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THE AUSTRALIAN SPECIES OF *TOSIA* (ASTEROIDEA).

By

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(Plates xliii-xliv.)

The opinion held by Fisher (1911) that the Australian forms are best kept together in the genus *Tosia* and the American and European forms relegated to allied genera such as *Ceramaster* and *Plinthaster*, appears to be not only the most reasonable solution to the problem, but also the most natural course out of a maze of difficulties. The proposition, however, solves for the present only part of the task for the systematist and, indeed, must be regarded as only an initial step in the reorganization of sea-stars of the Australian seas. A problem yet to be faced is the relationship of *Tosia* with *Pentagonaster*, which is not yet clearly understood, but it is felt that, when the question is fully investigated by one with sufficient data, the merging of both genera will be the only alternative.

Just as intricate and detailed is the task of separating the species. It is the purpose of the present paper to attempt a reorganization of the Australian species so far as available material will allow; to give the results of a study of the relative values of specific characters and a statement of their uses and practical application. Moreover, it will be of great assistance to future workers to have the Australian species assembled under one heading and to have also a range of figures which will render the species more easily recognizable.

The species mentioned herein are as follows; the status of each species is included:

- Tosia australis* Gray, genotype (valid).
- T. aurata* Gray (valid).
- T. astrologorum* (M. and Tr.) (a synonym of *T. australis*, or, at most, only a variety of that species).
- T. tuberculatus* Gray (valid).
- T. grandis* Gray (? synonym of *T. aurata* Gray).
- T. rubra* Gray (doubtful).
- T. queenslandensis* Liv. (valid).
- T. minima* (= *Pentagonaster minimus*) (Perrier) (in synonymy of *T. tuberculatus* Gray).

THE GRANULATION OF THE ACTINAL SURFACE AS A SPECIFIC CHARACTER.

(Only species represented by series are discussed under this head.)

(a).—In *T. aurata* Gray.—In this species the actinal granulation is not governed by growth. Four specimens of almost equal size (three with $R. = 36$ mm. and one with $R. = 33$ mm.) show the character to vary to a marked degree. In

one extreme case the actinal granulation is complete, no bare plates being seen. In the other extreme case seventy-two actinal plates are bare. These plates occur near the edge of the body as well as near the centre. In smaller specimens (R. less than 33 mm.) the number of bare actinal plates are few (0-16). A variation is also noticeable in specimens exceeding R. = 36 mm. up to 69 mm. R. measurement.

Conclusion.—The degree of actinal granulation is useless as a specific character and so is the arrangement of bare actinal plates.

(b).—In *T. australis* Gray.—In ten specimens ranging from R. = 6 mm. to R. = 16 mm., the actinal granulation varies from a complete covering of every plate to a complete nakedness, excepting, of course, the usual row of granules at the periphery. In specimens over R. = 16 mm. up to R. = 33 mm., all plates are bare, excepting some at or near the margins, which are entirely covered, but the number of series of granules at the periphery of the plates varies from 1 to 3.

In the light of the above facts it is clear that the variation in the granulation of the actinal surface is not entirely due to growth.

Conclusion.—Like *aurata*, the actinal granulation cannot be relied upon as a specific character.

(c).—In *T. tuberculatus* Gray.—All the specimens of a series of eight from one locality (Port Fairy, Victoria), with R. ranging from 11 mm. to 23.5 mm., show a very decided granulation on the actinal surface and in only one example are bare plates to be seen. In this specimen the bare plates number eighteen. A reversal of this finding is seen in Gray's earlier descriptions (1847 and 1866). Gray described his specimens as bare actinally, the plates having only a single series of granules at the periphery. However, the statement is qualified in the following words from Gray (1866): "Var. ? or young? The ossicula of the oral surface near the edges covered with granules." From the information available at present, it is clear that the actinal granulation of the species is not constant in either its presence or absence.

Conclusion.—It seems that, as in *australis* and *aurata*, the degree of granulation found on the actinal surface of the species must be discarded as a specific character, or must, at least, be used with caution.

THE VALUE OF OTHER SPECIFIC CHARACTERS.

The formula R. = K.r. should not be relied upon unless employed in cases where a clearly distinguishable range can be obtained, e.g., between *australis* and *tuberculatus*. In the case of these two species the formula is very useful, and, as the present range of specimens shows, reliable.

The number of superomarginals is a good and useful guide when the numbers are sufficiently at variance to justify the employment of the character, e.g., in *australis* and *aurata*. On the other hand, it would be a useless character to employ in the separation of young specimens of *tuberculatus* and *australis*.

