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Daldorfia Rathbun, 1904 (Crustacea: Decapoda) from the Neogene of Japan

Hiroaki Karasawa and Hisayoshi Kato

(H. Karasawa) Mizunami Fossil Museum, Yamanouchi, Akeyo, Mizunami, Gifu 509-61, Japan; (H. Kato) Natural History Museum and Institute, Chiba, 955-2 Aobacho, Chuoku, Chiba 260, Japan

Abstract.—*Daldorfia nagashimai,* new species, is described from the Higashimorogata Formation (Upper Miocene - Lower Pliocene), Miyazaki Group of Miyazaki Prefecture, Japan. This species is characterized by a large carapace with irregular, large, granulose tubercles dorsally and without a deep, eroded area behind a longitudinally hexagonal mesogastric lobe. Another specimen representing a second unnamed species is recorded from the Aoso Formation (Upper Miocene) of Miyagi Prefecture, Japan. These species represent the first records of Neogene decapod crustaceans from Japan and extend the geologic range of the genus *Daldorfia* to the Late Miocene age.

The subfamily Parthenopinae is a small group including eight Recent genera, *Daira* de Haan, 1833, *Dairoides* Stebbing, 1920, *Daldorfia* Rathbun, 1904, *Leiolambrus* A. Milne Edwards, 1878, *Parthenope* Weber, 1795, *Solenolambrus* Stimpson, 1871, *Thyrolambrus* Rathbun, 1894, and *Tutankhamen* Rathbun, 1925. The fossil record of *Parthenope* Weber, 1795, is robust in Cenozoic deposits throughout the world (Glaessner 1969). *Daira* is recorded from the Eocene-Miocene of Europe, the Pliocene of Fiji, and the Miocene of Japan (Glaessner 1969; Müller 1984; Müller & Collins 1991; Karasawa 1993). The only known fossil *Leiolambrus* was described from the Upper Eocene Bartonian of England (Quayle & Collins 1981) and *Tutankhamen* also has been reported from the Oligocene Gambier Limestone of Australia (Jenkins 1985). The fossil records of the other four Recent genera are unknown throughout the world, but the extinct, *Mesolambrus declinatus* Müller & Collins, 1991, similar to *Thyrolambrus* Rathbun, 1894, was described from the Szépvölgy Formation (Upper Eocene) of Hungary; Glaessner (1969) recognised the Upper Eocene, *Phrynolambrus* Bittner, 1893 as the junior synonym of the subgenus *Pseudolambrus* Paulson, 1875, in *Parthenope,* but subsequently Guinot (1979) separated *Phrynolambrus* from *Pseudolambrus* and suggested that *Phrynolambrus* has a close affinity with *Daira* and *Dairoides.*

The purpose of this paper is to describe a new species and a related, but unnamed species of *Daldorfia* from the Neogene deposits of Japan. The materials were collected from a road cut (Loc. MYZ-4 of Karasawa 1993, 31°56′48″N, 131°16′46″E) at Akatani, Uranona, Takaoka-cho, Higashimorogata-gun, Miyazaki Prefecture (Fig. 1A). Siltstone of the Aya Member of the Higashimorogata Formation, Miyazaki Group (Upper Miocene to Upper Pleistocene) is exposed at this locality (Tomida 1991; Karasawa 1993). This formation is assigned to Zones N.17b–18 (latest Miocene-earliest Pliocene) of Blow's scale of planktonic foraminifera (Suzuki 1987). *Daldorfia nagashimai,* new species, is based upon the holotype and two paratype specimens included within calcareous nodules. Karasawa (1993) reported two species of crabs from this locality. The decapod as-

