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AUCKLAND PREHISTORY: A REVIEW

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Abstract. Archaeological excavations in the Auckland area are reviewed. The sites, which vary greatly in size and nature, include volcanic cones, fortified sites, unfortified settlements and coastal middens, dating between approximately A.D. 1300 and 1800. Chronological changes in material culture and subsistence are defined. It is concluded that horticulture, fishing and shellfish gathering formed the basis of the economy and that changes of material culture cannot readily be correlated with changes in other aspects of culture in prehistoric Auckland.

This paper reviews the prehistory of greater Auckland as revealed by excavations in the past 20 years. The region considered centres on the Auckland isthmus but includes the mainland as far north as South Kaipara Head and as far south as the Waikato Heads on the west coast, a comparable stretch of the east coast, and the inner islands of the Hauraki Gulf. It thus lies on the boundary between Skinner's (1921) Northern and Central Culture Areas, and as might be expected from its rather fragmentary traditional history, indicates pressures and influences from both. The archaeological remains, while exhibiting considerable diversity, also show some unifying features, particularly in material culture. It thus seems appropriate at this stage in our knowledge to review the prehistory of this relatively compact region within a single framework.

Almost 20 years have passed since the publication of Golson's influential theoretical paper which defined an Archaic and a Classic Maori Phase of New Zealand East Polynesian Culture and suggested possible sequences linking the two (Golson 1959). Relatively little progress has been made in establishing a New Zealand wide sequence, partly because of continuing attempts to combine economic and social change with the changes in material culture on which Golson based his paper. It has become increasingly apparent that attention should be directed towards regional sequences, and that what holds good in one region need not apply in another. In some parts of the country, however, regional sequences have also proved elusive, because of the lack of stratified sites, the diversity of site types, and the difficulties of arranging them in chronological sequence.

The Auckland area exemplifies these difficulties. Although quite a number of excavations have taken place, it is not possible to set out a satisfactory sequential account of what happened in Auckland during the last 1000 years. In the following discussion, therefore, the evidence is reviewed under several headings, most of which relate to site type. In this way, it is possible to see what kinds of activities were taking place in the region at various times. Because the relationship between "Archaic" and "Classic Maori" remains a major preoccupation of archaeologists, these terms are retained here to describe material culture, and Golson's definitions are broadly followed. It is a major thesis of this paper, however, that changes in economy and social structure cannot readily be combined with changes in material culture to establish an overall cultural sequence for the region.

Sites with "Archaic" material culture

Assemblages of Archaic material come from three off-shore island sites, and one or more mainland sites on the southern shore of the Manukau Heads. With the exception of the last, whose remains are undated, none of these sites is likely to be older than A.D. 1300. It seems probable, therefore, that the earliest occupation of the greater Auckland area is as yet largely unknown.

Two stratified sites on Motutapu Island, Pig Bay (N38/21) and the Sunde Site (N38/24) have furnished important sequences. Motutapu Island was blanketed by fine volcanic ash, erupted from the adjacent volcano of Rangitoto at a point near the beginning of the known occupation of the area. The dating of this ash shower has proved difficult; the most likely age is mid-fourteenth century (Law 1975a). This is of great importance archaeologically, since the relevant Archaic artefacts are almost all stratified above the ash layer, and must therefore postdate it.

Principal activities at both sites seem to have been fishing and the manufacture of stone adzes. Both sites are situated in the northwest part of the island on small sandy flats adjacent to stream mouths. In each case a series of occupation layers is stratified between layers of windblown sand and water-laid volcanic ash redeposited from the surrounding slopes. Local greywacke, used for adze manufacture, outcrops nearby. Minor bands of cherts and jaspers exist in the greywacke and have been used for hammerstones. At the Sunde site, the earliest layer is stratified beneath a primary deposit of Rangitoto ash; carbon dates for this layer and the one above, however, suggest that the first occupation was immediately before the eruption, and that the site was reoccupied soon aferwards (Davidson 1974a).

The richer Pig Bay site provides the most detailed information on material culture. Its complex sequence may be summarised as follows.

Evidence of adze manufacture using local greywacke is found throughout the site, with particular concentrations in the early layers 15 and 13, and layers 8 and 5. Archaic adzes of Duff's (1956) Types 1A, 4A and 5 are present up to and including layer 8, in association with untanged quadrangular adzes and small flake adzes. Above layer 8, however, only roughouts of undiagnostic appearance and predominantly quadrangular section were found.

From the earliest layers (15 and 16) came a small assemblage of fishing gear comprising four broken bone one-piece hooks, a shell hook fragment, two bone points identical to the one-piece hooks in shape but perforated for attachment to the shank, two hook tabs and a dorso-ventrally perforated bone lure shank. Files and drill points were also found in these layers. Layers 14 to 12 yielded four one-piece bone hooks, one of which, although typically Archaic in shape, has ornamental notches on the outside of the shank, a hook tab centre, a broken stone lure shank which probably had a dorso-ventral perforation, and a shell point for a two-piece hook, elaborately notched for attachment to the shank. Other items from these layers were a drill point and three files, a bone needle, a piece of worked bone which could be a blank for an imitation whale tooth pendant and an elaborately flaked circular object which could be a blank for a stone pectoral amulet. From layer 8 came a number of fragments of shell fishhooks, one of which has decorative notching on the outer edge, four broken one-piece bone hooks, a large bone point fragment which may be either from a one-piece hook or a composite bait hook, some segments of *Dentalium nanum*, two bone lure shanks, one grooved, the other unfinished, a bird spear, a perforated seal tooth, and some files and drill points.

Above layer 8 very few items other than adze blanks were found. Bait hooks disappeared completely except for one shell point in layer 7. Three small grooved bone lure shanks were found in layers 7, 5 and 4, and one stone file in layer 5.

The essential points of this sequence are the association of bone and shell bait hooks throughout the lower half of the deposits, the replacement of the dorso-ventral lure with the grooved lure which continued almost to the top of the site, and the fact that the recognisably Archaic adzes are from the first half of the sequence, whereas evidence of adze manufacture by flaking is present throughout.

On the evidence of stratigraphy and radiocarbon dating, level 4 and the pre-Rangitoto ash deposit at the Sunde Site should be contemporary with or earlier than the lower part of the Pig Bay sequence (Davidson 1974a). The limited material includes a bird bone bead, parts of two one-piece bone hooks and one or two fishhook tabs, chert and greywacke drill points and a small collection of adze blanks including probable examples of Types 1A, 2A and 4, as well as examples with diamond-shaped cross-section (Davidson 1970a). The solitary complete adze cannot be classified according to Duff's typology. Level 3, with a grooved lure shank, a fishhook tab, files, drills and some 17 roughouts, still with a range of cross-sections, probably correlates with the middle of Pig Bay (layer 8). Level 2 with two quadrangular sectioned roughouts and some drill points and level 1 with only a partly drilled dog tooth may correlate with the upper levels at Pig Bay

The entire sequence at Pig Bay is bracketed in time between the eruption and a solitary radiocarbon date of A.D. 1670 $\pm$ 40 [all radiocarbon dates quoted in this paper are based on the old half life of C14 and have not been adjusted for secular effect]. A broad estimate for that part of the sequence which contains the more diagnostic Archaic material might be A.D. 1350 to 1500.

Within this general time range is probably to be associated Archaic material from a badly disturbed site at Motunau Bay on Ponui Island (N43/1), notably one-piece bone fishhooks, material relating to their manufacture, and two grooved stone lure shanks (Nicholls 1964).

It should be noted that the "Archaic" elements in these assemblages are largely restricted to adzes and fishhooks. Little is known of ornament forms, the only definite specimens being the bird bone bead from under the ash at the Sunde Site and the collection of dentalium units and perforated seal tooth from layer 8 at Pig Bay. The possible stone pectoral amulet and bone pendant from layer 13 at Pig Bay would strengthen the Archaic ornament content.

Knowledge of the Archaic occupation at Wattle Bay, Manukau South Head, rests largely on surface collections from eroding beach faces made over the years by a local resident. In this collection a very full range of Archaic material is represented, including a full adze kit with Types 1A, 2C, 3A, 3B, 4A and 5; a harpoon point, a fragment of a very large two-piece bone hook and a stone amulet of the kind described by Duff (1950: 110) as a hybrid reel. A controlled excavation in one site (N46-47/16) in this area revealed two thin cultural deposits beneath a very deep overburden of sand. An undiagnostic adze roughout, a finely polished, triangular-sectioned stone chisel, a fishhook blank, a file, drill points and chert and obsidian flakes were the only artefacts recovered (Ambrose 1961).

The diet of the inhabitants of these several "Archaic" sites is best described from the Sunde Site. The thin occupation layer beneath the Rangitoto ash contained remains of ten species of sea bird, six species of bush bird, two ducks and several extinct species including moa, crow and eagle. There were also tuatara, seals, dogs and large quantities of fish, mostly snapper (Scott 1970; and subsequent unpublished work by Davidson). The faunal remains decreased markedly in later layers, and although this must partly reflect changing conditions on the island and the disappearance of bush birds and extinct species after the eruption, it must also reflect changing activities, since sea birds, for example, must still have been available. Bones of whale, porpoise and moa were found at Pig Bay up to and including layer 8, but above this only dogs and seals (also present in earlier layers) were found. Bone remains at Motunau Bay included dog, rat and moa, with a limited range of sea and land birds.

The moa bones from the three off-shore island sites are largely or entirely of the category of "industrial moa bone" — bones that were brought to the islands for artefact manufacture, rather than actual food remains. Whereas the islands offered in other respects a full range of the same resources that were exploited for food in early sites throughout the country, it is unlikely that moas were found there at all. The most certain evidence of moa hunting in the Auckland area comes from Manukau South Head, where the association of man and *Dinornis* seems clear (Scarlett 1974).

Contemporary sites

The rather inconclusive evidence of radiocarbon dates suggests that occupation of several mainland sites was contemporary with the Motutapu Archaic sites. The mainland sites are very different in kind, however, and failed to produce any diagnostic artefacts from the relevant deposits.

A series of radiocarbon dates from a small living terrace on Wiri Mountain (N42/24) gives broad indications that this small part of a once much larger site may have been first occupied between A.D. 1200 and 1300 (Sullivan 1975) or at least as early as the beginning of the Archaic sequence on Motutapu Island. The interest of this site lies in the evidence for the construction of a stone-walled field boundary on the lower slopes of the volcanic cone before the construction and use of the living terrace. There are strong indications, therefore, that the beginnings of the extensive field systems once associated with most or all of the volcanic cones extend back to the beginning of the known sequence in the area.

A solitary date of A.D. 1430 ± 40 (Golson 1961) for an early point in the complex occupation history of a small part of Mount Wellington (N42/4), suggests that occupation here too began during the life of the Motutapu Archaic sites. Although the date in this instance is not clearly associated with horticultural activity, it is a not unreasonable assumption that occupation on the volcanic cones was intimately linked to the cultivation of their surrounding soils.

A third site whose sequence may partly overlap the Pig Bay and Sunde sites is Otakanini Pa (N37/37) at South Kaipara. Here, Period I, for which the recovered evidence consists of large rectangular and other storage pits, without associated artefacts, is dated to A.D. 1351 ± 78. The possibility that old timber was used must be borne in mind in considering a solitary date of this kind. It is, however, not inconsistent with a series of three dates bracketing the transition from Period II to III at the same site between A.D. 1493 ± 49 and 1653 ± 54 (Bellwood 1971, 1972, 1973). It is possible, therefore, that not only Period I but also Period II at Otakanini was broadly contemporary with the lower half of the sequence at Pig Bay. Defensive ditches were associated with the latter part of Period I and with Period II.

Two sites which may be contemporary with the upper part of the Pig Bay sequence are Rahopara Pa (N38/20) at Castor Bay (the nearest point on the mainland to Motutapu) whose earlier occupation has a date of A.D. 1572 ± 60 (Davidson 1974b) and Pawhetau Point (N43/59) on the mainland west of Ponui Island, from which human bone collagen returned a date of A.D. 1600 ± 80 (Fox 1974).

At Rocky Bay on Waiheke Island (N43/72) charcoal from an oven stratified beneath a deep deposit of agricultural made soil has been dated to A.D. 1540 ± 60 (Law 1975b).

These various dates suggest that horticulture, pit storage, and probably the construction of fortifications were contemporary in the Auckland area with the use of Archaic material culture on Motutapu Island.

Late sites

At this point it is appropriate to consider those sites which on the evidence of radiocarbon dates are later than the Motutapu Archaic sites. The most certain is Waioneke Pa (N37/25) somewhat north of Otakanini, whose entire sequence is bracketed between A.D. 1660 ± 95 (Period I) and the nineteenth century (McKinlay 1971). Waioneke yielded an artefact assemblage of acceptably Classic Maori type with affiliations to Otakanini Period III and several as yet undated sites such as Taylors Hill and Elletts Mountain.

Two sites at Motutapu probably date to the eighteenth century, although both have earlier conflicting radiocarbon dates as well. One is a headland pa (N38/25) and the other an open settlement (N38/37) on a broad ridge. Both are at Station Bay on the eastern side of the island. The pa, particularly, yielded material comparable in some respects to that from Waioneke (Davidson 1972).

A midden at Galatea Bay, Ponui Island (N43/33), dates to the late seventeenth or early eighteenth centuries (Moore & Tiller 1975) but contained almost no artefacts (Terrell 1967).

Important features of the Classic Maori material from Auckland are bone points from composite fishhooks, notched at the base and often barbed, tattooing chisels, bone needles, adzes of Duff's Type 2B, stone *patu* fragments, a perforated stone sinker, paua shell plates and shanks for trolling lures, toggles, simple bone pendants, greenstone adzes, chisels and pendants. Set out in this way, the material seems to be a good Classic Maori assemblage such as Golson defined. However, the numbers of items are very small and many are not really diagnostic. The principal differences between this material and the earlier Motutapu Archaic assemblage lie in the fishhooks and the absence of recognisably Archaic adzes. Yet the Classic assemblage does not include large numbers of 2B adzes and contains some undistinguished and unclassifiable fragments and roughouts which would not be out of place at Pig Bay.

Moreover, the difference in the nature of the sites from which the material comes, and the possibility of different activities in different seasons (including even different types of fishing) should not be overlooked. Finally, it must be said that the most convincing of these assemblages are late (almost certainly later than A.D. 1600) and their appearance seems to have little or no correlation with horticulture, settlement pattern or warfare in the Auckland district.

The volcanic cones

The Auckland volcanic cones have always been regarded as large and complex fortifications, and the impressive terracing of their slopes seen as largely defensive. Excavations on several, however, have yielded no evidence of supplementary defence in the form of palisades, except on the summit of Mount Roskill (Shawcross 1962), and it may be questioned whether defence was their major function. Ditch and bank earthworks on the crater rim of several, notably Mount Wellington and One Tree Hill, and particularly Mount Hobson (Fox 1977) show that in each case relatively small citadel areas were defended. The old view of all the terraces bristling with palisades and manned by huge populations of defending warriors is questionable.

Wherever excavations have been undertaken on volcanic cones (with the exception of Wiri Mountain) complex sequences of levelling of slopes and building and refilling of large rectangular storage pits have been revealed. Taylors Hill (N42/89), Mount Wellington (N42/4), Mount Roskill (N42/11) and Ellett's Mountain (N42/23) in turn have told a similar story, even where there was no surface evidence of such pits. That the cones were lived on, as well as used for storage, is clear from the enormous quantities of shell midden found on them. Little is known of dwellings, however, whose traces are difficult to find in the loose scoria. Stone-edged hearths have been reported from Mount Wellington, Mount Roskill, Elletts Mountain and Taylors Hill, but actual house plans have proved elusive.

Mount Wellington is the most intensively investigated volcanic cone. Three separate excavation programmes between 1960 and 1972 (all in response to imminent destruction of parts of the site) have investigated five different areas. An extensive area of the crater rim near the summit was found to have been artificially levelled but with little sign of actual occupation. This area can be seen as an assembly place or *marae*, or alternatively as a place prepared for occupation (by levelling which quite possibly destroyed earlier evidence) but on which occupation, for some reason, did not take place. Lower on the same part of the crater rim, the probable residence of a family group was revealed, consisting of a series of small storage pits, a cooking area, and some possible house sites. Rubbish from this unit had been thrown down the slope below. In contrast to both these areas, great complexity of occupational build-up was found at one of the lowest points of the crater rim. Here the rim had been artificially extended out into the crater, four large pits had been dug and one refilled and then partly cut away. The other three had eventually also been refilled and sealed with a sterile scoria layer. Only slight traces of cooking and scattered midden were found above this layer. Two large terraces below this part of the crater rim also revealed considerable artificial build-up and on the upper terrace a sequence of pit construction and refilling had probably been preceded by the construction of one or more houses on the terrace. Large quantities of midden were found in both these areas. Finally, a garden area low on the western slopes of the mountain was characterised by stone boundary walls, several large filled pits, and a single oven without associated midden remains.

The general outlines of occupation on the cones, then, are clear. Extensive cultivations were laid out on the volcanic soils surrounding the cones, and where these have not yet been completely destroyed it is clear that there was also considerable habitation (reflected by shell midden and evidence of structures) among the gardens. Storage of the crops and a considerable amount of habitation took place on the raised, well drained slopes of the cones themselves, while in some cases, at least, uppermost areas were fortified.

No analysis of midden from a volcanic cone has yet been published. Such middens consist largely of estuarine shellfish, sometimes with considerable amounts of fish bone. At Mount Wellington, dog and rat were present in some quantity but bird bone was rare and sea mammals absent.

Artefacts have not been numerous in excavations on volcanic cones. Needles, tattooing chisels, bone fishhook points, a bird spear, a toggle, a paua shell hook shank and assorted adzes (including two small nephrite examples from Taylors Hill) make up a small assemblage which is certainly different from Pig Bay, but hardly a rich example of Classic Maori. Among surface finds, two tiny scoria containers, one a figurine, are of particular interest (Fox 1977).

The series of dates for Wiri Mountain gives a general indication of the length of occupation of part of this one site (Sullivan 1975). It is very likely that the visible remains on all these sites today is best interpreted as a long series of shifting occupations, perhaps covering the greatest part of the prehistoric sequence of the area, and contemporary with a variety of other components.

Fortified sites

In striking contrast to the volcanic cones with their depth and complexity of occupation are two headland pa on the northern side of the Waitemata. Limited test excavations on Onewa Pa (N42/27) at Kauri Point, Birkenhead, suggested that it had been occupied only once, and relatively briefly. This site has splendid natural defences in the form of sheer cliffs around almost all sides, and required only the addition of a ditch and bank across the narrow neck. This advantage, however, was apparently outweighed by the lack of good soil in the vicinity. No storage pits were found on the pa, and it would seem that cultivations were not possible, or not deemed worthwhile, in its vicinity. Traditionally it was a fishing pa, but in this capacity it evidently attracted only brief occupation, not repeated.

Rahopara Pa (N38/20) at Castor Bay is on similar soils, but here horticulture evidently was attempted, for there are storage pits. There is also slightly more evidence of habitation. An extensive settlement, not necessarily fortified, occupying most or all of a peninsula is dated at A.D. 1572 $\pm$ 80 (Davidson 1974b). This initial occupation is characterised by large and small storage pits, a cooking area with earth ovens and possibly shelters represented by stake holes, and an accumulation of shell midden to a depth of 30 cm in places. At a later date one corner of the site was converted into a headland pa by construction of a substantial ditch and bank (Green 1970).

Several other pa have more complex histories. As noted above, Otakanini may have been occupied several times over a long period, with substantial rectangular storage pits present from the earliest occupation. There are three stages of the defensive system (Bellwood 1971, 1972). At Waioneke, dating to the seventeenth century or later, use of the site began with a series of large storage pits without associated living debris. Two later occupations reflect the construction of ditch and bank defences and further storage pits, followed by construction of more massive defences and intense habitation without storage pits (McKinlay 1971). Large quantities of shell midden were present at both Otakanini and Waioneke.

The Station Bay Pa (N38/25), a relatively small headland pa on Motutapu Island, has a similar history to Waioneke, beginning with the construction of a group of pits without associated living debris. This was transformed into a pa by the addition of a substantial ditch with an internal palisade across the neck of the headland. The history of the site as a pa appears to encompass an earlier phase when further pits were constructed, and a final phase when the palisade was renewed and there was intensive occupation without associated pits (Davidson 1972, Sullivan 1972).

Complexity was also revealed in excavations at a ridge pa at Orakei (N42/201). The site contained intercutting storage pits of various kinds, but its principal find was a clear and well preserved house floor, 16 x 10 feet (4.9 x 3 m), complete with hearth (L. M. Groube pers. comm. to R. C. Green, 1967). This remains the best example to date of a prehistoric Auckland house.

Considerably further south, an undated site at Maioro (N51/5) revealed two main occupations, both with storage pits of various sizes. Defence at this site depended on scarp and palisade; there is no excavated evidence of a defensive ditch (R. C. Green pers. comm.). The site yielded few artefacts other than obsidian flakes. Several adzes can be considered Classic Maori in type.

"Undefended" sites

Just as the fortified sites display considerable diversity, from the simplicity of Onewa Pa to the complexity of Otakanini, the undefended components vary greatly in size, complexity and even in kind.

Simplicity and specialisation are exhibited by a small storage component at Alberon Park (N42/114), Parnell, where two rectangular pits and possibly a raised storage structure represented by postholes were not associated with any evidence of habitation (Law 1970). Bald Hill (N46-47/22) in South Auckland is a similar but larger site. Restricted excavation uncovered plans of a very large pit and two associated much smaller ones (Allo & McKinlay 1971). Whereas excavations at Bald Hill were so restricted that they may have failed to reveal evidence of other activities nearby, the isolation of the storage unit at Alberon Park was confirmed by inspection of the ridge following removal of topsoil in preparation for quarrying.

Other sites, however, whose surface evidence consists largely or wholly of pits have been found when excavated to contain evidence of a wider range of activities. Three sites provide a glimpse of life in unfortified hamlets. Two are at Station Bay on Motutapu Island, one at Hamlins Hill (N42/137) on the mainland. At all three sites, storage pits were associated with cooking and dumping areas and evidence of tool manufacture and use. Houses were found at one Motutapu site and at Hamlins Hill; isolated burials were discovered in both Motutapu sites.

A convincing reconstruction of occupation on one terrace on a ridge at Station Bay (N38/30) has been made on the basis of excavation (Leahy 1970, 1972). A house and two storage pits were set out around a small open space, with a cooking area to one side. A well beaten path wound up through this complex to other parts of the settlement further up the ridge. In this case, the long narrow ridge had concentrated one domestic unit on one terrace, a simplicity that was not achieved at the other two sites under consideration because they are both on relatively flat broad areas of ridge or hilltop.

The second Station Bay site (N38/37) revealed a series of pits of various kinds, mostly contemporary, but with at least one earlier than the main group and one possibly later. No houses were found in the excavated area, but there was abundant evidence of cooking and living on the site in the form of midden, oven debris and a range of rather undiagnostic artefacts (Davidson 1970b).

Hamlins Hill, still under excavation, also contains houses, storage structures and evidence of cooking and dumping. During the period the site was occupied, the focus of activity shifted several times and at least three phases of activity can be detected in some parts of the site. With its houses, drains, and fences dividing the settlement, Hamlins Hill provides the best evidence of settlement lay-out of any site yet investigated in Auckland. The continuing excavations have been reported by several different writers (Davidson 1970c, Irwin 1975, Pearce 1975, 1977).

The artefact assemblages from these sites include flakes of obsidian and other stone, hammerstones and grindstones, and stone adzes which are untanged but hardly typical 2B. Greater wealth is merely hinted at by a few fragments — a tattooing chisel from one site, a broken fishhook point and the tiny fragment of a greenstone pendant from another. No real distinction can be drawn between the sparse and undiagnostic collections from these sites and the equally restricted collections from the volcanic cones, particularly Mount Wellington.

In the absence of precise dates these sites could be assigned with equal reason to almost any point in the sequence. One of the Station Bay sites (N38/37) as noted above is almost certainly eighteenth century in date. A single radiocarbon date on bone collagen suggests that the other, N38/30, may be several centuries earlier. There is no date as yet for Hamlins Hill.

A very different type of undefended site is Galatea Bay (N43/33) on Ponui Island. Like the Motutapu Archaic sites it is a midden on a small flat by a stream mouth, but its content is very different from all but the latest layers of the Motutapu sites. The deposit was shallow, and reflected only cooking and dumping activities. The midden consisted of shellfish and fish, with a few bones representing one human and one dog. The site has been interpreted as probably occupied by a small group of people for not more than three months in the summer, who were engaged in fishing and shellfish gathering, and preserving at least part of their fish catch for later consumption elsewhere (Shawcross 1967). The only artefacts apart from some possibly used shells were two broken adzes used as oven stones, an adze flake and what is probably the shell tip of a composite fishhook very similar to an example from a cave site at Manukau North Head (Terrell 1967). The apparently late age of Galatea Bay is confirmed by two radiocarbon dates suggesting a late seventeenth or early eighteenth century date.

Discussion

The above review of excavated evidence from the Auckland region demonstrates the diversity of site components and the difficulties of precisely grouping them, points made by several previous writers (e.g. Green & Shawcross 1962, Green 1963, Terrell 1967). Yet despite the difficulties of dating sites, certain chronological changes can be observed. First, however, the archaeological landscape in which the excavated sites exist should be briefly considered.

The development of a large modern conurbation centred on the Auckland isthmus has utterly obliterated an unknown but significant part of the Auckland archaeological landscape. In some peripheral parts of the region, however, large numbers of prehistoric sites have survived into the second half of the twentieth century and it is possible to gain a better appreciation of the proportions and distribution of various kinds of sites. Motutapu Island is a good example. Here there are 12 pa, 14 beach middens including Pig Bay and the Sunde Site, and probably more than 300 "undefended" sites varying from isolated pits to extensive settlements. It is in this context that the five excavated sites on the island must be viewed. Clearly the Archaic middens are unusual in this landscape, whereas the two excavated undefended settlements at Station Bay are a very small sample of what is overwhelmingly the most common form of archaeological evidence on the island. The sheer number of these sites, moreover, suggests that they must have been built over a considerable period of time — probably throughout the 400 or 500 years following the Rangitoto eruption. Motutapu is not unique. A similar picture was revealed by an intensive survey of the eastern parts of Waiheke Island. Even at South Kaipara, noted for its pa sites, unfortified sites far outnumber them.

On the Auckland isthmus much occupation undoubtedly centred on the volcanic cones. Indeed the proportion of undefended to defended sites can be seen to be rather similar to Motutapu if the terraced slopes and surrounding gardens are taken as "undefended" and only the ditched citadels regarded as fortified. Alberon Park reminds us that there were other sites on the isthmus — an unknown number — but the amount of prehistoric effort put into sites such as Alberon Park or Onewa Pa was surely negligible compared with that devoted to the volcanic cones and their immediate surroundings.

The distinction between volcanic cones, other fortified sites and undefended sites is useful to archaeologists, but in terms of prehistoric life can be misleading. The bulk of the archaeological evidence in the Auckland region relates to the everyday activities of people who were horticulturalists, fishers and shellfish gatherers, and who sometimes fortified their settlements or built citadels.

A remarkable feature of the Auckland sequence is its dating, as understood at present. The bottom layers of Pig Bay and the Sunde Site are similar to some of the earliest sites known elsewhere in the country. If they really date to the fourteenth or fifteenth century they require the prehistory of the region to be compressed into 500 years or less. A rather similar situation exists in the Coromandel, however, and there is as yet little evidence for occupation of the northern half of the North Island until long after more southern parts of the country had been settled.

Within the 500 year period for which we have good evidence several major changes can be observed. There is a change through time from the exploitation of a wide range of birds and other animals to a consistent reliance on fish and shellfish for protein. The wide range of species, however, was really evident only in the lowest layer at the Sunde Site and thereafter birds became relatively unimportant, even in deposits with what still appears to be an Archaic material culture. There is as yet no evidence that moas were ever important as food in the Auckland area, although discovery of sites dating earlier than the fourteenth century could reverse this opinion, since moas were naturally present in the area in earlier times. The change was accomplished quickly. The predominance of fish and estuarine shellfish is found not only in what may be specialised food processing sites such as Galatea Bay but in the undefended sites both on the mainland and on the islands, on the smaller pa throughout the district and on the volcanic cones. It appears that the bulk of the protein food of Auckland Maoris came from fish and shellfish, at least from about A.D. 1400.

It is also evident that horticulture, reflected by field systems, flourished from the beginning of the known sequence. The date of appearance of storage pits is less certain, but the evidence from Otakanini suggests that they, too, may have been present from the beginning of the known sequence. Horticulture and fishing, then, were the basis of the economy for several centuries.

Within the 500 year period, there were also significant changes in material culture. One-piece bait hooks which even in the early layers of Pig Bay were sometimes made from mammal rather than moa bone, dropped out in favour of the two-piece composite bait hook with bone or shell point and wooden shank, already foreshadowed in the shell hooks at Pig Bay. There is so far no sign of the small highly decorated Classic Maori one-piece hooks known from the Bay of Plenty. Trolling lures followed the Archaic style for longer, with the grooved lure shank replacing the dorso-ventral forms and continuing in use probably very late in the sequence, as it did in the Bay of Plenty and the East Coast. Evidence for the kahawai lure is slight and confined to the most recent sites.

The standard Archaic adze types eventually gave way to the Classic Maori 2B, but throughout the sequence local rocks were worked to produce nondescript but probably functional adzes which form a local tradition separate from either the distinctive Archaic types or the Classic 2B, both of which appear to have originated outside the region.

Very little is known about ornaments, neither the more notable Archaic forms nor the typical Classic Maori forms being represented so far. Auckland people were careful of their ornaments, if they had them, and seldom left them around for later generations to find. Dentalium units, bird bone beads, simple bone and tooth pendants could be of any age. The solitary greenstone pendant fragment for Motutapu probably dates to the middle of the sequence rather than the end.

Stone *patu* appear to be a significant late feature and are so far known only from the South Kaipara sites. Again it seems certain that they were invented elsewhere.

Thus one is led to conclude that although Auckland towards the close of prehistory had what might pass as a rather poor version of Classic Maori material culture, Auckland Maoris had little or no part to play in its development. All of the more striking elements appear to have developed elsewhere and reached Auckland by a process of diffusion.

Most difficult to document are changes in society. The large numbers of sites and their variations in size probably mean that no satisfactory account of social organisation in prehistoric Auckland, based on archaeological evidence, can ever be achieved. Related groups evidently banded together and separated again into minimal units depending on changing circumstances.

Warfare is another little understood factor in Auckland life. The late appearance of stone *patu* need have nothing to do with the development of warfare and fortifications. The evidence from Otakanini suggests that warfare and fort building were relatively early in the sequence. If so, however, warfare was sporadic, and its advent did not herald the permanent removal of the population into fortified sites, since so much of the landscape is taken up by undefended sites. A major problem for the future is to determine whether episodes of stress resulting in fort building increased significantly through time.

Conclusion

The above discussion has been concerned with change and the development from Archaic to Classic Maori. It has been possible to demonstrate that there was a change in material culture, although not a dramatic or striking one, and there was a change in some aspects of economy, from broader hunting to a concentration on fishing and shellfish gathering. It is also possible, however, to look at the prehistory of Auckland and see continuity. The early hunting is reflected in only a minute sample of the total archaeological evidence. Fishing and shellfish gathering are attested in many hundreds of archaeological sites representing the great bulk of the total evidence and reflecting centuries of activity. The continuing emphasis on horticulture has been stressed already. Prehistoric life in Auckland, then, can be seen to centre on a continuing round of activities relating to horticulture, the clearance of new gardens, the movement of settlements, the return to former gardens, and the renewal of settlements. Groups grew, fragmented and reunited. At times of stress, fortifications were built, but for much of the time people lived in unfortified settlements. In the short term, there were changes from large to small settlements and back again, from pa to open settlement and back again. In the long term, a similar way of life was maintained for centuries. Against this stability a few changes in the fashions of fishhooks and adzes — the change from Archaic to Classic Maori — can be seen to be of minor significance.

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RADIOCARBON DATES FOR THREE SITES AT STATION BAY, MOTUTAPU ISLAND

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Abstract. Four radiocarbon dates are reported and their significance discussed. Results on bone collagen and on charcoal are compared.

Four additional radiocarbon results for three excavated sites at Station Bay, Motutapu Island, have been received from the Institute of Nuclear Sciences, Gracefield. Three samples were human bone collagen and the fourth was charcoal. The human bone was dated as part of a wider programme carried out by Dr P. Houghton, Otago Medical School, to investigate age assessment by determination of nitrogen content. The significance of the results for that programme will be described elsewhere. The purpose of this note is to discuss the archaeological significance.

The results are as follows.

NZ 4346 human bone collagen from burial, site N38/37	
$\delta^{13}C$ w.r.t. PDB	— 15.0 ± 0.1‰
percentage modern w.r.t. N.Z. Bone Standard	94.1 ± 0.6%
^{14}C age w.r.t. N.Z. Bone Standard	490 ± 50 yrs. B.P.
^{14}C age calculated according to new half-life and corrected for secular effect	520 ± 60 yrs. B.P.
NZ 4347 human bone collagen from burial, site N38/30	
$\delta^{13}C$ w.r.t. PDB	— 18.2 ± 0.1‰
percentage modern w.r.t. N.Z. Bone Standard	92.8 ± 0.5%
^{14}C age w.r.t. N.Z. Bone Standard	600 ± 50 yrs. B.P.
^{14}C age calculated according to new half-life and corrected for secular effect	630 ± 40 yrs. B.P.
NZ 4348 human bone collagen from burial, site N38/25	
$\delta^{13}C$ w.r.t. PDB	— 25.0 ± 0.1‰
percentage modern w.r.t. N.Z. Bone Standard	95.1 ± 0.7%
^{14}C age w.r.t. N.Z. Bone Standard	410 ± 60 yrs. B.P.
^{14}C age calculated according to new half-life and corrected for secular effect	450 ± 30 yrs. B.P.
NZ 4349 charred bracken fronds from pit fill, N38/25	
$\delta^{13}C$ w.r.t. PDB	— 23.6 ± 0.1‰
percentage modern w.r.t. O.95 N.B.S. Ox. Ac. Std.	99.6 ± 0.9%
^{14}C age w.r.t. N.B.S. Ox. Ac. Std.	modern (<200 yrs. B.P.)

The excavations at the two undefended ridge sites, N38/37 and N38/30, have been described in detail (Allo 1970, Davidson 1970, 1972, Leahy 1970, 1972). A preliminary account of the excavations at the headland pa, N38/25, is available (Davidson 1972), and the same paper reports the results of radiocarbon dates obtained for N38/37, the only one of the three sites previously dated.

On the summit area of the pa, N38/25, two adjacent pits were found, both apparently dug from the same surface and subsequently refilled to provide the final flat surface during the last occupation of the site. The double burial which provided the collagen sample NZ 4348 was on the floor of the larger pit; the charcoal sample NZ 4349 came from bracken fronds which had burnt in the base of the smaller pit immediately before it was deliberately refilled. There is some indication that the smaller pit was filled first. Either the two samples are contemporary or the bracken could be slightly older, although not significantly older in radiocarbon terms. There is no possibility that the burial could be significantly older than the burning of the bracken in the adjacent pit.

Samples previously dated from N38/37, which were all charcoal, included three from beneath the Rangitoto ash, and two which were thought to date cultural activity on the site (Davidson 1972: 5-6). Of the latter, sample NZ 1168, with a result of 185 ± 71 B.P. was considered most consistent with the expected age of the site on cultural criteria.

The dating of the Rangitoto ash layer is most important in any consideration of the cultural sequence on Motutapu. In a review of the various carbon dates for this event, Law (1975) suggests that a fourteenth or early fifteenth century date is most likely. This has to be kept in mind in assessing the date for N38/30, a site which is certainly later than the Rangitoto ash.

It appears that the human bone collagen results may be consistently too old. At both N38/37 and N38/25, a human bone collagen date is considerably older than a charcoal date, and cultural considerations tend to suggest that the charcoal dates are more acceptable. There is no other date for N38/30, but the probable age of the Rangitoto ash, and the content of the site, suggest that this result, also, may be too old. On the other hand, the three bone dates appear to give an acceptable indication of the *relative* ages of the three sites. An age difference between N38/30 and N38/37 has previously been suggested on archaeological grounds, and was also indicated by the nitrogen content of the burials from the two sites (Houghton 1977: 40). It is likely, therefore, that N38/30 is the oldest of the three sites, and that N38/25 (in its final phase, at least) and N38/37 are younger and too close together in time to be distinguished by radiocarbon dates.

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SEASONAL SEA MAMMAL EXPLOITATION AND BUTCHERING PATTERNS IN AN ARCHAIC SITE (TAIRUA, N44/2) ON THE COROMANDEL PENINSULA

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Abstract. Detailed analysis of a small assemblage of sea mammal bones from the Archaic archaeological site (N44/2) of Tairua is presented. Consideration is given to the species of sea mammals present, their age and sex, and the manner in which they were killed and butchered. The results suggest a significant difference between the breeding distribution of fur seals in the past and that extant today. Mechanisms for this change, and the implications for New Zealand prehistory are considered.

The Tairua site (N44/2) on the Coromandel Peninsula is of considerable importance in New Zealand prehistory and has stimulated a long history of archaeological research. Excavations undertaken in 1958 and 1959, and an analysis of the fauna' and artefactual material were presented in the initial site report (Smart & Green 1962). Further excavation took place in 1964 (Green 1964). Various components of the site have been the subject of more intensive studies, including: the obsidian (Green 1964); the fishing gear, including a pearl shell lure shank (Crosby 1966, Green 1967); the stone technology (Jones 1972); the shell middens (Davidson 1964, Rowland 1977b); the limpet, *Cellana denticulata* (Rowland 1976); the birds (Rowland 1977b); and the question of seasonality and duration of occupation at the site (Rowland 1977a).

The cultural material in the site derives from two functionally and temporally discrete layers. The earlier of these, layer 2, contains a wide range of faunal, artefactual and structural evidence which is consistent with that in many other Archaic sites in the North Island. It has been argued that this layer may belong to the initial period of occupation in the Coromandel area (Green 1970: 17). The later occupation represents a markedly different pattern, being a midden composed almost entirely of mudflat shellfish species. The sea mammal material discussed in this paper is from the earlier layer.

Problems with the dating of layer 2 have been discussed elsewhere (Green 1967: 83, Rowland 1976: 6), but a brief summary is necessary here as the age of this occupation is of some importance in this paper. Two C^{14} dates for charcoal from an oven in this layer were obtained, giving the widely divergent results of A.D. 1072 ± 49 (N.Z. 594), and A.D. 1507 ± 40 (N.Z. 595) [dates calculated with respect to the 'old' half-life, and with no secular correction]. The earlier date was accepted, being more in keeping with the faunal and artefactual evidence from the site. Contamination of the second sample was suggested as a likely explanation for the discrepancy between the dates. However, identification of the wood in other charcoal samples has indicated the presence, in variable amounts, of the fossil remains of species such as kauri (Green pers. comm.). Thus the earlier date may be older than the occupation because it incorporated firewood from dead trees. This is supported by a more recent date on shell of A.D. 1380 ± 60 (N.Z. 1875) which also casts some doubt on the earliest date. The age of this layer must remain in question, although a date no later than the fourteenth century is to be preferred (Rowland 1976: 6).

The layer 2 sea mammal remains from both the 1958-59 excavations (housed in the National Museum) and the 1964 excavations (housed in the Auckland Institute and Museum) have been combined to provide a complete picture of sea mammal exploitation during the early occupation. Part of the material under study has been identified and described previously (Yaldwin 1962) and the remainder identified by R. J. Scarlett. However, a re-analysis in the light of a recently developed approach to the study of prehistoric sea mammal exploitation (Smith 1976) is considered appropriate, and in keeping with the history of research on this site. It also serves to supplement and correct inaccuracies in the sea mammal data and its assessment provided by Rowland (1977a: 141, 1977b: 239).

IDENTIFICATION AND MINIMUM NUMBERS

Identifications were made through comparison with specimens held in the Anthropology Department, University of Otago, with the exception of the cetacean bone which was identified at the National Museum. Apart from a small number of unidentifiable fragments all seal bones were able to be identified to species level. Three species were found to be present; the New Zealand fur seal (*Arctocephalus forsteri*), the Southern elephant seal (*Mirounga leonina*), and the New Zealand sea lion (*Phocarctus hookeri*). The two cetacean bones in the assemblage are from either a Pilot whale (*Globicephala melaena*) or a False Killer whale (*Pseudorca crassidens*), most probably the former (Green pers. comm.).

Two methods were employed to generate minimum numbers. Firstly a raw minimum number of individuals was calculated for each species using a method adapted from that outlined by B. F. Leach (1976: 426-9). The results of this analysis are presented in Table 1. A second calculation was performed on the fur seal material taking into account estimates of age and sex to produce a minimum number per age/sex category (see below).

Table 1. Raw minimum numbers of sea mammals.

Species	Raw Minimum Number
N.Z. fur seal	6 *
Southern elephant seal	1
N.Z. sea lion	1
Cetacean (probably Pilot whale)	1

* Minimum number of fur seals increased to 9 when age and sex are considered.

The number of individuals by which each species is represented is not large. This creates very real problems with respect to the validity and reliability of the following interpretations. Thus, they must be considered as merely a suggested explanation of the nature of sea mammal exploitation evidenced at the site.

PROPORTIONAL REPRESENTATION OF ANATOMICAL PARTS

Consideration of the relative frequency with which various anatomical parts occur in the site allows some assessment of the manner in which the seals were killed, and of the treatment of their carcasses after death. The remains of each species will be considered in turn.

Fur Seals

There is no direct evidence of the manner in which the fur seals in Tairua were killed. However, the nature of the cranial material in the site suggests that the simple and effective method employed by many of the European sealers might have been used. This involves delivering a sharp blow to the snout of the animal with a club, or some other heavy instrument. Breakage of at least some of the bones of the splanchnocranial region of the skull (the facial bones) would be a likely consequence of this procedure, while the neurocranium (the bones encasing the brain and inner ear) would be left relatively intact. The crania present in the site include only five bones from the splanchnocranium. The remaining 63 fragments are all from the neurocranium. Fourteen of these fragments came from a single quadrant in one square and were able to be reconstructed into an almost complete neurocranium. The same applies to 17 fragments from another square, and 30 from a third square. This suggests that the neurocrania were in a complete, unbroken condition when they were deposited in the site. The relative absence of splanchnocranial bones, and the more or less complete state of the neurocrania are consistent with the killing method suggested above.

Turning now to consider treatment of the fur seal carcass after death, the proportional representation of various anatomical parts can be used to determine the

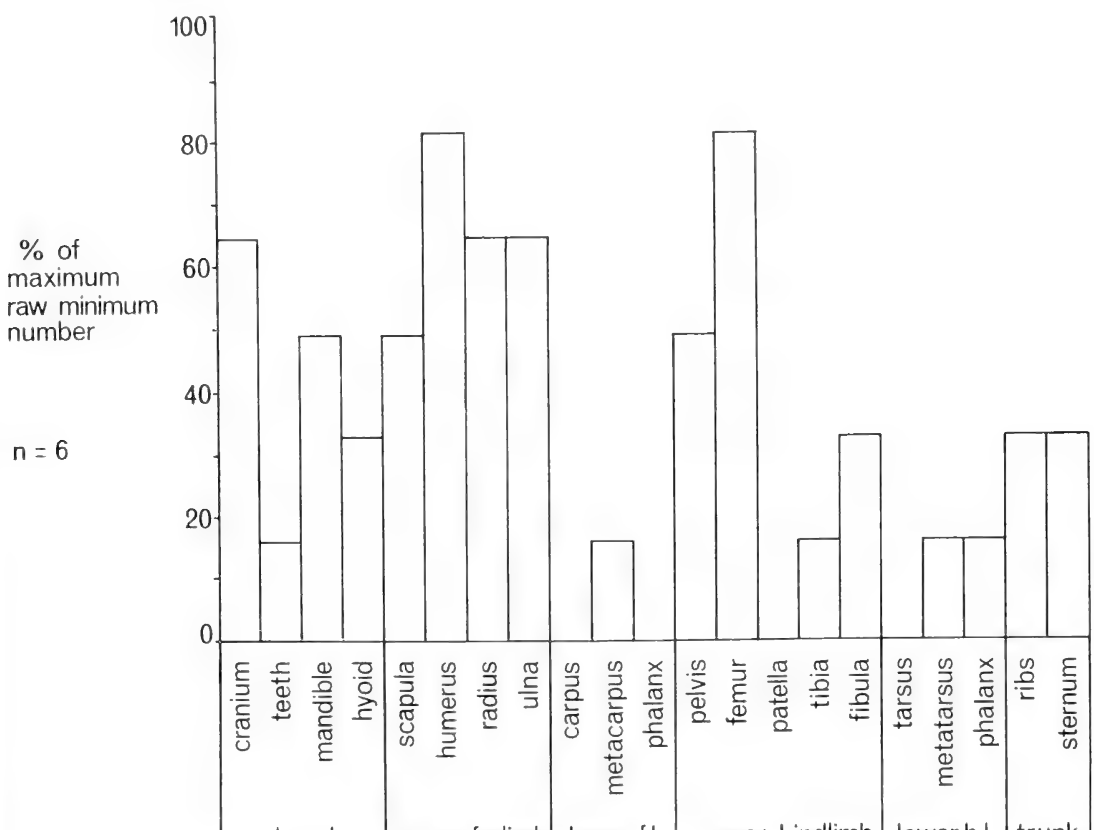

Fig. 1. Tairua fur seals. Histogram of raw minimum numbers by various body parts.

manner in which the animals were butchered. The raw minimum numbers of individuals represented by various body parts are presented as percentages of the maximum raw minimum number in Figs. 1, 2. Raw minimum numbers were used in this

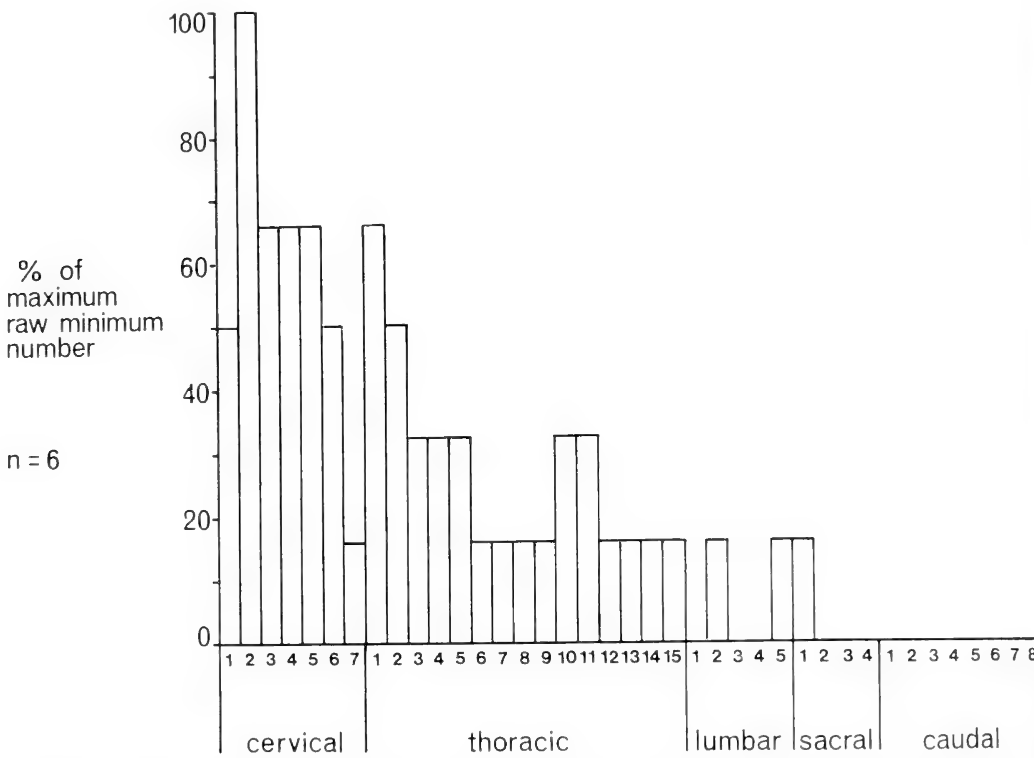

Fig. 2. Tairua fur seals. Histogram of raw minimum numbers by vertebral elements.

analysis to ensure completeness of data, as age/sex estimates could not be made for the skeletal elements of all body parts. The most frequently occurring bones derive from the neck and upper back (cervical and upper thoracic vertebrae), the upper forelimb, and the upper hindlimb. Also well represented are bones of the head. Conspicuous by their low representation or complete absence are the lower forelimb and hindlimb, and the lower back (lumbar, sacral, and caudal vertebrae). The trunk of the body and the middle section of the backbone (mid and lower thoracic vertebrae) are represented by a moderate number of individuals.

The complete absence of some body parts and the uneven distribution of others suggests that the fur seal carcasses were butchered before being brought to the site. The three body parts represented by the greatest numbers of individuals all provide substantial quantities of meat. While there is no quantative data on the meat content of various body parts, personal experience in the butchering of fur seals indicates that the greatest quantity of meat is found in the region of the upper forelimb and neck. The upper hindlimb also provides a substantial quantity of meat. The high representation of these body parts in the site suggest that the fur seals were butchered in such a way as to procure the best cuts of meat. Obversely, some of the body parts absent or represented by only a small number of individuals provide little or no meat. The lower forelimb, lower hindlimb, and lower back all fit into this category.

There are a number of alternative explanations for this pattern that should be considered. Some bones are less likely to survive in archaeological sites, or are more difficult to identify than others, and therefore may be under represented in Figs. 1, 2. This could well be the case for ribs which are extremely difficult to identify in the fragmentary condition in which they are usually found in archaeological sites. It may also apply to tibiae and fibulae. This explanation cannot be accepted for the other poorly represented body parts. The bones of the lower limbs, being dense and compact and with very distinctive shapes, usually survive well and are relatively easy to identify. Similarly, the absent caudal vertebrae are neither more fragile nor more difficult to identify than the commonly occurring cervical and thoracic vertebrae. A second possibility is that the less well represented bones were present in some unexcavated portion of the site. However, this possibitity cannot be evaluated.

Parts of the fur seal carcass could have been used as items of trade and as a consequence do not occur in the site. This would appear to be an unlikely explanation for the low representation of the lower limbs as they contain almost no meat, and would have little value as trade goods. The middle section of the vertebral column and the trunk of the body do provide a reasonable quantity of meat and their low representation in the site could be explained in this way.

Elephant seal

The small quantity of elephant seal material in the site — eighteen positively identified bones in all — makes assessment of killing and butchering methods almost impossible. The identified bones are from the head, trunk of the body, left forelimb, and the right hindlimb. This wide representation of body parts suggests that they came from an elephant seal which was killed or stranded near to the site, rather than from an animal butchered elsewhere.

Sea Lion

As this species was represented by only 3 teeth it is not possible to consider killing and butchering methods.

Cetacean

The Pilot whale or False Killer whale was represented by two bones from the upper forelimb. This may indicate the acquisition by trade or exchange of a single meat-bearing body part of this animal.

ESTIMATIONS OF AGE AND SEX

Accurate assessment of the age and sex of seals found in archaeological sites can provide important information on prehistoric human activity. Seals of particular age and sex groups exhibit specific behaviour patterns which impose limits on where and when they can be hunted by man (Smith 1976: Chapter One). At present, methods of age and sex determination are not sufficiently sophisticated to permit accurate estimations for all seal remains. A method has been developed that allows fur seals to be placed in one or other of five age/sex categories on the basis of the dimensions of their humeri and femora (Smith 1976: Chapter Three). Application of this method to the Tairua material indicates that the fur seals in the site are predominantly of sub-adult age. The number of individuals placed in each age/sex category are presented in Table 2. This expands the raw minimum number from six to nine individuals, placing one in the adult male category, four in the sub-adult male group, and two in each of the juvenile and pup categories. A subjective assessment of the age/sex status

Table 2. Minimum number of fur seals per age/sex group.

Age/Sex Category	Minimum Number
Adult male	1
Adult female	0
Sub-adult male	4
Juvenile	2
Pup	2
Maximum minimum number	9

of bone other than humeri and femora, based on their size with respect to comparative specimens of known age and sex, tends to corroborate these results.

Some reservations must be held about the accuracy of the separation of the juvenile and pup categories because of the lack of accurately aged comparative material for these two groups. Thus, it cannot be stated with certainty that the Tairua assemblage includes two juveniles and two pups. There is little doubt about the two individuals assigned to the juvenile category as they are too large to be pups. However, the other two fall at the borderline between these two groups, and until further accurately aged comparative material is available their assignation to the pup category must be accepted with due caution.

The single elephant seal is probably a sub-adult male. This assessment is based on its size, and the unfused state of its epiphyses. A metrical method is available for determining age and sex from elephant seal bones (Bryden 1972) but could not be used because of the fragmentary nature of the material. Estimates of age and sex were not possible for the other two species in the site.

SEASONALITY

Having established the age/sex composition of the Tairua fur seal assemblage it is now possible to consider the seasonal nature of the seal hunting exhibited there. A basis for the following interpretations has been presented elsewhere (Smith 1976: 13-19, 72-75). The small number of individuals involved requires that these interpretations be accepted with caution.

It is probable that the fur seals in Tairua were hunted at or near a breeding colony (see following section), and consequently would have been available for hunting at all times of the year. The evidence in the site is insufficient to establish with certainty whether advantage was taken of this year round availability. The presence of sub-adult males could indicate summer exploitation as this group are more common at breeding colonies during the summer months. However, as they are also present at other times of the year a definite assessment cannot be made. Similarly, the presence of juveniles may perhaps indicate winter exploitation as they are more common at breeding colonies at that time of year, but once again a positive conclusion cannot be drawn. The only conclusive evidence of seasonality is provided by observations of the size of the two juveniles. The bones of these two individuals are almost exactly the same size as a comparative specimen (FB 207) aged 17 months. As fur seal pups are born in December this would suggest that these individuals were hunted during the winter.

The presence of an elephant seal and a sea lion provide further possible indications of winter exploitation, as both these species are more common in New Zealand waters at this time of the year (Gaskin 1972: 149, 155). A number of recent sightings of elephant seals during the summer months suggest that the presence of this species in a site may not be a completely reliable winter indicator (Smith n.d).

The evidence presented here equates well with the results of a recent review of the shellfish, bird and sea mammal material from layer 2 of the Tairua site (Rowland 1977a: 138-145). Rowland considered the positive seasonal indicators from each faunal component and the problems involved in evaluating the worth of each in determining season of site occupation. While he was unable to preclude the possibility of occupation at other times of the year, the bulk of his evidence suggested early winter/winter occupation. The fuller assessment of all the sea mammal data presented here provides more concrete support for winter occupation than Rowland was able to adduce, principally through the evidence for hunting of juvenile and pup fur seals, which he indicated were not present (Rowland 1977a: 141). However, it still does not entirely preclude occupation during other seasons.

IMPLICATIONS FOR THE PREHISTORIC DISTRIBUTION OF FUR SEALS

The age/sex composition of the Tairua fur seal assemblage suggests that there were colonies — probably breeding colonies — in the Coromandel area at an early stage in New Zealand's prehistory. Pups are found almost exclusively at breeding colonies (Wilson 1974: 29). Juveniles occur at both breeding and non-breeding colonies, although when at the latter they are generally only at those near to breeding colonies (Wilson 1974: 71). As neither of these two groups undertake the long coastal migrations of adult and sub-adult males, it would appear likely that a breeding colony existed somewhere not too distant from Tairua. The presence of fur seals in a number of other early sites in the Coromandel area — for instance, Hotwater Beach (N44/9, q.v. Leahy 1974) and Whangamata Wharf (N49/2, q.v. Allo 1972) — provide some corroboration of this hypothesis, although detailed analysis of these assemblages would be necessary to establish whether or not breeding colonies were indicated.

In protohistoric and historic times there have been no fur seal colonies recorded in the Coromandel area. None were reported by the early European explorers and sealers (Chapman 1893: 447-9, Gaskin 1972: 47), and today fur seals are seldom seen anywhere on the east coast of the North Island, except for occasional sightings at Cape Kidnappers and Cape Brett (Wilson 1974: 29). In fact, the modern distribution of breeding colonies is restricted to the south and south-west coasts of the South Island, while non-breeding colonies are found in suitable locations all around the coasts of New Zealand except for the east coast of the North Island (Crawley & Wilson 1976: 4-6). The possibility that a breeding colony existed somewhere in the Coromandel area, more than 1300 km north of the present northern limit of breeding on the east coast, suggests that there have been major changes in fur seal distribution during the last millennium.

Two factors might be suggested to account for this — human predation, and climatic change. It is difficult to assess the possible effects of human predation on fur seals during the prehistoric period because of the paucity of information on the location and dating of their remains in archaeological sites. The history of European sealing around the New Zealand coast indicates that intensive exploitation can effect the distribution of fur seals (see, for instance, Chapman 1893: 447-8). Furthermore, analysis of the fur seal remains from a site in the Chatham Islands has shown a hunting pattern in which breeding adults appear to have been taken in preference to younger individuals (Smith 1976: 75-8). Continuation of this hunting pattern over a long period of time would almost certainly have reduced the size of the breeding population, and may have served to limit the distribution of the species. As yet, fur seal hunting at either the scale and intensity of European sealing, or of the selective nature evidenced in the Chatham Islands has not been documented for the prehistoric period in New Zealand. However, both these examples do suggest ways in which the distribution of this species might have been reduced by human predation.

Climatic change presents an alternative or perhaps complementary explanation for changes in fur seal distribution. The relationship between fur seal distribution and climate is complex and has not been studied intensively. Two climatic factors — high air temperatures and long hours of sunshine during the summer months — appear to influence the northward limits of the distribution of breeding colonies (Wilson 1974: 37-40). During periods with lower summer air temperatures and insolation a gradual northward extension of the breeding range would be expected, and in warmer periods the breeding range would be reduced. It is unlikely that fur seal distribution would respond rapidly to climatic changes, as this species is very conservative in its use of locations for breeding colonies. Fur seals have a strong tendency to return to the colony at which they were born, and females almost always breed at a colony at which they have previously given birth to a pup (Wilson 1974: 120). Thus a delay factor can be postulated, with fur seals continuing to breed in areas long after climatic changes have made these only marginally suitable for them. This is what seems to be evidenced at Tairua. There is now a considerable body of evidence concerning the nature and dating of climatic changes during the last millennium in New Zealand (H. M. Leach 1976: 162-6). Although the early occupation layer at Tairua has not been dated securely, it appears to coincide with one of the warmer, rather than cooler periods in New Zealand prehistory.

Fur seals are large animals, providing considerable quantities of meat, skins for clothing, and possibly blubber or oil for heating, lighting, or cooking. As such they would have been potentially important economic resources. Limitations imposed upon the exploitation of fur seals by their preference for certain habitats, and by seasonal fluctuations in the size and structure of their population may have been significant facters in determining the settlement patterns and seasonal economic activities of the prehistoric inhabitants in the areas in which they were available. There are some indications that this was the case on the south-west coast of Chatham Island (Smith 1976: 67-78). As fur seals appear to have been distributed more widely than has been thought previously, then factors such as these will need to be considered in the interpretation of archaeolgical material from areas in which it can be shown that they were present.

CONCLUSION

The application of modern zoological, behavioural and osteometric data to the Tairua sea mammal assemblage has permitted some tentative conclusions to be drawn about the nature of sea mammal exploitation at the site. The number and age/sex distribution of fur seals in the assemblage suggests regular predation of a breeding colony rather than exploitation of stray visitors or stranded animals. There is good reason to believe that these animals were killed and butchered elsewhere, and that the meaty body parts alone were brought to the site. The other sea mammals appear to represent a more opportunistic aspect of the food-quest, with the evidence from the elephant seal in particular indicating consumption of an animal stranded or killed on or near to the site.

The indications of seasonality provided by sea mammals fit well with those drawn from the bird and shellfish data. Exploitation of the sea mammals is most likely to have occurred during the winter, although other seasons cannot be discounted entirely.

More important perhaps, is the incompatibility of present day fur seal distribution with the evidence from Tairua and other Coromandel coast Archaic sites for the presence of fur seal colonies in this area. Therefore, it is suggested that a complete reassessment of the natural distribution of the New Zealand fur seal is required, taking into account climatic change and the effects of human predation before the onset of extensive European sealing in the nineteenth century. This will be possible only if further collections of sea mammal bone from archaeological sites are subjected to the same type of analysis as presented here.

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NEW AND INTERESTING RECORDS OF ADVENTIVE PLANTS FROM THE AUCKLAND INSTITUTE AND MUSEUM HERBARIUM 4

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AUCKLAND INSTITUTE AND MUSEUM

Abstract. This fourth list of some recent additions to the Auckland Institute and Museum Herbarium (AK) and re-identification of earlier gatherings provides first records for some adventive species and further information of the distribution of others.

Recent additions to the Auckland Institute and Museum Herbarium have been made by various collectors, including members of the staff. A few of the gatherings have provided first records for New Zealand or at least for the North Island so far as I have been able to ascertain, as, for example, *Ranunculus trichophyllus, Artemisia verlotiorum* and *Galium minutulum.* Corrected identifications have also been made as in the case of *Oenothera biennis* to *O. erythrosepala.* During the past two or three years much literature dealing with weeds and adventive plants in New Zealand has been published to which due attention has been given and, as in previous lists in this series, early publications have been referred to for historical background.

The nomenclature adopted is that published by the New Zealand Weed and Pest Control Society (1969) with amendments by Healy (1975). For species not in those works references are given to publications consulted. Specimens are cited by collector's numbers or, in the absence of these, by the AK Herbarium number.

RANUNCULACEAE

Ranunculus trichophyllus Chaix

Waitahanui stream, near outflow into Lake Taupo, 1977, A. E. Orchard 4884.

Water-buttercups have been recorded in New Zealand for some time, generally under the name *R. fluitans* Lam., of which Allan (1935) remarks "Widely distributed in streams and pools in North and South Islands. This is the *R. aquatilis* of Cheeseman's list." As may be seen from the treatment by Cook (1964) several species are recognised in Europe; it is likely that more than one has reached New Zealand, possibly introduced by aquarists. The specimen cited above differs from true *R. fluitans* in its shorter leaves, less than 4 cm long, its lunate nectaries and its shorter petals, not more than 5 mm long. Aquatic species of *Ranunculus* need to be carefully floated out before pressing and a note should be made as to whether the finely dissected submerged leaves collapse or not when taken out of water.

CERATOPHYLLACEAE

Ceratophyllum demersum L.

Auckland, Glen Innes, Tahuna-Torea Nature Reserve, 1975, R. M. Lockley, AK 136188; Waikato Co., Waikato River, between Mercer and Meremere, 1977, A. E. Orchard 4869.

These two are the only gatherings in the Herbarium of this aquatic species, another possible introduction by aquarists and one of the water-weeds potentially dangerous to hydro dams. Matthews (1975) and Mason (1976) provide information on the various lakes where it occurs and give the first record as 1961 from Napier.

ONAGRACEAE

Oenothera erythrosepala Borbas

Mangonui Co., Taipa beach, hollow of young dunes, 1950, R. C. Cooper, AK 36036 as *O. biennis* L.; Westland, Ruatapa rubbish tip, 1977, T. A. Halliday 540, conf. P. H. Raven; Rangitikei Co., Bulls, waste ground, 1978, P. J. Brownsey, AK 143481.

The specimen confirmed by Dr. Raven has clear yellow flowers with petals over 40 mm, the stem covered with red-based bulbous hairs and is from a population of plants up to 1.5 m tall. It lacks the reddish stripes on the sepals, which provide a character of at least mature plants of *O. erythrosepala* but the much larger flowers distinguish it from *O. rubricaulis* Klebahn, which has petals no longer than 25 mm. The specimen AK 36036 is tall enough to spread over five herbarium sheets and its stem is covered with red-brown hairs, which distinguish it from *O. biennis*: although flowers are lacking I would place it under *O. erythrosepala*. The third specimen, indicating a widespread distribution, completes the Herbarium representation of this evening primrose. Other records have been published under the synonym *O. lamarkiana* de Vries by Allan (1940) who gives Wellington and Tauranga as localities. Healy (1969) records it from two rivers in Canterbury and later (Healy 1973) says it occurs in low rainfall areas of the South Island, whilst Matthews (1975) states that it occurs in waste places in both Islands.

HYPERICACEAE

Hypericum mutilum L.

Matamata Co., swamp around stream in farmland, near Matamata, 1977, A. E. Wright 2064.

This constitutes the first New Zealand material of this St John's Wort in the Herbarium. Healy (1976) reports the species as "Recently found in swampy places in the North Cape district", giving Lake Omapere as a second locality and Tutira, Hawkes Bay, as a doubtful third. Connor (1977) mentions it as a naturalised species but without localities.

MALVACEAE

Abutilon theophrasti Medic.

Franklin Co., in a crop paddock, Ararimu, 1978, noxious weed Inspector, AK 143622.

A note with this specimen states that it was sent as a suspected impurity in millet seed to Mr A. W. Auld of the Ministry of Agriculture and Fisheries at Pukekohe. It was kindly presented to the Herbarium (AK) by Mr A. E. Esler as a first record in New Zealand. I certainly have found no other reference to the species, which is known both as a wool alien and a bird-seed alien in the British Isles. According to Webb (1968) it is native in some parts of the European continent but adventive to others.

Sida rhombifolia L.

Kermadec Islands, Raoul Island, 1956, R. C. Cooper, AK 44087; Mangonui, Ahipara golf course, 1977, R. C. Cooper, AK 141415, AK 141768.

The last two sheets bear specimens collected in January and March respectively, the labels of both noting that the plant was a troublesome weed. With reference to its occurrence in the Kermadecs, Sykes (1977) says "Probably accidently introduced to Raoul in the early days of European settlement" and goes on to comment that it had become common by 1908. Other references to the species are by Healy (1957) who records Dargaville and Mangonui as localities and by Matthews (1975) who states "Not widely known in New Zealand and possibly confined to higher rainfall areas." The Herbarium possesses only the three sheets cited above.

EUPHORBIACEAE

Euphorbia maculata L.

Streets of Auckland, T. F. Cheeseman, AK 74945 (under the synonym *E. hypericifolia* L.); Matamata, Arawa Street, waste ground, 1977, A. E. Wright 2053.

Of these two sheets, which represent the species in the Herbarium, the former is undated but it may be taken as a voucher for the record published by Cheeseman (1883), who subsequently reported it as nearly extinct. Allan (1940) adds no further localities and much later Connor (1977) refers to it as "occasional about Auckland City in waste places." Matamata, therefore, provides the first record that I can trace beyond Auckland.

UMBELLIFERAE

Ammi majus L.

Auckland Domain, T. F. Cheeseman, AK 33187; East Tamaki, 1965, L. A. Joy, AK 105815 det. New South Wales Nat. Herb.; Auckland, Mt Eden, weed in garden, 1977, K. A. J. Wise, AK 143179.

Cheeseman (1883) first recorded this species from the Auckland Domain and Remuera, with the comment "rare at present but likely to spread". No further localities are given by him in subsequent publications or by other authors such as Kirk (1899) and Allan (1940), who repeat Cheeseman's record, for which the first specimen cited above may be taken as a voucher. The second sheet indicates a continued distribution within the Auckland area, in which Mr Wise's gathering provides a further locality.

Eryngium campestre L.

Fields near Matamata, T. F. Cheeseman, AK 33298.

This undated specimen is the only example of this umbellifer, which is sufficiently thistle-like to be included by Healy (1976) in his section dealing with true thistles. He comments that it is rare in poor pastures. Allan (1940) says that it "has been noted at Matamata and near Mangonui". I have not come across other references to this plant in New Zealand except that Healy (1975) includes it in his additions to standard common names as "field eryngo".

RUBIACEAE

Galium minutulum Jord.

Auckland, Rangitoto Island, Islington Bay, in moss on rocks, 1977, A. E. Esler, AK 143201, det. Lynne Scott.

This specimen was presented by Mr Esler as the voucher for a potential first record. I am unable to find any reference in New Zealand literature to this minute bedstraw, the leaves of which are only 1.5-3 mm in length and 0.8-1 mm in width. The tiny ovoid fruits, with miniscule hooked hairs, are less than 1 mm long. According to Ehrendorfer (1976) it inhabits Mediterranean coast and hills and shady rocks in S.W. Europe.

COMPOSITAE

Artemisia verlotiorum Lamotte

Waitemata, Orewa, grounds of Orewa House, 1972, C. E. Gregory, AK 129759, as *A. vulgaris* L.: Waitemata, Waiwera, near hot pools, 1977, H. Skelton, AK 141849.

I find no other reference to the occurrence of this species in New Zealand. It differs from *A. vulgaris* in being strongly aromatic, having a much more leafy inflorescence, the leaves having conspicuously elongated ultimate segments, and in other less readily assessable characters. A description may be found in Tutin (1976), who includes it in the European flora as an adventive species from China.

Cynara cardunculus L.

Mangonui, T. F. Cheeseman, AK 89848; Auckland, Herne Bay, weed in flowerbed, 1977 (Mr) Joseph, AK 141692, AK 143324.

The cardoon was first recorded by Cheeseman (1897) from the North Cape district and his undated specimen may be taken as a voucher. The two sheets of the later, and only other, addition bear respectively typical large spiny leaves and two fine heads of purplish florets. Other localities for this spectacular composite are The Bluff, Napier in Kirk (1899) and Canterbury in Healy (1969). The latter author (Healy 1976) keys the species out among the thistles and Matthews (1975) states that the plant is found as an "isolated garden escape".

Gnaphalium candidissimum Lam.

Lake Waiparera, N. of Kaitaia, 1961, P. Hynes, AK 71205, det. A. J. Healy: Muriwai Lake, N.W. of Helensville, 1968, P. Hynes, AK 119830, det. C. Jeffrey (Kew); Mangonui, Ahipara gumfields, 1970, R. C. Cooper, AK 125601: Hokianga, mouth of Waihopai River, 1977, A. E. Wright 1638.

In his paper on the classification of the genus *Gnaphalium*, Drury (1970) cites a collection made in 1961 by Miss L. B. Moore from the same locality as that made by Mrs Hynes, who was on the same excursion. Miss Moore's specimen is in the Herbarium of Botany Division, DSIR, Christchurch (CHR). The other three cited above are additional records and I have discovered no further published ones. Drury (1970) states that this is the only African species among the adventive cudweeds in New Zealand and it differs from the several American ones in having a corymb of clusters instead of a spicate inflorescence. The whole plant is clothed in a dense white indumentum as indicated by the specific epithet.

Soliva valdiviana Phil.

Auckland, Parnell, Cathedral Place, rough lawn in E. G. Turbott's garden, 1976. J. H. Goulding 863.

The occurrence of this species in New Zealand was first noted by Healy (1948), who points out its confusion with other species but does not cite localities. In a paper devoted to the genus *Soliva*, (Healy 1953) localities are given and illustrations show *S. valdiviana* to be the only species lacking achenial wings. More recently, Healy (1969) comments that it has increased in abundance as a weed of lawns and playing fields in Canterbury. Matthews (1975) describes it as "possibly the most widespread". All material of the genus in the Herbarium was examined and that above was found to be the only example of this Onehunga-weed, and so far as I am aware, provides the furthest north record. Another Auckland locality, slightly further south, is Aratiki nature trail, quoted by Cameron (1975).

PRIMULACEAE

Anagallis minima (L.) E. H. L. Krause

Auckland, Waikumete Cemetery, 1976, A. E. Esler, AK 143022 (dupl. CHR 276649).

The only other record for this plant, known to British botanists as chaffweed, is from Cape Turakirae, Wellington, listed in an Appendix as rare by Bagnall (1975) under the synonym *Centunculus minimus* L. The specimen, a voucher for the second New Zealand record, was presenteed by Mr Esler. A description is given by Ferguson (1972). Very much smaller than the well-known scarlet pimpernel, *Anagallis arvensis* L., chaffweed needs to be carefully searched for.

PLANTAGINACEAE

Plantago arenaria Waldst. & Kit.

Auckland, Tooley Street, in crack between pavement and wall, 1977, A. E. Wright 2016.

This is the only Herbarium example of this species, which was first noticed for New Zealand by Healy (1957) from Omarama. He later (Healy 1969) gives it a casual and local status in his Canterbury list and indicates its origin as an impurity in seed. Chater & Cartier (1976) include the species in the European flora, citing *P. ramosa* Ascherson, *P. psyllium* L. and *P. indica* L. as synonyms. The common adventive plantains in New Zealand are scapose but *P. arenaria* has a leafy stem.

LABIATAE

Lycopus europaeus L.

Waikato, north end of Lake Waikare, *c.* 5 km east of Te Kauwhata, 1977, A. E. Orchard 4871.

This gathering appears to be the first recorded for the North Island as the only reference I have traced in New Zealand literature is in Allan (1940), who notes it as "established in one locality near Greymouth" in the South Island. Gipsy-wort is a frequent inhabitant of wet places in Europe.

LEMNACEAE

Spirodela punctata G. F. Meyer

Auckland, Lake Pupuke, 1972, J. Gurr, AK 129847, det. J. H. Goulding as *S. oligorrhiza* (Kurz) Hegelm. (a synonym, as is *Lemna oligorrhiza* Kurz.).

Lancaster (1930) first records this species from Awapuni, near Palmerston North, regarding it as "probably native". Moore & Edgar (1970) accept it as indigenous but Healy (1969) regards it as partly indigenous and partly introduced in the Canterbury area. More recently Healy (1973) includes it among the free-floating adventive aquatics and says it is widespread. Matthews (1975) and Mason (1976) indicate its occurrence from the Waikato to South Canterbury. The sole gathering in the Auckland Herbarium, therefore, provides the furthest north record for this small duckweed, characterised by its two or three rootlets and purplish underside.

AMARYLLIDACEAE

Allium ampeloprasum L.

Mangonui, T. F. Cheeseman, AK 95698, 95699; Mangonui, Doubtless Bay, 1977, C. Bearsley, AK 143325.

The former gathering, spread over two sheets, is a potential voucher for the record "shores of Doubtless Bay" in Cheeseman (1883). The latter, the only other in the Herbarium, is accompanied by a letter with some interesting information. It is called "French garlic" by older Maori residents in the area and was gathered at a little beach, "an unlikely place for gardens"; it is supposed to have originated from the de Surville expedition of 1769. I have not found other reference to the species in New Zealand literature.

CYPERACEAE

Cyperus polystachyus Rottb.

Hokianga, Te Rewa Point, saltmarsh beside road, 1977, A. E. Wright 1654; Hokianga, low scrub at mouth of Waihopai River, 1977, A. E. Wright 1655.

These constitute the first two acquisitions by the Herbarium and the first published records for New Zealand so far as I know. The species is included by many authors of Floras of the warmer regions of the world; a detailed description, for example, may be found in Bentham (1878) for Australia.

GRAMINEAE

Panicum dichotomiflorum Michx.

Auckland, corner of Symonds Street and Grafton Road, grass verge along base of wall, 1977, A. E. Wright 2017.

Since my earlier record for this grass (Bangerter 1976) this second sheet has been added to the Herbarium. The species is described by Matthews (1975) as "an aggressive weed . . . . confined to the northern half of the North Island." Smooth witch-grass is a crop weed recognised by agriculturists and is often observed in other habitats by botanical field-workers from whom I gain the impression that it is under-recorded. Matthews (1976) discusses its control, illustrating his paper with a photograph.

Urochloa panicoides P. Beauv.

Auckland, One Tree Hill, Korokino Road, growing in waste ground beside house, 1978, A. E. Wright 2658.

This appears to be the first New Zealand record for this grass, which originates from Africa, extending to India. It has also been introduced into Australia. The identification was kindly provided by the Royal Botanic Gardens, Kew. Further notes on the herbarium label state "low, spreading rosette-like form; leaves soft, light green, hairy; rooting at lower nodes". These indicate that this gathering should be placed under the var. *pubescens* (Kunth) Bor according to Bor (1960).

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ANNOTATED CHECKLIST OF TYPE SPECIMENS OF NEW ZEALAND PLANTS IN THE AUCKLAND INSTITUTE AND MUSEUM HERBARIUM

Parts 1 and 2. Pteridophyta and Gymnospermae

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AUCKLAND INSTITUTE AND MUSEUM

Abstract. Presumptive type material of New Zealand Pteridophyta and Gymnospermae in the AK Herbarium is presented in an annotated checklist of 43 taxa.

A systematic search for probable type material in the native plant collections in the Auckland Institute and Museum Herbarium (AK) has revealed many specimens additional to those listed by R. C. Cooper in the *Records of the Auckland Institute and Museum* in 1949 (Cooper 1949).

The annotated checklist is intended to amplify and bring up-to-date the 1949 list of "primary" types. As well as holotypes, lectotypes and syntypes, isotypes are included in the present list (accounting for the many Colenso fern specimens not listed by Cooper). The type material is selected in accordance with Article 7 (Typification) in the International Code of Botanical Nomenclature, 1966 (Lanjouw 1966). As before, plant names "are as originally published, although many have since been relegated to synonymy" (Cooper 1949).

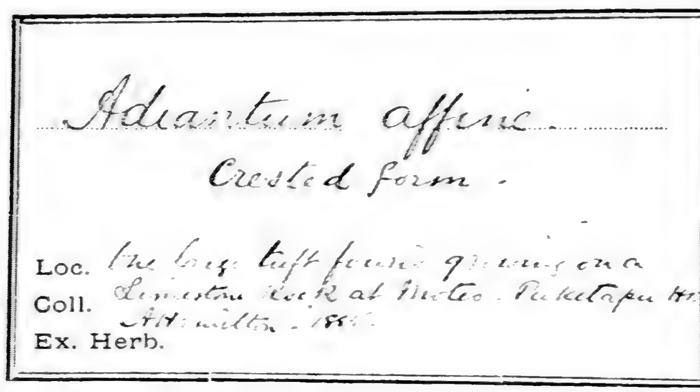
The checklist will be presented in several parts, beginning with Parts 1 and 2, Pteridophyta and Gymnospermae, in this paper and Part 3, Monocotyledones — Gramineae, in a following paper by Wright (1978 this volume). Occasional figures will be shown — depicting labels on the herbarium sheets of the mounted type material.

Specimens thought to have type status are listed, together with their author and publication reference. Details of the type locality, quoted directly from the original description, are given in quotation marks. In citing AK specimens, labels and notes of the collectors have been quoted where possible, giving their information in the following order: locality, collector, date, AK number. Metric equivalents of altitudes, distances and measurements have been added in square brackets. * before the specimen data denotes that the label is written in a handwriting other than that of the collector (often in Cheeseman's hand on labels printed "Herb. T. F. Cheeseman"). † after specimen information denotes published designation of the AK specimen as type material. Otherwise the class of type is not given unless designated by a specialist, on the herbarium sheet.

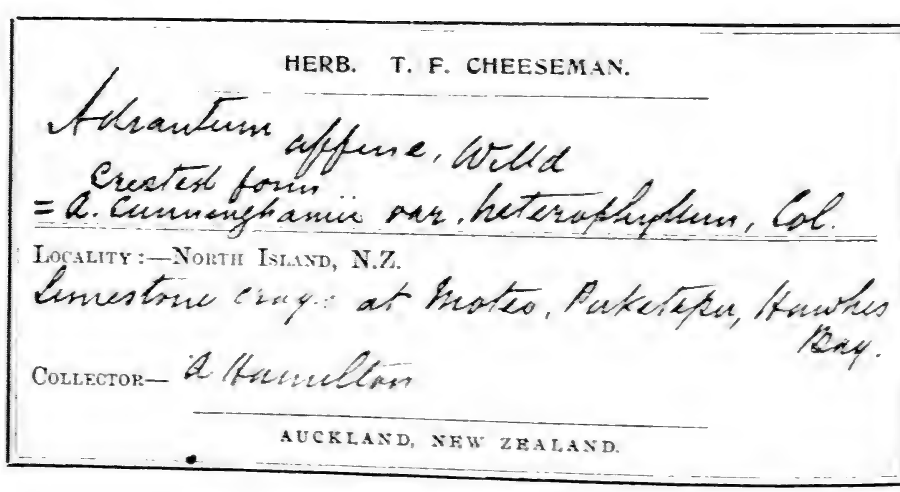
PART 1. PTERIDOPHYTA

Most of the pteridophyte types listed here were not published in the 1949 list of primary types in the Auckland Museum (Cooper 1949). Many are probable isotypes of Colenso specimens held in the Kew Herbarium (K) or in the National Museum Herbarium, Wellington (WELT). Some Colenso types are listed in Allan's *Flora of New Zealand* 1 (Allan 1961).

Adiantum affine Willd. var **heterophyllum** Col. *Trans. Proc. N.Z. Inst.* 20: 218 (1888)
TYPE LOCALITY. "On limestone crags at Moteo, Puketapu District, near Napier: 1885: Mr A. Hamilton."
Specimen. One large tuft found growing on a Limestone Rock at Moteo — Puketapu — H.B., A. Hamilton. 1885 (Fig. 1); * Limestone crags at Moteo, Puketapu, Hawkes Bay, A. Hamilton, no date, (Fig. 2) AK 135717.


Adiantum affine
Crested form.
Loc. One large tuft found growing on a
Coll. Limestone Rock at Moteo. Puketapu H.B.
A Hamilton. 1885
Ex. Herb.

1


HERB. T. F. CHEESEMAN.
Adiantum affine, Willd
Crested form
= A. Cunninghamii var. heterophyllum, Col.
LOCALITY:—NORTH ISLAND, N.Z.
Limestone crags at Moteo, Puketapu, Hawkes Bay.
COLLECTOR— A Hamilton
AUCKLAND, NEW ZEALAND.

2

Figs. 1, 2. Herbarium labels. 1. Label of A. Hamilton, 1885 (9 x 5 cm). 2. Label ex Herb. T. F. Cheeseman, in Cheeseman's handwriting (13.5 x 7.5 cm).

Adiantum polymorphum Col. *Trans. Proc. N.Z. Inst.* 20: 215 (1888)

TYPE LOCALITY. "On the ground at a steep declivity, forming a small bed or patch, and very closely growing together, in a thick wood south of Danneverke, County of Waipawa; May, 1887: W. C. (Not noticed anywhere else.)."

Specimens. * Dannevirke, Hawkes Bay, W. Colenso, no date, AK 135724-25.

Adiantum pullum Col. *Trans. Proc. N.Z. Inst.* 25: 319 (1893)

TYPE LOCALITY. "Open land, damp shaded spots rocky places, between Dannevirke and the East Coast, County of Waipawa; 1892: Mr H. Hill."

Specimen. * Near Dannevirke, Hawkes Bay, H. Hill ex Herb. Colenso, no date, AK 135718.

Adiantum tuberosum Col. *Trans. Proc. N.Z. Inst.* 20: 217 (1888)

TYPE LOCALITY. "Woods near Ormondville, County of Waipawa: Mr A. Hamilton."

Specimen. * Ormondville, Hawkes Bay, A. Hamilton ex W. Colenso, no date, AK 135731.

Alsophila colensoi Hook. f. *Fl. N.Z.* 2; 8 (1854)

TYPE LOCALITY. "Northern Island: Ruahine Range, Colenso."

Specimens. * Ruahine Mountains, W. Colenso, no date, AK 136260-61.

Aspiduim perelegans Col. *Trans. Proc. N.Z. Inst.* 29: 416 (1897)

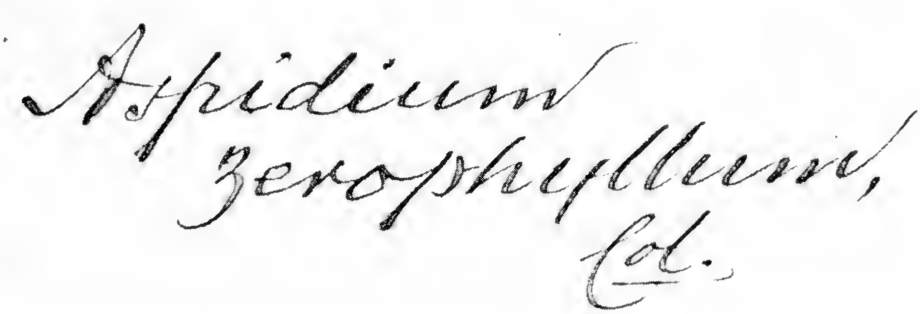
TYPE LOCALITY. "Forests south-west from Dannevirke; 1896: W. C."

Specimens. Aspidium perelegans (in Colenso's hand); * Dannevirke, Hawkes Bay, W. Colenso, no date, AK 139718 (2 sheets).

Aspidium zerophyllum Col. *Trans. Proc. N.Z. Inst.* 29: 418 (1897)

TYPE LOCALITY. "Hilly woods south-west of Dannevirke; 1896: W. C."

Specimens. Aspidium zerophyllum Col. (in Colenso's hand) (Fig. 3), no locality, collector or date; * Hawkes Bay, Dannevirke, W. Colenso, AK 139720; * Ex Herb. W. Colenso, no locality, collector or date, also note by D. Petrie, AK 139719.



3

Fig. 3. Colenso's handwriting.

Asplenium anomodum Col. *Trans. Proc. N.Z. Inst.* 15: 309 (1883)

TYPE LOCALITY. "On decomposing limestone ridges, forests near Norsewood, W. C.; at Takapau, Mr. J. Stewart; and at Te Aute, Mr. C. P. Winkelmann."

Specimens. * Norsewood, Hawkes Bay, W. Colenso, no date, AK 30347; Te Aute Range, Hawkes Bay, C. P. Winkelmann, no date, AK 30343.

Asplenium colensii Col. *Tasm. J. Nat. Sci.* 2: 170 (1846)
TYPE LOCALITY. "In clefts and on shaded rocks, dry places, on the borders of Waikare Lake: Dec. 1841."
Specimen. * Lake Waikare Moana, W. Colenso, Dec. 1841; One of the types of Colenso's *A. colensoi, Tasm. Journ. Nat. Sci.* recd from Mr Colenso (In Cheeseman's hand), AK 135884.

Asplenium gracillimum Col. *Trans. Proc. N.Z. Inst.* 22: 453 (1890)
TYPE LOCALITY. "Dry side of hills, shady woods south of Dannevirke, County of Waipawa (where it is plentiful); 1888, 1889: W. C."
Specimens. * Dannevirke, Hawkes Bay, W. Colenso, no date, AK 135792 (2 sheets).

Asplenium ornatum Col. *Trans. Proc. N.Z. Inst.* 22: 452 (1890)
TYPE LOCALITY. "On dry hilly ground at Kuripapango, County of Hawkes Bay; 1889: Mr. Pinckney."
Specimen. Mr Pinckney from Kuripapanga, — W C, -/89, AK 135844.

Botrychium biforme Col. *Trans. Proc. N.Z. Inst.* 18: 223 (1886)
TYPE LOCALITY. "In swamps, near Tahoraiti, County of Waipawa; April, 1885: Mr H. Hill."
Specimen. * Dannevirke, H. Bay, W. Colenso, no date, AK 950 (2 sheets).

Cheilanthes erecta Col. *Trans. Proc. N.Z. Inst.* 28: 619 (1896)
TYPE LOCALITY. "Country between lower Waikato (N.), head of Thames and Kaipara; 1843-44: W. C."
Specimen. * Near Auckland ?, W .Colenso, no date, AK 695(135699).

Cheilanthes pellucida Col. *Tasm. J. Nat. Sci.* 2: 173 (1846)
TYPE LOCALITY. "On clayey declivities in dry woods, between Cape Brett and Whangarei Bay, E. Coast; 1839 and 1842."
Specimen. * Between Whangarei & Cape Brett, W. Colenso, no date, AK 700.

Cyathea polyneuron Col. *Trans. Proc. N.Z. Inst.* 11: 429 (1879)
TYPE LOCALITY. ". . . . on my ground (Scinde Island, Napier) . . . . from the eastern slopes of the Ruahine Mountain forests, as well as from smaller woods near the sea on the east coast."
Specimen. * Hawkes Bay, W. Colenso, no date, AK 143439.

Cyathea tricolor Col. *Trans. Proc. N.Z. Inst.* 15: 304 (1883)
TYPE LOCALITY. "Deep forests (Seventy-mile Bush) on eastern outlying spurs of the Ruahine Mountain Range, between Norsewood and Danneverke villages; April, 1822."
Specimen. * Norsewood, Hawkes Bay, W. Colenso, no date, AK 136264.

Davallia pinkneyi Col. *Trans. Proc. N.Z. Inst.* 29: 415 (1897)
TYPE LOCALITY. "In a dry wood near margin of Mangatera Stream, south of Dannevirke; 1895: Mr. Pinkney."
Specimens. Davallia (Microlepia) Pinckneyi Col.; * Hawkes Bay (probably) no date, W. Colenso, AK 114359-60.

Davallia tasmani H. C. Field *Ferns N.Z.* 75 (1890)
TYPE LOCALITY. "Three Kings islands, near the North Cape, in 1887, by Mr. T. F. Cheeseman."

Specimens. Three Kings Islands, T.F.C., Aug. 1887, AK 419† (specified as type by Oliver, *Rec. Auckland Inst. Mus.* 3: 214 (1948)). Three Kings Islands, T.F.C., Aug. 1887, AK 10811-14.

Dicksonia gracilis Col. *Trans. Proc. N.Z. Inst.* 15: 306 (1883)

TYPE LOCALITY. "In low-lying forests between Norsewood and Danneverke, "Seventy-mile Bush" April, 1882."

Specimen. * Dannevirke, H. Bay, W. Colenso, no date, AK 137951.

Dicksonia microcarpa Col. *Trans. Proc. N.Z. Inst.* 20: 214 (1888)

TYPE LOCALITY. "Forests south of Danneverke, County of Waipawa, 1887: W. C."

Specimens. * Dannevirke, H.B., W. Colenso, no date, AK 137903 (4 sheets).

Dicksonia sparmanniana Col. *Trans. Proc. N.Z. Inst.* 12: 363 (1880)

TYPE LOCALITY. "In hilly shaded forests, western slopes of Ruahine Range, head of river Manawatu, 1877-80."

Specimens. Dicksonia sparmanniana Col. (sheet 1 in Colenso's hand); * Western slopes of Ruahine Range, W. Colenso, no date, AK 51026 (2 sheets).

Gleichenia ciliata Col. *Trans. Proc. N.Z. Inst.* 29: 414 (1897)

TYPE LOCALITY. "On east side of Mount Ruapehu, Taupo district; 1895: Mr. E. W Andrews."

Specimen. * Ruahine Range, Mr Andrews ex Herb. Colenso, no date, AK 876 (139767).

Hemitelia falciloba Col. *Trans. Proc. N.Z. Inst.* 24: 394 (1892)

TYPE LOCALITY. "On the side of a precipitous gully overhanging a small streamlet, in a forest south of Dannevirke, County of Waipawa; January, 1889: W. C."

Specimen. * Near Dannevirke, Hawkes Bay, T.F.C. (probably in error for W. Colenso), no date, AK 136267.

Hemitelia microphylla Col. *Trans. Proc. N.Z. Inst.* 27: 399 (1895)

TYPE LOCALITY. "In dense forests north-west from Dannevirke, County of Waipawa; 1894: W. C."

Specimens. * Dannevirke, Hawkes Bay, W. Colenso, no date, AK 51028-29.

Hemitelia stellulata Col. *Trans. Proc. N.Z. Inst.* 18: 222 (1886)

TYPE LOCALITY. "Edges of forests, banks of streams in the Seventy-mile Bush, between Norsewood and Danneverke, County of Waipawa; 1882-5: W. C."

Specimen. * Norsewood, Hawkes Bay, W. Colenso, no date, AK 143440.

Hymenophyllum alpinum Col. *Trans. Proc. N.Z. Inst.* 31: 263 (1899)

TYPE LOCALITY. "Ruahine Mountain-range, alpine woods, east side; 1898: Mr H. Hill. Same mountain-range, common; 1845-52: W.C."

Specimen. * Ruahine Range, Hawkes Bay, H. Hill, no date, AK 140011.

Hymenophyllum erecto-alatum Col. *Trans. Proc. N.Z. Inst.* 11: 431 (1879)

TYPE LOCALITY. "Growing diffusely among roots of trees in dry forests near Norsewood (Forty-mile Bush), Hawke Bay, 1876: and again, 1878."

Specimen. Hymenophyllum erecto-alatum Col. (in Colenso's hand); * Norsewood, Hawkes Bay, W. Colenso, no date, AK 119.

Hymenophyllum lophocarpum Col. *Trans. Proc. N.Z. Inst.* 17: 255 (1885)

TYPE LOCALITY. "On trunks and main branches of trees, hilly forests in the interior, Seventy-mile Bush, County of Waipawa; 1860-84: W. C."

Specimens. * Dannevirke, H. Bay, W. Colenso, no date, AK 83 (142558) (2 sheets).

Hymenophyllum megalocarpum Col. *Trans. Proc. N.Z. Inst.* 15: 308 (1883)

TYPE LOCALITY. "In open woods, in the Seventy-Mile Bush between Norsewood and Danneverke, both on the ground (but not growing thickly) and climbing trees — particularly the trunks of the tree-ferns, arborescent *Dicksonia* — 1881, 1882."

Specimen. * Dannevirke, H. Bay, W. Colenso, no date, AK 118.

Hymenophyllum melanocheilos Col. *Trans. Proc. N.Z. Inst.* 17: 255 (1885)

TYPE LOCALITY. "Woods, Whangaroa, County of Mongonui; 1884: Mr. R. W. Rowson."

Specimen. * Whangaroa, R. W. Rowson, 1885, AK 139868.

Hymenophyllum oligocarpum Col. *Trans. Proc. N.Z. Inst.* 31: 264 (1899)

TYPE LOCALITY. "Forests, Waikaremoana, Hawke's Bay; 1898: Mr H. Hill."

Specimen. * Lake Waikaremoana, H. Hill, no date, AK 140012.

Hymenophyllum polychilum Col. *Trans. Proc. N.Z. Inst.* 24: 395 (1892)

TYPE LOCALITY. "Dry shaded woods south of Dannevirke, County of Waipawa; 1890-91: W. C."

Specimens. * Dannevirke, Hawkes Bay, W. Colenso, no date, AK 117 (2 sheets).

Hymenophyllum revolutum Col. *Tasm. J. Nat. Sci.* 2: 186 (1846)

TYPE LOCALITY. "On sides of prostrate and reclining trees, shores of Waikare Lake, December, 1841."

Specimen. * Lake Waikare-moana, Colenso, no date, AK 128411.

Hymenophyllum truncatum Col. *Trans Proc. N.Z. Inst.* 23: 390 (1891)

TYPE LOCALITY. "Plentifully on trunk of a large tree, in a thicket, south of Dannevirke, County of Waipawa; 1887-90: W.C."

Specimen. * Dannevirke, Hawkes Bay, W. Colenso, no date, AK 140009.

Hypolepis petricana Carse *Trans. Proc. N.Z. Inst.* 50: 64 (1918)

TYPE LOCALITY. "Vicinity of Otorohanga, Waipa County, and Port Charles, Coromandel County. D. Petrie!"

Specimens. Near Otorohanga, on alluvial flats, D. Petrie, early Decr.; The same plant is common on flats fronting the head of Port Charles (in Petrie's hand), * Otorohanga, Upper Waipa, D. Petrie, no date, (on same herbarium sheet), AK 139599 (5 sheets).

Lomaria linearis Col. *Tasm. J. Nat. Sci.* 1: 376 (1842)

TYPE LOCALITY. "Margins of woods, near *Te Waiti*, a village in the interior of the North Island, two days journey south east from *Rotorua*. January, 1842."

Specimen. Lomaria linearis, W. Colenso Described March /42 — in Journal of Tasmanian Philos. Soc., (in Colenso's hand); * Te Whaiti, near Ruatahuna, W. Colenso, no date, AK 143479.

Lomaria parvifolia Col. *Trans. Proc. N.Z. Inst.* 20: 224 (1888)

TYPE LOCALITY. "High slopes of Tongariro Mountain Range, County of East Taupo: 1887: per Mr. H. Hill."

Specimen. Lom. parvifolia Col. (in Colenso's hand); * Tongariro, H. Hill, no date; AK 641 († Allan 1961: 82).

Lycopodium curvifolium Col. *Trans. Proc. N.Z. Inst.* 20: 235 (1888)

TYPE LOCALITY. "High lands, "altitude 2,000 feet," [609.60 m] north of Gisborne, County of Cook; 1887: Mr W. K. Chambers."

Specimen. * Near Gisborne, W. K. Chambers ex W. Colenso, no date, AK 1020.

Lycopodium novae-zelandicum Colenso *Trans. Proc. N.Z. Inst.* 19: 275 (1887)

TYPE LOCALITY. "Epiphytical on fern-trees, open marshy glades in low forest, bank of River Mangatawhainui, near Norsewood, County of Waipawa, 1886: W. C."

Specimen. Lycopodium Novae-Zealandicum sp. nov. Col. (in Colenso's hand), no locality or date, AK 985.

Polypodium pennigerum Forst. f. var. **giganteum** Col. *Trans. Proc. N.Z. Inst.* 14: 339 (1882)

TYPE LOCALITY. "Skirts of woods and thickets, head of River Manawatu; 1875-1881."

Specimens. * Manawatu River, W. Colenso, no date, AK 142518.

Polypodium pennigerum Forst. f. var. **hamiltonii** Col. *Trans. Proc. N.Z. Inst.* 14: 338 (1882).

TYPE LOCALITY. "Wet rocky sides of mountain streamlets, country S.W. from Napier, North Island; found by Mr A. Hamilton in 1881."

Specimens. Kereru, Petane Hawkes Bay, A. H. Ex Herb. A. Hamilton, 1881; * Kereru. Hawkes Bay, A. Hamilton, 1881, AK 142511 (2 sheets).

Polypodium rupestre Br. var. **sinuatum** Col. *Trans. Proc. N.Z. Inst.* 17: 257 (1885)

TYPE LOCALITY. "On living trees, woods, Seventy-mile Bush, between Matamau and Danneverke, County of Waipawa; 1883-84 (also in woods, East Coast): W. C."

Specimen. * Dannevirke, Hawkes Bay, W. Colenso, no date, AK 850.

Polypodium subsimilis Col. *Trans. Proc. N.Z. Inst.* 20: 233 (1888)

TYPE LOCALITY. "Sides of streams, forests near Matamau, County of Waipawa; 1882-83: W. C."

Specimen. * Matamau, Hawkes Bay, W. Colenso, no date, AK 142510.

Pteris macilenta A. Rich. var. **saxatilis** Carse *Trans. Proc. N.Z. Inst.* 51: 95 (1919)

TYPE LOCALITY. "Among detached rocks in hilly forests, Mongonui County, Bay of Islands, Whangarei, Manukau County; H.C. Coromandel Peninsula: H.B. Matthews! Thames; D. Petrie!"

Specimens. Among rocks, McKay's Bush, Kaiaka, Coll. H.C., Jan 1917, AK 12335. In forest, among loose rocks, Kaiaka, Mongonui Co, Coll. H. Carse, July 1919, AK 135552. In wood on rocky slope, Kaiaka, Mangonui Co, Coll H. Carse 1444, no date, AK 126986. * Among rocks, McKay's Bush, Kaiaka, Mongonui County, H. Carse, no date, AK 12340. Mauku, H.C., July 1900, AK 135548.

Pteris pendula Col. *Trans. Proc. N.Z. Inst.* 20: 218 (1888)

TYPE LOCALITY. "Ever shaded wet-dripping gravelly cliffs (among other ferns and shrubs), banks of a stream south of Danneverke Township, County of Waipawa; 1887: W. C."

Specimens. * Dannevirke, Hawkes Bay, W. Colenso, no date, AK 135544.

PART 2. GYMNOSPERMAE

This presumptive type material was not included in the 1949 list of primary types in the Auckland Museum (Cooper 1949).

Podocarpus acutifolius Kirk *Trans. Proc. N.Z. Inst.* 16: 370 (1884)

TYPE LOCALITY. "South Island — Upper part of the Buller Valley: T. Kirk, 1875. . . . . My specimens were obtained in the vicinity of Rotoiti, not far from the outflow of the lake. I have to acknowledge my indebtedness to Mr. Cheeseman for specimens collected in another habitat lower down the valley."

Specimens. Roto Iti, Nelson, T. Kirk, no date; * Lake Rotoiti, Nelson, 1800 ft [548.64 m], T.F.C., Jan. 1878, AK 1105/1-2. (There are two specimens on AK 1105/1 and it is presumed that one was collected by Kirk and one by Cheeseman as there are the two labels).

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WRIGHT, A. E.

1978 Annotated checklist of type specimens of New Zealand plants in the Auckland Institute and Museum Herbarium. Part 3. Monocotyledones — Gramineae. *Rec. Auckland Inst. Mus.* 15: 45-53.

ANNOTATED CHECKLIST OF TYPE SPECIMENS OF NEW ZEALAND PLANTS IN THE AUCKLAND INSTITUTE AND MUSEUM HERBARIUM

Part 3. Monocotyledones — Gramineae

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UNIVERSITY OF AUCKLAND

Abstract. An annotated checklist of 156 sheets of Herbarium specimens forming type material for 67 taxa of New Zealand native grasses is presented.

The native grass collection in the Herbarium of the Auckland Institute and Museum (AK) has been systematically searched for type specimens. All specimens with any claim to type status are listed below, together with their author and publication reference, and the type locality quoted directly from the original description. In citing specimens, labels and notes of the collector have been used where possible and the information contained therein standardised into the following form: locality, collector, date, AK number. Where the label is written in other than the hand of the collector, the specimen citation is preceded by an asterisk. In most cases this occurs when Cheeseman has relabelled specimens and discarded the original collector's label or notes. Where two or more sheets of a collection exist, the second and subsequent sheets' labels have usually been copied from the original by later herbarium workers. Metric equivalents of altitude ranges have been added in square brackets.

A prominent feature of the Cheeseman Herbarium grass collection which creates a number of difficulties with type material is the exchange of specimens and letters between T. F. Cheeseman and Professor E. Hackel in Bohemia. Cheeseman forwarded numbered duplicates of several hundred grass collections to Hackel who wrote back naming the specimens. These letters (held in the Auckland Institute and Museum Library), although never published, contain the descriptions (often in Latin) of a number of new species and varieties recognised by Hackel. Cheeseman later published many, but not all, of these taxa in his *Manual of the New Zealand Flora* (1906). Unfortunately, he rarely quoted type localities or type specimens, merely referring to the unpublished Hackel manuscripts. Thus it is presumed that the holotypes of these taxa are housed in the Hackel Herbarium in Vienna (W) and that the AK specimens are isotypes, or in some cases syntypes.

This paper is a continuation of the series begun by Goulding (1978 this volume).

Agropyron enysii Kirk, *Trans. Proc. N.Z. Inst.* 27: 325 (1895)

TYPE LOCALITIES. "South Island: Slopes of Mount Torlesse and Broken River; J. D. Enys! (1877): Bealey Gorge; T. Kirk: 2,500 ft to 4,000 ft [762-1219 m], Southern Alps; N. T. Carrington! (1881)."

Specimen. * Mount Torlesse, Canterbury Alps, J. D. Enys, no date, AK 2018.

Agropyron multiflorum Kirk var. **longisetum** Hack. ex Cheeseman. *Man. N.Z. Fl.*: 922 (1906)

TYPE LOCALITY. Not stated by Cheeseman. Variety named by Hackel from specimen numbers 1506, 1507 sent by Cheeseman.

Specimen. Matamata, Thames Valley, T. F. Cheeseman, no date, AK 2017 (no. 1506 to Hackel).

Agrostis dyeri Petrie, *Trans. N.Z. Inst.* 22: 441 (1890)

TYPE LOCALITIES. "Ruahine Mountains (west of Makaretu Bush), 5,000 ft [1524 m]; Tararua Mountains (Buchanan)!; Mount Arnould (Upper Hawea), 3,000-4,000 ft [914-1219 m]."

Specimen. * Ruahine Mountains, 5,000 ft [1524 m], D. Petrie, no date, AK 1400.

Agrostis dyeri Petrie var. **aristata** Hack. ex Cheeseman, *Man. N.Z. Fl.*: 864 (1906)

TYPE LOCALITY. Not stated by Cheeseman. Variety named by Hackel from specimen number 1088 sent by Cheeseman.

Specimen. * Maniototo Plain, Otago, D. Petrie, no date, AK 1421 (no. 1088 to Hackel).

Agrostis dyeri Petrie var. **delicatior** Hack. ex Cheeseman, *Man. N.Z. Fl.*: 864 (1906)

TYPE LOCALITY. Not stated by Cheeseman. Variety named by Hackel from specimen number 1095 from Cheeseman.

Specimens. Upper Waimakariri, T. Kirk, no date, AK 1422 (2 sheets, no. 1095 to Hackel).

Agrostis muelleri Benth. var. **paludosa** Hack. ex Cheeseman, *Man. N.Z. Fl.*: 864 (1906)

TYPE LOCALITIES. "Swamps by the Broken River, Kirk! Tasman Valley, T. F. Cheeseman."

Specimens. * Mountain bogs, Broken River, Canterbury, T. Kirk, no date, AK 1396 (no. 1111 to Hackel). Swamps in the Tasman Valley, alt. 2,000 ft, [610 m], T. F. Cheeseman, January 1897, AK 1395 (no. 1110 to Hackel).

Agrostis petriei Hack. var. **mutica** Hack., *Trans. N.Z. Inst.* 35: 379 (1902)

TYPE LOCALITY. "Cromwell, Central Otago, Petrie (10045 hb. Petrie, 1085 hb. Cheesem.)."

Specimens. * Cromwell, Central Otago, 900 ft [275 m], D. Petrie, no date, AK 1425 (2 sheets).

Agrostis striata Col., *Trans. N.Z. Inst.* 21: 107 (1889)

TYPE LOCALITY. "High lands in the interior near Lake Waikare, County of Wairoa; 1888: Mr H. Hill."

Specimen. * Lake Waikaremoana, H. Hill, no date, AK 1450 (ex Herb. Colenso).

Agrostis tenella Petrie, *Trans. N.Z. Inst.* 22: 442 (1890)

TYPE LOCALITY. "Macrae's, Waihemo County (Otago); 1,800 ft [548 m]."

Specimen. Macrae's, Waihemo County, 1,800 ft [548 m], D. Petrie, no date, AK 1434.

Apera purpurascens Col., *Trans. N.Z. Inst.* 21: 106 (1889)

TYPE LOCALITY. "Edges of streamlets in woods south of Dannevirke, County of Waipawa, flowering in February; 1887-88: W. C."

Specimens. * Near Dannevirke, Hawkes Bay, W. Colenso, no date, AK 1353 (3 sheets, the first annotated "Type of *Apera purpurascens* Colenso" by Cheeseman).

Arundo fulvida Buch., *Trans. N.Z. Inst.* 6: 242 (1874)

TYPE LOCALITY. "Collected by Dr Menzies on the Mataura River, Otago, in 1867; and by J. Buchanan at Wellington Heads, in 1873."

Specimen. *Wellington, J. Buchanan, no date, AK 1708 (note attached in Buchanan's hand stating name but no details of locality, date, etc.).

Asperella aristata Petrie, *Trans. N.Z. Inst.* 26: 272 (1894)

TYPE LOCALITIES. "Sources of the Broken River (4,000 ft) [1219 m], and the valleys of Mount Torlesse (3,500 ft) [1067 m], Alps of North Canterbury."

Specimens. Black Range, Canterbury Alps, 4,500 ft [1372 m], D. Petrie 1514, January 1893, AK 2021. * Broken River, Canterbury Alps, 3,500 ft [1067 m], D. Petrie, no date, AK 2020.

Asperella laevis Petrie, *Trans. N.Z. Inst.* 27: 406 (1895)

TYPE LOCALITIES. "Catlin's River district, near the seaside, and Matukituki Valley (Lower Wanaka) 1,100 ft [335 m]."

Specimens. * Matukituki Valley, Otago, D. Petrie, no date, AK 2038 (3 sheets).

Atropis antipoda Petrie, *Subantarctic Is. N.Z.*: 480 (1909)

TYPE LOCALITY. "Antipodes Island; B. C. Aston!"

Specimen. * Antipodes Island, B. C. Aston, 12 January 1909, AK 1973.

Atropis chathamica Cheeseman, *Man. N.Z. Fl.* 2nd Ed.: 203 (1925)

TYPE LOCALITY. "Chatham Islands: exact locality not stated, F. A. D. Cox!"

Specimens. * Chatham Islands, F. A. D. Cox, no date, AK 1978 (2 sheets).

Atropis pumila Kirk, *Trans. N.Z. Inst.* 14: 379 (1882)

TYPE LOCALITY. "South Island, common in Otago from 2,000 to 3,000 ft [610-914 m], D. Petrie."

Specimens. * Interior of Otago, D. Petrie, no date, AK 1715. Macrae's, and Upper Shag Valley, 1,200 ft [366 m], D. Petrie, no date, AK 1716. * Upper Waipori, Otago, 2,000 ft [610 m], D. Petrie, no date, AK 1717.

Atropis stricta (Hook. f.) Hack. ex Cheeseman var. **suborbicularis** Hack. ex Cheeseman, *Man. N.Z. Fl.*: 914 (1906)

TYPE LOCALITY. "Near Oamaru, Petrie!"

Specimen. * Near Oamaru, Otago, D. Petrie, no date, AK 1972.

Calamagrostis petriei Hack., *Trans. N.Z. Inst.* 35: 380 (1903)

TYPE LOCALITY. "Swampy Hill, Dunedin, Otago, leg. Petrie (10092 hb. Petrie, 1190 hb. Cheeseman)."

Specimen. * Dunedin, D. Petrie, no date, AK 1508 (no. 1190 to Hackel).

Catabrosa antarctica Hook. f., *Fl. Nov. Zel.* i: 308 (1853)

TYPE LOCALITY. "Northern Island: summit of the Ruahine Range, Colenso."

Specimen. * Ruahine Range, W. Colenso no. 1553, no date, AK 1546.

Danthonia planifolia Petrie, *Trans. N.Z. Inst.* 33: 328 (1901)

TYPE LOCALITY. "Scrubby slopes leading up to the Clinton Saddle, between Lake Te Anau and Milford Sound, on the eastern side of the saddle (2,500 ft) [762 m]."

Specimens. * Clinton Saddle, Lake Te Anau, D. Petrie, no date, AK 1650 (2 sheets).

Danthonia pungens Cheeseman, *Man. N.Z. Fl.*: 887 (1906)

TYPE LOCALITY. "Stewart Island, Smith's Lookout, altitude 1,000 ft [305 m], T. Kirk!"

Specimen. * Smith's Lookout, Stewart Island, T. Kirk, January 1887, AK 1640.

Danthonia raoulii Steud. var. **cheesemanii** Hack. ex Cheeseman, *Man. N.Z. Fl.*: 886 (1906)

TYPE LOCALITY. "Open forests near the source of the Takaka River, Nelson, altitude 3,000 ft [914 m], T. F. Cheeseman."

Specimens. Forests at the source of the Takaka River, Nelson, alt. 3,000 ft [914 m], T. F. Cheeseman, January 1881, AK 1633 (no. 1250 to Hackel); AK 1634 (2 sheets).

Danthonia thomsoni Buch., *N.Z. Grasses*: t36 (2) (1880)

TYPE LOCALITY. "South Island, Mount St Bathans, Otago, 1-2,000 ft [305-610 m], discovered by D. Petrie."

Specimen. * Mount St Bathans, Otago, 3,000 ft [914 m], no collector, no date, AK 1720. Two later labels have been added by Cheeseman. The first adds D. Petrie as the collector, the second alters the collector to J. Buchanan.

Deschampsia chapmani Petrie, *Trans. N.Z. Inst.* 23: 401 (1891)

TYPE LOCALITY. "Auckland Islands, coll. F. R. Chapman."

Specimen. * Auckland Islands, F. B. Chapman, January, 1890, AK 1540.

Deschampsia gracillima Kirk, *Journ. Bot.* 24: 237 (1891)

TYPE LOCALITY. "Carnley Harbour, Auckland Islands, 1,000 ft [305 m], T. Kirk."

Specimens. Carnley Harbour, Auckland Island, Kirk, no date, AK 1553 (2 sheets). * Auckland Islands, Kirk, January 1890, AK 1552.

Deschampsia pusilla Petrie, *Trans. N.Z. Inst.* 23: 403 (1891)

TYPE LOCALITY. "Hector Mountains 6,000 ft [1829 m]."

Specimens. Hector Mountains, 6,000 ft [1829 m], D. Petrie, February 1890, AK 1534 (2 sheets).

Deschampsia tenella Petrie, *Trans. N.Z. Inst.* 23: 402 (1891)

TYPE LOCALITY. "Catlin's River District, in moist rather open spots in woods up to 400 ft [122 m]."

Specimens. * Catlin's River, Otago, D. Petrie, no date, AK 1549 (2 sheets). Catlin's River, D. Petrie, January 1892, AK 1550.

Deyeuxia avenoides (Hook. f.) Buch. var. **brachyantha** Hack. ex Cheeseman, *Man. N.Z. Fl.*: 871 (1906)

TYPE LOCALITY. "Common throughout, ranging from sealevel to 3,500 ft [1067 m]". Variety named by Hackel from specimen numbers 1171-1189 (except 1177) sent by Cheeseman.

Specimens. Raglan Range, Wairau Valley, 3,000 ft [914 m], T. F. Cheeseman, January 1881, AK 1500 (no. 1186 to Hackel). Te Aroha, T. F. Cheeseman, January 1884, AK 1501 (no. 1188 to Hackel). Tokoroa Plains, Upper Waikato, T. F. Cheeseman, January 1884, AK 1502 (4 sheets — no. 1187 to Hackel). Clarence Valley, 2,000 ft [610 m], T. F. Cheeseman, January 1893, AK 1504 (no. 1185 to Hackel).

Deyeuxia billardieri Kunth var. **tenuis** Petrie ex Cheeseman, *Man. N.Z. Fl.*: 869 (1906)

TYPE LOCALITY. "Catlin's River, Otago, H. J. Matthews."

Specimen. * Catlin's River, Otago, H. J. Matthews, no date, AK 1481.

Deyeuxia forsteri Kunth var. **humilior** Hack. ex Cheeseman, *Man. N.Z. Fl.*: 868 (1906)

TYPE LOCALITY. "North and South Islands; probably not uncommon in mountain districts, Lake Waikaremoana, Hill! Clarence Valley, Lake Tennyson, Broken River, Tasman Valley, etc. T. F. Cheeseman; Lake Te Anau, Petrie!"

Specimens. Clarence Valley, T. F. Cheeseman, January 1893, AK 1451. Lake Tennyson, alt. 3,000 ft [914 m], T. F. Cheeseman, January 1893, AK 1453 (2 sheets). Mountains above the Broken River, Canterbury, alt. 3,500 ft [1067 m], T. F. Cheeseman, no date, AK 1452. Swamps of the Tasman Valley, T. F. Cheeseman, January 1898, AK 1454. * Lake Te Anau, Otago, D. Petrie, February 1891, AK 1457.

Deyeuxia forsteri Kunth var. **littoralis** Hack. ex Cheeseman, *Man. N.Z. Fl.*: 869 (1906)

TYPE LOCALITY. Not stated by Cheeseman. Variety named by Hackel from specimen numbers 1135-1137 sent by Cheeseman.

Specimens. * Kermadec Islands, R. H. Shakespear, no date, AK 1461 (no. 1135 to Hackel). Coast north of Manukau Harbour, T. F. Cheeseman, December 1880, AK 1458 (no. 1137 to Hackel).

Deyeuxia forsteri Kunth var. **micrathera** Hack. ex Cheeseman, *Man. N.Z. Fl.*: 868 (1906)

TYPE LOCALITY. "Antipodes Island, Campbell Island: Kirk!"

Specimens. Antipodes Island, T. Kirk, 17 January 1890, AK 1471. Campbell Island, T. Kirk, no date, AK 1472.

Deyeuxia forsteri Kunth var. **semiglabra** Hack. ex Cheeseman, *Man. N.Z. Fl.*: 868 (1906)

TYPE LOCALITY. "North and South Islands: Not uncommon." Variety named by Hackel from specimen number 1131 sent by Cheeseman.

Specimen. Broken River, Canterbury Alps, 2,000 ft [610 m], T. F. Cheeseman, no date, AK 1449 (no. 1131 to Hackel).

Dichelachne crinita (Linn. f.) Hook. f. var. **intermedia** Hack. ex Cheeseman, *Man. N.Z. Fl.*: 873 (1906)

TYPE LOCALITY. Not stated by Cheeseman. Variety named by Hackel from specimen numbers 1063 to 1065 sent by Cheeseman.

Specimen. * Bay of Islands, D. Petrie, November 1895, AK 1522 (no. 1063 to Hackel).

