Some Intertidal Sessile Barnacles of New Zealand.

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This paper deals with the four most abundant and most conspicuous Balanomorph barnacles occurring intertidally in the main islands of New Zealand.

The accompanying key summarizes the features by which they may be distinguished from other intertidal barnacles and from one another. Other cirripede species that have been recorded for the littoral of New Zealand are listed at the end of the account. Among them *Tetraclita purpurascens* and *Balanus* spp., especially *B. trigonus,* occur on shells and under stones at about low tide mark in many places, but they have not been seen by the present writer to form conspicuous bands. Stalked barnacles are quite abundant in well-shaded, damp crevices, or under overhanging rocks at about high tide level, usually on a fairly open coast.

KEY.

1.	Parietal valves of adult 6, basis calcareous	*Balanus.*
	Parietal valves of adult not 6, basis membranous ..	2.
2.	Parietal valves of adult firmly and completely fused into a ring	4. *Chamæsipho*
	Parital valves of adult 4: rostrum with radii ..	3.
3.	Parietal valves porose	*Tetraclita.*
	Parietal valves not porose	5. *Elminius.*
4.	Rarely exceeding 5 mm. diameter: body navy blue ..	*C. columna.*
	Fully grown shell about 10 mm. diameter: body brownish	*C. brunnea.*
5.	Parietal valves closely plicate internally at base: average diameter c. 15 mm.	*E. plicatus.*
	Parietal valves smooth internally at base: average diameter c. 5 mm.	*E. modestus.*

Previous work on the recent barnacles of New Zealand has been predominantly systematic, in the form of reports on specimens collected by various expeditions. An intensive study of local forms begun by L. S. Jennings was cut short in 1914 by war service from which he did not return. Some of his results were published (1918).

Linzey (1942a) has listed the Balanomorph barnacles collected by Oliver on the Kermadec Islands, and (1942b) has described the body appendages of *Balanus decorus.*

Ecological data are provided by Oliver (1923). In classifying the biotic communities of the littoral belt of New Zealand, he includes in his " shelled-animals formation " a sessile cirripede subformation within which he differentiates an *Elminius plicatus* association, an *Elminius modestus* association, and a *Chamæsipho* association. These he exemplifies by descriptions of specific localities, listing the plants and animals that accompany the dominant barnacle in each case.

Cranwell and Moore (1938), in a discussion of the intertidal communities of the Poor Knights Islands, off the North Auckland east coast, define two associations with sessile barnacles as dominants,

and illustrate diagrammatically their occurrence under different habitat conditions on these islands. A comparative table locating the Poor Knights communities in a schematic arrangement of some association-complexes of the coast of Auckland Province, involves reference to a third barnacle dominant on exposed rock faces, but is not concerned with the more sheltered waters where the fourth of the species here treated becomes important.

Material for the present work has been accumulated over some seven years, with field observations as opportunity offered from Doubtless Bay to Port Adventure. Contributions from parts of the coast not visited have been forwarded by numerous correspondents. The Jennings Collection at Canterbury College has been examined, and also the material available at the Auckland, Dominion, and Canterbury Museums. Hutton's type specimens of *Elminius* were obtained on loan from Otago Museum. The Sydney Museum lent several specimens, and Dr. W. R. B. Oliver put at my disposal his extensive private collection. Help from all these sources is gratefully acknowledged.

Scope of Work.

The study, originally intended to record the ecological relations of the intertidal sessile barnacles, perforce took on a systematic bias when it became obvious that two distinct and common forms were included under the name *Chamæsipho columna* and that the status of Hutton's two species of *Elminius* was uncertain.

Each of the four species is described, special attention being paid to the hitherto rather neglected body appendages, the importance of which in the classification of sessile barnacles has recently been emphasised in connection with the New Zealand species of Balanus (Linzey 1942b).

Field notes on breeding season, habitat, and distribution are summarized. It is hoped that future work will clarify the relationships that undoubtedly exist between the cirripede communities and other shore organisms, including marine algæ.

Chamæsipho columna (Spengler). Plate 46, Fig. A.

Lepas columna Spengler, 1790, Skrivter Naturhist. Selbskabet, Bd. 1, p. 192, Tab. 6, fig. 6.

Chamæsipho columna, Darwin, 1854, p. 470, Pl. 19, fig. 3 a-c; Hutton, 1879, p. 329; Hœk, 1883, p. 32; Fiihol, 1885, p. 487; Gruvel, 1905, p. 282, figs. 306, 307; Jennings, 1918, p. 63; Broch, 1922, p. 308, fig. 53; Linzey, 1942a, p. 280.

Distribution. Otaheite (Type locality), New South Wales, Victoria, Tasmania, New Zealand, Kermadec Islands.

Specific Diagnosis. Spengler: "Testa quadrivalvis columnaris, quadrangularis, rudis. Angularis carinatis obliquis."

Darwin: "Sutures, except during early youth, generally obliterated both externally and internally: tergum with small pits for the attachment of the depressor muscle."

Spengler's original description, of which a copy has been obtained through the good offices of Prof. T. Gislén, of Lund, contained further details, here quoted from Prof. Gislén's translation of the Danish. "Properly speaking, it is columnar, as the length is one

inch and the breadth 7 lines, and both ends are equally thick. The most curious of its characteristics consists in the fact that it has only four shells, which, at least from the outside, can only be detected by a specialist. . . . The most posterior or back shell, as in all Lepades, at its upper part is constricted interiorly so as to resemble the spout of a watering can. It is clasped by the thinner part of the two side shells. The opposed foremost shell, in the same way, is clasped by the side shells already mentioned. . . The opening, which is rifled interiorly, forms a bluntly four-edged figure; it is wide and much larger than the lowest part of the shell. It has no bottom; the four shells in this part are irregularly spiny with a sharp edge. . . A beautiful Patella . . . is exteriorly completely covered by small cylinder-shaped Lepades, like those I have just described. They stand as small columns close to each other, and resemble a honeycomb because of their white angular openings. These also are from Otaheite."

Darwin, in erecting the new genus *Chamæsipho*, which he placed next to *Chthamalus*, gave the generic diagnosis " Compartments four, with the sutures often much obliterated: basis membranous," and applied the name *Chamæsipho columna* to the common New Zealand barnacle, though admittedly he doubted whether it was identical with that originally described by Spengler from Otaheite (Tahiti).

Certainly Spengler's figure (of which a photograph was forwarded to me by Prof. Gilsén) could not easily be matched on the New Zealand coast. Though the general columnar shape is similar, the dimensions are much larger than those of any specimen I have seen. The arrangement of the four parietal valves, with carina and rostrum " clasped by " the radii of the lateral valves, is clearly seen in local specimens in the very early stages of growth, but in all older shells seen here the four valves are completely fused, with sutures indistinguishable even after treatment with acid. Spengler's figure, on the other hand, shows the sutures quite plainly even at the large size.

It seems very likely that our barnacle is not *L. columna* in Spengler's sense.

ADULT.

Size. Sometimes found fertile at diameter and height of only 2 mm. Extreme columnar form reaches 16 mm. tall with diameter of 4 mm. Maximum recorded size of conical form 9 mm. diameter and 6 mm. tall.

Shape. Low conical with slightly convex sides to columnar, either tall or short, when individuals are crowded together and more or less fused into sheets.

Orifice. Carino-rostral diameter only a little greater than the transverse one. Greatest width not near to carinal end.

Surface. Often pitted and rough, but without strong ridges or fluting.

