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Decapod Crustaceans from the Miocene Mizunami Group, Central Japan
Part 1. Superfamily Thalassinoidea, Leucosioidea and Grapsidoidea

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Decapod Crustaceans from the Miocene Mizunami Group, Central Japan Part 1. Superfamily Thalassinoidea, Leucosioidea and Grapsidoidea

Hiroaki Karasawa*

瑞浪層群の中新世十脚甲殻類化石　その1
アナジャコ上科・コブシガニ上科・イワガニ上科

柄沢宏明

（要　旨）

瑞浪層群から，8種のアナジャコ上科，5種のコブシガニ上科，3種のイワガニ上科に属する化石を記載した．この内，*Paramursia circularis, Miosesarma japonica* は新属新種として，*Laomedia praeastacina, Upogebia mizunamiensis, Philyra nishimotoi, P. plana, Cyclograpsus rectangularis, C. directus* は新種として記載した．

（**Abstract**）

Following eight Thalassinoids, five Leucosioids and three Grapsidoids of decapod crustacean fossils from the Miocene Mizunami Group, central Japan are systematically described. Eight species of which two belong to the new genera, are included.

Thalassinoidea, fam. gen. *et* sp. indet.
Laomedia praeastacina sp. nov.
Callianassa bona Imaizumi
C. *titaensis* Nagao
C. sp. 1
C. sp. 2
Upogebia mizunamiensis sp. nov.
U. sp.
Calappa sp. 1
C. sp. 2
Paramursia circularis gen. *et* sp. nov.

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Philyra nishimotoi sp. nov.
Ph. plana sp. nov.
Cyclograpsus rectangularis sp. nov.
C. directus sp. nov.
Miosesarma japonica gen. *et* sp. nov.

Introduction

The Early to Middle Miocene Mizunami Group developed in the Mizunami and Iwamura basins, Gifu Prefecture, yields numerous fossils which are included in various taxa. Paleontological studies of this group have advanced and most of taxa have been reported in detail up to now, as Itoigawa (1980) summarized these studies. Meanwhile, there have been a few studies of decapod crustaceans from the Mizunami Group such as the description of *Callianassa titaensis* by Nagao (1941), of *Ovalipes* sp. by Imaizumi (1958), of *Tymolus ingens* and *T. itoigawai* by Takeda and Tomida (1984), and of an outline of them reported by Tomida (1985). However, the whole aspect of the fauna has not clarified yet, though many decapod specimens have been deposited in the Mizunami Fossil Museum. Then, I studied the decapod crustaceans in the collection of the Mizunami Fossil Museum, and now described sixteen species of eight genera including two new species of two new genera and six new species as follows ;

Thalassinoidea	Thalassinoidea gen. et sp. indet.
	Laomedia praeastacina sp. nov.
	Callianassa bona Imaizumi
	C. titaensis Nagao
	C. sp. 1
	C. sp. 2
	Upogebia mizunamiensis sp. nov.
	U. sp.
Leucosioidea	*Calappa* sp. 1
	C. sp. 2
	Paramursia circularis gen. *et* sp. nov.
	Philyra nishimotoi sp. nov.
	Ph. plana sp. nov.
Grapsidoidea	*Cyclograpsus rectangularis* sp. nov.
	C. directus sp. nov.
	Miosesarma japonica gen. *et* sp. nov.

These species is summarized in Table 1 in connection with the formations and the localities.

The described specimens are preserved in the Mizunami Fossil Museum.

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Table 1. List of decapod crustaceans (Thalassinoidea, Leucosioidea and Grapsidoidea) from the Mizunami Group.

area	Mizunami basin							Iwamura basin	
formation	Akeyo Formation					Oidawara Formation		Toyama F.	
	Tsukiyoshi	Kujiri	Togari	Yamanouchi	Shukunohora	Nataki	Oidawara	Higashihora	Ryodenji
locality / species	Shobasamahora SE of Shobasamahora	Inkyoyama Nanamagari Jorinji Obora Anabora	Hesoyama Shimohonmachi	Asano Hesoyama Togari Bogahora	Shukubora Oginoshima	Okuna	Togari	Higashihara	Ryodenji
Thalassinoidea fam. gen. *et* sp. indet.	C								
Laomedia praeastacina sp. nov.	R								
Calliansa bona Imaizumi		C C C F C	R R						
C. titaensis Nagao							R		R
C. sp. 1				F					
C. sp. 2					R				
Upogebia mizunamiensis sp. nov.	C F								
U. sp.								R	
Calappa sp. 1					R				
C. sp. 2					R				
Paramursia circularis sp. nov.					R				
Philyra nishimotoi sp. nov.		C F	R	R				F	
Ph. plana sp. nov.					F F	R			
Cyclograpsus directus sp. nov.		F							
C. rectangularis sp. nov.					R				
Miosesarma japonica sp. nov.	R R			C F F C				F	

C, Common : F, Frequent : R, Rare.

of this study : Professor Hiroshi Shibata of the Nagoya University, Dr. Hisakatsu Minei of the Kyushu University, Mr. Hiroyuki Nishimoto of the Tajimi-kita High School, Mr. Susumu Tomida of the Chukyo Junior College, Mr. Yoshitsugu Okumura of the Mizunami Fossil Museum, Messrs. Atsushi Ujihara and Takeshi Saito of the Nagoya University, Messrs. Takeshi Endo and Kanji Kato of Mizunami City, and Mr. Ryugi Fukada of Nagoya City.

Systematic descriptions

Superclass Crustacea
Class Malacostraca

Order Decapoda
Suborder Pleocyemata
Infraorder Anomura
Superfamily Thalassinoidea Latreille, 1831
Thalassinoidea fam. gen. *et* sp. indet.
(Pl. 1, Figs. 1-5)

Materials : 27 specimens (MFM 9311-9325, 9377-9384).

Description : First legs chelate and unequal. Left first leg . . . . . Dactylus slender, elongate, tapering from the broad base to the sharp apex and strongly curved downward ; upper margin smooth ; lower margin of the sharp cutting edge with fine serrations and bearing a broad tooth near the base and a low triangular tooth in the middle part ; upper part of the outer surface distinctly keeled along the upper margin and ornamented with a row of small holes below its keel ; outer surface having a longitudinal ridge in the middle line and possessing a row of small holes below the longitudinal ridge ; upper part of the inner surface distinctly keeled along the upper margin, and its keel with small conical tubercles from the base to the middle part and with small holes from the middle part to the apex ; upper part of the inner surface tuberculate near the base, and lower part bearing a row of small holes along the lower margin. Fixed finger as long as the dactylus, slender, elongate, tapering from the broad base to the sharp apex and slightly curved upward ; upper margin of the cutting edge denticulate bearing a board tooth near the base ; lower part of the outer surface distinctly keeled along the lower margin, and its keel ornamented with small conical tubercles ; outer surface tuberculate from the base to the middle part, and its tubercles reducing in size from the front backward ; lower and upper parts of the inner surface distinctly keeled, and its keel of the lower part reaching to about the one-third of the palm ; upper part of the inner surface possessing a row of small holes below the keel ; inner surface having a longitudinal ridge, bearing a row of small holes below its ridge and tuberculate on its base. Palm slightly longer than the dactylus, rectangular and about 1. 2 times as long as the broad ; upper and lower margins smooth ; outer and inner surfaces moderately convex ; distal margin of the outer surface bearing a blunt tubercle on the upper part ; distal part of the palm tuberculate. Right first leg . . . . . Imperfect dactylus and fixed finger thinner than right ones. Palm rectangular and about 1. 2 times as long as the broad ; upper and lower margins smooth ; upper margin slightly convex, and lower margin moderately convex ; inner and outer surfaces smooth and moderately convex.

Remarks : The left first leg of the present species is similar to the larger first leg of *Laomedia astacina* De Haan and *L. praeastacina* sp. nov., but the present species differs from *Laomedia astacina* and *L. praeastacina* because of the first legs of the present species are unequal. The right palm of the present species resembles to the larger first leg of the living species, *Ctenocheles balssi* Kishinoue, and the Cretaceous to Paleogene species, *Ischnodactylus cookei* Rathbun, but the present species is distinguishable from *Ctenocheles* and *Ischnodactylus* having long and slender fingers of the both first legs. As I do not obtain the specimens which remain perfect first legs, further discussion is difficult, but the present

species may be included in the family Laomediidae or the subfamily Callianidiinae. This species commonly occurs in the Tsukiyoshi Member.

Occurrence : Shomasamahora (Locality 32 of Itoigawa, 1980), Tsukiyoshi, Akeyo-cho, Mizunami City . . . . . Tsukiyoshi Member.

Measurements (in mm) :

	MFM 9314 left first leg	MFM 9320 left first leg	MFM 9381 right first leg
Dactylus length	9.6	6.4	—
Palm length	10.5	7.9	8.9
Palm width	9.2	6.5	6.3

Family Laomediidae Borradaile, 1903

Genus *Laomedia* De Haan, 1847

Type species : *Laomedia astacina* De Haan, 1841 ; Living species.

Geologic range : Miocene—Recent.

Laomedia praeastacina sp. nov.

(Pl. 1, Figs. 8, 9)

Materials : Two specimens (MFM 9003, 9004).

Holotype : Right first to forth legs, and left first legs (MFM 9003).

Paratype : Right first and second legs (MFM 9004).

Type locality : Shomasamahora (Locality 32 of Itoigawa, 1980), Tsukiyoshi, Akeyo-cho, Mizunami City, Gifu Prefecture.

Formation : Tsukiyoshi Member, Akeyo Formation, Mizunami Group (Early to Early Middle Miocene).