Dichelachne sciurea Hook. f. var. **inaequiglumis** Hack. ex Cheeseman, *Man. N.Z. Fl.*: 874 (1906)

TYPE LOCALITY. Not stated by Cheeseman. Variety named by Hackel from specimen number 1068 sent by Cheeseman.

Specimen. * Western Park, Auckland, D. Petrie, no date, AK 1527 (2 sheets — no. 1068 to Hackel).

Festuca coxii Hack. ex Cheeseman, *Man. N.Z. Fl.*: 919 (1906)

TYPE LOCALITY. "Chatham Islands: Common on rocks and sands near the shore, Cox and Cockayne!"

Specimen. On rocks near the sea, Chatham Island, L. Cockayne and F. A. D. Cox No. 4024, January 1901, AK 2009.

Festuca foliosa Hook. f., *Fl. Antarctica* i: 99 (1844)

TYPE LOCALITY. "Lord Auckland's Group and Campbell's Island: on banks and in rocky places, chiefly near the sea, very abundant."

Specimen. * Auckland Islands, J. D. Hooker, no date, AK 1752 (ex Herb. Colenso).

Festuca multinodis Petrie et Hack., *Trans. N.Z. Inst.* 44: 186 (1912)

TYPE LOCALITIES. "Coastal cliffs and rocky slopes at Port Nicholson, and the shores of Cook Strait. Coll. B. C. Aston."

Specimens. * Island Bay, Wellington (on littoral rocks), B. C. Aston no. 14, no date, AK 2004 (2 sheets).

Festuca ovina L. subsp. **matthewsii** Hack., *Trans. Proc. N.Z. Inst.* 35: 385 (1903)

TYPE LOCALITY. "Mount Bonpland, Otago, leg. H. J. Matthews (hb. Cheesem. 1496)."

Specimens. * Mount Bonpland, Otago, H. J. Matthews, no date, AK 1990 (2 sheets — no. 1496 to Hackel).

Festuca ovina subsp. **novae-zelandiae** Hack., *Trans. N.Z. Inst.* 35: 384 (1903)

TYPE LOCALITY. "Canterbury Alps, in declivibus montis Torlesse, altit. 1000 m, leg. Cheeseman (Nro. 1497)."

Specimens. Slopes of Mount Torlesse, Canterbury, 3,000 ft [914 m], T. F. Cheeseman, January 1880, AK 1987 (2 sheets — no. 1497 to Hackel).

Hierochloe fraseri Hook. f. var. **recurvata** Hack. ex Cheeseman, *Man. N.Z. Fl.*: 855 (1906)

TYPE LOCALITY. Not stated by Cheeseman. Variety named by Hackel from specimen number 1039 sent by Cheeseman.

Specimen: * Ruahine Mountains, D. Petrie, no date, AK 1330 (no. 1039 to Hackel).

Imperata cheesemanii Hack., *Trans. N.Z. Inst.* 35: 378 (1903)

TYPE LOCALITY. "Kermadec Islands, leg. Cheeseman (Nro 1001)."

Specimens. Kermadec Islands, T. F. Cheeseman, August 1887, AK 1264 (no. 1001 to Hackel). * Kermadec Islands, Miss Shakespear, November 1900, AK 1265 (no. 1001 to Hackel.)

Microlaena carsei Cheeseman, *Trans. N.Z. Inst.* 47: 47 (1915)

TYPE LOCALITY. "North Island: Mangonui County, damp shaded places in the forest near Kaiaka, H. Carse!"

Specimens. Otukai, near Kaiaka, Mangonui County, H. Carse, May 1913, AK 1308 (2 sheets).

Microlaena ramosissima Col., *Trans. N.Z. Inst.* 21: 105 (1899)

TYPE LOCALITY. "In a thicket on the banks of a small streamlet south of Dannevirke, County of Waipawa (and only in that locality); 1887-88: W. C."

Specimens. * Near Dannevirke, Hawkes Bay, W. Colenso, no date, AK 1313 (2 sheets).

Poa anceps Forst. f. var. **condensata** Cheeseman, *Man. N.Z. Fl.*: 904 (1906)

TYPE LOCALITY. "Not uncommon as far as Canterbury."

Specimens. * White Island, Bay of Plenty, W. R. B. Oliver, no date, AK 1810 (3 sheets). * Growing at foot of limestone cliffs near breakwater at Napier, B. C. Aston, no date, AK 1811. Seacliffs between Waimarama and Mataroa (Cape Kidnapper), H. Tryon, no date, AK 1812. * Near Cape Kidnappers, Hawkes Bay, H. Hamilton, no date, AK 1813. * Precise locality not given, W. Colenso 3809, no date, AK 1814. * Canterbury Plains, J. B. Armstrong, no date, AK 1815.

Poa anceps Forst. f. var. **gracilis** Cheeseman, *Man. N.Z. Fl.*: 904 (1906)

TYPE LOCALITY. "To Foveaux Strait."

Specimens. * Great Barrier Island, T. Kirk, no date, AK 1816 (2 sheets). Oxford, Thames Valley, T. F. Cheeseman, no date, AK 1817 (2 sheets). Oxford, Upper

Thames, T. F. Cheeseman, no date, AK 1818 (3 sheets). Patatere Plateau, T. F. Cheeseman, January 1884, AK 1819 (5 sheets). Hawera, Taranaki, T. F. Cheeseman, January 1885, AK 1820 (4 sheets).

Poa aucklandica Petrie, *Subantarctic Is. N.Z.* ii: 478 (1909)

TYPE LOCALITIES. "Auckland Islands, on hills above Carnley Harbour; B. C. Aston! Campbell Island? R. M. Laing (not in flower)!"

Specimen. * Carnley Harbour, Auckland Island, B. C. Aston, no date, AK 1845.

Poa breviglumis Hook. f., *Fl. Antarctica* i: 101 (1844)

TYPE LOCALITY. "Campbell's Island; open grassy places near the sea, not uncommon."

Specimen. * Moist banks near the sea; not uncommon, Campbell's Island, J. D. Hooker, December 1840, AK 1956.

Poa caespitosa Spreng. var. **leioclada** Hack. ex Cheeseman, *Man. N.Z. Fl.*: 908 (1906)

TYPE LOCALITIES. "Mount Egmont, Petrie! near Westport, Townson!"

Specimens. * Mount Egmont, 4,000 ft [1219 m], D. Petrie, no date, AK 1870. * Cape Foulwind, near Westport, W. Townson no. 29B, no date, AK 1872 (2 sheets). * Near Westport, W. Townson no. 712, no date, AK 1873 (2 sheets).

Poa caespitosa Spreng. var. **planifolia** Petrie, *Trans. N.Z. Inst.* 47: 58 (1915)

TYPE LOCALITY. "Antipodes Island; H. J. Matthews."

Specimens. * Grown in Mr H. J. Matthews' Garden at Dunedin from a plant obtained from Antipodes Island, AK 1877. * Grown from a specimen brought from . . . ., H. J. Matthews, no date, AK 1876.

Poa chathamica Petrie, *Trans. N.Z. Inst.* 34: 394 (1902)

TYPE LOCALITY. "*Sphagnum* bogs at the Chatham Islands, where it was collected by Messrs L. Cockayne and F. A. D. Cox in January, 1900."

Specimens. * *Sphagnum* swamp, Chatham Islands, L. Cockayne, no date, AK 1858 (2 sheets). * Chatham Islands, Cox and Cockayne, no date, AK 1859.

Poa cheesemanii Hack., *Trans. N.Z. Inst.* 35: 383 (1903)

TYPE LOCALITY. "Nelson Alps, Lake Tennyson, Altit. 1000 m, leg. Cheeseman (Nro. 1316)."

Specimens. Lake Tennyson, alt. 3,000 ft [914 m], T. F. Cheeseman, January 1893, AK 1855 (3 sheets — no. 1416 to Hackel). Hackel has quoted the specimen number incorrectly in his publication (No. 1316 was *Arundo conspicua* Forst.).

Poa cockayniana Petrie, *Trans. N.Z. Inst.* 45: 274 (1913)

TYPE LOCALITY. "Banks of Rolleston River, Westland, L. Cockayne."

Specimen. * Rolleston River, Southern Alps, Dr Cockayne, no date, AK 1857.

Poa guthrie-smithiana Petrie, *Trans. N.Z. Inst.* 45: 275 (1913)

TYPE LOCALITY. "Herekopere Island, off Stewart Island."

Specimen. * Herekopere Island, H. Guthrie-Smith, no date, AK 1794.

Poa kirkii Buch. var. **collinsii** Hack. ex Cheeseman, *Man. N.Z. Fl.*: 910 (1906)

TYPE LOCALITIES. "Mount Fyffe (Marlborough), Kirk! Hooker Valley, T. F. Cheeseman. 2,000-5,000 ft [610-1524 m]."

Specimens. * Mount Fyffe, Marlborough, T. Kirk, no date, AK 1919 (2 sheets). Hooker Valley, Mount Cook District, 2,500 ft [762 m], T. F. Cheeseman, no date, AK 1920 (2 sheets).

Poa maniototo Petrie, *Trans. N.Z. Inst.* 22: 443 (1890)

TYPE LOCALITY. "Maniototo Plain, Upper Clutha Basin, Mounts Pisa and Cardrona; altitudinal range 1,000 ft-4,000 ft [305-1219 m]."

Specimen. Maniototo Plain, Upper Clutha, Otago, 1,000-3,000 ft [305-914 m], D. Petrie, no date, AK 1940.

Poa novae-zelandiae Hack., *Trans. N.Z. Inst.* 35: 381 (1903)

TYPE LOCALITIES. "Canterbury Alps ad Arthur's Pass, altit. 1000 m (Cheesem. nr. 1338, 1339) et Hooker Glacier (Cheesem. 1341), Nelson mountains ad Mount Arthur Plateau (Cheesem. 1340), Humboldt mountains (Cockayne, 1347 in hb. Cheesem.)."

Specimens. Arthur's Pass, Canterbury Alps, 3,000 ft [914 m], T. F. Cheeseman, no date, AK 1768 (2 sheets — no. 1338 to Hackel); AK 1769 (3 sheets — no. 1339 to Hackel). Mount Arthur Plateau, Nelson, alt. 4,000 ft [1219 m], T. F. Cheeseman, January 1886, AK 1773 (no. 1340 to Hackel). Hooker Glacier, Canterbury Alps, 3,500 ft [1067 m], T. F. Cheeseman, no date, AK 1765 (2 sheets — no. 1341 to Hackel).

Poa novae-zelandiae Hack. forma **humilior** Hack., *Trans. N.Z. Inst.* 35: 382 (1903)

TYPE LOCALITIES. "Mount Hikurangi, East Cape, alt. 1500 m (Petrie 10198, hb. Cheesem. 1345); Otira Glacier, Westland, alt. 1160 m (Cockayne 6557, in hb. Cheesem. 1348); Raglan Range, Wairau Valley, Nelson Alps, 1500 m (Cheesem. 1342)."

Specimens. Raglan Range, Wairau Valley, Nelson alt. 5,500 ft [1676 m], T. F. Cheeseman, no date, AK 1776 (2 sheets — no. 1342 to Hackel).

Poa oraria Petrie, *Trans. N.Z. Inst.* 42: 196 (1910)

TYPE LOCALITY. "Moist and wet stations at the head of several of the sounds of western Otago (Deep Cove etc.). Collected by Mr B. C. Aston in mid-January, 1909."

Specimen. * Deep Cove, S.W. Otago, B. C. Aston, January 1909, AK 1788 (2 sheets).

Poa polyphylla Hack., *Trans. N.Z. Inst.* 35: 383 (1903)

TYPE LOCALITY. "Kermadec Islands, leg. Shakspear (in herb. Cheesem. 1444-46)."

Specimen. * Kermadec Islands, R. H. Shakespear, no date, AK 1830 (no. 1446 to Hackel).

Poa polyphylla Hack. forma **compacta** Hack., *Trans. N.Z. Inst.* 35: 383 (1903)

TYPE LOCALITY. "'Kermadec Island, leg. Shakspear (in hb. Cheesem. 1445)."

Specimen. * Kermadec Islands, N.E. from New Zealand, R. H. Shakespear, no date, AK 10808 (no. 1445 to Hackel).

Poa ramosissima Hook. f., *Fl. Antarctica* i: 101 (1844)

TYPE LOCALITIES. "Lord Auckland's Group; very common on rocks overhanging the sea, trailing over banks etc. β. Campbell's Island; plentiful on the faces of hills sloping to the south; rare in Lord Auckland's Group."

Specimen. * Campbell Island, Sir J. D. Hooker (ex Kew Herbarium), no date, AK 1793.

Simplicia laxa T. Kirk, *Trans. N.Z. Inst.* 29: 497 (1897)

TYPE LOCALITIES. "North Island — Dry River Station, Ruamahanga, Lower Wairarapa: January, 1880: T. K. South Island — Waikouaiti and Deep Stream, Otago: D. Petrie!" Lectotype chosen by Zotov, *N.Z. J. Bot.* 9 (3): 541 (1971) — "Waikouaiti, Otago, D. Petrie."

Specimens. * Waikouaiti, Otago, D. Petrie, no date, AK 1370. * Waikouaiti, Otago, D. Petrie, no date, AK 1371. * Deep Stream, Waikouaiti, Otago, D. Petrie, no date, AK 1372.

Triodia australis Petrie var. **mucronulata** Hack. ex Cheeseman, *Man. N.Z. Fl.*: 896 (1906)

TYPE LOCALITY. "Swamps in the Tasman Valley, Canterbury, T. F. Cheeseman, 2,000-5,000 ft [610-1524 m]."

Specimen. Swamps in Tasman Valley, T. F. Cheeseman, January 1898, AK 1731.

Triodia macquariensis Cheeseman, *Vasc. Fl. Macquarie Is.*: 34 (1919)

TYPE LOCALITY. "Macquarie Island: Rock and cliffs near the coast. H. Hamilton (1912-1913)."

Specimens. Coastal form only found near the sea, Macquarie Island, H. Hamilton, no date, AK 1732. A common coastal grass, in crevices on bare rocks and cliffs, North end, Macquarie Island, H. Hamilton, no date, AK 1733.

Trisetum antarcticum Trin. var. **lasiorhachis** Hack. ex Cheeseman, *Man. N.Z. Fl.*: 880 (1906)

TYPE LOCALITY. Not stated by Cheeseman. Variety named by Hackel from specimen numbers 1213, 1217 and 1218 sent by Cheeseman.

Specimens. * Mount Hikurangi, East Cape, D. Petrie, no date, AK 1574 (no. 1217 to Hackel). * Mount Hikurangi, East Cape, 5,000 ft [1524 m], D. Petrie, no date, AK 1573 (2 sheets — no. 1218 to Hackel).

Trisetum cheesemanii Hack., *Trans. N.Z. Inst.* 35: 880 (1906)

TYPE LOCALITY. "Hooker Glacier, Mount Cook district, altit. 1200 m, leg. Cheeseman (Nro. 1221 sub nomine *T. subspicati*)."

Specimens. Hooker Glacier, Mount Cook, alt. 4,000 ft [1219 m], T. F. Cheeseman, no date, AK 1594 (3 sheets — no. 1221 to Hackel).

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NEW RECORDS OF NEOGASTROPOD MOLLUSCA FROM THE KERMADEC ISLANDS

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Abstract. The following species are new additions to the Kermadec Island molluscan fauna: *Nassarius nodiferus* (Powys), *N. himeroessa* (Melvill & Standen), *Neocancilla takiisaoi* (Kuroda), *Vexillum (Costellaria) sculptile* (Reeve), *V. (C.) castum* (H. Adams), and *V. (C.) angustissimum* (E. A. Smith) from the tropical Indo-Pacific; *Phos hirasei* (Sowerby) and *Ziba cf. rehderi* (Webb) from Japan; *Z. cernohorskyi* Rehder & Wilson from Pitcairn Island; and *Cancilla strangei* (Angas) and *Microvoluta royana* (Iredale) from Australia. *Ziba kermadecensis* n. sp. is a new member of the family Mitridae from the Kermadec Islands.

Through the courtesy of the Department of Molluscs, National Museum of New Zealand (NMNZ), I have received for examination specimens belonging to five neogastropod families. These specimens have been collected in the Kermadec Islands during October 1975 and September 1976 by museum expeditions on R.V. "Acheron".

The molluscan fauna of the Kermadec Islands has been reported upon by Iredale (1910, 1912), Oliver (1915) and Powell (1958, 1967). Kermadec Island Conidae have also been described and illustrated by the author (Cernohorsky 1976). Details of geography and topography may be found in Iredale, Oliver and Powell (op.cit.).

From previous accounts and material available in museums, we find that the Kermadec Island marine molluscan fauna comprises a mixture of tropical Indo-Pacific, New Zealand, and Australian elements with a moderately high proportion of endemics.

ORDER NEOGASTROPODA

Family BUCCINIDAE

Genus **Phos** Montfort, 1810

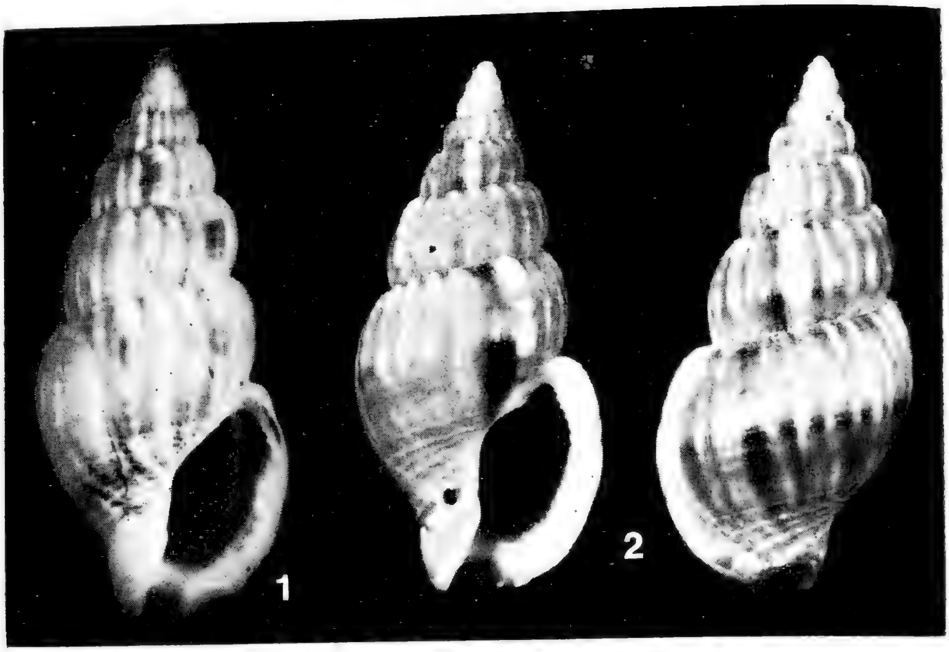
Phos Montfort, 1810, Conchyl. Syst. 2: 495. Type species by OD *Murex senticosus* Linnaeus, 1758. Recent, Indo-Pacific.

Phos hirasei Sowerby, 1913 (Figs. 1, 2)

1913. *Phos hirasei* Sowerby, Ann. Mag. Nat. Hist. (8), 11: 558, pl. 9, fig. 2; 1936 Hirase, Coll. Jap. shells ed. 5: 75, pl. 105, fig. 14; 1960 Azuma, Cat. Moll. Tosa Prov. Japan, p. 40; 1961 Habe, Col. illust. shells Japan 2: 61, pl. 31, fig. 7.

TYPE LOCALITY: Kii, Japan.

Material examined: BS 440, 29°16′S, 177°49.3′W, S.E. Chanter I, Raoul I, 512-585 m; 1 specimen and 3 fragments.



Figs. 1, 2. *Phos hirasei* Sowerby. 1. Holotype BMNH, length 38.0 mm. 2. Specimen from S.E. Chanter I, Raoul I, Kermadec Is, 512-585 m; length 18.2 mm.

The Kermadec I record is the first record of this species from outside Japan. The species has characteristic axial ribs which appear to be clasping the sutures and the whitish varices have 2-3 narrow brown bands.

The holotype of *Phos hirasei* is in the British Museum (Nat. Hist.), London, No. 1914.1.7.294., length 38.0 mm, width 17.0 mm (Fig. 1).

Family NASSARIIDAE

Genus **Nassarius** Duméril, 1806

Nassarius Duméril, 1806, Zool. analyt. p. 166. Type species by SM (Froriep, 1806) *Buccinum arcularia* Linnaeus, 1758. Recent, Indo-Pacific.

Nassarius nodiferus (Powys, 1835) (Fig. 3)

1835. *Nassa nodifera* Powys, Proc. Zool. Soc. Lond. p. 95.

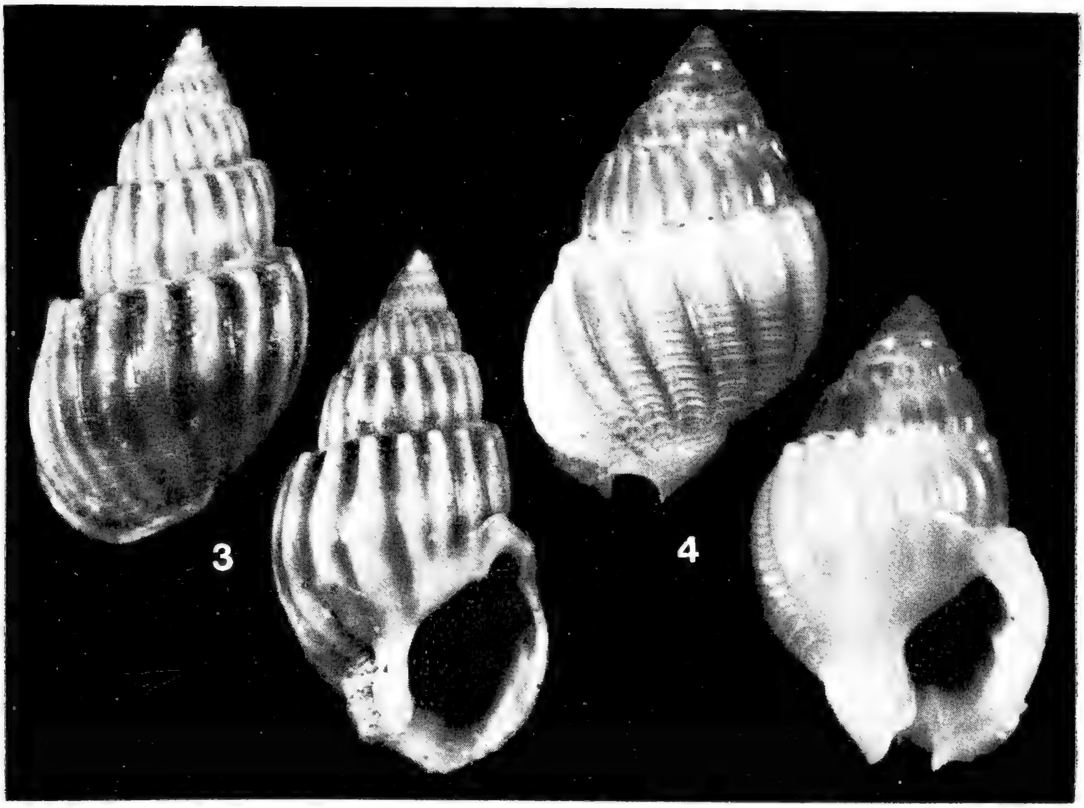
1972. *Nassarius (Niotha) nodiferus* (Powys), Cernohorsky, Rec. Auckland Inst. Mus. 9: 153, figs. 69, 70; 1975 Cernohorsky, Rec. Auckland Inst. Mus. 12: 222, fig. 23 (figd syntype).

TYPE LOCALITY: Gallapagos and Panama = error.

DISTRIBUTION: From Mauritius to China and the New Hebrides. Kermadec Is (new record).

Material examined: BS 438, 29°14.7′S, 177°49.4′W, S.E. Nugent I, Raoul I, 146-165 m; 11 specimens. BS 434, 29°12.7′S, 177°56.1′W, Fleetwood Bluff, Raoul I, 135 m; 4 specimens and 1 fragment.

All specimens were dredged dead, indicating that the species probably does not live at the depth indicated. All Kermadec I specimens lack the fully formed lip of mature individuals.



Figs. 3, 4. *Nassarius nodiferus* (Powys). S.E. Nugent I, Raoul I, Kermadec Is, 146-165 m; length 26.4 mm. 4. *N. himeroessa* (Melvill & Standen), E. Chanter I, Raoul I, Kermadec Is, 366-402 m; length 6.4 mm.

This may be the same species as recorded by Iredale (1910) and Oliver (1915) under the name "*Arcularia scalaris* (A. Adams, 1852)" [*non* Borson, 1825].

Subgenus **Niotha** H. &. Adams, 1853

Niotha H. & A. Adams, 1853, Gen. Rec. Moll. 1: 117. Type species by SD (Cossman, 1901) *Nassa cumingii* A. Adams, 1852 = *Buccinum conoidale* Deshayes in Bélanger, 1832. Recent, Indo-Pacific.

Nassarius (Niotha) himeroessa (Melvill & Standen, 1903) (Fig. 4)

1903. *Nassa (Alectryon) himeroessa* Melvill & Standen, Ann. Mag. Nat. Hist. (7), 12: 306, pl. 22, fig. 7.

1925. *Nassa innocens* Thiele, Wiss. Ergeb. deut. Tief. Exp. "Valdivia" 17: 183, pl. 20, fig. 12.

TYPE LOCALITY: Gulf of Oman, 7-156 fathoms (13-285 m) (*himeroessa*): near Dar-es-Salaam, 6°35′S and 39°36′E, 404 m (*innocens*).

DISTRIBUTION: From the Persian Gulf to East Africa, Malaysia and the Philippines. Kermadec Is (new record).

Material examined: BS 441, 29°15.5′S, 177°50′W, E. Chanter I, Raoul I, 366-402 m; 8 specimens. BS 442, 29°16.5′S, 177°49.5′W, S.E. Chanter I, Raoul I, 512-549 m; 1 specimen.

The Kermadec I record represents an appreciable eastward range-extension from the Philippine Is, but the absence of the species in intervening areas is most probably due to the paucity of deep-water dredgings.

Two syntypes of *N. himeroessa* are in the British Museum (Nat. Hist.), London, No. 1903.12.15.69-70., dimensions of one syntype length 4.4 mm. The holotype of *N. innocens* is in the Zoological Museum, Humboldt University, Berlin, length 6.3 mm. The largest Kermadec I specimen measured 6.4 mm in length.

Family MITRIDAE

Genus **Cancilla** Swainson, 1840

Cancilla Swainson, 1840, Treat. Malac. pp. 130, 320. Type species by SD (Herrmannsen, 1846) *Tiara isabella* Swainson, 1831. Recent, Indo-Pacific.

Subgenus **Domiporta** Cernohorsky, 1970

Cancilla (Domiporta) strangei (Angas, 1867) (Fig. 5)

1867. *Mitra (Cancilla) strangei* Angas, Proc. Zool. Soc. Lond. p. 110, pl. 13, fig. 4.
1877. *Mitra franciscana* Tenison-Woods, Proc. R. Soc. Tasmania for 1876: 133.
1912. *Mitra nodostaminea* Hedley, Rec. Austral. Mus. 8 (3): 150, pl. 43, fig. 35.
1951. *Mitra tasmantis* Laseron, Rec. Austral. Mus. 22 (4): 341, textfig. 3.

TYPE LOCALITY: Middle harbour, Port Jackson, N.S.W., Australia (*strangei*); Tamar Heads, Tasmania, Australia (*franciscana*); off Port Kembla, N.S.W., Australia, 63-75 fathoms (115-137 m) (*nodostaminea*); Twofold Bay, N.S.W., Australia, 50-70 fathoms (92-128 m) (*tasmantis*).

DISTRIBUTION: From Tasmania to Sth. Queensland, Australia. Kermadec Is (new record).

Material examined: Raoul I, Kermadec Is, 83 m (*ex*-"Galathea" Expedition).

The specimen from Raoul I is a senile individual with a coarse spiral sculpture. Specimens with fine and coarse, often nodulose spiral sculpture occur throughout the species distributional range.

Genus **Neocancilla** Cernohorsky, 1966

Neocancilla Cernohorsky, 1966, Veliger 9 (2): 110. Type species by OD *Voluta papilio* Link, 1807. Recent, Indo-Pacific.

Neocancilla takiisaoi (Kuroda, 1959) (Figs. 6, 7)

1958. *Mitra taki-isaoi* Kuroda, Jap. J. Malac. 20 (2): pl. 21, fig. 10 (*nomen nudum*).
1959. *Mitra (Scabricola) takiisaoi* Kuroda, Jap. J. Malac. 20 (4): 326.
1970. *Neocancilla takiisaoi* (Kuroda), Cernohorsky, Bull. Auckland Inst. Mus. 8: 78, pl. 7, fig. 12.

TYPE LOCALITY: Hachijo-jima, Izu-shichito I, Japan.

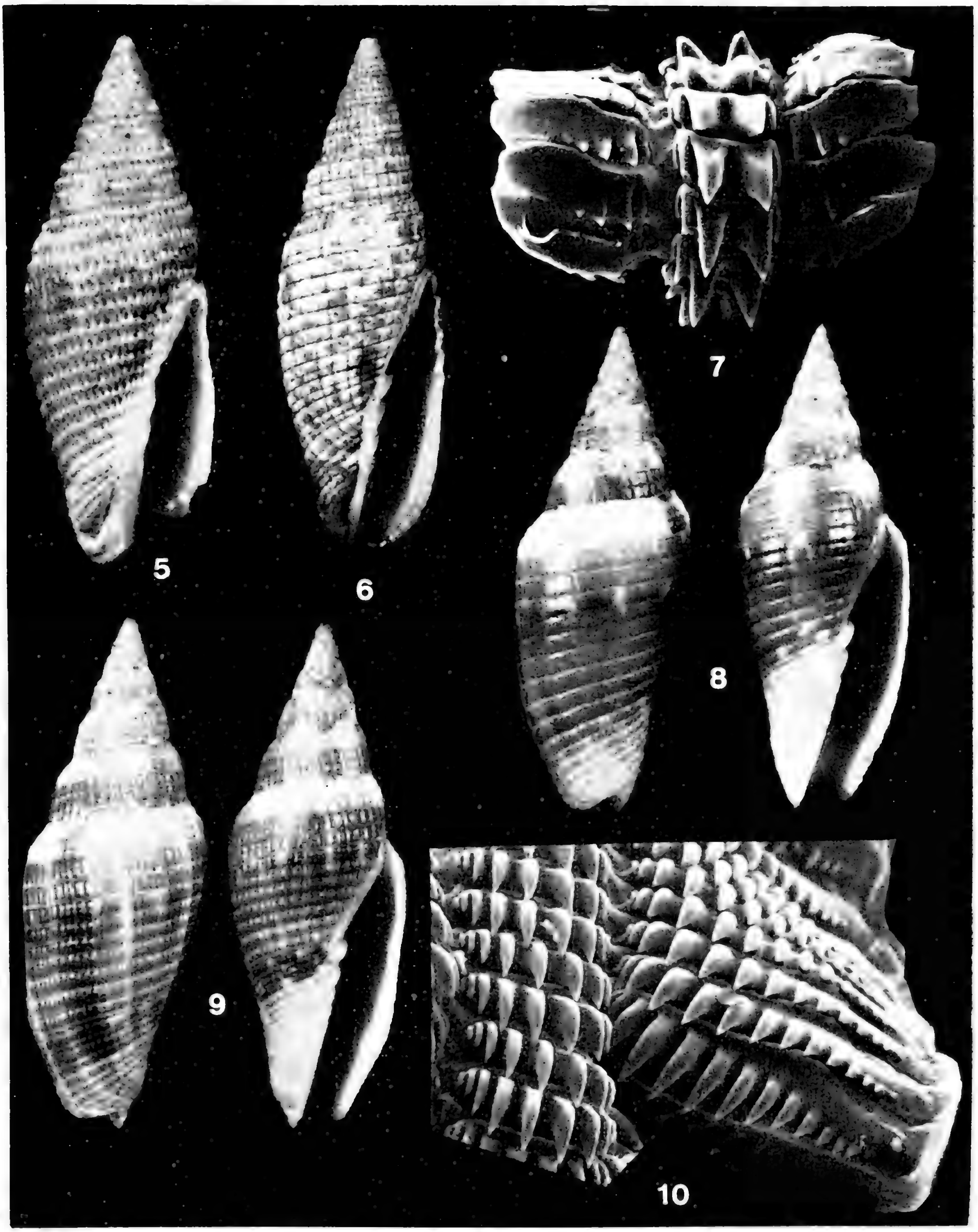
DISTRIBUTION: From Japan to Taiwan, New Caledonia and Pitcairn Island. Kermadec Is (new record).

Material examined: Raoul I, Kermadec Is (NMNZ No. MF-2839, 1 specimen without additional data). BS 435, 29°19.1′S, 177°54.6′W, S.E. D'Arcy Pt., Raoul I, 70 m; 1 specimen.

N. takiisaoi is a rare subtidal species whose exact distribution is still imperfectly known. The radula (Fig. 7) confirms the generic placement of *takiisaoi* in *Neocancilla*.

Genus **Ziba** H. &. A. Adams, 1853

Ziba H. & A. Adams, 1853, Gen. Rec. Moll. 1: 179. Type species by SD (Wenz, 1943) *Mitra carinata* Swainson, 1824. Recent, West Africa.



Figs. 5-10. 5. *Cancilla strangei* (Angas), Raoul I, Kermadec Is, 85 m; length 23.6 mm. 6, 7. *Neocancilla takiisaoi* (Kuroda). 6. Raoul I, Kermadec Is; length 44.0 mm. 7. Radula of *N. takiisaoi*. 8-10. *Ziba cernohorskyi* Rehder & Wilson. 8. Smooth form from between Dayrell and Chanter I, Kermadec Is, 31-45 m; length 22.5 mm. 9. Strongly sculptured form from E. of Smith Bluff, Raoul I, Kermadec Is, 40-47 m; length 27.2 mm. 10. Radula of *Z. cernohorskyi*.

The radulae of the type-species of *Cancilla* and *Ziba* are still unkown and it is difficult to decide at this stage whether *Ziba* is closer to *Cancilla* or *Mitra*. For this reason *Ziba* is tentatively used in a generic sense.

Ziba cernohorskyi Rehder & Wilson, 1975 (Figs. 8-10)

1975. *Ziba cernohorskyi* Rehder & Wilson, Smithson. Contrib. Zool. No. 203: 13, col. pl. fig. 13 (shell), textfig. 9 (radula).

TYPE LOCALITY: Off N.W. corner of Pitcairn Island, 44-45 fathoms (82-101 m).

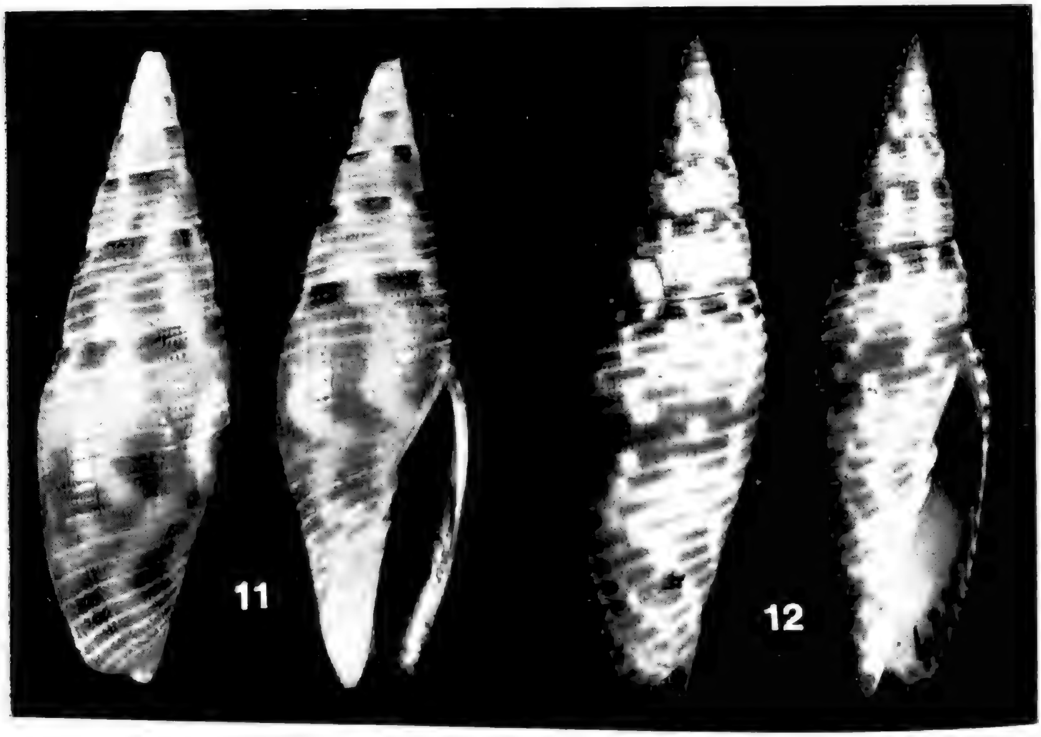
Material examined: Raoul I, Kermadec Is (NMNZ No. MF-27219, 1 specimen without additional data). BS 436, 29°18.5′S, 177°54.5′W, S.E. D'Arcy Pt., Raoul I, 44 m; 3 specimens. BS 573, 29°15′S, 177°50.9′W, between Dayrell and Chanter I, Raoul I, 31-45 m; 2 specimens. BS 576, 29°18.1′S, 177°56.3′W, E. of Smith Bluff, Raoul I, 40-47 m; 1 specimen. BS 579, 29°14′S, 177°59.3′W, N.W. Hutchison Bluff, Raoul I, 38 m; 1 specimen.

The species is very variable in sculpture, some individuals display the same type of discreet sculpture as the unique holotype from Pitcairn I, while a specimen from Smith Bluff, Raoul I, has a decussated pattern of axially oriented, low granules. The largest Kermadec I specimen measures 34.2 mm in length. The radula of the Kermadec Is specimen is extremely similiar to that of the Pitcairn I holotype.

Ziba *cf.* **rehderi** (Webb, 1958) (Figs. 11, 12)

1958. *Mitra rehderi* Webb, Jap. J. Malac. 20 (1): 30, textfigs. 1, 2.

TYPE LOCALITY: Tosa, Japan, 90-100 fathoms (165-183 m).



Figs. 11, 12. *Ziba cf. rehderi* (Webb). 11. S.E. Chanter I, Raoul I, Kermadec Is. 512-585 m; length 24.3 mm (young specimen). 12. Holotype of *Z. rehderi* (Webb), USNM No. 622597, length 44.6 mm

Material examined: BS 440, 29°16′S, 177°49.3′W, S.E. Chanter I, Raoul I, 512-585 m; 1 specimen. BS 581, 29°14′S, 177°52.8′W, N.W. Napier I, Raoul I, 530-567 m; 1 specimen.

The Kermadec Is species is known by 1 very worn, stained and broken specimen and another immature individual. Both specimens have the same sculpture as *Z. rehderi*, which consists of 6 flat spiral cords and intermediate spiral grooves which are pitted or indented by short axial lirae. The generic position of *rehderi*, as well as the species occurrence in the Kermadec Is require confirmation. The holotype of *Z. rehderi* is in the Smithsonian Institution No. USNM 622597, length 44.6 mm (Fig. 12).

Ziba kermadecensis sp. n. (Figs. 13-17)

Shell moderate in size for a mitrid, 22.6-31.6 mm in length, fusiformly-elongate, width 32%-35% of length, rather solid, teleconch of 9 flat-sided or only slightly convex whorls, protoconch missing in all specimens examined. Early mature whorls are finely nodulose, nodulose sculpture usually persisting to the penultimate whorl and the posterior region of the body whorl; some individuals, however, with a distinctly granulose body whorl, penultimate whorl with 4-6 spiral rows of fairly regular nodules, nodules on body whorl either confined to 4-6 rows below the suture and followed by wide-spaced, punctate spiral grooves or the complete body whorl has axially elongated nodules, siphonal fasciole with 7-12 oblique spiral cords. Aperture narrow, equal in height or longer than the spire, 51%-59% of length, outer lip moderately thickened and scalloped, wall of outer lip smooth, columella with 3-4 (usually 4) strong, oblique folds, siphonal notch distinct. Brown in colour, sutures broadly banded with white, brown zones with a few small, nebulous and slightly wedge-shaped white spots; some individuals, however, lack the white spots.

Radula similar to *Ziba bacillum* (Lamarck), rachidians with 6 strong cusps, lateral tooth twice the width of rachidian and with 7 strong cusps which become progressively smaller towards the end of the lateral (Fig. 17).

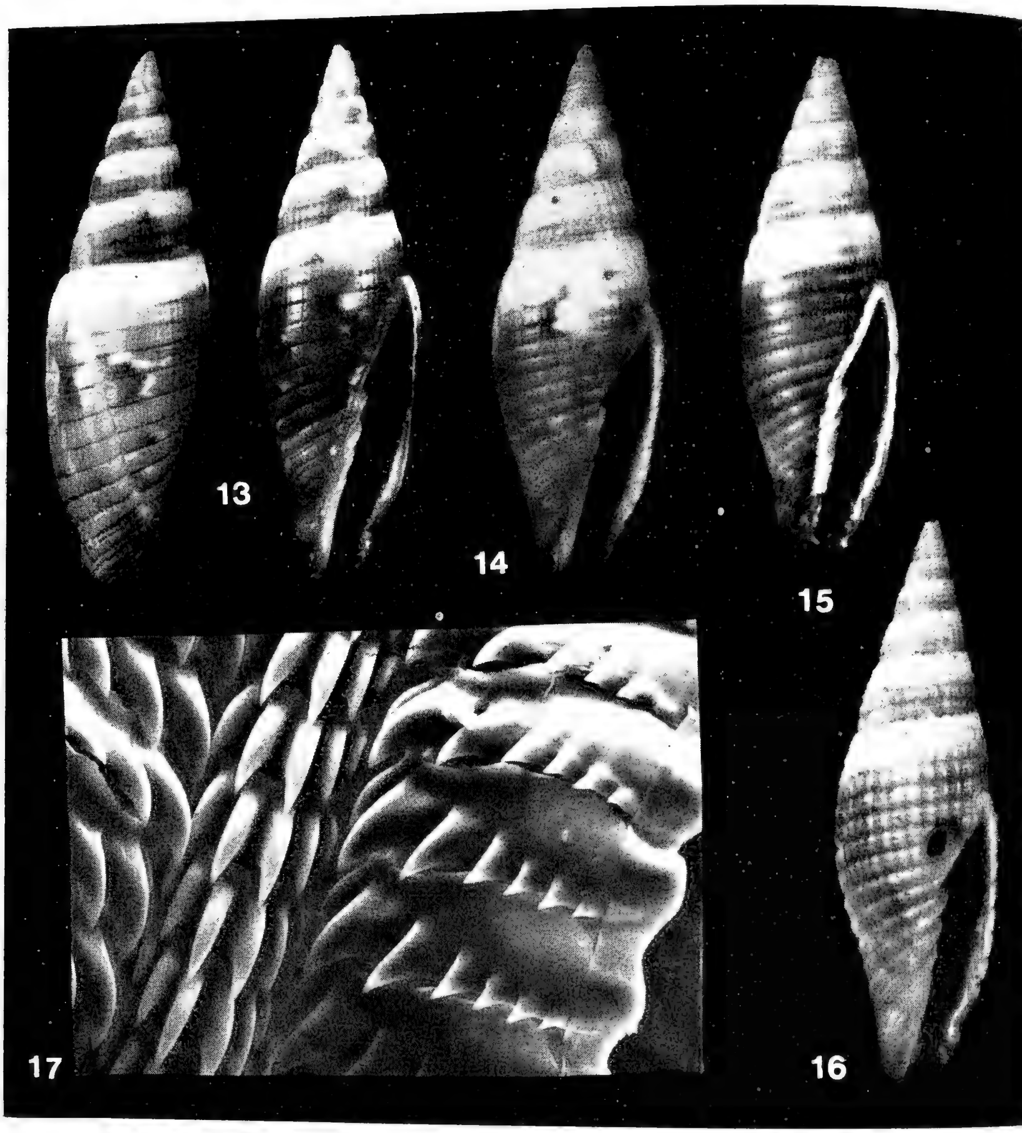
TYPE LOCALITY: BS 438, 29°14.7′S, 177°49.4′W, S.E. Nugent I, Raoul I, Kermadec Is. 146-165 m (*leg.* 28-10-1975).

Holotype: In NMNZ No. MF-30804, length 31.6 mm, width 10.0 mm, height of aperture 18.5 mm (Fig. 13).

Paratypes: No. 1 from type-locality in NMNZ No. MF-25659 (live-taken specimen which has been holed to facilitate removal of radula — Fig. 14) and paratype No. 2 from the type-locality in the Auckland Institute and Museum (AIM). Paratypes No.'s 3-6 from BS 437, 29°11.9′S, 177°56.2′W, N.W. Fleetwood Bluff, Raoul I, 154 m; in NMNZ No. MF-25410 and paratype No. 7 from the same locality in AIM. Paratypes No.'s 8-9 from BS 572, 29°18.9′S, 177°56.4′W, S.E. Smith Bluff, Raoul I, 82-100 m, in NMNZ No. MF-26588. Paratype No. 10 from BS 570, 29°14.7′S, 177°50.3′W, E. Dayrell I, Raoul I, 135-146 m in NMNZ No. MF-26630.

The smooth form of the species as exemplified by the holotype bears a superficial resemblance to *Scabricola (Swainsonia) ocellata* (Swainson, 1831) in features of coarsely sculptured spire-whorls, wide-spaced spiral grooves on the body whorl and colour ornamentation. The radular anatomy of *S. (S.) ocellata* is so obviously different that *ocellata* is rightfully assigned to a different genus (Cernohorsky 1970: 18, fig. 112).

Z. kermadecensis is highly variable in sculpture, particularly on the body whorl where the wide-spaced, punctate spiral grooves become spiral cords or even granules in some individuals.



Figs. 13-17. *Ziba kermadecensis* sp. n. Raoul I, Kermadec Is., 13. Holotype NMNZ No. MF-30804, length 31.6 mm (grooved form). 14. Paratype, length 30.8 mm. 15. Paratype, length 25.8 mm (corded form). 16. Paratype, length 27.9 mm (granulose form). 17. Radula.

Family COSTELLARIIDAE

Genus **Vexillum** Roeding, 1798

Vexillum Roeding, 1798, Mus. Bolten, p. 138. Type species by SD (Woodring, 1928) *V. plicatum* Roeding, 1798 = *Voluta plicaria* Linnaeus, 1758. Recent, Indo-Pacific.

Subgenus **Costellaria** Swainson, 1840

Vexillum (Costellaria) sculptile (Reeve, 1845) (Fig. 18)

1845. *Mitra sculptilis* Reeve, Conch. Icon. pl. 35, sp. 290.

1853. *Mitra delicata* A. Adams, Proc. Zool. Soc. Lond. Pt. 19: 137; 1908 Hedley, Proc. Linn. Soc. N.S.W. 33 (3): 484, pl. 7, fig. 1 (figd. syntype).

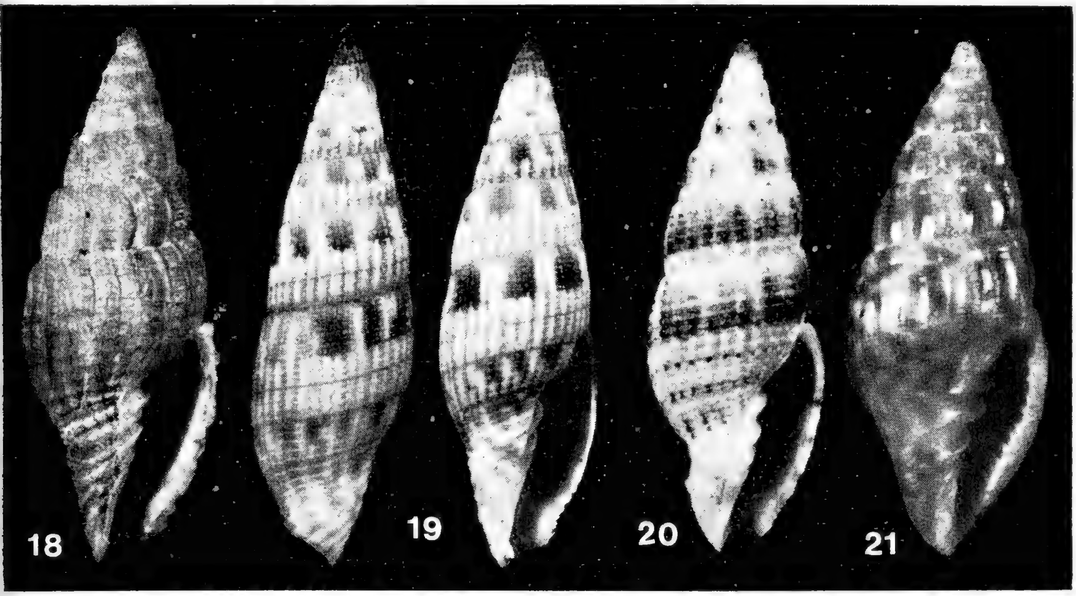
1918. *Mitra (Pusia) iteina* Melvill, Ann. Mag. Nat. Hist. (9), 1: 141, pl. 4, fig. 7.

TYPE LOCALITY: Ticao I, Philippines (*sculptile*); Cape York, Australia, 8 fathoms (15 m) (*delicata*); Henjam I, Persian Gulf, 10 fathoms (18 m) (*iteina*).

DISTRIBUTION: From the Red Sea and the Persian Gulf to New Britain and Queensland, Australia. Kermadec Is (new record).

Material examined: BS 441, 29°15.5′S, 177°50′W, E. Chanter I, Raoul I, 366-402 m; 1 specimen. BS 572, 29°18.9′S, 177°56.4′W, S.E. Smith Bluff, Raoul I, 82-100 m; 1 specimen.

V. (C.) sculptile is moderately frequent in dredgings. The Kermadec I record is a considerable eastward extension from Cape Moreton, Queensland and New Britain.



Figs. 18-21. *Vexillum (Costellaria) sculptile* (Reeve), E. Chanter I, Raoul I, Kermadec Is, 366-402 m; length 11.1 mm. 19. *V. (C.) angustissimum* (E. A. Smith), off Meyer I, Raoul I, Kermadec Is, 22-27 m; length 13.5 mm. 20. *V. (C.) iredalei* (Powell), East Anchorage, Raoul I, Kermadec Is, 42-47 m; length 16.9 mm. 21. *Microvoluta royana* (Iredale), E. Chanter I, Raoul I, Kermadec Is, 366-402 m; length 9.7 mm.

Vexillum (Costellaria) castum (H. Adams, 1872)

1872. *Turricula (Thala) casta* H. Adams, Proc. Zool. Soc. Lond. p. 9, pl. 3, fig. 2.

1874. *Mitra hastata* Sowerby, Thes. Conchyl. 4: 35, pl. 27, fig. 620 (*nom. subst. pro Turricula casta* H. Adams, 1872) [*non Mitra hastata* Karsten, 1849].

TYPE LOCALITY: Red Sea.

DISTRIBUTION: From the Red Sea and the Persian Gulf to the Society and Hawaiian Islands. Kermadec Is (new record).

Material examined: BS 441, 29°15.5′S, 177°50′W, E. Chanter I, Raoul I, 366-402 m; 1 specimen.

V. (C.) castum is an uncommon, subtidal species. *Mitra hastata* Sowerby, 1874, which is a primary homonym of *M. hastata* Karsten, 1849, is a superfluous substitute name for *Turricula casta* H. Adams, which has never been a primary or secondary homonym.

Vexillum (Costellaria) angustissimum (E. A. Smith, 1903) (Fig. 19)

1903. *Mitra angustissima* E. A. Smith, Faun. Geog. Mald. & Laccad. Archip. 2 (2): 605, pl. 35, fig. 5.

TYPE LOCALITY: Maldive Is, Indian Ocean.

DISTRIBUTION: From the Red Sea to the Tonga Islands. Kermadec Is (new record).

Material examined: BS 442, 29°14.7′S, 177°52.7′W, off Meyer I, Boat Harbour, Raoul I, 22-27 m; 7 specimens. BS 567, 29°16′S, 177°51.5′W, East Anchorage, Raoul I, 42-47 m; 2 specimens.

The species is moderately common in dredgings. Its occurrence in the Kermadec Is is not too surprising since the species is known from Fiji, Tonga and Norfolk Island.

Vexillum (Costellaria) iredalei (Powell, 1958) (Fig. 20)

1958. *Mitropifex iredalei* Powell, Rec. Auckland Inst. Mus. 5 (1/2): 81, pl. 9, fig. 3.

TYPE LOCALITY: Off Raoul I, Kermadec Is, 75-85 m.

Material examined: BS 567, 29°16′S, 177°51.5′W, East Anchorage, Raoul I, 42-47 m; 9 specimens. Raoul I, Kermadec Is (3 specimens without additional data). BS 572, 29°18.9′S, 177°56.4′W, S.E. Smith Bluff, Raoul I, 82-100 m; 1 specimen. BS 579, 29°14′S, 177°59.3′W, N.W. Hutchison Bluff, Raoul I, 38 m; 1 specimen.

The species is moderately frequent in dredgings and appears to be endemic to the Kermadec Islands.

Family VOLUTOMITRIDAE

Genus **Microvoluta** Angas, 1877

Microvoluta Angas, 1877, Proc. Zool. Soc. Lond. p. 34. Type species by M *M. australis* Angas, 1877. Recent, S.E. Australia.

Microvoluta royana Iredale, 1924 (Fig. 21)

1924 *Microvoluta royana* Iredale, Proc. Linn. Soc. N.S.W. 49 (3): 269, pl.35, fig. 13; 1966 Garrard, J. Malac. Soc. Australia 10: 5; 1970 Cernohorsky, Bull. Auckland Inst. Mus. 8: 122, pl. 15, fig. 13 figd. holotype).

1951. *Mitra jervisensis* Laseron, Rec. Austral. Mus. 22 (4): 341, textfig. 4.

TYPE LOCALITY: off Green Cape, N.S.W., Australia, 50-70 fathoms (92-128 m) *royana*; Jervis Bay, N.S.W., Australia, 15 fathoms (27 m) (*jervisensis*).

Material examined: BS 441, 29°15.5′S, 177°50′W, E. Chanter I, Raoul I, 366-402 m; 6 specimens and 4 fragments.

All Kermadec Is specimens have been dredged dead and all suffered damage in some way.

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THE TAXONOMY OF SOME INDO-PACIFIC MOLLUSCA

Part 6

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Abstract. New geographical records are recorded for *Strombus (Dolomena) kleckhamae* Cernohorsky, *Phalium angasi bulla* (Habe), *Mitra pele* Cernohorsky, *M. hilli* Cernohorsky, and *Vexillum (Costellaria) takakuwai* Cernohorsky & Azuma. The radula, oviposition and taxonomy of *Vanikoro helicoidea* (Le Guillou) are decribed and discussed. *Phalium sophia* (Brazier) is considered to be specifically distinct from *P. bisulcatum* (Schubert & Wagner), and *Chicoreus steeriae* (Reeve) is only a long-spined form of *C. maurus* (Broderip). *Pterynotus barclayanus* (H. Adams) has chronological priority over *P. lienardi* (Crosse) and the family-group name Thaidinae dates from Jousseaume, 1888 rather than Suter, 1913. *Ricinula rosea* Reeve, is not the Caribbean *rosea* of authors, and the Indo-Pacific *Morula parva* (Pease) is a secondary homonym of *M. parva* (Reeve). *Risomurex muricoides* (C. B. Adams) and *Drupella cariosa* (Wood) are primary homonyms and should be replaced with *R. rutila* (Reeve) and *D. fenestrata* (Blainville) respectively. A lectotype is designated for *Oliva parkinsoni* Prior, 1975, a species described without a holotype designation. A population study of *Mitra chrysostoma* Broderip, has shown this species to be conspecific with *M. contracta* Swainson. Scaphandridae Sars, must be replaced by the earlier Cylichnidae H. & A. Adams, and *Tornatina decorata* Pilsbry, is an earlier name for *Retusa gaimardi* Finlay.

Family STROMBIDAE

Genus **Strombus** Linnaeus, 1758

Strombus Linnaeus, 1758, Syst. Nat. ed. 10: 742. Type species by SD (Montfort, 1810) *Strombus pugilis* Linnaeus, 1758. Recent, Caribbean.

Subgenus **Dolomena** Iredale, 1931

Strombus (Dolomena) kleckhamae Cernohorsky, 1971 (Fig. 1)

1971. *Strombus (Dolomena) kleckhamae* Cernohorsky, Rec. Auckland Inst. Mus. 8: 131, figs. 1-3.

TYPE LOCALITY: Matupi I, Rabaul, New Britain.

The species was originally described from pumice deposits of Matupi I. It has also been recorded from Geelvink Bay, W. Irian and Indonesia (Dr R. T. Abbott, *in litt.*), and the most recent record of living specimens is from Tulagi, Solomon Is, in 183 m (*leg.* B. Bailey).

Family VANIKORIDAE

Genus **Vanikoro** Quoy & Gaimard, 1833

Vanikoro Quoy & Gaimard, 1833, Voy. L'Astralabe, Zool. 2: 239. Type species by M *Sigaretus cancellatus* Lamarck, 1822. Recent, Indo-Pacific.

Rec. Auckland Inst. Mus. 15: 67-86 1 December 1978

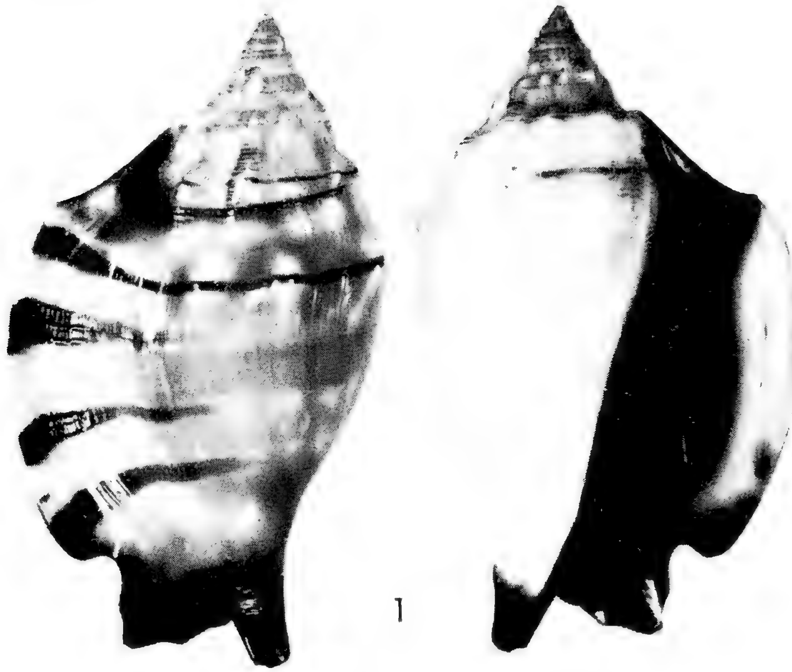


Fig. 1. *Strombus (Dolomena) kleckhamae* Cernohorsky. Tulagi, Solomon Is, 183 m; 44.6 x 26.0 mm.

Vanikoro helicoidea (Le Guillou, 1842) (Figs. 2-7, 9-11)

1842. *Sigaretus helicoideus* Le Guillou, Rev. Zool. Soc. Cuv. 5: 105.

1844. *Narica ligata* Récluz, Proc. Zool. Soc. Lond. Pt. 11: 138; 1845 Récluz, Mag. Zool. p. 22, pl. 121, fig. 2.

1844. *Narica helicoidea* Le Guillou, Rev. Zool. Soc. Cuv. 7: 8; 1845 Récluz, Mag. Zool. p. 51, pl. 131, fig.1.

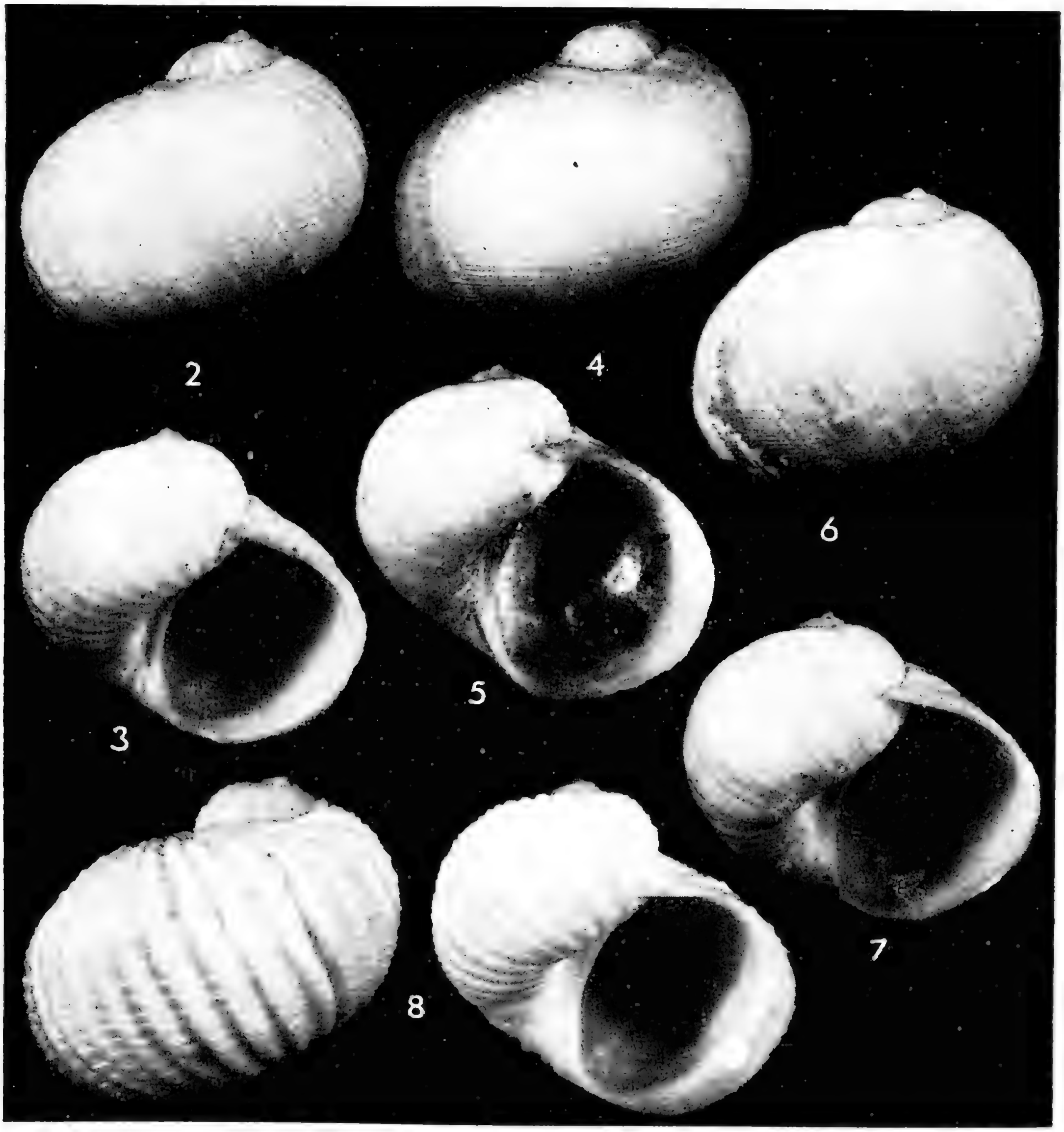
1844. *Narica deshayesiana* Récluz, Proc. Zool. Soc. Lond. Pt. 11: 138; 1845 Récluz, Mag. Zool. p. 48, pl. 130, figs. 1, 2.

1844. *Narica blainvilleana* Récluz, Proc. Zool. Soc. Lond. Pt. 11: 141; 1845 Récluz, Mag. Zool. p. 53, pl. 131, fig. 2.

TYPE LOCALITY: Amboina, Indonesia *helicoidea*); Catanuam, Tayabas Prov., Luzon, Philippines (*ligata*); St. Nicholas, Cebu I, Philippines, and Catanuam, Tayabas Prov., Luzon, Philippines (*deshayesiana*); Moluccas, Indonesia (*blainvilleana*).

Workers of the last century separated species of *Vanikoro* on the basis of a widely or narrowly umbilicate or imperforate shell and the presence or absence of low axial riblets on the body whorl. Smith (1908) remarked that "the true *helicoidea* is also like *ligata* in some respects, but more narrowly umbilicated, and with the plications almost obsolete on the whole of the body whorl". Widely or narrowly umbilicate and even almost imperforate individuals are found within the same species. In the typical form *helicoidea* the spire whorls are axially plicate but on the body whorl the plications become obsolete. In the *ligata* and *deshayesiana* forms only the ventral side of the body whorl has low plicae and these become obsolete or absent on the dorsal side. Spiral striae are numerous and some spirals are stronger than others. In the form *deshayesiana* the spiral striae are finer, more numerous and tend to be more regular.

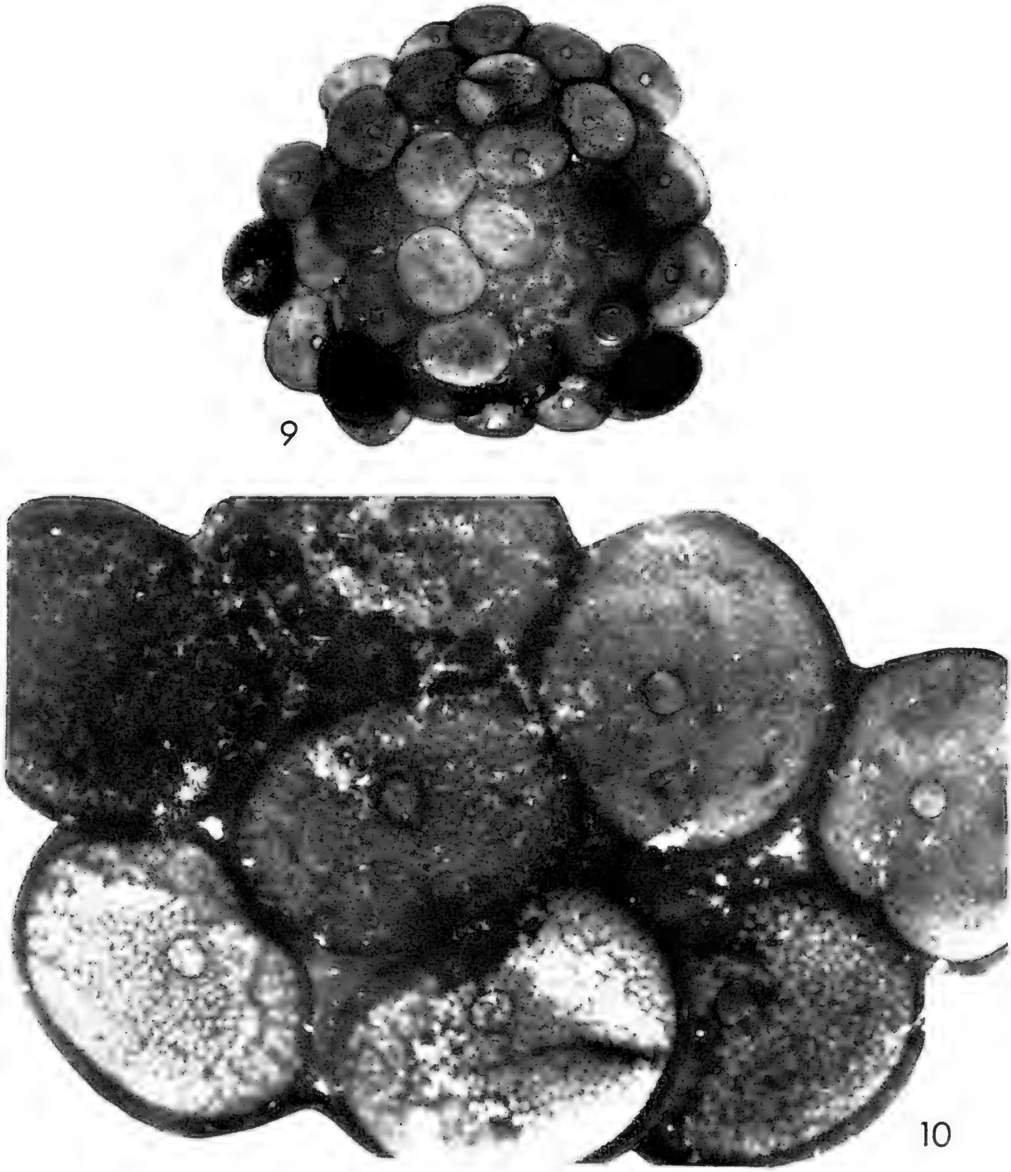
Three syntypes of *Narica ligata* Récluz, illustrated syntype (Figs. 2, 3), length 17.2 mm, width 17.8 mm, and four syntypes of *N. deshayesiana* Récluz, illustrated syntype (Figs. 6, 7), length 17.0 mm, width 17.7 mm, are in the British Museum (Natural History), London.



Figs. 2-8. 2-7. *Vanikoro helicoidea* (Le Guillou). 2, 3. Syntype of *Narica ligata* Récluz, BMNH, 17.2 x 17.8 mm. 4, 5. Specimen from Lakeba I., Lau group, Fiji Is; 14.5 x 14.6 mm. 6, 7. Syntype of *Narica deshayesiana* Récluz, BMNH 17.0 x 17.7 mm. 8. *Vanikoro plicata* (Récluz), syntype BMNH; 17.9 x 18.2 mm.

Vanikoro plicata Récluz, 1844, is similar in form to *V. helicoidea*, but the former is more solid and the entire shell is sculptured with strong, elevated and oblique axial ribs and overriding primary spiral cords and finer intermediate spiral striae. Two syntypes of *V. plicata* are in the British Museum (Natural History), London, illustrated syntype length 17.9 mm, width 18.2 mm (Fig. 8).

An egg-mass measuring *c.* 22 mm in diameter and 3.5 mm in thickness and containing *c.* 40 egg-capsules, has been collected from under a female of *Vanikoro helicoidea* attached to the underside of a coral rock on Lakeba I, Lau group, Fiji Is (Figs. 9, 10). Egg-capsules were laid in a cluster, frequently one on top of the other



Figs. 9, 10. Spawn of *Vanikoro helicoidea* (Le Guillou) from Lakeba I., Lau group, Fiji Is. 9. Whole egg-mass *c.* 22 mm in diameter. 10. Enlarged egg-capsules showing central circular escape hatch.

and partly overlapping; capsules were irregularly lens-shaped and had a circular membrane-covered escape hatch in the centre. Egg-capsules measured 4.0-4.5 mm in diameter and *c.* 1.0 mm in thickness. Capsules were in different stages of development, some capsules were already empty and the escape opening lacked the membrane.

other capsules contained hundreds of fully-formed, brown miniature snails and other capsules still had hundreds of small, round, unsegmented yellowish eggs. The ready to hatch snails were all in the same stage of development indicating that no feeding on nurse-eggs takes place.

The radula of *Vanikoro helicoidea* is typically Hipponicacean, translucent-white, small, 2.4 mm in length and with 66 rows (+ 5 nascentes) of teeth (Fig. 11).

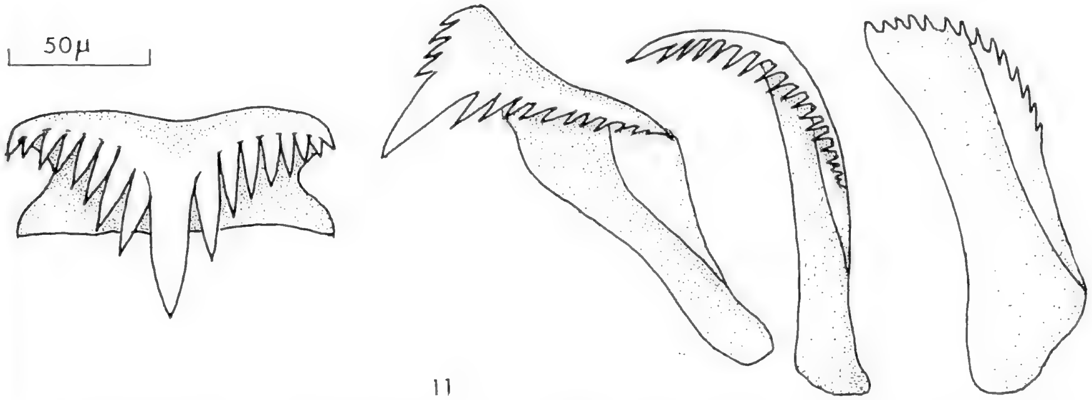


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Fig. 11. *Vanikoro helicoidea* (Le Guillou). Half-row of radula from Lakeba I, Lau group, Fiji Is.♀.

Family CASSIDAE

Genus **Phalium** Link, 1807

Phalium Link, 1807, Beschr. Nat.-Samml. Univ. Rostock p. 112. Type species by SD (Dall, 1909) *Buccinum glaucum* Linnaeus, 1758. Recent, Indo-Pacific.

Phalium angasi bulla (Habe, 1961) (Fig. 12)

1961. *Semicassis bulla* Habe, Col. Illust. shells Japan 2: 44, pl. 21, fig. 5.

1968. *Phalium (Semicassis) glabratum bulla* (Habe), Abbott, Indo-Pacif. Moll. 2 (9): 145, pl. 8, figs. 7, 8; pl. 129.

TYPE LOCALITY: Tosa, Shikoku I, Japan, 50-100 fathoms (92-183 m).

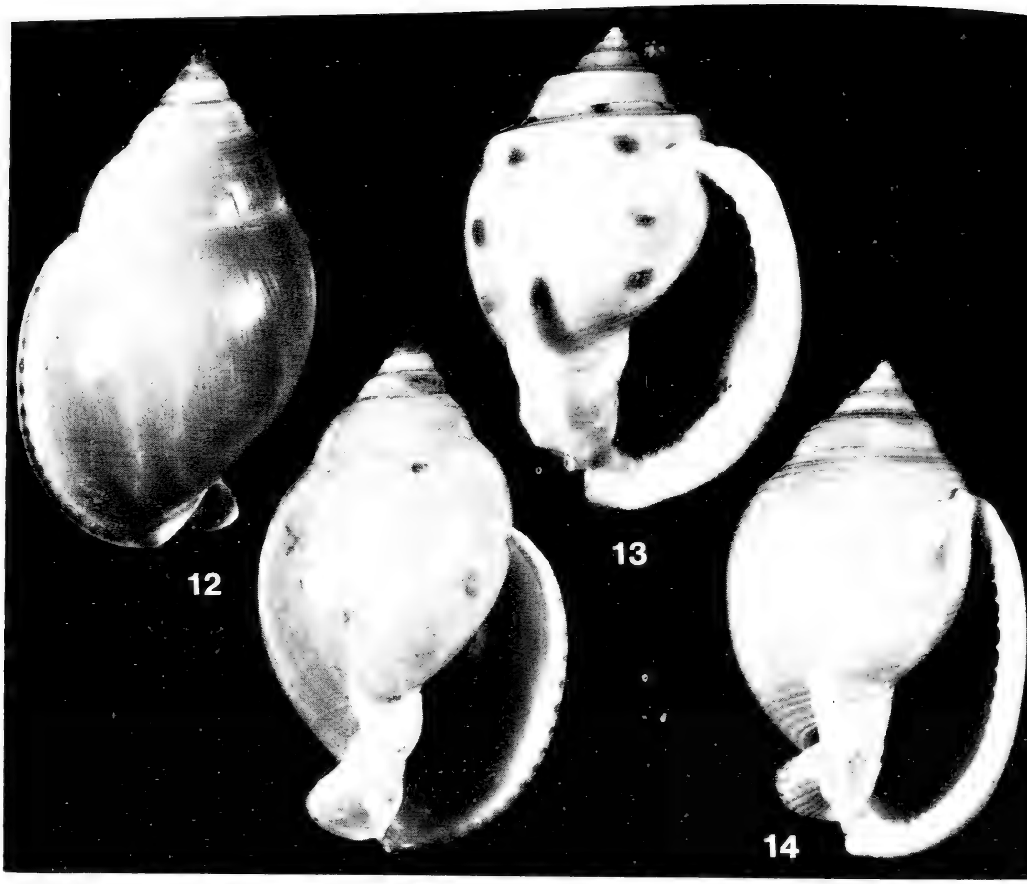
Abbott (1968) reported the species from the Hawaiian Is and the Sino-Japanese region. The recent record of *bulla* from the Punta Eganio area of Mactan, Cebu, Philippines (*leg.* A. Deynzer) represents a westward extension in distribution and at the same time creates taxonomic problems. Abbott (op. cit.) considered *bulla* a subspecies of *P. glabratum* Dunker, a species he also reported from the Cebu area of the Philippines. The now sympatric occurrence of *glabratum* and *bulla* in the Philippines prevents a subspecific nomenclature. However, *bulla* is extremely close to the Australian *P. angasi* (Iredale, 1927) and a subspecific classification of *P. angasi bulla* (Habe, 1961) appears to be appropriate at this time.

Phalium sophia (Brazier, 1872) (Fig. 13)

1872. *Cassis sophia* Brazier, Proc. Zool. Soc. Lond. p. 617, pl. 44, fig. 2.

1968. *Phalium (Semicassis) bisulcatum sophia* (Brazier), Abbott, Indo-Pacific Moll. 2 (9): 131, pl. 8, fig. 12; pl. 115, figs. 1-8.

TYPE LOCALITY: Under Grassy Head, mouth of the Macleay River, N. of Port Jackson, N.S.W., Australia.



Figs. 12-14. Cassidae. 12. *Phalium angasi bulla* (Habe). Punta Eganio, Mactan, Cebu, Philippines; 58.4 x 35.2 mm. 13. *P. sophia* (Brazier). Tin Can Bay, Qld., Australia, 20 m; 73.5 x 52.7 mm. 14. *P. bisulcatum* (Sch. & W.) forma *diuturna* Iredale. Tin Can Bay, Qld., Australia, 20 m; 64.4 x 41.0 mm.

Abbott (1968) considered *sophia* Brazier as a subspecies of *P. bisulcatum* Schubert & Wagner, 1829). Both these species are trawled at Tin Can Bay, Queensland, Australia, in 20 m, without any intergrading specimens having been encountered. *P. sophia* differs from *P. bisulcatum* (Fig. 14) in the prominently tabulated whorls, smooth surface and concavely indented parietal callus-shield.

Family MURICIDAE

Genus **Chicoreus** Montfort, 1810

Chicoreus Montfort, 1810, Conchyl. Syst. 2: 611. Type species (Opinion 911 of ICZN) *Murex ramosus* Linnaeus, 1758. Recent, Indo-Pacific.

Chicoreus maurus (Broderip, 1833) (Figs. 15-19)

1833. *Murex maurus* Broderip, Proc. Zool. Soc. Lond. Pt. 2: 174; 1834 Sowerby, Conch Illust. Pt. 59: fig. 12 (figd. type); 1845 Reeve, Conch. Icon. 3: pl. 4, fig. 16; 1879 Sowerby, Thes. Conchyl. 4: 15, pl. 5, fig. 54.

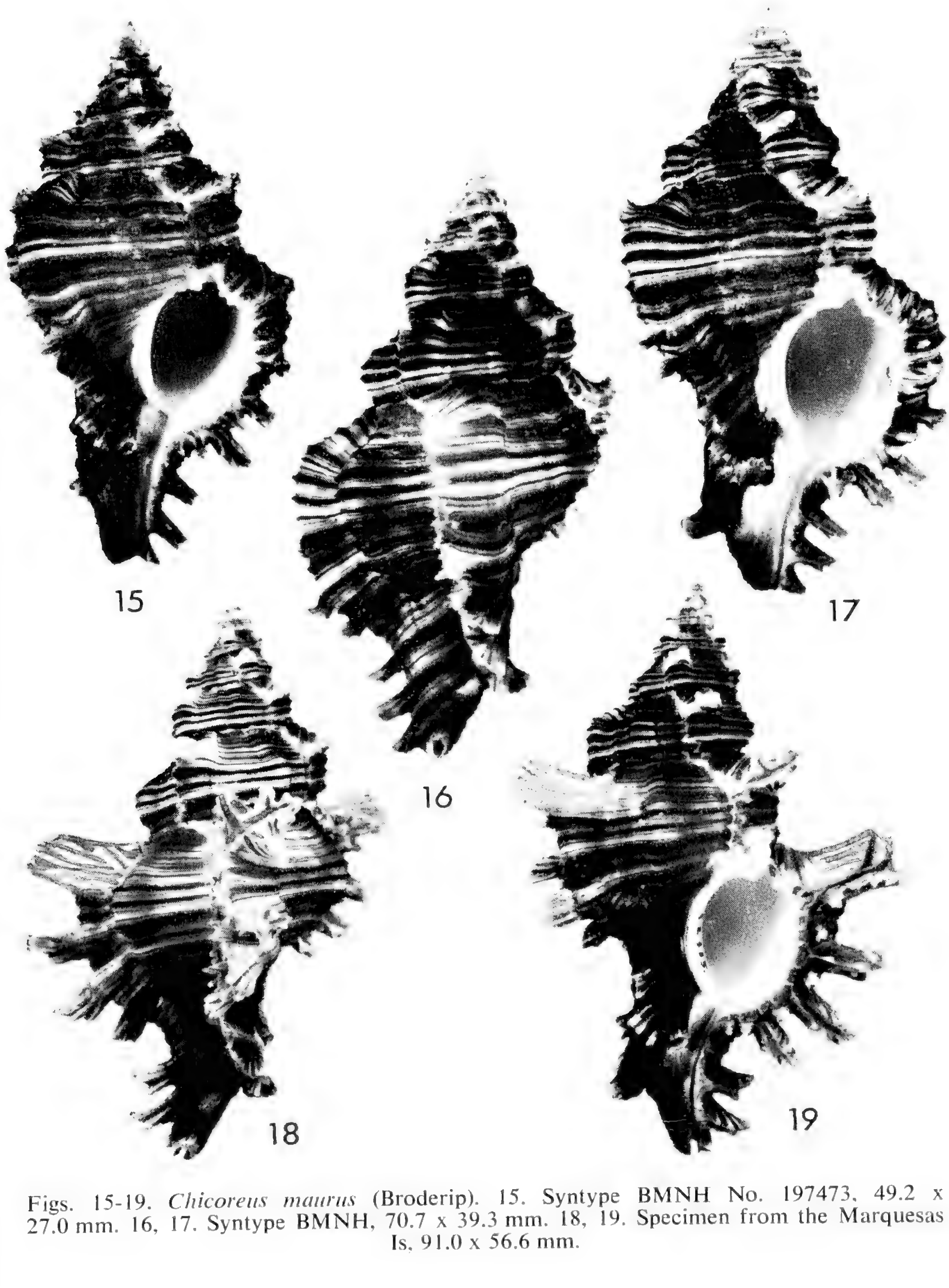
1845. *Murex steeriae* Reeve, Conch. Icon. 3: pl. 8, fig. 28.

1879. *Murex sturiae (sic)* Reeve, Sowerby, Thes. Conchyl. 4: pl. 4, fig. 38.

1975. *Chicoreus steeriae* (Reeve), Salvat & Rives, Coq. Polynésie p. 311, fig. 192; 1976 Fair, Murex book p. 78, pl. 8, fig. 106.

1976. *Chicoreus maurus* (Broderip), Radwin & Attilio, Murex shells world, p. 39, pl. 5, fig. 5.

TYPE LOCALITY: Anaa I., Tuamotus (*M. maurus*); none (*M. steeriae*). The locality of Tuamotus given for *maurus* could be an error since the species appears to be endemic to the Marquesas Is.



Figs. 15-19. *Chicoreus maurus* (Broderip). 15. Syntype BMNH No. 197473, 49.2 x 27.0 mm. 16, 17. Syntype BMNH, 70.7 x 39.3 mm. 18, 19. Specimen from the Marquesas Is. 91.0 x 56.6 mm.

Recent authors (Vokes 1971, Salvat & Rives 1975, Fair 1976) consider *Chicoreus steeriae* (Reeve) to be a valid species from the Marquesas Is. and Vokes (op. cit.) and Fair (op. cit.) treat *C. maurus* (Broderip) as a distinct Indo-Pacific species. Recently, however, Radwin & D'Attilio (1976) considered *C. maurus* (Broderip) to be an earlier name for the species know as *C. steeriae* (Reeve), but the authors at the same time erroneously synonymized *Murex thomasi* Crosse, 1872, from the Marquesas Is with *maurus* Broderip. The taxon *M. thomasi* is occasionally cited as having been authored by Crosse and Fischer, but Crosse is the sole author.

The 3 syntypes of *M. maurus* Broderip, are in the British Museum (Natural History), London, No. 197473. The smallest and most mature specimen, dimensions 49.2 x 27.0 mm (Fig. 15) appears to be the specimen illustrated by Sowerby (1834). The largest syntype, dimensions 70.7 x 39.3 mm (Figs. 16, 17), is immature and the fronds on the second body whorl varix show signs of having been broken off due to wear.

The length of the body whorl fronds is very variable in *C. maurus* but the spire whorl fronds do not differ in length in either the *maurus* or the *steeriae* forms. In the latter form, however, the body whorl fronds are larger than in the typical form (Figs. 18, 19). Both forms have a pale rose base-colour which is ornamented with blackish-brown spiral cords and the ends of the fronds are bright rose in colour.

The holotype of *Murex thomasi* Crosse, is in the British Museum (Natural History), London, No. 1902.5.28.53., dimensions 45.3 x 26.3 mm (Fig. 20). The species has only very short fronds on the base of the shell and the remaining surface is completely frondless. It differs in shape from *C. maurus*, being more angulate in outline with strong varices and main spiral cords. *M. thomasi* is light orange-brown to pale fawn in colour and the apex, siphonal canal and aperture are frequently stained with pale rose (Fig. 21).

Genus **Pterynotus** Swainson, 1833

Pterynotus Swainson, 1833, Zool. Illust. (2), 3: expl. to pl. 100. Type species by SM (Swainson, 1833) *Murex pinnatus* Swainson, 1822 = *Purpura alata* Roeding, 1798. Recent, Indo-Pacific.

Swainson (1833, expl. to pl. 100) established the genus *Pterynotus* without originally included species. In the same work (op. cit., expl. to pl. 122) Swainson cited only one nominal species in the genus-group "*Pteronotus*" (misspelling of *Pterynotus*) and this species becomes the type species by subsequent monotypy (art. 69 (a) (ii) (2) of ICZN) rather than by subsequent designation as given by Vokes (1964).

Pterynotus barclayanus (H. Adams, 1873) (Fig. 22)

1873. *Coralliophila barclayana* H .Adams, Proc. Zool. Soc. Lond. p. 205, pl. 23, fig. 1 (publ. June 1873).

1873. *Murex lienardi* Crosse, J. Conchyl. 21: 284 (publ. 16th July 1873); 1874 Crosse, J. Conchyl. 22: 74, pl. 3, fig. 4; 1880 Tapparone-Canefri, Ann. Soc. Malac. Belg. 15: 21.

1879. *Murex (Muricidea) barclayana* H. Adams, E. A. Smith, Proc. Zool. Soc. Lond. for 1878: 806 (Andaman Is).

1976. *Pterynotus lienardi* Crosse, Fair, Murex book p. 54, pl. 13, fig. 162 (figd. holotype).

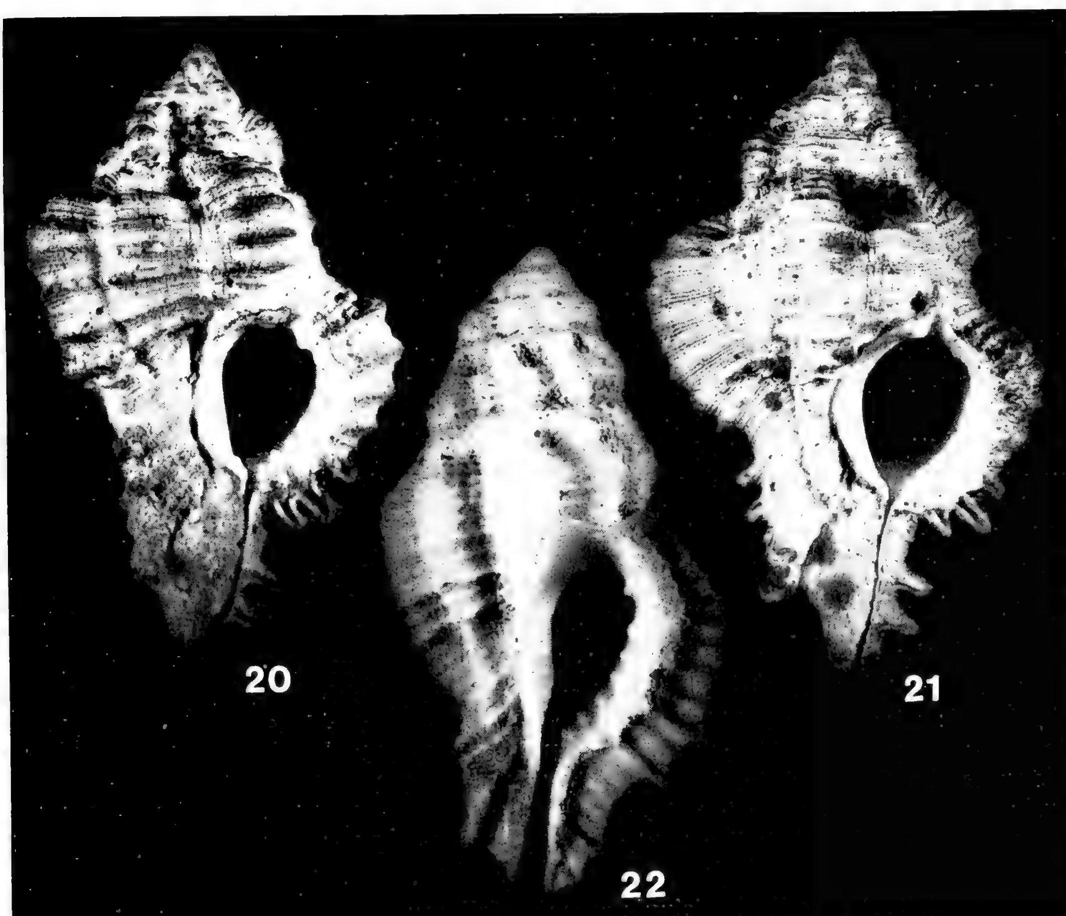
1976. *Pterynotus purpureus* Azuma, Jap. J. Malac. 35 (2): 47, fig. 1 (shell), fig. 2 (radula).

TYPE LOCALITY: Mauritius (*barclayanus* and *lienardi*); off Tanegashima, Kagoshima, Japan (*purpureus*).

DISTRIBUTION: From Mauritius to the Andaman Is. Japan and the Solomon Is.

Tapparone-Canefri (1880) was the first author who considered *Murex lienardi* Crosse, conspecific with *Coralliophila barclayana* H. Adams, but incorrectly adopted *lienardi* as the name of the taxon. Both species have been recently discussed by Vokes (1971) and Fair (1976) and both authors follow Tapparone-Canefri (op. cit.) in considering *Pterynotus lienardi* (Crosse) to be the chronologically prior name for the species.

Coralliophila barclayana was described by H. Adams (1873) on page 205 of the "Proceedings of the Zoological Society of London" for 1873, and pages 1-240 were



Figs. 20-22. 20, 21. *Chicoreus thomasi* (Crosse). 20. Holotype BMNH No. 1902.5.28.53.; 45.3 x 26.3 mm. 21. Specimen from Tahuata, Marquesas Is, USNM; 57.6 x 35.4 mm. 22. *Pterynotus barclayanus* (H. Adams). Holotype BMNH No. 1878.128.25.; 27.7 x 14.8 mm.

published in June 1873 (see Duncan 1937). Part 3 of the "Journal de Conchyliologie" in which Crosse's (1873) description of *Murex lienardi* appeared was published on the 16th July 1873 (see Fischer-Piette 1937). *Coralliophila barclayana* H. Adams, has a chronological priority by 16 days over *Murex lienardi* Crosse.

The illustrations of *Coralliophila barclayana* and *Murex lienardi* as given by H. Adams (op. cit.) and Crosse (1874) and descriptions of the holotypes of these species as given by Fair (1976) and this author (herein), leave no doubt that the two species are conspecific.

Specimens are either purplish-white or have a strong mauve, violet or purple cast. The holotype of *C. barclayana* H. Adams, is in the British Museum (Natural History) No. 1878.128.25., dimensions 27.7 x 14.8 mm. The specimen is pinkish-white and has a violet colouring which is most saturated between the axial ribs, the outer lip has 8 denticles and the base of the columella 4 denticles, interior of aperture is violet (Fig. 22). The recently described *Pterynotus purpureus* Azuma, 1976, from Japan, is undoubtedly conspecific with *P. barclayanus* (H. Adams).

Subfamily THAIDINAE Jousseaume, 1888

This family-group is usually cited as Thaididae Suter, 1913, but Jousseaume (1888) erected the family Thaididae (ex-Thaisidae) 25 years earlier.

Genus **Morula** Schumacher, 1817

Morula Schumacher, 1817. Essai nouv. syst. pp. 68, 227. Type species by M *M. papillosa* Schumacher, 1817 = *Drupa uva* Roeding, 1798. Recent, Indo-Pacific.

Morula rosea (Reeve, 1846) (Fig. 23)

1846. *Ricinula rosea* Reeve, Conch. Iconia 3: pl. 6, sp. 46.

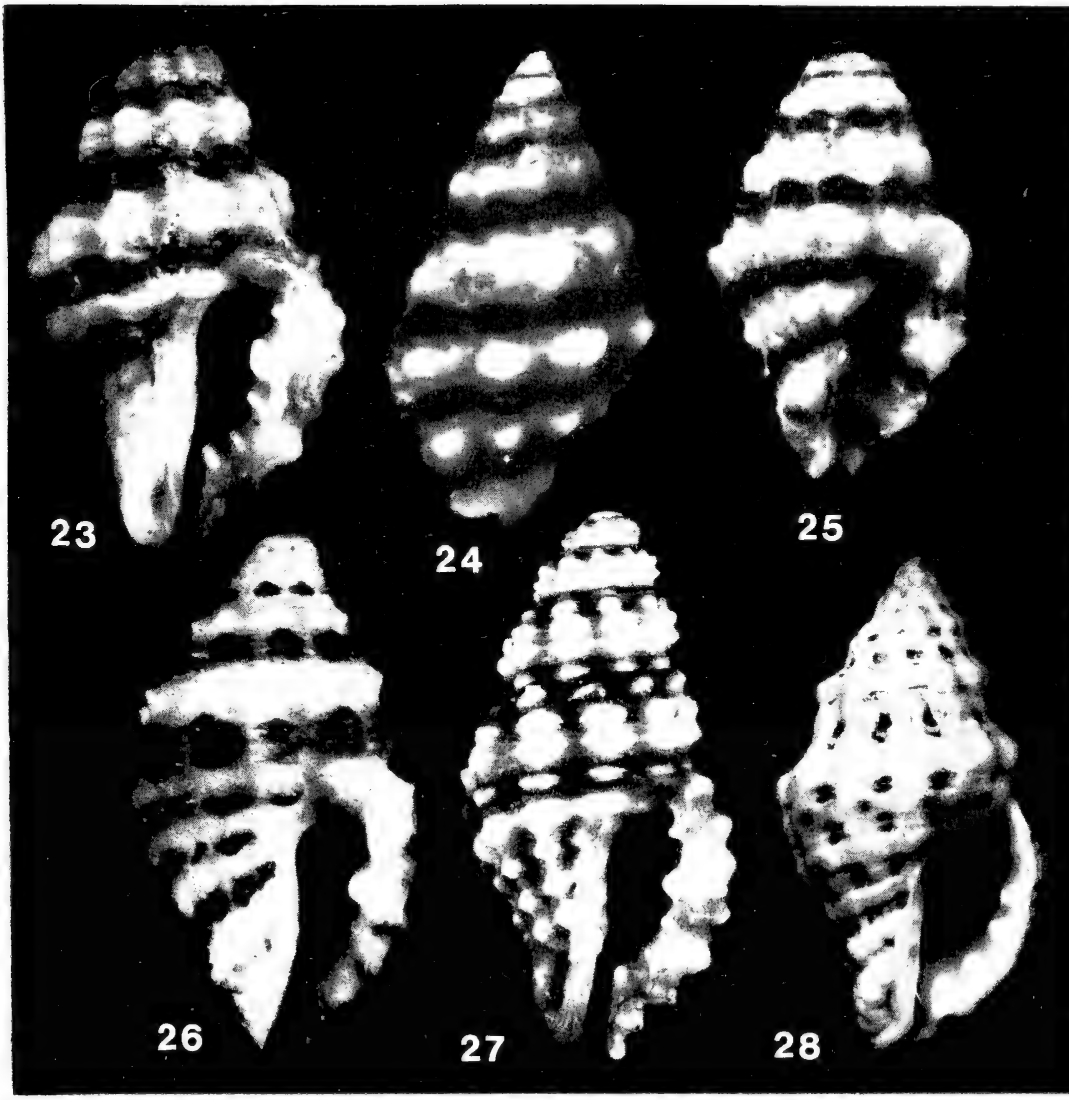
TYPE LOCALITY: Island of Masbate, Philippines, 5 fathoms (9 m).

Tryon (1883) claimed to have recognized *rosea* Reeve from the West Indies and suggested that the Philippine locality needed confirmation. He further placed *rosea* in the buccinid genus *Engina* Gray, with the Caribbean *Engina schrammi* Crosse, 1863, in synonymy. Dall (1889) reported *rosea* from the Gulf of Mexico but relocated the species in the muricid genus *Sistrum* Montfort, 1810 (= *Drupa* Roeding, 1798). All subsequent authors have considered *rosea* Reeve to be of West Atlantic origin. Warmke & Abbott (1961) place the species in the genus *Risomurex* Olsson & McGinty, 1958, and the specimen they illustrate is biconic, with a pronounced columellar callus and 2 strong plaits.The illustrated specimen is not conspecific with the type specimens of *Ricinula rosea* Reeve. Abbott (1974) placed the species in the ocenebrine genus *Ocenebra* Gray, but neither Vokes (1971) nor Fair (1976) consider the species to belong to the Ocenebrinae. Radwin & D'Atillio (1976) assigned the species to the muricine genus *Muricopsis* but the radula they illustrate is that of a typical thaidine *Morula* and is quite dissimilar to the radula of typical *Muricopsis*.

Reeve (1846) described *Ricinula rosea* as follows:

"Shell ovate, produced at the base, spire peculiarly shortened; whorls longitudinally nodosely ribbed, lip thickened, aperture small, rose-colour, zoned with blackish-brown."

Reeve's 4 syntypes of *Ricinula rosea* are in the British Museum (Natural History), London, No. 1968458, dimensions of illustrated syntype 10.8 x 6.3 mm. Adult specimens have an incoiled protoconch and a prominently constricted body whorl which gives the siphonal canal a produced appearance. The type-specimens are a species of *Morula* Schumacher, and are most probably of Indo-Pacific origin as indicated by the type-locality "Island of Masbate". The Caribbean "*rosea*" of authors will require a new name provided junior synonyms are unavailable.



Figs. 23-28. 23. *Morula rosea* (Reeve). Syntype BMNH No. 1968458, 10.8 x 6.3 mm. 24, 25. "*Morula parva*" (Pease) from Faone, Tahiti. 24. 5.4 x 3.0 mm (immature). 25. 4.8 x 3.0 mm (adult). 26. *M. parva* (Reeve). Syntype BMNH No. 1968471, 8.1 x 5.0 mm. 27. *M. rutila* (Reeve). Syntype BMNH No. 1968461, 12.0 x 5.5 mm. 28. *Drupella fenestrata* (Blainville). Naviti I., Fiji Is; 32:5 mm.

"Morula parva" (Pease, 1868) [*nom. praeocc.*] (Figs. 24, 25)

1868. *Engina parva* Pease, Americ. J. Conch. 3 (4): 276, pl. 23, fig. 11; 1883 Tryon, Man. Conch. 5: 195, pl. 63, fig. 55; 1967 Orr-Maes, Proc. Acad. Nat. Sci. Philad. 119: 135, pl. 12, fig. G.

TYPE LOCALITY: Tuamotu Archipelago.

The species has originally been described in the buccinid genus *Engina* Gray, but actually belongs to the muricid genus *Morula* Schumacher. The species is very small, 4.0-7.0 mm in length, young specimens have a conical protoconch of $2\frac{1}{2}$ whorls but adult individuals have an in-rolled protoconch of $1\frac{1}{4}$-$1\frac{1}{2}$ whorls. The shell is ornamented with alternate rows of pinkish-white and blackish-brown nodules.

Morula parva (Pease, 1868) is a secondary homonym of *Ricinula parva* Reeve, 1846, which is also a *Morula* (Fig. 26). If Pease's *parva* can be confirmed as a valid biospecies without available synonyms, the species will have to receive a substitute name when a revision of the moruline group is undertaken.

Morula rutila (Reeve, 1846) (Fig. 27)

1845. *Fusus muricoides* C. B. Adams, Proc. Boston Soc. Nat. Hist. 2: 3; 1950 Clench & Turner, Occ. Pap. Moll. Harvard Univ. 1 (15): 313, pl. 39, fig. 9 (*non Fusus muricoides* Deshayes, 1835).

1846. *Ricinula rutila* Reeve, Conch. Icon. 3: pl. 6, fig. 49.

1866. *Ricinula muricoides* (C. B. Adams), Krebs, Ann. Lyc. Nat. Hist. New York, 8: 396.

1883. *Engina rutila* Reeve, Tryon, Man. Conch. 5: 192, pl. 62, fig. 36.

1939. *Tritonalia (Ocinebrina) caribbaea* Bartsch & Rehder, Smiths. Misc. coll. 98: 7, pl. 1, fig. 1.

1958. *Risomurex muricoides* (C. B. Adams), Olsson & McGinty, Bull. Americ. Pal. 39 (177): 41.

1974. *Ocenebra (Risomurex) muricoides* (C. B. Adams), Abbott, Americ. Seashells ed. 2: 184, fig. 1922.

1976. *Muricopsis muricoides* (C. B. Adams), Radwin & D'Attilo, Murex shells world p. 168, pl. 2, fig. 3.

TYPE LOCALITY: Jamaica (*muricoides*); unknown (*rutila*); Old Providence I. Bahamas (*caribbaea*).

The name *Fusus muricoides* C. B. Adams, 1845, although firmly entrenched in West Atlantic malacological literature, is a primary homonym of *Fusus muricoides* Deshayes, 1835, which is an Eocene melongenid *Pugilina* from the Paris Basin.

Two syntypes of *Ricinula rutila* Reeve, are in the British Museum (Natural History), London, No. 1968461, dimensions of illustrated syntype 12.0 x 5.5 mm (Fig. 27). These syntypes are conspecific with *muricoides* C. B. Adams, which will have to bear the name *rutila* Reeve.

Genus **Drupella** Thiele, 1925

Drupella Thiele, 1925, Wiss. Ergeb. duet. Exp. "Valdivia", 17: 171.

The type-species and validity of the genus-group name *Drupella* in the Muricidae are at present under consideration by the International Commission on Zoological Nomenclature.

Drupella fenestrata (Blainville, 1832) (Fig. 28)

1828. *Murex cariosus* Wood, Suppl. Ind. Testac. p. 15, pl. 5, fig. 22a (*non* Linnaeus, 1767).

1832. *Purpura fenestrata* Blainville, Nouv. Ann. Mus. d'Hist. Nat. Paris 1 (2): 221, pl. 10, fig. 11.

1833. *Purpura cancellata* Quoy & Gaimard, Voy. L'Astrolabe 2: 563, pl. 37, figs. 15, 16 (*non* Roeding, 1798).

1846. *Ricinula elongata* Blainville, Reeve, Conch. Icon. 3: pl. 4, sp. 25 (*non Purpura elongata* Blainville, 1832).

1880. *Ricinula (Sistrum) cancellata* Quoy, Tryon, Man. Conch. 2: 188, pl. 58, figs. 242, 250.

1897. *Sistrum elongatum* Blainville, Sowerby, App. Mar. shells Sth. Africa, p. 6.

1903. *Sistrum cancellatum* (Quoy & Gaimard), E. A. Smith, Proc. Malac. Soc. Lond. 5: 377; 1906 E. A. Smith, Ann. Natal Govt. Mus. 1 (1): 40; 1939 M. Smith, Illust. Cat. Rock shells, p. 30, pl. 20, fig. 5.

1957. *Morula cariosa* Wood, Kaicher, Indo-Pacific sea shells, pl. 3, fig. 3.

1967. *Drupa (Morula) cariosa* (Wood), Orr-Maes, Proc. Acad. Nat. Sci. Philad. 119 (4): 130, pl. 11, fig. D.

1972. *Drupella cariosa* (Wood), Cernohorsky, Mar. shells Pacific 2: 126, pl. 36, fig. 1; 1975 Salvat & Rives, Coquill. Polynésie p. 316, fig. 213.

1973. *Drupa cancellatum* (Quoy & Gaimard), Kensley, Sea-shells Sth. Africa p. 136. fig. 463: 1974 Kensley in Barnard, Ann. Sth. Afric. Mus. 47 (5): 690.

Recent authors have reverted to the chronologically earliest name for the species, i.e. *Murex cariosus* Wood, 1828, which unfortunately is a primary homonym of *M. cariosus* Linnaeus, 1767. *Purpura cancellata* Quoy & Gaimard, 1833, a name used to this day by some authors, is also a primary homonym of *P. cancellata* Roeding, 1798, and the species should be known as *Drupella fenestrata* (Blainville, 1832).

Family OLIVIDAE

Genus **Oliva** Bruguière, 1789

Oliva Bruguière, 1789, Encyl. Méth. Hist. nat. vers 1: XV. Type species by SM (Lamarck, 1799) *Voluta oliva* Linnaeus, 1758. Recent, Indo-Pacific.

Oliva parkinsoni Prior, 1975 (Fig. 29)

1975. *Oliva parkinsoni* Prior, Keppel Bay Tidings Oct./Nov. p. 3, textfig.

1978. *Oliva* species Wolfe, Hawaiian Shell News 26 (2): 6, figs.

TYPE LOCALITY: Rabaul, New Britain, Papua New Guinea.

The validity of erection of the taxon *Oliva parkinsoni* published in the "Keppel Bay Tidings" (Prior 1975) had been queried both in private letters of malacologists and also in print (Wolfe 1978).

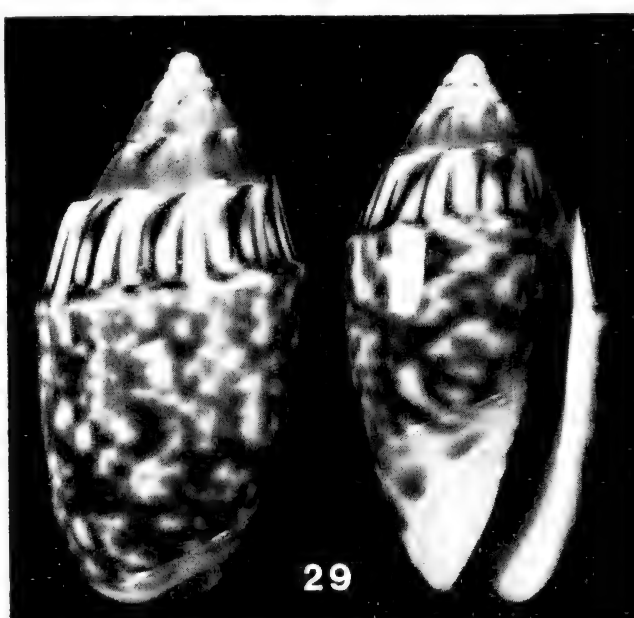


Fig. 29. *Oliva parkinsoni* Prior. Lectotype AIM No. TM-1359; 18.8 x 9.3 mm.

The description of *Oliva parkinsoni* appeared in a Club Journal, which is not exactly the ideal vehicle for descriptions of new taxa, and the description was not sent in by the author personally. The author also omitted to select a holotype. Despite the unusual way in which this taxon was erected, the description is nevertheless valid.

The author did supply a description, appended 2 textfigures, cited the type locality as Rabaul, New Britain and stated that the paratypes are in the Auckland Institute and Museum. All the above points make the species description valid and fulfill the requirements of the current Code of ICZN (1964). Recommendation 73a of ICZN (op. cit.) dealing with the selection of a holotype is not an article and therefore not binding.

The Auckland Institute and Museum received several paratypes of *Oliva parkinsoni* about 12 months after description. According to the author Dr. C. Prior (*in litt.* 13-XII-1977) all these paratypes were used in the description of *Oliva parkinsoni* despite the fact that the selection of a holotype was omitted. To correct this oversight, a lectotype is here selected in accordance with article 74(a) of the Code of ICZN (1964). This lectotype bears the Auckland Institute and Museum registration No. TM-1359, length 18.8 mm, width 9.3 mm (Fig. 29).

Family MITRIDAE

Genus **Mitra** Lamarck, 1798

Mitra Lamarck, 1798, Tabl. Encyl. Méth. pl. 369. Type species by tautonomy *Voluta mitra* Linnaeus, 1758 (Opinion 885 of ICZN). Recent, Indo-Pacific.

Mitra pele Cernohorsky, 1970 (Fig. 30)

1970. *Mitra pele* Cernohorsky, Nautilus 83 (3): 99, figs. 3, 4.

TYPE LOCALITY: N.W. of Pitcairn I, Pacific Ocean, 65-70 fathoms (119-128 m).

I have recently examined specimens of *M. pele* trawled in 183 m-220 m at Panlao, Bohol, Philippines (*leg.* V. Dan). Both specimens were faded but well-preserved, slender individuals which closely resembled the slender Hawaiian paratype. The Philippine I record is a considerable westward extension from Pitcairn I. and the Hawaiian Is.

Mitra hilli Cernohorsky, 1976 (Fig. 31)

1976. *Mitra hilli* Cernohorsky, Rec. Auckland Inst. Mus. 13: 111, figs. 1-5.

TYPE LOCALITY: Cape Moreton, Queensland, Australia, 132 m.

This recently described species had a previously known Queensland-Taiwan distribution. This new record from Panlao, Bohol Province, Philippines (*leg.* V. Dan) considerably extends the species distributional range.

Subgenus **Nebularia** Swainson, 1840

Nebularia Swainson, 1840, Treat. Malac. pp. 130, 131. Type species by SD (Herrmannsen, 1847) *M. contracta* Swainson, 1820. Recent, Indo-Pacific.

Mitra (Nebularia) contracta Swainson, 1820 (Figs. 32-34, 37)

1820. *Mitra contracta* Swainson, Zool. Illust. (1), 1: pl. 18, top and bottom figs.

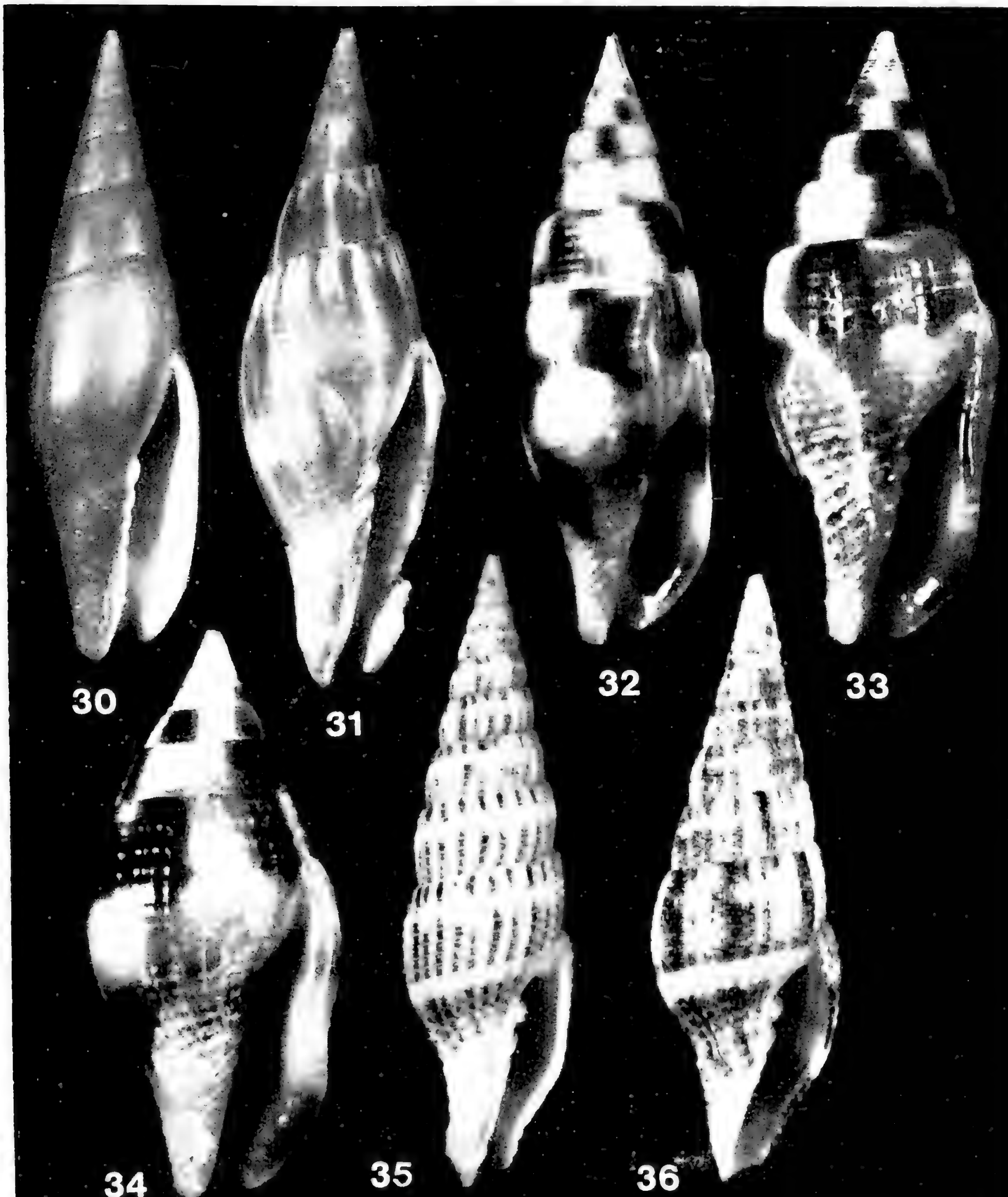
1836. *Mitra chrysostoma* Broderip, Proc. Zool. Soc. Lond. Pt. 3: 194.

1976. *Mitra (Nebularia) contracta* Swainson, Cernohorsky, Indo-Pacific Moll. 3 (17): 393, pl. 256, fig. 7 and pl. 331, figs. 1-7.

1976. *Mitra (Nebularia) chrysostoma* Broderip, Cernohorsky, Indo-Pacific Moll. 3 (17): 396, pl. 256, figs. 5, 6 and pl. 331, figs. 8-10.

TYPE LOCALITY: Anaa I, Tuamotu Is (*contracta* and *chrysostoma*).

In a recent monograph of the family Mitridae (Cernohorsky 1976) *Mitra chrysostoma* was only tentatively accepted as a valid species pending examination of larger series of specimens. It was pointed out that intergrading specimens were seen and



Figs. 30-36. 30. *Mitra pele* Cernohorsky. Panlao, Bohol, Philippines, 183-220 m; 62.4 mm. 31. *M. hilli* Cernohorsky. Panlao, Bohol, Philippines; 75.0 mm. 32-34. *M. (Nebularia) contracta* Swainson. Rabaul, New Britain. 32. Slender form, 34.7 x 10.8 mm (W.I. 31%). 33. Medium form, 29.2 x 11.2 mm (W.I. 39%). 34. Broad form, 26.4 x 12.0 mm. (W.I. 45%). 35, 36. *Vexillum (Costellaria) takakuwai* Cernohorsky & Azuma. 35. Panlao, Bohol, Philippines; 37.2 mm. 36. Harsa Bay, Laing I., Papua New Guinea; 26.3 mm (immature).

this has now been confirmed through 2 dozen specimens from Tulagi I, Florida group, Solomon Is (*leg.* T. Hallinan) and 58 specimens collected on the Korere-Bai coast of Rabaul, New Britain (*leg.* Dr. C. Prior).

All 58 specimens have been measured and the width-index ratio (width expressed as a percentage of length) computed. The mean width-index of the 58 Rabaul specimens ranged from 31% to 46%, with a mean of 39.4% (Fig. 37).