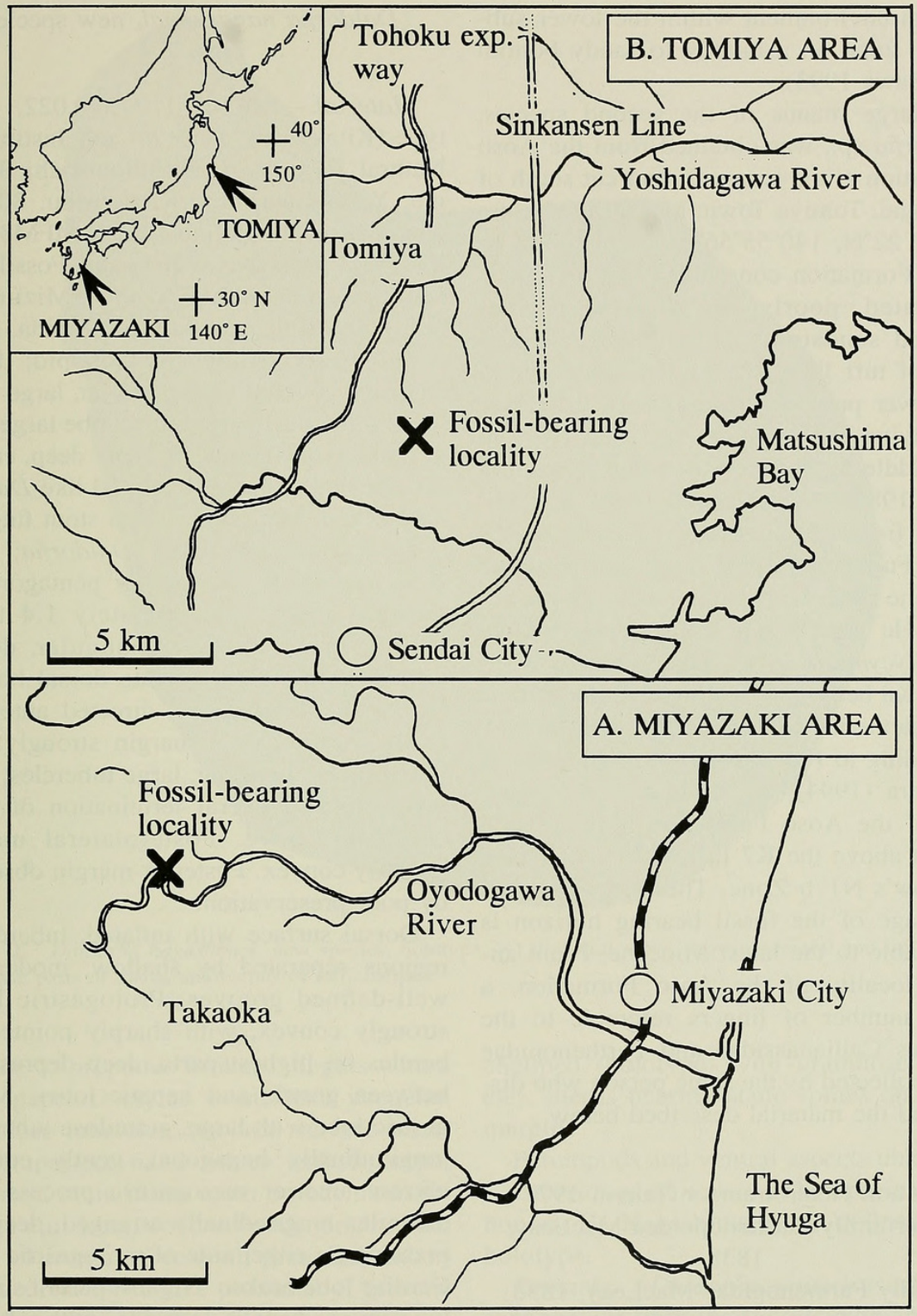

Fig. 1. Map of Japan showing the fossil-bearing localities.

semblage is dominated by *Carcinoplax prisca* Imaizumi. Two specimens of *Linuparus* sp. aff. *L. trigonus* (von Siebold) have been found also. Tomida (1991) reported some molluscs, *Perotrochus* sp., *Bathybembix* sp., *Hindsia* sp. and *Acila submirabilis* Makiyama from the locality. Decapods collected from the locality sug-

gest an environment within the lower sublittoral zone on a muddy to sandy bottom (Karasawa 1993).