Diagnosis : First legs chelate and equal. Dactylus and fixed finger slenedr and elongate, and its occulusal margin bearing fine serrations. Fixed finger slightly shorter than the dactylus. Palm about as long as the dactylus and subrectangular. Carpus short, triangular and tapering distally. Merus long, about 1.5 times as long as the carpus, and rhombic. Second legs simple.

Description of the holotype : Right first leg which lacks the dactylus and the fixed finger, showing the inner surface and the left first leg showing the outer surface. Right and left first legs chelate and equal. Dactylus slender, elongate, tapering from the broad base to the sharp apex and gently curved downward ; upper margin smooth and lower margin with fine serrations ; outer surface distinctly keeled along the upper margin. Fixed finger slightly shorter than the dactylus, slender, elongate and tapering from the broad base to the sharp apex ; upper margin bearing fine serrations and lower margin smooth, nearly straight. Palm slightly longer than the dactylus, subrectangular, about 1. 2 times of the broad and becoming narrower proximally ; upper and lower margins smooth ; outer surface slightly convex and the inner surface nearly flat. Carpus one-third times as long as the palm, triangular and tapered distally ; upper and lower margins smooth. Merus wide,

rounded. rhombic and about 1. 5 times longer than the carpus ; upper and lower margins smooth ; upper margin strongly convex, and the lower margin gently convex ; inner and outer surface flat. Ischium short, one-eighth times an long as the carpus. Right second leg showing the inner surface, simple. Right third and forth legs impression showing the outer surface.

Description of the paratype : Right first and right second legs showing the outer surface. First leg chelate. Dactylus slender, elongate, tapering from the broad base to the sharp apex and gently curved downward ; upper margin smooth and the lower margin with fine serrations ; outer surface distinctly keeled along the upper margin. Fixed finger slender, elongate and about two-third times as long as the dactylus ; apex of the fixed finger sharp ; upper margin bearing fine serrations, and lower margin nearly straight. Palm about two -third times as long as the dactylus, subrectangular and becoming narrower proximally ; outer surface gently convex and tuberculate. Carpus triangular, tapering distally and about two-third times as long as the palm ; upper and lower margins smooth and straight. Merus rounded, rhombic and about 1. 5 times as long as the carpus ; upper margin smooth, strongly convex, and the lower margin smooth, gently convex. Right second leg, lacking the carpus and the palm, showing the outer surface.

Remarks : The present new species is allied to *Laomedia astacina* De Haan, a living species, but the latter has the upper margin of the dactylus, the palm and the merus which are ornamented with fine serrations. The fossil species of the genus *Laomedia* is the first record from the Japanese Miocene formations. The occurrence of *Laomedia praeastacina* indicates that the genus *Laomedia* appears in the Early Miocene time.

In the mode of life, *L. astacina* are the burrowing species inhabiting in the intertidal zone with the muddy to sandy bottom in the tropical to temperate sea.

Occurrence : Shomasamahora (Locality 32 of Itoigawa, 1980), Tsukiyoshi, Akeyo-cho, Mizunami City . . . . . Tsukiyoshi Member.

Measurements (in mm):

	MFM 9003 (Holotype)		MFM 9004 (Paratype)
	Right firist leg	Left first leg	Right first leg
Dactylus length	9.6	9.0	6.9
Palm length	8.4	8.1	5.5
Palm width	7.8	7.6	5.5
Carpus length	6.0	4.3	4.1
Carpus width	4.9	4.2	3.6
Merus length	9.4	8.9	6.9
Merus width	6.3	5.5	4.1

Associated forms : Decapod crustaceans ;—Thalassinoidea fam. gen. et sp. indet., *Upogebia mizunamiensis, Scylla ozawai.* Gastropods ;— *Vicarya yokoyamai, Batillaria mizunamiensis, Vicaryella ishiiana, Phos tsukiyoshiensis.* Pelecypods ;— *Saxolucina khatai, Hiatula minoensis, Clementia papyracea, Cyclina japonica.* Plant fossils.

Family Callianassidae Dana, 1852
Subfamily Callianassinae Borradaile, 1903

Genus *Callianassa* Leach, 1814

Type species : *Cancer subterraneus* Montagu, 1808 ; Living species.

Geologic range : Cretaceous-Recent.

Callianassa bona Imaizumi, 1958

(Pl. 1, Figs. 6, 7 ; Pl. 2, Fig. 3)

1958. *Callianassa bona* Imaizumi ; p. 31, pl. 4, figs. 1-5.

1986. *Callianassa* sp., Fujiyama *et al.*; p. 372, pl. 186, fig. 1850.

Materials : 203 specimens (MFM 9101-9292, 9326-9336).

Diagnosis : First legs chelate and unequal. First legs of large sizes for the genus. Larger first leg . . . . . Dactylus broad and elongate ; upper margin rounded and bearing 6-8 conical holes ; lower margin ornamented with fine serrations from the distal part to the middle part, and a blunt tooth near the base and one in the middle part. Fixed finger slightly shorter than the dactylus. Palm about 1.5 times as long as the dactylus, rectangular becoming narrower distally. Carpus slightly longer than the broad and slighly shorter than the dactylus. Merus slightly shorter than the carpus ; upper margin smooth ; lower margin possessing a broad tooth, and its broad tooth becoming narrower from the proximal part to the distal part and armed with a low of denticules.

Description : First legs chelate and unequal. First legs of large sizes for the genus. Larger first leg . . . . . Dactylus broad, elongate, tapering from the broad base to the sharp apex and strongly curved downward ; upper margin strongly convex, rounded and bearing 6-8 conical holes ; lower margin moderately convex, having a cutting edge with fine serrated one from the apex to the middle part, a blunt tooth near the base and one in the middle part ; outer and inner surface strongly convex ; lower part of the outer surface possessing 4 small conical holes along the upper margin. Fixed finger shorter than the dactylus, triangular and tapering from the broad base to the sharp apex ; upper and lower margins nearly straight ; upper margin of the cutting edge with a low board tooth near the middle part ; lower margin ornamented with some small conical holes ; outer and inner surfaces nearly flat, and outer one being beset with some small holes. Palm about 1. 5 times as long as the dactylus, rectangular and becoming narrower to distally ; upper and lower margins smooth and nearly straight ; lower margin bearing small holes ; outer surface smooth and moderately convex ; inner surface smooth and nearly flat ; median distal margin at the base of the fixed finger having a deep notch and ornamented with a low conical tubercle. Carpus slightly longer than the broad and slightly shorter than the palm ; distal length longer than the proximal one ; upper and lower margins smooth ; upper margin nearly straight and lower margin curved ascending toward proximally ; outer surface smooth and moderately convex ; lower margin possessing a broad tooth, and its broad tooth becoming narrower from the proximal to distal parts, and armed with a row of denticules ; longitudinal carina obviously running the middle line of the outer surface. Smaller first leg . . . . . Smaller first leg slender and about one-third times as long as the

larger one. Dactylus slender and elongate ; upper margin smooth nearly straight ; lower margin bearing the serrated cutting edge. Fixed finger as long as the dactylus, slender and elongate ; upper margin of the cutting edge with fine serrations and lower margin smooth. Palm slightly shorter than the dactylus.

Remarks : *Callianassa bona* Imaizumi, 1958 was first reported from the Miocene Hatatate Fomation and the Miocene Moniwa Formation near Sendai City. The first legs of this species are larger compared with ones of living callianassids. *C. bona* is a dominant species of the Kujiri Facies and the Togari Member.

Callianassa sp. from the Miocene Kadonosawa Formation illustrated by Fujiyama *et al.* (1986) closely resembles to *C. bona* by having broad merus.

Occurrence : Inkyoyoma (Localities 21 and 22 of Itoigawa, 1980), Kujiri, Izumi-machi, Toki City ; Nanamagari (Locality 19 of Itoigawa, 1980), Jorinji, Izumi-machi, Toki City ; Jorinji (Locality 20 of Itoigawa, 1980), Izumi-machi, Toki City ; Obora (Locality 27 of Itoigawa, 1980), Kawai, Izumi-machi, Toki City ; Anabora (Locality 40 of Itoigawa, 1980), Kawai, Izumi-machi, Toki City . . . . . Kujiri Facies. Hesoyama (Locality 46 of Itoigawa, 1980), Togari, Akeyo-cho, Mizunami City ; Shimohondamachi (Locality 79 of Itoigawa, 1980), Terakawado-cho, Mizunami City . . . . . Togari Member.

Measurements (in mm):

	MFM 9101 Right larger first leg	MFM 9102 Right larger first leg
Dactylus length	26.3	18.9
Palm length	20.0	16.6
Palm width	22.0	19.1
Carpus length	28.9	19.8
Merus length	16.4	17.1

Callianassa titaensis Nagao, 1941
(Pl. 1, Fig. 10 ; Pl. 2, Fig. 6)

1941. *Callianassa titaensis* Nagao, p. 93, pl. 26, figs. 3-7.
1957. *Callianassa shikamai* Imaizumi, p. 86, pl. 14, figs. 1-5.
1986. *Callianassa titaensis* Nagao ; Fujiyama *et al.*, p. 372, pl. 186, fig. 1852.
1987. *Callianassa titaensis* Nagao ; Takeda *et al.*, p. 14, pl. 1, figs. 5, 6.

Materials : 8 specimens (MFM 9293-9299).

