges, so that one can not tell whether the granules were apparent on that surface. Color of surface now exposed dull light bluish.

*Paratype*.—About two-thirds as large as the holotype, and with both ends of the finger missing. Granules as follows: 3 large above the lower margin, 2 as in the holotype, the other above the basal sinus; on the inner surface are 3 similarly spaced but placed more distad. On the upper surface there is a row of 4 toward the inner surface, and below the second one from the proximal end are 2 near together. The small granules are more separated than on the holotype and are distributed chiefly on the upper half of the outer surface.

## CALLIANASSA, species.

Plate 59, fig. 5.

*Locality*.—Panama Canal Zone. Top part of limy sandstone below upper conglomerate, near foot of stairs, Gaillard Cut. Upper part of Culebra formation. Oligocene series. D. F. MacDonald and T. W. Vaughan, collectors. 1911. Station 6012c. Cat. No. 324277, U.S.N.M.

*Material*.—Manus of left cheliped of a small specimen. Outer surface visible. Very convex from top to bottom, a deep groove next to the edge articulating with the carpus; upper and lower margins ill-defined.



## CALLIANASSA ?, species.

Plate 64, fig. 10.

*Locality.*—Panama Canal Zone. Las Cascadas section. From lower part of lime-cemented soft gray to olive-colored limestone (with central parting of dark clay). The first hard, limy sandstone bed above the lower limestone just above station 6019*b*. Upper part of Culebra formation. Oligocene series. D. F. MacDonald and T. W. Vaughan, collectors. 1911. Station 6019*c*. Cat. No. 324280, U.S.N.M.

*Material.*—One small specimen resembling in shape the merus joint of the smaller of the chelipeds of the first pair. If the above guess be correct, this is from the right cheliped. The two oblique grooves near the distal end may have been artificially produced.

## Family PAGURIDAE.

## PETROCHIRUS BOUVIERI, new species.

"*Petrochirus cf. granulatus Olivier sp.*" TOULA, Jahrb. der k. k. Geolog. Reichsanstalt, Wien, vol. 61, 1911, p. 511 [25], pl. 30 [1], fig. 13.

Gatun; Miocene (Toula). Not represented in the collection at hand.

There are two recent species of *Petrochirus* on opposite sides of the continent, namely, *P. bahamensis* (Herbst)<sup>1</sup>=*P. granulatus* (Olivier), which extends from Florida to Brazil, and *P. californiensis* Bouvier<sup>2</sup> taken at La Paz, Mexico, and in Ecuador. One of the principal differences between them lies in the ornamentation of the chelae. The right chela of *P. bahamensis* is covered chiefly with fan-shaped clusters of granules, all of which trend forward and present a smooth, oval side-face when viewed dorsally; the clusters vary in size, and some are composed of only 2 granules, while others are represented by only one granule; all are fringed anteriorly with hair, which fills the interspaces. The right chela of *P. californiensis* has similarly clusters and single granules, but the clusters are not fan-shaped but round, or nearly round, and are composed of a large smooth central granule surrounded by small granules tipped with a sharp, horny point; the granules are much more elevated and have a more dorsal inclination than in *bahamensis*; the single granules are also more numerous than in that species.

The right chela of the fossil specimen figured by Toula resembles that of *P. californiensis*.

The left chela of *P. bahamensis* is covered with fan-shaped clusters of granules like those on its right chela, but the clusters are more

<sup>1</sup> *Cancer bahamensis* Herbst, Naturg. d. Krabben u. Krebse, vol. 2, 1796, p. 30.

<sup>2</sup> Bull. Mus. Hist. Nat., Paris, 1895, p. 6.



crowded, and single granules are fewer. The left chela of *P. californiensis* is covered with clusters like those on its right chela but more crowded, and the granules of which they are composed are of a smaller average size.

The left chela of the fossil agrees more nearly with that of *P. bahamensis*.

We therefore have a Tertiary species combining the characters of two Recent species, at least as far as the chelae are concerned, possessing the right chela of one and the left chela of the other.

### Tribe BRACHYURA.

#### Subtribe DROMIACEA.

#### Family DROMIIDAE.

#### Genus GONIOCHELE Bell.

#### GONIOCHELE? ARMATA, new species.

Plate 57, figs. 11 and 12.

*Type-locality*.—Panama Canal Zone. Las Cascadas section, Gaillard Cut. From lowest fossiliferous bed. Third bed below lowest limestone beds separated by rows of nodules. Lower part of upper half of Culebra formation. Oligocene series. D. F. MacDonald and T. W. Vaughan, collectors. 1911. Station 6020a. Movable finger of the left cheliped. Cat. No. 324259, U.S.N.M.

*Measurements*.—Length of movable finger (tip broken off), 19 mm.; width at about the middle, 6 mm.; greatest thickness, 4.5 mm.

*Holotype*.—The shape is elongate-triangular viewed from outside, the prehensile edge being nearly straight and the upper edge slightly arched; outer surface convex in both directions. The prehensile edge has a sinus at its base, defined distally by a broad tooth which is at present truncate, but may have been prolonged in two small teeth; beyond are four teeth separated by rounded sinuses and with their tips missing; the first two are spiniform, the last two broad and thin. The upper margin bears 5 low, spaced teeth, while just within and alternating there is a line of 3 teeth. On the outer surface are 2 rows of tubercles not far from the margins, 4 in the lower and 3 in the upper row; the proximal tubercle in the upper row is bifid. On the inner surface are 5 tubercles besides those above mentioned, 2 in a longitudinal row in the middle, 2 on the distal half a little above the prehensile edge, and 1 small one toward the top and behind the middle.



I have placed this specimen in *Goniochele*<sup>1</sup> on account of the dactylus being armed on both edges, as in *G. angulata* Bell,<sup>2</sup> the type of the genus, and because the general shape of the segment is similar. In Bell's species the dorsal surface is smooth.

### Subtribe OXYSTOMATA.

#### Family CALAPPIDAE.

##### HEPATUS CHILIENSIS Milne Edwards.

Plate 66, fig. 4.

*Hepatus chiliensis* MILNE EDWARDS, Hist. Nat. Crust., vol. 2, 1837, p. 117.

*Locality*.—Panama Canal Zone. From near Mount Hope in ditch through swampy ground. About one-quarter mile from present sea beach, 6 to 8 feet above high tide. Pleistocene series. D. F. MacDonald, collector. April, 1911. Station 5850. Cat. No. 324235, U.S.N.M.

*Material*.—Dactylus of right chela, 5.3 mm. long. This little specimen shows all the essential characters of recent individuals of this species: 8 shallow rounded teeth on the lower margin; a row of 5 tubercles on the proximal part of the upper margin and a row of 4 tubercles just below and on the outer surface; still further down, 2 more tubercles; a stridulating ridge on the inner surface just below the upper edge is formed of upwards of 45 fine parallel striae and occupies the greater part of the length of the finger.

*Distribution of Recent material*.—Ranges at the present time from Ecuador to Chile.

##### HEPATUS, species.

Plate 66, fig. 12.

*Locality*.—Panama Canal Zone. From lower part of lime-cemented soft gray to olive-colored sandstone (with central parting of dark clay). The first hard limy sandstone bed above the lower limestone just above fossil lot No. 6019*b*. Upper part of Culebra formation. Oligocene series. D. F. MacDonald and T. W. Vaughan, collectors, 1911. Station 6019*c*. Cat. No. 324239, U.S.N.M.

*Material*.—One dactylus of left chela, much worn and incomplete at both extremities; the proximal half of the upper margin is also wanting. The curves in side view are much like those of *H. chiliensis* Milne Edwards.<sup>3</sup> Both inner and outer surfaces are

<sup>1</sup> A Monograph of the Fossil Malacostracous Crustacea of Great Britain, pt. 1, 1857, p. 25.

<sup>2</sup> Idem, pl. 4, fig. 6.

<sup>3</sup> Hist. Nat. Crust., vol. 2, 1837, p. 117.



convex from top to bottom. The prehensile edge has traces of 2 small teeth, one near the base and one at about the distal third. There are also various depressed granules or pits, namely, a row of 5 small ones on the upper margin; opposite the distal one of these there is a larger one on the inner surface; and 3 or 4 on the outer surface. These are all sunken so that they do not project above the present surface, which is not the true outer surface.

This finger is not quite so flat inside as *H. chiliensis*.

*Measurements*.—Length of dactylus, 13.6 mm.; height at middle, 3.6 mm.; thickness at middle, 2.7 mm.

**CALAPPA COSTARICANA, new species.**

Plate 57, fig. 24.

*Type-locality*.—Costa Rica: City of Port Limon. Port Limon formation. Pliocene series. Dr. L. A. Wailes. 4269.

*Holotype*.—Cat. No. 324240, U.S.N.M. A triangular fragment measuring about 9 mm. on each margin, representing the propodal finger and the infero-distal portion of the palm of a left chela of the weaker form—that is, without a strong submarginal tooth or lobe characteristic of the stronger chela in *Calappa*. Lower margin very sinuous, the tip of the finger directed upward, proximal half of margin armed with 6 strong tubercles directed distally. Just above, on the outer side, and beginning nearer the finger-tip there is a row of 11 smaller tubercles, normal to the surface. The prehensile edge is nearly straight, inclined at an angle of about  $75^\circ$  with the lower margin of the palm, and is furnished with 6 large, unequal tubercles, which end at the small sinus which ordinarily exists just below the raised margin surrounding the articulation with the dactylus; on the upper side of this sinus are 2 small tubercles, and above this point, the specimen comes to an end. The outer surface is covered with upward of 40 flattened scale-like tubercles pointing upward; they are separated from the submarginal row by a smooth depression. The propodus is thick and the inner surface is beveled, the bevel for the most part smooth; remainder of inner surface studded with very unequal pearly granules and tubercles; interspace crowded with fine punctae; 2 sinuous ridges run toward the finger-tip.

This species resembles *C. gallus* (Herbst)<sup>1</sup>, which is found living at the present time from Florida Keys to Bahia, Brazil. The fossil species differs in the very prominent tubercles of the lower margin of the palm and the longer tubercles of the submarginal row just above, on the outer surface.

<sup>1</sup> *Cancer gallus* Herbst, Natur. Krabben u. Krebse, vol. 3, pt. 3, 1803, pp. 18 and 46, pl. 58, fig. 1.



**CALAPPA FLAMMEA (Herbst).**

Plate 61, figs. 4 and 5.

*Cancer flammeus* HERBST, Naturg. d. Krabben u. Krebse, vol. 2, 1794, p. 161, pl. 40, fig. 2; vol. 3, pt. 3, 1803, p. 19.

*Locality*.—Near Mount Hope, Panama Canal Zone, in ditch through swampy ground about one-fourth mile from present sea beach, 6 to 8 feet above high tide; Pleistocene series; D. F. MacDonald, collector. April, 1911. Station 5850. Cat. No. 324237, U.S.N.M.

Represented only by one dactylus or movable finger belonging to the stronger chela. The milling of the stridulating ridge on the inner surface just below the upper edge is more strongly marked than in most of the recent specimens examined.

*Measurements*.—Extreme length, 15 mm.; width just distal to the upper marginal tooth, 4.7 mm.

*Distribution of Recent material*.—From North Carolina to Colombia and Venezuela.

**CALAPPA ZURCHERI Bouvier.**

*Calappa zurcheri* BOUVIER, Bull. Mus. Hist. Nat. Paris, vol. 5, 1899, p. 190, text-fig.

Panama. Lower Miocene.

Not represented in the Museum collection.

**CALAPPELLA, new genus.**

Carapace very little broader than long, without clypeiform expansions, but with a spine at the junction of the antero-lateral and postero-lateral borders, and a spine at each end of the posterior border.

Front small, projecting forward beyond the orbits.

Orbits small, directed forward.

In the narrow front and small orbits, this genus resembles *Calappa*, but in its narrow carapace armed with 4 slender spines, it differs from that genus as well as from all other Calappinae.

*Type of the genus*.—*Calappella quadrispina*, new species.

**CALAPPELLA QUADRISPINA, new species.**

Plate 58, figs. 1 and 2.

*Type-locality*.—Panama Canal Zone. Las Cascadas section, Gaillard Cut. From lowest fossiliferous bed; third bed below lowest limestone beds separated by rows of nodules. Lower part of upper half of Culebra formation. Oligocene series. D. F. MacDonald



and T. W. Vaughan, collectors. 1911. Station 6020a. Cat. No. 324238, U.S.N.M.

*Measurements* (approx.).—Length of carapace (spines excluded), 14 mm.; width (spines excluded), 14.4 mm.

*Holotype*.—Species represented by one specimen showing part of the carapace and no appendages, enclosed in a nodule which has been broken in two. Nodule not much larger around than the carapace.

Carapace nearly as long as wide, spines excluded; width between outer angles of orbits a little greater than posterior margin. Chord of the antero-lateral margin nearly twice as long as that of the postero-lateral margin. Antero-lateral margin divided into 2 parts, the anterior two-fifths being slightly convex, the posterior three-fifths very convex with a tubercle at its middle. Postero-lateral margin somewhat sinuous, but in general concave; posterior margin slightly convex, about twice as long as the slender spine at either end which is directed backward and slightly outward. Lateral spine also slender, but longer, half as long as the postero-lateral margin and pointing obliquely backward.

The central and anterior part of the surface of the carapace is lacking. There are, however, two oblique, parallel, branchial furrows; between them a row of 3 tubercles and some scattered granules; the outer part of the branchial region is higher and rough with irregular tubercles which are more or less confluent. Cardiac region high, with a median tubercle on its posterior slope; in almost the same plane transversely, but on a lower level, there is another tubercle on each side just above the postero-lateral margin.

There is a very small hollow in the nodule where the point of the front rested, and on the other half of the nodule may be seen the lower surface of the front where it joined the interantennular septum.

The orbits are small, their upper and lower margins formed by two teeth, the innermost advanced, separated by a blunt V-shaped sinus.

On the lower surface, the inner tooth of the orbit is considerably elevated (that is, ventrally). A sharp ridge runs obliquely backward from or near the epistome, and is armed with a tooth at its posterior third.

**MURSIA MACDONALDI, new species.**

Plate 58, fig. 21.

*Type-locality*.—Panama Canal Zone. Las Cascadas section. Fifth or topmost limestone. Emperador limestone. Oligocene series. D. F. MacDonald and T. W. Vaughan, collectors. 1911. One specimen, part of left cheliped. Station 6019g. Cat. No. 324229, U.S.N.M.



*Measurements.*—Length of palm between articulations, 19 mm.; height (approx.), 10.2 mm.

Represented by the left palm only, which has the customary Calappoid form, and a portion of the immovable finger; the edges are not well shown; two teeth may be seen near the distal end of the upper margin. The only details of the outer surface that can be made out are a few large tubercles, more or less compressed as in Recent species of *Mursia*; these tubercles number about 15; there is a row of 4 a little above, and subparallel to, the lower margin; from these 4 tubercles irregular rows extend obliquely upward, trending toward the fingers; including those of the horizontal row, those of the distal oblique row are 4, of the second row 5, of the third row 3, of the proximal row 3; these rows are not strictly parallel nor their tubercles regularly spaced. The lower proximal tubercle is the largest and most compressed.

There is an indication of the distal spine of the arm-joint, which may be seen in the figure.

Resembles *Mursia armata* de Haan,<sup>1</sup> but in that species the principal tubercles of the hand are 9, arranged in 3 parallel and fairly regular rows.

MURSIA OBSCURA, new species.

Plate 61, fig. 18.

*Type-locality.*—Near Panama Canal Station "1910," north of Pedro Miguel locks, Panama Canal Zone. From dark clay, lower part of Culebra formation. Oligocene series. D. F. MacDonald and T. W. Vaughan, collectors. 1911. Station 6010. Cat. No. 324225, U.S.N.M.

Measurements of fragmentary specimen, 8.2 mm. long, 9 mm. wide.