A large manus of the second species, *Daldorfia* sp., was obtained from the Aoso Formation at the exposed road-cut south of Matsugai, Tomiya Town, Miyagi Prefecture (38°20′22″N, 140°55′56″E) (Fig. 1B). The Aoso Formation consists mainly of cross-laminated, poorly consolidated coarse-grained sandstone with remarkable key beds of tuff layer (K7) intercalated within the lower part and a pumiceous tuff layer underlying the conglomerate bed (K8) in the middle part of the Formation (Kitamura et al. 1983). The decapod fossil was obtained from this lithology beneath the K8 beds. Fujiwara (1992) discussed the Late Miocene molluscan assemblages of the region. He discriminated the *Serripes-Miya* and *Glycymeris-Dosinia* assemblages within the K8 beds, and regarded the inhabitants to be subneritic to mesoneritic, respectively. According to Fujiwara (1992) and Saito & Fujiwara (1994), the middle to the upper part of the Aoso Formation lying several meters above the K7 tuff bed is correlated to Blow's N17b Zone. Therefore, the geologic age of the fossil bearing horizon is assignable to the latest Miocene. From another locality of the Aoso Formation, a small number of fingers referable to the families Callianassidae and Parthenopidae were collected by the same person who discovered the material described below.

Section Heterotremata Guinot, 1977
Superfamily Parthenopoidea MacLeay, 1838
Family Parthenopidae MacLeay, 1838
Subfamily Parthenopinae MacLeay, 1838
Genus *Daldorfia* Rathbun, 1904

Type species.—*Cancer horridus* Linnaeus, 1758, by monotypy (ICZN Opinion 1582); Recent, Indo-West Pacific.

Geologic range.—Late Miocene—Recent.

Daldorfia nagashimai, new species
Figs. 2–4

Material.—KMNH IvP 300,022, holotype (Kitakyushu Museum and Institute of Natural History, 6, Nishihonmachi 3-chome, Yahatahigashiku, Kitakyushu, 805 Japan), coll. H. Nagashima, 1994; MFM83058, 83059, 2 paratypes (Mizunami Fossil Museum, Yamanouchi, Akeyo, Mizunami, Gifu, 509-61 Japan), coll. S. Tomida, 1993.

Diagnosis.—Large parthenopid; dorsal carapace covered with irregular, large granulose tubercles; mesogastric lobe large, longitudinally hexagonal, without deep, eroded area behind it; major cheliped like *Daldorfia horrida,* large, long, with stout fingers.

Description.—A large *Daldorfia*; carapace appears to be broadly pentagonal in outline, width approximately 1.4 times length. Front broadly triangular, downturned, with shallow, ovate dorsal hollow. Orbits small, subovate, directed anterolaterally. Anterolateral margin strongly convex, bearing irregular, large tubercles; deep notch defined lateral termination of from cervical groove. Posterolateral margin strongly convex. Posterior margin obscured by poor preservation.

Dorsal surface with inflated, tuberculate regions separated by shallow, moderately well-defined grooves. Protogastric lobes strongly convex, with sharply pointed tubercles on highest parts, deep depressions between gastric and hepatic lobes. Mesogastric lobe with large, granulose tubercles, longitudinally hexagonal, gently convex; narrow anterior mesogastric process with tubercles longitudinally arranged; deep depression on either side of mesogastric lobe. Cardiac lobe broken. Highest part of strongly convex hepatic regions with sharply pointed tubercles. Branchial lobes uneven, with irregular, large, granulose tubercles and small setal pits. Intestinal region depressed, with irregular tubercles.

Dactylus and propodus of right major cheliped (paratype) preserved, but tips of both fingers, and proximal end and mesial