Compartments. Completely fused in adult, forming a strong, bony ring. No trace of sutures seen beyond 2 mm. basal diameter; occasionally quite obliterated at 0·5 mm.

Sheath. Short, rifled with almost no cavity below.

Parietes. Solid, relatively thick, opaque, smooth and pale within.

Basis. Entirely membranous.

Scutum. External surface shows umbo when corroded: no growth zones except on edges. Occludent margin slightly inflected, with small basal cavity. Articular ridge prominent, with a furrow above it.

Articular furrow deep.

Adductor ridge not strongly developed, but almost always distinct.

Adductor muscle pit not deep, but wide.

Lateral depressor pit a slight hollow, overhung by tergal margin above.

Basal margin much longer than tergal.

Tergum. Twice as long as wide: basiscutal angle acute: weakly developed beak seen in one specimen: walls of depressor muscle pits show externally after corrosion.

Spur absent.

Articular ridge short, arcuate.

Articular furrow deep.

Crests for depressor 2–6, strongly developed in largest specimens, separated by pits that are sometimes deep; crest region occupies one quarter of the whole internal surface, the remainder of which is mostly occupied by a longitudinal groove.

Soft Body. Colour navy blue when alive: colour persists in dried specimens 40 years old. Labrum bullate: wide shallow sinus fringed with hairs: denticles about 5. Palp.: Hairs short proximally, long distally: longest hairs plumose. Mandible: Four teeth, of which the three smaller ones are often multiple: sometimes there is a small fifth included in the lower pectinate edge, which ends in a single, pale, small terminal tooth. Maxilla: Two large spines, or occasionally only one, above the notch that is deep or shallow or scarcely recognisable; notch contains 3–4 pairs of small spines and is followed by a flat cutting edge with 4–7 large spines and then many smaller ones. Second Maxilla: Not deeply notched: topped by long spines.

CIRRI.

I. Anterior ramus of 6–10 segments, usually 7; final segments often narrow and pale; all inner faces spiny. Posterior ramus of 4–7 segments, usually 5; all inner faces spiny. Spines mostly smooth, a few plumose.

II. Anterior ramus has regularly 5–7 segments, all bullate and thickly covered with spines, of which many, especially towards the terminal segments, are plumose: very commonly on segment 4 and not infrequently on segments 3, 5, and 6 there are stronger spines that can be called pectinate, though they rarely have more than one terminal and two pairs of lateral teeth, and may have fewer. Posterior ramus is occasionally little longer than anterior, and then has all segments bullate and spiny; usually it is distinctly longer, with only a few basal segments spiny and bullate, followed either by a few segments bearing five or four regular pairs of spines like those on cirri IV–VI, or by a greater number of antennæform segments, or by a few

of the former kind proximally, and many of the latter distally. The total number of segments may reach 25. The long antennæform kind is found to be common in many different localities, and in some gatherings, e.g., one from Stanley Bay, Auckland, and one from Scorching Bay, Wellington, is present in every individual; other gatherings show a great range.

In the few Australian specimens dissected, three-pronged pectinate spines were identified in several specimens from Tasmania, Melbourne, and New South Wales. II b was not antennæform in any of these, having only about 10 segments, with regularly paired spines on the distal ones.

III. Anterior ramus of 8–12 segments, of which the proximal 3–4 are bristly with many spines; each of the remaining segments carries 3–5 pairs of spines anteriorly, sometimes with a few intermediate ones, and a distal tuft posteriorly. Very commonly on the second and third there are short pectinate or three-pointed spines, that also are seen sometimes on the fourth and first. Some plumose spines on the inwardly-facing bullæ. Distal segments occasionally antennæform, but not so on any Australian specimen dissected.

Posterior ramus usually much longer, e.g., 16–37 segments; up to 7 of the proximal segments may carry paired spines anteriorally, the distal segments, or sometimes all, being antennæform. Specimens dissected from Tasmania, Melbourne, and New South Wales show IIIb little longer than IIIa, and like it with paired anterior spines on distal segments.

This posterior antennæform ramus of cirrus III seems to have an independent action and perhaps function in the feeding movements. Whereas the posterior cirri IV to VI emerge in a group and remain incurved, and the shorter anterior cirri scarcely reach beyond the opercular aperture, these long rami of the third cirri swing wide and straight to a horizontal or deflexed position, even lying momentarily down the outside of the shell. In the upward and withdrawing swing they do not curl inwards, but the tips remain straight until they meet above the mid line of the operculum. From this position they diverge again, not usually being retracted into the shell between strokes as are all the other cirri.

IV–VI. 11 to 19 segments with four or five (more usually five) pairs of anterior spines with a few short intermediates; distal tuft posteriorly.

Penis: Shorter than cirrus VI, tapering, with transverse furrows.

Reproductive Season. Nauplii and juveniles abundant throughout the year.

JUVENILE FORM.

At a diameter of about 0·5 mm. most shells have six parietal compartments of typical *Chthamalus* form and arrangement, i.e., with rostro-lateral compartments without alæ. As the shell grows the sutures between laterals and rostro-laterals are gradually obliterated, and beyond a diameter of 0·75 mm. are quite indistinguishable. At

this stage there are four valves of typical *Chamæsipho* arrangement, the rostrum and carina clasped by the two side shells.

The smallest specimen of this form seen had a diameter of 0·5 mm., the largest of 2 mm. In all larger specimens examined the parietal compartments are completely fused. Where the parietal sutures are still obvious, cirrus III is not antennæform, in the specimens dissected.

Substratum. The following substrata have been noted:—rock of various kinds, stones; concrete; wood very occasionally; other cirripedes, especially *Elminius plicatus*; also on *Chamæsipho brunnea, Mitella sertus,* and *Elminius modestus;* bivalves, e.g.,, *Mytilus canaliculus, M. planulatus, Modiolus* spp., and rock oysters; univalves, relatively stable like *Cellana* spp. and other limpets, or more active like *Lunella smaragda, Lepsiella scobina, Neothais haustrum, Lepsia succincta, Nerita melanotragus, Anisodiloma lugubris, Melagraphia æthiops, Siphonaria* spp.; loricates, e.g., *Sipharochiton pellisserpentis, Guildingia obtecta.*

Position on Shore. From high spring tide to low spring tide, most abundant just below high neap tide where it often covers the whole surface of sloping rock, forming a conspicuous white band. Below, it is much mixed with other barnacles, mussels and seaweeds; it does not favour pools, and has not been found below low spring tide. Specimens will resume active feeding movements after being dry 48 hours.

Geographical Distribution. The species occurs throughout the three main islands, and on many rocky shores these are some of the most abundant and conspicuous animals. They will tolerate estuarine conditions to some extent, but are not found in the upper reaches of tidal rivers where the water is often muddy and brackish. They are usually present on exposed coasts, but where conditions are severe, are restricted to more sheltered corners. The species is apparently absent from both Poor Knights and Mayor Islands, but is present on Cuvier, Mokohinau, Great and Little Barrier Islands, the Hen, and Kawau, and is recorded from the Kermadecs. Absence might be related to feeding or spawning difficulties on steep coasts running into deep water with few sheltered or shallow places.

Specimens were examined from the localities shown in Fig. 2 and also from Long Reef, New South Wales, Brown's River and Blackman's River, Tasmania (Coll. W. R. B. Oliver), and near Melbourne, Victoria (Coll. G. Dingley).

Chamæsipho brunnea n.sp., Plate 46, Fig. B; Plate 47, Fig. 1.

Chamæsipho columna, Darwin 1854, p. 470, in part; Oliver, 1924, p. 510, fig. 9.

