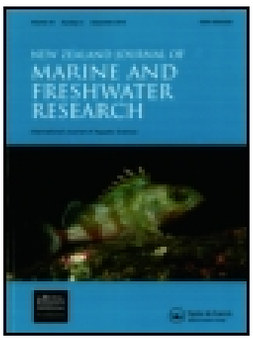

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DISTRIBUTION OF *DIVARICELLA HUTTONIANA* (MOLLUSCA: BIVALVIA: LUCINIDAE) IN THE NEW ZEALAND REGION

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ABSTRACT

The distribution of samples containing the lucinid *Divaricella (Divalucina) huttoniana* (Vanatta) from the continental shelf of the North, South, Stewart and Chatham Islands (New Zealand) in the New Zealand Oceanographic Institute collection is discussed in relation to published records and museum collections. The paucity of living specimens and large shells in shelf samples contrasts with beach collections, and is partly related to sampling problems close inshore off sandy beaches. Southern distributional limits are probably related to winter temperatures on the sea floor.

INTRODUCTION

Members of the Lucinidae live, often in large numbers, in substrates ranging from coarse sand to fine mud, from the intertidal zone down to over 2500 m in all tropical and sub-tropical seas. Usually the habitats they occupy do not support a very rich fauna, although apparently similar to nearby habitats supporting a rich fauna (Allen 1958). In the New Zealand region the family is represented by four genera and species, of which the commonest and most widespread is *Divaricella (Divalucina) huttoniana* (Vanatta) It is a distinctive, rounded, white shell with lines of sculpture running at an angle of about 45° to the lines of growth and converging at an acute angle in a line running from the umbo to the free margin of the shell (Fig. 1).

The New Zealand Oceanographic Institute (NZOI) benthic sampling programme on the continental shelf and slope has greatly increased the number of records of many invertebrate species. During these surveys, a regularly spaced pattern of stations along lines across the shelf and slope, as well as more numerous stations in areas of particular interest, have been sampled by trawls, dredges and grabs. (Details of NZOI stations at which *Divaricella huttoniana* was taken and sampling methods are listed in Appendix 1.) As there is a large amount of material available it was felt that a comparison should be made of the distribution of some bivalves, as known from museum specimens and published records, with that shown by the NZOI specimens. Molluscan names are those of Powell (1962) and Allen (1958).

SYSTEMATICS AND MORPHOLOGY

Divaricella huttoniana was described by Vanatta (1901) as *Lucina (Divaricella) huttoniana* from material from Auckland, New Zealand. The New Zealand shell has been referred to *Lucina divaricata* Lamarck by Gray (1843) and by Hutton (1873, 1880), and to *L. dentata* Wood by Hutton (1885). It was subsequently referred to *Divaricella cumingi* Adams & Angus by Hutton (1904), Suter (1913) and Fleming (1950), in error to *D. huttoni* by Hurley (1964), and to *D. (Divalucina) huttoniana* by Powell (1967).

Vanatta noted that it differed from *Lucina dentata* in lacking a dentate margin, from *L. quadrisulcata* in lacking a crenulate margin, and from *L. cumingi* by having a long narrow lunule, more delicate texture and lower beaks, and in being less globose.

The shell is almost circular with a smooth margin. The surface sculpture is divaricate and extends to the edge of the comparatively broad anterior area below the lunule. Although dead valves are almost always white, those of living animals may be partly covered by a yellowish epidermis and are often heavily discoloured black or brown around the edges of the shell, particularly anteriorly and posteriorly where the inhalent and exhalent apertures are situated. The right valve has a large, heavy, central cardinal tooth, a small anterior cardinal tooth directed forward, and a tubercular anterior lateral tooth. The left valve has a large posterior cardinal tooth, an anterior lateral tooth and no posterior lateral tooth. The anterior adductor scar is very long and narrow, while the posterior scar is oval (*see* Fig. 1).

The only other New Zealand shells with divaricate sculpture are the small bivalves belonging to the Leptonidae, and these are either oval, inflated, off-white shells (*Myllitella*) or elongate-oval shells (*Zemyllita*). Both have a smaller number of divaricate lines of sculpture in relation to their height, and reach a smaller maximum diameter than *Divaricella huttoniana*.

OCCURENCE

Although *Divaricella huttoniana* is known to occur around New Zealand and the Chatham Islands, it has been generally regarded as "uncommon" (Powell 1962: pl. 11), and it is only occasionally collected alive.

Previously published records of *Divaricella huttoniana* (Appendix 2) were concentrated on the east coast of the North Island from the Bay of Islands to the Bay of Plenty (Dell 1955, Mabey 1963, Hedley 1906, Suter 1908), the north of the South Island from Golden Bay to Nelson (Dell 1955, Elliott 1967, Parker 1966), Fiordland (Suter 1913, Fleming 1950, Hurley 1964); Chatham Rise and the Chatham Islands area (Finlay 1928, Dell 1956); a few from the Otago area (Graham 1962); Sumner (Suter 1913); and one from the beach between the Manukau Heads and Waikato Heads (Douglas 1964). Powell (1962) recorded it

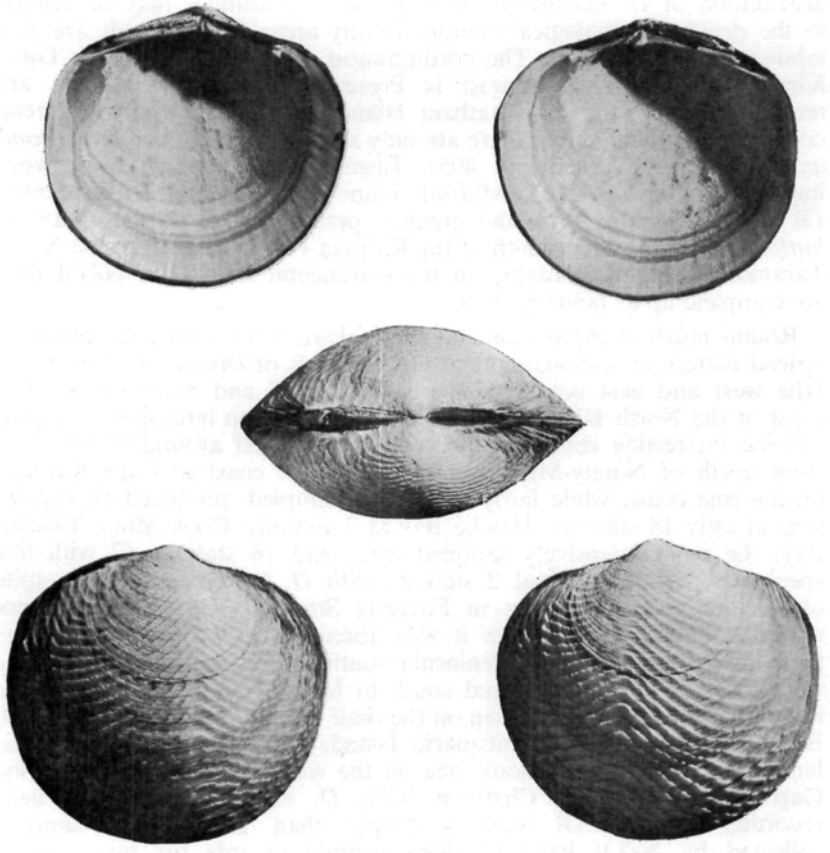


FIG. 1—*Divaricella* (*Divalucina*) *huttoniana* (Vanatta): interior and exterior of valves, showing sculpture, hinge teeth, muscle scars, pallial line and ligament. (Specimen from NZOI Sta. B 614, Dusky Sound).

