

# Fossil Decapod Crustaceans from the Marshall Islands

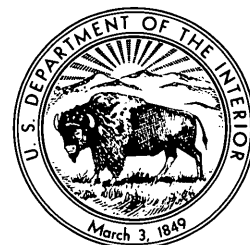
By HENRY B. ROBERTS

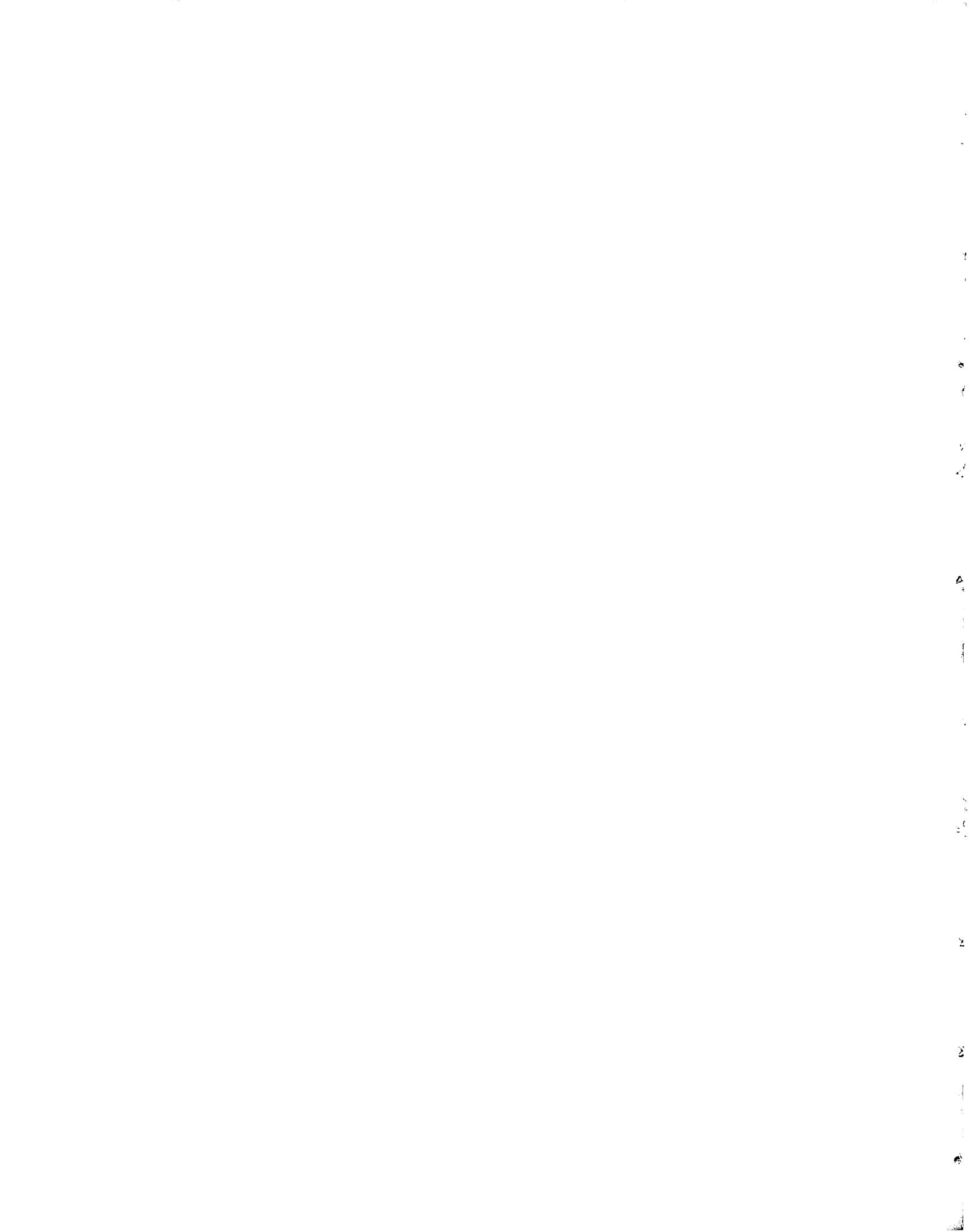
BIKINI AND NEARBY ATOLLS, MARSHALL ISLANDS

