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Two New Echinoids from Northern New Zealand, including a
New Species of *Diadema*

By ALAN N. BAKER,

Department of Zoology, Victoria University of Wellington.

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Abstract

A NEW species of the genus *Diadema* is described from seven specimens collected from 80-150ft near the Poor Knights Islands, New Zealand. A small heart-urchin *Brissus* (*Allobrissus*) *agassizii* Döderlein, is described from New Zealand material of two specimens taken at the Poor Knights Islands; *Brissus* (*Allobrissus*) *meridionalis*, from eastern Australia and Norfolk Island, is synonymised with this species. *Diadema* and *Allobrissus* are widely distributed throughout the Pacific Ocean, but have not previously been recorded from New Zealand.

INTRODUCTION

DURING 1965 members of the Whangarei Underwater Club began investigating the sublittoral fauna of the Poor Knights Islands, lying 12 miles offshore immediately to the north of Whangarei, New Zealand. Divers collected marine animals down to 250ft. New and rare molluscs, echinoderms, and fishes have subsequently been discovered amongst these collections.

At the invitation of Messrs K. Tarlton and W. Palmer of Whangarei, I examined some echinoids collected by them during the summer of 1965 from deep water alongside Tawhitirahi Island, the northern-most of the Poor Knights group. I found several excellent specimens of the giant heart-urchin *Brissus gigas* Fell, which had not previously been recorded outside the Bay of Islands (Baker, 1965), and one small heart-urchin of the subgenus *Brissus* (*Allobrissus*) Mortensen. The latter is a new record for New Zealand, having previously been described only from Japan, Norfolk Island, and eastern Australia. I have since obtained a further specimen of *Allobrissus*, taken alive from the same locality by Mr W. Doak of Wellsford.

In October 1965, Mr Palmer discovered several long-spined, brightly coloured regular echinoids in 80ft of water at the Poor Knights Islands. These sea urchins proved to be a new species of *Diadema*—a warm-water genus of wide Indo-Pacific distribution not hitherto recorded from New Zealand.

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I thank Messrs Tarlton, Palmer, and Doak for their enthusiastic collecting and for the opportunity to report on their finds. I also thank Mr M. D. King of this University, for his care in photographing the specimens described here. I am grateful to Miss Elizabeth C. Pope, Australian Museum, Sydney, for access to comparative material of *Allobrissus*, and to Dr D. L. Pawson, Smithsonian Institution, Washington, U.S.A., for commenting on the manuscript.

MATERIAL EXAMINED

Super-order DIADEMATAcea Duncan, 1889

Order DIADEMATOIDA Duncan, 1889

Family DIADEMATIDAE Gray, 1855

DIADEMA Gray, 1825

Diadema palmeri sp.n.* (Pls. 1-2, Fig. 1)

DESCRIPTION: Test circular at ambitus, apical system depressed, ambis raised aborally, interambis correspondingly sunken. Oral side slightly sunken towards peristome. Height approximately half horizontal diameter.

Amb plates trigeminate, middle component largest. Pores arranged in arcs of three, aboral pores largest, pore zone slightly widened towards peristome. Ambis 22% of interambis at ambitus. Primary tubercles perforate, crenulate and contiguous throughout, usually one to each compound plate, occasionally one tubercle to two compound plates adorally. Secondary tubercles small, similar to primaries, in single zig-zag series along amb midline.

Interambis with regular series of primary tubercles extending nearly to apical system, outer series continuous to second complete plate from above, second series to 5th-6th plate from above, leaving a naked median area adapically. Double admedian series extending from just above ambitus almost to peristome. Outer two series separated aborally by a branch of the naked median area which continues down between them. Adorally, areoles confluent. Between each series of primary interamb tubercles, and at adradial edge of each column, are numerous small secondary tubercles. Primary and secondary tubercles perforate and crenulate.

Apical system approximately 29% h.d., monocyclic, oculars all insert. Periproctal edge of genital plates distinctly raised, with 1-5 tubercles. Oculars with 1-2 tubercles. Periproctal membrane naked apart from scattered scales. Anal tube large.

Peristome approximately 35% h.d., with small plates embedded in buccal membrane, particularly in radii. Five pairs of buccal tube feet present, triphyllous pedicellariae occur on buccal plates, which are otherwise naked. Gill slits moderately deep, well-developed tag under each gill. Distinct notch in amb midline at peristome edge; apophysis present.

