

PAGURID CRABS (DECAPODA, ANOMURA)
FROM WALT AIR COAST

By

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(with 6 Text-figures)

I—INTRODUCTION

While the systematics of Anomura has been extensively studied in different parts of the world, comparatively very little work has been done on the Indian anomurans after Alcock's (1905) publication on Indian decapod Crustacea. Henderson (1915) described six hermit crabs from the Chilka lake. The pagurids from Krusadai island were described by Sundara Raj (1927). Gravely (1941), while studying the fauna of Madras coast, mentioned the occurrence of eight species of hermit crabs. The pagurid crabs collected after 1905 and deposited in the Indian Museum were described by Kamalaveni (1951). San-kolli (1961) described a new species of *Pagurus* from Ratnagiri.

The present work was undertaken with a view to make a systematic study of anomuran fauna of Waltair coast. During the course of the study twenty three species belonging to five genera of the family Paguridae were recorded. Out of these, one species of the genus *Pagurus* happens to be new to science. The material for the present study was collected from Lawson's Bay, Waltair and Visakhapatnam harbour.

II—SYSTEMATIC ACCOUNT

Family PAGURIDAE

Subfamily DIOGENINAE

Paguropsis Henderson

1888. *Paguropsis* Henderson, *Challenger*, Anomura : 98.
1899. *Chlaenopagurus* Alcock, *J. Asiat. Soc. Beng.* : 113.
1905. *Paguropsis* : Alcock, *Cat. Ind. Mus. Crust.* : 27.

Carapace moderately elongate, rostrum prominent. The abdomen is flexed, not spirally coiled. Eyestalks stout, ophthalmic scales separated, spiniform. Antennal acicle large, flagellum long, nonsetose. Chelipeds equal, finger tips corneous, opening horizontally. The 2nd and 3rd pair of walking legs long and short, 4th pair have chelae.

Paired abdominal appendages are present on the 1st two abdominal segments of the male and 1st abdominal segment in the case of female.

Paguropsis typica Henderson

(Text-fig. I, Fig. 1. A, B, C)

1888. *Paguropsis typicus* Henderson, *Challenger*, Anomura : 99.
 1899. *Chlaenopagurus andersoni* Alcock, *J. Asiat. Soc. Beng.* : 115.
 1905. *Paguropsis typica* : Alcock, *Cat. Ind. Mus. Crust* : 28.

Diagnosis.—Rostrum projects beyond the eyes, 3rd pair of legs chelate paired, abdominal appendages present.

Description.—The cervical groove is deep-cut and the carapace included within is well calcified. Rostrum projects well between the eyestalks. Eyes are large and reniform. Chelipeds massive, quite equal, covered with long, stiff, golden yellow bristles. 3rd pair of legs and in a chela. In males, the first two abdominal segments have paired appendages whereas in females only the first segment has paired appendages.

Material.—About 10 specimens were collected from Lawson's Bay, Waltair.

Measurements.—6.2 mm. carapace length.

Distribution.—Philippines, Cape Comorin and Gulf of Martaban.

Remarks.—This species is collected for the first time from Waltair coast.

Clibanarius Dana

1852. *Clibanarius* Dana, *U. S. Expl. Expd. Crust.* : 461.
 1905. *Clibanarius* : Alcock, *Cat. Ind. Mus. Crust.* : 40.
 1953. *Clibanarius* : Forest, *Bull. Mus. Hist. Nat. Paris.* : 437.

Carapace elongate, rostrum distinct but short. Abdomen well developed, spirally coiled. Eyestalks long and slender. Antennal acicle short; antennal flagellum long, nonsetose. Chelipeds subequal, fingers open and close horizontally. Tip corneous and spooned. Fourth pair of legs subcheliform, 5th pair cheliform, both have on the surface, near the tip a patch of imbricating corneous granules.

Key to the species of Clibanarius

1. The dactylus of the 3rd pair of thoracic legs is longer than propodus.
 - A. Eyestalks much shorter than the antennular peduncles ; a strong spine at the inner end of the lower inner border of the merus of the chelipeds. *C. infraspinatus*
 - B. Eyestalks as long as the antennular peduncle.
 - (1) Eyestalks much longer than the anterior border of the carapace, the eyes occupying about one eleventh of their lengths *C. padavensis*

- (2) Eyestalks a little longer than the anterior border of the carapace *C. longitarsus*
- (3) Eyestalks distinctly longer than the anterior border of the carapace, the eyes occupy about one tenth of the length of the eyestalk *C. olivaceous*
- (4) Eyestalks equal in length to the anterior border of the carapace, the eyes occupying about one eighth of their length. *C. striolatus*
- II. The dactylus of the 3rd pair of thoracic legs is decidedly shorter than the propodus, which on the left side has its outer surface remarkably flattened and the upper border of that surface very sharply defined. Carapace not abnormally elongate; chelipeds not remarkably setose. Eyestalks as long as the anterior border of the carapace or as the antennular peduncle *C. humilis*
- III. The dactylus of 3rd pair of thoracic legs is exactly of the same length as the propodus *C. eurysternus*

***Clibanarius infraspinatus* Hilgendorf**

(Text-fig. I. Fig. 2, A, B, C)

1869. *Clibanarius infraspinatus* Hilgendorf, *V. D. Decken's Reisen Ost Afr.* : 97.

1905. *Clibanarius infraspinatus* : Alcock, *Cat. Ind. Mus. Crust.*, : 44.

Diagnosis.—A strong blunt spine at inferior border of merus of each cheliped; distinct longitudinal striations on the legs and ocular peduncles.

Description.—Carapace with scattered tufts of long yellow bristles. Rostrum small, hardly reaching the base of the ophthalmic scales; eyestalks long and slender. Ophthalmic scales with the free edges spinose and setose, approximated. Antennal acicle setose and spinose, overlapping the base of the terminal joint of the peduncle; flagellum longer than the carapace. Chelipeds equal and similar, longer than the carapace. There is a very strong spine at the inner end of the lower inner border of the merus. The 2nd and 3rd pair of legs just reach beyond the chelipeds. The outer surface of the propodus of 3rd left leg somewhat flattened, besides being of a lighter colour and very distinctly striped in a longitudinal direction on eyestalks and on legs.

Material.—About 60 specimens were collected from Visakhapatnam harbour.

Measurements.—9.5 mm. carapace length.

Distribution.—Singapore, Mergui, Sydney, Red Sea, Philippines and Bay of Bengal.

***Clibanarius padavensis* de Man**

(Text-fig. I. Fig. 4, A, B, C)

1883. *Clibanarius padavensis* de Man, *J. Linn. Soc.* : 242.

1905. *Clibanarius padavensis* : Alcock, *Cat Ind. Mus. Crust.*, : 44.

Diagnosis.—Rostrum prominent, eyestalks $1/6$ th longer than anterior border of carapace, chelipeds equal and similar, the dactylus of the third pair of legs about one and $2/7$ times longer than propodus.

Description.—Fine silky setae are present on the sides of the carapace and on the antennal peduncles and legs. Rostrum rather prominent, reaching to a little beyond the base of the ophthalmic scales and beyond the antennal angles of the carapace. Ophthalmic scales approximated, their edges spinose. Antennal acicle setose, very indistinctly serrulate, flagellum nearly twice as long as the carapace. Chelipeds equal and similar, merus with 1 or 2 spinules at the far end of the outer lower border. Inner border of carpus indistinctly and of propodus more distinctly serrulate, the carpus having a distinct spine at the far end of the inner border : Outer surface of the fingers studded dark with tipped spinules. The fingers when closed are separated at the base by gap. The 2nd and 3rd legs exceed the chelipeds on the left side by more than a dactylus and on the right side by more than a dactylus and a half.

Material.—About 80 specimens were collected from Visakhapatnam harbour.

Measurements.—Length of carapace : 9.0 mm.

Distribution.—Port Canning, Mergui, Akyab, Singapore and Madras coast.

Remarks.—The species is recorded for the first time from Waltair coast.

***Clibanarius longitarsus* (De Haan)**

(Text-fig. I. Fig. 3, A, B, C)

1850. *Pagurus longitarsus* De Haan, *Faun. Jap. Crust.*, : 211.

1902. *Clibanarius longitarsus* : de Man, *Decapod und Stomatop.*, : 741.

1950. *Clibanarius longitarsus* : Barnard, *Ann. S. Afr. Mus.*, : 434.