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GEOLOGICAL SURVEY PROFESSIONAL PAPER 260-HH

*Eight species are identified from  
sediments ranging from Eocene  
(Tertiary b) to Recent*





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PLATE 303. Fossil decapod crustaceans from the Marshall Islands.

III

## BIKINI AND NEARBY ATOLLS, MARSHALL ISLANDS

### FOSSIL DECAPOD CRUSTACEANS FROM THE MARSHALL ISLANDS

By HENRY B. ROBERTS<sup>1</sup>

#### ABSTRACT

Fragments of eight species (*Callianassa armata*, *C. articulata*, *Calappa hepatica*, *Thalamitoides quadridens*, *Actaea hirsutissima*, *Chlorodopsis pugil*, *Etisus laevimanus*, and *E. splendidus*) of decapod crustaceans, plus numerous specifically unidentifiable fragments were collected from sediments of Tertiary *b* (Eocene), Tertiary *e*, *f*, and *g* (Miocene), and post-Miocene age in drill holes on Bikini and Eniwetok Atolls. The eight species are present-day coral-reef dwellers in the Indo-Pacific region, with the possible exception of *Callianassa armata* whose habitat is unknown; it is inferred that the sediments enclosing these corallidomous forms were deposited under similar environmental conditions. Distribution and ecology indicate an extension of geographic range for *Callianassa armata* and *C. articulata* and stratigraphic range for *C. armata*, *Etisus laevimanus*, and *E. splendidus*.

#### INTRODUCTION

Fragments of fossil decapod crustaceans, the first reported from the Marshall Islands, were obtained by the U.S. Geological Survey during Operation Crossroads on Bikini and nearby atolls in 1947 and on Eniwetok Atoll by the U.S. Atomic Energy Commission and the Los Alamos Scientific Laboratory in 1950, 1951, and 1952; the fragments were sent to the author for study early in 1959. The drilling operations, sample recovery, and geology on Bikini and Eniwetok Atolls are discussed by Ladd and others (1953), Emery and others (1954), and Ladd and Schlanger (1960).

#### LITERATURE ON FOSSIL DECAPODS OF PACIFIC ISLANDS

Previous reports concerning fossil decapods of the islands of the open Pacific Ocean have dealt with collections from the following places: Bonin Islands (Yabe and Sugiyama, 1935), Ellice Islands (Hinde, 1904), Fiji (Rathbun, 1934, 1945), Mariana Islands (Imaizumi, 1939, 1953; Kesling, 1958), New Caledonia (A. Milne-Edwards, 1873; Remy, 1952), and the New Hebrides (Kowalski, 1923, 1924; Abrard, 1947).

#### LOCATIONS

In the systematic descriptions the symbols, such as 2A, 2B, E-1, refer to the drill holes in which the speci-

mens were collected. The numbers following each symbol refer to the depth at which the sample was taken. For example, the notation E-1, 2,480-2,490 feet means that the specimen was present in a sample collected 2,480-2,490 feet below the surface in hole E-1 on Parry Island at Eniwetok Atoll. The locations of the island drill holes (Emery and others, 1954, fig. 31; and Ladd and Schlanger, 1960, p. 864-865, figs. 260, 261) are indicated in the following table. The exact sites of F-1, F-A, and F-C drilled on Elugelab are now only of academic interest as the entire island was destroyed by detonation of a thermonuclear device shortly after completion of the drilling.

