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6.—Observations on the Indo-pacific species of Kraussia Dana 1852 (Decapoda: Brachyura)

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Abstract

Ten Indo-pacific species of *Kraussia* are discussed and illustrated, and a key is provided for their identification. Five of the species are new, and described as *K. pelsartensis* and *K. roycei* from Western Australian waters, *K. bongensis* and *K. wilsoni* from the Sulu Sea area, and *K. marquesa* from the Marquesas Islands.

Introduction

The present observations refer to the study of the collections of *Kraussia* of the Western Australian Museum, and the National Museum of Singapore. Five species, two from Australian waters, one from the Marquesas Islands and two from the Sulu Sea are new. With ten different species in hand an opportunity is provided to review the situation of the Indo-pacific species of *Kraussia* and to suggest a key for their identification. None of the type material of the previously-described species has been examined.

The genus *Kraussia*, with as type species *Kraussia rugulosa* (Krauss 1843), includes in the order of my key the following species: *rugulosa* (Kraus 1843), *quadriceps* Yokoya 1936, *wilsoni* nov. sp., *pelsartensis* nov. sp., *roycei* nov. sp., *?nitida* Stimpson 1858, aff. *nitida*, *marquesa* nov. sp., *rastripes* Muller 1887, *integra* (De Haan 1835), *bongensis* nov. sp.

The species *porcellana* (White 1848) and *proporcellana* Ward 1936 are accepted as synonym of *rugulosa*. I am not sure of the position of *hendersoni* Rathbun 1902 as a valid species, considering the confused situation of *nitida*. The single non west Indo-pacific species of the genus is *K. americana* Garth 1939.

Specific characters

(1) *Chelipeds:* The key of Balss (1922) mentions as species with reduced fingers only *integra*, and his key of 1938 mentions all species save *rugulosa*. The relative size of the two chelipeds one to another, and the relative size of the palm and the fingers in major and minor chelipeds must be distinguished. Three species, *rugulosa*, *quadriceps*, and *wilsoni* have the two chelipeds of nearly the same size with the palm and fingers somewhat elongate. Five species, *pelsartensis*, *roycei*, *nitida*, *integra*, and *bongensis* have one cheliped clearly larger than the other, the major cheliped having the palm higher and the fingers shorter than the minor. The other two species, *marquesa* and *rastripes*, have the two chelipeds of nearly the same size with high palm and short fingers similar. The shape and proportion of palm and dactylus could slightly vary within one given species with the size of the specimen, but no sexual dimorphism seems to mark the chelipeds; those of females and males are identical on all species.

The extension on the palm of the black pigment of the fixed finger seems to be a specific character in some cases. On the superior border of the merus, a subdistal spine occurs some distance from the distal margin on nearly all the species; a second, smaller spine generally occurs on the distal margin.

(2) *Measurements.*—Rathbun (1902) gives a specific value to the fronto-orbital breadth in regard to the carapace breadth and the character is used in the key of Balss (1922). Balss (1935) thinks that the proportion of the two breadths can considerably vary on specimens of the same species, but he expresses his views only in regard to the definition of *hendersoni* Rathbun 1902 and with reference to few specimens examined, which in my opinion are perhaps not conspecific.

The breadth of the carapace is mentioned as specific characters in the key of Sakai (1939). Balss (1938) considers also that the proportion of the breadth to the length of the carapace (elongation of the carapace) has a questionable value as a specific character. I have only used this character to separate *roycei* from *pelsartensis*, because it is such a clearly diagnostic feature. However, the views of Balss deserve new consideration. In my key, the measurements are those of the specimens illustrated in the present paper and are in millimetres; the carapace breadth (cb) is the largest.

(3) *Anterior frontal margin.*—To have its full specifice value the bilobate character of the frontal margin must be associated with the absence of preorbital teeth and the quadrilobate character to its presence. Among the species with bilobate front, *integra* presents on each lateral lobe a feeble concavity which could be interpreted as feebly quadrilobate when no comparative material is available. In the species with quadrilobate front, the outer lobe is generally a little more protuberant and broader than the inner.