Chthamalus sp. Cranwell and Moore, 1938, p. 384, Pl. 53, fig 3.

Distribution. New Zealand. (?) Australia.

Localities of Specimens Examined. (The collector is indicated in each case, O. meaning Dr. W. R. B. Oliver, and M., L. B. Moore.)

North Island, east coast:—Coal Pt., Parenga, O.; Cooper's Beach, M.; Matauri Bay, H. H. Allan; Cape Brett, E. Alexander; Whananaki, Matapouri Bay, Bream Hd., Whangarei Heads, Lang's Beach, Waipu, Leigh, Waiwera, Poor Knights, Hen Is., M.; Mokohinau, E. Alexander; Cuvier Is., Grenfell and Barr (L. S. Jennings

coll.); Whangapoua (Gt. Barrier Is.) O.; Little Barrier Is., H.M. Shakespear, O., M.; Terakihi Rock, O.; Takapuna, Noises Is., M.; Rangitoto Is., Australian Museum, Sydney (labelled "Rocks between tide marks, Rangitoto, 1916, *Elminius plicatus* det. Dr. Pilsbry"), M.; Motuihi Is., Hope Cr. (Colville), M.; Mt. Maunganui (Tauranga), O., M.; Karewa Is., O.; Mayor Is., Ohope, Parinui Pt., Te Kaha, Maræhako, Waihau Bay, Cape Runaway, M.; Hicks Bay, D. W. Christie, M.; Tuparoa, Tolaga Bay, Mahia Pen., Aohanga, Castlepoint, Mukumuku, Cape Turakirae (old shells still in situ on rocks raised 9 ft. above high tide level in the earthquake of 1855), Hinds Pt. (Pt. Nicholson), M.

West Coast:—Ahipara, H. H. Allan, M.; Mitimiti, M.; Waimamaku (Hokianga Hds.), J. Ardts; Muriwai, Te Henga, Anawhata, Piha, Kaawa Cr., M.; base of Mt. Karioi, O.; near Albatross Pt., C. A. Fleming, M.; Paritutu, H. H. Allan; New Plymouth, Cape Egmont, Pukerua Bay, Titahi Bay, Te Kaminaru Bay, Red Rocks, Ohiro Bay, M.; Island Bay, O., M.; Lyall Bay, Karaka Bay, M.; Worser Bay, I. Davey.

South Island:—Nelson, L. J. Dumbleton; D'Urville Is., west side, noted but not accessible for examination, M.; Cape Campbell, M.; South of Kaikoura, H. H. Allan; Goose Bay, G. Simpson; Giant's Eye (Taylor's Mistake), M.

Specific Diagnosis. Parietal valves at first six, reduced to four by fusion of rostro-laterals with laterals, all sutures ultimately obliterated internally and externally; adductor ridge not distinct on scutum; inner face of tergum smooth and unsculptured except for deep pits and raised crests for tergal depressor muscles; body brown, rami of cirri II and III rarely if ever antennæform, III resembling IV in size and, except towards the base, in setation.

Field studies during 1936 convinced the present writer that the New Zealand intertidal barnacles with obliterated sutures could be divided into two groups sharply distinguished by differences in habitat, in size, and in colour and structural details of the soft body.

Oliver (1923, p. 535), in describing the *Chamæsipho* association of the North Rocks of Mt. Maunganui, Tauranga, differentiates between the lower portion of the mid-tide belt where the rocks are almost entirely covered with small specimens of *Chamæsipho columna,* and the upper portion where large specimens of *C. columna* are the dominant forms. In my opinion these are quite distinct species.

Both Darwin (1854) and Broch (1922) have assigned to *Chamæsipho columna* the small barnacle that grows abundantly on shells of *Elminius plicatus.* Although neither this nor the larger one matches Spengler's description of *Lepas columna* at all satisfactorily, their example has been followed with some misgivings in the present work, since neither Spengler's type specimens nor any topotypes are available. The larger kind was distinguished by Cranwell and Moore (1938) as *Chthamalus* sp., but was not formally described. Subsequent study has shown that this cannot be referred to any described species of *Chthamalus,* and the most logical course seems to be to erect a new species of *Chamæsipho* for it. For this I propose the name *Chamæsipho brunnea.*

Oliver's specimen from Island Bay, figured on p. 510 *(loc. cit.)*, I would refer to *C. brunnea* which is abundantly represented in his collections from that locality. To this species also probably belonged the specimens, whose soft parts had not been preserved, from Bay of Islands, referred by Borradaile (1916) " with some doubt " to *Chthamalus stellatus.*

ADULT.

Size. Type: Basal diameter, carino-rostral 10 mm., transverse 9 mm., height 4 mm., opercular diameter 5 mm.; Smuggler's Cove, Whangarei Heads., 12 x 12 x 6·5 x 6·5; Anawhata, Auckland west coast, 13 x 13 x 9 x 7·5; Ohiro Bay, Wellington, 24 x 24 x 8 x 10; Lyall Bay, Wellington (maximum), 17·5 x 14·5 x 7·5 x 7·5; Cape Turakirae (old shells, maximum), 12 x 12 x 19 x 6. Minimum with nauplii, Lyall Bay, 5·5 mm. basal diameter.

Shape. Either conical or depressed, spreading at base, or, where closely crowded together, more columnar; broadly oval; type low conical.

Orifice. Wide, broadest at the level of the almost transverse tergo-scutal articulation.

Surface. Greyish white, pale when eroded, brownish towards base; surface remains smooth for some time, later, except when crowded, becoming more or less ribbed and crenate at the base with conspicuous growth laminæ; type corroded above, crenate and laminate below.

Compartments. Completely fused in adult, with no indication of sutures, even after etching with acid; largest specimens showing sutures have diameter of 6 mm.

Sheath. Rifled within, not overhanging at all.

Parietes. Thick (3 mm.), very solid, white and marble-like in parts exposed by corrosion; smooth and pale internally when dark body is removed.

Basis. Entirely membranous.

Scutum. External surface: Between brown and grey; smooth, with umbo; basal growth ridges.

Occludent margin: Straight, slightly inflected basally to form small, deep cavity.

Articular ridge: Prominent and strongly sinuous.

Articular furrow: Deep.

Adductor ridge: Lacking, or at most, less distinct than in *C columna.*

Adductor muscle pit: Obvious, either deep or shallow.

Lateral depressor pit: Shallow.

Greatest width more than half length.

Tergum. Trapezoid, basiscutal angle wide; interior smooth, except about raised depressor crests.

Spur: Absent.

Beak: Not in type, but occasionally present; walls of depressor muscle pits conspicuous externally after corrosion.

Articular ridge: Short, rounded, prominent.

Articular furrow: Deep.

Depressor crests: About seven thin septa, separated by deep pits.

Soft Body. Colour: Light and dark brown, cirri appearing almost black when feeding.

Labrum: Bullate, rough with fine, sharp tubercles, sinus broad, rather shallow, fringed with short, stiff hairs.

Palps.: Fairly large, almost meeting, fringed at their ends with long, plumose spines, and bearing shorter ones laterally.

Mandible: Large upper tooth widely separated from two smaller double ones (sometimes simple), followed by a minute double fourth (occasionally better developed or absent); the pectinate edge ends at the lower angle in three, four, or five small teeth; bristles of medium length fringe upper and lower borders; surface setose.

Maxilla: Two spines above notch, which is filled with small spines; below notch about 6 pairs of spines of different sizes, gradually increasing, then a series of small, stiff bristles to the lower angle; surface finely setose.