as occurring "uncommonly in the Auporian, Cookian, Moriorian and Forsterian provinces on sandy beaches". Examination of Dominion Museum collections (Appendix 3) moves the southernmost records to Ringaringa Point and Paterson Inlet, Stewart Island, and the northernmost to Spirits Bay, but otherwise only fills in the distributional range (*see* Fig. 2).

DISTRIBUTION OF *Divaricella huttoniana* FROM NZOI SAMPLES

The distribution of all the NZOI continental shelf and slope stations where biological samples have been taken between 30°–48° S is shown in Fig. 3 in blue. Stations where live or dead *Divaricella huttoniana* were included have been over-plotted in Fig. 3 in red so that the

distribution of *D. huttoniana* as valves or live animals may be related to the density of biological stations in any area; these records are also tabulated in Appendix 1. The northernmost record is north of the Three Kings area, the southernmost is Preservation Inlet, and there are records from around the Chatham Islands. In spite of the widespread occurrence of dead valves there are only six stations with live *D. huttoniana*: in the Bay of Plenty (C 805), Tasman Bay (D 268, C 186), Wellington Harbour (D 311), Milford Sound (A 327) and Dusky Sound (B 614). The area with the greatest percentage of stations with *D. huttoniana* is from the mouth of the Kaipara Harbour south to the North Taranaki Bight off Waitara, on the continental shelf. The NZOI data are complete up to January 1970.

Round much of the continental shelf where there is only the regularly spaced pattern of stations there are few records of *Divaricella huttoniana* (the west and east coasts of the South Island and much of the east coast of the North Island), but areas that have been intensively sampled provide interesting contrasts. The continental shelf around North Cape from north of Ninety-Mile Beach on the west coast to Cape Karikari on the east coast, while fairly intensively sampled, produced *D. huttoniana* at only 18 stations; Hawke Bay at 3 stations; Cook Strait–Tasman Bay, the most intensively sampled area, had 16 stations (2 with live specimens); Kaikoura had 2 stations with *D. huttoniana*, but in spite of a close grid of stations in Foveaux Strait *D. huttoniana* was not recorded. Other areas where it was absent (NZOI records) include: from just south of Banks Peninsula south to Puysegur Point, and the west coast of the South Island south to Milford Sound. *D. huttoniana* is absent from collections taken on the shelf around Auckland, Campbell, Bounty, Antipodes and Macquarie Islands to the south of New Zealand. Except for two stations, one on the western slope of the Mernoo Gap and one on the Chatham Rise, *D. huttoniana* has not been recorded from NZOI stations deeper than 250 m. The samples collected by NZOI have provided definite records for many areas, although low sampling density in other areas has not yet produced positive samples where previous workers had found *D. huttoniana*, e.g., off Otago and in the Hauraki Gulf. Graham (1962) recorded *D. huttoniana* as rare dead shell from 55–120 m off Otago but the only NZOI records from the area prior to 1970 were from two stations (B 554, B 556) just south of Banks Peninsula. The NZOI Otago Benthos cruise in January 1970 failed to collect any specimens, but inshore collections off Warrington Beach in 15 m in March 1970 (NZOI) contained numerous small (2–5 mm diameter) dead valves. These small valves were thin and fragile and appeared to represent a year class that had settled and failed to survive. In at least some years, larvae must occur in the inshore waters off Otago and South Canterbury, but breeding adult populations are apparently absent.

Cool shelf water in the Otago area is warmed by the influx of the warm, highly saline Southland Current (a branch of the Tasman Current) which passes through Foveaux Strait and to the south of Stewart Island, then up the east coast of the South Island (Jillett 1969).

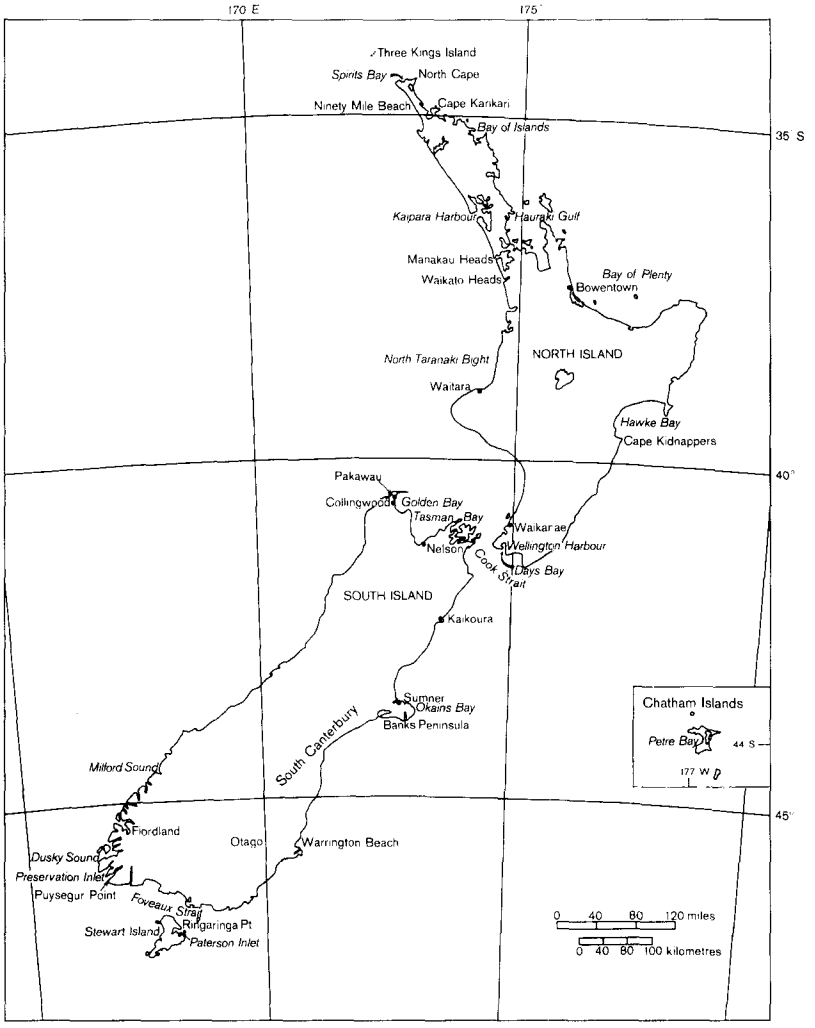


FIG. 2—Localities mentioned in the text and at which *Divaricella huttoniana* was recorded (localities in Appendices not included).