Diagnosis : First legs chelate and unequal. First legs of common to large sizes for the genus. Dactylus of the larger first leg slender and elongate ; lower margin of the cutting edge smooth and possessing triangular teeth near the base and the middle part. Its fixed finger as long as the dactylus. Palm about as long as the dactylus or slightly longer than the dactylus, rectangular and slightly shorter than the broad ; distal part of the outer surface ornamented with some tubercles. Carpus short, half or one-third times as long as the palm, about half times as long as the broad rectangular. Merus about 1.2 to 1.5 times

as long as the carpus and about half as long as the broad ; upper and lower margins smooth and convex outward.

Description : Each specimens badly preseved, but some specimens remaining the first and second legs and the abdmen. First legs chelate and unequal. First leg of common to large sizes for the genus. Larger first leg . . . . . Dactylus slender, elongate, tapering the broad base to the sharp apex and gently curved downward ; upper margin smooth and rounded ; lower margin of the cutting edge smooth and possessing triangular teeth near the base and the middle parts ; upper part of the outer surface distinctly keeled along the upper margin. Fixed finger about as long as the dactylus, slender, elongate, tapering distally and gently curved upward ; upper and lower margins smooth ; upper part of the outer surface distinctly keeled along the upper margin, and upper part of its keel possessing three conical tubercles from the base to the middle part. Palm about as long as the dactylus or slightly longer than the dactylus, rectangular and slightly shorter than the broad ; upper and lower margins smooth ; distal part of the outer surface ornamented with some tubercles. Carpus short and half or one-third times as long as the palm, about half times as long as the broad and rectangular ; upper margin smooth and nearly straight ; lower margin smooth and curved ascending toward proximally. Merus about 1.2 to 1.5 times as long as the carpus and about half as long as the broad ; upper and lower margins smooth and convex outward ; outer surface bearing a longitudinal carina. Smaller first leg . . . . . Smaller first leg about half to one-third times as long as the larger one. Dactylus and fixed finger slender and elongate. Palm about 1.8 times as long as the dactylus, about one-third times as long as the broad and rectangular.

Remarks : *Callianassa shikamai* Imaizumi from the Miocene Arakida Formation has the palm ornamented with tubercles on the outer surface and the short carpus curved ascending proximally. The characters of the species quite coincide with ones of *C. titaensis*. Therefore, *C. shikamai* are considered to be synonymous with *C. titaensis*. Fossils of the family callianassidae in Japan commonly occur in the intertidal to upper sublittoral deposits but this species is often found with the lower sublittoral to upper bathyal molluscan fossils.

This species occurs in the Japanese Miocene formations as the Mizunami Group (this paper), the Morozaki Group (Nagao, 1941 and Takeda *et al.*, 1987), the Shidara Group (Karasawa MS), the Tomikusa Group (Imaizumi, 1957) and the Itsukaichi Group (Fujiyama *et al.*, 1986). The fossil records of *C. titaensis* are chronologically limited in the Early to Early Middle Miocene time.

Occurrence : Togari (Locality 77 of Itoigawa, 1980), Akeyo-cho, Mizunami City . . . . Oidawara Member. Ryodenji, Agi, Nakatsugawa City . . . . . Ryodenji Member.

Measurements (in mm):

	MFM 9296 Right first leg	MFM 9297 Left first leg	MFM 9298 Right first leg
Dactylus length	16.2	22.7	22.1
Palm length	17.3	22.1	15.4

Palm width	19.0	21.3	16.6
Carpus length	9.4	10.6	—
Carpus width	15.1	20.2	—
Merus length	13.0	—	13.5

Callianassa sp. 1
(Pl. 2, Figs. 8, 9)

Materials : 13 specimens (MFM 9301-9308, 9337-9340).

Description : First legs of common sizes for the genus. Larger first leg chelate. Dactylus slender, elongate, tapering from the broad base to the sharp apex and strongly curved downward ; upper margin strongly convex and rounded ; lower margin denticulate from the apex to the middle part and possessing a blunt tooth near the base ; lower part of the outer surface ornamented with two small holes along the lower margin. Fixed finger about as long as the dactylus, slender, elongate and tapering distally ; upper margin bearing fine serrations and convex ; lower margin smooth and concave, and its cutting edge showing proximally a deep depression with the distal part of the palm. Palm about 1.5 times as long as the dactylus, rectangular and slightly longer than the broad ; distal margin roundly convex. Carpus about 1.2 times as long as the palm and triangular ; upper and lower margins smooth ; upper margin nearly straight ; lower margin curved ascending toward proximally. Merus about 1.2 times as long as the carpus ; upper margin irregularly ridged ; lower margin bearing a proximal tooth at the proximal part ; proximal tooth on the lower margin characteristically protruded, of which the posterior margin roundly protruded, while the anterior margin is rather straight. Ischium as long as the merus.

Remarks : *Callianassa* sp. 1 is easily distinguished from *Callianassa bona.* The larger first leg of the former is moderate, but that of the latter is large. The merus of the former has a narrow proximal tooth on the lower margin, but that of the latter bears a broad tooth on the lower margin. The present species differs from *C. titaensis* which has the palm with some granules on the outer surface. From the Oligocene to Miocene species, *C. elongatodigitata* Nagao, *C.* sp. 1 is easily distinguished for the carpus of *C. elongatodigitata* is shorter than the palm, while that of *C.* sp. 1 is as long as the palm. The present species differs from the Miocene species, *C. tanakai* Imaizumi, which has the fixed finger ornamented with two rows of granules, and differs from the Miocene species, *C. yagii* Imaizumi, which has the palm bearing nine granules on the distal margin. *C.* sp. 1 is similar to the Miocene species, *C. inornata* Nagao and Huzioka, but *C. inornata* is easily distinguishable from the present species by its dactylus ornamented with three granules on the outer surface.

Occurrence : Togari (Locality 48 of Itoigawa, 1980), Akeyo-cho, Mizunami City . . . . Yamanouchi Member.

Measurements (in mm):

	MFM 9301	MFM 9303	MFM 9304
	Left first leg	Left first leg	Left first leg

Palm length	11.3	12.0	11.3
Palm width	6.8	8.3	9.3
Carpus length	15.1	14.6	15.6
Carpus width	8.0	8.4	9.1
Merus length	—	8.4	9.2

Callianassa sp. 2
(Pl. 2, Fig. 1)

Materials : One specimen (MFM 9371).

Description : A specimen remaining only a fixed finger and a palm of a larger first leg and its leg of common size for the genus. Fixed finger broad, triangular and tapering from the broad base to the sharp apex ; upper margin of the cutting edge with fine serrations, and bearing a board tooth in the middle part ; lower margin smooth and sharp ; upper part of the outer surface distinctly keeled along the upper margin, and its keel with small holes reaching about to the distal part of the palm. Palm rectangular, and slightly shorter than the broad ; upper and lower margins sharp and smooth ; outer and inner surfaces smooth ; outer surface moderately convex and inner surface nearly flat.

Remarks : Although the specimen in imperfectly preserved, it is easily distinguished from *Callianassa bona, C. titaensis, and C.* sp. 1 by having the broader fixed finger and the short palm.

Occurrence : Shukubora (Locality 58 of Itoigawa, 1980), Hiyoshi-cho, Mizunami City . . . . . Shukunohora Facies.

Measurements (in mm):

	MFM 9371
	Right first leg
Palm length	7.2
Palm width	7.8

Subfamily Upogebiinae Borradaile, 1903
Genus *Upogebia* Leach, 1814

Type species : *Cancer stellatus* Montagu, 1808 ; Living species.

Geologic range : Upper Cretaceous ? — Recent.

Upogebia mizunamiensis sp. nov.
(Pl. 2, Figs. 2, 4, 5)

Materials : 22 specimens (MFM 9005-9007, 9351-9369).

Holotype : Carapace, right first to third legs and left first to third legs (MFM 9005).

Paratype (1) : Carapace, right first and second legs, and left first and second legs (MFM 9006).

Paratype (2) : Carapace, right and left first legs (MFM 9007).

Type locality : Shomasamahora (Locality 32 of Itoigawa, 1980), Tsukiyoshi, Akeyo-cho, Mizunami City, Gifu Prefecture.

Formation : Tsukiyoshi Member, Akeyo Formation, Mizunami Group (Early to Early Middle Miocene) .

Diagnosis : Rostrum triangular and about as long as the broad at the base. Lateral frontal teeth well developed, and each bearing a row of tubercles. Median groove of the gastric region deeply concave in the anterior third. Dorsal surface of the gastric region abundantly being beset with some conical tubercles. First legs subchelate and equal. Dactylus slender and elongate ; outer surface bearing a row of 7 conical tubercles from the base to the middle part ; upper part of the outer surface distinctly keeled ; inner surface provided with a serrated ridge in the middle line ; proximal part of the upper margin ornamented with some conical tubercles. Fixed finger short and triangular. Palm about 1.5 times as long as the dactylus and rectangular ; lower part of the outer surface under the middle line ornamented with two rows of conical tubercles from the apex to the middle part along the middle line ; inner surface possessing 13 striae ; upper margin distinctly denticulate. Carpus short, triangular and tapering distally.

Description of the holotype : Anterior part of the carapace well preserved, showing the dorsal surface. Rostrum triangular and about as long as the broad at the base, and its lateral margin bearing 4 tubercles. Lateral frontal teeth well doveloped, and each bearing a row of tubercles, 6 on the left side, 8 on the right side ; anterior part on each side forms the lateral border of the notch at the base of the rostrum. Median groove of the gastric region deeply concave in the anterior third. Dorsal surface of the gastric region abundantly being beset with conical tubercles, especially, tubercles on the gastric region of the posterior part of the median groove and of the lateral part dense. Posterior part of the cervical groove remaining but badly preserved. First legs showing the upper part of the outer surface. First legs equal. Dactylus slender, elongate and tapering from the broad base to the sharp apex. Fixed finger lacking. Palm about 1.5 times as long as the dactylus and rectangular ; upper part of the outer surface bearing two rows of shallow holes along the upper margin. Carpus about half as long as the palm, tapering proximally and triangular. Merus lacking. Right second to forth legs, and the left second and the third legs, showing the outer surface.