Primary radioles long (to 160mm), slender, densely clothed with overlapping rings of small, sharp barbs pointing away from test. Milled ring strongly developed. Radioles hollow, with solid radiating wedges connected by 1-3 trabeculae. Secondary radioles similar.

Large, slender tridentate pedicellariae with valves meeting only at tip occur in ambis, usually on 2nd-3rd plate from periproct. Tridentate pedicellariae with short, broad, spoon-shaped valves present, plus typical triphyllous and claviform types.

Skin covering test crimson. Periproct and peristome greyish-pink, anal cone with black tip. Primary radioles banded red and white, secondary radioles uniformly red, occasionally white adorally. Median naked area in interambis cream with 2-3 red spots.

In life, a series of brilliant blue or lilac lines and spots occur on test, corresponding to position of iridophores. Lines present on plates around periproct, where they may form a continuous ring; each genital plate with a blue band 2-6 iridophores wide running between genital pore and radioles bordering periproct. Separate blue lines extend from each side of naked median interamb area down between two outer series of primary tubercles. They are occasionally broken by secondary tubercles and may give impression of being discontinuous. They do not join circum-apical ring and stop short of peristome edge. A small blue spot occurs on each interamb plate at adradial edges of each column.

* The inadvertent publication of the name *Diadema palmeri* in DIVE South Pacific Underwater Magazine 6(2), September, 1966, is regarded as a *nomen nudum*.