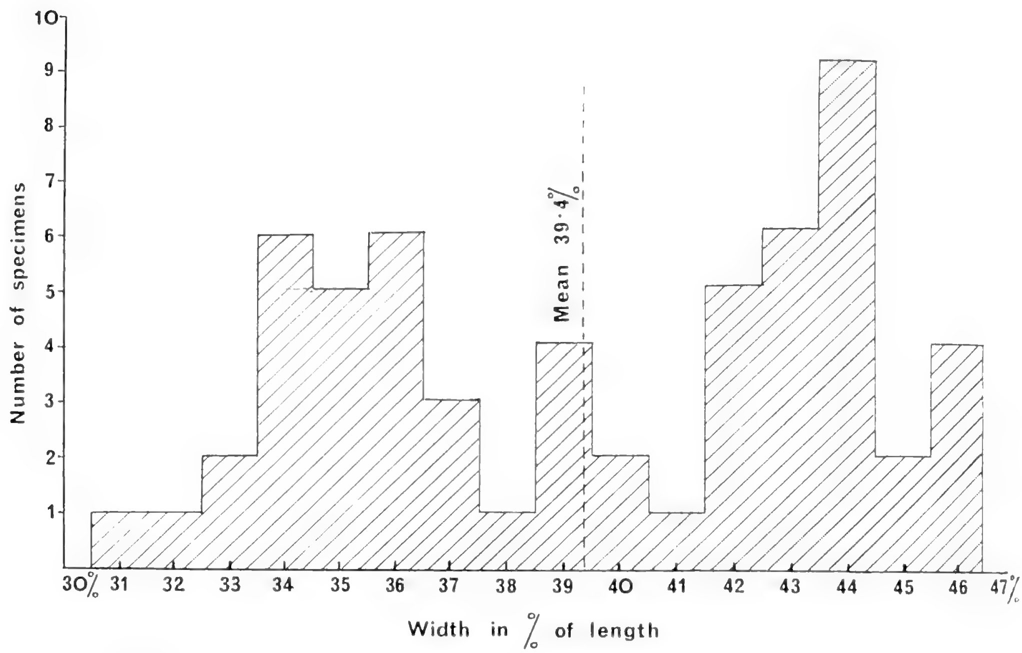


Fig. 37. Width-index — frequency histogram of *Mitra (Nebularia) contracta* Swainson from Rabaul, New Britain.

Specimens below this mean resembled the slender *contracta* form and specimens above 40% in width resembled the broader *chrysostoma* form. The sculpture proved to be as variable as the shell-outline and usually broader specimens had a coarser sculpture than slender ones. The characters of shell-outline and prominence of sculpture, which were previously used in a specific separation between *contracta* and *chrysostoma* proved to be of no consequence in a large series where these characters merge and vary from individual to individual.

The length of the aperture proved to be as variable as the shell-outline and ranged in aperture height-index from 49% to 66%, showing that the aperture can be equal in height to the spire or considerably longer. *M. chrysostoma* Broderip, 1836, must now be placed in synonymy of *M contracta* Swainson, 1820. For an expanded synonymy of the species see Cernohorsky (1976).

Family COSTELLARIIDAE

Genus **Vexillum** Roeding, 1798

Vexillum Roeding, 1798, Mus. Bolten. p. 138. Type species by SD (Woodring, 1928) *V. plicatum* Roeding, 1798 = *Voluta plicaria* Linnaeus, 1758. Recent, Indo-Pacific.

Subgenus **Costellaria** Swainson, 1840

Vexillum (Costellaria) takakuwai Cernohorsky & Azuma, 1974 (Figs. 35, 36)

1974. *Vexillum (Costellaria) takakuwai* Cernohorsky & Azuma, Venus: Jap. J. Malac. 33 (1): 7, figs. 1-5.

TYPE LOCALITY: off Okinoshima, Tosa, Japan, 37-55 m.

The new records from Panlao, Bohol Province, Philippines (*leg.* V. Dan) and from Harsa Bay, Laing I, Papua New Guinea, 45 m (*leg.* Laing I Biological Station) represent a south and southwest extension for this species. The Philippine Island specimens are very similar to the holotype from Japan.

Family CYLICHNIDAE H. &. A. Adams, 1854

(= Scaphandridae Sars, 1878 = Tornatinidae Fischer, 1883 = ? Acteocinidae Pilsbry, 1921)

Keen (1971), Marcus (1977) and other authors use the family-group name Scaphandridae for the genera *Scaphander* Montfort and *Cylichna* Lovén. The family name Cylichnidae must replace Scaphandridae as the earlier name.

Genus **Tornatina** A. Adams in Sowerby, 1850

Tornatina A. Adams in Sowerby, 1850, Thes. Conchyl. 2: 566. Type species by SD (Woodward, 1866) *Bulla voluta* Quoy & Gaimard, 1883 (*non* Gmelin, 1791) = *Tornatina decorata* Pilsbry, 1904. Recent, Indo-Pacific.

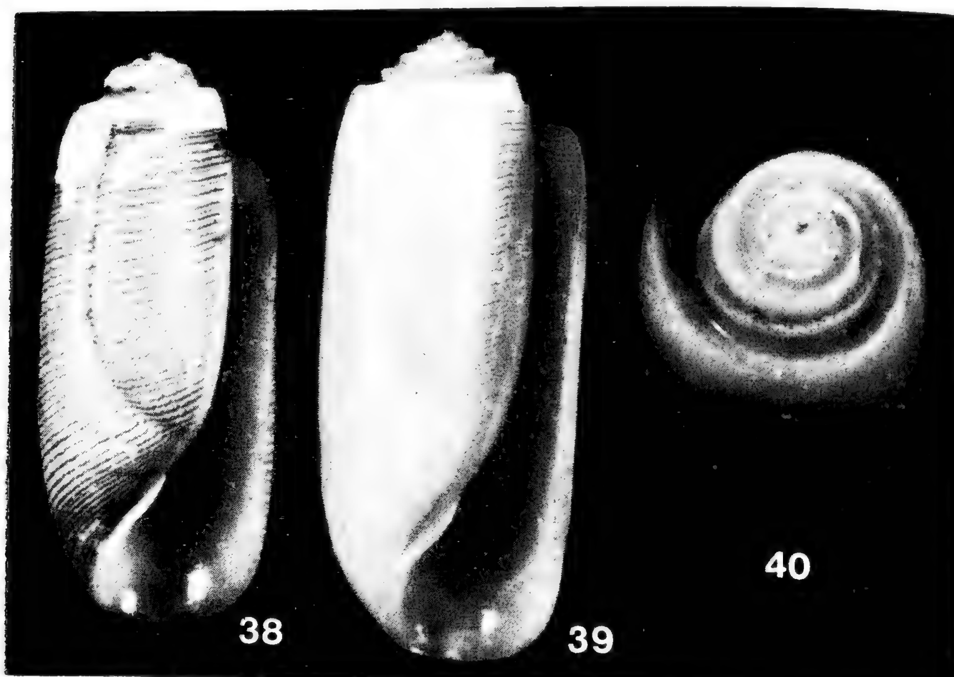
The majority of authors have either synonymized *Tornatina* A. Adams, with *Acteocina* Gray, 1847, whose type species *A. wetherilli* (Lea, 1833) is a fossil from the New Jersey Miocene, or considered *Tornatina* as a subgenus of *Acteocina*. Marcus (1977) retained *Tornatina* for Recent Indo-Pacific species contending that without a comparison of anatomy between the fossil and Recent species of *Acteocina* and *Tornatina* it is not only impossible to ascertain whether or not they are congeneric but whether they belong to the family Cylichnidae or the Retusidae. The taxonomy of cephalopod tectibranchs relies strongly on comparative anatomy and for this reason it is advisable to disassociate the Recent Indo-Pacific *Tornatina* from the American Miocene *Acteocina*.

Tornatina decorata Pilsbry, 1904 (Figs. 38-40)

1833. *Bulla voluta* Quoy & Gaimard, Voy. L'Astrolabe 2: 359, pl. 26, figs. 33-35 (*non* Gmelin, 1791).
1850. *Bulla (Tornatina) voluta* Quoy, A. Adams in Sowerby, Thes. Conchyl. 2: 566, pl. 121, fig. 4.
1904. *Tornatina decorata* Pilsbry, Proc. Acad. Nat. Sci. Philad. 56: 37, pl. 5, fig. 51.
1927. *Retusa gaimardi* Finlay, Trans. Proc. N.Z. Inst. 57: 520 (*nom. subst. pro Bulla voluta* Quoy & Gaimard, 1833).
1952. *Acteocina voluta* (Quoy & Gaimard), Kuroda & Habe, Check-list Moll. Japan p. 37.
1964. *Acteocina (Tornatina) decorata* (Pilsbry), Habe, Shells west. Pacif. col. 2: 139, pl. 43, fig. 13.
1977. *Tornatina gaimardi* (Finlay), Marcus, J. Moll. Stud. Suppl. 2: 6, figs. 1-11 and pl. 1.

TYPE LOCALITY: Guam, Marianas Is (*voluta* and *gaimardi*); Hirado, Hizen, Japan (*decorata*).

The substitute name *Retusa gaimardi* Finlay, 1927, for the homonymous *Bulla voluta* Quoy & Gaimard, 1833 (*non* Gmelin, 1791) has proved to be superfluous. Examination of the holotype and 2 paratypes of *Tornatina decorata* Pilsbry, 1904, in the Academy of Natural Sciences, Philadelphia No. 85985, clearly shows that *decorata* is conspecific with *voluta*. The holotype of *decorata* (Fig. 38), dimensions 6.8 x 2.8 mm (width-ratio 41%) still has most of the orange-brown periostracum adhering to the shell. The writer has collected several specimens in the Lau group, Fiji Is, and larger individuals always display features of calloused columella which more or less creeps upwards and adds a sharp border to the canaliculate spire whorls. The largest individual collected in the Lau group measured 10.0 x 4.1 mm (width-ratio 41%), which is still slightly smaller than the original dimensions of 5 x 2 lignes = 11.25 x 4.5 mm (width-ratio 40%) given for *T. voluta* (Quoy & Gaimard).



Figs. 38-40. *Tornatina decorata* Pilsbry. 38. Holotype Acad. Nat. Sci. Philad. No. 85985; 6.8 x 2.8 mm. 39, 40. Specimen from Moce I, Lau group, Fiji Is; 10.0 x 4.1mm. 39. Ventral view. 40. Spire view.

Tornatina conspicua Preston, 1908, despite small differences in some anatomical features as found by Marcus (1977), is indistinguishable from *T. decorata* and is most probably conspecific. Marcus (1977) quoted Lemche who considered *T. acrobeles* (Watson, 1883) and *T. exilis* (Dunker, 1860) to be conspecific with *voluta* Quoy & Gaimard (= *decorata* Pilsbry). If this assumption can be confirmed through examination of the respective type specimens then another name change for *T. decorata* will be required.

Acknowledgements. I am grateful to Ms K. Way and Ms A. Blake, British Museum (Natural History), London, and Dr G. Davis and Ms E. V. Scott, Academy of Natural Sciences, Philadelphia, for the loan of molluscan type material. I would like to thank Mr V. Dan, Manila, Philippines, Major A. Deynzer, Okinawa, Mr B. Parkinson, Rabaul, New Britain, Dr C. Prior, Keravat, New Britain, and Mr J. Trondle, Papeete, Tahiti, for the loan of molluscan specimens.

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THE TAXONOMY OF CARIBBEAN – ATLANTIC COSTELLARIIDAE (MOLLUSCA : GASTROPODA)

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Abstract. This account deals with 17 species of Costellariidae. Fourteen of these inhabit the east coast of America and the Caribbean, with some species ranging as far south as Brazil. One species lives in the N.E. Atlantic and 2 species are endemic to St. Helena. *Mitra rawsoni* Moerch and *M. brandii* Verrill, are considered *nomina dubia* and *M. pleurotomoides* E. A. Smith, *M. torticula* Dall, and *M. zilpha* Dall, are transferred from the Costellariidae to the Turridae.

This paper is a preliminary study of Caribbean-Atlantic Costellariidae, based on type-specimens of described species and collections of recent specimens in various United States Museums. Only species of the subgenera *Pusia* Swainson and *Costellaria* Swainson, have been included. The two species of *Thala* H. & A. Adams, i.e. *T. foveata* Sowerby, 1874, and *T. floridana* Dall, 1884, have been dealt with in detail by Maes & Raeihle (1975).

The three dimensions given throughout this paper represent in sequential order the length x width x height of aperture expressed in "mm". The British Museum (Natural History), London, has been abbreviated "BMNH" and the National Museum of Natural History, Smithsonian Institution, Washington, D.C., is abbreviated "USNM".

Family COSTELLARIIDAE Macdonald, 1860

Recent anatomical research (Ponder 1972) has shown that the Mitridae differ quite markedly in certain anatomical features from the Costellariidae and that a familial separation is warranted. The Costellariidae have paired accessory salivary glands which are absent in the Mitridae, and the Costellariidae have a pycnonephridian kidney and the Mitridae a meronephridian kidney. Apart from other differences, the spawns and radulae are also very different.

For details concerning chronological priority of Costellariidae Macdonald, 1860, over Vexillidae Thiele, 1929, see Cernohorsky (1976).

Genus **Vexillum** Roeding, 1798

Vexillum Roeding, 1798, Mus. Bolten. p. 138. Type species by SD (Woodring, 1928) *V. plicatum* Roeding, 1798 = *Voluta plicaria* Linnaeus, 1758. Recent, Indo-Pacific.

Subgenus **Pusia** Swainson, 1840

Pusia Swainson, 1840, Treat. Malac. p. 320. Type species by *M. P. microzonis* (Lamarck) = *Mitra microzonias* Lamarck, 1811. Recent, Indo-Pacific.

Vexillum (Pusia) dermestinum (Lamarck, 1811) (Fig. 1)

1811. *Mitra dermestina* Lamarck, Ann. Mus. d'Hist.. Nat. Paris 17: 221; 1969 Cernohorsky, Rev. Suisse Zool. 76 (4): 987. pl. 7, fig. 51 (figd. lectotype).

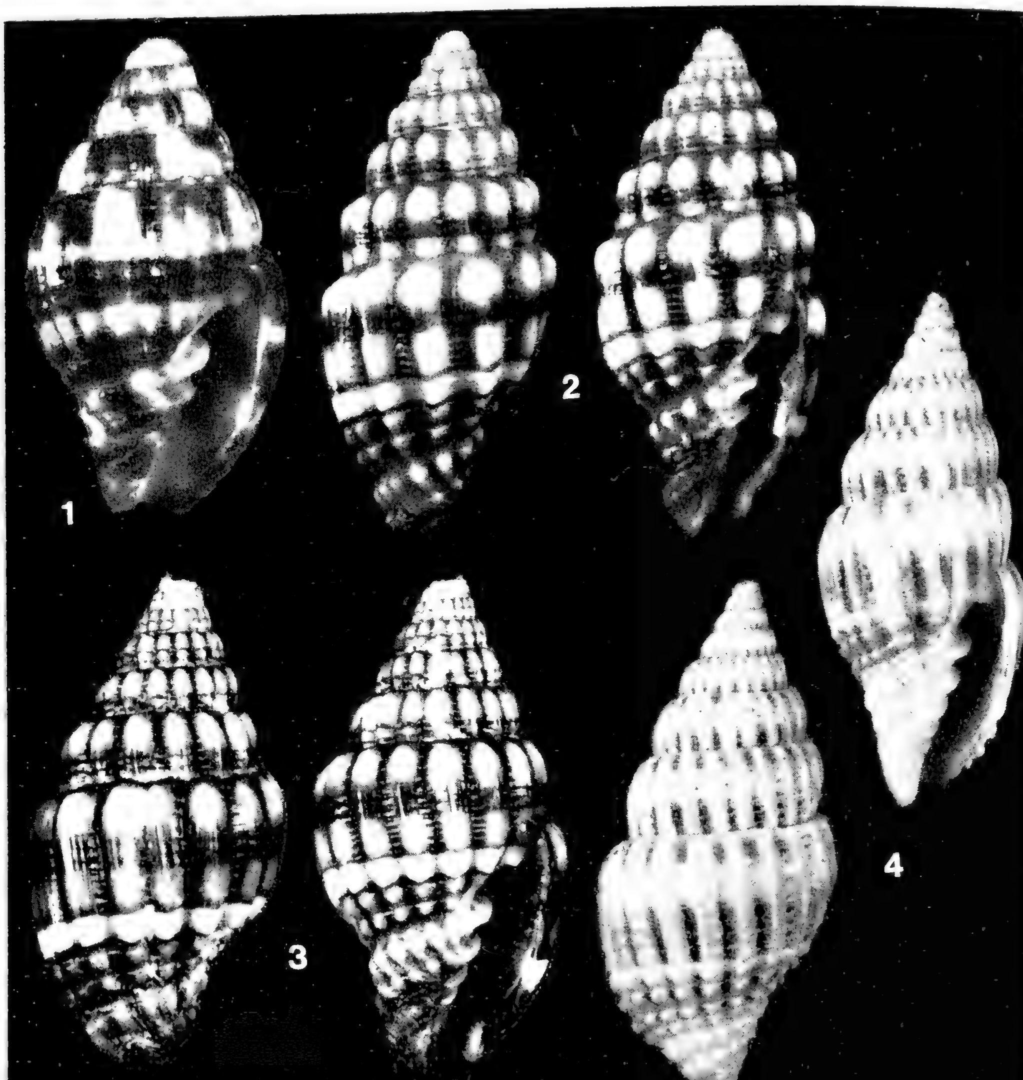
1850. *Mitra albicostata* C. B. Adams, Contrib. Conch. 1: 57; 1950 Clench & Turner, Occ. Pap. Moll.Harv. Univ. 1 (15): 252, pl. 36, fig. 11 (figd. holotype).

1974. *Vexillum (Pusia) dermestinum* (Lamarck). Abbott. Americ. Seashells ed. 2: 240 fig. 2632.

TYPE LOCALITY: Indian Ocean = error (*dermestina*); Jamaica (*albicostata*).

DISTRIBUTION: From the Florida Keys to the east coast of Mexico to Tobago and the Bahama Is. Peile's (1926) record from Bermuda requires confirmation.

Type specimens: The lectotype of *M. dermestina* Lamarck, is in the Museum of Natural History, Geneva, No. 1102/82/1, dimensions 14.5 x 8.0 x 8.0 mm, and the



Figs. 1-4. 1. *Vexillum (Pusia) dermestinum* (Lamarck). Mujeres I, Quintana Roo, Yucatan; USNM 253884, 11.3 mm. 2, 3. *V. (P.) variatum* (Reeve). 2. Lectotype BMNH No. 1967906, 19.6 x 8.7 x 10.3 mm. 3. Specimen from Long reef, St. Croix, Virgin I; 12.7 mm. 4. *V. (P.) pulchellum* (Reeve). Lectotype BMNH No. 1967849, 19.4 mm.

holotype of *M. albicostata* C. B. Adams, is in the Museum of Comparative Zoology, Harvard University, No. 177083, dimensions 16.4 x 8.6 x 8.5 mm. Both type-specimens have been illustrated by Cernohorsky (1969) and Clench & Turner (1950).

Vexillum (Pusia) variatum (Reeve, 1845) (Figs. 2, 3)

1844. *Mitra speciosa* Reeve, Conch. Icon. 2: pl. 26, fig. 209 (*non M. speciosa* Reeve, 1844, pl. 19, fig. 148).

1845. *Mitra variata* Reeve, Conch. Icon. 2: Errata end of Index (*nom. subst. pro M. speciosa* Reeve, 1844, pl. 26, fig. 209).

1970. *Vexillum histrio* (Reeve), Rios (*pars*), Coast. Braz. Seashells p. 107, pl. 34, right hand fig. in bottom row (*non Mitra histrio* Reeve, 1844).

1974. *Vexillum (Pusia) variatum* Reeve, Abbott, Americ. Seashells ed. 2: 240, fig. 2633.

1975. *Pusia splendidula* Sarasua, Poeyana No. 140: 7, figs. 4, 5.

TYPE LOCALITY: None (*variatum*); Marianao, Habana, Cuba, 20-25 m (*splendidula*).

DISTRIBUTION: Cuba, Virgin Is and N.E. Brazil. Peile's (1926) record of "Bermuda" requires confirmation.

Type specimens: The type-series of *Mitra variata* Reeve, BMNH No. 1967906, consists of 3 specimens. The largest two, i.e. 19.6 mm and 17.3 mm being the species as illustrated by Reeve (1845) on pl. 26, fig. 209, while the smallest 16.4 mm specimen is a not fully mature individual of the tropical Indo-Pacific *Vexillum (Pusia) unifascialis* (Lamarck, 1811). The largest syntype, i.e. 19.6 x 8.7 x 10.3 mm, which appears to be the specimen illustrated by Reeve (op.cit.) is here designated as the lectotype of *Mitra variata* Reeve (Fig. 2); the lectotype has 8 + whorls, 14 axial ribs on the penultimate and 12 on the body whorl, *c.* 8 flattish cords on the penultimate whorl, 4 rows of basal nodules of which the two anterior ones are extensions of the posterior columellar folds, a lirate aperture, 5 columellar folds and a distinct parietal denticle. The axial ribs are whitish with a yellowish cast, the whorls have a posteriorly situated dark reddish-brown narrow band and the body whorl has an additional narrow white peripheral band which is bordered on either side by a reddish-brown line. The holotype of *Pusia splendidula* Sarasua, is in the Zoological Institute, Academy of Sciences, Cuba, No. 32, dimensions 19.0 x 8.0 x 7.0 mm.

The species can be usually readily separated from *V. (P.) histrio* on features of angulated whorls, stronger and more angulate axial ribs and more prominent nodulose cords especially those which are extensions of the columellar folds.

Garrett (1880) listed *V. (P.) variatum* (Reeve) from the Tuamotus and the Fiji Islands, and he placed his own *Mitra fratercula* Garrett, 1873, from the Pacific in synonymy. The original diagnosis of *M. fratercula* suggests a species closely similar to the highly variable Indo-Pacific *V. (C.) unifascialis* (Lamarck, 1811), and Garrett's remaining type-specimen in the Bernice P. Bishop Museum, Honolulu, shows that it is indeed conspecific with Lamarck's *V. (C.) unifascialis*.

Tryon (1882) reported *V. (C.) variatum* from Fiji and the Tuamotus, Hedley (1899) from Funafuti, Ellice Is, and most subsequent authors placed the species in the Pacific Ocean rather than the Caribbean. Peile (1926) was an exception since he listed "*Mitra dermestina* var. *variata* Rve." from Bermuda, but this record remains dubious. In 1968 during a study of the Mitracea in the world's leading Museums I came across only one specimen of an undoubted *V. (P.) variatum* in the National Museum of Natural History, Washington, which was originally in the Lea collection and bore the erroneous label "Java".

Rios (1970) illustrated a specimen of *V. (P.) variatum* collected at Maracajau reefs, Rio Grande de Norte, N.E. Brazil, under the name *Vexillum histrio* (Reeve). The first well-localized specimen examined by this writer was collected in 1974 by Mr. & Mrs. C. G. Bennett at Long Reef, St. Croix, Virgin Is (Fig. 3) and the same year Abbott (1974) correctly listed the species from the Caribbean. With such a locality confusion it is not at all surprising that the species has recently been re-described as *Pusia splendidula* Sarasua, 1975.

Vexillum (Pusia) pulchellum (Reeve, 1844) (Fig. 4)

1844. *Mitra pulchella* Reeve, Conch. Icon. 2: pl. 19, fig. 142.

1970. *Vexillum pulchellum* (Reeve), Rios, Coast. Braz. Seashells p. 108, pl. 34, fig. on left in centre row.

TYPE LOCALITY: Island of Barbados, West Indies.

DISTRIBUTION: From the Florida Keys through the Caribbean to East Brazil.

Type specimens: Three syntypes of *Mitra pulchella* Reeve, are in the BMNH No. 1967849, and the largest syntype, i.e. 19.4 x 8.8 x 9.3 mm, which appears to be the specimen illustrated by Reeve (1884) is here designated as the lectotype of *M. pulchella* Reve (Fig. 4). The lectotype has 8 whorls, a missing apex, 21 axial ribs in the penultimate and 19 on the body whorl, deep intersticial spiral grooves, a lirate aperture and 5 columellar folds. It is orange in colour, the spire whorls have 2 rows of axially elongated brown spots at the sutures between the ribs, the body whorl has 3 rows of similar spots and an additional narrow white peripheral band.

Apart from the type-specimens only about another half dozen lots have been seen in Museums. The species is closely allied to *V. (P.) variatum* (Reeve), but differs in features of more inflated, convex whorls, more numerous, slender and lower axial ribs and general colour ornamentation. Should, however, at some future date *V. (P.) pulchellum* be found to be conspecific with *V. (P.) variatum* then the former name would have chronological priority. The species has not been mentioned by Abbott (1974).

Vexillum (Pusia) histrio (Reeve, 1844) (Figs. 5-7)

—— *Mitra sulcata auctt.* (*non Voluta sulcata* Gmelin, 1791, p. 3455).

1844. *Mitra histrio* Reeve, Conch. Icon. 2: pl. 19, fig. 144.

1850. *Mitra monilifera* C. B. Adams, Contrib. Conch. No. 47: 57 (*non M. monilifera* C. B. Adams *sensu* Clench & Turner, 1950).

1852. *Pusia sulcata* var. *bifasciata* Moerch, Cat. Yoldi p. 84 (*nom. nud.)*

1950. *Mitra albocincta* Adams, Clench & Turner, Occ. Pap. Moll. Harv. Univ. 1 (15): pl. 36, fig. 10 (*non* C. B. Adams, 1845).

1959. ? *Mitra cruzana* Nowell-Usticke, Mar. shells St. Croix, p. 76, pl. 4. fig.7

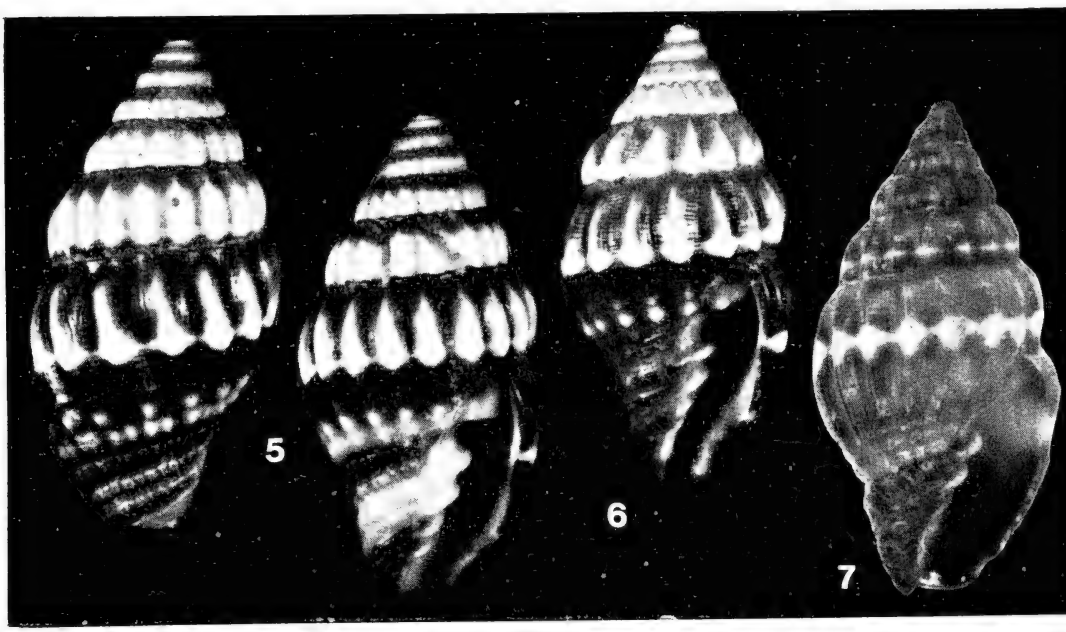
1959. ? *Mitra hayesae* Nowell-Usticke, Mar. shells St. Croix, p. 77, pl. 4, fig. 8 (*spec. juv.)*

1974. *Vexillum* (*Pusia*) *albocinctum* (C. B. Adams). Abbott, Americ. Seashells ed. 2: 239, figs. 2623, 2623a (*non M. albocincta* C. B. Adams, 1845).

TYPE LOCALITY: None (*histrio*;) Jamaica (*monilifera*); Ham Bay, St. Croix, Virgin Is *(cruzana* and *hayasae).*

DISTRIBUTION: From the Bahamas to N.W. Florida, East coast of Mexico and Panama, Curacao to Bahia, E. Brazil and throughout the Caribbean. From the intertidal zone to 275 m. Although not previously reported from N.W. Florida, there are specimens in the Academy of Natural Sciences, Philadelphia, from "off Destin, N.W. Florida, 14 fathoms (26 m)".

Type specimens: Three syntypes of *Mitra histrio* Reeve, are in the BMNH No. 1967778. The largest syntype (Fig. 5), dimensions 16.6 x 8.0 x 9.0 mm, corresponds reasonably well with Reeve's description and figure and is here designated as the lectotype of *M. histrio*. The lectotype has 7 whorls, a worn apex, 17 axial ribs on the penultimate and 15 on the body whorl, fine spiral striae in the interspaces, a lirate aperture and 4 columellar folds. Base colour faint scarlet, banded and clouded with blackish-brown, and the body whorl with a white moniliform peripheral band which appears as white spots upon the band. The other two paralectotypes (Fig. 6) are other colour forms of the species. Reeve received the specimens of *M. histrio* from C. B. Adams, a fact which was acknowledged in the description (ex-Mus. Adamsonianum).



Figs. 5-7. *Vexillum (Pusia) histrio* (Reeve). 5. Lectotype BMNH No. 1967778, 16.6 mm. 6. Paralectotype BMNH No. 1967778, 15.6 mm. 7. Probable type of *Mitra monilifera* C. B. Adams, MCZ No. 177080, 18.0 mm (= *M albocincta* of Clench & Turner, 1950).

Clench & Turner (1950) illustrated C. B. Adams' western Atlantic mollusc types, and a mix-up with some of the Mitracean types is suspected. The specimen illustrated as the holotype of "*Mitra monilifera* C. B. Adams", is a uniformly brown specimen which is conspecific with *M. nodulosa* (Gmelin, 1791). Adams (1850) described his *M. monilifera* as being brownish-black with a white spiral band which is dilated into spots on the ribs and with about 14 rather acute longitudinal ribs on each whorl and numerous, excessively minute and subequal raised spiral lines and 8-9 convex whorls. In addition, Adams (op. cit.) compared his species to *M. microzonias* Lamarck and *M. leucodesma* Reeve, both tropical Indo-Pacific species with blackish-brown shells and a white moniliform band. The specimen illustrated by Clench & Turner (op. cit.) as "*Mitra monilifera*" is tan in colour without a trace of a white band, the whorls are flat-sided and not convex, there are no acute longitudinal ribs and the species does not resemble either *M. microzonias* or *M. leucodesma* as Adams stated.

The individual illustrated by Clench & Turner (op. cit.) on plate 36, fig. 10 as "*M. albocincta* C. B. Adams" appears to be the type of *M. monilifera* C. B. Adams (Fig. 7) and not the real *M. albocincta* C. B. Adams. For further discussions see under *V. (P.) gemmatum* (Sowerby) below.

The original description of both *M. cruzana* Nowell-Usticke, 1959, and *M. hayesae* Nowell-Usticke, 1959, is inadequate and the illustrations are unrecognizable for specific identification. Nowell-Usticke (1969) placed his immature *M. hayesae* in synonymy with *M. cruzana*, and I agree with Abbott (1974) in considering *M. cruzana* conspecific with *V. (P.) histrio* (Reeve). The type specimens of *M. cruzana* and *M. hayesae* are presumably in Nowell-Usticke's private collection.

The species *V. (P.) histrio* (Reeve) has often appeared in literature as "*Mitra sulcata* Gmelin, 1791". Gmelin's *Voluta sulcata* appearing on page 3455 in Gmelin (1791) has been based on an illustration in Chemnitz (1780), who simply described his species as axially ribbed and brown in colour with a white central band. Chemnitz's locality indication of "Tranquebar" (India) would place *Voluta sulcata* Gmelin, 1791, in synonymy with the tropical Indo-Pacific *Vexillum (Pusia) microzonias* (Lamarck, 1811). The mitracean *V. sulcata* described by Gmelin (1791) on page 3455 is conveniently disposed of as a primary homonym of *V. sulcata* Gmelin, 1791, on page 3436, which is the acteonid species *Pupa solidula* (Linnaeus).

V. (P.) histrio is very variable in form, depending on its stage of development, and also colour which ranges from a uniform brown with a single moniliform white band to white or scarlet and variously banded with blackish-brown or stained with orange.

Vexillum (Pusia) cubanum Aguayo & Rehder, 1936 (Figs. 8, 9)

1845. ? *Mitra articulata* Reeve, Conch. Icon. 2: pl. 36, fig 302.

1936. *Vexillum cubanum* Aguayo & Rehder, Mem. Soc. Cuba Hist. nat. 9 (4): 266, pl. 24, fig 4.

1943. *Pusiolina aresta* Rehdeer, Proc. U.S. Nat. Mus. 93: 201, pl. 20, fig. 1.

1958. *Pusia cubana* Aguayo & Rehder, Abbott, Mon. Acad. Nat. Sci. Philad. No. 11: 82.

1973. *Pusia histrio* (Reeve), Morris, Field Guide shells ed. 3: 225, pl. 62, fig. 6 (*non Mitra histrio* Reeve, 1844).

1974. *Vexillum (Pusia) arestum* Rehder, Abbott Americ. Seashells ed. 2. 239, fig. 2624.

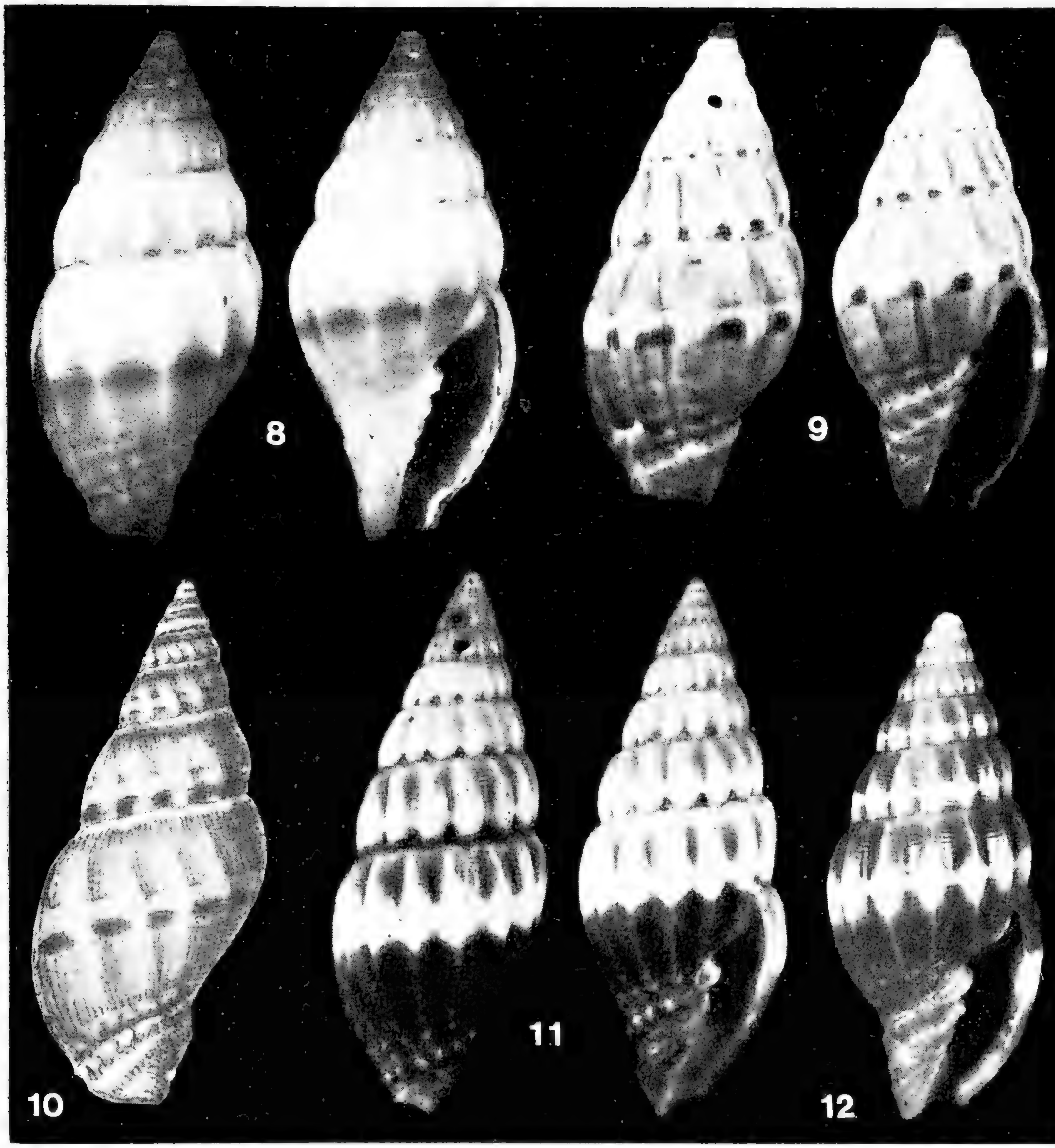
1974. *Vexillum (Pusia) cubanum* (Aguayo & Rehder), Abbott, Americ. Seashells ed. 2: 240.

TYPE LOCALITY: La Chorrera, Habana, Cuba (*cubanum*); Santa Rosa, N. coast Pinar del Rio, Cuba (*arestum*).

DISTRIBUTION: Bahamas; Cuba; Haiti; Antigua; Virgin Is; Grand Cayman Is; Barbados. From 11-146 m.

Type specimens: The holotype of *V. (P.) cubanum* is in the USNM No. 420978, dimensions 12.0 x 5.3 x 6.4 mm (Fig. 8). The holotype has 7 whorls and a missing apex, 12 axial ribs and 6 spiral striae on the penultimate and 11 ribs and 16 striae on the body whorl, a lirate aperture and 4 columellar folds. It is faded white in colour with a peripheral narrow brown band on the body whorl and the apex is faded brown, interior of aperture with a brown stain. A paratype in the Academy of Natural Sciences, Philadelphia, No. 247096 has spire whorls with faded brown spots between the axial ribs at the anterior of the sutures; on the body whorl the brown colouring is also confined to the interspaces.

The holotype of *V. (P.) arestum* is in the USNM No. 517056, dimensions 10.0 x 4.4 x x4.7 mm (Fig. 9). The holotype has 7 whorls and a broken protoconch, 12 axial ribs on the penultimate and 10 on the body whorl, spiral striae and 4 columellar folds. The colour is straw-yellow, spire whorls have a narrow white band at the anterior of the sutures and quadrate brown spots between the ribs, the body whorl has a white peripheral band and anterior quadrate brown spots, embryonic whorls and aperture are brownish.



Figs. 8-12. 8-10. *Vexillum (Pusia) cubanum* Aguayo & Rehder. 8. Holotype USNM No. 420978, 12.0 mm. 9. Holotype of *Pusiolina aresta* Rehder, USNM No. 517056, 10.0 mm. 10. Type-figure of *Mitra articulata* Reeve (from Reeve 1845, pl. 36, fig. 302). 11, 12. *V. (P.) epiphaneum* Rehder. 11. Holotype USNM No. 414278, 23.6 mm. 12. Specimen from Pompano beach, Florida, 21.0 mm.

V. (P.) cubanum and *V. (P.) arestum* are similar in size and almost identical in shape and numbers of axial ribs and differ only slightly in colour pattern, making allowance for the dead-collected types of *V. (P.) cubanum*. The two taxa are clearly conspecific and both resemble the form *articulata* Reeve. The type of the latter species is no longer extant having been sold at auction of the Norris collection. The type-figure of *V. (P.) articulatum* (Fig. 10) closely resembles the form *arestum* in colour pattern of dark brown spots and short dashes, but in shape it is closer to *V. (P.) epiphaneum* (Rehder). *V. (P.) cubanum* may eventually prove to be a small colour form of *V. (P.) histrio* (Reeve).

Vexillum (Pusia) epiphaneum (Rehder, 1943) (Figs. 11, 12)

1943. *Pusia epiphanea* Rehder, Proc. U.S. Nat. Mus. 93 (3161): 201, pl. 20, fig. 14.

1974. *Vexillum (Costellaria) epiphanea* Rehder, Abbott, Americ. Seashells ed. 2: 239, fig. 2620 (figd. holotype).

TYPE LOCALITY: Off Tortugas, Florida, 15 fathoms (27 m).

DISTRIBUTION: From the Gulf of Mexico to Florida and the Bahamas.

Type specimens: The holotype of *Pusia epiphanea* Rehder is in the USNM No. 414278, dimensions 23.6 x 8.9 x 11.0 mm. There are 14 axial ribs and 10 spiral threads on the penultimate and the same number on the body whorl in addition to the 5-6 rows of nodulose cords at the base, columella with 4 folds, aperture lirate. Brown in colour with a white subsutural band which tends to be rather broad on the spire whorls (Fig. 11).

V. (P.) epiphaneum is similar to *V. (P.) trophonium* (Dall) but differs in its squatter, more biconic shape, shorter whorls and prominent angulate ribs. *V. (P.) epiphaneum* is more closely related to *V. (P.) histrio* from which it differs only in its more elongate form.

Vexillum (Pusia) trophonium (Dall, 1889) (Figs. 13, 14)

1889. *Mitra (Costellaria?) trophonia* Dall, Bull. Mus. Comp. Zool. Harv. Coll. 18: 161.

1970. *Mitra (Cancilla) trophonia* Dall, Rios, Coast. Braz. Seashells pl. 34, fig. top row on left.

1974. *Vexillum (Costellaria) trophonium* (Dall), Abbott, Americ. Seashells ed. 2: 240.

TYPE LOCALITY: St. 247, off Grenada, 170 fathoms (311 m), at 53.5°F (12°C). Dall (1889) cited 2 localities for his *Mitra trophonia*, i.e. St. Croix, Virgin Is, and off Grenada. The holotype, however, originated from the latter locality.

DISTRIBUTION: From Florida to the Virgin Is and East Brazil. From 27-311 m.

Type specimens: The holotype is in the USNM No. 508728, dimensions 19.3 x 6.9 x 8.8 mm (Fig. 13). The specimen is worn and faded has 15 axial ribs and 11 spiral striae on the penultimate and 13 ribs and 12 striae on the body whorl and 5 additional nodulose cords at the base, 4 columellar folds and a lirate aperture. The colour is a faded yellowish-brown with a white subsutural band on each whorl.

V. (P.) trophonium differs from *V. (P.) epiphaneum* in its more slender, elongate shape, longer spire whorls and more produced siphonal canal. The species appears to be very rare since I have examined only a few lots in Museums.

Vexillum (Pusia) puella (Reeve, 1845) (Fig. 15)

1845. *Mitra puella* Reeve, Conch. Icon. 2: pl. 34, fig. 276.

1874. *Mitra albomaculata* "A. Adams ? MS", Sowerby, Thes. Conchyl. 4: 16, pl. 21, fig.449.

1958. *Pusia puella* Reeve, Abbott, Mon. Acad. Nat. Sci. Philad. No. 11: 83.

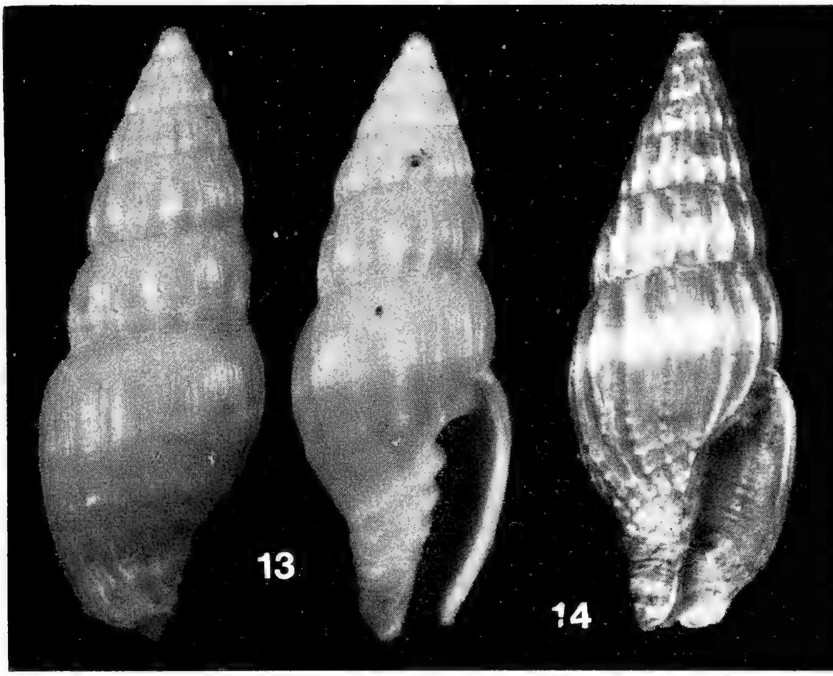
1974. *Vexillum (Pusia) puella* (Reeve), Abbott, Americ. Seashells ed. 2: 239, fig. 2625.

1976. *Vexillum puella* Reeve, Bandel, Veliger 19 (2) L182, fig. 5 (spawn).

TYPE LOCALITY: Island of St. Thomas, West Indies (*puella*); none (*albomaculata*: "Jamaica" on tablet with type).

DISTRIBUTION: From North Carolina to Florida, East coast of Mexico through the Caribbean as far east as Barbados. Usually intertidal.

Type specimens: Three syntypes of *M. puella* Reeve are in the BMNH No. 1967849, dimensions of lectotype (here designated) 9.7 x 5.3 x 6.0 mm. The lectotype has 5 whorls, a worn apex, the body whorl has 14 striae which are followed by 5 rows of axially elongated nodules, columella with 4 strong folds and a parietal denticle, outer lip with 6 denticles. Dark brown in colour, nodules paler, spire whorls and sutures of body whorl with large, partly confluent white blotches.



Figs. 13, 14. *Vexillum (Pusia) trophonium* (Dall). 13. Holotype USNM No. 414278. 23.6 mm. 14. Specimen from Camamu, Bahia, E. Brazil, 49 m; 16.5 mm.

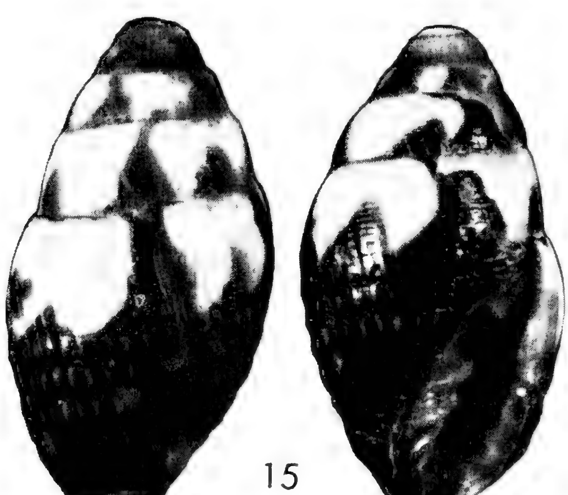


Fig. 15. *Vexillum (Pusia) puella* (Reeve). Lectotype BMNH No. 1967849, 9.7 mm.

The holotype of *M. albomaculata* Sowerby (marked on tablet "ex-Prof. C. B. Adams — Jamaica") is in the BMNH No. 1845.3.5.84., dimensions 7.7 x 4.2 x 4.5 m. The holotype has 5 whorls, a worn apex, axial plicae and spiral striae, 4 columellar folds, a lirate aperture and 7 denticles on the outer lip. Base colour dark reddish-brown, axial riblets and elongated nodules paler and the white sutural blotches are smaller and less confluent.

This is an easily recognized species with an uncomplicated taxonomic history.

Vexillum (Pusia) exiguum (C. B. Adams, 1845) (Figs. 16, 17)

1845. *Mitra exigua* C. B. Adams, Proc. Boston Soc. Nat. Hist. 2: 2; 1950 Clench & Turner, Occ. Pap. Moll. Harvard Univ. 1 (15): 278; 1956 Turner, Occ. Pap. Moll. Harvard Univ. 2 (20): 136, pl. 21, fig. 3 (figd. lectotype).

1861. *Mitra hanleyi* Dohrn, Malakozool. Blaetter 8: 138; 1863 Dunker, Novit. Cinch. (2), p. 47, pl. 15, figs. 7, 8.

1874. *Mitra roseocaudata* "Hanley", Sowerby, Thes. Conchyl. 4: 27, pl. 28, fig. 655.

1958. *Pusia (Pusiolina) hanleyi* Dohrn, Abbott, Mon. Acad. Nat. Sci. Philad. No. 11. 83.

1969. *Mitra hanleyi* form *antiguensis* Nowell-Usticke, Suppl. list shells St. Croix p. 20, pl. 4, fig. 911 (invalid — art. 15 of ICZN).

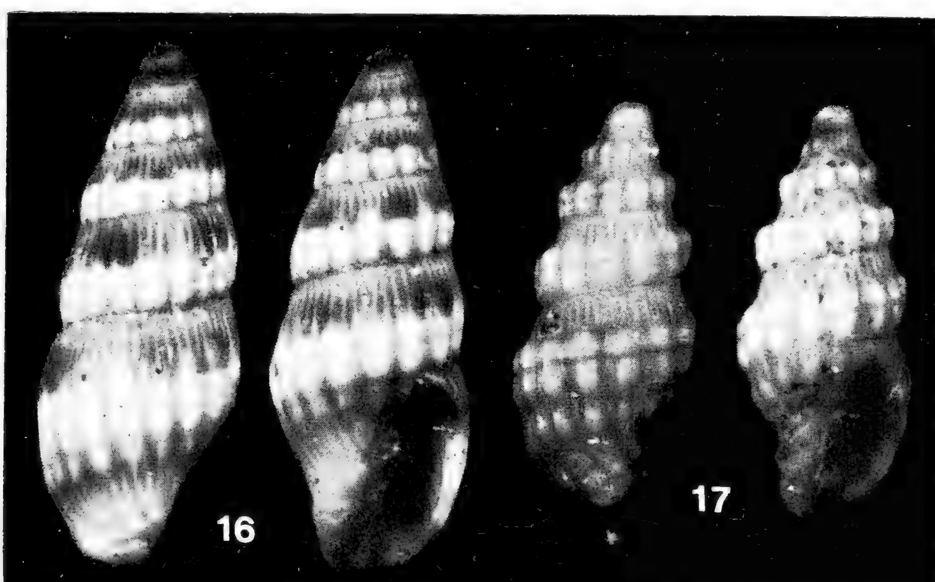
1971. *Mitra antiguaensis* Nowell-Usticke, Suppl. list shells St. Croix rev. ed. fig. 911.

1974. *Vexillum (Pusia) hanleyi* (Dohrn), Abbott, Americ. Seashells ed. 2: 239, fig. 2621.

TYPE LOCALITY: Jamaica (*exigua*) none (*hanleyi* and *roseocaudata*); Antigua (*antiguaensis*).

DISTRIBUTION: From southern Florida to Cuba, Barbados and the Bahamas. From the intertidal zone to 128 m. Also reported by Peile (1926) from Bermuda.

Type specimens: The lectotype of *M. exigua* C. B. Adams, is in the Museum of Comparative Zoology, Harvard, No. MCZ 186593, dimensions 4.7 x 3.0 x 2.6 mm. The selected lectotype (selected Turner 1956) is very worn, has 4½ whorls with part of the apex worn and missing, 15 axial ribs on the penultimate and 14 on the body whorl, 4 columellar folds and a partially worn outer lip. The colour is faded brown with a broad white subsutural band on each whorl (see Turner, op. cit.).



Figs. 16, 17. *Vexillum (Pusia) exiguum* (C. B. Adams). 16. Lectotype of *Mitra hanleyi* Dohrn, BMNH No. 1900.3.19.39., 5.3 mm. 17. Holotype of *M. roseocaudata* Sowerby. BMNH No. 1900.3.9.35., 4.0 mm.

Two syntypes of *M. hanleyi* Dohrn, are in the BMNH No. 1900.3.19.39-40, and the larger specimen, dimensions 5.3 x 2.2 x 2.5 mm is here designated as the lectotype (Fig. 16). The lectotype has 6 whorls and a worn apex, 16 axial ribs on the penultimate and the same number on the body whorl, numerous slender, crowded axial wrinkles (*c.* 2-3 per broad axial rib) in the subsutural area, 4 columellar folds and a lirate aperture. The base colour is greenish-brown, spire whorls with a broad white band at the sutures and the body whorl with a white peripheral band which contains fine greenish-brown spiral lines, sutural wrinkles pale and interstices darker, aperture whitish and with 2 darker brown bands.

The holotype of *M. roseocaudata* Sowerby is in the BMNH No. 1900.3.9.35., dimensions 4.0 x 1.7 x 2.2 mm. The holotype has 6 whorls which tend to be biangulate, penultimate with 13 and body whorl with the same number of axial ribs, columella with 4 fold and some nodulose cords basally. The colouring is very similar to the lectotype of *M. hanleyi* (Fig. 16).

The holotype of *M. antiguaensis* Nowell-Usticke, given dimensions 4.5 x 2.25 mm, is most probably in the describer's private collection. The species has been described as having 6 whorls, 15 axial ribs and subsutural band with short riblets.

Clench & Turner (1950) when dealing with C. B. Adams' types of West Atlantic marine molluscs, remarked that the type of *M. exigua* has been lost. Turner (1956) however, reported the type of *M. exigua* as having been found and illustrated a very worn, faded specimen as the lectotype; under magnification a few subsutural axial wrinkles can still be seen. C. B. Adams (1845) described *M. exigua* with "numerous upper riblets and broader lower ribs" leaving no doubt that his species was conspecific with the subsuturally axially wrinkled *hanleyi* form. Adams' given dimensions of 0.13 x 0.06 poll. (= 3.3 x 1.52 mm), the mention of 6 whorls and description of a white colour with blackish-purple and dark staining, clearly shows that the much larger and considerably broader, 4½ whorled, worn and faded lectotype was most probably not the specimen Adams described.

Both Dohrn and Sowerby received their specimens from Hanley, and neither author realized that both were describing the same species. For further discussion and comparison see *V. (P.) gemmatum* (Sowerby) below.

Vexillum (Pusia) gemmatum (Sowerby,1874) (Figs. 18-20)

1845. ? *Mitra albocincta* C. B. Adams, Proc. Boston Soc. Nat. Hist. 2: 2 (*non M. albocincta sensu* Clench & Turner, 1950).
1874. *Mitra gemmata* Sowerby, Thes. Conchyl. 4: 24, pl. 28, fig. 649.
1901. *Mitra hanleyi* var. *gemmata* Sowerby, Dall & Simpson, U.S. Fish. Comm. Bull. 1: 396.
1958. *Pusia (Pusiolina) gemmata* Sowerby, Abbott, Mon. Acad. Nat. Sci. Philad. No. 11: 82.
1969. ? *Mitra minutus* Nowell-Usticke, Suppl. list shells St. Croix, p. 20, pl. 4, fig. 912 (*non M. minuta* Roeding, 1798; *nec* Michelotti, 1847).
1970. *Vexillum (Pusia) exiguum* (C. B. Adams), Rios, Coast Braz. Seashells p. 107,pl. 34, fig. middle row on right.
1971. ? *Mitra minuta* Nowell-Usticke, Suppl. list shells St. Croix rev. ed., No. 911 (*non* Roeding, 1798; *nec* Michelotti, 1847).
1974. *Vexillum (Pusia) gemmatum* (Sowerby, Abbott, Americ. Seashells ed. 2: 239, fig. 2622.

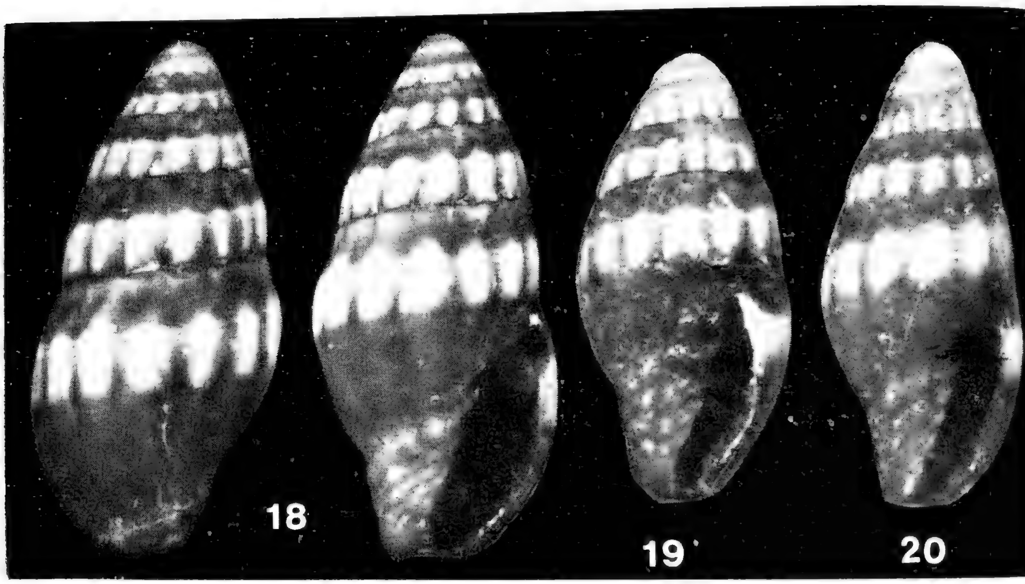
TYPE LOCALITY: Jamaica (*albocincta*); none (*gemmata*); Conch Bay, Beef I, Virgin Is (*minuta*).

DISTRIBUTION: From southern Florida to the east coast of Mexico and Panama, the Bahamas and E. Brazil. From the intertidal zone to 81 m. Also reported by Peile (1926) from Bermuda.

Type specimens: Two probable syntypes of *M. albocincta* C. B. Adams, are in the BMNH No. 1845.3.5.85-86, dimensions 4.0 x 1.9 mm and 3.9 x 2.0 mm. These two specimens have been accessioned in 1845 ex-Prof. C. B. Adams from "Jamaica".

They are slightly worn specimens which lack the subsutural wrinkles and are conspecific with the form *gemmata* Sowerby (Figs. 19, 20).

Three syntypes of *M. gemmata* Sowerby, are in the BMNH No. 1900.3.19.36-38., and the largest specimen, i.e. 7.0 x 3.3 x 3.6 mm, is here designated as the lectotype (Fig. 18). The lectotype has 14 axial ribs on the penultimate and 13 on the body whorl, weak spiral striae, granulose cords basally, 4 columellar folds and a lirate aperture. The base colour is pirmarily greenish-brown, spire whorls have a broad, white sutural band and the body whorl a broad white peripheral band, aperture greenish-brown with white bands.



Figs. 18-20. *Vexillum (Pusia) gemmatum* (Sowerby). 18. Lectotype BMNH No. 1900.3.19.36., 7.0 mm. 19, 20. Probable syntypes of *Mitra albocincta* C. B. Adams. BMNH No. 1845.3.5.85-86 (ex-C. B. Adams). 19. 3.9 x 2.0 mm. 20. 4.0 x 1.9 mm.

The holotype of *M. minuta* Nowell-Usticke (*non* Roeding) is probably in the describer's private collection. The given dimensions are 3.9 x 1.9 mm.

As pointed out already in the discussion of *V. (P.) histrio* (Reeve), some mix-up probably occurred with Adams' types of Mitridae and Costellariidae. C. B. Adams (1845) described *M. albocincta* as having 6 whorls and gave the size as 0.2 poll. x 0.1 poll. = 5.1 x 2.5 mm. The specimen selected and illustrated by Clench & Turner (1950) as the holotype of "*M. albocincta* C. B. Adams" disagrees with Adams' diagnosis. The Clench & Turner "type" measures 18.0 x 8.5 mm which is over three times the size as given by Adams (op. cit.), the shell has 8 whorls and a missing protoconch and not 6 whorls as given by Adams. The specimen illustrated by Clench & Turner (op. cit.) as the "holotype" of *M. albocincta* is in my opinion the type-specimen of *M. monilifera* C. B. Adams for which Adams gave a size of 18.8 x 9.1 mm. All available evidence and the existence of the 2 probable syntypes of *M. albocincta* in the British Museum (Nat. Hist.) which originated from the C. B. Adams collection and were accessioned in 1845, strongly suggest that *M. albocincta* C. B. Adams is an earlier name for *M. gemmata* Sowerby. Another point worth noting is that C. B. Adams (op. cit.), and Dohrn (1861) compared *M. albocincta* and *M. hanleyi* to

"*M. savignyi* Payraudeau, 1826" [= *Vexillum (Pusia) tricolor* (Gmelin, 1791)], a species which closely resembles *exiguum* and *gemmatum*. I have only tentatively adopted Sowerby's name of *gemmatum* for this species pending discovery of other genuine C. B. Adams material of *M. albocincta* in other Museums, which might shed some light on the real identity of *M. albocincta* C. B. Adams.

V. (P.) exiguum and *V. (P.) gemmatum* are closely similar in form, shape of whorls, adpressed sutures, concave subsutural area, often biangulate whorls, columellar folds and colouring which can range from tan to greenish-brown or blackish-brown with a white or cream band which may contain a brown spiral line. Both species have about 12-16 main axial ribs on either the penultimate or the body whorl. The only difference is the presence in *V. (P.) exiguum* of numerous, slender and crowded axial riblets which descend from the sutures onto the broader main axial ribs which are frequently developed into somewhat biangulate nodes in the white area; these subsutural riblets are so slender that 2-3 of these riblets fit within the width of one main axial rib. I have examined 54 lots of over 230 specimens from various Caribbean localities and found no difficulty in separating *exiguum* from *gemmatum* on the basis of presence or absence of subsutural axial riblets, until I encountered individuals in which the subsutural wrinkles were extremely faint or only 4-5 subsutural riblets were present on the whole shell-surface. It was also found that both species were sympatric in Florida, Cuba, Puerto Rico and the Bahamas and both species were taken in the same batch at Cardenas Bay, Cuba, in 2-5.5 m (ex-Barrera Exped., USNM). Both forms have a similar habitat and depth range, a similar size-range, i.e. 3.0-7.0 mm for *exiguum* and 4.0-9.0 mm for *gemmatum*, and the same number of axial ribs occur in both forms. Several authors (Dall & Simpson 1901, Peile 1926, Abbott 1958, 1974, *etc.*) have suggested that one is only a form of the other, an opinion this writer endorses after having seen intergrading individuals. Further population and animal studies are needed particularly in areas where both forms are sympatric, before both can be accepted as valid biospecies.

Vexillum (Pusia) sykesi (Melvill, 1925) (Figs. 21, 22)

1925. *Mitra (Pusia) sykesi* Melvill, Proc., alac. Soc. Lond. 16 (5): 218, pl. 10, fig. 1.

1955. *Mitra moisei* McGinty, Proc. Acad. Nat. Sci. Philad. 107: 77, pl. 1, figs. 4, 4a; 1958 Abbott, Mon. Acad. Nat. Sci. Philad. No. 11: 83; 1959 Nowell-Usticke, Cheklist shells St. Croix, p. 75.

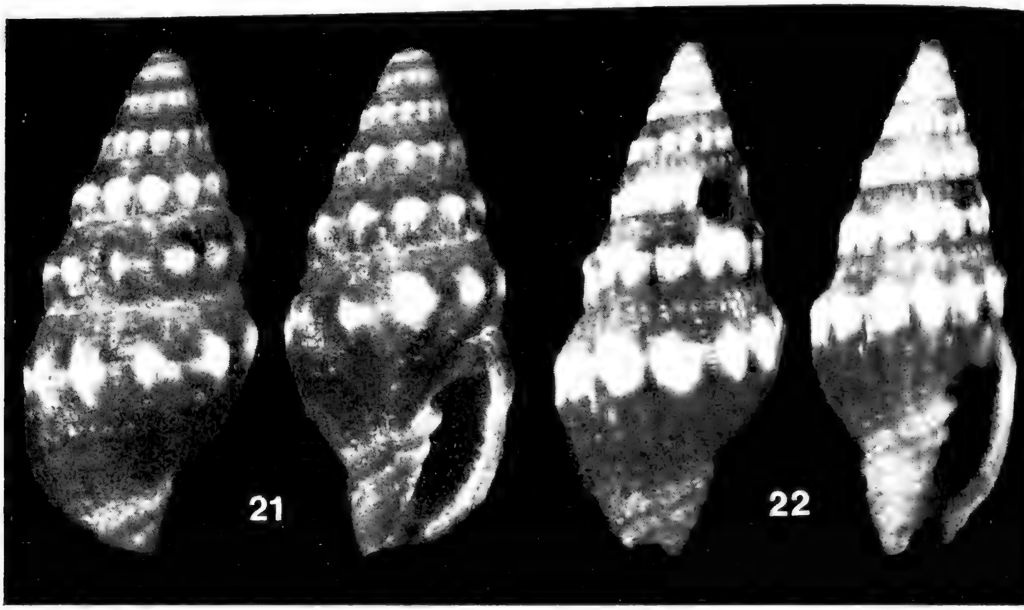
1974. *Vexillum (Pusia) moisei* McGinty, Abbott, Americ. Seashells ed. 2: 240, fig. 2630.

TYPE LOCALITY: West Indies (*sykesi*); off Palm Beach, Florida, 25 fathoms (46 m) (*moisei*).

DISTRIBUTION: From southern Florida to the Virgin Is and Curacao, Antilles, from 2.5-73 m.

Type specimens: Four syntypes of *M. sykesi* Melvill, are in the BMNH No. 196584, ranging from 11.1 mm to 13.2 mm in size. The syntype measuring 12.0 x 5.3 x 5.8 mm, is here designated as the lectotype of *M. sykesi* (Fig. 21). The lectotype has somewhat biangulate whorls on the presutural ramp, adpressed sutures, a concave and obsoletely granose subsutural area, 10 axial ribs on the penultimate and the same number on the body whorl, the lower half of the body whorl has 4 spiral rows of small granules followed by half a dozen strong, oblique cords, 4 columellar folds and a lirate aperture. The colour is faded orange-brown with a white band across the nodes.

The holotype and four paratypes of *Mitra moisei* McGinty, are in the Academy of Natural Sciences, Philidelphia, No. ANSP 194061. The holotype measures 10.0 x 4.1 x 4.6 mm, has 7 whorls plus part of a protoconch, 12 axial ribs on the penultimate and 11 on the body whorl, the lower half of the body whorl has 5 spiral rows of granules followed by 5 oblique cords, 4 columellar folds and a lirate aperture. The colour is reddish-brown with a white band across the nodules (Fig. 22). The remaining four paratypes range in size from 5.6 mm to 9.7 mm.



Figs. 21, 22. *Vexillum (Pusia) sykesi* (Melvill). 21. Lectotype BMNH No. 196584, 12.0 mm. 22. Holotype of *Mitra moisei* McGinty, ANSP No. 194061, 10.0 mm.

V. (P.) sykesi (Melvill) is very similar to *V. (P.) gemmatum* (Sowerby), and both have about the same number of axial ribs, i.e. 11-13 on the penultimate and 10-13 on the body whorl in specimens examined, but *V. (P.) sykesi* is coarser in sculpture particularly the granulose subsutural area and lower half of the body whorl. The very small paratypes of *moisei* are very close to *V. (P.) gemmatum*. Further study may show that *V. (P.) sykesi* is only a larger, more coarsely sculptured form of *V. (P.) gemmatum* as already suggested by Abbott (1974).

Vexillum (Pusia) zebrina (d'Orbigny in Webb & Berthelot, 1839) (Figs. 23-25)

1839. *Mitra zebrina* d'Orbigny in Webb & Berthelot, Hist. nat. iles Canaries, Moll. 2: 86, pl. 6, figs. 29-31; 1874 Sowerby, Thes. Conchyl. 4: 23, pl. 22, fig. 481; 1890 Dautzenberg, Mem. Soc. Zool. France 3: 151, pl. 2, figs. 6, 6a; 1897 Watson, J. Linn. Soc. Zool. Lond. 26: 293.

1845. *Mitra semen* Reeve, Conch. Icon. 2: pl. 32, fig. 256; 1874 Sowerby, Thes. Conchyl. 4: 22, pl. 28, fig. 659.

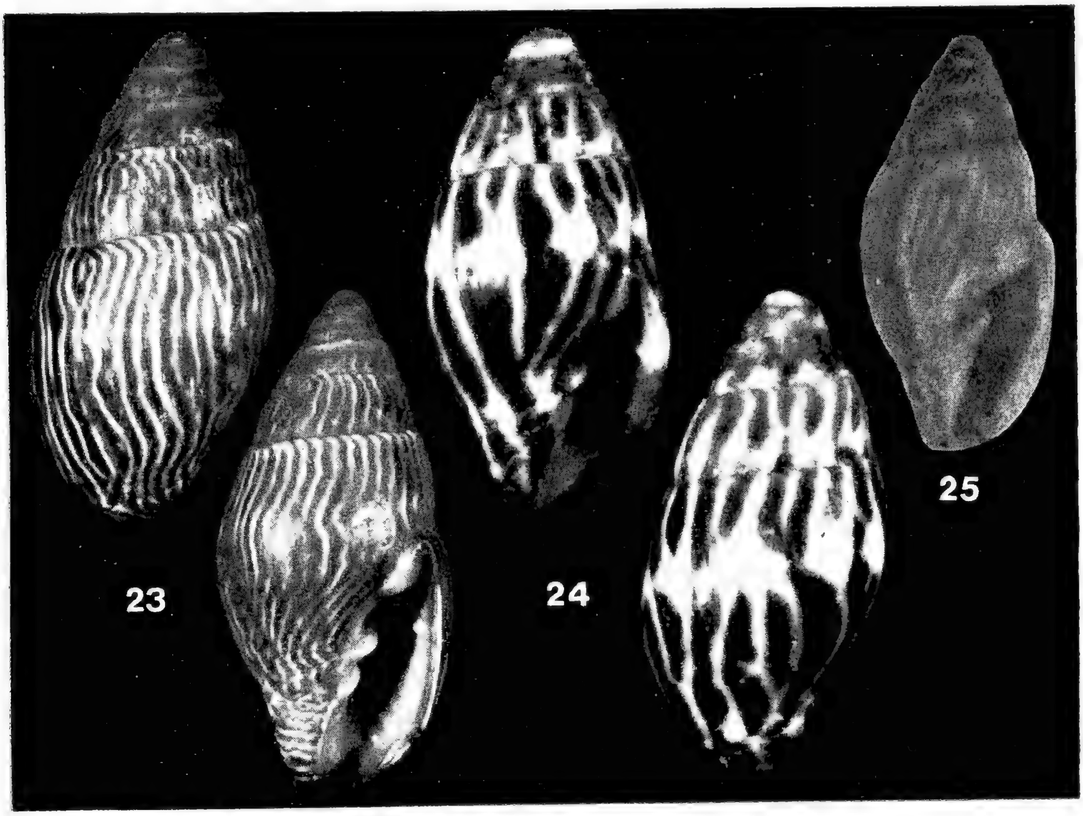
1850. *Mitra capillata* Gould, Proc. Boston Soc. Nat. Hist. 3: 171; 1852 Gould, U.S. Expl. Exped. 12: 273, pl. 20, figs. 351a, b.

TYPE LOCALITY: Canary Is (*zebrina*); Puerto Galera, Island of Mindoro, Philippines = error (*semen*); Madeira (*capillata*).

DISTRIBUTION: From Morocco to the Azores and the Canary Is. Intertidal.

Type specimens: The holotype of *M. zebrina* d'Orbigny, is in the BMNH No. 1845. 9.28.103., dimensions 12.1 x 5.9 x 6.7 mm. The holotype has 5 smooth whorls, *c.* 7 basal cords, 3 columellar folds, a parietal callus-pad and a lirate aperture. The colour is greenish-brown, ornamented with thin, wavy white axial lines (Fig. 23).

The specimen marked as a holotype of *M. semen* Reeve, in the BMNH No. 1967878, dimensions 7.8 x 3.8 x 4.5 mm (fig. 24) is certainly not the specimen which was illustrated by Reeve (1845). The specimen extant in the BMNH is a colour-form of *zebrina* with fewer, wider-spaced wavy axial lines and a few white spots superimposed over the axial lines at the sutures of the penultimate and periphery of the body whorl, and the outer lip has been partially broken off. Reeve's (op. cit.) original illustration of *semen* is close to the typical colour form of *zebrina* and the outer lip is complete.



Figs. 23-25. *Vexillum (Pusia) zebrina* (d'Orbigny). 23. Holotype BMNH No. 1854.9.28.103., 12.1 mm. 24. Questionable holotype of *Mitra semen* Reeve, BMNH No. 1967878, 7.8 mm. 25. Holotype of *M. capillata* Gould, USNM No. 5746, 11.0 mm.

The holotype of *M. capillata* Gould, is in the USNM No. 5746, dimensions 11.0 x 5.0 x 6.2 mm (Fig. 25). The holotype has 6 smooth whorls, 5 basal cords, 3 columellar folds, a lirate aperture and a parietal callus-pad, and is closely similar in colour and ornamentation to the type of *zebrina*.

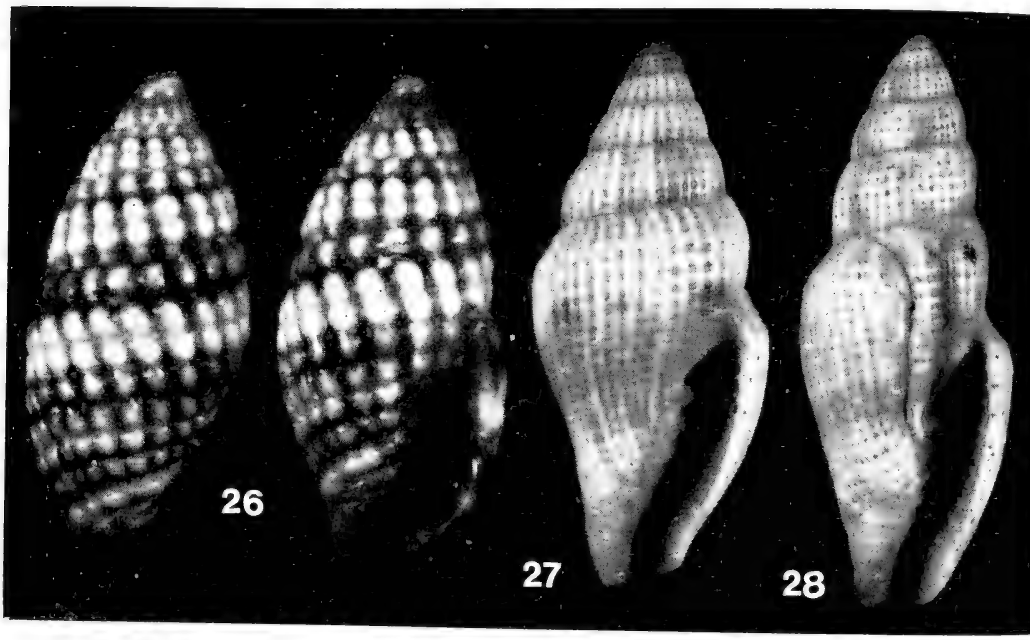
The species is very variable in colour, ranging from dark green to greenish or purplish-brown, and the ornamentation consists of either numerous close-set, wavy axial lines, sometimes occasional white spots upon the lines, or wide-spaced wavy axial lines with coalescing white blotches.

Vexillum (Pusia) sanctaehelenae (E. A. Smith, 1890) (Fig. 26)

1890. *Mitra (Pusia) sanctaehelenae* E. A. Smith, Proc. Zool. Soc. Lond. p. 265, pl. 22, fig. 2.

TYPE LOCALITY: St. Helena, Atlantic Ocean.

DISTRIBUTION: Apparently endemic to St. Helena and probably subtidal.
Type specimen: A series of 18 syntypes is in the BMNH No. 1189.10.1.2398-415., ranging in size from 4.5 mm to 5.0 mm. A specimen which agrees closely with the original description and dimensions has been selected as the lectotype of *V. (P.) sanctaehelenae*, dimensions 5.0 x 2.5 x 2.2 mm (Fig. 26). The lectotype has 16 axial ribs on the penultimate and 19 on the body whorl, ribs are studded with small, round nodules, 3 spiral rows of nodules on the penultimate and 8 rows on the body whorl, base of shell with 3-4 nodulose cords, 3 columellar folds, aperture lirate, sutural nodules separated from subsequent row by a slightly broader trough. The nodules are whitish in colour, sutures on spire whorls with a dark greenish-brown band, body whorl with 3 greenish-brown bands, aperture greenish-brown and banded with white.



Figs. 26-28. 26. *Vexillum (Pusia) sanctaehelenae* (E. A. Smith). Lectotype BMNH No. 1889.10.1.2398., 5.0 mm. 27, 28. *V. (Costellaria) laterculatum* (Sowerby). 27. Holotype BMNH No. 1875.4.19.5., 14.0 mm. 28. Holotype of *Mitra oriflavens* Melvill, BMNH No. 196582, 16.8 mm.

Subgenus **Costellaria** Swainson, 1840

Costellaria Swainson, 1840, Treat. Malac. pp. 130, 320. Type specimens by M *Mitra rigida* Swainson, 1821 = *Mitra semifasciata* Lamarck, 1811. Recent, Indo-Pacific.

Vexillum (Costellaria) laterculatum laterculatum (Sowerby, 1874) (Figs. 27, 28)

1874. *Mitra laterculata* Sowerby, Thes. Conchyl. 4: 28, pl. 28, fig. 651.
1925. *Mitra oriflavens* Melvill, Proc. Malac. Soc. Lond. 16 (5): 216, pl. 10, fig. 3.
1955. *Mitra olssoni* McGinty, Proc. Acad. Nat. Sci. Philad. 107: 78, pl. 1, fig. 3.
1974. *Vexillum (Costellaria) laterculatum* (Sowerby), Abbott, Americ. Seashells ed. 2: 239, fig. 2626 (fig. on left holotype of *Mitra olssoni* McGinty).

TYPE LOCALITY: None (*laterculatum*); West Indies (*oriflavens*); off Palm Beach, Florida, 30 fathoms (55 m) (*olssoni*).

DISTRIBUTION: Known records are from Southern Florida, Cuba, Jamaica, Puerto Rico and the Virgin Is. Subtidal, to 92 m.

Type specimens: The holotype of *M. laterculata* Sowerby, is in the BMNH No. 1875.4.19.5., dimensions 14.0 x 6.1 x 8.2 mm. The holotype has 7 whorls and a worn apex, 36 axial ribs and 5 spiral cords on the penultimte and 35 ribs and 22 spiral cords on the body whorl, whorls weakly subangulate on the presutural ramp, columella with 5 folds, aperture lirate. Creamy-white in colour, spire whorls with orange-brown streaks, body whorl with a peripheral row of quadrate orange-brown spots, aperture orange (Fig. 27).

The holotype of *M. oriflavens* Melvill, is in the BMNH No. 196582, dimensions 16.8 x 6.4 x 9.0 mm. The holotype has 7 whorls and a worn apex, 36 axial ribs and 6 spiral cords on the penultimate and 42 ribs and 20 cords on the body whorl, whorls weakly subangulate on presutural ramp, columella with 5 folds, aperture lirate. White in colour, ornamented with orange streaks, body whorl with an additional orange central band, aperture orange (Fig. 28).

The holotype of *M. olssoni* McGinty, is in McGinty's private collection, dimensions 12.8 x 4.6 mm. According to McGinty (1955), the type has 7 mature whorls and 3½ glassy, light brown embryonic whorls, numerous axial ribs, 5 cords on the penultimate whorl and 5 columellar folds. The holotype has been well illustrated by McGinty (op. cit.) and also Abbott (1974).

This rather rare species is characterized by the numerous, slender axial ribs which are overridden by equally as slender, flattish spiral cords which either produce low nodules at the point of intersection or minute pits in the interspaces; the colouring is generally orange or fawn. *V. (C.) laterculatum voraginosum* Woodring, 1928, from the Miocene of Bowden, Jamaica, is so similar to recent specimens of *laterculatum* that it remains debatable whether *voraginosum* should even be retained as a subspecies purely on the basis of separation in time.

Vexillum (Costellaria) hendersoni (Dall, 1927) (Figs. 29, 30)

1927. *Mitra hendersoni* Dall, Proc. U.S. Nat. Mus. 70 (18): 49.

1943. *Pusia hendersoni* Rehder, Proc. U.S. Nat. Mus. 93: 200, pl. 20, fig. 12 (described as a new species).

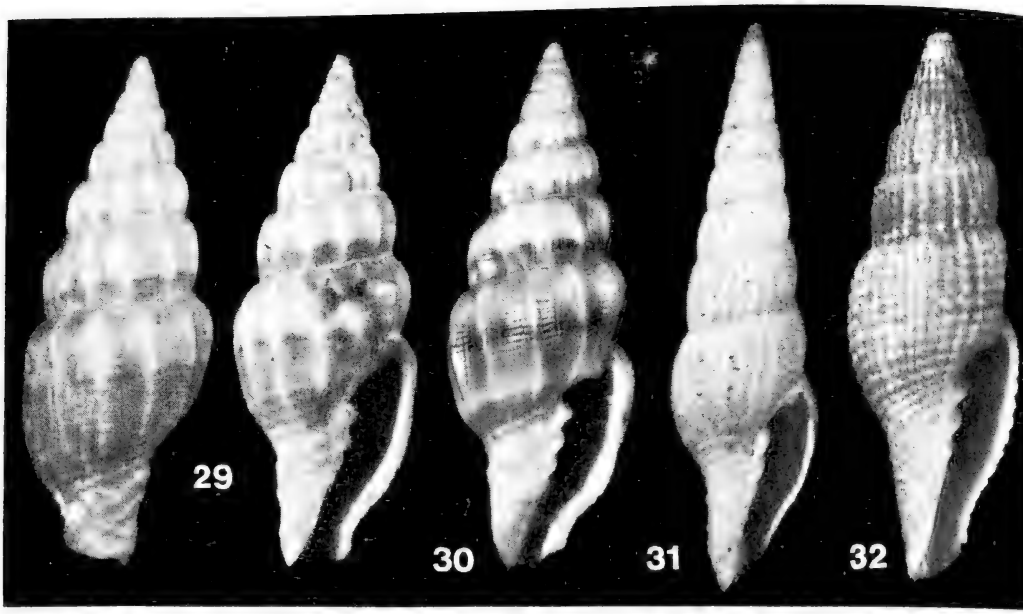
1970. *Vexillum (Costellaria) hendersoni* (Dall), Rios, Coast. Braz. Seashells, p. 107, pl. 33, figs. centre row on right; 1974 Abbott, Americ. Seashells ed. 2: 239, fig. 2618 (figd. type of *Pusia hendersoni* Rehder, 1943).

TYPE LOCALITY: Off Georgia, 440 fathoms (805 m) (*hendersoni* Dall); off Bear's Cut, Miami, Florida, 30 fathoms (55 m) (*hendersoni* Rehder).

DISTRIBUTION: From off Georgia to off southern Texas, through the Caribbean to East Brazil. From 11-805 mm, in sand and weed.

Type specimens: The holotype of *M. hendersoni* Dall, is in the USNM No. 333455, dimensions 17.0 x 6.2 x 8.0 mm (Fig. 29). The holotype has 9 whorls and a missing apex, 18 angulate axial ribs on the penultimate and 12 on the body whorl, overriding spiral cords and nodulose cords at the base, 4 columellar folds and a lirate aperture. Creamy-white in colour, spire whorls with a narrow brown sutural band, lower two-thirds of body whorl brown.

The holotype of *Pusia hendersoni* Rehder, is in the USNM No. 414359, dimensions 14.6 x 6.1 x 7.1 mm. The holotype is immature and therefore broader than adult *hendersoni*, has 7 whorls, 10 axial ribs and 6 spiral cords on the penultimate and 9 ribs and 15 cords on the body whorl and 4 columellar folds. The colour ornamentation is closely similar to the holotype of *hendersoni* Dall. The holotype of *hendersoni* Rehder, has been illustrated by Abbott (1974).



Figs 29-32. 29, 30. *Vexillum (Costellaria) hendersoni* (Dall). 29. Holotype USNM No. 333455, 17.0 mm. 30. Specimen from Venice, Gulf of Mexico, 19.8 mm. 31, 32. *V. (C.) styria* (Dall). 31. Holotype USNM No. 86948, 18.4 mm (adult). 32. Specimen from off Fowey light, Florida, 50 fathoms (92 m); 14.8 mm (immature).

Some individuals of *V. (C.) hendersoni* are closely spirally striate with up to 10 spiral threads on the penultimate and 25 threads on the body whorl having been counted on specimens from off Fowey light, Florida. The occurrence of*V. (P.) hendersoni* from the west side of the Gulf of Mexico has not been reported before, but a specimen from off Port Isabel, southern Texas, 50 fathoms (92 m), is in the Museum of Comparative Zoology, Harvard (ex-Weisenhaus coll.).

Vexillum (Costellaria) styria (Dall, 1889) (Figs. 31, 32)

1889. *Mitra (Costellaria?) styria* Dall, Bull. Mus. Comp. Zool. Harv. Coll. 18: 159, pl. 15, fig. 6 (June 1889); 1889 Dall, U.S. Nat. Mus. Bull. No. 37: 181, pl. 15, fig. 6 (December 1889).

1927. ? *Mitra styliola* Dall, Proc. U.S. Nat. Mus. 70 (18): 48.

1974. *Vexillum (Costellaria) styria* (Dall), Abbott, Americ. Seashells ed. 2: 239, fig. 2619 (copy of Dall's type-figure).

1974. *Costellaria styliola* (Dall), Kaicher, Card cat. world-wide shells, Pack No. 3/4: card 266, 3 figs. (figd. juvenile holotype).

TYPE LOCALITY: Blake station 185, off St. Domingo, Dominican Republic, 333 fathoms (609 m) (locality of the holotype of *styria*); off Georgia and Fernandina, Florida (*styliola*).

DISTRIBUTION: From Florida to the Mississippi River Delta and Yucatan, Mexico to Barbados. From 46-609 m.

Type specimens: The holotype and several paratypes of *M. styria* Dall (Dall 1889), are in the USNM No. 86948 dimensions of holotype 18.4 x 4.9 x 6.8 mm (Fig. 31). The holotype has 13 whorls inclusive of part of the protoconch 20 finely nodulose axial ribs and 8 overriding spiral cords on the penultimate and 24 ribs and 20 cords on the body whorl, 3 columellar folds and a lirate aperture. Faded white in colour with an indication of a yellow peripheral band on the body whorl.

The holotype of *M. styliola* Dall (Dall 1927) is in the USNM No. 108440 dimensions 11.0 x 5.5 x 6.0 mm. The type is a very juvenile specimen with an immature convex outer lip and a prominent constriction towards the base of the body whorl. The number of axial ribs and spiral threads is very similar to the holotype of *styria*. The holotype has been illustrated by Kaicher (1974).

Fresh specimens are usually light straw-yellow in colour under a thin, pale grey periostracum. The species varies in shape according to the stage of development. Larger adults are fusiform in shape and have short aperture in relation to the spire, whereas smaller, immature specimens are broader and the aperture is longer (Fig. 32).

V. (C.) callipictum Woodring, 1928, and *V. (C.) uncidum* Woodring, 1928, from the Bowden Miocene, Jamaica, and *V. (C.) mauryae* (Anderson, 1929) from Miocene deposits of North Colombia, are very similar to the Recent *V. (C.) styria*.

Vexillum (Costellaria) wandoense (Holmes, 1860) (Figs. 33, 34)

1858. *Pyramidella reticulta* (*sic*) Emmons, Rept. Nth. Carolina Geol. Surv. p. 268, textfig. 155 (corrected to *reticulata* in Index) [rejected homonym *fide* emended art. 59 (b) (i) of ICZN].

1860. *Volutomitra wandoensis* Holmes, Post-Plioc. Foss. Sth. Carolina p. 77, pl. 10, figs. 10, 10a.

1887. *Mitra rushii* Dall, Conch. Exchange 2 (1): 9.

1889. *Mitra (Costellaria) rushii* Dall, Bull. Mus. Comp. Zool. Harv. Coll. 18: 160.

1890. *Mitra wandoensis* Holmes, Dall, Wagner Free Inst. Sci. Philad. 3 (1): 92 (*Pyramidella reticulata* Emmons and *Mitra rushii* Dall, tentatively placed in synonymy); 1927 Dall, Proc. U.S. Nat. Mus. 70: 50; 1930 Mansfield, Florida Geol. Surv. Bull. No. 3: 60, pl. 5, fig. 7.

1937. *Vexillum (Uromitra) wandoense* (Holmes), Gardner, U.S. Geol. Surv. Prof. Pap. No. 142F: 412, pl. 48, fig. 26.

1974. *Vexillum (Costellaria) wandoense* (Holmes), Abbott, Americ. Seashells, ed. 2: 40, fig. 2627.

TYPE LOCALITY: Wando River, Post-Pliocene of Sth. Carolina (*wandoensis*); St. 2372, between Mississippi Delta and Cedar Keys, Gulf of Mexico, 27 fathoms (49 m) (*rushii*).

DISTRIBUTION: Upper Miocene to Recent. From Nth. Carolina to Cuba and the Gulf of Mexico. From 22-805 m.

Type specimens: The holotype of *Volutomitra wandoensis* Holmes, is in the American Museum of Natural History, New York.

The holotype of *Mitra rushii* Dall is in the USNM No. 86957 dimensions 5.2 x 2.0 x 2.4 mm (Fig. 33). The holotype has 5 mature whorls and 1½ mamillate embryonic whorls, 24 very slender axial ribs on the penultimate and 26 on the body whorl, fine spiral striae in interspaces, 3 columellar folds and a lirate aperture. Uniformly brown in colour. The type is holed above the outer lip at the suture of the last two whorls.

The species is moderately frequent in Upper Miocene deposits of Carolina and Florida, and several closely similar Miocene species may upon closer examination prove to be conspecific with the recent *V. (C.) wandoense*.

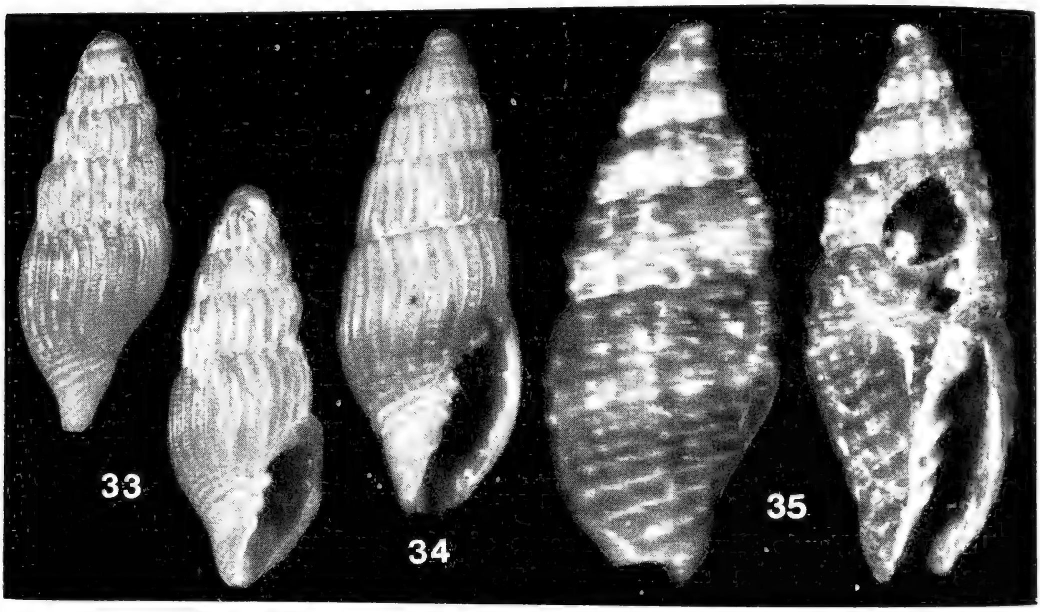
Vexillum (Costellaria) innotabilis (E. A. Smith, 1890) (Fig. 35)

1890. *Mitra (Turricula) innotabilis* E. A. Smith, Proc. Zool. Soc. Lond. p. 265, pl. 23, fig. 9.

TYPE LOCALITY: St. Helena, Atlantic Ocean.

Type specimen: The holotype is in the BMNH No. 1889.10.1.371., dimensions 7.0 x 2.8 x 3.4 mm (Fig. 35). The holotype is worn and the dorsal side has a large hole extending over the penultimate and a small part of the body whorl. Teleconch of 4½ whorls, protoconch of 1½ smooth embryonic whorls, penultimate whorl with 13 coarse axial ribs, body whorl with *c.* 12, penultimate whorl with 3 spiral cords which produce laterally elongated nodules upon the ribs, aperture lirate, columellar with 3 folds. Brown in colour, anterior part of spire whorls cream, third anterior row of nodules white.

This is a very rare species which is absent in Museum collections and apart from the holotype I have not seen any other specimens.



Figs. 33-35. 33, 34. *Vexillum (Costellaria) wandoense* (Holmes). 33. Holotype of *Mitra rushii* Dall, USNM No. 86957, 5.2 mm. 34. Specimen from off Fowey light, Florida, 55 fathoms (101 m); 6.4 mm. 35. *V. (C.) innotabilis* (E. A. Smith). Holotype BMNH No. 1889.10.1.371., 7.0 mm.

DUBIOUS AND EXCLUDED SPECIES OF COSTELLARIIDAE

Vexillum (? Pusia) brandii Verrill, 1950

1950. *Mitra brandii* Verrill, Min. Conch. Club Sth. Calif. No. 104: 3, right figure.

TYPE LOCALITY: off Dominica, British West Indies, 75-100 fathoms (137-183 m).

Type specimen: Lost. Formerly in coll. A. H. Verrill. Original dimensions 24.0 x 12.0 mm (width-index 50%). Described as having 5 whorls, 8-10 low, rounded axial ribs which end in low nodules at shoulder, columella with 4 folds. Dull brownish or greenish-orange in colour with a pale yellow columella.

The textfigure supplied by Verrill (1950) is a stylized drawing consisting only of a few strokes and lacking details of sculpture. The relative dimensions of the text-figure do not agree with the measurements given in the text and the shell is shown to be considerably narrower (width-index 43%) and the siphonal canal also appears truncated due to excessive wear. The taxon remains a *nomen dubium*.

Vexillum (Costellaria) rawsoni (Moerch, 1876)

1876. *Turricula (Costellaria) rawsoni* Moerch, J. Conchyl. 24: 373.

TYPE LOCALITY: Antilles, probably Barbados.

Type specimen: Lost. Formerly in coll. Sir R. W. Rawson. Original dimensions given as 16.0 x 5.5 mm. Described as having 18 reddish axial ribs and 13 spiral threads on the body whorl and 4 subnodulose threads on the penultimate whorl with a white, subcentral band, triplicate brown columella and 9 lirae within the aperture.

Moerch (1876) remarked that his new species is very similar to *Vexillum (Costellaria) virgo* Linnaeus, 1767 (formerly *cruentatum* Gmelin, 1791) and the description certainly confirms this. The taxon remains a *nomen dubium*.

Mitromorpha torticula (Dall, 1889)

1889. *Mitra (Thala ?) torticula* Dall, Bull. Mus. Comp. Zool. Harv. Coll. 18: 162, pl. 15, fig. 8; 1972 Cernohorsky, Rec. Auckl. Inst. Mus. 9: 227 (placed in *Mitromorpha* Carpenter, 1865).

TYPE LOCALITY: Off Morro, Havana, Cuba, 400 fathoms (732 m).

Type specimen: The holotype of *M. torticula* Dall, is in the USNM No. 508727, dimensions 12.2 x 4.0 x 5.5 m. The holotype has 12 axial ribs and 6 spiral cords on the penultimate and 11 ribs and 20 cords on the body whorl and only 2 typical mitromorphine folds on the columella.

This species, together with all other biplicate species like *Mitra haycocki* Dall & Bartsch, 1911, from Bermuda (= *Mitrolumna biplicata* Dall, 1889), *Mitra grammatula* Dall, 1927, from off Georgia, *M. zilpha* Dall 1927, from off Georgia and Florida, and *M. pleurotomoides* E. A. Smith, 1890, from St. Helena, belong to the mitromorphine group of the family Turridae.

Acknowledgements. I would like to thank Drs J. Rosewater and H. A. Rehder, National Museum of Natural History, Smithsonian Institution, Washington; Dr J. Taylor, Ms K. Way and Ms A. B. Blake, British Museum (Natural History), London; Dr W. Emerson, American Museum of Natural History, New York; Dr K. Boss, Museum of Comparative Zoology, Harvard, and Dr R. Robertson and Mrs V. Maes, Aacademy of Natural Sciences, Philadelphia, for access to their respective Mitracean type collection, assistance during research and the loan of type material. I am grateful to Ms H. Eker, Phoenix, Arizona, U.S.A., and Dr E. C. Rios, Museu Oceanografico de Rio Grande, Brazil, for the loan of West Atlantic and Brazilian Costellariidae.

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FURTHER RECORDS OF SUBANTARCTIC TRICHOPTERA

K. A. J. WISE

AUCKLAND INSTITUTE AND MUSEUM

Abstract. The larva of the Auckland I species *Tiphobiosis kuscheli* Wise, 1972 is described and further locality records given for this and other species. *Oxyethira albiceps* (McLachlan, 1862) is recorded from Snares Is and Antipodes Is for the first time.

Since previous records of subantarctic islands Trichoptera were published (Wise 1964, 1972) more specimens have been examined and further information gained. The larva of *Tiphobiosis kuscheli* is described and the distribution of *Oxyethira albiceps* is extended. Specimens are all in the collections of Entomology Division, Auckland, except for some duplicates retained in Auckland Museum.

Family RHYACOPHILIDAE

Costachorema notoptera Wise, 1972

Costachorema notoptera Wise, 1972, Rec. Auckland Inst. Mus. 9: 253.

Specimens examined. Immatures. AUCKLAND IS. Enderby I: stream from lake, with pupal cases, 2.I.1963, (1 larva), L. J. Dumbleton. Auckland I: Deas Head, stream, 19.I.1963, (1 larva), L. J. Dumbleton.

DISTRIBUTION. Auckland Is. A common species in the northern area around Port Ross, it is also present in the extreme south on Adams I and probably occurs in all suitable streams throughout the group.

Tiphobiosis kuscheli Wise, 1972 (Figs. 1-6)

Tiphobiosis kuscheli Wise, 1972, Rec. Auckland Inst. Mus. 9: 258.

LARVA (in alcohol)

Pale, almost colourless and transparent.

Head (Fig. 1) little longer than wide, pale without markings, margins of clypeus indistinct as indicated in figure.

Prothorax (Figs. 2, 3). Pronotum broader than long, pale with black on posterior flange. Prosternum consisting of a transverse band with a median rounded spot posteriorly.

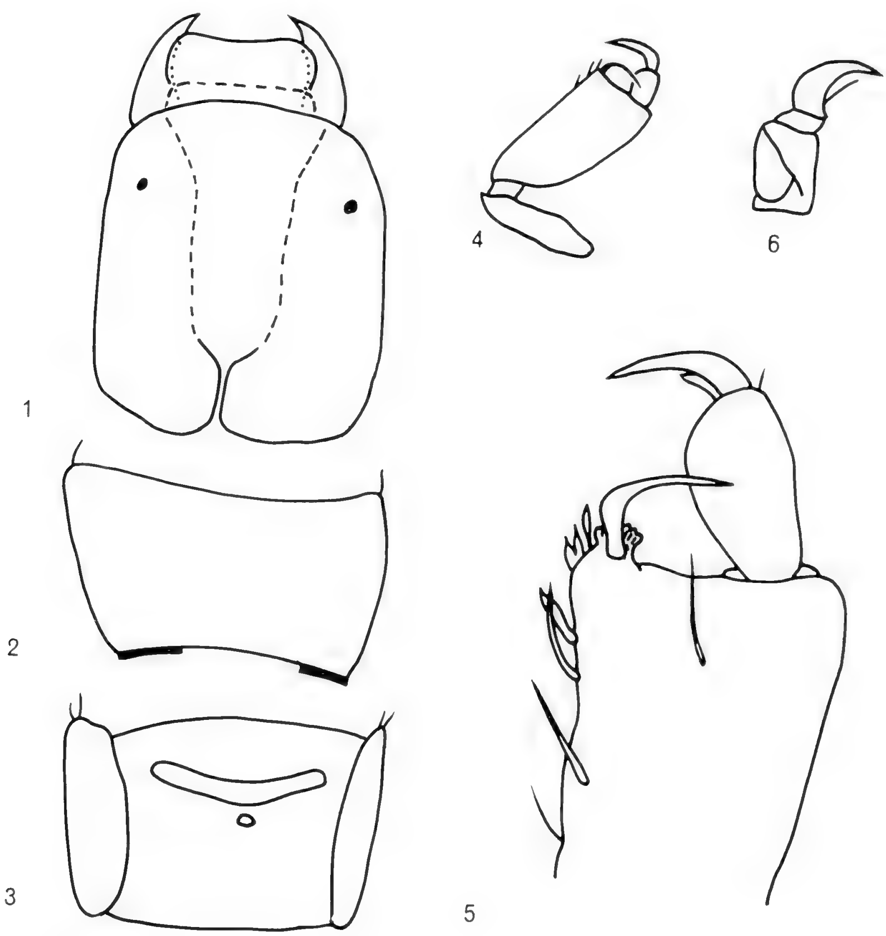
Prothoracic legs (Figs. 4, 5). Massive, distally with setae and spines as in Fig. 5.

Pygopods (Fig. 6). Slender.

Measurements. Length, 7 mm; head, length 0.550 mm, width 0.500 mm; pronotum, length 0.375 mm, width 0.625 mm.

Specimen examined. Immature. AUCKLAND IS. Auckland I: Port Ross, Laurie Harbour, at foot of Hooker Hills, in small creek under a stone, near high water mark, 12.XI.1954, (1 larva), E. S. Gourlay.

When the two rhyacophilid species *Costachorema notoptera* and *Tiphobiosis kuscheli* were recorded from the Auckland Is only the larva of the former was known and it was described at the same time (Wise 1972). The present larva is quite distinct from that of *C. notoptera* and those of New Zealand species of Rhyacophilidae described by McFarlane (1951) except that it is obviously close to the larva of *Tiphobiosis montana* Tillyard, 1924 (McFarlane 1951: 279, and figs.). There are definite similarities with *T. montana* in the head shape, the prothoracic legs and the pygopods. In view of this similarity with the larva of a *Tiphobiosis* species and the present knowledge of only two rhyacophilid species in the subantarctic Auckland Is it seems a reasonable assumption that this larva is an immature of *Tiphobiosis kuscheli*.



Figs. 1-6. *Tiphobiosis kuscheli* Wise, 1972. Larva. 1. Head, dorsal. 2. Pronotum. 3. Prothorax, ventral. 4, 5. Prothoracic leg. 4. Leg. 5. Distal portion. 6. Pygopod. (Specimen slightly distorted as seen in dorsal and ventral views, Figs. 1-3).

DISTRIBUTION. Auckland Is. The presence of the winged adult (Wise 1972) on Adams I, south of the main Auckland I, and of the larva on the northern end of Auckland I indicates that the species occurs throughout the group although lack of specimens after extensive collecting during at least three scientific expeditions in the 1960s and 1970s suggests this species may be more restricted in occurrence than *Costachorema notoptera*.

Family HYDROPTILIDAE

Oxyethira albiceps (McLachlan, 1862)

Hydroptila albiceps McLachlan, 1862, Trans. Ent. Soc. London 3 (1): 304.

Specimens examined. SNARES IS. Snares Is: Colony 3 area, Fernbird nest 2, 15. XII.1970, (3); Station Cove, Fernbird nest 14, 19.I.1971, (4), Fernbird nest 18, 17.II.1971, (2); Station Point, Fernbird nest 21B, 26.II.1971, (2); H. A. Best: Muttonbird Ck., Litter 71/37, 11.III.1971, (1), D. S. Horning. ANTIPODES IS. Antipodes I: Reef Point, sweeping pool behind hut, 31.I.1969, (3); Ringdove Stm., ferns alongside stm., 19.II.1969, (4); P. M. Johns: Reef Point, 6.II.1969, (1), G. Kuschel. AUCKLAND IS. Auckland I: Ranui Cove, light trap, 14.I.1963, (3), J. L. Gressitt: Carnley Harbour, Fleming Plateau, 563 m, swards 73/43, 7.II.1973, (2), swards 73/63, 20.II.1973, (1), swards 73/54, 20.II.1973, (1); Fleming Plateau, 487 m, swards 73/56, 16.II.1973, (1); Breaksea Pt., swards 73/66, 2.II.1973, (2), swards 73/68, 2.II.1973, (1), litter 73/65, 2.II.1973, (1); Camp Cove, litter 73/44, 22.II.1973, (1); Ranui Cove, to light, 1.III.1973, (1); J. S. Dugdale. Disappointment I: Plant 73/51, 15.II.1973, (2), plant 73/49, 15.II.1973, (1), mats 73/46, 15.II.1973, (12), plant 73/52, 15.II.1973, (2), plants 73/48, 15.II.1973, (1), plant 73/53, 15.II.1973, (1); D. S. Horning. CAMPBELL I. Campbell I: Signal Hill, sweeping veg. by stream, 15.I.1969, (3), P. M. Johns; Tucker Track, 9 m, turf 71/64, 23.II.1971, (1), P. Wilson.

Immatures. ANTIPODES IS. Antipodes I: Attached to Dicot root in water hole, —.I.1969, (2 larval-pupal cases); Reef Point, 6.II.1969, (8 larval-pupal cases); G. Kuschel.

DISTRIBUTION. This species is now known from New Zealand, Chatham Is, Snares Is (new record), Antipodes Is (new record), Campbell I and Auckland Is. In the Aucklands it is recorded from northern and southern areas of the group and even from the inhospitable Disappointment I west of the main island.

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CONTENTS

"MAORI PLACE NAMES"

BY GEORGE GRAHAM

D. R. SIMMONS (Editor)

AUCKLAND INSTITUTE AND MUSEUM

Abstract. George Graham's writings on Maori Place Names are presented.

This paper is derived from a manuscript written by George Graham for presentation at a meeting of the Anthropology and Maori Studies Section (Auckland Institute and Museum) in 1926. A different version was published in "The Eden Gazette" newspaper (Auckland) later the same year. These have been edited into a single version which is presented here.

George Graham collected traditional information relating to Auckland and the other areas with which he was connected. His other manuscript material is being prepared for publication.

The Museum is indebted to Mrs F. C. Scales, daughter of George Graham, and the Mika family for adding greatly to the Graham collection of manuscripts.

MAORI PLACE NAMES
by George Graham

The student of the history of any country from time to time in his researches, comes across the fact that its nomenclature often requires to be studied in order to correctly understand the circumstances surrounding any particular historical event.

So far, very little has been done in a systematic manner to put Maori nomenclature on record. Several valuable essays on the subject have been given before the N.Z. Institute, and throughout the mass of New Zealand Literature there is much that can be gleaned by the student. However, it would be a long and laborious process to effect anything approaching completeness.

I propose to deal only with some outstanding features of Maori nomenclature, giving examples of place names under the several classifications which they may be arranged. Such a classification of place names I would suggest for the purpose should be as follows:-

Rec. Auckland Inst. Mus. 16: 1-10 — 25 January 1980

First — Names descriptive of the locality.

Secondly — Names commemorative of some event which happened in the place so named.

Thirdly — Names commemorative of places in the Maori home-land or of important personages.

In giving some examples of each of these various classes of place names I propose to confine the selection particularly to those in local use.

Taking the first class of names, those descriptive of localities; we find such are always remarkably appropriate; and this fact added to the natural beauty of the Maori language makes such names very commendable to European use. Of such names in common use I will select a few examples:

PUKEKOHE The hill of the Kohe tree.
MANGAWHAU The Whau Mountain. The whau is a shrub or small tree still found in the neighbourhood.
WAIWERA Hot water, where is the famous hot mineral spring.
WAIKOWHAI The name of the now favourite Park area on the shores of the Manukau, it means the ''waters of the Kowhai tree''.
WAIKATO is so called because of its well-known characteristic of having, no doubt within the Maori period, several times altered its course: hence its name — ''the nibbling water'' — they cut and nibble away the banks so as to change ultimately the river's course.

At one time the Waikato is said to have run out across the Piako Plains to the Hauraki Gulf: later, to have run via Waiuku into the Manukau, and after that again to have its present course to the sea. I leave it to the geologist to decide as to the correctness of this.

KAIPARA is the food of the para, a kind of fern with a tuberous root, formerly a favourite food of the Maori, and for which the district was famous.
HAURAKI is really the name of the site of the present Thames township and means the North West wind.
RANGITOTO means ''sky-blood''. This certainly does not imply that the Maori witnessed the volcanic energies of this mountain . Though recent *geologically,* its activities probably took place at a time long prior to Maori occupation of N.Z. This name in fact is that given to the particular kind of black lava rock, which is the feature of the Island. There is an interesting tradition, however, in respect of Rangitoto. It is to the effect that a volcanic mountain stood at the site of Lake Takapuna. this mountain gradually subsided and Rangitoto simultaneously rose from the sea. This is quite feasible; such convulsions have occurred in other places within historic times. I am sure, however, that this is only a tradition to be attributed to the fact that the Maori is a keen and intelligent observer of Nature in her many moods.
PUPUKE-MOANA is the actual name of Lake Takapuna.
Pupuke — 'to ooze' or be pushed out —
'to leak' or flow over,
Moana — a sea or large lake.

This name was given because it was observed by the Maori that along the outer sea-shore, as well as at several places on the Waitemata side, there are a series of fresh-water springs which are undoubtedly the underground outflow from the lake. This Lake got its present name of Lake Takapuna in European times. Takapuna itself was a certain spring of water on the Western slope of the North Head, it probably means "spring water falling" (as in a cascade). When the Tainui canoe visited the Waitemata after her long voyage from Hawaiki her crew landed on the beach thereabouts, and ascended the North Head hill. They then named the Spring; (still, I understand, flowing there) after one of that name in their homeland.

HAUKAPUA was the name given to Torpedo Bay. It means the "Wind-scoop" that is it caught the boisterous Easterly sea winds, and gave shelter to the inner Harbour waters.

WAIPARUROA (long muddy creek) and 'Wai Paru-iti' (Short muddy creek are respectively the appropriate names of "Big" and "Little" Muddy Creek on the Manukau.

TE KAPUA (The Basin, or trough) is the fit name of "the Basin" at Onehunga. It is an old crater rim, of which there are several other examples about Auckland, of which I will mention two.

NGAKAPUARUA "the two basins" are similar formations at the head of Shoal Bay. Each has its own particular name and tradition. Here, traditions says an unfortunate giant (tipua) and his wife quarreled in former times, because they felt cold. Mr Tipua blamed Mrs Tipua, because she had not woven his garments properly. Mrs Tipua blamed her husband because of the quality of the flax he had gathered. Between the two they cursed Mahuika; she was the goddess of subterranean fires. This lady divinity stopped the unseemly affair by drawing them both down into her fiery regions, where no doubt since those far off days they have had ample time to reflect on the consequences of cursing holy people. These crater basins represent the site of the disappearance of that unfortunate couple.

This is, of course, a localised story of very ancient origin, and is similar to many name places names and myths the wide-world over. Like all mankind, Polynesian man thereby desired to account for topographical features of a remarkable character.

TE TOKAROA is another such example. This is the name of the long reef off Point Chevalier.

Like many of these formations of Nature it is an old lava flow. The Maori, however, invested its origin with an appropriate tradition as follows:

A fairy people of ancient times were at inter-tribal war with one another. The weaker party, desiring to get away from strife, and impending defeat, decided to cross the Harbour. Therefore they started to build this rocky causeway. The sun arose on their unfinished labours. Like all true fairies they could no longer work. Worse than that, instead of at once seeking the gloomy seclusion of their native forests at Waitakerei, they were by the incantations of their enemies not able to see the coming dawn, until it suddenly broke and dried them all up. Their bones are said to be still found there; being in fact certain remains of treelimbs etc., covered by this old time convulsion of nature. Thus again the producing of a class of myth found all over the world.

ONEHUNGA means the "friable" or "pulverous soil" — a very correct name.

There are several names as we might imagine in N.Z. as well as in the Islands. However, this name is correctly One*u*nga — meaning the landing or going ashore (Unga) beach or sand (One) — There the canoes were drawn up — where even into the 40's, there existed a large settlement — a kind of port for the large fleet of canoes that once plied the Manukau Harbour.

WAI-TE-MATA means the "Flint stone waters".

Te Mata is "The flint stone" — is a pinnacle rock mid stream up harbour. It was formerly a tribal fishing boundary; as also a place whereon offerings were made by the fishers of their first catches, so as to propitiate the local deities, hence the name of the Harbour: "Wai-te-mata". It does *not* mean as is usually stated the "sparkling" or "flashing waters".

There are some names called after ancient chieftains which might be referred to: The Bay at Orakei where the Native Villages is located is "OKAHU" i.e. of Kahu or Kahu's place. This Kahu was Kahu-mata-mamoe, an Arawa chieftain, who for a time lived here and later went to Kaipara with his clan. Hence it is the Kaipara people remember their Arawa lineage.

OTAHUHU Likewise was called after Tahuhu, a chief who arrived in N.Z. in early times.

Leaving his first settlement at Te Arai (South of Whangarei), he came hither and lived. His descendants were the Ngai-Tahuhu, who ultimately intermarried and were absorbed by the local people. This name also is usually given another meaning i.e. "the Ridge-pole", because like the ridge of a house the Otahuhu Isthmus divides the watersheds — on the one side is the Manukau and on the other is the Otaiki or Tamaki River.

I will now pass on to the second class of Place Names i.e. those given in commemoration of some event which there took place. These names in all countries are the most numerous — and the circumstances of the event having been often forgotten as time goes on this leads in many cases to the origin of the name being also forgotten.

So it is with very many Maori names: they are quite intelligible as to their meaning, but *how* or *why* they are so called is often not now known. If the name becomes mutilated in spelling, the difficulty is also increased of ascertaining the origin of the name.

For example — "*Te Muka*" in the South Island seems a correct place name, it means "Flax Fibre"; but, as a matter of fact it should be "Te Uma-Ka", i.e. "The burning oven", a tribal conflict had taken place there and the ovens were already merrily burning — in preparation to receive the unfortunate victims of the consequential cannibal feast. The victors were however surprised and attacked at this stage by an enemy reinforcement; and being defeated were many of them consigned without further ceremony to their own "burning ovens". Hence the name of that place Te Umu-ka.

REMUERA is a name which will interest us all, as being one in everyday use, and no doubt it has survived because of its euphony. Now its meaning and history is more tragic than poetic. In olden days a party of Hauraki chiefs were visiting the Tamaki Isthmus people. On their way back to rejoin their canoes on the Tamaki River, they were waylaid by some of the local people. Among the slain was a young chieftainess of high rank Hinerau whose body was consigned to the cannibal oven.

Her Remu (or skirt) was scorched in the process, and the incident gave its name to this affair and the place where it happened, which was somewhere near the Dilworth Institute. This name became the name of the locality and was mis-spelled at an early era by our pioneers. It should be Remu (skirt), wera (burnt). Now many of the lady's companions escaped death then, only to be eventually captured and killed with the exception of a few survivors at St. John's College. Hence the name of that now holy and peaceful spot, "Patu-tahi" together, or at one time.

TAMAKI is a name now confined as a named place to the districts on either bank of the Wai-o-Taiki tidal river also called the Tamaki. It is however correctly the name of the Isthmus as a whole. Te Tamaki-makau-rau to give it its full name, and means *Tamaki* — (a thing which is the object of interminable contest or strife,) *makau* is a young person sought after as a spouse, *rau* a hundred or numerous. Hence the name of this appropriately named and much contested tribal area, the scene of centuries of tribal conflict for its possession:- Hence "The land contested for by hundreds".

MAUINAINA means "caught basking in the sun". It is the name of a ridge pa at Panmure, on the Tamaki shores. Here in olden times the people were surprised by an invading enemy under the chief Kapetawa, under the circumstances mentioned.

MAUNGAREI was the "watchful, alert mountain", the people in that pa were not on that same occasion "caught napping". They were much awake and alert, (rei) to the position, and the attack on them was repulsed. This is the name of Mt. Wellington.

There are again some place names which preserve the memory of certain customs now passed away with the times wherein they were observed. I will give a few examples of such.

When a chief wished to take possession of a place for the benefit of his people, he would go there and comb his hair. Hence we have on the Tamaki River a place called "Te Pupu-a-Kawau"; here a Ngati-Whatua chieftain of old named Kawau combed his hair, and left the combings in a small bundle on a pole. He thereby made the locality quite tapu to himself.

TE IHUAMATAAHO near Mangere is a type of name given probably to secure possession of that locality by the ancient immigrants. It means "The Nose of Mata". It has however, had myth cast over its meaning. Mataaho was a giant, (the god of earth quakes). In search of warmth, he invoked his gods to send subterranean fires for his comfort. The consequent convulsions of nature resulted in many of the topographical features of the country side, and this hill is said to be Mataaho's nose. Hence all earth seismic phenomena are called "Nga huringa o Mataaho". The turnings of Mataaho.