Description of the paratype (1) : Carapace only remaining a part of the gastric region which bears some conical tubercles. First legs subchelate and equal. Dactylus slender, elongate, and tapering from the broad base to the sharp apex ; outer surface bearing a row of 7 conical tubercles from the proximal part to the middle part, and its tubercles reducing in size from the front backward ; upper part of the outer surface distinctly keeled ; inner surface provided with ridges having coarse serrations in the middle line ; proximal part of the upper margin beaded with some conical tubercles. Fixed finger short, about one-forth times as long as the dactylus and triangular ; its apex sharp ; upper margin possessing triangular teeth on the middle part and the distal part ; lower margin smooth. Palm rectangular, about 1.5 times as long as the dactylus, and 1.8 times as long as the broad ; outer surface moderately convex, and inner surface slightly convex ; upper part of the outer surface bearing three rows of small holes along the upper margin ; outer surface provided with shallow holes in the middle line ; lower part of the outer surface under the

middle line ornamented with two rows of conical tubercles from the distal part to the middle part along the middle line ; a lower row of tubercles stronger than the upper one ; its tuberles diminishing in size from the front backward ; lower part of the outer surface under a row of tubercles with many small holes ; upper margin distinctly denticulate ; upper margin of the inner surface ornamented with shallow holes along the upper margin ; inner surface possessing 13 striae oblique to proximally, and its striae diminishing in length toward both tips. carpus showing the outer surface ; carpus short, about one-third times as long as the palm, triangular, and tapering proximally ; upper margin gently convex and lower margin nearly straight. Second legs showing the outer surface. Merus and carpus of the right second leg, and the merus and the palm of the left one remaining.

Description of the paratype (2) : Carapace remaining a part of the gastric region which bears a median groove and some conical tubercles. First legs remaining the dactylus, the palm and the merus, showing the upper part. First legs equal. Dactylus showing the upper margin ; upper part of the outer and the inner surfaces distinctly keeled ; proximal part of the upper margin ornamented with some conical tubercles. Palm showing the outer surface ; palm rectangular, about 1.5 times as long as the dactylus and about 1.8 times as long as the broad ; outer surface moderately convex ; upper part of the outer surface bearing two rows of shallow grooves along the upper margin ; a row of holes in the middle line and tubercles indistinct. Imperfect merus short, triangular and tapering proximally.

Remarks : The fossil species of the genus *Upogebia* is the first record from the Japanese Miocene formations. In Seas around Japanese islands, there are eight living species, *Upogebia acanthchela* Sakai, *U. issaeffi* (Balss), *U. isodactyla* (Ortmann), *U. major* (De *Haan*), *U. miyakei* Sakai, *U. kiiensis* Sakai and *U. trypeta* Sakai. *U. mizunamiensis* is clearly distinguished from these living species by having the palms of the first legs which possess the striae on the inner surface. This species is commonly found in the Tsukiyoshi Member.

Occurrence : Shomasamahora (Locality 32 of Itoigawa, 1980), Tsukiyoshi, Akeyo-cho, Mizunami City ; Dry riverbed southeast of Shomasamahora (Locality 36 of Itoigawa, 1980), Tsukiyoshi, Akeyo-cho, Mizunami City . . . . . Tsukiyoshi Member.

Measurements (in mm):

	MFM 9006 (Holotype)		MFM 9007 (Paratype-1)		MFM 9008 (Paratype-2)	
	Carapace					
length	20.3		—		—	
width	10.4		—		—	
	Left leg	Right leg	Left leg	Right leg	Left leg	Right leg
Dactylus length	4.0	3.7	6.3	6.1	6.7	8.0
Palm length	7.5	7.1	9.9	9.8	11.2	11.9
Palm width	—	—	5.3	5.4	—	—
Carpus length	5.2	5.4	5.1	4.7	—	—
Carpus width	—	—	4.3	—	—	—

Associated forms (at the type locality) : Decapod crustaceans ; —Thalassinoidea fam. gen.

et sp. indet., *Laomedia praeastacina, Scylla ozawai.* Gastropods ; —*Vicarya yokoyamai, Batillaria mizunamiensis, Vicaryella ishiiana, Phos tsukiyoshiensis.* Pelecypods ; —*Saxolucina khataii, Hiatula minoensis, Clementia papyracea, Cyclina japonica.* Plant fossils.

Upogebia sp.
(Pl. 2, Fig. 7)

Materials : Two specimens (MFM 9309, 9310).

Description : Specimens badly preserved. First legs subchelate and equal. Dactylus slender, elongate, tapering from the broad base to the sharp apex and gently curved downward ; outer surface bearing two longitudinal ridges, its upper one distinctly denticulate and the lower one oranamented with small tubercles near the base. Palm about 1.8 tims as long as dactylus, about twice times as long as the broad and rectangular ; upper margin smooth and lower margin bearing fine serrations. Upper part of the outer surface possessing two shallow grooves along the upper margin ; inner surface having longitudinal shallow grooves in the middle line and the lower part. Carpus short, triangular and tapering proximally. Second legs simple.

Remarks : This species differs from the former species, *Upogebia mizunamiensis* by having the palm with no striae on the inner surface.

Occurrence : Higashihora, Yamaoka-cho, Ena-gun . . . . . Higashihora Member.

Measurements (in mm):

	MFM 9309	
	Left first leg	Right first leg
Dactylus length	—	8.9
Palm length	13.5	13.6
Palm width	8.1	7.7

Infraorder Brachyura
Section Oxystomata
Superfamily Leucosioidae Samouelle, 1819
Family Calappidae De Haan, 1833
Subfamily Calappinae De Haan, 1833
Genus *Calappa* Weber, 1795

Type species : *Cancer granulatus* Linnaeus, 1758 ; Living species.

Geologic range : Eocene ? — Recent.

Calappa sp. 1
(Pl. 3, Fig. 1)

Materials : One specimen (MFM 9605).

Description : A specimen remaining an imperfect dactylus of right cheliped. Dactylus lacking the apex and small, tapering distally, and strongly curved downward. Upper

margin bearing small conical tubercles, and these tubercles diminishing in size from the back forward. Lower margin possessing 3 obscure teeth. Outer surface covered with fine tubercles, which are rather dense on the proximal half and rather sparse on the distal half. Proximal part of the outer surface possessing a large projection, and its tip pointed downward. Inner surface smooth ; upper part bearing 9 transverse striae from the middle part to the apex.

Remarks : Although this single specimen is an only small dactylus, it is identical with the dactylus of the genus *Calappa*, for the dactylus strongly curved downward and possessing a large projection on the outer surface.

Occurrence : Shukubora (Locality 58 of Itoigawa, 1980), Hiyoshi-cho, Mizunami City . . . . . Shukunohora Facies.

Calappa sp. 2
(Pl. 3, Fig. 4)

Materials : One specimen (MFM 9390).

Description : A specimen remaining the proximal part of the dactylus of the right cheliped, and showing the outer surface. Outer surface covered with coarse granules. Proximal part of the outer surface possessing a large projection.

Remarks : This species is distinguished from the former species, *Calappa* sp. 1, for the dactylus is larger than one of *C.* sp. 1 and the projection of *C.* sp. 2 at the proximal part is not strongly pointed downward.

Occurrence : Oginoshima (Locality 07), Kamigiri, Kamado-cho, Mizunami City . . . . . Shukunohora Facies.

Paramursia gen. nov.

Type species : *Paramursia circularis* sp. nov.

Diagnosis : Dorsal surface of the carapace subcircular, very convex, slightly wider than long, and covered with fine granules and prominences which vary in size. Granules and the prominences rather dense on the anterior half on the carapace, and rather sparse on the posterior half. Carapace traversed by five strong tuberculate ridges, one median, the others branchial and oblique ; median ridge bearing 5 tubercles on the gastric and the cardiac regions, inner ridge with 4 low tubercles on the branchial region, and outer ridge with 3 tubercles. Furrow between the meso- and protogastric regions distinct. Protogastric region convex and ornamented with 3 tubercles. Furrow separating the branchial region from the gastric and cardiac regions distinct and sinuous. Branchial region along the metagastric region possessing two longitudinal tubercles and the branchial region beaded with some tubercles along the anterolateral margin. Hepatic region distinct and ornamented with two tubercles. Front narrow. Orbital border flat and possessing 3 shallow notches. Anterolateral margin strongly convex outward. Lateral epibranchial spine very small, acute triangular. Posterolateral margin about one-third times as long as the anterolateral margin and gently concave, and its posterior part possessing an obscure

tooth. Posterior margin as long as the posterolateral margin and gently convex. Palm long and triangular in the cross section ; upper margin fringed with 4 large tubercles ; lower margin beaded with fine granules ; outer surface covered with tubercles and granules of which sizes are variable ; inner surface smooth, and its upper part sharp and ornamented with 4 serrations irregularly.

Remarks : The present new genus is clearly distinguished from *Calappa* Weber and *Paracyclois* Miers, for the carapace of *Paramursia* lacks the posterolateral expansion in which the walking legs concealed. *Paramursia* is allied to *Mursia* Desmarest in its character of the ridges of the carapace ornamentations, namely, the former has a circular carapace which is strongly convex with an obscure lateral epibranchial spine and the latter possesses a long lateral epibranchial spine. The present new genus also differs from *Mursia* in the characters of the orbital border and the posterior border. The present genus is similar to *Cyclöes* De Haan by having an obscure epibranchial spine, but the carapace ornamentations of *Paramursia* are clearly close to ones of *Mursia*.

