

The thoracic shield is rather longer than broad, and excavated posteriorly. The last pair of thoracic limbs are about two-thirds of the length of the penultimate pair, and provided with a well-developed dactylos.

The abdomen nearly equals the thorax in length; the transverse diameter of its segments is about three times the antero-posterior, the former diminishing slightly posteriorly; the abdominal segments (as also the last segment of the thorax) have each, as in *Ibacus*, a mesial dorsal carina ending on the posterior border in a small conical tooth; the pleura are very prominent, and resemble those of the adult; but they are more strongly curved backwards; those of the penultimate segment have two triangular teeth (represented in *Ibacus Peronii*) on their posterior border. The abdominal appendages have both rami slender and tapering; the endopodite has a small, tooth-like internal process. The form of the telson agrees precisely with that of the corresponding structure in *Ibacus Peronii*.

It is not unlikely that the *Phyllosoma Duperreyi* of *Güerin*, (*Voyage de Duperrey, Zool.*, t. II., p. 2, p. 46; pl. 5, fig. 2; *Mag. d'Ent.*, 1830, 4 me. livraison, pl. 12), which, like the present form was obtained in Port Jackson, may be an earlier stage in the development of the same animal—the antennæ and abdomen being less highly specialised.

ON SOME NEW AUSTRALIAN ECHINI.

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[Plates XIII.-XIV.]

The following species were collected between Port Jackson and Moreton Bay. They are new and extremely interesting, but the observations I have to make on each I will reserve for the end

of the diagnosis. These will show how very much there is yet to be discovered on the Australian Coast. At the conclusion of the paper I give a revised list of the Australian Echini known to me, both recent and fossil.

HEMIASTER (RHYNORISSUS, Agass).

Test thin, easily separating into hexagonal plates, outline somewhat angular, vertex not central, odd ambulacrum flush with the test. Three independent fascioles, viz., peripetalous, anal, and subanal. Primary tubercles with a raised, flat, scrobicular circle. Spines of abactinal surface short, silk-like, curved; actinal surface long, curved. Posterior lateral ambulacra passing gradually into the actinal surface.

HEMIASTER (RHYNORISSUS) APICATUS. n. s.

Test thin, outline from above broadly oval, greatest breadth a little below the lateral ambulacra. *Vertex anterior* a little above the lateral petals. Seen in profile the test is high, swelling roundly outwards for a little way above the anterior ambitus and then slightly receding to the high vertex, whence it slopes very gently, forming a level or almost level elevated ridge to the anal edge, where it is truncated in outward direction to the subanal fasciole, where it slopes inwardly forming an obtuse angle in the middle and terminating in a point at the ambitus. The anal system is an oval shallow depression in the rounder posterior extremity. The opening is vertical, oval, pointed at each end. From regular points at each side ridges extend to the surrounding fasciole where they terminate in small round protuberances. Immediately below this is the subanal fasciole enclosing a broad almost orbicular subanal plastron which is closely covered with secondary tubercles, rather larger, more crowded, and with a well defined scrobicular circle in the lower part. The anal fasciole is narrow, with a wavy inner edge and scarcely apparent above the opening. The subanal fasciole is

much better defined, broad above, gradually narrowing below, and joins in a beak the elongate actinal plastron. The central line of the actinal plastron forms an angular keel which is prominent for the posterior half only. The actinal surface is slightly convex and gradually rounded and raised at the ambitus. It is rather flat anteriorly, but slopes upwards from the keel on the plastron posteriorly. At that end it is gradually rounded, and without forming a distinct ambitus passes to the vertical face of the anal end. The actinosome is very large transversely, nearly equalling one-third the width of the test. It is crescentic, the posterior lip a little prominent. The bare ambulacral avenues are connected round the actinosome, forming a bare anterior space extending into an obtuse point on each side of the test and about one-sixth of the whole width from the edge. The anterior lateral phyllodes become narrow gradually from the actinosome and are scarcely apparent near the subanal fasciole. Round the mouth the pores are regular and close, situated on the edge of a large oval scrobicular area. At the faint anterior sulcus they are interrupted, and one or two pores are visible on the sulcus itself. They become scattered and disappear a little below the actinosome. Outside the phyllodes they are large, close, with a distinct raised area, not perforate, and gradually decreasing in size towards the ambitus, above which there are nothing but miliaries. The abactinal surface is convex, with an equal inclination upwards towards the peripetalous fasciole: inside this it is suddenly much more raised towards the apex, which is a conspicuous broad protruberance just about the anterior transverse petals, and anterior to the reproductive system. The whole abactinal surface is covered with miliaries of uniform size. There is no anterior sulcus, but with a lens a narrow zigzag interrupted groove may be traced along the mesial line. Below the ambitus a faint wide depression is visible. From the genital pores to the anal orifice there is a distinct depressed slightly undulating sutural line. The fasciole is rather