*Holotype.*—The central part of the carapace, devoid of its margin, except perhaps the middle of the posterior margin. This fragment is embedded wrong side up in a piece of rock; only the thin outer crust of the specimen remains and its under surface alone is visible. It has been referred to this genus because the cavities or pits, which represent tubercles on the dorsal surface of the shell, are arranged much as in *Mursia*. There are 5 longitudinal rows of these pits: The median row consists of 3 large pits, one cardiac, one genital, one gastric, preceded by 2 small pits side by side; the two lateral rows (on each side) are very little oblique to the median line, but subparallel to each other; the inner of these rows consists of 4 pits, the penultimate one being in a transverse line with the last pit of the median row; the last pit of the inner lateral row is round and deep

<sup>1</sup> Fauna Japonica, 1839, p. 73, pl. 19, fig. 2.



and indicates a large excrescence, perhaps a spine, on the dorsal surface; 3 pits only are visible in the outer row, the middle pit is in transverse line with the anterior pit of the other rows, while the anterior pit of the outer row is not quite in line with the two behind it. Either side of the pair of small submedian gastric pits there is a large cavity. The furrows separating the branchial from the gastric and cardiac regions are indicated by sinuous ridges.

Judging from the proximity of the rows of pits, this carapace is narrower in proportion to its length than in other species of *Mursia*. This together with the evidence of a strong prominence near the postero-lateral borders points to a genus different from any described.

#### MURSILIA, new genus.

The manus resembles that of *Mursia*, but lacks the crest or ridge on the inferior margin.

*Type of the genus.*—*Mursilia ecristata*, new species.

#### MURSILIA ECRISTATA, new species.

Plate 57, fig. 27.

*Type-locality.*—Gatun beds. Gatun formation. Miocene series. Robert T. Hill, collector.

*Holotype.*—Cat. No. 135219, U.S.N.M.

*Measurements.*—Length of palm, 9.8 mm., height of palm, 7.4 mm.

Represented by only one specimen showing the right palm and a portion of the wrist. Palm short and high. Surface finely and rather distantly granulated on the upper half of the outer surface and at the proximal end; more closely granulated on the lower surface. There are 9 large tubercles arranged in 3 oblique, subparallel rows; the tubercle at the inferior proximal corner is much the largest, is flattened above and has a raised rim; between it and the next tubercle in the horizontal row, but a little below, there is a smaller tubercle. Below the distal tubercle of the horizontal row of 3, and nearer the inner than the outer surface there is a small tubercle. On the upper margin there are 7 narrow, thickened teeth similar to those of *Calappa*. Below the sinus between the fifth and sixth teeth (counting from the wrist) there is a low tubercle; also one on the base of the second tooth. A part of a tubercle near the beginning of the immovable finger is visible.

The outline of the wrist is defined, but very little of the surface remains; a small piece near the distal upper corner is granulated like the upper half of the palm.

The tuberculation of the manus or palm resembles that of *Mursia*, the dentation of the upper margin is nearer that of *Calappa*, while



the segment differs from both those genera in lacking the crest on the lower margin of the palm.

### Family LEUCOSIIDAE.

#### LEUCOSILIA JURINEI (Saussure).

*Guaia (ilia) jurinei* SAUSSURE, Rev. et Mag. de Zool., No. 8, 1853, p. 12, pl. 13, fig. 4.

*Leucosilia jurinii* BELL, Trans. Linn. Soc. London, vol. 21, 1855, p. 295, pl. 32, fig. 1.

*Locality*.—Panama Canal Zone. From near Mount Hope in ditch through swampy ground. About one-quarter mile from present sea beach, 6 to 8 feet above high tide. Pleistocene series. D. F. MacDonald, collector. April, 1911. Station 5850.

*Material*.—Six small arm-joints more or less worn; four of them are incomplete at one or both ends.

*Size*.—Length of a large one, 5.6 mm.

*Distribution of Recent Material*.—Ranges from Mazatlan, Mexico, to Peru and the Galapagos Islands.

#### LEUCOSILIA BANANENSIS, new species.

Plate 57, figs. 6-8.

*Type-locality*.—Banana River, Costa Rica. Probably equivalent to Gatun formation. Miocene series. D. F. MacDonald, collector. 1911. Station 5882*h*, 5*b*, 1 arm, holotype, from seventh fossiliferous zone below the uppermost one of the section. Station 5882*g*, 5*a*, 1 arm, paratype (*a*), from sixth fossiliferous zone below the uppermost one of the section. Station 5882*f*, 3*f*, 1 arm, paratype (*b*), from fifth fossiliferous zone below the uppermost one of the section.

*Types*.—Cat. Nos. 324230, 324231, and 324232, U.S.N.M.

*Measurements*.—Length of holotype, 11.1 mm.; greatest diameter, 4.2 mm.

Represented by only 3 arms from 3 different layers. The best specimen represents the left arm nearly complete, lacking only the distal articulating edge.

Shape subcylindrical, slightly compressed in a vertical direction, the greatest diameter being proximal to the middle, the smallest diameter at the proximal end. The ornamentation consists of tubercles or large granules, the granules becoming small at both ends of the arm; around the middle of the segment the granules number about 15; the tops of the granules are broken off so that they appear much flatter than they really were. Compared with *L. jurinei*, the arm is more swollen, the granules less numerous, more equal and further apart.



**LEUCOSIIDAE?, genus and species indeterminable.**

Plate 60, figs. 7 and 8.

*Locality*—Panama Canal Zone. From near Mount Hope in ditch through swampy ground. About one-quarter mile from present sea beach, 6 to 8 feet above high tide. Pleistocene series. D. F. MacDonald, collector. April, 1911. Station 5850. Cat. No. 324236, U.S.N.M.

*Material*.—Dactylus of left chela, 11.4 mm. long, with proximal end lacking. This dactylus differs from those of *Persephona* and allied genera in its strong curvature upwards, supposing the prehensile edge to be directed inwards. This edge is nearly straight except just at the tip and is armed with 25 small unequal teeth, 2 of which in the proximal third are the largest. Besides this edge the surface is composed of 4 high, smoothly rounded ridges separated by narrow grooves; 2 of the ridges are inferior, and 2 superior, the outermost of the latter embracing the outer edge and having a longitudinal row of punctae near its middle. Each side of the prehensile edge there are 2 or 3 rows of punctae. Tip of finger bent rather abruptly but obliquely inward, while in its upward trend it continues the curve of the rest of the dactylus.

**Subtribe BRACHYGNATHA.****Superfamily BRACHYRHYNCHA.****Family PORTUNIDAE.****CALLINECTES DECLIVIS, new species.**

Plate 66, figs. 1-3.

*Type-locality*.—Banana River, Costa Rica. Eighth fossiliferous zone below the uppermost one of the section. Probably equivalent to Gatun formation. Miocene series. D. F. MacDonald, collector. 1911. Station 5882*i*; 5*c*. Cat. No. 324262, U.S.N.M.

*Measurements*.—Greatest height, 14 mm.; length of manus measured horizontally from extreme base of proximal spine, 21 mm.; thickness, 9.2 mm.

*Holotype*.—The propodus of the left cheliped, with the tip of the finger broken off. The palm is prismatic as in recent species of *Callinectes*, with 7 facets, more or less distinct; 4 facets on the outer surface and 3 on the inner surface. The surface, or what remains of it, is smooth and shining to the naked eye, but under a lens, shows very fine granulation, and larger scattered punctae. The facets are separated by blunt ridges; one facet is a little above the middle of



the outer surface, and has subparallel margins; the facet below this widens distally and its lower edge, not very prominent, is continued upon the finger, where it is sharper; the lower facet of the outer surface is not sharply marked; the facet above the middle narrows slightly toward either end and has raised margins; at its proximal end there is the stout base of a large spine such as exists in *Callinectes* of the present day. The upper facet of the inner surface is narrow, wider in the middle than at the ends, and is not depressed, its distal outer corner only is visible when the manus is viewed externally; at the distal end just outside the inner margin is an indication that a spine has been broken off. The remainder of the inner surface is divided into 2 facets of nearly equal width separated by a prominent ridge.

The finger is a little curved inward; on the outer and inner surface there are 2 grooves, each with a row of large punctae, the groove at the middle of each surface being deeper than that near the prehensile teeth. The teeth are of moderate size, irregular, the larger ones alternating with one or two smaller ones; at the broad proximal end of the cutting edge there are 2 small teeth side by side, one near the inner the other near the outer surface.

This propodus differs from those of all the Recent *Callinectes* in the position of the uppermost facet. In *C. sapidus*, etc., this facet is a part of the outer series, that is, continues the slope of the adjoining facet on the outer surface; while in the fossil it inclines downward toward the inner surface except at the distal end where it is nearly horizontal. Furthermore, the propodus is shorter in proportion to its height than in recent *Callinectes*.

I have placed this species in *Callinectes* rather than in *Portunus* (= *Neptunus* of authors) because the palm is nearer the shape of *Callinectes* than it is to similar segments in the genus *Portunus*, as *P. sanguinolentus*; the fossil is very unlike any *Portunus* now living on the coast of tropical America.

CALLINECTES RETICULATUS, new species.

Plate 66, figs. 5-7.

*Type-locality*.—Panama Canal Zone. Las Cascadas section, Gailard Cut. From lowest fossiliferous bed; third bed below lowest limestone beds separated by rows of nodules. Lower part of upper half of Culebra formation. Oligocene series. D. F. MacDonald and T. W. Vaughan, collectors. 1911. Station 6020a. Cat. No. 324261, U.S.N.M.

*Measurements*.—Greatest height of manus, 15.6 mm.; length of manus measured horizontally on middle of outer surface, 19.2 mm.; thickness, 10 mm.



*Holotype*.—The propodus of the right cheliped, the immovable finger being broken off near its middle.

In shape, this hand is shorter, higher, and thicker than the preceding. The surface, aside from the ridges and the uppermost facet is covered with a fine reticulation of transverse grooves. The facets are 7 in number and in position are like those of *C. declivis*, excepting that the narrow uppermost one which appears to belong to the inner surface in *C. declivis* is more horizontal in *C. reticulatus* and forms the upper surface of the segment. The next facet on the outer side is narrowest at the distal end and widens to the middle, after which the margins are subparallel; the next facet widens distally, and the next also, but in a lesser degree; the lower facet is ill defined. The 2 facets of the inner surface are subequal and widen distally.

There is the base of a tooth at the inner distal end of the upper facet, and a short blunt spine at the distal end of the crest between the upper and middle facets. If there was a tooth at the proximal end it is broken off.

The propodal finger bears on its upper edge the stumps of 3 subequal teeth; nearer the palm on the same surface there are 2 small acute tubercles transversely placed, the inner one the larger.

Aside from the difference in shape and ornamentation between this species and the preceding, there is a difference in the form of the facets which may be seen by comparing figures 5 to 7 with 1 to 3 on plate 66.

CALLINECTES, species.

Plate 65, figs. 1 and 2.

*Locality*.—Panama Canal Zone. From the 4 feet of dark, stratified tuff and clay immediately overlying the lower limestone bed, Las Cascadas section. Upper part of Culebra formation. Oligocene series. D. F. MacDonald and T. W. Vaughan, collectors. 1911. Station 6019*b*. Cat. No. 324255, U.S.N.M.

A specimen of a left manus and carpus, very much worn, the upper and lower margins and the distal end of the manus being lacking. The palm is narrower than in *C. reticulatus* described above; the facet near the middle of the outer surface is wider than in *C. declivis*, and widens distally instead of having subparallel margins as in that species.

CALLINECTES, species.

Plate 65, fig. 7.

*Locality*.—Panama Canal Zone. From top part of limy sandstone below upper conglomerate, near foot of stairs, Gaillard Cut. Upper part of Culebra formation. Oligocene series. D. F. MacDonald



and T. W. Vaughan, collectors. 1911. Station 6012*c*. Cat. No. 324268, U.S.N.M.

The distal third of the immovable finger of a claw of a *Callinectes*. On the prehensile edge is shown the most distal of the large teeth customary in the genus followed (toward the tip) by 3 smaller teeth; the tip is defective, having been broken off, then reattached in the wrong place. There is a punctated groove down the middle of the inner and the outer surface.

Of the species of *Callinectes* living on the Pacific coast of America, this fragment resembles most *C. toxotes* Ordway,<sup>1</sup> which occurs from Cape St. Lucas to Peru.

ARENÆUS, species.

Plate 64, fig. 1.

*Locality*.—Panama Canal Zone. From near Mount Hope in ditch through swampy ground. About one-quarter mile from present sea beach, 6 to 8 feet above high tide. Pleistocene series. D. F. MacDonald, collector. April, 1911. Station 5850. Cat. No. 324252, U.S.N.M.

*Material*.—Five fingers worn and more or less incomplete. Probably all are movable fingers or dactyli. Length of most perfect specimen, 8.2 mm. On the outer surface there are two grooves dotted with minute punctae; one is shallow and near the prehensile teeth, the other is above the middle of the segment; on the upper surface there are also two punctated grooves, but near together, while the inner surface has two furrows similar to those of the outer surface. Three or four of the prehensile teeth are enlarged as is usual in Portunids, and the tip is curved downward. There are evidences of close granulation on the uppermost ridges and on the proximal part of the segment.

This is near *A. mexicanus* (Gerstaecker<sup>2</sup>), a Recent species which occurs from the west coast of Mexico to Peru. The shape, curvature, and granulation are similar, but three of the six grooves belong definitely to the outer surface.

EUPHYLAX CALLINECTIAS, new species.

Plate 65, figs. 3-6.

*Type-locality*.—Banana River, Costa Rica; ninth fossiliferous zone below the uppermost one of the section. Probably equivalent to Gatun formation. Miocene series. D. F. MacDonald, collector. 1911. Station 5882*j*; 5*d*. Cat. No. 324234, U.S.N.M.

<sup>1</sup> Boston Journ. Nat. Hist., vol. 7, 1863, p. 576.

<sup>2</sup> *Euctenota mexicana* Gerstaecker, Arch. für Naturg., vol. 22, pt. 1, 1856, p. 131, pl. 5, figs. 3 and 4.



*Measurements.*—Length of carapace, 45 mm.; gastro-cardiac suture, 9.6 mm.

*Holotype.*—One male specimen, showing parts of the upper and lower surfaces, but no appendages. The outer layer of the shell of the carapace remains only in the central part, where the gastric, branchial and cardiac regions meet. This surface is granulated and areolated much as in *Callinectes*;<sup>1</sup> that is, the regions are separated by definite depressions, the gastro-cardiac groove is transverse, there is an areola at the inner angle of the branchial region, but there is a shallower division into 2 lobules than in *Callinectes*. The post-gastric area is incomplete anteriorly, so that it is impossible to tell whether it is marked by a raised and granulated margin; the shape of this area most nearly resembles that of *C. exasperatus* (Gerstaecker<sup>2</sup>), and its granulation that of *C. bocourti* A. Milne Edwards, the granules being absent or sparse along the lateral and posterior borders. Across the middle of the gastric region runs a blunt elevation, concave forward. The branchial region is divided in two by a depression running obliquely backward and outward. These last two features suggest the carapace of *Euphylax dovi*i Stimpson,<sup>3</sup> a species now existing on the Pacific coast of America, between Central America and Payta, Peru.

Anterior margin very broad, as in *E. dovi*i, most of it being occupied by the orbits; the front is narrow, T-shaped, much constricted at base; the anterior part of the T has a concave surface and is deflexed to meet the epistomial spine. This is more advanced than the front; its tip is broken off. The upper margin of the orbit slopes backward and outward and is somewhat undulating. The shape of the orbit can not be definitely made out, but a portion of the smooth inner lining of the outer extremity remains. The indications are that the eyestalk is long and the corneal extremity large, as in *E. dovi*i.