Location	Drill hole
Bikini Atoll: Bikini Island .....	2A. 2B.
Eniwetok Atoll: Parry Island .....	E-1.
Elugelab .....	F-1. F-1-A, F-3-A, F-10-A, F-15-A. F-24-A, F-2-C, F-4-C, F-6-C, F-7-C, F-8-C, F-9-C, F-12-C, F-14-C, F-15-C.
Engebi .....	K-1B.
Mujinkarikku .....	MU-4.

#### DISTRIBUTION AND ECOLOGY

The material was collected between 0 and 4,553 feet below the surface in sediments of Tertiary *b* (Eocene), Tertiary *e*, *f*, and *g* (Miocene), and post-Miocene age. It comprises 212 specimens of which 193 are segments of pincer-bearing limbs, 16 are fragments of carapaces, 2 are small carapaces that are nearly complete, and 1 is a basal joint of an antenna. The sizes of these specimens range from 0.5 to 12.5 mm in length, with approximately 85 percent between 2 and 5 mm. Two of the specimens are of Eocene age, 53 are of Miocene age, and 157 are of post-Miocene age. Ninety-three percent of the post-Miocene examples are from the uppermost 60 feet of the stratigraphic section. The age assignments are based on Cole's (1957, p. 745-750) interpretation of the stratigraphic sections at Bikini and at Eniwetok.

<sup>1</sup> U.S. National Museum. This report is published by permission of the Secretary of the Smithsonian Institution.

In this study, 88 specimens were not identified, 113 were identified at the family level and represent 7 families (Callianassidae, Paguridae, Calappidae, Leucosidae, Portunidae, Xanthidae, and Majidae), and 11 specimens were specifically identified and represent 8 species. The species identified (*Callianassa armata*, *C. articulata*, *Calappa hepatica*, *Thalamitoides quadridens*, *Actaea hirsutissima*, *Chlorodopsis pugil*, *Etisus laevimanus*, and *E. splendidus*) are forms now living in the Indo-Pacific region where, with the possible exception of *C. armata* whose habitat is unknown, they inhabit coral reefs. As seven of these species are corallidomous forms, it is inferred that the sediments that enveloped them were deposited under conditions similar to present-day coral reef environments.

The evidence discussed in the systematic descriptions indicates an extension of geographic range for *Callianassa armata* and *C. articulata* to include the Marshall Islands and an extension downward of stratigraphic range for *C. armata*, *Etisus laevimanus* and *E. splendidus* to include Miocene age.

#### IDENTIFICATION METHOD

Fragmental specimens from the Marshall Islands were compared with whole specimens of preserved living decapods belonging to numerous species, genera, and families and with the identified fossil species represented in the collection of the U.S. National Museum. When the fragment—a finger for example—appeared to be morphologically similar to, or “matched,” the finger of an identified specimen of a recent or fossil species, it was considered to be conspecific. When a fragment could not be matched in this way, but bore a strong resemblance to identified specimens of several species belonging to one and the same family, it was considered to be confamilial. When a fragment neither could be matched with an identified specimen, nor resembled identified specimens belonging to a particular family, it was considered to be unidentifiable.

It is true that this method of identifying and classifying decapod fragments is open to objections. Nevertheless, it is the only method available at the present time. As yet, an organized body of information concerning detailed comparative morphology and range of variation exhibited by isolated parts of decapods does not exist. Moreover, the taxonomic devices (such as figures, keys, diagnoses, and descriptions) which neocarcinologists employ to identify and classify whole animals, are insufficiently refined for use in studying isolated parts of whole animals.

#### SYSTEMATIC DESCRIPTIONS

##### Order DECAPODA

##### Suborder MACRURA

##### Family CALLIANASSIDAE (Mud shrimps)

##### Genus CALLIANASSA Leach, 1814

##### *Callianassa armata* A. Milne-Edwards

Plate 303, figures 1-3

1870. *Callianassa armata* A. Milne-Edwards. *Nouv. Archiv. Mus. histoire nat. Paris*, v. 6, p. 90, pl. 1.