In the present status of our knowledge, it would be unwise to give a specific value to the prominence of the frontal margin in regard to the inner, supra-orbital angle, and to the shape of the frontal lobes. Generally the species clearly differ from one another by those characters (depth and shape of median and submedian sinus, prominence and shape of the frontal lobes). Whether these characters show marked intraspecific variations is still uncertain. A significant example is illustrated by two specimens,

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identified *marquesa*, in the present paper. Further observations could demonstrate that the frontal margin provides a means for specific differentiation.

(4) *Pre-orbital tooth.*—The pre-orbital tooth, which corresponds to a marked inner supra-orbital angle, is separated from the outer frontal margin by the sinus giving passage to the antennal flagellum. When the pre-orbital tooth exists, the antennal flagellum stands out of the orbit; when it does not exist, the flagellum stands in the orbit. Only the three species with bilobate fronts have no pre-orbital tooth. The term "pre-orbital tooth" is used with reference to the previous authors. It would be more appropriate to designate the character by indicating the presence or absence of the antennal sinus between the frontal margin and the inner supra orbital angle; in many cases the term "tooth" being really inadequate. The strong marking or, on the contrary, the disappearance in some cases of the sinus on the outer half of the supra orbital border, also serve for specific differentiation.

(5) *Carapace.*—The distinctly separate, long, acute, forwardly-directed 4 spines on the lateral margin of the carapace behind the extraorbital angle only exists on *rugulosa*. Nearly all the other species have one notch situated at some distance (approximately one-third of the total length of the lateral margin) behind the extra-orbital angle; sometimes this notch is marked posteriorly by a larger spinule of the lateral margin. On some species, *pelsartensis, marquesa* and *bongensis,* a second notch (like a small concavity) is situated immediately behind the extra-orbital angle. Other notches can mark the lateral borders, for example, *quadriceps* presents two other feebler notches situated posterior to that corresponding to the anterior third of the lateral border. Sakai (1939) mentions that on *nitida* "one or two shallow indentations occur behind" that of the anterior third. All these structures are more easily observed on the ventral side and probably have a specific value. Comments on their possible function are given at the end of the present paper.

In some species, the dorsal convexity of the carapace is comparatively stronger than in the other species. The ornamentation (granules, setae) of the carapace seem to be specific. However, the rugae on the dorsal surface of *rugulosa* clearly differ from those of other species. The smoothness of the dorsal surface of some species is conspicuous.

(6) *Third maxilliped.*—The ratio of the total length of the third maxilliped to its largest breadth (ischium) is on *rugulosa*: 3.14, *quadriceps*: 2.90, *marquesa*: 2.70, *integra*: 2.60, *rastripes:* 2.57. These discrepancies are not sufficient for specific differentiation but could assist to improve the grouping of the species; the case of the elongate third maxilliped of *rugulosa* is the most significant.

(7) *Pereopods 2-5.*—The upper (anterior) border of the dactyli of pereopods 2-5 on all species tend to be proximally flattened, the two (anterior and posterior) margins of the upper border forming a kind of distinct carinae. Such a structure varies with the species on pereopods 2-4 and is always more developed on pereopod 5. Only on *rastripes* is it fully developed on pereopods 2-4 which, like pereopod 5, is sharply denticulate along the anterior and posterior margins of the upper border. On the other species, the flattening of the proximal part of dactylus is always (at least on pereopods 3-4) short and the main part of the upper (anterior) margin is like the edge of a blade, generally concave, sometimes sinuous, sometimes straight, sometimes with a row of small denticulations, sometimes smooth. These differences seem to have specific value. Comparison of the dactyli of pereopods 4 and 5 provide an accurate means to separate the species. The posterior margin of the dactyli is always like the edge of a blade and convex. The largest breadth of dactyli in relation to length could also sometimes give a specific discrepancy, but more observations are needed.