The sternum and abdomen resemble those of *E. dovi*i, the anterior end of the sternum is depressed, the depression having a convex posterior margin, from which a furrow leads back to the abdomen. Surface of sternum and abdomen covered with large and distant punctae. Abdomen broadly triangular; first segment not distinguishable; second, third, and fourth segments each crossed by a transverse ridge; third, fourth, and fifth fused, and perhaps also the second with them. The sides of the penult segment are less convergent than in *E. dovi*i.

This species in all the characters visible in the type-specimen resembles the genus *Euphylax* as typified by *E. dovi*i, excepting in the

<sup>1</sup> Proc. U. S. Nat. Mus., vol. 18, 1896, pls. 12-23.

<sup>2</sup> Arch. f. Naturg., vol. 22, pt. 1, 1856, p. 129.

<sup>3</sup> Ann. Lyc. Nat. Hist. N. Y., vol. 7, 1860, p. 226, pl. 5, fig. 5.



areolation and ornamentation of the central part of the carapace which indicate an affinity with *Callinectes*.

EUPHYLAX FORTIS, new species.

Plate 64, figs. 11-13.

*Type-locality*.—Banana River, Costa Rica; tenth fossiliferous zone below the uppermost one of the section. Probably equivalent to Gatun formation. Miocene series. D. F. MacDonald, collector. October, 1911. Station 5882k. Cat. No. 324233, U.S.N.M.

*Measurements*.—Length of body (approx.), 43.5 mm.; length of movable finger, 27.3 mm.; width of the sternum between the coxae of the chelipeds, 24.5 mm.

*Holotype*.—One specimen showing a part of the lower surface and the right cheliped. The abdomen resembles that of an immature female or is possibly that of a male.

Sternum broad, surface rough with coarse punctae and fine reticulating lines; anterior part depressed and with a median groove leading back to the abdomen much as in *E. callinectias*; the ridge just in front of the abdomen is more transverse than in that species.

Abdomen broadly triangular; it is impossible to tell which segments, if any, are fused; terminal segment subequilateral; surface of sixth and seventh segments like that of the sternum, of fourth and fifth segments covered with a low, confluent granulation.

Ischium of external maxilliped with a longitudinal groove, the surface on the inner side of the groove more raised than on the outer side.

Cheliped elongate. A cross section of the arm is shown and a portion of its lower surface; this last has a broad longitudinal depression through the middle, and the surface near the margins, at least, is coarsely granulate.

The general outline of the fingers can be made out and the surface of some of the prehensile teeth. The fingers are elongate, as in the usual Portunid, and gradually taper, ending in slender black tips which cross each other. The prehensile teeth are large, thick, dark-colored, and very irregular, the one at the base of the dactylus being the largest; they appear to fit close together. The cheliped is larger and stronger in proportion to the size of the body than in any recent species of Portunid.

The generic position of this species is problematical; in the width of the sternum it resembles *Euphylax*; in the strong teeth of the digits it approaches *Scylla*, while the groove on the lower side of the arm joint is unique.



## GATUNIIDAE, new family.

Characters of the type genus, *Gatunia*.

## GATUNIA, new genus.

Carapace of the customary Cancrid outline, that is, transversely oval, with a narrow, dentate front (between the orbits); orbits narrow, with a forward inclination; antero-lateral margins arcuate, longer than the postero-lateral, and armed with 8 teeth, including the orbital tooth; postero-lateral margins strongly convergent. Genital region very narrow. Carapace without transverse ridges.

Outer maxilliped with the ischium greatly elongate, and longitudinally grooved.

Chelipeds massive; palms thick, not flattened on the inner side, devoid of ridges on the outer side.

Last pair of feet with the propodus and dactylus flattened and broadened to form a swimming organ as in the Portunids.

Abdomen of the male with the third, fourth, and fifth segments fused.

This genus resembles the family Cancridae in the form of the carapace, front and orbits; while the swimming paddles and the abdomen are like those of the Portunidae. The chelipeds approach those of the genus *Scylla* in their massiveness, long fingers and lack of costae, but the absence of spines gives them the appearance of many of the Xanthidae.

*Type of the genus.*—*Gatunia proavita* Rathbun.

## GATUNIA PROAVITA, new species.

Plates 54–56; plate 58, figs. 16 and 17.

*Type-locality.*—Gatun formation, near Gatun Dam, Panama Canal Zone. Miocene series. Collected by one of the workmen and shipped by D. F. Macdonald. Station 5659. One specimen (holotype), nearly complete. Cat. No. 324289, U.S.N.M.

*Measurements.*—Length of carapace, from tip of submedian teeth, 133.2 mm.; from median sinus, 128.3 mm.; width, between tips of teeth of posterior pair, 182.5 mm.; width between teeth of penultimate pair, the same.

*Holotype.*—Carapace about  $1\frac{1}{3}$  times as wide as long; antero-lateral margin strongly arched, cut into 7 strong teeth, besides the tooth at the outer angle of the orbit; teeth similar in shape, having a convex posterior and a concave anterior margin, tip acute; the 7 teeth increase in size from the first to the fifth and then diminish to the



seventh, which is the most spiniform. The orbit has a strong tooth at the outer and at the inner angle and one less prominent between; below the inner angle there is a narrow tooth more advanced than those above. Frontal region, between the orbits, with a concave dorsal surface; anterior border cut into 4 teeth, those of the middle pair nearer to each other than they are to those of the outer pair, and separated by a shallower sinus; teeth of inner pair oblong, with rounded end; those of outer pair thicker. Postero-lateral margins nearly straight; posterior margin slightly convex and thickened.

Surface covered with a pavement of fine, flattened granules, and with less numerous and unequal punctae visible to the naked eye. The depression between the gastric and branchial regions is well marked except anteriorly, the hepatic region not being defined. Genital region very narrow, longer than wide. Cardiac and intestinal regions incompletely outlined.

Neither the eyes nor the antennae are visible.

Epistome subtriangular, prolonged downward at the middle in an acute angle; thence a small button-hole groove runs obliquely backward. Palatal ridge strong except anteriorly where it is low and blunt. Pterygostomian region granulate, densely so near the buccal cavity. On the sternum a furrow runs obliquely forward from the coxae of the chelipeds to the median line.

The abdomen of the male is broad and at the base reaches to the coxae of the last pair of feet; there is only one segment visible between the carapace and the third segment; it is probably the second, while the first is hidden under the carapace much as in the Portunid genus *Callinectes*; the second is of nearly even length throughout its width; the third, fourth and fifth are fused, but their extent is indicated by indentations in the lateral margins and by a short groove at the middle; the 3d segment is produced sideways beyond the 2d and 4th and its margins are very convex; margins of the 4th to 6th segments, inclusive, taken together are slightly convergent, those of the 4th a little convex; 6th segment about  $1\frac{3}{4}$  times as wide as long; terminal segment nearly as long as the preceding, subtriangular, end rounded.

Chelipeds very stout, in general smooth, there being no ridges nor spines. The surface is finely granulate and punctate, the granules a little higher than on the carapace. The inferior, anterior margin is the only margin of the merus visible; it is smoothly rounded. Carpus massive, with a broad tooth at inner angle. Chelae unequal, thick, broadly rounded above and below without marginal lines; right or larger manus about  $1\frac{1}{4}$  times as long as high, left or smaller manus about  $1\frac{1}{3}$  times as long as high; next the articulation of the larger palm with the dactylus there is a large lobe or tooth directed toward the end of the dactylus, as in *Scylla*. The digits each have 2



longitudinal punctate impressions on the outer surface, the larger dactylus is more arched than the smaller; the fingers cross each other a little before the tips, at least in the smaller chela; the end of the larger immovable finger is broken off; prehensile edges armed with large irregular, separated teeth, the basal tooth of the larger dactylus being of enormous size and directed obliquely backward as in *Scylla*. The distal half or two-fifths of the fingers is dark-colored, also the prehensile teeth.

The 3 pairs of ambulatory legs are only partially preserved; they would, if extended, reach about to the middle of the manus of the chelipeds; the first five segments are stout; the propodus, of which only impressions exist, has a groove through the middle and appears to be flattened; the dactylus can not be made out with any degree of certainty; the swimming-feet, or those of the last pair, are very broad, the carpus is as broad as long; the propodus is about twice as long as broad; the dactylus is lanceolate-oval, about  $2\frac{1}{2}$  times as long as broad.

Another specimen (paratype *a*) lacking the dentate border of the carapace, and all appendages except the coxal joints of the legs, was taken from the Gatun formation, Gatun Locks, by D. F. MacDonald, May, 1911. Station 5900. Cat. No. 324241, U.S.N.M.

A much smaller specimen (paratype *b*) which is identified as probably belonging to this species is labeled: "Near Gatun. Miocene. Rev. G. Rowell. Cat. No. 113706, U.S.N.M." It is probably from the Gatun formation. A portion of the left side of the carapace is preserved, showing the base of the 3 posterior of the anterolateral teeth; on the under side is shown the margin of the buccal cavity, fragments of a maxilliped and the base of the cheliped. A separate specimen (paratype *c*), from the same locality, is the left manus, somewhat crushed, proximally incomplete and lacking the propodal finger, but with the base of the dactylus attached, including the first or large, rounded tooth.

A fragment of a finger bearing 3 teeth (paratype *d*) is referred here; the smooth outer layer is almost gone except a few bits near the teeth; it was taken from the 85-foot cut on north side of big swamp on relocated line of the Panama Railroad,  $1\frac{1}{2}$  to 2 miles beyond Camp Cotton toward Monte Lirio; Gatun formation; Miocene series; D. F. MacDonald and T. W. Vaughan, collectors, 1911; Station 6030; Cat. No. 324242, U.S.N.M.

I refer here with doubt a curved fragment of a thick-shelled species, which has a large tooth occupying half its surface. It may belong near one of the articulations. It was taken at Station 6033*b*, in the upper part of the lowest bed, Gatun section; Gatun formation; Miocene series; MacDonald and Vaughan; 1911; Cat. No. 324286, U.S.N.M.



The larger claw of this species is strikingly like that described by A. Milne Edwards<sup>1</sup> under the name *Scylla michelini* from Sceaux, near Doué, France, in the Miocene shell deposits of the shell-marl of Anjou. M. Milne Edwards founded the species on the claw alone. It is very likely congeneric if not conspecific with the form here described.

### Family XANTHIDAE.

#### CARPILIUS, species.

Plate 58, fig. 22.

*Locality*.—Panama Canal Zone. Foraminiferal marl and coarse sandstone about 200 yards south of southern end of switch at Bohio Ridge station, relocated line Panama Railroad. Upper part of Culebra formation. Oligocene series. D. F. MacDonald and T. W. Vaughan, collectors. 1911. Station 6025. Cat. No. 324243, U.S.N.M.

*Material*.—Piece of propodal segment of ambulatory leg on left side of crab. Length 17 mm., greatest width 7.2 mm., least width 5.7 mm., proximal thickness 4.5 mm., distal thickness 3.7 mm. Viewed dorsally, the anterior margin is slightly convex, the posterior faintly concave. Viewed edgewise, the upper surface is longitudinally convex, and the lower surface concave. Cross section oval. Surface, except for accidental breaks, smoothly rounded, without ridges, furrows, or tubercles.

In its smoothness and general form, resembles the propodus of the first ambulatory leg of *Carpilius corallinus* (Herbst<sup>2</sup>), for which reason I venture to attach the name *Carpilius* to this fragment.

#### HETERACTAEA LUNATA (Milne Edwards and Lucas).

Plate 63, figs. 7-9.

*Pilumnus lunatus* MILNE EDWARDS and LUCAS, d'Orbigny's Voy. Amér. MÉR., vol. 6, 1843, p. 20; vol. 9, atlas, 1847, pl. 9, fig. 2.

*Locality*.—Costa Rica: City of Port Limon. Port Limon formation. Pliocene series. Dr. L. A. Wailes, collector. Station 4269. Cat. No. 324265, U.S.N.M.

*Distribution*.—Recent, San Diego, California, to Chile.

*Material*.—One specimen showing distal portion of outer surface of larger palm, with proximal half of dactylus (showing all surfaces) attached. This must have belonged to a small individual with carapace about 15 mm. wide. The fossil is crushed and the tips of the tubercles are lacking. The shape of the two segments so

<sup>1</sup> Histoire des Crustacés podophthalmiques fossiles, Paris, 1861, p. 136, pl. 3, figs. 3, 3A.

<sup>2</sup> Naturg. d. Krabben u. Krebse, vol. 1, 1783, p. 133, pl. 5, fig. 40.



far as it is preserved accords with that of recent specimens; the dactylus is more deflexed than it could be if the immovable finger were preserved *in situ*. The tubercles of the palm are arranged in general as in recent individuals, and slight divergences are attributable to individual variation. The dactylus has 6 punctated grooves, and the prehensile tooth situated at a little distance from the base is present; the three uppermost ridges bear some tubercles, the outer ridge two tubercles, the upper one three tubercles, and the inner ridge one tubercle followed by several crenulations.

**PANOPEUS ANTEPURPUREUS, new species.**

Plate 58, figs. 3-11.

*Type-locality*.—Panama Canal Zone. From near Mount Hope in ditch through swampy ground. About one-fourth mile from present sea beach, 6 to 8 feet above high tide. Pleistocene series. D. F. MacDonald, collector. April, 1911. Station 5850.

*Types*.—Cat. No. 324245, U.S.N.M.

*Material*.—18 dactyli of stronger chela from right side; 9 dactyli of stronger chela from left side; 4 dactyli of weaker chela from left side; one propodal finger of weaker chela from right side.

With one exception these digits belonged to small individuals; the exception, a right dactylus 12.8 mm. long, is made the holotype.

The dactyli are very much like the corresponding parts of *P. purpureus* Lockington,<sup>1</sup> a recent species ranging from Lower California to Peru. The only differences are as follows: The fingers are a little longer, slenderer, and straighter; the large basal tooth of the stronger chela is closer to the articulation with the manus; there is no coarse granulation on the basal portion of the dactyli, as there is on the living form. Most of the specimens are purplish-blue except at the tip.

The propodal finger also is slenderer than in *P. purpureus*; the lower groove of the outer surface is nearer the lower margin. As this finger was not attached to a dactylus, one cannot be positive that it belongs to the same species as the dactyli.

**PANOPEUS TRIDENTATUS, new species.**

Plate 58, figs. 12-15.

*Type-locality*.—Panama Canal Zone. From near Mount Hope in ditch through swampy ground. About one-quarter mile from present sea beach, 6 to 8 feet above high tide. Pleistocene series. D. F. MacDonald, collector. April, 1911. Station 5850.

*Types*.—Cat. No. 324244, U.S.N.M.

<sup>1</sup> Proc. California Acad. Sci., vol. 7, 1876 (1877), p. 101.



*Material.*—Eleven dactyls and three propodal digits of the right chela, all detached. One of the dactyls is made a holotype.

*Measurements.*—Length of longest dactyl 9.2 mm., height 3 mm.; length of holotype 6.1 mm., height 2.3 mm.

*Holotype.*—I have chosen a small specimen for holotype because it is the best preserved. The dactyl is rather slender for the major chela of a Panopeid, but it has the general character of *Panopeus* and its allies. The prehensile edge has 3 enlarged teeth, placed as follows, beginning at the proximal end: 1 l., 2 s., 1 l., 3 s., 1 l., 7 s., tip. The proximal tooth is of the customary backward-pointing type, and is of moderate size compared to the basal tooth of living Panopeids. The second of the large teeth is of nearly the same size, more pointed, and directed downward; the third large tooth is definitely smaller than the others. The small teeth are unequal and shallow. The longitudinal depression either side of the teeth is punctate; there are 3 other punctate furrows, one external, one internal and the other dorsal but nearer the outer side; just within the proximal half of the dorsal furrow there is a marginal line of granules.

*Paratypes.*—The number of small teeth intervening between the larger teeth of the prehensile edge vary as follows, beginning at the proximal end: 1-3, 4-6, 6-8.

