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## A second species of the genus *Thermochiton* Saito et Okutani, 1990 (Mollusca: Polyplacophora)

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**ABSTRACT.** The paper describes a new species of the genus *Thermochiton*, *T. papuaensis* sp. nov., found in deep waters off Papua New Guinea. This species differs from *T. undocostatus* primarily in the dorsal scales, the marginal spicules, sculpture of the jugal area and the shape of the central teeth of radula. There are apparent similarities between the species of the genus *Thermochiton*, *Connexochiton platynomenus*, *C. kaasi* and *Ischnochiton crassus*. The last species is proposed to be transferred to *Connexochiton*. Owing to the friable, rusty brown deposits that densely cover the shell and girdle of both specimens of *T. papuaensis*, the latter probably lives in areas of high chemical activity.

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Второй вид рода *Thermochiton* Saito et Okutani, 1990 (Mollusca: Polyplacophora)

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Еще один новый вид рода *Thermochiton*, *T. papuaensis* sp. nov. описан из глубоких вод у Папуа Новая Гвинея. Этот новый вид отличается от *T. undocostatus*, главным образом, дорсальными чешуйками, маргинальными спикулами, скульптурой югально-го поля и формой центрального зуба радулы. Отмечено сходство между видами рода *Thermochiton*, *Connexochiton platynomenus*, *C. kaasi* и *Ischnochiton crassus*. Последний вид предложено перевести в род *Connexochiton*. Судя по рыхлым красно-коричневым отложениям, плотно покрывающим раковину и перинотум обоих экземпляров *T. papuaensis*, последний, по-видимому, обитает в местах с высокой химической активностью.

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### Introduction

The genus *Thermochiton*, described by Saito and Okutani [1990], has peculiarities such as strongly raised lateral areas, apophyses smoothly connected by narrow plate, slit formula many/1–3/many, tegmentum sculptured with concentrically arranged undulating costae, which strengthen towards outer margin, girdle covered with imbricating convex scales, the scales with spherules or granules and longitudinal ribs on dorsal side, radula with 86–140 transverse rows of mature teeth, major lateral teeth of radula with unicuspid bent, claw-shaped head, more than 20 gills arranged from valve II to valve

VII. Probably species inhabit communities with chemical activity like hydrothermal vents. Below the new species of the genus collected near Papua New Guinea is described.

### Materials and methods

The investigated specimens were collected during the PAPUA NIUGINI expedition (doi.org/10.17600/18000841).

The specimen treatments follow Sirenko [2018].

**Abbreviations:** BL – body length. MNHN – Muséum National d’Histoire Naturelle, Paris, France. Stn. – station. ZISP – Zoological Institute of Russian Academy of Sciences, St. Petersburg, Russia.

### Taxonomy

Class Polyplacophora Gray, 1821

Subclass Neoloricata Bergenhayn, 1955

Order Chitonida Thiele, 1909

Family Ischnochitonidae Dall, 1889

Genus *Thermochiton* Saito et Okutani, 1990

Type species: *Thermochiton undocostatus* Saito et Okutani, 1990, by original designation

*Thermochiton papuaensis* sp. nov.

(Figs 1–5)

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**Type material.** Holotype (MNHN IM-2013-19402) now disarticulated, consisting of mount of part of girdle and radula, vial with valves, part of radula and part of girdle, and 1 paratype (MNHN IM-2013-19405).