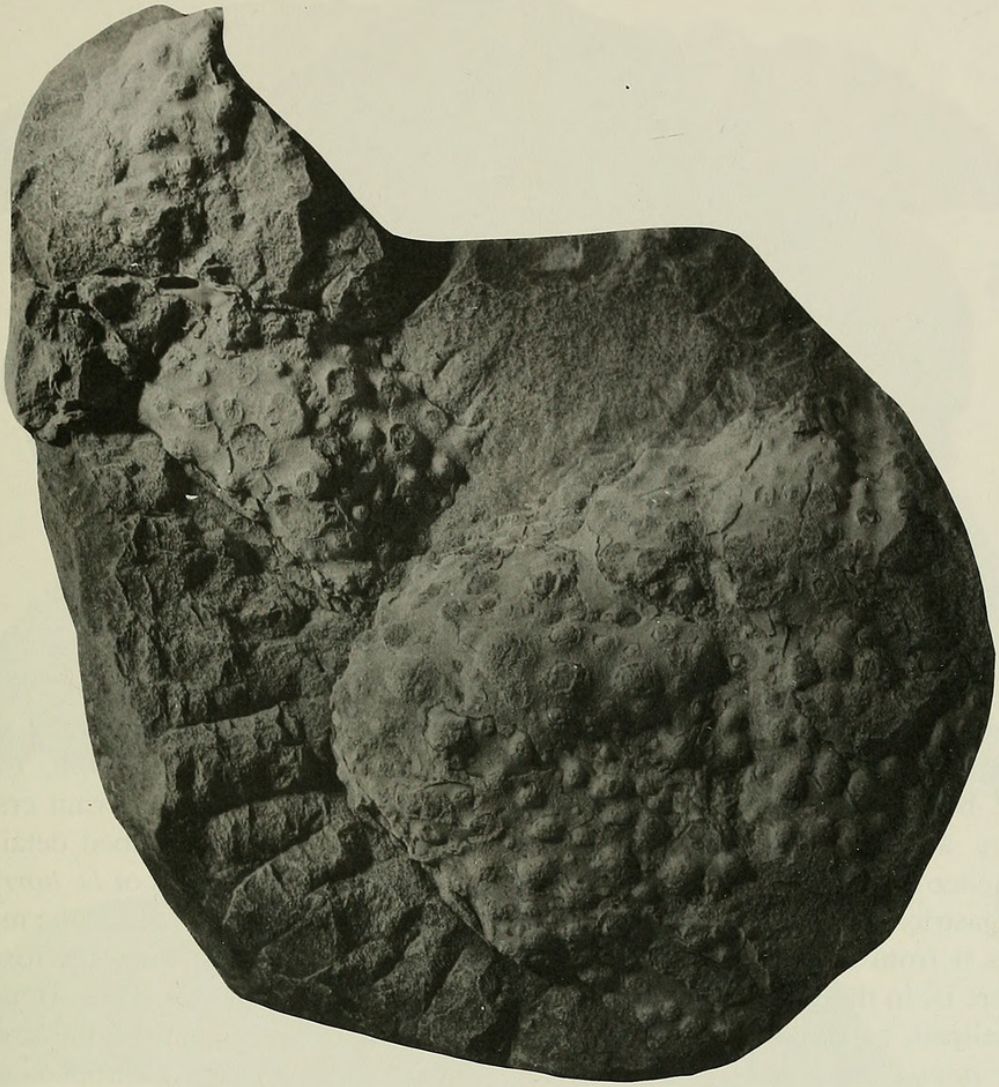

Fig. 2. *Daldorfia nagashimai,* new species, holotype, ×1.0; dorsal view; showing central and left side of carapace, parts of merus and carpus of left cheliped.

surface of propodus broken. Fingers with a wide gape. Dactylus stout, with irregular, granulose tubercles; occlusal surface missing. Imperfect fixed finger with a broad, flattened, molariform tooth on occlusal surface. Palm long, covered with longitudinal rows of irregular, conical, granulose tubercles decreasing in size proximally; greatest distal width about 1.5 times proximal width; tubercles large on dorsal and lateral surfaces, rather small on ventrolateral surface; ventral margin with conical, granulose tubercles; four longitudinal rows of spines present on ventromesial surface; two broken bases of large mesial spines present, others missing. Carpus and merus of left cheliped (holotype) with granulose tubercles, merus bearing acute spines on dorsal margin.

Pereiopods and ventral aspects unknown.

Derivation of name.—The species name honors H. Nagashima, who collected the holotype.

Remarks.—*Daldorfia* comprises nine Recent species from the Indo-Pacific and East Atlantic Oceans. Of these, *Daldorfia nagashimai* most closely resembles *D. horrida* (Linnaeus 1758) and *D. rathbuni* (de Man 1902), from the Indo-West Pacific Oceans, but the new species has a moderately uneven, not eroded dorsal surface with irregular, granulose tubercles. This new