(8) *Male pleopod.*—Pleopod 2 is short. Pleopod 1 has been illustrated by Sakai (1934, fig 17a, b) for *integra* and *rugulosa*, Stephensen (1945, fig. 33) for *?nitida*, Barnard (1950, fig 36c) and Buitendijk (1960, fig 1b) for *rugulosa*, and Buitendijk (1960, fig 1a) for *integra*.

All the ten species have pleopod 1 with the same elongate and slim stem. However their clear differences from one another in regard to the distribution of subdistal spines and setae and the shape of the apex provide the most secure specific character. The illustrations of pleopod 1 given by previous authors are generally insufficient to allow positive identification.

Several of the specific characters given in the following key and in the illustrations could present intraspecific variations which in some cases are sufficient to mislead identification. More exhaustive observation, taking into consideration the size and sex of the specimens, would probably define other new and secure specific discrepancies. It also will improve the grouping of the species; already *rugulosa* clearly seems to belong to a group quite separate from the other species.

Note on the Illustrations

As in many other cases, lack of illustration is the main obstacle to identification of the species of *Kraussia* described and recorded previously. Special care has therefore been taken to illustrate the present material.

The photographs and drawings are made by the author with a Projectina. On the drawings under the largest magnification (x450 on the screen), the lines representing the outlines of each apex correspond to the projection of a selected contour, which varies with the position of the pleopod on the slide. The selection partly reflects the personal interpretation of the author for the shape of the apex; other observations could offer more accurate or different interpretations. The setae of the apex are generally on the ventral side (at least the largest), and their origins are sometimes indicated on the drawings by dotted lines. In any case, the size of the specimen must always be taken into consideration when comparing drawings of pleopod 1.

Key for the Indo-pacific Species of Kraussia

1 Lateral border of carapace denticulate with 4 salient separate acute spines behind extraorbital angle. Dorsal surface of carapace with short transverse rugae. Front feebly prominent in regard to preorbital teeth which are salient and separated from frontal margin by a deep incision (antennal sinus). Both chelipeds similar subequal with outer surface ornamented with transverse rugae; fingers somewhat elongate (fixed finger a little longer than superior border of palm). Large gaping between fingers which at tip are deeply hollowed. Size: 16.5x19 .... *rugulosa* (Krauss 1843)

Lateral border of carapace always more or less regularly denticulate without distinctly longer and more salient spines; generally 1 but sometimes 2-3 notches marked. Dorsal surface of carapace granular or nearly smooth; sometimes granules arranged in short ripple-like transverse rows but not forming clear transverse rugae. Fingers of both chelipeds without hollowed tip 2

2 (1) Pre-orbital tooth marked. Front quadrilobate 3

Pre-orbital tooth absent. Front bilobate 8

3 (2) Fingers of cheliped not remarkably shortened. Both chelipeds nearly identically shaped, one being only a little larger than the other. Palm not or very little swollen with outer surface nearly smooth. Cutting edge of fixed finger of cheliped with an elongated subdistal tooth, which is less marked on minor cheliped. Carapace punctate with small granules arranged in feeble and short transverse ripples near frontal and antero-lateral borders 4

One cheliped or both chelipds with remarkably shortened fingers and palm swollen 5

4 (3) Both chelipeds with palm and fingers similarly elongate; major cheliped a little longer than minor cheliped, but with less high palm. Fixed finger approximately as long as height of palm on minor cheliped, much longer than height of palm on major cheliped. On cutting edge of fixed finger of minor cheliped a well marked elongated subdistal tooth; nearly absent on major cheliped. Black pigment of fixed finger not extending on palm of cheliped. Frontal lobes rounded, deeply separated and strongly prominent beyond preorbital teeth. Dactyli of pereopods 3-4 sickle shaped with anterior border concave. Male pleopod 1 with apex bent laterally and a subdistal bunch of long setae. Size: 17x19 .... *quadriceps* Yokoya 1936

Both chelipeds of same length with palm clearly higher and fingers shorter than on *quadriceps*. One cheliped (major) with palm higher and finger shorter than the other (minor). Fixed finger shorter than length of upper border of palm on major cheliped, longer than upper border of palm on minor cheliped. Black pigment of fixed finger a little extending on palm. Frontal lobes not deeply separated and slightly prominent. Dactyli of periopods 3-4 with anterior border straight. Male pleopod 1 with apex straight truncate without subdistal bunch of long setae. Size: 11x12 .... *wilsoni* nov. sp.