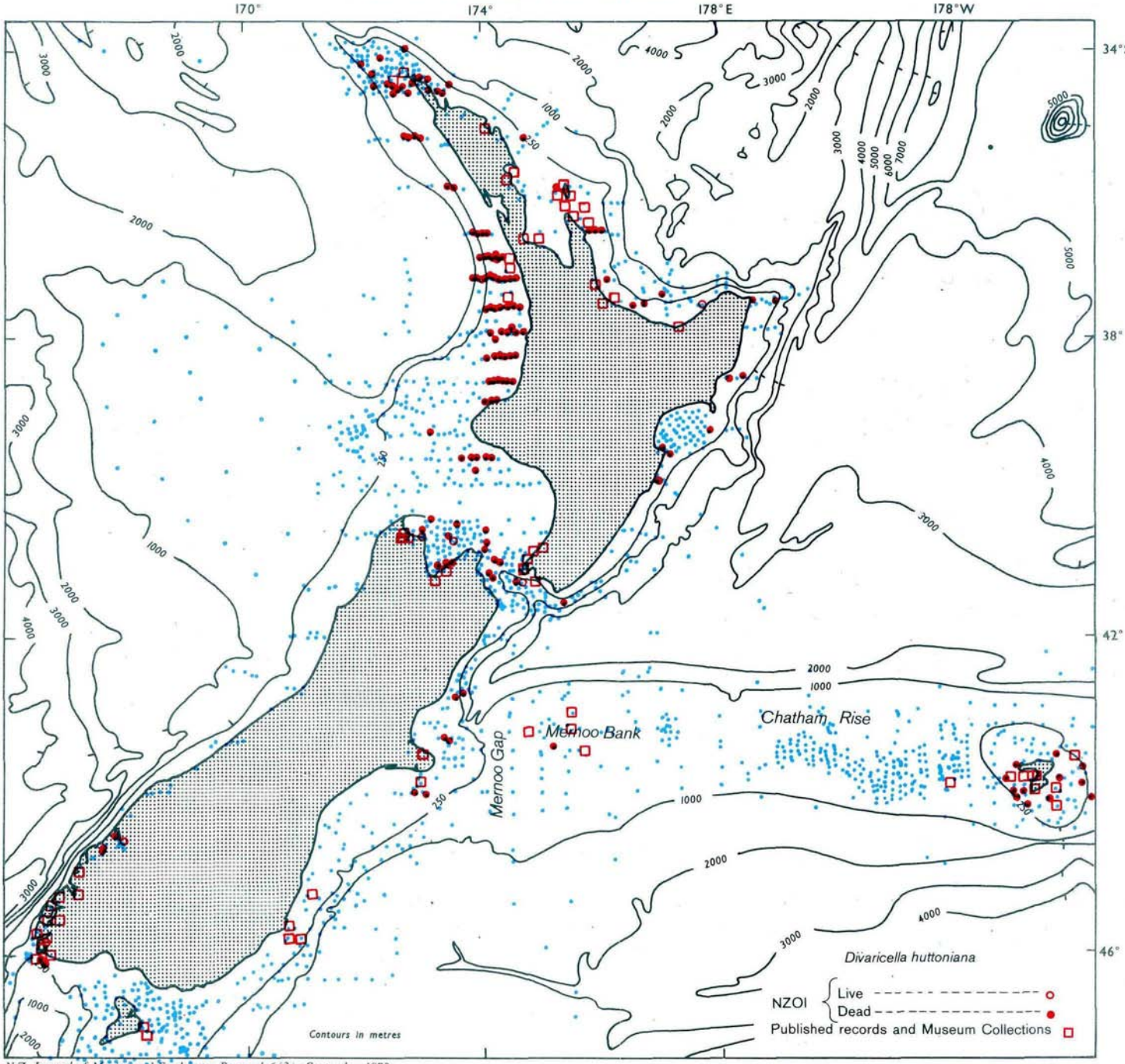
The influence of the Southland Current on the Otago shelf water varies from year to year and in some years larvae could well be carried from the Fiordland area to the Otago shelf, but their survival there would depend on the continuing suitability of such factors as temperature and salinity. In spite of the warming effect of the Southland Current (and partly since this is itself cooled by the adjacent Subantarctic Surface Water), the Otago shelf area is the coolest part of the New Zealand continental shelf (Garner 1969a and b).

The paucity of records of *Divaricella huttoniana* in the Otago - South Canterbury continental shelf contrasts with their abundance in the Fiordland area. Fleming (1950) recorded *D. huttoniana* from 17 of a total of 40 bottom stations (*New Golden Hind* Expedition) in the fiords, but did not differentiate between "dead" and "live" shells. NZOI stations are not very numerous in the fiords, but the samples with the greatest numbers of living specimens were recorded from Sta. B 614 in Dusky Sound (28 specimens) and Sta. A 327 in Milford Sound (Hurley 1964). Fleming noted that the presence of northern forms in south-western New Zealand which are not recorded from east Otago suggests that the Fiordland coast is less affected by the Subantarctic Drift than is the rest of the southern coast of New Zealand, and this is supported by the midshelf temperatures recorded around the area in summer and winter (Garner 1969a and b). The sea temperatures at the Auckland Islands in the Middle Miocene when a fossil *Divaricella* was present there were considerably higher than they are now, when *D. huttoniana* is absent from the subantarctic area (Fleming 1968). This reinforces the likelihood that temperature is a limiting factor in southward distribution of *Divaricella*. In the north, lack of samples means that no definite northern limit can be drawn, but it is expected that the deeper waters off the continental shelf would restrict *D. huttoniana* to the shelf around the North Island. It is not recorded from the Kermadec Islands.

DEPTH DISTRIBUTION OF DEAD VALVES AND LIVE ANIMALS

While living animals are usually to be found in groupings or aggregations often reflecting reactions to some environmental factor (used in its widest sense), their dead shells become part of the non-living environment and their subsequent movements are related to the same sorting and carrying forces that affect the rest of the substrate. Thus, an originally aggregated living population may eventually become a widely dispersed scatter of dead valves. Later, selective sorting may result in the separation of particles of different sizes and to a secondary aggregation of dead shells. For enclosed or semi-enclosed areas, dead shell can be presumed to have been produced within the area, but with increasing depths on open continental shelf areas the point of origin of any particular component of the substrate becomes less certain. Fleming (1950) has noted the problem of assigning depth ranges to individual species in steep-sided fiords where gravitation of dead shells of shallow water molluscs into the deeper basins seems to be a regular process. If living animals also gravitate to deeper basins this would account for the collection of live *Divaricella huttoniana* from 113 m in Milford Sound (both a published record and an NZOI sample in Fig. 4).