Diagnosis.—Eyes a little longer than anterior border of carapace; chelipeds subequal, tarsus longer than the preceding segment covered with number of tufts of hairs. Propodus of left cheliped and propodus of 3rd pair of walking legs somewhat flattened on the external surface.

Description.—The portion of the carapace anterior to the cervical groove is little longer than broad, slightly convex, covered with yellow bristles on the sides; rostrum pointed, triangular, ocular peduncle a little longer than the anterior margin of carapace, almost equal to the antennular peduncle; ophthalmic scales small, pointed with two small teeth at the free end; antennal scale small, with long hairs, hardly reaches the middle of the last segment of the peduncle. Chelipeds subequal, the right a little longer, merus covered with a number of small patches in the anterior region; outer border armed with two small spines.

Material.—Nearly 15 specimens were collected from Visakhapatnam harbour.

Measurements.—Carapace length : 5.5 mm.

Distribution.—Japan, Singapore, Ternate, Indian Ocean, China, Africa, Pondichery and Chilka lake.

Remarks.—This species is recorded for the first time from Waltair coast.

***Clibanarius olivaceus* Henderson**

(Text-fig. II. Fig. 2, A, B, C)

1915. *Clibanarius olivaceus* Henderson, *Rec. Indian. Mus.*, : 287.

Diagnosis.—Rostrum moderately prominent, eyestalks distinctly longer than the anterior border of carapace; chelipeds subequal and similar. The dactylus of 3rd leg is about 1/4 longer than propodus.

Description.—Carapace with tufts of setae on the sides and behind the cervical groove. Rostrum moderately prominent reaching a little beyond antennal angles of the carapace. Ophthalmic scales with the outer edge setose and faintly spinose. Antennal acicle setose and slightly spinose, the proximal spinule being most prominent, scarcely reaching the terminal joint of the peduncle. Chelipeds subequal and similar; merus with the upper margin obscurely serrulate and 2 spinules at the distal end of the outer lower margin; hand only slightly roughened and comparatively free of setae; fingers rougher and more setose than the palm. The length of the hand, including the fingers, is about twice its breadth. The 2nd and 3rd legs exceed the chelipeds on both sides by the length of the dactyli and nearly half the propodi. A spinule is present at the lower distal end of the merus and another at the upper distal end of the carpus in both pairs of legs. The dactylus of the 3rd leg is about 1/4th longer than the corresponding propodus; the dactylus of the 2nd leg while stouter is still distinctly longer than its propodus.

Material.—About 85 specimens were collected from Visakhapatnam harbour.

Measurements.—Carapace length : 7.0 mm.

Distribution.—Chilka lake and Madras coast.

Remarks.—This species is recorded for the first time from Waltair coast.

***Clibanarius striolatus* Dana**

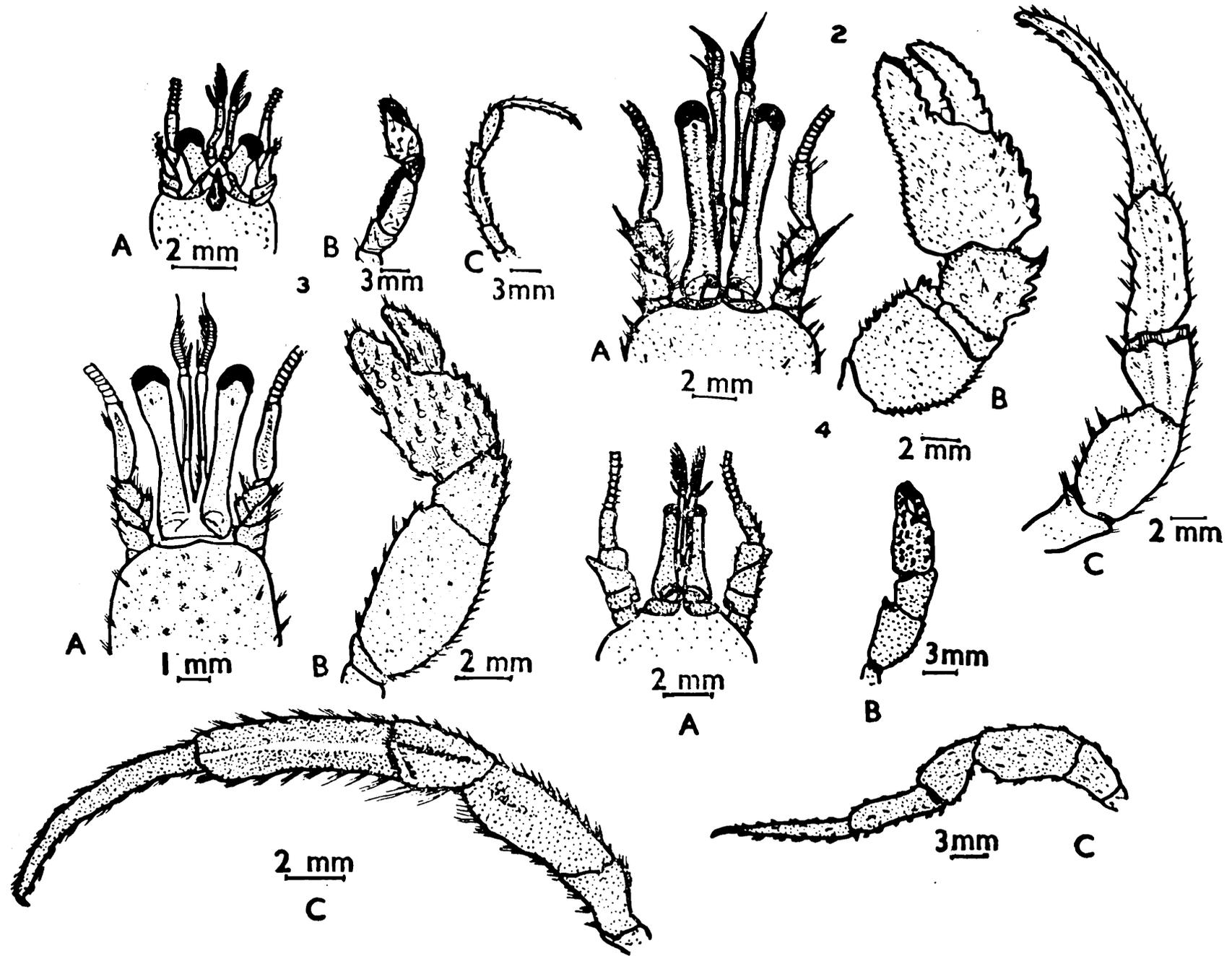
(Text-fig. II. Fig. 1, A, B, C)

1852. *Clibanarius striolatus* Dana, *U. S. Expl. Expd. Crust.*, : 463.

1905. *Clibanarius striolatus* : Alcock, *Cat. Ind. Mus. Crust.*, : 46.

1953. *Clibanarius striolatus* : Forest, *Bull. Mus. Hist. Nat.*, : 448.

Diagnosis.—Rostrum small, does not reach to the base of the ophthalmic scales. Eyestalks as long as the anterior border of carapace; hands short and stout. Propodus of 3rd left leg has the



Text-fig. I— Fig. 1. *Paguropsis typica* Henderson. Fig. 2. *Clibanarius infraspinatus* Hilgendorf.
 Fig. 3. *Clibanarius longitarsus* (De Haan). Fig. 4. *Clibanarius padavensis* de Man. A.
 anterior portion of the animal; B. cheliped, C. walking leg.

upper border of its outer surface well defined; dactylus of this pair of legs is a little shorter.

Description.—Anterior region of the carapace quadrangular. Fine silky setae present on the sides of the carapace, antennal peduncles and legs. Rostrum little shorter and does not reach to the base of the ophthalmic scales. Eyestalks shorter and stouter, being only as long as the anterior border of the carapace; eyes larger, occupying from $1/7$ to $1/8$ of the length of the eyestalk. Ophthalmic scales approximated, their edges spinose. Antennal acicle setose very indistinctly serrulate, usually not overlapping the base. Chelipeds equal, similar, shorter and stouter. Usually the hands and the wrists are rougher and more setose. The 2nd and 3rd legs exceed the chelipeds on the left side by more than a dactylus and on the right side by more than a dactylus and a half. The propodus of the 3rd left leg has the upper border of its outer surface fairly well defined and the dactylus of this pair of legs is a little shorter than in *C. padavensis*.

Material.—About 70 specimens were collected from Visakhapatnam harbour.

Measurements.—Carapace length : 5.0 mm.