One can not be sure that the propodal digits referred here belong to the same species as the dactyli. They too have 3 large teeth, which are subequal and are separated by small teeth as follows, beginning with the proximal large tooth: 2, 4-5, 4-6. Proximal end broken off in each case, but in one instance a small tooth is visible proximal to the first large tooth. When an immovable finger is applied against a movable finger of complementary size, the large teeth of the former shut into the sinuses distal to the corresponding large teeth of the latter. There are 6 longitudinal punctate depressions on each propodus, one adjacent to the teeth on either side, one external, one internal, and two inferior.

PANOPEUS, species.

Plate 66, figs. 8 and 9.

*Locality.*—From the four feet of dark, stratified tuff and clay immediately overlying the lower limestone bed. Las Cascadas section. Upper part of Culebra formation. Oligocene series. D. F. MacDonald and T. W. Vaughan, collectors. 1911. Station 6019b. Cat. No. 324254, U.S.N.M.

*Material.*—One dactylus of right cheliped, with proximal end incomplete. Dactylus very broad at base in proportion to its length, also unusually thick. Length, 9.2 mm.; width, 4.7 mm.; thickness, 3 mm. In outer view the upper margin is much curved, the surface



is much worn, but there is a line of punctae visible through the middle; there is a large subbasal tooth directed obliquely backward, and bounded posteriorly by a deep, wide groove; the tooth does not project beyond the general lower margin, but it may have done so when entire. On the distal portion of the outer edge of the prehensile surface there are a few shallow crenulations.

This specimen comes nearer to *Panopeus* than to any other known genus; from *P. chilensis* Milne Edwards and Lucas<sup>1</sup> it differs in its greater width, in the large tooth originating higher up on the outer surface and in the groove behind it being deeper and more extensive.

**EURYTIUM CRENULATUM, new species.**

Plate 64, figs. 8 and 9.

*Type-locality*.—Panama Canal Zone. From near Mount Hope in ditch through swampy ground. About one-quarter mile from present sea beach, 6 to 8 feet above high tide. Pleistocene series. D. F. MacDonald, collector. April, 1911. Station 5850.

*Holotype*.—Cat. No. 324253, U.S.N.M. Dactylus of right chela, 7.6 mm. long. This has the general shape of a *Eurytium* finger, but the large basal tooth of the prehensile edge is inserted higher up, its oblique base running posteriorly well up on the outer surface; the tooth is directed strongly backward and is broadly rounded at the extremity. It is followed by about ten low teeth, the first and third of which are the larger. Somewhat above the middle of the inner and of the outer surface there is a longitudinal depression containing a row of a few punctae. There is a deep groove on the upper surface and just within it but higher up there is a row of separated granules or crenulations; they point outward, that is, a side view of them may be obtained by looking down on the top of the finger. The ridge just outside the dorsal groove is proximally microscopically granulate.

This finger can not be referred to *E. affine*<sup>2</sup> or *E. tristani*<sup>3</sup> of the Panamanian fauna on account of the elevation and direction of the basal tooth, and the row of granules on the upper edge.

**Family GONEPLACIDAE.**

**Subfamily PRIONOPLACINAE.**

**EURYPLAX CULEBRENSIS, new species.**

Plate 66, figs. 13 and 14.

*Type-locality*.—Panama Canal Zone. Top part of limy sandstone below upper conglomerate, near foot of stairs, Gaillard Cut. Upper

<sup>1</sup> D'Orbigny's Voy. Amér. MÉR., vol. 6, pt. 1, 1843, p. 16; vol. 9, atlas, 1847, pl. 8, fig. 2.

<sup>2</sup> *Panopeus affinis* Streets and Kingsley, Bull. Essex Inst., vol. 9, 1877, p. 106.

<sup>3</sup> Rathbun, Proc. Biol. Soc. Washington, vol. 19, 1906, p. 100.



part of Culebra formation. Oligocene series. D. F. MacDonald and T. W. Vaughan, collectors. 1911. Station 6012c.

*Holotype*.—Cat. No. 324226, U.S.N.M. Propodus of right and major cheliped with only the base of the immovable finger remaining. Palm swollen. In side view the upper and lower margins are arcuate, the palm narrowing considerably toward the wrist. Surface smooth. At the distal end above the lower margin there is a deep groove which is prolonged on the finger. The palmar tooth which overlaps the dactylus is present; also 4 prehensile teeth of the fixed finger, arranged in 2 transverse rows on the upper surface, the outer tooth of the distal pair being much the largest.

*Measurements*.—Length of palm, to sinus, 6.5 mm.; height, 4.3 mm.; thickness, 2.7 mm.

This specimen has the general form of *E. nitida* Stimpson,<sup>1</sup> a Recent species occurring on the coast of the Gulf of Mexico and the West Indies. I have no example of the Panamanian species, *E. polita* Smith<sup>2</sup> for comparison. *E. nitida* is considerably larger than the fossil form, the fixed finger is somewhat wider at the base but it has the 4 basal teeth similarly disposed; the proximal end of the upper margin is thinner and more acute than in *E. culebrensis*.

#### Subfamily HEXAPODINAE.

Living representatives of this subfamily are restricted to the Indo-Pacific region.

#### Genus THAUMASTOPLAX Miers.

*Thaumastoplax* MIERS, Ann. Mag. Nat. Hist., ser. 5, vol. 8, 1881, p. 261.

The generic position of the species placed here has to be determined by the characters discernible in a dorsal view. As in *Thaumastoplax*, the shape of the carapace is subrectangular with the antero-lateral corners rounded off; the second ambulatory leg is stronger than the first and third. Of the other Hexapodinae, or Goneplacids with only 3 pairs of walking legs, *Hexapus* de Haan<sup>3</sup> is more subcylindrical and has the three legs of subequal size; *Lambdophallus* Alcock<sup>4</sup> has smaller orbits; *Hexaplax* Doflein<sup>5</sup> has very oblique orbits seen from above, while *Paeduma* Rathbun<sup>6</sup> (= *Amorphopus* Bell<sup>7</sup>) is said to be almost cylindrical.

<sup>1</sup> Ann. Lyc. Nat. Hist. New York, vol. 7, 1859, p. 60.

<sup>2</sup> Trans. Connecticut Acad. Sci., vol. 2, 1870, p. 163.

<sup>3</sup> Fauna Japon., 1833, p. 5; 1835, p. 35.

<sup>4</sup> Journ. Asiat. Soc. Bengal, vol. 69, 1900, p. 329.

<sup>5</sup> Wiss. Ergeb. deutschen Tiefsee-Exped. Valdivia, 1898-99, vol. 6, 1904, p. 122.

<sup>6</sup> Proc. Biol. Soc. Washington, vol. 11, 1897, p. 163.

<sup>7</sup> Jour. Linn. Soc. London, Zool., vol. 3, 1858, p. 27.



## THAUMASTOPLAX PRIMA, new species.

Plate 66, figs. 15-18.

*Type-locality.*—Panama Canal Zone. Las Cascadas section, Gaillard Cut. From lowest fossiliferous bed; third bed below lowest limestone beds separated by rows of nodules. Lower part of upper half of Culebra formation. Oligocene series. D. F. MacDonald and T. W. Vaughan, collectors. 1911. Station 6020a.

*Measurements.*—Length of carapace, paratype, 12.2 mm. (approx.); width, 18 mm. (approx.) The holotype is a little wider, about 19.6 mm., but the length can not be measured as the front part of the carapace is not visible.

*Holotype and paratype.*—Carapace about  $1\frac{1}{2}$  times as broad as long, longitudinally very convex, from side to side nearly horizontal. Upper surface not bordered by a definite line; H-shaped depression in the center of the carapace deep; surface deeply punctate, punctae crowded near the margins, sparse near the middle. Fronto-orbital distance about two-fifths as great as the extreme width of the carapace. Antero-lateral margins long, arcuate; postero-lateral margins subparallel; posterior margin slightly convex. Front deflexed and widening a little from the base of the eyestalks downward. The orbit is about as wide as the narrowest part of the front and is filled by the eyestalk; its upper margin is transverse.

Chelipeds short, when flexed scarcely reaching beyond the outer end of the orbit; carpus very large, convex, smooth, and punctate; chela small, not much longer than carpus and considerably narrower; finger shorter than palm; the end of the finger is, however, not visible. The merus of the first leg reaches quite to the end of the carpus of the cheliped, its upper margin has a row of small conical tubercles or granules, and there is a cluster of granules near the articulation with the carpus. The merus of the second leg reaches a little beyond that of the first, and is very much stronger; it also has a superior row of granules and a few granules on the outer surface; carpus elongate, about half as long as merus; propodus as wide as the greatest width of the carpus; only a portion of it is visible. Third leg very much shorter and slenderer, its carpus reaching little beyond the merus of the second pair; its merus, as well as that of the second pair, is longitudinally grooved.

The above description is made from two specimens from the same place. Each specimen was enclosed in a nodule which is broken in two. The holotype shows the upper surface of the carapace (except the front part), portions of the left cheliped, and of the 3 legs of both sides. The nodule is not large enough to have included the whole of the legs in their extended position. Cat. No. 324227, U.S.N.M. The paratype shows the carapace only; there is no trace



of chelipeds or legs; the nodule is very little wider than the carapace. Cat. No. 324228, U.S.N.M.

### Family GECARCINIDAE.

#### CARDISOMA GUANHUMI Latreille.

Plate 64, figs. 2-4.

*Cardisoma guanhumi* LATREILLE, Encyc. Méth., Hist. Nat., Insectes, vol. 10, 1825, p. 685.

*Locality*.—Costa Rica: City of Port Limon. Port Limon formation. Pliocene series. Dr. L. A. Wailes, collector. Station 4269. Cat. No. 324263, U.S.N.M.

*Material*.—Left propodal finger of cheliped, with extremities lacking; length 18.5 mm. Pieces of the outer crust remain along the prehensile teeth, around the distal end, and on the lower part of the proximal end, where it shows the characteristic scaly granulation of the species.

*Distribution of Recent Material*.—From Bahamas and Florida Keys to Brazil; Bermudas.

### Family OCYPODIDAE.

#### UCA MACRODACTYLUS (Milne Edwards and Lucas).

Plate 64, fig. 7.

*Gelasimus macrodactylus* MILNE EDWARDS and LUCAS, d'Orbigny's Voy. Amér. MÉR., vol. 6, 1843, p. 27; vol. 9, atlas, 1847, pl. 11, fig. 3.

*Locality*.—Panama Canal Zone. From near Mount Hope in ditch through swampy ground. About one-quarter mile from present sea beach, 6 to 8 feet above high tide. Pleistocene series. D. F. MacDonald, collector. April, 1911. Station 5850. Cat. No. 324251, U.S.N.M.

*Material*.—A single dactylus, 6.7 mm. long, of an ambulatory leg corresponds with that of a recent specimen from Costa Rica. The dactylus is rather slender, regularly tapering and strongly curved on its concave as well as on its convex margin, it has 6 longitudinal grooves separated by as many smooth rounded ridges; toward the horny tip these ridges are themselves guttered by a narrow groove.

*Distribution of Recent Material*.—From Guaymas, Mexico, to Valparaiso, Chile.

#### BRACHYRHYNCHA, family, genus, and species indeterminable.

Plate 64, fig. 6.

*Locality*.—Panama Canal Zone. Las Cascadas section, Gaillard Cut. From lowest fossiliferous bed. Third bed below lowest lime-



stone beds separated by rows of nodules. Lower part of upper half of Culebra formation. Oligocene series. D. F. MacDonald and T. W. Vaughan, collectors. 1911. Station 6020*a*. Cat. No. 324294, U.S.N.M.

*Material*.—A specimen 9.3 mm. long and 7.7 mm. wide, which resembles the proximal part of the right manus of a crab. The outer and lower surfaces are exposed, but the outer layer of shell has almost disappeared. The surface gradually ascends to a line a little below the middle where a blunt longitudinal ridge is formed. Just below the upper margin, and also just within the lower margin on the inner side, there is a narrow furrow.

The blunt crest is suggestive of the Portunidae.

**BRACHYRHYNCHA, family, genus, and species indeterminable.**

Plate 64, fig. 5.

*Locality*.—Panama Canal Zone. Las Cascadas section, Gaillard Cut. From lowest fossiliferous bed. Third bed below lowest limestone beds separated by rows of nodules. Lower part of upper half of Culebra formation. Oligocene series. D. F. MacDonald and T. W. Vaughan, collectors. 1911. Station 6020*a*. Cat. No. 324258, U.S.N.M.

*Material*.—Two specimens, each embedded in a nodule, of a fragment which appears to be the merus segment of an ambulatory leg of a crab. The surface is flat, the lateral margins are arcuate and there is a shallow longitudinal depression near one edge. The shape is very suggestive of the Portunidae and yet they do not closely resemble any known species.

**Superfamily OXYRHYNCHA.**

**Family PARTHENOPIDAE.**

**PARTHENOPE PANAMENSIS, new species.**

Plate 66, figs. 10 and 11.

*Type-locality*.—Panama Canal Zone. Las Cascadas section. From fifth or topmost limestone. Emperador limestone. Oligocene series. D. F. MacDonald and T. W. Vaughan, collectors. 1911. Station 6019*g*. Cat. No. 324257, U.S.N.M.

*Measurements*.—Length of arm measured along lower margin (incomplete), 24.6 mm.; distal width, measured on inner, lower surface, 6.6 mm.; minimum width, on the same surface, 4.7 mm.

*Holotype*.—One specimen represented by only the merus joint of the left cheliped. This segment is thick; a cross section is quadri-



lateral and nearly as broad as long; the proximal end is broken off, the distal end is embedded in a hard matrix. The two upper surfaces are each not much more than half as wide as either of the two lower surfaces. The upper, inner and outer margins are armed with irregular spines and tubercles, the lower margin with tubercles only, which are not in a single row; the surfaces also have a few scattered spines and tubercles. The tips of most of the spines are broken off; the largest spines are one on the upper margin near the proximal end (of the specimen), and one just above the outer margin in the middle third. The distal extremity of the segment widens in a manner suggestive of the propodus of a Parthenopid, but it is not triangular-prismatic as customary in the propodal segments.

**PARTHENOPE PLEISTOCENICA, new species.**

Plate 61, figs. 10 and 11.

*Type-locality*.—Panama Canal Zone. From near Mount Hope in ditch through swampy ground. About one-quarter mile from present sea beach, 6 to 8 feet above high tide. Pleistocene series. D. F. MacDonald, collector. April, 1911. Station 5850. Cat. No. 324247, U.S.N.M.

*Holotype*.—Propodal finger of right and major chela; lower proximal portion missing. Lower margin, so far as it remains, nearly straight, tip upturned; upper margin broad at the proximal end and armed with 5 unequal blunt teeth; the first or that nearest the palm is broadly united with the second which is much larger; third of similar size and shape to the second and well separated from it; fourth much smaller and fifth minute. Four lateral rows of punctae, one either side of the prehensile teeth, and one through the middle of the inner and of the outer surface. The posterior half of both surfaces is sparsely covered with prominent and very unequal granules.

*Parthenope excavata* (Stimpson)<sup>1</sup> of which there is an example from Panama in the United States National Museum collection has a similar prehensile surface, but the lateral face is shorter and higher and is granulate all over outside.

EXPLANATION OF PLATES.

PLATE 54.

*Gatunia proavita* Rathbun, holotype, dorsal view,  $\times \frac{3}{2}$ .

PLATE 55.

*Gatunia proavita*, holotype, ventral view,  $\times \frac{1}{2}$ .

<sup>1</sup> *Lambrus excavatus* Stimpson, Ann. Lyc. Nat. Hist. New York, vol. 10, 1871, p. 98.



## PLATE 56.

*Gatunia proavita*, holotype.

- FIG. 1. Anterior view,  $\times \frac{2}{3}$ .  
 2. Posterior view,  $\times \frac{2}{3}$ .