5 (3) Both chelipeds with palm nearly smooth; upper border of dactyli feebly carinate and granular on proximal part only 6

Both chelipeds with palm ornamented distally with a transverse row of large granules and at least on its distal part smaller granular ripples. Upper border of dactyli strongly carinate and granular 7

6 (5) Carapace remarkably broad with front-orbital breadth subequal to half breadth of carapace. Frontal margin with widely open median sinus. Major cheliped with strongly swollen palm and short fingers; length of fixed finger much less than half height of palm. Minor cheliped with slim elongate fingers regularly tapering; fixed finger bent downwards with length nearly equal to height of palm. Dactyli of pereopods 2-5 with anterior border nearly straight, flattened and acutely granular at least on proximal half. Apex of male pleopod 1 straight, without subdistal bunch of long setae. Size: 14.6x18. .... *pelsartensis* nov. sp.

Carapace moderately broad with fronto-orbital breadth clearly less than half breadth of carapace. Frontal margin with nearly closed median sinus. Major cheliped with palm feebly swollen and fingers moderately elongate; length of fixed finger clearly more than half height of palm. Minor cheliped as in *pelsartensis* but with fixed finger not bent downwards with strong subdistal tooth on cutting edge; dactylus broader and more canaliculate. Dactyli of pereopods 2-5 with anterior border sinuous without marked flattening and devoided of granules. Apex of male pleopod 1 as a short beak bent at 45° with a subdistal bunch of long setae. Size: 13.2x14 .... *roycei* nov. sp.

7 (5) Both chelipeds clearly unequal; palm of major cheliped higher than that of minor cheliped; dactyli of at least minor cheliped not remarkably recurved; fixed finger of major cheliped clearly shorter than half height of palm, of minor cheliped clearly longer than half height of palm. No indication of black colour extending on palm. Frontal margin with closed median sinus. A clear sinus on outer part of upper orbital border. Dactyli of pereopods 2-5 sickle shaped without granules on anterior border. Male pleopod with apex bent at 50° and ornamented with a preapical bunch of long setae. Size: 9.8x10.8 .... aff. *nitida* Stimpson 1858

Both chelipeds subequal; dactyli similarly and remarkably recurved and strongly granular. Fixed finger in one cheliped shorter than in the other; its length approximately one-fourth of height of palm instead of one-third in the other. Black

colour of fixed finger extending on palm. Frontal margin with a V-shaped open median sinus. No trace of sinus on upper orbital border. Anterior border of dactyli of pereopods 2-5 feebly concave (nearly straight) with granules only on pereopod 5. Male pleopod with nearly straight apex and a few subdistal setae. Size: 12.7x14 .... *marquesa* nov. sp.

8 (2) Dactyli of pereopods 2-5 with upper (anterior) margin nearly straight, flattened with on each side a row of acute granules. Dorsal surface of carapace nearly smooth, strongly and regularly convex in the middle. Anterolateral borders of carapace regularly convex, thickly armed with acute granules without indication of any notch. No indication of sinus on upper orbital border. Two chelipeds subequal with short fingers identically shaped. On both chelipeds length of fixed finger approximately one-fourth of height of palm. Male pleopod distally acuminate with a subdistal bunch of long setae. Size: 11.1x12.8 .... *rastripes* Muller 1886

Dactyli of pereopods 2-4 with anterior border concave, flattened and granular only on short proximal part; anterior border of pereopod 2 with a row of some acute granules, those of pereopods 3-4 without granules. Dorsal surface of carapace granular. Anterolateral borders of carapace with a notch at some distance behind the orbit. Strongly marked sinus on upper orbital border. Two chelipeds slightly but clearly unequal 9