Distribution.—Fiji islands, Persian Gulf, Mergui, Tahiti, Trincomalee, Seychelles and Gulf of Aden.

Remarks.—This species is recorded for the first time from Indian coast.

Clibanarius humilis (Dana)

(Text-fig. II. Fig. 3, A, B, C)

1851. *Pagurus humilis* Dana, : 271.

1852. *Clibanarius humilis* : Dana, *U. S. Expl. Exped. Crust.*, : 469.

1907. "*Clibanarius aequibilis* : Dana", *Nobili.*, : 367.

1915. "*Clibanarius aequibilis*, var. *merguiensis* de Man" : *Bouvier.*, . 29.

1957. *Clibanarius humilis* : Forest, *Proc. 8th Pacif. Sci. Congr.*, : 1057

Diagnosis.—Eyestalks a little longer than anterior border of carapace. Chelipeds unequal, the right being larger than left.

Description.—Carapace a little longer than broad; rostrum short, exceeds the antennal angles. Eyestalks a little longer than antennal peduncles. Antennal peduncles as long or longer than the ocular peduncles. Chelipeds unequal, the right being larger than the left; the left reaches only to the propodus of right. Carpus covered with small tubercles, propodus with sharp pointed teeth near the internal margin and also on the fingers. The propodus of the third right walking leg with a keel on the lateral margin.

Material.—Only 5 specimens were collected from Visakhapatnam harbour.

Measurements.—Carapace length : 6.00 mm.

Distribution.—Tuamotu, Hikueru, Tahiti and Pakume.

Remarks.—This species is recorded for the first time from Indian coast.

Clibanarius eurysternus Hilgendorf

(Text-fig. II. Fig. 4, A, B, C)

1878. *Pagurus (Clibanarius) eurysternus* Hilgendorf, *Monts. Akad. wiss.*, : 822.
 1888. *Clibanarius eurysternus* : de Man, *Decapod und Stomatop.*, : 447.
 1938. *Clibanarius eurysternus* : Yap-Chiongco, *Philipp. J. Sci.*, : 189.

Diagnosis.—Cephalothorax and basal segments of chelipeds and legs depressed; carapace striated with colour markings, outer surface of legs similarly striated, chelipeds similar and equal, dactylus of legs flattened remarkably from below.

Description.—Carapace compressed; six longitudinal reddish brown stripes on dorsal surface of the carapace. Rostrum exceeding antennal angles of carapace, eyestalks with alternating reddish brown and yellowish white, longitudinal stripes. Ophthalmic scales approximated, broadly triangular and spinose at free edges. Antennal acicle stout, setose, spinose on top, distinctly overlapping base of last segment of peduncle. Chelipeds and legs striped similar to eyestalks. Chelipeds similar and equal, slightly stouter than legs, equal to or slightly longer than carapace. Merus unarmed except for two spines and a tubercle on distal outer lower margin; carpus with a strong spine on distal inner border; hands and fingers on dorsal surface studded with corneous-tipped spines with a cluster of yellowish bristles arising from base of each. Fingers closed, meet only at tips. Legs much longer than chelipeds, right legs longer than left, carpus of legs with sharply pointed corneous-tipped spine on inner dorsal distal border; few spines of similar nature are also present on distal inner margin of carpus of left leg. Propodus and dactylus of 3rd leg equal in length, both compressed from below.

Material.—About 60 specimens were collected from Visakhapatnam harbour.

Measurements.—Carapace length : 7.0 mm.

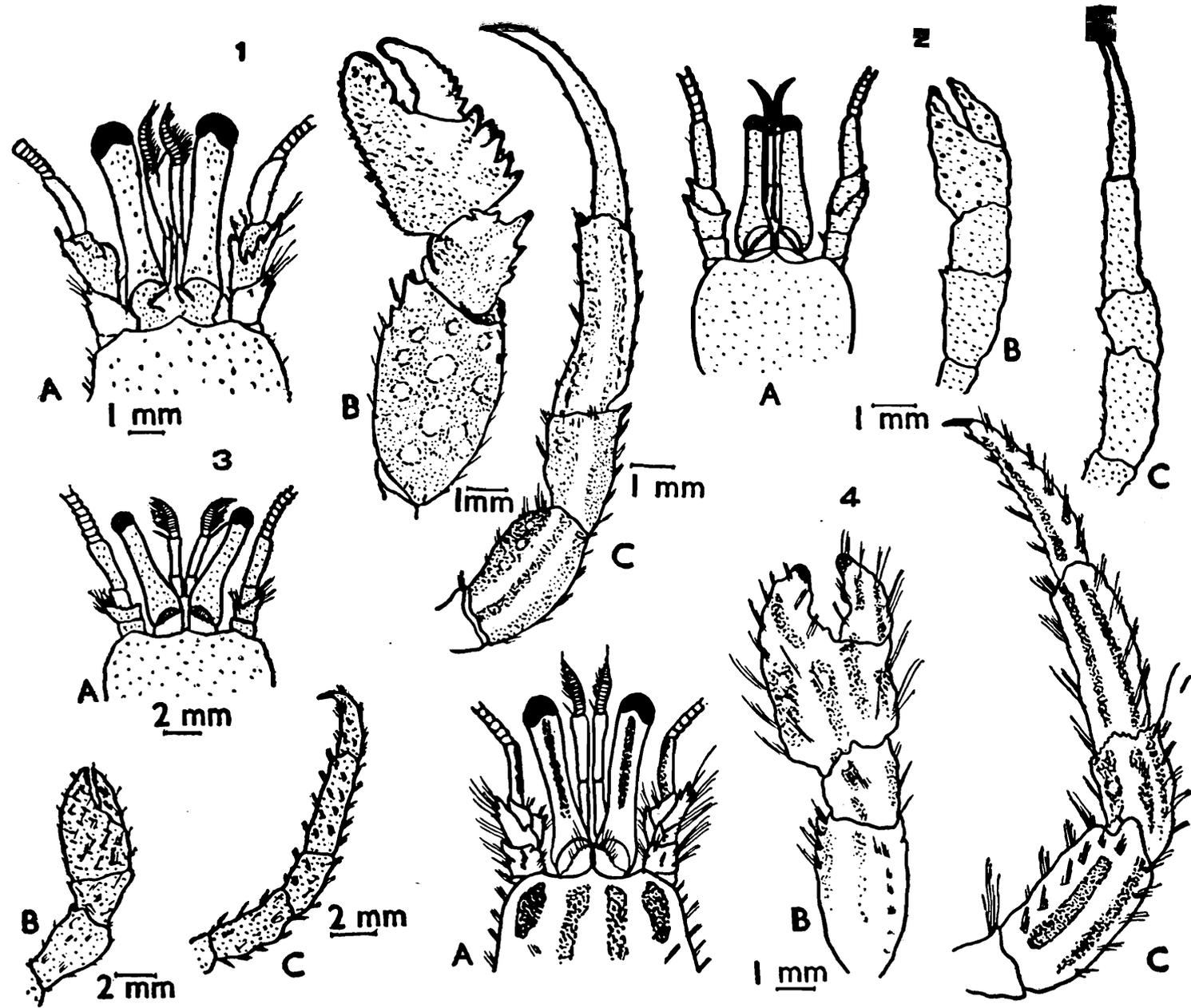
Distribution.—Mozambique, Malay Archipelago, Malayasia and Philippines.

Remarks.—This species is recorded for the first time from Indian coast.

Diogenes Dana

1852. *Diogenes* Dana, *U. S. Expl. Exped. Crust.*, : 438.
 1893. *Diogenes*: Stebbing, *Hist. Crust.*, : 160.
 1905. *Diogenes* : Alcock, *Cat. Ind. Mus. Crust.*, : 59.

Carapace usually elongate, broadened posteriorly, well calcified in front of the cervical groove; rostrum replaced by a movable rostriform process of the ophthalmic somite. Eyestalks moderately slender; ophthalmic scales large, separated by rostrum. Antennal acicle well formed; flagellum more or less setose. The chelipeds are



Text-fig. II— Fig. 1. *Clibanarius striolatus* Dana. Fig. 2. *Clibanarius olivaceus* Henderson.
 Fig. 3. *Clibanarius humilis* (Dana). Fig. 4. *Clibanarius eurysternus* Hilgendorf.
 A. anterior portion of the animal; B. cheliped; C. walking leg.

dissimilar and unequal, the left being greatly the larger, the fingers open and close in an obliquely vertical direction, the finger tips acuminate and calcareous. The 4th pair of legs are subchelate and the 5th pair chelate.