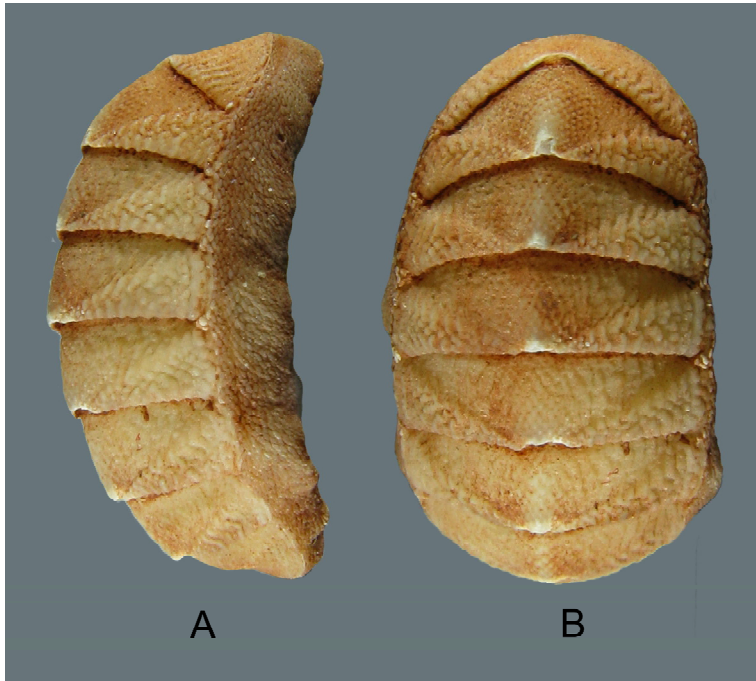


FIG. 1. *Thermochiton papuaensis* sp. nov., holotype (MNHN IM-2013-19402), Papua New Guinea, BL – 11.0 mm. **A.** Lateral view; **B.** Dorsal view.

РИС. 1. *Thermochiton papuaensis* sp. nov., голотип (MNHN IM-2013-19402), у Папуа Новой Гвинеи, BL – 11,0 мм. **A.** Вид сбоку; **B.** Вид сверху.

**Type locality.** Papua New Guinea, near the north-east coast of New Guinea Island, 05°30'S, 146°09'E, depth 400 m, holotype BL 11.0 mm and paratype BL 14.0 mm, (PAPUA NIUGINI, stn. CP4020, 13.12.2012).

**Etymology.** Named after the Papua, Papua New Guinea.

**Distribution.** Only known from type locality.

**Diagnosis.** Chiton of small size, oval, shell rather elevated, slightly carinated, intermediate valves not beaked, jugal areas of valves covered with granules, other areas with undulating costae. Slit formula 11/1(2)/12. Girdle dorsally covered with juxtaposed, bent, wide scales with large round granules on distal end and about 18 longitudinal rows of smaller granules on dorsal side of scales. Marginal spicules of three types: long, smooth spicules-needles, sharply pointed spicules with one wide rib in the middle and several thin ribs inclined to the sides and short blunt-topped spicules with longitudinal ribs on upper half. Central tooth of radula elongate with wide base. Head of major lateral tooth of radula unicuspid, bent, claw-shaped, with extended base ending with a long sharp pointed process directed inside.

[**Диагноз.** Хитон мелких размеров, форма тела овальная, раковина довольно приподнятая, слегка килеватая, промежуточные щитки без клюва, югальные поля щитков покрыты гранулами, остальные поля с волнистыми ребрышками. Формула разрезов 11/1(2)/12. Перинотум дорсально покрыт налегающими друг на друга, изогнутыми, широкими чешуйками с крупными округлыми гранулами на дистальном конце и 18 продольными рядами маленьких гранул на дорсальной стороне чешуек. МARGINАЛЬНЫЕ СПИКУЛЫ ТРЕХ ТИПОВ: длинные гладкие спикулы-иглы, островершинные спикулы с одним широким ребром посередине и несколькими тонкими ребрами от-

клоняющимися к бокам и короткие туповершинные спикулы с продольными ребрами на верхней половине. Центральный зуб радулы удлиненный с широким основанием. Наконечник крючковой пластинки радулы изогнутый, когтеобразный с удлиненным основанием оканчивающимся длинным острым отростком направленным внутрь.]

**Description.** Holotype small, BL 11 mm, valves moderately elevated (dorsal elevation 0.38), slightly carinated, not beaked, side slopes weakly convex. Color of valves and girdle white with friable, rusty brown deposits.

Head valve semicircular, front slope straight, posterior margin widely V shaped, weakly notched in the middle. Intermediate valves broadly rectangular with front margin slightly convex, side margins rounded, hind margin straight, apices not indicated, lateral areas strongly raised. Tail valve less wide than head valve, the length about half the width, antemucronal and postmucronal slopes slightly convex, mucro central, not swollen.