The degree of convexity of abactinal and marginal plates, so far as can be ascertained, is a reliable specific character.

While the structure and size of the last superomarginal plate is useful it should be employed only in association with other characters. The size of the terminal plate, however, is a very good character; it at once distinguishes

T. queenslandensis from all other members of the genus and fortunately it appears to be constant.

The presence or absence of pedicellariæ is a reliable character.

Key to the Australian Species of *Tosia*.

- (*T. grandis* and *T. rubra* have been omitted as they are only imperfectly known.)
- a. Terminal plate small, inconspicuous.
 - b. Superomarginal plates 6 to 8 on each side.
 - c. Median radials and adjoining abactinal plates, as well as superomarginals, markedly convex. Pedicellariæ may occur.
 - d. Interbrachial arc comparatively acute ($R. = 1.6$ to 1.9 r.). Minute actinal pedicellariæ present *tubercularis*
 - dd. Interbrachial arc more obtuse ($R. = 1.5$ or less r.). No actinal pedicellariæ present *australis* var. *astrologorum*
 - cc. Abactinal and superomarginal plates not markedly convex. Pedicellariæ never occur *australis*
 - bb. Superomarginal plates 10 to 16 on each side *aurata*
 - aa. Terminal plate large, as big as, or bigger than any superomarginal *queenslandensis*

***Tosia australis* Gray.**

(Pl. xlivi, figs. 10–13, Pl. xliv, fig. 6.)

Tosia australis Gray, Ann. Mag. Nat. Hist., vi, 1840, p. 281.

Astrogonium australe Müller and Troschel, Syst. Asteriden, 1842, p. 55.

Tosia australis Gray, Proc. Zool. Soc., 1847, p. 81.

Tosis australis Gray, Syn. Starfish Brit. Museum, 1866, p. 11, pl. 16, fig. 1.

Pentagonaster australis Perrier, Stell. Mus. d'Hist. Nat., Paris, 1875, p. 200 (and synonymy).

P. (Tosia) australis Tenison-Woods, Trans. Proc. Phil. Soc. Adelaide, S. Austr., 1879, p. 92.

Pentagonaster australis Bell, Proc. Linn. Soc. N. S. Wales, ix, pt. iii, 1884 (1885), p. 498.

Pentagonaster australis Sladen, Voy. "Challenger" Zool., xxx, 1889, pp. 266 and 745.

Tosia australis Verrill, Trans. Conn. Acad., x, i, 1899, pp. 148 and 160.

Tosia australis H. L. Clark, Rec. W. Austr. Mus., 1, pt. iii, 1914, p. 135.

Tosia australis H. L. Clark, Rec. S. Austr. Mus., iii, pt. iv, 1928, p. 381.

The marked variation in the actinal granulation of this species has been dealt with earlier in this paper.

Dr. Clark (*loc. cit.*) has clearly set out other varying characters relating to the plate system.

I believe Perrier (*loc. cit.*, p. 204) and Sladen (*loc. cit.*, pp. 744–5) to be in error when relegating Müller and Troschel's *Astrogonium australe* to the synonymy of *Tosia aurata*. Müller and Troschel, judging by their remarks, had *australis* before them and not *aurata*. Further, Gray (1866) evidently recognized the faithfulness of Müller and Troschel's identification when he included a reference to those authors under *australis*.

Material Examined:

- 5 specimens (R. = 20.5 mm. to 32.5 mm.), Victoria (Austr. Mus. Reg. Nos. J:3871-5).
- 5 specimens (R. = 14.5 mm. to 22 mm.), Reef at Portsea, Port Phillip, Victoria (Austr. Mus. Reg. No. J:4926).
- 4 specimens (R. = 12 mm. to 21.5 mm.), Westernport, Victoria (Austr. Mus. Reg. Nos. J:4214-7).
- 1 specimen (R. = 11.5 mm.), Lucky Bay, E. of Esperance, W. Austr. (Austr. Mus. Reg. No. J:3969).
- 2 specimens (R. = 10 mm., R. = 12.5 mm.), King George's Sound, W. Austr. (Austr. Mus. Reg. No. J:3982).
- 1 specimen (R. = 12.5 mm.), 3 miles south of Yellow Rock River, King Island, Bass Strait (Austr. Mus. Reg. No. J:4195).
- 2 specimens (R. = 12.5 mm., R. = 17 mm.), Currie Harbour, King Island, Bass Strait (Austr. Mus. Reg. Nos. J:4188-9).
- 4 specimens (R. = 10 mm. to 22.5 mm.), Tasmania (Austr. Mus. Reg. Nos. J:1242-5).
- 21 specimens (R. = 6.5 mm. to 20 mm.). Dredged 5 fathoms off Gordon, d'Entrecasteaux Channel, Tasmania (Austr. Mus. Reg. No. J:5428).
- 1 specimen (R. = 19 mm.), Tasmania (Austr. Mus. Reg. No. G:11308).