Geologic range : Miocene.

Paramursia circularis sp. nov.
(Pl. 3, Figs. 7, 8)

Materials : Two specimens (MFM 9013, 9014).

Holotype : Carapace (MFM 9013).

Paratype : Left cheliped (MFM 9014).

Type locality : Oginoshima (Locality 07 of Itoigawa, 1980), Kamigiri, Kamado-cho, Mizunami City, Gifu Prefecture.

Formation : Shukunohora Facies, Akeyo Formation, Mizunami Group (Early to Early Middle Miocene).

Diagnosis : as for the genus.

Description of the holotype : Carapace lacking a part of the left branchial region, but well preserved. Dorsal surface of the carapace subcircular, very convex, slightly wider than the length, and covered with fine granules and prominences which vary in size. Granules and prominences rather dense on the anterior half of the carapace, and rather sparse on the posterior half. Carapace traversed by five strong tuberculate ridges, one median, the others branchial and oblique ; median ridge bearing 4 tubercles on the gastric region and one on the cardiac region, and its tubercles low and oblique posteriorly ; inner ridge with 4 low tubercles on the branchial region, and its tubercles diminishing in size from the front backward ; outer ridge with 3 tubercles. Furrow between the meso- and protogastric regions distinct ; mesogastric region covered with 3 longitudinal tubercles, and the median tubercle larger than the others ; protogastric region convex, ornamented with 3 tubercles, and the tubercle at the posterior part larger than the others. Furrow separating branchial region from the gastric and cardiac regions distinct and sinuous ; branchial region along the metagastric region possessing two longitudinal tubercles and the branchial region beaded with some tubercles along the anterolateral margin. Hepatic region distinct

and ornamented with two tubercles. Front narrow but its details indistinct. Orbital border flat and possessing 3 shallow notches. Anterolateral margin strongly convex, outward. Lateral epibranchial spine very small, acute triangular, and its tip pointed forward and upward. Posterolateral margin about one-third times as long as the anterolateral margin and gently concave ; posterior part possessing an obscure tooth. Posterior margin as long as the posterolateral margin and gently convex.

Description of the paratype : left cheliped with a part of a fixed finger and a palm. Fixed finger lacking the apex and short ; outer surface distinctly tuberculate ; upper margin sharp and lower margin rounded. Palm long and triangular in the cross section ; distal length longer than the proximal one ; upper margin fringed with 4 large tubercles ; lower margin beaded with fine granules ; outer surface covered with tubercles and granules of which sizes are variable ; inner surface smooth and concave ; distal part of the inner surface covered with fine granules ; upper part of the inner surface sharp and ornamented with 4 serrations irregularly.

Remarks : The presest new species can be compared with each species of the genus *Mursia* such as the Oligocene species, *Mursia yaquinensis* Rathbun and *M. marcusana* Rathbun, the Miocene species, *M. lienharti* (Bachmayer) and *M. takahashii* Imaizumi, and the liveng species, *M. armata* De Haan, *M. cristimana* Latreille and *M. gaudichaudii* (A. Milne Edwards). But it differs from in its carapace which possesses an obscure lateral epibranchial spine. Also the present species resembles a living species, *Cyclöes granulosa* De Haan, but the new species can be distinguished from the latter in characters of the carapace ornamentations.

It appears that *Paramursia circularis* inhabits in the intertidal to upper sublittoral zone with sandy bottom in the tropical to subtropical sea.

Occurrence : Oginoshima (Locality 07 of Itoigawa, 1980), Kamigiri, Kamado-cho, Mizunami City . . . . . Shukunohora Facies.

Measurements (in mm):

	MFM 9013 (Holotype) Carapace	MFM 9014 (Paratype) Left cheliped
Carapace length	11.4	—
Carapace width	12.2+	—
Palm length	—	9.8

Associated forms : Decapod crustaceans ;—*Tymolus itoigawai, Philyra plana, Cyclograpsus rectangularis*. Pelecypods ;—*Glycymeris rhynchonelloides, Mytilus coruscus, Chlamys itoigawae*. Gastropods ;—*Miohaliotis amabilis, Cellana depressa*. Elasmobranchs.

Family Leucosiidae Samouelle, 1819

Subfamily Philyrinae Rathbun, 1837

Genus *Philyra* Leach, 1817

Type species : *Cancer globus* Fabricus, 1775 ; Living species.

Geologic range : Miocene—Recent.

Philyra nishimotoi sp. nov.
(Pl. 3, Figs. 5, 6, 9)

Materials : 49 specimens (MFM 9008-9011, 9413-9457)

Holotype : Carapace (MFM 9008).

Paratype-(1): Carapace and abdmen (MFM 9009).

Paratype-(2): Merus (MFM 9010).

Type Locality : Inkyoyama (Locality 22 of Itoigawa, 1980), Kujiri, Izumi-machi, Toki City, Gifu Prefecture.

Formation : Kujiri Facies, Akeyo Formation, Mizunami Group (Early to Early Middle Miocene).

Diagnosis : Carapace rhombic in outline. Dorsal surface gently convex and covered with minute, more or less tuberculate granules of variable sizes ; granules rather densed on the branchial region, rather sparse on the gastric, hepatic and cardiac regions. Frontal region microscopically granuled, and on this region the median groove shallow. Branchio-cardiac grooves rather distinct, becoming broader and shallower posteriorly. Gastric and cardiac regions with the median ridge distinct. Cardiac region shallowly separated from the gastric region. Hepatic region weakly ridged. Front-orbital margin raised. Front border comparatively wide and nearly flat, and its lateral ends angulated. Orbital border extremely small and postorbital border weakly protruded to the front. Anterolateral border gently convex outward and fringed with minute granules. Posterolateral border gently convex outward and beaded with minute granules. Pterygostmian region strongly swollen and covered with microscopical granules. Fuse segment of female tapering frontally, ornamented with minute granules on anterior and posterior parts, and its posterior margin in the middle part slightly protruded posteriorly. Merus long and triangular in the cross section. Each margin beaded with fine conical granules.

Description of the holotype : Carapace well preserved, and rather rhombic in outline. Dorsal surface gently convex and covered with minute, more or less tuberculate granules of variable sizes ; granules rather dense on the branchial region, rather sparse on the gastric, hepatic and cardiac regions. Frontal region microscopically granuled, and on this region the median groove shallow. Branchio-cardiac grooves rather distinct, becoming broader and shallower posteriorly. Gastric and cardiac regions with the median ridge distinct, and its median ridge on the anterior part ornamented with granules densely. Cardiac region shallowly separated from the gastric region. Hepatic region weakly ridged. Front-orbital margin raised. Front border comparatively wide, nearly flat and its lateral ends angulated. Orbital border extremely small and the postorbital border weakly protruded to the front. Anterolateral border gently convex outward and fringed with minute granules. Posterolateral border gently convex outward and beaded with minute granules. Pterygostomian region strongly swollen and covered with microscopical granules. Pterygostomian region and the anterior margin of the buccal frame visible from above beyond the hepatic region and the front, respectively.

Description of the paratype-(1) : Carapace of female well-preserved but the left surface

bored by a gastropod, and rhombic in outline. Dorsal surface showing the same character as the holotype. Fuse segment of female tapering frontally, ornamented with minute granules on the anterior and posterior parts, and its posterior margin in the middle part slightly protruded posteriorly.

Description of the paratype-(2) : Merus long, and triangular in the cross section. Each margin beaded with fine conical granules.

Remarks : The fossil species, *P. nishimotoi* is the first record from the Miocene Mizunami Group in Japan. The appearance is surely close to the known recent species of the genus *Philyra* which is represented by nine Japanese species —*P. carinata* Bell, *P. priscum* De Haan, *P. platycheira* De Haan, *P. heterogrona* Ortmann, *P. syndactyla* Ortmann, *P. kanekoi* Sakai, *P. misagoana* Sakai, and *P. taekoae* Takeda. The presest new species has the similarity with *P. heterogrona, P. kanekoi, P. taekoae, P. carinata* and *P. priscum* in the Japanese species, having the carapace covered with tubercles, but surely distinguished from them by rhombic outline of the carapace, which bears median ridges on the gastric and cardiac regions.

In the mode of life, each living species of the genus *Philyra* inhabits in the intertidal to upper sublittoral zone of muddy to sandy bottom in the tropical to subtropical sea.

This species name is dedicated to Mr. Hiroyuki Nishimoto of the Tajimi-kita High School.

Occurrence : Inkyoyoma (Locality 22 of Itoigawa, 1980), Kujiri, Izumi-machi, Toki City ; Obora (Locality 40 of Itoigawa, 1980), Kawai, Izumi-machi, Toki City ..... Kujiri Facies. Shimohonmachi (Locality 79 of Itoigawa, 1980), Terakawado-cho, Mizunami City ..... Togari Member. Yamanouchi (Locality 45 of Itoigawa, 1980), Akeyo-cho, Mizunami City ..... Yamanouchi Member. Higashihora, Yamaoka-cho, Ena-gun ..... Higashihora Facies.

Measurements (in mm):

	MFM 9008 (Holotype) Carapace	MFM 9009 (Paratype-1) Merus	MFM 9010 (Paratype-2)
Carapace length	9.8	9.6	—
Carapace width	9.2	9.5	—
Merus length	—	—	12.9

Associated forms (at the type locality) : Decapod crustaceans ; —*Callianassa bona,* Xanthidae, gen. *et* sp. indet. Pelecypods ;—*Glycymeris ikebei, Nipponomarcia nakamurai, Siratria siratoriensis.* Gastropods ;—*Protorotella depressa, Turritella sagai, Euspira meisensis.*

Philyra plana sp. nov.
(Pl. 3, Figs. 2, 3)

Materials : 11 specimens (MFM 9011, 9012, 9391-9399).