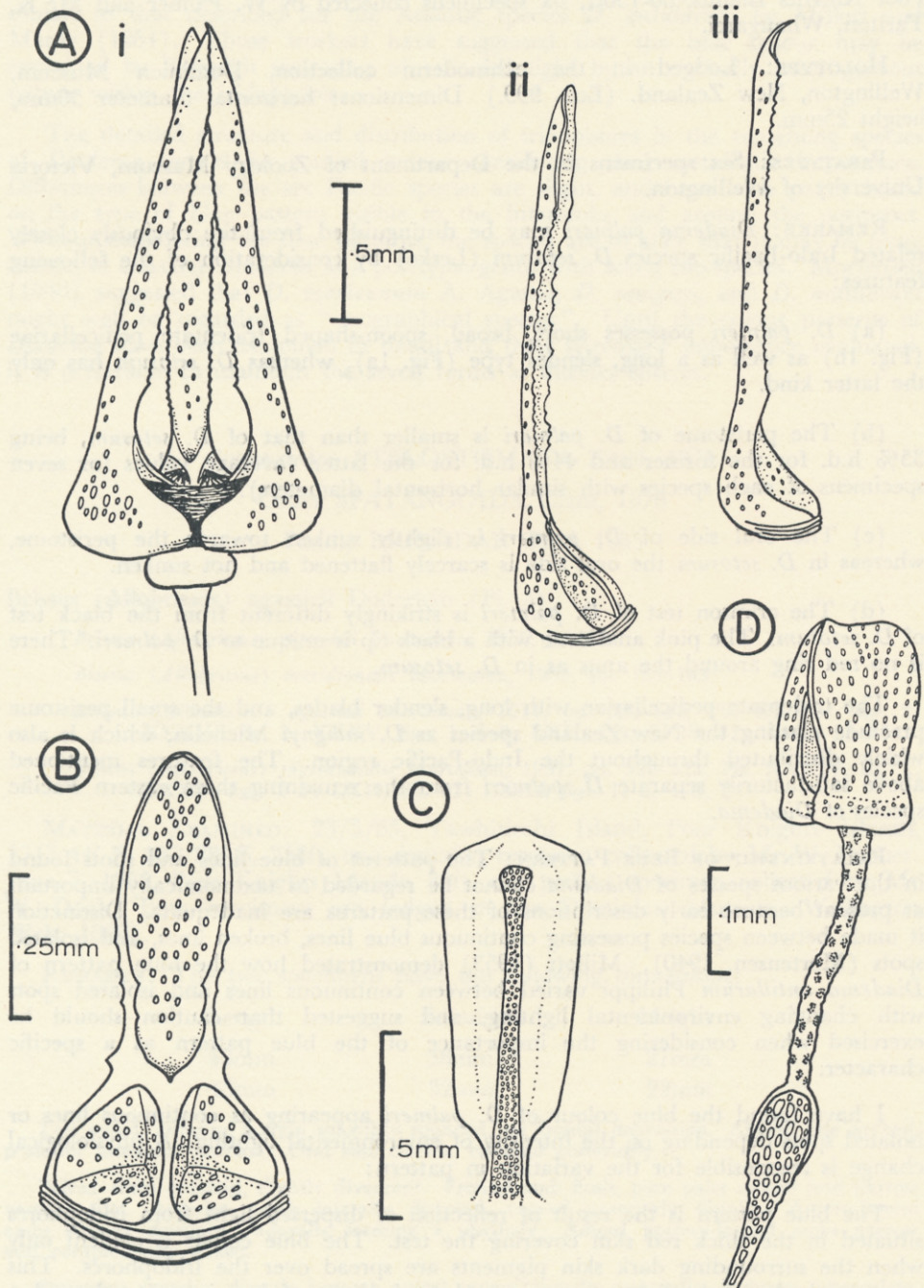


FIG. 1.—*Diadema palmeri* Baker. A: Tridentate pedicellaria, showing variation in shape of narrow valves (i, ii, iii); B: Spoon-shaped valve of tridentate pedicellaria; C: Claviform pedicellaria; D: Triphyllous pedicellaria.

MATERIAL EXAMINED: 16/10/65, Poor Knights Islands 174° 44' E, 35° 28' S, 80ft, one specimen collected by Mr W. Palmer, Whangarei. January 20, 1966, Poor Knights Islands, 80-150ft, six specimens collected by W. Palmer and Mr K. Tarlton, Whangarei.

HOLOTYPE: Lodged in the echinoderm collection, Dominion Museum, Wellington, New Zealand. (Ech. 999.) Dimensions: horizontal diameter 50mm, height 25mm.

PARATYPES: Six specimens in the Department of Zoology Museum, Victoria University of Wellington.

REMARKS: *Diadema palmeri* may be distinguished from the obviously closely related Indo-Pacific species *D. setosum* (Leske) by consideration of the following features:

(a) *D. palmeri* possesses short, broad, spoon-shaped tridentate pedicellariae (Fig. 1b) as well as a long, slender type (Fig. 1a), whereas *D. setosum* has only the latter kind.

(b) The peristome of *D. palmeri* is smaller than that of *D. setosum*, being 35% h.d. for the former and 44% h.d. for the latter (average values for seven specimens of each species with similar horizontal diameters).

(c) The oral side of *D. palmeri* is slightly sunken towards the peristome, whereas in *D. setosum* the oral side is scarcely flattened and not sunken.

(d) The crimson test of *D. palmeri* is strikingly different from the black test of *D. setosum*. The pink anal cone with a black tip is unique to *D. palmeri*. There is no red ring around the anus as in *D. setosum*.

The tridentate pedicellariae with long, slender blades, and the small peristome preclude classing the New Zealand species as *D. savignyi* Michelin, which is also widely distributed throughout the Indo-Pacific region. The features mentioned above satisfactorily separate *D. palmeri* from the remaining three eastern Pacific species of *Diadema*.

RELATIONSHIP OF BLUE PATTERN: The patterns of blue lines and spots found in the various species of *Diadema* cannot be regarded as taxonomically important at present because early descriptions of these patterns are inadequate. Distinction is made between species possessing continuous blue lines, broken lines, and isolated spots (Mortensen, 1940). Millott (1953) demonstrated how the blue pattern of *Diadema antillarum* Philippi varied between continuous lines and isolated spots with changing environmental lighting, and suggested that caution should be exercised when considering the importance of the blue pattern as a specific character.

I have found the blue colour of *D. palmeri* appearing as continuous lines or isolated spots depending on the intensity of environmental lighting. A physiological change is responsible for the variation in pattern:

The blue pattern is the result of reflection of dispersed light from iridophores situated in the thick red skin covering the test. The blue colour is evident only when the surrounding dark skin pigments are spread over the iridophores. This occurs only in bright light; a specimen kept in light of low intensity showed a concentration, rather than a dispersion, of pigment and the blue colour was replaced by the white of the plates underlying the skin. As the dark pigment continues to spread in bright light, the blue lines break up into isolated spots.