Tegmentum of all valves with undulating costae except for jugal area where it is covered by randomly arranged granules. Numerous pores of aesthetes evenly cover both the costae and the interstices between them.

Articulamentum white, apophyses short, very wide, rounded, coalescing across the small, shallow sinus, slit formula 11/1(2)/12, slit rays hardly indicated, solid teeth short, blunt, eaves narrow. Four from six intermediate valves have 2 slits at one side whereas other sides and other valves have only one slit per side. Ventral tegmental callus well developed.

Girdle dorsally covered with imbricated, bent, wide scales (up to 173 x 167  $\mu$ m), with large round granules at distal end and about 18 longitudinal

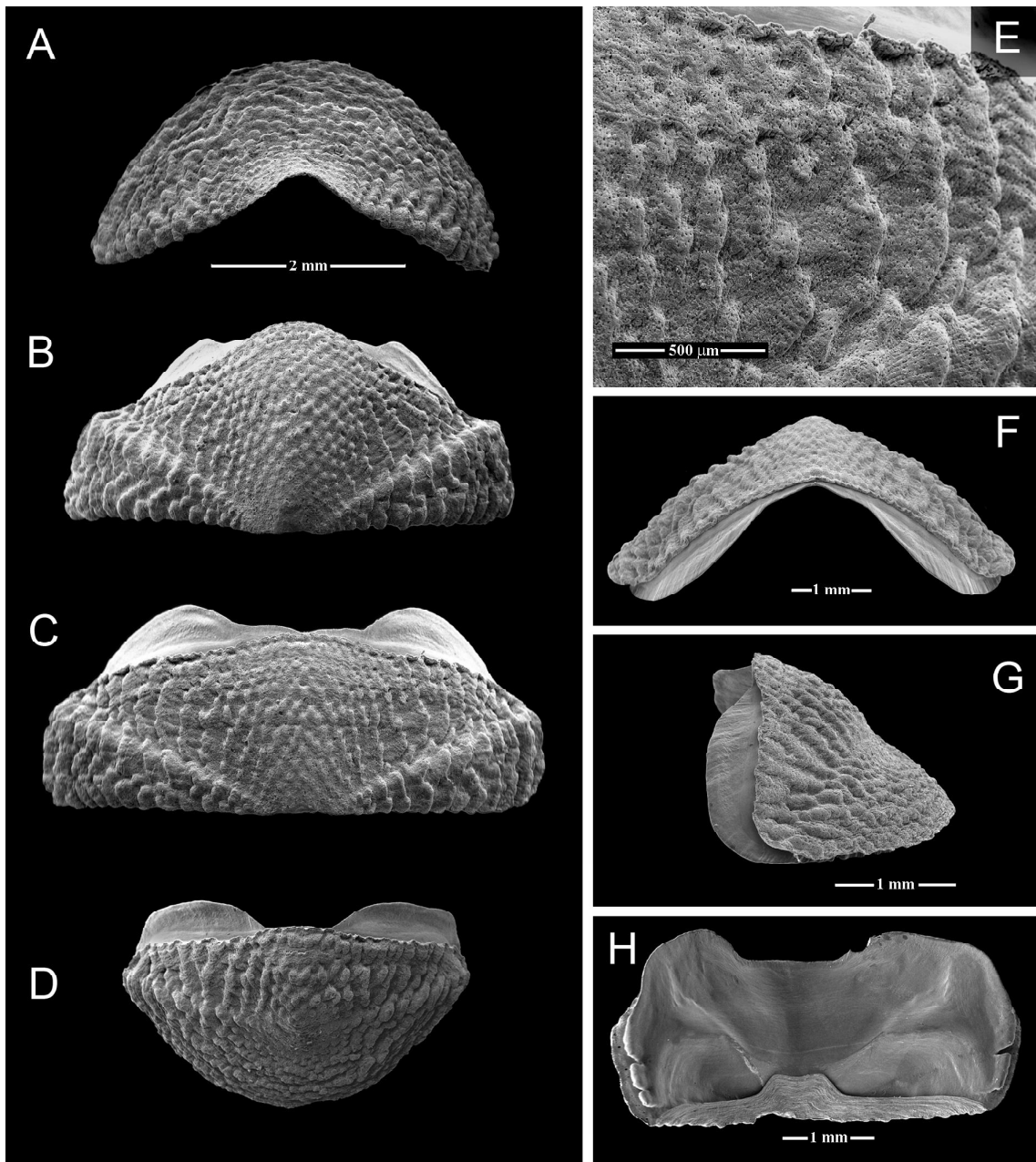


FIG. 2. *Thermochiton papuaensis* sp. nov., holotype (MNHN IM-2013-19402), Papua New Guinea, BL – 11.0 mm. **A.** Head valve, dorsal view; **B.** Valve II, dorsal view; **C.** Valve V, dorsal view; **D.** Valve VIII, dorsal view; **E.** Valve II, central area; **F.** Valve V, rostral view; **G.** Valve VIII, lateral view; **H.** Valve VII, ventral view.