9 (8) Frontal margin feebly undulate; dorsal surface of carapace slightly flattened. Both chelipeds with palm and fingers differently shaped. Major cheliped with palm higher, dactylus more recurved, fixed finger shorter than on minor cheliped. Length of fixed finger one-fourth of height of palm in major cheliped, one-third of height of palm in minor cheliped; black colour of fixed finger not extending on upper half of palm. Male pleopod with apex acuminate. Size: 16x19.5 .... *integra* De Haan 1835

Frontal margin straight; dorsal surface of carapace regularly convex. Both chelipeds with palm and fingers identically shaped; length of fixed finger one-fourth of height of palm; black colour of fixed finger extending on upper half of palm. Male pleopod with apex broadened as a round lobe. Size: 20x23 .... *bongensi* nov. sp.

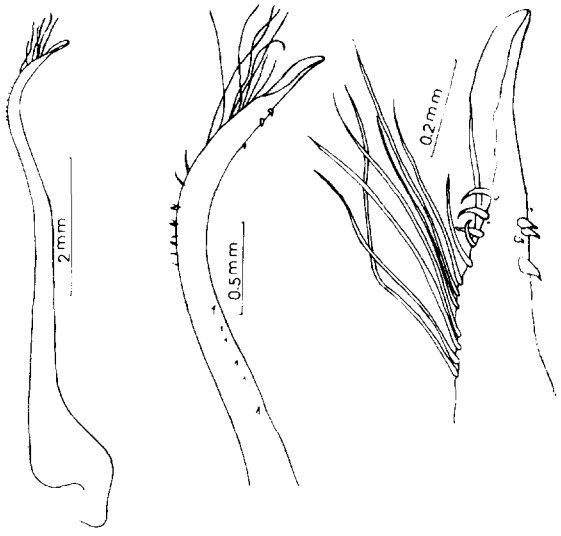

Figure 1.—Male pleopods 1 and 2 of *K. rugulosa*, WAM 262-70 of cl:16.0, cb:16.5.

Kraussia rugulosa (Krauss 1843)

(Figs. 1, 2, 23A)

Platyonichus rugulosa, Krauss, 1843, p. 26, pl.1, fig. 5.

Trichocera porcellana, White, 1848, p. 59.

Kraussia rugulosa, Dana, 1852, p. 302, pl. 9, fig. 1.—De Man, 1887, p. 343, pl. 14, fig. 2.—Borradaile, 1903, p. 270.—Rathbun, 1906, p. 876 (no material).—Stebbing 1910, p. 310.—1918, p. 54.—Balss, 1922, p. 98.—1938, p. 27, fig. 10.— Urita, 1926, p 11.—Edmondson, 1925, p. 36.—1946, p. 284, fig. 175.—Sakai, 1934, p. 305, text-figure. 76b—1936, p. 139, text-fig. 65.—1939, p. 431, text-fig. 21.—Tweedie, 1947, p. 28.—1950, p. 108.—Barnard, 1950, p. 195, fig. 36A, B. C.—Buitendijk, 1960, p. 253, fig. 1b.

Kraussia proporcellana, Ward, 1935, p. 10, pl. 1, fig. 7.

Type locality: South Africa.

Material.—WAM.262-70, series of 6 specimens, largest male of cl:16.5, cb:19.0, Loc: Flying Fish Cove, Christmas Island, Coll: Mr. Powell, 23.6.1961, Det: *proporcellana;* NMS.1965. 10.10.3 male, Loc: Cocos Keeling, Coll: Gibson Hill, 1941, Det: Tweedie, 1950, p. 108; NMS.1965. 10.10.2, male of cl:10, cb:11.40, Loc: Christmas Island, Indian Ocean, Coll: Gibson Hill, 1940, Det: Tweedie, 1947, p. 281; NMS. 1965.10.10.1, Loc: Christmas Island, Coll: Ward, 1934, Paratype specimen of *K. proporcellana* Ward, 1934, Balss (1938, p. 28) corrected as *rugulosa*.