Key to the species of the genus Diogenes

- I. The rostrum is a narrow lamina, with the free edge spinose distally.
- A. The carapace is longer than broad; left hand when fully extended not inclined inwards.
- (i) Antennal acicle bifurcate, the inner branch reaches about half way along the penultimate joint of the peduncle.
- (a) The outer (longer) branch of the antennal acicle just or barely reaches the base of the terminal joint of the peduncle; outer surface of the left hand beset with claw-shaped spines. *D. diogenes*
- (b) The outer branch of the acicle reaches well beyond the base of the last joint of the peduncle; outer surface of left hand closely and finely granulose. *D. custos*
- (ii) Antennal acicle obscurely bifurcate, the outer branch does not reach the base of the terminal joint of the peduncle; outer surface of left hand closely and finely granulose.
- (a) Left hand nearly oval, the palm higher than long. *D. affinis*
- (b) Left palm as long as high, the lower part of its outer surface flattened. *D. planimanus*
- (c) Left hand oblong, the palm longer than high. *D. violaceous*
- (d) Left hand with longitudinal rows of tubercles *D. waltairensis*
- B. The carapace broader than long; left hand, even when fully extended, strongly inclined inwards. *D. miles*
- II. The rostrum is a slender non-serrated spinule; eyestalks not so long as the anterior border of the carapace or as the antennal peduncle; fixed finger of left cheliped deflexed.
- (a) The eyestalks reach nearly to the middle third of the terminal joint of the antennular peduncle; wrist and hand of left cheliped of adult more remarkably elongate. *D. avarus*
- (b) The eyestalks hardly reach the base of the terminal joint of the antennular peduncle.
- (i) A simple obliquely-longitudinal crest on the outer surface of the left palm *D. costatus*
- (ii) Two obliquely-longitudinal crests on the outer surface of the left palm. *D. bicristimanus*

Diogenes diogenes (Herbst)

(Text-fig. IV. Fig. 4, A, B, C)

1791. *Cancer diogenes* Herbst, *Krabben*, : 17.
 1893. *Diogenes diogenes* : Henderson, *Trans. Linn. Soc. Zool.*, : 412.
 1905. *Diogenes diogenes* : Alcock, *Cat. Ind. Mus. Crust.*, : 62.

Diagnosis.—Rostrum much longer than ophthalmic scales, its anterior half spinose; antennal acicle is bifurcate, the opposed edges of the forks being spinulose, the outer fork just or barely reaches the base of the terminal joint. Left cheliped nearly twice as long as the carapace.

Description.—Rostrum much longer than ophthalmic scales, its anterior half spinose. Ophthalmic scales spinulose. The antennal peduncle reaches to about middle of the terminal joint of the antennular peduncle. The antennal acicle is bifurcate. The chelipeds and legs are copiously and elegantly spinose, the fingers of the smaller cheliped and the dactyli of 2nd and 3rd legs being thickly plumed.

Material.—About 20 specimens were collected from Lawson's Bay, Waltair.

Measurements.—Carapace length : 5.0 mm.

Distribution.—Due to the confusion of this species the distribution is uncertain.

Diogenes custos (Fabricius)

(Text-fig. III. Fig. 2, A, B, C)

1798. *Pagurus custos* Fabricius, *Ent. Syst. Suppl.*, : 412.

1893. *Diogenes custos* : Henderson, *Trans. Linn. Soc. Zool.*, : 414.

1905. *Diogenes custos* : Alcock, *Cat. Ind. Mus. Crust.*, : 64.

Diagnosis.—Eystalks short, less than $\frac{2}{3}$ the length of the anterior border of carapace, rostrum is longer in relation to eystalks; antennular and antennal peduncles are of equal length.

Description.—The eystalks are short, being less than $\frac{2}{3}$ the length of the anterior border of the carapace; hence the rostrum is longer in relation to the eystalks, being nearly half its length. The antennular and antennal peduncles are of equal length. The upper border of the hand, the dactylus of the cheliped and the anterior border of the four terminal joints of the 2nd and 3rd legs are spinose or spinulose.

Material.—About 10 specimens were collected from Lawson's Bay, Waltair.

Measurements.—Carapace length : 6.00 mm.

Distribution.—South east coast of Australia, Mergui, Andamans and Bay of Bengal.

Diogenes affinis Henderson

(Text-fig. III. Fig. 3, A, B, C)

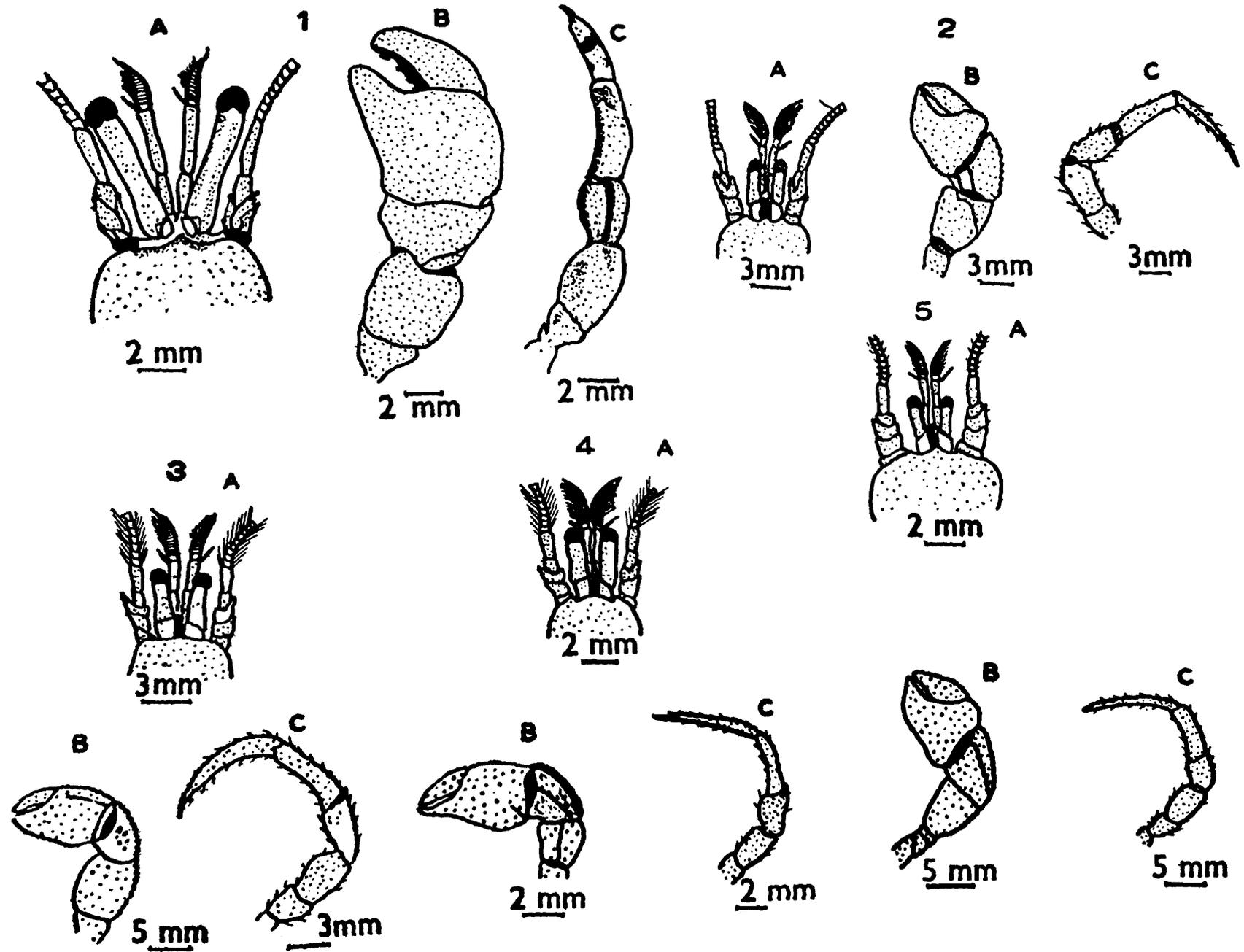
1893. *Diogenes affinis* Henderson, *Trans. Linn. Soc. Zool.*, : 415.

1852. *Diogenes custos* Dana, *U. S. Expl. Exped. Crust.*, : 439.

1905. *Diogenes custos* var. *affinis* : Alcock, *Cat. Ind. Mus. Crust.*, : 65.