Most published records (Appendix 2) refer only to dead valves, the exceptions being mainly records of live animals washed ashore after storms. Such storm drift is derived from shallow waters (generally no deeper than 20–30 m) off that particular beach. Since *Divaricella*



N.Z. Journal of Marine and Freshwater Research 6(3): September 1972.

FIG. 3: Distribution of *Divaricella huttoniana* from published records, Dominion Museum and Auckland Museum collections, and NZOI collections (red symbols) shown against all NZOI benthic biological stations (except those in Wellington Harbour) from 30–48° S up to end of January 1970 (blue symbols).

huttoniana is regarded as a fairly common component of beach drift after storms in certain areas, the animals probably live in shallow subtidal areas there.

Unfortunately, the area from extreme low water down to about 10 m is little sampled. The shallowest stations of the NZOI survey were from 8–20 m, and thus records of live animals cast ashore after storms provide almost the only samples from these shallow subtidal levels. Since the number of stations is different for each depth range, it is clearer to show the number of stations where *Divaricella huttoniana* was recorded, as a percentage of the total number of stations in that range (Fig. 4). There is little agreement between the number of stations and the percentage with *D. huttoniana* for any one depth, i.e., the depths with the largest number of stations are not those with the highest percentage of *D. huttoniana*.

Except for the Fiordland sample from 113 m, all the living specimens were shallower than 70 m, corresponding roughly with the main grouping at depths of 10–100 m. At deeper levels there are three subsidiary peaks of dead shell at 140–150 m, 180–200 m and 280–300 m, which may correlate with what were shallower areas of live occurrence during times of lower sea level in the Upper Pleistocene.

The number of live records decreases as the depth increases. While four out of the eight published records of beach drift specimens were of samples containing living animals, only four samples in the 0–40 m depth range, one sample in the 41–80 m depth range and one sample in the 80–120 m depth range of the NZOI records were found to contain live *Divaricella huttoniana*. Hence although Dell (1956) groups *D. huttoniana* as a shelf species that extends down to deep-water well away from the shelf (dead valves were collected at depths of 201–475 m on the 1954 Chatham Islands Expedition), it seems likely that this is true only for dead valves and not for the living animals.

Dead valves of *Divaricella huttoniana* remain recognisable for long periods and may be carried well away from areas where the animals live. This could account for the disparity between the depth records of live specimens and of valves. All the valves from deeper than 180 m were old and worn. Since there is a complete absence of live records below 120 m, *D. huttoniana* seems to be confined to the continental shelf and to be more common in depths of less than 100 m.

SIZE AND ABUNDANCE

The original description of *Divaricella huttoniana* gave the size of the type as "altitude 29.5, diameter 32 and thickness of right valve 8 mm". Powell (1962) gives the size of his specimens as 29 × 27 mm, and a

number of the Dominion Museum specimens are considerably larger than this, the largest (from Ringaringa, Stewart Island) being 43 mm in diameter. Most of the NZOI specimens are less than 10 mm in diameter, with the living specimens from Dusky Sound among the largest (22.4 mm high, 23.6 mm diameter, 14.8 mm thick—two valves).

In contrast to the NZOI records, both published records and the Dominion Museum specimens include many with a diameter of >34 mm from beaches throughout New Zealand and the Chatham Islands—Spirits Bay, Waikanae, Days Bay, Collingwood, Okains Bay, Bowentown, Paterson Inlet and Petre Bay (Dominion Museum collections). Many of the stranded specimens were alive when cast ashore. The area most noted for both live stranded specimens and particularly large specimens is Pakawau-Collingwood in Golden Bay (Dell 1955; Elliott 1967; Parker 1966) but only three of the NZOI stations in Golden Bay included *Divaricella huttoniana*.

Of 159 stations with *Divaricella huttoniana*, only 18 have more than 10 valves. These include the Dusky Sound station (B 614) with 28 live *D. huttoniana* and four valves, and the Milford Sound stations A 326 (12 valves) and A 327 (15 live and 7 dead valves). The station with the most numerous valves is E 73 on Mernoo Bank where 66 valves and 1 pair, ranging from 8 mm to 33 mm in diameter and from recently dead, to old, worn and encrusted valves were collected. The Chatham Islands Expedition also collected a few eroded valves from the Mernoo Bank.

DISTRIBUTION IN RELATION TO SUBSTRATE

Sixty-seven percent of the NZOI stations where dead valves were collected had sediments ranging from muddy sand to sand, while a further 19 percent were sandy mud.

Allen (1958) remarked that members of the Lucinacea had successfully adapted themselves to conditions in which food is at a minimum and where the oxygen content of the substratum is very low, but they are not restricted to these environments alone. Although they can occur in habitats ranging from gravel to fine mud these particular habitats do not support a very rich infauna. The ability to construct an anterior inhalent tube with the foot has probably enabled these animals to inhabit substrata unsuitable for other species. The food-sorting mechanisms, highly developed in many bivalves, have been poorly developed in this group, so all available food may be accepted. *Divaricella quadrisulcata* is found in clean coral sand in Bimini lagoon in 5 ft (1.5 m) of water and among the roots of the turtle-grass *Thalassia*, while the related *Codakia orbiculata* was found in muddy gravel in mangrove swamps and in clean coral sand.

At Roscoff (France), where two other lucinids were collected alive by Allen, an excess of hydrogen sulphide in the substrate was thought to be responsible for the lack of other animals; at NZOI Sta. B 614