Another such name is Te Pane-o-Horoiwi "The Head of Horoiwi"; which is the headland east of St. Heliers Bay. Horoiwi was one of the immigrants by the Tainui canoe (1250 a.d.), he went South with his people in the canoe and afterwards returned here with his immediate family. He settled down thereabouts without any opposition or trouble, for no one dare to live on his head, (pane).

Names of this kind were good and sufficient title to occupation of lands — The calling of a place after an ancestral nose or head in fact constituted to the Maori the equivalent of our Land Transfer Act — It was his tribal Certificate of Title — without any encumbrance noted against the same. A good holding title — until a stronger arm might dispossess the ownership.

For who would dare to trespass on the nose or head of ancestors of another tribe — for again apart from the necessity of resisting the attacks of all that ancestors tribal descendants — there was still another fearsome danger — the grave effects of the pervading influence of the law of tapu.

PANE-PANE is a place on the Manukau shores. It means "The heads"; so called from a war ceremonial performed there, when a victorious war party was returning and about to leave the confines of the enemies territory, it there performed a war dance, each warrior holding a head of the slain enemy in his hand. The idea was that the slain foes might there for the last time behold their former homes. Hence that name "Pane-pane", its full form being "Whaka-tahurihuri panepane".

Connected with peace making we have various names locally:-

TE TAUPAKI, a place on the Kaipara Railway line, is near where a neutral chief called the contesants of an inter-tribal war to a halt; and he marked near by there a ditch or trench to define the limits of the conquest affected by the victors, and beyond which the vanquished must not be followed. This in later years was recognised as a tribal boundary, and still appears as such on our County maps. It means — "The Binding (Tau) or firmly held peace" (Paki).

Another such name connected with peace-making is KOHIMARAMA which should be Kohi-maramara the final syllable 'ma' giving the name quite a different meaning i.e. Kohi — to gather or collect together "maramara" the fragments.

Here in olden times was a tribal peace making was effected, after a devastating war by Ngati-Paoa of Waiheke against these parts by Kapetawa already mentioned. Many local clans had been decimated, and the occasion of their being assembled to formally make peace gave that place its name. In 1860 the Ngati Whatua and Waikato chiefs, being desirous of bringing about a political re-union of the New Zealand tribes summoned a conference of chiefs at Kohimaramara from all parts of New Zealand. The memory of the more ancient event actuated them in selecting Kohimaramara as appropriate for their purpose. Officially this place name like that of Remuera has never been spelt correctly. As now spelt it might mean "The waning moon".

In dealing with Maori names one needs to know something of the history of the tribal area in which it is found. Unless one possesses that knowledge, it is not always safe to be certain, even if the meaning might appear to be so. For place names, even appearing to be correctly spelt, are often not so: being a mutilated form of the original.

A local name which has caused from time to time much controversy is *Otahuhu* — often stated as *Ota* (Now) *huhu* (grub) of former times a much sought after delicacy by the epecures of ancient Maori times. But its second significance is O (The local home) of Tahuhu (Mt Richmond). He was the ancestor of the tribe Ngai Tahuhu of the neighbourhood.

An example of this is the Southern name place *Oamaru* which "W.B." an authority of Maori matters, says means the O (an expressed wish embodied in an incantation) a — of — Maru a chief of that name. Now I have always understood it means the "place of Amaru", — he was a Southern Island ancestor of a tribe called Ngati-Amaru.

Again in the South Island we have *Kekerengu* (Marlborough) this is called after an unfortunate exile chief, who, to escape the fury of Rauparaha's people fled to that district — only to fall there a victim to the local tribes at the place now so called after him. "Te Kotinga-o-Kekerengu". The dismemberment of "K".

Not being aware of this incident the name place is said by some to mean "black-bags".

Now "Keke-rangu" or Kekerengu was so called to commemorate the similar dismemberment of a grand-uncle killed, also thereabouts — He was suspended on stakes drawn onto his arm-pits. Rangu — suspended (aloft) Keke — arm pits. This tragedy took place at *Tapu-te-rango.* The sacred (tapu) place of rango suspension — Island Bay near Wellington.

The idea of his slayers was to impress his people of the futility in so naming him; for he himself now fell to a similar death as that of his elder relative.

Among this class of names are a number quite modern in their origin. These in some cases were given to perpetuate the memory of various native chief famous in the early days of Colonization, among such are:-

WAHAROA called after the Ngati Haua chief. This name was bestowed on him in early boyhood. His uncle had been killed on the attack on a Southern fortress, and was slain as he tried to enter the Waharoa (long-opening) the name for the gateway entrance to a fort.

TAKAANINI a station beyond Otahuhu so called after Takaanini the old time chieftain who owned the land thereabouts.

There are a number of place names in New Zealand commemorative of places in the South Seas whence the Maoris came to New Zealand.

Among numerous examples of this class of names we have *Rarotonga* (Mt. Smart) *Te Papa-i-Tonga,* the plains or flat of Tonga [Rotorua], *Motu-tapu* (Holy Island) also the name of Mokoia Island at Rotorua. *O-Mangaia* — Long Bay, on the coast north of Takapuna. *Hikurangi* in the Waitakere and at other places and so on. Manukau should be Manuka — a name of this class.

Now let us look at some of the well known names in Auckland.

Point Chevalier was *Rangi-mata-rau* (the day of the hundred spears) — really the name of a tribal battle of ancient times which took place on the foreshore thereabouts.

Out in the Waitemata is a pinnacle rock (Boat Rock) known as *Te Mata* (flint stone) after a tribal talisman buried there. This rock gives its name to the harbour — *Wai-te-*

mata, the waters of the Mata Rock. This rock also had another name, *Te Niho-kiore,* the rat's tooth, because, like a rat's tooth, it withstands all wear, despite the flow and rise of the tides about it. This rock was a tribal "tohu", or boundary mark of the tribal fisheries, and was "tapu" at one time. The prisoner victims of a tribal battle were left thereon by their enemies to drown. The "tapu" was rigorously observed until European times, and to fish in this area was a serious matter.

The Watchman Island was *Motu-ngaengae* (Shell Fish Island). Probably it was a favourite collecting place for such food. The name of Shelly Beach (Ponsonby) was *One-maru* (Sheltered Sands). Point Erin (where the Park now is) was *Te Koraenga* (the Headland). St. Mary's Bay was *Oka-a* (the Sharp, Rocky Cliffs), a feature of the foreshore there. Freeman's Bay, now wholly reclaimed, was *Wai-kokota* (cockle waters). A headland at the western side thereof, where the Gas Works now stand, was *Te To* (the Dragging-up Place), i.e. where canoes were kept. Where Queen Street now is was a tidal creek, which met the waters of several rivulets which flowed from the gullies inland; the name was *Wai-horotiu* (waters gliding along).

At the foot of Shortland Street was a rock used as a landing place, called *Te Whatu* (the Rock). Where the Waitemata Hotel now stands was a headland known as *Te Ngutu-wera* (Burnt Lips). Here a careless servant caused an accident of this nature to a young visiting chief, which resulted in quite a lot of trouble to the people concerned. The Fort Street foreshore was a small bay called *Wai-ariki* (the Chief Water); why so cannot now be known. The headland which formerly stood at the termination of Princes Street was "*Te Rerenga-oraiti*", i.e., the Leap of the Survivors. From this cliff a number of escapees of a tribal disaster jumped to save their lives; probably an incident well remembered for future revenge.

Mechanic's Bay (also now wholly reclaimed), where the Maori Hostelry stands at the foot of Parnell Rise, was *Wai-papa*; strictly speaking this was the name of the tidal creek which ran inland where Stanley Street is now formed. The bay itself was known as *Te Toangaroa,* (the long dragging up, no doubt because of the dragging into the waters of canoes here in old times to escape from a coming enemy). History almost repeated itself here in European times (1851), when Sir George Grey ordered a hostile party away, threatening them with the guns of the warship. No time was given for the tide to come in, and the natives were obliged to drag their canoes to low water mark. This incident is still known as Te Toangaroa, and doubtless further accentuated the memory of the place name long after the bay itself had disappeared. The headland where the Parnell Baths are was *Te Tau-rarua* (the Song of Annoyance), alluding to an incident of olden times, a song having been sung by a passing war canoe party intended to annoy the people in that village. The hill in the Domain where the museum stands was *Pukekawa* (Sour Hill), because the kumara crops there grown were always very poor; so the soil was blamed — it was reported as sour. It was later renamed *Pukekawa* (Hill of Bitter Memories) by Potatau te Wherowhero in memory of those who had died in wars between Ngapuhi and Waikato. That big gully leading from Newmarket to Hobson Bay was *Te Rua-reoreo* (the Echoes), because the voice of anyone calling out there was duplicated by an echo. The beach at the foot of Brighton Road was *Mata-hare-hare* (the Brandishing of Spears), to commemorate a quarrel there between two chiefs. *Orakei* is a name of doubtful meaning, but I am inclined to think it is the name of a particular place thereabouts so called from one Rakei-iriora of the Tokomaru canoe, some of whose chief people settled here. The native settlement at Orakei is *Okahu*, called after Kahu-mata-momoe, an Arawa chief who once resided here and in the Kaipara with the ancient Wai-ohua people. *Purewa* (the site of the cemetery) is really the name of a high point at the back of Orakei, whereon stood a look-out tower or sentry post on poles. The correct spelling is *Pourewa*. Lake St. John was *Waiatarua* (Reflecting Waters). Mount Wellington is *Maunga-rei* (the Watchful Mountain). The occupants of the stronghold were alert and ready when an attack was made thereon. At Panmure village, where the township stands, was a large fortified village — *Mau-inaina* (Caught Basking in the Sun). Its occupants were surprised and decimated under the circumstances the name implies. The end of the Tamaki River was *Whangai-makau* (Await the Loved One). Here the Tainui canoe awaited the arrival of one of their chieftainesses, Marama, who left her on the coast of Wharekawa and came overland. *Te Manu-ka* is the correct name of Manukau, though both seem to have been in use even in olden times. Other familiar names are:- *Manuka* (Anxious Thought) — the navigation of the entrance was a good reason for its name; *One-hunga* (pulverised earth), the soil there being notable for its friable nature. An old Maori, however assured me the name was O-nehunga (the Burial Grounds) because, said "there were anciently numerous urupas or nehunga of the dead thereabouts". The Three Kings were *Te Tatua* (the Belt). These hills were said to stand as in a group around a central citadel. A little lakelet, formerly in the hollow at the back of St. Alban's Church, was *Roto-a-rangi*. Rangi was a young chieftainess who, with a party of attendants, was captured there whilst gathering kakahi shell-fish. She was a chieftainess of One-Tree Hill, and her romantic escape from her captors is a story still told among the people. Mount Roskill was *Te Pa-tapapa*, i.e., the hill fort with the flat top. Mount Albert was *O-wairaka* — strictly, no doubt, the name, not so much of the hill, as of the whole locality. It means — of Wairaka, named after Wairaka of the Mataatua canoe. *Titirangi* (Veronica Shrub) is the name of that district to the west of Mt. Albert. It was the area on which was fought the Maori Waterloo, whereby the ancient Waiohua tribes fell before their Kaipara conquerors.

There is a Maori lament used at funeral assemblies which refers to their nomenclature, viz:

E Maunga-whau e tumai tonu ana
Ka whiti tonu nga Wai-o-mata.
Koia ena nga putake o nehe ra —
Nga tau-tohe o namata — E!
E Rau Rangatira o nga iwi!
E Tamaki! Whenua parekura!
Ka mihi matou kia koe
E Tamaki makau rau — E!

Thou, of Maungawhau, standest as of yore,
And flashest still thy waves — Wai-o-mata.
These indeed were the cause of ancient strife
And the endless warfare of the men of old. Alas!
Oh, warrior chieftains of the tribes of yore!
Oh, Tamaki, land of battlefields!
We greet thee still in sad affection —
Oh, Tamaki, the contested of a hundred lovers — E!

When the late Maori King Tawhiao officially visited Auckland for the first time to make peace subsequent to the Waikato War, he landed at the Remuera Station, proceeding to Orakei, where he stopped that night. Much had happened in Tamaki since his visits in years gone by. His father, Te Wherowhero, the first king, had died, the Waikato War had been fought, and much tribal land confiscated by the victorious white man. No doubt his feelings were running in a doleful vein, for many of the warrior chieftains who had fallen in the late war were the companions of his early years, when, as a youth, he for some time lived in this district. On that occasion he sung the lament of which the above is part.

I think I have now given an idea of the wealth of historic memory and meaning to the Maori people there is in their place names. There are many names now obsolete — others practically so; but to refer to them all would unduly extend this article. In a future attempt I hope to include some I have omitted, as well as give an account of the names of some of the surrounding districts.

"It is much more interesting to use the native names . . . Without doubt it is a sacred duty to respect the names given by the first discovered of uninhabited places. I think that those of the indigenous people should prevail as soon as they are known. A time will come when these names will be the only vestiges of the language spoken by the primitive inhabitants." (From Captain Dumont d'Urville's visit to Whangarei, Waitemata and the Thames, 1827.)

GEORGE GRAHAM'S MAORI PLACE NAMES OF AUCKLAND

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Abstract. Maori place names of Auckland collected by George Graham are presented together with their meanings.

These place names were collected by George Graham a prominent member of the Anthropology and Maori Studies Section (Auckland Institute and Museum) and of the Akarana Maori Association. From 1890 until his death in 1952 he assiduously collected traditions and information remembered by the elders of the Tamaki tribes. Many place names of Tamakimakaurau, now called Auckland, are included in a manuscript book in the Museum Library (Graham MS.). Leslie Kelly, author of "Tainui" (Kelly 1949) had access to this book and used some of the names in his book. He also left a typed version of the names (Kelly MS.) and made a map of the area with the names placed in position. For the present publication the names have been rearranged in alphabetical order and extra names inserted from other Graham manuscripts in the Museum Library. In some cases, references to topographical maps (N.Z.: 16630 inch to mile) or explanatory notes have been added. All additions by me have been placed in square brackets, otherwise the text is as written by Graham.

The listing of place names is not complete. It represents the names known to Graham's informants who still knew the traditions associated with them. It is presented as a reminder of the debt present and future generations of Tamakimakaurau owe to George Graham's energy, scholarship, and knowledge of things Maori.

Haere e koro, haere ki Hawaiki nui, Hawaiki roa, Hawaiki pamamao. Moe ra e koro moe ra. (Farewell sir, go to great Hawaiki, long Hawaiki, distant Hawaiki. Sleep well there, sleep well.)

TE AHIKAARAKA "the fire lit by Raka" (Wairaka). Raka was of Mataatua (of Ngatiawa) and lit this fire to let her people know she took possession thereof. Mt. Albert or thereabouts. [N42 c 240556]

TE AHURUTANGA "The haven or sheltering place" (for canoes). Following a slip on the east side of Pt. Britomart, the sea rapidly washed the spoil and formed a small cave. Vide Te Hororoa. [N42 289610]

TE AKOOTETUI "the teaching of the tui". A bush creek and waterfall running through the Auckland Domain and joining the Waipapa creek. [N42 293598]

TE ANAARANGI "the cave of Rangi" after an accident in the escape of Rangi who was of One Tree Hill Vide Rotoarangi. Name of a cave near Windmill Rd. vide Rotoarangi.

TE ANAOKAHUMAUROA "The cave of Kahumauroa". A cave on the foreshore between North Head and Cheltenham beach. Kahumauroa was a canoe made by Ngati Paoa, but captured by Nga Puhi and used by them in their invasion of Takapuna about 1790-1793. The canoe was hidden in this cave by Nga Puhi when they attacked the Takapuna pa. Haukapua was part of the affair. [N42 329634]

NGA ANAPEKARAU "The cave of numerous bats". The volcanic caves to the south of Mt. Eden, vicinity of the old mill, Windmill Rd.

TE ANAPUAREARA "The open cavern of Ra". A sea cave on the foreshore, to the east of Birkdale.

NGA ANAWAI "The cavern or grotto waters". Cabbage tree swamp, Eden Park, Mt. Eden. The waters were said to flow into underground caverns. [N42 c 264578]

AOTEA. "Dawn". Great Barrier Island. Named from the Aotea canoe.

TE APUNGAOTAINUI "The Billow of Tainui". McLennan Hills, Otahuhu.

TE ARAHURIHAERE "The path which bends and turns". The track from Te Okingaatoroa to Maraeohine. Vide Te Maraeohinekakaea and Te Okingaatoroa.

TE ARAIATIRITI "The wind shelter of Tiriti". Tiriti quarreled with her brother Hape and went to this place where she resided some time with her grandson. A bay about half way up Paremoremo Creek on west side.

TE ARAPUERU, also TE ARATOPUNI "The path littered with garments". "The path littered with dogskin garments". Another name for Mangere pa. Really the name of a battle there. After the battle between Waiohua and Ngati Whatua at Paruroa or Muddy Creek, Titirangi, where Kiwi was killed, some of the Waiohua took refuge at Mangere and to prevent surprise, spread shells all around the walls of the pa. This device was rendered useless by Tuperiri, who led the Te Taou (Ngati Whatua) warriors up to the pa in the dark and spread their dogskin garments over the shells, thus deadening the sound of their footsteps. The pa was surprised and only a few of the defenders escaped.

ARARATA "Quiet creek". A stream at Mangere.

ARATAKIHAERE "Path of the single file". A track formerly leading from Mt. Eden to Owhatihue. [N42 284570]

TE ARATOMOORUARANGI "The entrance pathway (to a cave) of Ruarangi". Cave on the south side of Mt. Albert. Ruarangi was a Patupaiarehe chieftain. Vide Te Arawhakapekapekaaruarangi. [N42 c 240553]

TE ARAWHAKAPEKAPEKAARUARANGI "The perplexing pathway of Raurangi". Another name for the reef off Pt. Chevalier. Vide Te Tokaroa.

TE ATATU "Standing towards the dawn". The neck of land between Te Whau Creek and Te Huruhuru Creek, Henderson. [N42 170605]

TE AUANGA (AUAUNGA). Oakley Creek. Whirling or whirlpool creek. [N42 219577]

AWANUIOPERETU "The big river or channel of Peretu". Rangitoto Channel. Peretu was a chief who lived in those parts in very ancient times and resided at Narrow neck. Peretu was so called because his father was killed in battle by a dart. "Pere" a dart, "Tu", pierced. He owned Rangitoto where he had a "Rahui kaka" or parrot reserve.

AWARATA Between Otahuhu and Papakura.

AWATAHA "The river flowing at the side". A place at Shoal Bay on northern headland of the basin Te Kopuaomatakamokamo. [N42 279663]

AWATUNA "Eel River". A creek at Northcote which flows through the southern volcanic basin (Te Kopuaomatakerepo, vide) into the sea on the western shore of Shoal Bay. [N42 270653]

NGA HAPUAATO "The ponds of To". A series of holes in the rocks to east of Te Tauhinu headland pa. Somewhere in the vicinity of Paremoremo landing, to the west thereof. Excavated to keep shellfish in while being collected.

HAUKAPUA "The cloud bank carried along by the wind". A beach at North Head itself on the Devonport side [Torpedo Bay]. Site of a great battle when Nga Puhi, Te Kawerau and Te Parawhau who were in alliance, raided Takapuna. On the beach was fought a great battle with Ngati Paoa, who were living at Takapuna. (About the year 1700-1793) Vide Te Anaokahumauroa [N42 324632]

HAURAKI "North west wind". Originally name of spot where Thames stands. The wind brought many raiding parties.

HAUTURU "The wind standing up". Little Barrier Island.

TE HIKAARAMA "The fire lighting of Rama". Rama was a chief of Waiohua. He was hiding at this place and foolishly lit a fire to warm his grandchild. A Ngati Whatua war-party camped at Northcote Point noticed the smoke and crossed the harbour. They surprised Rama and he and his people were captured. This place was a small bay or gap in the cliff at the foot of Nelson St.

HINEREI "The watchful maiden". One of two rocks at the south end of Takapuna Beach known as "The Twins". Hinerei, the one to the east. Vide Ngamahanga. [N42 310667]

HINGAHIA Name of creek that passes through Drury township.

TE HORORОA "The long land slip". A place to the east of Pt. Britomart. The pa front there slipped away and many of the people perished. Said to have been a "tohu" or omen of coming disaster. This happened just prior to the Ngati Whatua invasion, Parerautoroa was the chief and Ngati Rauiti was the hapu. This place rapidly washed away and formed eventually a cave known as Te Ahurutanga — sheltering place for canoes.

HOROTIU "Crumbling away". Site of the flagstaff, Albert Park. Formerly a pa. Vide Waihorotiu. [N42 285606]

NGA HURUATAIKI "The hairs of Taiki". A tree on the cliff at Awataha, Shoal Bay. Whereby to make it tapu.

HURUHURU "Feather Creek". Leading to Henderson's Creek. [N42 145604]

NGA HURHURUAPERETU "The hair or feathers of Peretu". An ancient name of Rangitoto. Peretu had a rahui kaka (parrot reserve) there.

TE HURUHURU "The hair (or feathers)". The tidal creek to west of Te Atatu Pt., and now called Lawson's Creek. [N42 155635]

TE IHUAMATAOHO "The nose of Mataoho". Mataoho was a fabulous giant who prayed for fire to warm him, hence the volcanic mountains of this district. This place is south of Mangere and is now spelt Ihumatao. [N42 267430]

TE IPUAMATAOHO "The bowl of Mataoho". Mt. Eden crater. Mataoho a god of volcanoes, this place was tapu to him.

TE IPUPAKORE "The cracked water bowl". A spring of water (now dried up) a little to the east of Mt. Eden Road, near the railway line, about the site of the present timber mill. Site of Kelly's home in the early days. Said to have been one of the main water wells of Maungawhau pa. A massacre of Waiohua women took place at the hands of Kawharu's people. Remembered by above name. [N42 c 277582]

TE IRINGAORAURU "The hanging up of Rauru's body". Rauru was one of Ngati Whatua killed by Waiohua. His body was hung on a tree which grew somewhere near the site of the old windmill, Karangahape Rd. His death was one of the causes of the Ngati Whatua conquest. [N42 282597]

KAHUTOPUNI "Clothes made of dog skins". A place at Riverhead, to the north thereof. Vide Rangitopuni.

KAIAHIKA "The food of Hika". Panmure Basin. No account as to whom Hika was. [N42 365540]

KAIMOEONE "Eat the earth grubs". A place inland of Birkdale landing. General name for that district formerly. [N42 c 208663]

KAIPARA "Eat para fern". District.

KAIPATIKI "Eat flatfish". Lucas creek.

KAIPATIKI "Flounderfood" creek. [N42 216685]

KAIWHANAKE "Cabbage Tree food". A little bay to the east of Birkdale landing. [N42 204664]

KAKARAMEA "Sweet scent of speargrass". Bombay Hills.

KAKATAHI "One parrot". A clump of bush formerly on northern slope of the hill Te Tokatu. Te Tokatu was a hill pa on the east side of the Three Kings Road. Vide Te Tokatuawhaoroa. [N42 c 276542]

TE KAPUAARANGI "The basin of Rangi". Onehunga Basin. Also Te Kapuaamataaho.

TE KAPUAKAIOMATAOHO "The food bowl of Mataoho". Mt. Eden crater. Mataoho was a fabulous giant. Vide Te Ihuamataoho. [N42 282572]

KARAKA "Name of a tree". A little bay on Manukau harbour in the vicinity of Green Bay to the west thereof. Actually Green Bay itself. [N42 199500]

KARANGAHAPE Former name of Cornwallis district. Meaning uncertain, perhaps karanga — to call and Hape the name of a chief who lived there in ancient times "Hape's call". [N42 126421]

NGA KAUAEWHATI "The broken jaw bones". A pa formerly on ridge at Arch Hill overlooking the Western Springs. Really name of a battle there during Kawharu's invasion of Tamaki. [N42 c 246588]

KAURITUTAHI "The kauri tree standing alone". A place on the upper foreshore of the harbour in vicinity of Paremoremo landing.

KIRITAI "Skin of the ocean". Narrow Neck beach because it separates the ocean from the inner waters (Tamihana). Might also mean "ocean sands". [N42 317652].

TE KOARI "The Koari tree". About the site of the Auckland Grammar School. Statement by Pairama Mu of Ngati Whatua. [N42 285589]

KOHERAUNI A hill on the south-east side of Three Kings now nearly quarried away. [Koheranui] [N42 277534]

KOHIMARAMA "To gather up the fragments (as of kumara)". So named because of a great gathering of tribes there in ancient times when all the fragments of the people were collected together. Name of a strong pa that stood on the Bastion Rock, now cut away.

KOHUORA "A living cloud". The Tuff craters near Papatoetoe. [N42 347441]

TE KOKANGA "The planting of the corn". A headland on the upper reaches of the Waitemata, opposite Whenuapai. (Waionoke).

KOMITI "To lick". A place at Tamaki Heads, east side. [N42 419608]

NGA KONARAMA "The food baskets of Rama". The sunken volcanic tuff craters on west side of Shoal Bay. Ramakaroa was a Kawerau ancestress. [N42 c 270655 and N42 272662]

TE KOPUAOMATAKAMOKAMO "The basin of Matakamokamo". The northernmost of two volcanic basins of west shore of Shoal Bay. [N42 271665]

TE KOPUAOMATAKEREPO "The basin of Matakerepo". The southern volcanic basin in the same district as the above. [N42 114674]

KOPUPAKA "The scorched stomach". A place at the top of Brigham's Creek.

TE KOU "Good". An island at the south of Oakley Creek. [N42 218578]

TE KORAENGA "The headland". The headland is at Ponsonby, Pt. Erin, also called Oka.

TE KORANGA "The scaffolding" (for drying fish). At the foot of Victoria St. West. Probably a modern name as the fish were dried there in the forties. [N42 284606]

KORORIPO "Eddy". On Panmure Basin to west of Waipuna Creek.

KOTAKEREHAEA "The split canoe hull". The beach at St. Mary's Bay. A canoe had been hauled up there by some slaves. They carelessly let it fall sideways and were clubbed to death. [N42 265614]

TE KOTUITANGA "The dovetailing". A creek at the headwaters of the Whau Creek on the eastern side. Builders of canoe attacked when dovetailing canoe. [N42 213534]

KUKUWAKA "Nip or scratch the canoe". A place at the north end of Narrow Neck Beach. In former times there was a waterway at spring tides leading from the ocean to the Waitemata at this place and was used by canoes. Sometimes canoes were nipped or caught therein. North end of Kiritai Beach. [N42 321651]

TE KUPENGAATARAMAINUKU "The net of Taramainuku". Manukau Harbour bar.

TE KURAEATURA "The headland of Tura". Devonport Beach. Site of ferry wharf. [N42 313625]

NGA MAARAATAHURI "The cultivations of Tahuri". Tahuri was the mother of Kiwi Tamaki and was famous for her industry and cultivations. Generally speaking the name applies to the One Tree Hill district.

NGA MAHANGA "The twins". Two pinnacles of rock on the foreshore at Takapuna Beach. Vide Te Tokaatukiata. Twins named Hinerei and Matamiha.

MAKETU "Lift or pull up with rollers". Near Bombay, originally tribal area of Ngariki. Te Korahura of Ngati Paoa attacked them, battle was called Te Rakahorahora (dried up and withered in the sun) because the slain lay all day in a hot summer sun before being eaten by Ngati Paoa. Noia, whose pa was at Maketu attacked Korahura to avenge this and defeated Ngati Paoa at Tuahu (Wairoa district) hence the canoe Kahumauroa was skidded on rollers.

MANUKA "The anxious mind". Probably because of its difficulty of navigation. Ancient name of Manukau Harbour. The name actually applies to the bar at the mouth of the harbour and was so named by a chief of Tainui named Hotunui.

MANUKAU "Only Birds". The people of Mangere pa noticed what appeared to be a war party on the sand banks near the middle of the harbour. A war party set out from the pa intending to engage the invaders on the sandbanks. However, on nearing their objective it was discovered that the dark specks noticed from the shore were only birds, hence "e manukau". The name Manukau is said to apply only to that part of the harbour in the vicinity of Mangere. Another story states that a certain chief and his followers were invading these parts and sailed up the harbour. However, no sign of habitation could be seen. No people, only birds, hence the name Manukau. Vide Manuka.

MANUREWA "Soaring kite". Hill and district. From a kite flying competition.

MANGAHEKEA "The branch hanging down or falling down". A place in Albert Park. [N42 286605]

MANGERE "Lazy". Mangere Mountain. No record as to how the name came to be given. [N42 301487]

TE MARAEIKOHANGIA The village square where shell-fish were shelled. The lower hillock of Mt. Eden. Site of the reservoir. [N42 283575]

TE MARAEOHINEKAKEA "The enclosure of Hinekakea". An old village at the head-waters of Paremoremo tidal creek on the eastern side. (Allot.7P, Paremoremo)

TE MATA "The flintrock" Boat rock. The rock off Sugar Works. Some state that it is from this rock that the harbour got its name, hence Waitemata. A fishing rock over which Ngati Paoa claim ownership — also a Rohe (boundary mark) a ceremonial place (uruuruwhenua).

MATAHAREHARE "Spear brandishing". A beach in Hobson Bay at the foot of Brighton Road. Brighton Beach. [N42 c 310598]

MATAMIHA The westerly of the two pinnacle rocks at the southern end of Takapuna Beach, known as the twins. Vide Ngamahanga.

MATANGARAU "The shellfish" Cape Horn. [N42 250498]

MATARAE "The headland". Bayswater Point, now the site of Bayswater wharf. [N42 286642]

TE MATARAEAMANA "The headland of Mana". Kauri Point. Manaoterangi was chieftain of the local tribe (Ngati Kawerau) and flourished about 1720-1790 A.D. A pa stood thereon, an account of which appeared in the Northcote Meteor in 1910. [N42 228633]

MATENGARAHI "Big head". Cape Horn, Manukau Harbour. [N42 250497]

MATUKURUA "The two bitterns". The Wiri and McLaughlins Mounts, Puhinui.

MATUKUTURURU "The watchful bittern". McLaughlin's Mt., Puhinui. The inhabitants kept their defences ready.

MATUKUTUREIA "The careless bittern". The inhabitants were careless and so were surprised by Kawharu.

MAUINAINA "Caught basking in the sun". Panmure township, near the site of the old wooden bridge. The people were surprised by Kawharu's war party. [? incident in first Ngapuhi raid 1818.] [N42 370546]

MAUNGAKIEKIE "The mountain of Kiekie shrub". One Teee Hill. Another meaning given: "The mountain culminating in a pinnacle". [N42 300545]

MAUNGANUI "Big mountain". A pa in former times near Trig Station on the ridge at the back of Kauri Point. Birkenhead district. [N42 229635]

MAUNGARAHIRI "Rahiri's hill". A hill now quarried away near the foot of Orakei Rd., and known as little Rangitoto. Rahiri was an ancestor who settled in Kawhia, hence Orahiri, a place there and origin of an old proverb; "Rahiri kainga rua". Rahiri of the two fireplaces or homes, he is also said to have lived in the far north. [N42 324583]

MAUNGAREI "Watchful mountain". Mt. Wellington. The inhabitants were always vigilant and could not be surprised when attacked by Kawharu. [N42 363556]

MAUNGATAKETAKE "The everlasting mountain". Gabriels Mt., Mangere.

MAUNGAWHAU "The mountain of the whau shrub". Mt. Eden [N42 283572]

MAUNGAUIKA "Uika's mountain". North Head. [N42 329632]

MOERANGI "Sky sleep". One name of Gabriels Mt. also applied to Pukaki.

MOKOIA "Bubbled up in froth". The name of the old pa on the east side of the channel that connects the Panmure Basin with the Tamaki River. A pa that stood on the knoll at the far end of the old wooden bridge that formerly spanned the Tamaki River. The old road cuts through the pa site. About 1810 this pa was rebuilt to confirm with the introduction of the musket and was occupied by a section of Ngati Paoa, under the chief Te Hinaki. In 1821 came the invasion of Hongi Hika who had met Te Hinaki in Sydney and warned him of his intention. After a long siege Mokoia pa was taken and Te Hinaki, with a large number of his people, was slain. [N42 373536]

TE MOKONUIOKAHU also Omokonuiokahu. A headland on Rangitoto at mouth of Islington Bay, near quarry. Kahumatamomoe, of the Arawa canoe, who settled here, in Tamaki, took possession of Rangitoto by leaving a lizard guardian named Te Mokonuioahu. [N42 410680]

MOTUIHI Should be (Motuaihenga) "Ihenga's Island". Ihenga an Arawa ancestor who temporarily lived there. [N42 c 460650]

MOTUKOREA "The island of the oyster catcher bird". Brown's Island. This is said to be the correct form of the name. [N42 c 410630]

MOTUKOREHA "Island sinking out of sight". Brown's Island. So called because Brown of Brown and Campbell first settled there. In certain weather conditions the low lands thereof disappear or appear uplifted above the sea when viewed from a distance, a sign of easterly weather, hence another name Motutohuhau "The island indicating the weather to come". A pa of Ngati Paoa, Ngati Kahua hapu, prior to European times. Te Hinaki, chief at time just prior to Hongi's raid when he plus his people exterminated at Tamaki.

MOTUMANAWA "The island of the Manawa shrub". A large island at the mouth of the Whau Creek. Or Heart Island. Pollen Island. [N42 190590]

MOTUNGAENGAE "The island of the ngaengae shell fish". Watchman Island. [N42 251624]

MOTUTAPU "Holy Island". This place was named by Taikehu of Tainui canoe in commemoration of an island in Hawaiki. Hence it belonged to the Ngaitai hapu of these parts. Te Motutapuataikeku. [N42 c 420690]

MOTUTOHUHAU "The island indicating the wind to come". A pa of Ngati Paoa, Ngati Kahua hapu prior to European times. Vide Motukorea.

MUTUKARAKA "The end of the karaka". A sand bank in the Manukau Harbour off Green Bay. Also Motukaraka, "Island of karaka". [N42 210490]

TE MUIANGAOTINIRAU Near Puponga, where Tinirau was slain. Moka 17.6.93

TE NAUPATA "A shrub" (*Coprosma repens.*) Musick Point.

TE NIHOKIORE "The rat's tooth". Another name for Te Mata rock [Boat rock].

NIHOTUPU "Tusk tooth". The name of a fairy chief of Waitakere.

TE NGAHUWERA "Burnt Breasts". The headland at the mouth of Waihorotiu (Queen St.) site of Waitemata Hotel approximately.

NGAUTERINGARINGA "The finger bitten". Stanley Bay. An incident in which a child in its innocence bit the fingers of the chief and raised a long argument over a violation of tapu. [N42 297633]

NGA NGUTUKO "The pouted lips". The entrance to Hellier's Creek. [N42 200680]

NGANUI "The many". Headland opposite Puhinui Creek.

NGUTUWERA "Burnt lips". Another name for the little bay west of Kauri Point. [N42 228636]

OATORU A bay on the Manukau foreshore below Titirangi. The bay to the east of Opou Point. Meaning uncertain. [N42 191494]

OHINERAU "The place of Hinerau". Hinerau was an ancestress from whom both Ngati Whatua and Waiohua claim descent. The ancient name of Mount Hobson. Explanation of Pairama Mu of Ngati Whatua. [N42 305571]

OKA (or OKAA) "Sharp cliff". Point Erin Campbell. (Te Oka). [N42 258621]

OKAHU "O Kahu" The place of Kahu. Anciently O KAHUMATAMOMOE. The name of the bay and settlement at Orakei, so called after the Arawa chief Kahumatamomoe, who lived here and at Kaipara, and from whom both Waiohua and Ngati Whatua claim descent and therefore relationship with Arawa. [N42 335605]

OKAURIRAHI "Big Kauri". A place at Waikumete (Smyth's Grant). [N42 c 170540]

TE OKINGAATOROA "The hill top resting place of Toroa". Ridge at the back of Paremoremo landing. Toroa was looking for the home of Kakea and rested here. Seeing the camp fire at Te Maraeohine she went thither and found Hine and her people.

TE OKOARATANGA "The undulated or twisted up and down". A headland east of Greenhithe Landing, near the mouth of Hellier's Creek.

OKOARE "The place where the young kauri trees grow". A place near Newmarket. [N42 c 300583]

TE OKORIKI "Gradually wearing away" (as by erosion) to a vanishing point. A small headland just to west of Hobsonville Landing.

OMAHUTAKA A place on the shore of Hobson Bay, at the end of the gully which runs from Newmarket. [N42 308588]

OMANGAIA "Of Mangaia". Deep Creek, Milford.

OMATAWAIA "The eyes strained". (with searching afar). Stanley Point. [N42 291631]

ONEHUNGA "Friable earth". Potene states that it should be O Nehunga "Place of burials" because of the burial caves in the vicinity. This statement has since been contradicted. Oneunga, landing or disembarking beach. [N42 c 303510]

ONEHIRITEA "Gritty white earth". Hobsonville wharf landing.

ONEMAEWAO "The fairy's beach". The Maewao were a fairy people who came only by night, from the inland bushes, to gather shell-fish. A party of them was surprised by an early sunrise and perished as a result. Now Milford Beach.

ONEMARU "Sheltered sands", originally Te Onemaruohuatau, "the sheltered beach of Huatau". Shelly Beach. [N42 326636]

ONEONEROA "Long sands". Shoal Bay. Sulphur Beach. [N42 268646]

ONEPANEA "Beach of the heads in line". The beach, now reclaimed, and now Fort Street. Nga Puhi had been on an expedition into the Waikato country and on their way back to the north stopped at Tamaki. Certain ceremonies to lift the tapu from the warriors were performed at a stream which flowed down where Swanson St is now. The heads of their slain enemies were stuck on posts on the beach and it is said that they were so numerous that the line of dried heads stretched from one end of the beach to the other. [N42 286610]

ONEPOTO "The short beach". A little beach on the west side of Northcote Point. [N42 270648]

ONEPUWHAKATAKATAKA "The place where one slipped or lost footing". The eastern headland of Hobson Bay. A war party of Ngati-whatua under Kawharu (1680 A.D.) attacked the pa at Pokanoa. Several escapees slipped onto the beach at this place and were caught by an ambuscade on the foreshore. [N42 324602]

ONETAIPU "Sandy foreshore". A headland opposite Paremoremo, now called Waimarie.

ONETAUNGA "Beach of rest". Where the canoes were hauled up and where travelling parties camped. A wharf so named built there. (Quarryman's Bay). [N42 217640]

TE ONEWA "Name of a dark grey stone". A large deep trench running from one side of the cliff to the other at Northcote Point. "A kind of stone". Northcote Point, or really the name of a ditch that cuts the point off the mainland. After the fall of Tamaki to Ngati Whatua the pa on this point was occupied by Tarahawaiki.

ONEWHERO "Red beach". The beach on Motutapu facing Rangitoto.

OPAHEKE "Of Paheke". Area near Ramarama.

OPAKETAI "Place of driftwood". Such is washed up on the beach there in westerly weather. The beach at Birkdale landing. [N42 208652]

OPANUKU "Of Panuka" Creek. [N42 136555]

OPERETU "Peretu's place or home". The headland between Narrow Neck and Cheltenham Beach. Peretu was a chief who lived in ancient times. He is reported to have been living at the above place when Toi visited these parts. Site of Narrow Neck Military Camp. [N42 324647]

OPOU (OPOUTUKEHA) "Cox's Creek". An ancient boundary between Ngati-Riu and Ngati-huarere. After a certain Poutukeha. [N42 244604]

OPOU A headland on Manukau Harbour. (N42 191486)

OPUAWANANGA "The place where the clematis grows". Known as Quick's Bush, Northcote.

ORAKEI "O Rakei". The place of Rakei. Reputed to be anciently Orakeiiriora. Rakeiiriora was a chief of Tokomaru canoe, said to have visited these parts and resided thereabouts. A place on the shore of Hobson Bay at mouth of Pourewa creek. [N42 329591]

ORATIA "Of Ratia". Stream, into Lawson's Creek, Waitemata. [N42 146635]

ORAWAHO "Of Rawaho". Channel between Motutapu and Rangitoto.

OROHE "Rohe — a boundary". A place near the west head of Tamaki River. Site of several battles in former times.

ORONGOUAHUKEA "The cooking oven mats uncovered". Somewhere near the site of the Auckland Hospital. Name of a battle. Ngati-Whatua surprised a party of Nga Puhi about to eat their meals after having uncovered their ovens. [N42 290595]

ORUARANGI "The place of Ruarangi". A creek on the Manukau at Ihumatao, Mangere. Ruarangi was a chief of Patupaiarehe. [N42 c 285445]

ORUKUWAI "The place where one dived into the water". A point at Te Atatu nearly opposite Onetaunga to the south thereof. [N42 174633]

OTAHUHU Tahuhunui was an immigrant chieftain about 1350 A.D., who built a pa at this place. Now called Mt. Richmond. [N42 407506]

OTAHUTIMAI "Place of calling in welcome". A headland to the west of Pt. Erin, at the foot of Sentinel Road. [N42 c 257618]

OTAIKI The Tamaki River entrance. Taiki was a chief on Tainui canoe. [N42 c 465610]

OTAKEREHAIA "The split canoe hull". St. Mary's Beach. A canoe had been hauled up there by some slaves — they carelessly let it slip sideways, and they were clubbed to death for their remissions.

OTAU (Tau an ancestor of Ngai Tai) Name of site of Clevedon township.

OTITORI "Of Titori". A bay on the Manukau between Opou Pt. and Shag Pt. [N42 187485]

OTUATAUA "The place at the rear from whence the war party came". A hill pa at Oruarangi, Ihumatao, Mangere. [N42 290450]

OUE Pa at Umupuia

OWAIRAKA "Wairaka's place". Mt. Albert. Wairaka was a Ngatiawa ancestress who lived there for some time. [N42 230556]

OWAROA Vicinity of Islington Bay, Rangitoto. [N42 408684]

OWHATIHUE "The breaking of the hue (gourd)". A small pa formerly near the southern base of Mt. Eden. (Now the site of the training college). [N42 283564]

PAEMOHANI "The ridge of mohani". The mohani was a fern, the roots of which were gathered for food. The ridges at the back of Waikawau, Manukau Harbour. [N42 254505]

TE PAEOTOKOAHI "The dividing ridge of Tokoahi". He was a chief of the Ngati Manoke — a Waikato hapu descendant of Tanenui, another name was also Ngati Rewha — being also descendants of Rewha. This was the name given to that series of pa in the vicinity of Mercer Railway Station.

TE PAHIOTEPOA "The camp of Te Poa". Pine Island; really the northern end. Te Poa was a Kawerau chief, ancestor of the Ngati Poataniwha, and was killed here by Ngati Whatua.

TE PAKARAKAORONGO "Rongo's plantation of karaka trees". A headland on eastern side of Paremoremo Creek near the mouth.

PAKURANGA fully *Pakurangarahihi* (battle of the sun's rays). Name of a battle here between Koiwi and Putere, who belong to the Nukumaitore people (a fairy people). [N42 418558]

TE PANAPA (meaning doubtful) "Napa" said to be a method of splicing, "Pa" a stockade or fortress fencing. Pa farm estate Royal Oak. [Named from Banabans of the Melanesian Mission who lived there.]

TE PANEIRIIRI "The head hung up". The eastern headland of Freeman's Bay. Probably a wartime incident. Where a ceremony of Whangaihau was performed by Ngati Paoa in conquest of Tamaki.

TE PANEOHOROIWI "The head of Horoiwi". The headland on the eastern side of St. Heliers Bay. Horoiwi arrived by Tainui canoe and took possession of this point by naming it Upokotamarimari. Ripokoi of Ngati Paoa, states that Te Paneohoroiwi is the name of the eastern headland of the Tamaki River, but it would be as well to note that it is generally believed to apply to the St. Heliers Bay Point, which place by the way Ripokoi says was called Te Wharau. He is probably not quite correct in saying this. The name Te Wharau being a common descriptive name meaning a shed, probably only applied to some small part of the point. Tutewana of Ngati-paoa, who has much to say about this part of Tamaki, gives the following "Whakaaraara pa" or sentinel's watch-song, which he states was sung from the watch-towers of Mokoia pa at Panmure.

Tirohia te Paneohoroiwi,
Ka whakapukupuku,
Ka whakatikitiki,
Ki waho ra.
A----- He kawau! He kawau!
A----- He kawau-tikitiki
Kei te eke ki runga
Ki Tahuna-torea.
A----- He kawau tikitiki, he Kawau!

Behold the head of Horoiwi,
Behold its many pinnacles,
Out there beyond it stands with many crests,
Ah! A cormorant. A cormorant.
Ah! A crested cormorant alights
On Tahunatorea.
Ah! A cormorant. A cormorant.
Ah! There is the crested cormorant
That comes ashore on the beach at Waipapa.
Ah! A crested cormorant! A cormorant!

Tahunatorea is a sandbank in the Tamaki River just off the long point called Te Pupuokawau or Whangamata, that juts out into the river on the western shore. From here was to be obtained the first view of Mokoia pa and when shags flew before approaching canoes and landed on Tahunatorea, it was the sign of approaching visitors or possible enemies. Tahuna — a sand bank. Torea or Korea — the oyster bird. Ripikoi says Waipapa is the place of that name at the foot of Stanley St., but Tutewana thinks it another place of the same name.

TE PANEOPOATANIWHA "The head of Poataniwha". A hill top where track runs from Paremoremo Wharf to Araparera. Almost due north of Paremoremo landing.

PANIPANIKOKOWAI "Paint over with red ochre". An old pa at the west headland of Paremoremo Creek.

TE PAPAATAMATERA "The flat of Tamatera". Really rocks stretching out into the sea at foot of the headland to the west at the mouth of the Tamaki River. The northern point of Karaka Bay. [N42 391610]

PAPATOETOE "Toetoe flat". Papatoetoe district.

PAPAKURA "Red earth". Named from Redhill, the red earth there.

TE PAPAKUAWHAI "Whai's shoal". The shaol bank off St. Mary's Point. No record as to whom Whai was. Once known as Boyland's Paddock.

TE PAPAPA "The fortress built of rock slabs". District between Penrose and Onehunga.

PAREMOREMO "Drowned". A tidal creek in the upper Waitemata Harbour.

NGA PARETOKAATERAUITI "The stone parapets of Te Rauiti". A pa enclosed by stone walls in place of palisading, situated on the westernmost hill overlooking the Three Kings College at Three Kings. (Still extant 1929) [N42 276541]

PARINGAWHARA "Crumbling cliffs or foreshore". The cliffs at the north end of Narrow Neck Beach. [N42 316653]

PARITAIURU "The slope from the cliff front". (a) A hill pa now known as Pukekiwiriki which is really a corruption of Pukeokoiwiriki, another and more recent name. Now a domain under the Papakura Town Board. About two miles east of Papakura town in the direction of Red Hill and Hunua. (b) "The slope from the cliff front". Name of a very old pa about two miles east of Papakura on the heights above Red Hill. Now part of a domain called Pukekiwiriki. Paritaiuru was the ancient name of this pa and is descriptive of the place. In after times the pa was called Pukeokoiwiriki, the hill of the small skeleton, from the fact that a certain chief's bones had been hung up there. Pukekiwiriki is a mis-spelling of this. Paritaiuru is important in that the great chieftainess Marama who came in the Tainui canoe, visited it and finally settled hereabouts founding a tribe known as Nga-marama.

PARITUHU "Perched on the cliff". The cliff above the site of the old graving dock, hence the name of Graham's homestead "The Perch", since demolished when the cliff was cut away in 1884. A pa there in olden days. [N42 313626]

PARUROA "The long stretch of mud". Big muddy creek, on the Manukau Harbour below Titirangi. Site of the great battle between Waiohua and Ngati-Whatua. [N42 145455]

TE PATAPAPA "The pa with the flat top". Mt Roskill. Also called Puketapapa. A pa of Ngati-awa.

TE PATUNAAPI "The eel weir of Pi". A turn on the Paremoremo Creek just above Te Pakarakaorongo, and formerly the site of an eel weir. Pi was a slave of Kakea and was killed here by Ngati-whatua.

PATUNARUA "The double eel weir", or possibly a weir to prevent eels from retreating into a deep hole. A place at the headwaters of Shoal Bay to the east.

PATUROA "The prolonged beating". The bay to the east of Opou or Davie's Bay, Manukau Harbour. [N42 181482]

PATUTAHI "Killed together". A place near the site of St. John's College. Here a party of Ngati Paoa and Ngati Whangaunga chiefs on a visit, was waylaid and murdered by Waiohua, the incident at Remuwera being part of the affair. The massacre and locality were known as Patutahi or the "killed together" and led to future wars. Vide Remuwera.

PEHIMANAWA Home Bay, Motutapu Island. (meaning uncertain).

TE PIKIHAERE "The climbing up". The track leading to the Summit above the hill where the trig is situated, north of Paremoremo landing.

PITOITOI "Name of a bird". Brigham's Creek. [N42 125694]

PITOUHI "Tip of the tuber". A peak at Waitakere, south of Okaurirahi.

POKANOA, fully *Te Pokanoa a Tarahape*. "The foolish act to Tarahape". Tarahape was a minor wife of Te Ikamaupoho. She interfered with a tapu canoe moored at the above place resulting in the death of several people. The headland at the west end of Okahu Bay, Orakei. [N42 329604]

NGA PONATORUAPERETU "The three knuckles of Peretu". Another name for Rangitoto's peaks.

TE POUHAWAIKI "The pillar (from) Hawaiki". A small hill now excavated for scoria, formerly on south side of Mt. Eden. Origin of name now lost, but reputed to have been a "Tuahu" a post or pillar before which ceremoies were performed before the departure of fishing or hunting expeditions.

POUREWA "The elevated platform". The name of a high point on the Orakei block overlooking the Purewa Creek. On this point stood a sentry post on poles. The sentry warned the watchers in other watch towers by a system of signalling (tuhi or tuhituhi). Now known as Purewa. Also the name of a creek in that locality. [N42 c 338581]

TE POUTUARAKATAURA "The post erected by Raka". To this post the Tainui canoe was moored. A place on the foreshore of Otahuhu and a tribal boundary mark in modern times. Manukau shore.

TE PUHEA, anciently TE PUHEATANGAOTEATA. "The blowing in of Te Ata". A little cove below Hillsborough cemetery on eastern side. Te Ata, ancestress of the Ngati te Ata tribe, left here with an attendant in a small canoe to visit relatives further along the coast. She was blown back by a gale said to have been sent by jealous persons who disapproved of her intended visit.

PUHINUI "Big plumes". Named from the sighting of a war canoe stern with feathers in the creek. An incident from Kawharu's war.

TE PUKAKITAPU "Sacred fountain head". A spring at the head of Pukaki Lagoon, Mangere. A place of ceremonial importance of Waiohua.

PUKAPUKA Name of a shrub, *Brachyglottis repanda*. The headland at Kohimarama wharf. [Probably N42 354609]

PUKEITI "Small hill". A small pa at Ihumatao, Mangere, overlooking the mouth of the Oruarangi Creek. [N42 c 273440]

PUKEKAROA Hill behind Wintergarden in Domain.

PUKEKARORO "Karoro hill". Hillsborough Cemetery, Onehunga. Karoro, a seagull, *Larus antipodium;* 2. A kind of shell-fish. [N42 287528]

PUKEKAWA "Sour hill". The hill now occupied by the War Memorial Museum, and was so called because the land thereabouts was "kawa" (sour or bitter) and would not grow kumara. Renamed "bitter memories" by Potatau Te Wherowhero in memory of the dead in the wars of ancient times. [N42 296593]

PUKEKOHE "Hill of the Kohe tree". Hill at Pukekohe.

PUKEKOI "Sharp hill". A small hill at Greenhithe almost opposite Hobsonville landing. [N42 196682]

TE PUKEOKOIWIRIKI "The hill of Koiwiriki". Redhill, Papakura.

PUKEOTARA "Hill of Tara". A hill pa near the headwates of the Waiotara branch of the Tamaki River, to the south thereof. [N42 412497]

PUKETAPAPA "Hill with the flat top". Also called Te Patapapa, "The hill fort with the flat top". Mt. Roskill. Originally a pa of Ngati-awa. [N42 c 257528]

PUKETUTU "Hill of the tutu shrub". The island to the west of Mangere. [N42 c 265465]

TE PUNAARANGI "The spring of Rangi". A spring of water formerly where Mt. St. John Avenue joins Manukau Road. (approximately).

TE PUNAREREAMARU "The flowing spring of Maru". The Maruiwi were an ancient people of Tamaki who came from the south. They were named after their chief Muruiwi who, however, never lived here. Name of the spring at Seccombe's brewery, now Brown Bros. and Geddes Ltd. Also called "Te Punarereamarutohutau" and "Te Punaamarutohutau". If it flowed violently in spring weather: sign of a fruitful harvest.

TE PUNAWAIATENE "Tene's spring of water". A spring at Awataha, Shoal Bay, Catholic Native Reserve. Tene — Aomea — Hirawa — Otaimea — Potene — Patea — Putoutei — Nga uri a Tene. [Tene seven generations ago].

TE PUNATUNAOHINEKAKEA "The eel pond of Hinekakea". A pool where the fresh water creek enters the head of the Paremoremo Creek. Near the old village site Te Marae o Hinkakea. Eels were only taken from here at new moon.

PUPONGA "Bundle of tree fern". Puponga Pt. A shark fishery on olden times. [N42 c 357579]

TE PUPUOKAWAU "The bundle of Kawau". The long point on the west shore of Tamaki River mouth. Kawau had his hair cut here. The hair was hung in a bunch on a tree and was therefore "tapu" and a burial place. Kawau was Tuhaere's uncle, of Ngati-Whatua.

PUPUKEMOANA "The overflowing sea (or lake)". Because it sends springs of water to the seashore. [N42 280690]

TE PURANGAKUPENGAAMAKI "Maki's heap of fishing nets". A sandbank in the Manukau southwest of Mangere and just north of Puketutu Island. Maki was of Ngati Awa, from Taranaki, and came to Tamaki via Kawhia and Waikato. He attacked several pa on the isthmus, among which was Rarotonga where he lived for some time.

PURAKAU "A clump of trees". A channel in the Manukau between the sandbanks immediately to the west of Puketutu Island, Mangere. [N42 c 238460]

PUREWA (correctly *Te Pourewa*) Name of a high ridge on the Orakei Block overlooking the Pourewa Creek. Vide Pourewa.

TE RAEOKAWHARU "Kawharu's Brow". The bridge now known as Arch Hill. Kawharu's war party rested here. Kawharu relaxed; hence the place was tapu until European times. (1680 A.D.) (Te Mianga a Kawharu).

TE RAHOOTEPOA "The lump of Te Poa". A large globular boulder at the top of Paremoremo tidal creek. Te Poataniwha of the Kawerau tribe.

TE RAHOPARAOPERETU "The fern tubers of Peretu". The headland at Milford Beach by Wairau Creek.

RAMARAMA "A gleam". Near Drury.

RANGIMATARAU "Day of a hundred spears". The beach at Pt. Chevalier. Really the name of a battle fought there between Ngati Paoa and Ngati Whatua (about 1750-1760). Ngati Paoa, who were invading Tamaki, were defeated. [N42 222660]

RANGIMATARAU "The day of a hundred spears". Pt. Chevalier. [N42 222604]

RANGIMATARIKI "The day of the small spears". Possibly name of battle. Also Rangi — sky; Matariki — Pliedes, a group of stars. The eastern headland of the Whau Creek. [N42 185592]

RANGITOPUNI "The day of the dog skins". A place at the head-waters of the Waitemata River north of Riverhead. Named after a battle between Waiohua and Ngati Whatua. The chiefs wore their dogskin garments (topuni). So many lay dead on the field that the battle and place were so called. Vide Kahutopuni.

RANGITOTO "Blood from the sky". i.e. lava. Toto, the name of the black stone (volcanic lava) characteristic of the island. "Day of blood of Tamatekapua". He was wounded in a battle at Motutapu inlet — blood stained rocks.

RANGIURU Clevedon way.

NGA RANGOERUA (O TAINUI) "The two skids of Tainui". The small island at the headwaters of the Manukau Harbour to the west of Otahuhu. Probably named by the Tainui immigrants when passing this district on their way to Kawhia. [N42 330507 and N42 339499]

RAROTONGA "The lower south". Mt. Smart, Onehunga. This place was named by the Tainui immigrants after their Pacific home. The name is applied to the whole district. [N42 330523]

TE RATOROA (misnamed Rotoroa) "The long delayed sunset". A battle. An island.

RAUPUNGATA "Dried up foliage". A hillside at Awataha. The foliage of the puriri there became dried up during one dry season. A modern name.

TE REHU The site of the Auckland zoo, where the fresh water enters the salt in Motions Creek. Te Kawau camped here for some time after the Nga Puhi raids in 1821.

REMUWERA, misspelt Remuera. "Burnt edge" (of a skirt). A young chieftainess, one of a party of visitors from Wharekawa to these parts, was murdered here-abouts (near the old Dilworth homestead), Great South Rd. Her body was cooked in the oven with the skirt attached. The 'remu' or edge of the skirt was scorched, hence 'Remuwera', the name of a village that stood near Dilworth homestead, Great South Rd. This incident was part of an affair in which Kahurautao, his son Kiwi and other Marutuahu chiefs were murdered. These people were returning from Waikato by canoe and visited the pa at Mt. Eden. While returning to their canoes at Tamaki River they were ambushed at St. John's College. A war in which the Mt. Eden pa was captured resulted, about 1600 A.D. Vide Patutahi. [N42 306571]

TE RERENGAORAITI "The leap of the survivors". The headland afterwards called Pt. Britomart. Also spelt Te Terengaoraiti. Named after an incident in Kawharu's time (1680 A.D.) and repeated during a Nga Puhi raid in 1822.

TE REREREETIOKE "The sledge sliding of Ke". A slope on the side of the northern lagoon on west shore of Shoal Bay. The south-western headland of the lagoon, Te Kopuaomatakamokamo. Formerly the game of "reti" was played here. (Heath's land).

TE REUROA "The long outer palisading". A pa that stood on the site of the Supreme Court, extending to the foreshore.

TE RIMUTAHI "One rimu".. Locality of the reservoir, Karanghape Road.

RONGOHAU "Nook sheltered from the wind". It was a favourite sheltering place for canoe parties in heavy weather. Kendall's Bay, Kauri Pt. [N42 227636]

TE ROREAAKEHU "The swishing sound (of waters) of Kehu", short for Taikehu. The stream that flows down from the Hillsborough Cemetery into Te Puhea Cove, Onehunga.

ROTOARANGI "The lake of Rangi". A small lake, now dried up, at the rear of St. Alban's church, Dominion Rd., the site of which was recently a raupo swamp. Rangi belonged to One Tree Hill and had come to this lake with her attendants, to gather fresh water shell-fish. She was captured here by a party of Ngati Whatua.

TE ROUKAI "The food gathering". A pipi bank which lay formerly between the site of the Waitemata Hotel and Pt. Britomart, mouth of Horotiu Creek.

TE ROUTUOUREIA "The comb of Ureia". A reef of Pt. Erin Campbell. Ureia was an ancient monster, probably a pet whale, which resorted here to scratch itself on his journey from Hauraki to Manukau.

TE RUAARANGI "The pit of Rangi". Somewhere about the junction of Great South Rd. and Manukau Rd.

TE RUAREOREO "The duplicating of voices", i.e. the Echoes. The gully leading from Newmarket to Hobson Bay.

TAHINGAMANU "The flocking together of kuaka birds". The sandspit to the east of Hobsonville.

TAHUNATOREA "The sand-bank of the oyster bird". A sand-bank on the Tamaki River just off the long point called Whangamata or Te Pupuokawau that juts out from the western shore. From here there was to be obtained the first view of Mokoia pa. When shags flew before incoming canoes, it was a sign of approaching visitors or possible enemies. Vide Motukorea. Korea and Torea both mean oyster bird.

TAIHARAPAKI also TAIHARAPAPAKI "Sea beaten cliff front". The cliffs between Orakei wharf and Mission Bay.

TAKAPARAWHAU "The cutting down and clearing of the Whau shrub". The point of Orakei wharf.

TAKAIWAHO "The rock outside". Heaphy Mt., Devonport.

TAKAPU Gannet Rock. Known as Passage rock, south west of Cape Colville. Anciently Te Poito o te kupenga o Taramainuku, "the net-float of Taramainuku". He was a chief on board Te Arawa canoe, and was the grandson of Tamatekapua. It was at this isle that the Arawa canoe touched in order to perform a ceremony and leave a certain stone as a Mauri or mascot, to avoid evil, hence possibly the name of Hauraki gulf. Usually spelt Tikapa.

TAKAPUNA "The rock with a spring". North Head.

TAKARARO "The rock below". Cambria, Mt., Devonport.

TAKAWHENUA "The fall of the land". A place about half way between Narrow Neck beach and Takapuna Beach, say about the foot of Seacliffe Road, off Victoria Rd.

TANGIHANGAPUKAEA "The blowing of the war trumpet". A pa on the site of Pt. Britomart.

TAMAKIMAKAURAU "Tamaki of the many lovers". The general name for the Auckland Isthmus. So named because tribes were continually at war for its possession.

TE TAPERE "The family meeting house". The bay or point on Manukau Harbour below Hillsborough Cemetery.

TE TAPOTUOTAINUI "The launching or refloating of Tainui". Headwaters of the Manukau at Otahuhu, end of Portage Road.

NGA TAPUWAEAMATAOHO "The footmarks of Mataoho". The inlets at Pukaki, to the south of Mangere. Where that god left his footprints is still to be seen. Vide Te Ihuamataoho and Te Kapukaiomataoho. [N42 c 325420]

TE TARAKARAIHI (a small sea-bird of the tern variety). A canoe landing at the foot of what is now Swanson St., opposite Te Whatu. A track led from here to Swanson St., to Te To.

TE TARAPOUNAMU Track from Swanson St. to Queen St.

TE TATUAARIUKIUTA "The belt of Riukiuta". Three Kings Hills. Riukiuta was one of the Tainui people and settled here. Ngati Riukiuta was the local hapu. Said because the hills formed a group around the central citadel or Te Tatua a Mataoho.

TE TAU A large sandbank south of Blockhouse Bay. (Marked on Admiralty Chart).

TE TAUHINU (a kind of hearth). A pa on the eastern headland of Paremoremo Creek.

TE TAUHOKAIAPI "The fishing net pole of Pi". A mud flat to east of Waimarie.

TAUMATAREA POINT "Bellbird lookout". [N42 155448]

TAUNAHI "Nahi — a tree". Nahi lookout. The eastern headland of Blockhouse Bay.

TE TAUNGAROA "The long-abiding". Headland immediately to the north-west of Hobsonville landing.

TE TAUOMA An abbreviation of a longer name. The land bordering the Tamaki River on western shore. Also applied to Purchas Hill, now quarried.

TAURARUA "Song of annoyance". Pt. Resolution and site of Parnell Baths. In olden times a pa stood on the headland and was attacked and captured by Ngati Whatua. In later times the name was applied to the Parnell foreshore generally.

TAURERE A place on West Tamaki Head, near the present Karaka Bay. So called by the Tainui chief Te Keteanataua, after his daughter. Also TAURERE "lament" Taylor's Hill, Glendowie, named after the lament of Ruahine.

TAWHIWHIKAREAO "Entanglement of supplejack". The deeply wooded gully which runs down into Soldiers Bay on the upper harbour. Inland of Kauri Point to the west thereof. Where Kareao supplejack was gathered used in lashing canoes. As supplied by Te Pataka of Paremoremo.

TIKAPA Hauraki Gulf so called from a ceremony performed on board Tainui there. Possibly more correctly Takapu vide. [? on board Te Arawa].

TINANA "The body (of a person)". A place in Hobson Bay at the foot of Victoria Ave. Now called Wilson's Beach. Possibly named after the local chief Tinana.

TIRITIRIMATANGI "Blown in the wind". The island appears to move and appear in different places.

TITIRANGI (a veronica plant). The hills so called. Name from Hawaiki.

TITIKOPUKE or PUKETITIKO "Hill of Titiko". Titiko is a shellfish found in brackish waters, tidal creeks, a kind of periwinkle. Mt. St. John. Reason for name not obvious or now ascertainable.

TE TITUTAHI "The cabbage tree standing alone". An historic cabbage tree resorted to for ceremonial purposes stood here. Main Rd., Newmarket.

TE TO or TE TOO "The dragging up" (of canoes). A pa on the western headland of Freeman's Bay. Site of present orphanage.

TE TOANGAKIOTAHUHU "The portage of Otahuhu". Portage Rd. also called Tauoma.

TE TOANGAROA "The long pulling or dragging" (of canoes). Mechanics Bay.

TE TOKAATUKIATA "Tukiata's rock". A pinnacle of rock standing in the sea at Rangitoto Beacon. In days gone by there dwelt at what is now Takapuna, a man named Matahuripo. This man quarrelled with his wife over the making of garments. He thereupon cursed the cold, and the gods in their anger caused the hill on which he lived to subside and in its place came Lake Pupuke. At the same time Rangitoto arose from the sea. To this place Matahuripo fled together with his wife and a female slave named Tukiata, but in their haste they left their twin children on the beach at Takapuna. Tukiata was then ordered to make a raft and go to their rescue, but she was told on no account to look back for fear the gods should become angry. Away she went but forgot and looked back. She and the children were immediately turned to stone. The pinnacle of rock by the Rangitoto Beacon is Tukiata (or Te Whatu Kaupapaatukiata), while the two rocks on the shore at Takapuna are the twins and are known by the name of Ngamahanga. (One to the east is Hinerei, that to the west is Matamiha, according to Mu Paerama).

TE TOKAOKAPETAUA "The rock of Kapetaua". Bean Rock. When Kapetaua (or Kapetawa) was a lad he came from Waiheke with his sister Taurua, to Kohimaramara. Taurua had married Taramokomoko of this place. Kapetaua in an act of mischief plundered the kumara store of his brother-in-law, who marooned him on Bean Rock. On being rescued by his sister he returned to his people the Ngati Paoa, later to return with a war party to avenge the insult.

TOKAPUREWHA "Black Mussel Rock". Probably the black mussel was to be found here. A pa on the eastern point of Okahu Bay, Orakei. Captured by the Ngati Whatua after the defeat of Kiwi Tamaki at Paruroa.

TE TOKAROA "The long neck or reef". The reef off Pt. Chevalier. vide Te Arawhakapekepekearuarangi. Said to be remains of a fairy bridge etc.

TOKAROA "Long Rock" Point in Manukau. [N42 168460]

TE TOKATUAWHAOROA "The stone pillar of Wharoa". A hill pa that stood on the high ridge immediately to the east of Three Kings Rd. (at rear of Kinloch's homestead). Wharoa came from Moehau. He was of the Arawa (Ngati-huarere) people, and set up a stone pillar at the above place. It was a kumara god and general tribal mascot (Uruuruwhenua). (The stone in question stood on the old pa site on the eastern rim of the old tuff crater at Three Kings. During the eighties of last century the stone was dragged down by some vandals who rolled it down the hillside where it remained for some years. It was eventually recovered by Sir John Logan Campbell, who had it set up near Acacia Cottage in Cornwall Park, One Tree Hill).

TOKIWHATINUI "Axe badly chipped". Somewhere in the vicinity of Auckland Hospital. Really the name of a battle there in Kawharu's time (1680).

TOROTOROA "Stretched out as into headlands". An island east of Waiheke now misnamed Rotoroa "Long lake".

TOTARA Name of tree. A creek flowing into Brigham's Creek, upper harbour, on east side.

TE TOTARAIAHUA "The totara standing alone". Another name of One Tree Hill. The totara grew from a stick on which the cord of Koroki (1600 A.D.) was cut. A tapu tree from which the name One Tree Hill came. Now replaced by a pine.

TOTARATAHI "One totara tree". Northcote Point. Probably name of the place where the tree itself stood. Note: One still stands there planted by Maori in 1909.

TE TUAHUOHUAKAIWAKA "The sacred stone of Hua the canoe eater". Huakaiwaka was chief of Mangawhau pa and flourished about 1650-1680 A.D. The "tuahu" was a lava outcrop about at the entrance of the Domain Drive. Here ceremonies were performed, before going into battle etc. Kiwi Tamaki is said to have offered propitiatory rites there before his war with Kaipara. Huakaiwaka was an ancestor of the Waiohua people of Mt. Eden. He destroyed or subjugated other tribes, hence his names Kaiwaka (Waka a tribe).

TE TUAHUA O HUAKAIWAKA "The ceremonial place of Hua." Stone lava crop on N.W. slope of Mt. Eden (near entrance from Mt. Eden Rd. Hua was ancestor of Waiohua. He destroyed or subjugated many tribes, therefore Kaiwaka — eater of waka (tribes).

NGA TUAITARAATAIKEHU "The dorsal fins of Taikehu". The three peaks of Rangitoto. Taikehu was a Tainui immigrant who settled hereabouts at Takapuna, hence the name of the local tribe Ngai-tai. Another name of the peaks was NGA TUAITARATOHUHAU. They gave indications of weather changes. Mist thereon indicated rain: if clear, fine weather. [N42 373682]

TUHIMATA Old pa now known as Peach Hill.

TUHIPARAPARA "The place smelling of decayed fish". A place at Blockhouse Bay on the east side.

TUKITUKIMUKA "Beat out the flax fibre". To the north of Cox's Creek.

TUNAMAU "Eel caught". A creek formerly between the foot of Franklin Rd. and Union St.

TE TUPOOTETINI "The caverns or burial pits of many". A burial cavern on One Tree Hill. The bodies of the dead were lowered therein. This was a common sepulchre of the greater number of the people. On south-west of the tihi of the pa. Hone Tutere 19.8.91

TURANGAOKAWAU "The standing place of Kawau". "The place where he stood". A place on the extreme upper reaches of the Waitemata, where Brigham's Creek joins the Waitemata River. The western head of Brigham's Creek.

TE TURERENGA "The slipping away". A headland to the east of Onetaipu, near Pine Island (vide Onetaipu). Nga Puhi had caught some prisoners here, but during the night they unfastened their lashings and escaped.

TE TURIPONAOIRI "Iri's knee-cap". A large stone on the Paneopoataniwha hillside. Te Paneopoataniwha hill is immediately to north of Paremoremo landing. Vide Te Paneopoataniwha.

TE UMUPONGA "The oven in which ponga was cooked". A spot near the western end of Okahu Bay, Orakei.

UMUPUIA "Steaming oven". Duder's Beach.

TE UPOKOTAMARIMARI "The head of Marimari". The headland east of St. Helier's Bay. So called by a chief in Rakataura's exploratory canoe Te Pauiriaraira. (Raira's bones were placed in the tree so called and from which the canoe was made and named). The later Tainui people called this headland Te Paneohoroiwi.

TE URITUOHAPE "Hape's upstanding son". A rock off Paremoremo wharf landing to the west thereof.

URUHOUHI "The houhi tree grove". A place at St. Helier's Bay. Exact position not certain. Somewhere on the flats. Houhi, *Hoheria populnea*.

TE URUKARAKA "The karaka grove". A gully at rear of Newton Rd., to the south thereof (Newton St.) Origin of name of Karaka St.

TE URUKOWHAI "The kowhai grove". A headland on east side of Paremoremo Creek about half way up, opposite Te Araia-Tiriti.

URUKOWHAI "The kowhai grove". Northcote.

TE URUPA "The burial ground". A point at the headwaters of Shoal Bay on the west side. (Almost opposite Esmond Rd. point, Takapuna).

TE URUTAPU "The sacred grove". A place on the foreshore at northern end of Takapuna Beach. About the "Strand", Takapuna.

NGA (H)UWERA "Burnt Breasts". The headland at the mouth of the Waihorotiu. Site of the Waitemata Hotel. [N42 286612]

WAIARIKI "Waters of the ariki (head chief)" or "waters having a curative value". Probably a spring of water so reputed hereabouts. Formerly Official Bay.

WAIAROHIA O NGARIKI "The panoramic waters of Ngariki". The creek or tidal inlet of Hobsonville Point, facing Pine Island. Ngariki an ancient tribe.

WAIATAIKEHU (anciently) afterwards called *Waiakehu* "Waters of Taikehu". St. George's Bay, now reclaimed, or perhaps a small creek that flowed into the bay, which was so called as no other name is on record.

WAIATARAU "Waters reflecting shadows". Stream in Freeman's Bay.

WAIATARUA "Waters of double reflections". Lake St. John.

WAIATEAO "Te Ao's Creek". Motion's Creek.

WAIHOROTIU "Horotiu Creek". The name of the creek that formerly flowed down Queen St. Named after Horotiu Pa on the hill above, namely Albert Park.

TE WAIINUROAORAKA "The long water drinking of Raka". A small lagoon formerly on the northern side of Balmoral Road about halfway between Mt. Eden Rd. and Dominion Rd.

WAIKAHIKATOA "Ti tree waters". A creek flowing into the northern arm of Hellyer's Creek.

WAIKARAKA "Waters of the karaka tree". Now a cemetery on the shores of Manukau Harbour to east of Onehunga.

WAIKARORO "Waters of the karoro gull". That part of the Manukau Harbour in the vicinity of Puketutu Island to the south-west thereof. Karoro, *Larus antipodum*.

WAIKOHANGA "The nest by the creek". A small pa formerly at entrance to Auckland Domain near Grafton Rd. A block-house was erected there during the Waikato War.

WAIKOKOTA "Cockle water". Freeman's Bay. Probably a modern name. Now reclaimed. Ancient name said to be *Waiatarau* "waters reflecting shadows".

WAIKOTUKUTUKU "Waters of the fuchsia". A creek at Waimarie, upper Waitemata Harbour. Kotukutuku: *Fuchsia excorticata*.

WAIKOWHAI "Waters of the kowhai tree". A tidal creek immediately to north of Sulphur Beach, Shoal Bay.

WAIKOWHAI "Waters of the kowhai tree". A bay still so called on Manukau Harbour. May also mean "yellow water".

WAIKUMETE "Stream in a bowl". Stream on Manukau shore.

WAIKUTA "Water-reed river". A creek at the foot of College Hill to the south thereof. (Kuta a weed used for making floor mats).

WAIKUTA "Water-reed creek". A creek at the foot of Hauraki Rd., Takapuna, to the south thereof.

WAIMARIE "Calm, peaceful waters".

WAIMOKOIA "Waters bubbled up in froth". Meaning as given by Tutewana of Ngati paoa. Moi, to be bubbled up in froth, and Mokoia the passive thereof. Said to be the name of the Tamaki River, so named after the famous pa, Mokoia. Tutewana says that Waimokoia was the name of a spring on the western side of the Panmure Basin also called Waipuna.

WAIMOKOIA (TAMAKI RIVER). Mokoia the name of the pa at Panmure — where old bridge head is. Mokoia — a method of collecting fragments or small objects into one place or a heap. So called as a place of assembly for mutual protection. Potene's explanation Awataha 1904.

WAIONOKE Pipeclay creek. Now called Riverlea.

WAIORAKA "Waters of Raka". A swamp to the south of Mt. Albert. Raka or Wairaka was a Ngati-awa ancestress who lived at Mt. Albert.

WAIOREA "The eel water". Western Springs. Orea, a kind of eel.

WAIOROKA "Waters of Roka". A small tidal inlet on east side of Shoal Bay at the foot of Francis St., south end.

TE WAIOTAIKI "The waters of Taiki". Tamaki River. Taiki was a chief on Tainui who took possession of the river.

WAIOTARA "The creek of Tara". A tidal inlet on the eastern side of Tamaki River to the south of the Howick Road. Tara evidently a person who lived in this locality as other names in which his name appears are found there.

WAIPAORAORA "Dried up or shallow water". The upper reaches of Shoal Bay, because the spring tides did not cover them.

WAIPAPA "The waters of the flats". The name of a tidal creek which formerly flowed down Stanley Street, Mechanics Bay.

WAIPARERA Duck Creek. The creek at the eastern extremity of St. Heliers Bay.

WAIPAREIRA "The creek at the place before mentioned". A creek flowing into the upper Waitemata Harbour, to the south of Lime-burner's Bay, Hobsonville.

WAIPARURU "Shady or gloomy creek". Cemetery gully.

WAIPOHARU "Waters stagnant, boggy and marshy". A swamp formerly to west of Epsom Rd., near St. Andrews Church.

WAIPOKANOA "Waters of foolishness". A fishery off Kauri Pt. near Boat Rock (Te Nihokiore).

WAIPUNA "Waters flowing from a spring". A creek flowing into western end of Panmure Basin.

WAIRAU "Enclosed waters, as in a net or scoop". The creek at north end of Milford Beach.

WAIROPA "The slaves' water". A channel in the Manukau Harbour off Karaka Bay. On the south side of the Mutukaraka sandbank.

WAIRORIA "The whirlpool or swirling waters". Name given to this spot, rather than the headland itself, to the west of Kauri Pt. A strong tide rip always found there explains the name which is appropriate to the place and is the name by which this foreshore is known generally.

WAITAHURANGI "Fairy river". A creek at the headwaters of Whau creek on western side.

WAITAKEREI, misspelt Waitakere, "Waters bubbling forth", stream and district.

WAITARAMOA "Spear grass water". Hobson Bay, also applied to a creek at headwaters of Bay, near Hay's Gardens.

WAITEMATA "Waters of Te Mata". Auckland Harbour. Said to have been named after the rock Te Mata, in the upper harbour, now called Boat Rock. Vide Te Mata.

WAITEPUTA "The water flowing forth". A stream flowing into headwaters of Brigham's Creek on west side.

TE WAITIOTOROA "The little space or area of Toroa". A small islet near Birkdale on the upper Waitemata. Now called Island Bay. Toroa rested here on her way to Paremoremo.

WAITITIKO "Periwinkle creek". Meola Creek.

WAITITIKO Headwaters of Ngataringa Bay, towards Narrow Neck.

WAITOMOKOIA "Water that flows under the ground". A hill so called at Ihumatao. [Also applied to the sewerage ponds.]

WAIURUTOA "Waters of the clump of ti tree". A place at Northcote; the stream that flows into Waikowhai tidal creek on western shore of Shoal Bay to north of Sulphur Beach. A settlement of Kawerau there in modern times.

WAIWERA "Hot water". Named from the hot springs there.

WAIWIWI "Waters filled with rushes". An inlet on eastern side of Shoal Bay at foot of Eversleigh Road, to the south thereof.

WAIWHAKAATA "Water reflecting image". Freeman's Bay.

WAIWHARARIKI Wai — water, Wharariki — a mat used as a carpet. Takapuna, to the south thereof.

WAKAKAIWHARA Pt. at Umupuia.

WAKATATERE "The drifting canoe". A creek at extreme headwaters of Shoal Bay on western side. Formerly an old tapu canoe derelict there and drifted about at high tides.

TE WAONUIOTIRIWA "The forest of Tiriwa". Old name of Waitakerei.

TE WAROWARO "Echoing or murmuring sounds". The cliffs at Motutapu at headland of "Drunken Bay".

TE WARUWARU "To grate or scrape (food)". Now called Drunken Bay. Really the name of a pa that stood on Motutapu at the head of the bay.

NGA WHAKAIROATITAHI "The carving of Titahi". Titahi of Ngati Awa carved the hill in the likeness of his own tattoo. He flourished about 1200 A.D. and is said to be the first builder of a volcanic hill pa. [One Tree Hill]

WHAKAMUHU "To lead into a thicket". The old volcanic crater partly washed away at St. Heliers Bay Point.

TE WHAKAPUTANGA "The bringing out" or "ridding of tapu", in Waitakere forest — near Pukehuhu. Ceremony before drawing out from forest a partly shaped canoe.

WHAKATAKATAKA fully Te Whakatakatakanga "The place where one slipped or lost footing". A war party attacked Pa at Pokanoa, several escapers slipped on to the beach below and were caught by an ambuscade on the foreshore. (Kawharu's invasion from Kaipara). Also Te Onepuwhakatakataka.

TE WHAKATORO "The jutting out". A reef extending from the headland to Okoarotanga (vide).

NGA WHANAKE "Cabbage trees". A place inland of Kohimarama.

WHANGAIMAKAU "Cherish the loved one". The headwaters of the Tamaki River, where the Tainui canoe party awaited the arrival of the chieftainess Marama before crossing into the Manukau.

WHANGAMATA The long headland and sandbank on west shore of Tamaki River opposite Bucklands Beach. Also called Te Pupuokawau.

WHANGANUI "Big bay". St. Helier's Bay.

WHAKARONGO "Listen" A place on the foreshore, Mangere.

TE WHARAUAKAE "The shed of Kae". A bay immediately to east of Greenhythe. Kae was a man of Kawerau tribe and was killed here by Ngati-whatua.

NGA WHARAUATAKO "Tako's reed huts". The name of an old village on the ridge between Queen St. and Hobson St., near the foreshore probably near the site of the Star Hotel, because the track to the creek now Queen St., led down where Swanson St. is now situated. [N42 c 282605]

TE WHAREMOENANU "The house where one talked while asleep". A bad omen. The south headland of Albany Creek.

WHATAROA "Long storehouse". Pa at Pa Road. Catholic convent.

TE WHATU "The rock". A rocky ledge formerly at the foot of what is now Shortland St., where canoes were moored, it being a convenient landing.

TE WHATUATUKIATA "The rock of Tukiata". Vide Te Tokaatukiata.

TE WHATUKAUPAPAATUKIATA

TE WHAU a shrub (*Entelea arborescens.*). Tidal creek flowing into the Waitemata. Known as Whau Creek.

TE WHAU (a shrub) The western headland off Blockhouse Bay, Manukau.

WHENUAPAI "Good land". Place so called at upper Waitemata, eastern edge of Brigham's Creek.

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A RADIOCARBON DATE FOR THE ARCHAIC BURIAL CONTEXT (N44/97) AT HAHEI

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Abstract. Radiocarbon results obtained on charcoal from Site N44/97 at Hahei are reported and their significance is assessed.

Salvage excavations of an Archaic burial context at N44/97, Hahei, Coromandel Peninsula, on behalf of the Auckland Museum, were reported on earlier (Edson & Brown 1977). Radiocarbon results obtained for two samples of charcoal, collected in 1976 while carrying out these investigations, have now been received. The dates, provided by the New Zealand Radiocarbon Dating Laboratory, Institute of Nuclear Science, N.Z.D.S.I.R. (Lower Hutt), are as follows.

Sample No.	*Excavation Context*	*N.Z. Radiocarbon No.*	*Age*
N44/97(1)	Square B^2, bottom of Layer II	N.Z. 4344	Post Bomb
N44/97(2)	Square B^1, charcoal lense in Layer III	N.Z. 4345	
		A(old T½)	760 ± 50
		B(new T½)	790 ± 60
		C(new T½ corrected for secular effect)	740 ± 50

Significance of the results

The NZ 4344 Post Bomb age determination for sample N44/97(1) is most likely explained by contamination of Layer II as the result of greater general disturbance, through bulldozing, to this part of the site than was realised at the time of the investigation. Characterised by charcoal lumps and sizeable *haangi* stones contained in a 10-16 cm deep, grey-black, charcoal-enriched, sandy matrix, Layer II was interpreted as the basal remnant of an oven area exposed to weathering. Its inferred stratigraphic relationship to Layer IV in the control section on Lot 20 of Wigmore Road (Edson & Brown 1977: 29-30) is not so much in question as is its integrity as an undisturbed stratum.

The second sample, giving an age determination of NZ 4345A 760 + 50 (old half-life), was collected from the thin lense of very fine charcoal (wood species unidentified) in the north-west quadrant of Square B^1 and in close proximity to the spot where the burial context (since destroyed) with its spectacular grave gifts had been discovered in December, 1975. A single radiocarbon date on charcoal from oven debris recovered in close proximity to, nonetheless in unproven association with, an important archaeological find, would normally be treated with extreme caution. As there were insufficient quantities of bone collagen and shell recovered from the excavation for radiocarbon dating purposes, an attempt was made, therefore, to check the validity of the above result by means of obsidian dating. One grey and five green obsidian flakes from N44/97 were subjected to an experimental radiochemical method of hydration shell measurement by a research student at the University of Waikato (Lowe n.d.). The results, presented as uncorrected dates BP (Lowe n.d.: 88, 90, 94), are as follows.

Artefact Accession No.	*Excavation Context*	*Uncorrected Age*
AR6024/19 (green obsidian)	B^2 Layer II	600 ± 41
AR6047/1 (green obsidian)	B^4 Layer II	510 ± 38
AR6047/3 (green obsidian)	B^4 Layer II	632 ± 44
AR6059/17 (green obsidian)	B^2 Layer II	600 ± 53
AR6059/15 (grey obsidian)	B^2 Layer II	961 ± 104
E47418 (green obsidian)	Surface find 1975	480 ± 43

The technique of obsidian dating is still at a developmental stage generally (Davidson 1975: 37; Green 1964: 134-136; Leach 1977: 136; Lowe n.d.: 2-22; Tuggle, Cordy & Child 1978: 58) and the above results are far from conclusive. These are based on the known site thermal constant for Kauri Point some 75 km to the south of Hahei. It would be simplistic to argue that these ages should be corrected back slightly in time and that the anomalies provided by samples 47418 and 6059/15 could be explained by the former's exposure to weathering and the consistently older ages reached for grey obsidian by Lowe. Errors in and anomalies amongst these uncorrected ages may be due to a host of factors — inherent physical properties, environmental and cultural factors, procedural errors etc. All that may be concluded with certainty is that the obsidian from N44/97 provides a general indication of the site's age which is independent of but not inconsistent with the antiquity implied by the early radiocarbon date.

The radiocarbon age of NZ 4345 A 760 ± 50, when adjusted for the new half-life and corrected for secular effect, provides a calendrical date of 1210 AD ± 50 years. The result is significant in several respects. Firstly, it establishes time-depth for prehistoric activity at Hahei. Further, it represents an important addition — at a geographically intermediate location — to a group of early radiocarbon dates on material derived from archaeological excavations at Sarah's Gully, Skipper's Ridge, and Tairua. The earliest of these dates are NZ 594 878 ± 49 BP on charcoal from Layer II, N44/2 at Tairua (Green 1967: 83), subsequently, and as a result of NZ 1875 570 ± 60 BP on shell (Green *in* Rowland 1976: 6), thought to be too early; NZ 358 810 ± 50 BP on wood from N40/9, the Sarah's Gully settlement, rejected in favour of NZ 359 650 ± 50 BP on charcoal (Green 1963: 66; 1970: 21); NZ 1740 A 807 ± 57 BP on charcoal for N40/7 at Skipper's Ridge, which Davidson (1974: 50; 1975: 36) accepts on the basis of the archaeological evidence and the relative compatibility of hydration rim measurements on obsidian flakes between this and other sites known to be early.

On the basis of the demonstrably close morphological affinities and their associations between the Hahei and Wairau Bar ornaments, it was intimated by Edson & Brown (1977: 34) that there may be a temporal link between these two sites. Comparison of the single radiocarbon date for N44/97 with those obtained for S29/7 strengthens the case for broad contemporaneity. Radiocarbon dates for Wairau Bar include NZ 50 850 ± 50 and Y204 935 ± 110 on charcoal, NZ 1835 780 ± 80 BP on human collagen, NZ 1837 680 ± 50 BP on shell aragonite and NZ 1838 590 ± 60 BP on moa-bone collagen (Trotter 1975: 90).

Direct evidence for physical contact between N44/97 and Marlborough is confined, for the present, to a single flake struck from a polished adze of metasomatised, black argillite derived from the Nelson-D'Urville Island Mineral Belt. Perhaps more intriguing than the question of direct contact between these two sites which, by the shortest sea-route, are 900 km apart, are the implications provided by the rare association of distinctively Wairau Bar type ornaments with an already well-developed Coromandel aspect of Archaic material culture. The full significance of this association for the broader canvas of New Zealand prehistory needs to be explored further.

Acknowledgements. Thanks are due to the staff of the N.Z. Radiocarbon Dating Laboratory for dating the charcoal samples, Paul Lowe for processing the obsidian and Professor Roger Green of University of Auckland Anthropology Department for helpful criticism.

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THE PA ON MOUNT ROSKILL, AUCKLAND (N42/11): DATING EVIDENCE FROM THE 1961 EXCAVATIONS

AILEEN FOX

AUCKLAND

Abstract. Salvage excavations on Mount Roskill, Auckland, were undertaken in 1961 by R. C. Green, L. M. Groube and F. W. Shawcross in advance of reservoir construction. It was found that the crater rim had been defended by a double palisade; a series of inter-cutting storage pits of two or three periods were examined. Radiocarbon dating of stratified charcoals showed that the main occupation lay within the period A.D. 1430-1620; the latest series of pits were undated. It is likely that the pa was abandoned after about A.D. 1700.

Mount Roskill (Puketapapa) is one of the Auckland volcanic cones situated on the southern side of the isthmus, about 2 km from the Manukau harbour at Blockhouse Bay (Fox 1977: fig. 1). Today it is surrounded by streets of small houses and by the main thoroughfare of Dominion Road. There is a small recreation area named Winstone Park at the base of the hill on its northern side and the whole forms a Public Reserve administered by the Mount Roskill Borough Council. There is now a sealed road to the hill top where an underground reservoir was constructed in 1961-2 by the Auckland City Council and subsequently transferred to the Auckland Regional Authority.

Originally, Mount Roskill was a dual crater showing at least two foci of eruption dating from late Pleistocene times and with the lava flowing south and east towards Oakley creek and Mount Albert (Searle 1964: 66 and fig. 11). The external slopes of the crater were extensively modified by the Maori people to form a series of terraces for living sites and stores. In the southern portion there are three or four tiers of terracing along the contour, ending on the east above Dominion Road as shown on the air photograph (Fig. 1). These terraces vary in length and some are divided into segments by ridges of unquarried hillside. The uppermost terrace continues round the northern portion of the hill. Storage pits are visible on most of the terraces as well as many exposures of shell midden, mainly small cockles and a few scallops. The rim of the crater was much altered when the reservoir and the road were built but two raised portions still survive intact. The northern eminence of 335 ft (102 m) is squarish and appears to have been made defensible by means of steep artificial scarps on the north and east sides and by two terraces on the west (Fig. 2). It may be interpreted as a strongpoint or *tihi* similar to those on other terraced pa in Auckland, as for example Mount Eden (Fox 1977: 5), though on a smaller scale. The southern eminence, 340-350 ft (104-107 m) high, has been defined by transverse scarps at either end; on the top there are two very large storage pits and at least four smaller ones; it can be deduced that this was primarily a defensible food store. There are no earthwork defences on Mount Roskill, such as occur on Mount Hobson or One Tree Hill and which are held to be a late feature (Fox 1977: 7), but in other respects it is a typical terraced pa of the Auckland series, which is attributed to the Waiohua people. The date of the occupation, therefore, is of much importance could it be established on archaeological grounds.

Rec. Auckland Inst. Mus. 16: 45-61 25 January 1980

Fig. 1. Air photo of Mount Roskill before the construction of the reservoir and access road. The sites of the 1961 excavations are marked in white. (Photo: Whites Aviation.)

Fig. 2. The northern *tihi* on Mount Roskill, looking towards the Three Kings, about A.D. 1900. Site of the 1961 excavations was in the foreground. (Photo: Percy Smith colln, Auckland Institute and Museum.)

Before the reservoir was constructed in 1961-2 an archaeological investigation was carried out by the Anthropology Department, Auckland University, directed by Roger Green, L. M. Groube and Wilfred Shawcross. A brief account was published by Shawcross (1962: 81) and the finds and photographs were deposited in the Department. The notebooks and drawings were taken to Canberra by Shawcross but Xerox copies have recently been made available. The finds have now been placed in Auckland Museum and Green suggested that I should prepare a report for publication. Among the finds, there were four samples of stratified charcoals which the excavators had selected as suitable for radiocarbon dating, a process which was not easily obtainable at that time. The woods have now been identified by Dr Molloy and the samples analysed by the D.S.I.R. Nuclear Sciences Laboratory; the results are tabulated in Appendix 1. Human bones from three burials found during the excavations have been examined by Dr P. Houghton of Otago Medical School and his report appears as Appendix 2.

THE EXCAVATIONS

Two areas were uncovered during the six weeks of excavation but no overall location plan has survived: the sites have been indicated approximately by Roger Green on the air-photo (Fig. 1). Area I was situated on the upper edge of the crater adjoining the northern strongpoint or *tihi*, and Area II was on the top of the rim further to the south-east where two pits were visible. A 60 ft (18.3 m) long section trench was also cut mechanically down the inner slope of the crater revealing a terrace with remains of occupation (Fig. 3). There was a small hearth in a dark humic layer in which obsidian pieces were found, covered by a slip of scoria. There were also some human bones (Appendix 2, Burial 3).

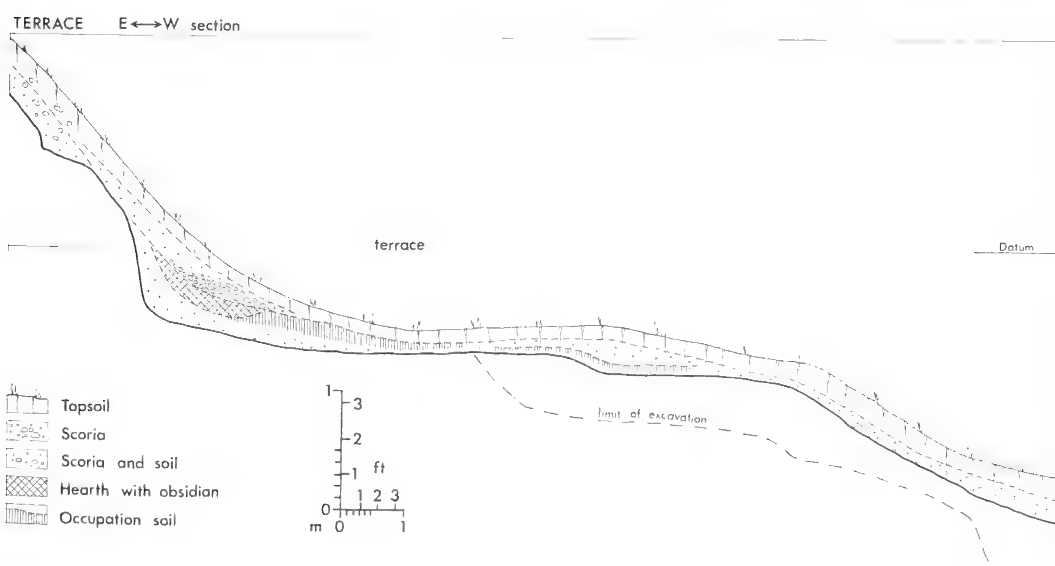

Fig. 3. Section of the inner slope of the crater, south of Area I.

Area II, the defences

No plans or notes are available for Area II, except for the diagram and brief remarks in the interim report (Shawcross 1962: 81). The excavation measured approximately 60 x 50ft (18.3 x 15.2 m) and was dug in a series of 10ft (3 m) squares. Five storage pits, M to Q, were excavated, but more important were the indications of a defence system.

Three lines of postholes are shown on the diagram plan (Fig. 4). The outer two lines were built on a narrow platform or terrace at the edge of the external slopes and in the original faded photos appear to be a major defensive work. They consisted of an irregularly spaced row of 5 or 6 postholes, 2 to 4ft (0.6-1.2 m) apart, in front of a row of wider-spaced holes, 8 to 10ft (2.4-3.0 m) apart, the latter linked by a narrow bedding trench (Fig. 5). This trench could have held either a series of small uprights lashed to each

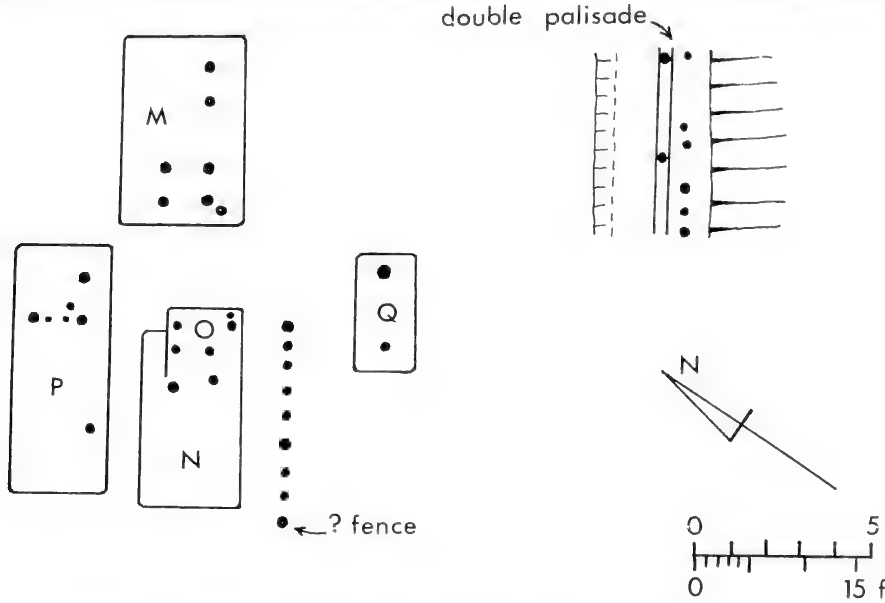

Fig. 4. Area II. Diagram plan, showing position of the defences.

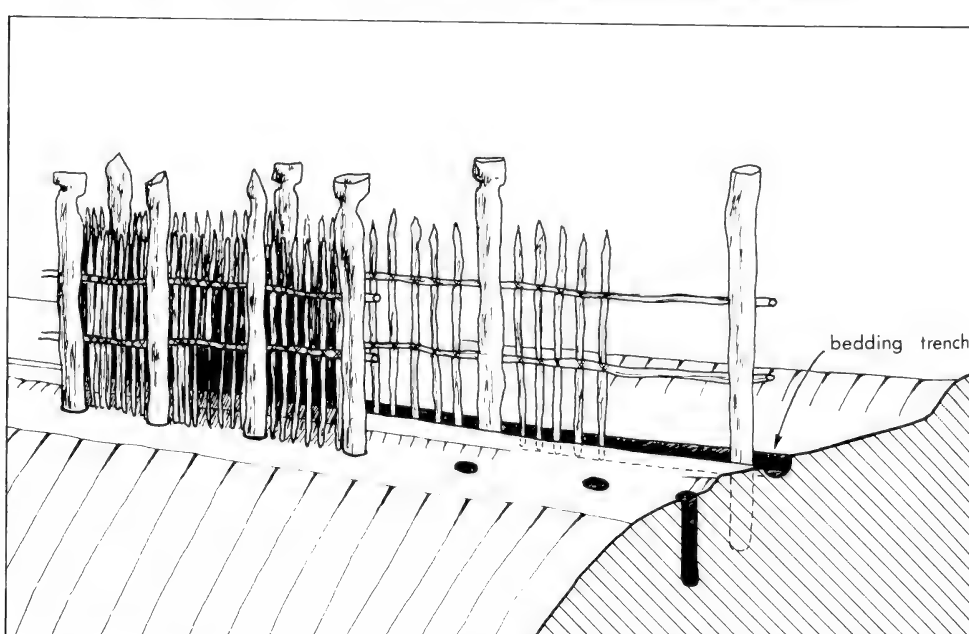

Fig. 5. Area II. Reconstruction of the defences. Main uprights of the inner palisade are shown as 3 m high and bedded 0.75 m into the ground. (Drawn by Caroline Phillips.)

other and to the main timbers, or else a horizontal timber or sleeper beam against which the small uprights were placed for greater firmness in the loose scoria. Such a horizontal timber would also lock the main uprights in position and so strengthen the whole line. It is unfortunate that no dimensions of the postholes were recorded but there is sufficient evidence to make a reconstruction sketch of the double palisades (Fig. 5). A double palisade is unusual, though Cook and Banks recorded "two rows of picketing" in association with earthwork defences at Wharetaewa pa in Mercury Bay in 1769 (Beaglehole 1955: 198). The third line of postholes was about 35ft (10.7 m) to the north on the flat portion of the crater rim and near the five storage pits (Fig. 4). It consisted of 9 close-set postholes, 3 to 4ft (0.9-1.2 m) apart, but probably the line extended beyond the area shown on the diagram. These posts could have been part of an earlier line of palisade, but are more likely to have belonged to a fence for a property division, such as Augustus Earle drew at Rangihoua pa in the Bay of Islands (Murray-Oliver 1968: Pl. 33).

Area I, pit storage

The area excavated consisted of fifteen 10ft (3 m) squares dug with 2ft (60 cm) wide balks between, most of which were subsequently removed (fig. 6). A complex of 11 storage pits was uncovered, some cutting into each other and some placed on differing alignments. Most had been filled deliberately and were level with the present surface, but the three largest pits, A, B and C, showed as shallow depressions. All had rows of postholes cut in the scoria on the pit floor (Figs. 9-11) which had held timber uprights acting as roof supports (Fox 1974: 142). There was a side "buttress" in Pit D, which presumably was a step at the entrance to the roofed store, as found in pits of the first occupation at Skippers' Ridge, Coromandel (Davidson 1975: 18 and fig. 2). The filling usually consisted of three layers: layer 1, surface deposits; layer 2, dark humic soil, in some cases containing midden material, charcoal and burnt stones, indicating the hollow had been used as a rubbish deposit; layer 3, fine loose scoria which had slipped down from the pit walls (Figs. 7, 8).

In Pit B the humic layer was absent and the pit appears to have been filled up in pre-historic times with scoria and some large stones. In contrast Pit A had been filled in recent times with loose rubble and boulders above the primary slip, which suggests the pit was open at a late date (Fig. 7).

A construction sequence was established by Shawcross (1962: 83) and was further discussed by Green (1970: 39-40). It is clear from the plan (Fig. 6) that Pits D, G, I, and K, were the earliest; with the exception of G, all had a single central row of posts. Pit D was very shallow, only 11ins (28 cm) deep in the scoria (Fig. 8, section). All four had been cut into by smaller pits, E, F and H (Fig. 6, plan). Pit E was on a markedly different alignment to the earlier series. Pits A, B and C were three large pits with multiple rows of posts on the same alignment as Pit E, and therefore must be considered to be late constructions on the stratigraphical evidence. Pit C, which contained a human burial, also cut into the corner of the early shallow pit D. Pit J had also been reduced in size and re-used (Fig. 8).

A small stone edged hearth was found near the south edge of Pit C (Fig. 12); it was quadrangular, measuring approximately 2ft 6ins (0.8 m) square internally and enclosed by 5 large slabs and two small ones.

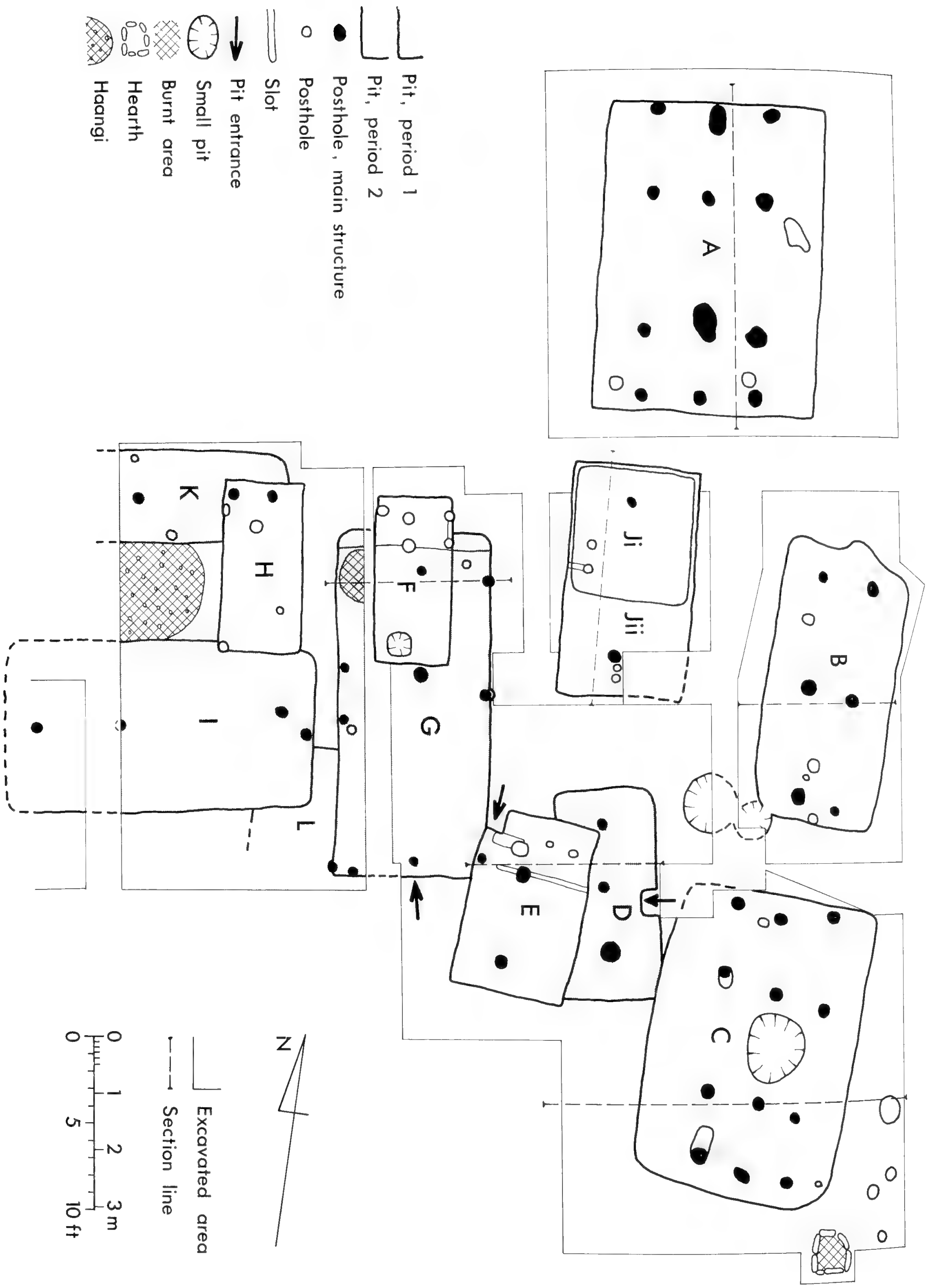

Fig. 6. Area I. Plan: the earlier pits are shaded.

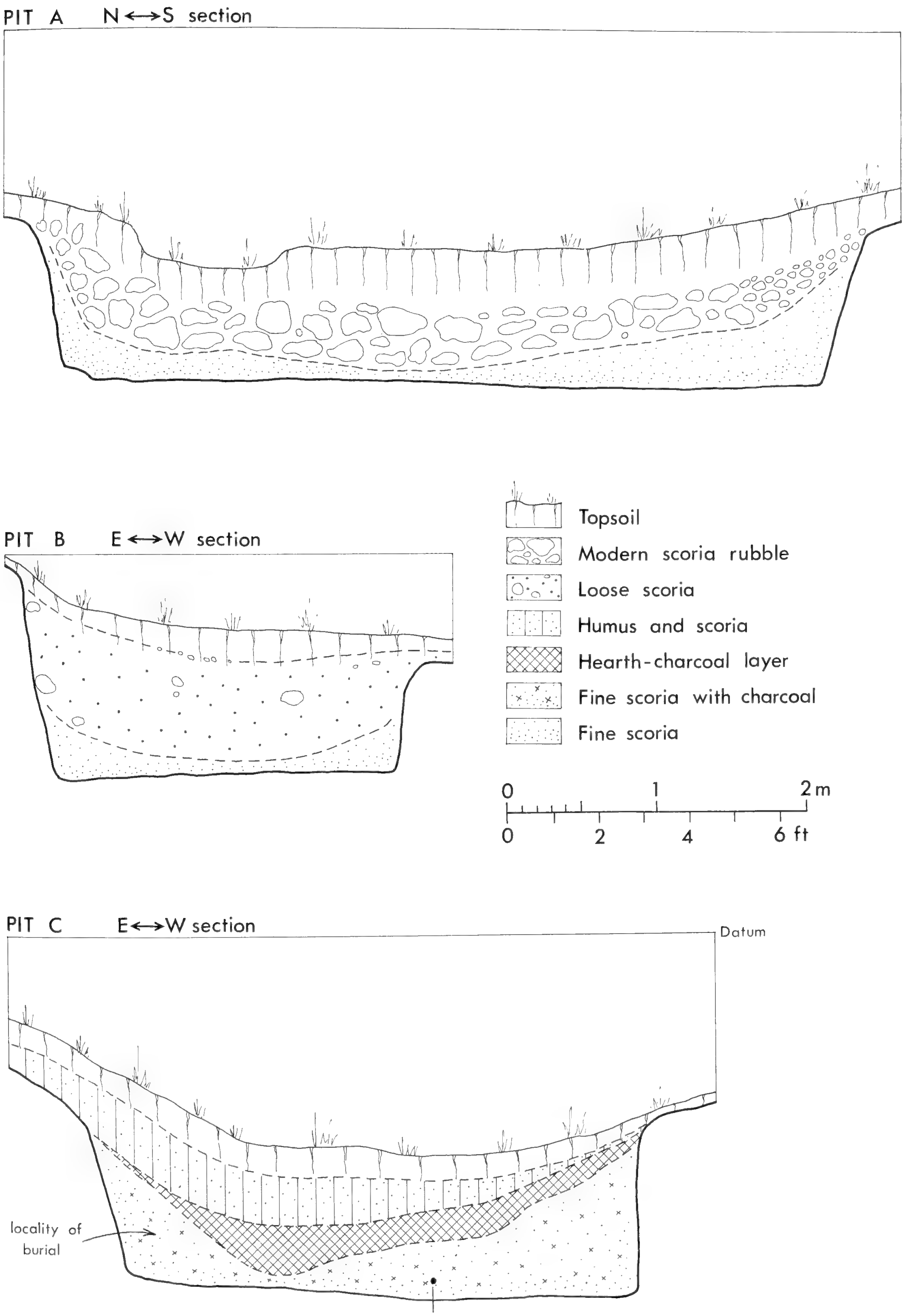

Fig. 7. Area I. Sections of pits: for position see Fig. 6.

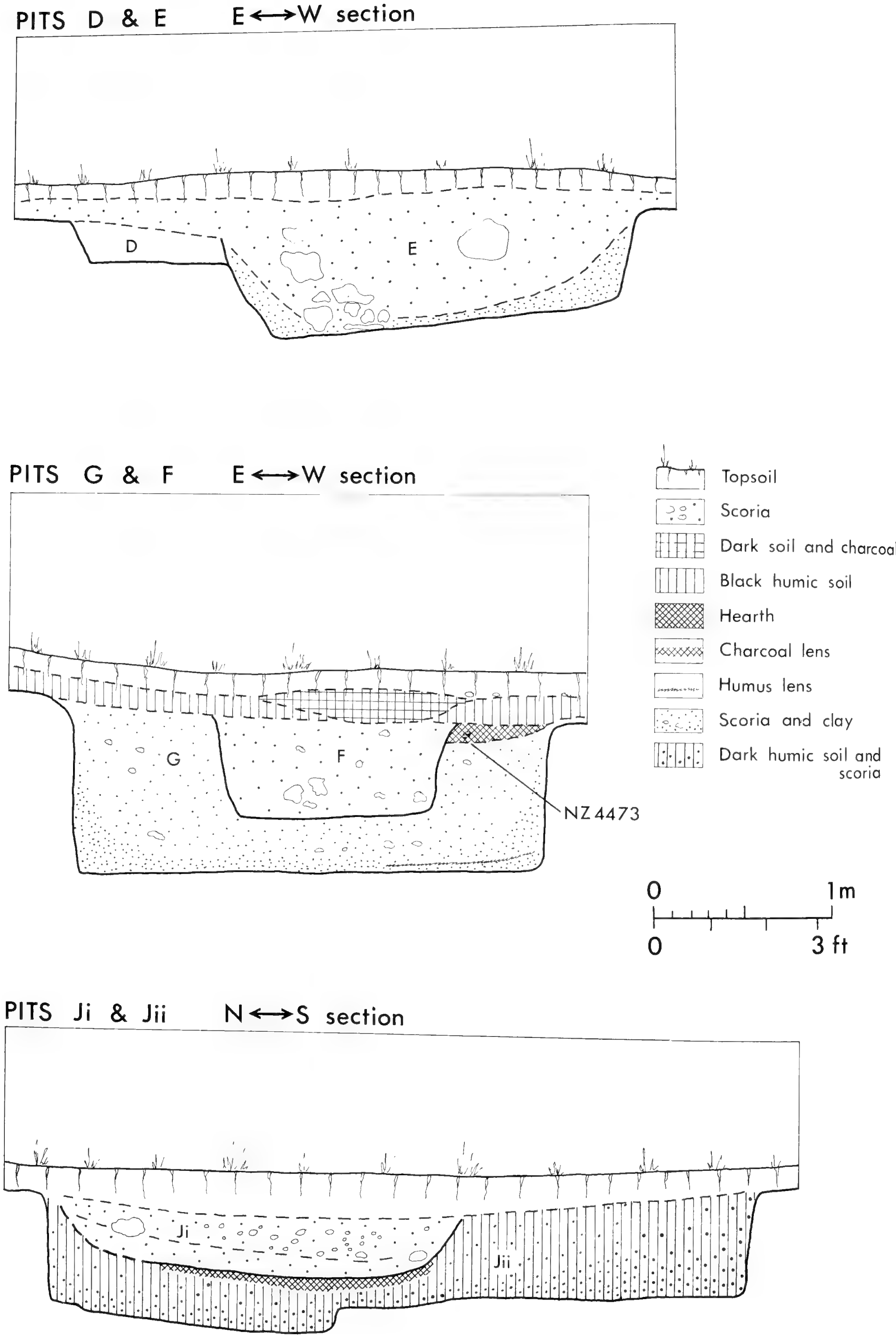

Fig. 8. Area I. Sections of intercutting pits: for position see Fig. 6.

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Figs. 9-12. Area I. 9. Pit A, showing multiple rows of postholes for roof supports. 10. Pit C, showing postholes for roof supports and floor pit. 11. Intercutting pits F and G, showing side posts and bedding trench for pit lining in Pit F. 12. Stone-edged fireplace near Pit C. (Photos: Anthrop. Dept., Auckland University.)

THE CARBON SAMPLES

Wood identifications and radiocarbon dates are given in Appendix 1.

The earliest dated sample (NZ 4473) was obtained from a hearth in the filling of Pit G (Fig 8). This was a large pit 19ft 9ins (6 m) long, 8ft 6ins (2.6 m) wide and up to 3ft 6in (1 m) deep. It had one large central post and 3 others visibly slotted into each of the side walls (Fig. 11). These must have held a lining or revetment to prevent loose scoria falling on to the floor; several other examples of uprights for pit linings have been recorded (Fox 1974: 149), including one in Auckland in Alberon Park, Parnell. There was an external ledge at the southern end of the pit, indicating an original entrance to this end. The bottom of the pit was covered with loose red soil and scoria to a depth of 9 to 12ins (23-30 cm), which had fallen from the walls presumably after the lining had been removed. It covered a thin layer of humus which had accumulated on the pit floor while it was in use. The pit was then filled up deliberately with 2ft (0.6 m) of scoria and stones, on top of which there was a hearth or hangi, containing burnt shells and the charcoal sample (Fig. 8). This was cut through when a smaller pit, Pit F, was dug at the northern end of Pit G, measuring 9ft 6ins (3 m) by 4ft 4ins (1.3 m), and only 2ft 4ins (0.7 m) deep. It too had a revetment lining, shown by a bedding trench between two postholes (Fig. 11) on the side wall. In due time pit F was also disused and filled with scoria, and dark soil and charcoal was then heaped over it (Fig. 8).

The charcoals from the hearth in Pit G were from totara and kohekohe trees with some *Coprosma* and yielded a corrected radiocarbon date of A.D. 1480 ± 50 (N.Z. 4473, 470 B.P.). A comparable date of A.D. 1510 ± 50 (N.Z. 4553) was obtained from totara and kohekohe charcoals at the bottom of Pit I. This was another large pit, 16ft (4.9 m) long 9ft 7 ins (2.9 m) wide with a central row of three or four postholes (Fig. 6). These two finds indicate there was occupation on Mount Roskill probably before A.D.1500, since the charcoals from Pit G were from a secondary deposit.