Distribution.—Victoria; King Island, Bass Strait; Tasmania; South Australia; Western Australia.

Tosia australis Gray var. *astrologorum* (Müller and Troschel).

(Pl. xlivi, figs. 1-2.)

Astrogonium astrologorum Müller and Troschel, Syst. Asteriden, 1842, p. 54.

Pentagonaster astrologorum Perrier, Rev. Stell. Mus. d'Hist. Nat., Paris, 1875, p. 196 (and synonymy—? Perrier's reference to Gray "... Synopsis, p. 11", a direct dealing with *astrologorum* does not appear in Gray's paper; the name certainly does appear on p. 11, but only in the text matter under *Pentagonaster dubeni* Gray).

P. (Tosia) astrologorum Tenison-Woods, Trans. Proc. Phil. Soc., Adelaide, South Austr., 1879, p. 92.

? *Pentagonaster astrologorum* Sladen, Voy. "Challenger" Zool., xxx, 1889, p. 269.

? *Pentagonaster astrologorum* Whitelegge, Journ. Roy. Soc. N. S. Wales, xxiii, 2, 1889, p. 38.

Tosia astrologorum Verrill, Trans. Conn. Acad., x, i, 1899, p. 161.

Tosia australis var. *astrologorum* H. L. Clark, Rec. South Austr. Mus., iii, No. 4, 1928, pp. 381, 384.

The lowering of the status of *astrologorum* to varietal rank by Clark is fully justified in view of the evidence before me. Further, I am in complete accord with that authority when he states that "It is doubtful whether the use of even a varietal name is justifiable". However, it seems best to retain Müller and Troschel's name for specimens of *australis* which have swollen superomarginals until such time as the question can be settled, as Dr. Clark states, "at the shore and not in the museum".

Sladen (*loc. cit.*), who was followed by Whitelegge (*loc. cit.*), apparently made an error when he recorded *astrologorum* from "Sydney Harbour". The "species" has never been seen in Port Jackson (Sydney Harbour) since Sladen's record, a fact which is rather significant in view of the vast amount of collecting that has been done in the locality during the last forty years.

The specimens before Sladen when he made his record were, I believe, young specimens of *Pentagonaster düberi* Gray, a variable sea-star fairly well represented in Port Jackson and a species which could easily have been confused with *astrologorum* by Sladen in the earlier days.

Material Examined:

1. specimen (R. = 29 mm.), on Reef at Portsea, Port Phillip, Victoria (Austr. Mus. Reg. No. J:4926).
- 1 specimen (R. = 30 mm.), Westernport, Victoria (Austr. Mus. Reg. No. J.4218).
- 1 specimen (R. = 30.5 mm.), dredged in 5 fathoms off Gordon, d'Entrecasteaux Channel, Tasmania (Austr. Mus. Reg. No. J:5428—part).
- 2 specimens (R. = 34 mm., R. = 36.5 mm.), Western Australia (Austr. Mus. Reg. No. G:11303).

Distribution.—Victoria; Tasmania; South Australia; Western Australia.

Tosia aurata Gray.

(Pl. xlili, figs. 3–9; Pl. xliv, fig. 8.)

Tosia aurata Gray, Proc. Zool. Soc., 1847, p. 80.

Tosia aurata Gray, Syn. Starfish Brit. Museum, 1866, p. 11, pl. xvi, fig. 2, 2a.

Pentagonaster auratus Perrier, Rev. Stell. Mus. d'Hist. Nat., Paris, 1875, p. 204 (and synonymy in part).

P. (Tosia) auratus Tenison-Woods, Trans. Proc. Phil. Soc. Adelaide, South Austr., 1879, p. 92.

Tosia aurata Verrill, Trans. Conn. Acad., x, i, 1899, p. 161.

Pentagonaster (Tosia) aurata McCoy, Prodr. Zool. Victoria, dec. xx, 1890, p. 373, pl. 200, fig. 3.

Tosia aurata H. L. Clark, Biol. Res. F.I.S. "Endeavour", iv, 1916, p. 43.