РИС. 2. *Thermochiton papuaensis* sp. nov., голотип (MNHN IM-2013-19402), у Папуа Новой Гвинеи, BL – 11,0 мм. **A.** Головной щиток, вид сверху; **B.** Щиток II, вид сверху; **C.** Щиток V, вид сверху; **D.** Щиток VIII, вид сверху; **E.** Щиток II, центральное поле; **F.** Щиток V, вид спереди; **G.** Щиток VIII, вид сбоку; **H.** Щиток VII, вид снизу.

rows of smaller granules on dorsal side of scales. Scales near valves are directed without incline but in other places they have incline in different directions. Some scales have 1–4 short longitudinal ribs near side margin. Marginal spicules of three types: long, smooth spicules-needles (up to  $300 \times 30 \mu\text{m}$ ), sharply pointed spicules ( $90\text{--}132 \times 30 \mu\text{m}$ ) with one wide rib in the middle and several thin ribs inclined to the sides and short blunt-topped spicules ( $80 \times 30 \mu\text{m}$ ) with longitudinal ribs on upper half.

Ventral side of girdle paved with smooth, elongate scales ( $60\text{--}90 \times 11 \mu\text{m}$ ).

Radula of the holotype 4.1 mm long with 86 transverse rows of mature teeth. Central tooth rectangular, oblong ( $82 \mu\text{m}$  in length), parallel-sided, keeled medially, with small blade and large base, first lateral tooth slightly curved and with sharp blade on distal portion, major lateral tooth thin, long, shaft broadened near base, head of major lateral tooth unicuspid, bent, claw-shaped, with extended