## PLATE 57.

- FIG. 1. *Natantia*, indeterminable, lateral view of pleon.  $\times 2$ .  
 2. *Axius reticulatus* Rathbun, holotype, outer view of propodus of left cheliped,  $\times 3$ .  
 3. Impression of same.  
 4. *Macrobrachium*, species, Cat. No. 324256, outer view of propodus of left cheliped,  $\times 3$ .  
 5. Upper view of same.  
 6. *Leucosilia bananensis* Rathbun, paratype *a*, arm joint,  $\times 3$ .  
 7. *Leucosilia bananensis*, paratype *b*, arm joint,  $\times 3$ .  
 8. *Leucosilia bananensis*, holotype, arm joint,  $\times 3$ .  
 9. *Macrobrachium?*, species, Cat. No. 324248, segment of large cheliped,  $\times 3\frac{1}{2}$ .  
 10. *Axius?*, species, Cat. No. 324250, scaphocerite,  $\times 3\frac{1}{2}$ .  
 11. *Goniochele? armata* Rathbun, holotype, outer view of dactylus of left cheliped,  $\times 2$ .  
 12. Lower view of same,  $\times 2$ .  
 13. *Nephrops costatus* Rathbun, holotype, dactylus of left cheliped, inner view,  $\times 3\frac{1}{2}$ .  
 14. Dorsal view of same,  $\times 3\frac{1}{2}$ .  
 15. *Nephrops costatus*, paratype *a*, dactylus of left cheliped, dorsal view,  $\times 3\frac{1}{2}$ .  
 16. *Nephrops costatus*, paratype *c*, propodal finger of left cheliped, dorsal view,  $\times 3\frac{1}{2}$ .  
 17. *Nephrops costatus*, paratype *b*, dactylus of left cheliped, dorsal view,  $\times 3\frac{1}{2}$ .  
 18. *Petrolisthes avitus* Rathbun, holotype, palm of left cheliped, dorsal view,  $\times 3\frac{1}{2}$ .  
 19. Inner view of same,  $\times 3\frac{1}{2}$ .  
 20. Ventral view of same,  $\times 3\frac{1}{2}$ .  
 21. *Pachycheles latus* Rathbun, holotype, propodus of left cheliped, ventral view,  $\times 3\frac{1}{2}$ .  
 22. Dorsal view of same.  
 23. *Pachycheles latus*, paratype, left chela, dorsal view,  $\times 3\frac{1}{2}$ .  
 24. *Calappa costaricana* Rathbun, holotype, portion of propodus of left chela, outer view,  $\times 3$ .  
 25. *Nephrops*, species, Cat. No. 324249, dactylus of right cheliped, prehensile edge,  $\times 3\frac{1}{2}$ .  
 26. Dorsal view of same,  $\times 3\frac{1}{2}$ .  
 27. *Mursilia ecristata* Rathbun, holotype, right cheliped, outer view,  $\times 3$ .

## PLATE 58.

- FIG. 1. *Calappella quadrispina* Rathbun, holotype, impression of carapace,  $\times 3$ .  
 2. Carapace of figure 1,  $\times 3$ .  
 3. *Panopeus antepurpureus*, Rathbun, holotype, dactylus of right cheliped,  $\times 3\frac{1}{2}$ .



- FIG. 4, 5. *Panopeus antepurpureus*, paratypes, dactyli of right chelipeds,  $\times 3\frac{1}{2}$ .  
 6. *Panopeus antepurpureus*, paratype, immovable finger of right cheliped,  $\times 3\frac{1}{2}$ .  
 7-11. *Panopeus antepurpureus*, paratypes, dactyli of left chelipeds,  $\times 3\frac{1}{2}$ .  
 12. *Panopeus tridentatus* Rathbun, paratype, dactylus of right cheliped,  $\times 3\frac{1}{2}$ .  
 13. *Panopeus tridentatus*, paratype, propodal finger of right cheliped,  $\times 3\frac{1}{2}$ .  
 14. *Panopeus tridentatus*, holotype, dactylus of right cheliped, outer view,  $\times 3\frac{1}{2}$ .  
 15. Upper edge of same,  $\times 3\frac{1}{2}$ .  
 16. Fragment of *Gatunia proavita* ??, Cat. No. 324286, showing lobe in profile,  $\times 2$ .  
 17. Flat surface of same,  $\times 2$ .  
 18. *Callianassa hilli* Rathbun, paratype *b*, sixth segment of pleon,  $\times 2$ .  
 19. *Callianassa hilli*, holotype, merus and carpus of right cheliped,  $\times 2$ .  
 20. *Callianassa hilli*, paratype *a*, right cheliped,  $\times 2$ .  
 21. *Mursia macdonaldi* Rathbun, holotype, left palm,  $\times 2$ .  
 22. *Carpilius*, species, Cat. No. 324243, piece of propodus of a left ambulatory leg,  $\times 2$ .

## PLATE 59.

- FIG. 1. *Callianassa ovalis* Rathbun, holotype, left cheliped,  $\times 2$ .  
 2. *Callianassa ovalis*, paratype *a*, propodus of left cheliped,  $\times 2$ .  
 3. Impression of figure 1,  $\times 2$ .  
 4. *Callianassa ovalis*, paratype *b*, carpus of left cheliped,  $\times 2$ .  
 5. *Callianassa*, species, Cat. No. 324277, manus of left cheliped,  $\times 3\frac{1}{2}$ .  
 6. *Callianassa lacunosa* Rathbun, holotype, left manus, distal view,  $\times 3$ .  
 7. Outer view of same,  $\times 3$ .  
 8. Inner view of same,  $\times 3$ .  
 9. *Callianassa lacunosa*, paratype, left manus, inner view,  $\times 3$ .  
 10. Outer view of same,  $\times 3$ .  
 11. Distal view of same,  $\times 3$ .

## PLATE 60.

- FIG. 1. *Callianassa moinensis* Rathbun, holotype, propodus of right cheliped, lower view,  $\times 3$ .  
 2. Upper view of same,  $\times 3$ .  
 3. Outer view of same,  $\times 3$ .  
 4. *Callianassa elongata* Rathbun, holotype, propodus of left cheliped, upper view,  $\times 2$ .  
 5. Outer view of same,  $\times 2$ .  
 6. Lower view of same,  $\times 2$ .  
 7. Leucosiidae?, indeterminate, Cat. No. 324136, dactylus of left chela, outer view,  $\times 3\frac{1}{2}$ .  
 8. Upper view of same,  $\times 3\frac{1}{2}$ .  
 9. *Callianassa scotti* Brown and Pilsbry, holotype, left manus, lower view,  $\times 1\frac{1}{2}$ .  
 10. *Callianassa scotti*, paratype, Cat. No. 2259, left propodus, upper view,  $\times 1\frac{1}{2}$ .  
 11. Outer view of same,  $\times 1\frac{1}{2}$ .  
 12. *Callianassa scotti*, Cat. No. 324279, left manus, distal view,  $\times 1\frac{1}{2}$ .  
 13. *Callianassa tenuis* Rathbun, holotype, left manus, inner view,  $\times 3$ .  
 14. Outer view of same,  $\times 3$ .



## PLATE 61.

- FIG. 1. *Callianassa crassa* Rathbun, holotype, dactylus of left cheliped, upper view,  $\times 2$ .
2. Outer view of same,  $\times 2$ .
3. *Callianassa crassa*, paratype, dactylus of left cheliped, outer view,  $\times 3$ .
4. *Calappa flammea*, dactylus of right cheliped, inner view,  $\times 2$ .
5. Outer view of same,  $\times 2$ .
6. *Callianassa spinulosa* Rathbun, paratype in Mus. Acad. Nat. Sci. Phila., propodus of left cheliped, outer view,  $\times 2$ .
7. *Callianassa spinulosa*, holotype and impression, left propodus, outer view,  $\times 2$ .
8. Distal view of same holotype,  $\times 2$ .
9. Inner view of same,  $\times 2$ .
10. *Parthenope pleistocenica* Rathbun, holotype, propodal finger of right chela, upper view,  $\times 3\frac{1}{2}$ .
11. Outer view of same,  $\times 3\frac{1}{2}$ .
12. *Callianassa stridens* Rathbun, holotype, left manus, outer view,  $\times 3$ .
13. Upper view of same,  $\times 3$ .
14. Inner view of same,  $\times 3$ .
15. *Callianassa crassimana* Rathbun, holotype, propodus of left cheliped, inner view,  $\times 2$ .
16. Impression of same, and piece of finger,  $\times 2$ .
17. Holotype laid against impression of same, outer view,  $\times 2$ .
18. *Mursia obscura* Rathbun, holotype, carapace,  $\times 3$ .

## PLATE 62.

- FIG. 1. *Callianassa magna* Rathbun, holotype, dactylus of right cheliped, inner view,  $\times 1\frac{1}{2}$ .
2. Outer view of same,  $\times 1\frac{1}{2}$ .
3. Upper view of same,  $\times 1\frac{1}{2}$ .
4. *Callianassa quadrata* Rathbun?, carpus of left cheliped, upper view,  $\times 2$ .
5. Lower view of same,  $\times 2$ .
6. Outer view of same,  $\times 2$ .
7. *Callianassa quadrata*, holotype, left manus, distal view,  $\times 2$ .
8. Inner view of same,  $\times 2$ .
9. Outer view of same,  $\times 2$ .
10. *Callianassa quadrata*, paratype *a*, left manus, outer view,  $\times 2$ .
11. Inner view of same,  $\times 2$ .
12. Distal view,  $\times 2$ .
13. *Callianassa quadrata*, paratype *c*, right manus, outer view,  $\times 2$ .
14. *Callianassa quadrata*, paratype *d*, left manus, outer view,  $\times 2$ .

## PLATE 63.

- FIG. 1. *Callianassa abbreviata* Rathbun, holotype, right manus, inner view,  $\times 3$ .
2. Outer view of same,  $\times 3$ .
3. Distal view of same,  $\times 3$ .
4. Impression of same,  $\times 3$ .
5. *Callianassa abbreviata*, paratype *b*, piece of propodus of left cheliped, outer view,  $\times 3$ .



- FIG. 6. *Callianassa abbreviata*, paratype *a*, left manus, outer view,  $\times 3$ .  
 7. *Heteractaea lunata* (Milne Edwards and Lucas), right chela, Cat. No. 324265, outer view,  $\times 3\frac{1}{2}$ .  
 8. Upper view of same,  $\times 3\frac{1}{2}$ .  
 9. *Heteractaea lunata*, right chela of Recent specimen, Cat. No. 2146,  $\times 3\frac{1}{2}$ .  
 10. *Callianassa vaughani* Rathbun, paratype *b*, portion of propodus of left cheliped, outer view,  $\times 2$ .  
 11. *Callianassa vaughani*, paratype *a*, left manus, outer view,  $\times 2$ .  
 12. Inner view of same,  $\times 2$ .  
 13. *Callianassa vaughani*, holotype, right chela, outer view,  $\times 2$ .

## PLATE 64.

- FIG. 1. *Arenaeus*, species, Cat. No. 324252, left movable finger, outer view,  $\times 3\frac{1}{2}$ .  
 2. *Cardisoma guanhumi* Latreille, propodal finger of left cheliped, outer view,  $\times 3$ .  
 3. Lower view of same,  $\times 3$ .  
 4. Upper view of same,  $\times 3$ .  
 5. *Brachyrhyncha*, indeterminable, Cat. No. 324258, merus of ambulatory leg,  $\times 3$ .  
 6. *Brachyrhyncha*, indeterminable, Cat. No. 324294, right manus,  $\times 3$ .  
 7. *Uca macrodactylus* (Milne Edwards and Lucas), Cat. No. 324251, dactylus of ambulatory leg,  $\times 3\frac{1}{2}$ .  
 10. *Callianassa?*, species, Cat. No. 324280, merus of right cheliped (?), view,  $\times 3\frac{1}{2}$ .  
 9. Upper view of same,  $\times 3\frac{1}{2}$ .  
 10. *Callianassa?*, species, Cat. No. 324280, merus of right cheliped (?),  $\times 3\frac{1}{2}$ .  
 11. *Euphylax fortis* Rathbun, holotype, right side, showing cross sections of merus of cheliped and of two legs,  $\times 1\frac{1}{2}$ .  
 12. Front view of same, showing remains of fingers,  $\times 1\frac{1}{2}$ .  
 13. Ventral view of same,  $\times 1\frac{1}{2}$ .

## PLATE 65.

- FIG. 1. *Callinectes*, species, Cat. No. 324255, manus and carpus of left cheliped, outer view,  $\times 1\frac{1}{2}$ .  
 2. Upper view of same,  $\times 1\frac{1}{2}$ .  
 3. *Euphylax callinectias* Rathbun, holotype, dorsal view,  $\times 1\frac{1}{2}$ .  
 4. Posterior view of same,  $\times 1\frac{1}{2}$ .  
 5. Ventral view of same,  $\times 1\frac{1}{2}$ .  
 6. Anterior view of same,  $\times 1\frac{1}{2}$ .  
 7. *Callinectes*, species, Cat. No. 324268, distal third, tip missing, of immovable finger,  $\times 3$ .

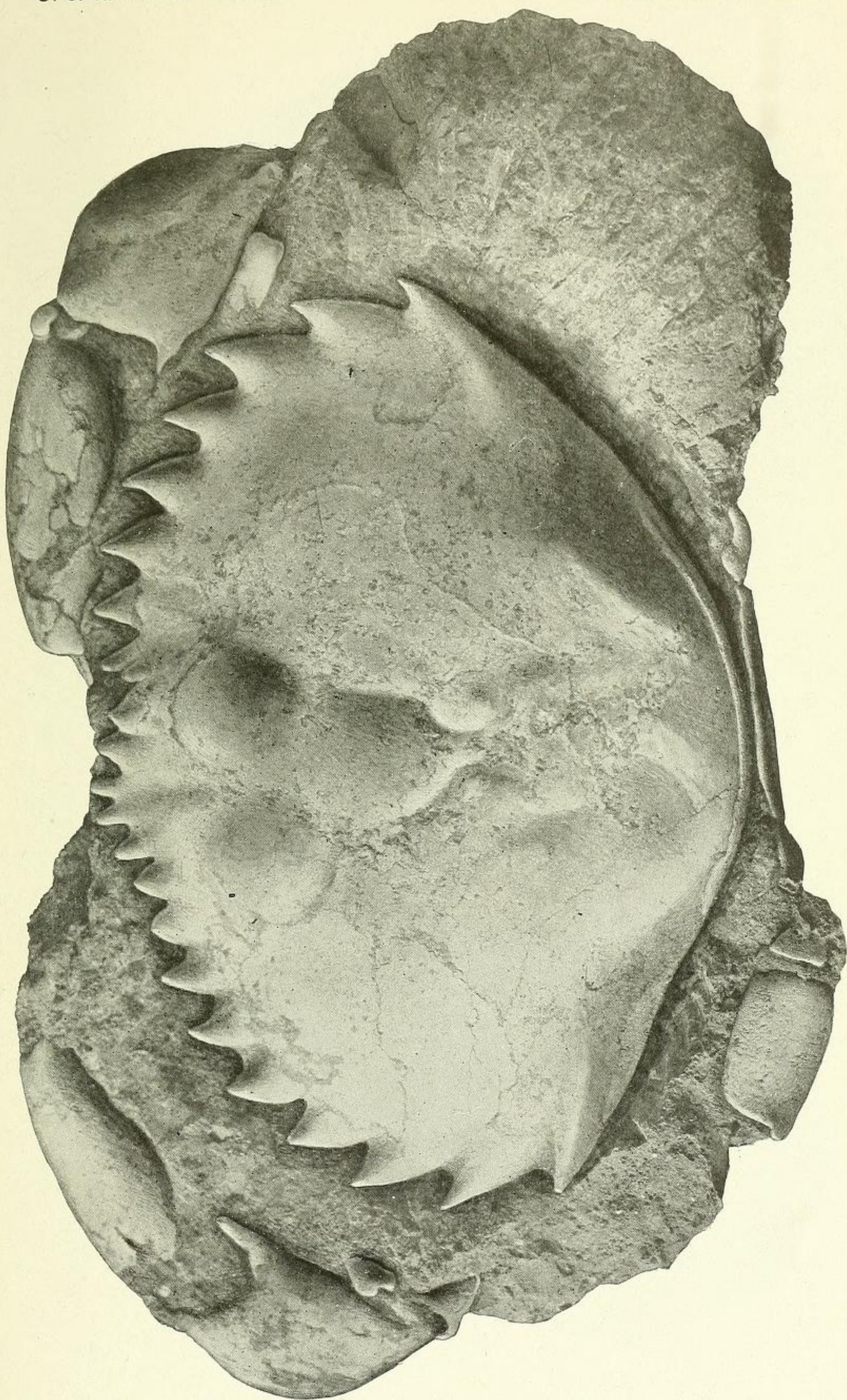
## PLATE 66.