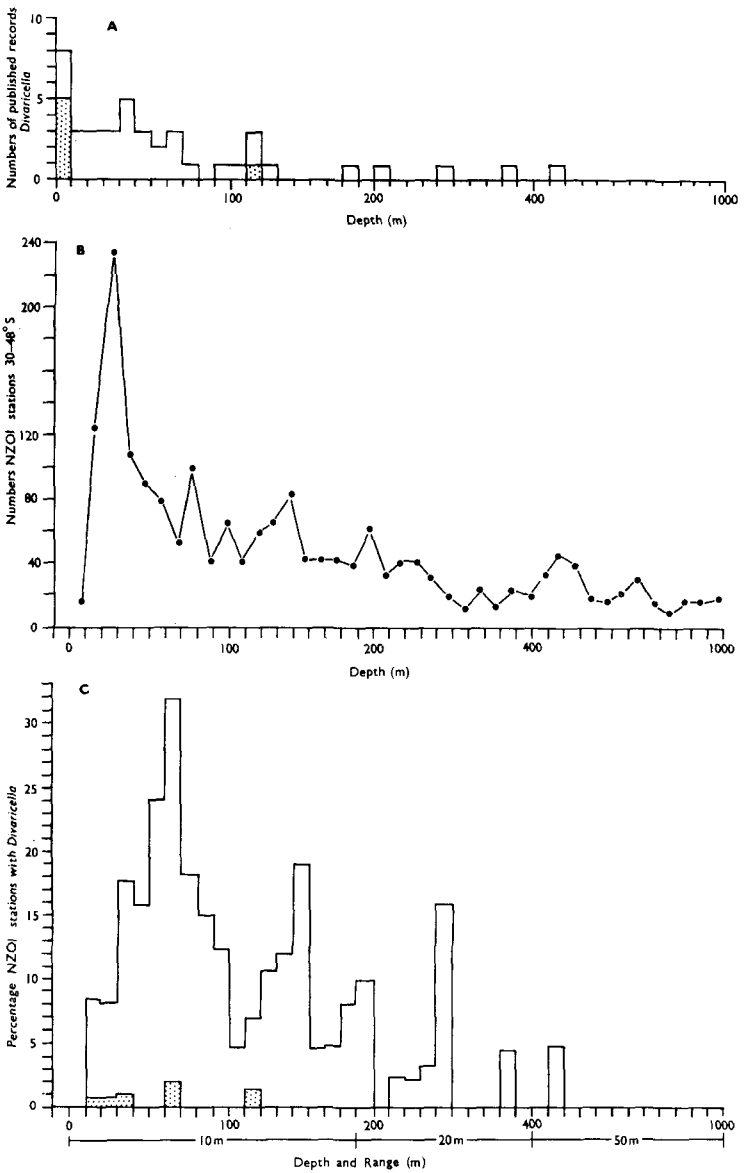


FIG. 4—The distribution of *Divaricella huttoniana* in relation to depth. Stations where live specimens were taken are shown by stippled columns.

(a) Previously published records. The height of each column represents the number of stations or recorded localities in each depth range where *D. huttoniana* has been recorded, not the number of specimens.

(b) The total number of NZOI benthic stations in each depth range down to 1000 m between 30–48° S.

(c) The percentage of NZOI benthic stations at which *D. huttoniana* was recorded in each depth range down to 1000 m.

in Dusky Sound, where the largest sample of live animals was collected and where *Divaricella huttoniana* was the most abundant animal, the substrate was noted as an evil-smelling, sandy, black mud, implying at least some degree of de-oxygenation. The other stations with live specimens were all either sandy mud, or muddy or silty sand.

Hurley (1964) has shown that the New Zealand species *Lucinoma galathea*, another member of the Lucinidae, "may be associated with reducing basin or fiord conditions sufficient to deter other species". This is paralleled by the occurrence of *L. acutilineata* in a similar situation in Beppu Wan, Japan (Miyadi 1941). Dead *L. galathea* was present at both Stas A 326 and A 327 in Milford Sound, but dead valves of *Divaricella huttoniana* were twice as numerous at Sta. A 326 (12, 6 respectively), and live specimens were collected from Sta. A 327 (15 live and 7 dead valves *D. huttoniana*, 30 dead *L. galathea*).

The heart-urchin *Echinocardium cordatum* was present with *Divaricella huttoniana* at Stas B 614 (9 live urchins) and C 186 (254 live urchins) and is normally found live in sediments ranging from sand to mud with most recorded from sandy mud. At Pakawau, Elliott (1967) recorded thousands of *E. cordatum* washed ashore with hundreds of *D. huttoniana* and many other molluscs.

In his discussion on the infaunal benthic communities of the New Zealand continental shelf, McKnight (1969) records *Divaricella huttoniana* as occurring in 43% of the samples included by him in the *Scalpomactra scalpellum - Maorimactra ordinaria* community. This is a widespread open shelf community occurring mainly on sand substrates in depths of mainly 20–60 m and characterised by *S. scalpellum, M. ordinaria, Tellinella huttoni* and *Nucula nitidula*. However, he included the muddier of the *New Golden Hind* stations (Fleming 1950) where *D. huttoniana* was collected, under his *Amphiura rosea-Dosinia greyi* community, but did not discuss the rest of the *New Golden Hind* Expedition stations nor attempt to fit them within the system he proposed. NZOI Stas A 327 (sandy mud) and B 614 (mud) where live *D. huttoniana* were collected were also omitted from his discussion of benthic communities.

CONCLUSIONS

Presentation of the distribution of *Divaricella huttoniana* in the NZOI collection in relation to previously published records, museum holdings, and the distribution of NZOI benthic stations enables various comparisons to be made. Distribution of *D. huttoniana* records is independent of the density of NZOI stations in any one area, or at any one depth range.

Divaricella huttoniana is absent from the Subantarctic islands probably because of the low temperatures in winter, although a species was present at the Auckland Islands in the Middle Miocene. Its sporadic occurrence in the Otago area probably reflects the varying influence of the Southland Current on the Otago shelf temperatures.

Divaricella huttoniana has been recorded by most expeditions collecting benthic samples in Fiordland, and the NZOI samples from there include both those with the largest number of live specimens and those live specimens from the greatest depths. Some of these stations are subject to periods of low oxygen availability. The number of live records decreases as the depth increases. Specimens with a diameter greater than 34 mm have been collected from beaches throughout New Zealand and the Chatham Islands, but not from the continental shelf.

Divaricella huttoniana is abundant in the shallow water zone off sandy beaches which is perhaps the least sampled area of the continental shelf. This location, and the animals' presumed relatively deep burial in the substrate while alive, account for both the small size and paucity of live specimens in the NZOI samples. Dead valves appear resistant to abrasion and are found over a wider depth range (0–300 m) than the live animals (0–113 m).

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APPENDIX 1—NZOI Stations where *Divaricella huttoniana* was recorded

(DB, Bucket dredge; DC, Cone dredge; DCM, Mesh cone dredge; DCMB, Mesh cone dredge with bag; DD, Devonport dredge; DL, Large dredge; DP, Pipe dredge; GHO, Medium orange-peel grab; GLO, Large orange-peel grab; GP, Petersen grab; TAL, Large Agassiz trawl; TAM, Medium Agassiz trawl; TAS, Small Agassiz trawl)