Second Maxilla: Not deeply notched, spines rather strongly plumose.

CIRRI.

I. Rami of seven segments each, the anterior branch slightly longer, much stouter at the base, and tapering suddenly; inner faces of all segments closely beset with long, finely plumose spines, more abundant on the anterior branch; posterior ramus occasionally, e.g., from Ohiro Bay and Kaawa Creek, has a few strongly pectinate spines.

II. Anterior ramus: Eight segments, stout below, tapering sharply; each segment bullate with 6–7 pairs of lateral simple spines enclosing crowded, finely plumose spines anteriorly; coarsely pectinate spines abundant amongst plumose ones of upper six segments.

Posterior ramus: Much more slender and slightly longer; 10 segments, upper ones each with three pairs of spines; in proximal segments these are separated by a dark cushion densely beset with long plumose spines; a dense tuft of small bristles on the posterior upper angle of each segment.

III. Basal segments bullate, with simple lateral spines enclosing densely crowded, finely plumose ones, amongst which, in the upper segment only, are usually some strongly pectinate ones.

Anterior ramus: Slender, gradually tapering, 13 segments, with paired, simple spines, three pairs on upper segments; on lower segments, four pairs, between which are short intermediate spines, most numerous on the somewhat bullate two to three proximal segments, which bear also strongly pectinate spines.

Posterior ramus: Slender, like IV–VI; 13–14 segments each with four pairs of simple spines, with intermediate tufts of much shorter simple spines best developed on the lower segments.

IV–VI. 14–16 segments; four pairs of simple spines, with conspicuous intermediate tufts.

Penis: About as long as cirrus III, rarely more than half as long as VI; stout proximally, faintly ridged, tapering narrowly, with spines to the end.

Reproductive Season. Eggs and nauplii have been found inside shells in September, October, November, December, January and February; four- and six-valved juveniles throughout the year.

JUVENILE FORM.

Nauplii: Nauplii from eggs in a specimen submitted for comment were examined by Dr. R. Bassindale, of Manchester. In a letter (20/4/37) he states, " They have a similar setation to *Chthamalus stellatus* nauplii (as is to be expected), but they appear narrower, and have a much longer fronto-lateral horn."

Sutured-shell stages: In the smallest specimens, 0·5 mm. diameter and less, the parietal valves are always six and of typical *Chthamalus* form and arrangement. The six valves remain distinct, commonly to a diameter of 2 mm., less frequently to 4 mm., and sometimes are distinguishable in an even larger shell. Fusion of rostro-laterals with laterals is gradual, and may begin at less than 1 mm. diameter, and is, with few exceptions, complete at 4 mm. diameter, when the shell has the typical *Chamæsipho* four-valve form. All sutures are occasionally completely obliterated at 2 mm. diameter, but often four are easily seen at 5–6 mm. No unfused specimen has been found fertile. The smallest fertile individual examined was 5·5 mm. diameter. The unfused shell is smooth, conical, and rather dark-coloured.

Substratum. Almost invariably on rock; noted also on shells of its own species, on *Elminius plicatus,* and on wood.

Position on Shore. Always the highest species of barnacle where it grows, though sometimes accompanied almost to its highest limit by *C. columna.* Where big waves break high up the cliffs, it extends far above high tide level (e.g., at Poor Knights Is.), and on the roughest coasts forms an almost solid cover on the rocks down to the level of low tide neaps. When the water is calm many individuals are left dry at neap tide. It seems to require a certain minimum of exposure, and with increasing shelter gradually dwindles to a narrower band, giving place below to C. *columna.*

Geographical Distribution. In North Island this barnacle is abundant on all the more exposed coasts, both of the main island and of the smaller island groups. In South Island it is known from only a few localities, from Nelson to Banks Peninsula. It could not be found at Bluff, Stewart Island, or the mouth of Milford Sound, in places similar to those it favours in North Island. Mr G. Simpson, who collected it at Goose Bay, searched vainly for it at Waitati Cliffs and other places near Dunedin, and at Charleston on the west coast. Dr. H. H. Allan, who also and independently collected it south of Kaikoura, failed to secure it in a number of collections from the west coast from the Kowhaihai River to Bruce Bay. As it can be reached even at high tide, it seems fairly safe to assume that it is of very restricted distribution in South Island, and probably does not reach Stewart Island.

A breeding season restricted to spring and summer, and a preference for deep waters suggest that sea temperatures may be the limiting factor.

Type Locality: Lyall Bay, Wellington.

Deposition of Type Material: Holotype, Dominion Museum.

Paratypes, Dominion Museum, Canterbury College, Auckland Museum.

Comparisons and Affinities. The form of the parietal compartments in the six-valved stage, and of the mouth-parts and cirri in the adult leave no doubt that this barnacle should be placed in the family *Chthamalidæ,* and very near to *Chthamalus.* At the four-valve stage the shell fulfils the requirements of the genus *Chamæsipho,* and the adult matches the form generally called *Chamæsipho columna* in the complete fusion of the parietal valves, in the elongated tergum with deeply sinous scutal margin, and in the pits for the tergal depressors. The main structural differences are the much greater size, the shell laminate on corrosion, not pitted, the absence of adductor ridge on the scutum, the smooth internal surface of the tergum, the body brown, not blue, mandibles with three teeth, not four, rami of cirri II and III with larger pectinate spines, not differing greatly in length, and rarely if ever antennæform, posterior cirri with a tuft of intermediate spines between the main pairs, of which there are usually four, not five.

" Mr Cuming's great Australian specimen," described by Darwin (1854, p. 472) under *C. columna,* shows a similar setation of the posterior cirri, the same order of size (0·55 inch diameter x 0·3 inch high), and conspicuous, large pectinated spines on the anterior cirri, and would appear to belong to the present species.

Where *C. brunnea* and *C. columna* meet they dominate separate but overlapping communities, the former always above the latter, and extending to more exposed aspects, and lacking from estuarine shores.

C. brunnea has a restricted spring and summer breeding season, and has not been found south of Banks Peninsula, while *C. columna* breeds freely throughout the year and is abundant from North Cape to Stewart Island.

Both species of *Chamæsipho* differ from described species of *Chthamalus* in the regular fusion, first of rostro-laterals with laterals to give a four-valved shell, followed by complete obliteration of all sutures in the adult.

Darwin (p. 470) states that "*Chamæsipho* bears nearly the same relation to *Chthamalus* as *Tetraclita* and *Elminius* do to *Balanus.*" Even the youngest shells of *Elminius* show four valves like the adult, not six valves like *Balanus.* Had Darwin seen the six-valved juveniles of the New Zealand Chamæsiphos, he must have considered them more nearly related to *Chthamalus,* and might even have been able to introduce them into the latter genus without " doing violence to the principles of classification " (p. 470).

Should the developmental features shared by the two New Zealand forms be common also to those of Tahiti and to *C. scutelliformis* Darwin, " probably from the seas of China," Darwin, Indian Ocean,

Gruvel (1909), they might best be all united in a sub-genus *Chamæsipho* within the genus *Chthamalus*. A discussion of group relationships is, however, beyond the scope of the present paper.

Elminius plicatus Gray, Plate 46, Fig. C.

Elminius plicatus Gray, 1843, Appendix to Dieffenbach's "Travels in New Zealand," p. 269; Darwin, 1854, p. 351, pl. 12, figs. 2a–2f; Hutton, 1879, p. 328; Hœk, 1883, p. 32; Filhol, 1885, p. 489; Gruvel, 1905, p. 296, figs. 318–321; 1909, p. 26; Pilsbry, 1916, p. 261; Jennings, 1918, p. 62; Broch, 1922, p. 341, fig. 74.