- FIG. 1. *Callinectes declivis* Rathbun, holotype, propodus of left cheliped, upper view,  $\times 1\frac{1}{2}$ .  
 2. Inner view of same,  $\times 1\frac{1}{2}$ .  
 3. Outer view of same,  $\times 1\frac{1}{2}$ .  
 4. *Hepatus chiliensis* Milne Edwards, Cat. No. 324235, dactylus of right chela, inner view,  $\times 3\frac{1}{2}$ .  
 5. *Callinectes reticulatus* Rathbun, holotype, propodus of right cheliped, upper view,  $\times 1\frac{1}{2}$ .



- FIG. 6. Inner view of same,  $\times 1\frac{1}{2}$ .  
7. Outer view of same,  $\times 1\frac{1}{2}$ .  
8. *Panopeus*, species, Cat. No. 324254, dactylus of right cheliped, upper view,  $\times 3$ .  
9. Outer view of same,  $\times 3$ .  
10. *Parthenope panamensis* Rathbun, holotype, merus of left cheliped, outer view,  $\times 1\frac{1}{2}$ .  
11. Inner view of same,  $\times 1\frac{1}{2}$ .  
12. *Hepatus*, species, Cat. No. 324239, dactylus of left cheliped, outer view,  $\times 2$ .  
13. *Euryplax culebrensis* Rathbun, holotype, propodus of right cheliped, upper view,  $\times 3\frac{1}{2}$ .  
14. Outer view of same,  $\times 3\frac{1}{2}$ .  
15. *Thaumastoplax prima* Rathbun, paratype, carapace,  $\times 2$ .  
16. Impression of same,  $\times 2$ .  
17. *Thaumastoplax prima*, holotype,  $\times 2$ .  
18. Impression of same,  $\times 2$ .

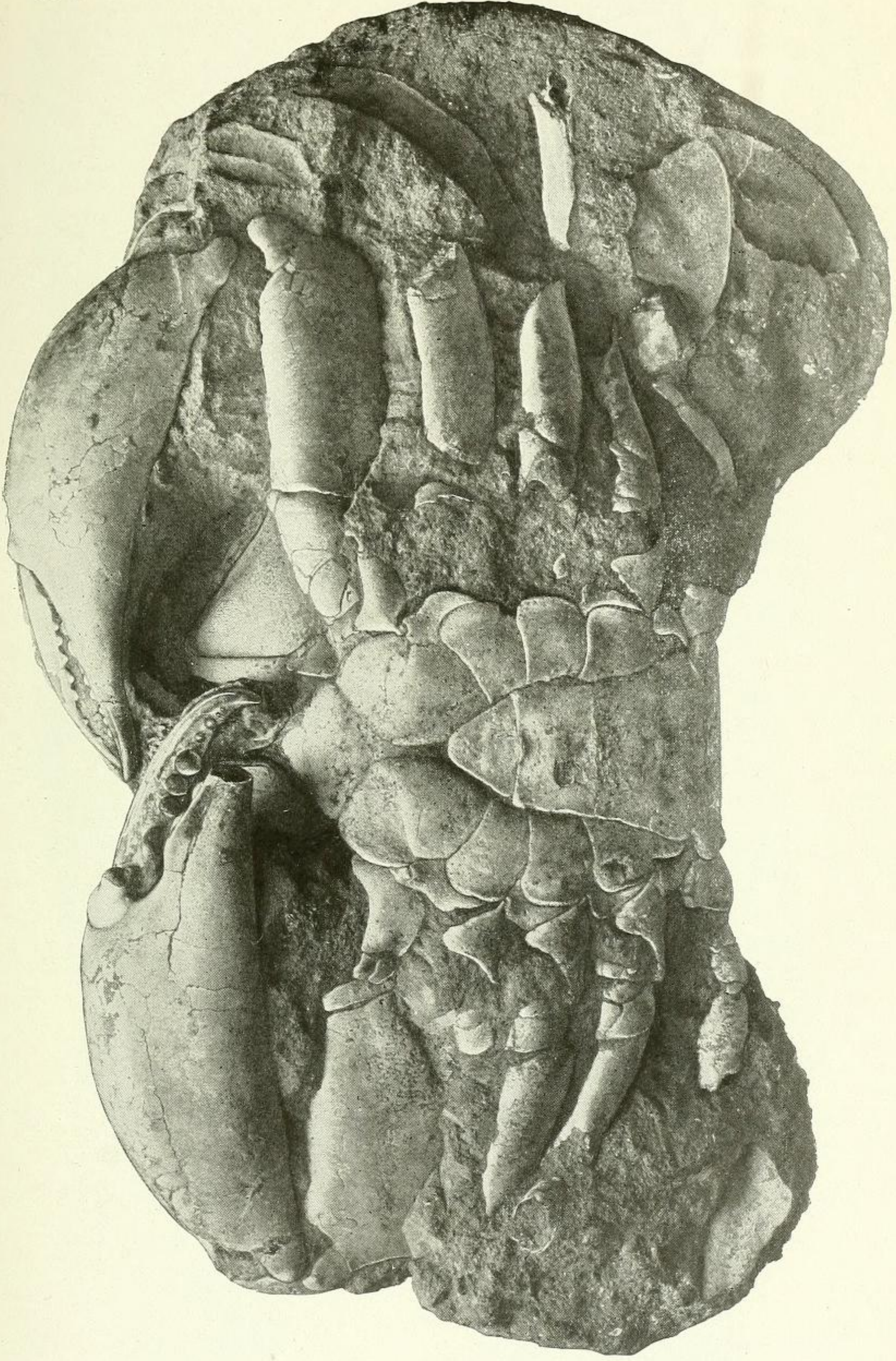




GATUNIA PROAVITA RATHBUN.

FOR EXPLANATION OF PLATE SEE PAGE 179.



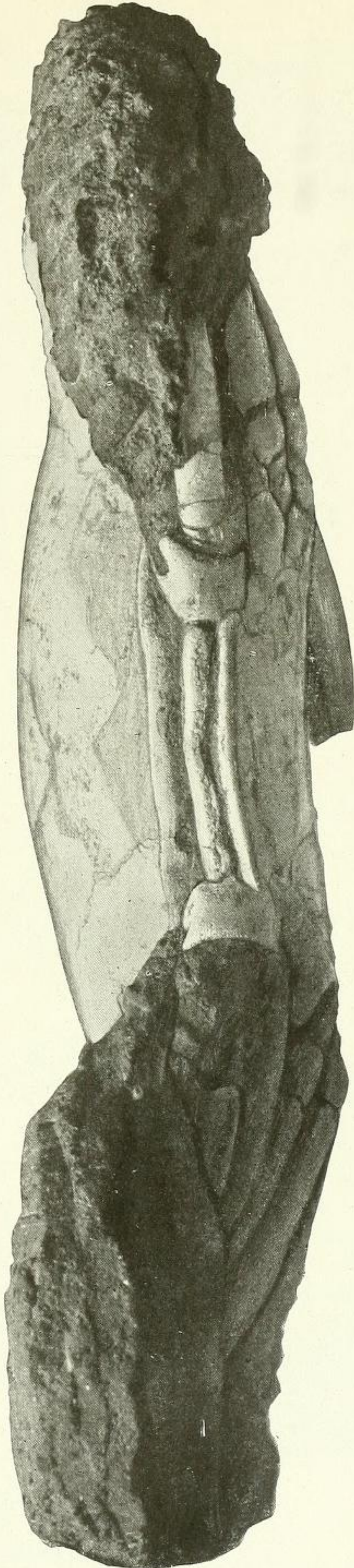


GATUNIA PROAVITA RATHBUN.  
FOR EXPLANATION OF PLATE SEE PAGE 179.





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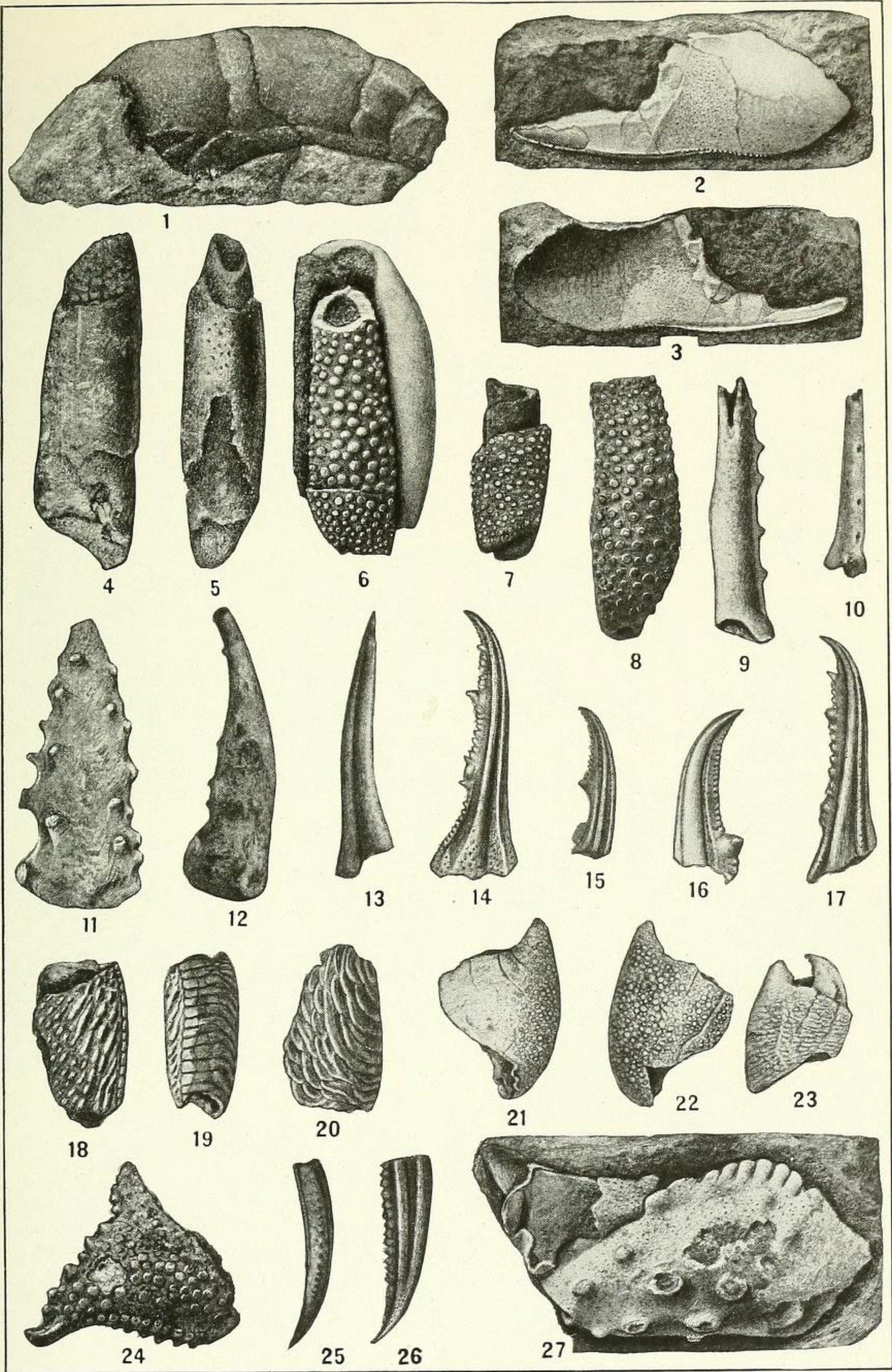


2

GATUNIA PROAVITA RATHBUN.

FOR EXPLANATION OF PLATE SEE PAGE 180.

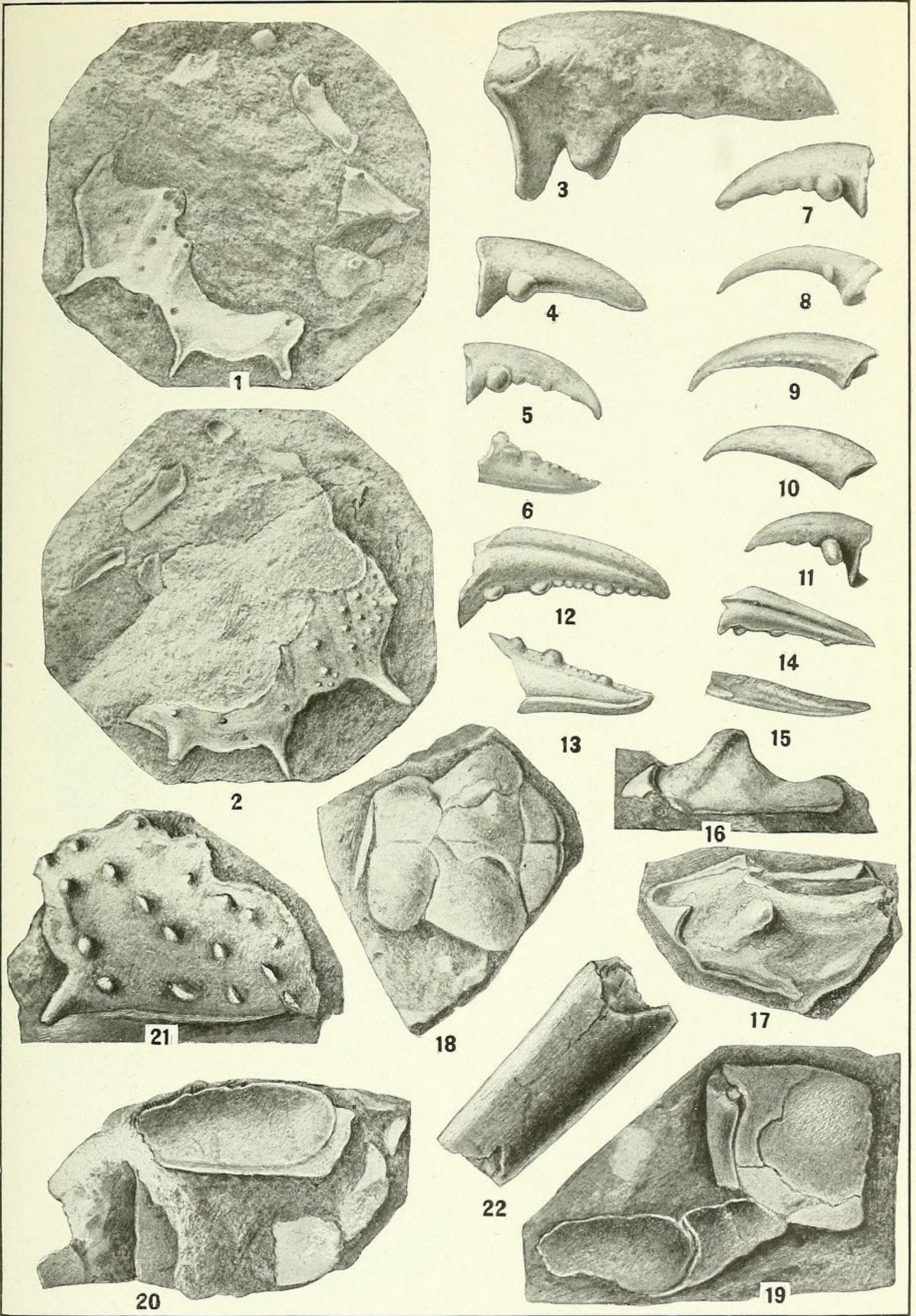




PANAMA DECAPOD CRUSTACEANS.