Sta. No.	Latitude (° 'S)	Longitude (° ')	Depth (m)	Gear	*Divaricella* Living	*Divaricella* Dead Valves	Sediment
A 326	44 34.3	167 48.4 E	113	DCMB	..	12	Muddy sand
A 327	44 36	167 49.2 E	113	DCMB	15	7	Sandy mud
A 427	41 32.9	174 26.0 E	91	DC	..	5	Mud
B 19	39 23	177 52.0 E	71	DC	..	1	Sandy mud
B 52	39 33.1	177 04.6 E	26	DC	..	1	Sandy mud
B 497	40 45.8	173 59.1 E	26	DD	..	1	Muddy sand
B 498	40 46.3	174 02.8 E	44	DD	..	5	Shell
B 547	43 20	173 20.8 E	77	GLO	..	P	Muddy sand
B 554	44 00	172 58.2 E	81	TAL	..	1	Muddy sand
B 556	44 00	173 47.5 E	179	DCM	..	2, 1 pr	..
B 608	46 05.3	166 36.73 E	17	GLO	..	1	Sand
B 614	45 43.8	166 39.6 E	27	GLO	28	2, 1 pr	Mud
B 619	44 42	167 32.28 E	95	DCMB	..	13	Sand
B 661	38 40	174 36 E	22	TAL	..	1	Sand
B 667	37 18.7	174 37.2 E	17	DCMB	..	14	Sand
B 672	36 40	174 03.3 E	75	TAL	..	1	..
B 828	41 0.8	173 28.7 E	18	GHO	..	1	Muddy sand
B 839	41 01.3	174 15.2 E	20	GHO	..	1	Sandy mud
C 176	39 40	173 57 E	40	TAS	..	3	..
C 177	39 40	174 10 E	24	TAS	..	1	..
C 177	39 40	174 10 E	24	DC	..	1	..
C 182	39 50	173 57 E	55	TAS	..	1	..
C 186	40 40	173 03 E	37	TAS	1	1	..
C 261	38 20	174 38.5 E	37	GP	..	1	Sandy mud
C 262	38 19.7	174 37 E	46	GP	..	12	Sandy mud
C 263	38 20	174 35.7 E	49	GP	..	6	..
C 264	38 19.5	174 34.8 E	51	GP	..	9	Muddy sand
C 266	38 20	174 29.8 E	49	GP	..	2	Sandy mud
C 267	38 20	174 27.3 E	53	GP	..	3	Sand, shell
C 268	38 19.7	174 25.1 E	57	GP	..	2	Sand
C 269	38 20	174 23.3 E	70	GP	..	2	Sand
C 270	38 19.8	174 20 E	79	GP	..	2	Sand
C 271	38 20	174 11.8 E	91	GP	..	5	Sand
C 272	38 20.3	174 11.8 E	91	GP	..	4	Sandy mud
C 273	38 20.3	174 05.2 E	97	GP	..	1	Sand
C 274	38 23	173 53 E	123	GP	..	frags	Sandy mud
C 276	38 20	173 28.5 E	146	GP	..	3 frags	Sandy mud
C 280	38 01.2	174 45.2 E	31	GP	..	2	Muddy sand
C 282	38 01.2	174 42.4 E	37	GP	..	1	Muddy sand
C 284	38 01.2	174 39.5 E	51	GP	..	1	Sand
C 285	38 01.2	174 37.7 E	59	GP	..	1	Sand
C 286	38 01.2	174 35.2 E	55	GP	..	3	Sand
C 289	38 01.6	174 27.2 E	57	GP	..	4	Sand
C 290	38 01.2	174 25.2 E	60	GP	..	16	Sand
C 291	38 02.5	174 13.5 E	68	GP	..	2	Sand
C 292	38 01.2	174 10.5 E	70	GP	..	2	Sand
C 295	26 39.8	174 17.5 E	22	GP	..	3	Sand
C 296	36 40	174 16.2 E	29	GP	..	3	Muddy sand

Continued on next page

APPENDIX 1—*continued*

Sta. No.	Latitude (° 'S)	Longitude (° ')	Depth (m)	Gear	*Divaricella* Living	*Divaricella* Dead Valves	Sediment
C 297	36 40	174 15 E	31	GP	..	3	Shelly sand
C 298	36 40	174 13.6 E	37	GP	..	3	Shelly sand
C 299	36 40	174 12.4 E	42	GP	..	1	Muddy sand
C 301	36 39.8	174 08 E	64	GP	..	4	..
C 302	36 40.1	174 05 E	64	GP	..	frag	Sandy mud
C 303	36 40	174 02 E	102	GP	..	2	Sand
C 309	37 00	174 26.2 E	22	GP	..	1	Sand
C 310	37 00	174 23.8 E	35	GP	..	2	Sand
C 312	37 00	174 18.8 E	53	GP	..	3	Muddy sand
C 313	37 00	174 16.3 E	68	GP	..	8	Muddy sand
C 316	37 00	174 09 E	112	GP	..	1	Sandy mud
C 317	37 00	174 00 E	135	GP	..	1	Muddy sand
C 320	37 18.2	174 33.8 E	11	GP	..	2	Sand
C 321	37 18.6	174 31.2 E	20	GP	..	1pr, 9	..
C 322	37 18.6	174 28.9 E	27	GP	..	3	Sand
C 323	37 18.6	174 26.7 E	33	GP	..	3	Shelly sand
C 324	37 18.6	174 24.0 E	33	GP	..	7	Shelly sand
C 326	37 18.6	174 19.0 E	70	GP	..	2	Sand
C 333	37 41.8	179 39.5 E	40	GP	..	1	Sand
C 334	37 41.8	174 37 E	49	GP	..	2	Muddy sand
C 335	37 41.8	174 34.5 E	55	GP	..	2	Sand
C 336	37 41.8	174 32.4 E	64	GP	..	1	Sand
C 337	37 41.8	174 29.8 E	64	GP	..	1	Sand
C 338	37 41.8	174 29.8 E	73	GP	..	1	Sand
C 339	37 41.8	174 24.6 E	84	GP	..	3	Sandy mud
C 341	37 41.8	174 17.4 E	123	GP	..	7	Muddy sand
C 342	37 41.8	174 13.9 E	155	GP	..	1	Muddy sand
C 344	37 58.6	174 34.4 E	55	GP	..	27	..
C 346	38 40	174 35.2 E	24	GP	..	2	Sand
C 347	38 40	174 33.6 E	35	GP	..	2	Sand
C 348	38 40	174 31 E	42	GP	..	1 pr, 1	Sand
C 349	38 40	174 28.4 E	48	GP	..	3	Muddy sand
C 350	38 40	174 25.9 E	49	GP	..	1	Sand
C 352	38 40	174 20.8 E	60	GP	..	7	Sand
C 353	38 40	174 18.33 E	62	GP	..	2	Sand
C 354	38 40	174 15.5 E	66	GP	..	2	Sand
C 355	38 40	174 13.0 E	71	GP	..	7	Sand
C 358	38 40	173 47.5 E	121	GP	..	1	Muddy sand
C 360	38 40	173 20.5 E	143	GP	..	1	Muddy sand
C 362	38 40	172 56 E	150	GP	..	1	Sandy mud
C 369	38 54	172 58 E	143	GP	..	1	Mud
C 370	38 54	173 10 E	135	GP	..	1	Muddy sand
C 375	38 54	174 08.5 E	71	GP	..	2	Muddy sand
C 376	38 54	174 11 E	68	GP	..	2	Sandy mud
C 377	38 54	174 14 E	49	GP	..	1	Muddy sand
C 429	39 20	173 08 E	124	GHO	..	2	Sandy mud
C 433	39 40	173 43.5 E	68	GHO	..	1	Sandy mud
C 449	40 00	174 54 E	29	GHO	..	1	Sand
C 460	39 40	174 00 E	33	GHO	..	3 frags	Shelly sand
C 461	39 40	173 57.2 E	44	GHO	..	15	Shelly sand
C 462	39 40	173 54.5 E	48	GHO	..	7	Shelly sand
C 471	40 37.5	172 59 E	33	GHO	..	1	Sandy mud