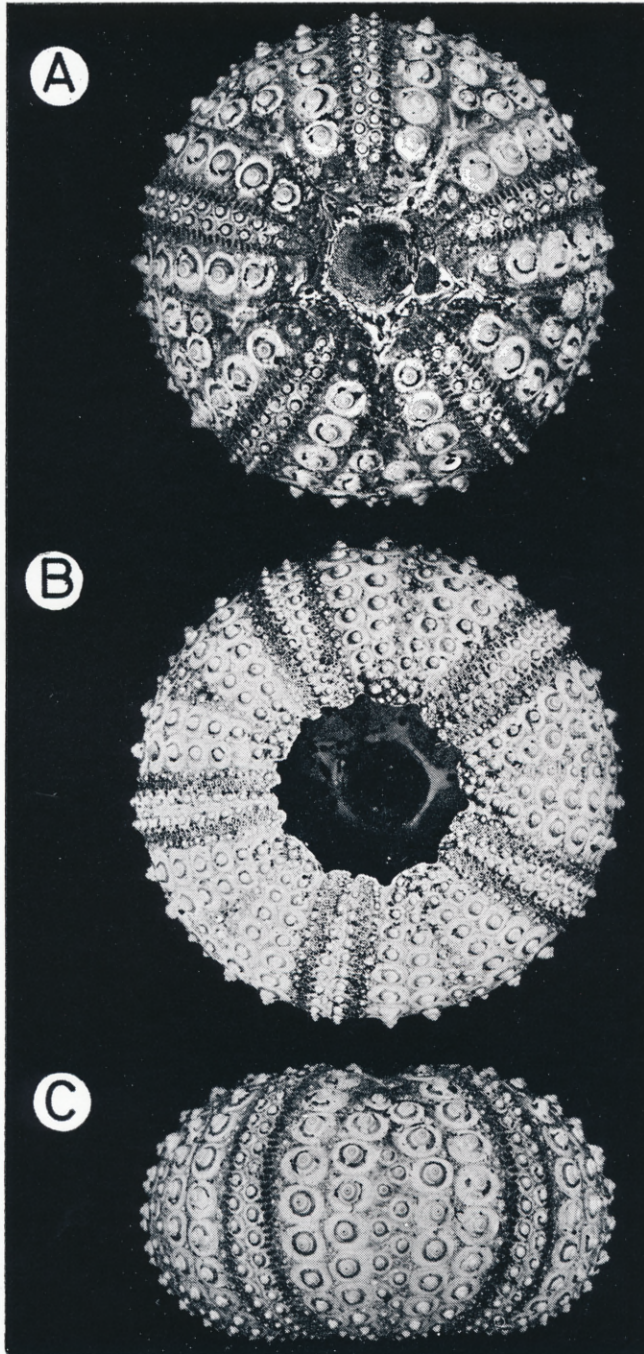


PLATE 1.—*Diadema palmeri* Baker. A: Aboral view of test; B: Oral view; C: Side view.—
Photo: M. D. King.



PLATE 2.—*Diadema palmeri* Baker. Holotype, side view.—Photo: M. D. King.