The large number of superomarginals (10 to 16 on each side) serves as a ready guide to the identity of this species. Gray (1866) has made use of the actinal granulation to separate his species, including the present one, but I have pointed out elsewhere in this paper that this character is, for practical purposes, worthless. It is perhaps advisable to point out the differences seen in plates which are naturally naked and those which are rendered naked by accidental means. In the case of the former type the plates are invariably smooth and shiny, while in the case of the latter the plates are always rugged or pitted. This rugged character of plates, however, is quite different to the naturally rugged and faintly nodular appearance of abactinal plates of *T. queenslandensis*.

The resemblance of *aurata* to *T. grandis* Gray is very marked. It is known that in *aurata* the numerical range of the superomarginals is 10 to 16, and it is at once seen that the range embraces the number set out by Gray for *grandis*. It is clear, then, that the number of superomarginals in *grandis* is useless as a character distinguishing it from *aurata*.

The distribution of the actinal granulation in *grandis* as described by Gray applies also to variable specimens of *aurata*. The only remaining differences of possible value seem to be bound up in the following words from Gray's description: "Dorsal ossicula very unequal". From this, aided by Gray's figure, one infers that *grandis* lacks the central pentagon of large plates so characteristic of *aurata*, and that the abactinal plates are unusually unequal. A re-examination of Gray's type, however, seems to be the only way to clear away these uncertainties.

Sladen and Perrier include under this species as a synonym Müller and Troschel's (1842) *Astrogonium australe*. Such a course is, I believe, incorrect; the specimen before these latter authors had six superomarginal plates ("Sechs dorsale und acht ventrale Randplatten") which at once disassociates it from *aurata*.

Material Examined:

- 2 specimens (R. = 47 mm., R. = 44 mm.), Western Australia (Austr. Mus. Reg. No. G:11302).
- 2 specimens (R. = 54 mm., R. = 55 mm.), South Coast of South Australia, "Endeavour" Collection identified by H. L. Clark (Austr. Mus. Reg. Nos. J:1674, J:1677).
- 2 specimens (R. = 55 mm., R. = 68 mm.), Oyster Bay, Tasmania, 20-40 fathoms, "Endeavour" Coll., identified by H. L. Clark (Austr. Mus. Reg. Nos. J:1541-2, J:1544).
- 17 specimens (R. = 22 mm. to 44 mm.), dredged 5 fathoms off Gordon, d'Entrecasteaux Channel, Tasmania (Austr. Mus. Reg. Nos. J:5426-7).
- 43 specimens (R. = 27 mm. to 49 mm.), Simpson's Bay, d'Entrecasteaux Channel, Tasmania (Austr. Mus. Reg. No. J:5010).
- 1 specimen (R. = 45 mm.), Hobart, Tasmania (Austr. Mus. Reg. No. G:11301).

Distribution.—Victoria; Tasmania; South Australia; Western Australia.

Tosia tubercularis Gray.
(Pl. xliv, figs. 1-2, 7.)

Tosia tubercularis Gray, Proc. Zool. Soc., 1847, p. 91.

Tosia tubercularis Gray, Syn. Starfish Brit. Museum, 1866, p. 11, pl. 16, figs. 4-4a.

Pentagonaster minimus Perrier, Rev. Stell. Mus. d'Hist. Nat., Paris, 1875, p. 207.
P. (Tosia) tubercularis Tenison-Woods, Trans. Proc. Phil. Soc. Adelaide, S. Austr., 1879, p. 92.

Pentagonaster minimus Sladen, Voy. "Challenger" Zool., xxx, 1889, p. 266.

Pentagonaster tubercularis Sladen (*tom. cit.*), pp. 266, 748-9.

Description.—Rays five, body pentagonal. R. = 1·6 to 1·9 r. Interbrachial arc comparatively acute. Abactinal plates are numerous and collectively are unequal in size and shape. The largest plates occur as a pentagon on the centre of the disc. These plates are flat in young examples and only slightly convex in older specimens. The median radial plates and the adjoining series which run down to the tip of the ray are very noticeably swollen, particularly in small specimens. The plates in the area bounded by the central pentagon of large plates, are also noticeably swollen. The plates in the inter-radial areas on the abactinal

surface are for the most part only slightly convex; in young examples these plates are flat. Further, these plates are the largest on the abactinal surface with the exception of the plates forming the central pentagon. Every abactinal plate is bounded by a single row or series of granules. Papular pores occur singly on the abactinal surface.

The madreporite is inter-radial in position and lies next to one of the large plates forming the pentagon. It is triangular in shape with the three sides bulging out into a marked convexity.