Diagnosis.—Rostrum short, little longer than ophthalmic scales.

Description.—The rostrum is shorter, being a little longer than the ophthalmic scales. Antennal flagellum thickly setose to the tip.



Text-fig. III— Fig. 1. *Calcinus herbstii* (de Man). Fig. 2. *Diogenes custos* (Fabricius). Fig. 3. *Diogenes affinis* Henderson. Fig. 4. *Diogenes planimanus* Henderson. Fig. 5. *Diogenes violaceus* Henderson. A. anterior portion of the animal; B. cheliped; C. walking leg.

In the left cheliped the hand is shorter and broader, the dactylus does not make up $\frac{2}{3}$ the total length of the hand and the lower edge of the fixed finger is spinuous. The anterior surface of the propodus and dactylus of the 2nd and 3rd legs is granulose, not spinulose.

Material.—About 15 specimens were collected from Lawson's Bay, Waltair.

Measurements.—Carapace length : 5.5 mm.

Distribution.—Bay of Bengal.

***Diogenes planimanus* Henderson**

(Text-fig. III, Fig. 4, A, B, C)

1893. *Diogenes planimanus* Henderson, *Trans. Linn. Soc. Zool.*, : 416.
 1905. *Diogenes custos* var. *planimanus* : Alcock, *Cat. Ind. Mus. Crust.*, : 66.

Diagnosis.—Rostrum short, narrow, inner branch of antennal acicle obsolete and the outer branch falls far short of the base of the terminal joint of peduncle, flagellum more setose. The fixed finger of the left hand is straight.

Description.—The inner branch of the antennal acicle is obsolete and the outer branch falls far short of the base of the terminal joint of the peduncle. The rostrum is short, not much exceeding the ophthalmic scales but is remarkably narrower. On the outer surface of the carpus of the left cheliped there is an irregular row of enlarged granules parallel with the inner border. The palm of the hand is as long as high and the lower portion of its outer (granular) surface forms a flat facet bounded posteriorly by a short ridge running parallel with the carpal articulation; the granules on this ridge and at the junction with the lower border of the palm are enlarged. The left hand when fully extended has a slight inclination inwards.

Material.—About 15 specimens were collected from Lawson's Bay, Waltair.

Measurements.—Carapace length : 6.0 mm.

Distribution.—Malaya Peninsula and Bay of Bengal.

***Diogenes violaceus* Henderson**

(Text-fig. III. Fig. 5, A, B, C)

1893. *Diogenes violaceus* Henderson, *Trans. Linn. Soc. Zool.*, : 416.
 1905. *Diogenes custos* var. *violaceus* : Alcock, *Cat. Ind. Mus. Crust.*, : 66.

Diagnosis.—Rostral scale is long, inner fork of the antennal acicle nearly obsolete and the outer fork falls far short of the base of the terminal joint of the peduncle. Left hand is narrow, fixed finger of the same has a straight lower margin.

Description.—The inner fork of the antennal acicle is nearly obsolete, and the outer fork falls far short of the base of terminal joint of the peduncle. The antennal flagellum is less coarsely setose. The

palm of the left hand is longer than broad, so that the dactylus, though long, does not make up $\frac{2}{3}$ the total length of the hand and the hand as a whole is oblong instead of nearly oval.

Material.—10 specimens were collected from Lawson's Bay.

Measurements.—Carapace length : 6.0 mm.

Distribution.—Bay of Bengal.

***Diogenes waltirensis* Kamalaveni**

(Text-fig. IV. Fig. 1, A, B, C)

1951. *Diogenes custos* var. *waltirensis* Kamalaveni, *Rec. Indian Mus.*, : 78.

Diagnosis.—Rostrum prominent extending upto the base of the eyestalks. Eyestalks a little more than half the length of the anterior border of carapace. Ophthalmic scales well developed and margins serrated. Left cheliped twice as long as the right.

Description.—Carapace is almost as long as broad, posterior margins rounded. The rostrum is prominent extending upto the base of the eyestalks and is slightly longer than the ophthalmic scales. Eyestalks are long and slender. Ophthalmic scales are well developed and their margins are finely serrated. The antennal peduncles are hairy and the basal segment bears a stout spine on its outer anterior margin. Chelipeds dissimilar and unequal, the left being twice as long as the right. The left cheliped is slightly shorter and stouter than the legs and less hairy than the right cheliped. The movable finger of the left cheliped is studded with rounded tubercles which form longitudinal rows on the upper margin. The 2nd and 3rd pair of legs are similar being longer than the left cheliped by about half their dactylus and the 2nd pair slightly exceeds the 3rd pair.

Material.—Only 5 specimens were collected from Lawson's Bay, Waltair.

Measurements.—Carapace length : 10.0 mm.

Distribution.—Waltair coast.

***Diogenes miles* (Herbst.)**

(Text-fig. V. Fig. 1, A, B, C)

1791. *Cancer miles* Herbst, *Krabben.*, : 19.

1893. *Diogenes miles* : Henderson, *Trans. Linn. Soc. Zool.*, : 413.

1905. *Diogenes miles* : Alcock, *Cat. Ind. Mus. Crust.*, : 67.

Diagnosis.—Carapace broader than long and very flat. Rostrum longer than ophthalmic scales, its edge spinulose. Eyestalks $\frac{3}{5}$ the length of anterior border of carapace. Antennal acicle hardly bifurcate, flagellum thickly setose almost to the tip. Left cheliped vastly larger than the right with the hand much inclined inwards.

Description.—Cephalothorax broad and very flat. Carapace broader than long. Rostral appendage longer than ophthalmic scales, its edge spinulose. Left cheliped vastly larger than the right, with the wrist much inclined outwards and the hand inwards, the fingers have the outer surface granulose and the opposed edges setose in tufts. The 2nd and 3rd legs of both sides exceed the left cheliped by nearly half their dactylus.

Material.—About 20 specimens were collected from Lawson's Bay, Waltair.

Measurements.—Carapace length : 5.0 mm.

Distribution.—Bay of Bengal.

***Diogenes avarus* Heller**

(Text-fig. V, Fig. 5, A, B, C)

1865. *Diogenes avarus* Heller, *Novara Crust.*, : 83.

1887. *Diogenes avarus* : Walker, *J. Linn. Soc. Zool.*, : 113.

Diagnosis.—Rostrum a slender spine, not so long as the ophthalmic scales; eyestalks stout, not $\frac{2}{3}$ the length of the anterior border carapace; left cheliped vastly longer than the right.

Description.—Carapace moderately elongate, its antero-lateral border finely serrulate. Rostrum a slender spine, not so long as the ophthalmic scales. Eyestalks stout. The antennules are slightly longer than antennal peduncles. The antennal acicle is a simple spine. The left cheliped is vastly longer than the right and in the adult male is nearly $2\frac{1}{2}$ times the length of the carapace. The carpus is longer than the merus and a little longer than the palm of the hand; its inner edge is very well defined and serrate. The right cheliped is setose, especially as to the fingers. The 3rd right leg, which is a little longer than the 2nd, hardly reaches the base of the dactylus of the left cheliped.

Material.—About 50 specimens were collected from Lawson's Bay, Waltair.

Measurements.—Carapace length : 4.0 mm.

Distribution.—East Africa, Persian Gulf, Singapore, Torres Strait, Philippines, Madras coast and Krusadai island.

Remarks.—This species is recorded for the first time from Waltair coast.