E. rugosus Hutton, 1879, List of N.Z. Cirripedia in Otago Museum, Trans. N. Z. Inst., vol. 11, p. 328; Hœk, 1883, p. 32; Filhol, 1885, p. 489; Gruvel, 1907, p. 1, figs. 1–3.

Distribution. New Zealand, New South Wales (?), Darwin, Australia, Filhol, Indian Ocean, Gruvel (1909).

Specific Diagnosis. Gray: "Valves yellow, strongly plicated and folded, especially at the base; opercular valves thick. The apical part of the valves are much worn; like *E. Kingii* the valves are solid and not cellular. When young, the valves of these shells are purplish white and low."

Darwin: "Shell deeply folded longitudinally, corroded, coloured in parts orange: radii very narrow, with their edges sinuous, and slightly dentated: scutum having an adductor ridge."

This species has been described in considerable detail, and the shell figured very accurately by Darwin (1854). The short note by Broch (1922) adds little and introduces an error in that the peculiar pectinate spines are attributed to Cirrus II instead of to Cirrus III. Broch's figures of labrum, mandible, and maxilla are correct, but other body appendages have not been illustrated. Other published figures of the shell are Gruvel (1905 and 1907), the latter as *E. rugosus* Hutton.

ADULT.

Size. Maximum, diameter, 35 mm., height 25 mm.

Shape. The shape of the shell is related to its position on the shore. Those high up with maximum exposure are tall, tubulo-conical, with orifice little smaller than base; lower down, with decreasing time of emersion, and in pools, both height and size of orifice become less, giving a conical shell with carina straight or concave outwards, rostrum convex outwards, and orifice acentric and nearer the carinal end. Slow growth in height associated with little corrosion of the rim of the orifice would give this latter shape, rapid growth in height with simultaneous rapid corrosion of rim of aperture would give the former.

The two extremes are differentiated by Darwin, and their opercula figured (Pl. XII, fig. 2 c–f). Hutton's type specimens of *E. rugosus* match the conical forms. Field study and the examination of the soft body indicate that these two forms are merely epharmones of the one species. The straight articular ridge of the tergum, mentioned by Hutton, is an inconstant character that may differ on the two sides of one shell.

Orifice. May be toothed.

Surface. Deeply plicate to almost smooth; strong, close, longitudinal ribs. White, commonly more or less corroded to show patches of the alternate smooth yellow and rather chalky white layers of the

shell. Transverse lines of hairs in the juvenile, pitted with age. Sutures sometimes obscure after corrosion, but never quite obliterated.

Radii. Well developed, transversely ribbed, with crenate margin unless much corroded; summits oblique; recognisable at 6 mm. x 4 mm.

Alæ. Well exposed; smmits oblique.

Sheath. Well developed; obvious transverse ridges; definite cavity below.

Parietes. Strong, in largest specimens 5–8 mm. thick at base; interior with a large number of irregular gill-like ridges more or less coalescing, or even, in large specimens, produced into downwardly directed pegs; ridges visible at 2–4 mm.

Basis. Membranous.

Scutum. External surface. Growth ridges plainly marked against sheath; no longitudinal lines or umbo.

Occludent margin: Inflected towards rostral end, forming a deep, slightly twisted cleft at basal angle.

Articular ridge: Straight, may be short, terminates abruptly.

Articular furrow: Usually rather deep and narrow.

Adductor ridge: Strongly developed, curved, either narrow and sharp or high and rounded; identifiable at 1·5, 3, and 6 mm.

Pit for adductor muscle: Well defined, usually deep.

Lateral depressor pit: Well developed, crossed by 3–7 sharp crests or ridges.

Basal margin: Often shorter than tergal.

Tergum. Oblong and waisted, or narrowing towards the basi-scutal angle; carinal and basal margins from confluent to at right angles; beak from strongly developed, curved and sharp, to scarcely distinguishable.

Longitudinal furrow: None externally.

Spur: Absent.

Articular ridge: Prominent, slightly arcuate, backed by a deep groove, reaching to the basi-scutal angle.

Articular furrow: Wide and rather deep.

Crests for depressors: 6–10, strong, prominent, may stretch almost across valve; secondary folds on sides.

Soft Body. Labrum: Notch open, fringed with hairs; denticles on oral aspect.

Palps: Spines plumose (or almost pectinate), long above, short below.

Mandible: The second, third and fourth teeth may be double or multiple; the fourth may be obsolescent, or there may be a small fifth on the lower pectinate edge; usually there is a short spur on the lower angle, and bristles below it; surface setose.

Maxilla: Two large spines, followed by a notch with smaller spines; next 10–12 medium-sized spines, more or less paired, and sometimes with smaller ones intermingled; group of smaller spines near lower angle; hairs below lower angle, and tufts of hairs on upper border of gnathite; surface setose.

Second Maxilla: Inner surface with a deep notch, hairs plumose.

CIRRI.

I. Rather widely separated from II. Both rami short and stumpy in juvenile of 4 mm. diameter; in adult, anterior ramus 5–9 segments longer (e.g., 13:8, 20:11), paler, tapering distally; posterior ramus and basal part of anterior show dark with many grooved plumose spines.

II. Rami subequal, intermediate in length between Ia and Ib; stout, blunt, bullate inwardly, with many grooved plumose spines, but less densely covered than I.

III. Rami at first both short and stout like those of II (e.g., in juveniles of 1·5–2 mm. diameter) and occasionally found so in the adult. Usually the posterior, and quite frequently the anterior also, becomes very long, often twice as long as II and sometimes longer than IV. Basal segments of both are stout and dark, bullate, with many spines and, usually on segments between the second and the tenth, many grooved pectinate spines; distal to the pectinate spines, each long ramus tapers and becomes antennæform.

Examples:—

a 9, pectinate spines on 4th to 8th segments.
b 10, pectinate spines on 2nd to 7th segments. } Juvenile
a 10, pectinate spines to end.
b 18, pectinate spines on 2nd to 10th, rest antennæform.
a 30} 8th to 10th with pectinate spines, rest antennæform.
b 30}

Though two long antennæform rami of III are found most often in large specimens, not all large individuals show this. IIIb is nearly always partly antennæform in adults, and most localities provide examples with IIIa similar. No correlation could be traced between shape or proportions of shell or any diagnostic character, and the development of an antennæform IIIa.

IV–VI. Average about 20 segments. An intermediate tuft of small spines between the spines of larger size, of which there are usually three pairs on median segments, less frequently four or two pairs.

Penis: About as long as Cirrus IV; emerging between Cirri I and II.

Reproductive Season. Nauplii have been taken from shells in every month except April.

Juvenile Form. Four-valved at 0·5 mm.; surface with lines of hairs 0·1 mm. long.

Substratum. Most commonly rock, including soft sandstone; on concrete, on one another, very commonly on mussel shells (e.g., *Mytilus canaliculus, M. planulatus, Volsella* spp.), less frequently on *Sypharochiton, Mitella sertus,* and occasionally overgrowing sheets of *Chamæsipho columna.*

Position on Shore. From high tide neap to low tide neap, reaching greatest abundance from high tide neap to half tide in suitable localities on rock (e.g., on papa at Waiwera and Mahurangi Heads) growing tall and columnar in extensive sheets as the physiognomic dominant. Lower down, low-growing individuals are usually scattered, often on or amongst mussels.