Remarks:—The two chelipeds differ slightly; one has its palm a little longer and higher with rugae of the outer surface more marked than the other. The male pleopod is like that illustrated by Barnard (1950) and has a distally broadened apex with a subdistal bunch of long setae; it also has some heavy short pre-apical spines which are not indicated on Barnard's figure. Laurie (1906), examining the type of *porcellana*, stated it to be identical with *rugulosa* as suggested by Dana (1852). Ward (1934) separated *proporcellana* from *rugulosa* and considers *porcellana* as a distinct species. The syntype of *proporcellana* deposited in the National Museum of Singapore does not present any discrepancy in regard to the present series and confirms the views of Balss on the identity of the two forms. However, the comparison of the Type specimen of *rugulosa* or a topotype from South Africa or material from Japan and Hawaii with the types of the species of *proporcellana* and *porcellana* (the two in the British Museum) could suggest that more than one species should be recognised.

The recorded size of specimens are by De Man (1887) 17.5x20.75; Sakai (1939) a male of 17x20; Barnard (1950) one male of 13x15 and one female of 11x12; Ward (1934) three specimens of 8.5, 10, 12 as carapace width. The species is recorded from South Africa (Krauss, Stebbing, Barnard), Philippines (White), Hawaii (Dana, Rathbun, Edmondson), Mergui Archipelago (De Man), Minikoi, Laccadives (Borradaile), Gilbert Islands, Ellice Islands, Samoa Islands, Marshall Islands (Balss), Christmas Islands in Indian Ocean (Ward), Tweedie, Cocos Keeling Islands (Tweedie), Timor (Buitendijk), Japan, Formosa (Urita, Sakai).

Kraussia quadriceps Yokoya 1936

(Figs. 3, 4, 23B)

Kraussia quadriceps, Yokoya, 1936, p. 143, fig. 9.—Sakai, 1939, p. 431.

Type locality: Japan.

Material.—WAM.266-70, male of cl:17, cb:19, Loc: North Steamboat Island, Dampier Archipelago, N.W.A., 14 faths Hon. drge, Coll: Royce on "Davena", Date coll: 27.5.1966; WAM.273-70, male of cl:10, cb:11.5, Loc: 20 miles N. of Delambre Is., Dampier Arch., N.W.A., Source: B. R. Wilson on "Davena", Date coll: 7/6/1960; NMS. 1970.1.3.1., female with cl:12.00, cb:13.00, carapace with only one cheliped and no other pereopod, Loc: Colombo, Ceylon, R. Serene coll. 1966.

Observations.—The present specimens have: (1) the front salient with four lobes anteriorly rounded (the left is damaged on the illustrated specimen and deeply separated).—2) the two chelipeds similarly shaped, with the palm and fingers elongate and smooth, but slightly unqual; one cheliped is a little longer than the other with palm less high; the cutting edge of the fixed finger of shorter cheliped has an elongate subdistal tooth, which is very feeble on the other cheliped. Also, the cutting edge of dactylus of the shorter cheliped has a proximal low tooth which does not exist on the other cheliped.—3) a notch marking the posterior limit of the anterior third of lateral border and with a distinct tooth behind; a second notch situated more posteriorly is well marked.—4) the dactyli of pereopods 2-5 sickle shaped and elongate with concave anterior border.

Their identity with *quadriceps* appears valid. The low elongate tooth of the cutting edge of the fixed finger is not indicated on the description of Yokoya (1936), who only mentions: "thumb of chela normally well developed." The male pleopod 1 has its apex bent nearly at right angle to form a transverse beak and presents on one side a large bunch of very long setae. Examination of the type specimen for these