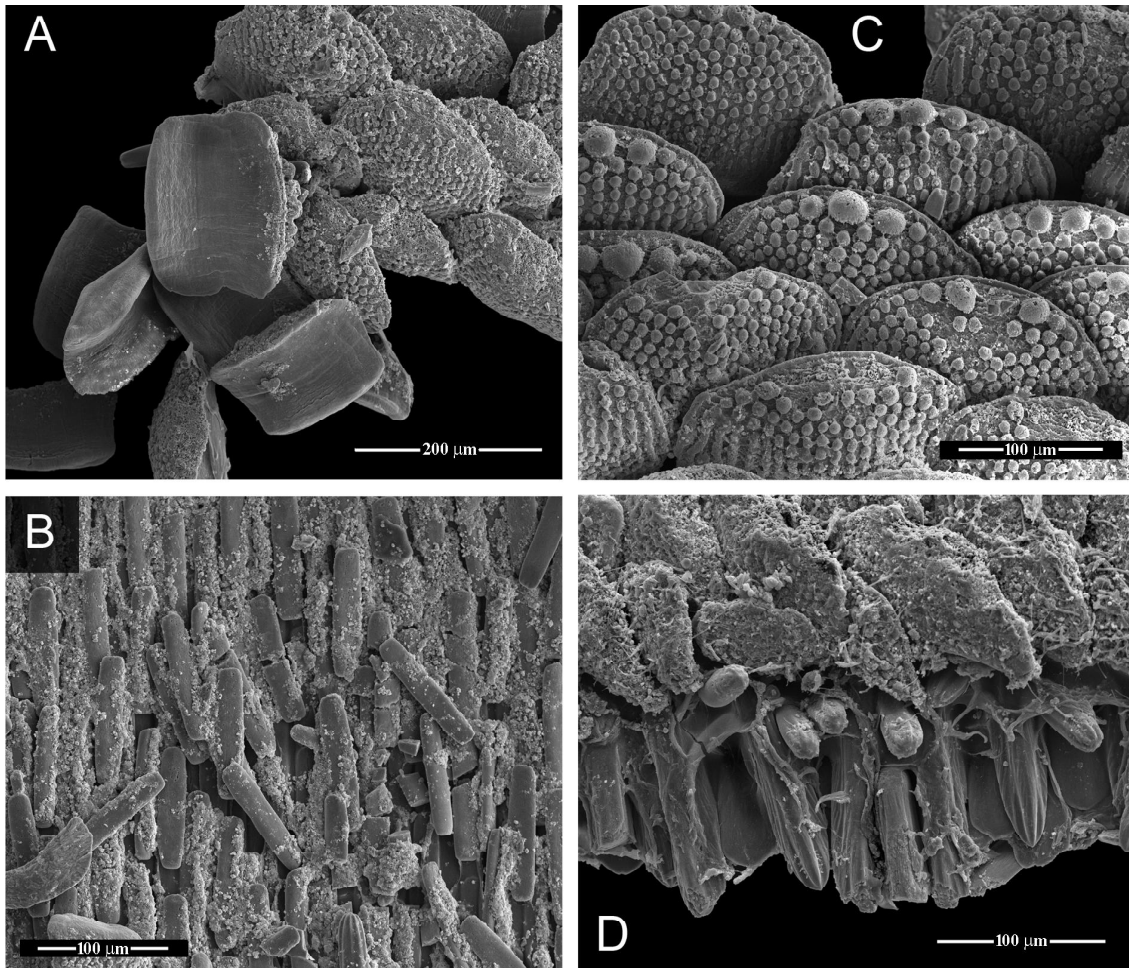


FIG. 3. *Thermoichiton papuaensis* sp. nov., holotype (MNHN IM-2013-19402), Papua New Guinea, BL – 11.0 mm. A, C. Dorsal scales; B. Ventral scales; D. Dorsal scales and marginal spicules.

РИС. 3. *Thermoichiton papuaensis* sp. nov., голотип (MNHN IM-2013-19402), у Папуа Новой Гвинеи, BL – 11,0 мм. А, С. Дорсальные чешуйки; В. Вентральные чешуйки; D. Дорсальные чешуйки и маргинальные спикулы.

base ending with a long, sharp pointed process directed inside.

Holotype has 21 gills, paratype has 23 gills on each side extending from valve II to valve VII.

The gut contains rusty brown particles of detritus.

**Remarks.** The new species is very similar to *Thermoichiton undocostatus* Saito et Okutani, 1990. The differences are in their dorsal scales being mostly granulated, most granules are not connected to each other (vs. the dorsal scales finely ribbed with elongated or somewhat drop-shaped granules in *T. undocostatus*), the two types of marginal spicules with ribs (while only smooth in *T. undocostatus*), 1- rare 2 slits of insertion plates in the intermediate plates (2-3 slits in *T. undocostatus*), and a jugal area of the intermediate and tail valves with granules (jugal areas with undulating costae in *T. undocostatus*). The central tooth of radula is also two times longer (82  $\mu\text{m}$ ) than the central tooth in *T. undocostatus* (38  $\mu\text{m}$ ), and there are fewer transverse rows in radula in *T. papuaensis* (86 rows of mature teeth) than in *T. undocostatus* (139 rows).