broad and deeply impressed. It encloses a rhomboidal area which has an obtusely angular anterior apex, a very broad rounded posterior base, and is rounded at the ends of the anterior petals. It re-enters slightly at about the same obtuse angle above and below the anterior petals. All the petals are rather broad, deeply sunken in the middle, and becoming flush with the test at the ends. The depression extends beyond the line of pores at each side. The anterior ones are the shortest. They are at right angles to the mesial line, and extend about half-way to the edge of the test. The posterior petals almost touch at the genital pores. They do not diverge very much posteriorly, and though longer are not quite so deep or so wide as the anterior pair. The pores in all are large, wide, and conspicuous. There are four rows in each petal, quite distinct and separated from each other by a distinct raised broad ridge. There are about 15 pores on each row in the posterior petals, but they become rather faint at the attenuated apical ends. There are 12 in each row in the anterior petals, which are quite distinct, but a little smaller at both the ends, which are rounded and not attenuate. The whole of the test shows uneven undulations, the sutures of the plates are faintly visible in places, and they form a double zigzag diverging line of suture anteriorly from the apex. Long. 64, lat. 58, alt. 35. Posterior petals, long. $19\frac{1}{2}$, lat. 5. Anterior petals, long. 15, lat. 6. Alt. of test at anal end, 30.

This very interesting urchin has been found only at Moreton Bay, where it is sometimes washed ashore. It has never been found alive or with the spines, and being very brittle is nearly always broken in the surf. There is only one other species of the sub-genus *Rhynobrissus*, which occurs in the Chinese seas. The differences of this species from ours are:—The apex is posterior and not elevated above the rounded outline of the surface. The peripetalous fasciole is oval. The petals are much smaller, narrower, and more divergent. The pores are conjugate. The abactinal tubercles are not uniform, and are

larger and more conspicuous, and the whole test smaller and more angular, almost pointed at the greatest diameter. There are of course many other minor differences, but the two species cannot possibly be mistaken for one another.

PHYLLACANTHUS PARVISPINA, n. s.

Test elevated, solid, flattened at each end, but not swollen at the sides. Poriferous zone, slightly undulating, rather broad; ambulacral area with a regular row of miliaries bordering each side, and two or three rows of smaller and less prominent ones in the central area. Primary tubercles, eight, but the two last near the actinosome small and crowded. Mammary boss elevated, with a large perforation, and with a rather deep groove round the neck so as to give a hemispherical surface to the boss, which is raised on a smooth conical mound. Scrobicular area, somewhat squarely oval, margined by an irregular row of secondaries, and then surrounded by a thickly packed mass of miliaries, which decrease in size to the coronal sutures which are well and distinctly marked, but not deeply, and the whole aspect of the interambulacral space is solid and elevated. Actinosome large, round, with the series of plates covered with short flat spines on secondary tubercles. Auricles remarkably broad, stout, concave, united below for some distance, but the arch not complete, leaving a broad wedge-shaped opening. Anal system large. Genital plates nearly square with the opening, small and exactly in the centre. Madreporin body twice the size of the others, with the pore a third of the width from the edge. Ocular plates quite excluded, crescentic in shape. Anal plates rather large on the outer side, but numerous and gradually decreasing towards the opening, which is also large. The whole system densely covered with miliaries, which are rather larger at the edges of the plates. Primary spines rather short, slender, tapering very slightly, obliquely bevelled at the extremity, where they are very conspicuously grooved for a short distance. The rest of the

shaft is a close series of small granulations in very regular lines, at the base there is a smooth area which thickens gradually up to a small very finely milled ring. The basal socket is broadly concave. The whole of the base is surrounded by a close thatch of short flat spines, and a finer row makes a short flat fringe along the poriferous zones. There are no other spines except the very small ones covering the miliaries which are like scales on the wings of lepidoptera. The whole surface has a smooth and velvety appearance.