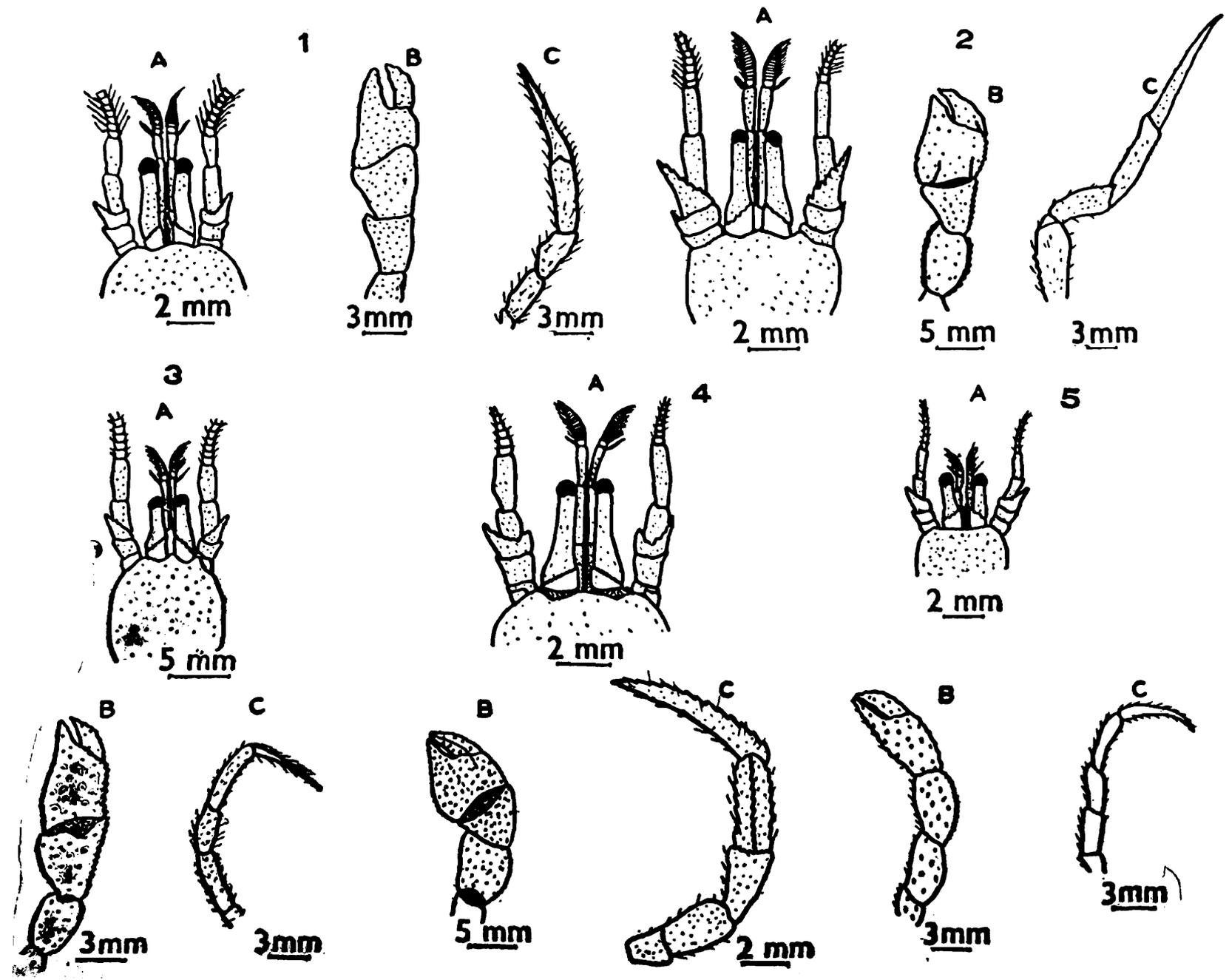
***Diogenes costatus* Henderson**

(Text-fig. IV. Fig. 2, A, B, C)

1893. *Diogenes costatus* Henderson, *Trans. Linn. Soc. Zool.*, : 418.

1905. *Diogenes costatus* : Alcock, *Cat. Ind. Mus. Crust.*, : 70.

Diagnosis.—Rostrum a slender spine; eyestalks about $\frac{4}{5}$ the length of the antero-lateral border of carapace. Antennal flagellum



Text-fig. IV— Fig. 1. *Diogenes waltirensis* Kamalaveni. Fig. 2. *Diogenes costatus* Henderson.
 Fig. 3. *Diogenes bicristimanus* Alcock. Fig. 4. *Diogenes diogenes* (Herbst).
 Fig. 5. *Diogenes avarus* Heller. A. anterior portion of the animal; B. cheli ped;

thickly setose upto the tip, antennal acicle a simple spine; left cheliped vastly larger than the right.

Description.—Carapace moderately elongate; rostrum a slender spine, shorter than ophthalmic scales. Eyestalks about $\frac{4}{5}$ the length of the antero-lateral border of the carapace. Eyes small. Antennal acicle a simple spine, strongly spinose along the inner edge. Left cheliped vastly larger than the right; merus a little shorter than the carpus; fixed finger deflexed. The right cheliped hardly reaches the base of the left hand; it is granular, spinose and especially on the hand setose. The 2nd and 3rd legs do not quite reach the end of the larger cheliped. The anterior edge of the carpus and propodus is spinulose and setose, the spinules of the carpus being the most distinct; the dactyli are longer than the propodi and are plumose.

Material.—About 30 specimens were collected from Lawson's Bay, Waltair.

Measurements.—Carapace length : 5.0 mm.

Distribution.—Indian peninsula.

Remarks.—This species is recorded for the first time from Waltair coast.

Diogenes bicristimanus Alcock

(Text-fig. IV. Fig. 3, A, B, C)

1905. *Diogenes bicristimanus* Alcock, *Cat. Ind. Mus. Crust.*, : 72.

Diagnosis.—Carapace narrower and more elongate, antennal acicle does not reach the base of the terminal joint of the peduncle; flagellum carries only a few setae.

Description.—The carapace is narrower and more elongate. The antennal acicle falls a good deal short of the base of the terminal joint of the peduncle. The antennal flagellum is considerably longer than the carapace and carries only a few setae. In the left cheliped the merus is little longer than the carpus and has the upper border ill defined and the lower border not serrulate; the anterior border of the carpus is not spinose and the whole outer surface of the hand is granulose. A broad longitudinal ridge runs without a break along the middle of the outer surface of the palm and is continued downwards to the tip of the deflexed fixed finger. There is a second obliquely longitudinal ridge which does not quite reach the dactylus. In the 2nd and 3rd legs the only joint whose anterior border is distinctly spinulose is the carpus.

Material.—This is the most common species occurring in large numbers throughout the year at Lawson's Bay Waltair.

Measurements.—Length of carapace : 6.0 mm.

Distribution.—South Arabian coast, South African coast, Indus delta and Bay of Bengal.

Calcinus Dana

1852. *Calcinus* Dana, *U. S. Expl. Expd.*, : 456.
 1905. *Calcinus* : Alcock, *Cat. Ind. Mus. Crust.*, : 51.
 1950. *Calcinus* : Barnard, *Ann. South. Afr. Mus.*, : 436.

Carapace elongate, broadened posteriorly, its anterior part calcified. Rostrum small but very distinct. Eyestalks long and slender. Antennal acicle well formed; flagellum nonsetose. Chelipeds unequal and dissimilar, the left being vastly the larger; the fingers move on obliquely vertical plane. Finger tips calcareous and much spooned. The 4th pair of legs subchelate, 5th pair chelate.

Calcinus herbstii de Man

(Text-fig. III. Fig. 1, A,B,C)

1836. *Pagurus tibicen* H. Milne-Edwards, *Ann. Sci. Nat. Zool.*, : 278.
 1852. *Calcinus tibicen* : Dana, *U. S. Expl. Expd. Crust.*, : 457.
 1888. *Calcinus herbstii* de Man, *Arch. fur Naturg.*, : 437.
 1905. *Calcinus herbstii* : Alcock, *Cat. Ind. Mus. Crust.*, : 53.

Diagnosis.—Eyestalks stout, slightly curved. Both chelipeds smooth and unarmed; left more massive than right. The 2nd and 3rd legs considerably shorter than larger cheliped; the dactyli are much shorter than the propodi.

Description.—Eyestalks stoutish, slightly curved. Ophthalmic scales acute. Antennal acicle stout. Both chelipeds are smooth and unarmed, with the edges of all the joints entire. There is an oblique groove across the near end of the outer surface of the carpus of the left cheliped. The 2nd and 3rd legs of both sides are considerably shorter than the larger cheliped; their joints are smooth and unarmed, except for a spinule at the far end of the anterior border of the carpus; the dactyli are much shorter than the propodi.

Material.—About 10 specimens were collected from Lawson's Bay.

Measurements.—Carapace length : 5.0 mm.

Distribution.—Cocos islands, Andamans, Palk Strait, Laccadives, Mauritius, East Africa and Sandwich islands.

Remarks.—This species is recorded for the first time from Bay of Bengal.

PAGURINAE**Pagurus* (Brandt)**

1851. *Eupagurus* Brandt. *Middendorff's Reisein Sibiriens, Zool.*, : 105.
 1905. *Eupagurus* : Alcock, *Cat. Ind. Mus. Crust.*, : 122.
 1961. *Pagurus* : Sankolli, *J. zool. Soc. India.*, : 136.