Geographical Distribution. Common throughout New Zealand (see map). Specimens examined also from Chatham and Auckland Islands.

Elminius modestus Darwin. Plate 46, Fig. D.

Elminius modestus Darwin, 1854, Monograph of the Cirripedia, p. 350. pl. 12, figs. 1a–1e; Hutton, 1879, p. 328; Hœk, 1883, p. 32; Filhol, 1885, p. 489; Gruvel, 1905, p. 296, figs. 319–322; Pilsbry, 1916, p. 261; Jennings, 1918, p. 62.

E. sinuatus Hutton, 1879, List of N.Z. Cirripedia in Otago Museum, Trans. N.Z. Inst., vol. 11, p. 328; Hœk, 1883, p. 32; Gruvel, 1905, p. 295; Jennings, 1918, p. 62; Broch, 1922, p. 342, fig. 76.

Distribution. New Zealand, New South Wales, Van Diemen's Land (Darwin), Chatham Is. (recorded by Young, 1929), Tasmania, Victoria.

Specific Diagnosis. Darwin: "Shell folded longitudinally, greenish or white; radii of moderate breadth, smooth edged; scutum without an adductor ridge; tergum narrow, with the spur confluent with the basi-scutal angle."

Darwin's original description of this species is fairly full, and he figured the complete shell and isolated opercular valves. All points mentioned can be verified with ease.

Broch, under *E. sinuatus* Hutton figures two entire shells, opercular valves internal and external views, mandible and maxilla. The broad, rounded folds or cristæ which Hutton designates as characteristic and diagnostic features of *E. sinuatus,* he says are not always distinctly developed. In describing the opercular plates, which Hutton mentions in the type description as being almost identical with those of *E. modestus,* he says the differences are obvious, and specifies "Only two or three small crests are developed for the depressor of the tergum, and the spur is confluent with the scutal margin; in the scutum an adductor ridge is feebly developed and indistinctly limited; the interior side of the scutum is on the whole very feebly sculptured." All these features are directly or indirectly attributed to *E. modestus* in Darwin's type description and are adequately represented amongst Hutton's type specimens. It is difficult to see that Broch's specimens distinctly differ in any way from Darwin's "dates of *E. modestus,*" which one can hardly agree to call "rather scarce" compared with Hutton's few-line diagnosis, on which Broch seems to have based his determination.

Jennings (1918) says "*E. sinuatus* Hutton is probably only a variety of *E. modestus* Darwin. In groups of *E. modestus* many young specimens have parietes of each valve with two rounded folds, referred to by Hutton in his description of *E. sinuatus.* The two distinct folds show also when specimens are not crowded together."

The present writer, after confirming Jennings's field observations in many places, including the type locality of *E. sinuatus,* and after studying Hutton's type material, unhesitatingly quotes *E. sinuatus* as a synonym of *E. modestus,* with no claims even to varietal rank.

ADULT.

Size. Largest diameter, 13 mm.; greatest height, 9 mm.; average, c. 5 x 4 mm.

Shape. Conical, with flat, not convex, sides; often depressed, occasionally tall, conical, rarely cylindrical.

Orifice. Broadest towards the carinal end.

Surface. More or less plicate, with two or more broad, open grooves and ridges on each valve; from white to pale grey or greenish; often smooth, becoming finely pitted when corroded.

Compartments. Of about equal lengths at base; carina narrow and spout-like at apex, but with wide alæ.

Radii: Little differentiated, almost smooth-edged.

Alæ: Very wide, obliquely truncated at orifice.

Sheath. Short, with slight cavities or pits below.

Parietes. Solid, usually thin, sometimes translucent; inner surface fluted but smooth, white or grey.

Basis: Membranous.

Scutum. External surface: Growth ridges evident throughout, longitudinal ridges absent; no umbo.

Occludent margin: Slightly inflected towards rostral end; either strongly or little thickened; no basal cavity.

Articular ridge: Moderately developed.

Articular furrow: Rather wide.

Adductor ridge: Usually indistinguishable, when best developed merely a rounded prominence.

Pit for adductor muscle: Occasionally well marked; sometimes bordered above by a row of tiny pits from the tergo-occludent angle.

Lateral depressor pit: Represented at most by a slight twisted hollow.

Basal margin: Not greatly different in length from tergal margin; may be slightly longer or shorter.

Tergum: Roughly triangular, narrowing rather suddenly below the depressor crests, tapering, and often longitudinally channelled or grooved inside towards the basi-scutal angle; rarely any indication of beak.

Spur: Absent.

Articular furrow: Wide.

Articular ridge: Arcuate.

Crests for depressors: Two to three tabular ridges occupying the basi-carinal corner; occasionally strongly developed with subsidiary crests.

Soft Body. Labrum: Sinus deep and narrow, with 2 or 3 teeth on each side.

Palp: Long smooth spines distally, and on upper side shorter plumose ones.

Mandible: Five teeth, of which the four smaller ones are double or multiple; a short pectinate edge terminating in a short curved spine; long bristles below lower angle and on upper border.

Maxilla: Two large spines followed by a notch with about four fine spines, then three strong and 5–6 finer spines; bristles on oblique lower margin.

Second maxilla: Dark, tipped with long smooth spines.

CIRRI.

I. Anterior ramus of 10–20 segments, the basal 5–9 bullate and thickly beset with spines, the distal segments paler and antennae-form—i.e., with a distal ring of spines; posterior ramus

of 5–7 segments, all dark, bullate, and with many spines; plumose spines often present on bullate segments.

II. Both rami short and stout, 6–9 segments, all bullate, and with many plumose spines among the smooth ones.

III. Anterior ramus 1–3 segments longer than posterior (e.g., 9:8, 12:10, 12:9), segments bullate, with many spines, some of which, especially towards the tip, are strongly plumose and more or less grooved.

IV–VI. About 20 segments, median ones carrying usually 5 pairs of spines anteriorly, the proximal often very short.

Penis: Much longer than the cirri, emerging between I and II.

Reproductive Season. Nauplii have been taken from shells in every month and juveniles are always plentiful. In Auckland Province breeding is certainly continuous throughout the year, and the same may well be the case all round the coast.

Juvenile Form. The smallest juvenile shell seen had a diameter of 0·5 mm. Juveniles show no trace of colour, and are almost transparent. Parietal valves are 4 as in adult, but with alae relatively small.

Rate of Growth. In Ngataringa Bay, Auckland Harbour, on newly developing mangrove leaves, and on surfaces scraped clean (wood and iron on a barge, mangrove bark, rock) these barnacles took two and a-half to three months to grow to maturity—i.e., to produce nauplii. Marked adults lasted up to six months. Test planks submerged for six months at Karaka Bay, Wellington, had a heavy growth of *Elminius modestus*, about half of them with nauplii.

Substratum. The nature of the substratum seems immaterial if conditions otherwise are suitable. The following substrata have been observed:—Rock—all kinds, but those that are pitted, bored, or undercut seem particularly suitable.

Concrete of piles, fillings and breakwaters.

Iron stakes, rails, old wire, keels of boats.

Wood of piles, stakes, sleepers, barges, launches and perhaps bigger vessels; stabilized drift wood; indiscriminately on many different species of timber in Wellington Harbour Board's test planks.

Living plants—e.g., pohutukawa roots, the seaweed *Hormosira banksii*, trunks, pneumatophores, and leaves of mangrove (*Avicennia*).