APPENDIX 1—*continued*

Sta. No.	Latitude (° ′S)	Longitude (° ′)	Depth (m)	Gear	*Divaricella* Living	*Divaricella* Dead Valves	Sediment
C 472	40 37.5	172 52 E	26	GHO	..	2	Sandy mud
C 624	43 57.5	175 52 W	120	DP	..	1	..
C 653	42 49.5	171 31.3 E	95	GLO	..	1	Muddy sand
C 664	42 40	173 31.5 E	284	GHO	..	1	Mud
C 666	42 46.5	173 35.7 E	239	GHO	..	3	Mud
C 745	36 40	174 13.6 E	33	GHO	..	22	Shelly sand
C 748	36 00	173 32.3 E	135	GLO, TAL	..	6	Muddy sand
C 750	35 20	173 10.5 E	20	GLO	..	1	Shelly sand
C 751	35 19.8	173 2.2 E	75	GLO, TAL	..	7	Muddy sand
C 752	35 19	172 57.5 E	131	GLO	..	8	Muddy sand
C 753	35 20.1	172 52 E	190	GLO	..	1	Muddy sand
C 754	34 40	172 51.3 E	24	GLO	..	2	Sand
C 756	34 40	172 32.4 E	75	GLO	..	1	Muddy sand
C 768	34 40	173 2.8 E	24	GLO	..	1	Shelly sand
C 769	34 40.1	173 11.2 E	77	GLO	..	8	Muddy sand
C 771	34 40	173 27 E	192	TAL	..	1	Muddy sand
C 778	35 19.8	174 47.6 E	187	GLO	..	18	Muddy sand
C 780	35 59.8	174 47.8 E	75	GLO	..	2	Sandy mud
C 799	37 40	176 15.3 E	20	GLO	..	1	Sandy mud
C 801	37 40.3	176 48.1 E	134	GLO	..	1	Muddy sand
C 805	37 40	177 47.8 E	26	GLO	1	..	Sand
C 820	38 40	178 08 E	22	GHO	..	1	Mud
C 822	38 40	178 23 E	79	GHO	..	3	Muddy sand
C 842	41 38.5	175 20 E	77	GHO	..	1 pr	Muddy sand
C 848	41 38.8	174 13.6 E	22	GHO	..	1	Sand
C 906	40 53.6	174 26.8 E	140	GHO	..	2	Muddy sand
C 937	40 55.4	174 27 E	25	GHO	..	1	Sandy mud
D 268	40 45	173 43 E	70	GHO	1	39	Sandy mud
D 274	41 04.5	174 19 E	27	GHO	..	4	Sandy mud
D 311	41 18.5	174 50.9 E	12	GHO	1	..	Sand
D 331	41 19.5	174 40.9 E	15	GHO	..	1	Sand
D 337	41 22	174 50.5 E	25	GHO	..	1	Sand
D 339	41 23	174 50.5 E	37	GHO	..	1	Sand
D 340	41 23	174 50 E	43	GHO	..	1	Sand
E 73	43 28	175 13 E	143	DCMB	..	66, 1pr	Shelly sand
E 106	43 55	177 10 W	179	DCMB	..	2	Muddy sand
E 107	43 45.5	177 00 W	113	TAM	..	3	Shelly sand
E 114	43 35	176 15 W	135	TAM	..	2	Sandy mud
E 114	43 35	176 15 W	135	DCMB	..	57	Sandy mud
E 125	43 45	176 00 W	150	DCMB	..	32	Shell
E 127	43 55	175 50 W	128	DCMB	..	21	Muddy sand
E 134	44 10	176 25 W	99	DCMB	..	26	Sand
E 154	44 19.5	176 44.5 W	176	DCMB	..	4, 1pr	Ooze
E 159	44 00.5	176 59 W	165	TM/DP	..	2, 1pr	Sandy Mud
E 160	44 00	176 50.0 W	128	TM/DP	..	9	Sandy mud
E 241	34 39	172 37.5 E	44	GHO	..	1	Sand
E 248	34 35	172 43 E	37	GHO	..	1	Muddy sand
E 261	34 35	172 15 E	161	DL	..	12	Shelly sand
E 278	34 25	172 15 E	141	DCMB	..	1	Shelly sand
E 294	34 16.5	172 5 E	245	DCMB	..	5	Shelly sand
E 326	34 10	172 22.5 E	190	DCMB	..	2	Shelly sand
E 365	34 30	173 03 E	35	GHO	..	4	Sand

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APPENDIX 1—*continued*

Sta. No.	Latitude (° ′S)	Longitude (° ′)	Depth (m)	Gear	*Divaricella* Living	*Divaricella* Dead Valves	Sediment
F 30	36 30	175 46 E	77	DCMB	..	1	Coarse sediment
F 165	40 45	173 29.5 E	55	GHO	..	1	Sandy mud
F 180	40 35	173 36.5 E	70	GHO	..	1	Sandy mud
F 184	40 35	173 09.5 E	55	GHO	..	1	Muddy sand
F 905	36 25	174 48.5 E	157-161	TAM		1	Muddy sand
F 931	34 28	173 03.5 E	51	TAM	..	1	Sand
G 46	44 00.9	176 57 W	274-293	DB	..	7	Shell

APPENDIX 2—Published distributional records of *Divaricella huttoniana*

HEDLEY, C. 1906: 2 valves, Cuvier Island, 110fm (201m).

SUTER, H. 1908: A few small valves, 5 miles south of Cuvier Island, 38fm (70m).

———— 1913: Bay of Islands, near Little Barrier Island, 20fm (37m); Channel Island, Hauraki Gulf, 25fm (46m); Auckland Harbour; Whangarei Heads; Nelson; Sumner; Dusky Sound, 12fm (22m); Chatham Islands; Off Great Barrier Island, 110fm (210m); Kermadec Islands (Capt. Bollons).

FINLAY, H. J. 1928: Chatham Islands—no depths given.