Holotype : Carapace (MFM 9011).

Paratype : Carapace (MFM 9012).

Type locality : Oginoshima (Locality 07 of Itoigawa, 1980), Kamigiri, Kamado-cho, Mizunami City, Gifu Prefecture.

Formation : Shukunohora Facies, Akeyo Formation, Mizunami Group (Early to Early Middle Miocene).

Diagnosis : Carapace rhombic in outline. Dorsal surface gently convex and smooth. Gastric to cardiac regions with the median ridge distinct. Branchio-cardiac grooves inconspicuous. On the frontal region the median groove shallow. Hepatic region indistinct. Front-orbital margin raised. Front border narrow, and the preorbital border triangular and weakly protruded forward. Orbital border extremely small and the postorbital border sharp, triangular and protruded forward. Anterolateral and posterolateral borders gently convex outward and fringed with minute tuberculate granules.

Description of the holotype : Carapace well prererved, and rhombic in outline. Dorsal surface gently convex and smooth. Gastric to cardiac regions with the median ridge distinct. Branchio-cardiac grooves inconspicuous, but they become broader and shallower toward the posterior surface. On the frontal region the median groove shallow. Hepatic region indistinct. Front-orbital margin raised. Front border narrow, and preorbital border triangular and weakly protruded forward. Orbital border extremely small and the post-orbital border sharp, triangular and protruded forward. Anterolateral and posterolateral borders gently convex outward and fringed with minute tuberculate granules. Pterygostomian region strongly swollen.

Description of the paratype : Carapace well-preserved, slightly smaller than the holotype and rhombic in outline. Character of the carapace similar to one of the holotype, but branchio-cardiac groove distincter than the holotype.

Remarks : The present new species is clearly distinguished from the former species, *Philyra nishimotoi* in having the carapace which does not covered with tubercles. Among the living species in the Japanese waters, *P. syndactyla, P. platycheira* and *P. misagoana* are near to the present species, but they are different from *P. plana.* The carapace of the present species has a median ridge on the gastric and the cardiac regions.

Decapod C from the Miocene Bihoku Group illustrated by Nishikawa (1975) closely resembles to the present new species.

Occurrence : Oginoshima (Locality 07 of Itoigawa, 1980), Kamigiri, Kamado-cho, Mizunami City ; Shukubora (Locality 58 of Itoigawa, 1980), Hiyoshi-cho, Mizunami City . . . . . Shukunohora Member. Okuna (Locality 62 of Itoigawa, 1980), Toki-cho, Mizunami City . . . . . Nataki Member.

Measurements (in mm):

	MFM 9011 (Holotype) Carapace	MFM 9012 (Paratype) Carapace
Carapace length	8.3	7.2
Carapace width	7.4	6.6

Associated forms (at the type locality) : Decapod crustaceans ;—*Tymolus itoigawai, Par-*

amursia circularis, Cyclograpsus rectangularis. Pelecypods ;—*Glycymeris rhynchonelloides, Mytilus coruscus, Chlamys itoigawae.* Gastropods ;—*Miohaliotis amabilis, Cellana depressa.* Elasmobranchs.

Section Brachyrhyncha
Superfamily Grapsidoidea MacLeay, 1838
Family Grapsidae MacLeay, 1838
Subfamily Sesarminae Dana, 1851
Genus *Cyclograpsus* H. Milne Edwards, 1837

Type species : *Cyclograpsus punctatus* H. Milne Edwards, 1837 ; Living species.
Geologic range : Miocene—Recent.

Cyclograpsus rectangularis sp. nov.
(Pl. 3, Figs. 14, 16)

Materials : Two specimens (MFM 9019, 9020).
Holotype : Carapace(MFM 9019).
Paratype : Carapace and left cheliped (MFM 9020).
Type locality : Oginoshima (Locality 07 of Itoigawa, 1980), Kamigiri, Kamado-cho, Mizunami City, Gifu Prefecture.
Formation : Shukunohora Facies, Akeyo Formation, Mizunami Group (Early to Early Middle Miocene).
Diagnosis : Dorsal surface of the carapace rectangular, moderately convex, smooth and its regions poorly defined. Carapace length about three-forth times as long as the width. Frontal region divided into two by a very shallow groove. Furrow between the mesogastric and epigastric regions indistinct. Boundary between the frontal and gastric regions weakly ridged. Cervical groove conspicuous, very shallow, and its groove inconspicuous toward margins. Cardiac regions well defined, rectangular. Branchial regions slightly convex. Front border about one-third times as long as the width, nearly straight and its lateral end angulated. Orbital border large and rounded, and the postorbital border sharp. Antero-lateral margin convex on the anterior part, and nearly straight on the posterior part ; its anterior part cutting one microscopically notch. Posterolateral margin divergent posteriorly. Suborbital crest sharp and smooth. Palm of the cheliped rectangular and tapering proximally ; lower part of the outer surface weakly keeled along the lower margin.
Description of the holotype : Carapace lacking the right side. Dorsal surface of the carapace, rectangular, moderately convex, smooth and its regions poorly defined. Carapace length about three-forth times as long as the width. Frontal region divided into two by a very shallow groove. Furrow between the mesogastric and epigastric regions indistinct. Boundary between the frontal and gastric regions weakly ridged. Cervical groove conspicuous, very shallow, and its groove inconspicuous toward the margins. Cardiac regions well defined, rectangular. Branchial regions slightly convex ; boundary between the mesobranchial and metabranchial regions distinctly keeled ; its posterior part ornamented with a

weak keel along the posterolateral margin. Front border about one-third times as long as the width, nearly straight and its lateral end angulated. Orbital border large and rounded, and the postorbital border sharp. Anterolateral margin convex on the anterior part, and nearly straight on the posterior part ; its cutting edge weakening from the front backward ; its anterior part cutting one microscopically notch. Posterolateral margin divergent posteriorly.

Description of the paratype : Carapace badly preserved and larger than of the holotype. Ornamentations of the dorsal surface similar to one of the holotype. Suborbital crest sharp and smooth. Remaining thoracic sternum wide and composed of the first to the forth somites. Left cheliped remaining the dactylus, the fixed finger, the palm and the carpus. Dactylus lacking from the middle part to the apex, rounded in the cross section and details of it obscure. Fixed finger lacking an apex, tapering distally and rounded in the cross section ; outer surface bearing a longitudinal shallow groove in the middle line ; upper margin distinctly denticulate and lower margin rounded. Palm rectangular and tapering proximally ; upper and lower margins rounded ; lower part of the outer surface weakly keeled along the lower margin. Carpus short.

Remarks : The present new species is close to the living species, *Cyclograpsus integer* H. Milne Edwards, *C. intermedius* H. Milne Edwards and *C. longipes* Stimpson. *C. intermedius* and *C. longipes* differ from *C. rectangularis* by having the anterolateral margin cutting two obscure notches. *C. integer* is allied to the present species by having the anterolateral margin cutting a blunt notch. But the present species is discriminated from *C. integer,* for *C. integer* has the anterolateral margin becoming narrower anteriorly.

In the mode of life, the genus *Cyclograpsus* is the intertidal inhabitant in the tropical to subtropical sea of pebbly bottom.

Occurrence : Oginoshima (Locality 07 of Itoigawa, 1980), Kamigiri, Kamado-cho, Mizunami City . . . . . Shukunohora Facies.

Measurements (in mm):

	MFM 9019 (Holotype)	MFM 9020 (Paratype)
Carapace length	14.7	15.5
Carapace width	16.4	21.0+
Palm length	—	10.6
Palm width	—	7.5

Associated forms : Decapod crustaceans ;—*Tymolus itoigawai, Paramursia circularis, Philyra plana.* Pelecypods ;—*Glycymeris rhynchonelloides, Mytilus coruscus, Chlamys itoigawae.* Gastropods ;—*Miohaliotis amabilis, Cellana depressa.* Elasmobmanchs.

Cyclograpsus directus sp. nov.
(Pl. 3, Fig. 15)

Materials : One specimen (MFM 9021).

Holotype : Carapace and abdmen (MFM 9021).

Type Locality : Obora (Locality 27 of Itoigawa, 1980), Kawai, Izumi-machi, Toki City, Gifu Prefecture.

Formation : Kujiri Facies, Akeyo Formation, Mizunami Group (Early to Early Middle Miocene).

Diagnosis : Dorsal surface of the carapace rectangular, gently convex, and its surface smooth and poorly defined. Carapace length about four-fifth times as long as the width. Furrow between the protogastric and mesogastric regions indistinct. Gastric region continuous anteriorly with a shallow median furrow of the frontal region. Boundary between the frontal and gastric regions moderately ridged. Cardiac region defined, rectangular. Branchial region slightly convex ; boundary between the mesobranchial and metabranchial regions distinctly keeled. Front border about one-third times as long as the width, and its lateral end rounded. Orbital border wide and rounded, and its postorbital border sharp. Anterolateral margin convex on the anterior part, and nearly straight on the posterior part. Posterolateral margin divergent posteriorly. Suborbital crest cutting 3 blunt teeth on the anterior part and one sharp tooth on the posterior part.