The difference of this species from all others is that there are eight primary tubercles, while in *P. dubia* and *imperialis* there are only six, and the number of these, according to Agassiz, is very constant for every age and condition of growth. The spines are entirely different from any described species. The anal system is also quite different in the size of the genital plates, their shape, the shape and size of the madreporiform body, the smallness and position of the openings, the size and disposition of the anal plates, and the whole size, shape, and solidity of the test.

Found occasionally at Botany Bay, Port Jackson, and along the east coast as far as Moreton Bay. The species has been confounded with *Phyllacanthus dubia*, Brandt. So firmly do the spines adhere to the test that they are always washed up quite entire, and any attempt to remove the primary spines either breaks them, or tears away the coronal plate to which they are attached.

Height of adult specimen, 100; diam., 90; width of actinosome, 32; anal system, 28; length of largest primary spine, about 62, width at base, 5, at tip, $2\frac{1}{2}$; length of flat secondaries, about 10, width about $2\frac{1}{2}$, thickness 1 millim. The secondaries are very finely grooved and bevilled at the edge.

The following is a revised list of all the Echini known to me as occurring on the Australian coast. It will be observed that

several new habitats are added to the list given by me in 1877, in the second volume of the proceedings of this Society, p. 145:—

Phyllacanthus annulifera, Lamarck.

dubia, Brandt, Tasmania, Bass's Straits.

imperialis, Lam., Manly Beach?

parvispina, nobis, Port Jackson to Moreton Bay.

Stephanocidaris bispinosa, Lam., habitat unknown.

Goniocidaris geranioides, Lam., North East Australia, within tropics.

tubaria, Lam., Tasmania, South East Australia, Bass's Straits.

Diadema setosum, Gray, East Australia, generally within the tropics, but young specimens have been recently dredged up in Port Jackson by Mr. Ramsay. It is common in the Pacific, but its range has never been known out of the tropics previously.

Centrostephanus Rodgersii, Peters. This seems one of the few urchins with a very restricted habitat. I have never heard of it except at Botany Heads, Bondi, Manly Beach, and seldom inside the heads of Port Jackson.

Astropyga radiata, Leske, extreme North East Australia only.

Heterocentrotus mammillatus, Klein, North East Australia.

Echinometra lacunter, Leske, North East Australia, as far south as Moreton Bay, where it is not uncommon.

Stomopneustes variolaris, Lam., East Australia, Hab. unknown.

Strongylocentrotus armiger, Agas., Australia, Hab. unknown.

eurythrogrammus, Valenc., East Australia, Bass's Straits, Tasmania, and as far as South Australia. It is very common about Port Jackson.

tuberculatus, Lam., Australia, habitat unknown.

Sphærechinus Australiae, Agas., Port Jackson, Tasmania?

Temnopleurus toruematicus, Klein., all the coasts of Australia, but rare outside the tropics.

Microcyphus maculatus, Agas., East coast of Australia.

zigzag, Agas., extra tropical Australia, and Tasmania.

Salmacis bicolor, Agas., North East Australia, tropics.

sulcata, Agas., North East Australia, not uncommon in Moreton Bay.

rarispina, Agas., North East Australia, tropics.

globator, Agas. I find that this is rather common in Port Jackson. Spines few, scattered, short, stoutish, dull green; violet on the base. The test when fresh is conspicuously marked with pink on the raised edges of the I. and A. spaces, the median sulcus is dull green, and the deep furrows at the coronal sutures (almost like *Temnopleurus*) are white.