The superomarginals range in number from six to eight; each is surrounded by a single row of granules. They are moderately swollen. In young specimens the superomarginals are of equal size excepting the ultimate which is conspicuously elongated and at least twice the size of any other superomarginal. In the largest specimens before me both the ultimate and the penultimate superomarginals are elongated and much bigger than any other superomarginal. In the largest specimen also is seen in one instance a fusion of an ultimate and a penultimate, the result being the formation of a plate of considerable size. The terminal plate is small and inconspicuous.

The inferomarginals number eight to ten. Like the superomarginals, each is separated by a single series of granules. Inferomarginals in young specimens are equal in size excepting the ultimate which is comparatively small. In older examples, particularly in the largest specimen before me, the antepenultimate is the largest plate in the inferomarginal series; the smallest is the ultimate as is seen in juvenile examples.

The plates of both marginal series are bare except for the single series of granules which surrounds each plate. Before passing on it is necessary to point out, in connection with the inferomarginals of the largest specimen, that there are indications of an additional plate at both ends of each series. This additional plate (if it can be called such), which is hardly more than an enlarged bald granule, is wedged between the ultimate plates of the marginal series and the terminal plate. Its presence is constant in every instance. If this plate is taken into consideration in the count of the inferomarginals, the range would be altered to eight to twelve and not eight to ten as previously stated. For the purposes of this description, however, these plates are not included in the range.

The actinal surface may be partially or wholly covered by coarse granules. Bivalved pedicellariae with the appearance of split granules occur sparingly on the actinal surface. In most cases the pedicellaria is placed on a bare plate thus rendering its presence easily detected. The adambulacral armature is in four series, two on each side of the ambulacral groove. Each furrow comb is made up of two spines of equal size and length. Behind the furrow spines a second series occurs. This second series is made up of paired spines, the innermost spine of each pair being invariably the smaller both in size and height.

Remarks.—Apart from Gray's original description in 1847 and his re-description and figures which appeared in 1866, nothing of any interest has appeared regarding this species. A fact, however, which has led to a considerable amount of trouble is that Sladen (*loc. cit.*, p. 749) made an apparent reference to a record by Perrier which I have vainly spent much time in attempting to trace in the literature available to me.

Synonymy.—It is fairly clear that Perrier (*loc. cit.*) had *T. tuberculatus* before him when describing his *Pentagonaster minimus*. The description applies so well to *tuberculatus*, taking into consideration individual variation, that *minimus* must be placed as a synonym under *tuberculatus*. The inclusion of "(E.P.)" after the name *Pentagonaster minimus* in Perrier's above cited work implies that there is an earlier reference to the species but no trace of such can be found in the literature available to me.

Material Examined:

8 specimens (R. = 11 mm. to 23.5 mm.), Port Fairy, Victoria (Austr. Mus. Reg. Nos. G:11309-10).

Distribution.—Western Australia and Victoria.

***Tosia grandis* Gray.**

Tosia grandis Gray, Proc. Zool. Soc., 1847, p. 80.

Tosia grandis Gray, Synop. Starfish Brit. Museum, 1866, p. 11, pl. 3, fig. 1-1a.

P. (Tosia) grandis Tenison-Woods, Trans. Proc. Phil. Soc. Adelaide, South Austr., 1879, p. 92.

Tosia grandis Bell., Ann. Mag. Nat. Hist., (6), ii, 1888, p. 402.

The only record other than those of Gray which furthers our knowledge of this species is that of Bell (*loc. cit.*). That author's record, however, tells us nothing beyond the fact that his specimen or specimens came from Port Phillip, Victoria; no mention is made of the nature of the material examined, a fact which is to be regretted in view of the meagre information that existed, and still exists, concerning the species.

Taking the available information as a whole, a doubt cannot be suppressed concerning the validity of *grandis*. In no way can the species be satisfactorily separated from large specimens of *T. aurata*. Since Bell saw fit to retain the name it is perhaps best for the time being to allow it to stand until such time as a re-examination of Gray's type specimen is made.

Distribution.—Victoria and Western Australia.

***Tosia rubra* Gray.**

Tosia rubra Gray, Proc. Zool. Soc., 1847, p. 81.

Tosia rubra Gray, Synop. Starfish Brit. Museum, 1866, p. 11, pl. xvi, figs. 3-3a.