Description of the holotype : Carapace well preseved but lacking the left hepatic region. Dorsal surface of the carapace rectangular, gently convex, and its surface smooth and poorly defined. Carapace length about four-fifth times as long as the width. Furrow between the protogastric and mesogastric regions indistinct. Gastric region continuous anteriorly with a shallow median furrow of the frontal region. Boundary between the frontal and gastric regions moderately ridged. Cardiac region defined, rectangular, and subdivided into two by shallow median groove. Branchial region slightly convex ; boundary between the mesobranchial and metabranchial regions distinctly keeled ; posterior part of branchial regions ornamented with a keel along the posterolateral margin. Front border about one-third times as long as the width, possessing shallow median hollows, and its lateral end rounded. Orbital border wide and rounded, and its postorbital border sharp. Anterolateral margin convex on the anterior part, and nearly straight on the posterior part. Posterolateral margin divergent posteriorly. Suborbital crest cutting 3 blunt teeth on the anterior part and one sharp tooth to the posterior part. ·Second to sixth segments of abdmen of female remain, the sixth segment triangular and narrow ; segments reducing in the broad from the front backward.

Remarks : The present new species differs from the former new species, *C. rectangularis* by having an entire anterolateral margin. *C. directus* is clearly ditinguished from the living species, *C. integer, C. intermedius* and *C. longipes,* for the former has an entire anterolateral margin and the latter three species have the anterolateral margin cutting some blunt notches.

Occurrence : Obora (Locality 27 of Itoigawa, 1980), Kawai, Izumi-machi, Toki City . . . . Kujiri Facies.

Measurements (in mm):

	MFM 9021 (Holotype)
Carapace length	12.7

Carapace width 15.9

Associated forms : Decapod crustaceans ;—*Callianassa bona.* Pelecypods ;—*Glycymeris ikebei, Nipponomarcia nakamurai, Siratoria siratoriensis.* Gastropods ;—*Protorotella depressa, Turritella sagai, Euspira meisensis.*

Genus *Miosesarma* gen. nov.

Type species : *Miosesarma japonica* sp. nov.

Diagnosis : Carapace about three-forth times as long as the broad and rectangular. Dorsal surface gently vaulted and smooth. Mesogastric region well defined, slightly convex and continuous anteriorly with the median furrow of the frontal region. Protogastric region also slightly convex. Hepatic region nearly flat. Cardiac furrow distinct. Cervical groove discernible and reaching anteriorly to the first lateral tooth. Cardiac region transversely convex. Branchio-cardiac furrow distinct. Branchial region transversely convex ; branchial lobe well defined ; epibranchial region strongly ridged ; furrow between the epibranchial and mesobranchial regions linking a branchial lobe with the third lateral tooth ; mesobranchial region possessing an oblique keel reaching the third tooth ; metabranchial region nearly flat and distinctly keeled along the posterolateral margin. Intestinal region conspicuous and rectangular. Front border about one-third times as long as the width, subdivided into two by a shallow groove in the median line, and its lateral end rounded. Orbital border broad and oblique to the anterolateral margin. Anterolateral margin nearly straight and cutting 4 teeth. Posterolateral margin divergent posteriorly. Suborbital crest sharp, and not granulate.

Remarks : The present new genus resembles to *Halice* De Haan and *Metaplax* H. Milne Edwards, and the carapace ornamentation of this genus is very close to ones of *Metaplax.* But *Miosesarma* is clearly distinguished to *Halice* and *Metaplax,* for the former bears no suborbital crest composed of some tubercles which *Halice* and *Metaplax* characteristically possess.

Geologic range : Miocene.

Miosesarma japonica sp. nov.
(Pl. 3, Figs. 10-13)

Materials : 74 specimens (MFM 9015-9018, 9620-9689).

Holotype : Carapace (MFM 9015).

Paratype-(1) : Carapace (MFM 9016).

Paratype-(2) : Carapace and abdmen of male (MFM 9017).

Paratype-(3) : Carapace and abdmen of female (MFM 9018).

Type locality : Asano (Locality 25 of Itoigawa, 1980), Tokitsu-cho, Toki City, Gifu Prefecture.

Formation : Yamanouchi Member, Akeyo Formation, Mizunami Group (Early to Early Middle Miocene).

Diagnosis : as for the genus.

Description of the holotype : Carapace well preserved. Carapace about three-forth times as long as the broad and rectangular. Dorsal surface gently vaulted and smooth, but surface on the branchial region covered with microscopical granules. Boundary between the frontal and gastric regions strongly ridged. Mesogastric region well defined, slightly convex and continuous anteriorly with a median furrow of the frontal region. Protogastric region also slightly convex. Hepatic region nearly flat. Cardiac furrow distinct. Cervical groove discernible, becoming broader and shallower toward the lateral margin and reaching anteriorly to the first lateral tooth. Cardiac region transversely convex. Branchiocardiac furrow distinct. Branchial region transversely convex ; branchial lobe well defined ; epibranchial region strongly ridged ; furrow between the epibranchial and mesobranchial regions shallow and broad, and its furrow links a branchial lobe with the third lateral tooth ; mesobranchial region moderately convex and possessing an oblique keel reaching the third tooth ; furrow between the mesobranchial and metabranchial regions discernible, and metabranchial region nearly flat and distinctly keeled along the posterolateral margin. Intestinal region conspicuous and rectangular. Front border about one-third times as long as the width, subdivided into two by a shallow groove in the median line, and its lateral end rounded. Orbital border broad and oblique to the antrolateral margin. Anterolateral margin nearly straight and cutting 4 teeth, of which the first two are large, the third small and the forth broad. Posterolateral margin divergent posteriorly. Suborbital crest sharp, and not granulate.

Description of the paratype-(1) : Carapace as long as one of the holotype. Ornamentation of the dorsal surface similiar to one of the holotype, but more smooth.

Description of the paratype-(2) : Carapace smaller than of the holotype. Ornamentation of the dorsal surface very similar to one of the holotype. Thoracic sternum wide and composed of the first to the fifth sternal segments. First somite triangular, the second to fifth somites rectangular transversely, and the third one longer than the others. Abdmen of male probably remaining the first, the third, the forth and the fifth segments, and its segments diminishing in size from the back forward.

Description of the paratype-(3) : Carapace smaller than of the holotype. Dorsal surface showing the character same as one of the holotype. Remaining abdmen of female broad and concealed the thoracic sternum.

Remarks : The present new species differs from the living species of the genus *Halice* by having the carapace which is transversely rectangular in outline. *Miosesarma japonica* bears resemblances to the known recent species of the gunus *Metaplax* which is represented by nine Indo-Pacific species *M. crenulata* (Gerstaecker), *M. longipes* Stimpson, *M. indica* H. Milne Edwards, *M. dentipes* (Heller), *M. distincta* H. Milne Edwards, *M. elegans* De Man, *M. intermedia* De Man, *M. sheni* Gordon and *M. takahashii* Sakai. But the present species bears the smooth suborbital crest and the recent species of the genus *Metaplax* has suborbital crests composed of some tubercles.

Camptandrium ? sp. from the Miocene Chichibumachi Group (Fujiyama *et al.*, 1986) and Decapoda A from the Miocene Bihoku Group (Nishikawa, 1975) are identical with *M. japonica.* The present species is a doninant species in the Yamanouchi Member and the

Higashihora Member. Judging from the molluscan assemblage, the strata which yielded *M. japonica* contain the fauna of shallow water inhabitants down to about 50 to 60 m deep in the subtropical to temperate Zone.

Occurrence : Asano (Locality 25 of Itoigawa, 1980), Tokitsu-cho, Toki City ; Hesoyama (Locality 46 of Itoigawa, 1980), Togari, Akeyo-cho, Mizunami City ; Togari (Locality 49 of Itoigawa, 1980), Akeyo-cho, Mizunami City ; Bogabora (Locality 50 of Itoigawa, 1980), Yamanouchi, Akeyo-cho, Mizunami City . . . . . Yamanouchi Member. Shomasamahora (Locality 32 of Itoigawa, 1980), Tsukiyoshi, Akeyo-cho, Mizunami City ; Dry riverbed southeast of Shomasamahora (Locality 36 of Itoigawa, 1980), Tsukiyoshi, Akeyo-cho, Mizunami City . . . . . Tsukiyoshi Member. Higashihora, Yamaoka-cho, Ena -gun . . . . . Higashihora Memer.

Measurements (in mm):

	MFM 9015 (Holotype)	MFM 9016 (Paratype-1)	MFM 9017 (Paratype-2)	MFM 9018 (Paratype-3)
Carapace length	13.3	12.8	11.4	10.0
Carapace width	19.2	18.1	15.3	12.8

Associated forms (*at the type locality*) : Decapod crustaceans ;—*Parathranites* sp. Pelecypods ;—*Macoma optima, M. izurensis, Cultellus izumoensis.*

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Explanation of Plate

Plate 1

Figs. 1-5. Thalassinoidea, gen. *et* sp. indet.

Fig. 1. Right first leg. Shomasamahora, Mizunami City. a, outer ; b, inner view.

Fig. 2. Left first leg. Shomasamahora, Mizunami City. a, outer ; b, inner view.

Fig. 3. Right first leg. Shomasamahora, Mizunami City. outer view.

Fig. 4. Right first leg. Shomasamahora, Mizunami City. inner view.

Fig. 5. Left first leg. Shomasamahora, Mizunami City. a, outer view ; b, inner view.

Figs. 6, 7. *Callianassa bona* Imaizumi, 1958. Right first leg. × 1.0. Anabora, Toki City. outer view.

Figs. 8, 9. *Laomedia praeastacina* sp. nov.

Fig. 8. Paratype (MFM 9004). Right first and second legs. Shomasamahora, Mizunami City. outer view.

Fig. 9. Holotype (MFM 9003). Right first to forth legs and left first leg. Shomasamahora, Mizunami City.