*T. undocostatus* inhabits hydrothermal vents [Saito, Okutani, 1990]. Owing to friable, rusty brown deposits that densely cover the shell and girdle of both specimens of *T. papuaensis*, the latter probably also lives in areas with high chemical activity like *T. undocostatus*.

Both species of genus *Thermoichiton* have similarities with some deep-sea species of genera *Connexochiton* Kaas, 1979 and *Ischnochiton* Gray, 1847 (*C. platinomenus* Kaas, 1979, *C. kaasi* Saito, 1996, *Ischnochiton crassus* Kaas, 1985). One of the main features of the genus *Connexochiton* was uninterrupted connection of apophyses by jugal plate. Only valve II of the holotype of *Ischnochiton crassus* has such jugal plate. In spite of the absence of uninterrupted plate connecting the apophyses on all other valves the last species will have to be transferred to genus *Connexochiton*, because all other main features (uncommon shape of valves, unique sculpture of tegmentum formed meshes, dorsal scales covered with spherules or longitudinal ribs, head of major lateral teeth unicuspid, bent, claw-shaped,

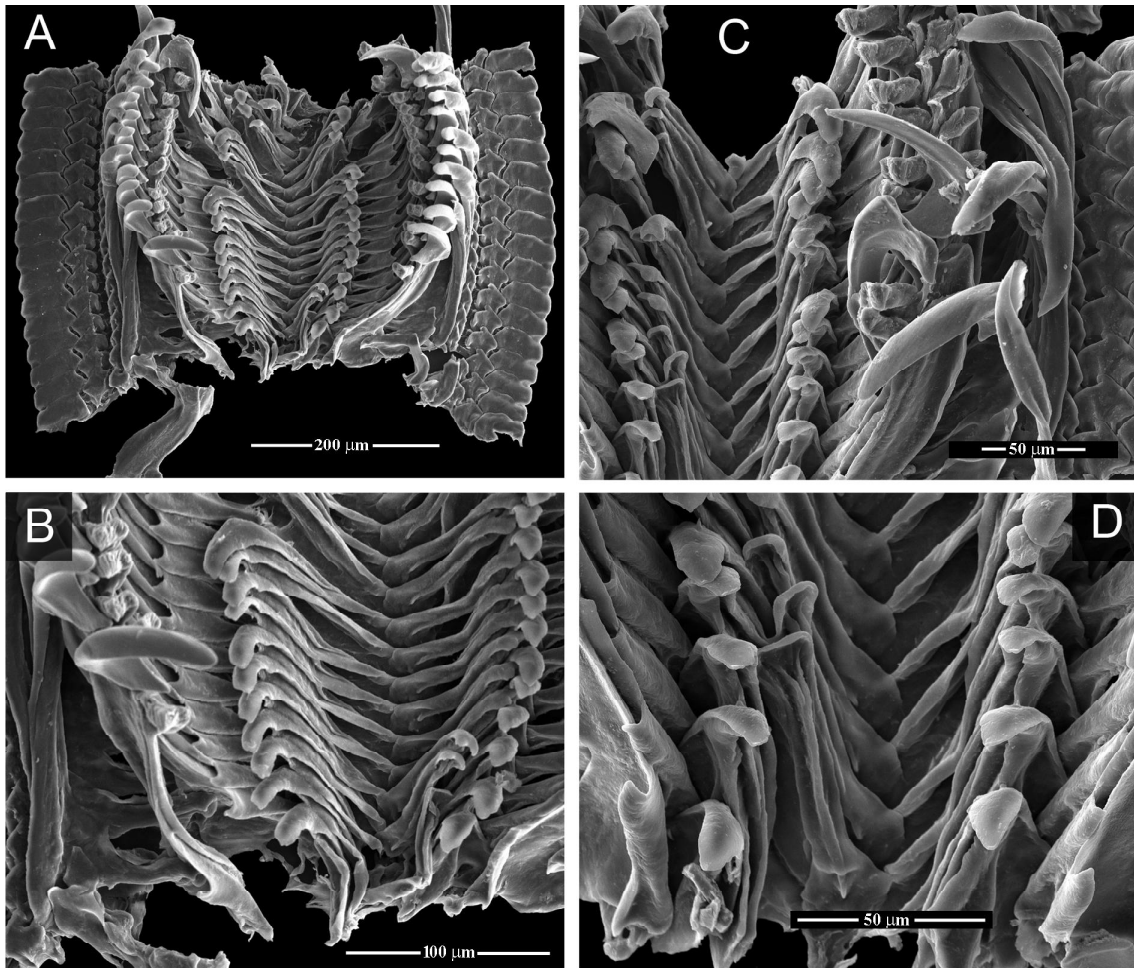


FIG. 4. *Thermochiton papuaensis* sp. nov., holotype (MNHN IM-2013-19402), Papua New Guinea, BL – 11.0 mm. A. Portion of radula; B-D. Central teeth of radula.

РИС. 4. *Thermochiton papuaensis* sp. nov., голотип (MNHN IM-2013-19402), у Папуа Новой Гвинее, BL – 11,0 мм. А. Часть радулы; B-D. Центральные зубы радулы.