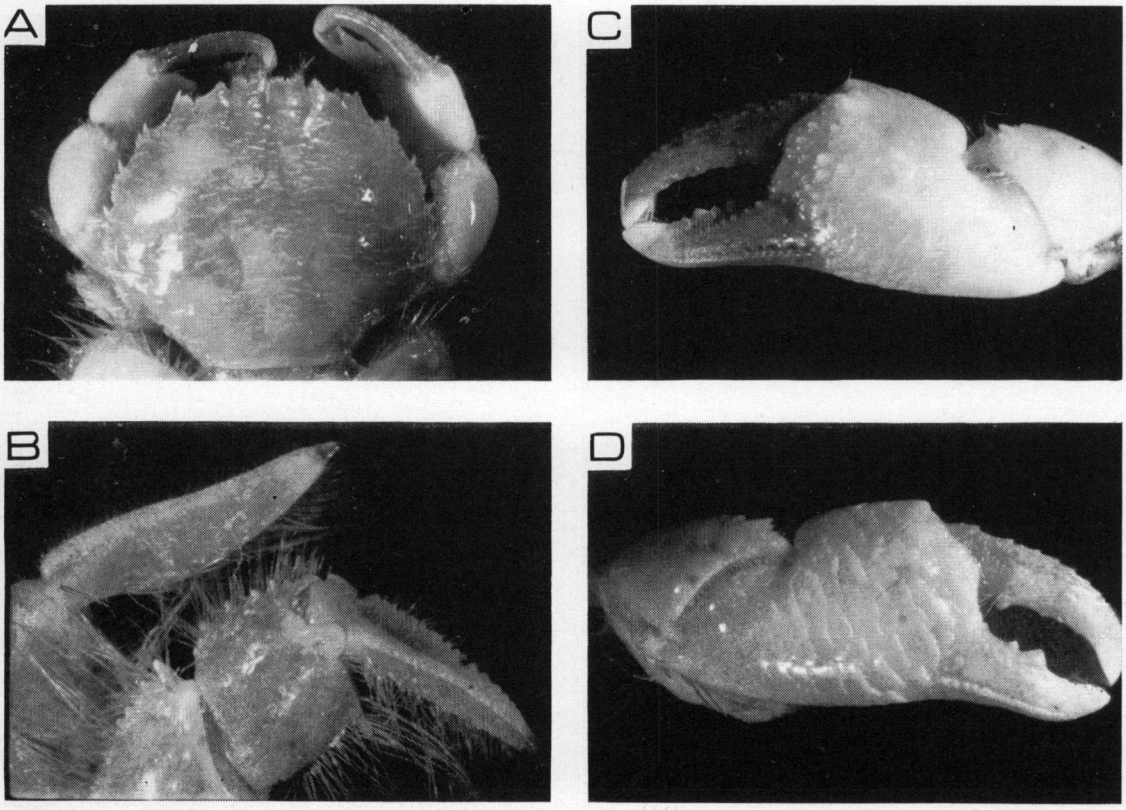

Figure 2.—*Kraussia rugulosa*, WAM 262-70, male of cl:16.5, cb:19.0. A, entire animal.—B, pereopods 4, 5 (ventral view).—C, right cheliped.—D, left cheliped.

Diagnosis.—Carapace nearly smooth, punctuate with some granules on the area close to frontal and antero-lateral margins. Frontal margin consists of four round lobes, only a little salient beyond the inn r supra orbital angle which is blunt, like the extraorbital angle. Antero-lateral margin of carapace with a feeble notch. Both chelipeds smooth with same length but one with palm higher and finger a little shorter than on the other. Both fingers relatively strong, normally developed, longitudinally carinate, their length clearly less (0.66 on major cheliped, 0.78 on minor cheliped) than height of palm; cutting edge of fixed finger of major cheliped with a low elongate subdistal tooth; cutting edge of dactylus with a proximal large low tooth. No clear tooth on cutting edge of fingers of minor cheliped. On both chelipeds brown colour of fixed finger extends a little on palm. Anterior border of the pereopods 2-5 nearly straight with a longitudinal row of small granul s. Granules a little acute and extend nearly all along on pereopod 2; feeble on pereopod 5 and limited to the proximal part on pereopods 3 and 4. Male pleopod devoid of any bunch of setae, with truncate apex, ornamented with subdistal acute spinules, larger and more numerous on outer side.