*Material*.—One dactylus of a right chela; F-1, 800-810 feet; Tertiary *g*; USNM 564067.

*Modern ecology*.—Habitat and bathymetric range are not recorded in the literature and are unknown to the present writer.

*Bathymetric range*.—No data.

*Geographic range*.—Fiji (A. Milne-Edwards, 1870, p. 91), and the Moluccas (de Man, 1902, p. 754).

*Stratigraphic range*.—Recent; Pliocene (Abrard, 1947, p. 92; New Hebrides); Miocene (Tertiary *g*), Marshall Islands.

*Remarks*.—Not previously reported from the Marshall Islands or from the Miocene.

##### *Callianassa articulata* Rathbun

Plate 303, figures 13-15

1906. *Callianassa articulata* Rathbun. *U.S. Fish Comm. Bull. for 1903 (1906)*, p. 892, text figs. 47 a-e.

*Material*.—One dactylus of a right chela; F-15-C, 39 feet 8 inches-42 feet 2 inches; post-Miocene; USNM 564068.

*Modern ecology*.—Sublittoral; on coral reefs. According to Edmondson (1944, p. 56) *C. articulata* “has always been taken about Oahu from porous coral blocks and does not seem to conceal itself through burrowing habits as fully as do some of the larger forms [of *Callianassa*].”

*Bathymetric range*.—23-33 fathoms (Rathbun, 1906, p. 892).

*Geographic range*.—Hawaiian Islands and Marshall Islands.

*Stratigraphic range*.—Recent; post-Miocene of Marshall Islands.

*Remarks*.—Not previously reported from the Marshall Islands.

##### Unidentifiable callianassids

Hands and fingers of unidentifiable callianassids were collected at the following stations: 2B, 1,807½-1,818 feet; E-1, 2,410-2,420 feet, 2,480-2,490 feet (Ter-

tiary *e*); F-1, 800-810 feet; K-1B, 829 feet 9 inches—831 feet 3 inches (Tertiary *g*); F-1, 20-45 feet, 55-60 feet; F-15-A, 26 feet 6 inches-29 feet; F-12-C, 29 feet 2 inches-30 feet 2 inches; F-14-C, 33 feet 2 inches-35 feet 8 inches; F-15-C, 39 feet 8 inches-42 feet 2 inches (post-Miocene).

**Suborder ANOMURA**

**Family PAGURIDAE (Hermit crabs)**

The collection contains 18 tips of fingers of pagurid crabs. These tips are those of pointed fingers (spooned fingers were not found in the material) and are of both the calcareous and the corneous types. The specimens were collected at the following stations: E-1, 2,950-2,960 feet (Tertiary *b*); E-1, 2,480-2,490 feet, 2,410-2,420 feet (Tertiary *e*); E-1, 840-850 feet; F-1, 820-830 feet; K-1B, 642 feet 3 inches-652 feet 9 inches, 652 feet 9 inches-663 feet 3 inches, 841 feet 9 inches-852 feet 3 inches; 2A, 909-914½ feet, 914½ feet-919½ feet, 956½-967 feet (Tertiary *g*); F-7-C, 16 feet 8 inches-19 feet 2 inches; K-1B, 558 feet 3 inches-568 feet 9 inches (post-Miocene).

**Suborder BRACHYURA**

**Family CALAPPIDAE (Box crabs)**

**Genus CALAPPA Weber, 1795**

***Calappa hepatica* (Linnaeus)**

Plate 303, figures 4-6

1758. *Cancer hepaticus* Linnaeus. Syst. Nat., I, ed. 10, p. 630.

*Material*.—One dactylus of a right chela; F-7-C, 16 feet 8 inches-19 feet 2 inches post-Miocene; USNM 564069.

*Modern ecology*.—Sublittoral; on sandy and shelly bottoms on coral reefs; often buried just beneath the sand. In the Marshall Islands, *C. hepatica* has been collected from under rocks on the reefs and from near-shore sand in lagoons (Holthuis, 1953, p. 3).