with extended base ending with a long sharp pointed process directed inside. Specimen from New Caledonia, identified as *Ischnochiton crassus* by Sirenko [2008] belongs to *Connexochiton kaasi*. Saito [2011] was first who paid attention on relation between species of *Connexochiton* and *Ischnochiton crassus* from New Caledonia.

Figures given in the works [Kaas, 1979; Kaas, Van Belle, 1987, 1990; Saito, Okutani, 1990; Saito, 1997, 2011; Sirenko, 2008] indicate a close relationship of genera *Thermochiton* and *Connexochiton*. Indeed dorsal scales and claw-shaped head of major lateral teeth of species of both genera are very similar. *Thermochiton* differs from *Connexochiton* mainly by sculpture of tegmentum which has undulating costae (vs. granules which formed meshes in *Connexochiton*), by pores of aesthetes which arranged in all surface of tegmentum (vs. pores of aesthetes arranged only in granules in *Connexochiton*).

It is interesting to note that several species of genera *Lepidozona*, *Ischnochiton*, *Subterenchiton* and

*Callistochiton* have dorsal scales with granules and/or longitudinal ribs which are similar to that in *Thermochiton* and *Connexochiton*. This may also indicate the relationship of the taxa under discussion.

### Acknowledgements

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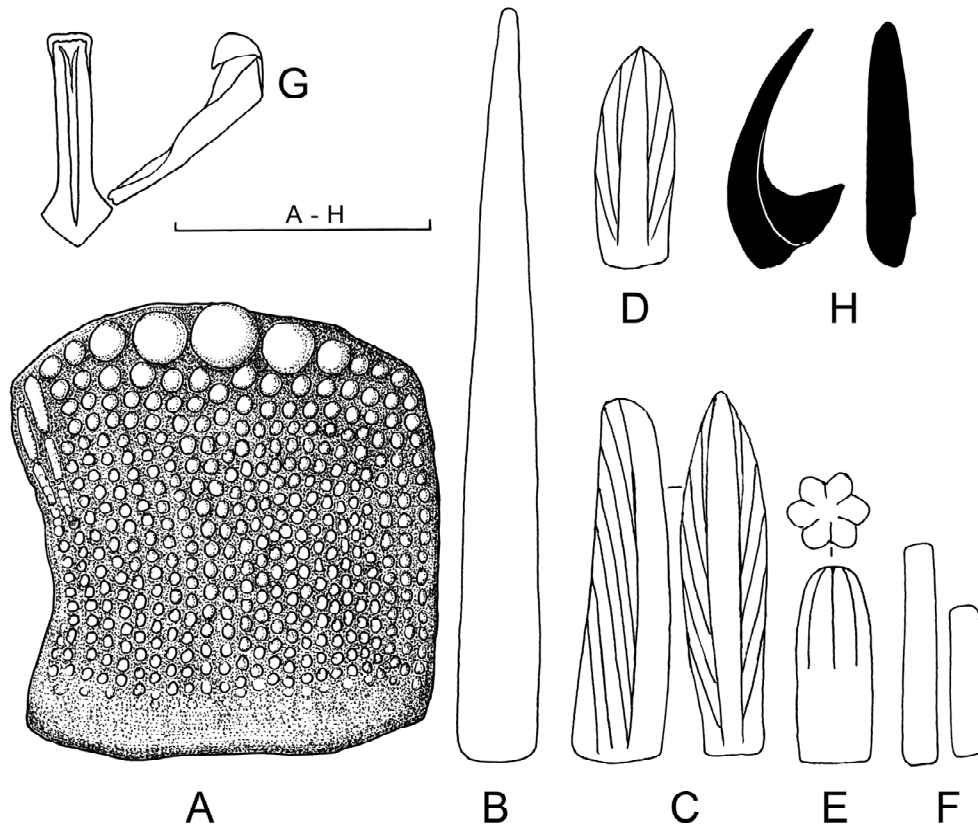