FLEMING, C. A. 1950: Long Sound, Preservation Inlet, 11fm (20m); Chalky Inlet, 11fm (20m); North Port, 4–8fm (7–14m); Edwardson Sound, 24fm (44m); Cunaris Sound, 34fm (62m); Cascade Cove, Dusky Sound, 18fm (33m); Facile Harbour, Dusky Sound, 12fm (22m); Boat Pass, east of Pigeon Island, 2–5fm (4–9m); Opp. Cormorant Cove, Dusky Sound, 2–4fm (4–7m); Supper Cove Anchorage, Dusky Sound, 10fm (18m); Dusky Sound, 0–13fm (18–24m); Dusky Sound, 29fm (53m); Breaksea Sound, 15–20fm (27–36m); Daggs Sound, 58fm (106m); Doubtful Sound, 38fm (69m); McDonald Is. Anchorage, Braddock Sound, 15–25fm (27–46m); Caesar Creek Chalky Inlet, beach

DELL, R. K. 1955: Collingwood area for large shells; Mt. Maunganui as washed up shells.

———— 1956: Chatham Rise and off Great Barrier Island, 201–475m; N 30°E of Kaingaroa, Doubtless Bay 284m; Chatham Rise, 476m; Chatham Rise, 375m; Off Great Barrier Island, 201m; Hanson Bay, 55m; Off Cape Young, 37m; Petre Bay, 92m; 172m; 128m; 40m; S of Little Mangere, 79m; Owenga, Chatham Islands (Powell 1933).

GRAHAM, J. 1962: Rare dead shells, North Otago shelf, 55–120m.

MABEY, F. 1963: Drift, Okiwi, Great Barrier Island.

DOUGLAS, N. 1964: Drift on beach between Waikato and Manukau Heads (live).

PARKER, G. W. 1966: Drift at Pakawau, Golden Bay (live).

HURLEY, D. E. 1964: Milford Sound, NZOI Stas A326, A327 (live).

ELLIOT, B. 1967: Drift at Pakawau, Golden Bay (live).

APPENDIX 3—Collections of *Divaricella huttoniana*

Locality	Ref. No.	Depth	Valves	Collector
DOMINION MUSEUM				
Spirits Bay		Beach drift	2v	
Spirits Bay			3v	Oliver 1929
Cuvier Island		50fm (91m)	1v	Bollons coll.
Great Barrier Island		10fm (18m)	2v small	
Bowentown, Waihi			2pr large	Ponder coll.
Mount Maunganui, Tauranga		Beach	5v	Oliver coll.
27 miles SW Albatross Point, Kawhia Harbour		33fm (60m)	2v	Bollons BS 193
Waikanae beach		Beach	13pr 14v	Ponder coll.
Waikanae beach		Beach	1pr	Oliver coll.
Paraparaumu			10pr 7v	Dell 1948
Days Bay			6v	
Collingwood			7v	Oliver 1949
Collingwood, Nelson			5v large	Dell coll.
West Wanganui Inlet, Nelson			2v large	Oliver coll.
Sumner			1pr	Oliver coll.
Okains Bay			4v large	Oliver coll.
Mernoo Bank 43° 21′ S, 175° 00′ E		52fm (95m)	1pr, 3v, very small	
Mernoo Bank 43° 21′ S, 175° 00′ E		52fm (95m)	5v	
Chatham Islands Expedition	Sta. 2	61fm (111m)	1v	
	Sta. 3	41fm (75m)	1pr	
	Sta. 15	30fm (55m)	3v	
	Sta. 28	50fm (91m)	3v	
	Sta. 29	94fm (172m)	2″×1″ tube (all small)	
	Sta. 30	70fm (128m)	3v	
	Sta. 31	20fm (37m)	5v, 1 large	
	Sta. 38	43fm (79m)	1v	
	Sta. 44	120–125fm (220–228m)	12v small	
	Sta. 52	260fm (480m)	1v	
	Sta. 60	206fm (380m)	2v very old and worn	
Chatham Islands			1v large	Oliver coll. 1909
Earshell Cove, Doubtful Sound			5v	E. Smith coll.
Off Passage Point, Dusky Sound		12–15fm (22–28m)	1v	BS 137
Dusky Sound			11v	R. Henry
Ringaringa, Stewart Island			1v large	D. Allan 1947
Paterson Inlet, Stewart Island			2pr 2v	
AUCKLAND MUSEUM				
Oneroa, Waiheke Island	AM 14204		2pr	AWBP Jan. 1933
Paekakariki, Wellington	AM 14206		1 pr 8v	Blamey 1937

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APPENDIX 3—*continued*

Locality	Ref. No.	Depth	Valves	Collector
AUCKLAND MUSEUM (*continued*)				
Chatham Islands, South Pacific Ocean	AM 14205		9v	H. J. Finlay coll.
Orua Bay, Manukau	AM 14220		2pr 2v	W. H. Webster coll.
Takapuna beach	AM 14128		7pr 6v	C. R. Lewis coll.
Auckland, N.I.	AM 14211		9v	H. J. Finlay coll.
Owenga, Chatham Islands	AM 14207		1pr	AWBP 1936 coll.
Near Dunedin	AM 14221		2pr 2v	G. J. Smith 1951
The Spit, Otago Heads	AM 14210		5v	Old Mus. coll.
Mt. Maunganui, Tauranga	AM 14208		7pr 4v	Mrs E. Flinn 1934
Cape Saunders	AM 14214	40fm (74m)	1v	C. R. Laws coll.
Stewart Island	AM 14212		8v	H. J. Finlay coll.
Stewart Island	AM 14213		1v	H. J. Finlay coll.
Collingwood beach, Nelson	AM 14209		9pr 6v	AWBP 18–1–30
Tauranga	AM 14023		1pr 2v	Old Mus. coll.
Cape Maria van Diemen	AM 14216		1v	H. J. Finlay coll.
Stewart Island	AM 14215		12v	Dredged Capt. J. Bollons Chas Cooper coll.
Opotiki, Bay of Plenty	AM 14217		4v	H. J. Finlay coll.
Nelson			6pr 2v	1963 C. Barker coll.
Tahunanui, Nelson	AM 34045		11pr	Jenkings coll. Miss J. Robertson 1963
AUCKLAND MUSEUM: Powell Collection				*Identification*
Oneroa, Waiheke Island	S 1110		3pr large	*(D. cumingi)*
Waikanae beach (Wellington), 1928	4060	Beach	1v	*(D. cumingi)*
Bull's Point, Stewart Island	28416		2v	
Off Hen and Chickens	8918	25–30fm (48–56m)	5v small	*(D. cumingi)*
Pakawau beach, Collingwood, 1961	33782	Beach	4pr	
Pakawau beach, Collingwood		Beach	5pr	*(D. cumingi)*
Tahunanui, Nelson	48483		9pr	
Near Dunedin	26784		6pr large	*(D. cumingi)*
Tryphena, Great Barrier Island	1360		2pr	*(D. cumingi)*
Mt. Maunganui, Bay of Plenty			10pr	*(D. cumingi)*
Pakawau beach, Collingwood, 1927	11821	Beach	4pr	*(D. cumingi)*
Collingwood, W. Nelson	17974		8pr	*(D. cumingi)*
Anita Bay, Milford Sound		17fm (31m)	6v	