Another slightly later sample relates to Pit C. This measured 17ft (5.2 m) by 13ft 3ins (4 m) and was 3ft 4ins (1 m) deep on the lower side, 5ft (1.5 m) deep on the upper. It was an aisled pit, with 3 longitudinal rows of 4 postholes, some of which showed signs of replacement and enlargement (Fig. 6). The centre row will have carried the ridge pole, with secondary horizontals on either side (Fox 1974: 146). In the centre there was a small round floor pit (Fig. 10) probably a receptacle for selected kumara tubers for replanting as found at Station Bay on Motutapu (Sullivan 1972: 39, fig. 3). The charcoals were obtained from layer 3 'a loose fine-grained scoria with charcoal' which covered the floor of the pit (Fig. 7, section), and were probably derived from fires lit to disinfect the pit from time to time (Fox 1975: 204). The sample consisted of twigs of *Hebe* and *Coprosma* species, and yielded a corrected radiocarbon date of A.D.1560 ± 60 (N.Z. 4471). The same layer, which in places appears to have been quite deep, also contained an articulated human burial though this is not shown on the originals of the plan (Fig. 6) or section (Fig. 7). These primary deposits were sealed by a layer of black midden soil in which there were some large stones and a cooking hearth (layer 2). The fourth sample (N.Z.4472) was obtained from the stone-edged hearth (Fig. 12) on the level ground close to Pit C. This produced a date of A.D.1570 ± 50, and indicates that the use of the pit and the hearth were contemporary.

These finds show that there was agricultural activity by the people living on Mount Roskill throughout the 16th century. Whilst there is nothing to indicate occupation after A.D.1620, it must be remembered that no dating evidence was obtained from any of the small secondary pits E, F and H which were clearly constructed when the earlier pits, I and G were out of use. It is interesting to see that the earlier charcoals contain a high proportion of tree pollen, totara and kohekohe, whilst the two later samples are derived from shrubby species, *Coprosma, Hebe* and *Letospermum.* This may reflect the clearance of forest from the Auckland volcanic soils in the first half of the 16th century.

THE BURIALS

The evidence of the burials must now be considered; detailed results are given in Appendix 2. Three lots of human bones were found, all in Area I. Burial 1 was identified by Philip Houghton as that of an adult Polynesian male, aged 40 or more. The bones were catalogued as from "the south end of square E7, layer 3", the greater part of which lies within Pit C (Fig. 6). The field notes with an accompanying sketch state that the articulated burial was in the lower layer (layer 3) and was sealed by dark soil with large stones (layer 2). The individual was lying on his left side with knees drawn up on the chest and arms bent upwards. It can be deduced that the corpse had been bound in this position before burial. The burial, however, is not shown on the original plan or section and presumably was removed by the excavators before the drawings were done. Houghton's examination of the nitrogen content of the bones indicated that the burial was 'certainly before A.D.1500 and probably 13th century'. These dates are not in accord with the archaeological evidence, unless it is assumed that a 200 year old mummified corpse was re-buried in a pit in use in the 16th century.

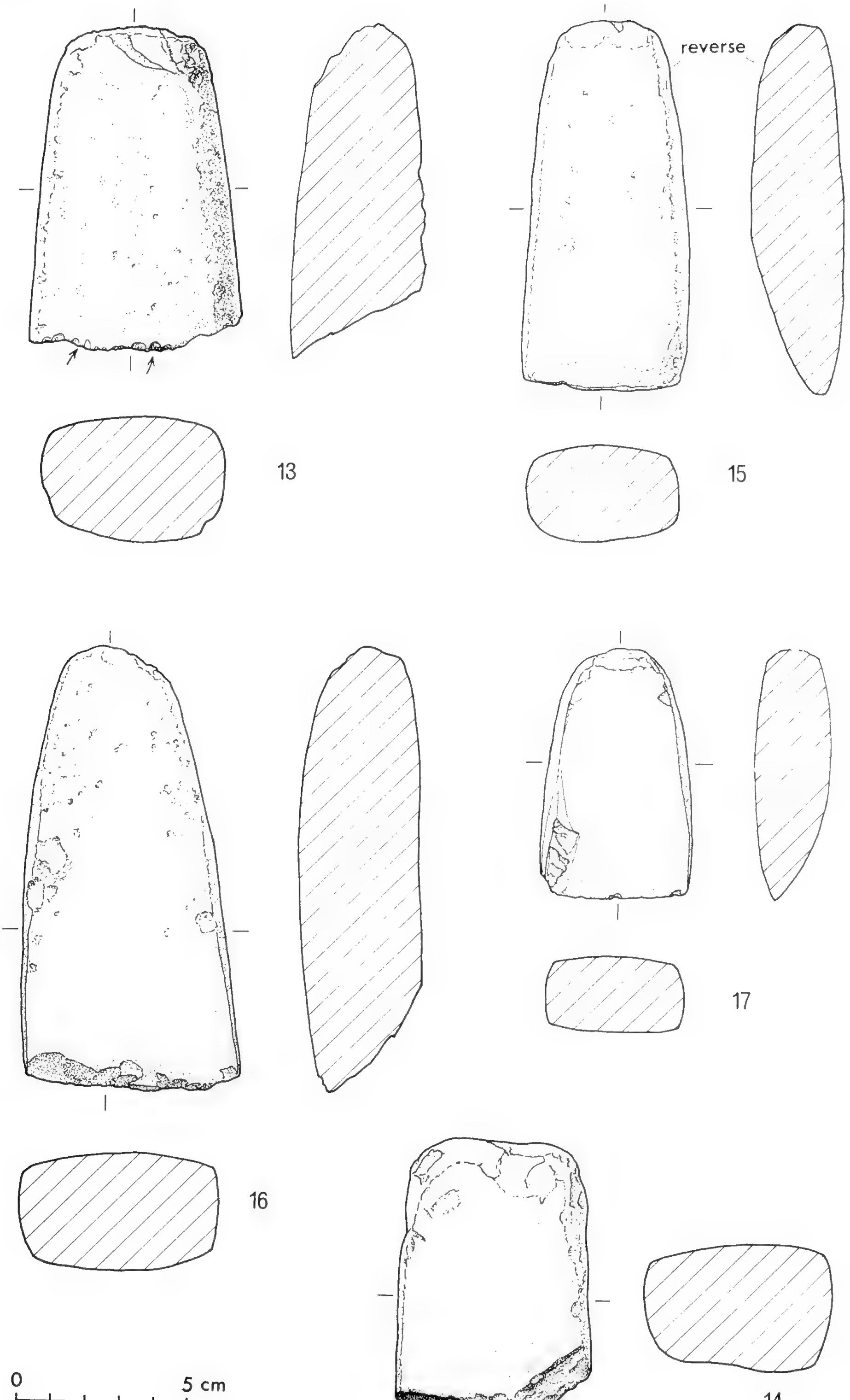
Burial 2 was recorded from Area I, square F2, layer 1: this was outside the area planned (Fig. 6) but close to Pit A. Since layer 1 is the uppermost layer in all sections, the burial must have been quite shallow, and presumably unstratified. The fragmentary remains were of an 18 year old individual, probably a male. Burial 3 was also from a superficial deposit; it is labelled "Trench top", which refers to the 60ft (18.3 m) long section trench cut down the inner slope of the crater by a machine; the burial is not shown in the drawn section (Fig. 3). Houghton reports that the scanty remains belong to two individuals, a 5 year old child and an adult, probably a female. The nitrogen content of all three is similar to that of Burial 1, again suggesting to Houghton 'burial in the 13th century'.

THE FINDS

The objects found were numbered and catalogued by the Anthropology Department. The more important are illustrated or described below, together with three adzes and a small wooden image found casually on Mount Roskill previously.

Adze, Type 2 B (Fig. 13), broken 92 mm from the butt. Greywacke, dark greenish grey, with remains of polish on one face and both sides. The fragment appears to have been hammer-dressed and re-used; there is some fine retouch along the edge. Area I, between Pits B and C, unstratified (No. 443).

Adze (Fig. 14), broken 75 mm from the butt. Basalt, dark bluish grey polished surface. Simon Best kindly examined this specimen and reports that it is "almost certainly from the Tahanga quarries, Opito, Coromandel. Hand specimen: has the blue-grey colour



Figs. 13-17. Adzes from Mount Roskill.

which is often found on polished sections of Tahanga basalt. Thin section: appears identical to the majority of source specimens from the quarry, especially with regard to altered olivines and flow layered felspars. This specimen comes from the coarser end of the range of Tahanga basalt textures.'' Area I, Pit G, layer 2. (No. 767).

Three other adzes in the Auckland Museum collection are recorded from Mount Roskill and although not precisely located, have been included in this report.

Adze, type 2 B (Fig. 15), greywacke, or indurated sandstone, greenish grey, hammer-dressed, with remains of polish at base of blade and on one side. The blade has been blunted, presumably preparatory to re-sharpening. No. 29344:1 (1929).

Adze, type 2 B (Fig. 16), greywacke, or perhaps a basalt, grey polished surface. The blade is much worn, and re-sharpening has been attempted. No. 7787 (G. Graham collection, 1943).

Adze, type 2 B (Fig. 17), argillite, black polished surface, apart from the butt which is roughened. No. 29344.2. (1929).

There were also 6 small chips of polished adzes, one (No. 765) probably of basalt, the others of greywacke; these were found in Area I in unstratified deposits or in layer 1, topsoil. Some indications of local stone working were recovered from a test square (B106) north of the pits in Area I, where a concentration of 62 small flakes of greywacke (No. 415) was uncovered at the bottom of layer 3. Other finds from this square include a drill point (No. 414) 7 pieces of chert (No. 416) 22 small bits of obsidian (No. 417), and three pieces of Waitemata sandstone used as polishers or files (No. 800). Other larger greywacke flakes came from layer 2 near the hearth beside Pit C as well as a greywacke core (No. 448) which had been used as a hammer stone.

Two small roundels, 2.5 and 2 cm in diameter (No. 760) shaped in reddish-brown clay, baked hard probably by volcanic action, were found in a test square (A 108) north of the pits in Area I. They were probably intended as beads: the larger has an 0.7 mm drilled perforation which in the smaller broken example was started but not completed.

A small wooden image (Figs. 18, 19), probably 'about 9 cms high', was brought to the excavations by a woman who said she had found it 'on the top of Mount Roskill' (Simmons pers. comm.). It was photographed and then returned to the finder; its present whereabouts are unknown. The little carved figure is naked with legs and arms bent and the hands resting on the abdomen. The back is flat but the prominent buttocks are carved in relief. The front of the round head is decorated with a diagonal patterning of incised lines and dots, which continue across the cheeks. The eyes are slits, slightly askew; the mouth is open with a triangular extended tongue.

This is a unique piece, but the discovery of a small image on the summit of a volcanic cone can be matched at One Tree Hill pa. The figure there was carved in pumice and probably was a container for tattooing pigments (Fox 1977: fig. 14). Mr D. Simmons has pointed out to me that a similar treatment of the head and face occurs on a stone image 15 cm high found at Northcote, on the Waitemata (Auckland Mus: No. 7104). This is double-sided, with male and female forms on opposite sides, each body being elaborately decorated. A deep groove across the base and continuing up the sides indicates that it was intended for suspension.

For cultural reasons, these images have been removed.
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Figs. 18, 19. Wooden image found on Mount Roskill. 18. Front view. 19. Side view. (Photo: Anthrop. Dep., Auckland University.)

SUMMARY AND DISCUSSION

The excavations on Mount Roskill were essentially a salvage operation carried out under pressure over 18 years ago; it is therefore not reasonable to expect them to comply with present-day standards of methods and techniques. Some difficulties have been experienced in placing the drawn sections on the plan (Fig. 6) and the lack of dimensions of the posts and postholes has made interpretation of some structures uncertain. Nevertheless important results were obtained which have implications for the prehistoric Maori settlement of the Tamaki isthmus as a whole.

First, nothing was found to indicate that Mount Roskill was occupied in the Archaic phase, prior to A.D.1400-1450 apart from the conflicting evidence of the human bones. The earliest radiocarbon date from a secondary deposit in Pit G was A.D.1480 ± 50. This may be compared with the only previous uncalibrated C14 date of A.D.1440 ± 40 from a volcanic cone pa, derived from a midden pre-dating one of the lower terraces on Mount

Wellington (Golson 1960: 33). One of the two broken adzes of Type 2 B found in the excavations was a basalt from the Tahanga quarries in the Coromandel; it is a small specimen (Fig. 14) that Simon Best considers could be of 15th century date.

Secondly, the four radiocarbon dates differ little in time and allowing for the standard deviations, could all lie within the period A.D.1430-1620. Two were obtained from the primary deposit in storage pits C and I, one from a secondary hearth in the filling of Pit G. This is the first time that a series of dates has been obtained which reflect the principal period of occupation on one of the cones. It is likely, though by no means certain, that the double palisade defending the outer edge of the crater rim in Area II belongs to the same period. This is also the first time that defensive timber work has been located on a cone. Janet Davidson's excavation in 1972 demonstrated that there were no palisade postholes on one of the lower terraces at Mount Wellington (Davidson pers comm.). The discoveries at Mount Roskill suggest that in the event of a war-scare, the inhabitants of the lower terraces retreated up the slopes to find shelter on the crater rim behind the palisades.

It is clear that pit replacement and backfilling were common occurrences on Mount Roskill as elsewhere, and that the resulting hollows were used for sunk cooking hearths or *hangi* and as dumping places for shell midden. A stone-edged hearth (Fig. 12) on level ground close to one of the pits presumably was used for some special type of cooking, perhaps spit-roasting. The simple form of pit roofing with a ridge pole resting on a central row of timber uprights was characteristic of the earliest series of pits. The more complex aisled construction occurred in the later series of large pits on a different alignment (Fig. 6, Pit A,B,C). Nevertheless, the radiocarbon dates from Pit C indicate that this form was not much later, as they occur within one standard deviaation of the earlier dates.

Finally, it must be stressed that there is no radiocarbon dating evidence for the end of the occupation of the pa. The latest series of small pits (Fig. 6, E,F,H) did not yield any charcoal; for these a 17th century date seems reasonable. Nothing was found to indicate that the pa had been attacked or burnt and it seems unlikely that the occupation continued for long after A.D.1700. This accords with the traditional evidence set down in the Orakei Judgement by Mr Justice Fenton, in which Puketapapa is not mentioned among the pa belonging to the famous Waiohua chief, Kiwi Tamaki, in the mid-18th century (Fenton 1879:62). The absence of earthwork defences on Mount Roskill also suggests that the pa was abandoned before the attacks of Te Taou and the Ngati Whatua in the late 18th century.

Acknowledgements. I am much indebted to Professor Roger Green and Dr Wilfred Shawcross for releasing the material on which this report is based. All finds and notes are now deposited in Auckland Museum.

For assistance in the preparation of the report I am grateful to: Mr Simon Best for his identification of the stone material; Dr B. Molloy and the D.S.I.R., Nuclear Science Laboratory, for identification and analysis of the charcoals; Mr D. R. Simmons for making available adzes from the Museum collection, and for helpful recollections of the 1961 excavations; and finally to Caroline Phillips for her patience and skill in the preparation of the drawings.

APPENDIX I

Report on charcoal samples from N42/11

Wood identifications by Dr B. Molloy, D.S.I.R. Botany Division.

Radiocarbon dating by C. McGill, D.S.I.R. Nuclear Sciences Laboratory, Wellington.

		B.P.	*Corrected*	*A.D.*
N.Z. 4471		300 ± 60	390	1560 ± 50
Coprosma sp.	80%			
Hebe sp.(twigs)	20%			
Pit C, layer 3				
N.Z. 4472		290 ± 50	380	1570 ± 50
Coprosma sp.	46%			
Leptospermum sp. probably *L. scoparium*	42%			
Hebe sp.	12%			
Fireplace near Pit C, layer 2				
N.Z. 4473		440 ± 50	470	1480 ± 50
Dysoxylum spectabile	53%			
Podocarpus totara/hallii	31%			
Coprosma sp.	11%			
Unidentified	4%			
Pit G, hearth, layer 2, cut by Pit F				
N.Z. 4553		350 ±	440	1510 ± 50
Podocarpus totara/hallii	93%			
Dysoxylum spectabile	7%			
Pit I, layer 3				

APPENDIX 2

The Human Skeletal Material from Mt Roskill (N42/11)

by Philip Houghton

University of Otago Medical School

Burial 1. The fragmentary, incomplete remains of an adult Polynesian male aged 40+ years. This was a robust person, standing about 1711 mm (5'7⅓'') tall. No significant gross pathology is evident and the cause of death cannot be determined. A considerable number (12-15) of lines of arrested growth are apparent in the tibial X-ray. These have been formed between the ages of about 6 and 14 years, and suggest seasonal shortage of food rather than recurrent illness in this robust individual. Despite this suggestion, the general lack of joint degeneration for age implies that this individual had an easy physical existence, by the standards of New Zealand prehistory. There are no clavicular first-rib grooves, suggesting that canoe transport was not regularly used.

The only remaining teeth are two molars and an incisor. All are worn to the roots. This actually indicates a less abrasive diet than is usually found in New Zealand's later (post 1500) prehistoric period, where the same degree of wear is sometimes found in an individual some 20 years younger.

The nitrogen level of the bone is 1.08%, suggesting burial in the thirteenth century: the material is certainly pre-1500.

Burial 2. The fragementary, incomplete remains of an 18-year-old individual, about 1666 mm (5'5¾") tall and probably a male. No significant pathology is evident and the cause of death cannot be determined. The femora are very bowed antero-posteriorly, with marked reduction of the transverse diameter of the shaft, but the incompleteness of the bones makes further comment impossible. The teeth show only slight wear, with the emphasis on the anterior dentition, the pattern which appears to be more typical of New Zealand's early prehistoric period. The upper incisors show many fine lines of enamel hypoplasia, and these are matched in the long bone X-rays by recurrent lines of arrested growth formed throughout childhood. This pattern again suggests seasonal food deprivation.

The nitrogen level of the bone is 1.03%, again suggesting burial in the thirteenth century.

Burial 3. Two individuals are scantily represented under this heading. A five-year old child is represented by some long bone and pelvic fragments. An adult, possibly female, is represented by most of a right ulna, and various other fragments. The morphology of the root of a second molar from this adult suggests an age of more than 25 years, yet the tooth shows minimal wear and salivary calculus, suggesting the softer diet more typical of the earlier prehistoric period. The nitrogen estimates on the bone of these two individuals are similar, 0.88% and 0.87%, suggesting they were interred together. The difference in level of nitrogen between these and Burials 1 and 2 is not significant, and they were probably interred at much the same time.

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REGIONAL VARIATIONS IN MAORI GREENSTONE PENDANTS OF THE KURU STYLE

GARRY LAW

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Abstract. A multivariant statistical study of straight pendants suggests at least three types exist which have significant variations in distribution through northern New Zealand. The range of styles represented by the types appears to be prehistoric and reflect local styles.

In 1972, D. Wayne Orchiston published an exhaustive study of a collection of pendants in the Australian Museum and compared these with the Museum collection held at the Auckland Institute and Museum (Orchiston 1972a). This study concentrated on greenstone pendants of the straight form (*kuru*). On the basis of the technology employed in forming the perforation, the Australian Museum collection could be split into those which post-date the availability of European tools, and a second group apparently using traditional tools for the perforation — these being potentially prehistoric examples. The assemblage selected for study from the Auckland collection was all of the latter type. Orchiston's study looked for differences between the European tool-perforated group and the others, looked at relationships between dimensions taken off the pendants and dimensional differences between the two museum collections. On the basis that the European tool perforated group (Orchiston's E series) and the others (M series) were little distinguished when their metrical and other characters were studied, that *kuru* pendants are not as prominent in 18th century descriptions of Maoris while *kuru* are common in museum collections, that *kuru* are the most readily made of the Maori ornaments, and that, European supplied iron released nephrite tools for conversion to ornaments, Orchiston (1972a: 211) concluded "their number increased enormously during protohistoric times." In another paper Orchiston (1972b: 101) pointed to an apparent increase in the frequency of *kuru* pendants by Cook's third voyage visit to Queen Charlotte Sound as evidence that this change was a very early one. In respect of the M series *kuru*, the argument is not very secure and a prehistoric derivation for much of the assemblage is not disproven. In any event, from their method of manufacture M series *kuru* appear to be the products of the same technology that produced the prehistoric pendants and presumably products of much the same society.

Greenstone is a casual term which covers a variety of materials. The commonest is nephrite found in Nelson, Otago and Westland in the South Island (Ritchie 1976). Other nephrites are found in Central Otago. A related but softer material, serpentine, was also used for ornaments and some has a similar appearance to darker nephrites but is much softer. Some sources of this material are in Nelson but suitable material for ornaments may possibly be found in widely dispersed parts of New Zealand.

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Greenstone tools or ornaments or waste are not commonly found in excavated prehistoric sites. Two exceptions, Houhou pounamou (S 76/7) containing waste and Murdering Beach (S164/16) containing tools, ornaments and waste (Skinner 1959) are both in the South Island. However, greenstone tools and ornaments are not predominantly localised in the South Island. The localised examples of *kuru* covered in this paper are predominantly of northern North Island origin. Moreover, at least one variety of ornament, *pekapeka*, comes predominantly from the far north (Skinner 1974: 64) and Simmons (1971: 96) suggests that there are regional styles in *Hei tiki*, both records carrying the suggestion that manufacture of ornaments from greenstone was an activity dispersed through New Zealand.

There can be little doubt that greenstone was a prestigious material in prehistoric New Zealand, this being demonstrable from its unique distribution if nothing else. Many of the specimens now available to us may have passed through exchange relationships between different groups of Maoris. Elsewhere I (Law n.d.) have argued for the importance of these relationships in considering the regional diversity of prehistoric New Zealand. There is a considerable potential in New Zealand for studying the movement of common raw materials such as chert and obsidian (Leach 1977), but movement of more prestigious items might be expected to differ from this. If localised styles do exist in the forms of greenstone ornaments and tools the movement of these items could be open to study, although time control is always going to be difficult.

The inception of this study was the development by the writer of a computer programme for cluster analysis for application to adzes. The data on *kuru* were available from Orchiston and were used as test data but with the above in mind, with the additional aim of seeing if regional diversity existed in straight *kuru*.

Defining regional variations

Two alternate strategies may be envisaged for defining regional variations. One approach is to arbitrarily divide a collection of localised artefacts into regional groups. Once populations were so defined a study could be made using discriminant analysis or between-population distance statistics, or both, on metrical data from each population to determine the separateness of the populations. A second approach is to initially ignore the find localities of the localised artefacts and on evidence of their shapes develop a system of types with rules which will classify every artefact in the population. At this stage an arbitrary division of the localised artefacts into regional groups can be made and statistically tested to see if frequency of the types differs between regions. Both approaches may be biased by museum or donator selection in acquisition to museum collections. The second procedure suffers from the disadvantage that regional groups must be reasonably large to have any hope of showing significant differences and that the types found may be biased by over-representation of a region. However, it does offer distinct advantages, namely that unlocalised artefacts are included increasing the security of any differences discovered, and that the definition of types is of use to people studying other artefacts or collections of artefacts, and occasional items from dated contexts once typed can be used to evaluate the history of the forms. The second form of analysis is the one the author prefers.

The Population studied

From Orchiston's data, 113 M series pendants were available. A further three localised pendants were added, two being from the archaeological collections of Auckland Museum. Data for the extra three are listed in Table 1. Only 42 of the population are localised. Of the dimensions given by Orchiston, seven were selected for use in the clustering programme. These were:

1. The pendant length.
2. The distance from the centre of the perforation to the top end.
3. The perforation diameter at the neck, that is the smallest diameter.
4. The width at the perforation.
5. The width at one third of the length from the top.
6. The width at two thirds of the length.
7. The thickness at two thirds of the length.

All these dimensions were available for all pendants to the nearest 0.1 mm.

Table 1. Data for three localised pendants.

No.	Length		Perf.	Width			Thickness	Remarks
	Total	to perf.	dia.	At perf.	0.33	0.66	0.66	
NZ5/128	44.1	4.1	1.8	10.8	12.8	12.8	6.7	Sting Ray Pt. Pa, Gt. Mercury.
AR3820	64.7	5.3	2.5	8.3	8.2	7.8	4.6	Tahanga Quarry, Opito.
Private Collect.	70.8	3.2	2.1	6.4	8.1	8.7	8.8	Queenstown.
Dimension No.	1	2	3	4	5	6	7	

All measurements in mm.

The clustering procedure used can only deal with continuous variables, and not with alternate state or multi-state data. Consequently, some of the information given by Orchiston could not be used — in particular, the form of the edges, though some of the edge forms he describes are almost exclusively E series forms. The distal end form classification suffers from some confusion of geometric terms, and figures presented elsewhere are no clearer (Orchiston 1974, Fig. 2: 171). Three dimensions were not used, the maximum width, the thickness at one third of the length and the maximum thickness. These were judged to contain little more information than the seven selected.

Cluster analysis

This section is intended for the general reader. An appendix gives more technical details and discussion of choices made.

If two dimensions are measured on each unit (item) of a population and the values for each unit are used as plotting co-ordinates on a graph then a scatter plot results. Such a plot may show only one centre or mode, or it may show a number of clusters, each with a central point or mode. If each unit is assigned to a cluster, the cluster centre can be taken as the centre of gravity of the points so assigned. A measure of the success of such a clustering is the distance the units are away from their cluster centre. One such measure is the sum of all the distances squared, that is multiplied by themselves, and this is termed Sum Squared Error (SSE). If one dimension has a wider range than another, this dimension has a greater weight in these distances. There is no reason why any dimension should be so weighted so it is important to scale all the dimensions to have the same range. This is done so that looking at any one dimension alone then SSE is equal to the number of units (n), or more technically the variance (SSE/n) is unity. This process is called standardising. A second adjustment which is applied is to take the logarithms of the scores if this reduces the skewness of the distribution on any dimension. This ensures that scores above the mean do not have greater weight than those below the mean. If two dimensions covary then a large score on one dimension of a unit can be used to predict a large score on the other dimension of the same unit. If both of these two dimensions had only one mode (i.e. they were unimodal), then when the population points were plotted then they would form a cigar-shaped pattern. A quite efficient division into two clusters can be made of such a pattern with a cluster centre within each end of the "cigar". This does not reflect any real modes in the population and thus it is important to correct the data to remove this correlation. To do this for two dimensions, one is taken with no further modification while only that part of the second dimension which cannot be predicted from the first is further used. These residual variations are treated as a dimension and are scaled again so that the variance for the new dimension is unity. The two resulting dimensions are then uncorrelated.

The considerations above are not restricted to two dimensions but can be applied to any number of dimensions.

The clustering process applied to the data once converted, is one known as a 'K-Means' procedure described by Hodson (1971), M. Kendall (1975) and Hartigan (1975).

It will not be described fully here but its essence is that for a specified number of clusters it is attempted to find the best cluster centres for the population and success of any set is judged by the size of the value of SSE, the lower the better. As applied here once a clustering had been found a Mahalanobis distance was calculated for the distances between cluster centres and units and a unit was shifted to a new cluster if the Mahalanobis distance to that cluster centre was less than that to which it was assigned. A Mahalanobis distance is a more sophisticated distance measure which takes account of the shape of the clusters. This reassignment was iterative as shifting units alters the cluster centres and the distances. Such shifts usually result in small increases in the value of SSE. Mahalanobis distances can also be calculated between cluster centres. Such distances are referred to further below.

The clustering was performed using a computer programme "SUPERK", written by the author in ALGOL and run on the University of Auckland Burroughs B6700 computer.

Application

For these data all seven dimensions were logarithmically transformed as all had lesser skew in this form. Table 2 shows the correlation matrix for the seven dimensions so transformed.

Table 2. Correlation matrix of dimensions after log transformation.

		Dimension 1	2	3	4	5	6	7
Dimension	1	1.00						
	2	0.32	1.00					
	3	0.21	0.49	1.00				
	4	0.17	0.65	0.39	1.00			
	5	0.20	0.56	0.37	0.92	1.00		
	6	0.18	0.54	0.30	0.86	0.97	1.00	
	7	0.20	0.18	0.07	0.17	0.22	0.25	1.00

Lower half only shown. Dimension numbers as in Table 1.

As might be expected the three width dimensions show the highest correlations. A correlation of 0.18 or above suggests the correlation is at a statistical level of 'probably — significant' ($p = 0.05$ for null hypothesis of zero correlation, $n = 116$). Excepting the correlations of width there are no very high correlations in this population, as Orchiston observed.

Following removal of the correlations the data were clustered using from two to seven clusters. Figure 1 shows the best SSE values for each of the best divisions found with from two to seven clusters. As can be seen, there is a consistent improvement in the SSE as more clusters are allowed but this occurs even in unclustered data. The difficult point on any cluster analysis is to decide where valid clustering ends. The curve in Fig. 1 does not show any pronounced shoulder as might be expected if tight clusters existed. Plots of the distance between clusters and the Mahalanobis distance between clusters (Fig. 2) show little improvement after three clusters.

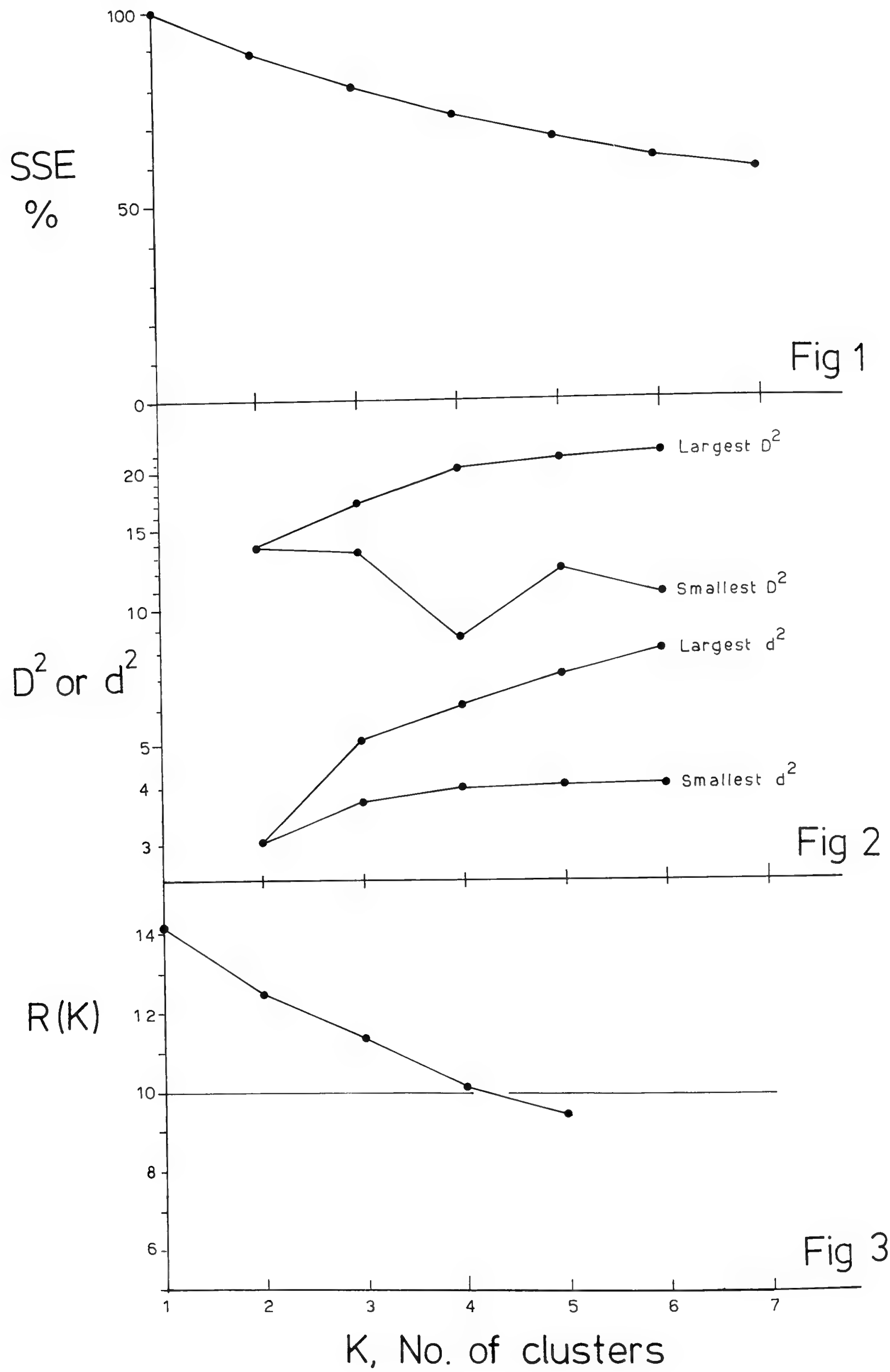
Hartigan (1975: 90) suggests that if the ratio

$$R(K) = \frac{SSE(K) - SSE(K+1)}{SSE(K+1)} \quad (n-K-1)$$

is greater than about 10 then increasing from K to K + 1 clusters is justified. Here SSE (K) is the sum squared errors found for dimension into K clusters and n is the total number of units. This statistic is shown graphically on Fig. 3 and shows again no clear cut-off point though strictly applying the 10 cut-off would allow five clusters. The author must declare a bias against a large number of clusters in that when the distribution of the types is studied too many types will weaken the possibility of finding significant patterns given the limited number of localised specimens.

Clustering at the level of 3 types was adopted for the regional study. It must be emphasised that the success or otherwise of finding regional differences did not enter into the decision on the number of types to adopt, other than as noted above.

The characters of the three types are illustrated in Fig. 4. These are not actual pendants but synthetic pendants drawn from the parameters of the cluster centres. Table 3 illustrates the ways in which the types vary but it must be emphasised that attempts to classify pendants on even the two most useful measurements will meet low success.



Figs. 1-3. Variations of statistics with increasing numbers of clusters (K). 1. Reduction of SSE, the unexplained variance, with increasing K. 2. Greatest and least inter-cluster distances (D, Mahalanobis distances; d, Euclidean distances). 3. Ratio R(K) indicating validity of increasing from K to K + 1 clusters.

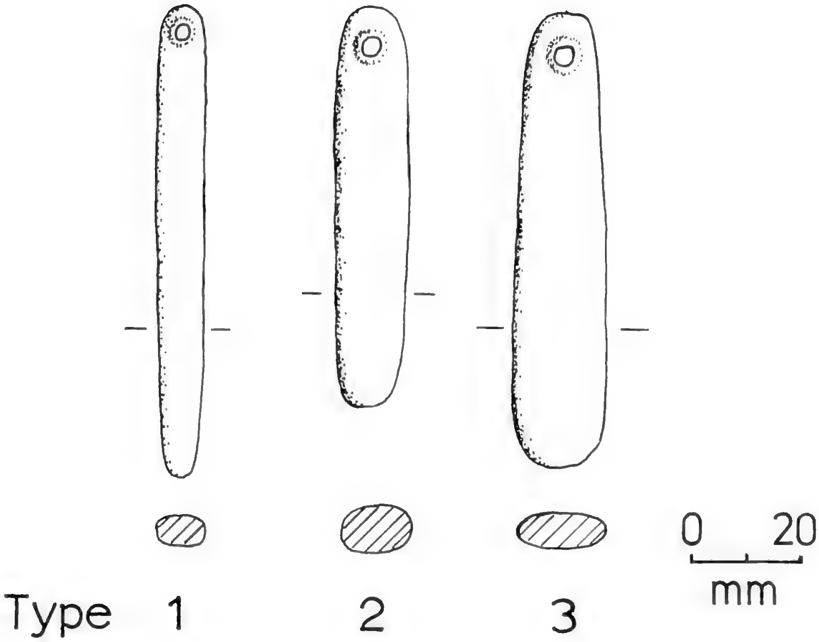


Fig. 4. The three pendant types represented by synthetic pendants drawn from the cluster centre parameters.

Linear discriminant functions can be given for the three types but are not included here. These types explain only a low proportion of the variance in the converted data. Over the seven dimensions they explain only 20% of the variance, and even over the most clustered two dimensions in the converted data, the three clusters explain only 43% of the variance.

The character table (Table 3) suggests types 2 and 3 are the closest together. This can be confirmed as the matrix of inter-cluster Mahalanobis D squared values shows this is the case (Table 4). However the way the units separated from the best K = 2 clustering into the best K = 3 clustering is contradictory (Table 5) showing the units in clusters 1 and 3 come predominantly from one cluster.

Orchiston (1974 2: 263) had previously suggested there were two varieties of *kuru* in Northland distinguished by their width, but the scatter plot from which the varieties were identified is not of itself convincing.

In conclusion it can be said that the population studied has a homogeneous character but imposed over that character are some weak modes which can be considered centres of diffuse clusters. It cannot be concluded that clear discrete types exist in the population. The utility of the types found must then depend on other criteria, namely are they significant when special or temporal data are used to group the data.

Regional variations

On completion of the clustering considerations the provenances of the pendants were studied. Figure 5 shows a distribution map for the three types. It should be noted that some locality attributions are to a district only and the plotted points are not all at precise find

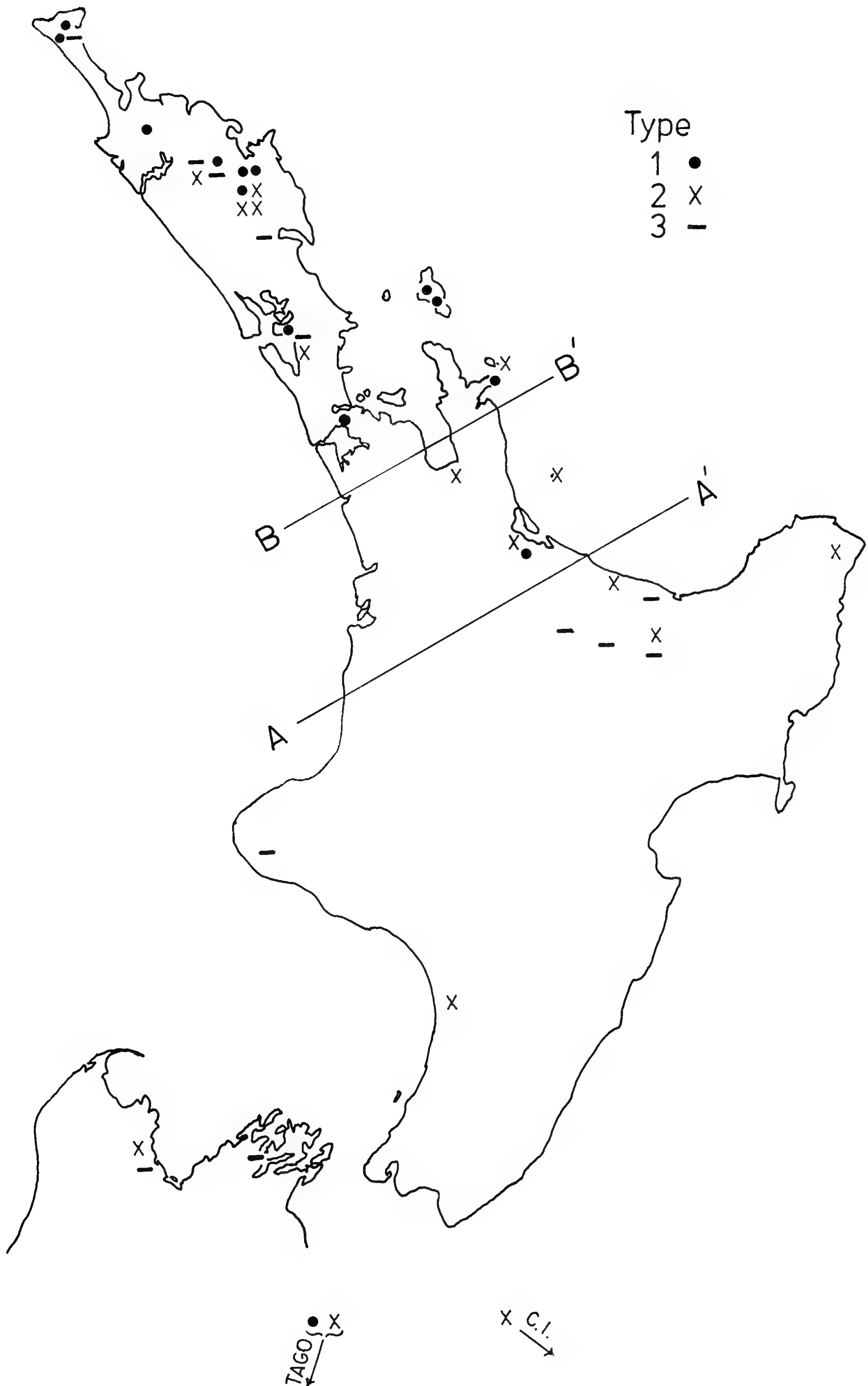


Fig. 5. Distribution map for pendant types.

Table 3. Characteristics of types.

Character	Type 1	Type 2	Type 3
Length to perf.	Short	Long	Long
Thickness	Thin	Thick	Thin
Width	Narrow	Wide	Wide
Plan Shape	Straight	Straight	Flaring

The characters are listed in order of significance.

Table 4. Inter-cluster Mahalanobis D-squared values.

		Cluster 1	Cluster 2	Cluster 3
Cluster	1	—		
	2	14.5	—	
	3	17.1	13.4	—

Table 5. Pendant transfers between clusters for K = 2 and K = 3.

		K = 3 Cluster 1	Cluster 2	Cluster 3	Total
K = 2	Cluster I	<u>19</u>	12	<u>26</u>	57
	Cluster II	8	<u>38</u>	13	59
	Total	27	50	39	116

Figures underlined indicate the predominant derivations of the K = 3 clusters from the K = 2 clusters.

Table 6. Type localities by areas.

	Type 1	Type 2	Type 3	Totals
South of A-A'	1	7	7	15
A-A' to B-B'	1	3	—	4
North of B-B'	12	6	5	23
Totals	14	16	12	42

localities. Moreover, four locality attributions Orchiston records as less secure have been accepted here. There is a noticeable concentration of types 2 and 3 in the eastern Bay of Plenty. If the population is split into two groups along the line A-A' on Fig. 5, the distribution of the types is as in Table 6. This distribution is unlikely to have arisen by chance (Chi — squared probability of null hypothesis of no difference is less than 0.025). Moving the split line to B-B' results is no less a significance suggesting the pattern is not sensitive to the choice of the division. Type 1 is over-represented in the northern area while type 3 is over-represented in the southern area.

Some other comparisons are of interest, such as type representations in collections (Table 7). The Australian Museum unlocalised collection (n = 38) is significantly different from the Northern area group (A-A' division) (Chi-squared p less than 0.005) but it does not differ from the southern area group. The Auckland Museum unlocalised collection is of similar size (n = 36). It does not vary significantly from either the northern subgroup or the southern. In view of the size of the southern area group (n = 15) establishing such a difference is not likely as the statistical methods used lose power with such small numbers.

Table 7. Type representations in collections.

	Type 1	Type 2	Type 3	Totals	
Australian Museum					
— localised	2	2	1	5	43
— unlocalised	4	14	20	38	
Auckland Museum					
Ethnographic Collection					
— localised	10	13	11	34	70
— unlocalised	9	20	7	36	
Archaeological Collection					
— localised	1	1	—		2
Private — localised	1	—	—		1
Totals	27	50	39		116

Despite the relatively unpromising results of the clustering, the three types decided on seem to have some utility and it would be valuable to extend the number of typed specimens in localities from the southern and western North Island, as well as the South Island. It is clear that the types do not have exclusive distributions. One or more of three processes might explain this. Firstly that the distributions were exclusively in space for manufacturing but exchange has blurred them, or secondly that the full range of styles was recognised and made in each area but the proportions made differed, or thirdly that each region had a single mode but more extreme examples cross the classification boundaries. These data are quite insufficient to look at these possibilities.

Time control

Only one of the pendants treated here is from controlled excavation. A type 2 pendant was recovered in the excavation of N40/11, Sting Ray Point Pa on Great Mercury Island. The site is pre-European but could date as far back as A.D.1400. A type 2 pendant was taken from the body of a defender at Gate Pa, Tauranga in 1864. The observations on pendants by L'Horme at Doubtless Bay in 1769 (Orchiston 1972a: 166) show the width to thickness ratios varied noticeably, perhaps over types 1 and 3.

A type 1 specimen from the summit of One Tree Hill (N42/6) can be suggested as a prehistoric specimen, perhaps earlier than A.D.1750 (see Fox 1977). The cluster of specimens from the Bay of Islands may well all relate to the burial caves known there. Two type 1 pendants come from Kawakawa, a type 1 and a type 3 from Ohaeawai, both definitely from burial caves, and three type 2's and a type 1 from Waiomio. If the latter are from burial caves, the date of the carved wooden burial chests from this valley may be relevant. A stylistic study of these by Fox (pers. comm. 1978), suggests these are late in sequence, though still prehistoric. Finally, a type 1 example from Tahanga adze quarry is unlikely to post-date the availability of steel tools.

This review of possible datings does little but suggest that the range represented by the three types is prehistoric.

Discussion

This present study adds to the literature suggesting greenstone ornaments differ between regions of New Zealand. This obviously has implications in considering the regional diversity of Maori Culture but has more specific implications for the material itself. To have regional variety, knowledge of the particular technology used for working nephrite must have been available throughout New Zealand, and suitable raw material or blanks (adzes?) must have been available. Both commodities must have passed through some exchange network to the artisans. The original quarry workers or middlemen in such an exchange would have had the option of converting the raw material into finished ornaments before exchanging it further. That they did not, suggests they were specialist traders at least in respect of nephrite. If they were optimising their behaviour, the rewards of exchange in handling minimally processed nephrite must have been greater than attempting to add value by further processing. In a situation where competition prevails, the rewards of exchange are the added value through transporting and marketing large volumes of material. But where a monopoly prevails, the rewards can result by limiting supply. This aspect of the exchange mechanisms and their microeconomics has been neglected in New Zealand. It would appear that data from nephrite tools and ornaments might be of use to compare with movements of more mundane materials.

Acknowledgements. For the opportunity to study the straight pendants in the Auckland Institute and Museum collections I should like to thank the Director of the Museum Mr E.G. Turbott and his staff. For facilitating access to the computer to develop the SUPERK programme for use by archaeologists, I should like to thank Professor Roger Green.

APPENDIX

FURTHER CLUSTERING CONSIDERATIONS

Clustering

A variety of procedures operate with a central aim of improving a global statistic (such as SSE) by shifting units between clusters where this improves the global statistic. All suffer from the fault that the outcome may be dependant on the initial cluster centres, and the less general tend to create clusters of equal numbers of units. In the case where the clusters are considered to be multi-variate normal distributions, likelihoods or log-likelihoods for the cluster sets can be found by linear mathematics.

The most general approach is to minimise a statistic of the sum of the product of the number of units each cluster by the log of the determinants of the within cluster covariance matrix. Minimising this maximises the log-likelihood. This approach allows different clusters to have different sizes, shapes and orientations and this approach can be applied to raw data where scales of dimensions vary widely and dimensions covary. The computation in finding an optimum is unattractive. For seven dimensions, 35 parameters must be estimated for each cluster (7 means and 28 covariances). With multiple clusters large populations are required in order that the parameters may be safely estimated.

A less general approach is to consider the clusters to be of the same size, shape, and orientation; that is, they have identical within cluster covariance matrices. This is the usual model applied in discriminant analysis. This reduces the parameters to be estimated in the seven dimension case to 28 covariances and seven means for each cluster. The statistic to be minimised is the determinant of the within cluster covariance matrix which again maximises the log-likelihood. This approach will tolerate correlated data but the scales of the different dimensions will affect the clustering. As Hartigan (1975: 97) argues, dimensions with the greatest variance are split first into segments with within segment variance more equivalent to the variance on other dimensions. This may be a quite acceptable clustering in some circumstances where clusters are sought to represent the population variance, but this is not a pertinent aim for artefact typing where the smaller dimensions may well be those which display distinct modes.

The least general approach is to assume the clusters are equi-sized and symmetrical, that is they have the same variance on each dimension with each cluster. The within cluster covariance matrix reduces to a diagonal form with equal values on that diagonal. Likelihood is maximised in this case by minimising this common variance. The ML estimate of this variance is SSE/n where n is the number of units. Thus minimising SSE minimises the common variance. Here the clustering is sensitive to correlation between dimensions as well as the scale of dimensions. This approach is the most simple computationally.

The approach followed here was to convert the data to a correlationless and standardised form and apply the least general approach of minimising SSE. Once clustered, converting to Mahalanobis distances for a final reassignment alters the cluster model to the form of intermediate generality above. The optimum thus found is not necessarily the best which might be found by working entirely with this more general procedure.

Reclustering by Mahalanobis distances is an iterative process where within cluster covariances are recalculated after each reassignment pass and the scores readjusted. This iteration was halted when less than five percent of the units shifted in a pass.

Correlation removal

The process used is to standardise each input dimension, including a logarithmic transformation if this reduces the skewness, the covariance matrix is found (A) (the correlation matrix in this case), and then its square root extracted (B) followed by the inverse of the square root matrix (B^{-1}). For each unit the vector of scores used for clustering is found by pre-multiplying the column vector of standardised scores on each dimension by B^{-1}. The correlation matrix for these new scores is the identity matrix.

This process of removing the correlation is equivalent to (and simpler than) extracting principal components from the data, and standardising the principal component scores. Such a set of scores can be converted to a set identical to those produced by the process explained above by an orthoganal rotation of the axes. Distances between any two units are the same in either case.

In converting from Euclidean distances to Mahalanobis distances a similar process is followed but the covariance matrix used to find B^{-1} is the within-cluster matrix. The scores which are premultiplied are those output by the correlation removal procedure above.

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NEW AND INTERESTING RECORDS OF ADVENTIVE PLANTS FROM THE AUCKLAND INSTITUTE AND MUSEUM HERBARIUM 5

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AUCKLAND INSTITUTE AND MUSEUM

Abstract. This fifth list of some recent additions to the Auckland Institute and Museum Herbarium (AK) and re-examination of earlier gatherings provides new records for some adventive species and further information on the distribution of others.

Various collectors have recently added material to the Herbarium, providing new records in some cases and in others contributing to the knowledge of the distribution of rarely recorded adventive species. The third volume of the *Flora of New Zealand,* which deals with naturalised monocotyledons (except grasses), is expected to appear before this paper is published. It will be of major importance to all who have an interest in the description, history and spread of adventive plants. Reference should also be made to two checklists of naturalised plants published in 1978 by members of the D.S.I.R. Botany Division staff at Christchurch, one of the Umbelliferae (Webb 1978) and the other of the Lamiales (Sykes 1978).

The nomenclature adopted in this paper is that published by the New Zealand Weed and Pest Control Society (1969) with amendments by Healy (1975). For species not in these works references are given to publications consulted. Specimens are cited by collector's numbers or, in the absence of these, by the AK Herbarium number. Unless otherwise stated the specimens may be regarded as the only material of the species possessed by the Herbarium and, where no previous literature is cited, as first records to the best of my knowledge at the time of writing.

RANUNCULACEAE

Consolida ambigua (L.) P. W. Ball & Heywood

Auckland, Mt. Cambria, Devonport Borough Council yards, 1978, A. E. Wright 2757.

Larkspur was first recorded by Smith (1904) as *Delphinium ajacis* L. from Ashburton. Thomson (1922), Allan (1940) and Healy (1969) all referred to Smith's record. Later Mason (1974) mentioned it under the name *Delphinium ambiguum* as occurring in a Canterbury cemetery. It is more frequent than *D. consolida* as a garden escape according to Connor (1977). Differences between the two species may be found in Chater (1964). The Herbarium gathering consists of two specimens, one being blue-flowered and the other pink, with a note that the former colour is more usual. Mr Wright informs me that he has a specimen, collected in 1976 from Domain Drive, Auckland, in his personal herbarium.

Ranunculus bulbosus L.

Vicinity of Auckland, T. F. Cheeseman, AK 12729; Auckland, Owairaka Park, hillside, 1978, A. E. Esler and Lynne Scott, AK 145360.

In my first list of records (Bangerter 1975) I stated that there was no specimen of *Ranunculus bulbosus* in the Herbarium but the undated Cheeseman sheet has since been discovered misplaced in the *R. sardous* cover. The recent gathering, determined as subsp. *bulbosus*, was presented by Mr A. E. Esler.

PAPAVERACEAE

Papaver dubium L.

Lake Co., Pembroke, shores of Lake Wanaka, 1936, H. H. Allan, AK 92383; Auckland, on soil heap between Albert Park and University Conservatorium of Music, 1978, A. E. Wright 2760; Auckland, Devonport Borough Council yards, 1978, A. E. Wright 2759.

The first record for the long-headed poppy, Clutha Valley, 1885, G. M. Thomson, was published by Thomson (1922) and repeated by Allan (1940). Cheeseman (1906, 1925) added "Otago, Petrie" and "Near Ashburton, H. H. Allan." For Canterbury, Healy (1969) gave it as rare and occasional as a seed impurity. Recently, Connor (1977) went no further than "very occasional in Canterbury and Otago." Two of the specimens recorded above indicate a distribution in the North Island.

RESEDACEAE

Reseda alba L.

Waitemata Co., Milford, near beach, 1978, E. B. Bangerter 5382; Auckland, One Tree Hill, 1978, A. E. Wright 2590.

Thomson (1875) first observed this plant in Dunedin, listing it as *R. suffruticulosa* L. He later recorded Poverty Bay as an additional locality (Thomson 1922). Later authors repeated these records and Healy (1944) extended the distribution to Feilding and Wellington. In his Canterbury list Healy (1969) indicated white mignonette as local and rare and gave its means of introduction as an impurity in seed.

Reseda odorata L.

Auckland, soil heap between Albert Park and the University Conservatorium of Music, 1978, A. E. Wright 2671.

The label with this specimen bears the following information: "scented, capsule three-lobed, flowers white with orange anthers, leaves flushed with red." As a constituent of the European flora this mignonette is described by Yeo (1964).

CAROPHYLLACEAE

Lychnis flos-cuculi L.

In Bangerter (1976) I recorded a gathering of this species from Onewhero as a possible first record for the Auckland Province. In fact it was recorded by Cheeseman (1883) from Whangarei in his list of plants naturalised in the Auckland district.

AIZOACEAE

Aptenia cordifolia (L.f.) N.E.Br.

Waitemata Co., Karekare, road to Mercers Bay, 1978, A. E. Wright 2632.

A note on the label of this gathering states "scrambling through *Stenotaphrum* and *Tetragonia trigyna* at roadside". The species was noted by Healy (1959) as a succulent constituent of coastal cliff communities but also occurring in other habitats; he gave the first record as from Thorndon, near Wellington, 1953, and cited localities in the South Island. Both he (Healy 1969) and Mason (1969) recorded it for the Canterbury area. Mercers Bay seems to be the furthest north for it.

POLYGONACEAE

Polygonum punctatum Ell.

Waitemata Co., Waitakere, Anzac Valley Road, 1978, A. E. Wright 2652.

The only reference to this species that I have found in New Zealand literature is in Healy (1976) where it is keyed out and recorded from North Auckland, Waikato, Marlborough and Nelson. It is close to *P. hydropiper* L. but is a much taller plant. The label has the information "standing more or less erect in deep drain, approx. 1.5 m tall."

PAPILIONACEAE

Lupinus angustifolis L.

Waitemata Co., Milford, sandy waste area, 1978, E. B. Bangerter 5389.

Blue lupin was first recorded for New Zealand by Healy (1958) who gave several localities, the earliest being Palmerston North in 1945, and who stated that it is more common in the South Island. None of his records, however, are as far north as Milford. The plant is apparently grown for ploughing-in and it figures not infrequently in agricultural literature. Connor (1977) published an illustration and discussed its toxicity, but stated that its acreage has decreased.

UMBELLIFERAE

Heracleum mantegazzianum Somm. & Lev.

Wellington, near Eastbourne, Point Howard, 1978, J. C. Yaldwyn, AK 149173.

First recorded by Healy (1969) as noted by Webb (1978), the giant hogweed has not often been reported in New Zealand literature. The above gathering, sent by Dr P. J.

Brownsey, bears the information "garden weed established naturally". The species was listed for Mount Cook National Park by Wilson (1976), as rare in disturbed ground near the Hermitage. Connor (1977) says "roadsides and waste places from southern Marlborough to Otago."

COMPOSITAE

Chrysanthemum frutescens L.

North Auckland, Maungaturoto, 1945, M. Judd, AK 89774 det. H. H. Allan; Wellington, Roroa Road, steep road banks, abundant, 1978, P. D. Wisheart, AK 145128, det. P. J. Brownsey; Hokianga Co., Waipoua State Forest, mouth of Wairau River, 1977, A. E. Wright 2569.

In Canterbury (Healy 1969, Mason 1969) the marguerite was noted as a coloniser of coastal cliffs and Allan (1940), who did not cite precise localities, commented that it "tends to escape and persist for long periods."

CAMPANULACEAE

Trachelium caeruleum L.

Rodney Co., Muriwai, roadside under native forest, 1978, P. J. Brownsey, AK 143482; Auckland, Symonds Street, cemetery walls, 1978, E. B. Bangerter 5398.

Mr A. E. Esler kindly directed me to the locality of my specimen above and he also informs me that he has in his herbarium a plant collected in 1972 by himself and S. J. Estridge from rocks at Government House, Epsom, Auckland. A description of the species may be found in Tutin (1976).

SOLANACEAE

Solanum sublobatum Wild.

Manukau Co., Papatoetoe, Roscommon Road, weedy road edge, 1978, R. O. Gardner 2056; Auckland, Parnell, Laurie Avenue, weed in garden, 1978, E. A. Brown, AK 149107.

Formerly recorded under the name *S. gracilius* Herter, velvety nightshade was originally collected from Greymouth in 1941 according to Healy (1976), who commented that it was well established in South Island districts and occurred about Wellington and near Kakariki in the North Island. In his Canterbury list Healy (1969) described it as occasional and local, the means of introduction unknown. It occurs in hedgerows and bush margins according to Connor (1977).

LENTIBULARIACEAE

Utricularia biflora Lam.

Auckland, Waitakere Stream, 1978, R. O. Gardner 1911, det. P. Taylor (Kew).

Reference to North American Floras will provide a description of this bladderwort.

Dr. Gardner's notes on the label of his material state "several colonies up this stream and in Bethell's Swamp."

ACANTHACEAE

Acanthus mollis L.

Waitemata Co., Karekare, road to Mercer Bay, 1978, A. E. Wright 2626.

Originally recorded from Hutt Valley, 1953, by Healy (1958), it is given in his Canterbury list (Healy 1969) as a widespread but rare horticultural escape. I have seen acanthus often in Auckland gardens (there is an example in the Herbarium) and not infrequently as a roadside adventive. It is also known in the Auckland area to Mr A. E. Esler.

LILIACEAE

Muscari armeniacum Baker

Waitemata Co., Mairangi Bay, roadside, 1974, E. B. Bangerter 5187.

I am indebted to Dr. E. Edgar for the correct name of this grape-hyacinth, which I had placed in the Herbarium under *M. atlanticum*. It was first recorded as *M. neglectum* Guss. by Healy (1958), collected by him in 1953 from Palmerston North.

AMARYLLIDACEAE

Nothoscordum inodorum (Ait.) Nichols.

Hutt Co., Lower Hutt, weed in garden, 1966, J. H. Goulding, AK 117938, det. A. J. Healy; Auckland, Parnell Rose Garden, troublesome weed, 1977, S. Fox, AK 143064.

The first certain record for this plant is Whakatane, 1914, published by Healy (1946). He described it as a persistent and troublesome escape in gardens and about footpaths, repeating these habitats in later publications (Healy 1969, 1973).

IRIDACEAE

Chasmanthe floribunda (Salisb.) N. E. Brown

Hokianga Co., Waipoua State Forest, around hut at Kawerau, 1976, A. E. Wright 1394.

First recorded by Kirk (1870) as *Antholyza aethiopica* Ker., this species was referred to by White (1969) and is known to Mr A. E. Esler as a garden escape in Auckland. Two cultivated specimens collected by Dr. M. Goodey from gardens in Parnell are also in the Herbarium.

Schizostylis coccinea Back. & Harv.

Taupo Co., Tokaanu, south end of Lake Taupo near wharf, 1959, K. Wood, AK 58837; Ohinemuri Co., Karangahake Gorge, 1977, S. Reed, AK 141830.

The latter specimen has a note "flowers red; 2ft tall." Describing the plant as "persistent and spreading", Healy (1958) recorded it from Wellington, 1945, and Kaitaia, 1955. In his list of Canterbury adventives (Healy 1969) he classed it as rare and widespread. Martin (1971) noted its occurrence in Hokianga.

CYPERACEAE

Cyperus polystachyus Rottb.

In the fourth paper of this series (Bangerter 1978) I gave Mr A. E. Wright's specimens from Hokianga as possible first records for New Zealand. Dr. E. Edgar, however, has kindly drawn my attention to Healy (1957) where the first record from Motutangi, 1953, was published. Kaitaia and Silverdale were cited by him as additional localities so Hokianga is of interest only as a new locality.

GRAMINEAE

Aira multiculmis Dum.

Mangonui Co., Tauroa, marsh, 1913, H. Carse, AK 98165; Mangonui Co., Kaitaia, 1923, H. B. Matthews, AK 98174; Coromandel, Goat Island, 1970, E. M. Dickson, AK 140350; Hokianga Co., Waipoua State Forest, Kawerua, 1976, A. E. Wright 982; Waitemata Co., Bethells Beach, roadside, 1977, A. E. Wright, 1846.

The first three of the above gatherings were placed under *A. caryophyllea* L. but have been re-determined by Mr A. E. Wright as *A. multiculmis* Dum., which at one time was considered to be a variety of the former species. A few other specimens in the Herbarium are not cited as they do not add to the distribution. Allan (1936) described *A. multiculmis* as "much taller and with more numerous culms." Healy (1969) gave it as rare and local in his Canterbury list.

Avena sterilis L.

Auckland, Adam Street, Green Lane, 1978, A. E. Esler and Lynne Scott, AK 143599; Auckland, Lower Grafton Gully, motorway earthworks, 1978, A. E. Wright 2698.

Mr A. E. Esler kindly presented the former of these two specimens as a voucher for the record; a note on the label states that it was "abundantly naturalised in a grassy railway margin." Hubbard (1954), speaking of its occurrence in the British Isles, stated that this oat "is occasionally introduced and sometimes cultivated for ornament; it has larger spikelets than *A. ludoviciana*."

Echinochloa utilis Owhi & Jabuno

Auckland, Takapuna, Wairau Road, 1979, A. E. Wright 3122.

At one time the name *E. frumentacea* was erroneously applied to this grass; the correction was made both by Healy (1975) and Sykes (1977), the latter recording the plant for the Kermadec Islands. Matthews (1975) under this name stated that it is infrequent whilst Connor (1977) using the correct name described it as "rarely cultivated" and reported that photosensitisation in grazing lambs has been recorded from various places, the earliest in 1940.

Secale cereale L.

Waitomo Co., south end of Awakino Gorge in unfarmed grassland, 1978, M. R. Idoine, AK 144498.

Much has been written about rye in agricultural literature but I find little reference to it as an escape from cultivation. A description may be found in Lambrechsten (1972). Healy (1969) commented on its spread by seeds falling from trucks in railway sidings and along roadsides.

Sorghum halepense (L.) Pers.

Franklin Co., Pukekohe, Buckland, John Kane's Farm, 1978, A. Pollock, AK 149068, det. A. E. Wright.

This example of Johnson-grass was identified for the Ministry of Agriculture and Fisheries, Pukekohe. Hilgendorf (1967) noted it as a noxious weed occurring in Auckland and Napier. Matthews (1975) stated "reported from Kerikeri." In an article expounding its noxious potential, Findlay (1975) was particularly concerned with its presence in a crop of sweet-corn at Korokipo, Hakwes Bay; he stated that it was known from Gisborne but there was no present knowledge of it in Napier. Connor (1977) described it "only as a rare and localised weed in the northern half of the North Island." Recent reports through the popular media, however, suggest that it is spreading considerably.

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ANNOTATED CHECKLIST OF TYPE SPECIMENS OF NEW ZEALAND PLANTS IN THE AUCKLAND INSTITUTE AND MUSEUM HERBARIUM

Part 4. Monocotyledones — except Gramineae

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Abstract. In continuation of an annotated checklist of presumptive type material of New Zealand species in the AK Herbarium the following families of monocotyledons are included: Burmanniaceae, Centrolepidaceae, Cyperaceae, Juncaceae, Liliaceae, Orchidaceae, Potamogetonaceae and Zannichelliaceae.

This part includes all monocotyledonous types except Gramineae which was published as Part 3 (Wright 1978). Specimens thought to have type status are listed, together with their author and publication reference. Details of the type locality, quoted directly from the original description, are given in quotation marks. In citing AK specimens, labels and notes of the collectors have been quoted where possible, giving their information in the following order: locality, collector, date, AK number. Metric equivalents of altitudes, distances and measurements have been added in square brackets. An asterisk before the specimen data denotes that the label is written in a handwriting other than that of the collector (often in Cheeseman's hand on labels printed "Herb. T. F. Cheeseman"). † after specimen information indicates reference to published designation of the AK specimen as type material.

In this paper, the institution holding the major portion of the herbarium of the collector, if other than AK, is indicated in brackets at the end of the specimen data. Herbarium abbreviations are:- AK = Auckland Institute and Museum; BM = British Museum (Natural History); CHR = Botany Division, D.S.I.R., Christchurch; K = Royal Botanic Gardens, Kew; LD = Botanical Museum, Lund, Sweden; MEL = National Herbarium of Victoria, Royal Botanic Gardens, Melbourne; WELT = National Museum, Wellington.

BURMANNIACEAE

Bagnisia hillii Cheesem. *Kew Bull. for 1908:* 420 (1908)

TYPE LOCALITY. "Northern Island; in primeval woods at Opepe, near Lake Taupo, H. Hill; T. F. Cheeseman."

Specimen. *Opepe, Taupo, H. Hill, Jan. 1908, AK 116750 (in spirits) (†Moore and Edgar 1970: 101). (K and WELT).

CENTROLEPIDACEAE

Centrolepis minima Kirk *Trans. Proc. N.Z. Inst.* 23: 441 (1891)

TYPE LOCALITY. "Shores of Lake Brunner, T. Kirk."

Specimen. Lake Brunner, Kirk, no date, AK 2892 (†Moore and Edgar 1970: 83). (WELT).

Gaimardia ciliata Hook. f. *Fl. Antarct.* 1: 85 (1844)

TYPE LOCALITY. "Lord Auckland's group; exposed places on the hills, very abundant, forming large green patches."

Specimen. *Auckland Island, J. D. Hooker, November 1840, AK 2910 (†Moore and Edgar 1970: 84). (K).

CYPERACEAE

Carex allanii Hamlin *Trans. R. Soc. N.Z. Bot.* 1: 272 (1962)

TYPE LOCALITY. "North Otago Botanical District: Old Man Range, Clutha Valley, 1,200 m, Nov. 1893, Petrie."

Specimen. *Old Man Range, Otago, D. Petrie, no date, AK 2476 (†Hamlin 1962: 273). (WELT).

Carex australis Kirk *Trans. Proc. N.Z. Inst.* 26: 262 (1894)

TYPE LOCALITY. "Stewart Island. C. Traill and T. Kirk (1882)."

Specimen. *Stewart Island, T. Kirk, no date, AK 2751 (†Hamlin 1968: 106). (WELT).

Carex berggrenii Petrie *Trans. Proc. N.Z. Inst.* 18: 297 (1886)

TYPE LOCALITY. "Mount Pisa Range, at the head-waters of the Luggate Creek, 4,000 to 5,000 feet [1219-1524 m]."

Specimens. *Summit of Mt Pisa, Otago, 4,500ft [1371 m], D. Petrie, no date, AK 2693 (2 sheets) (†Hamlin 1968: 105). (WELT).

Carex carsei Petrie Trans. Proc. N.Z. Inst. 54: 570 (1923)

TYPE LOCALITY. "Swampy stations on the Waimarino Plain: H. Carse and H. B. Mathews! Near Lake Tennyson (Southern Nelson): W. G. Morrison!"

Specimens. In bogs in several parts of Waimarino Plain, H. Carse, Jan. 1921, AK 1283; Waimarino Plain, H. Carse, no date, AK 59072; *Waimarion Plain, H. Carse, no date, AK 59069. (CHR).

Carex cephalotes F. Muell. *Trans. Phil. Soc. Vict.* 1: 110 (1855)

TYPE LOCALITY. "On the grassy summits of the Munyang Mountains, moistened by the perpetual glaciers, or on the most elevated springs."

Specimen. Munyang Mountains,, no collector, no date (on label printed "Phytologic Museum of Melbourne. Baron Ferd. von Mueller, Ph. and M.D.) AK 96550 (†Moore and Edgar 1970: 244). (MEL).

Note. In Moore and Edgar (1970: 244) the type locality is not exactly the same as that in Mueller (1855) which is quoted above. The original description was headed "*Carex cephatotes*" presumably a printer's error, as the AK label on Mueller's specimen has "cephalotes" in his handwriting.

Carex cheesemanii Petrie *Trans Proc. N.Z. Inst.* 15: 358 (1883)

TYPE LOCALITY. "Maniototo Plain 1,000-2,000 feet [304-609 m]; Nevis Valley 1,500 feet [457 m]."

Specimens. Naseby, Herb. D. Petrie, no date, AK 2731 (2 sheets) (†Hamlin 1968: 107). (WELT).

Carex cinnamomea Cheesem. *Trans. Proc. N.Z. Inst.* 14, 301 (1882)

TYPE LOCALITY. "Graham River and other tributaries of the Motueka rising in Mount Arthur. Sources of the Takaka River, ascending to 3,500 feet [1066 m] altitude."

Specimen. Takaka River, Nelson, 3,000ft [914 m], T.F.C., Jan. 1881, AK 2828 (†Moore and Edgar 1970: 246).

Carex cirrhosa Bergg. *Minneskr. fisiogr. Sällsk. Lund* Art 8, 29, t.7, f.27-34 (1878)

TYPE LOCALITY. "ad flumen Waimakariri in alpibus insulae australis Novae Zelandiae".

Specimen. *"Utricles from Berggren's own cirrhosa collected in the Alps near the Waimakariri River" written on small package ex C. B. Clarke attached to sheet of *C. cirrhosa* AK 2687. (L).

Carex cirrhosa Bergg. var. **lutescens** Kuk. ex Cheesem. *Man. N.Z. Fl.:* 825 (1906)

TYPE LOCALITY. "Canterbury — Upper Waimakariri and Lake Lyndon, Berggren! Enys! Kirk! Cockayne! T.F.C."

Specimen. Lake Lyndon, Canterbury Alps, T.F.C., Jan. 1880, AK 2688 (2 sheets) (†Hamlin 1968: 108).

Carex comans Bergg. var. **stricta** Cheesem. *Trans. Proc. N.Z. Inst.* 24: 415 (1892)

TYPE LOCALITY. "Lake Tekapo"

Specimens: Lake Tekapo, Canterbury, alt. 2,500ft [762 m], T.F.C., Jan. 1883, AK 2739 (52 to Kukenthal) (†Hamlin 1968. 107); also AK 2740, AK 2742 (2 sheets).

Carex cryptocarpa Cheesem. *Trans Proc. N.Z. Inst,* 16: 412 (1884)

TYPE LOCALITY. "Lake Tekapo, Canterbury; altitude 2,500 feet (762 m)."

Specimen. Lake Tekapo, Canterbury, alt. 2,500ft [762 m], T.F.C., Jany 1883, AK 2697 (†Hamlin 1968: 105).

Carex dallii Kirk *Trans. Proc. N.Z. Inst.* 26: 261 (1894)

TYPE LOCALITY. "Near the source of the Heaphy River, Nelson. J. Dall."

Specimen. *Heaphy River, South Island, no collector, no date, AK 2704 ex Herb. T. Kirk (†Hamlin 1968: 100). (WELT).

Carex devia Cheesem. *Trans. Proc. N.Z. Inst.* 15: 301 (1883)

TYPE LOCALITY. "Mountain districts in Nelson, not uncommon above 2,500 feet [762 m] altitude."

Specimens. Red Hills, Wairau Valley, Nelson 3,000ft [914 m], T.F.C., no date, AK 2662 (3 sheets) (†Hamlin 1968: 110).

Carex dissita Boott var. **ochrosaccus** C. B. Clarke ex Cheesem. *Man. N.Z. Fl.:* 831 (1906)

TYPE LOCALITY. "Whangarei, Carse! Kaipara, Kirk! vicinity of Auckland, T.F.C."

Specimens. St Heliers, Auckland, T.F.C., Nov. 1882, AK 2775, AK 2776 (56 to Kukenthal). (†Hamlin 1968: 99).

Carex elingamita Hamlin *Trans. R. Soc. N.Z.* 85: 393 (1958)

TYPE LOCALITY. "Three Kings Islands: Nov. 1889, Cheesemen"

Specimens. Three Kings Islands, T.F.C., Nov. 1889, AK 2839, AK 3840.

Carex fascicularis Sol. ex Boott var. **minor** Boott in Hook.f. *Fl. N.Z.* 1: 283 (1853)

TYPE LOCALITY. "Northern and Middle Islands; common in moist woods, etc. Banks and Solander, etc."

Specimen. *New Zealand 1769-70, Banks and Solander (Ex Herbario Musei Britannici) AK 109850. (BM).

Carex flagellifera Col. *Trans. Proc. N.Z. Inst.* 16: 342 (1884)

TYPE LOCALITY. "On sides of abrupt clayey declivities, woods, between Norsewood and Danneverke, Waipawa County, 1881-1883: W.C."

Specimen. *Norsewood, Hawkes Bay, W. Colenso, no date, AK 2672. (WELT).

Carex flaviformis Nelmes *Kew Bull.* 10: 84 (1955)

TYPE LOCALITY. "New Zealand, Cheeseman."

Specimens. Lake Tekapo, Canterbury, alt. 2,500ft [762 m], T.F.C., Jan. 1883, AK 2821-2; Mount Arthur Plateau, Nelson, 4,000ft [1219 m], T.F.C., Jan. 1886, AK 2815.

Note. No type indicated by Nelmes (1955) but AK 2815 listed as representative by Moore and Edgar (1970: 266).

Carex fretalis Hamlin *Rec. Dom. Mus. Wellington* 6: 107 (1968)

TYPE LOCALITY. "Bluff Hill, north side, wet ground among stones and alien grasses, 28 Feb. 1967, B. G. Hamlin 976."

Specimen. *Halfway up Bluff Hill, Southland, B. G. Hamlin, 28.2.1967, AK 116482. (WELT).

Carex gibbsii Petrie *Trans. Proc. N.Z. Inst.* 46:35 (1914)

TYPE LOCALITY. "Shallow open swampy flats at Cedar Creek, Waimangaroa River (near Denniston), west Nelson, about 1,760ft [536 m]."

Specimen. *Cedar Creek, near Denniston, D. Petrie, no date, AK 2705 (†Hamlin 1968: 101). (WELT).

Carex goyeni Petrie *Trans. Proc. N.Z. Inst.* 14: 363 (1882)

TYPE LOCALITY. "Head of Lake Wakatipu, 1,100ft [335 m]."

Specimen. First land at head of Lake Wakatipu. 1,100ft [335 m], D.P., no date, AK 2616 (†Hamlin 1968: 111). (WELT).

Carex hectori Petrie *Trans. Proc. N.Z. Inst.* 27: 405 (1895)

TYPE LOCALITY. "Old Man Range (4,800ft) [1463 m]."

Specimen. Old Man Range, Central Otago, 4,800ft [1463 m]. D.P., March 1894, AK 2695 (2 sheets). (†Hamlin 1968: 105). (WELT).

Carex inconspicua Col. *Trans. Proc. N.Z. Inst.* 28: 612 (1896)

TYPE LOCALITY. "Ruahine Mountain-range, east side: Mr A. Olsen; 1895"

Specimen. *Ruahine Range, A. Olsen, 1895, AK 2469 (†Hamlin 1962: 270). (WELT).

Carex inopinata Cook *Trans. R. Soc. N.Z.* 81: 162 (1953)

TYPE LOCALITY. "Castle Hill, Canterbury, 1946, Talbot; 1947, Cook. Type in Auckland Museum. No. 24076."

Specimen. Castle Hill, Canterbury, ca 2,800ft [853 m], V. J. Cook 1006, Jan. 1947, (Type species), AK 24074 (†Moore and Edgar 1970: 267).

Note. The type number AK 24074 does not tally with that given by Cook 1953 and no specimen numbered AK 24076 has been found.

Carex inversa R. Br. var. **radicata** Cheesem. *Trans. Proc. N.Z. Inst.* 16: 425 (1884)

TYPE LOCALITY. "Lakes Tekapo and Pukaki, Canterbury, altitude 2,500ft [762 m]."

Specimens: Lake Tekapo, Canterbury, alt. 2,500ft [762 m], T.F.C., Janr. 1883, AK 2542 (†Moore and Edgar 1970: 282). Also AK 2543.

Carex kermadecensis Petrie *Trans. Proc. N.Z. Inst.* 47: 56 (1915)

TYPE LOCALITY. "Denham Bay, Sunday Island, Kermadecs."

Specimen. Denham Bay, Sunday Island, W.R.B.O., 7 Nov. 1908, AK 2837. (WELT).

Carex kirkii Petrie *Trans. Proc. N.Z. Inst.* 18: 297 (1886)

TYPE LOCALITY. "Mount Pisa Range, at the head-waters of the Luggate Creek, 4,000 to 5,000ft [1219-1524 m]."

Specimen. Headwaters of Luggate Creek, Mt Pisa, 4,000ft [1219 m] (From the Herbarium of D. Petrie), Feby 1885, AK 2480 (†Moore and Edgar 1970: 279). (WELT).

Carex kirkii Petrie var. **elatior** Kuk. ex Cheesem. *Man. N.Z. Fl.:* 811 (1906)

TYPE LOCALITY. "Mount Arthur Plateau, T.F.C.; Mount St. Bathan's (Otago), Petrie!"

Specimens. Mount Arthur Plateau, Nelson, alt. 4,000ft [1219 m], T.F.C., Jan 1886, (n.14 Kukenthal), AK 2485 (†Moore and Edgar 1970: 280). Also AK 2486.

Carex kirkii Petrie var. **membranacea** Kuk. ex Cheesem. *Man. N.Z. Fl.:* 811 (1906)

TYPE LOCALITY. "Mount Arthur Pleateau, T.F.C."

Specimens. Mount Arthur Plateau, Nelson, alt. 4,000ft [1219 m], T.F.C., Jan. 1886, AK 2490 (n.15 Kukenthal), AK 2489.

Carex petriei Cheesem. *Trans. Proc. N.Z. Inst.* 16: 413 (1884)

TYPE LOCALITY. "Mountains of Canterbury, apparently not uncommon between 2,500 and 4,500 feet [762-1371 m]: T.F.C. Dunstan Mountains, Lake Wanaka, and near Naseby, Otago: D. Petrie."

Specimen. Mountains above the Broken River, Canterbury, alt. 4,000ft [1219 m], T.F.C., Jan. 1883, AK 2707 (47 Kukenthal) (†Hamlin 1968: 101).

Carex picta Col. *Trans. Proc. N.Z. Inst.* 21: 103 (1889)

TYPE LOCALITY. "Open grassy plains at Tahoraiti, south of Dannevirke, County of Waipawa; 1887: W.C."

Specimen. *Near Dannevirke, Hawkes Bay, W. Colenso, no date, AK 2548 (†Moore and Edgar 1970: 283). (K and WELT).

Carex pleisotachys C. B. Clarke ex Cheesem. *Man. N.Z. Fl.:* 829 (1906)

TYPE LOCALITY. "Otago-Milford Sound, Kirk!"

Specimen: Milford Sound (From the Herbarium of T. Kirk, Wellington, New Zealand printed on label), no collector, no date, AK 2734 (†Hamlin 1968: 105). (WELT).

Carex pumila Thunb. var. **macrocarpa** Carse *Trans Proc. NZ. Inst.* 48: 241 (1916)
TYPE LOCALITY. "In damp hollows, among sand-dunes, Tauroa (Reef Point)."
Specimen. In damp hollow among sandunes Tauroa, H.B.M., H.C., Jan. 1915 (ex Herb. H. Carse, Kaiaka, Auckland, N.Z.), AK 2809.

Carex semiforsteri C. B. Clarke ex Cheesem. *Man. NZ. Fl.:* 836 (1906)
TYPE LOCALITY. "Kermadec Islands: T.F.C., Miss Shakespear! North and South Islands: Not uncommon throughout. Sea-level to 2,000ft [609 m]."
Specimen. *Herb. Colenso, no. 1622, AK2838 (†Moore and Edgar 1970: 244). Also Herb. Colenso 4189, AK 2833, and AK 2834. (K and WELT).

Carex smaragdina Col. *Trans. Proc. NZ. Inst.* 27: 398 (1895)
TYPE LOCALITY. "Interior damp forests at Dannevirke, County of Waipawa; March, 1894; W.C."
Specimen. *Dannevirke, H. B., W. Colenso, no date, AK 2535 (†Moore and Edgar 1970: 282). (K and WELT).

Carex ternaria Boott var. **gracilis** Cheesem. *Trans. Proc. NZ. Inst.* 16: 431 (1884)
TYPE LOCALITY. ". . . from the North Cape to Stewart Island and the Auckland Isles, and from sea level to 4,000ft [1219 m]."
Specimen. Lake Waihi, Waikato, T.F.C., no date, AK 2590 (†Hamlin 1954: 59).

Carex ternaria Boott var. **minor** Boott forma **nigrescens** Kuk. *Pflanzenr.* 38: 369 (1909)
TYPE LOCALITY. "Arthur's Pass 900 m (Cockayne 1535)."
Specimen. *Arthurs Pass, in running water, L. Cockayne, no date, AK 2595. (WELT).

Carex ternaria Boott var. **pallida** Cheesem. *Trans. Proc. NZ. Inst.* 16: 431 (1884)
TYPE LOCALITY. "Marshy places in the mountains of the South Island, apparently plentiful, D. Petrie! T.F.C."
Specimen. Lake Tekapo, Canterbury Alps, 2500ft [762 m], T.F.C., Jan. 1883, AK 2596. (†Hamlin 1954: 64).

Carex trachycarpa Cheesem. *Trans. Proc. NZ. Inst.* 24: 413 (1892)
TYPE LOCALITY. "Nelson Province: Mount Owen, alt. 4,000ft [1219 m] Mount Arthur and Mount Peel, alt. 3,500ft to 4,500ft [1066 to 1371 m]."
Specimen. Mount Arthur, Nelson, alt 4500ft [1371 m], T.F.C., no date, AK 2491 (†Moore and Edgar 1970: 281).

Carex traversii Kirk *Trans. Proc. NZ. Inst.* 26: 262 (1894)
TYPE LOCALITY. "Dun Mountain, & c; 3,000ft-4,000ft [914 m to 1219 m]. W. T. L. Travers."
Specimen. *Dun Mountain, Nelson, H. H. Travers, no date, AK 2706 (†Hamlin 1968: 101). (WELT).

Carex uncifolia Cheesem. *Trans. Proc. NZ. Inst.* 16: 412 (1884)
TYPE LOCALITY. "Mountains flanking the Wairau Valley, Nelson; alt. 3,000-4,000ft [914-1219 m]."
Specimen. Red Hills, Wairau Valley, Nelson, alt. 3,000ft [914 m], T.F.C., Jan. 1882, AK 2700 (†Hamlin 1968: 104).

Carex uncifolia Cheesem. var. **libera** Kük. *Pflanzenr.* 38: 685 (1909)

TYPE LOCALITY. "Nelson: Mt Arthur Plateau, 4,000ft [1219 m] (Cheeseman!)."

Specimen. Mount Arthur Plateau, Nelson, 4,000ft [1219 m], T.F.C., 1886, AK 2703 (46 Kukenthal. "C.uncifolia") (†Hamlin 1968: 103).

Carex virgata Sol. ex Boott in Hook.f. *Fl.N.Z.* 1: 282 (1853)

TYPE LOCALITY. "Throughout the Islands; common in woods, Banks and Solander, etc."

Specimen. *New Zealand 1769-70, Banks and Solander (Ex Herbario Musei Britannici), AK 109675. (BM).

Carex viridis Petrie *Trans. Proc. N.Z. Inst.* 13: 332 (1881)

TYPE LOCALITY. "Rough Ridge, 3,000ft [914 m]; Nevis Stream, Otago, 2,000ft [609 m]."

Specimen. Rough Ridge, Otago, 3,000ft [914 m], no collector or date, but label, numbered 26, is in Petrie's hand, AK 2499. (WELT).

Carex wakatipu Petrie *Trans. Proc. N.Z. Inst.* 14: 363 (1882)

TYPE LOCALITY. "Ben Lomond, near Queenstown, 3,000-5,000ft [914-1524 m]."

Specimen. Ben Lomond near Queenstown 3,000-5,000ft [914-1524 m], D.P. 42, no date, AK 2659. (WELT).

Carex wallii Petrie *Trans. Proc. N.Z. Inst.* 53: 371 (1921)

TYPE LOCALITY. "Wet ground at Centre Hill, Southland: Arnold Wall! Collected February, 1920."

Specimen. *In wet ground, Centre Hill, Southland, Arnold Wall, Feby 1920 (Ex Herb. D. Petrie), AK 2477 (†Moore and Edgar 1970: 266). (CHR).

Chaetospora tendo Banks et Sol. ex Hook. f. *Fl. N.Z.* 1: 273 (1853)

TYPE LOCALITY. "Northern Island. Opuragi, in wet, shrubby places, Banks and Solander. On clay hills, common, Sinclair, etc."

Specimens. New Zealand, Banks and Solander, 1769-70 (Ex Herbario Musei Britannici), AK 109501-2. (BM).

Eleocharis neozelandica C. B. Clarke ex Kirk *Trans. Proc. N.Z. Inst.* 26: 260 (1894)

TYPE LOCALITY. "Cape Farewell, Nelson (1884) T.K."

Specimen. Cape Farewell, Nelson, from the Herbarium of T. Kirk, no date, AK 2048 (†Moore and Edgar 1970: 190). (WELT).

Schoenus carsei Cheesem. *Man. N.Z. Fl.* 781 (1906)

TYPE LOCALITY. "Auckland — Swamps at Whangarei and between the Manukau Harbour and the Waikato River, H. Carse! Papatoetoe, Kirk! Taranaki — Ngaire Swamp, T.F.C."

Specimens. Big Swamp, Maungatapere, H.C., 25 Jany '99, AK 2180-81 (†Moore and Edgar 1970: 194). (CHR).

Schoenus moorei Kirk *Trans. Proc. N.Z. Inst.* 13: 384 (1881)

TYPE LOCALITY. "North Island — at remarkable saline springs, Glenburn, East Coast."

Specimen. Glenburn, East Coast, T. Kirk, no date, AK 2205 (†Moore and Edgar 1970: 195). (WELT).

Schoenus vacillans Kirk. *Trans. Proc. N.Z. Inst.* 10: 421 (1878)

TYPE LOCALITY. "North Island. — Deep gullies at the source of the Matai River, Mount Wynyard."

Specimen. *Ravines near the base of Mount Wynyard, Thames, T. Kirk, no date, AK 2199 (†Moore and Edgar 1970: 196). (WELT).

Scirpus antipodus Cook *Trans. R. Soc. N.Z.* 81: 159 (1953)

TYPE LOCALITY. "Lake Waahi, near Huntly."

Specimen. Lake Waahi (Western edge), V.J.C. 1764, Sept 1942, AK 59164 (†Cook 1953: 160).

Scirpus caldwellii Cook *Trans R. Soc. N.Z.* 76: 568 (1947)

TYPE LOCALITY. "Waitakaruru, Thames Estuary."

Specimen. Waitakaruru nr Thames, V. J. Cook 542, Jan 1944, AK 59206 (†Cook 1947: 569).

Scirpus caligenis Cook *Trans. R. Soc. N.Z.* 81: 158 (1953)

TYPE LOCALITY. "Jackson, Teramakau River, Westland."

Specimens. Jackson's Teremakau River 2,000ft [609 m], D. Petrie, Jany. 1893, AK 2079 (2 sheets) (†Cook 1953: 159). (WELT).

Scirpus inundatus (R.Br.) Spreng. var **major** Cheesem. *Man. N.Z. Fl.* 776 (1906)

TYPE LOCALITY. "Abundant throughout."

Specimen. Kaitaia, T.F.C., Jan 1896, AK 2123.

Note. This is the earliest Cheeseman collection of this species in AK. No precise locality was given in the original description.

Scirpus medianus Cook *Trans. R. Soc. N.Z.* 76: 569 (1947)

TYPE LOCALITY. "vicinity of Thames."

Specimen. Waitakaruru nr Thames, V. J. Cook 463, Mch 1940, AK 61798, (Fig. 1) (†Cook 1947: 570).

Scirpus muscosus Kirk *Trans. Proc. N.Z. Inst.* 17: 224 (1885)

TYPE LOCALITY. "A minute species, less than one inch in height forming moss-like patches at the head of Paterson's Inlet. Also on the Bluff Hill."

Specimen. Stewart Island, T.K., no date, AK 2093. (WELT).

Scirpus perviridis Cook *Trans. R. Soc. N.Z.* 76: 570 (1947)

TYPE LOCALITY. "Vicinity Port Waikato."

Specimen. Port Waikato, V.J.C., no date, AK 59189 (†Cook 1947: 571).

Scirpus pottsii Cook *Trans. R. Soc. N.Z.* 81: 157 (1953)

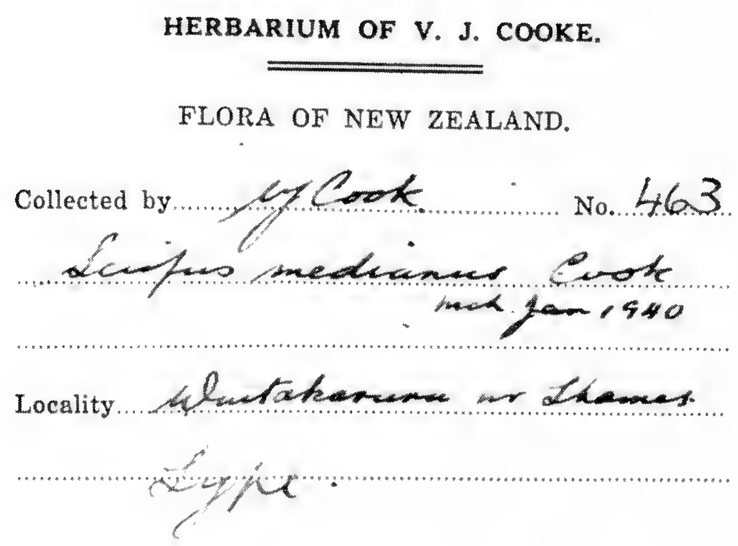
TYPE LOCALITY. "Waimarino Plateau."

Specimen. Waimarino Plateau near Matatoke Viaduct, V.J. Cook 2469A, AK 24077 (†Cook 1953: 157).

Uncinia aucklandica Hamlin *Bull. Dom. Mus. Wellington* 19: 63 (1959)

TYPE LOCALITY. "Carnley Harbour, Auckland Islands, Aston."

Specimen. Carnley Harbour, Auckland Is, B. C. Aston, Jan. 1909, AK 2431 (2 sheets) (†Moore and Edgar 1970: 232). (WELT).


HERBARIUM OF V. J. COOKE.

FLORA OF NEW ZEALAND.

Collected by V J Cook No. 463

Scirpus medianus Cook

Jan 1940

Locality Whatakaruru nr Thames

Type

Fig. 1. Herbarium label of V. J. Cook (10 x 7.5 cm).

Uncinia australis Pers. var. **clavata** Kuk. ex Cheesem. *Man. N.Z. Fl.* 802 (1906)

TYPE LOCALITY. "Near Wellington, Kirk! Otira Gorge, Kirk! T.F.C.; Mount Cook district, T.F.C."

Specimen. *Crow's Nest near Wellington, T. Kirk, no date, AK 2384 (85 Kukenthal) (†Hamlin 1959: 68). (WELT).

Uncinia caespitosa Boott ex *Hook. f. Fl. N.Z.* 1: 287 (1853)

TYPE LOCALITY. "Northern Island; woods, Ruahine mountains."

Specimen. *No locality, no date, Colenso 1644, AK 2359. (†Moore and Edgar 1970: 228). (K and WELT).

Uncinia cheesemanniana Boeck. *Engl. Bot. Jb.* 5: 521 (1884)

TYPE LOCALITY. "Mt Nelson alt. 4,000 ped. [1219 m] — T. F. Cheeseman leg."

Specimen. Mount Arthur, Nelson, 3,500ft [1066 m], T.F.C., Jan. 1881, AK 2330 (99 Kukenthal) (†Hamlin 1959: 59).

Uncinia compacta R. Br. var. **petriei** C. B. Clarke ex Cheesem. *Man. N.Z. Fl.* 800 (1906)

TYPE LOCALITY. ". . . South Island. Abundant in mountain districts throughout."

Specimen. Eweburn Creek, Naseby, 2,000ft [609 m], D. Petrie, Jan. 1887, AK 2339. (WELT).

Uncinia filiformis Boott ex Hook. *f. Fl. N.Z.* 1: 286 (1853)

TYPE LOCALITY. "Northern Island; top of the Ruahine mountains, Colenso. Middle Island, Lyall."

Specimen. *Ruahine Mountains, Colenso 1641, no date, AK 2451. (K and WELT).

Uncinia laxiflora Petrie *Trans. Proc. N.Z. Inst.* 17: 271 (1885)

TYPE LOCALITY. "Owake Flat near Catlin's River (P. Goyen); Stewart Island; Buller Valley (T. F. Cheeseman)."

Specimen. Buller Valley, Nelson, T.F.C., Jan. 1881, AK 2408.

Uncinia purpurata Petrie *Trans. Proc. N.Z. Inst.* 17: 272 (1885)

TYPE LOCALITY. "Signal Hill, Dunedin."

Specimen. *Near Dunedin, D. Petrie, no date, AK 2353 (114 Kukenthal). (WELT).

Uncinia sinclairii Boott var. **elegans** Kuk. ex Cheeseman. *Man. N.Z. Fl.* 799 (1906)

TYPE LOCALITY. "Black's, Otago, Petrie! 1,200-4,000ft [365-1219 m]."

Specimen. Blacks, Otago, D. Petrie, no date, AK 2325. (†Moore and Edgar 1970: 219). (WELT).

Uncinia strictissima Petrie *Trans. Proc. N.Z. Inst.* 47: 55 (1915)

TYPE LOCALITY. "Blueskin, Waitahuna, Lawrence, Roxburgh."

Specimen. *Waitahuna, Otago, D. Petrie, no date, AK 2442 (†Moore and Edgar 1970: 225). (WELT)

Uncinia tenella R. Br. var. **longifructus** Kuk. *Pflanzenr.* 38: 66 (1909)

TYPE LOCALITY. "Sudinsel, Otago (Kirk! Petrie!)."

Specimen. *Routeburn, Otago, T. Kirk, no date, AK 2328 (103 Kukenthal). (WELT).

IRIDACEAE

Libertia grandflora (R. Br.), Sweet Hort. Brit. ed 2: 498 (1830)

TYPE LOCALITY. Tolaga Bay?

Specimens. *Banks and Solander, 1769-70, AK 103854-5 (BM).

JUNCACEAE

Juncus macrostigma Col. *Trans. Proc. N.Z. Inst.* 17: 253 (1885)

TYPE LOCALITY. "Sides of water-courses, Seventy-mile Bush, between Norsewood and Matamau, County of Waipawa; 1882: W.C."

Specimen. *Norsewood, Hawkes Bay, W. Colenso, no date, AK 2919 (†Moore and Edgar 1970: 61). (K and WELT).

Juncus pallidus R. Br. var. **triandrus** Cheesem. *Man. N.Z. Fl.* 725 (1906)

TYPE LOCALITY. "Vicinity of Auckland, T.F.C.; Paterson's Inlet, Stewart Island, D. Petrie!"

Specimens. St John's College, near Auckland, T.F.C., Dec. 1883, AK 2925, AK 2921, AK 2923 (†Edgar 1964: 182).

Luzula banksiana E. Mey. var. **orina** Edgar *N.Z.J. Bot.* 4: 171 (1966)

TYPE LOCALITY. "Near Lake Forsyth . . ."

Specimen. Near Lake Forsyth, rocky bank beside road to Little River. In stony ground in shade. E. Edgar, 20.10.1964. AK 110493 ex Botany Division D.S.I.R., Christchurch, dup. 149563. (CHR).

Luzula campestris (L.) DC var. **migrata** Buch. *Öst. bot. Z.* 48: 220 (1898)

TYPE LOCALITY. "Neuholland, Tasmania, Neuseeland."

Specimen. Mt Egmont Ranges, T.F.C., Jan. 1885, AK 109271 (†Edgar 1966: 170).

Luzula celata Edgar *N.Z. J. Bot.* 4: 165 (1966)

TYPE LOCALITY. "Potts River near bridge . . ."

Specimen. Potts River Bridge, Rangitata Valley. In dried out centre of *Raoulia* mat, on shingly ground above river bed, E. Edgar, 29.10.1964, AK 110488 ex Botany Division, Christchurch, dup. 149586. (CHR).

Luzula cheesemanii Buch. *Bot. Jb.* 12: 146 (1890)

TYPE LOCALITY. "Gordon's Nob, Nelson und Black Range, Canterbury Alps."

Specimen. Summit of Gordon's Nob, Nelson, alt. 4,000ft [1219 m], T.F.C., Jan. 1882, AK 3066, (Fig. 2) (†Edgar 1966: 179).

Fig. 2. Herbarium label of T. F. Cheeseman (13.5 x 7.5 cm).

Luzula leptophylla Buch. & Petrie *Öst. bot. Z.* 48: 214 (1898)

TYPE LOCALITY. "Mount Kyeburn, Eastern Otago, 3,500ft [1066 m], leg. Don. Petrie."

Specimen. Mt Kyeburn, 3,000ft [914 m], D.P. ex Herb. D. Petrie, AK 3068 (†Edgar 1966: 178). (WELT).

Luzula micrantha Buch. *Öst. bot. Z.* 48: 166 (1898)

TYPE LOCALITY. "Mt. Cardona near Lake Wanaka, 5,0000ft [1524 m], Otago, Neu-Seeland; leg. Don. Petrie."

Specimen. *Mt Cardrona, Otago, 6,000ft [1828 m], Petrie, no date, AK 105078 (†Edgar 1966: 180). (WELT).

Luzula rhadina Buch. *Öst. bot. Z.* 48: 212 (1898)

TYPE LOCALITY. "Kurow, Waitaki-River (300ft) [91 m] October 1892 leg. Don. Petrie

Specimen. Kurow, Waitaki River, D. Petrie, Oct. 1892, AK 3120 (†Edgar 1966 171). (WELT).

Luzula rufa Edgar var. **albicomans** Edgar *N.Z.J. Bot.* 4: 168 (1966)

TYPE LOCALITY. "Junction of Mingha and Bealey Rivers, Canterbury . . ."

Specimen. Junction of Mingha and Bealey Rivers, Cantebury. Sand on terrace, 2,200ft [670 m], W. Burke, 23.12. 1964, AK 110489 ex Botany Division, D.S.I.R., Christchurch 143378. (CHR).

Luzula wettsteinii Bush. *Öst. botZ.* 48: 213 (1898)

TYPE LOCALITY. "Oberes Clintonthal bis zum See Te Anau, Otago, Sudinsel von Neuseeland, 1,500-2,000 Fuss [457-609 m]; Januar 1892 gesammelt von Donald Petrie."

Specimen. Clinton Valley, Te Anau, *Petrie, Jany 1892, AK 3097 (†Edgar 1966: 183). (WELT).

LILIACEAE

Arthropodium reflexum Col. *Trans. Proc. NZ. Inst.* 18: 275 (1886)

TYPE LOCALITY. "Shaded sides of mountain streams, Seventy-mile Bush, County of Waipawa; 1870-83: W.C."

Specimen. *Waipawa, Hawke's Bay, W. Colenso, no date, AK 3252. (K and WELT).

Astelia banksii A. Cunn. *Compan. Bot. Mag.* 2: 374 (1837)

TYPE LOCALITY. "New Zealand (Northern Island) -1769, Sir Joseph Banks."

Specimen. *New Zealand 1769-70, Banks and Solander Ex Herbario Musei Britannici, AK 108251. (BM)

Astelia hastata Col. *Trans. Proc. NZ. Inst.* 19: 265 (1887)

TYPE LOCALITY. "Forests, hilly country north of Napier, County of Wairoa; January, 1886: Mr A. Hamilton."

Specimen. *Wairoa, Hawkes Bay, A. Hamilton, January 1886, AK 3191. (WELT).

Astelia nana Carse *Trans. Proc. NZ. Inst.* 57: 91 (1927)

TYPE LOCALITY. "North Island: On trunks of trees, Kaiaka (Mangonui Co.); Maungatapere (Whangarei Co.), H. Carse."

Specimens: Maungatapere, H. Carse, Aug. 1898; Growing on upper branch of dead Puriri, Kaiaka, H. C., 11 Sep. 1913, AK 3228 (2 on 1 sheet). Mauku, H. Carse, June 1901, AK 3227 (2 sheets). (CHR).

Astelia nivicola Ckn. ex Cheesm. *Man. NZ. Fl.* 319 (1925)

TYPE LOCALITY. "Mount Cook district, altitude 4,500ft [1371 m] and upwards, Cockayne!"

Specimen. Hollows where snow lies along on Mt Ollivier, Sealey Range 4,000ft [1219 m] and upwards, L.C., 12 Feb 1919, AK 3224 (†Moore and Edgar 1970: 37). (WELT).

Bulbinella gibbsii Ckn. *Rep. Bot. Surv. St. Id.* 42 (1909)

TYPE LOCALITY. "Stewart Island: Bogs and subalpine meadows; abundant."

Specimens. Mt Anglem, Stewart Island, L.C. 9013, Jan. 1907 AK 3239. (Fig. 3) (†Moore and Edgar 1970: 23). Also L.C. 9008, AK 108733. (WELT).

Dianella nigra Col. *Trans. Proc. NZ. Inst.* 16: 339 (1884)

TYPE LOCALITY. "Dry hillsides among undershrubs, forests near Matamau (S.), Waipawa County, 1882: W.C."

Specimen. *Norsewood, Hawkes Bay, W. Colenso, no date, AK 3229. (K and WELT).

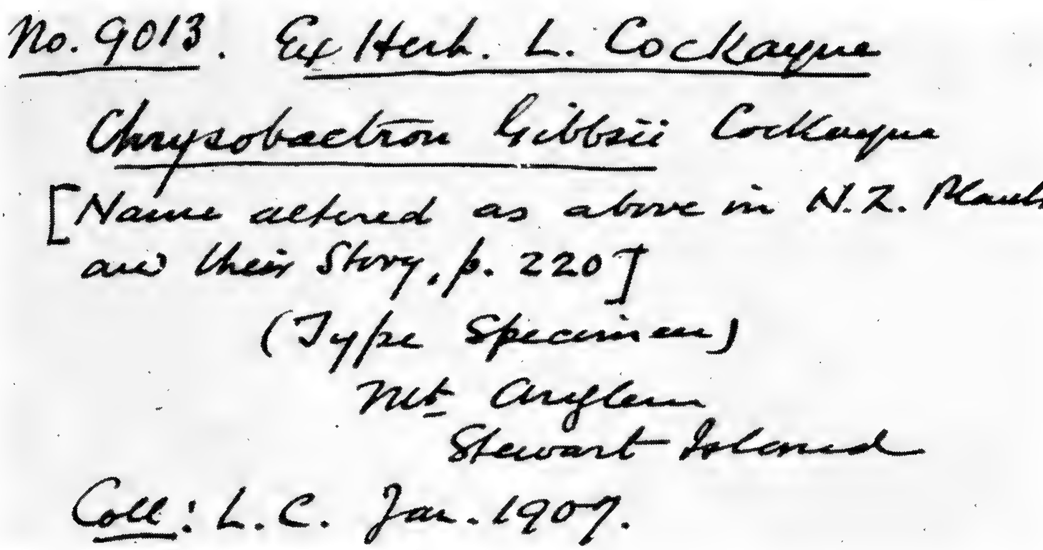


Fig. 3. Herbarium label of L. Cockayne (17.5 x 9 cm).

ORCHIDACEAE

Caladenia carnea R. Br. var. **bartlettii** Hatch *Trans. R. Soc. N.Z.* 77: 402 (1949)

TYPE LOCALITY. "Wade River, Silverdale, 8.10.1947, F.W. Bartlett."

Specimen. *Wade River, Silverdale, F.W. Bartlett, ex Herb. Hatch 567, AK 24847 (†Moore and Edgar 1970: 110)

Caladenia carnea R. Br. var. **minor** forma **callinger** Hatch *Trans. R. Soc. N.Z. Bot.* 2: 187 (1963).

TYPE LOCALITY. "Bankside, Silverdale, 12.10.1949, F.W. Bartlett."

Specimen. *'Bankside', Silverdale, F.W. Bartlett, 12.10.1949, AK 116832 (No. 1 on sheet) (†Hatch 1963: 187)

Caladenia minor Hook. f. var. **exigua** Cheesem. *Man. N.Z. Fl.* 688 (1906)

TYPE LOCALITY. "Kaitaia (Mongonui County) R.H. Matthews!"

Specimen. *Kaitaia, Mangonui County, R.H. Matthews, no date, AK 3589 (†Moore and Edgar 1970: 110)

Caladenia variegata Col. *Trans. Proc. N.Z. Inst.* 17: 248 (1885)

TYPE LOCALITY. ". . . Shady woods, top of a high hill near Norsewood, County of Waipawa; December 1883: W.C."

Specimen. *Norsewood, Hawkes Bay, W. Colenso, no date, AK 3582 (†Moore and Edgar 1970: 110). (K and WELT).

Corybas macranthus Hook. f. var. **longipetalus** Hatch *Trans. Proc. R. Soc. N.Z.* 76: 580 (1947)

TYPE LOCALITY. "Waitangi Stream (Waiouru), 3,000ft [914 m] September 2, 1944, E. D. Hatch".

Specimen. Waitangi Stream, Waiouru, 3,000ft [914 m], E.D.H., 2.9 1944, ex Herb. Hatch 563, AK 24788 (†Moore and Edgar 1970: 119).

Corybas saprophyticus Hatch *Trans. Proc. R. Soc. N.Z.* 79: 366 (1952)

TYPE LOCALITY. "Wellsford, 29.7.1950, E. D. Hatch."

Specimen. Leptospermum scrub between Warkworth & Wellsford, E.D.H. 569, 29.7.1950, AK 26468A (†Moore and Edgar 1970: 118).

Note. C. saprophyticus is a rejected name — see Hatch 1956: 577.

Corysanthes cheesemanii Hook. f. ex Kirk *Trans Proc. N.Z. Inst.* 3: 180 (1871)

TYPE LOCALITY. "Te Whau, 1865, T. K. Ourakei, Mr T. F. Cheeseman, 1867. Titirangi, T. K."

Specimens. Orakei, near Auckland, T.F.C., June 1869, AK 3628; *Ourakei, T.F.C. (in Kirk's hand), no date, AK11242 ex T. Kirk collection.

Corysanthes matthewsii Cheesem. *Trans. Proc. N.Z. Inst.* 31: 351 (1889)

TYPE LOCALITY. "Vicinity of Kaitaia, Mongonui County: Mr R. H. Matthews."

Specimen. *Vicinity of Kaitaia, R. H. Matthews, 1897, AK 3631.

Cyrtostylis macrophylla Hook. f. *Fl. N.Z.* 1: 246 (1853)

TYPE LOCALITY. "Northern Island. East Coast, Colenso."

Specimen. *East Coast, W. Colenso, no date, AK 3559. (K and WELT).

Dendrobium lessonii Col. *Trans. Proc. N.Z. Inst.* 15: 326 (1883)

TYPE LOCALITY. "In forests, Norsewood, Hawkes Bay district, ...; 1879-1882; also among rocks near the sea at Cape Turakirae (the south head of Palliser Bay), 1845-6: W.C."

Specimen. *Norsewood, Hawkes Bay, W. Colenso, no date, AK 3284. (K and WELT).

Earina aestivalis Cheesem. *Trans. Proc. N.Z. Inst.* 51: 93 (1919)

Type locality. "Near Ahipara, R. H. Mathews! and at Kaiaka, H. Carse! both localities in Mongonui County. In forest at Muriwai, and near the mouth of the Waitakere River; T.F.C. Forest by the Waikanae River, Wellington; B. H. Morison!"

Specimens. Muriwai, T.F.C., Jan. 17, 19, 15, AK 3310 (†Moore and Edgar 1970: 161). Also AK 3305 (X3) and AK 3306; Jan 16, AK 3304 and AK 3309.

Earina alba Col. *Trans. Proc. N.Z. Inst.* 267 (1886)

TYPE LOCALITY. "......: banks of River Mangatawhainui, Seventy-mile Bush, County of Waipawa; 1878-85: W.C."

Specimen. *Waipawa, Hawkes Bay, W. Colenso, no date, AK 3316. (K and WELT).

Earina quadrilobata Col. *Trans. Proc. N.Z. Inst.* 15: 325 (1883)

TYPE LOCALITY. "..... base of the Ruahine mountain range, east side ....1845.....; also .....near Norsewood, district of Hawkes Bay, 1878-1881; flowering in November: W. C. Heights of Mount Kaweka, near Napier, 1882: Mr A. Hamilton."

Specimen. * Norsewood, Hawkes Bay, W. Colenso, no date, AK 3300. (K and WELT).

Gastrodia leucopetala Col. *Trans. Proc. N.Z. Inst.* 18: 268 (1886)

TYPE LOCALITY. "In dark forests on the eastern slopes of the Ruahine mountain range. 1850-52; and in similar spots in the Seventy-mile Bush, between Norsewood and Danneverke, County of Waipawa, 1884-85: W.C."

Specimen. *Dannevirke, Hawkes Bay, W. Colenso, no date, AK 3682 (†Moore and Edgar 1970: 159). (K and WELT).

Gastrodia minor Petrie *Trans. Proc. NZ. Inst.* 25: 273 (1893)

TYPE LOCALITY. "Town Belt, Dunedin, in shady manuka bush."

Specimen. Town Belt, Dunedin, D.P., Decr. 1892, AK 3688 (Ex Herb. D. Petrie: Dunedin). (†Moore and Edgar 1970: 159). (WELT).

Microtis longifolia Col. *Trans. Proc. NZ. Inst.* 17: 247 (1885)

TYPE LOCALITY. "Skirts of woods near Norsewood, County of Waipawa; ..... 1883-84: W.C."

Specimen. *Norsewood, Hawkes Bay, W. Colenso, no date, AK 3452 (†Moore and Edgar 1970: 154). (K and WELT).

Othoceras strictum R. Br. forma **viride** Hatch *Trans. R. Soc. NZ. Bot.* 2: 188 (1963)

TYPE LOCALITY. "Browns Bay, 15.12.1958, P. Bond."

Specimen. *Browns Bay, Auckland, roadside embankment, no collector, 12.1958, AK 116752 (No. 1 on sheet) (†Hatch 1963: 188).

Petalochilus calyciformis Rogers *J. Bot. Lond.* 62: 66 (1924)

TYPE LOCALITY. "Kaitaia, County Mangonui, H. B. Matthews, 27 October-15 Nov. 1916."

Specimen. *Kaitaia, H. B. Matthews, 11.1916, AK 24554 (ex Rogers' Herbarium University of Adelaide ex Eardley) (†Moore and Edgar 1970: 110).

Pterostylis furcata Ldl. var. **linearis** Hatch *Trans. Proc. R. Soc. NZ.* 77: 243 (1949)

TYPE LOCALITY. ". . . Murimotu, 12, 1944, E. D. Hatch."

Specimen. Murimotu, E. D. H. no. 565, 12.1944, AK 24686 (†Moore and Edgar 1970: 146).

Pterostylis humilis Rogers *Trans. Roy. Soc. S. Aust.* 46: 151 (1922)

TYPE LOCALITY. "The Haunted Whare, near Waimarino (H. B. Matthews)."

Specimen. *"Haunted Whare", Mt Ruapehu, H. B. Matthews, 1.1921, AK 108491 (B & C on sheet) (†Hatch 1945: 246).

Pterostylis irsoniana Hatch *Trans. Proc. R. Soc. NZ.* 78: 104 (1950)

TYPE LOCALITY. ". . . North Egmont Hostel, 3,800ft [1158 m], 12.1948, O. E. Gibson."

Specimen. *North Egmont Hostel, 3,800ft [1158 m], O. E. Gibson, 12.1948, AK 24604 ex Herb. Hatch no. 568 (†Moore and Edgar 1970: 147).

Pterostylis matthewsii Cheeseman *Trans. Proc. NZ. Inst.* 47: 46 (1915)

TYPE LOCALITY. "Mangonui County, crest of ridge leading to Pukemiro Hill, near Kaitaia, H. B. Matthews!"

Specimen. *Kaitaia, Mangonui County, H. B. Matthews, August 1914, AK 3518.

Pterostylis montana Hatch *Trans. Proc. R. Soc. NZ.* 77: 239 (1949)

TYPE LOCALITY. ". . . Halfmoon Bay, Stewart Island, 11.1946, C. Smith."

Specimen. *Halfmoon Bay, Stewart Island, Cedric Smith, 11.1946, AK 24628 ex Herb. Hatch no. 564 (†Moore and Edgar 1970: 146).

Pterostylis speciosa Col *Trans. Proc. NZ. Inst.* 22: 488 (1890)

TYPE LOCALITY. "Near Mount Tongariro, County of East Taupo: 1889: Mr H. Hill."

Specimen. *Near Mount Tongariro, H. Hill, no date, AK 3491 (†Moore and Edgar 1970: 144). (K and WELT).

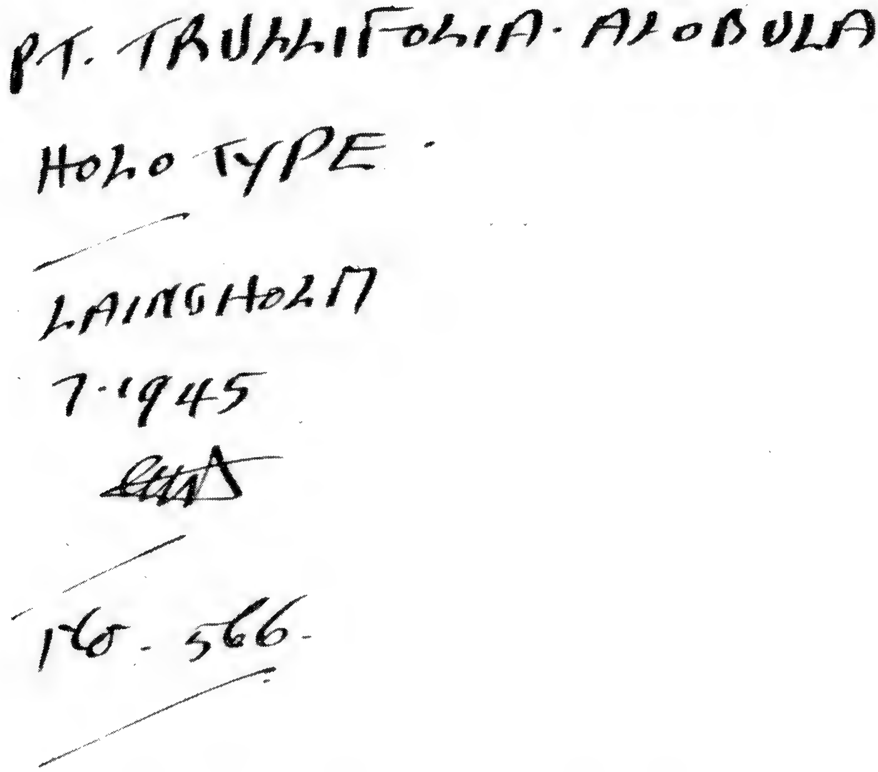


Fig. 4. Hand-printing by Edwin D. Hatch on herbarium sheet now in AK.

Pterostylis trullifolia Hook. f. var. **alobula** Hatch *Trans. Proc. R. Soc. N.Z.* 77: 244 (1949)

TYPE LOCALITY. "Laingholm, 7, 1945, E.D. Hatch, No. 566."

Specimen. Laingholm, E.D.H., No. 566, 7, 1945, AK 24608 (Fig. 4) (†Moore and Edgar 1970: 139).

Pterostylis trullifolia Hook. f. var. **gracilis** Cheesem. *Trans. Proc. N.Z. Inst.* 47: 46 (1915).

TYPE LOCALITY. "Vicinity of Auckland, Waitakerei and Hunua Ranges, T.F.C.; Thames, J. Adams! Kaitaia, R. H. Matthews!"

Specimen. Titirangi, near Auckland, T.F.C., Sept. 1883, AK 3531.

Sarcochilus adversus Hook. f. *Fl. N.Z.* 1: 241 (1853)

TYPE LOCALITY. "Opuragi, Banks and Solander. Bay of Islands and Wairarapa, Edgerley, Colenso."

Specimen. *No locality, Banks & Solander, Cook's first Voyage, 1768-71, AK 108367 (Ex Herbario Musei Britannici). (BM).

Thelymitra decora Cheesem. *Man. N.Z. Fl.* 1151 (1906)

TYPE LOCALITY. "Summit of Mount Kakaramea, Taupo, and hills near the base of Ngauruhoe, alt. 3,000-5,000ft [914-1524 m], T.F.C."