* Genus *Pagurus* was previously known as *Eupagurus*; according to the rules of nomenclature and decisions of the International Commission on Zoological Nomenclature, the correct generic name is *Pagurus*.

Carapace elongate, broadened posteriorly. Rostrum either distinct or obsolescent. Abdomen well developed, spirally coiled. Eystalks either stout or slender, ophthalmic scales usually distinct. Antennal acicle long, flagellum long, more or less setose. External maxillipeds widely separated at base. The chelipeds are usually dissimilar and unequal, the right being much the larger, very rarely are they subequal; the fingers move in a more or less horizontal plane and the finger tips are calcareous, rarely corneous. The 4th pair of legs are subcheliform, the 5th pair are imperfectly cheliform, the fingers being very short and blunt; in both pairs the usual subterminating pavement of imbricating granules are found.

Key to the species of the genus Pagurus

- I. Eystalks as long as or longer than the anterior border of the carapace. Rostrum obsolescent. The upper border of the right palm overhangs the base of dactylus as a lobe. *P. pergranulatus*
- II. Eystalks distinctly shorter than anterior border of carapace.
 - A. Rostrum acute, long and prominent. *P. anceps*
 - B. Rostrum not so prominent as the antennal angles of carapace.
 - (1) Chelipeds and legs sparsely hairy. *P. indicus*
 - (2) Chelipeds densely hairy with a pinhole sized foramen in the under surface of the carpus of one or both chelipeds. *P. carpofoaminatus*

***Pagurus pergranulatus* (Henderson)**

(Text-fig. V. Fig. 2, A,B,C)

1896. *Eupagurus pergranulatus* Henderson, *J. Asiat. Soc. Beng.*, : 520.

Diagnosis.—Rostrum obsolescent, eystalks longer than the anterior border of carapace; upper border of the right palm overhanging the base of the dactylus as a lobe.

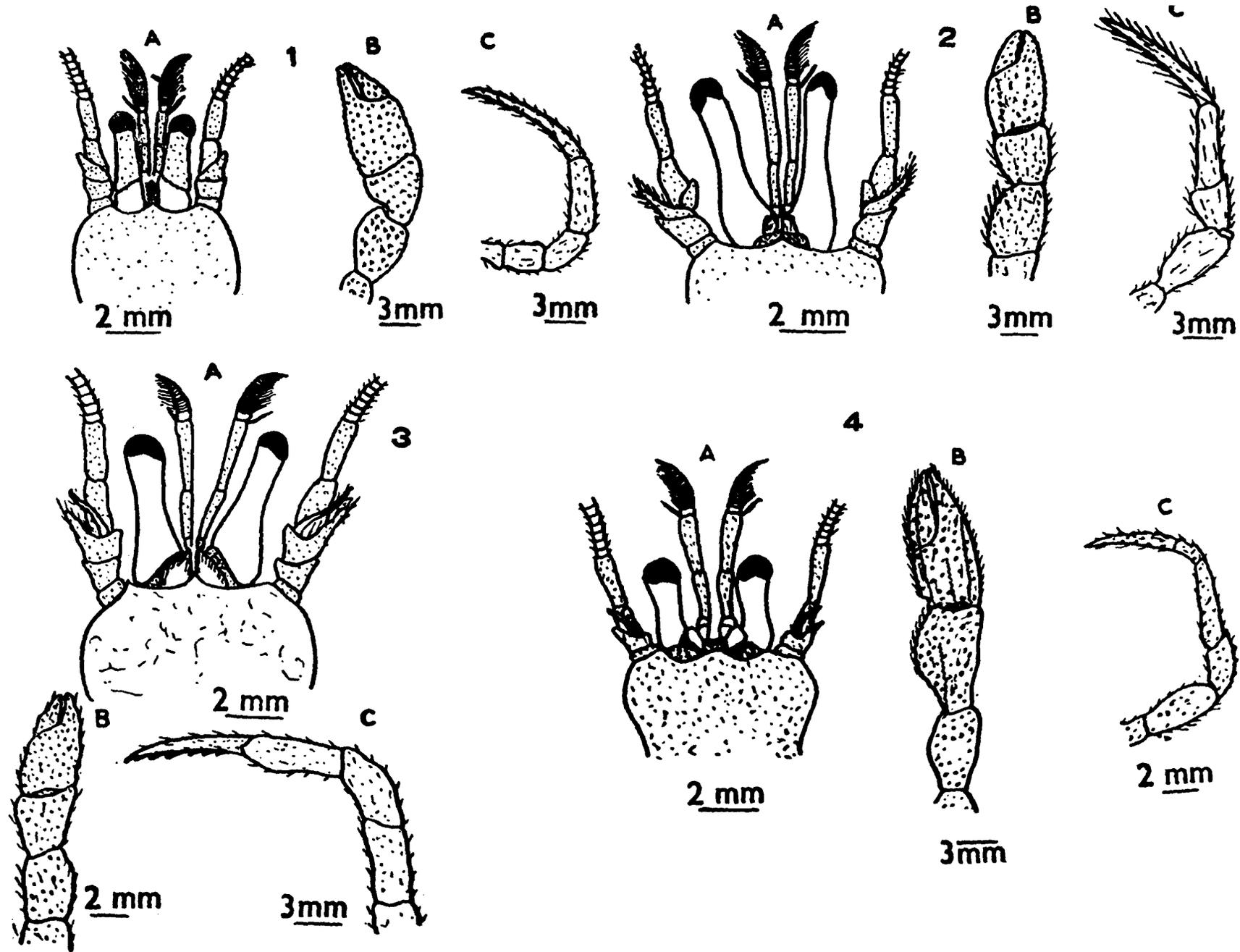
Description.—Carapace a little longer than broad. Rostrum obsolescent. Eystalks longer than the anterior border of the carapace. Ophthalmic scales narrow, foliaceous. Antennal peduncle reaches to the middle of the terminal joint of the antennular peduncle. Antennal acicle curved, smooth. Chelipeds unequal, the right being much the larger, the upper border of the right palm overhangs the base of the dactylus as a lobe. The 2nd and 3rd legs longer than the right cheliped by the dactylus.

Material.—About 50 specimens were collected from Lawson's Bay, Waltair.

Measurements.—Carapace length : 7.0 mm.

Distribution.—Andamans and north east coast of Ceylon.

Remarks.—This species is recorded for the first time from Bay of Bengal.



Text-fig. V— Fig. 1. *Diogenes miles* (Herbst). Fig. 2. *Pagurus pergranulatus* (Henderson). Fig. 3. *Pagurus anceps* Forest. Fig. 4. *Pagurus carpofoaminatus* (Alcock). A. anterior portion of the animal; B. cheliped; C. walking leg.

***Pagurus anceps* Forest**

(Text-fig. V. Fig. 3, A,B,C)

1954. *Pagurus anceps* Forest, *Bull. Mus. Hist. Nat. Paris.*, 26.

Diagnosis.—Carapace a little longer than broad, rostrum long, acute, prominent. Ocular peduncles $\frac{5}{7}$ th the length of the anterior border of carapace. Right cheliped presents an important sexual dimorphism. Propodus and dactylus of walking legs subequal.

Description.—Carapace a little longer than broad, rostrum long, acuminate, denticles on the frontal margin not striking, ocular peduncles cylindrical, three times longer than broad, $\frac{5}{7}$ the length of the anterior border of carapace. Ocular scales broad, round, a small spine at the point of its attachment to the carapace. Last segment of the antennule exceeds the cornea in length. Antennal peduncle a little longer than ocular peduncle. Among the males, the propodus of the right cheliped is equal to the carapace in length, asymmetrical, internal border of the fixed finger oblique in relation to the longitudinal axis of the hand. Anterior region of the finger curved. Among the females the hand is scarcely longer than the anterior region of carapace. Propodus of the left cheliped $\frac{4}{5}$ th of the carapace in length. Chelipeds very finely granulated among adult males. In the females the granules have a tendency to grow into spiniform processes on the margins of the hand. Propodus and dactylus of walking legs subequal, a small corneous spinule is present on the ventral distal border of propodus; dactylus long, with 5-6 corneous spinules. The left 4th pleopod in the case of female and 3rd left pleopod in the case of male are biramous.

Material.—About 10 specimens were collected from Lawson's Bay, Waltair.

Measurements.—Carapace length : 6.0 mm.