FOR EXPLANATION OF PLATE SEE PAGE 180.

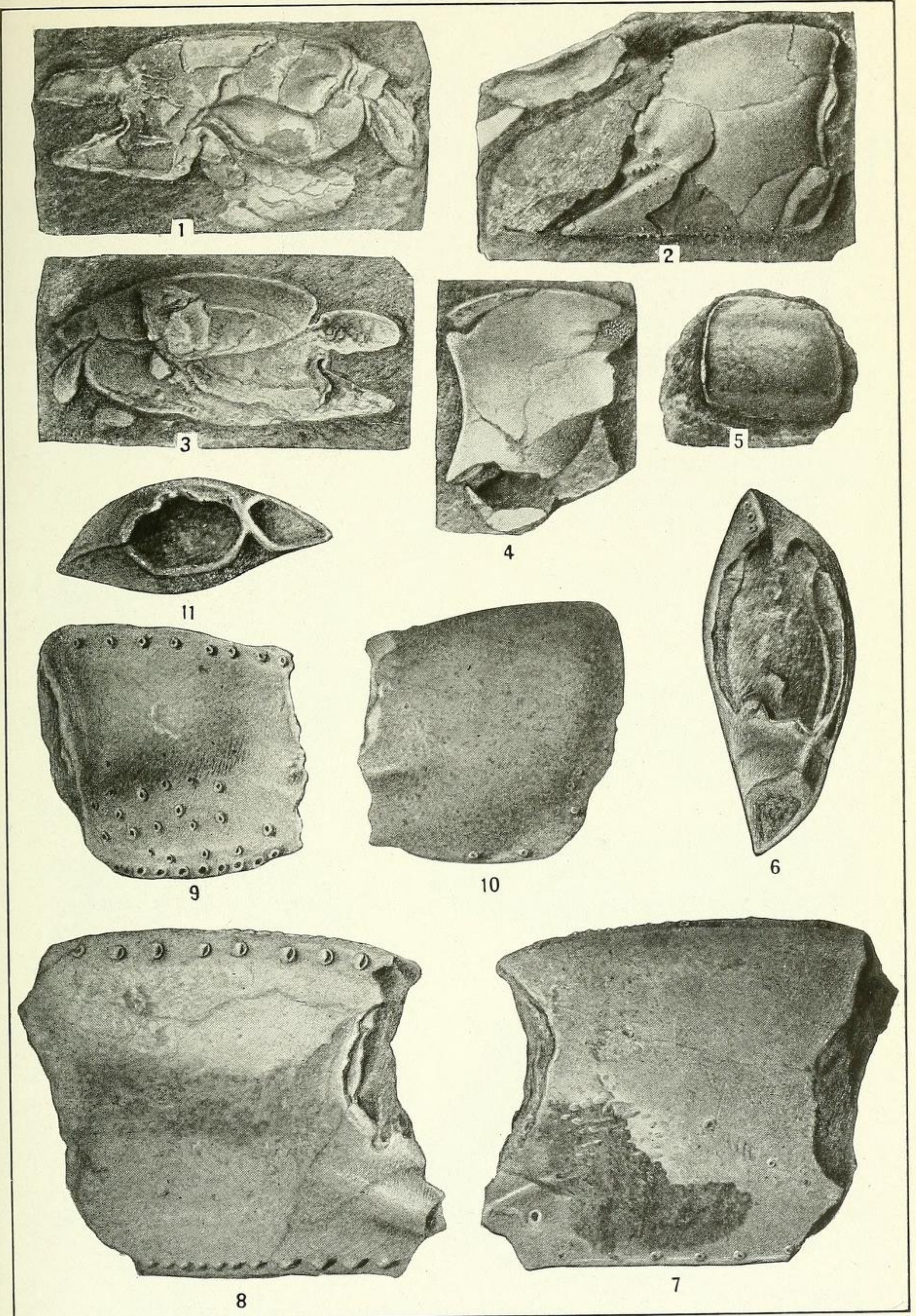




PANAMA DECAPOD CRUSTACEANS.

FOR EXPLANATION OF PLATE SEE PAGE 180

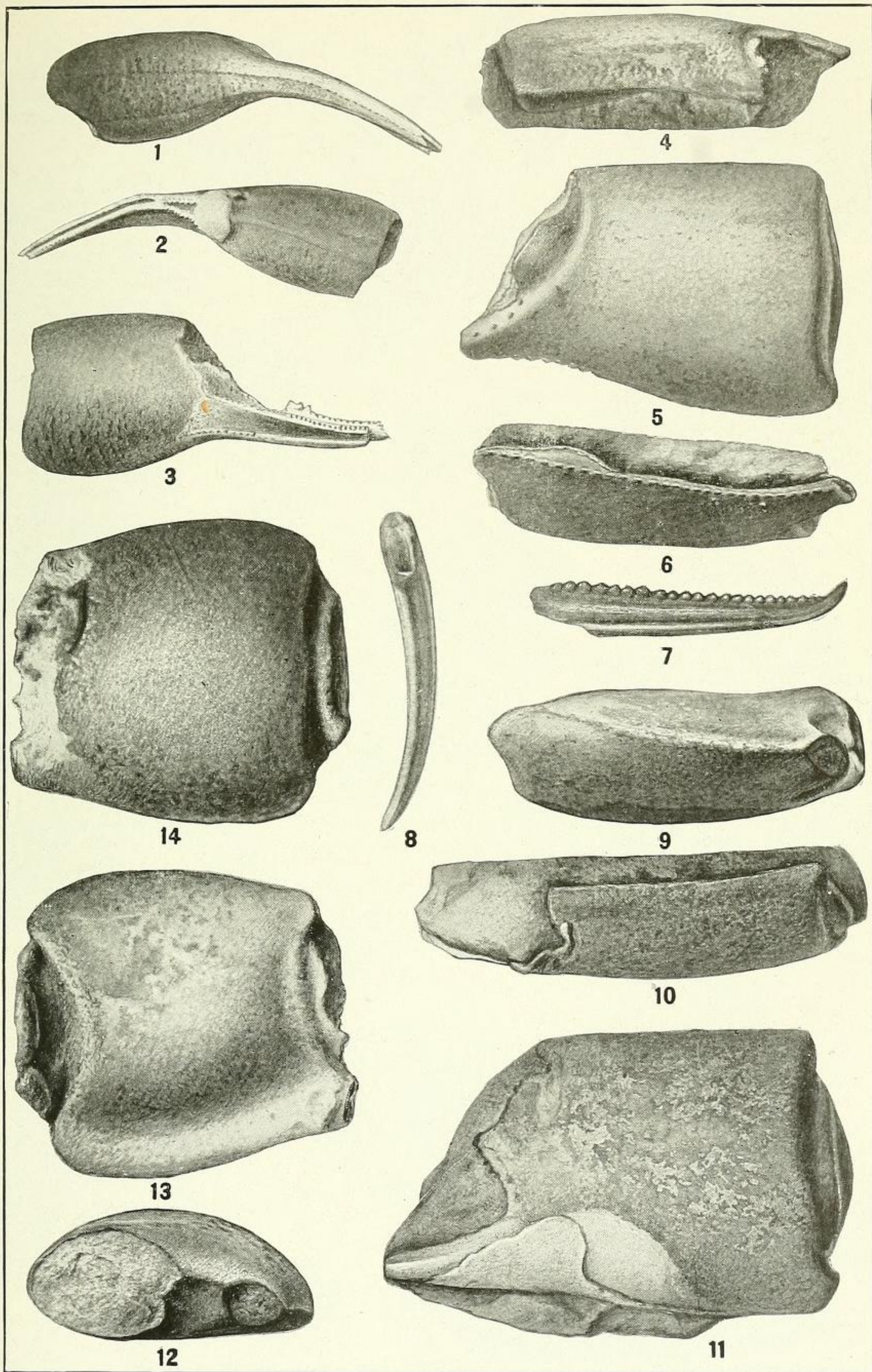




PANAMA DECAPOD CRUSTACEANS.

FOR EXPLANATION OF PLATE SEE PAGE 181

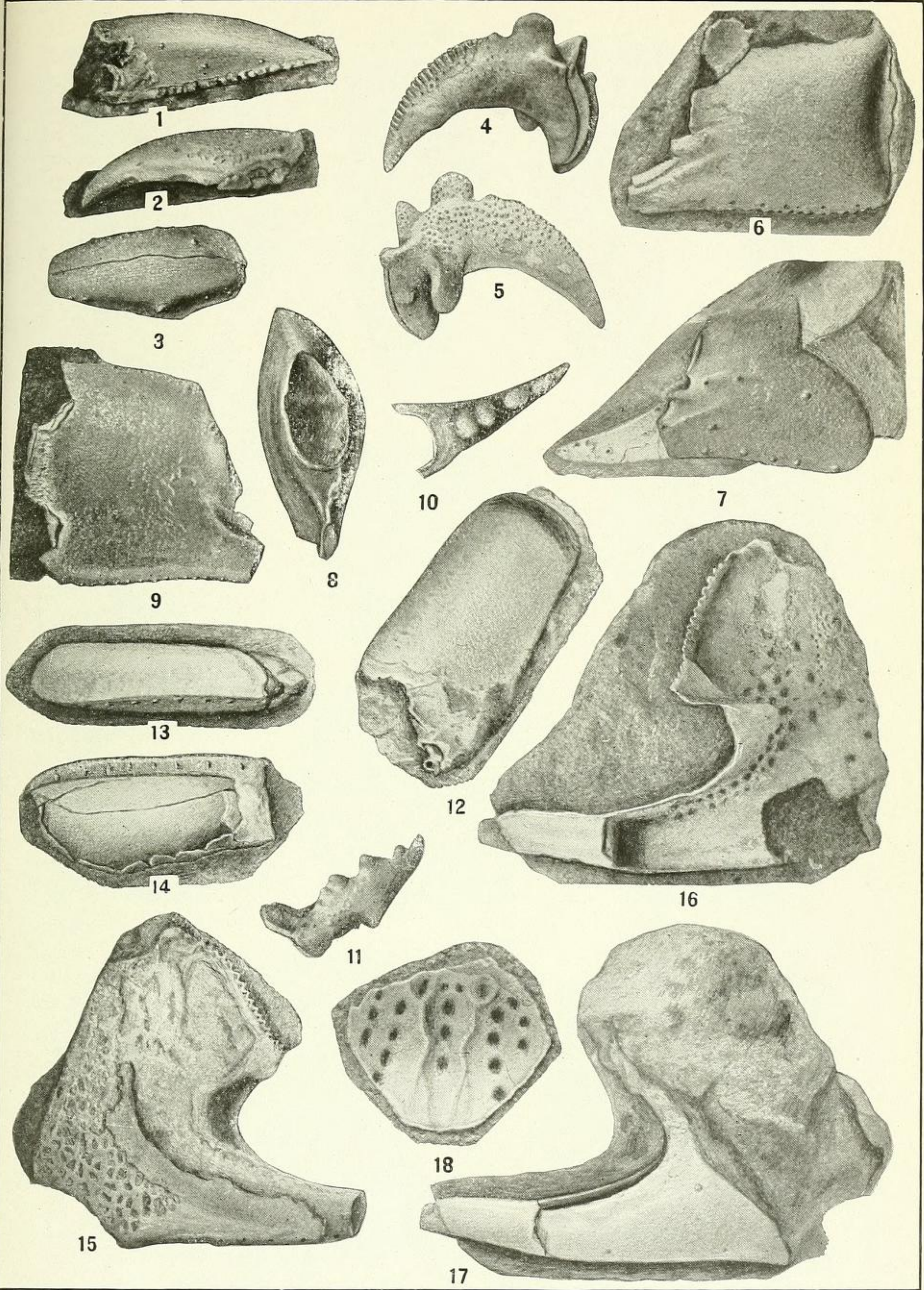




PANAMA DECAPOD CRUSTACEANS.

FOR EXPLANATION OF PLATE SEE PAGE 181.

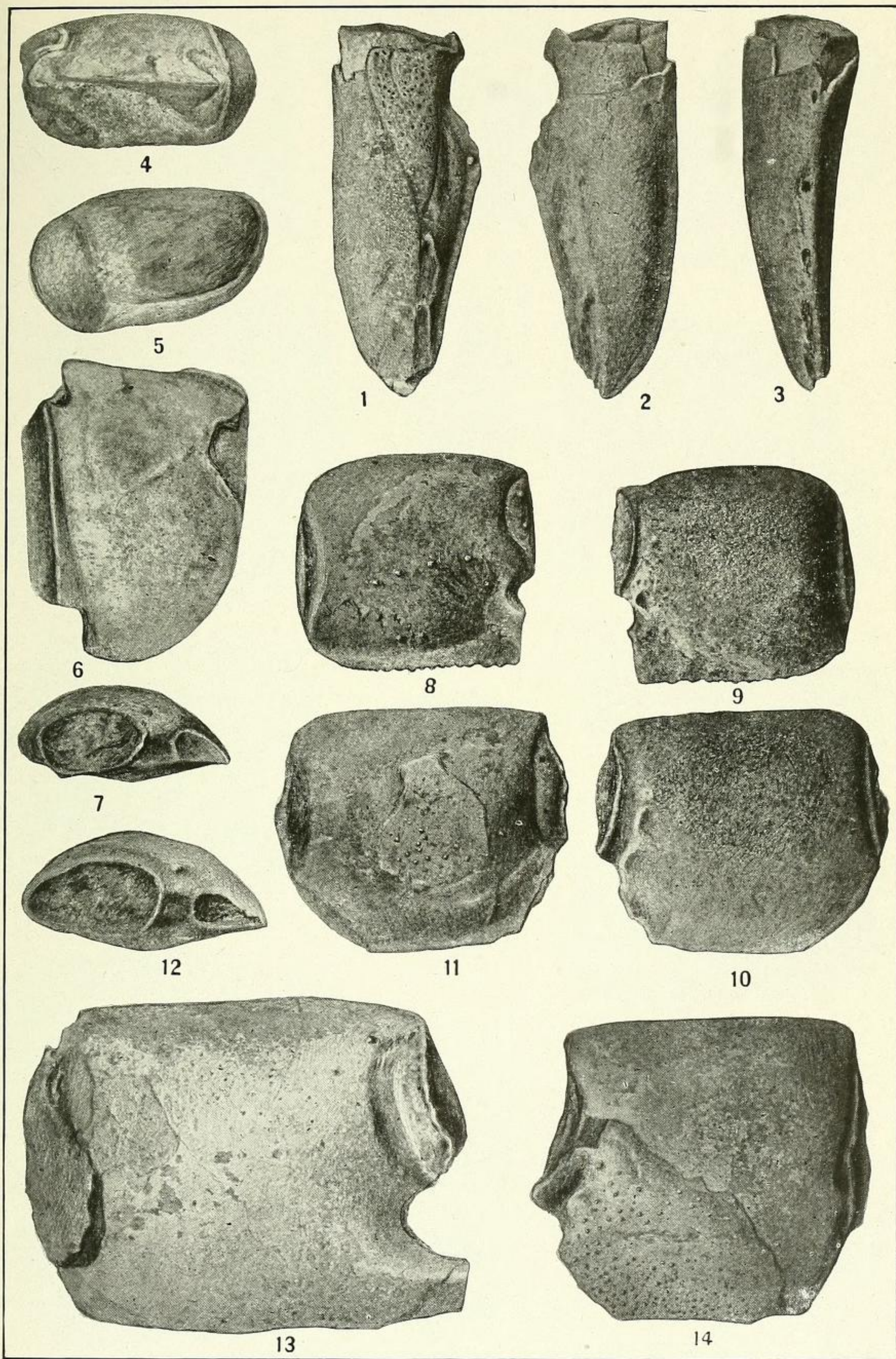




PANAMA DECAPOD CRUSTACEANS.