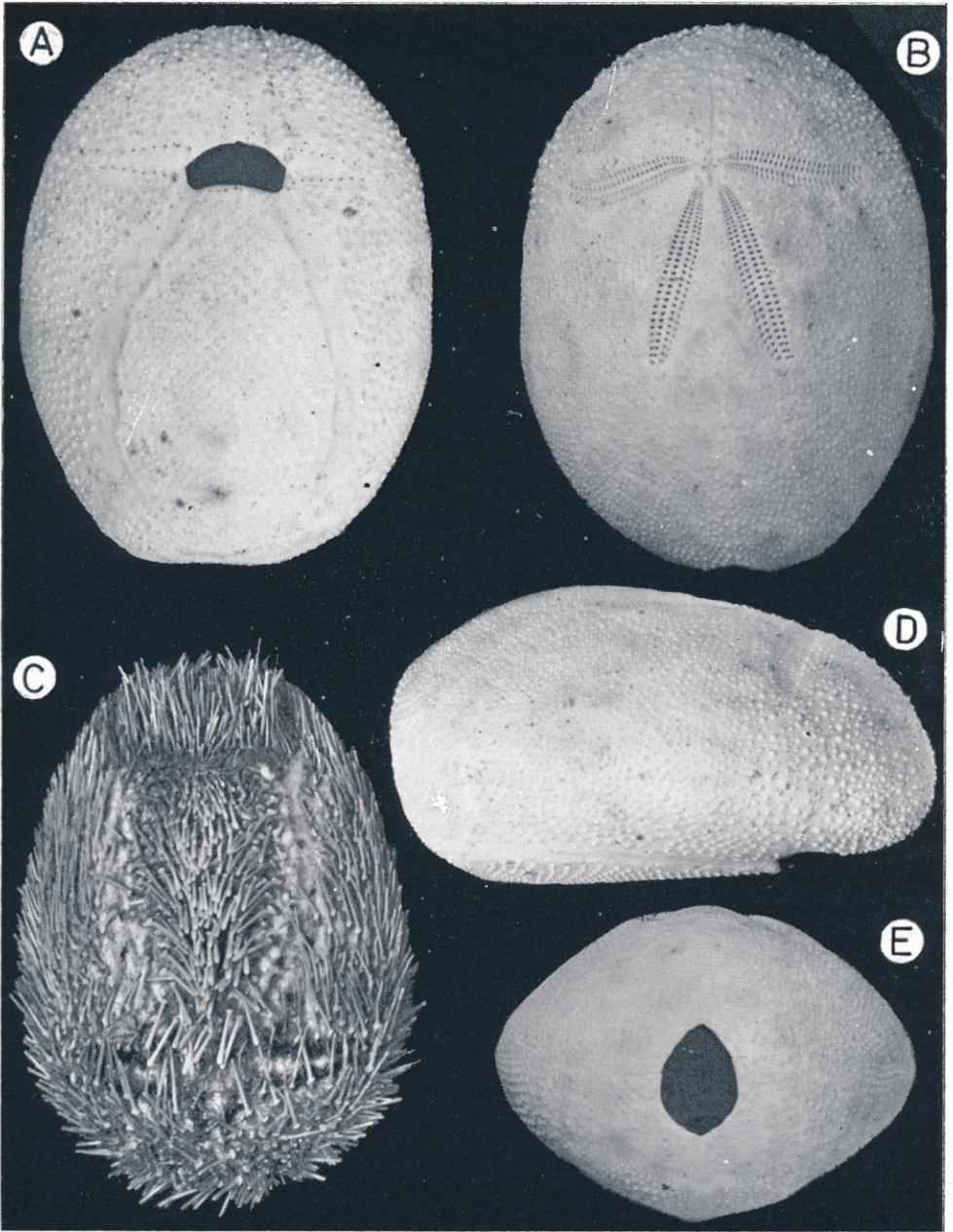


PLATE 3.—*Brissus (Allobrissus) agassizii* Döderlein. A: Abactinal view of denuded test; B: Actinal view of test; C: Abactinal view of specimen with radioles; D: Side view of denuded test; E: Posterior end of test.—Photo: M. D. King.

The distribution of iridophores in *D. palmeri* corresponds with the blue pattern first visible in bright light. The microstructure of these organs in *D. palmeri* is similar to that described for the Atlantic species *D. antillarum* by Millott and Manly (1961). Those workers have suggested that the blue colour may be explained by Rayleigh scattering of reflected light by an optically heterogeneous system within the iridophores.

The detailed structure and distribution of iridophores in the remaining species of *Diadema* should be studied before considering their systematic importance. Differences between the six Pacific species are slight, and have been partly based on the type of blue pattern visible in the interamb and around the periproct. Without considering the blue patterns, the species are so alike that it may be more correct to consider *Diadema* as a polytypic genus with seven sub-species. Mortensen (1940) suggested that *D. mexicanum* A. Agassiz, *D. savignyi*, and *D. antillarum* might well be regarded as "geographical species". Until the colour patterns of *Diadema* have been examined in detail and their systematic importance evaluated, it is preferable to maintain the seven forms as distinct species.

Super-order ATELOSTOMATA Zittel, 1879

Order SPATANGOIDA Claus, 1876

Family BRISSIDAE Gray, 1855

Brissus (Allobrissus) agassizii Döderlein (Pl. 3)

Brissus (Allobrissus) agassizii Mortensen, 1950, p. 162.

Brissus (Allobrissus) meridionalis Mortensen, 1950, pp. 162–163.

Brissus (Allobrissus) agassizii Mortensen, 1951, pp. 520–522, Pls. XXXIII, fig. 2; XXXIV, fig. 2; XXXV, figs. 1, 6–8; LXII, figs. 9, 10, 12, 16–21, 23–28.