Fig. 10. *Callianassa titaensis* Nagao, 1941. Right first and second legs, and abdmen. ×1. 0. Ryodenji, Yamaoka-cho. outer view.

All figures × 1.5 otherwise stated.

1 a

2 a

3

5 a

1 b

2 b

4

5 b

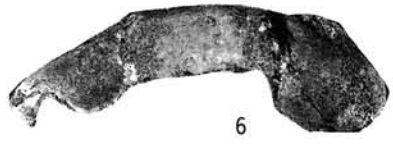

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Plate 2

Fig. 1. *Callianassa* sp. 2. Palm of right first leg. × 1.5. Shukubora, Mizunami City. a, outer ; b, inner view.

Figs. 2, 4, 5. *Upogebia mizunamiensis* sp. nov.

Fig. 2. Paratype (2) (MFM 9007). Carapace, right and left first legs. × 1.5. Shomasamahora, Mizunami City. dorsal view.

Fig. 4. Paratype (1) (MFM 9006). Carapace, right first and second legs, and left first and second legs. × 1.5. Shomasamahora, Mizunami City. a, dorsal ; b, d, outer ; c, e, inner view.

Fig. 5. Holotype (MFM 9005). Carapace, right first to third legs and left first to second legs. × 1.5. Shomasamahora, Mizunami City. a, dorsal ; b, c, lateral view.

Fig. 3. *Callianassa bona* Imaizumi, 1958. Right and left first legs. × 1.0. Shimohondamachi, Mizunami City.

Fig. 6. *Callianassa titaensis* Nagao, 1941. legs. × 1.0. Ryodenji, Yamaoka-cho.

Fig. 7. *Upogebia* sp. legs. × 1.0. Higashihora, Yamaoka-cho.

Figs. 8, 9. *Callianassa* sp. 1. Right first leg. × 1.5. Togari, Mizunami City. outer view.


1 a


1 b


2


3

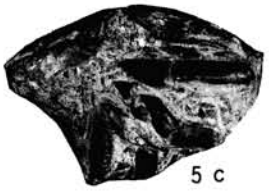

4 e

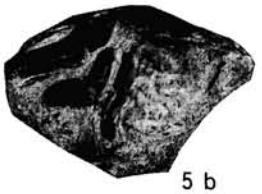

4 d


4 a


4 b


4 c


5 c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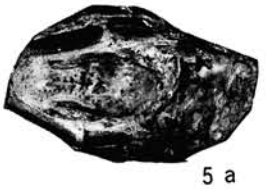
5 a


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7

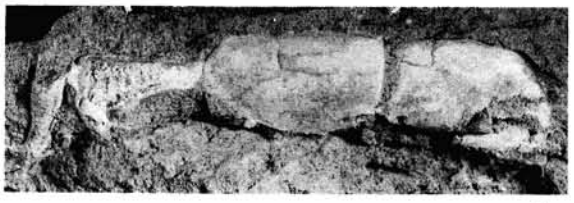
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Plate 3

Fig. 1. *Calappa* sp. 1. Dactylus of right cheliped. × 2.0. Shukubora, Mizunami City. a, outer ; b, inner view.

Figs. 2, 3. *Philyra plana* sp. nov.

Fig. 2. Paratype (MFM 9012). Carapace. × 2.0. Oginoshima, Mizunami City. dorsal view.

Fig. 3. Holotype (MFM 9011). Carapace. × 2.0. Oginoshima, Mizunami City. a, dorsal ; b, ventral view.

Fig. 4. *Calappa* sp. 2. dactylus of right cheliped. × 2.0. Oginoshima, Mizunami City. outer view.

Figs. 5, 6, 9. *Philyra nishimotoi* sp. nov.

Fig. 5. Holotype (MFM 9008). Carapace. × 2.0. Inkyoyama, Toki City. a, ventral ; b, dorsal view.

Fig. 6. Paratype (1) (MFM 9009). Carapace. × 2.0. Inkyoyama, Toki City. a ; dorsal ; b, ventral view.

Fig. 9. Paratype (2) (MFM 9010). Merus. × 2.0. Inkyoyama, Toki City. a, outer ; b, inner view.

Figs. 7, 8. *Paramursia circularis* sp. nov.

Fig. 7. Holotype (MFM 9013). Carapace. × 2.0. Oginoshima, Mizunami City. dorsal view.

Fig. 8. Paratype (MFM 9014). Palm. × 2.0. Oginoshima, Mizunami City. a, outer ; b, inner view.

Figs. 10-13. *Miosesarma japonica* sp. nov.

Fig. 10. Holotype (MFM 9015). Carapace. × 1.5. Asano, Toki City. dorsal view.

Fig. 11. Paratype (3) (MFM 9018). Carapace. × 1.5. Asano, Toki City. a, ventral ; b, dorsal view.

Fig. 12. Paratype (2) (MFM 9017). Carapace. × 1.5. Asano, Toki City. a, dorsal ; b, ventral view.

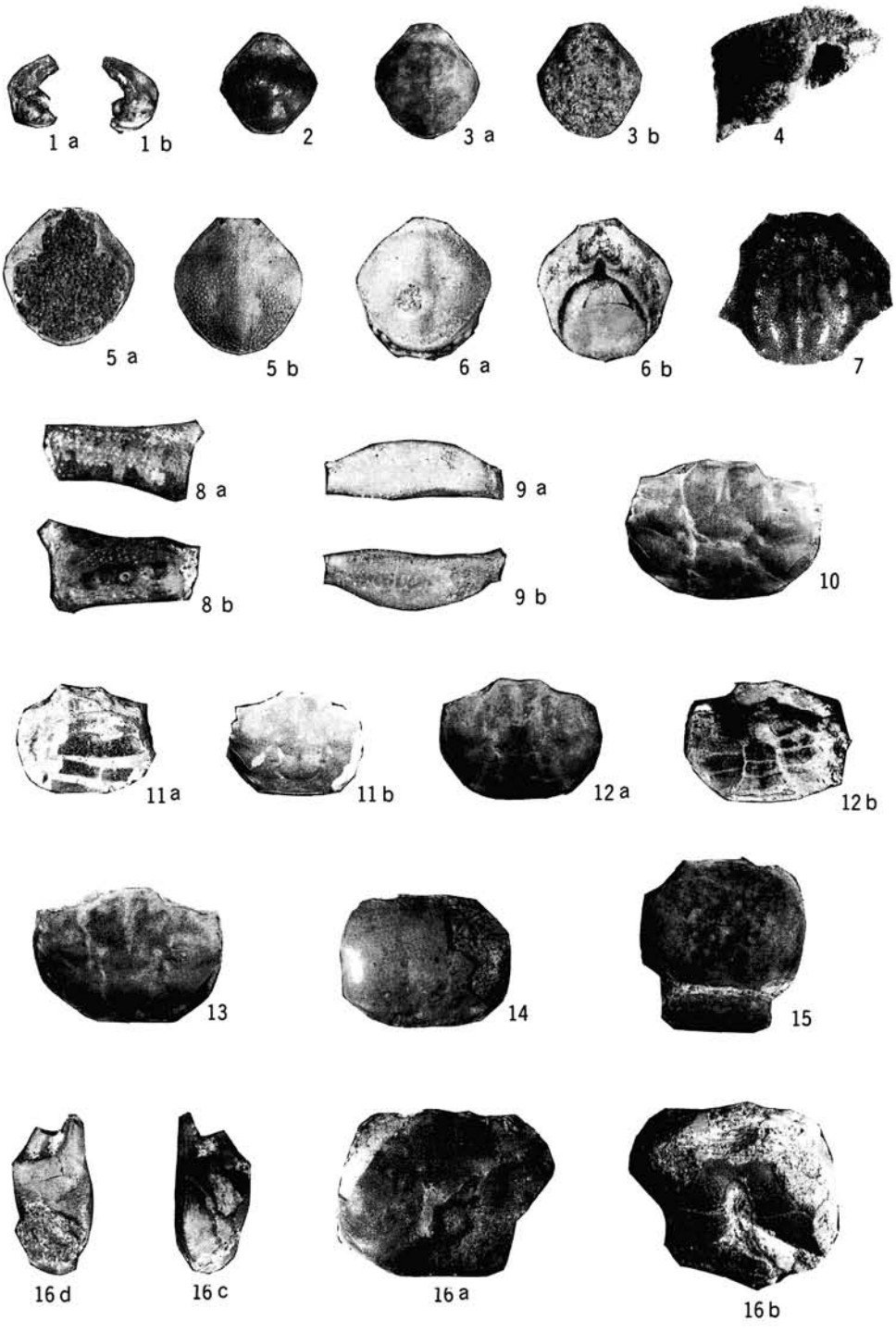
Fig. 13. Paratype (1) (MFM 9016). Carapace. × 1.5. Asano, Toki City. dorsal view.

Figs. 14, 16. *Cyclograpsus rectangularis* sp. nov.

Fig. 14. Holotype (MFM 9019). Carapace. × 2.0. Oginoshima, Mizunami City. dorsal view.

Fig. 16. Paratype (MFM 9020). Carapace and left cheliped. × 2.0. Oginoshima, Mizunami City. a, dorsal ; b, ventral ; c, outer ; d, inner view.

Fig. 15. *Cyclograpsus directus* sp. nov. Holotype (MFM 9021). Carapace. × 2.0. Obora, Toki City. dorsal view.


1 a
1 b
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3 a
3 b
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5 a
5 b
6 a
6 b
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8 a
8 b
9 a
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11 a
11 b
12 a
12 b
13
14
15
16 d
16 c
16 a
16 b