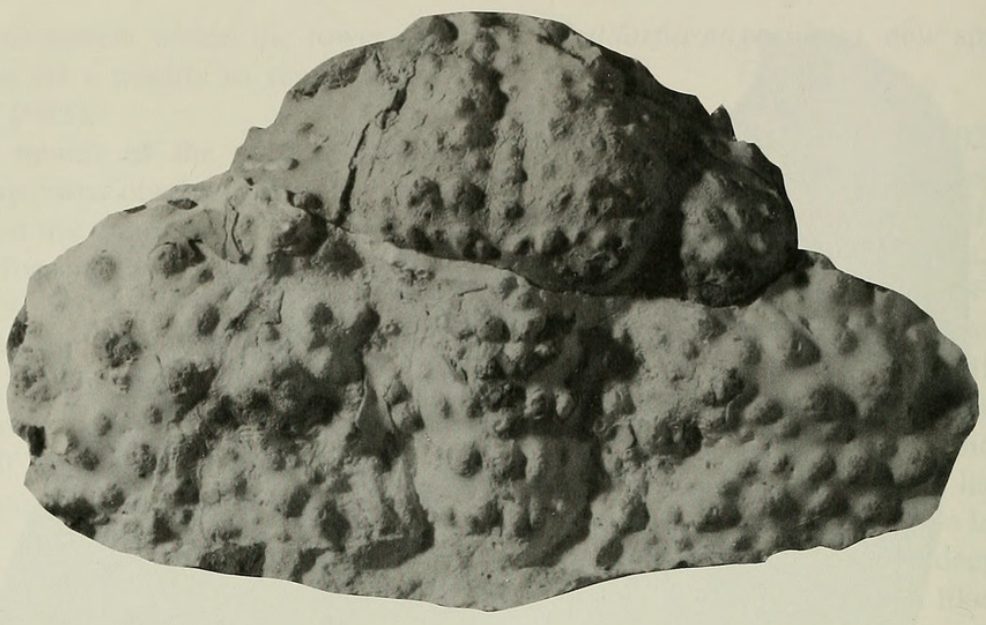

Fig. 3. *Daldorfia nagashimai,* new species, paratype, ×1.0. Dorsal view of carapace.

species has a large, longitudinally hexagonal mesogastric lobe with large, granulose tubercles, but *D. horrida* and *D. rathbuni* each have a small, rounded mesogastric lobe. Absence of a deep, eroded area behind the mesogastric lobe in the new species distinguishes it from *D. horrida* and *D. rathbuni.* There is, in the general features of the major cheliped, considerable similarity between *D. nagashimai,* and *D. horrida*: the latter bears two large, conical, distal tubercles, one on the lateral surface and the other on the dorsal surface of the propodus, but in *D. nagashimai,* the distal ends of the lateral and dorsal surfaces are covered with irregular, conical tubercles. Absence of spines on the mesial surface of the dactylus readily distinguishes *D. nagashimai* from *D. horrida.*

Recent *D. horrida* and *D. rathbuni* differ from most other parthenopine crabs, including the other species of *Daldorfia* (i.e., *D. investigatoris* (Alcock 1895), *D. spinosissima* (A. Milne Edwards 1862)), in having both fingers of the major cheliped with large blunt molariform denticles on the proximal occlusal surfaces.

Zipser & Vermeij (1978) observed that the Recent *Daldorfia horrida* uses the occlusal surfaces with molariform teeth of the major cheliped to crush gastropod shells (i.e., *Cerithium, Cypraea, Drupa, Cantharus, Vasum*) and to feed on hermit crabs. Ng & Rodríguez (1986) described detail the dentition on both chelipeds of *D. horrida.* There is, on the occlusal surface of the major chela, a great similarity between the fossil species and Recent *D. horrida.* Thus, *D. nagashimai* appears to have acquired the crushing behavior of feeding on gastropods and hermit crabs at least by the Late Miocene.

Daldorfia sp.
Fig. 5

Material.—SSME 13320 (Sendai Science Museum, 4-1, Forest Park, Dainohara, Aobaku, Sendai 981). 1 specimen, coll. Y. Takaizumi, 1991.