P. (Tosia) ruber Tenison-Woods, Trans. Phil. Soc. Adelaide, South Austr., 1879, p. 92.

Like *grandis*, this species is very difficult to separate from *aurata*. The nature of the actinal granulation and the number and character of the marginals do not serve as a means of separation as was thought to be the case by Gray, therefore the only remaining character which may be useful is the convex nature of the abactinal plates. The information supplied by Gray in reference to this character is "Dorsal ossicula rather convex, rounded". This statement alone, however, does not convey much, as the reader has no means of deciding upon the degree of convexity.

The deepness of the convexity of the interbrachial arc would, at first thought, be considered useful as a basic character for the separation of *rubra* and

aurata, but it has been pointed out and illustrated elsewhere in this paper that the character is too variable to be useful.

The exact status of *rubra* can be settled only after a re-examination of Gray's type specimen.

Distribution.—Australia.

Tosia queenslandensis Livingstone.

(Pl. xliv, fig. 3.)

Tosia queenslandensis Livingstone, British Museum (Nat. Hist.), Great Barrier Reef Expedition, 1928-29, Sci. Reports, iv, No. 8, Asteroidea, 1932, p. 243, pl. v, figs. 1, 2, 7.

When this species and a young specimen of *Pentagonaster dübeni* Gray (see Pl. xliv, figs. 4-5) are compared three important points are at once recognizable. Firstly, the additional evidence of the intergradation of the species of *Tosia* with those of *Pentagonaster*. Secondly, the added difficulty of securing grounds to preserve these two genera, and, thirdly, the extremely close association of the two species themselves. The first two points I must be content merely to indicate at present, but the third can be dealt with here, taking into consideration the affinities of the two species and the means to be employed in their separation.

Both species possess large and conspicuous terminal plates, *queenslandensis* being the only species at present in *Tosia* in possession of such a character. The points of difference between the two species are as follows:

Pentagonaster dübeni Gray
(juvenile specimen).

1. The ultimate or penultimate superomarginal (in some rays both) always meets across the tip of the ray, being separated only by a double row of minute granules.
2. Body comparatively thin.
3. R. = 18 mm., r. = 9 mm., R. = 2 r.
4. Rays comparatively long and narrow.
5. Abactinal plates bare and smooth.
6. Granules separating abactinal plates flat and inconspicuous.

Tosia queenslandensis Livingstone
(mature specimen).

1. Neither the ultimate nor penultimate superomarginal ever meet across the tip of the ray. Both are always separated by one or more abactinal plates.
2. Body comparatively thick and robust.
3. R. = 17 mm., r. = 10 mm., R. = 1.7 r.
4. Rays comparatively short and wide.
5. Abactinal plates bare and nodular (or pitted), never smooth.
6. Granules separating abactinal plates are for the most part swollen, but always conspicuous.

Material Examined.—Specimens referred to in original description (*loc. cit.*).

Distribution.—Great Barrier Reef, Queensland.

EXPLANATION OF PLATES.

PLATE XLIII.

Fig. 1.—*Tosia australis* Gray var. *astrologorum* (M. and Tr.). Abactinal surface of specimen from d'Entrecasteaux Channel, Tasmania (R. = 30.5 mm). (Austr. Mus. Reg. No. J: 5428 part.) Natural size.

Fig. 2.—*Tosia australis* Gray. var. *astrologorum* (M. and Tr.). Actinal surface of same specimen. Natural size.

Figs. 3-5.—*Tosia aurata* Gray. Abactinal surface of three specimens from Tasmania, all approximately of equal size, showing variation, particularly in the degree of acuteness of the interbrachial arc. (Austr. Mus. Reg. Nos. J: 5426; J: 1544. "Endeavour" specimen.) Slightly under half natural size.

Figs. 6-9.—*Tosia aurata* Gray. Actinal inter-radial areas selected from four specimens from d'Entrecasteaux Channel, Tasmania, to show variation in the granulation. (Austr. Mus. Reg. No. J:5427 part.) Slightly over natural size.

Figs. 10-13.—*Tosia australis* Gray. Actinal inter-radial areas selected from four specimens from Tasmania to show variation in granulation. (Austr. Mus. Reg. No. J:5428 part.) $\times 2$.

PLATE XLIV.

Fig. 1.—*Tosia tubercularis* Gray (R. = 23·5 mm.). Actinal surface of specimen from Victoria. (Austr. Mus. Reg. No. G:11309 part.) Slightly over natural size.

Fig. 2.—*Tosia tubercularis* Gray. Enlarged portion of actinal surface showing pedicellariæ. (Austr. Mus. Reg. No. G:11309 part.) Approx. $\times 9$.