Mespilia globulus, Agas. I have reason now to doubt the Australian habitat of this species.

Amblypneustes ovum, Lam., South Australia and Tasmania, rare on East coast.

griseus, Blainville, not known on East coast.

formosus, Valenc., ditto ditto

pallidus, Lam., ditto ditto

Holopneustes porosissimus, Lutken, South Australia and Tasmania.

inflatus, Lutken, Hab. unknown.

purpurascens, Lutk. Probably only a variety of first named species.

Echinus magellanicus, Phillipi. I do not think this occurs in Australia.

angulosus, Agas., South Australia.

darnleyensis, nobis, North East Australia.

Hipponoe variegata, Leske, East Australia, common.

Evechinus chloroticus, Verril, Port Jackson, rare and young specimens only, to which my *E. Australiae* must be referred.

Fibularia australis, Desmoulins, Tropical Australia?

volva, Agas., North East Australia, Tropics.

Echinanthus testudinarius, Gray, Port Jackson and East Coast.

tumidus, nobis, Port Jackson?

Laganum Bonami, Klein., South East Australia and Tasmania.

depressum, Lesson, East Australia?

Peronella decagonalis, Lesson, East Australia.

orbicularis, Leske, East Australia.

Peronii, Agas.

Echinarachnius parma, Lam., Australia generally.

Arachnoides placenta, Linné, North East Australia.

Maretia planulata, Leske, East Australia.

Eupatagus Valenciennesii, Agas., North East Australia only.

Lovenia elongata, Gray, East Australia. The Port Jackson specimens small.

Breynia australasie, Leach, East Australia generally.

Echinocardium australe, Gray, South East Australia, Tasmania, West Australia?

Hemiaster (Rhynocrissus) apicatus, nobis, Moreton Bay.

Brissus carinatus, Lam., common in all extratropical Australia. It is to this species and not to *Linthia australis* the following remarks in my previous list (loc. cit.) refer. "On one occasion, thousands of them were thrown upon the beach at Portland Bay, Western Victoria after a slight storm. I have often seen it on the New South Wales coast and it has been dredged in Bass's Straits at 30 fathoms. There is a specimen in the Sydney Museum which measures 150 mil. in length.

Linthia australis, Gray, North East Australia, Tropics. The genus is distinguished by a *lateral* fasciole as well as a perepetalous one, while in *Brissus* it is perepetalous and subanal only.

Metalia sternalis, Lamouroux, East Australia?

maculosa, Agas., Australia?

EXPLANATION OF PLATE XIII.

- Fig. 1.—HEMIASTER (RHYNOBRISSUS) APICATUS, abactinal system.
 „ 2.— „ „ „ half of actinal system.
 „ 3.— „ „ „ lateral view.
 „ 4.— „ „ „ anterior end.
 „ 5.— „ „ „ posterior end.

Plate XIV.

- PHYLLACANTHUS PARVISPINA, A. test with spines.
 „ „ B. denuded of spines showing anal system.

ON DORIS ARBUTUS, Angas.

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[Plate XVII.]

Branchiæ nine, tripinnate, totally retractile, (Angas, from examination of only one small specimen $\cdot 551$ in. by $\cdot 177$ in., thought they were subretractile) united only at base, when extended, the whole assume a melon shape; at first sight they appeared to be united at the summit, but in the tank under a two-inch object glass x 20 diam., were seen to be totally separate.

In addition to the only specimen yet found, that by Angas, I have obtained three, and in the same locality, Coogee Bay, the largest of which measured $\cdot 795$ by $\cdot 374$ in. The number of branchiæ is not given by Angas. The stem of the tentacle is perfectly transparent, whilst the summit of the tentacle is deeply divided into about 11 laminæ, coloured white, interspersed with dark brownish spots. A ring of about 24 yellowish, white tipped papillæ surrounds each tentacle. The rim of the retractile cavity of the branchiæ rises, then these are expanded and on its edge are set numerous tubercles arranged in pairs. Of some other of our *Nudibranchiates*, *Angasiella Edwardsi*, is interesting, being



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