Other cirripedes of its own species, *E. plicatus, Chamaesipho columna, Balanus trigonus, Mitella sertus, Lepas anatifera* (recorded by Jennings on the hull of the Terra Nova at Lyttelton).

Bivalves—e.g., *Mytilus canaliculus, M. planulatus, Volsella* spp., living rock oysters or their exposed lower valves, vacated tubes of teredo.

Univalves—relatively stable forms—e.g., *Cellana ornata, C. radians*, and others of limpet form, *Crepidula* sp.; more active animals, e.g., *Amphibola, Cominella, Haliotis australis, Lepsiella scobina, Lepsia haustrum, Neothais scalaris, Nerita melanotragus, Melagraphia aethiops, Lunella smaragda.*

Crabs—e.g., *Ozius truncatus, Leptograpsus variegatus.*

Miscellaneous living animals—e.g., *Sypharochiton pellisserpentis*

and other loricates, the ascidians *Pyura trita* and *Cnemidocarpus cerea,* the brachiopod, *Terabratella inconspicua.*

In one observed case where contiguous wood and iron surfaces were available, the wood was colonized much the faster.

Position on Shore. Darwin (1854, p. 348) states: "At Sydney I found *E. modestus* adhering to oysters in a muddy lagoon, almost separated from the sea and apparently very unfavourable for cirripedes." Hedley (1915, p. 45) does not refer to *E. modestus, Balanus trigonus* being the only sessile barnacle mentioned in his account of muddy estuarine reaches where mangroves thrive.

Darwin picked on the most striking ecological attribute of *E. modestus,* its ability to withstand brackish and very muddy water. In New Zealand, this is the barnacle that penetrates furthest into harbours and estuaries, and it is the typical, and probably the only barnacle of mangrove forest and *Zostera* beds. It is also found in the more sheltered niches of open coasts with clean water, but will stand only moderate wave action, and is absent from the most exposed stretches of rocky coast.

In its relation to tide level it is fairly versatile. Where fresh or brackish water seeps over a rock or where a damp shaded ledge is available, this may be the highest barnacle; usually, however, it holds the middle levels, where, as in slight shade on wharf piles or under mangroves, it may form an almost pure and quite conspicuous community. It is unlike the other belt-forming intertidal barnacles in that it grows not only on the upper rock and other surfaces, but also on the under side of stable boulders (e.g., where the half-crab *Petrolisthes elongatus* hides), and also some feet at least below low tide level. In Auckland, mussels dredged from a depth of two fathoms may be covered with these barnacles. In Wellington they were equally abundant throughout the three feet depth of submerged test planks, and to the same depth on the sides and bottom of a Harbour Board barge.

Where a good current runs these barnacles grow exceptionally strongly and to an unusually high level. When growing on horizontal substrata, they are often protected by a layer of silt with or without small algae. Vertical rock, washed clean and facing the sun is not favourable, and the species will be replaced in such places by *Chamaesipho columna. E. modestus* favours moving animals as hosts, and on them occurs at a distance from its nearest stable substratum—e.g., on sandy mud flats.

Amongst mangroves, growing on pneumatophores and lower stems and leaves it thrives best on the edge of channels, where the current is faster, and in such places has been seen to smother and kill seedling mangroves. Dislike of insolation may explain why, as at Pt. Chevalier Reef, Auckland, it sometimes grows on the trunks of inshore mangroves, but not on the rocks nearby.

Resistance to dessication is considerable. A group of specimens on a mangrove leaf was left without water on a sunny laboratory bench for ten days in early December. Upon being put into fresh water, the majority opened up and displayed active feeding movements.

Geographical Distribution. In favourable situations *E. modestus* is found throughout New Zealand, and is as plentiful, for example in Deep Cove, Doubtful Sound, as it is in Mair Creek, at the head of Whangarei Harbour.

Specimens were examined also from Brown's River, Tasmania (coll. W. R. B. Oliver) and from near Melbourne, Victoria (coll. G. Dingley).

OTHER SPECIES.

The following cirripede species have been recorded for the littoral of New Zealand, in addition to the four principal ones treated above. Purely sublittoral species are not included.

STALKED BARNACLES.

Calantica villosa (Leach) Gray, from Stewart Island, Broch; Dunedin, Hutton (as *Scalpellum villosum*); several localities, Auckland to Stewart Island, Jennings (as *S. villosum*).

Protomitella paradoxa Broch, from Slipper Island, Plimmerton, Broch.

Mitella sertus (Darwin) from Hen and Chickens Islands, Broch; as *Pollicipes sertus* Darwin by Filhol, no locality; and as *P. spinosus* (Q. and G.) from Cook Strait to Stewart Island, Filhol; from Wellington and Dunedin, Hutton; several localities from Russell to Port Pegasus, Jennings; from Chatham Island, Young; and as *Pollicipes Darwini* Hutton from Dunedin, Hutton, Filhol.

SESSILE BARNACLES.

Balanus campbelli Filhol from Campbell Island, Filhol, Broch.

B. amphitrite Darwin from Dunedin, Cook Strait, Filhol.

B. amphitrite var. *variegatus* Darwin from Dunedin, Hutton.

B. trigonus Darwin from Kawau Island, Broch; Rangitoto Reef, Jennings; and as *B. porcatus* Da Costa from Stewart Island and Campbell Island, Filhol; Campbell Island, Hutton; Auckland, Jennings.

B. vestitus Darwin from Auckland Island, Broch; Stewart Island, Middle Island, Filhol, Stewart Island, Hutton.

B. decorus Darwin from Bluff, Filhol; Dunedin, Hutton; New Brighton, Wanganui, Chatham Island, Auckland Islands, Jennings; Kermadec Island and many localities in North and South Island, Linzey.

B. tintinnabulum subsp. *tintinnabulum* (Linnaeus) from Kermadec Is., Linzey.

B. tintinnabulum var. *concinnus* Darwin from Poor Knights Islands, Cranwell and Moore.

Tetraclita purpurascens (Wood) Darwin from Auckland Islands, Broch; Cook and Foveaux Straits, Filhol; Wellington, Bluff, Hutton; Otago, Jennings; Kermadec Island, Linzey; and as *Conia depressa* Gray from Bay of Islands, Gray.

T. rosea (Krauss) from Kermadec Island, Linzey.

T. porosa (Gmelin) Darwin (?) from Poor Knights Islands, Cranwell and Moore.

Elminius simplex Darwin from Kermadec Island, Linzey.