Brissus (Allobrissus) meridionalis Mortensen, 1951, pp. 522–523, Pls. XXXIV, fig. 1; XXXV, figs. 2–5; LXII, fig. 22; LXIII, figs. 1, 2, 4–6, 24.

MATERIAL EXAMINED: 23/5/65, Tawhitirahi Island, Poor Knights Islands, 174° 44' E, 35° 28' S, 250ft, one denuded specimen collected by Mr W. Palmer. June 7, 1965, Poor Knights Islands, 80ft, one perfect specimen collected by Mr W. Doak. Both specimens are lodged in the Dominion Museum, Wellington (Ech. 1000).

REMARKS: The two specimens have the following dimensions:

Length	Breadth	Height
48mm	38mm	27mm
43mm	32mm	22mm

Test ovoid, anterior margin smoothly rounded, no frontal depression. Aboral side arched, posterior interamb carinate. Oral side convex, carinate posteriorly.

Paired amb s petaloid, slightly divergent. Frontal amb flush, pore pairs united into narrow vertical slits. Anterior petals laterally directed, curved anteriorly distally. Antero-lateral amb strongly developed adorally forming a phyllode. Adoral postero-lateral amb narrow and conspicuously naked.

Peristome anterior, directly beneath apical system, broadly crescentic. Labrum tuberculate, deflected slightly downwards. Madreporite lenticular.

Posterior end of test vertically truncate, slightly concave. Periproct oval, pointed above and below, aboral margin visible from above. Subanal plastron wide and reniform. Sternal plastron large, convex and carinate posteriorly.

Radioles short and dense; spade-shaped on sternal plastron. Globiferous pedicellariae with curved valves terminating in a slit bordered by six long teeth. Tridentate pedicellariae of two kinds: one with long narrow valves strongly dentate in the lower part and expanded into a spoon-shaped blade distally; the other with small, pointed valves. Typical rostrate, ophicephalus, and triphyllous pedicellariae present.

Test with radioles light brown; denuded test uniform cream.

The sub-genus *Allobrissus* Mortensen is distinguished from the typical *Brissus* by the character of its globiferous pedicellariae, the valves of which terminate in a narrow slit bordered by long, curved teeth. Mortensen (1951) places two species in the sub-genus: *B. agassizii* Döderlein and *B. meridionalis* Mortensen, the former from Japan, and the latter from Norfolk Island and eastern Australia. Mortensen regards the southern form as a separate species on the basis of small differences in the shape of globiferous, tridentate, and rostrate pedicellariae. The New Zealand form possesses a variety of pedicellariae whose shapes may be regarded as a combination of those described for *B. agassizii* and *B. meridionalis*. The occurrence of the different types of pedicellariae in the *Brissus* species is extremely variable, and thus their taxonomic importance must be regarded with caution. For example, the globiferous pedicellariae were entirely lacking in a specimen of *Allobrissus* from Norfolk Island. The variation in pedicellariae on this and another specimen from New South Wales, has led me to consider *B. meridionalis* identical with *B. agassizii*, or at the most a variety of the latter species. The pedicellariae on the New Zealand specimen strengthen this view, and I therefore prefer to classify it as *B. agassizii*.

The discovery of *Allobrissus* in New Zealand and also at Easter Island (Dr D. L. Pawson, pers. comm.) indicates that the sub-genus is much more widespread in the Pacific Ocean than formerly supposed.

DISCUSSION

The occurrence of *Diadema* and *Allobrissus* in New Zealand waters is not surprising since in recent years more and more evidence has accumulated to substantiate the view that the echinoderm fauna of our northern waters has strong tropical Indo-Pacific affinities (Fell, 1953; Pawson, 1961, 1965). The newly recorded heart-urchin may be added to the group of "immigrant" species of echinoderms (Pawson, 1965), known from the Australian-Indo-Pacific region and warmer northern waters. The New Zealand *Diadema* must be regarded as an endemic species at present, although it may eventually prove to be a sub-species of *D. setosum* with a restricted distribution off the northern coasts.

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ALAN N. BAKER, B.Sc. (Hons.),
Marine Laboratory,
Department of Zoology,
Victoria University of Wellington,
P.O. Box 196, Wellington, New Zealand.