Description.—A large propodus of left minor cheliped, oval in cross section, covered on every surface except for fixed finger with large, conical tubercles. Tubercles vary in size, up to 1 cm in diameter. Lateral surface has flattened tubercles, dorsal border bears rather pointed ones. A hook-shaped projection with which carpus articulates on dorsal border situated near proximal articulation. Fixed finger short, about $\frac{1}{5}$ of total length, slightly curved inward,

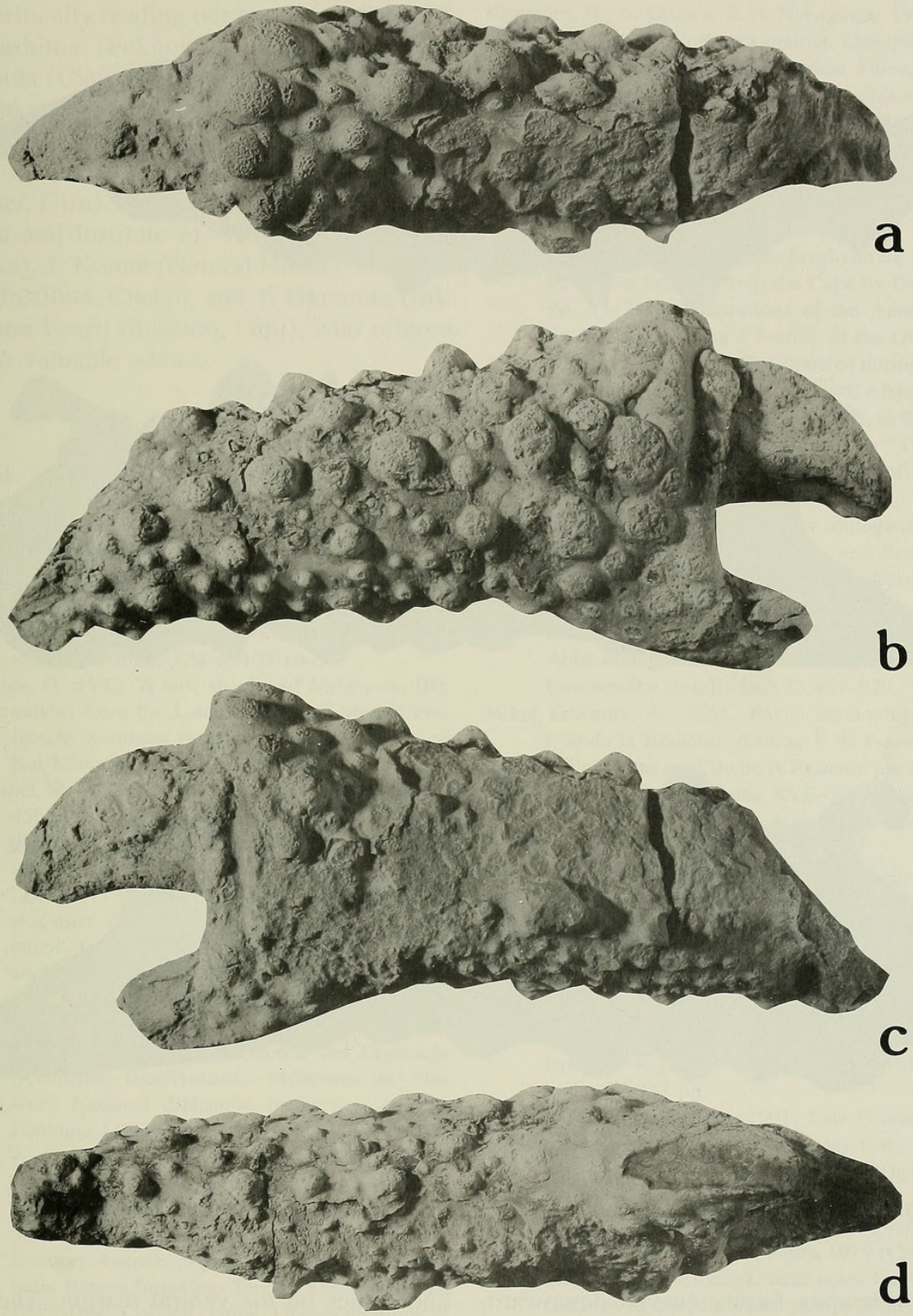

Fig. 4. *Daldorfia nagashimai,* new species, paratype, ×0.93. Right major cheliped: a, dorsal; b, lateral; c, mesial; d, ventral view.