Fig. 3.—*Tosia queenslandensis* Livingstone. Abactinal surface of holotype (R. = 17 mm.) showing differences between it and a juvenile specimen of *Pentagonaster dübeni* figured near by. (Austr. Mus. Reg. No. J:5534.) Slightly under $\times 2$.

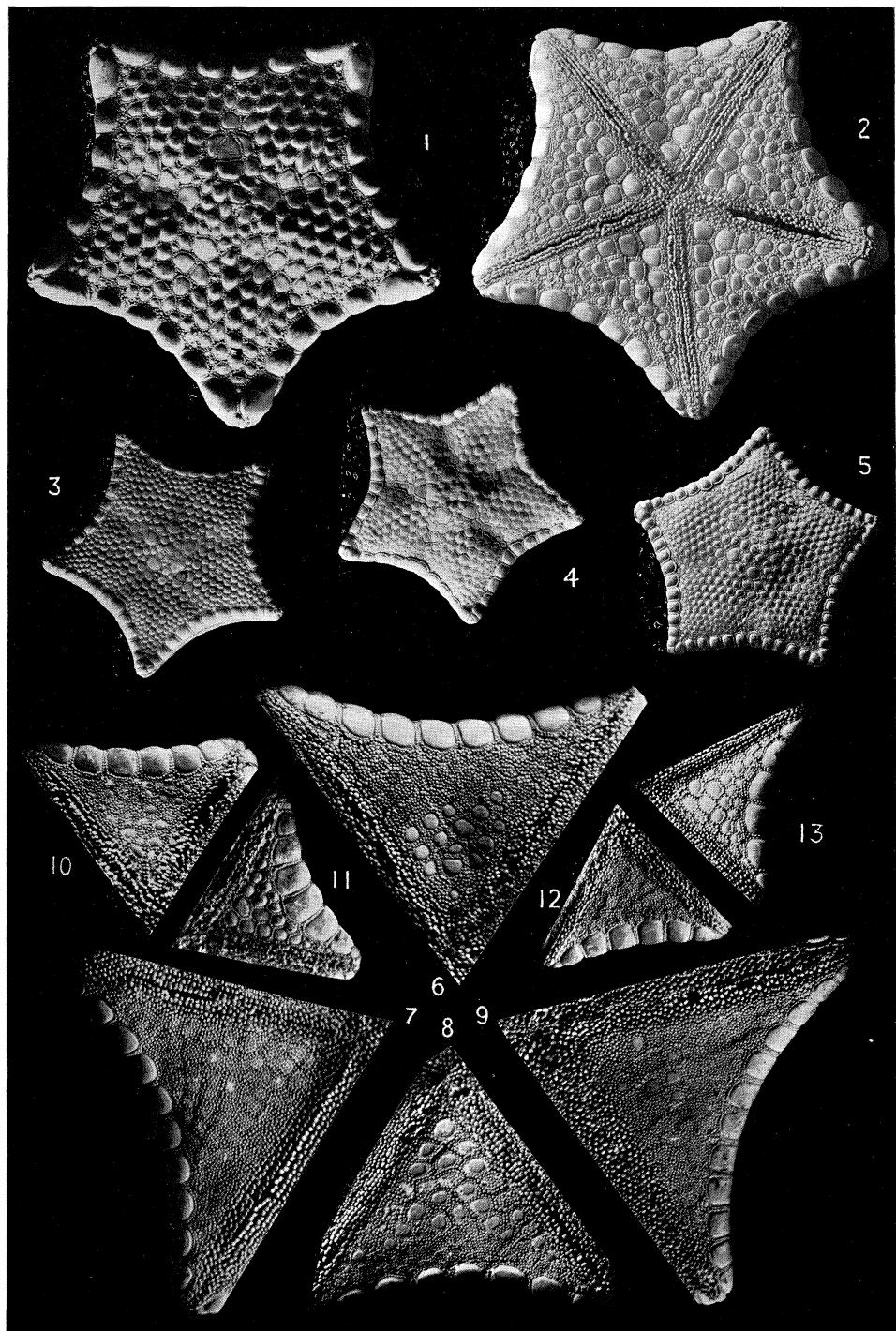
Fig. 4.—*Pentagonaster dübeni* Gray. Abactinal surface of juvenile specimen from Port Jackson, N.S.W., showing affinities with, and differences from, *T. queenslandensis* Liv. (R. = 18 mm.). (Austr. Mus. Reg. No. J:1820.) Slightly over natural size.

Fig. 5.—*Pentagonaster dübeni* Gray. Actinal surface of same specimen. Slightly over natural size.