Specimen. Summit of Mount Kakaramea, Taupo, 4,000ft [1219 m]. T.F.C., Jan. 1905, AK 3361 (3 sheets) (†Moore and Edgar 1970: 128).

Thelymitra pachyphylla Cheesem. *Man. NZ. Fl.* 1151 (1906)

TYPE LOCALITY. "Nelson — Vicinity of Westport, Townson! Westland — Kumara, Brame!"

Specimens. *Vicinity of Westport, W. Townson, no date, AK 3376 (2 sheets) (†Moore and Edgar 1970: 128).

Townsonia deflexa Cheesem. *Man. NZ. Fl.* 692 (1906)

TYPE LOCALITY. "Nelson — Vicinity of Westport, Townson."

Specimens. *Near Westport, W. Townson No. 480, no date, AK 3624, *Mount Frederic, near Westport, W. Townson, no date, AK 3625; *Mt Rochfort, near Westport, W. Townson, no date, AK 3626 (†Moore and Edgar 1970: 107).

Yoania australis Hatch *Trans. R. Soc. NZ. Bot.* 2: 185 (1963)

TYPE LOCALITY. "Glorit 24.12.1962. R. Beever."

Specimen. *Glorit (Kaipara) under mature Taraire, R. & J. Beever, 24.12.1962, AK 108769 (No. 1 on sheet) (†Hatch 1963: 185).

POTAMOGETONACEAE

Potamogeton cheesemanii A. Benn. *J. Bot. Lond.* 21: 66 (1883)

TYPE LOCALITY. "New Zealand, St John's Lake, North Island, December, 1881; Mr T. F. Cheeseman . . ."

Specimen. St John's Lake, T.F.C., Dec. 1881, AK 1237 (†Moore and Edgar 1970: 12).

Potamogeton suboblongus Hagstrom *K. svenska Vet. Akad. Handl.* 55: 182 (1916)

TYPE LOCALITY. "Taupaki, Kaipara, N. Island, N. Zealand."

Specimen. Taupaki, Kaipara, T.F.C., April 1884, AK 108158, (†Moore and Edgar 1970: 13).

ZANNICHELLIACEAE

Lepilaena bilocularis Kirk *Trans. Proc. NZ. Inst.* 28: 500 (1896)

TYPE LOCALITY. "South Island — Canterbury — drains and streams running into the Selwyn. In a small stream near the outlet of Lake Ellesmere: T. Kirk. Otago — Waihola Lake: D. Petrie!"

Specimens. Water courses near Lake Ellesmere, ex Herb. T. Kirk, no date, AK 1256 (†Moore and Edgar 1970: 18). (WELT). Lake Waihola, D. P., Feby 2nd 1891, AK 1255. †Moore and Edgar 1970: 18. (WELT).

Acknowledgement. I am indebted to Mr A. E. Wright for his help in preparing the list of Carices.

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NEW SPECIES OF BATHYAL GASTROPODS FROM AUSTRALIA AND NEW ZEALAND

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Abstract. A species of *Peculator (Parvimitra)*, family Volutomitridae, from South Australia and a species of *Boreotrophon*, family Muricidae, from the North Island of New Zealand are described as new to science.

For many years two specimens of a new volutomitrid species from the Great Australian Bight, South Australia, have been set aside pending the discovery of further material. Recently a specimen of the same species from West Australia was found in collections of the Australiam Museum, Sydney.

Recent exploratory prawn-trawl operations conducted by Sanfords Ltd. with the trawler "San Caroline" in the Bay of Plenty area between White I, Mayor I and Motiti I, resulted in the collection of Mollusca from several stations. Among the molluscan material brought back by the Museum's marine biologist Mr A. B. Stephenson, there was an unexpected find of a new *Boreotrophon* species, which also represents a new generic record for New Zealand. Species of *Boreotrophon* are best known from subarctic waters and the North Pacific and North Atlantic Oceans.

Family VOLUTOMITRIDAE
Genus **Peculator** Iredale, 1924

Peculator Iredale, 1924, Proc. Linn. Soc. N.S.W. 49(3): 269. Type species by M *P. verconis* Iredale, 1924. Recent, S.E. Australia.

Peculator bacatus sp. n. (Fig. 1)

Shell very small, up to 6.4 mm in length, biconic, rather solid, width 46%-47% of length, teleoconch of 4½ whorls, protoconch incomplete but probably of 1½ whorls. Whorls concave anteriorly to sutures and sculptured with moderately large, round nodules which are both axially and horizontally aligned; penultimate whorl with 3 spiral rows of nodules, anterior row sometimes obscured by suture on the ventral side, body whorl with 6-7 rows of nodules; the nodules are also aligned in axial rows which number from 12-14 on the penultimate and from 13-15 on the body whorl. Aperture only slightly longer than the spire, smooth within, outer lip thickened and simple, columella with 4 moderately thin folds, first posterior fold thinner and smaller than subsequent folds which become longer and more oblique towards the base; siphonal fasciole with 2-3 strong, oblique cords, siphonal canal straight, siphonal notch absent. Uniformly white to cream in colour.

TYPE LOCALITY. East of Wood Point, Great Australian Bight, Sth. Australia, 158 m.

Holotype. In the Auckland Institute and Museum, No. TM-1361, length 6.4 mm, width 3.0 mm, height of aperture 3.4 mm (Fig. 1).

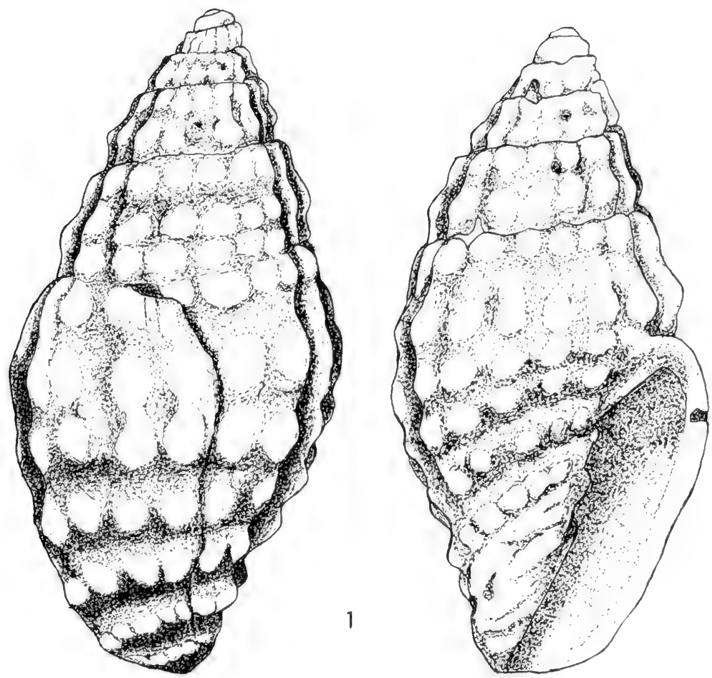


Fig. 1. *Peculator bacatus* sp. n. E. of Wood Pt., Gt. Australian Bight, Sth. Australia. Holotype AIM No. TM-1361; 6.4 x 3.0 mm.

Paratypes. No. 1 from the type-locality in AIM; paratype No. 2 from W. of Bunbury, West Australia, 33°03'S & 114°44'E, 156 m, in Australian Museum, Sydney (ex-H.M.A.S. "Gascoyne", 10-VIII-1962).

The species bears no resemblance to any of the Recent species of Volutomitridae living in Austral-Neozelanic waters. Its next closely allied species appears to be *Peculator (Parvimitra) clathurella* (Tate, 1889) from the Victorian Miocene of Australia, but this species has a sculpture of distinct axial ribs and spiral threads. *P. (P.) pukeuriensis* (Finlay, 1930), the type-species of *Parvimitra* Finlay, 1930, is also superficially similar but this species has a single row of nodules on the spiral whorls and another single row on the presutural keel of the body whorl. In view of the recent discovery, the genus-group *Parvimitra* Finlay, which contains Miocene species from Australia and New Zealand, may be more appropriately placed as a subgenus of the genus *Peculator* Iredale, which contains recent species from Australia and New Zealand.

Family MURICIDAE
Subfamily TROPHONINAE
Genus **Boreotrophon** P. Fischer, 1884

Boreotrophon P. Fischer, Man. Conchyl. p. 640. Type species by M *Trophon clathratus* Linne = *Murex clathratus* Linnaeus, 1767.

Recent, Arctic, Nth. Pacific and Nth. Atlantic.

This is not the first occurrence of species assignable to *Boreotrophon* in the southern hemisphere. The South African deep water species *Trophon acceptans* Barnard, 1959, appears to belong to *Boreotrophon,* and *Trophon tenuirostratus* E. A. Smith, 1899, from 339 m off the Andaman Islands is another species with the external appearance of a *Boreotrophon*.

Boreotrophon shirleyi sp. n. (Figs. 2-5)

Shell moderate in size for the genus, up to 52.0 mm in length, elongate-ovate, teleoconch of 5¾-6 whorls which are convex but are distinctly tabulate at sutures, protoconch not differentiated from teleoconch but consisting of 1-1½ flaked whorls, sutures impressed. Sculptured with angulate axial ribs which become irregular, occasionally intercalate, less prominently angulate and slightly arcuate on the body whorl; spiral sculpture usually absent but in one specimen the penultimate whorl has 4 very shallow spiral grooves on the anterior half while the lower two-thirds of the body whorl have 16 very shallow grooves which become slightly deeper towards the base. Aperture longer than the spire, smooth within, outer lip thin and convex, columella weakly ''S''-shaped and narrowly calloused and with a small angular thickening on top of the siphonal fasciole; siphonal canal only moderately long, open, and moderately recurved. Uniformly white in colour and chalky in texture, interior of aperture and columella glossy-white.

Operculum corneous, dark orange-brown in colour with an apical nucleus and measuring 12.0 mm x 7.3 mm in the holotype (Fig. 5).

Animal creamy-white, tentacles white, short and lacking eyes, penal appendage very large for size of shell. Radular ribbon very minute, *c*. 1.5 mm in lenth, fragile, rachidian tooth with a concave base and with 3 main cusps which lack the intermediate small denticles; laterals simple and sickle-shaped (Fig. 4).

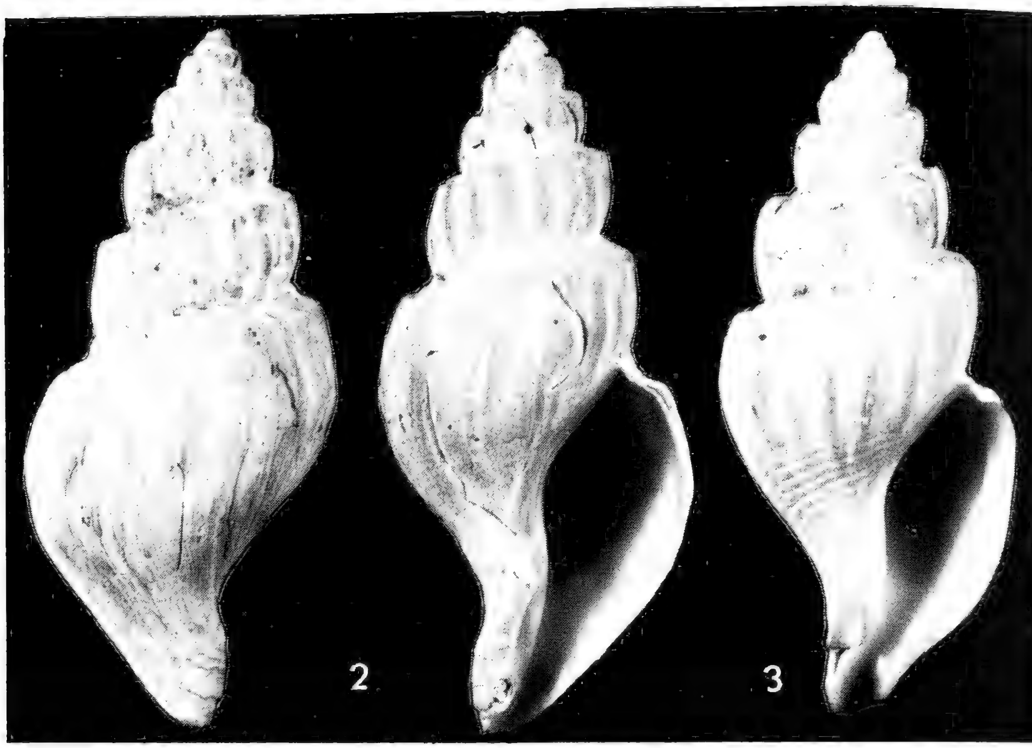
TYPE LOCALITY. Near Motiti I, Bay of Plenty, New Zealand, 37°36'S & 176°34'E, in 200-260 fathoms (366 m-476 m), in mud (*leg.* 6 June 1979).

Holotype. In Auckland Institute and Museum No. TM-1362, length 51.7 mm, width 22.3 mm, height of aperture 29.0 mm (Fig. 2).

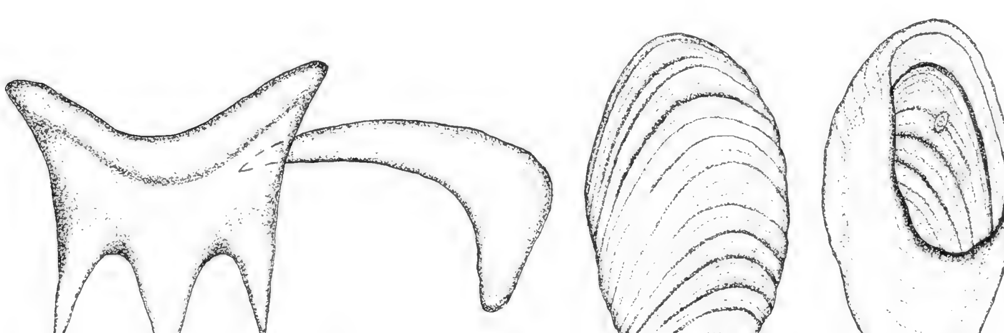
Paratypes. No. 1 from W. of White I, Bay of Plenty, 37°37'S & 176°45'E, in 195-220 fathoms (357 m-403 m) (46.9 x 19.2 x 25.3 mm) in AIM (Fig. 3); paratype No. 2 from W. of White I, 37°36'S & 176°50'E, in 250-340 fathoms (458 m-622 m) in AIM.

No similar species has been described from the Austral-Neozelanic region. *B. shirleyi* can be compared to *B. acceptans* (Barnard) from South Africa but this species is only about one-third the size of *B. shirleyi* and is distinctly angulate in the middle of the spire whorls and on the presutural ramp of the body whorl. *B. shirleyi* is perhaps closest to the northern hemisphere subarctic *B. truncatus* (Stroem, 1768). In this species the axial ribs are more lamellate and the whorls more convex and not tabulate at the sutures. The radula of *B. shirleyi,* although muricid, differs somewhat from other Trophoninae, particularly in the shape of the rachidian and the absence of 2 small intermediate denticles between the 2 side-cusps. The only other trophonine genus lacking these intermediate denticles is *Austrotrophon* Tomlin from South Africa.

The species is named for Mr Frank Shirley, Tauranga, the skipper of the ''San Caroline'' who donated molluscs, fish and other invertebrate material to the Auckland Museum.



Figs. 2, 3. *Boreotrophon shirleyi* sp. n. 2. Near Motiti I, Bay of Plenty, N.Z., 366 m-476 m. Holotype AIM No. TM-1362; 51.7 x 22.3 mm. 3. Paratype No. 1 from W. of White I, Bay of Plenty, N.Z., 357 m-403 m; 36.9 x 19.2 mm.



Figs. 4, 5. *Boreotrophon shirleyi* sp. n. 4. Half-row of radula, male. 5 Operculum, length 12.0 mm, showing dorsal and attachment side.

Acknowledgements. I would like to thank Sanfords Ltd. and Mr F. Shirley, Tauranga, for having made material available for study and Mr A. B. Stephenson, Auckland Institute and Museum, for having sorted the molluscan material on board the "San Caroline". I have benefited through discussions with Dr. A. W. B. Powell and Mr R. Willan, Auckland, concerning the new New Zealand *Boreotrophon* and am indebted to Mr J. Quinn for the line drawings.

REVISION OF THE AUSTRALIAN AND NEW ZEALAND TERTIARY AND RECENT TEMPERATE SPECIES OF THE FAMILY COSTELLARIIDAE (MOLLUSCA: GASTROPODA)

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Abstract. One hundred and thirteen taxa proposed either in the Mitracea or Costellariidae or subsequently referred to the latter family, have been elucidated. In this account 12 Recent and 9 Tertiary species from Australia and 5 Recent and 5 Tertiary species of Costellariidae from New Zealand are recognized as valid. *Austromitra minutenodosa* from the Great Australian Bight, South Australia, is described as new.

Species of Costellariidae are not particularly numerous in the temperate waters of the Austral-Neozelanic region and only 17 species belonging to 3 genus-groups live in that area. A fossil record of 14 species shows that there has been only an insigificant increase in the number of species since the late Tertiary. From the 113 names proposed for the group, 46 names belong to non-costellariid taxa, 36 are synonyms and 31 are considered to belong to recognized species. Australian Recent species outnumber New Zealand species *c.* 2.5:1 and Tertiary species *c.* 2:1 (Table 1).

Table 1. Number of Recent and Tertiary species of Costellariidae in Australia and New Zealand.

	Australia Recent	New Zealand Recent	Australia Tertiary	New Zealand Tertiary
(Costellaria) spp.	4	-	4	4
(Pusia) spp.	3	-	-	-
Austromitra spp.	5	5	5	1
Total	12	5	9	5

The first record of Costellariidae in the Austral-Neozelanic region was the appearance of *Austromitra* during the Upper Eocene in Australia and the later appearance of *Costellaria* species during Lower Miocene times in New Zealand and Mid-Miocene times in Australia. Although 4 *Costellaria* species are still living in Australian waters, in New Zealand the subgenus became extinct sometime during the Lower Pliocene. The three temperate water *Pusia* species from S.W. Australia must have arrived there in comparatively recent times and no *Pusia* species are known from New Zealand.

Austromitra appeared first during Upper Eocene times in Australia, during the Upper Miocene in New Zealand and during the Late Tertiary lived also in Patagonia, Sth. America and South Africa. Recent species have actually increased in numbers and continue to flourish in South Africa, Australia and New Zealand. The S.E. Atlantic species *innotabilis* E. A. Smith, 1890, has on re-examination been found not to belong to *Austromitra* but to *Vexillum (Costellaria)*.

List of recognized species of Australian — New Zealand Recent temperate and Tertiary Costellariidae
(asterisk denotes fossil species)

Vexillum (Costellaria) lincolnense (Angas, 1878). Recent, S.E. Australia.
V. (C.) pellucidum (Tate, 1887). Recent, Southern Australia.
**V. (C.) leptaleum* (Tate, 1889). M. Miocene, S.E. Australia.
**V. (C.) euglypha* (Tate, 1889). M. Miocene, S.E. Australia.
**V. (C.) biornatum* (Tate, 1889). M. Miocene, S.E. Australia.
V. (C.) apicitinctum (Verco, 1896). Recent, Southern Australia.
V. (C.) acromiale (Hedley, 1915). Recent, East and Southern Australia.
**V. (C.) kalimnanense* Cernohorsky, 1970. Pliocene, S.E. Australia.
**V. (C.) neozelanicum* (Laws, 1939). L. Miocene, New Zealand.
**V. (C.) etremoides* (Finlay, 1924). L. Miocene, New Zealand.
**V. (C.) caudatum* (Marwick, 1931). L. Pliocene, New Zealand.
**V. (C.) elatior* (Finlay, 1924). Lower to M. Miocene, New Zealand.
Vexillum (Pusia) australe (Swainson, 1820). Recent, Southern Australia.
V. (P.) hansenae Cernohorsky, 1973. Recent, S.W. Australia.
V. (P.) marrowi Cernohorsky, 1973. Recent, S.W. Australia.
**Austromitra ambulacrum* (Marwick, 1927). U. Miocene, New Zealand.
A. rubiginosa (Hutton, 1873). Recent, New Zealand.
A. lawsi Finlay, 1930. Recent, New Zealand.
A. angulata (Suter, 1908). Recent, New Zealand.
A. planata (Hutton, 1885). Recent New Zealand.
A. zafra Powell, 1952. Recent, New Zealand.
A. analogica (Reeve, 1845). Recent, East and Southern Australia.
A. arnoldi (Verco, 1909). Recent, S.E. Australia.
A. volucra (Hedley, 1915). Recent, S.E. Australia.
**A. sordida* (Tate, 1889). M. Miocene to Pliocene, S.E. Australia.
**A. pumila* (Tate, 1889). U. Eocene, S.E. Australia.
**A. ralphi* (Cossmann, 1900). M. Miocene, S.E. Australia.
**A. angusticostata* Ludbrook, 1941. Pliocene, Southern Australia (only tentatively included as a valid species).
**A. lacertosa* (Cernohorsky, 1970). Miocene, S.E. Australia.
A. tasmanica (Tenison-Woods, 1876). Recent, S.E. Australia.
A. minutenodosa sp. n. Recent, Sth. Australia.

The following abbreviations have been adopted in this paper: AIM = Auckland Institute and Museum, Auckland; AMS = Australian Museum, Sydney; BMNH = British Museum (Natural History), London; CMC = Canterbury Museum, Christchurch; MHNP = Muséum National d'Histoire Naturelle, Paris; NMNZ = National Museum of New Zealand, Wellington; NMV = National Museum of Victoria, Melbourne; NZGS = New Zealand Geological Survey, Lower Hutt; SAM = South Australian Museum, Adelaide; TMAG = Tasmanian Museum and Art Gallery, Hobart; USNM = National Museum of Natural History, Smithsonian Institution, Washington, D.C.; VUW = Victoria University, Wellington; WAM = Western Australian Museum, Perth; ZMC = University Zoological Museum, Copenhagen.

The three dimensions given in the text represent in sequential order length x width x height of aperture expressed in "mm". The single measurement cited in the explanations to figures represents the length of the specimen.

Family COSTELLARIIDAE Macdonald, 1860

Genus **Vexillum** Roeding, 1798

Subgenus **Costellaria** Swainson, 1840

Costellaria Swainson, 1840, Treat. Malac. pp. 130, 320. Type species by M *Mitra rigida* Swainson, 1821 = *M. semifasciata* Lamarck, 1811. Recent, Indo-Pacific.

1840. *Callithea* Swainson, Treat. Malac. pp. 130, 320. Type species by SD (Herrmannsen, 1846) *Voluta sanguisuga* Linnaeus, 1758. Recent. (*Non Callithea* Feisthamel, 1835).
1887. *Uromitra* Bellardi, Mem. R. Accad. Sci. Torino 38: 277. Type species by SD (Harris, 1897) *U. antegressa* Bellardi, 1887. Mio-Pliocene of Europe.
1927. *Balcomitra* Finlay, Trans. Proc. N.Z. Inst. 57: 508. Type species by OD *Mitra paucicostata* Tate, 1889 (*non* Speyer, 1862) = *Vexillum (Costellaria) lacertosum* Cernohorsky, 1970. Miocene, S.E. Australia.
1929. *Arenimitra* Iredale, Mem. Queensl. Mus. 9 (3): 286. Type species by OD *A. arenosa* (Lamarck) = *Voluta exasperata* Gmelin, 1791. Recent.
1929. *Pulchritima* Iredale, Mem. Queensl. Mus. 9 (3): 287. Type species (art. 67 of ICZN) *Voluta sanguisuga* Linnaeus, 1758. Recent. (*Nom. subst. pro Callithea* Swainson, 1740).
1929. *Mitropifex* Iredale, Austral. Zool. 5 (4): 346. Type species by M *M. quasillus* Iredale, 1929 = *Mitra obeliscus* Reeve, 1844. Recent.

GEOGRAPHICAL DISTRIBUTION. Caribbean; Indo-Pacific; S.E. Australia.

STRATIGRAPHICAL RANGE. Eocene to Recent.

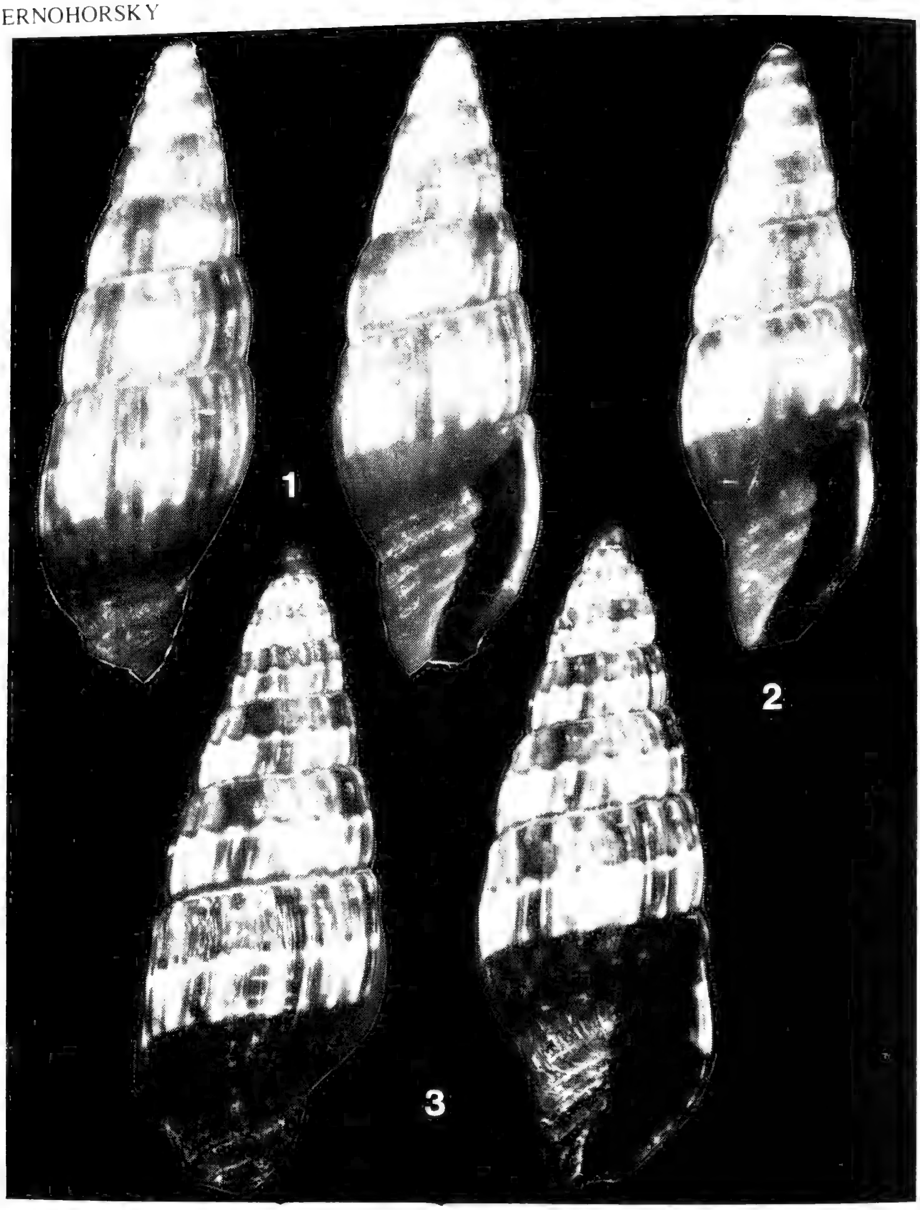
Four Recent endemic and 4 fossil species of the *Costellaria* group are known from southern Australia and only 4 fossil but no living species have been recorded from New Zealand. A full diagnosis of the genus and subgenus can be found in Cernohorsky (1970).

Australian species of *Vexillum (Costellaria)*

Vexillum (Costellaria) lincolnense (Angas, 1878) (Figs. 1-3)

1878. *Mitra (Costellaria) lincolnensis* Angas, Proc. Zool. Soc. Lond. p. 313, pl. 18, figs. 10, 11.
1882. *Turricula (Costellaria) lincolnensis* Angas, Tryon, Man. Conch. 4: 177, pl. 52, fig. 513.
1908. *Turris lincolnensis* (Angas), Verco, Cat. mar. Moll. Sth. Aust. p. 13.
1932. *Austromitra lincolnensis* (Angas), Cotton, & Godfrey, Sth. Aust. Nat. 13 (2): 80, pl. 4, fig. 10; 1954 Macpherson, Aust. Geog. Soc. Rept. No. 1: 61; 1957 Cotton, R. Soc. Sth. Aust. Malac. Sect. No. 12: fig. 16; 1978 Hinton, Guide Austral. shells pl. 54, figs. 27, 27a; 1978 Ludbrook, Geol. Surv. West. Aust. Bull. 125: 158, pl. 17, figs. 15, 16.

Shell up to 17.0 mm in length, fusiformly-elongate, teleoconch of 5¾-7 weakly convex whorls, protoconch of 1½-1¾ smooth, glassy-brown embryonic whorls, sutures distinct. Sculptured with moderately regular, slender axial ribs which number from 14-19 on the penultimate and from 15-22 on the body whorl; axial ribs occasionally weakly nodulose at the body whorl suture. Spiral sculpture extremely faint or even absent. Aperture shorter than the spire, narrow, frequently lirate within, outer lip convex, columella with 4-5 prominent oblique folds, siphonal fasciole with 6-10 oblique cords. Greyish-white in colour, lower half of body whorl dark reddish-brown, sutural area with a



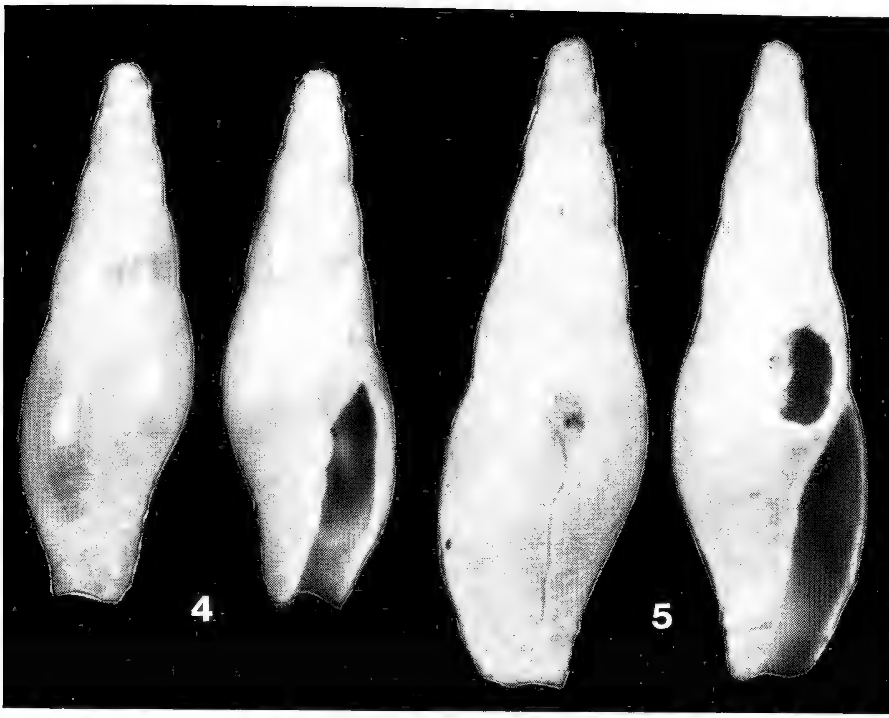
Figs. 1-3. *Vexillum (Costellaria) lincolnense* (Angas). 1. Lectotype BMNH No. 1878.4.10.2.; 14.9 mm. 2. Paralectotype, 12.9 mm. 3. Specimen from Coffin Bay, Sth. Australia; 12.8 mm.

broad, blotched reddish-brown spiral band and occasional axial streaks extending from suture to suture, interior of aperture brown and banded with white.

TYPE LOCALITY. Port Lincoln, South Australia.

DISTRIBUTION. From Adelaide, Sth. Australia to Augusta, West Australia. From the intertidal zone to a depth of 20 m, usually under rocks.

Type specimens. Two syntypes of *V. (C.) lincolnense* are in the BMNH No. 1878.4.10.2. The larger syntype, dimensions 14.9 x 5.0 x 6.4 mm, is here designated as the lectotype of *V. (C.) lincolnense* (Fig. 1).



Figs. 4-5. *Vexillum (Costellaria) pellucidum* (Tate). 4. Holotype SAM No. D-13514; 6.1 mm. 5. Paratype, 7.3 mm.

Material examined. Sth. Australia: Outer Harbour, Adelaide (AIM; AMS; USNM); Smoky Bay; Acraneens Creek near Ceduna; Pt. Brown, Sth. of Ceduna, 20 m; Coffin's Bay (all coll. Marrow); Port Lincoln (BMNH). West Australia: Esperance (AMS); Hopetoun, between Esperance and Albany (NMV; AMS); right side of lighthouse, Augusta (AMS).
Fossil record: Roe Plains, Roe Calcarenite, Eucla Basin, S.W. Australia, Early Pleistocene (Ludbrook, 1978).

This uncommon but easily recognized species appears to be intermediate in characters between *Vexillum (Costellaria)* and *Austromitra*. The elongate form, short aperture and disposition of axial ribs resembles *Costellaria,* but the lack of a distinct spiral sculpture favours a placement in *Austromitra*.

Vexillum (Costellaria) pellucidum (Tate, 1887) (Figs. 4, 5)

1887. *Mitra pellucida* Tate, Trans. Proc. R. Soc. Sth. Aust. 9: 63, pl. 4, fig. 13; 1906 Pritchard & Gatliff, Proc. R. Soc. Victoria N.S. 18 (2): 45; 1908 Verco, Cat. mar. Moll. Sth. Aust. p.13.

1932. *Mitroidea pellucida* Tate, Cotton & Godfrey, Sth. Aust. Nat. 13 (2): 82, pl. 4, fig. 7; 1951 Macpherson & Gabriel, Mem. Mus. Nat. Victoria No. 17: 134; 1962 Macpherson & Gabriel, Nat. Mus. Victoria Handb. No. 2: 209.

1957. *Mutyca pellucida* (Tate), Cotton, R. Soc. Sth. Aust. Malac. Sect. No. 12: fig. 5.

Shell up to 8.0 mm in length, thin, shining and translucent, elongate-fusiform, teleoconch of 4¼-4½ almost flat or weakly convex whorls, protoconch of 1½ smooth embryonic whorls, sutures distinct and oblique. Sculptured with low, numerous and slender axial riblets which number from 19-30 on the penultimate and from 7-26 on the body whorl; spiral sculpture consists of extremely fine macrostriae. Aperture shorter than the spire, narrow, outer lip thin, columella with 3-4 folds, siphonal fasciole with 6-7 oblique threads, siphonal notch distinct. Translucent white in colour.

TYPE LOCALITY. Fowler and Streaky Bays, Great Australian Bight, Sth. Australia.

DISTRIBUTION. From Portsea, Victoria to the Great Australian Bight, Sth. Australia.

Type specimens. The holotype and 1 paratype of *V. (C) pellucidum* are in the Tate collection, SAM No. D-13514, dimensions of holotype 6.1 x 2.0 x 2.6 mm (Fig. 4), paratype 7.3 x 2.3 x 3.0 mm (Fig. 5).

Material examined. Victoria: Portsea (coll. Marrow). Sth Australia: Fowler and Streaky Bays, Australian Bight (BMNH); Great Australian Bight, 33°05'S & 128°40'E (AMS).

The species is imperfectly known and only 6-8 specimens have been collected to date, all of them devoid of animal.

Vexillum (Costellaria) leptaleum (Tate, 1889) (Figs. 6-11)

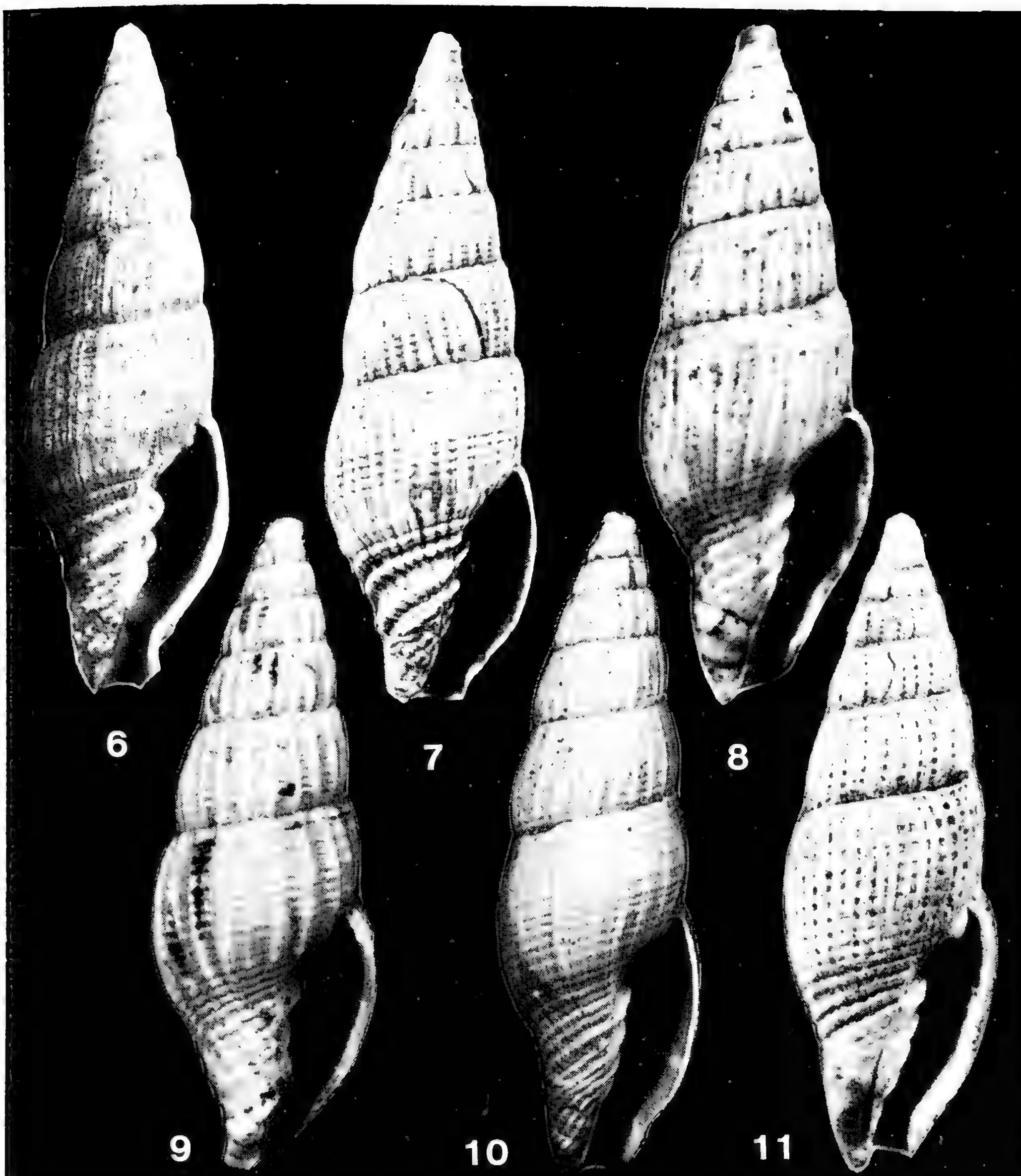
1889. *Mitra leptalea* Tate, Trans. Proc. R. Soc. Sth. Aust. 11. 140, pl. 5, fig. 3; 1893 Tate & Dennant, Trans. Proc. R. Soc. Sth. Aust. 17 (1). 220.
1889. *Mitra escharoides* Tate, Trans. Proc. R. Soc. Sth. Aust. 11. 139, pl. 5, figs. 8a, b.
1897 *Uromitra leptalea* Tate, Harris, Cat. Tert. Moll. Brit. Mus. Pt. 1. 125, pl. 5, figs. 3a, b (protoconch).
1970. *Mitropifex escharoides* (Tate), Darragh, Mem. Nat. Mus. Victoria 31. 168.
1970. *Balcomitra leptalea* (Tate), Darragh, Mem. Nat. Mus. Victoria 31. 177.

Shell up to 20.0 mm in length, fusiformly-elongate, teleoconch of 6-7 almost flat or weakly convex whorls, protoconch of 1½-2 smooth, embryonic whorls, sutures distinct. Sculptured with numerous, weak or distinct, slender axial ribs which are bisected by close-set, weak or distinct, unequal spiral threads, base of body whorl with 4-5 strong and occasionally nodulose oblique cords. Aperture shorter than the spire, smooth within in immature individuals but lirate in adults, outer lip convex and constricted basally, columella narrowly calloused and with 3-4 oblique, strong folds, parietal wall with a denticle in adult individuals; siphonal canal produced and straight, siphonal notch distinct.

TYPE LOCALITY. Lower beds at Muddy Creek, Victoria, Mid-Miocene of Australia.

Type specimens. The holotype and 13 paratypes of *V. (C.) leptaleum* are in the Tate collection, SAM No. T-629, dimensions of holotype 16.7 x 5.0 x 7.3 mm (Fig. 6). The holotype of *V. (C.) escharoides* is in the same Institution No. T-648, dimensions 16.8 x 5.6 x 7.0 mm (Fig. 11).

The species is very variable and the holotype of *V. (C.) escharoides,* which is a more mature individual than the types of *V. (C.) leptaleum,* falls clearly within the variational range of the latter species. In *V. (C.) escharoides* the spiral and axial threads are flatter and closer set and produce minute pits at the point of intersection. Since both taxa have been published simultaneously, I here select *V. (C.) leptaleum* as the name of the taxon and relegate *escharoides* Tate to its synonymy. The species appears to be the ancestral form of the Recent *V. (C.) apicitinctum* (Verco).



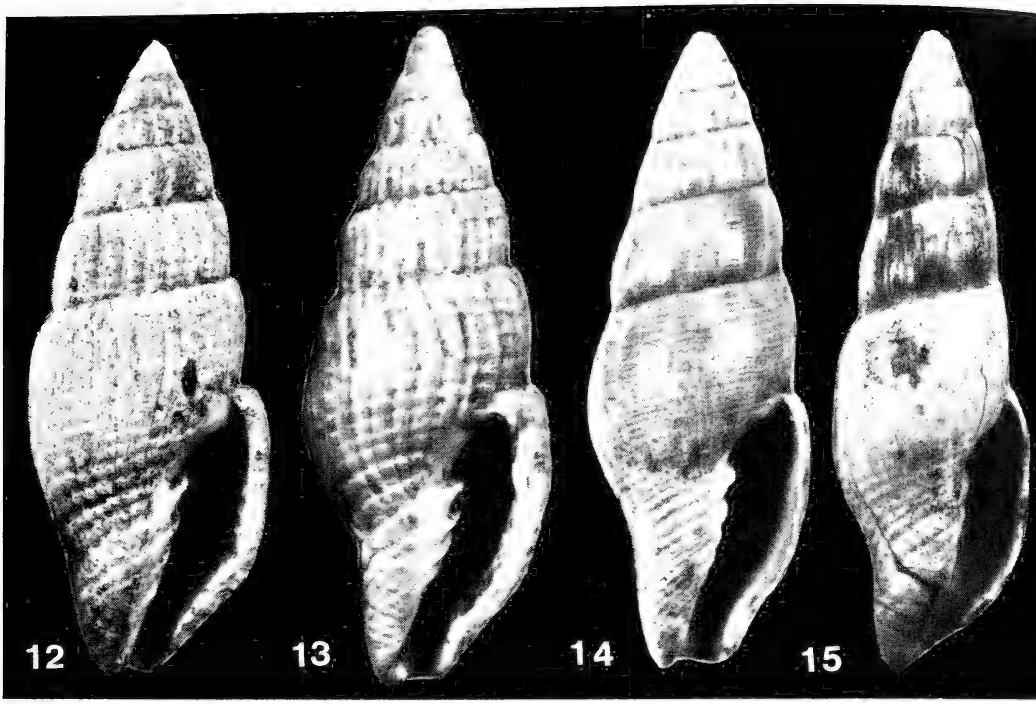
Figs. 6-11. *Vexillum (Costellaria) leptaleum* (Tate). 6. Holotype SAM No. T-629; 16.7 mm. 7. Paratype, 20.0 mm. 8. Paratype, 11.7 mm. 9, 10. Specimens from Mornington, Balcombe Bay, Victoria, Australia, M. Miocene; 12.4 mm and 13.3 mm respectively. 11. Holotype of *Mitra escharoides* Tate, SAM No. T-648; 16.8 mm.

Vexillum (Costellaria) euglypha (Tate, 1889) (Figs. 12-13)

1889. *Mitra euglypha* Tate, Trans. Proc. R. Soc. Sth. Aust. 11: 140, pl. 5, fig. 13.
1970. *Balcomitra euglypha* (Tate), Darragh, Mem. Nat. Mus. Victoria 31: 168.

The species is similar to *V. (C.) leptaleum* and differs in the following characters: the outline is broader, the protoconch has 2½ embryonic whorls, the sculptur is coarser, consisting of fewer and slightly thicker axial ribs and spiral threads, the outer lip is more angulate and the whorls have a slightly turreted appearance.

TYPE LOCALITY. Gippsland, Victoria, Miocene of Australia.



Figs. 12-15. 12, 13. *Vexillum (Costellaria) euglypha* (Tate). 12. Holotype SAM No. T-634; 15.0 mm. 13. Paratype, 12.6 mm. 14, 15. *V. (C.) biornatum* (Tate). 14. Holotype SAM No. T-646; 10.8 mm. 15. Paratype, 13.7 mm.

Type specimens. The holotype and paratype of *V. (C.) euglypha* are in the Tate collection, SAM No. T-634, dimensions of holotype 15.0 x 5.8 x 7.5 mm (Fig. 12).

This species may be the ancestral form of the Recent *V. (C.) acromiale* (Hedley).

Vexillum (Costellaria) biornatum (Tate, 1889) (Figs. 14, 15)

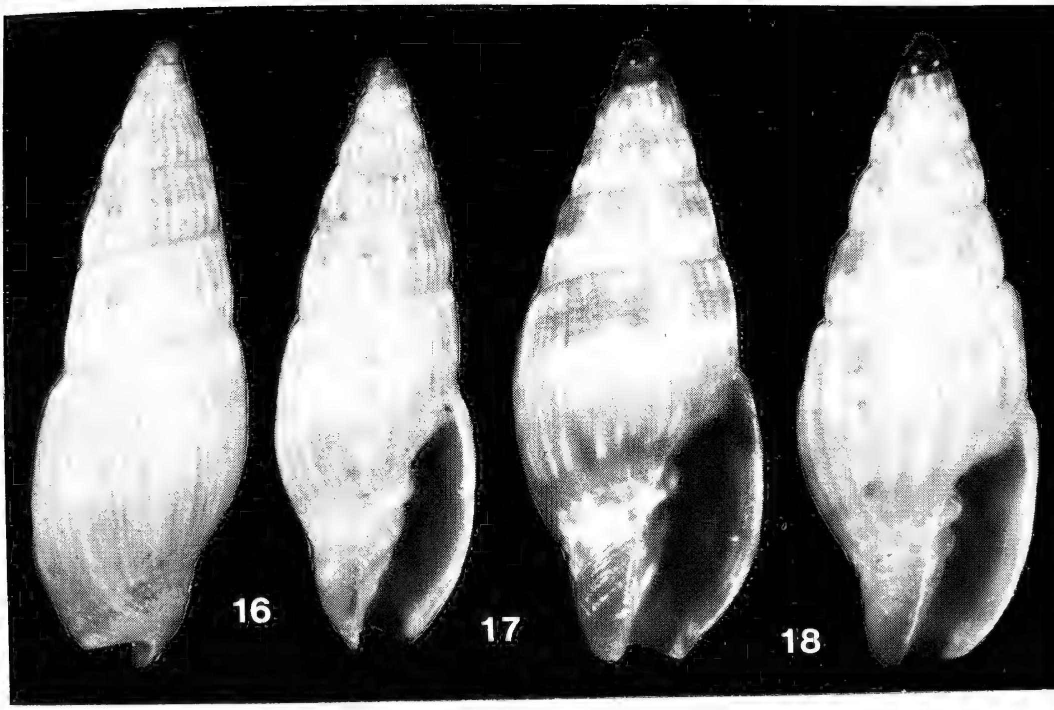
1889. *Mitra biornata* Tate, Trans. Proc. R. Soc. Sth. Aust. 11. 142, pl. 5, fig. 10.
1970. *Cancilla biornata* (Tate), Darragh, Mem. Nat. Mus. Victoria 31: 158.

The species is extremely similar to *V. (C.) leptaleum* in general shape, structure of whorls and apertural features. The early whorls are axially ribbed and only the last 1-2 whorls lack axial ribs which are replaced by fine spiral threads.

TYPE LOCALITY. Lower beds at Muddy Creek, Victoria, Mid-Miocene of Australia.

Type specimens. The holotype and paratype of *V. (C.) biornatum* are in the Tate collection, SAM No. T-646, dimensions of holotype 10.8 x 3.7 x 4.8 mm (Fig. 14).

In the Harris collection, Department of Palaeontology, BMNH, there is a lot of 5 specimens of *V. (C.) leptaleum* and one of the small specimens is the same form as *V. (C.) biornatum*, lacking the axial ribs on the last 2 whorls.



Figs. 16-18. *Vexillum (Costellaria) apicitinctum* (Verco). 16. Holotype SAM No. D-13510; 11.3 mm. 17. Broad, fine-ribbed form from Pt. Sinclair, Sth. Australia; 8.0 mm. 18. Broad, coarse-ribbed form from Port Lincoln, Sth. Australia; 10.5 mm.

The assignment of *biornatum* to the genus *Cancilla* Swainson, by Darragh (1970) is inappropriate since the species is axially ribbed and has a lirate aperture and clearly belongs to the family Costellariidae and not the Mitridae.

Vexillum (Costellaria) apicitinctum (Verco, 1896) (Figs. 16-18)

1896. *Turricula apicitincta* Verco, Trans. Proc. R. Soc. Sth. Aust. 20 (1): 225, pl. 8, figs. 4, 4a, b; 1908 Verco, Cat. mar. Moll. Sth. Aust. p. 13.

1932. *Austromitra apicitincta* Verco, Cotton & Godfrey, Sth. Aust. Nat. 13 (2): 79; 1957 Cotton, R. Soc. Sth. Aust. Malac. Sect. No. 12: fig. 14.

Shell up to 12.0 mm in length, fusiformly-elongate to elongate-ovate, teleoconch of 4½-6 weakly convex whorls, protoconch of 1½-2 smooth, glassy-brown embryonic whorls, sutures distinct. Sculptured with numerous, low, irregular and slender axial ribs which number from 19-35 on the penultimate and from 20-40 on the body whorl, axial ribs weakly constricted anteriorly to suture in some individuals; spiral sculpture consists of very fine spiral striae which number from 9-13 on the penultimate and from 12-26 on the body whorl. Aperture moderately narrow, outer lip convex, columella narrowly calloused in adult specimens and with 3-4 oblique folds, siphonal notch distinct, siphonal fasciole slightly calloused in mature adults and with 6-7 oblique cords. Greyish-white in colour, sutural area with a broad, brownish band which is frequently broken up into darker blotches, interspaces of axial ribs frequently pinkish-brown, body whorl occasionally with 2-3 very faint or distinct bands, base of shell sometimes dark brown, some individuals with a few small brown spots.

TYPE LOCALITY. Newland Head, South Australia, 20 fathoms (37 m) (locality of holotype; other locality cited was St. Vincent's Gulf, Sth. Australia, 17 fathoms (31m)).

DISTRIBUTION. From Port Stephens, N.S.W. along the South Australian coast to Cowaramup S.W. Australia. Subtidal, to 147 m, in sand, mud and gravel.

Type specimens. The holotype of *V. (C.) apicitinctum* is in SAM No. D-13510, dimensions 11.3 x 4.0 x 5.1 mm (Fig. 16). Paratypes in BMNH. 10.9 mm, 9.8 mm and 8.7 mm.

Material examined. South Australia: St. Vincent's Gulf, 31 m (SAM; BMNH); off Newland Head, 37 m (SAM); Port Lincoln; Pt. Sinclair; Smoky Bay (all coll. Marrow); off Port Lincoln, 88 m; S.W.W. of St. Francis I; St. Francis I, 20 m-30 m; 161 km E. of Salisbury, 34°13'S & 125°04'E, 123 m-125 m; Neptune I, 73 m (all AMS). New South Wales: Port Stephens (coll. Marrow). West Australia: between Eucla and Esperance, 79 m-147 m (AMS); Cowaramup (coll. Marrow).

There is a high degree of variation in shape and number of axial ribs in this species.

Vexillum (Costellaria) acromiale (Hedley, 1915) (Figs. 19-21)

1903. *Turris tasmanica* Ten. Woods. Hedley, Mem. Aust. Mus. 4 (6). 372 (*non Mitra tasmanica* Tenison-Woods, 1876).

1915. *Mitra acromialis* Hedley, Proc. Linn. Soc. N.S.W. 39. 730, pl. 84, fig. 85.

1951. *Austromitra acromialis* Hedley. Macpherson & Chapple, Mem. Nat. Mus. Victoria No. 17, 133; 1962 Macpherson & Gabriel, Nat. Mus. Victoria Handb. No. 2, 209; 1962 Iredale & McMichael, Austral. Mus. Mem. 11: 63.

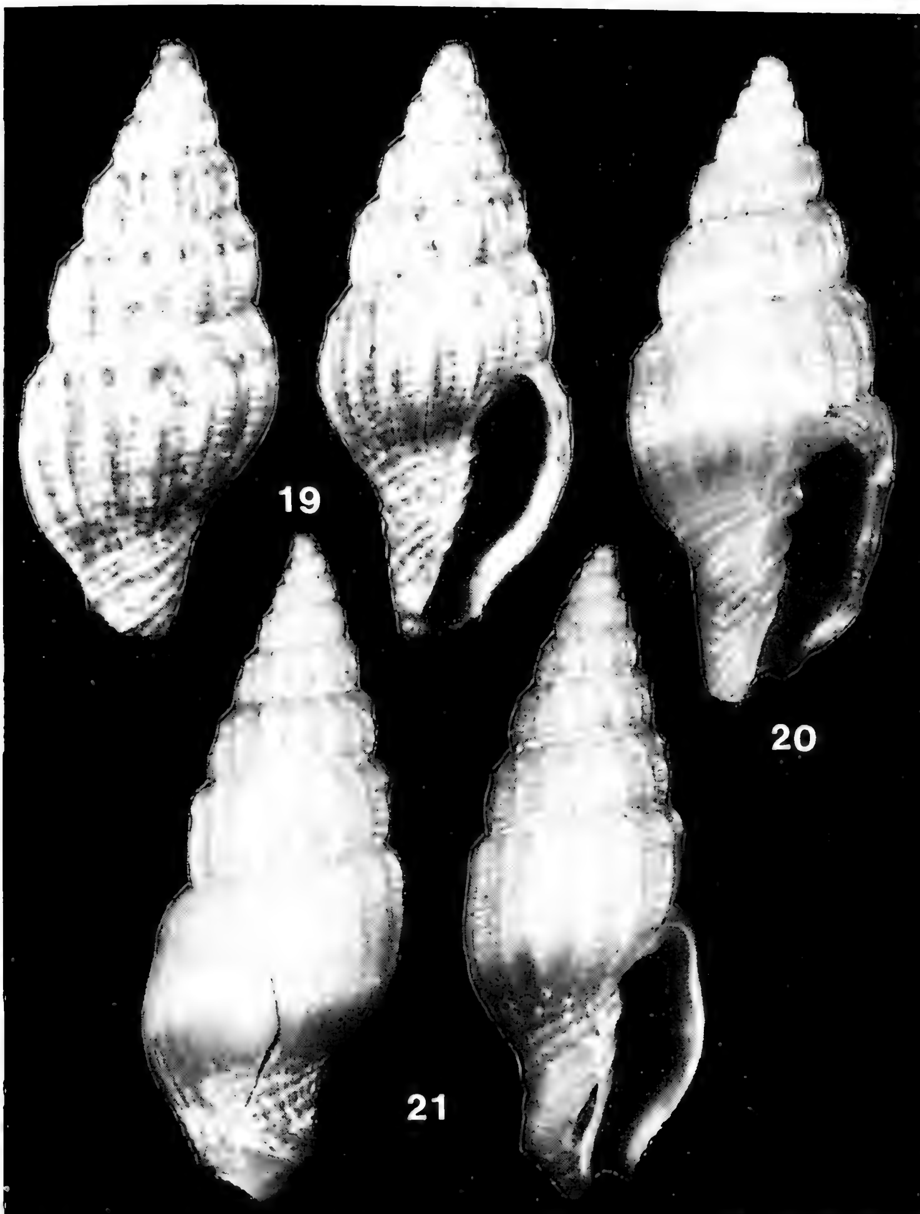
Shell up to 16.0 mm in length, adult specimens fusiformly-elongate, teleoconch of 5-7 whorls which are subangulate to almost angulate on the presutural ramp, protoconch of 1¼-1¾ smooth embryonic whorls. Sculptured with angulate axial ribs which number from 13-19 on the penultimate and from 11-19 on the body whorl, ribs becoming frequently obsolete on the dorsal side of the body whorl near the aperture; in juvenile and immature specimens the ribs on the presutural ramp are echinate but in adults they are constricted and nodose at this point. Spiral sculpture consists of fine spiral striae which number from 5-9 on the penultimate and from 9-14 on the body whorl. Aperture moderately narrow, outer lip convex in juveniles but angulate in adults, columella narrowly calloused and with 4 oblique folds, siphonal fasciole with 5-7 oblique cords. Base colour white, ornamented with 2 broad brown bands on the body whorl and a single band on spire whorls.

TYPE LOCALITY. Off Cabbage-Tree I, off Port Stephens, N.S.W., Australia, 63 m (locality of holotype).

DISTRIBUTION. From Cape Moreton, Sth. Queensland to Tasmania and along the South Australian coast to King George Sound, S.W. Australia. Subtidal, to 467 m.

Type specimens. The holotype and paratypes of *V. (C.) acromiale* are in AMS No. C-39854, dimensions of holotype 9.8 x 4.0 x 4.5 mm (juvenile — Fig. 19).

Material examined. Queensland: off Cape Moreton, 114-124 m (AMS). New South Wales: off Port Hacking, 82 m (coll. Garrard); Wooli; Cape Everard, 20 m; off Eden; Port Stephens, 80 m-100 m (all coll. Marrow); Broughton I, N. of Port Stephens, 64 m; off Port Kembla, 115 m-137 m; 26 km E. of Wollongong, 183 m; 37 km E. of Sydney, 456 m; 35 km E. of Narrabeen, 146 m; 8 km E. of Sydney Heads, 137 m; off Port Hacking, 82 m; E. of Broken Bay, 137 m; E. of Port Jackson, 118-302 m; E. of Twofold Bay, 73 m and 294 m-304 m; *c.* 32 km E. of Little Bay, Sth. Head, Sydney, 192 m-203 m; off Jibbon, Port Hacking, 80 m; off Sydney, 366 m; 1.5 km S.E. of Long Bay, Sydney, 28 m; Jervis Bay, 119 m; Crookhaven, 64 m; 3.5 km off Little Bay, Sydney, 59 m; Disaster



Figs. 19-21. *Vexillum (Costellaria) acromiale* (Hedley). 19. Holotype AMS No. C-39854; juvenile — 9.8 mm. 20 Specimen from Port Stephen, N.S.W., Australia; immature — 11.1 mm. 21. Specimen from off Eden, N.S.W., Australia, 80-100 m; adult — 15.6 mm.

Bay; 18 km N.W. of Crowdy Head, 91 m; off Ballina, 255 m; 24 km E. of Ballina, 28°49'S & 153°51'E, 185 m; E. of Bermagui, 36°27'S & 150°19'E, 321 m-381 m; off Sydney, 33°36'S & 151°19'E, 132 m; E of Brush I, Bateman's Bay, 35°28'S & 150°48'E, 448 m-467 m; E. of Green Cape, 37°21'S & 150°21'E, 330 m (all AMS). Victoria: S.E. of Lakes Entrance, 109 m and 155 m; off Cape Everard, 32 m-146 m; S. of Mt. Cann, 128 m-161 m; between Cape Howe and Lakes Entrance, 146 m-158 m; S.E. of Gabo I, 37°45'S & 150°12'E, 402 m-438 m (all AMS). Tasmania: E. of Babel I, Bass Strait; N.E. of Cape Pillar, 92 m-110 m (both AMS). West Australia: King George Sound, 22 m (AMS).

The holotype and paratypes of *V. (C.) acromiale* are immature individuals which lack the more fusiform shape, strong columellar folds, angulate outer lip and thickened siphonal fasciole of adult individuals. The species is moderately common in dredgings but live-taken specimens are rare.

Vexillum (Costellaria) kalimnanense Cernohorsky, 1970 (Figs. 22, 23)

1889. *Mitra terebraeformis* Tate, Trans. Proc. R. Soc. Sth. Aust. 11, 141, pl. 5, fig. 5 (*non* Conrad, 1848).

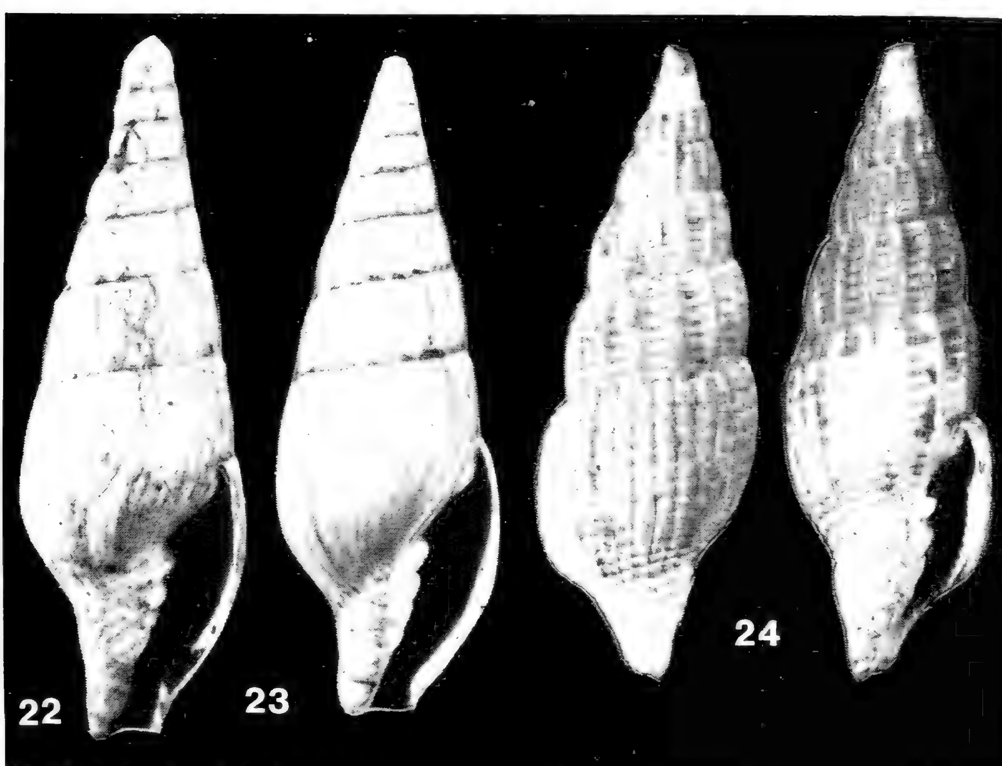
1897. *Uromitra terebriformis (sic)* Tate, Harris, Cat. Tert. Moll. Brit. Mus. Pt. 1, 128 (*non* Bellardi, 1887).

1970. *Balcomitra terebraeformis* (Tate), Darragh, Mem. Nat. Mus. Victoria 31, 201.

1970. *Vexillum (Costellaria) kalimnanense* Cernohorsky, Bull. Auckland Inst. Mus. No. 8, 28, pl. 9, fig. 6 (*nom. subst. pro. Mitra terebraeformis* Tate, 1889).

Shell up to 20.0 mm in length, somewhat terebriform in shape, last whorl slightly inflated, smooth and shining, teleoconch of 7 almost flat-sided whorls, protoconch of 1½-1¾ smooth embryonic whorls. Sutures distinct and indented by a narrow, ill-defined subsutural band, whorls sculptured with slender, angulate and slightly curved axial ribs, interspaces smooth, base of body whorl constricted, siphonal fasciole with a few oblique cords. Aperture shorter than the spire, outer lip convex but constricted basally, columella with 4 oblique folds, siphonal canal straight.

TYPE LOCALITY. Upper beds at Muddy Creek, Victoria, Pliocene of Australia.



Figs. 22-24. 22, 23. *Vexillum (Costellaria) kalimnanense* Cernohorsky. 22. Holotype SAM No. T-626; 16.6 mm. 23. Paratype, 17.7 mm. 24. *V. (C.) neozelanicum* (Laws). Holotype NZGS No. TM-1297; 17.7 mm.

Type specimens. The holotype and 7 paratypes of *V. (C.) kalimnanense* (also of *Mitra terebraeformis* Tate) are in the Tate collection, SAM No. T-626, dimension of holotype 16.6 x 5.5 x 5.9 mm (Fig. 22).

Mitra terebraeformis Tate, 1889, being a primary homonym of *M. terebraeformis* Conrad, 1848, has been replaced with *V. (C.) kalimnanense.*

New Zealand species of *Vexillum (Costellaria)*

Vexillum (Costellaria) neozelanicum (Laws, 1939) (Fig. 24)

1939. *Uromitra neozelanica* Laws, Trans. Proc. R. Soc. N.Z. 68: 495, pl. 65, fig. 43; 1966 Fleming, N.Z. Dept. Sci. Res. Bull. 173: 65.

1970. *Vexillum (Costellaria) neozelanicum* (Laws), Cernohorsky, Bull. Auckland Inst. Mus. No. 8: 54.

Shell *c.* 18.0 mm in length, fusiformly-elongate, teleoconch of 7 convex whorls, protoconch unknown. Sculptured with slender, angulate axial ribs which number from 14-25 on the penultimate and about 21 on the body whorl; spiral sculpture consists of finely impressed spiral grooves which produce narrow, low, flattish spiral cords which number from 7-8 on the penultimate and *c.* 15 on the body whorl. Aperture shorter than the spire, narrow, finely lirate within, columella with 4 oblique folds, siphonal canal produced, straight, and with 8-9 slightly more prominent oblique cords.

TYPE LOCALITY. Pakaurangi Point, Otaian, L. Miocene of New Zealand.

Type specimen. The holotype of *V. (C.) neozelanicum* is in NZGS No. TM-1297, dimensions 17.7 x 6.0 x 8.0 mm (Fig. 24).

Vexillum (Costellaria) etremoides (Finlay, 1924) (Figs. 25, 26)

1924. *Uromitra etremoides* Finlay, Trans. Proc. N.Z. Inst. 55: 469, pl. 50, figs. 6a, b; pl. 51, figs. 10a-c; 1966 Fleming, Bull. N.Z. Dept. Sci. Ind. Res. 173: 65.

1970. *Vexillum (Costellaria) etremoides* (Finlay), Cernohorsky, Bull. Auckland Inst. Mus. No. 8: 54, pl. 9, fig. 10 (figd. holotype).

Shell up to 14.0 mm in length, fusiformly-elongate, teleoconch of 5-6½ convex whorls, protoconch of 3-3¼ conical, smooth, embryonic whorls, sutures distinct. Sculptured with prominently angulate, swollen and wide-spaced axial ribs which number from 6-8 on the penultimate and from 5-7 on the body whorl; spiral sculpture consists of narrow, low spiral threads which number from 6-9 on the penultimate and from 13-20 on the body whorl, cords on siphonal fasciole of the same strength as on body whorl. Aperture shorter than the spire, smooth within, columella with 3-4 folds, siphonal canal straight.

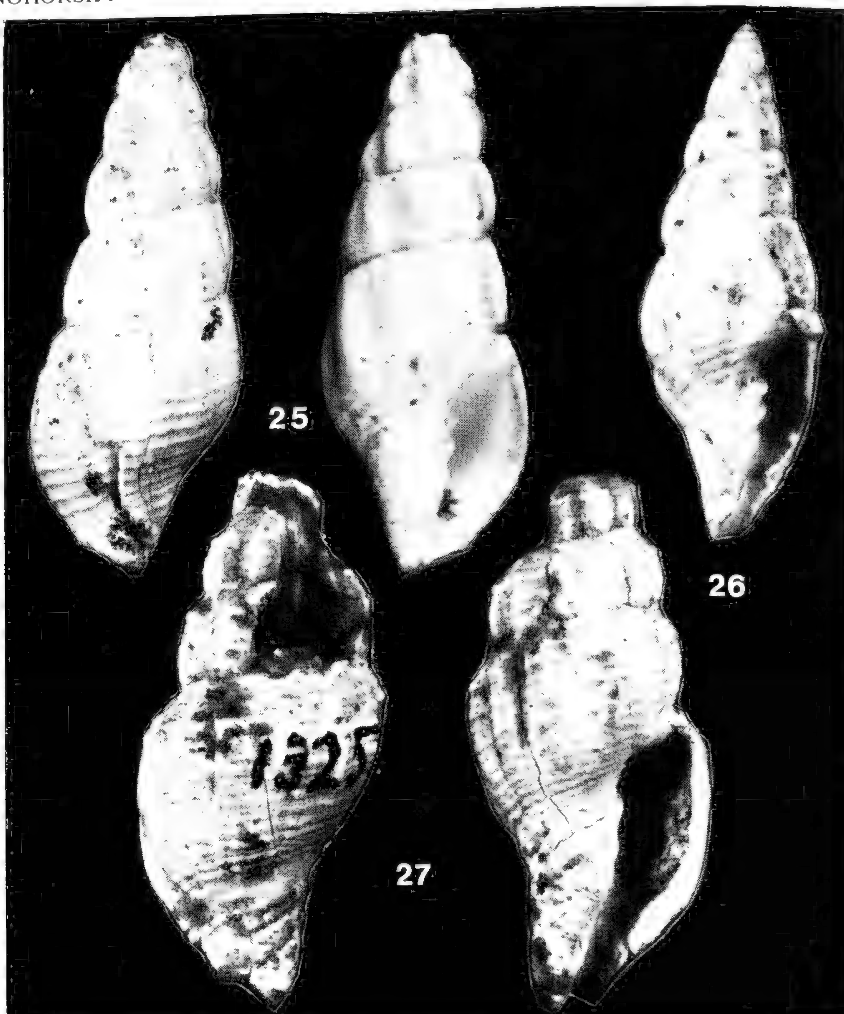
TYPE LOCALITY. Target Gully, Awamoan, L. Miocene of New Zealand.

Type specimens. The holotype and 9 paratypes of *V. (C.) etremoides* are in AIM No. TM-818, dimensions of holotype 11.1 + x 4.2 x 5.0 mm (Fig. 25).

Vexillum (Costellaria) caudatum (Marwick, 1931) (Fig. 27)

1931. *Austromitra caudata* Marwick, N.Z. Geol. Surv. Paleont. Bull. No. 13: 124, pl. 13, fig. 244; 1966 Fleming, N.Z. Dept. Sci. Ind. Res. Bull. 173: 64, pl. 113, fig. 1371; 1970 Cernohorsky, Bull. Auckland Inst. Mus. No. 8: 57.

Shell incomplete, 12.2 mm in length, whorls incomplete, convex and subangulate on presutural ramp, 3¼ whorls present. Sculptured with angulate axial ribs which number *c.* 10 on the body whorl, ribs tending to be obsolete on the dorsal side of the body whorl;



Figs. 25-27. 25, 26. *Vexillum (Costellaria) etremoides* (Finlay). 25. Holotype AIM No. TM-818; 11.1 + mm. 26. Paratype, 7.0 mm. 27. *V. (C.) caudatum* (Marwick). Holotype NZGS No. GS-1325; 12.2 + mm.

spiral sculpture consists of well-defined, narrow spiral cords which number 7 on the penultimate and 21 on the body whorl, cords on siphonal fasciole more prominent. Outer lip angulate, columella not calloused and with 4 oblique folds, siphonal canal produced and slightly recurved.

TYPE LOCALITY. Waikohu district, Ormond series, Opoitian, L. Pliocene of New Zealand.

Type specimens. The holotype of *V. (C.) caudatum* is in NZGS No. GS-1325, dimensions 12.2 + x 5.5 x 7.0 mm (Fig. 27).

The produced siphonal canal and prominent spiral sculpture are features which are more compatible with the *Costellaria* group of species rather than *Austromitra,* and pending discovery of complete specimens, the species is tentatively assigned to *Vexillum (Costellaria)*. The species bears a superficial resemblance to the Australian Recent species *V. (C.) acromiale* (Hedley). Fleming (1966) reported *V. (C.) caudatum* from the Upper Miocene to the Lower Pliocene.

Vexillum (Costellaria) elatior (Finlay, 1924) (Figs. 28-30)

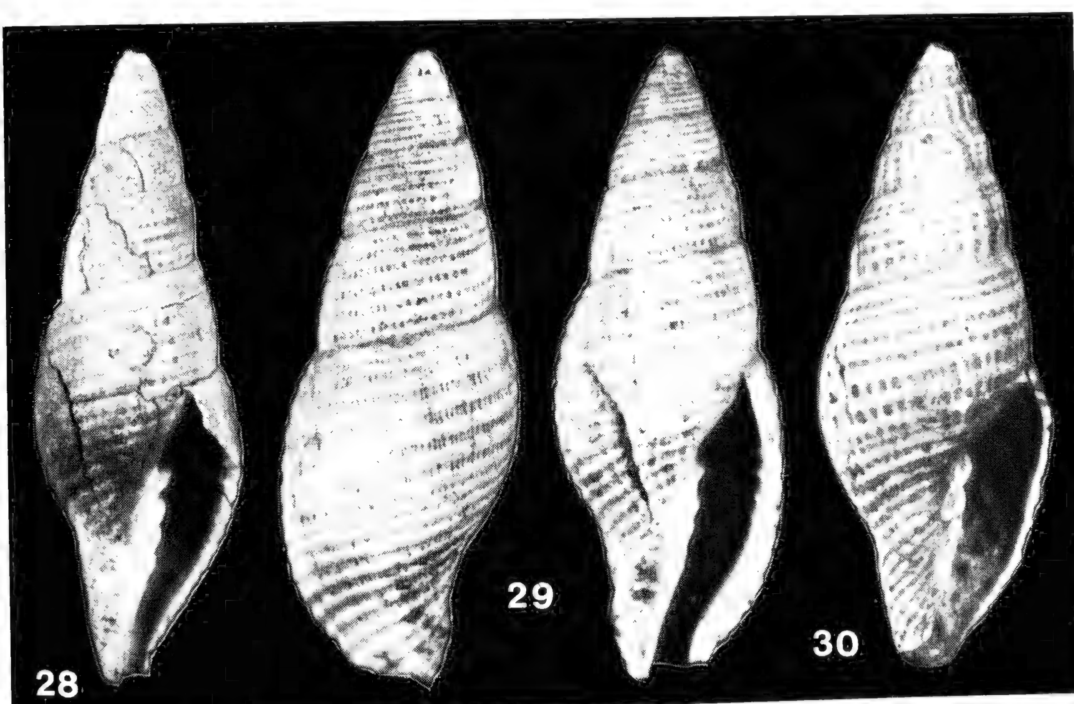
1924. *Mitra elatior* Finlay, Trans. Proc. N.Z. Inst. 55: 469, pl. 50, figs. 5a, b; 1966 Fleming, N.Z. Dept. Sci. Ind. Res. Bull. 173: 64.

1970 *Mitra (Nebularia) elatior* Finlay, Cernohorsky, Bull. Auckland Inst. Mus. No. 8: 36, pl. 2, fig. 11.

Shell up to 19.0 mm in length, fusiformly-elongate, teleoconch of 5-6 slightly convex whorls, protoconch of 3¼-4 smooth, conical embryonic whorls. Sculpture consists of narrow, flat spiral cords which number from 5-7 on the penultimate and from 17-20 on the body whorl; interspaces either pitted or with numerous axial striae, surface of shell with some longitudinal growth-striae, rare individuals with axial ribs on spire whorls. Aperture equal in height or slightly longer than the spire, narrow, distinctly lirate within, outer lip regularly convex, columella with 4-5 (one specimen with 6) oblique folds, siphonal canal produced and straight.

TYPE LOCALITY. Clifden, Southland, Altonian, M. Miocene of New Zealand.

Type specimens. The holotype and numerous paratypes of *V. (C.) elatior* are in AIM No. TJ-479, dimensions of holotype 18.7 x 6.2 x 9.2 mm (Fig. 28).



Figs. 28-30. *Vexillum (Costellaria) elatior* (Finlay). 28. Holotype AIM No. TM-479; immature — 18.7 mm. 29. Paratype, 14.0 mm. 30 Axially ribbed specimen from Clifden, Miocene of New Zealand; 9.5 mm.

The presence of apertural lirae, which never occur in species of Mitridae, and the rare occurence of axial ribs on the spire whorls, necessitate a re-assignment of *elatior* from the Mitridae to the Costellariidae. Although almost all specimens examined lacked axial ribs, one Clifden individual had well-developed ribs on 3½ post-embryonic whorls, ribs later became weak on the last half of the penultimate whorl and absent on the body whorl (Fig. 30).

Subgenus **Pusia** Swainson, 1840

Pusia Swainson, 1840, Treat. Malac. p. 320. Type species by M *M. microzonis* (Lamarck) = *Mitra microzonias* Lamarck, 1811. Recent, Indo-Pacific.

1917. *Ebenomitra* Monterosato, Boll. Soc. Zool. Ital. 4: 26. Type species by SD (Coan, 1966) *Mitra ebenus* Lamarck, 1811. Recent.
1917. *Pusiola* Monterosato, Boll. Soc. Zool. Ital. 4: 26. Type species by M *Voluta tricolor* Gmelin, 1791. Recent (*non* Wallengren, 1863).
1921. *Pusiolina* Cossmann, Rev. Crit. Paleozool. 25 (2): 79. Type species (art. 67i of ICZN) *Voluta tricolor* Gmelin, 1791. (*Nom. subst. pro Pusiola* Monterosato, 1917).
1921. *Idiochila* Pilsbry, Proc. Acad. Nat. Sci. Philad. 72: 311. Type species by OD *Mitra turben* Reeve, 1844. Recent.
1968. *Ebenomitra* Nordsieck, Europ. Meeres-Gehauseschecken 1: 149. Type species by OD *Mitra ebenus* Lamarck, 1811. Recent (established as a new subgenus of *Mitra*).
1970. *Pusidina* Parenzan, Carta ident. conch. Medit. p. 189 (*nom. nudum*).

GEOGRAPHICAL DISTRIBUTION. Mediterranean; East Atlantic; Caribbean; Indo-Pacific; Southern Australia.

STRATIGRAPHICAL RANGE. Eocene to Recent.

A detailed definition of the genus-group has been given by Cernohorsky (1970). Three Recent endemic species of the *Pusia* group are confined to the southern part of Australia and no Recent species are known from New Zealand.

Australian species of *Vexillum (Pusia)*

Vexillum (Pusia) australe (Swainson, 1820) (Figs. 31-35, 40)

1820. *Mitra australis* Swainson, Zoolog. Illust. (1), 1: pl. 18, centre figs.; 1844 Reeve, Conch. Iconica 2: pl. 16, fig. 118; 1874 Sowerby, Thes. Conchyl. 4: 6, pl. 363, fig. 182; 1877 Tenison-Woods, Proc. R. Soc. Tasmania p. 8; 1899 Pritchard and Gatliff, Proc. R. Soc. Victoria, N.S. 11 (2): 185; 1908 Verco, Cat. mar. Moll. Sth. Aust. p. 13; 1921 May, Check-list Moll. Tasmania p. 79; 1923 May, Illust. Ind. Tasman. shells p. 79, pl. 37, fig. 11; 1923 May, Pap. Proc. R. Soc. Tasmania p. 54; 1932 Cotton and Godfrey, Sth. Aust. Nat. 13 (2): 77, pl. 4, fig. 2; 1936 Gabriel, Victorian Seashells p. 14, textfig.; 1940 Cotton and Godfrey, Sth. Aust. Nat. 20 (4): 12, textfig.; 1951 Macpherson amd Chapple, Mem. Nat. Mus. Victoria No. 17: 133, 1954 Macpherson, Austral. Geog. Soc. Repts. No. 1: 61.
1833. *Mitra melaleuca* Quoy and Gaimard, Voy. l'Astrolabe 2 (2): 657, pl. 45 bis, figs. 26, 27; 1838 Kiener, Spec. gen. icon. coq. viv. 3: 34, pl. 11, fig. 34.
1874. *Mitra kieneri* Sowerby, Thes. Conchyl. 4: 32, pl. 357, fig. 324 (*non* Philippi, 1850).
1896. *Mitra vincentiana* Verco, Trans. Proc. R. Soc. Sth. Aust. 20 (2): 223, pl. 8, fig. 3; 1899 Pritchard and Gatliff, Proc. R. Soc. Victoria, N.S. 11 (2): 186; 1908 Verco, Cat. mar. Moll. Sth. Aust. p. 13 (*non M. vincentiana* Cossmann, 1881).
1920. *Vexillum australe* Swains., Cooke, Proc. Zool. Soc. Lond. for 1919: 419, text fig. 18 (radula).
1922. *Pusia australis* Swainson, Peile, Proc. Malac. Soc. Lond. 15: 94.
1957. *Vicimitra australis* (Swainson), Cotton, R. Soc. Sth. Aust. Malac. Sect. No. 12. fig. 1.
1957. *Austromitra vincentiana* Verco, Cotton, R. Soc. Sth. Aust. Malac. Sect. No. 12. fig. 18.
1962. *Eumitra australis* (Swainson), Macpherson and Gabriel, Nat. Mus. Vict. Hanb. No. 2. 210, fig. 251; 1971 Wilson and Gillett, Austral. Shells p. 118, pl. 76, fig. 6.
1970. *Vexillum (Pusia) australe* (Swainson), Cernohorsky, Bull. Auckland Inst. Mus. No. 8: 22, fig. 147 (radula); 1978 Hinton, Guide Austral. shells, pl. 54, fig. 20.
1975. *Pusia australae (sic)* Swainson, Coleman, What shell is that, p. 74, fig. 218.
1978. *Mitra (Eumitra) australis* Swainson, Ludbrook, Geol. Surv. West. Aust. Bull. 125. 159, pl. 18, figs. 1, 2.

Shell up to 60.0 mm in length but frequently smaller, fusiformly-elongate to elongate-ovate, teleoconch of 9-10 weakly convex whorls, protoconch usually missing, sutures deeply impressed. Sculptured with moderately thick axial ribs on the early spire whorls, ribs becoming indistinct to obsolete on the last 3-5 whorls and sometimes only visible as very weak axial folds or longitudinal lirae. Spiral sculpture consists of spiral threads which number from 4-13 on the penultimate and from 6-22 on the body whorl; in some individuals the spiral threads are subdued and in others they are more prominent and most distinct anteriorly to the sutures. Aperture shorter than the spire, frequently lirate within, outer lip convex, columella not calloused and with 4-5 very strong oblique folds, siphonal fasciole with 7-10 oblique cords, siphonal notch distinct. Usually brown in colour, spire whorls with a single narrow whitish band or rarely blotches, body whorl with a white central band and occasionally small, dark brown spots, columella folds sometimes whitish; some individuals are uniformly dark brown. The periostracum is thin, brown and opaque.

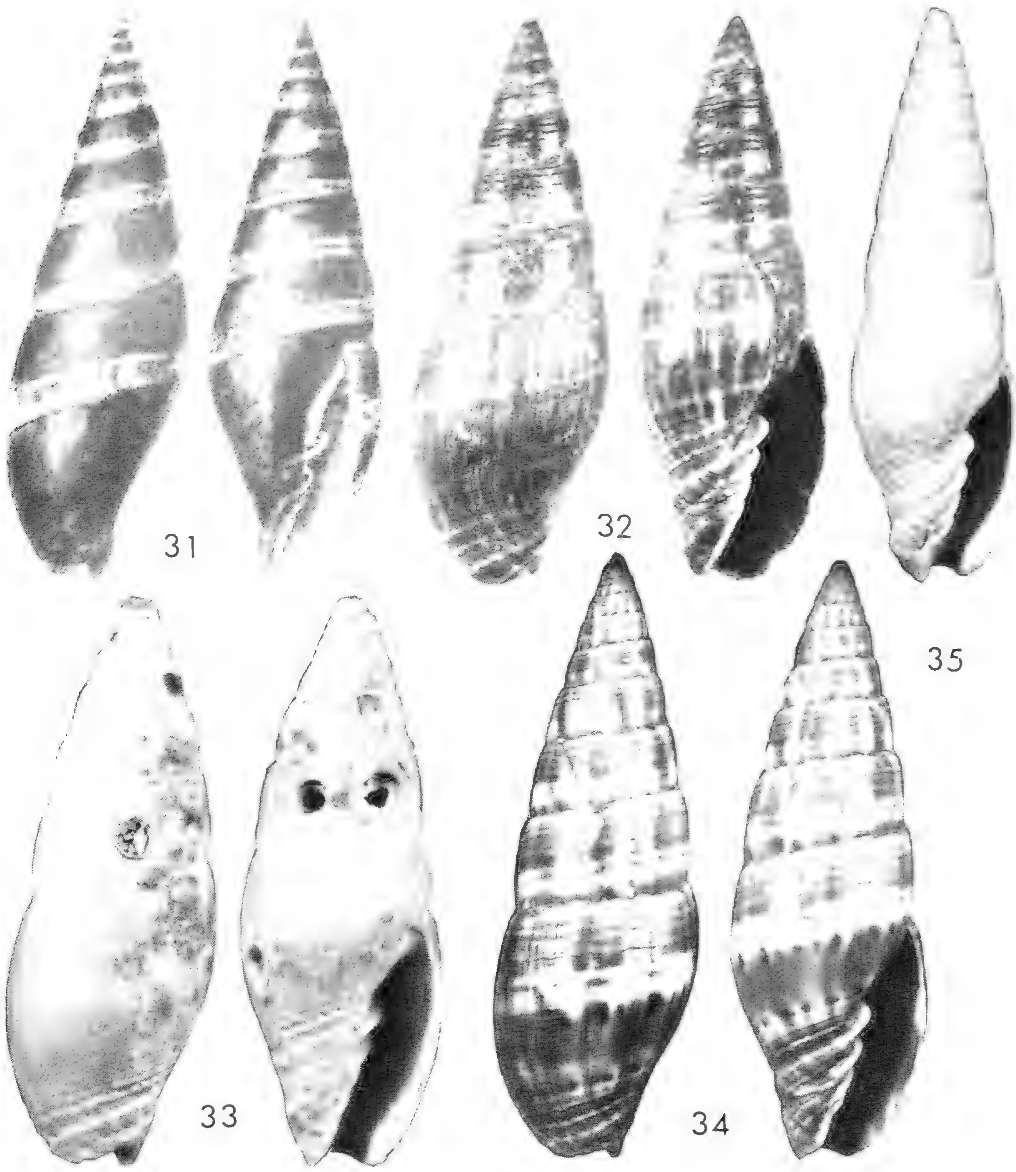
TYPE LOCALITY. Van Diemans Land (*australe*); probably Port Roi Georges, New Holland (*melaleuca*); none (*kieneri*); Investigator's Straits, Sth. Australia, 13-15 fathoms (24-27 m) (*vincentiana*).

DISTRIBUTION. From Waratah Bay, Victoria to Tasmania and along the South Australian coast to Exmouth Gulf, West Australia. On reef-flats and under stones, from the intertidal zone to a depth of 33 m. Species dredged from 73 m were collected devoid of animal.

Type specimens. The original type of *Mitra australis* ex-coll. Humphrey can no longer be traced. The original 2 figures in vol. I, pl. 18, centre figures from Swainson (1820-1833) are here designated as the illustrated lectotype (Fig. 31). The type of *M. melaleuca* is in the MNHP and the holotype of *M. kieneri* Sowerby (*non* Philippi) in BMNH No. 1879.2.26.128., dimensions 32.4 x 10.8 x 14.9 mm (Fig. 32). The holotype and paratypes of *M. vincentiana* Verco (*non* Cossmann) are in SAM No. D-13508, dimension of holotype 19.0 x 8.8 x 10.8 mm. They are beach-worn, faded specimens and the holotype has 2 holes on the ventral side and 1 hole on the dorsal side of the penultimate whorl (Fig. 33).

Material examined. Victoria: Port Fairy (AIM); Western Port (coll. Clover); Airey's Inlet; Balnering; Somers; 2 km E. of Cape Liptrap, Waratah Bay, 30 m (all coll. Marrow); Mallacoota; Lorne; Flinders, Western Port Bay; Pt. Leo, Western Port Bay; Portsea; Port Fairy (all AMS). Tasmania: Kelso (AIM); Wynyard beach; Brickmaker's beach near Rocky Cape; near Somerset; E. of King I, Bass Str., 40°00'S and 144°14'E, 33 m; S. of Currie Harbour, King I, Bass Str. (all AMS). Sth. Australia: Kings Beach near Rosetta Heads (USNM); Outer Harbour, Adelaide (AIM; AMS); Wallaroo (coll. Clover); Port MacDonnell (coll. Marrow); Glenelg beach near Adelaide; St. Vincent's Gulf; Scales Bay; Holiday Land, Port Lincoln (all AMS); Investigator's Straits, 24 m-27 m (SAM). West Australia: Cheyne Beach, E. of Albany; Rottnest I; Cape Vlaming; Port Gregory; Cowaramup Bay (all WAM); Yallup; Margaret River (both coll. Clover); Albany (WAM); Exmouth Gulf (coll. Marrow); King George Sound; Hopetoun; Cape Riche, 113 km E. of Albany (all AMS).
Fossil record: Pit 0.64 km N. of Hampton repeater tower, Roe Plain, Roe Calcarenite, Eucla Basin, Early Pleistocene of S.W. Australia (WAM).

Ludbrook (1978) placed *australe* in the genus *Mitra* Lamarck, family Mitridae, but the axial ribs, lirate interior of aperture and type of radula (Fig. 40) clearly demonstrate that the species belongs in the subgenus *Pusia*, family Costellariidae. Like most other *Pusia* species, *V. (P.) australe* is very variable in form, some individuals being broad and squat, others fusiformly elongate.



Figs. 31-35. *Vexillum (Pusia) australe* (Swainson). 31. Illustrated lectotype from Swainson, 1820, pl. 18, centre figures. 32. Holotype of *M. kieneri* Sowerby, BMNH No. 1879.2.26.128.; 32.4 mm. 33. Holotype of *M. vincentiana* Verco, SAM No. D-13508; 19.9 mm. 34. Specimen from Pt. Nepean, Queenscliff, Victoria, Australia; 33.0 mm. 35. Specimen from Roe Calcarenite, Madura dist., Eucla Basin, E. Pleistocene of S.W. Australia; 27.3 mm.

Vexillum (Pusia) hansenae Cernohorsky, 1973 (Figs. 36, 37)

1973. *Vexillum (Pusia) hansenae* Cernohorsky, Rec. Auckland Inst. Mus. 10: 138, figs. 13-16.

Shell up to 21.0 mm in length but usually smaller, variable in form, elongate-ovate to fusiformly-elongate. Teleoconch of 4-6 convex whorls, protoconch of 1-1½ smooth and slightly globose embryonic whorls; sculptured with broad, irregular, ill-developed flattish axial folds numbering 12-21 on the penultimate and 2-15 on the body whorl. Spiral sculpture not visible to the naked eye, base of body whorl with 6-14 oblique spiral cords, sutures narrowly incised. Aperture narrow, equal in height or slightly longer than the spire, lirate within, lirae occasionally obsolete, columella only thinly glazed and with 4 prominent oblique folds. Base colour bluish-white to steel-grey, spire whorls ornamented at sutures with a turret-like, dark olive-green narrow band which appears as small quadrate spots at the sutures; lower two-thirds of body whorl dark olive-green, interrupted in places by narrow, interrupted bluish-white bands of the protruding base colour. At periphery, the dark olive-green zone has a turret-like border; aperture greenish-brown and occasionally cream-banded, columellar folds white or grey, parietal wall dark olive-green.

TYPE LOCALITY. Sarge Bay, Augusta, S.W. Australia.

DISTRIBUTION. From Cape Riche to Thomson Bay, West Australia. Normally in sheltered pools on exposed coasts, under rocks.

Type specimens. The holotype of *V. (P.) hansenae* is in WAM No. 13-72, dimensions 14.6 x 5.5 x 7.2 mm (Fig. 36).

Material examined. West Australia: 3 km N.W. of Busselton (WAM); Margaret River; Bunbury; Moses Rocks (all coll. Marrow); Sarge Bay, Augusta (WAM; coll. Eker; coll. Hansen); Two People's Bay, 225 km E. of Albany (AMS; coll. Marrow; coll. Haddrill); Cape Riche, E. of Albany (AMS; coll. Marrow; coll. Eker); off Dunsborough; Tor Bay, W. of Albany; S. of Cowaramup; Thomson Bay, N.E. of Rottnest I; Beach at Kwinana refinery, Cockburn Sound; *c.* 3 km of Cape Naturaliste; Hopetoun; Albany (all AMS).

Vexillum (Pusia) marrowi Cernohorsky, 1973 (Fig. 38)

1966. *Proximitra pica* (Reeve), Hodgkin, Kendrick, Marsh & Slack-Smith, West Aust. Nat. Club Handb. No. 9. 47, pl. 18, fig. 4 (*non Mitra pica* Deshayes and Edwards, 1844; *nec* Reeve, 1845).

1973. *Vexillum (Pusia) marrowi* Cernohorsky, Rec. Auckland Inst. Mus. 10: 140, figs. 19-23; 1978 Hinton, Guide Austr. shells pl. 54, figs. 22, 22a.

Shell up to 21.0 mm in length but frequently smaller, generally ovate to elongate-ovate, solid, teleoconch of 4-6 short, convex whorls, protoconch of 1½-2½ smooth embryonic whorls; sutures sharply incised, whorls sculptured with slender and occasionally angulate axial ribs numbering 15-28 on the penultimate and 1-20 on the body whorl. Slender and often flattened and irregular spiral striae encircle whorls numbering 5-14 on the penultimate and 8-17 on body whorl apart from 7-13 oblique basal cords; interspaces of spiral cords minutely punctate giving the impression of being finely striate. Aperture longer than the spire, moderately wide and lirate within, outer lip constricted anteriorly; columella calloused and with 4 prominent folds, siphonal canal short and straight. Brown to purplish-brown in colour, ornamented with an irregular white presutural spiral band, occasional chevron-shaped markings and small or large white blotches; aperture brown near edge of outer lip and violet or purplish within, parietal wall brown, columellar folds bluish-white or violet.

TYPE LOCALITY. Yanchep reef, *c.* 48 km N. of Perth, West Australia.

DISTRIBUTION. From Murchison River mouth to Margaret River, S. of Cape Naturaliste, W. Australia. From the intertidal zone to 24 m, on rocks.

Figs. 36-38. 36, 37. *Vexillum (Pusia) hansenae* Cernohorsky. 36. Holotype WAM No. 13-72; 14.6 mm (slender form). 37. Paratype, 9.5 mm (broad form). 38. *V. (P.) marrowi* Cernohorsky. Holotype WAM No. 408; 12.9 mm.

Type specimens. The holotype of *V. (P.) marrowi* is in WAM No. 408, dimensions 12.9 x 6.2 x 7.8 mm (Fig. 38).

Material examined. West Australia: Port Gregory, East Wallaby I and Zeewyck Channel, Houtman Abrolhos Archipelago; Pt. Dennison reef, S.W. of Dongara; Yanchep reef; North Beach, Perth; Woodman's Pt., Coburn Sound; Lady AdelineBay, Rottnest I; Shoalwater Bay, via Rockingham; N.W. of Busselton jetty, 22 m-24 m; Bunker Bay (all WAM); Sth. Cottesloe Beach, Perth; Margaret River, S. of Cape Naturaliste (coll. Eker); Kilcarnup; Trigg I; Devils Brook; Horrock's Beach; Sorrento Beach, N. of Perth (all coll. Marrow); Pt. Peron, 48 km S. of Perth; *c.* 3 km S. of Cape Naturaliste; Geographe Bay;

Murchison River mouth; S.W. end of Garden I, S. of Perth; Wyadup, 6 km S. of Yallingup; off Dunsborough; Ellensbrook, Sth. Cowaramup; Geraldton (all AMS).

This common, intertidal species has been confused with *Mitra pica* Reeve, 1845 (*non* Deshayes and Edwards, 1844), which is *Waimatea obscura* (Hutton, 1873), an operculate species from Australia and New Zealand belonging to the family Volutomitridae.

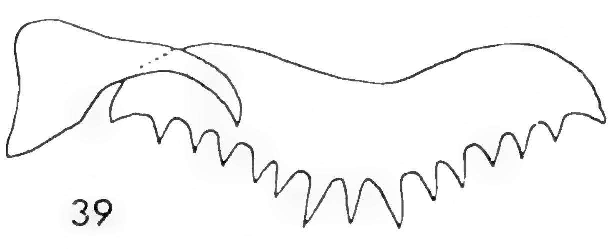
Genus **Austromitra** Finlay, 1927

Austromitra Finlay, 1927, Trans. Proc. N.Z. Inst. 57: 410. Type species by OD *Columbella rubiginosa* Hutton, 1873. Recent, New Zealand.

GEOGRAPHICAL DISTRIBUTION. Southern hemisphere: New Zealand; Australia; South Africa (Recent and fossil). Tertiary of Patagonia, Argentina (fossil).

STRATIGRAPHICAL RANGE. Eocene to Recent.

A diagnosis of the genus has been given by Cernohorsky (1970). Ponder (1972) who studied the anatomy of *Austromitra* advocated a separation from other costellariid genera on the basis of differences in the mid-esophagus, bursa copulatrix and primitive nature of the gland of Leiblein. The radula of *Austromitra* is of the vexilline type, consisting of a bow-shaped, multicuspid rachidian and a sickle-shaped lateral; these teeth are usually simple but some individuals have a few very minute denticles on the interior cutting edge (Fig. 39).



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Figs. 39, 40. Half-row of radulae. 39. *Austromitra rubiginosa* (Hutton). N. of Tutukaka Beach, New Zealand. 40. *Vexillum (Pusia) australe* (Swainson) (after Cooke, 1920, fig. 18).

Egg-capsules of *Austromitra* according to Ponder (op. cit.) are found embedded in the tests of various species of compound and colonial tunicates. Capsules are transparent, horny and hemispherical with the flat side uppermost, and each capsule contains only 3-5 eggs with all embryos developing. It would appear that the majority of South and South-east Australian species of Costellariidae produce larvae with a direct development which is reflected in the slightly globose, paucispiral embryonic whorls of the protoconch (Fig. 41) as opposed to the conical, multispiral protoconch of species with a pelagic development. The same type of paucispiral protoconch of 1½-2 embyronic whorls of *Austromitra* is also present in several tropical species of the subgenus *Pusia* and has also been observed in a specimen of the large *Vexillum taeniatum* (Lamarck) dredged in deep water in Papua New Guinea.

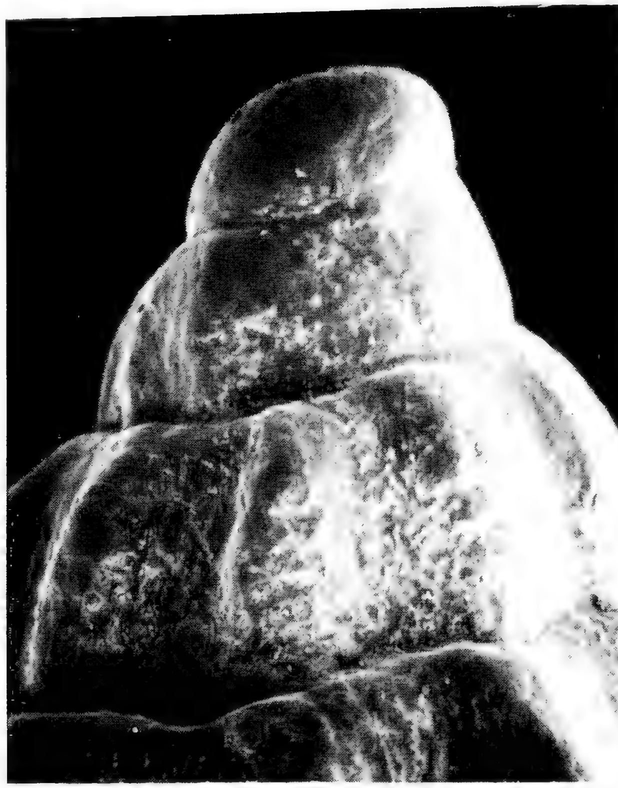


Fig. 41. *Austromitra analogica* (Reeve). South Australia. S.E.M. photograph of senile individual (protoconch).

Although all adult specimens of tropical Costellariidae species have distinct lirae on the interior wall of the outer lip, only 2 senile specimens from 1263 individuals of New Zealand *Austromitra* examined had 4-5 lirae in the aperture. Australian species of *Austromitra* either have or have not developed apertural lirae.

New Zealand species of *Austromitra*

Austromitra ambulacrum (Marwick, 1927) (Fig. 42)

1927. *Vexillum ambulacrum* Marwick, Trans. Proc. N.Z. Inst. 56: 320, pl. 73, fig. 11.
1927. *Austromitra ambulacra* (Marwick), Finlay, Trans. Proc. N.Z. Inst. 57: 140.
1966. *Austromitra ambulacrum* (Marwick), Fleming, N.Z. Dept. Sci. Ind. Res. Bull. 173:64, pl. 113, fig. 1370.

Shell up to 9.0 mm in length, elongate-ovate, sutures with a very narrow, flat sutural ramp, teleoconch of 4½ weakly convex and only slightly subangulate whorls, protoconch of 1½ moderately large, smooth embryonic whorls. Sculptured with narrow, irregular axial ribs which number 18 on the penultimate and 13 on the body whorl, ribs becoming obsolete towards base of body whorl; very fine and almost obsolete spiral striae are present, striae slightly stronger at the sutural ramp, siphonal fasciole with slightly stronger, oblique cords. Aperture only slightly longer than the spire, part of outer lip missing, columella not calloused and with 4 oblique folds, siphonal canal only slightly produced and straight.

TYPE LOCALITY. Tirangi Stream, Taranaki, Tongaporutuan, U. Miocene of New Zealand. *Type specimens.* The holotype of *A. ambulacrum* is in NZGS No. GS-1135, dimensions 8.9 x 4.0 x 4.7 mm (Fig. 42).

This species appears to be the Miocene forerunner of the Recent *A. rubiginosa* (Hutton).

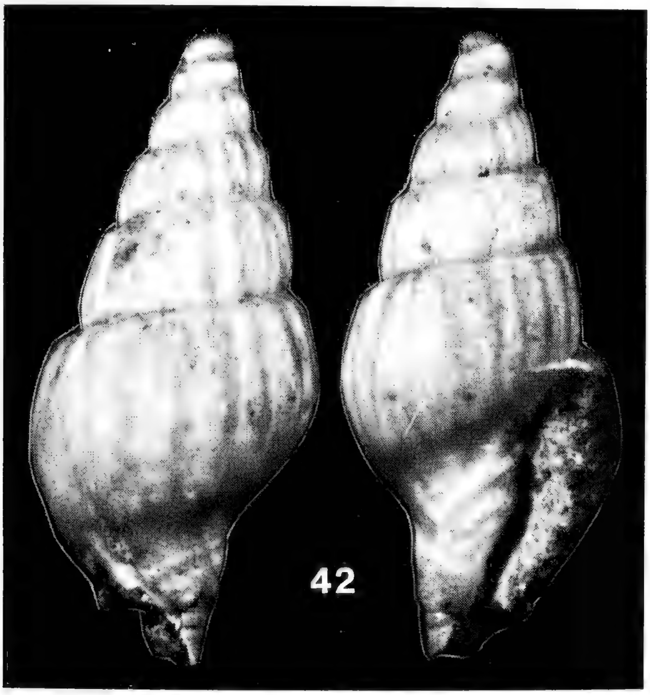


Fig. 42. *Austromitra ambulacrum* (Marwick). Holotype NZGS No. GS-1135; 8.9 mm.

Austromitra rubiginosa (Hutton, 1873) (Figs. 39, 43-57, 65)

1873. *Columbella (Atilia) rubiginosa* Hutton, Cat. Mar. Moll. New Zealand p.20.
1878. *Mitra rubiginosa* (Hutton), Hutton, J. Conchyl. 26: 22; 1880 Hutton, Man. N.Z. Moll. p. 60.
1884. *Turricula (Pusia) rubiginosa* (Hutton), Hutton, Trans. Proc. N.Z. Inst. 16: 226.
1893. *Turricula rubiginosa* (Hutton), Hutton, Macleay, Mem. vol. Linn. Soc. N.S.W. p. 46, pl. 6, fig. 19.
1904. *Vulpecula rubiginosa* (Hutton), Hutton, Ind. fauna Novaezeal. p. 74.
1908. *Vulpecula marginata* (Hutton), Suter, Trans. Proc. N.Z. Inst. 40: 349, pl. 27, fig. 8 (*non Turricula marginata* Hutton, 1885).
1913. *Vexillum pseudomarginatum* Suter, Man. N.Z. Moll. p. 364; 1915 Suter, Atlas, pl. 18, fig. 5 (*nom. subst. pro Vulpecula marginata* Suter, 1908).
1913. *Vexillum planatum* Hutton, Suter, Man. N.Z. Moll. p. 365; 1915 Suter, Atlas, pl. 18, fig. 6 (*non Turricula planata* Hutton, 1885).
1913. *Vexillum rubiginosum* Hutton, Suter, Man. N.Z. Moll. p. 366; 1915 Suter, Atlas, pl. 18, fig. 7; 1924 Bucknill, Seashells N.Z. p. 61, pl. 8, fig. 10.

1927. *Austromitra rubiginosa* (Hutton). Finlay, Trans. Proc. N.Z. Inst. 57. 410; 1928 Finlay, Trans. Proc. N.Z. Inst. 59. 256; 1952 Williams, Bull. Auckland Inst. Mus. Conch. Club No. 8. 4; 1961 Powell, Shells N.Z. p. 99, pl. 16, fig. 23; 1966 Fleming, N.Z. Dept. Sci. Ind. Res. Bull. 173: 64, 1968 Moreton and Miller, N.Z. Seashore p. 163, text fig. 57, fig. 12 (animal, egg-capsules and embryos); 1970 Cernohorsky, Bull. Auckland Inst. Mus. No. 8. 57, pl. 10, figs. 5, 6, 8 (shell), textfig. 149 (radula), textfig. 179 (protoconch); 1972 Ponder, Malacologia 11 (2). 312, figs. 5A-D, 6A-E (anatomy, radula and egg-capsules); 1972 Mannering, Poirieria 6 (3). 60.

1927. *Austromitra rubiradix* Finlay, Trans. Proc. N.Z. Inst. 57. 411 (*nom. subst. pro Mitra planata auctt.*); 1972 Ponder, Malacologia 11 (2). 312, fig. 5E (radula).

1927. *Vexillum antipodum* Brookes, Trans. Proc. N.Z. Inst. 56: 588, pl. 102, fig. 1.

1934. *Austromitra erecta* Powell, Trans. Proc. R. Soc. N.Z. 64. 156, pl. 21, fig. 12; 1961 Warren, Bull. Auckland Inst. Mus. Conch. Sect. 16. 20.

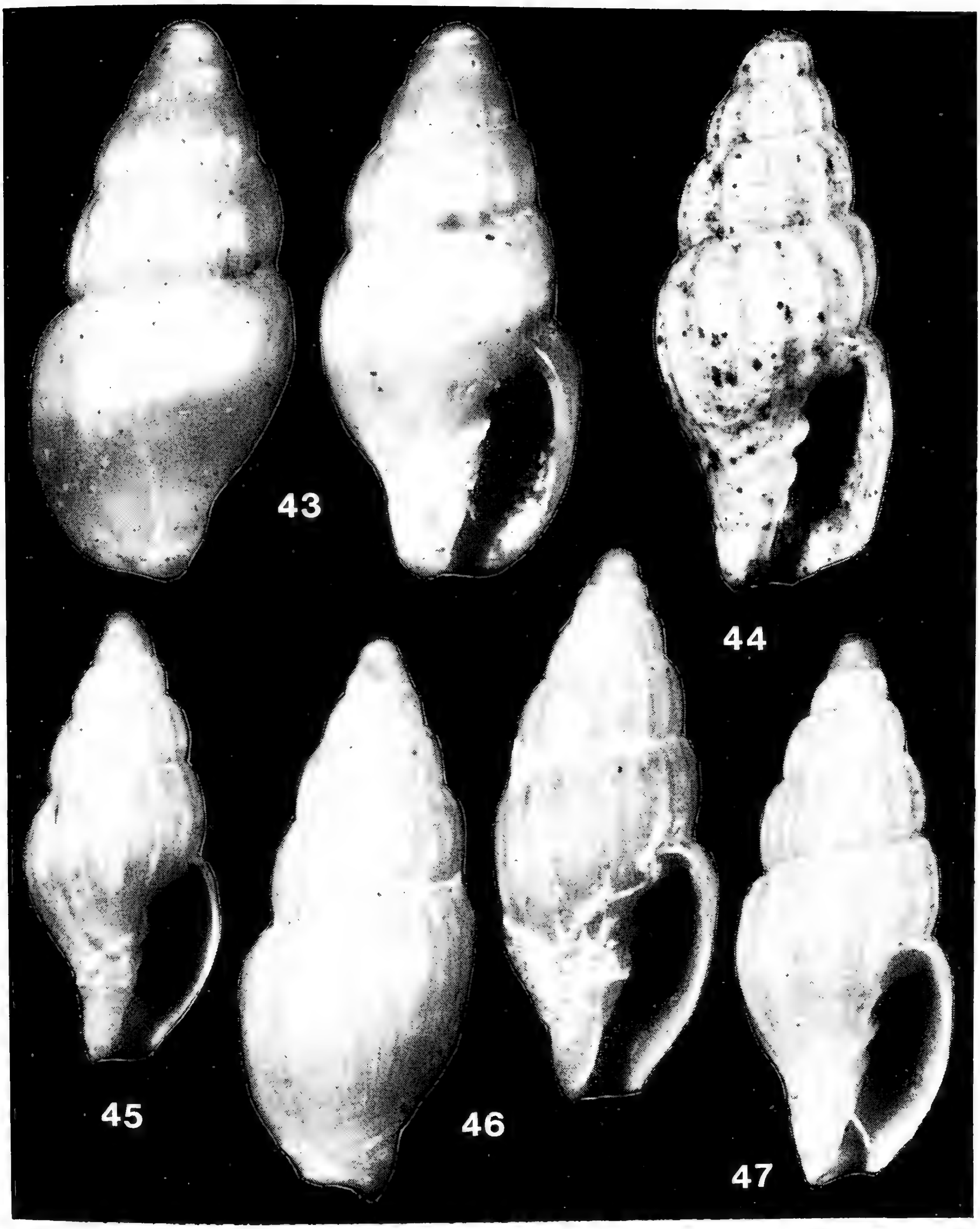
1952. *Austromitra pseudomarginata* (Suter). Williams, Bull. Auckland Inst. Mus. Conch. Club 8:4; 1958 Powell, Shells N.Z. ed. 3: 99; 1966 Fleming, N.Z. Dept. Sci. Ind. Res. Bull. 173: 64.

Shell up to 12.0 mm in length, variable in shape but usually elongate-ovate, teleoconch of 5-6 convex, weakly or distinctly subangulate whorls, protoconch of 1½-2 smooth, embyronic whorls. Sculptured with moderately elevated and frequently angulate axial ribs which number from 12-17 on the penultimate and from 0-16 on the body whorl, axial ribs being replaced in some individuals by longitudinal growth-striae on the dorsum of the body whorl; the axial ribs do not quite reach the posterior sutures and stop short at the presutural ramp where in some specimens they tend to become slightly nodose at this point; the smooth presutural area contains macroscopic axial striae and in some cases also a single spiral cord. Spiral sculpture variable, consisting of either very shallow or distinct spiral threads which in some individuals tend to override axial ribs; spiral striae number from 0-20 on the body whorl and in some specimens 2-3 spiral threads on the presutural ramp most prominent. Aperture about equal in height to the spire, almost always smooth within, outer lip convex and slightly constricted basally, columella not calloused and with 3-5 (usually 4) oblique folds, siphonal fasciole with 4-8 distinct oblique cords, siphonal canal straight. Variable in colour, usually dark reddish-brown to almost purplish-brown in some specimens, body whorl with a narrow white central band, siphonal canal orange in many specimens; some individuals white, fawn to pale yellowish-brown, body whorl with a broad, dark brown spiral band, spire whorls with a narrow brown band adjacent to sutures.

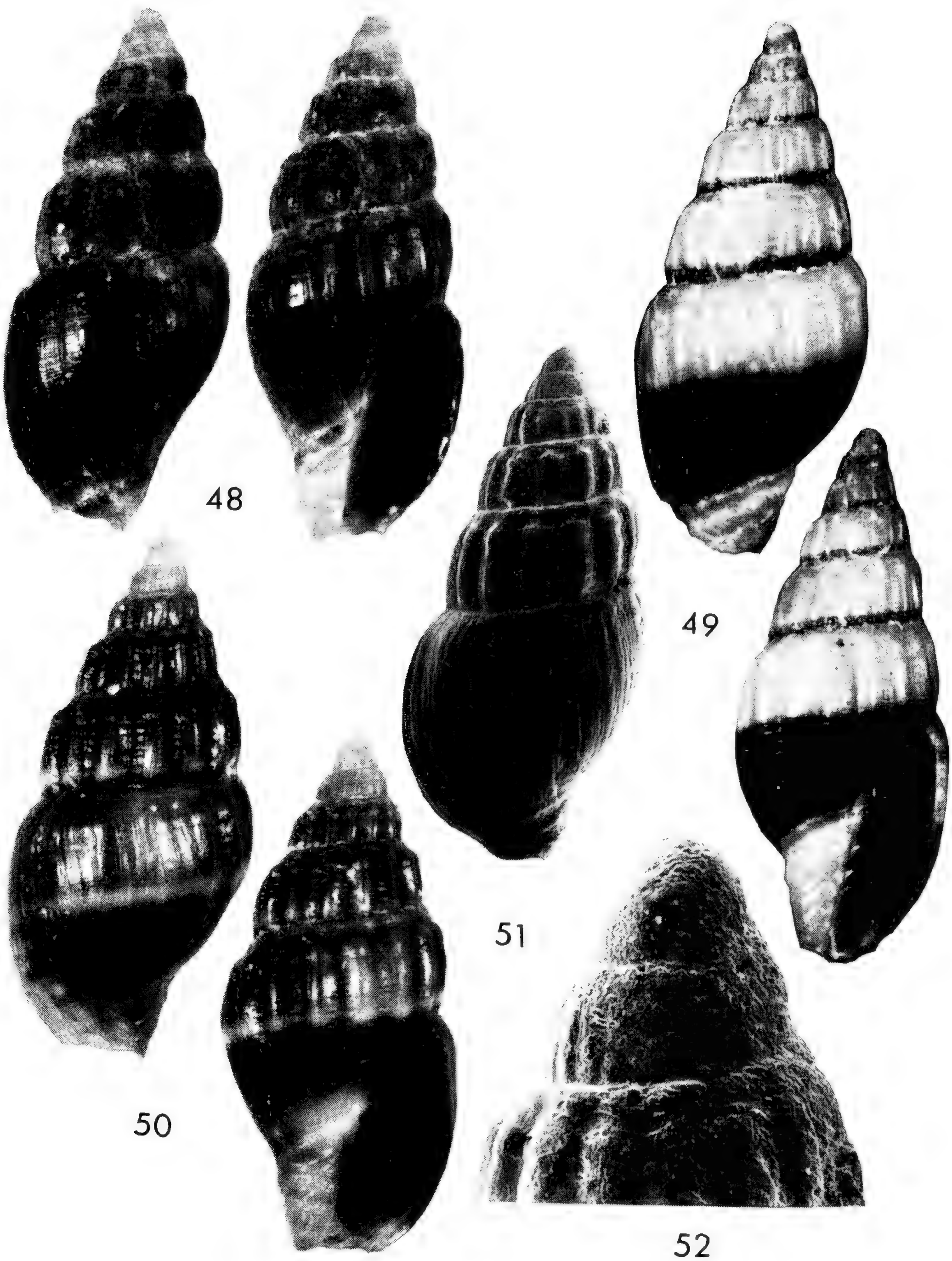
TYPE LOCALITY. Chatham Is (*rubiginosa*); 5 miles (8 km) Sth. of Cuvier I, 38 fathoms (70 m) (*pseudomarginata*); Whangaroa Harbour (*rubiradix*), Cooper's Beach, Doubtless Bay (*antipoda*); Taupo Bay, Whangaroa (*erecta*).