FIG. 5. *Thermochiton papuaensis* sp. nov., holotype (MNHN IM-2013-19402), Papua New Guinea, BL – 11.0 mm. A. Dorsal scale; B. Smooth marginal needle; C, D. Sharply pointed marginal spicules with one wide rib in the middle and several thin ribs inclined to the sides; E. Short blunt-topped marginal spicules with longitudinal ribs on upper half; F. Ventral scales; G. Central and first lateral teeth of radula; H. Head of major lateral tooth of radula. Scale bar: 100  $\mu$ m.

РИС. 5. *Thermochiton papuaensis* sp. nov., голотип (MNHN IM-2013-19402), у Папуа Новой Гвинеи, BL – 11,0 мм. А. Дорсальная чешуйка; В. Гладкая маргинальная игла; С, D. Заостренные спикулы с одним широким ребром посередине и несколькими тонкими ребрами, отклоняющимися к бокам; E. Короткая туповершинная спикула с продольными ребрами на верхней половине; F. Вентральные чешуйки; G. Центральный и первый латеральный зубы радулы; H. Наконечник крючковой пластинки радулы. Масштабная линейка: 100 мкм.

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## References

- Kaas P. 1979. On a collection of Polyplacophora (Mollusca, Amphineura) from the Bay of Biscay. *Bulletin du Muséum National d'Histoire Naturelle de Paris*, 4(A)A(1): 13–31.
- Kaas P., Van Belle R.A. 1987. *Monograph of living chitons. 3, Ischnochitonidae: Chaetopleurinae, Ischnochitoninae (pars)* E.J. Brill/ W. Backhuys, Leiden, 302 pp.
- Kaas P., Van Belle R.A. 1990. *Monograph of living chitons. 4, Suborder Ischnochitonina: Ischnochitonidae: Ischnochitoninae (continued). Additions to vols 1, 2 and 3.* E.J. Brill, Leiden, 298 pp.
- Saito H. 1997. Deep-sea chiton fauna of Suruga Bay (Mollusca: Polyplacophora) with descriptions seven new species. *National Science Museum Monographs*, 12: 31–58.
- Saito H. 2011. Chitons (Mollusca: Polyplacophora) from submarine banks off Izu Island and Boso Peninsula, Japan. *Memoires of the National Museum of Natural Science, Tokyo*, 47: 65–81.
- Saito H., Okutani T. 1990. Two new chitons (Mollusca: Polyplacophora) from a hydrothermal vent site of the Iheya Small Ridge, Okinawa Trough, East China Sea. *Venus*, 49(3): 165–179.
- Sirenko B. 2008. Bathyal chitons (Mollusca, Polyplacophora) from off New Caledonia and Vanuatu: families Callochitonidae, Ischnochitonidae and Loricidae. *Tropical Deep-Sea Benthos*, 25. *Mémoires du Muséum national d'Histoire naturelle*, 196: 41–75.
- Sirenko B. 2018. Description of two new species of *Callochiton* (Mollusca: Polyplacophora) from Vietnam and Tonga. *Ruthenica, Russian Malacological Journal*, 28(1): 1–10.