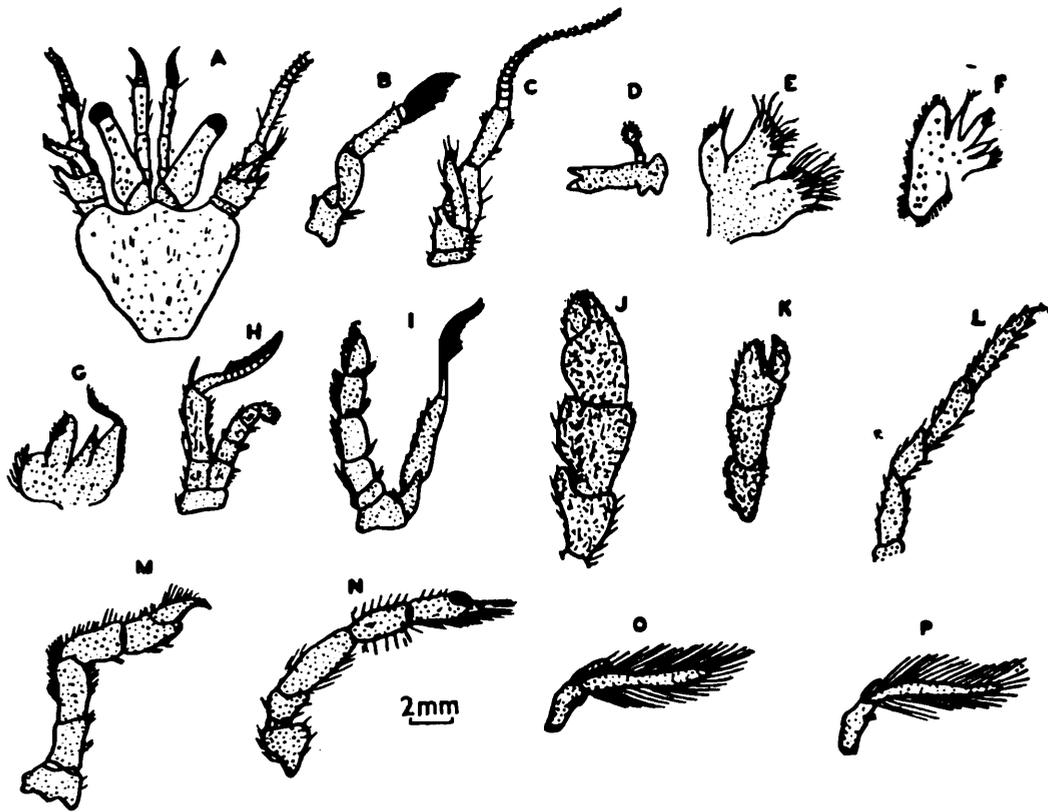
Distribution.—Cocos-Keeling islands.

Remarks.—This species is recorded for the first time from Indian coast.

***Pagurus indicus* sp. nov.**

(Text-fig. VI, A-P)

Diagnosis.—Carapace shield shaped, rostrum rounded, does not reach the antennal angles of carapace, frontal margins concave, finely serrated; ophthalmic scales leaf-shaped with hairs on margins, ocular peduncles shorter than anterior border of carapace, antennal acicle long, exceeds the proximal point of terminal segment; right cheliped longer and stouter than left, inner surface of merus of right cheliped with a rounded keel; outer and inner margin of carpus smooth, distal margin serrate, keel on the inner lateral surface denticulate, 6 prominent teeth arranged in a longitudinal row on the carpus; palm longer than broad, with a serrated longitudinal crest on the outer surface of palm. Cutting edges of fingers with 3 big and 3 small teeth.

TEXT-FIG VI. *Pagurus indicus*. sp. nov.

A. entire animal; B. antennule; C. antenna; D. mandible; E. 1st maxilla; F. 2nd maxilla; G. 1st maxilliped; H. 2nd maxilliped; I. 3rd maxilliped; J. right cheliped; K. left cheliped; L. 2nd pereopod; M. 4th pereopod; N. 5th pereopod; O & P. pleopods.

Description.—The anterior hard portion of the abdomen shield-shaped, as long as broad, with 3 tufts of hairs on the gastric region; rostrum rounded, does not reach the antennal angles of carapace, frontal margins on either side of rostrum concave and finely serrated, ophthalmic scales leaf-shaped, ocular peduncles shorter than anterior border of carapace, antennular peduncles more or less equal in length to antennal peduncle. Second segment of antennal peduncle longer than broad, acicle simple, exceeds the proximal end of the terminal segment of the peduncle; chelipeds unequal, the right being longer and stouter than the left; upper inner and outer lateral surfaces of the right merus are quite smooth, the lower distal portion of the inner lateral surface forms a keel; the carpus is longer and broader than merus, outer and inner margins smooth; distal margin finely serrulate, the lower inner lateral surface forms a distal keel which is denticulate, 6 large teeth arranged in a longitudinal row on the mid-dorsal surface; palm longer than broad, with a serrated longitudinal crest on the outer margin, the cutting edge of the fingers with 3 big and 3 small teeth, no keel on the merus and carpus and no longitudinal row of teeth on carpus and no crest on the palm are present on the left cheliped. The two chelipeds are covered with fine granules and sparsely setose. Pereiopods of both the sides surpass the tip of the right cheliped, the merus is longer than carpus, the propodus is covered on the anterior side with tufts of long hairs, dactylus smaller

than propodus, bears 6 spine like teeth on the posterior margin which increase in size distally, the tip is black and slightly falciform.

Material.—About 20 specimens were collected from Lawson's Bay, Waltair.

Measurements.—Carapace length : 6.0 mm.

Colour.—With red longitudinal bands on the chelipeds and legs which disappear in preserved specimens.

Remarks.—This species resembles *Pagurus kulkarnii* Sankolli in many respects. But it differs from it in the following aspects : (1) Frontal margin on either side of the rostrum concave and finely serrated, (2) no spines at the distal end of the antennal acicle and second segment of the antenna, (3) inner and outer margins of both merus and carpus smooth, (4) keel of the carpus denticulate, longitudinal row of 6 teeth on the carpus, (5) a longitudinal serrated crest on the outer margin of palm, (6) cutting edges of fingers with 3 small and 3 big teeth, (7) dactylus of walking legs with 6 spine-like teeth and (8) chelipeds and legs with red longitudinal bands in living condition.

Pagurus carpofoaminatus (Alcock)

(Text-fig. V. Fig. 4, A,B,C)

1905. *Eupagurus carpofoaminatus* Alcock, *Cat. Ind. Mus. Crust.*, : 130.

Diagnosis.—Rostrum broad, rounded, eyestalks about $\frac{3}{4}$ the length of the anterior border of carapace ; antennal peduncle reaches to the middle of the terminal joint of the antennular peduncle. Right cheliped slender, larger than the left ; a pin-hole sized pit near the middle of the under surface of the carpus of cheliped.

Description.—Rostrum broad, rounded, not nearly so prominent as the well pronounced antennal angles of the carapace. Eyestalks about $\frac{3}{4}$ the length of the anterior border of the carapace. Ophthalmic scales narrow, foliaceous. The antennal peduncle reaches to the middle of the terminal joint of the antennular peduncle ; antennal acicle curved. Chelipeds tomentose, but not so as to conceal surface sculpture. Right cheliped rather stender but much larger than the left, about $2\frac{1}{2}$ times the length of the carapace. Near pre middle of the under surface of the carpus in the adult is a deep pin hole sized pit. The 2nd and 3rd legs, which are nude, considerably exceed the large cheliped.

Material.—Only 5 specimens were collected from Lawson's Bay Waltair.

Measurements.—Carapace length : 8.0 mm.

Distribution.—Bay of Bengal, Malabar coast and Ceylon.

III—ACKNOWLEDGEMENTS

We wish to express our sincere thanks to Prof. P. N. Ganapati and Prof. S. Mehdi Ali for kindly providing facilities to carry out the investigation. Thanks are also due to Dr. J. Forest, Paris for verifying

the pagurid collections and confirming the new species of *Pagurus* and to Dr. K. K. Tiwari for supplying the literature.

IV—SUMMARY

A detailed study of the anomuran fauna of Lawson's Bay, Waltair and Visakhapatnam harbour was made. During the course of the investigation, twenty three species belonging to the family Paguridae were recorded. Out of these, one species of *Pagurus*, *P. indicus* happens to be new to science. Besides, *Clibanarius striolatus*, *C. humilis*, *C. eurysternus* and *Pagurus anceps* are recorded for the first time from Indian coast.

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