*Bathymetric range*.—15-50 fathoms (Sakai, 1937, p. 90).

*Geographic range*.—Indo-Pacific: from east coast of Africa and the Red Sea to Australia, Japan, and the Hawaiian Islands (Stephensen, 1946, p. 65).

*Stratigraphic range*.—Recent; post-Miocene of Marshall Islands.

**Unidentifiable calappids**

A fragment of a hand of a small calappid was collected at 2B, 1,849½-1,860 feet (Tertiary *e*).

**Family LEUCOSIIDAE (Purse crabs)**

Arms and fingers of leucosiids were collected at E-1, 970-980 feet (Tertiary *f*); F-1, 20-45 feet, 60-70 feet; F-15-C, 39 feet 8 inches-42 feet 2 inches; F-1-A, about 4 feet; F-24-A, 64½-71½ feet; MU-4, 14½-15 feet (post Miocene).

**Family PORTUNIDAE (Swimming crabs)**

**Genus THALAMITOIDES A. Milne-Edwards, 1869**

***Thalamitoides quadridens* A. Milne-Edwards**

Plate 303, figures 11, 12

1869. *Thalamitoides quadridens* A. Milne-Edwards. Nouv. Archiv. Mus., Mem., v. 5, p. 147, pl. 6, figs. 8-15.

*Material*.—One basal antennal joint; F-1, 55-60 feet; post-Miocene. USNM 564070.

*Modern ecology*.—Sublittoral; on coral reefs on lime-sand and lime-mud bottoms. A swimming crab.

*Bathymetric range*.—2-3 fathoms (Edmondson, 1944, p. 271; Hawaiian specimens).

*Geographic range*.—Indo-Pacific: Red Sea, Madagascar, Indonesia, and Oceania (Balss, 1938, p. 35).

*Stratigraphic range*.—Recent; post-Miocene, Marshall Islands.

**Unidentifiable portunids**

A fragment of a hand of a portunid crab was collected at F-1, 55-60 feet, and a finger at F-14-C, 33 feet 2 inches-35 feet 8 inches. Both specimens are of post-Miocene age.

**Family XANTHIDAE**

**Genus ACTAEA de Haan, 1833**

***Actaea hirsutissima* (Ruppell)**

1830. *Xantho hirsutissimus* Ruppell. 24 Krabben roth. Meer., p. 26, pl. 5, fig. 7.

*Material*.—One right chela; F-1, 35-40 feet; post-Miocene; USNM 564071.

*Modern ecology*.—Sublittoral; on coral reefs on lime-sand bottoms among corals, coral blocks and sponges.

*Bathymetric range*.—14-33 fathoms (Rathbun, 1906, p. 852).

*Geographic range*.—Indo-Pacific: Red Sea and east coast of Africa to Japan and northeast Australia; Mauritius (Odhner, 1925, p. 69; Boone, 1934, p. 124).

*Stratigraphic range*.—Recent; post-Miocene, Marshall Islands.

*Remarks*.—In the course of cleaning the specimen on which this record is based, it broke into several small pieces. As an attempt to repair the specimen might have resulted in further breakage, it was not repaired. The several pieces have been included in the collection under USNM 564071.

**Genus CHLORODOPSIS A. Milne-Edwards, 1873**

***Chlorodopsis pugil* (Dana)**

Plate 303, figures 9, 10

1852. *Pilodius pugil* Dana. U.S. Explor. Exped., v. 13, Crustacea, pt. 1, p. 219, pl. 12, figs. 8a-i.

*Material*.—Two right hands and two left hands; E-1, 30-40 feet; post-Miocene; USNM 564072.

*Modern ecology*.—Sublittoral; on coral reefs. *C. pugil* occurs on limesand bottoms among dead corals and algal blocks and on the coral *Acropora* (Holthuis, 1953, p. 17; Cloud, 1959, p. 432).