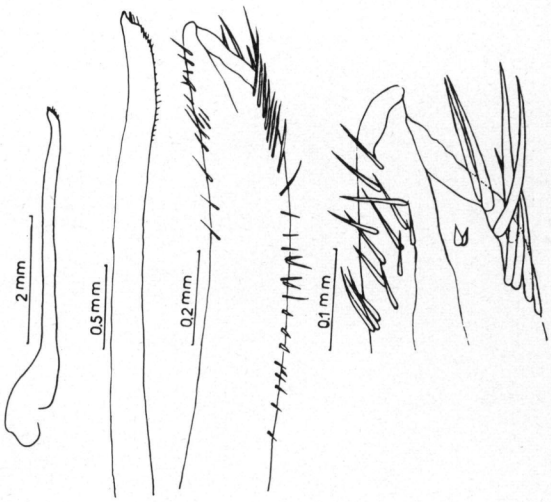

Figure 5.—Male pleopod 1 of *K. wilsoni*, WAM 278-70 of cl:10.0, cb:10.8

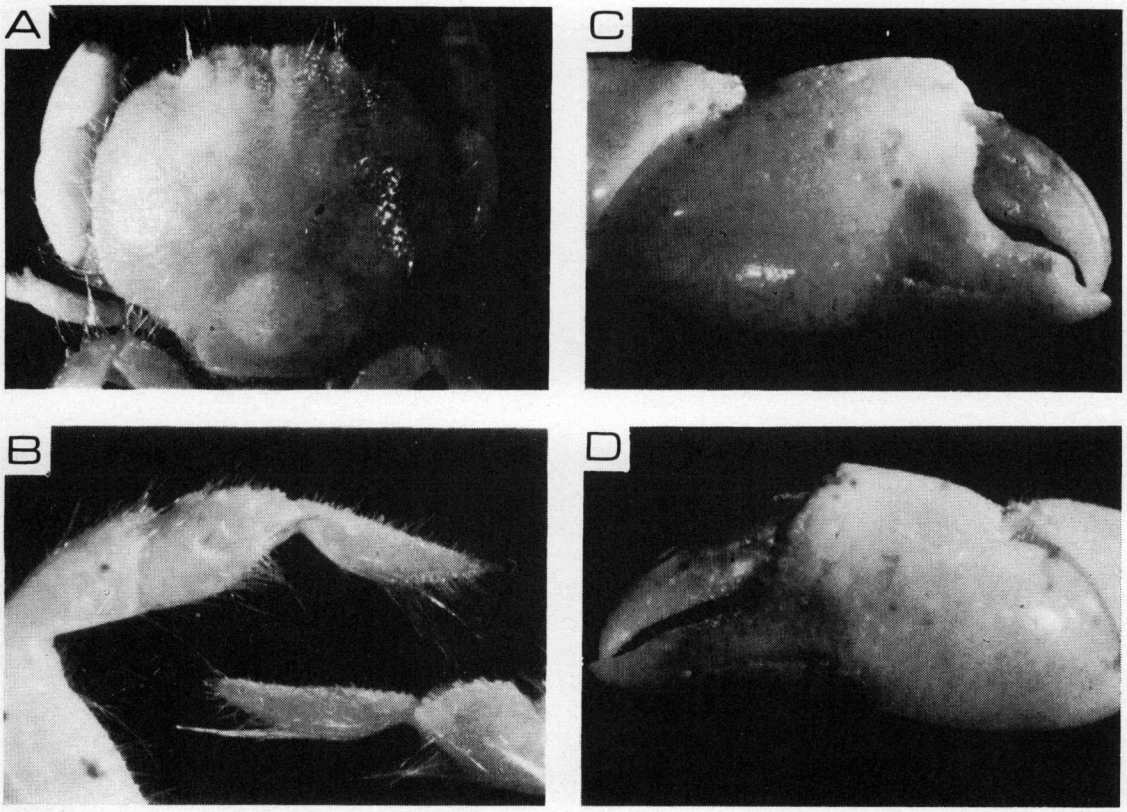

Figure 6.—*Kraussia wilsoni*, WAM 278-70, male of cl:11.0, cb:12.0. A, dorsal view.—B, pereopods 2, 3.—C, major cheliped.—D, minor cheliped.