FOR EXPLANATION OF PLATE SEE PAGE 182

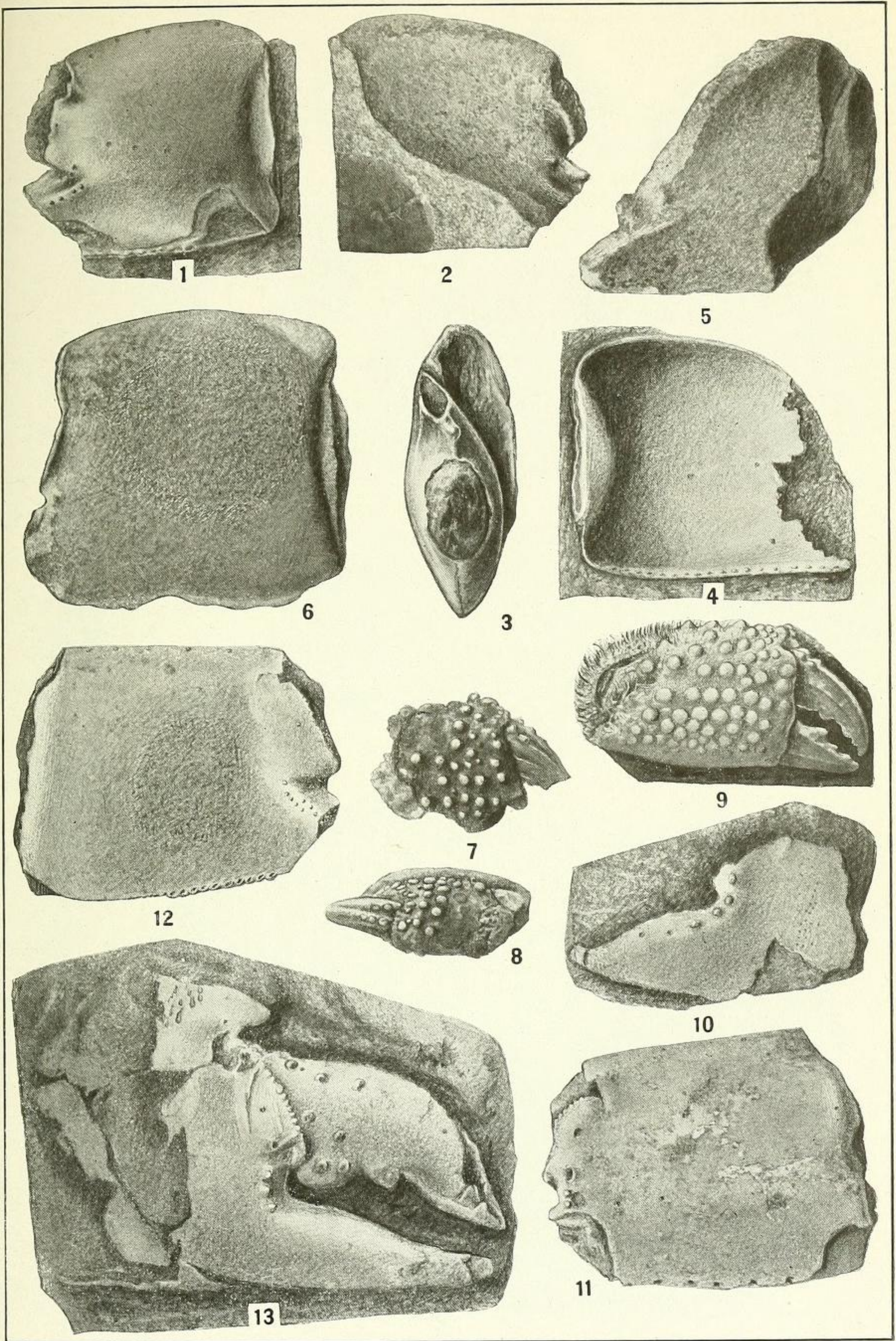




PANAMA DECAPOD CRUSTACEANS.

FOR EXPLANATION OF PLATE SEE PAGE 182

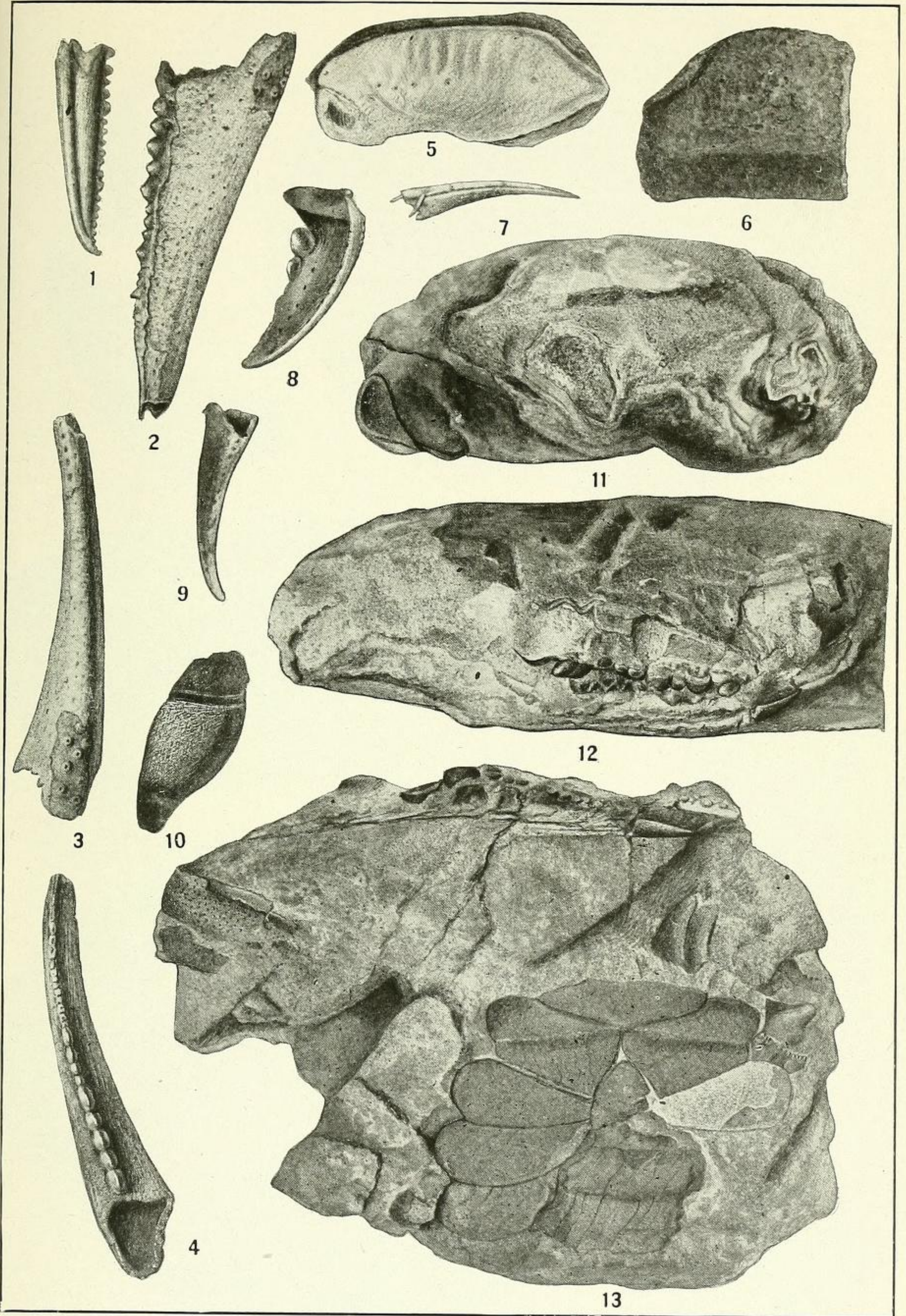




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FOR EXPLANATION OF PLATE SEE PAGES 182, 183.

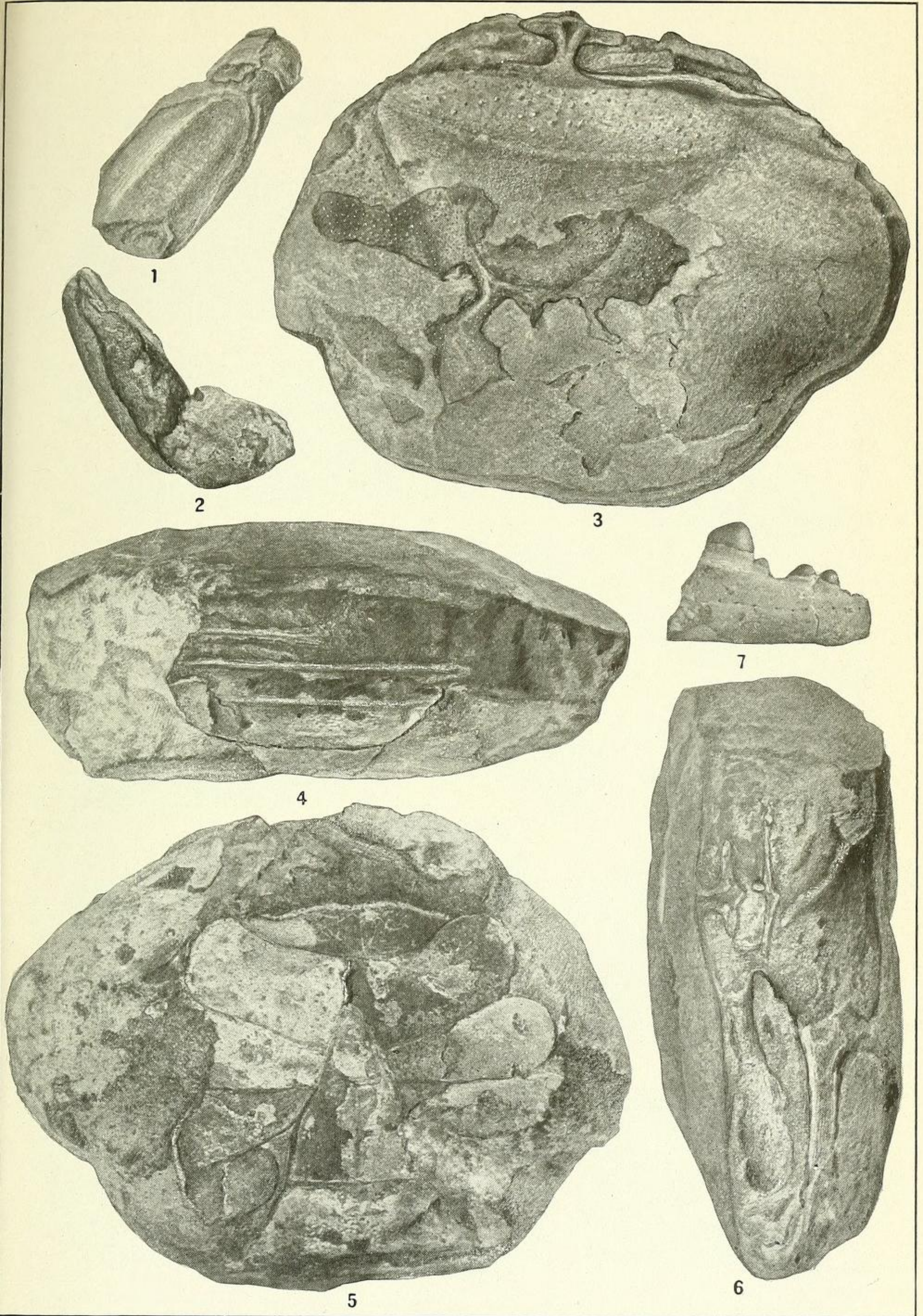




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FOR EXPLANATION OF PLATE SEE PAGE 183.

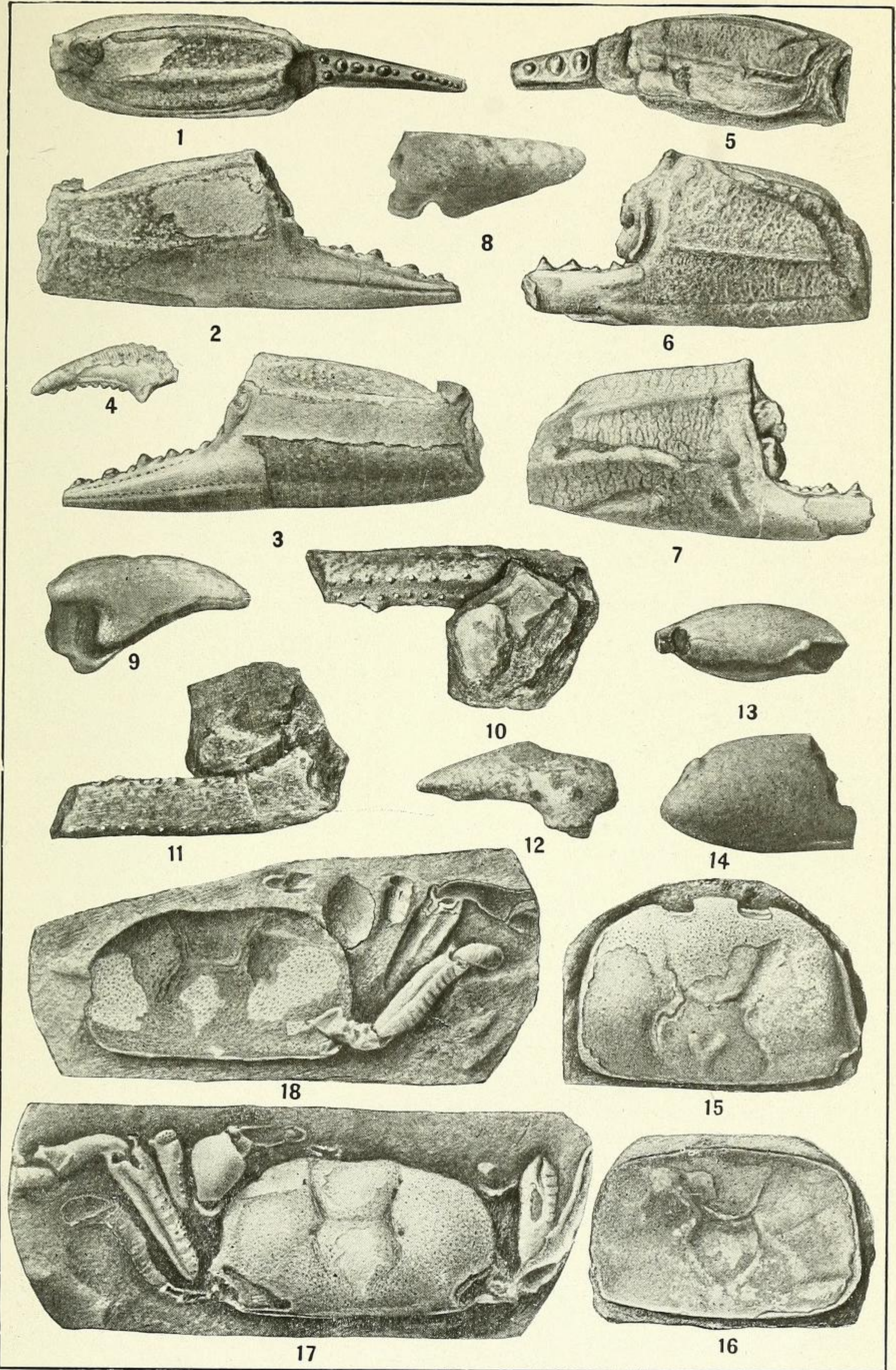




PANAMA DECAPOD CRUSTACEANS.

FOR EXPLANATION OF PLATE SEE PAGE 183.





PANAMA DECAPOD CRUSTACEANS.

FOR EXPLANATION OF PLATE SEE PAGES 183, 184.



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