DISTRIBUTION. Throughout New Zealand. From the Three Kings Is to the Chatham Is and Stewart I (Fig. 57). From the intertidal zone to a depth of 88 m, under rocks and in shell-sand, juvenile specimens occasionally among algae. Although recorded from depth greater than 88 m, all specimens dredged were devoid of animal.

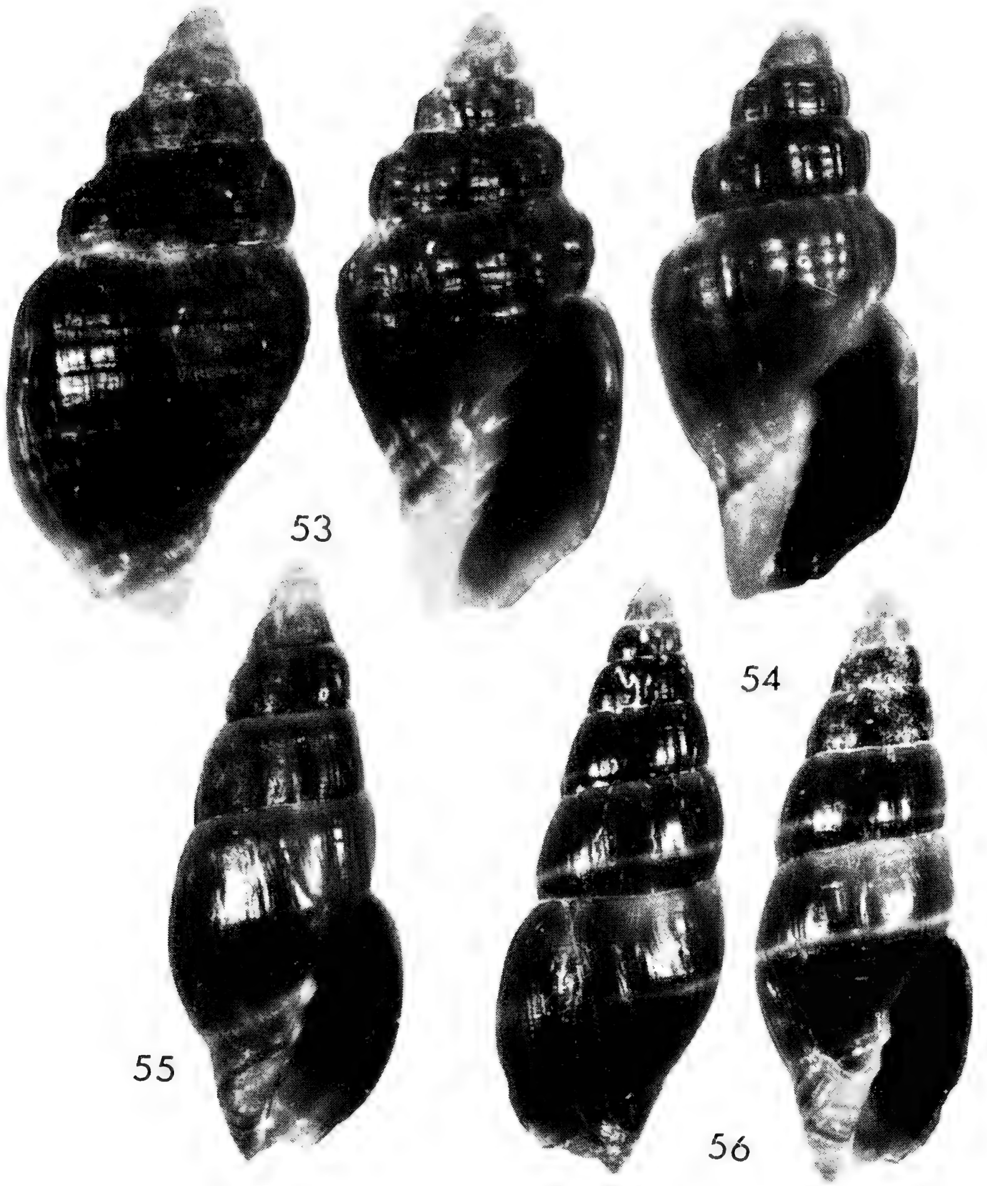
Type specimens. The lectotype of *A. rubiginosa* (here designated) is in NMNZ No. M-150, dimensions 7.6 x 3.6 x 3.8 mm (Fig. 43 — a very worn individual). The probable holotype and 4 paratypes of *A. pseudomarginata* are in NZGS No. TM-923, dimensions of probable holotype 4.0 x 1.8 mm (Fig. 45) (Suter's given size for the specimen he illustrated was 6.2 x 2.5 mm). The following holotypes are in the AIM: *A. rubiradix* No. TM-70, dimensions 8.2 x 3.5 x 4.0 mm (Fig. 48); *A. antipoda* No. TM-1291, dimensions 10.0 x 4.3 x 4.8 mm (Fig. 49) and *A. erecta* No. TP-10086, dimensions 9.6 x 4.6 x 5.5 mm, which is in Dr. A. W. B. Powell's private collection (Fig. 53).



Figs. 43-47. *Austromitra rubiginosa* (Hutton). 43. Lectotype NMNZ No. M-150; 7.6 mm (very worn). 44. Specimen from Petane, L. Pleistocene of New Zealand; 9.3 mm. 45. Probable juvenile holotype of *A. pseudomarginata* (Suter), NZGS No. TM-923; 4.0 mm. 46. Paratype NZGS, 5.4 mm. 47. Topotypé from off Cuvier I, 70 m; 5.7 mm.



Figs. 48-52. *Austromitra rubiginosa* (Hutton). 48. Holotype of *A. rubiradix* Finlay, AIM No. TM-70; 8.2 mm. 49. Holotype of *A. antipoda* (Brookes), AIM No. TM-1291; 10.0 mm. 50-52. Specimen from Mt. Maunganui, Tauranga. 50. 8.7 mm. 51, 52. S.E.M. photograph of dorsal side of shell and protoconch.



Figs. 53-56. *Austromitra rubiginosa* (Hutton). 53. Holotype of *A. erecta* Powell, AIM Powell coll. No. TP-10086; 9.6 mm. 54. Specimen from Leigh, Hauraki Gulf; 8.4 mm. 55, 56. Slender and smooth froms. 55. Nelson Harbour; 9.00 mm. 56. Goat I, Leigh, Hauraki Gulf; 9.3 mm.

Material examined. New Zealand: S.E. Bay, Great King I, Three Kings Is, 55 m (NMNZ; coll. Willan); between Three Kings Is and Nth. Cape, 34°21'S and 172°37'E, 88 m (NMNZ); Cape Maria van Diemen (AIM); Doubtless Bay (NMNZ; AMS; coll. Powell); Mangonui Heads (AIM,coll. Powell); Cable Bay, Doubtless Bay; Cooper's Beach, Doubtless Bay; Tauranga Bay, Whangaroa (all NMNZ); Taupo Bay, Whangaroa (coll.

Powell); Main Channel and Kaouou Bay, Whangaroa Harbour (NMNZ); Mahinepua near Whangaroa (coll. Willan); Outer Bay of Islands, 35°09'S and 174°12'E, 81 m (NMNZ); Albert Channel, Bay of Islands, 49 m; Ngataki Beach, Great Exhibition Bay (both coll. Willan); Reef Pt., Ahipara; Entrance to Deep Water Cove, 33-46 m; Koginga Pt., Parekura Bay (all NMNZ); Houhora Harbour (coll. Willan); near Knob Pt., Bay of Islands, 35°15'S and 174°11'E, 4 m; Tararoa Bay Pt., Bay of Islands (both NMNZ); between Marotiri I and Hen I, 55 m (coll. Powell); Hini Beach (NMNZ); Tutukaka Harbour (coll. Willan); Taurikura Bay, Whangarei Heads; Hen and Chicken Is, 46 m (both AIM); off Hen I, 35°58'S and 174°44'E, 4 m (NMNZ); Rocky Bay, Port Abercrombie, Gt. Barrier I; Port Fitzroy, Gt. Barrier I (both coll. Powell); Whangaparapara Harbour, Gt. Barrier I (coll. Willan); Goat I, Leigh (NMNZ; AMS); Ti Pt., Leigh (NMNZ); Matheson Bay, Leigh (coll. Willan); Colville Channel, 48-64 m (NMNZ; ZMC); off Cuvier I, 46-70 m (AIM; AMS; NMNZ); 6.4 km S. of Cuvier I, 73 m (coll. Powell); E. coast of Motutapu I (NMNZ); Red Bluff, Takapuna (coll. Powell); Takapuna reef, Auckland (AIM; NMNZ); Wenderholm Reserve, East coasts, Auckland; Kawau I, Hauraki Gulf; Orua Bay, Manukau Harbour, Auckland (all coll. Willan); off Motuihe I, Hauraki Gulf; Huia, Manukau Heads (both NMNZ); off Whale Rock, Mercury I, 24 m (coll. Willan); Kaiaua, Coromandel coast (coll. Marshall); 0.8 km off W. side of Mayor I, 33 m; N.N.E. of Mayor I, 84-150 m; Cape Runaway (all coll. Powell); off Mayor I, 256-311 m; N.W. of White I, 37°30'S and 177°03'E, 530 m; Matakoa Pt., Hicks Bay (all NMNZ); Waihau Bay, Cape Runaway (AIM; coll. Willan; coll. Marshall); Cemetery Pt., Waihau (NMNZ); Mt. Maunganui, Tauranga (AIM; coll. Powell); Te Kaha, East Cape (NMNZ; coll. Willan); Omaio, Cape Runaway area (coll. Marshall); Motonui Rock, Omaio Bay, Cape Runaway; Rurima Rocks; Otarawairere Bay, Ohope (all NMNZ); Tatapouri Beach, Gisborne (coll. Willan); Sponge Bay, Gisborne (coll. Marshall); between N. of Black I and Moturoa, 31 m (NMNZ); Mahia Peninsula (ZMC); Kai Iwi, near Wanganui (AIM); *c.* 16 km S.W. of Waitotara River mouth, 39°57'S and 174°34'E, 33-35 m; *c.* 29 km S. of Waitotara River mouth, 17-82 m; *c.* 18 km S.W. of Whangaehu River mouth, 40°09'S and 174°54'E, 55-57 m; *c.* 18 km S.W. of Wanganui, 40°11'S and 174°49'E, 58-64 m; *c.* 21 km W. of Rangitikei River mouth, 40°18'S and 174°59'E, 75-82 m; *c.* 19 km N.W. of Manawatu River mouth, 40°22'S and 174°59'E, 86 m; *c.* 18 km N. of Kapiti I, off Levin; *c.* 16 km E. of Stephens I, 40°38'S and 174°12'E, 128 m; Paturau, N.W. Nelson (all NMNZ); Cook Strait, 40°44'S and 174°34'E, 146 m (AIM. NMNZ); Channel between S. Rangitoto Is and D'Urville I, 40°46'S and 173°57'E, 59-64 m; off W. coast of D'Urville I, between Nile Head and Greenville Harbour, 40°47'S and 173°48'E, 62 m; W. of Castlepoint; Head of Titirangi Bay, Marlborough Sounds; Pauatahanui Arm, Paramata Harbour; Ship's Cove, Queen Charlotte Sound; Titahi Bay, Wellington (all NMNZ); W. side of Lyall Bay, Wellington (AMS); Nelson Harbour (AIM; coll. Powell); Tahunanui Beach, Nelson (coll. Powell); Island Bay, Wellington (NMNZ; coll. Powell); Plimmerton Beach, Wellington Harbour (coll. Willan); Lyall Bay, Wellington (AIM, NMNZ); 10 km off Karori Rock, Cook Strait, 41°24'S and 174°33'E, 468-501 m; Palliser Bay, 41°35'S and 175°04'E, 128-146 m (both NMNZ); Rocks Road, Nelson (AIM); Pegasus Bay, 43°14'S and 173°39'E, 512 m; Boulder Bay, Whale I; Purau, Lyttelton Harbour; Chatham Rise, 43°38'S and 177°19'E, 531 m; Hanson Bay, Chatham Is, 44°00'S and 176°21'E, 27 m (all NMNZ); Chatham Is (AIM; AMS); Rangatira I, Chatham Is (coll. Willan); Kaiangaroa and Ouwenga, Chatham Is; Head of Waitaki Canyon, off Oamaru, 45°10'S and 171°30'E, 256-293 m; Karitane Canyon, N.E. of Taiaroa Head, 585 m; Karitane Canyon, off E. Otago, 45°38'S and 171°01'E, 200 m; N.E. of Cape Saunders, E. Otago, 45°50'S and 170°56'E, 105 m (all NMNZ); Portobello, Dunedin (AIM); E. of Cape Saunders, Otago,

73-91 m (coll. Powell); Dunedin Harbour, 6 m (AIM); Foveaux Strait (AMS); Halfmoon Bay, Stewart I (NMNZ; AMS); Bravo I, Paterson Inlet, Stewart I; Easy Harbour, Stewart I, 7-20 m; off Poutama I, South Cape, Stewart I, 55 m (all NMNZ).
Fossil record: Petane, Nukumaruan, L. Pleistocene of New Zealand (AIM).

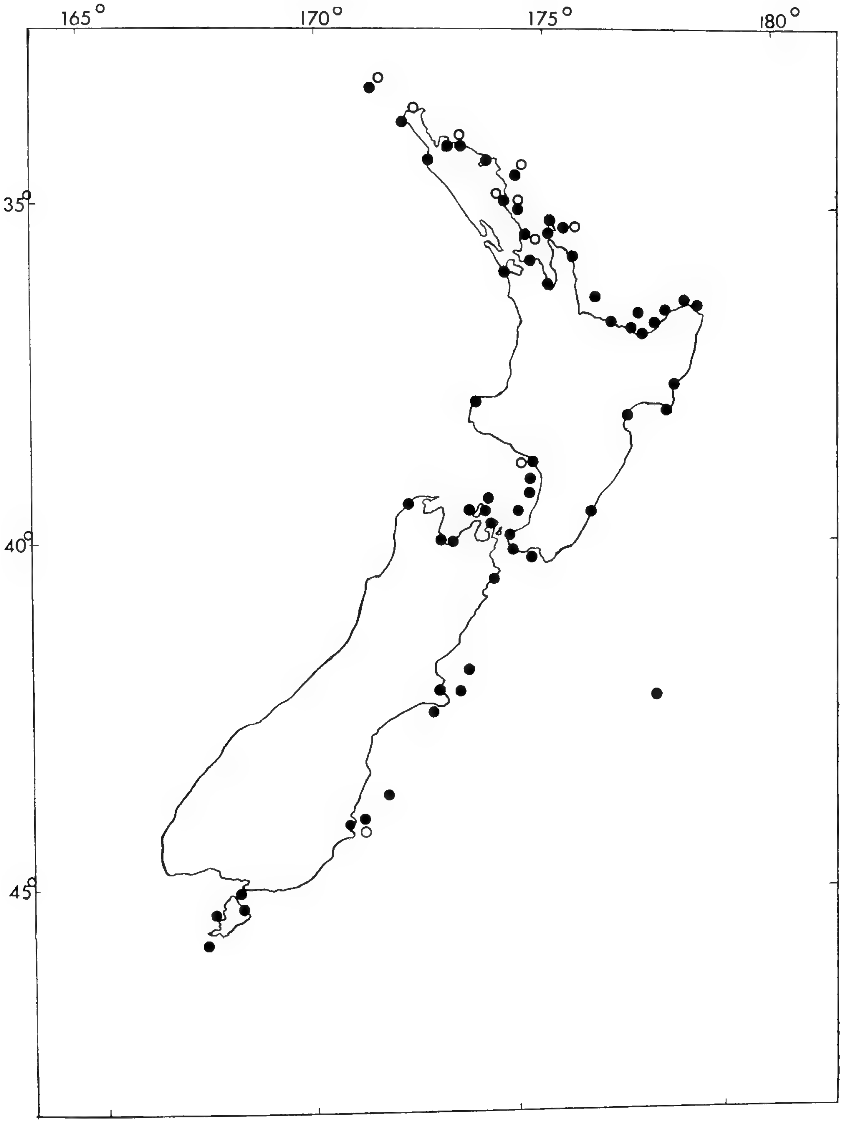


Fig. 57. Distributional map. *Austromitra rubiginosa* (Hutton) (full circles) and *A. angulata* (Suter) (open circles).

The following sculptural and colour variants have been described.

rubiradix Finlay: this is the common intertidal dark reddish-brown form with an orange siphonal canal and obsolete spiral sculpture.

erecta Powell: this is a coarsely sculptured, intertidal, dark reddish-brown form with an orange siphonal canal. The spiral sculpture consists of moderately deep spiral grooves which produce 3 flattish cords on the penultimate and 3-6 flattish cords on the body whorl. Among a series of 30 specimens, 1-2 specimens of *erecta* may be present.

antipoda Brookes: this is a colour form which is usually buff and ornamented with a broad, dark reddish-brown to purplish-brown band on the body whorl and a narrow band adjacent to the sutures on the spire whorls, siphonal canal frequently orange. Although more frequently encountered intertidally, this colour-form also occurs at Hen I in 55 m.

pseudomarginata Suter: this is another minute, 4.0-6.0 mm long subtidal, subadult form with whorls which are only weakly subangulate and the subsutural area has usually 1-3 more strongly pronounced spiral threads. All specimens examined were devoid of colour and animal.

Illustrated are some other unnamed forms encountered among the numerous specimens examined (Figs. 55, 56).

Austromitra lawsi Finlay, 1930 (Fig. 58)

1930. *Austromitra lawsi* Finlay, Trans. Proc. N.Z. Inst. 61: 235, pl. 43, fig. 17; 1956 Dell, Dominion Mus. Bull. No. 18: 174; 1958 Powell, Shells of N.Z. ed. 3: 99; 1970 Cernohorsky, Bull. Auckland Inst. Mus. No. 8: 58.

Species similar to *A. rubiginosa,* 9.0-13.0 mm in length, fusiformly-elongate, whorls distinctly subangulate, axial ribs as in *A. rubiginosa*. Spiral sculpture consists of numerous, distinct spiral threads. Penultimate whorl with 12-14 axial ribs and 6-8 spiral striae, body whorl with 10-13 ribs and 12-17 spiral striae. Siphonal canal more produced than in *A. rubiginosa* but the one uppermost stronger cord on the siphonal fasciole and axial ribs which do not quite reach the posterior sutures are also evident in *A. lawsi.*

TYPE LOCALITY. 10 miles (16 km) E.N.E. of Otago Heads, 50 fathoms (92 m).

DISTRIBUTION. Only known from the type locality and immediate vicinity. Subtidal, from 92 m-549 m; all specimens examined were dredged devoid of the animal and the exact depth range of living specimens is unknown.

Type specimens. The holotype of *A. lawsi* is in AIM No. TM-68, dimensions 12.3 x 4.9 x 5.5 mm (Fig. 58). Paratypes are in Dr. A. W. B. Powell's private collection.

Material examined. New Zealand: E.N.E. of Otago Heads, 92 m (AIM; coll. Powell); Cape Saunders, 132 m (AIM); off E. Otago coast, 45°45'S and 171°05'E, 549 m and 45°47'S and 171°07'E, 458-549 m (both NMNZ).

The species is imperfectly known and only a very few specimens have been seen in collections. Most of these specimens were faded and collected devoid of animal. A similar strong spiral sculpture has also been observed in some subtidal examples of *A. rubiginosa* and the only difference between the two species appears to be the more turreted shape and produced siphonal canal in *A lawsi.* The species may, when more material becomes available, prove to be another southeastern subtidal form of *A. rubiginosa.*

Fig. 58. *Austromitra lawsi* Finlay. Holotype AIM No. TM-68; 12.3 mm.

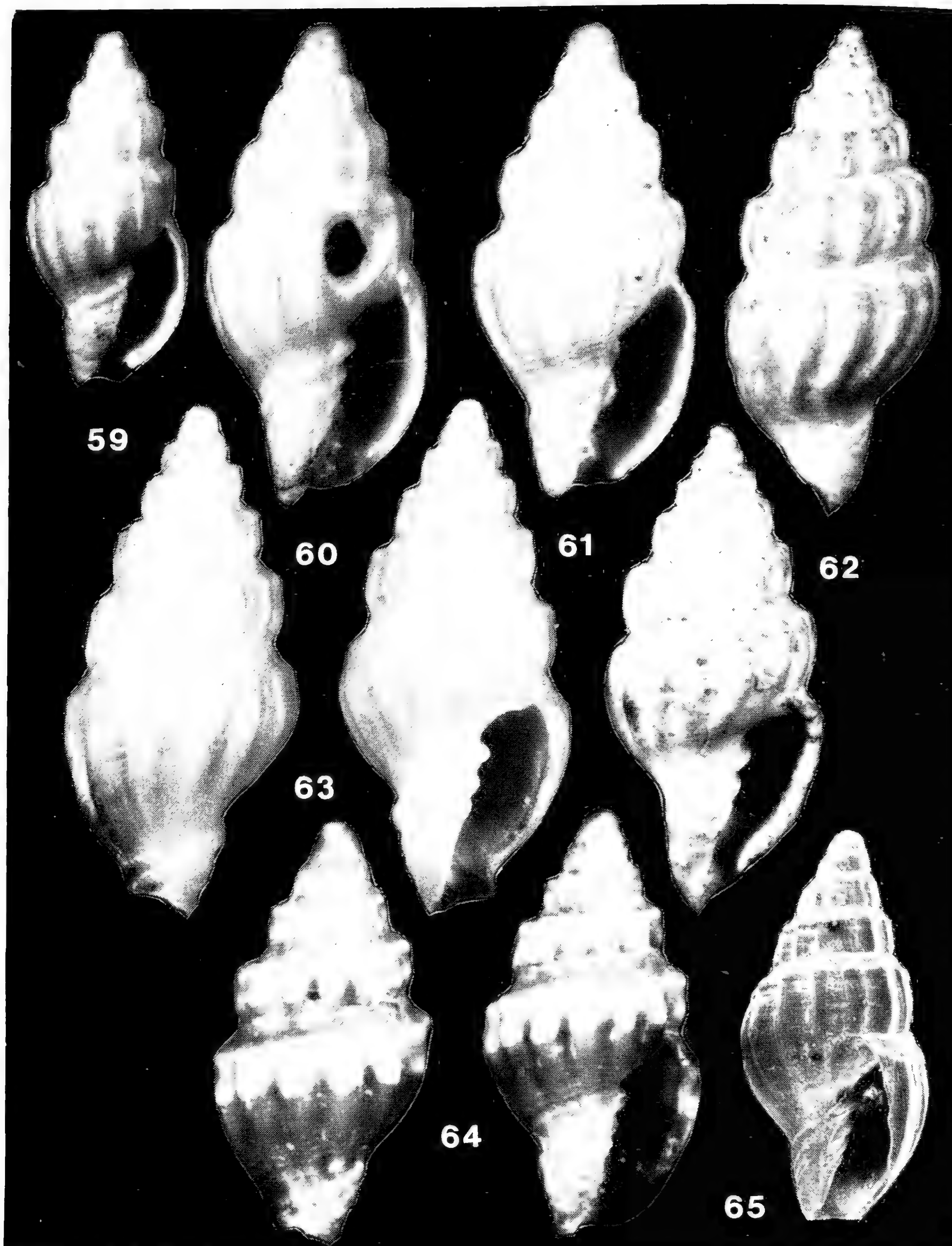
Austromitra angulata (Suter, 1908) (Figs. 57, 59-64)

1908. *Vulpecula marginata* subsp. *angulata* Suter, Trans. Proc. N.Z. Inst. 40: 350.
1913. *Vexillum pseudomarginatum* subsp. *angulatum* Suter, Suter, Man. N.Z. Moll. p. 364.
1943. *Austromitra quenelli* Fleming, Trans. Proc. R. Soc. N.Z. 73 (3): 199, pl. 29, fig. 12; 1966 Fleming, N.Z. Dept. Sci. Ind. Res. Bull. 173: 64; 1970 Cernohorsky, Bull. Auckland Inst. Mus. No. 8: 57, pl. 10, fig. 11.
1958. *Austromitra angulata* (Suter), Powell, Shells of N.Z. ed. 3: 99; 1958 Hulmes, Bull. Auckland Inst. Mus. Conch. Sect. 14: 6; 1972 Seelye, Poirieria 6 (4): 77.

Shell up to 11.0 mm in length but frequently smaller, elongate-ovate, similar to *A. rubiginosa* but squatter, teleoconch of 4-5½ angulate or occasionally bi-angulate whorls, protoconch of 1½ smooth embryonic whorls, suture adpressed, presutural ramp concave and occasionally even ledged. Sculptured with prominently angulate axial ribs which sometimes become nodose upon reaching the angulate shoulder; like in *A. rubiginosa,* the axial ribs only reach the presutural ramp and do not extend to the posterior suture. Spiral sculpture very weak and consisting of very fine spiral striae, siphonal fasciole with 6-8 oblique cords, first posterior cord strong and being almost an extension of the first posterior columellar fold. Aperture about equal in height to the spire, narrow, smooth within, columella with 3-4 oblique folds. Uniformly fawn in colour, some individuals glassy-white to orange-brown in colour with the posterior part of axial ribs white and sometimes orange-brown spots on the summits of the white axial ribs; some individuals have a broad, reddish-brown band on the body whorl and darker spots in the interspaces.

TYPE LOCALITY. South of Cuvier I, 38 fathoms (70 m) (*angulata*); Takapau (N.E.) and Tahoraite (S.W.), sandstone facies of the Waitotaran, U. Pliocene of New Zealand (*quenelli*).

DISTRIBUTION. North and South Islands, New Zealand (Fig. 57). Subtidal, from 6-150 m, in bryozoan rubble, sand and shell-fragments.



Figs. 59-65. 59-64. *Austromitra angulata* (Suter). 59. Lectotype NZGS No. TM-920; 4.7 mm. 60. Paralectotype, 4.9 mm. 61. Spirally striate form from Cuvier I, 46 m; 4.9 mm. 62. Holotype of *A. quenelli* Fleming, NZGS No. GS-2314; 11.0 mm. 63. Bi-angulate form from off Three Kings Is, 92 m; 7.0 mm. 64. Specimen from off Motutapere I, Cavalli Is, 33 m; 4.3 mm. 65. *A. rubiginosa* (Hutton), juvenile specimen; 6.8 mm (S.E.M. photo).

Type specimens. The lectotype of *A. angulata* (here designated) and 2 paralectotypes are in NZGS No. TM-920, dimensions of lectotype 4.7 x 2.1 mm (Fig. 59). The holotype and paratype of *A. quenelli* are in NZGS No. GS-2314, dimensions of holotype 11.0 x 4.9 x 5.0 mm (Fig. 62).

Material examined. New Zealand: Three Kings Is, 92 m (coll. Powell); S.W. end of Tokananohia reef, N. of Motutapere I, Cavalli Is, 33 m (coll. Willan); Whangarei Heads, 6 m; 6.4 km S. of Cuvier I, 73 m (both coll. Powell); Cuvier I, 46 m (AIM); Poor Knights Is, 110 m; N.N.E. of Mayor I, 84 m-150 m (both coll. Powell); Hen and Chicken Is, 46 m (AIM); 29 km S. of Waitotara River mouth, 17 m-82 m (NMNZ); off Otago, 45°48'S and 170°59'E, 118 m (AMS).
Fossil record: Palliser Bay, Wellington, L. Pliocene of New Zealand (AIM); Takapau, Waitotaran, U. Pliocene of New Zealand.

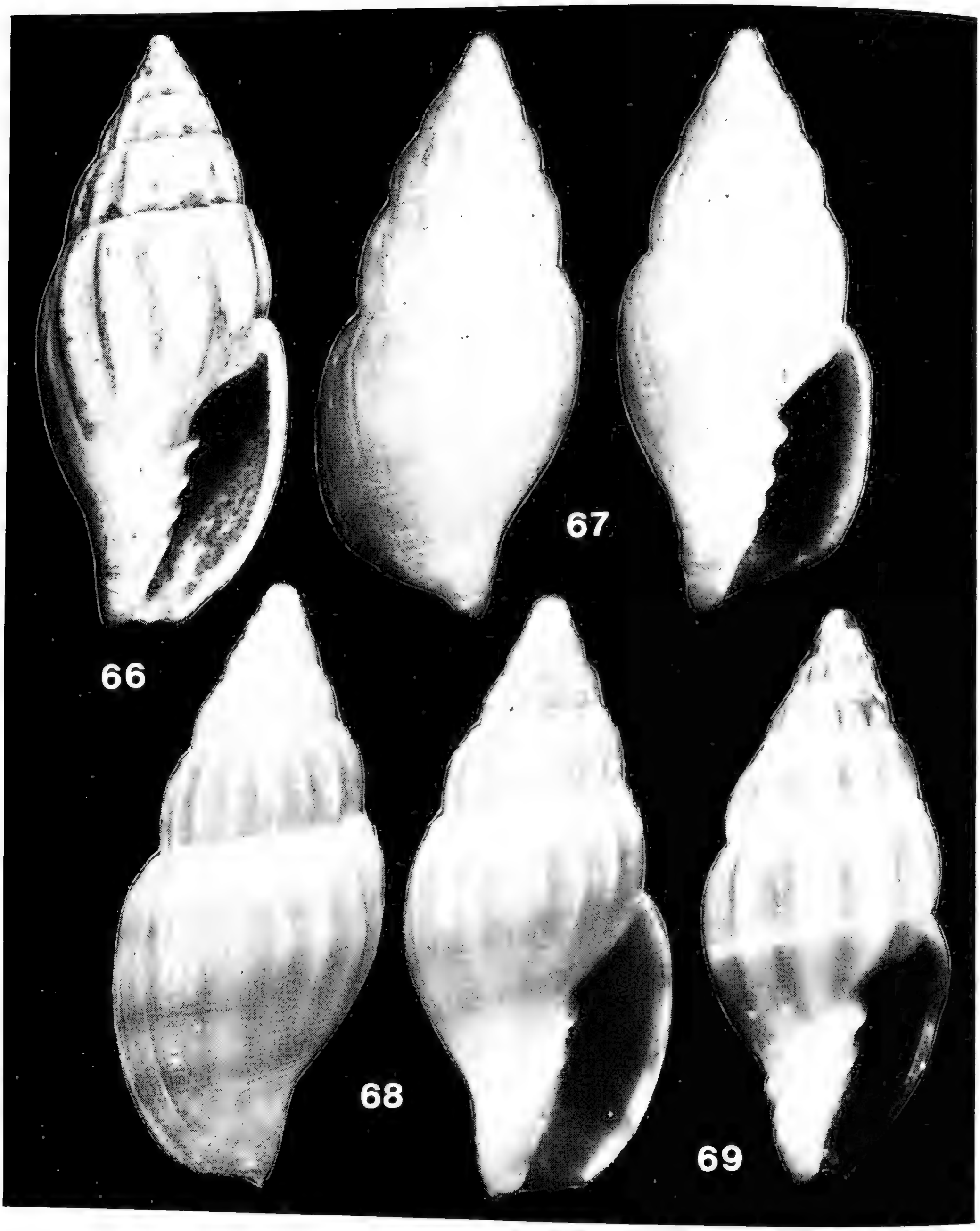
A. angulata is only tentatively listed as a valid species. It is impossible to determine without detailed population studies, if intermediate specimens are hybrids between *A. rubiginosa* and *A. angulata* or simply intergrading forms of a single species. Some juvenile individuals of *A. rubiginosa* (Fig. 65) cannot be dinguished from *A. angulata.*

Austromitra planata (Hutton, 1885) (Figs. 66-69)

1885. *Turricula planata* Hutton, Trans. Proc. N.Z. Inst. 17: 315, pl. 18, fig. 3.
1904. *Vulpecula planata* (Hutton), Hutton, Ind. fauna Novaezeal, p. 74.
1915. *Vexillum planatum* (Hutton), Suter, N.Z. Geol. Surv. Palaeont. Bull. No. 3: 22.
1927. *Austromitra planata* (Hutton), Finlay, Trans. Proc. N.Z. Inst. 57: 410; 1966 Fleming, N.Z. Dept. Sci. Ind. Res. Bull. 173: 64.
1930. *Austromitra planatella* Finlay, Trans. Proc. N.Z. Inst. 61: 235, pl. 43, fig. 18; 1952 Powell, Rec. Auckland Inst. Mus. 4 (3): 182, 1958 Powell, Shells of N.Z. ed. 3: 99.
1952. *Austromitra brunneacincta* Powell, Rec. Auckland Inst. Mus. 4 (3): 173, pl. 36, fig. 4; 1958 Powell, Shells of N.Z. ed. 3: 99, 41, fig. 4; 1964 Williams, Moll. Bay of Plenty, p. 41, textfig.
1970. *Austromitra rubiginosa* (Hutton), Cernohorsky, Bull. Auckland Inst. Mus. No. 8: 84, pl. 10, figs. 7, 9, 10 (*non Columbella rubiginosa* Hutton, 1873).
1976. *Austromitra rubiginosa* forma *brunneacincta* Powell, Shells of N.Z. rev. ed.: 45, fig. 4.

Shell up to 15.0 mm in length, elongate-ovate and somewhat inflated, teleoconch of 4¾-5½ distinctly convex whorls, protoconch of 1½-1¾ smooth embryonic whorls. Sculptured with thin and slightly angulate axial ribs which extend from suture to suture and number from 10-20 on the penultimate and from 8-18 on the body whorl; axial ribs become less elevated, irregular and more crowded on the dorsal side towards the outer lip. Spiral sculpture consists of numerous, extremely fine spiral striae which number from 10-20 on the penultimate and from 25-45 on the body whorl. Aperture wider than in *A. rubiginosa,* outer lip occasionally angulate but usually convex, columella with 4-5 oblique, thin folds. In juvenile specimens the siphonal fasciole has 7-8 oblique cords but in adult individuals these become almost as fine as the remaining spiral striae. The majority of specimens examined were uniformly faded brown or fawn, but some specimens are brown and have 1-4 white narrow bands on the body whorl and a single white band adjacent to the sutures on spire whorls.

TYPE LOCALITY. Wanganui, Castlecliffian, L. Pleistocene of New Zealand (*planata*); off Cuvier I, 38 fathoms (70 m) (*planatella*); ½ mile (0.8 km) off west side of Mayor I, *ex-pisces* (*Cheilodactylus macropterus* Bloch & Schneider) taken in 18 fathoms (33 m) (*brunneacincta*).



Figs. 66-69. *Austromitra planata* (Hutton). 66. Holotype CMC No. M-3142; 14.5 mm. 67. Holotype of *A. planatella* Finlay, AIM No. TM-69; 10.6 mm. 68. Holotype of *A. brunneacincta* Powell, AIM No. TM-1192; 10.3 mm. 69. Juvenile specimen from off Northeast I, Three Kings I, 102 m; 10.8 mm.

DISTRIBUTION. East coast of the North Island, from the Three Kings Is to Mayor I. Subtidally, from 32 m-150 m, in sand and grit.

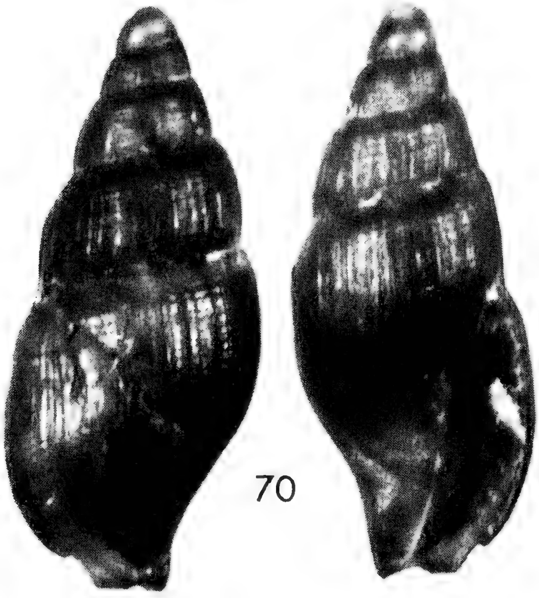
Type specimens. The holotype of *A. planata* is in CMC No. M-3142, dimensions 14.5 x 6.2 x 7.7 mm (Fig. 66). The holotype of *A. planatella* is in AIM No. TM-69, dimensions 10.6 x 4.5 x 5.2 mm (Fig. 67). The holotype of *A. brunneacincta* is also in AIM No. TM-1192, dimensions 10.3 x 4.5 x 6.1 mm (Fig. 68).

Material examined. New Zealand: off Northeast I, Three Kings Is, 34°09'S & 172°11'E, 102 m; off Three Kings Is, 34°11'S & 172°10'E, 92 m; off Nth. Cape, 92 m (all NMNZ); Spirits Bay, 59 m (coll. Powell); Whangaroa (AIM; coll. Powell); off Spirits Bay, 64 m (coll. Willan); Entrance to Deepwater Cove, 33-46 m; 4.8 km E. of Hen and Chicken I, 92 m; W. side of Tryphena reef, towards Cape Banner, 32 m; Colville Channel, trawled (all NMNZ); off Cuvier I, 70 m (AIM); N.N.E. of Mayor I, 84-150 m; off Mayor I, Bay of Plenty, 55 m (both coll. Powell); off Mayo I, *ex-pisces,* 33 m (AIM; NMNZ);
Fossil record: Wanganui, Caslteclififian, L. Pleistocene of New Zealand (CMC).

Adult specimens of *A. planata* can be separated from *A. rubiginosa* on characters of inflated convex whorls, continuous axial ribs which reach from suture to suture and the extremely fine oblique spiral threads on the siphonal fasciole.

Austromitra zafra Powell, 1952 (Fig. 70)

1952. *Austromitra zafra* Powell, Rec. Auckland Inst. Mus. 4 (3): 183, pl. 36, fig. 3; 1958 Powell, Shells of N.Z. ed. 3:99, 41, fig. 3; 1964 Williams, Moll. Bay of Plenty, p.41, textfig.; 1976 Powell, Shells of N.Z. ed. 5: 103, 45, fig. 3.



70

Fig. 70. *Austromitra zafra* Powell. Holotype AIM No. TM-1193; 5.2 mm.

Shell minute, 5.3 mm in length, fusiformly-ovate, teleoconch of 3½ slightly convex whorls, protoconch of 1½ smooth embyronic whorls. Sculptured with numerous, low, thin and irregular axial ribs which extend from suture to suture and number *c*. 27 on the penultimate and *c*. 40 on the body whorl; spiral sculpture consists of numerous, extremely fine spiral striae which number *c*. 9 on the penultimate whorl; oblique threads on the siphonal fasciole only imperceptibly thicker than main spiral striae. Aperture about equal in height to the spire, narrow, outer lip thin and brittle, columella with 4 oblique folds. Uniformly dark reddish-brown in colour, becoming slightly translucent toward the outer lip.

TYPE LOCALITY. 1.6 km off S.W. end of Mayor Island, from stomach of a tarakihi fish (*Cheilodactylus macropterus* Bloch & Schneider) taken in 92 m.

DISTRIBUTION. Known only from the type locality.

Type Specimens. The holotype of *A. zafra* is in AIM No. TM-1193, dimensions 5.2 x 2.2 mm (Fig. 70).

The holotype is the only specimen known to date. It is a juvenile individual in a slightly worn condition. *A. zafra* bears some resemblance to very small juveniles of *A. planata* (Hutton).

Australian species of *Austromitra*

Austromitra analogica (Reeve, 1845) (Figs. 41, 71-101)

1845. *Mitra analogica* Reeve, Conch. Icon. 2: pl. 35, sp. 293; 1882 Tryon, Man. Conch. 4: 126, pl. 37, fig. 103 only; 1923 May, Pap. Proc. R. Soc. Tasmania p. 54; 1923 May, Illust. Ind. Tasman. shells p. 79, pl. 37, fig. 16.

1855. *Volutomitra vincta* A. Adams, Proc. Zool. Soc. Lond. for 1854: 134.

1855. *Volutomitra cinnamomea* A. Adams, Proc. Zool. Soc. Lond. for 1854: 134.

1874. *Mitra vincta* Adams, Sowerby, Thes. Conchyl. 4: 25, pl. 23, figs. 520, 521; 1882 Tryon, Man. Conch. 4: 125, pl. 37, fig. 94 only.

1876. *Mitra scalariformis* Tenison-Woods, Pap. Proc. R. Soc. Tasmania for 1875: 140; 1970 Hedley, Rec. Austral Mus. 6 (4): 287; 1911 Hedley, Zool. Res. Fish. Exp. "Endeavour" p. 95; 1915 Hardy, Pap. Proc. R. Soc. Tasmania p. 69; 1921 May, Check-list Moll. Tasmania p. 80; 1923 May, Illust. Ind. Tasman. shells p. 79, pl. 37, fig. 20 (*non M. scalariformis* Borson, 1820).

1876. *Mitra teresiae* Tenison-Woods, Pap. Proc. R. Soc. Tasmania for 1875: 140; 1879 Tenison-Woods, Pap. Proc. R. Soc. Tasmania for 1878: 34; 1882 Tryon, Man. Conch. 4: 128; 1915 Hardy, Pap. Proc. R. Soc. Tasmania p. 72.

1876. *Mitra legrandi* Tenison-Woods, Pap. Proc. R. Soc. Tasmania for 1875: 140; 1879 Tenison-Woods, Pap. Proc. R. Soc. Tasmania for 1878: 34; 1900 Hedley, Rec. Aust. Mus. 3: 219, textfig.; 1913 Hedley, Proc. Linn. Soc. N.S.W. 38(2): 314; 1915 Hardy, Pap. Proc. R. Soc. Tasmania p. 67; 1918 Hedley, Proc. R. Soc. N.S.W. 51: M85; 1921 May, Check-list Moll. Tasmania p. 79; 1923 May, Illust. Ind. Tasman, shells p. 79, pl. 37, fig. 18.

1876. *Mitra scita* Tenison-Woods, Pap. Proc. R. Soc. Tasmania for 1875: 141; 1882 Tryon, Man. Conch. 4: 182; 1899 Pritchard and Gatliff, Proc. R. Soc. Victoria N.S. 11(2): 189; 1915 Hardy, Pap. Proc. R. Soc. Tasmania p. 69.

1878. *Mitra schomburgki* Angas, Proc. Zool. Soc. Lond. for 1878: 313, pl. 18, figs. 12, 13.

1878. *Mitra weldii* Tenison-Woods, Pap. Proc. Rm Soc. Tasmania p. 73.

1879. *Mitra tatei* Angas, Proc. Zool. Soc. Lond. for 1878: 861, pl. 54, fig. 8; 1922 Gatliff and Gabriel, Proc. R. Soc. Victoria N.S. 34: 135.

1882. *Turricula (Costellaria) schomburgki* Angas, Tryon, Man. Conch. 4: 173, pl. 51, fig. 470.

1882. *Turricula (Pusia) tatei* Angas, Tryon, Man. Conch. 4: 183, pl. 54, fig. 567.

1899. *Turricula scalariformis* T. Woods, Pritchard and Gatliff, Proc. R. Soc. Victoria N.S. 11(2): 189.
1901. *Turris schomburgki* Angas, Tate and May, Proc. Linn. Soc. N.S.W. Pt. 3: 361; 1908 Verco, Cat. Mar. Moll. Sth. Aust. p. 13.
1901. *Turris legrandi* T.W., Tate and May, Proc. Linn. Soc. N.S.W. Pt. 3: 361; 1908 Verco, Cat. Mar. Moll. Sth. Aust. p. 13.
1901. *Turris scalariformis* T.W., Tate and May, Proc. Linn. Soc. N.S.W. Pt. 3: 361; 1908 Verco, Cat. Mar. Moll. Sth. Aust. p. 13.
1906. *Mitra cinnamomea* A. Adams, E. A. Smith, Ann. Natal Mus. 1(1): 33.
1908. *Turris weldei (sic)* T.W., Verco, Cat. Mar. Moll. Sth. Aust. p. 13.
1908. *Turris vincta* A. Adams, Verco, *ibid.* p. 13.
1909. *Mitra bellapicta* Verco, Trans. R. Soc. Sth. Aust. 33: 337, pl. 25, fig. 1; 1921 May, Check-list Moll. Tasmania p. 79; 1923 May, Illust. Ind. Tasman. shells, p. 79, pl. 37, fig. 21.
1909. *Mitra retrocurvata* Verco, Trans. R. Soc. Sth. Aust. 33: 338, pl. 24, figs. 4, 5; 1911 Hedley, Zool. Res. Fish. Exp. "Endeavour" p. 95; 1921 May, Check-list Moll. Tasmania p. 79; 1923 May, Illust. Ind. Tasman. shells p. 79, pl. 37, fig. 17.
1916. *Vexillum pumilio* May, Proc. R. Soc. Tasmania p. 85, pl. 1, fig. 5; 1921 May, Check-list Moll. Tasmania p. 79; 1923 May, Illust. Ind. Tasman. shells p. 79, pl. 37, fig. 19.
1920. *Vexillum teresiae* T. Woods, Cooke, Proc. Zool. Soc. Lond. for 1919: 418 (description of radula).
1922. *Mitra analogica* var. *vincta* A. Adams, Gatliff and Gabriel, Proc. R. Soc. Victoria N.S. 34: 135.
1932. *Austromitra scalariformis* T.W., Cotton and Godfrey, Sth. Aust. Nat. 13(2): 78; 1941 Ludbrook, Trans. R. Soc. Sth. Aust. 65(1): 100; 1951 Macpherson and Chapple, Mem. Nat. Mus. Victoria No. 17: 133; 1952 Cotton, Bull. Dept. Mines 27: 9; 1956 Gabriel, Me. Nat. Mus. Victoria 22(4): 12; 1957 Cotton, R. Soc. Sth. Aust. Malac. Sect. No. 12: fig. 12; 1962 Macpherson and Gabriel, Nat. Mus. Vict. Handb. No. 2: 209.
1932. *Austromitra legrandi* T.W., Cotton and Godfrey, Sth. Aust. Nat. 13(2): 78; 1951 Macpherson and Chapple, Mem. Nat. Mus. Victoria No. 17: 133; 1962 Macpherson and Gabriel, Nat. Mus. Vict. Hanb. No. 2: 209; 1966 Macpherson, Mem. Nat. Mus. Vict. 27: 255.
1932. *Austromitra analogica* Reeve, Cotton and Godfrey, Sth. Aust. Nat. 13(2): 78; 1951 Macpherson and Chapple, Mem. Nat. Mus. Vict. No. 17: 133; 1962 Macpherson and Gabriel, Nat. Mus. Victoria Handb. No. 2: 209; 1978 Hinton, Guide Aust. shells pl. 54, figs. 23, 23a.
1932. *Austromitra schomburgki* Angas, Cotton and Godfrey, Sth. Aust. Nat. 13(2): 78, pl. 4, fig. 3; 1951 Macpherson and Chapple, Mem. Nat. Mus. Vict. No. 17: 133; 1952 Cotton, Bull. Dept. Mines 27: 9; 1954 Macpherson, Austral. Geog. Soc. Rept. No. 1: 61; 1962 Macpherson and Gabriel, Nat. Mus. Vict. Handb. No. 2: 209; 1966 Macpherson, Mem. Nat. Mus. Vict. 27: 255.
1932. *Austromitra retrocurvata* (Verco), Cotton and Godfrey, Sth. Aust. Nat. 13(2): 80; 1951 Macpherson and Chapple, Mem. Nat. Mus. Vict. 17: 133; 1957 Cotton, R. Soc. Sth. Aust. Malac. Sect. No. 12: fig. 11; 1962 Macpherson and Gabriel, Mem. Nat. Mus. Vict. Handb. No. 2: 209.
1932. *Austromitra tatei* (Angas), Cotton and Godfrey, Sth. Aust. Nat. 13(2): 80; 1951 Macpherson and Chapple, Mem. Nat. Mus. Vict. No. 17: 133; 1957 Cotton, R. Soc. Sth. Aust. Malac. Sect. No. 12: fig. 17; 1962 Macpherson and Gabriel, Nat. Mus. Vict. Handb. No. 2: 209; 1966 Macpherson, Mem. Nat. Mus. Vict. 27: 255.
1932. *Mitroidea jaffaensis* Cotton and Godfrey, Sth. Aust. Nat. 13(2): 82, pl. 4, fig. 8.
1951. *Austromitra pumilio* May, Macpherson and Chapple, Mem. Nat. Mus. Vict. No. 17: 133; 1962 Macpherson and Gabriel, Nat. Mus. Vict. Handb. No. 2: 209.
1956. *Austromitra bellapicta* (Verco), Gabriel, Mem. Nat. Mus. Vict. 22(4): 12; 1962 Macpherson and Gabriel, Nat. Mus. Vict. Handb. No. 2: 209; 1957 Cotton, R. Soc. Sth. Aust. Malac. Sect. No. 12: fig. 10.

1957. *Mutyca jaffaensis* (Cotton and Godfrey), Cotton, R. Soc. Sth. Aust. Malac. Sect. No. 12: fig. 6.
1957. *Austromitra vincta* A. Adams, Cotton, R. Soc. Sth. Aust. Malac. Sect. No. 12: fig. 13.
1962. *Austromitra analogica tincta (sic)* A. Adams, Macpherson and Gabriel, Nat. Mus. Vict. Handb. No. 2: 209.
1978. *Austromitra* sp. cf. *A. retrocurvata* (Verco), Ludbrook, Geol. Surv. West. Aust. Bull. 125: 159.

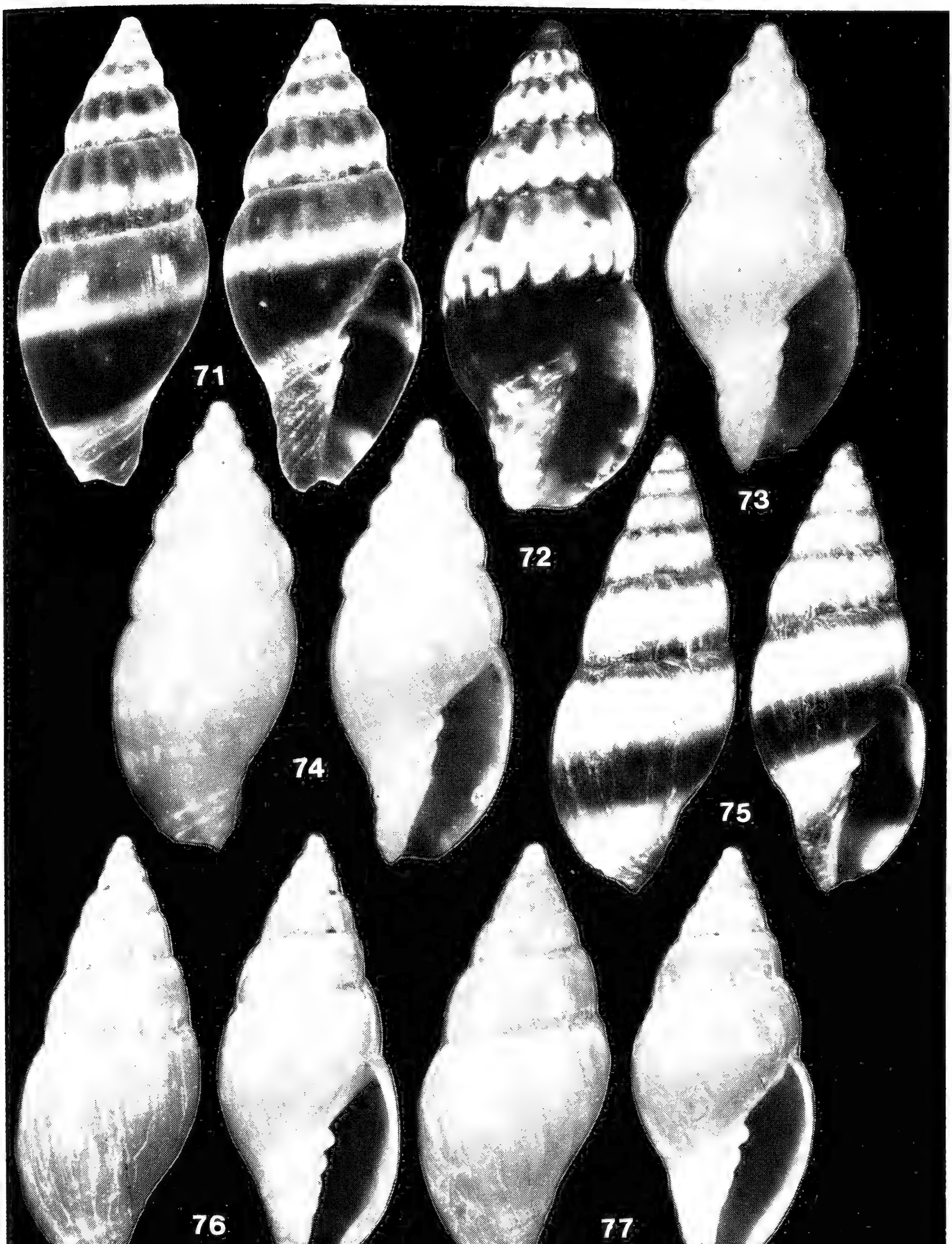
Shell up to 18.0 mm in length but frequently smaller,fusiformly-elongate to elongate-ovate, teleoconch of 4-6 convex whorls, protoconch of 1½-2 smooth glassy-brown embryonic whorls, sutures distinct. Sculpture extremely variable, consisting of thick or thin, usually angulate axial ribs which number from 0-20 on the penultimate and from 0-17 on the body whorl. Spiral sculpture is usually absent except for a few macrostriae. Aperture longer or shorter than the spire, frequently lirate within in mature specimens, outer lip convex, constricted or occasionally flaring, columella with 3-4 oblique folds, siphonal fasciole straight or sometimes slightly recurved and with 4-10 oblique cords. Variable in colour, some individuals uniformly tan or dark brown, others white and banded with dark brown or greenish-brown, some specimens with quadrate blotches at sutures.

The radula is of the vexilline type with bow-shaped rachidians which have 10-11 denticles (*fide* Cooke, 1920).

TYPE LOCALITY. None (*analogica*); Natal = error (*vincta* and *cinnamomea*); Long Bay, Tasmania (*scalariformis*); King I, Bass Strait, Tasmania (*teresiae*, *legrandi* and *scita*); South Australia (*schomburgki*); Long Bay and Blackman's Bay, Tasmania (*weldii*); Surveyor's Pt., Sth. Australia, 2 fathoms (4 m) (*tatei*); off Beachport, Sth. Australia, 40 fathoms (73 m) (*bellapicta*); off Beachport, Sth. Australia, 110-150 fathoms (201 m-275 m) (*retrocurvata*); off Thouin Bay, Tasmania, 40 fathoms (73 m) (*pumilio*); Cape Jaffa, Sth. Australia. 90 fathoms (165 m) (*jaffaensis*).

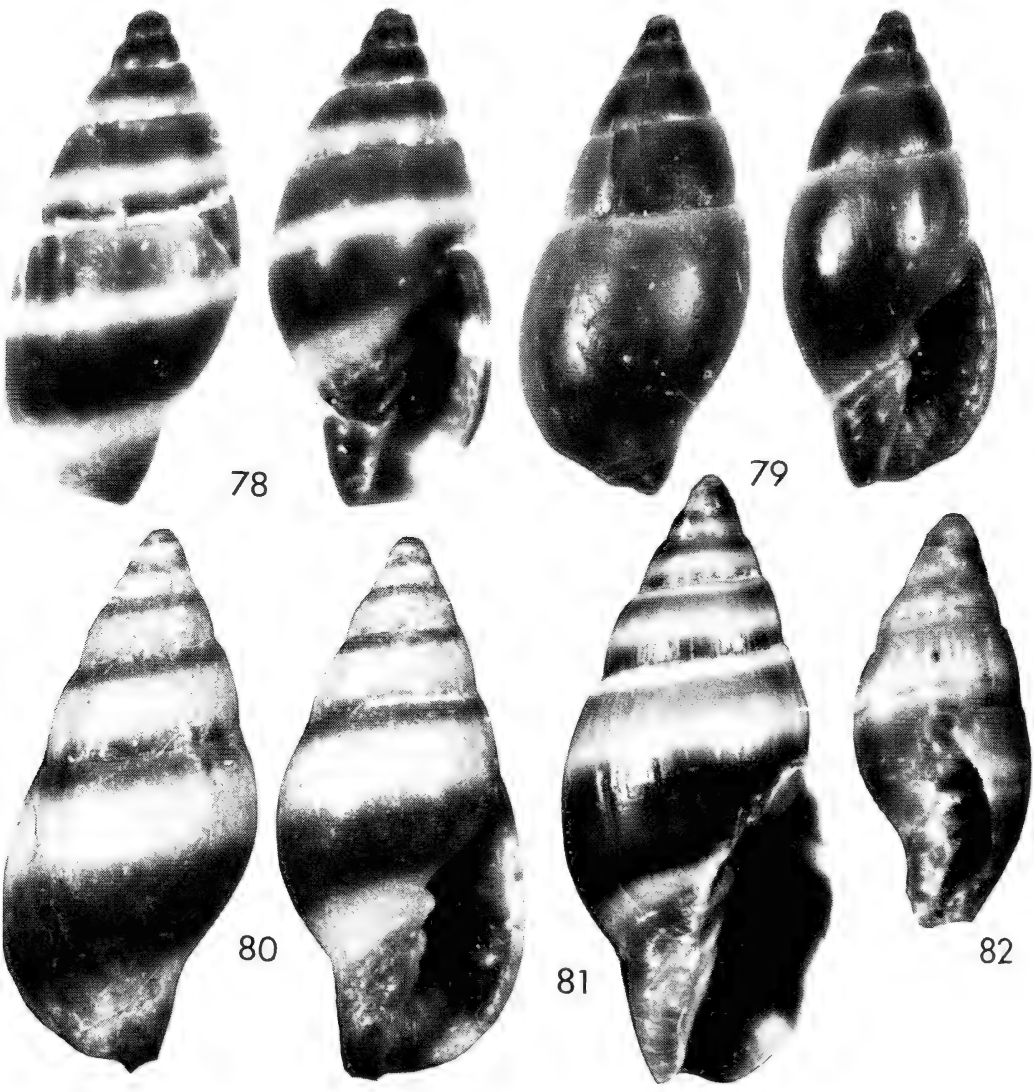
DISTRIBUTION. From southern Queensland along the southeast and south Australian coast to Cape Leeuwin, S.W. Australia (Fig. 101). Under rocks and in algae, from the intertidal zone to a depth of 570 m.

Type specimens. The following types are in the BMNH: three syntypes of *A. analogica* No. 1966667, dimensions of illustrated syntype 13.1 x 5.4 x 6.7 mm (Fig. 71); four syntypes of *A. vincta* No. 1958.8.30.2., dimensions of illustrated syntype 13.4 x 5.3 x 6.4 mm (Fig. 75); three syntypes of *A. cinnamomea* No. 1958.8.30.1., dimensions of illustrated syntypes 11.9 x 4.7 x 6.1 mm (Fig. 76) and 11.8 x 5.3 x 8.2 mm (Fig. 77); one syntype of *scita* Tenison-Woods (other syntypes in TMAG) No. 1900.8.14.80.; two syntypes of *A. schomburgki* No. 1878.4.10.3, dimensions of illustrated syntypes 9.6 x 3.9 x 4.8 mm (Fig. 83) and 9.9 x 4.4 x 5.5 mm (Fig. 84); two syntypes of tatei No. 1879.1.31.1, dimensions of illustrated syntype 7.0 x 3.4 x 3.3 mm (Fig. 90). The following types are in TMAG: two syntypes of *A. scalariformis* No. E-758 (old No. TM-5317), dimensions of illustrated syntype 9.2 x 3.9 x 4.6 mm (Fig. 85); five syntypes of *teresiae* No. E-764 (old No. TM-5315), dimensions of illustrated syntype 7.0 x 3.2 x 3.8 mm (Fig. 78); four syntypes of *legrandi* No. E-751 (old No. TM-5319) — the specimen marked as "holotype" (Fig. 92 — 6.0 x 2.4 mm) does not correspond to Tenison-Wood's description whereas the smaller 5.0 mm long paratype does (Fig. 82); three syntypes of *scita* No. E-767 (old No. TM-5318), dimensions of illustrated syntype 8.0 x 3.6 x 4.3 mm (Fig. 79); three syntypes of *weldii* No. E-765 (old No. TM-5314), dimensions of illustrated syntype 10.2 x 4.8 x 5.7 mm (Fig. 80); the holotype of *pumilio* May, No. E-753 (old No. C-539) dimensions 4.2 x 2.0 mm — the juvenile holotype has

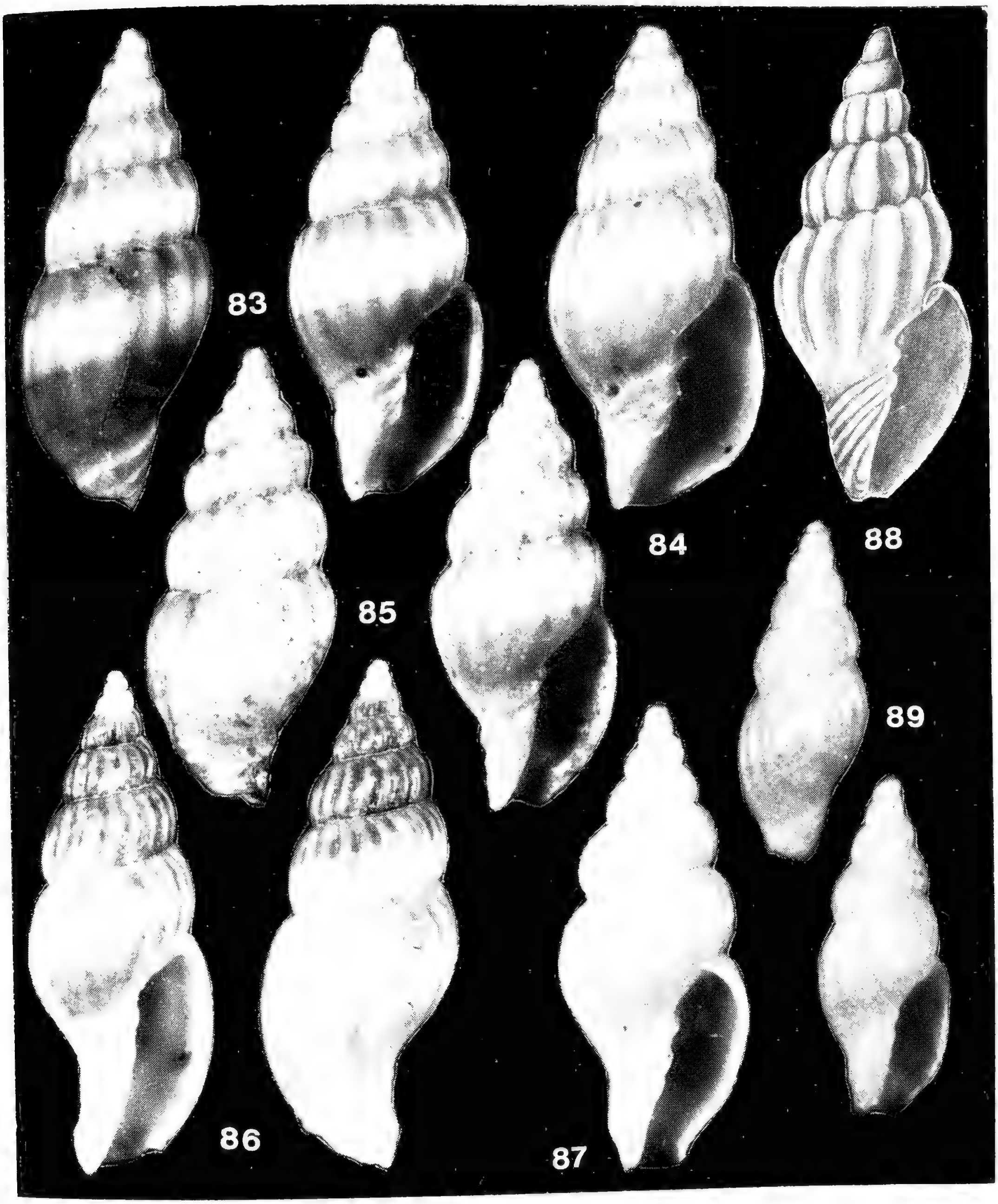


Figs. 71-77. *Austromitra analogica* (Reeve). 71. Syntype BMNH No. 1966667; 13.1 mm. 72. Specimen from Green I, Port Fairy, Victoria; 9.1 mm. 73, 74. Types of *A. bellapicta* (Verco). 73. Paratype, 9.3 mm. 74. Holotype SAM No. D-14097; 9.6 mm. 75. Syntype of *A. vincta* (A. Adams), BMNH No. 1958.8.30.2.; 13.4 mm. 76, 77. Syntypes of *A. cinnamomea* (A. Adams), BMNH No. 1958.8.30.1.; 11.9 mm and 11.8 mm respectively.

been badly affected by Museum disease (Fig. 88). The following types are in SAM: the holotype and several paratypes of *bellapicta* No. D-14097, dimensions of holotype 9.6 x 4.0 x 5.0 mm and illustrated paratype 9.3 x 4.0 x 5.5 mm (Figs. 73, 74); the holotype and several paratypes of *retrocurvata* No. D-13512, dimensions of holotype 16.8 x 6.7 x 8.5 mm (Fig. 86) and illustrated paratype 8.0 x 3.4 x 3.9 mm (Fig. 87) — the young paratypes have a straight siphonal canal; the holotype of *jaffaensis* No. D-10182, dimensions 4.8 x 1.7 mm (Fig. 89 — juvenile).

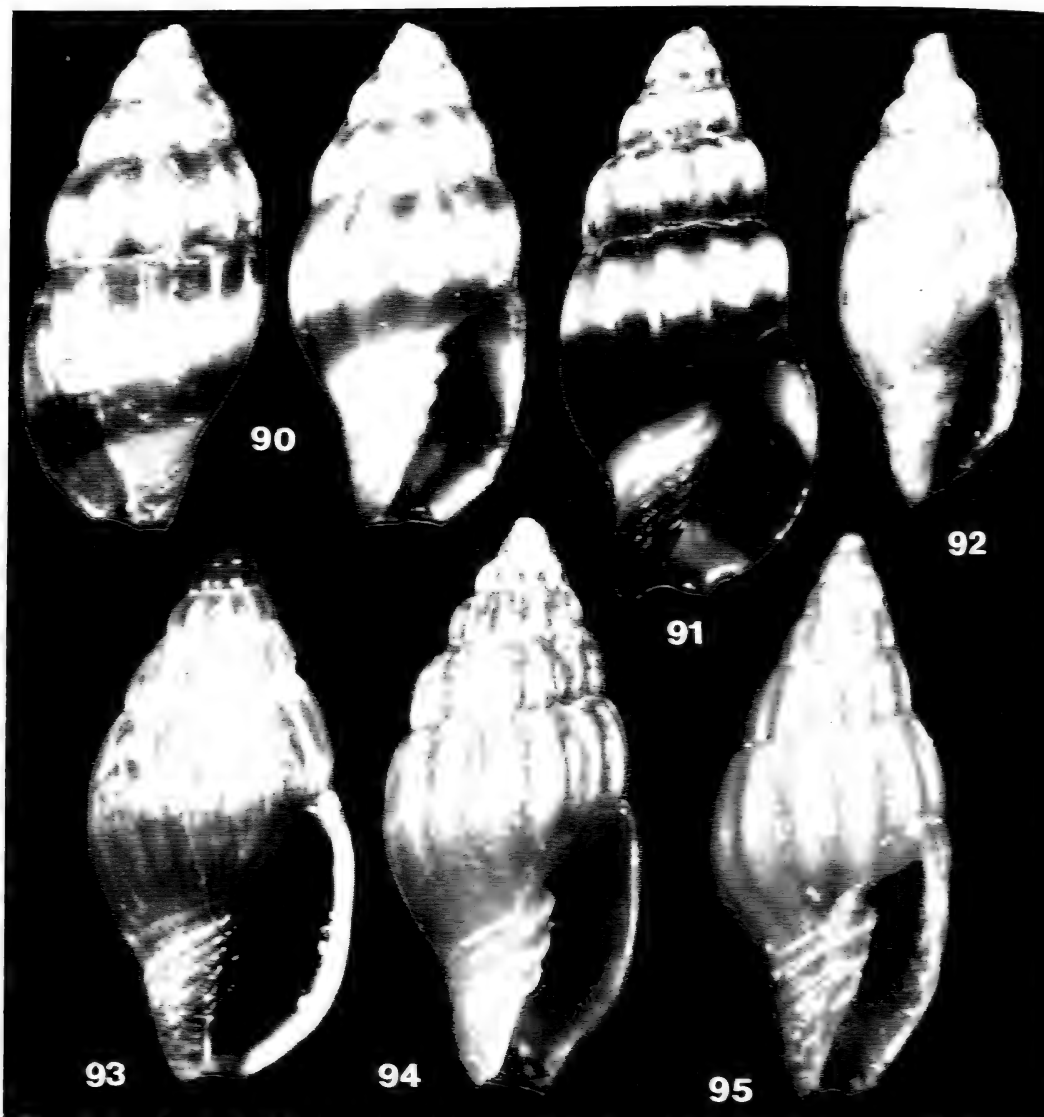


Figs. 78-82. *Austromitra analogica* (Reeve), smooth form. 78. Syntype of *A. teresiae* (T.W.), TMAG No. E-764; 7.0 mm. 79. Syntype of *A. scita* (T.W.), TMAG No. E-767; 8.0 mm. 80. Syntype of *A. weldii* (T.W.), TMAG No. E-765; 10.2 mm.



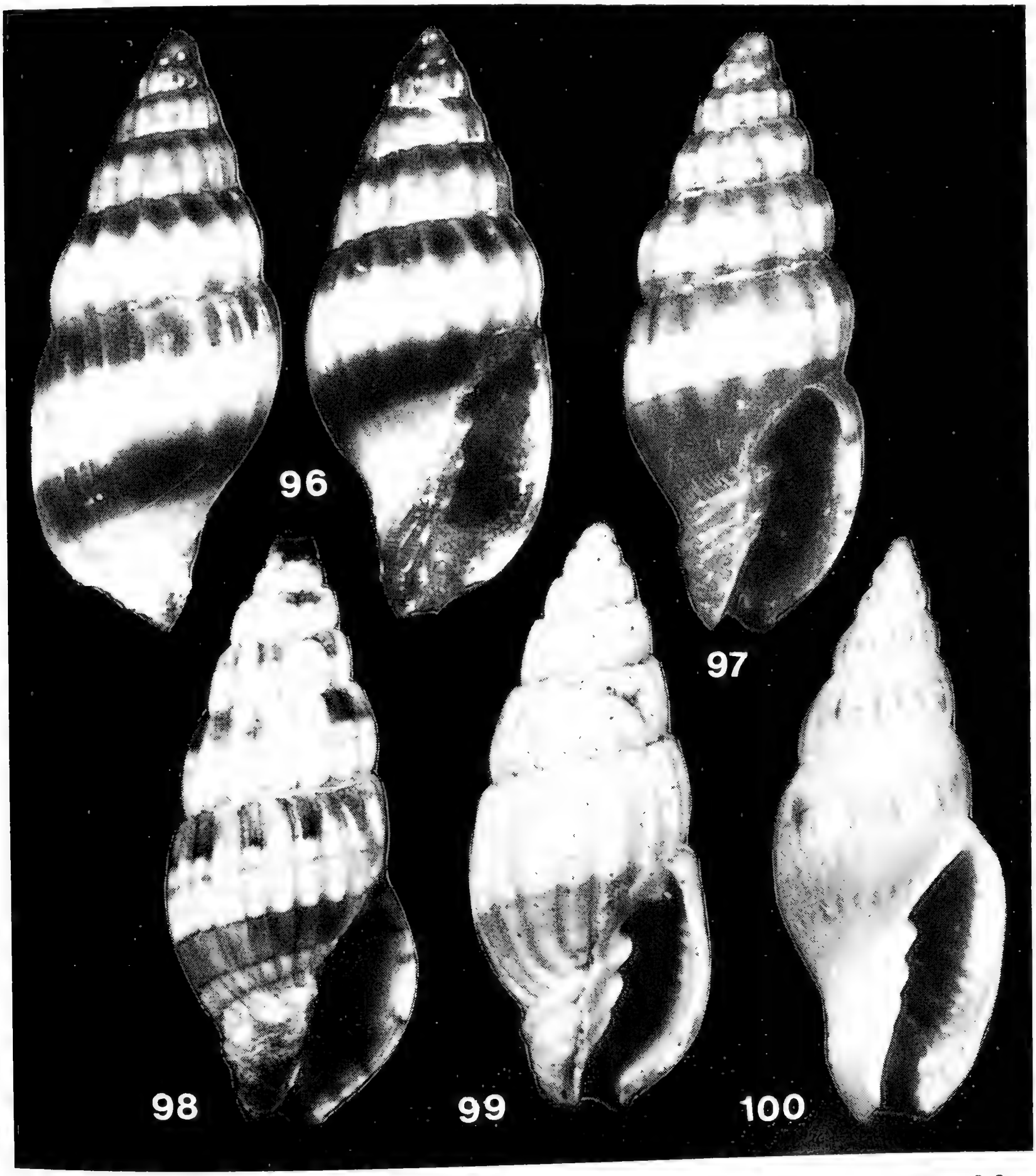
Figs. 83-89. *Austromitra analogica* (Reeve). 83, 84. Syntypes of *A. schomburgki* (Angas). BMNH No. 1878.4.10.3.; 9.6 mm and 9.9 mm respectively. 85. Syntype of *A. scalariformis* (T.W.), TMAG No. E-758; 9.2 mm. 86, 87. Holotype of *A. retrocurvata* (Verco), SAM No. D-13512; 16.8 mm (adult) and 8.0 mm (juvenile) respectively. 88. Type-figure of *A. pumilio* (May); 4.2 mm — juvenile. 89. Holotype of *A. jaffaensis* (Cotton & Godfrey), SAM No. D-10182; 4.8 mm — juvenile.

Material examined. Queensland: off S. end of Frazer I. 25°38'S & 153°51'E. 210-219 m; N.E. end of Cape Moreton. 114-124 m (both AMS). New South Wales: 35 km E. of Narrabeen. Sydney. 146 m; South Head. Sydney. 192-293 m; E. of Sydney. 75-150 m; c 32 km E. of Little Bay; Geringong. S. of Wollongong; Sussex Inlet. Jervis Bay; 40 km E of Twofold Bay. 37°27'S & 150°17'E. 294-304 m (all AMS). Victoria: Gabo I. 28 m (AMS); Cape Everard (coll. Marrow); Lakes Entrance; S.E. of Lakes Entrance. 155 m; 40 km S. of Wilson's Promontory. 39°19'S & 146°12'E. 76 m (all AMS); off Cape Liptrap. 30 m; Bear's Gully. Walkerville (both coll. Marrow); Phillip I; Western Port. 2-5 m; Port



Figs 90-95. *Austromitra analogica* (Reeve). 90. Syntype of *A. tatei* (Angas). BMNH No 1879.1.31.1.; 7.0 mm. 91. Specimen from Golfcourse reef. Flinders. Victoria; 11.0 mm. 92. Syntype of *A. legrandi* (T.W.), erroneously marked as "holotype". TMAG No. E-751; 6.0 mm. 93. Broad form from Cape Liptrap. Victoria; 7.0 mm. 94, 95. Axially ribbed form. 94 Western Port. Victoria; 8.7 mm. 95. Port Lincoln. Sth. Australia; 7.7 mm

Leo, Western Port, 4 m; Warmest Channel, Western Port, 4 m; Balnarring, Western Port; Crayfish Rock, Western Port, 3-5 m (all AMS); Stony Pt.; Shoreham (both coll. Marrow); Flinders; Golf course near Flinders; Flinders Ocean platform (all AMS); Port Phillip (AMS; USNM); Balcombe Bay near Mornington (AMS); Portarlington, Port Phillip (USNM); Pt. Lonsdale; Moonlight Head (both coll. Marrow); Lorne; Portland (both AMS); Port Fairy (AMS; coll. Marrow); Tasmania: Bass Strait, 10-30 m; Deal I; Little Squally Cove; Thouin Bay, 73 m; Oyster Bay, 8 m; Eaglehawk Nook; Pirates Bay; Green Cape, Maria I, 15 m; 4 km N.E. Beaching Bay, 42°27'S & 148°12'E, 82 m; Kilburn Bay,



Figs. 96-100. *Austromitra analogica* (Reeve). 96-98. Port Lincoln, Sth. Australia, 73 m; 8.2 mm, 8.1 mm and 9.5 mm respectively. 99. W. of Pinjarra, W. Coolup, seismic shot-hole, E. Pleistocene of W. Australia; 8.0 mm — senile individual. 100. Cape Pillar, Tasmania; 16.7 mm.

7 m; off Cape Pillar, 182 m; 15 km N.E. of Tasman I, 43°12'S & 148°45'E, 570 m; Port Arthur; Primrose Pt.; E. side of Frederick Henry Bay; Derwent River; Timberbox, Hobart, 5 m; D'Entrecastaux Channel; Port Esperance; N.W. of Sandy Cape, 132 m; S. of West Pt., 41°09'S & 144°24'E, 88 m; N.W. of Hunters I; S.E. of King I, Bass Str., 40°20'S & 144°36'E, 55 m; E. of Grassy, King I, 58-77 m; Somerset; near Burnie; Ulverstone; off Devonport; Port Sorell; Brown River (all AMS). South Australia: Port MacDonnell; 18 km off Cape Marlin; Beachport; off Beachport, 201 m; Victor Harbour (all AMS); Wright I (coll. Marrow); 81 km S.E. of Kangaroo I, 77 m; Normanville (both AMS); Port Willunga (coll. Powell); Glenelg Beach near Adelaide; Outer Harbour Adelaide (both AMS); Gulf of St. Vincent (USNM); American River, Kangaroo I, 73-150 m; Knob's Bluff, N. coast of Kangaroo I (both AMS); Corny Pt. (coll. Marrow); Hardwicke Bay; Arno Beach, Spencer Gulf; Tumby Bay; off Port Lincoln, 88 m; S. of Cape Carbot, 170 m; Neptune I, 73 m; S. of Cape Catastrophe; 64 km S. of Cape Wiles, 183 m; 161 km E. of Salisbury, 34°13'S & 135°04'E, 123 m; off Streaky Bay, 65 m (all AMS); Port Brown; Sales Bay (both coll. Marrow); Smokey Bay, 40 m; West I, Nuyt's Archipelago, 53 m; 52 km S.S.W. of Francis I, 64 m; 81 km S.W. of Cape Adieu, 79 m; Pt. Sinclair; Gt. Australian Bight, 33°05'S & 128°40'E, 73 m (all AMS). West Australia: S.W. of Eucla, 79-140 m; Two Mile Beach, Hopetoun (both AMS); Hopetoun; Albany (both coll. Marrow); S. Point, S. of Two People's Bay near Albany; Windy Harbour; Cape Leeuwin, 77-144 m (all AMS).

Fossil record: Adelaidean stage, Pliocene Sth. Australia (Cotton, 1952); Paulik's bore, Jandikot, 33.5 m, E. Pleistocene of S.W. Australia; 150 miles (242 km) W. of Pinjarra, W. Coolup, from seismic shot-hole, E. Pleistocene of S.W. Australia (both WAM).

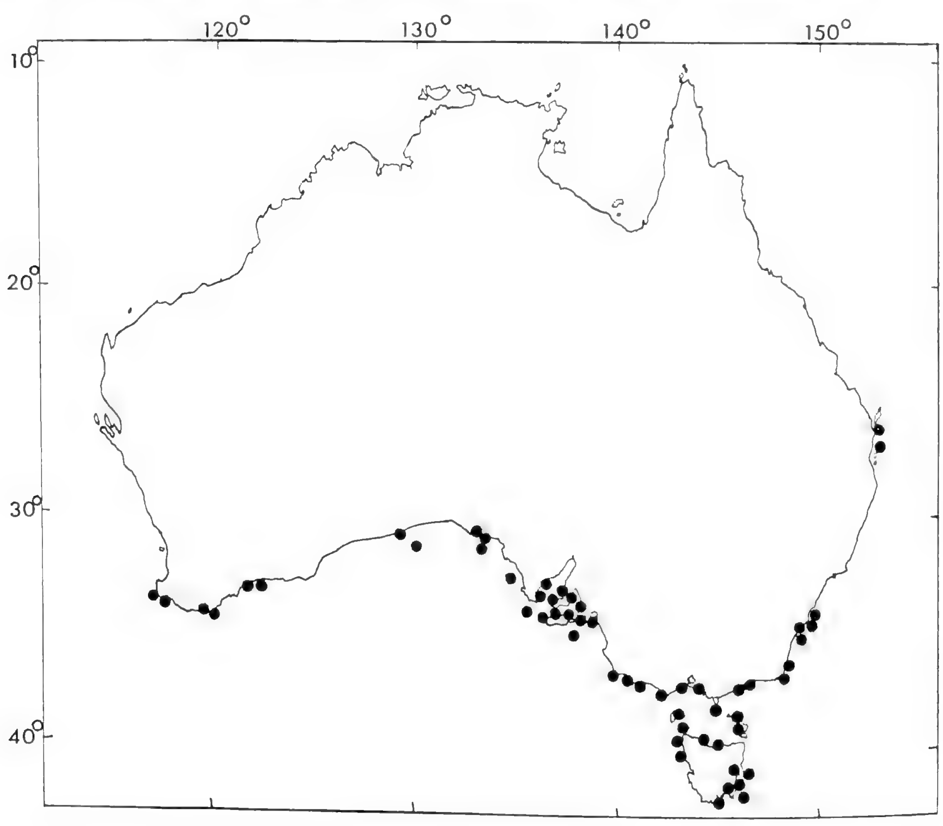


Fig. 101. Distributional map. *Austromitra analogica* (Reeve).

The species is extremely variable and consequently has received a total of 14 names, which may not be excessive when compared with the over 35 names proposed for the highly variably Mediterranean *Vexillum (Pusia) ebenus* (Lamarck). Early Australian authors had their doubts about the existence of so many "species" of *Austromitra* judging from the various synonymic treatments of the species. Tenison-Woods (1876) suggested that his *teresiae* could be a variety of *vincta* A. Adams. Pritchard and Gatliff (1899) synonymized *weldii* T.W. with *tatei* Angas and *scalariformis* T.W. with *legrandi* T.W. and *schomburgki* Angas. May (1903) considered *legrandi* to have been based on young shells of *schomburgki* Angas, and suggested that both taxa be combined with *scalariformis* T.W. Verco (1909) thought that his *bellapicta* could be a variety of *vincta* A. Adams. May (1921) synonymized *teresiae* T.W., *scita* T.W. and *weldii* T.W. with *vincta* A. Adams and two years later (May 1923) he combined *vincta* A. Adams with *analogica* Reeve and *bellapicta* Verco with *cinnamomea* A. Adams. Gatliff and Gabriel (1922) synonymized *vincta* A. Adams and *teresiae* T.W. with *analogica* Reeve, and *tatei* Angas with *weldii* T.W. Cotton and Godfrey (1932) combined *vincta* A. Adams, *teresiae* T.W., *scita* T.W. and *weldii* T.W. with *analogica* Reeve, and placed *bellapicta* Verco in synonymy of *cinnamomea* A. Adams, and later Cotton (1957) equalled *schomburgki* Angas with *scalariformis* T.W.

Seven names proposed last century apply to forms found within the intertidal zone, 5 names are applicable to forms found exclusively subtidally and 2 names have been applied to juvenile stages of subtidal forms. The various forms are discussed here in detail.

analogica Reeve: the typical form is axially ribbed but ribs become weak on the ventral side of the body whorl and obsolete on the dorsal side. The shell is blackish-brown, banded with white. The typical form occurs in the intertidal zone or very shallow depth (Figs. 71, 72).

bellapicta Verco: This form is essentially the same in form and sculpture, but is pellucid pinkish-brown with narrow dotted white bands and occasionally a row of brown dots. This form is found subtidally (Figs. 73, 74).

vincta A. Adams: this intertidal form has the same shape as *analogica* but differs in the axial ribs becoming obsolete on the last 2-4 whorls (Fig. 75).

cinnamomea A. Adams: in shape and sculpture this intertidal form resembles *vincta* and differs only in its uniform horny-brown colour (Figs. 76, 77).

teresiae Tenison-Woods: this intertidal form is closely similar to the *vincta* form and differs only in its smaller size and slightly squatter appearance. *M. weldii* Tenison-Woods is an identical form (Figs. 78, 80, 81).

scita Tenison-Woods: this is the same smooth intertidal form as *teresiae* Tenison-Woods but is uniformly dark brown in colour (Fig. 79).

legrandi Tenison-Woods: this is another small, intertidal dwarf form but the axial ribs are weakly produced and apart from being banded with brown has a narrow interrupted brown band within the white zone. The specimen erroneously marked as the "holotype" of *legrandi* is faded white in colour and represents the form *schomburgki* Angas (Figs. 82, 92).

tatei Angas: this is a small, broad and axially ribbed form with a brown sutural band and a peripheral band on the body whorl. It occurs in fairly shallow water of the subtidal region. Some specimens have brown axial ribs within the broad white zone (Fig. 90).

schomburgki Angas: this subtidal form is closely similar to the *analogica* form and differs in having the axial ribs more distinct on the body whorl. *Mitra scalariformis* Tenison-Woods, 1876, which is a primary homonym of *M. scalariformis* Borson, 1820, is the same form as *schomburgki* (Figs. 83-85).

retrocurvata Verco: this subtidal form is closely similar to the *schomburgki* form, but the holotype has a more produced and slightly recurved siphonal canal, a feature which is usually found in large, subtidal individuals. The immature paratypes do not differ from the *schomburgki* form (Figs. 86, 87).

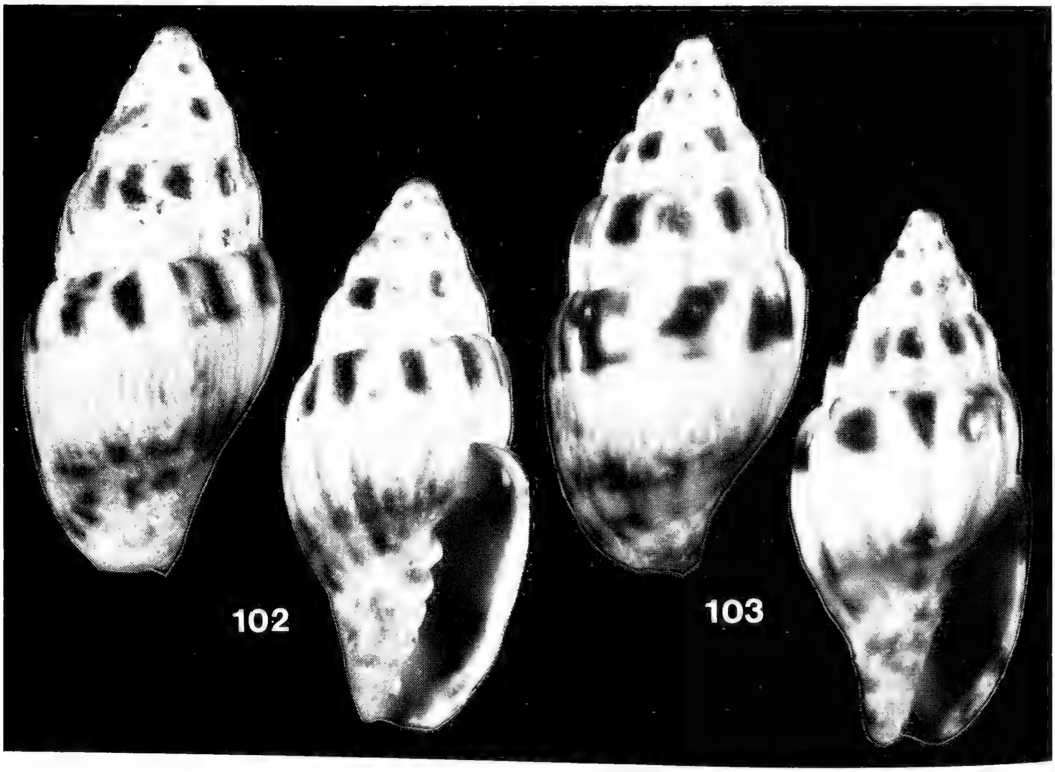
pumilio May and *jaffaensis* Cotton and Godfrey: both taxa have been based on juvenile examples of the subtidal *schomburgki* form (Figs. 88, 89).

Austromitra arnoldi (Verco, 1909) (Figs. 102, 103)

1909. *Mitra arnoldi* Verco, Trans. Proc. R. Soc. Sth. Aust. 33: 336, pl. 24, fig. 6.

1932. *Austromitra arnoldi* (Verco), Cotton and Godfrey, Sth. Aust. Nat. 13(2): 80; 1957 Cotton, R. Soc. Sth. Aust. Malac. Sect. No. 12: fig. 9.

Shell up to 13.0 mm in length, elongate-ovate, teleoconch of 4-5 weakly shouldered whorls, protoconch of 1½-2 smooth, glassy-brown embryonic whorls, sutures distinct. Sculptured with angulate asial ribs which number from 10-13 on the penultimate and from 5-11 on the body whorl and which become obsolete towards the base, spiral sculpture absent except for obsolete macroscopic striae. Aperture moderately narrow, lirate within, outer lip convex, columella not calloused and with 4 oblique folds, siphonal fasciole with 5-6 oblique cords, siphonal notch distinct. Whitish in colour, sutures with large, rectangular dark brown to greenish-brown blotches between axial ribs, white areas with thin, interrupted brown axial hair-lines, base of body whorl with 1-2 brown bands which are irregularly broken up into small blotches; aperture brownish, occasionally banded with white.



Figs. 102, 103. *Austromitra arnoldi* (Verco). 102. Holotype SAM No. D-13511; 11.4 mm. 103. Topotype from St. Francis I, Sth. Australia; 9.2 mm.

TYPE LOCALITY. Petrel Bay, St. Francis Island, South Australia.

DISTRIBUTION. Apparently confined to South Australia. On muddy sand, under stones, intertidal.

Type specimens. The holotype and paratype of *A. arnoldi* is in SAM No. D-13511, dimensions of holotype 11.4 x 5.3 x 6.6 mm (Fig. 102).

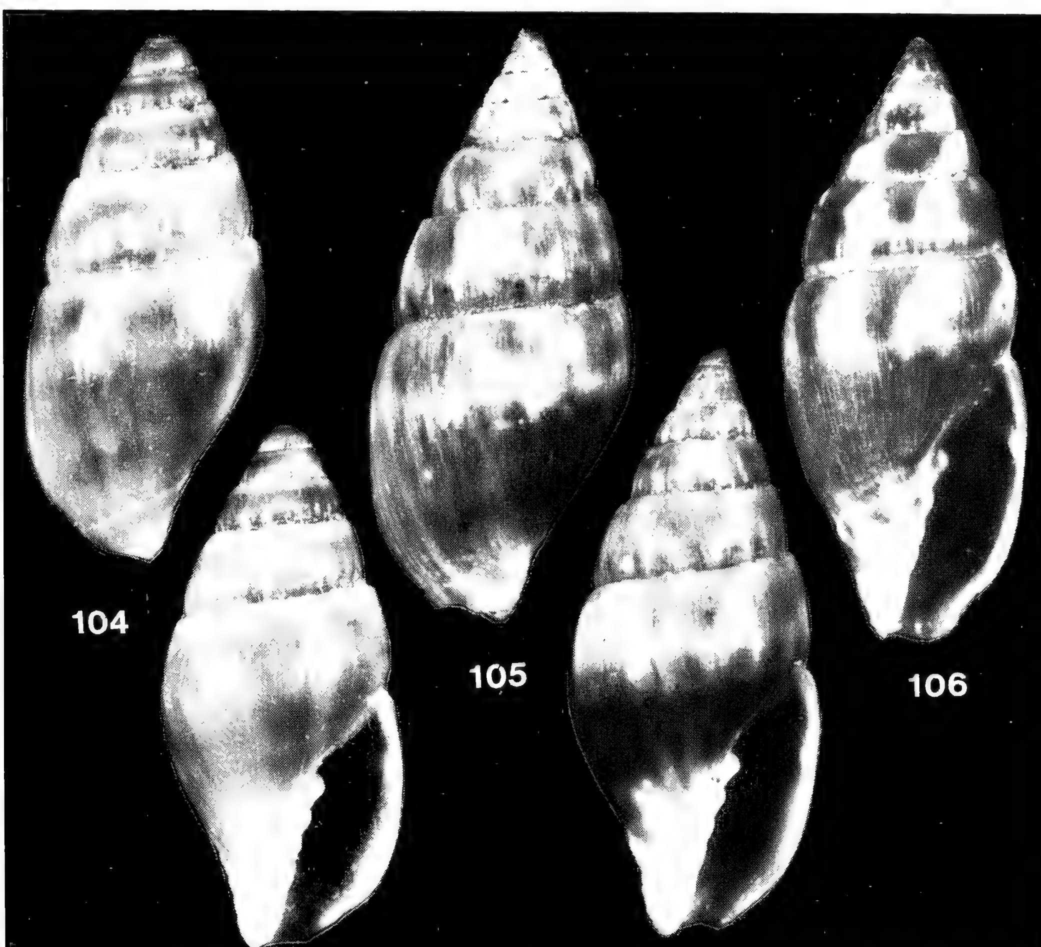
Material examined. South Australia: St. Francis I; (AMS; SAM; coll. Powell); Streaky Bay; Ceduna (both AMS); Pt. Sinclair (AMS; coll. Marrow); Halls Bay; Pt. Brown; Smoky Bay (all. coll. Marrow).

The species appears to be rare and only a few lots were available for examination.

Austromitra volucra (Hedley, 1915) (Figs. 104-106)

1915. *Mitra volucra* Hedley, Proc. Linn. Soc. NS.W. 39: 730, pl. 84, fig. 84; 1951 Laseron, Rec. Aust. Mus. 22(4): 340, textfig. 6 (protoconch).

1962. *Austromitra volucra* Hedley, Iredale and McMichael, Aust. Mus. Mem. 11: 63.



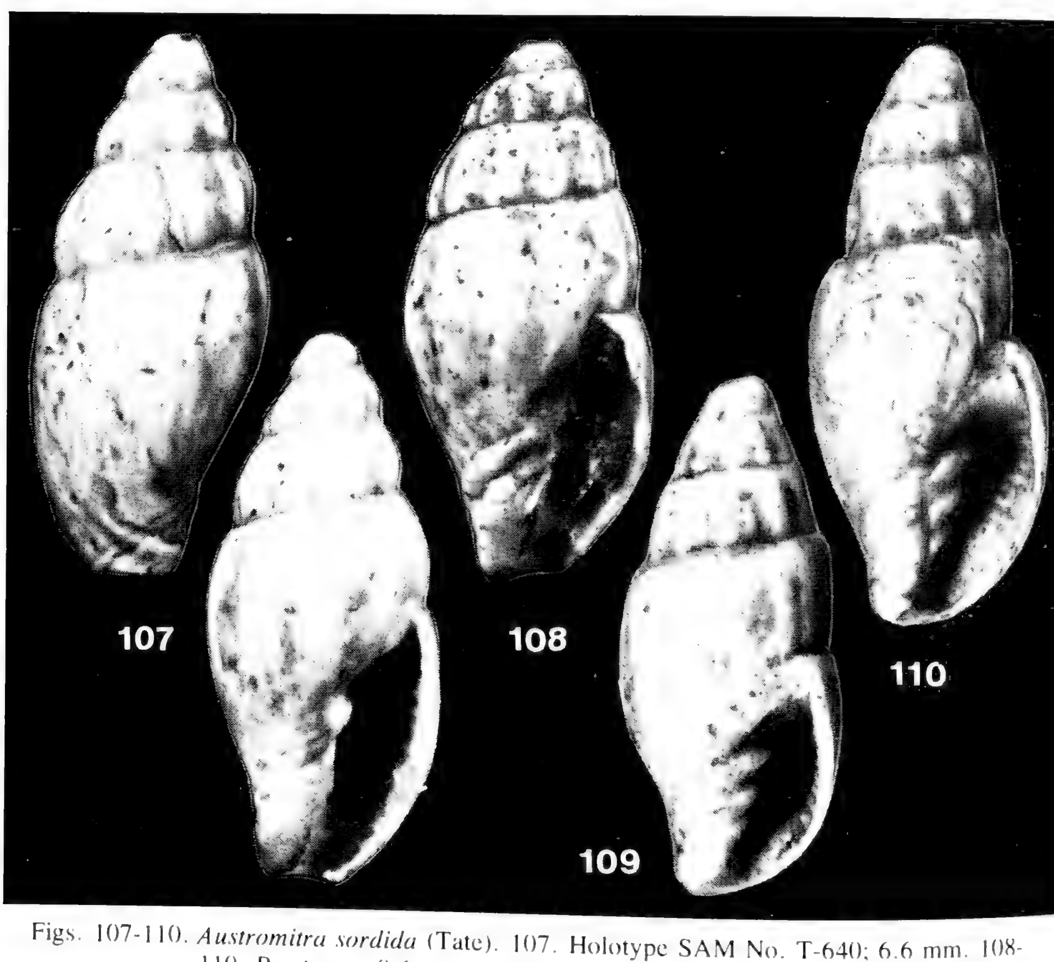
Figs. 104-106. *Austromitra volucra* (Hedley). 104. Holotype AMS No. C-28463; 10.0 mm. 105. Specimen from Angourie, N.S.W.; 12.3 mm. 106. Specimen from Wooli Beach, N.S.W.; 13.3 mm.

Shell up to 16.0 mm in length, elongate-ovate and solid, teleoconch of 5-6 convex whorls, protoconch of 1¾-2 smooth, brown embryonic whorls, sutures narrowly and distinctly canaliculate. Early whorls with axial ribs which sometimes become obsolete on later whorls and are usually only visible as short riblets at the anterior end of the whorls descending into the canaliculate sutures; axial riblets number from 12-16 on the penultimate and from 0-5 on the body whorl, longitudinal growth-striae usually distinct; spiral sculpture absent but occasionally visible as weak macrostriae. Aperture about equal in height to the spire, lirate within, columella narrowly calloused in adult specimens and with 4 oblique folds, siphonal fasciole with 5-7 oblique cords. Brown to purplish-brown in colour, sometimes with a distinct purplish cast on upper spire whorls, ornamented with large white blotches which appear connected to each other by a narrow white line, base of shell white, interior of aperture purplish-brown, edge of outer lip orange-brown.

TYPE LOCALITY. Woolgoolga, New South Wales, Australia.

DISTRIBUTION. From southern Queensland to southern New South Wales. On coasts, under rocks, intertidal.

Type specimens. The holotype and 2 paratypes in AMS No. C-28463, dimensions of holotype 10.0 x 4.8 x 5.4 mm (Fig. 104).



Figs. 107-110. *Austromitra sordida* (Tate). 107. Holotype SAM No. T-640; 6.6 mm. 108-110. Paratypes, 8.6 mm, 6.7 mm and 7.4 mm respectively.

Material examined. Queensland: Mooloolaba Beach (AMS); New South Wales: Yamba (AMNH); Minnie Waters, N. of Wooli; Woody Head near Yamba; Woolgoolga; Clarence River; Shelly Beach, Angourie; Nambucca River (all AMS); Angourie; Wooli Beach (both coll. Marrow).

Austromitra sordida (Tate, 1889) (Figs. 107-110)

1889. *Mitra sordida* Tate, Trans. Proc. R. Soc. Sth. Aust. 11: 143, pl. 6, fig. 6.

1970. *Austromitra sordida* (Tate), Darragh, Mem. Nat. Mus. Victoria 31: 195.

Shell up to 9.0 mm in length, elongate-ovate and solid, whorls number 5 inclusive of protoconch which is not distinguishable in the type specimens, whorls prominently convex. Sculptured with thick, curved axial ribs which may become obsolete on the dorsal side of the body whorl, spiral sculpture either obsolete or worn away in type specimens, siphonal fasciole with a few oblique cords. Aperture about equal in height to the spire, lirate within, outer lip convex, columella with 4 thick, oblique folds, siphonal canal straight or slightly recurved.

TYPE LOCALITY. Lower and Upper beds at Muddy Creek, Mid-Miocene to Pliocene of Victoria, Australia.

Type specimens. The holotype and 11 very worn paratypes of *A. sordida* are in the Tate collection SAM No. T-640, dimensions of holotype 6.6 x 3.0 x 3.5 mm (Fig. 107).

The species is very similar to *A. analogica* (Reeve) and, as in that species, the axial ribs are either well-developed or obsolete on the body whorl. *A. sordida* appears to have thicker axial ribs than *A. analogica* but this may be due entirely to excessive wear in specimens of the type series.

Austromitra pumila (Tate, 1889) (Figs. 111, 112)

1889. *Peristernia pumila* Tate, Trans. Proc. R. Soc. Sth. Aust. 11: 117, pl. 8, fig. 4; 1970 Darragh, Mem. Nat. Mus. Victoria 31: 190.

Shell up to 5.0 mm in length, elongate-ovate, teleoconch of 3¼-3¾ whorls which are angulate at the presutural ramp, protoconch of 1½ smooth embryonic whorls, sutures weakly adpressed. Sculptured with prominent, thick and angulate axial ribs which number about 9-10 per whorl, ribs at shoulder thickly rounded without becoming tuberculate. Spiral sculpture consists of a few spiral striae which may be quite distinct in some individuals but almost obsolete in others. Aperture about equal in height to the spire, outer lip constricted basally, columella not calloused and with 3 close-set, oblique, parallel thin folds.

TYPE LOCALITY. Clayey green sands, Adelaide bore, Upper Eocene of South Australia.

Type specimens. The holotype and 9 paratypes of *A. pumila* are in the Tate collection, SAM No. T-560, dimensions of holotype, length 4.3 mm (Fig. 111).

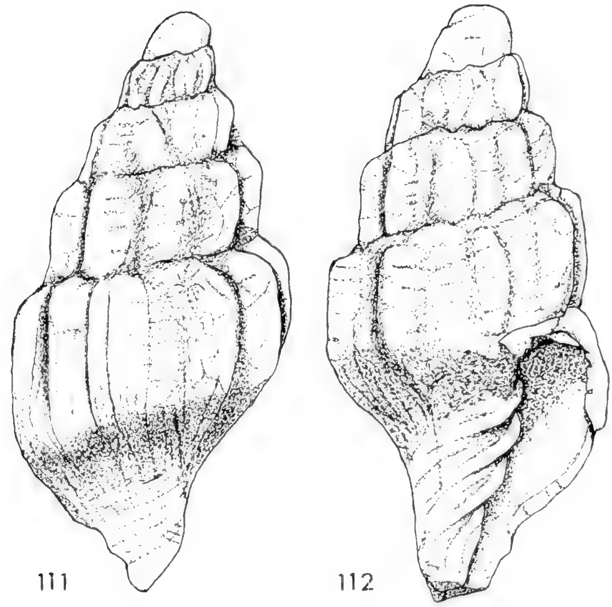
This species is the oldest *Austromitra* on record and bears some resemblance to the New Zealand *A. rubiginosa* (Hutton).

Austromitra ralphi (Cossmann, 1900) (Figs. 113-116)

1889. *Mitra semilaevis* Tate, Trans. Proc. R. Soc. Sth. Aust. 11: 143, pl. 5, fig. 9; 1893 Tate and Dennant, Trans. Proc. R. Soc. Sth. Aust. 17(1): 220 (*non* Edwards, 1856).

1897. *Uromitra semilaevis* Tate, Harris, Cat. Tert. Moll. Brit. Mus. Pt. 1: 127.

1899. *Mitra tatei* Cossmann, Essai paléoc. comp. 3: 165 (*nom. subst. pro M. semilaevis* Tate, 1889) (*non M. tatei* Angas, 1879).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Figs. 111, 112. *Austromitra pumila* (Tate). 111. Holotype SAM No. T-560; 4.3 mm. 112. Paratype, 4.2 mm.

1899. *Turricula tatei* Cossmann, Rev. paléoc. comp. 3(4): 144.

1899. *Costellaria tatei* Cossmann, Rev. paléoc. comp. 3(4): 193.

1900. *Mitra ralphi* Cossmann, Rev. Crit. Paléozool. 4(4): 186 (*nom. subst. pro M. semilaevis* Tate, 1889); 1927 Finlay, Trans. Proc. N.Z. Inst. 57: 508.

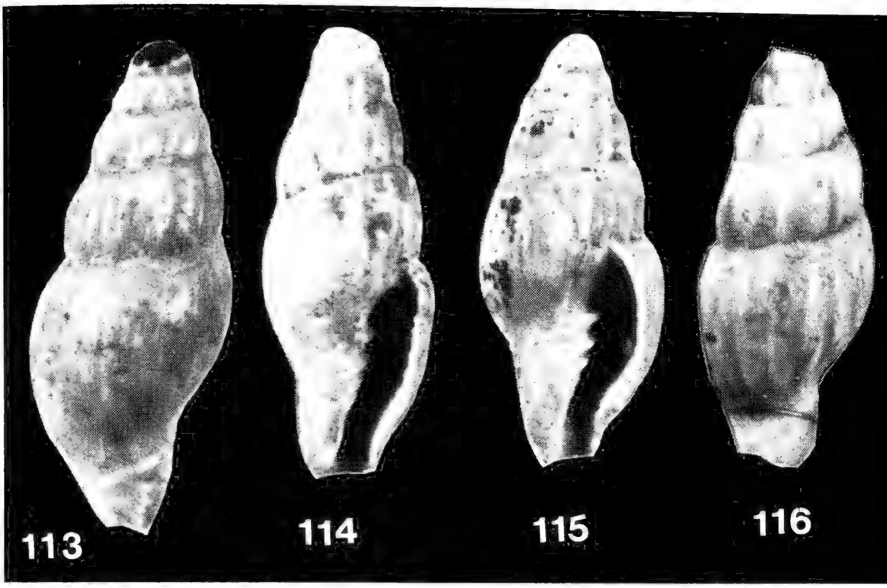
1928. *Uromitra ralphi* Cossmann, Chapman, Rec. Geol. Surv. Victoria 5(1): 42, 43, 59, 61.

Shell minute, up to 6.0 mm in length, fusiformly-elongate, teleoconch of 3-3½ convex whorls, protoconch of 1½ smooth embryonic whorls, sutures distinct. Sculptured with curved, sub-angulate axial ribs on the spire whorls, axial ribs becoming obsolete on the body whorl in some specimens but in others axial ribs continue on the body whorl to the outer lip. Spiral sculpture consists of weak and at times obsolete spiral threads which are usually most distinct anteriorly to the sutures. Aperture equal in height or slightly longer than the spire, lirate within, outer lip convex and constricted basally, columella with 4 oblique folds, siphonal canal straight and with oblique cords, one cord usually more prominent than others.

TYPE LOCALITY. Lower beds at Muddy Creek, M. Miocene of Victoria, Australia. (Other locality mentioned is blue clays at Schnapper Point).

Type specimens. The holotype and 13 paratypes of *A. ralphi* (also type of *Mitra semilaevis* Tate and *M. tatei* Cossmann) are in the Tate collection, SAM No. T-645, dimensions of holotype 5.5 x 2.0 x 3.0 mm (Fig. 113).

Mitra semilaevis Tate, 1889, is a primary homonym of *M. parva* var. *semilaevis* Edwards, 1856, and *M. semilaevis* Koenen, 1885, and *M. tatei* Cossmann, 1899, is a primary homonym of *M. tatei* Angas, 1879.



Figs. 113-116. *Austromitra ralphi* (Cossmann). 113. Holotype SAM No. T-645; 5.5 mm. 114-116. Paratypes, 5.0 mm, 4.8 mm and 4.7 mm respectively.

Harris (1897) remarked that *A. ralphi* can be readily distinguished from other species on the basis of the smooth body whorl. The prominence or obsolescence of axial sculpture on the body whorl in species of Costellariidae is a variable feature and some paratypes of *A. ralphi* have quite distinct axial ribs all the way to the outer lip.

Austromitra angusticostata Ludbrook, 1941 (Figs. 117-120)

1941. *Austromitra angusticostata* Ludbrook, Trans. R. Soc. Sth. Aust. 65(1): 96, pl. 5, fig. 13; 1952 Cotton, Bull. Dept. Mines 27: 9.

1941. *Austromitra schomburgki* (Angas), Ludbrook, Trans. R. Soc. Sth. Aust. 65(1): 100.

1954. *Austromitra mawsoni* Ludbrook, Trans. R. Soc. Sth. Aust. 77: 61 (*nomen nudum*).

1954. *Austromitra pauciplicata* Ludbrook, *ibid.* 77: 61 (*nomen nudum*).

1954. *Austromitra multiplicata* Ludbrook, *ibid.* 77: 61 (*nomen nudum*).

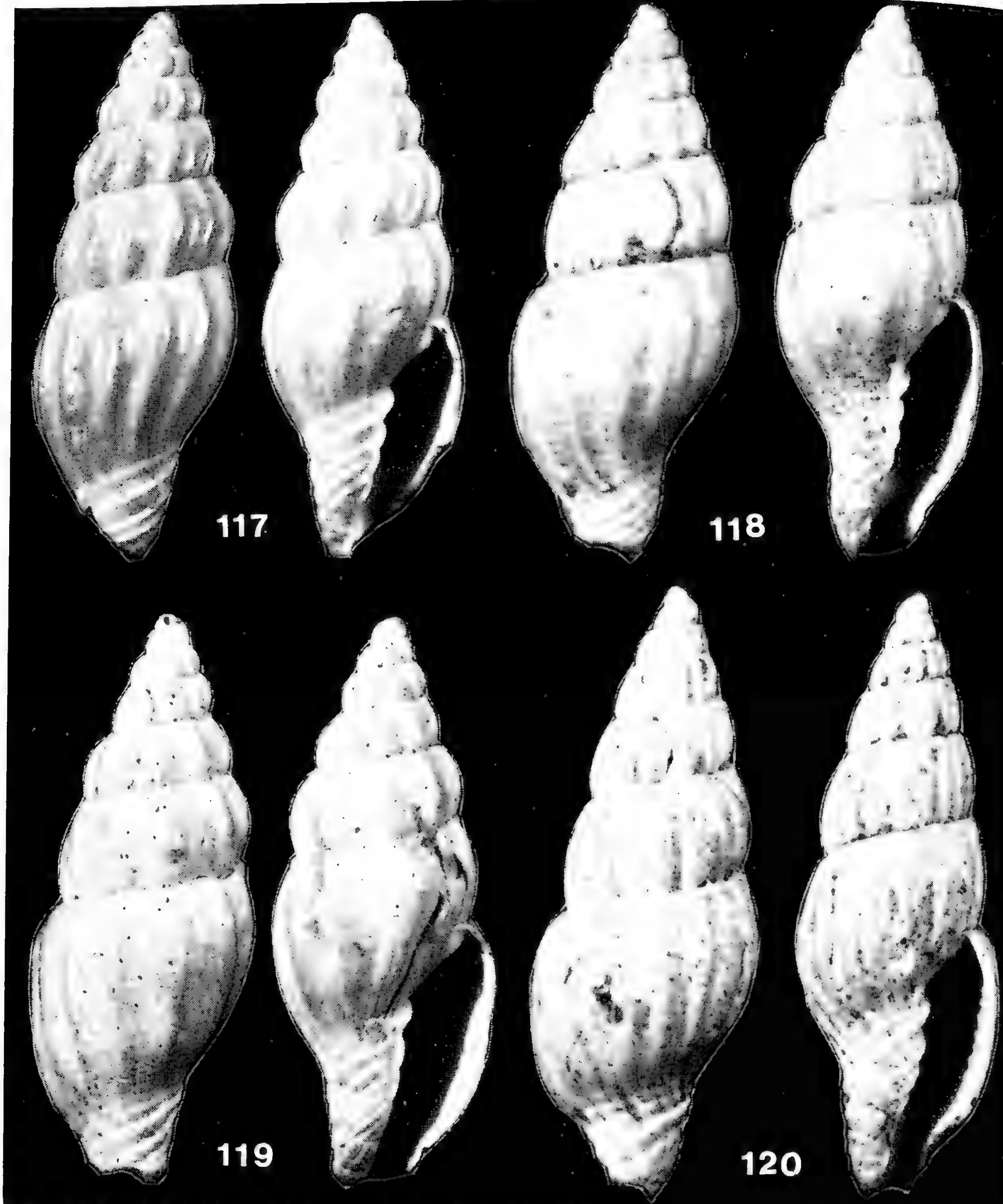
1958. *Austromitra mawsoni* Ludbrook, Trans. R. Soc. Sth. Aust. 81: 69, pl. 3, fig. 6.

1958. *Austromitra pauciplicata* Ludbrook, *ibid.* 81: 70, pl. 3, fig. 7; 1978 Ludbrook, Geol. Surv. West. Aust. Bull. 125: 159, pl. 17, figs. 17, 18.

1958. *Austromitra multplicata* Ludbrook, Trans. R. Soc. Sth. Aust. 81: 71, pl. 3, fig. 8.

Shell up to 9.0 mm in length, fusiformly-elongate, teleoconch of 4¾-5¼ convex whorls, protoconch of 1½ smooth embyronic whorls, sutures distinct. Sculptured with angulate axial ribs which number from 9-17 on the penultimate and from 10-15 on the body whorl; spiral sculpture absent except for some macroscopic spiral striae. Aperture narrow, sometimes lirate within, columella with 4 oblique folds, siphonal fasciole with 6-9 oblique cords.

TYPE LOCALITY. Abbatoir's Bore, Pliocene of Sth. Australia (*angusticostata* and *paucipplicata*); Weymouth's Bore, Pliocene of Sth. Australia (*mawsoni* and *multiplicata*).



Figs. 117-120. *Austromitra angusticostata* Ludbrook. 117. Holotype SAM No. T-1655; 8.0 mm. 118. Holotype of *A. mawsoni* Ludbrook, SAM No. F-15406; 8.2 mm. 119. Holotype of *A. pauciplicata* Ludbrook, SAM No. F-15407; 8.4 mm. 120. Holotype of *A. multiplicata* Ludbrook, SAM No. F-15408; 8.8 mm — adult specimen.

DISTRIBUTION. Abbatoir's Bore; Weymouth's Bore; Hindmarsh Bore, Dry Creek Sands, Adelaide District, Pliocene of Sth. Australia; Roe Calcarenite, Eucla Basin, E. Pleistocene of S.W. Australia.

Type specimens. The following holotypes are in the Department of Palaeontology, SAM: *A. angusticostata* No. T-1655, dimensions 8.0 x 3.0 x 3.7 mm (Fig. 117); *A. mawsoni* No. F-15406, dimensions 8.2 x 3.3 x 3.6 mm (Fig. 118); *A. pauciplicata* No. F-15407, dimensions 8.4 x 3.6 x 3.7 mm (Fig. 119), and *A. multiplicata* No. F-15408, dimensions 8.8 x 3.2 x 4.2 mm (Fig. 120).

The diagnostic characters given by Ludbrook (1958) to separate the "species" *mawsoni, pauciplicata* and *multiplicata* from *A. angusticostata* Ludbrook, or even *A. analogica* (Reeve), do not appear to be significant when tabulated in detail and compared with the actual recorded range of variability of diagnostic features of *A. analogica* (Table 2).

Table 2. Comparison of diagnostic characters in *Austromitra*.

Species	Size in mm	teleoconch whorls	Protoconch whorls	ribs on body whorl	ribs on penult whorl	Cords on fasciole
angusticostata	8.0	5¼	1½	12	12	6
mawsoni	8.2	4¾	1½	12	13	8
pauciplicata	8.4	5	1½	10	9	9
multiplicata	8.8	5	1½	15	17	9
analogica	5.0-18.0	4-6	1½-2	0-17	0-20	4-10

All these Pliocene forms of *A. analogica* are sympatric in either the Abbatoir's Bore, Weymouth's Bore or Hindmarsh Bore, and are further sympatric with specimens reported by Cotton (1952) under the name "*schomburgki*" and "*scalariformis*" from the Adelaidean stage, Pliocene of Sth. Australia. These Pliocene forms described by Ludbrook lack any constant diagnostic feature by which they can be separated from the numerous forms of the Recent *A. analogica*.

Austromitra lacertosa (Cernohorsky, 1970) (Figs. 121-123)

1889. *Mitra paucicostata* Tate, Trans. Proc. R. Soc. Sth. Aust. 11: 141, pl. 5, fig. 2; 1893 Tate and Dennant, Trans. Proc. R. Soc. Sth. Aust. 17(1): 220 (*non* Speyer, 1862).

1897. *Uromitra paucicostata* (Tate), Harris, Cat. Tert. Moll. Brit. Mus. Pt. 1: 126.

1899. *Costellaria paucicostata* (Tate), Cossmann, Essai paleoc. comp. 3: 165, pl. 8, fig. 3.