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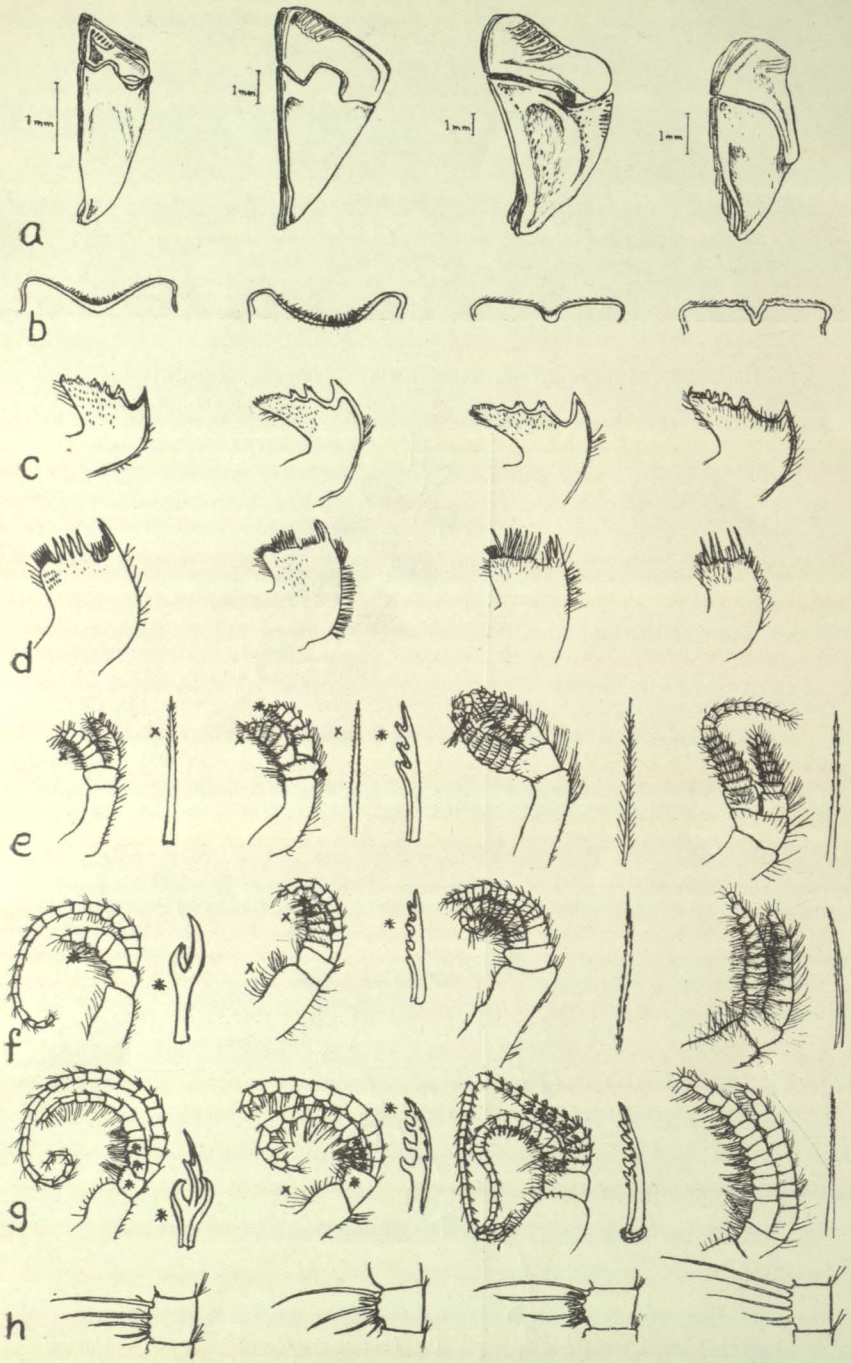

A *C. columna* B *C. brunnea* C *E. plicatus* D *E. modestus*

Dissections. *Chamaesipho columna* from Karaka Bay, Wellington; *C. brunnea* from Lyall Bay, Wellington; *Elminius plicatus* from Lyall Bay,; *E. modestus* from Islington Bay, Rangitoto.

a, opercular plates seen from within; *b*, labrum; *c*, mandible; *d*, maxilla; *e*, *f*, and *g*, cirri I, II, and III, with examples of spines; *h*, 7th segment of anterior ramus of cirrus V.

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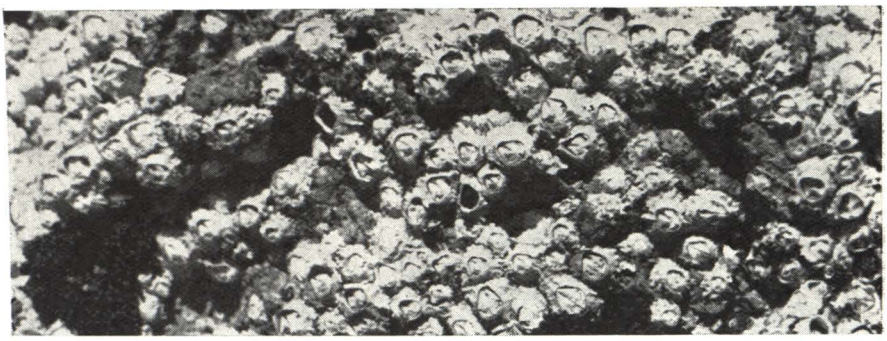

FIG. 1.
Chamaesipho brunnea on Poor Knights Islands, natural size.
Photo L. M. Cranwell.

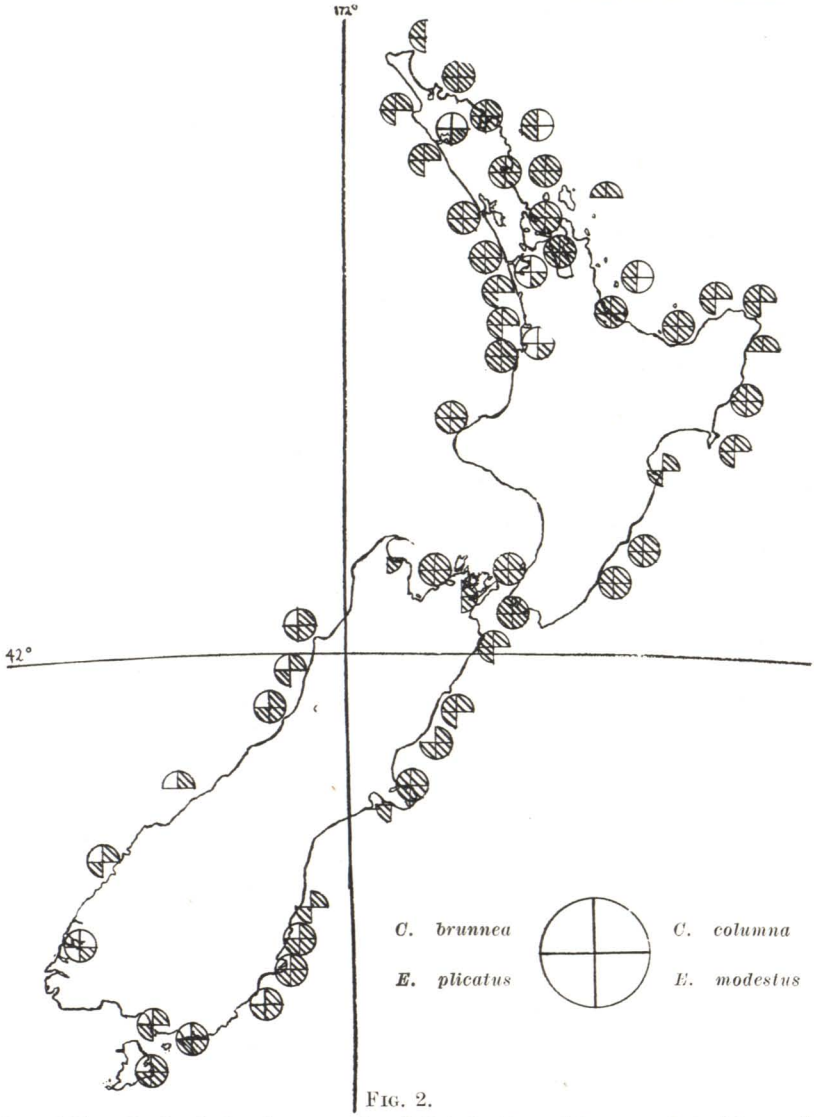

FIG. 2.
Map of New Zealand showing records of distribution of four species of barnacles. Hatched quadrant indicates presence, unshaded quadrant absence; the circle is incomplete where information about some species is wanting.