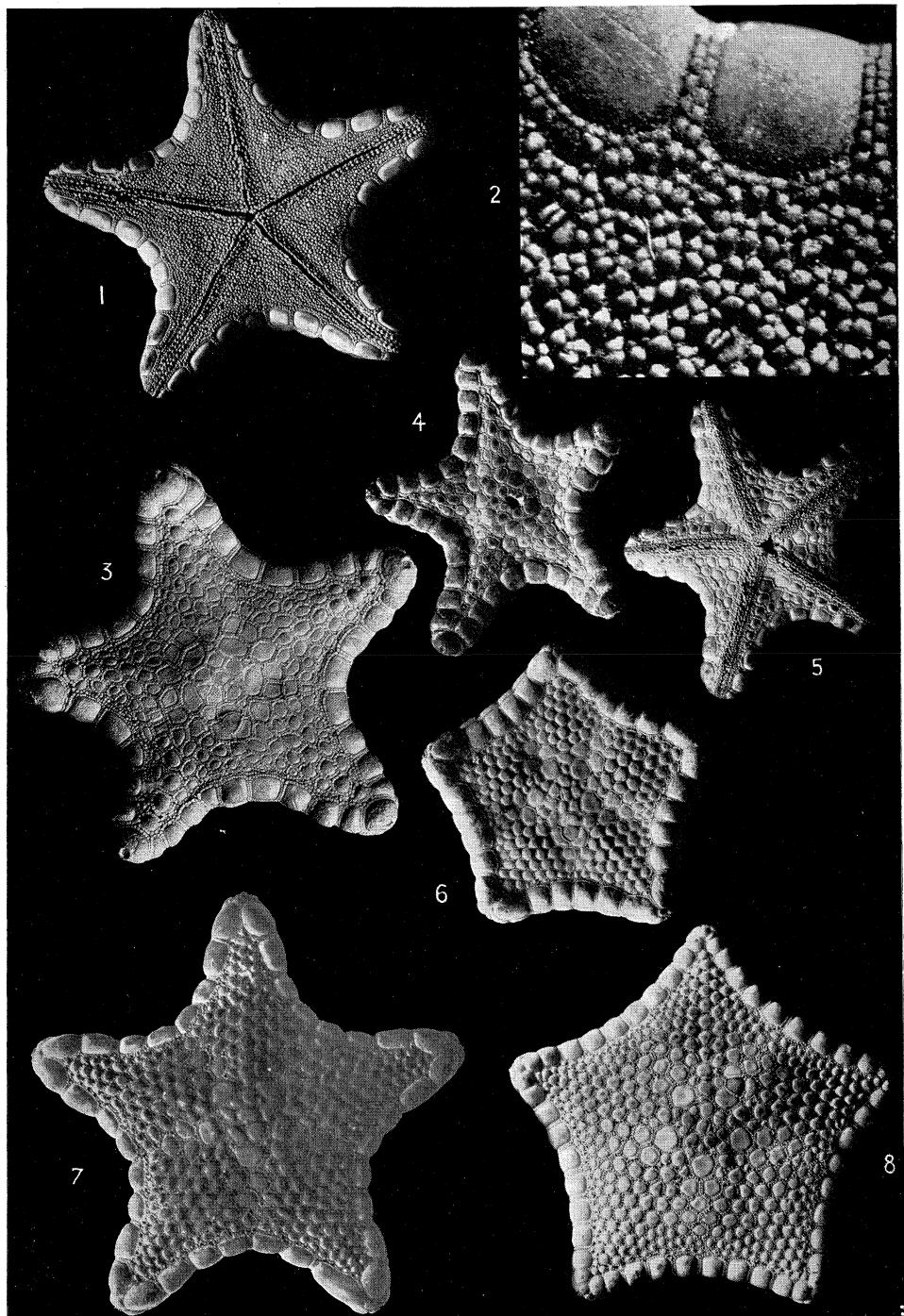
Fig. 6.—*Tosia australis* Gray. Abactinal surface of specimen from Victoria (R. = 21·5 mm.). (Austr. Mus. Reg. No. J:3871.) Natural size.

Fig. 7.—*Tosia tubercularis* Gray. Abactinal surface of same specimen as Fig. 1. Approx. $\times 1\cdot3$.

Fig. 8.—*Tosia aurata* Gray. Abactinal surface of specimen from d'Entrecasteaux Channel, Tasmania (R. = 28 mm.). (Austr. Mus. Reg. No. J:5427 part.) Natural size.



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