*Bathymetric range*.—1–10 feet (Holthuis, 1953 p. 17).

*Geographic range*.—Indo-Pacific: Madagascar, Indonesia, Oceania, and Japan (Sakai, 1939, p. 507).

*Stratigraphic range*.—Recent; post-Miocene, Marshall Islands.

**Genus ETISUS H. Milne-Edwards, 1834**

***Etisus laevimanus* Randall**

Plate 303, figures 7, 8

1839. *Etisus laevimanus* Randall. Acad. Nat. Sci. Philadelphia Jour., v. 8, p. 115.

*Material*.—One dactylus of a right chela; F-1, 880–890 feet; Tertiary *f*; USNM 564073.

*Modern ecology*.—Sublittoral; on coral reefs. "Found under stones or in crevices of rock, just below low tidal mark" (Sakai, 1939, p. 498).

*Bathymetric range*.—No data.

*Geographic range*.—Indo-Pacific: from the east coast of Africa to Australia, Hawaiian Islands, and Japan (Sakai, 1939, p. 498; Boone, 1934, p. 121).

*Stratigraphic range*.—Recent; late Pleistocene or Recent (Rathbun, 1934, p. 239; Fiji); Miocene (Tertiary *f*), Marshall Islands.

*Remarks*.—Not previously reported from the Miocene.

***Etisus splendidus* Rathbun**

Plate 303, figures 17, 18

1906. *Etisus splendidus* Rathbun. U.S. Fish Comm. Bull. for 1903 (1906), p. 850, pl. 3 (in color) and pl. 10.

*Material*.—One propodal finger of a left hand; F-1, 770–780 feet; Tertiary *g*; USNM 564074.

*Modern ecology*.—Sublittoral; on coral reefs. "Shallow water on coral reef" (Sakai, 1939, p. 501).

*Bathymetric range*.—No data.

*Geographic range*.—Indo-Pacific: Red Sea, Madagascar, Hawaiian Islands, Marshall Islands, and Japan (Sakai, 1939, p. 501).

*Stratigraphic range*.—Recent; Quaternary (?) (Kowalski, 1923, p. 24; 1924, p. 95; New Hebrides; raised coral reefs, with mollusks and *Lithothamnion*); Miocene (Tertiary *g*), Marshall Islands.

*Remarks*.—Not previously reported from the Miocene.

**Unidentifiable xanthids**

One minute carapace of a xanthid (F-1, 55–60 ft)—perhaps that of a younger *Chlorodiella*—and 65 limb

segments of xanthid crabs were found. The limb segments were collected at the following stations: E-1, 1,260–1,270 feet, 1,746–1,777 feet, 2,120–2,130 feet, 2,130–2,140 feet, 2,660–2,670 feet (Tertiary *e*); E-1, 920–930 feet; F-1, 880–890 feet (Tertiary *f*); F-1, 770–780 feet, 800–820 feet; K-1B, 820 feet 9 inches–831 feet 3 inches, 841 feet 9 inches–852 feet 3 inches (Tertiary *g*); F-1, 20–45 feet, 55–60 feet; F-1-A, about 4 feet; F-14-C, 33 feet 2 inches–35 feet 8 inches (post-Miocene).

**Family MAJIDAE (Spider crabs)**

Spider crabs are represented by one arm (E-1, 40–45 ft) and one small carapace (F-15-A, 26½–29 ft). The carapace (USNM 633950; pl. 303, fig. 16) has a superficial resemblance to Sakai's figure of *Leptopisa nipponensis* Sakai (1938, p. 323, fig. 50), a living species.