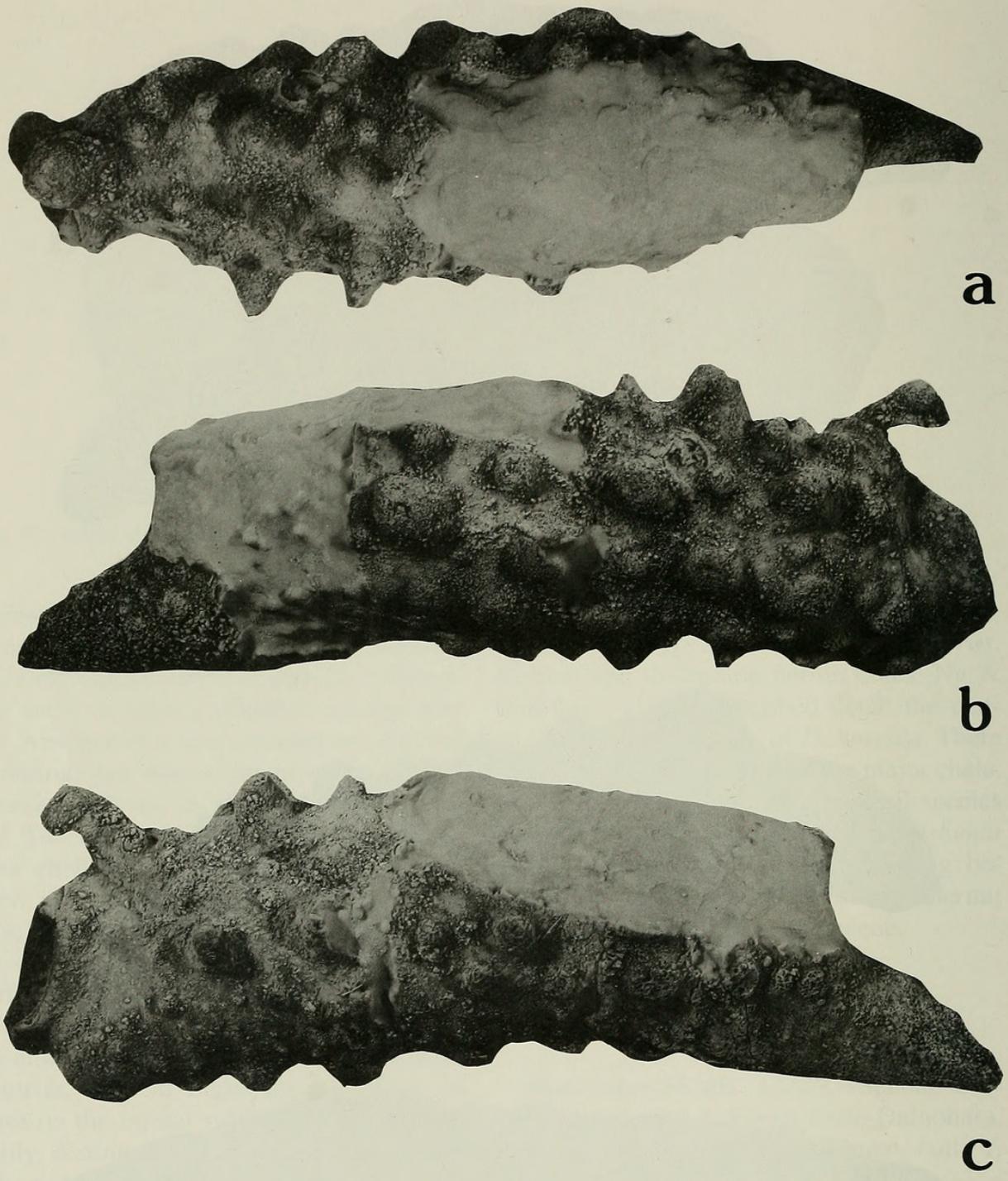

Fig. 5. *Daldorfia* sp., ×0.9. Propodus of left major cheliped: a, dorsal; b, lateral; c, mesial view.

stout with apex faintly curved downward. Occlusal surface with 3 blunt, subconical teeth. A shallow, short longitudinal furrow on apex below occlusal edge.

Remarks.—In general shape, the present chela most closely resembles the minor chela of *D. horrida,* but differs in lacking granulose tubercles on the lateral surface and spines on the ventral margin. The minor chela of *D. nagashimai* being as yet unknown, precludes comparison with *D.* sp.

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