**Family undeterminable**

The undeterminable specimens comprise 72 limb segments and 16 fragments of carapaces, collected at the following stations: F-1, 4,528–4,553 feet (Tertiary *b*); E-1, 2,410–2,420 feet, 2,470–2,480 feet, 2,480–2,490 feet, 2,500–2,510 feet, 2,680–2,690 feet, 2,710–2,720 feet; F-1, 2,010–2,020 feet; K-1B, 1,164 feet 7 inches–1,175 feet 1 inch; 2B, 1,828½–1,839 feet, 2,420½–2,430½ feet (Tertiary *e*); E-1, 910–920 feet; F-1, 870–880 feet (Tertiary *f*); E-1, 40–45 feet; F-1, 20–45 feet, 55–60 feet; F-1-A, 0–5 feet; F-3-A, 5 feet 4 inches–6 feet 10 inches; F-10-A, 15–16½ feet; F-15-A, 26½–29 feet; F-2-C, 2½–5 feet; F-4-C, 9 feet 2 inches–11 feet 7 inches; F-6-C, 14 feet 2 inches–16 feet 8 inches; F-7-C, 16 feet 8 inches–19 feet 2 inches; F-8-C, 19 feet 2 inches–22 feet 2 inches; F-9-C, 22 feet 2 inches–27 feet 2 inches; F-12-C, 29 feet 2 inches–30 feet 2 inches; F-14-C, 33 feet 2 inches–35 feet 8 inches; F-15-C, 39 feet 8 inches–42 feet 2 inches; MU-4, 14½–15 feet, 35½–36 feet; 2A, 242½–253 feet (post-Miocene).

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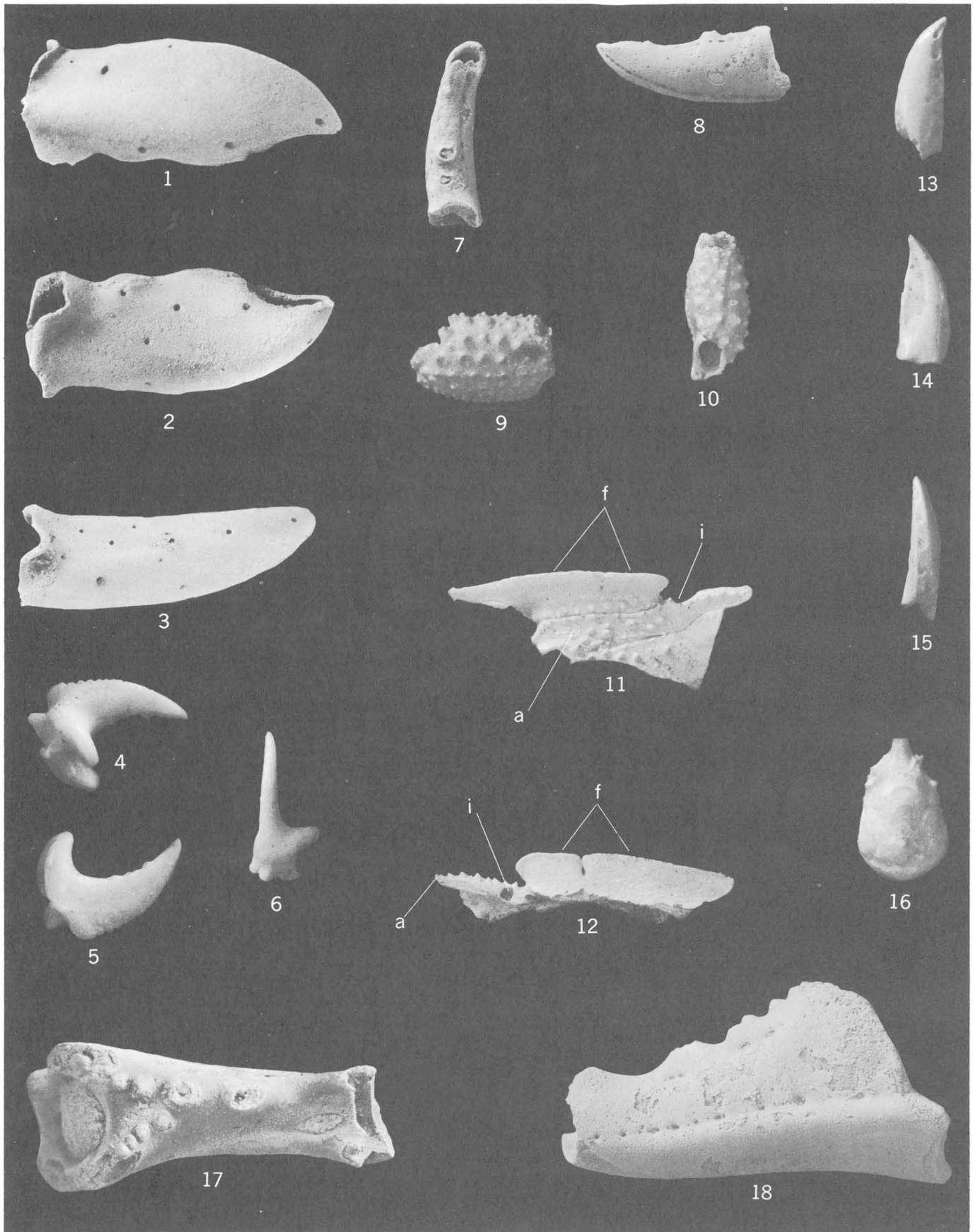
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### PLATE 303

- FIGURES 1-3. *Callianassa armata* A. Milne-Edwards (p. 1128).  
Outer, inner, and upper views of dactylus of right chela,  $\times 6$ , USNM 564067, hole F-1, 800-810 ft, Tertiary *g*, (specimen coated with ammonium chloride).
- 4-6. *Calappa hepatica* (Linnaeus) (p. 1129).  
Outer, inner, and upper views of dactylus of right chela,  $\times 8$ , USNM 564069, hole F-7-C, 16 ft 8 in.-19 ft 2 in., post-Miocene. In the outer view (fig. 4), the lower edge of the specimen is tilted upward toward the observer at an angle of  $15^\circ$ .
- 7, 8. *Etisus laevimanus* Randall (p. 1130).  
Occludent and outer surfaces of propodal finger of left manus,  $\times 6$ , USNM 564073, hole F-1, 880-890 ft, Tertiary *f*, (specimen coated with ammonium chloride).
- 9, 10. *Chlorodopsis pugil* (Dana) (p. 1129).  
Outer and upper views of manus of right chela,  $\times 8$ , USNM 564072, hole E-1, 30-40 ft, post-Miocene.
- 11, 12. *Thalamitoides quadridens* A. Milne-Edwards (p. 1129).  
Frontal and dorsal views of basal joint of antenna and of two frontal lobes of carapace,  $\times 6$ , USNM 564070, hole F-1, 55-60 ft, post-Miocene. *a*, basal antennal joint; *f*, frontal lobes; *i*, insertion of antennal flagellum.
- 13-15. *Callianassa articulata* Rathbun (p. 1128).  
Outer, inner, and upper views of dactylus of right chela,  $\times 10$ , USNM 564068, hole F-15-C, 39 ft 8 in.-42 ft 2 in., post-Miocene. In the inner view (fig. 14), the posterior edge of the outer side of the specimen is not visible, as it was buried when the specimen was mounted for photography.
16. Carapace of a spider crab (Family Majidae) (p. 1130).  
Dorsal surface,  $\times 8$ , USNM 633950, hole F-15-A, 26½-29 ft, post-Miocene. The specimen bears a superficial resemblance to *Leptopisa nipponensis* Sakai, a living species.
- 17, 18. *Etisus splendidus* Rathbun (p. 1130).  
Occludent and outer surfaces of propodal finger of left manus,  $\times 6$ , USNM 564074, hole E-1, 770-780 ft, Tertiary *g*, (specimen coated with ammonium chloride).



FOSSIL DECAPOD CRUSTACEANS FROM THE MARSHALL ISLANDS