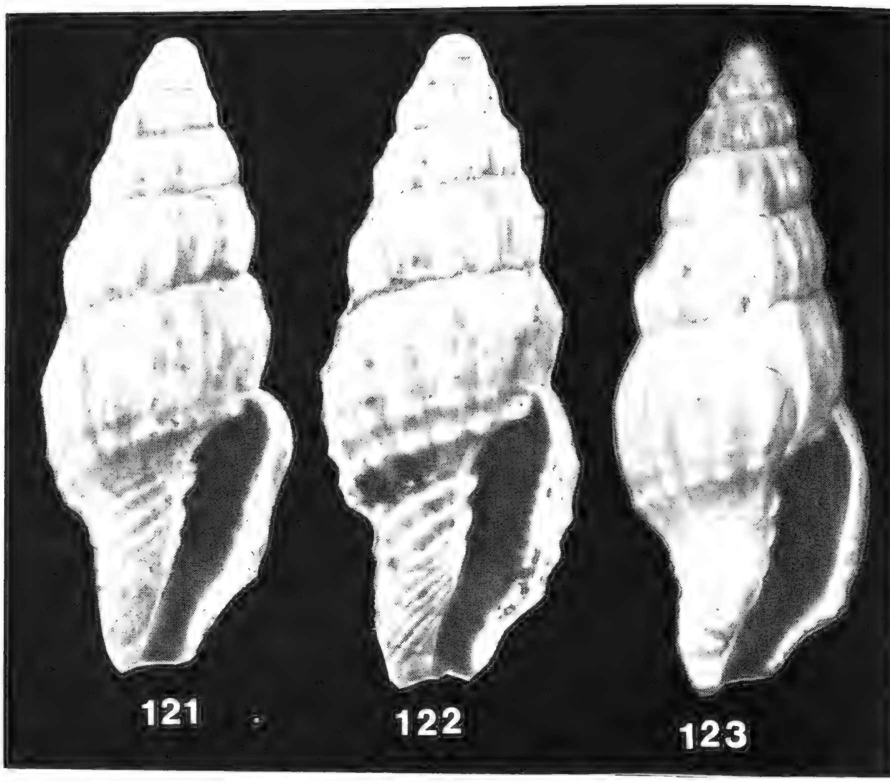
1927. *Balcomitra paucicostata* (Tate), Finlay, Trans. Proc. N.Z. Inst. 57: 508; 1970 Darragh, Mem. Nat. Mus. Victoria 31: 186.

1970. *Vexillum (Costellaria) lacertosum* Cernohorsky, Bull. Auckland Inst. Mus. No. 8: 28 (*nom. subst. pro Mitra paucicostata* Tate, 1889).

Shell up to 12.0 mm in length but frequently smaller, fusiformly-elongate and angulate on the presutural ramp of spire whorls, body whorl bi-angulate, teleoconch of 5 whorls, protoconch of 1½ smooth embryonic whorls. Sculptured with elevated and angulate axial ribs which are slightly nodose at sutures, spire whorls concave anteriorly to sutures and then descending almost vertically to the next suture. Body whorl with 2-4 strong but ill-defined cords which become nodose at the point of intersection with axial ribs, peripheral cord most prominent, siphonal fasciole with 6-8 strong, crowded oblique cords, interspaces of axial ribs obsoletely spirally striate. Aperture shorter than the spire, lirate within and constricted basally, columella not calloused and with 3-4 oblique folds, siphonal canal produced, siphonal notch distinct.

TYPE LOCALITY. Lower beds at Muddy Creek, M. Miocene of Victoria, Australia. Some paratypes from blue clays at Schnapper Point.

Type specimens. The holotype and 12 paratypes of *A. lacertosa* (and *Mitra paucicostata* Tate) are in the Tate collection, SAM No. T-625, dimension of holotype 8.9 x 3.6 x 3.9 mm (Fig. 121).



Mitra paucicostata Tate, 1889, is a primary homonym of *M. paucicostata* Speyer, 1862. Paratypes "G" and "N" of *A. lacertosa* appear to be the *schomburgki* form of *A. analogica* (Reeve).

Austromitra tasmanica (Tenison-Woods, 1876) (Figs. 124-128)

1876. *Mitra tasmanica* Tenison-Woods, Pap. Proc. R. Soc. Tasmania for 1875: 139; 1903 May, Proc. R. Soc. Tasmania for 1902: 109, fig. 1 only (figd. holotype); 1907 Hedley, Rec. Aust. Mus. 6(4): 287; 1911 Hedley, Zoool. Res. Fish. Exp. "Endeavour", p. 95; 1915 Hardy, Pap. Proc. R. Soc. Tasmania p. 70; 1921 May, Check-list Moll. Tasmania p. 80; 1923 May, Illust. Ind. Tasman, shells p. 79, pl. 37, fig. 15; 1923 May, Pap. Proc. R. Soc. Tasmania p. 54.

1901. *Turris tasmanicus* (Tenison-Woods), Tate and May, Proc. Linn. Soc. N.S.W. pt. 3: 361.

1903. *Turris tasmanica* (Ten. Woods), Hedley, Mem. Aust. Mus. 4(6): 372.

1906. *Turricula tasmanica* (T. Woods), Pritchard and Gatliff, Proc. R. Soc. Victoria, N.S. 18(2): 45; 1906 Gatliff, Proc. R. Soc. Victoria, N.S. 19(1): 3, pl. 2, figs. 6, 7.

1932. *Austromitra tasmanica* (Tenison-Woods), Cotton and Godfrey, Sth. Aust. Nat. 13(2): 78; 1962 Macpherson and Gabriel, Nat. Mus. Victoria Handb. No. 2: 209, textfig. 249; 1978 Hinton, Guide Aust. shells pl. 54, fig. 25.

1951. *Mitra cericosta* Laseron, Rec. Aust. Mus. 22(4): 342, textfig. 9.

1962. *Austromitra bucklandi* Gabriel, Mem. Nat. Mus. Victoria No. 25: 192, textfig. 6; 1962 Macpherson and Gabriel, Nat. Mus. Victoria Handb. No. 2: 209; 1969 Garrard, J. Malac. Soc. Aust. No. 12: 11; 1971 Wilson and Gillett, Aust. shells p. 118, pl. 76, fig. 7.

1962. *Austromitra bucklandi bassiana* Gabriel, Mem. Nat. Mus. Victoria No. 25: 192, textfig. 7; 1962 Macpherson and Gabriel, Nat. Mus. Victoria Handb. No. 2: 209.

1962. *Austromitra cericosta* Laseron, Iredale and McMichael, Aust. Mus. Mem. No. 11: 63.

1978. *Austromitra tasmanica* forma *bucklandi* Gabriel, Hinton, Guide Aust. shells pl. 54, figs. 24, 24a.

1978. *Austromitra tasmanica* forma *cericostata (sic)* Laseron, Hinton, Guide Aust. shells pl. 54, fig. 30.

Shell up to 18.0 mm in length, elongate-ovate, some individuals broader than others, teleoconch of 5-6½ almost flat-sided or weakly convex whorls which are roundly angulate at sutures, protoconch of 1½-2 smooth embryonic whorls, sutures distinct and narrowly ledged. Sculptured with angulate and occasionally slender axial ribs which are either distinct or absent on the body whorl and number from 15-29 on the penultimate and from 3-25 on the body whorl; spiral sculpture consists of numerous, fine spiral striae which number up to 22 on the penultimate and up to 40 on the body whorl. Aperture narrow, smooth within, outer lip convex, columella narrowly calloused in adult individuals and with 4 strong, oblique folds, siphonal fasciole with 6-8 cords, siphonal notch distinct. White in colour, spire whorls with dark brown blotches between ribs posteriorly to sutures, interspaces of axial ribs occasionally darker, body whorl with a nebulous band at sutures, a central row of brown blotches and lower third of body whorl brown in colour, aperture brown and occasionally banded with white.

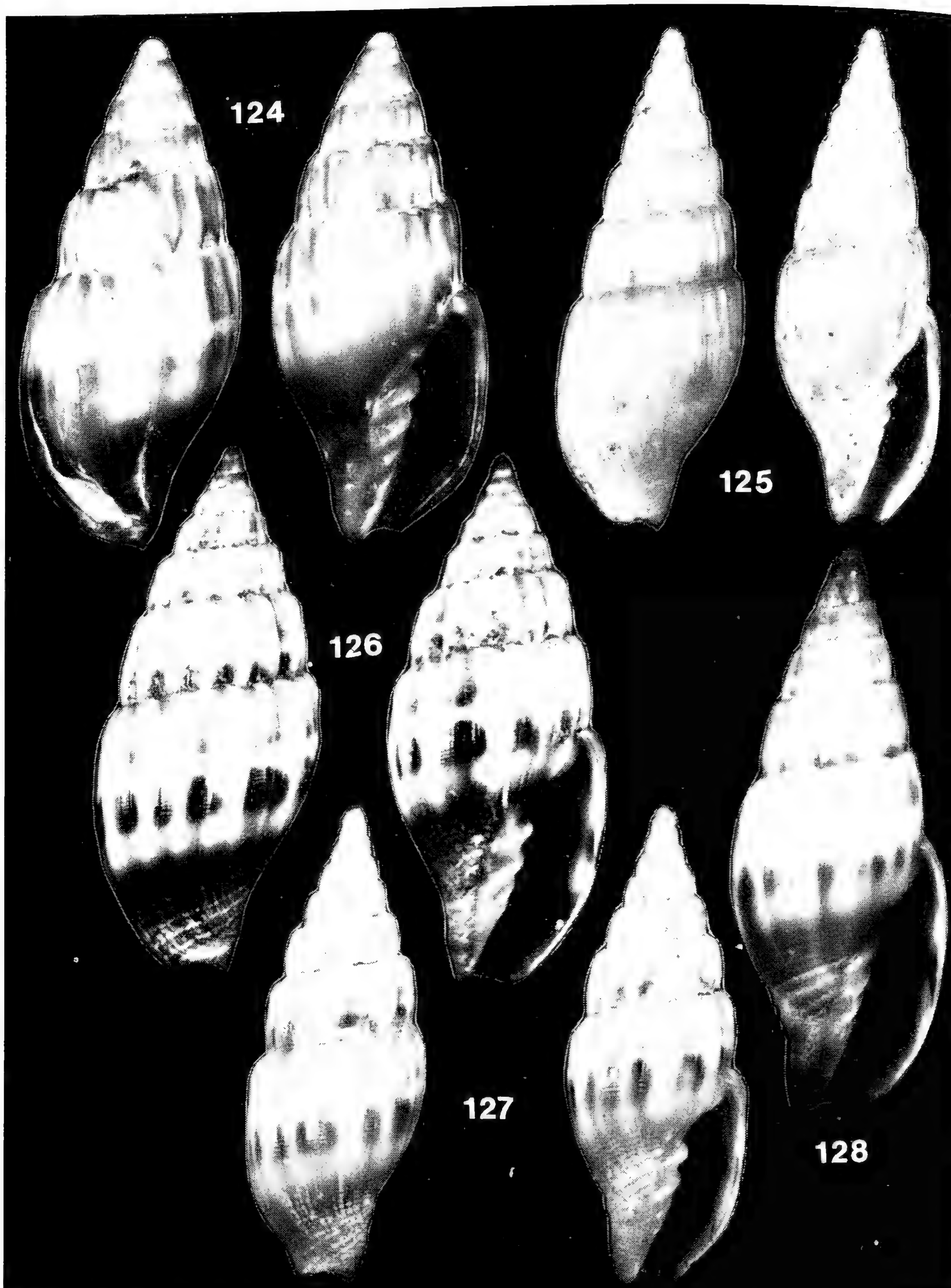
TYPE LOCALITY. Tasmania, Australia (*tasmanica*); off Crookhaven, N.S.W., Australia, 30-35 fathoms (55-64 m) (*ceriocsta*); Twofold Bay, N.S.W., Australia, 10 fathoms (18 m) (*bucklandi*); 18 miles (29 km) E. of Lakes Entrance, Victoria, 15 fathoms (27 m) (*bassiana*).

DISTRIBUTION. From New South Wales to Victoria and Tasmania. Subtidal to a depth of *c*. 183 m. Specimens dredged from 439 m were faded individuals devoid of animal.

Type specimens. The holotype of *A. tasmanica* is in TMAG No. E-761 (old No. TM-5316), dimensions 12.5 x 5.2 x 6.2 mm (Fig. 124); the holotype of *A. cericosta* is in AMS No. C-65641, dimensions 14.7 x 5.1 x 6.8 mm (Fig. 125); the holotype of *A. bucklandi* is in NMV No. F-20727, dimensions 15.4 x 6.5 x 7.8 mm (Fig. 126), and the holotype of *A. bucklandi bassiana* is also in NMV No. F-20729, dimensions 13.8 x 5.0 x 6.6 mm (Fig. 127).

Material examined. New South Wales: 2.3 km E. of Malabar, 66 m; E. of Port Jackson, 54-91 m and 146 m; off Shoalhaven Bight, 150°17'E & 33°58'S, 66 m; off Port Hacking, 183 m; off Crookhaven, 55-64 m; off Jervis Bay, 36 m; 16 km N. of Eden, 36 m; Brush I, S. of Ulladulla (all AMS); off Eden, 36°00'S & 150°20'E, 66-119 m; S. of Eden, 38°10'S & 141°55'E, 347-439 m (both ZMC); Eden; 16 km N. of Twofold Bay, 24 m; off Twofold Bay, 18 m; Disaster Bay (all AMS); Victoria: E. of Lakes Entrance, 24 m; off Lakes Entrance, 36 m; Western Port (all AMS); Western Port Bay (coll. Marrow); Tasmania: off N.E. Tasmania, 128 m (coll. Powell); Little Swanport, 33 m; Cape Pillar, 183 m; Derwent River; N.W. of Hunter I, 63 m; off Tinderbox, 11 m (all AMS).

This is a composite species and only the holotype represents *A. tasmanica*. The paratype of var. A (11.0 x 5.1 x 6.0 mm) is a large *tatei* form of *A. analogica* (Reeve), and paratype of var. B (11.6 x 4.7 x 5.8 mm) is the *schomburgki* form of *A. analogica*.



Figs. 124-128. *Austromitra tasmanica* (Tenison-Woods). 124. Holotype TMAG No. E-761; 12.5 mm (broad form). 125. Holotype of *A. cericosta* (Laseron), AMS No. C-65641; 14.7 mm (slender form). 126. Holotype of *A. bucklandi* Gabriel, NMV No. F-20727; 15.4 mm (broad form). 127. Holotype of *A. bucklandi bassiana* Gabriel, NMV No. F-20729; 13.8, (slender form). 128. Broad, obsoletely sculptured specimen from Western Port Bay, Victoria; 13.2 mm.

According to Cooke (1920) the radula is of the *Vexillum* type with a bow-shaped rachidian containing 10-11 cusps.

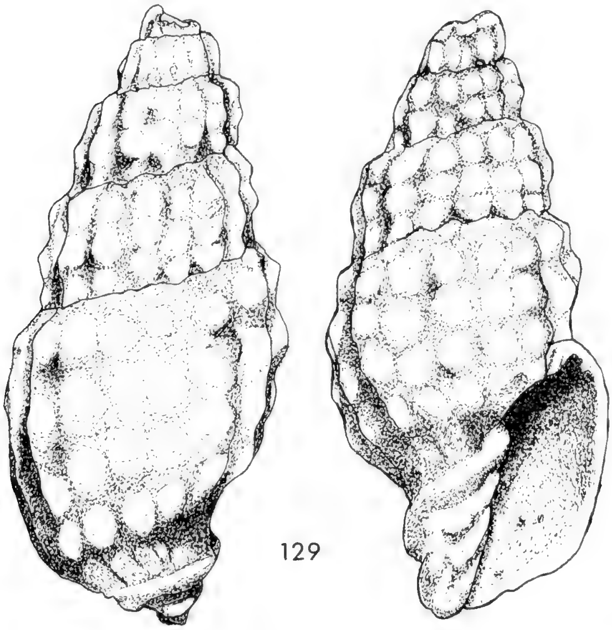
Austromitra minutenodosa sp. n. (Figs. 129, 130)

Shell minute, up to 4.5 mm in length, elongate-ovate, teleoconch of 4½ whorls which are sub-angulate at sutures, protoconch (missing in adult specimens) of 1¼ smooth embryonic whorls in juvenile individuals. Whorls sculptured with moderately large, round nodules which are connected to each other by axial ribs which are prominent on early whorls but become less thick and concave between nodules on body whorl; penultimate whorl with 3 spiral rows of nodules, anterior row of nodules pressed against and partly covered by suture, body whorl with 4 rows of nodules. Axial ribs number from 13-14 on the penultimate and the body whorl and extremely fine, macroscopic longitudinal striae are visible in some individuals, spiral sculpture absent. Aperture about equal in height to the spire, smooth within, columella not calloused and with 3 strong, oblique folds, first two posterior folds become thick and rope-like and extend onto the siphonal fasciole towards the dorsal side. All specimens white to creamy-white in colour.

TYPE LOCALITY. Great Australian Bight, 33°05'S and 128°40'E, in 75 m.

Holotype. In AMS No. C-114474; length 4.2 mm, width 1.9 mm (*leg*. H.M.A.S. "Gascoyne", 5 July 1962) (Fig. 129).

Paratypes. One paratype in AIM, remaining 6 paratypes in AMS.



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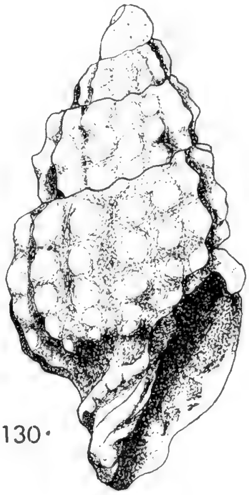

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Figs. 129, 130. *Austromitra minutenodosa* sp. n. Great Australian Bight, Sth. Australia, 75 m. 129. Holotype AMS No. C-114474; 4.2 mm. 130. Immature paratype, 3.5 mm.

There is no similar Australian or New Zealand species with which *A. minutenodosa* could be compared. The only superficially similar species, belonging to a different genus, is *Vexillum (Costellaria) nodospiculum* Cernohorsky, 1970, from deep water in the Philippines, but that species is considerably more fusiform with a conical protoconch of 3½ embryonic whorls, 2 sutural rows of spikey nodules on the penultimate whorl, differently formed axial ribs and spiral sculpture. Although the new species is described on the basis of specimens collected devoid of animals, it is so distinct from any known *Austromitra* to warrant description on the basis of the present material.

Excluded species of Costellariidae

Species previously recorded in the closely allied families Mitridae and Volutomitridae have been recorded and re-assigned to their respective families by Cernohorsky (1972). Species now excluded from the Costellariidae are listed below and will be discussed in detail in a subsequent paper.

Thala marginata Tenison-Woods, 1877, now a synonym of *Rugobela columbelloides* (Tenison-Woods, 1877), family Turridae.

Vexillum apicicostatum Suter, 1917, now a synonym of *Waimatea inconspicua* (Hutton, 1885), family Volutomitridae.

Vulpecula (Pusia) biconica Murdoch and Suter, 1906, now a synonym of *Microvoluta marginata* (Hutton, 1885), family Volutomitridae.

Vexillum fenestratum Suter, 1917, now a member of *Egestas* Finlay, 1927, family ? Fasciolariidae.

Vexillum fractum Marwick, 1926, now in the family Volutomitridae.

Vulpecula (Pusia) hedleyi Murdoch, 1905, now a member of *Peculator* Iredale, 1924, family Volutomitridae.

Vexillum ligatum Suter, 1917, now a synonym of *Waimatea enysi* (Hutton, 1873), family Volutomitridae.

Turricula lincta Hutton, 1885, now a synonym of *Microvoluta marginata* (Hutton, 1885), family Volutomitridae.

Vexillum lornense Marwick, 1926, now a member of *Waimatea* Finlay, 1927, family Volutomitridae.

Turricula marginata Hutton, 1885, now a member of *Microvoluta* Angas, 1877, family Volutomitridae.

Vexillitra marwicki Vella, 1954, now a member of *Microvoluta* Angas, 1877, family Volutomitridae.

Vexillum parki Allan, 1926, now a member of *Waimatea* Finlay, 1927, family Volutomitridae.

Vexillum plicatellum Marshall and Murdoch, 1923, now a member of *Conomitra* Conrad, 1865, family Volutomitridae.

Austromitra plicifera Marwick, 1928, now a member of *Proximitra (Parvimitra)*, family Volutomitridae.

Vexillum (Latiromitra) problematicum Ponder, 1968, now a member of *Volutomitra (Latiromitra)*, family Volutomitridae.

Vexillum (Costellaria) rutidolomum Suter, 1917, now a member of *Proximitra* Finlay, 1927, family Volutomitridae.

Vexillum suteri Finlay, 1924, now a synonym of *Waimatea enysi* (Hutton, 1873), family Volutomitridae.

Austromitra tricordata Beu, 1970 (Fig. 131)

1970. *Austromitra tricordata* Beu, Trans. R. Soc. N.Z. Earth Sci. 7(12): 225, pl. 4, fig. f. (Bell's Creek, tributary of Mangaopari Stream, Wairarapa, New Zealand; Tongaporutuan, U. Miocene).

The holotype of *A. tricordata* Beu, is in VUM No. VM-427, length 6.1 mm, width 2.3 mm (Fig. 131 — immature). The species does not appear to belong to *Austromitra*. The sculpture, uncorded siphonal fasciole, unnotched siphonal canal and the three very minute, short folds placed high on the columella are features incompatible with *Austromitra*. These characters, however, compare favourably with species of *Egestas* Finlay, 1927, particularly the Lower Miocene *Egestas fenestrata* (Suter, 1917). This species is about the same size as *E. tricordata* but is more slender and some immature specimens also show a bi-cordate penultimate and tri-cordate body whorl and the same minute columellar folds. The Lower Miocene *E. fenestrata* is most probably the ancestral form of the Upper Miocene *E. tricordata*.

The radular anatomy of *Egestas waitei* (Suter, 1909), the type-species of *Egestas*, remains unknown and the assignment of *Egestas* to the family Fasciolariidae is only tentative.

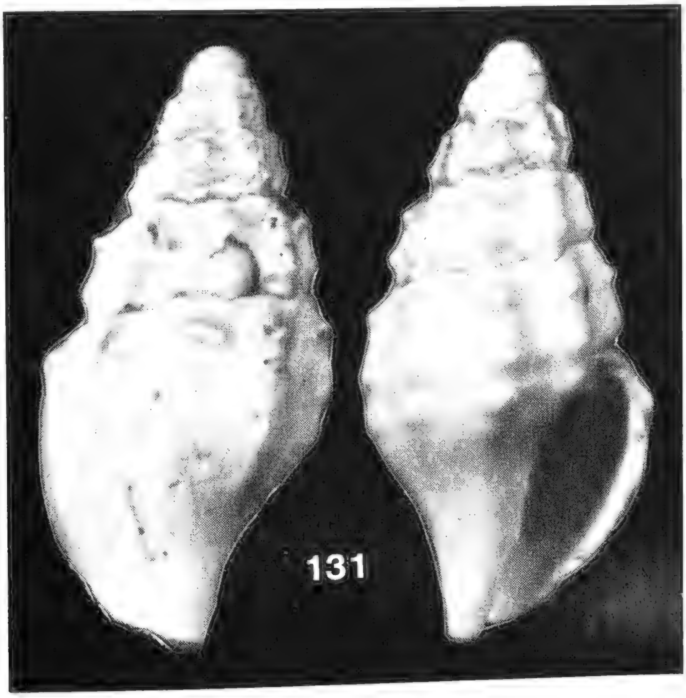

Fig. 131. *Egestas tricordata* (Beu). Holotype VUM No. VM-427; 6.1 mm.

Vexillum waitei Suter, 1909, now a member of *Egestas* Finlay, 1927, family ? Fasciolariidae.

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THE TAXONOMY OF SOME INDO-PACIFIC MOLLUSCA

PART 7

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Abstract. New geographical records are recorded for *Coralliophila squamosissima* (E. A. Smith), *Terebra circumcincta* (Deshayes), *Xenuroturris kingae* Powell, *Turridrupa astricta* (Reeve) and *Conus spiculum* Reeve. *Vitularia crenifera* (Montrouzier) is compared to *V. miliaris* (Gmelin) and is reported from the Hawaiian and Marianas Is. The type species of *Coralliophila amirantium* E. A. Smith is illustrated and the species taxonomy discussed. *Latirus gibbus* Pease, is re-assigned from *Nassarius* and *Favartia* to *Cronia* H. & A. Adams and *Nassarius metuliformis* MacNeil is transferred from the Nassariidae to *Phos* Montfort, in the Buccinidae. *Engina bonasia* (v. Martens) has chronological priority over *E. zatricium* Melvill. *Nassarius subtranslucidus* (E. A. Smith) is a prior name for *N. hayashii* (Habe) and *Vexillum citrinum* (Gmelin) will replace *V. regina* (Sowerby). *Nassarius fijiensis* Ladd, is a synonym of *Phos (Philindophos) vitiensis* Ladd, and is re-assigned to the Buccinidae.

Family MURICIDAE

Genus **Vitularia** Swainson, 1840

Vitularia Swainson, 1840, Treat. Malac. p. 297. Type species by M *V. tuberculata* Swainson, 1840 = *Murex miliaris* Gmelin, 1791. Recent, Indo-Pacific.

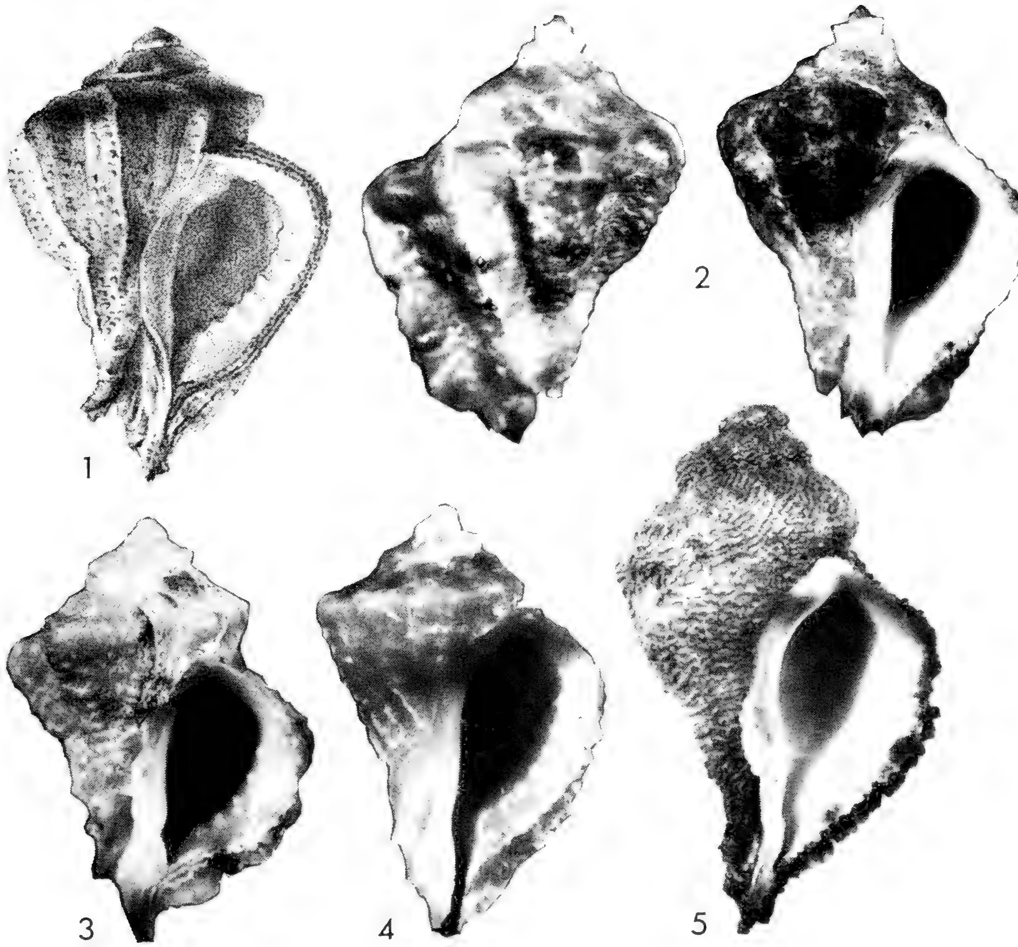
1929. *Transtrafer* Iredale, Mem. Queensl. Mus. 9(3):290, 295. Type species by OD *T. longmani* Iredale, 1929 = *Murex miliaris* Gmelin, 1791.

Vitularia crenifera (Montrouzier in Souverbie, 1861) (Figs. 1-4)

1861. *Murex crenifer* Montrouzier in Souverbie, J. Conchyl. 9: 279, pl. 11, figs. 9, 10.
1880. *Vitularia crenifer* Montrouzier, Tryon, Man. Conch. 2: 133, pl. 35, fig. 395; 1976 Fair, *Murex* book p.34, text fig. 19.
1959. *Transtrafer* sp. Kira, Col. Ill. shells Japan 1: 64, pl. 25, fig. 11
1960. *Transtrafer asiaticus* Kuroda, Cat. Moll. fauna Okinawa p.74.
1962. *Transtrafer asiatica* Kuroda, Kira, Col. Ill. shells Japan, rev. ed. 1: 64, pl. 25, fig. 11.
1966. *Vitularia crenifera* (Montrouzier), Habe & Kosuge, Shells world col. 2: 54, pl. 20, fig. 1.

TYPE LOCALITY. Balade, New Caledonia (*V. crenifera*); Okinawa, Ryukyu Is (*V. asiatica*).

This species has been either confused with the larger and more prominently sculptured *Vitularia miliaris* (Gmelin) (Fig. 5), or has been re-described as a new species. Recently collected specimens from Bolo Pt., Okinawa, Ryukyu Is (Figs. 2, 3 — *leg.* A. Deynzer) are without doubt conspecific with New Caledonian populations of *V. crenifera*. The specimen from Keehei, Hawaiian Is, 46 m (Fig. 4) represents a new range-extension.



Figs. 1-5. 1-4. *Vitularia crenifera* (Montrouzier). 1. Type-figure, length 35.0 mm. 2,3. Specimens from Bolo Pt., Okinawa, Ryukyu Is; 17.8 mm and 18.1 mm respectively. 4. Specimen from Keehei, Hawaiian Is, 46 m; 9.0 mm. 5. *Vitularia miliaris* (Gmelin). Vatia wharf, Fiji Is; 51.2 mm.

Subfamily THAIDINAE Jousseaume, 1888

Genus **Cronia** H. & A. Adams, 1853

Cronia H. & A. Adams, 1853, Gen. Rec. Moll. 1: 128. Type species by M *Purpura amygdala* Kiener, 1835. Recent, Indo-Pacific.

Cronia gibba (Pease, 1865) (Figs. 6-11)

1865. *Latirus gibbus* Pease, Proc. Zool, Soc. Lond. p.54; 1868 Pease, Americ. J. Conch. 3(4): 279, pl. 23, fig. 17.
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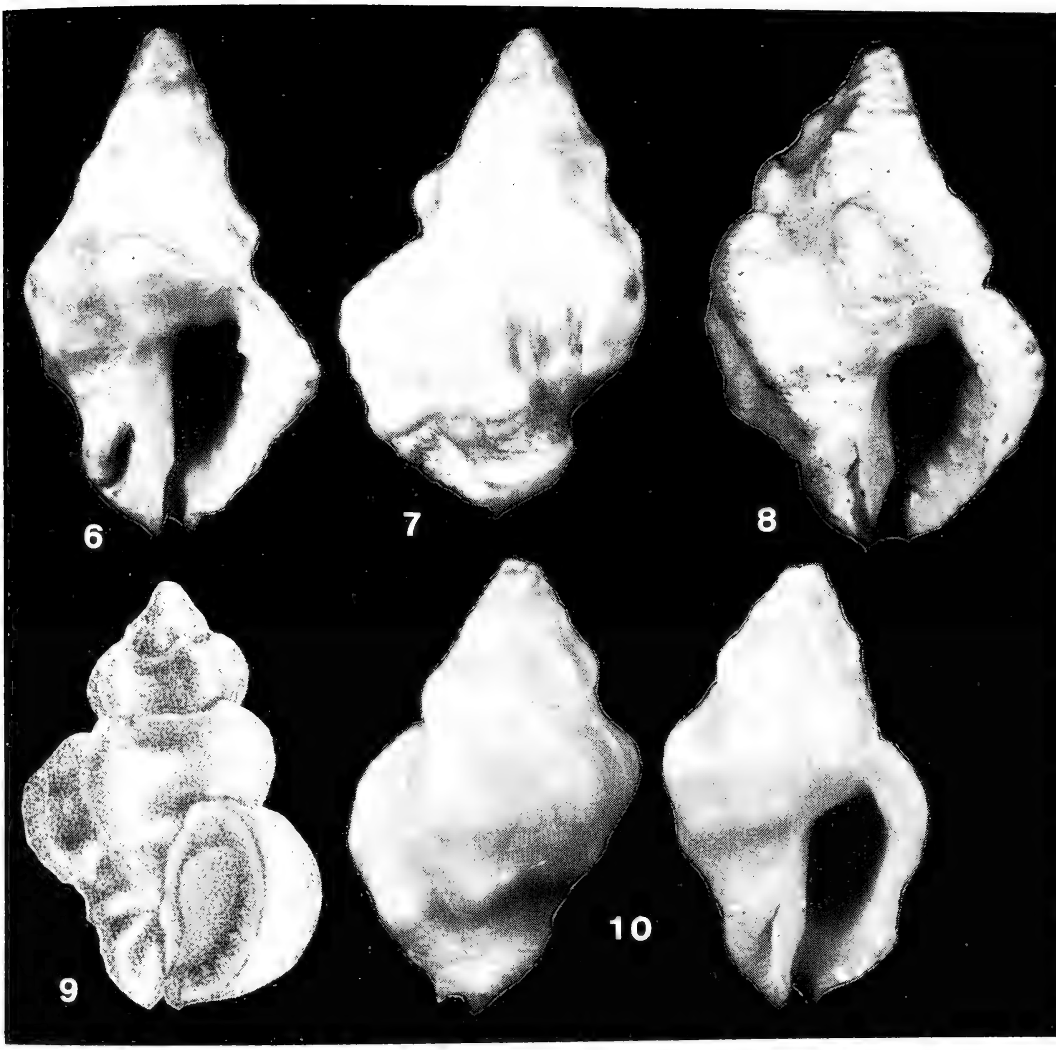
1904. *Coralliophila dissimulans* Preston, J. Malac. 11(4): 77, pl. 7, figs. 5, 6.
1930. *Drupa gibba* Pease, Fulton, Proc. Malac. Soc. Lond. 19: 18.
1976. ? *Favartia crossei* (Lienard), Radwin & D'Attilio, Murex shells world p. 146, pl. 24, figs. 17, 18.



Figs. 6-10. *Cronia gibba* (Pease). 6. Lectotype MCZ No. 261182; length 12.6 mm. 7. Paralectotype MCZ (immature); 10.6 mm. 8. Specimen from Palmyra I (senile specimen), AMS No. C-61091; 15.8 mm. 9. Type-figure of *Murex crossei* Lienard; 17.0 mm. 10. Holotype of *Coralliophila dissimulans* Preston (immature), BMNH No. 1905.2.8.9.; 9.3 mm.

TYPE LOCALITY. Howland I, Pacific Ocean (*gibba*); Mauritius (*crossei*); Ceylon (*dissimulans*).

Type specimens. The lectotype and paralectotype of *Latirus gibbus* Pease, are in the Museum of Comparative Zoology, Harvard, No. 261182, dimensions of lectotype length 12.6 mm, width 6.2 mm. The lectotype has 6-7 axial ribs on the penultimate and 5 ribs on the body whorl, the outer lip has 6 denticles, the columella 3 denticles and the interior of the aperture is rose-violet (Fig. 6). The type-specimen of *Murex crossei* Lienard remained in Lienard's collection whose whereabouts are unknown. The holotype of *Coralliophila dissimulans* Preston, is in the British Museum (Natural History), London, No. 1905.2.8.9., length 9.3 mm, width 5.4 mm. The holotype has 6 axial ribs on the penultimate and 5 ribs on the body whorl and impressed, wavy sutures; being an immature individual, the apertural denticles have not formed as yet (Fig. 10).

G. & H. Nevill (1875) suggest that *Latirus gibbus* is a synonym of *Murex crossei* and report the species from Ceylon. Vokes (1971) tentatively placed *M.crossei* in the Nassariidae while Radwin & D'Attilio (1976) tentatively assign the species to the muricid genus *Favartia* Jousseaume. Fulton (1930), whose paper appears to have been overlooked by recent workers, gave a detailed synonymy of the species and stated that the taxa *M.crossei* Lienard and *Coralliophila dissimulans* Preston, were synonyms of *Latirus gibbus* Pease. Having examined the type-specimens of the taxa concerned, I concur with Fulton as to specific synonymy. The species, however, is neither a species of Nassariidae nor a member of *Favartia* but belongs to the moruline genus *Cronia* H. & A. Adams, closely resembling *Cronia ochrostoma* (Blainville) (see Cernohorsky 1976). Both these species are similar in shape, with a sculpture of swollen, nodose ribs, adpressed and wavy sutures and denticles on the outer lip. The radula of *C.gibba* (extracted and mounted by Dr. W. F. Ponder, AMS No. C-61091) has a rachidian with 3 cusps and a simple, unicuspid sickle-shaped lateral and conforms to the radular pattern of *Cronia* (Fig. 11).

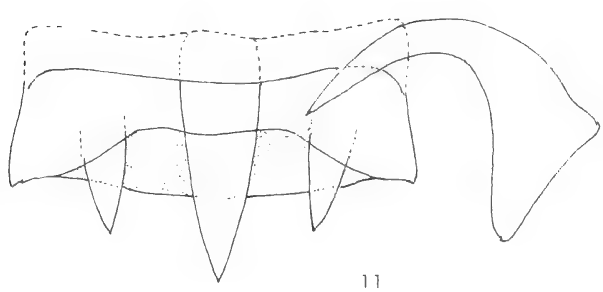


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Fig. 11. *Cronia gibba* (Pease). Half-row of radula.

Radwin & D'Attilio (op. cit.) correctly point out that gerontic individuals have quite a different appearance and become rather coarse and heavy with thickened varices and more obtuse whorls. Their illustration of the gerontic specimen on plate 24, fig. 18, is closely similar to the type of *Murex crossei* (Fig. 9), while the individual illustrated in fig. 17 resembles the lectotype of *Latirus gibbus*. Meagre records show that *Cronia gibba* is widely distributed throughout the Indo-Pacific, the known range extending from Mauritius to Ceylon and the Line Islands.

Family CORALLIOPHILIDAE Chenu, 1859

The family name Coralliophilidae Chenu, 1859, has chronological priority over Coralliophilidae Hoyle, 1888.

Genus **Coralliophila** H. & A. Adams, 1853

Coralliophila H. & A. Adams, 1853, Gen. Rec. Moll. 1: 135. Type species by SD (Iredale, 1912) "*Murex neritoideus* Chemnitz" = *Purpura violacea* Kiener, 1836. Recent, Indo-Pacific.

Subgenus **Pseudomurex** Monterosato, 1872

Coralliophila (Pseudomurex) squamosissima (E. A. Smith, 1876) (Figs. 12-14)

1847. ? *Fusus inflatus* Dunker in Philippi, Abb. Beschr. Conchyl. 2: 193, pl. 4, fig. 2
1876. *Rhizochilus (Coralliophila) squamosissimus* E. A. Smith, Ann. Mag. Nat. Hist. (4), 17: 404; 1879 E. A. Smith, Phil. Trans. R. Soc. Lond. 168: 483, pl. 51, figs. 8, 8a.
1895. *Coralliophila stearnsii* Pilsbry, Cat. mar. Moll. Japan p. 45, pl. 2, fig. 12; 1971 Kuroda & Habe, Seashells Sagami Bay, p. 155, pl. 43, fig. 14
1962. *Coralliobia stearnsi* (Pilsbry), Kira, Shells west. Pacif. col. 1: 68, pl. 26, fig. 8.
1972. *Coralliophila (Latimurex) meyendorffi* (Calcara), Kilburn, Ann. Natal Mus. 21(2): 412, fig. 9c (*non Murex meyendorffii* Calcara, 1845).
1977. *Coralliophila (Pseudomurex) squamosissima* (E. A. Smith), Kilburn, Ann. Natal Mus. 23(1): 189.

TYPE LOCALITY. Rodriguez I, Indian Ocean (*squamosissima*); Japan (*stearnsii*).

Type specimens. The holotype of *C. squamosissima* is in the British Museum (Natural History), London, No. 1876.5.1.88., length 30.7 mm, width 20.0 mm. The type has 13 irregular axial ribs and *c*. 10-11 primary and secondary spiral cords on the penultimate and 15 ribs and 21 cords on the body whorl (Fig. 12).

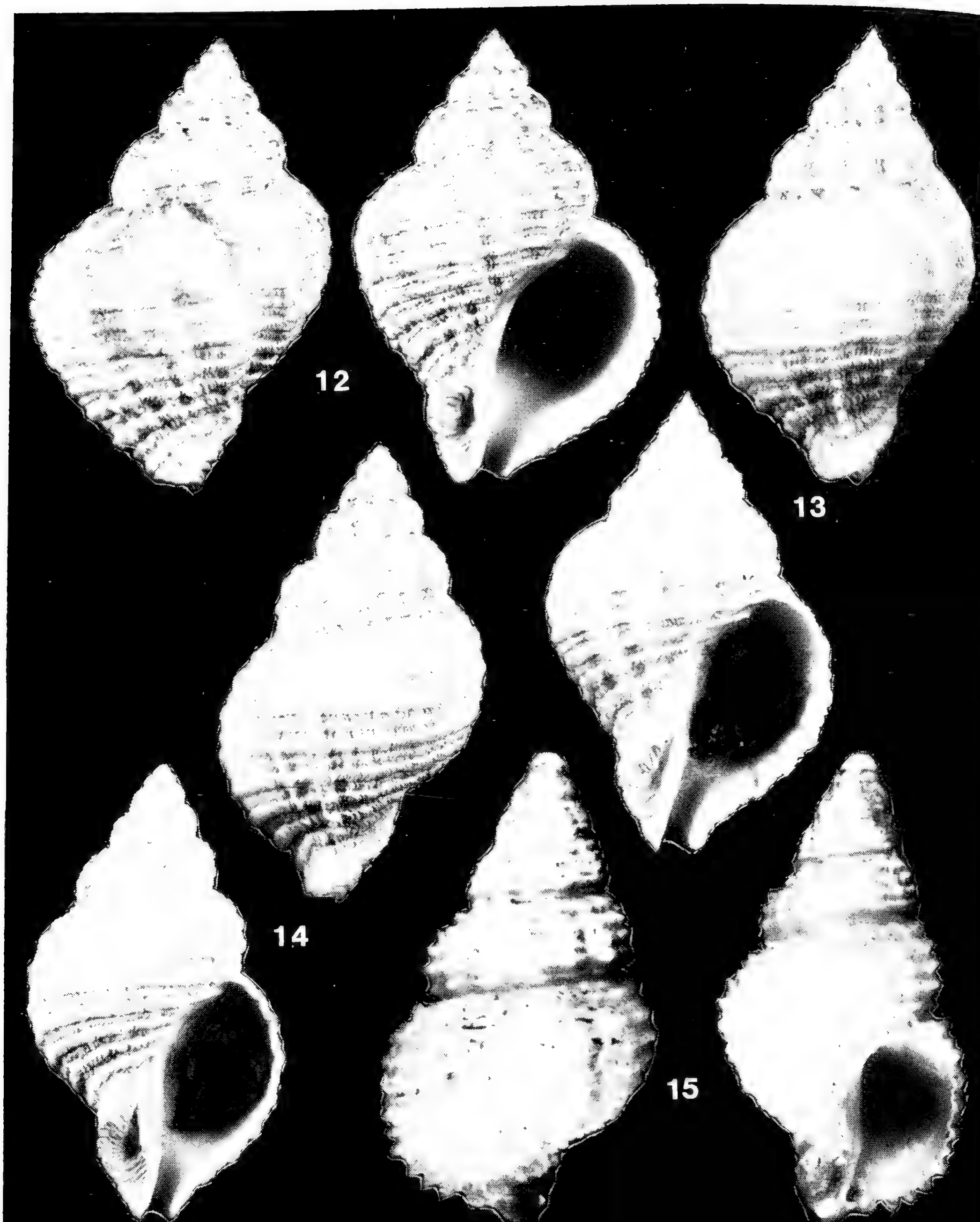
A cluster of about 15 specimens have recently been collected from the side of a sea-anemone at Bolo Pt., Okinawa, Ryukyu Is (*leg.* A. Deynzer). These 15 specimens clearly demonstrate variability of shape and culpture in Coralliophilidae, some individuals being considerably narrower than others and some specimens also lack axial ribs on the body whorl. The teleoconch has 6½-6¾ mature whorls and the protoconch 3 embryonic whorls, the colour is creamy-white and the operculum has a lateral nucleus.

C. squamosissima bears a close resemblance to the type figure of *Fusus inflatus* Dunker in Philippi, described from Java, Indonesia. Ladd (1977) recently illustrated "*Latiaxis (Latimurex) inflata* (Dunker)" from Late Miocene deposits of Eniwetok, Marshall Is, but this specimen closely resembles the Pacific *Coralliophila bulbiformis* (Conrad, 1837). To complicate matters, the type of *Fusus inflatus* Dunker in Philippi, is not in the Dunker collection of the Zoological Museum of the Humboldt University, Berlin (Dr. R. Kilias, *in litt.*) and probably remained in Winter's private collection. I therefore consider *Fusus inflatus* Dunker in Philippi to be a *nomen dubium* and adopt *C. squamosissimus* for the species illustrated. I follow Kilburn (1977) in considering *C. stearnsii* Pilsbry, a synonym of *C. squamosissima*.

Coralliophila amirantium E. A. Smith, 1884 (Fig. 15)

1884. *Coralliophila amirantium* E. A. Smith, Rept. Zool. Coll. voy. H.M.S. "Alert" p. 497, pl. 44, fig. M (spelled *amirantensis* on plate expl.).
1978. *Coralliophila amirantensis* Smith, D'Attilio, Festivus 10(10): 73 (invalid emendation).

TYPE LOCALITY. Marie-Louise, Amirantes Is, Indian Ocean. Smith (1884) also listed "African I and Eagle I" among his localities, but the two syntypes came from Marie-Louise I.



Figs. 12-15. 12-14. *Coralliophila (Pseudomurex) squamosissima* (E.A. Smith). 12. Holotype BMNH No. 1876.5.1.88.; length 30.7 mm. 13, 14. Specimens from Bolo Pt., Okinawa, Ryuku Is. 13. Broad form; 35.7 mm. 14. Slender form; 40.7 mm. 15. *C. amirantium* E.A. Smith. Syntype BMNH No. 1882.12.6.176.; 11.3 mm.

Type specimens. The two syntypes of *C. amirantium* are in the British Museum (Natural History), London, No. 1882.12.6.176-177, dimensions of illustrated syntype length 11.3 mm, width 6.3 mm (Fig. 15).

D'Attilio (1978) recently re-introduced the species under the invalid name "*amirantensis*" into coralliophilid nomenclature. Smith (op. cit.) spelt the specific name "*amirantium*" on pages XX, 632 and 497 and only once on page 678 in the plate explanations the specific name was spelt "*amirantensis*". The label accompanying the two syntypes reads "*C. amirantium*" and von Martens (1885) was the first reviser who selected the spelling "*amirantium*" in accordance with art. 32 (b) of the Code of ICZN (1964).

C. amirantium closely resembles *C. crebrilamellosa* (Sowerby, 1913) from Japan.

Family BUCCINIDAE

Genus **Phos** Montfort, 1810

Phos Montfort, 1810, Conchyl. Syst. 2: 495. Type species by OD *Murex senticosus* Linnaeus, 1758. Recent, Indo-Pacific.

Phos metuliformis (MacNeil, 1960) (Fig. 16)

1960. *Nassarius (? Niotha) metuliformis* MacNeil, U.S. Geol. Surv. Prof. Pap. 339: 80, pl. 3, fig. 29.

TYPE LOCALITY. Yonabaru clay member, Miocene of Okinawa, Ryukyu Is.

Type specimen. The holotype of *P. metuliformis* is in the National Museum of Natural History, Washington, No. USNM 562704, dimensions length 15.0 mm, width 6.4 mm (Fig. 16).

MacNeil (1960) remarked that no Indo-Pacific species of *Nassarius* resembled his *metuliformis* and that the species resembled *Phos metuloides* Maury, 1917, most closely. An examination of the holotype of *metuliformis* shows that the species is not a nassarid and that it belongs in the Photinae, family Buccinidae.

Subgenus **Philindophos** Shuto, 1969

Philindophos Shuto, 1969, Mem. Fac. Sci. Kyushu Univ., ser. D, Geol. 19 (1): 118. Type species by OD *Phos dijki* K. Martin, 1884. Mio/Pliocene of Indonesia and the Philippines.

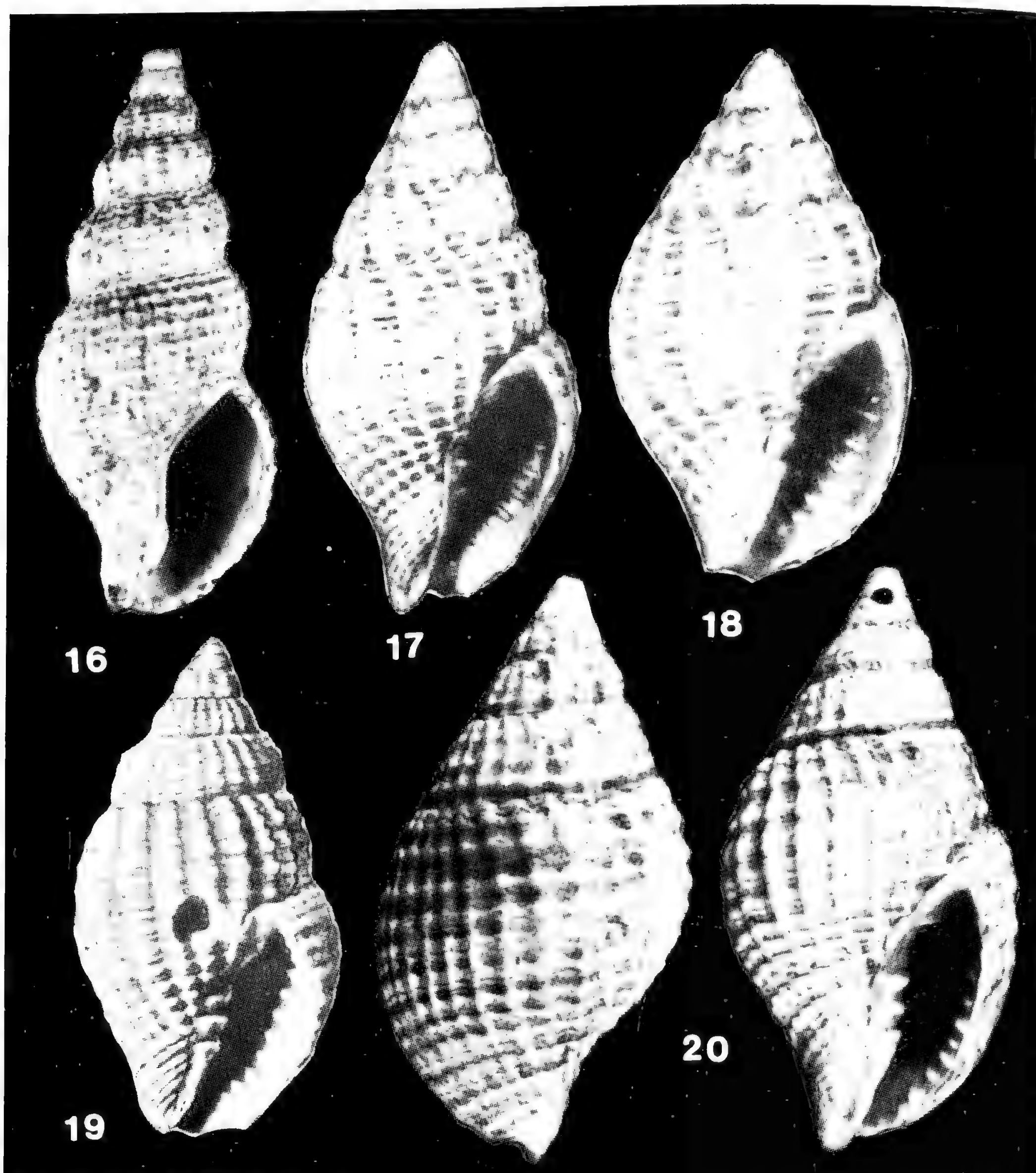
Phos (Philindophos) vitiensis (Ladd, 1934) (Figs. 19, 20)

1934. *Phos vitiensis* Ladd, Bern. P. Bishop Mus. Bull. 119: 226, pl. 40, fig. 6.
1977. *Nassarius (Niotha) fijiensis* Ladd, U.S. Geol. Surv. Prof. Pap. 533: 54, pl. 18, figs. 3, 4 (*nom. subst. pro Phos vitiensis* Ladd, 1934).

TYPE LOCALITY. St. 165, upstream from Wailoa River, *c.* 1 mile (1.6 km) W. of Nasogo, 995 feet (303 m), Upper Miocene of Viti Levu, Fiji Is.

Type specimen. The holotype of *P. vitiensis* is in the Bernice P. Bishop Museum, Honolulu, No. 1165, length 18.0 mm, width 9.5 mm, height of aperture 9.9 mm.

Ladd (1934) originally placed *vitiensis* in the genus *Phos* and remarked that the species should perhaps be placed in a separate subgenus. In a later paper Ladd (1977) re-assigned the species to the Nassariidae and changed the name to *Nassarius fijiensis* on account of a prior *Nassarius vitiensis* (Rousseau, 1854).



Figs. 16-20. 16. *Phos metuliformis* (MacNeil, 1960). Holotype USNM No. 562704; length 15.0 mm. 17, 18. *P. (Philindophos) dijki* K. Martin (From Shuto, 1969, pl. 9, figs. 8, 14). 17. Slender form; 16.5 mm. 18. Broad form; *c*. 13.7 mm. 19, 20. *P. (P) vitiensis* Ladd. 19. Holotype BPBM No. 1165; 18.0 mm. 20. Specimen from Viti Levu, Pliocene of Fiji Is, USNM No. 175058; 16.1 mm.

Shuto (1969) provided a new buccinid subgenus for these species which differ from *Phos s. str.* in their abbreviated, ovate shape, narrowly channeled sutures, strong lirations within the aperture and strong, almost costellariid-like 3-4 folds on the columella and denticle on the parietal wall. The species *P. vitiensis* (Figs. 19, 20) is very similar to *P. dijki* K. Martin, 1894, and does not differ specifically from *P. dijki* reported and illustrated by Shuto (op. cit.) from the Philippines (Figs. 17, 18). *P. dijki* has been recorded from Lower Miocene to Lower Pliocene deposits of Indonesia and Pliocene deposits of the Philippines, while *P. vitiensis* is known from the Upper Miocehe to Pliocene deposits of the Fiji Islands. The species *Nassa (Hinia) ickei* K. Martin, 1914, from the Upper Eocene of Java is also a photine buccinid and is also best assigned to *Phos (Philindophos).*

Genus **Engina** Gray, 1839

Engina Gray, 1839, Zool. Capt. Beechey's Voy. "Blossom", p. 112. Type species by SD (Gray, 1847) *E. zonata* Gray, 1839 = *Purpura turbinella* Kiener, 1836. Recent, Caribbean.

Engina bonasia (von Martens, 1880) (Fig. 21)

1880. *Plicatella (Peristernia) bonasia* v. Martens, Beitr. Meeresf. Mauritius & Seychellen, p. 246, pl. 20, fig. 6.

1893. *Engina zatricium* Melvill, Proc. Malac. Soc. Lond. 1:51; 1895 Melvill & Standen, J. Conch. 8: 106, pl. 2, fig. 4; 1975 Cernohorsky, Rec. Auckland Inst. Mus. 12: 180, fig. 9; 1978 Hinton, Guide Shells Papua New Guinea, pl. 31, fig. 21.

1971. *Engina phasinola* (Duclos), Cernohorsky, Rec. Auckland Inst. Mus. 8: 159, fig. 79; 1972 Cernohorsky, Mar. shells Pacific 2: 144, pl. 39, fig. 5 (*non Columbella phasinola* Duclos, 1840).

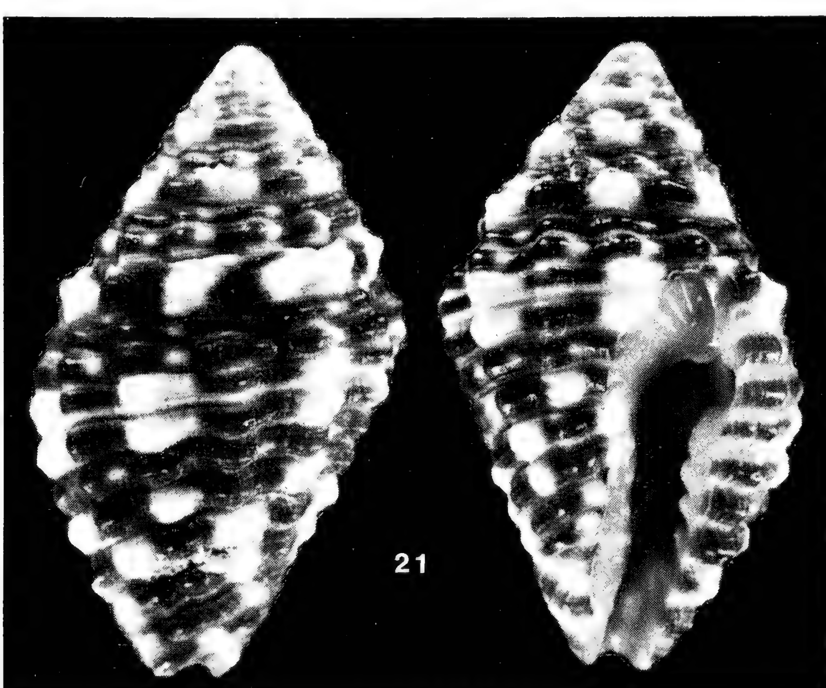


Fig. 21. *Engina bonasia* (v. Martens). Holotype Zool. Mus. Humboldt Univ., Berlin; length 14.2 mm (Photo courtesy Ms Vera Kopske, ZMHUB).

TYPE LOCALITY. Seychelles Is (*bonasia*); Lifu, Loyalty Is (*zatricium*).

Type specimens. The holotype of *E. bonasia* is in the Zoological Museum, Humboldt University, Berlin, length 14.2 mm, width 8.4 mm (Fig. 21). Nine syntypes of *E. zatricium* Melvill are in the University Museum, Manchester (K. Way, *in litt.*).

Originally described in the family Fasciolariidae, *E. bonasia* proves to be conspecific with the buccinid *E. zatricium* Melvill, which is now relegated to the synonymy of *E. bonasia*.

Family NASSARIIDAE

Genus **Nassarius** Dumeril, 1806

Nassarius Dumeril, 1806, Zool. Analyt. p. 166. Type species by SM (Froriep, 1806) *Buccinum arcularia* Linnaeus, 1758. Recent, Indo-Pacific.

Nassarius subtranslucidus (E. A. Smith, 1903) (Figs. 22-26)

1903. *Nassa subtranslucida* E. A. Smith, Fauna & Geog. Mald. & Laccad. Archip. 2 (2): 607, pl. 35, fig. 11.
1961. *Zeuxis hayashii* Habe, Col. Illust. shells Japan 2: App. p. 23, pl. 32, fig. 15.
1964. *Niotha hayashii* (Habe), Habe, Shells west. Pacif. col. 2: 99, pl. 32, fig. 15.

TYPE LOCALITY. Sth. Nilandu Atoll, Maldive Is, 1-36 fathoms (2-66 m) (*subtranslucidus*); off Isshiki, Aichi Pref., Enshu-nada, Japan, *c.*50 m (*hayashii*).

DISTRIBUTION. From the Maldive Is and Sri Lanka to Indonesia, N.W. Australia, the Philippines and Japan; subtidal, to 69 m.

Type specimens. The holotype of *N. subtranslucidus* is in the British Museum (Natural History), London, No. 1903.9.17.41., length 8.0 mm, width 3.9 mm. (Fig. 22). The holotype of *N. hayashii* (Habe) is in the National Science Museum, Tokyo, No. 43866, length 11.7 mm, width 6.3 mm (Fig. 25).

Specimens of *N. subtranslucidus* have been collected in the Kai and Aru Islands, Moluccas, Indonesia, by the "Mariel King Memorial Moluccas Expedition 1970". The species is variable in sculpture and the axial ribs number up to 26 on the body whorl, but these ribs may be weak or even absent in some individuals. The base colour is fawn and the ornamentation consists of irregular, often dilacerated orange-brown markings and brown spots at sutures and the protoconch has glassy-brown, keeled embryonic whorls. The recently described *N. hayashii* (Habe) from Japan, does not differ in any way from *N. subtranslucidus* (E. A. Smith).

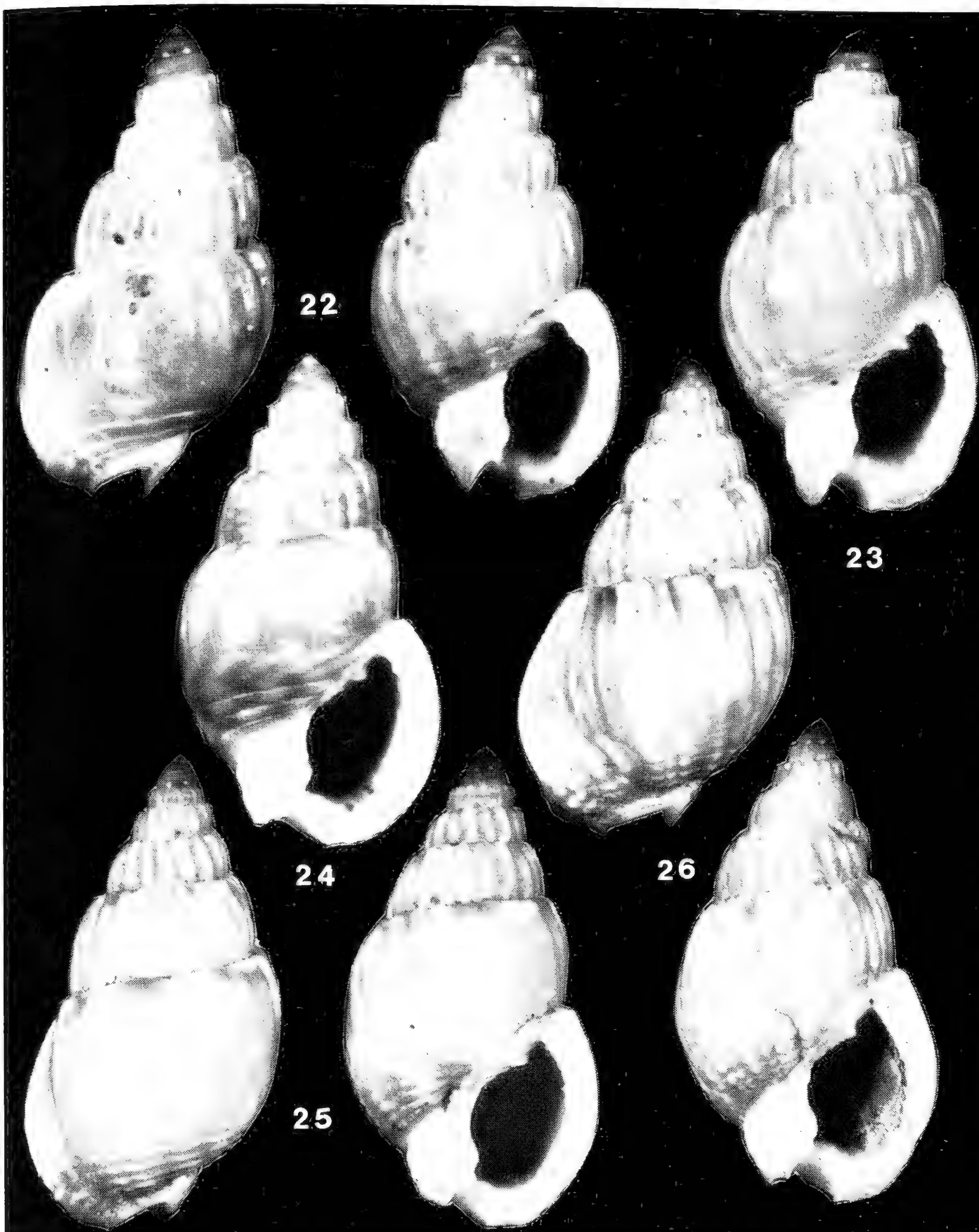
Family COSTELLARIIDAE

Genus **Vexillum** Roeding, 1798

Vexillum Roeding, 1798, Mus. Bolten, p. 138. Type species by SD (Woodring, 1928) *V. plicatum* Roeding, 1798 = *Voluta plicaria* Linnaeus, 1758. Recent, Indo-Pacific.

Vexillum citrinum (Gmelin, 1791) (Figs. 27, 28)

1788. "*Voluta plicaria valde elongata*" Chemnitz, Neues syst. Conchyl. Cab. 10: 173, pl. 151, figs. 1444, 1445 (*non-binom.*)



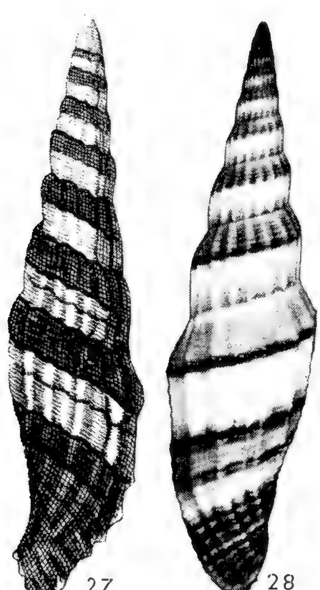
Figs. 22-26. *Nassarius subtranslucidus* (E. A. Smith). 22. Holotype BMNH No. 1903.9.17.41.; length 8.0 mm. 23. Specimen from between Warbal and Ur I, Kai Is, Indonesia, 59 m-62 m; WAM, 9.0 mm. 24. Specimen from Tg Ratoe, Maikoor, Aru I, Indonesia, 4 m; WAM, 9.3 mm. 25, 26. *N. hayashii* (Habe). 25. Holotype NMT No. 43866; 11.7 mm. 26. Paratype NMT; 12.3 mm.

1791. *Voluta citrina* Gmelin, Syst. Naturae ed. 13, 1 (6): 3456.
1807. *Voluta elegans* Link, Beschr. Nat.-Samml. Univ. Rostock Pt. 3:127 (ref. to Chemnitz, *op. cit.*, figs. 1444, 1445) (*non* Gmelin, 1791).
1825. *Mitra regina* Swainson in Sowerby, Cat. shells coll. Tankerville p.77 (*nomen nudum*).
1828. *Mitra regina* Sowerby, Gen. Rec. & fossil shells, 2 (31): pl. 250, fig. 4; 1838 Kiener, Spéc. gén. icon. coq. viv. 3:66, pl. 19, figs. a, a; 1839 Kuester, Syst. Conch. Cab. Martini & Chemnitz 5 (2): 43, pl. 8, figs. 5, 6; 1844 Reeve, Conch. Iconica 2: pl. 7, fig. 48; 1859 Chenu, Man. Conchyl. 1: 196, fig. 1029; 1874 Sowerby, Thes. Conchyl. 4:28, pl. 4, fig. 53; 1935 Dautzenberg, Mem. Mus. R. d'Hist. Nat. Belg. 2 (17): 135; 1940 M. Smith, World-wide sea shells, p. 69, fig. 927; 1951 Webb, Handb. shell coll. ed. 9:113, fig. 2; 1966 Melvin, Sea shells world p.106, pl. 43, fig. 17.
1882. *Turricula regina* Sowerby, Tryon, Man. Conch. 4:164, pl. 48, fig. 382.
1961. *Vexillum regina* (Sowerby), J. Cate, Veliger 4 (2): 76, pl. 18, figs. 1a, b; pl. 19, fig. 1; 1962 J. Cate, Veliger 5 (1): 55; 1970 Cernohorsky, Bull. Auckland Inst. Mus. No. 8: 53; 1974 Dance, Encycl. shells p. 171, 2 textfigs.

TYPE LOCALITY. Originally none. Amboina, Moluccas, Indonesia, here designated (*citrinum*); China Seas (*regina* — originally no locality given, but "China Seas" designated by J. Cate (1961)).

DISTRIBUTION. From East Africa, to the Andaman Is, Indonesia, the Philippines, China and the Solomon Is.

Type specimen. The type specimens of *Voluta citrina* Gmelin are no longer extant and figure 12 on plate 2 from Valentyn (1773) (Fig. 27) is here designated as the illustrated lectotype of *V. citrina* (length from figure 60.0 mm).



Figs. 27, 28. *Vexillum citrinum* (Gmelin). 27. Lectotype figure from Valentyn, 1773, pl. 2, fig. 12; length *c.*60.0 mm (engraved in reverse). 28. Specimen from Nossi-Be, Madagascar, AMS No. C-113192; 57.3 mm.

Gmelin (1791) described *Voluta citrina* as a new species and cited figure 12 on plate 2 from Valentyn (1773) as reference. Valentyn's drawing of his "Gnemon Schnecke" depicts the species later named *Mitra regina* Sowerby, 1828, and in the drawing the aperture is shown on the left hand side in error. During a revision of Gmelin's Mitridae names, the unused and forgotten name *Voluta citrina* was discovered and the International Commission on Zoological Nomenclature has been petitioned for a suppression of *Voluta citrina* Gmelin, 1791, as a *nomen oblitum* in favour of its junior synonym *Mitra regina* Sowerby, 1828 (Cernohorsky 1967). The Commission did not process the application at that time and only recently reviewed the case (The Secretary, *in litt.* 10-XI-1978). The interim appearance of emended articles 23 and 79 of the Code of ICZN (1974) has changed the status of *V. citrina* and *M. regina*. The latter taxon can no longer be regarded as having been in "general current use" since the species-group name *Mitra regina* has been used only 6 times by at least 5 different authors between 1917 to 1967 instead of the required 10 times usage by 5 different authors.

Species described after 1828 and considered conspecific with *Vexillum citrinum* (Gmelin) have been omitted from the synonymy list.

Family TEREBRIDAE

Genus **Terebra** Bruguière, 1789

Terebra Bruguière, 1789, Encycl. Meth. Hist. Nat. vers 1:XV. Type species by SM (Lamarck, 1799) *Buccinum subulatum* Linnaeus, 1767. Recent, Indo-Pacific.

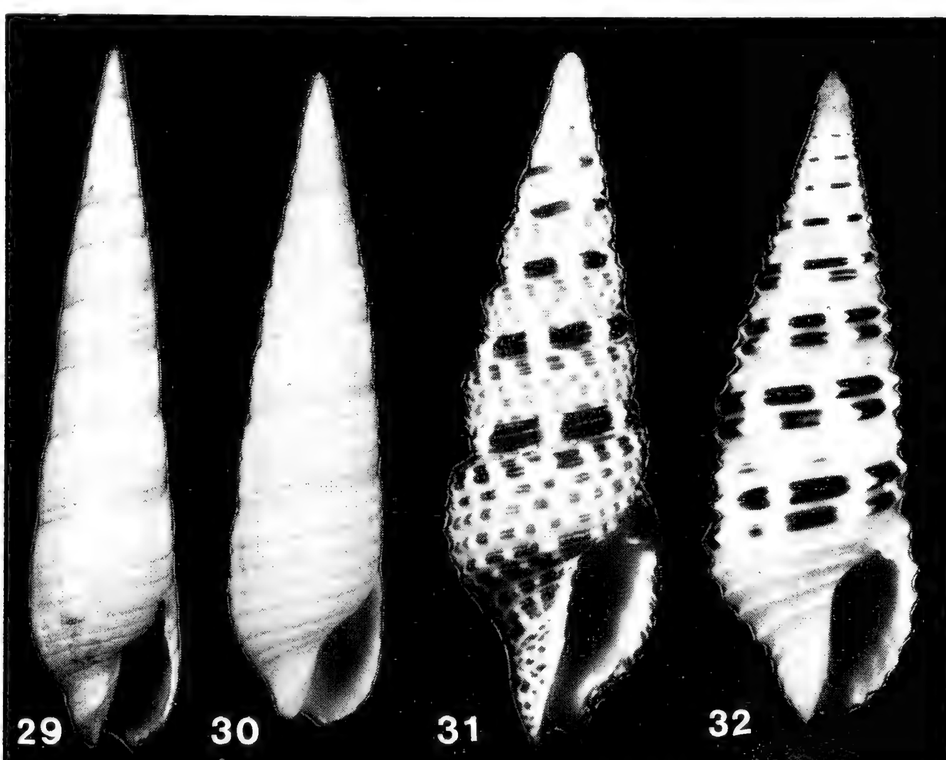
Terebra circumcincta Deshayes, 1857 (Figs. 29, 30)

1857. *Terebra circumcincta* Deshayes, J. Conchyl. 6: 77, pl. 3, fig. 9; 1860 Reeve, Conch. Iconica, Mon. *Terebra* pl. 15, sp. 70; 1885 Tryon, Man. Conch. 7: 13, pl. 11, figs. 8, 9; 1969 Cernohorsky, Veliger 11 (3): 213; 1971 Powell, Rec. Auckland Inst. Mus. 8: 225, fig. 26; 1974 Powell, Rec. Auckland Inst. Mus. 11: 206.

1964. *Perirhoe circumcincta* (Deshayes), Cotton, Rec. Americ.-Austral. Sci. Exp. Arnhem Land 4: 35, pl. 5, No. 10.

TYPE LOCALITY. Red Sea (= error ?).

Type specimen. The holotype of *T. circumcincta* is in the British Museum (Natural History), London, length 38.0 mm, width 8.0 mm (Fig. 29).



Figs 29-32. 29, 30. *Terebra circumcincta* Deshayes. 29. Holotype BMNH No. 1978 150; length 38.0 mm. 30. Specimen from False Entrance, N.W. of Noumea, New Caledonia; 34.8 mm. 31. *Xenuroturris kingae* Powell. Orote Pt., Guam I, Marianas Is, 18-23 m; 21.7 mm. 32. *Turridrupa astricta* (Reeve). Orote Pt., Guam I, Marianas Is, 18-22 m; 16.1 mm.

The type locality of "Red Sea" remains unconfirmed. According to a specimen in the British Museum, the species occurs at Port Curtis, Queensland, Australia. Cotton (1964) reports *T. circumcincta* from Port Keats, Arnhem Land, Northern Territory, and Powell (1971) from the Bay of Islands, Northern New Zealand. Recently collected specimens from False Entrance, N.W. of Noumea, New Caledonia (*leg.* M. Marrow) (Fig. 30), confirm the species continuous range from Arnhem Land, N. Australia to Northern New Zealand.

Family TURRIDAE

Genus **Xenuroturris** Iredale, 1929

Xenuroturris Iredale, 1929, Mem. Queensl. Mus. 9 (3): 285. Type species by OD *X. legitima* Iredale, 1929 = *Pleurotoma cingulifera* Lamarck, 1822. Recent, Indo-Pacific.

Xenuroturris kingae Powell, 1964 (Fig. 31)

1964. *Xenuroturris kingae* Powell, Indo-Pacif. Moll. 1 (5): 325, pl. 252, fig. 6.

TYPE LOCALITY. Off Keehi, Oahu I, Hawaiian Is, 20-40 fathoms (36 m-73 m).

Type specimen. The holotype of *X. kingae* is in the Bernice P. Bishop Museum, Honolulu, length 18.2 mm, width 6.4 mm.

A specimen of *X. kingae* has been recently collected off Orote Pt., Guam I, Marianas Is, in 18 m-23 m (*leg.* A. Deynzer), dimensions of illustrated specimen length 21.7 mm, width 5.4 mm (Fig. 31). Originally described from the Hawaiian Is, the Marianas Is record represents a considerable westward extension.

Genus **Turridrupa** Hedley, 1922

Turridrupa Hedley, 1922, Rec. Austral. Mus. 13 (6): 226. Type species by OD *Pleurotoma acutigemmata* E. A. Smith, 1877. Recent, Indo-Pacific.

Turridrupa astricta (Reeve, 1843) (Fig. 32)

1834. *Pleurotoma interrupta* Sowerby, Proc. Zool. Soc. Lond. for 1833: 138 (*non* Lamarck, 1816).
1843. *Pleurotoma astricta* Reeve, Conch. Iconica 1: pl. 12, fig. 98 (*nom. subst. pro P. interrupta* Sowerby, 1834).
1967. *Turridrupa astricta astricta* (Reeve), Powell, Indo-Pacific Moll. 1 (7): 419, pl. 305, fig. 4.
1978. *Turridrupa astricta* Reeve, de Vaul, Hawaiian Shell News 26 (7): 11, textfig.

TYPE LOCALITY. Anaa I, Tuamotu Archipelago.

Type specimen. The lectotype of *T. astricta* is in the British Museum (Natural History), London, length 13.5 mm, width 5.0 mm.

The species was previously known only from the Tuamotu Archipelago, but recently specimens have been collected off Koko Head, Oahu, Hawaiian Is, 18 m (*leg.* E. de Vaul) where it is sympatric with *T. consobrina* Powell, 1964, a taxon which will have to be elevated to specific rank. Another specimen has been collected as far west as Orote Pt., Guam I, Marianas Is, 18 m-22 m (*leg.* A. Deynzer), length of illustrated specimen 16.1 mm, width 4.3 mm (Fig. 32). The protoconch of *T. astricta* consists of 4¼ whorls, with the first whorl being smooth and remaining 3¼ embryonic whorls being axially costate.

Family CONIDAE

Genus **Conus** Linnaeus, 1758

Conus Linnaeus, 1758, Syst. Nat. ed. 10: 712. Type species by SD (Children, 1823) *C. marmoreus* Linnaeus, 1758.

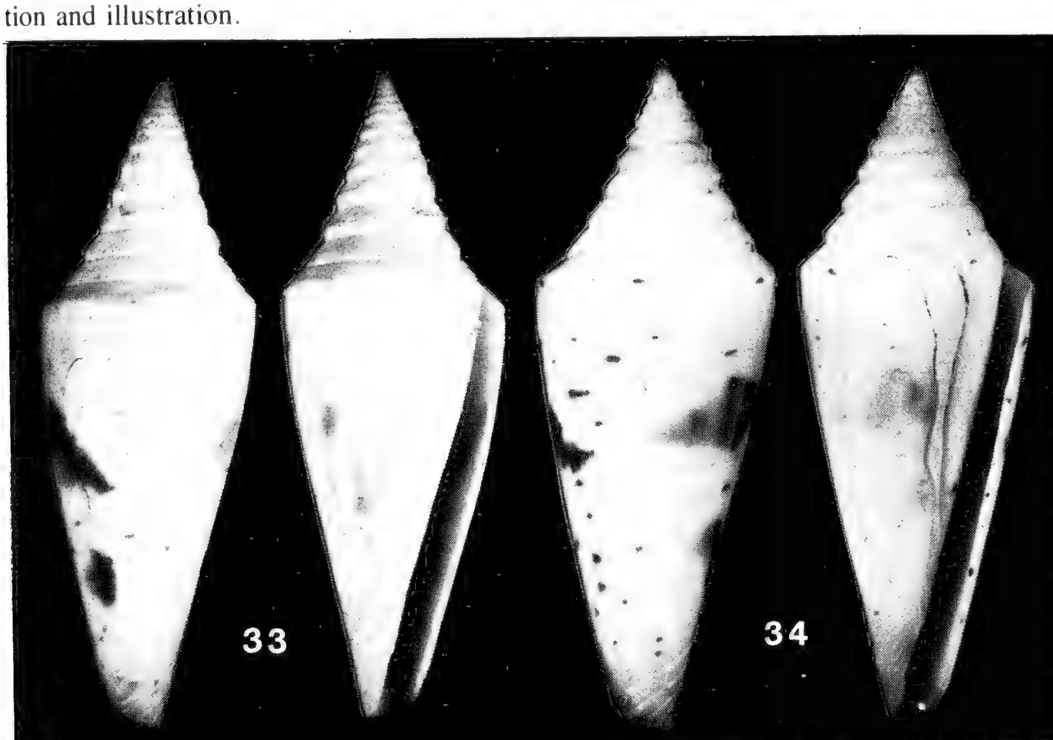
Conus spiculum Reeve, 1849 (Figs. 33, 34)

1849. *Conus spiculum* Reeve, Conch. Iconica 1: Suppl. pl. 7, sp. 266; 1858 Sowerby, Thes. Conchyl. 3 (18): 16, pl. 202, fig. 362; 1884 Tryon, Man. Conch. 6: 32, pl. 9, fig. 62; 1937 Tomlin, Proc. Malac. Soc. Lond. 22 (5): 310.

TYPE LOCALITY. Cagayan, Mindanao I, Philippine Is, 25 fathoms (46 m).

Type specimen. The illustrated syntype of *C. spiculum,* length 23.2 mm, width 8.0 mm, is in the British Museum (Natural History), London, (Fig. 33).

Weinkauff (1875) erroneously placed *C. spiculum* Reeve in the synonymy of *C. longurionis* Kiener, 1845, while other authors merely repeated Reeve's original description and illustration.



Figs. 33, 34. *Conus spiculum* Reeve. 33. Syntype BMNH, length 23.2 mm. 34. Specimen from Simpson Harbour, Rabaul, New Britain; 19.1 mm.

Recently a specimen has been dredged between Vulcan and Beehives, Simpson Harbour, Rabaul, New Britain, in 91 m (*leg.* B. Parkinson). The specimen measures 19.1 mm in length and 6.3 mm in width, has 9 smooth, mature whorls which are carinated centrally and 3 embryonic whorls; the first 3-4 whorls are nodulose and the last 5-6 smooth except for faint, arcuate axial striae and the shoulder is smooth. The spire is long, the body whorl and aperture narrow and the base has *c*. 9 oblique cords; it is white in colour, ornamented with wide-spaced rows of small brown spots and 3-4 larger, smudged, reddish spots (Fig. 34).

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REVIEW OF THE GENUS *Naultinus* Gray (REPTILIA: GEKKONIDAE)

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Abstract. Evidence for the recognition of *Naultinus grayi* Bell and *N. elegans* Gray is given, and two subspecies *N. elegans elegans* and *N. elegans punctatus* Gray (stat. nov.) are distinguished. These findings are based on differences in the reproductive cycle, and morphological features such as size, colour of skin and tongue, and scalation. The geographical distribution of the taxa is described, and a revised synonymy given.

Naultinus is one of three genera of geckos endemic to New Zealand. It is widely distributed throughout the North Island, to which it is largely confined, although occasionally specimens have been found on some of the larger off-shore islands in the Hauraki Gulf (e.g. Great and Little Barrier Islands, and the Mokohinau Islands).

The genus *Naultinus* was erected in 1842 by J.E. Gray, of the British Museum (Gray 1842) to accommodate specimens of two types of gecko collected by Dr Ernst Dieffenbach and later presented to the Museum by Sir Richard Owen. One of these forms was brown, and the other green; the former Gray named *N. pacificus* and the latter *N. elegans*. Boulenger (1885) later transferred *N. pacificus* to the genus *Hoplodactylus*, while *N. elegans* has so far survived as described by Gray, despite several attempts to rename it.

Since the erection of the genus in 1842 a number of changes and additions have been proposed, the majority of these proposals resulting from the wide variety of colour patterns which occur among these basically green geckos. In 1843 Bell added the species *grayi* to the genus (Bell 1843), and in the same year Gray (1843) described *N. punctatus*. Although both species were synonymised with *N. elegans* by Boulenger (1885), and all subsequent writers followed his lead, we are of the opinion that the former is a good species and the latter should be regarded as a subspecies of *N. elegans*. In 1851 Dumeril (1851) placed *N. elegans* in the genus *Gymnodactylus*, but this move was not accepted by other zoologists.

Buller (1871) added the species *N. sulphurus* to accommodate the yellow forms; doubt was cast on the validity of this species by Lucas & Frost (1897), while McCann (1955) accepted the name *sulphurus*, with some reserve, to denote what he assumed to be the only colour form to produce young like itself. However, it has been observed by us that even the yellow forms do not breed true to colour.

In 1880 Colenso (1880) described *N. pentagonalis*, from Hawkes Bay, noting differences between this larger, southern North Island form, and the more delicately built specimens common to the Auckland region. Later writers (notably Lucas & Frost 1897, and McCann 1955) did not accept this distinction, and Colenso (1880) did not recognise that his *pentagonalis* was in fact the same taxon as Gray's *punctatus*.

Rec. Auckland Inst. Mus. 16: 189-200 25 January 1980

In 1961 Chrapliwy, Smith & Grant (1961) raised the question of priority regarding the generic names *Hoplodactylus* and *Naultinus,* pointing out that while Gray had described both *N. elegans* and *N. pacificus* in the same publication, the latter had page priority over the former. They therefore proposed that the generic name *Hoplodactylus* Fitzinger, 1843 should be replaced by *Naultinus* Gray, 1842; and they further suggested that the generic name *Naultinulus* be adopted to replace the former usage of *Naultinus.* These proposals were rejected, following argument by Myers (1961) against their adoption. Wermuth (1965) supported Myers' contention that the two generic names should not be changed, as indeed do we.

Species originally placed in the genus *Naultinus* and later discarded as synonyms of species in other genera include *Naultinus greyii* Knox, 1869, now *Hoplodactylus granulatus,* (Knox 1869); *Naultinus lineatus* Gray, 1869, now *Heteropholis gemmeus* (?), (Gray 1869); *Naultinus elegans stellatus* Hutton, 1872, now *Heteropholis stellatus,* (Hutton 1872); *Naultinus pulcherrimus* Buller, 1876, now *Heteropholis stellatus,* (Buller 1876); *Naultinus sylvestris* Buller, 1880, now *Hoplodactylus granulatus,* (Buller 1880); *Naultinus versicolor* Colenso, 1884, now *Hoplodactylus granulatus,* (Colenso 1884).

Genus **Naultinus** Gray, 1842

1842 *Naultinus* (part) Gray, *Zool. Misc.* pp. 58 & 72.
1843 *Naultinus* (part) Gray, In: Dieffenbach, *N. Zeal,* 2, p. 202.
1843 *Naultinus:* Bell, *Voy. of the Beagle,* Rept. p. 27.
1845 *Naultinus* (part) Gray, *Cat. Liz.* p. 169.
1851 *Gymnodactylus* (part) A. Duméril, *Cat. Meth.,* Rept. p. 42.
1857 *Naultinus:* Girard, *U.S. Exploring Exped.* Herp., p. 309, p. xvi, figs 17-26.
1861 *Hoplodactylus* Fitzinger, *Sber. Akad. Wiss. Wien* 42: 383.
1867 *Nautlinus* (part): Steindachner, *Novara* Rept. p. 19-20 (note spelling).
1871 *Naultinus* (part): Buller, *Trans. Proc. N.Z. Inst.* 3: 6.
1875 *Naultinus* (part): Gunther, *Voyage of Ereb. and Terror* Rept. p. 17.
1875 *Naultinus* (part): Hutton, *Trans. Proc. N.Z. Inst.* 4: 171.
1897 *Naultinus* (part): Lucas and Frost, *Trans. Proc. N.Z. Inst.* 29: 267.
1933 *Naultinus:* Smith, *Rec. Ind. Mus.* 31: 13.
1955 *Naultinus:* McCann, *Dom. Mus. Bull.* 17: 28.
1961 *Naultinulus* Chrapliwy, Smith and Grant, *Herpetologica* 17: 7.
1965 *Naultinus:* Wermuth, *Das Tierreich* 80: 110.

Diagnosis. Digits free, feebly dilated, narrowing distally, clawed, and with a series of transverse lamellae on the ventral surface. Anterior head scales enlarged. Dorsal scales uniformly granular, or tubercular. Pupil vertical. Males with preanal and femoral pores, and 2-4 large spines on each side of the base of the tail; females with or without abortive preanal and femoral pores, and vestiges of spines at base of tail.

Naultinus elegans Gray, 1842 (Figs. 1, 2, 5, 7)

1842 *Naultinus elegans* Gray, *Zool. Misc.* 4: 72.
1843 *Naultinus elegans* Gray, In: Dieffenbach, *N. Zeal.* 2, p. 203.
1843 *Naultinus punctatus* Gray, *loc. cit.* p. 204.
1845 *Naultinus elegans* Gray, *Cat. Liz.* p. 169.
1845 *Naultinus punctatus* Gray, *loc. cit.* p. 170.
1851 *Gymnodactylus elegans* A. Duméril, *Cat. Meth.,* Rept. p. 43.
1857 *Naultinus punctatus:* Girard, *U.S. Exploring Exped.* Herp., p. 309, p. xvi, figs 17-26.
1861 *Hoplodactylus elegans:* Fitzinger, *Sber, Akad. Wiss. Wien.* 42: 400.

1867 *Nautlinus elegans* (part): Steindachner, *Novara* Rept. p. 19.
1867 *Nautlinus punctatus:* Steindachner, *loc. cit.* p. 20.
1871 *Naultinus elegans:* Buller, *Trans. Proc. NZ. Inst.* 3: 7, pl. 2, fig. 1.
1871 *Naultinus punctatus:* Buller, *loc. cit.* p. 8.
1871 *Naultinus sulphurus* Buller, *loc. cit.* p. 8.
1872 *Naultinus elegans:* Hutton, *Trans. Proc. NZ. Inst.* 4: 170.
1872 *Naultinus punctatus* (part): Hutton, *Trans. Proc. NZ. Inst.* 4: 171.
1872 *Naultinus sulphurus:* Hutton, *Trans. Proc. NZ. Inst.* 4: 172.
1875 *Naultinus elegans:* Gunther, *Voyage of Ereb and Terror* Rept. p. 17.
1875 *Naultinus punctatus:* Gunther, *loc. cit.* p. 17.
1880 *Naultinus pentagonalis* Colenso, *Trans. Proc. NZ. Inst.* 12: 262.
1885 *Naultinus elegans* (part): Boulenger, *Cat. Liz.* 1: 168.
1897 *Naultinus elegans* (part): Lucas and Frost, *Trans. Proc. NZ. Inst.* 29: 267.
1933 *Naultinus elegans:* Smith, *Rec. Ind. Mus.* 31: 13.
1955 *Naultinus elegans* (part): McCann, *Dom. Mus. Bull.* 19: 28.
1961 *Naultinulus elegans* (part) Chrapliwy, Smith and Grant, *Herpetologica* 17: 7.
1965 *Naultinus elegans* (part): Wermuth, *Das Tierreich* 80: 110.

Diagnosis. Medium to large-sized *Naultinus;* (snout-vent length 65-95 mm) dorsal surface of snout, to level of eyes, covered with large dome-shaped scales, more posteriorly head scales smaller and granular; rostral (of adult) two and a half times or less as broad as depth at centre, often with median cleft from upper edge; mental usually roughly square or oblong, bordered posteriorly by 3 or more small post-mental scales. The species is diurnal.

Description. Head oviform, small to large; snout bluntly rounded, forehead flat; ear-opening small, oval, horizontal; body and limbs moderate to robust; digits free, clawed, somewhat dilated, narrowing distally, 10-18 straight-edged lamellae under 4th toe; dorsal surface of snout (Fig. 5) to level of eyes, covered with large dome-shaped scales, rest of head covered with smaller granular scales; rostral (Fig. 1) (of adult) usually less than two and a half times as broad as depth at centre, often with median cleft extending downward from upper border; nostril pierced between first upper labial and 3-5 (usually 4) nasals, the anterior-most of which is enlarged; 1 large internasal; 9-14 upper labials, and 9-13 lower labials; mental (Fig. 2) roughly square or oblong, posterior margin shorter than anterior and usually bordered by 3-4 small post-mental scales; dorsal body scales small, granular, abdominal scales small, subimbricate; males with large patch (4-8 series) of preanal pores, and 2-3 rows of femoral pores; in females preanal and femoral pores absent or few, and vestigial; tail elongate, prehensile, tapering finely, covered with small to moderate sized scales; in males the base of the tail swollen to accommodate the hemipenes and with 2-4 enlarged, pointed concical scales on each side of the swollen base; females with vestiges of these scales.

Colour. Dorsal surface dark or vivid green, with or without pale green, yellow or white markings in the form of lines, spots or blotches, which may or may not be outlined in dark green, brown or black. Lower lip frequently edged with white; mouth and tongue dark blue. Ventral surface paler than dorsal surface, blue in some males; blue stripe along flanks of some males. Under-surface of feet and toes grey/green or bright yellow.

RANGE. North Island, New Zealand, south of Whangarei and Dargaville (Fig. 7).

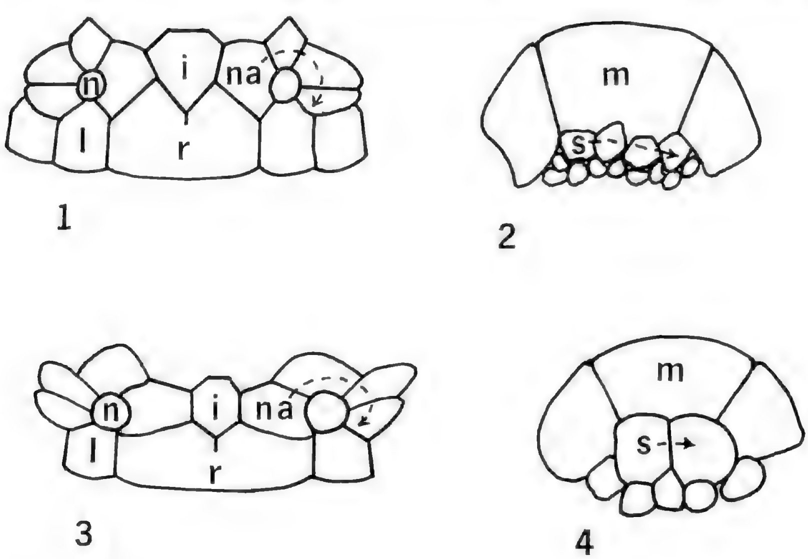
Type. Adult female in the collection of the British Museum (Natural History) (BMNH 1946.8.22.36.).

Naultinus elegans elegans Gray, 1842 (Figs. 1, 2, 5, 7)

Diagnosis. Medium-sized *Naultinus;* (snout-vent length 65-75 mm) dorsal surface of snout to level of eyes covered with large dome-shaped scales, more posteriorly head scales smaller and granular; rostral (of adult) usually less than two and a half times as broad as depth at centre; mental usually roughly square or oblong, bordered posteriorly by 3 or more small postmental scales. Vivid green dorsally, paler beneath; undersurface of feet and toes grey/green. The subspecies is diurnal.

Description. Head oviform, moderate, snout bluntly rounded, forehead flat, ear opening small, oval, horizontal; body and limbs moderate; digits free, clawed, somewhat dilated, narrowing distally, 10-16 (usually 10-13) straight-edged lamellae under 4th toe; dorsal surface of snout, to level of eyes, covered with large dome-shaped scales, rest of head covered with smaller granular scales; rostral (of adult) usually less than two and a half times as broad as depth at centre, often with median cleft extending downward from upper border; nostril pierced between first upper labial and 3-5 (usually 4) nasals, the anterior-most of which is enlarged; 1 large internasal; 9-14 (usually 10-12) upper labials, and 9-13 (usually 10-11) lower labials; mental roughly square or oblong, posterior margin shorter than anterior and usually bordered by 3-4 small postmental scales; dorsal body scales small, granular; abdominal scales small, subimbricate; males with large triangular patch (up to 8 series) of preanal pores, and 2-3 long rows of femoral pores; in females, a triangular patch of enlarged preanal scales, with or without a few vestigial pores; vestigial femoral pores absent or very few; tail elongate, prehensile, tapering finely, covered with moderate-sized scales; in males the base of the tail swollen to accommodate the hemipenes, and with 3-4 enlarged, pointed, conical scales (often with up to 4 similar but smaller scales immediately behind) on each side of the swollen base; females with vestiges of these scales.

Colour. Normally vivid green dorsally, either without markings, or with a varying amount of white, yellow, or pale pink in the form of stripes, spots or blotches, any of which may be outlined with a fine dark green, brown or black line, and extend on to the tail. Ventral surface of females a much paler shade of the dorsal coloration, males normally with blue



Figs. 1-4. *Naultinus* spp. 1,2. *Naultinus elegans elegans*. 1. Anterior head shields. 2. Anterior shields of lower jaw. 3,4. *Naultinus grayi*. 3. Anterior head shields. 4. Anterior shields of lower jaw.

i, internasal; 1, first upper labial; m, mental; n, nostril; na, nasal; r, rostral; s, submental.

undersurface. Lower lip frequently outlined in white, mouth and tongue dark blue. Undersurface of feet and toes pale grey/green. Yellow individuals sometimes occur, which may be plain coloured, or have spots or stripes of white or pink, with or without brown or black outline; in yellow males the ventral surface is white, or almost so.

It may be noted that green specimens frequently turn pink in preservative.

RANGE. This subspecies is found from Dargaville and Whangarei in the north of the North Island, through the Auckland and Waikato districts, northern Bay of Plenty and northern Taranaki, and also on some islands in the Hauraki Gulf (Fig. 7).

5

6

Figs. 5, 6. Snout. 5. *Naultinus elegans elegans.* 6. *Naultinus grayi.*

TYPE LOCALITY. Auckland.

Type. Adult female in the collection of the British Museum (Natural History). (BMNH 1946.8.22.36.).

Material examined. Naultinus elegans elegans. Holotype: B.M. (N.H.) 1946.8.22.36. Ecology Division, D.S.I.R., collection: G304, 435, 471, 772, 893, 894, 899, 1077, 1078, 1090, 1107, 1121, 1122. Auckland Institute and Museum collection: Rep. 27.1-27.23, 27.26-27, 27.42. Zoology Department, University of Auckland, collection: R39, 47, 68, 78, 80-83, 87, 100-104. National Museum collection: R82. Live specimens: 7 in private collection (R.A.H.), Turangi area (1), Albany (1), Glenfield (1), Massey (West Auckland) (2), Bethell's Beach (2); 17 in collection of Mr R.C. Sutton, Turangi; 17 in field, Gill's Road, Albany.

Naultinus elegans punctatus Gray, 1843 (stat. nov.) (Fig. 7)

1843 *Naultinus punctatus* Gray, In: Dieffenbach, *N. Zeal.* 2, p.204.
1845 *Naultinus punctatus* Gray, *Cat. Liz.* p. 170.
1857 *Naultinus punctatus:* Girard, *U.S. Exploring Exped.* Herp. p. 309.
1861 *Hoplodactylus punctatus:* Fitzinger, *Sber. Akad. Wiss. Wein.* 42: 400.
1867 *Nautlinus punctatus:* Steindachner, *Novara* Rept, p. 20 (note spelling).
1871 *Naultinus punctatus:* Buller, *Trans. Proc. N.Z. Inst.* 3: 8.
1872 *Naultinus punctatus* (part): Hutton, *Trans. Proc. N.Z. Inst.* 4: 171.

1875 *Naultinus punctatus:* Gunther, *Voyage of Ereb. and Terror.* Rept. p. 17.
1880 *Naultinus pentagonalis* Colenso, *Trans. Proc. N.Z. Inst.* 12: 262.
1885 *Naultinus elegans* (part): Boulenger, *Cat. Liz.* 1: 168.
1897 *Naultinus elegans* (part): Lucas and Frost, *Trans. Proc. N.Z. Inst.* 29: 267.
1955 *Naultinus elegans* (part): McCann, *Dom. Mus. Bull.* 17: 28.
1961 *Naultinulus elegans* (part): Chrapliwy, Smith and Grant, *Herpetologica* 17: 7.
1965 *Naultinus elegans* (part): Wermuth, *Das Tierreich* 80: 110.

Diagnosis. Large-sized *Naultinus* (snout-vent length up to 95 mm); dorsal surface of snout to level of eyes covered with large dome-shaped scales, more posteriorly head scales smaller and granular; rostral (of adult) usually less than two and a half times as broad as depth at centre; mental usually roughly oblong, bordered posteriorly by 3 or more small postmental scales. Dark green dorsally, paler beneath, males with blue band along flank. Dorsal edge of toes bright yellow. Enlarged scales on base of tail in males yellow/brown.

Description. Head oviform, large, snout bluntly rounded, forehead flat, ear opening small, oval, horizontal; body and limbs robust; digits free, clawed, somewhat dilated, narrowing distally, 11-18 (usually 13-14) straight-edged lamellae under 4th toe; dorsal surface of snout to level of eyes, covered with large dome-shaped scales, rest of head covered with smaller granular scales; rostral (of adult) usually less than two and a half times as broad as depth at centre, often with median cleft extending downward from upper border; nostril pierced between first upper labial and 3-5 (usually 4) nasals, the anterior most of which is enlarged; 1 large internasal; 10-13 (usually 11-12) upper labials, and 9-13 (usually 11-12) lower labials; mental roughly oblong, posterior margin shorter than anterior, and usually bordered by 3-4 small postmental scales; dorsal body scales small, granular; abdominal scales small, subimbricate; males with large rounded patch of preanal pores, and 2-3 medium length rows of femoral pores; in females vestigial preanal pores few or absent, femoral pores absent; tail elongate prehensile tapering finely, covered with moderate-sized scales; in males the base of the tail swollen to accommodate the hemipenes, and with 2-3 enlarged pointed conical yellow/brown scales on each side of the swollen base; females with vestiges of these scales.

Colour. Less variable in colour than *N. e. elegans;* generally dark bluish-green dorsally, with or without paler leaden-grey spots or lines, which when present are not darkly outlined. Ventral surface of females pale green, often with yellowish tone; that of males bright pale green. Dorsal and ventral coloration of males separated by a blue stripe along the flank, between insertion of fore and hind limbs. Lower lip frequently edged in white; mouth and tongue dark blue. Undersurface of feet and toes bright yellow. Dorsal surface of toes fringed in yellow. Yellow individuals known, but much less common than in *N. e. elegans*.

Although the colour description is based on preserved material it is consistent with colours of live specimens as previously observed by both of us.

RANGE. This subspecies is found in the south-eastern region of the North Island, from East Cape to southern Hawkes Bay east of the main dividing ranges and across the southern part of the island (Fig. 7).

TYPE LOCALITY. New Zealand.

Type. Adult male in the collection of the British Museum (Natural History) (BMNH 1946.8.22.38).

Material examined. Naultinus elegans punctatus. Holotype: BM(N.H.) 1946.8.22.38. Ecology Division, D.S.I.R. collection: G19, 21, 23, 25, 35, 36, 304-7, 334, 418, 526, 531, 863, 867-9, 1050, 1074, 1076, 1104, 1105, 1108. Zoology Department, University of Auckland, collection: R108-114. National Museum collection: R70, 75-79, 80-84, 87, 344, 413, 437, 460, 508-09, 799, 828, 837, 888, 915-18, 976-80, 1581.

Naultinus grayi Bell, 1843 (Figs. 3, 4, 6, 7)

1843 *Naultinus grayi* Bell, *Zool. Voyage "Beagle"* 5, Rept. p. 27; pl. 16, fig. 2.
1845 *Naultinus grayi:* Gray, *Cat. Liz.*, p. 170.
1861 *Hoplodactylus grayi:* Fitzinger, *Sber. Akad. Wiss. Wien.* 42: 400.
1871 *Naultinus grayi:* Buller, *Trans. Proc. N.Z. Inst.* 3: 7.
1872 *Naultinus punctatus* (part): Hutton, *Trans. Proc. N.Z. Inst.* 4: 171.
1875 *Naultinus grayi:* Gunther, *Voyage of Ereb and Terror* Rept. p. 17.
1885 *Naultinus elegans* (part): Boulenger, *Cat. Liz.* 1: 168.
1897 *Naultinus elegans* (part): Lucas and Frost, *Trans. Proc. N.Z. Inst.* 29: 267.
1955 *Naultinus elegans* (part): McCann, *Dom. Mus. Bull.* 17: 28.
1961 *Naultinus elegans* (part): Chrapliwy, Smith and Grant, *Herpetologica* 17: 7.
1965 *Naultinus elegans* (part): Wermuth, *Das Tierreich* 80: 110.

Diagnosis. Large-sized *Naultinus* (snout-vent length up to 95 mm); dorsal surface of snout, to level of eyes, covered with very large, flat, polygonal scales, more posteriorly head scales smaller and granular; rostral (of adult) usually more than two and a half times as broad as depth at centre; mental broad, subtriangular, usually bordered below by two medium-sized postmental scales. The species is diurnal.

Description. Head oviform, moderately large; snout wedge-shaped, canthus rostralis relatively well defined; forehead flat; ear-opening small to minute, oval, horizontal; body and limbs moderate to robust; digits free, clawed, somewhat dilated, narrowing distally, 11-17 (usually 13-14) straight-edged lamellae under 4th toe; dorsal surface of snout (Fig. 6), to level of eyes, covered with very large, flat, close-packed scales, more posteriorly, head scales small and granular; rostral (Fig. 3) (of adult) usually more than two and a half times as broad as depth at centre, with median cleft extending downwards from upper border; nostril pierced between first upper labial and 3-5 (usually 4) nasals, the anterior-most of which is enlarged; 1 large internasal; 9-14 (usually 12) upper labials, and 9-13 (usually 11) lower labials; mental (Fig. 4) broad, subtriangular, usually bordered below by two medium-sized postmental scales; dorsal body scales small, granular, abdominal scales small, subimbricate; males with large oval patch of preanal pores, and 2-3 rows of femoral pores, females with vestigial preanal pores and with or without a few scattered vestigial femoral pores; tail elongate, stout, prehensile, tapering finely, covered with moderate-sized scales; in males the base of the tail swollen to accommodate the hemipenes, and with 2-3 large, pointed conical scales on each side of the swollen base; females with small vestiges of these scales.

Colour. Dorsal surface vivid green, frequently with tan, yellow, pale green or grey markings, which may be outlined with a fine black or brown line, and extend on to the tail; in some individuals markings may be in the form of mosaics of different coloured scales. Ventral surface pale, bright green, sometimes with a yellowish tinge; males with a blue stripe on the flank separating dorsal and ventral coloration. Lower lip sometimes with a white band; mouth deep blue, tongue bright orange or red. Undersurface of feet and toes yellow; dorsal surface of toes fringed with yellow. Greenish yellow individuals occur very infrequently; these may be marked with white.

RANGE. Confined to the northern extremity of the North Island (Fig. 7).

TYPE LOCALITY. Bay of Islands.

Holotype. Adult female in the collection of the British Museum (Natural History). (BMNH 1946.9.8.16).

Material examined. Naultinus grayi. Holotype: B.M.(N.H.) 1946.9.8.16. Ecology Division, D.S.I.R. collection: G231, 232, 303, 308, 770, 789, 797, 897. Auckland Institute and Museum collection: Rep. 27-24, 27-25. Zoology Department, University of Auckland, collection: R105-7. Live specimens: 7 in private collection (R.A.H.), Kaitaia area (3), Lake Ohia district (4); 83 in field, Lake Ohia district.

DISCUSSION

Three distinct forms of *Naultinus* can be distinguished morphologically — one found in the extreme north of the North Island, one in the central area of the North Island, and some off-shore islands, and one in the southern and south eastern regions of the island. These forms are designated in this paper *N. grayi*, *N. elegans elegans*, and *N. elegans punctatus* (stat. nov.) respectively. They have allopatric distributions with very little overlap or intergradation between them (Fig. 7). The only obviously hybrid population known to the authors is one near Turangi, in which most animals are typical *N. e. elegans*, but some are much larger and more heavily built, probably indicating *N. e. punctatus* ancestry.

Morphologically the three forms may be distinguished mainly by colour, scalation, and size differences. *N. grayi* has an orange to red tongue contrasting with dark blue mouth lining, whereas in both subspecies of *N. elegans* the tongue and mouth are uniformly blue. *N. e. elegans* (snout-vent length 65-75 mm) is considerably smaller than *N. e. punctatus* and *N. grayi* (snout-vent length 95 mm). *N. e. punctatus* is relatively heavier and more stocky in build, than specimens of the other two forms.

The most common colour in all three forms is plain green in various shades. In *N. e. punctatus* the only common variation of this is a double line of pale grey-green spots or streaks down the back, but in both *N. e. elegans* and *N. grayi* the markings may be much more pronounced and varied in form and colour. Despite the superficial similarities in the variety of markings in these two forms, however, numerous small but consistent differences suggest that they represent parallel elaborations from a simpler ancestor. In both forms the markings may be simple (as in *N. e. punctatus)* or outlined in dark green or black. A double row of spots on the dorsal surface is the most common form of marking, and in more heavily marked specimens there is usually longitudinal striping on the undersurface, and there may be an extra row of smaller spots along each flank, and markings on the limbs.

Bright yellow, white, or light green markings are found in both of these forms, while pale gold and pink markings are found only in *N. e. elegans*, and pale grey or tan markings are unique to *N. grayi*. This latter form is also the only one in which markings made up of mosaics of differently coloured scales occur. In *N. elegans* individual markings are, in our experience, always of a single colour, (except when provided with a brown or black outline).

Rostral and mental scales show differences, as indicated in Table 1 and Figs. 1-4. All *Naultinus* adults show sexual dimorphism in colour; males have a blue lateral or ventral component which is absent in females. In *N. grayi* males are born with a pale blue belly and dark green dorsal surface, while newborn females may show some blue mottling on the belly. In the female the blue quickly disappears so that by the time the animal is six months old the adult colouration (bright green dorsally, pale green ventrally) is established. In the male of this species the blue colouring migrates laterally to form a band along each flank, separating the dark green dorsal surface from the vivid pale green belly characteristic of the adult. Adult male *N. e. punctatus* show the same colour pattern. In *N. e. elegans* however, no change of distribution of the blue pigment occurs except for a slight spreading and intensification as the animal matures, so that the whole ventral surface and the lower part of the lateral surface is light blue in the adult male, and in some specimens the dorsal surface also appears to have been "washed" with blue.

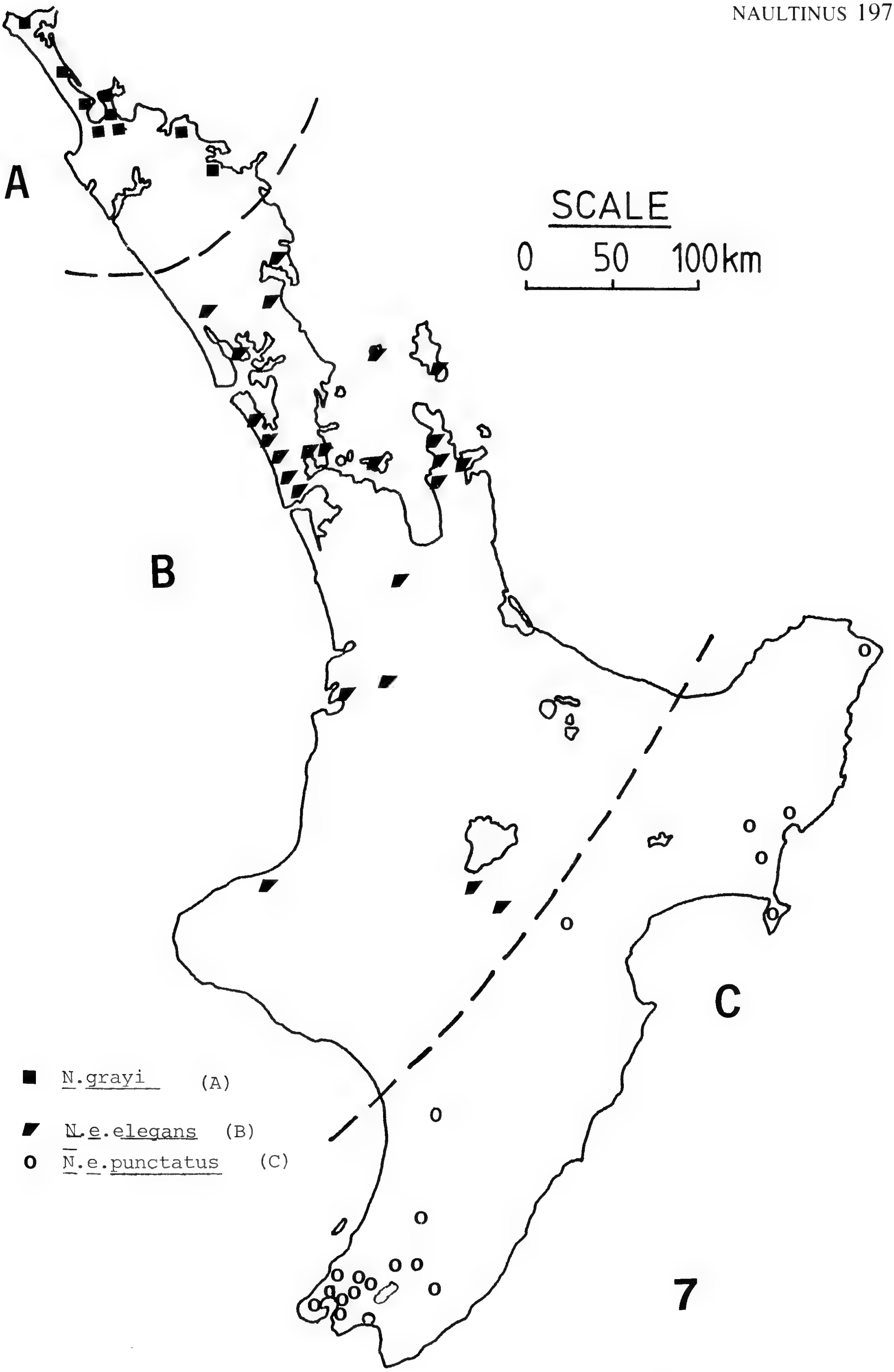


Fig. 7. Localities of *Naultinus* specimens examined.

Table 1. Summary of characters distinguishing taxa within the genus *Naultinus*.

	N. elegans		*N. grayi*
Scales on snout	Domed, round-based		Flat, polygonal
Rostral	Width less than two and a half times height at centre		Width two and a half or more times height at centre
Mental	Usually roughly oblong or square, bordered posteriorly by 3-4 small submentals.		Usually roughly subtriangular or oblong, bordered posteriorly by two submental scales
Snout	Bluntly rounded		Wedge-shaped
Earhole	Moderate		Small
Vestigial preanal pores in female	Absent, or very few		Usually present
Young born	Late winter — early spring		Late summer
	N.e. elegans	*N.e. punctatus*	
Markings	Complex	Simple	Complex
Undersurface of feet and toes	Grey-green	Yellow	Yellow
Belly of adult male	Blue	Green	Green
Enlarged scales at base of tail in male	Green	Yellow	Green

Apart from the differences in structure, colour, and size between the three forms described above, *N. grayi* is separated by its reproductive cycle from the subspecies of *N. elegans*. The young of the former are born during late summer (March) in the field after a gestation period of 7-8 months, mating occurring in early spring (late July-August). Most animals mature during their second spring at 16-17 months of age, and have their first young at two years of age. By contrast *N. elegans* produces its young in the field in early spring (August) and mating occurs within a month to give a gestation period of about 11 months. A combination of slower juvenile growth and the much longer gestation period means that in this form the first young are not born until the animal is at least three years old.

We are of the opinion that these consistent physical differences justify a formal description of three separate taxa, and the demographic differences between the northern taxon and the other two warrant a specific distinction between them. Accordingly, two species, *N. grayi* and *N. elegans* are recognised by this study, and *N. elegans* is split into two subspecies *N. elegans elegans* and *N. elegans punctatus*.

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CONTENTS

MAORI FORTIFICATIONS OF THE OMATA AND OAKURA DISTRICTS, TARANAKI

NIGEL PRICKETT

AUCKLAND INSTITUTE AND MUSEUM

Abstract. Thirty-two Maori fortifications of the Omata and Oakura districts, Taranaki, are described. The majority of sites have ring-ditch defences. A high proportion enclose only a very small occupation area.

In recent years there has been a considerable effort put into archaeological site surveying, funded mainly by the New Zealand Historic Places Trust. This has added to the public record a very large number of previously unrecorded sites including many fortified pa. Most surveying work, however, has been extensive rather than intensive in nature. Districts have been covered rapidly with the aim of recording most prehistoric archaeological sites within them. This has followed partly from the conservation and site management goals of the Historic Places Trust acting under the Historic Places Amendment Act 1975, and partly because of a widespread interest in site distribution studies. One result of this approach has been that topographically complex sites such as pa have been sketched quickly by pacing or tape and compass techniques and that more accurate mapping has been deferred until some time in the future when resources can be specifically directed to this end.

The archaeological study of Maori fortifications has proceeded fitfully since Best's pioneer work *The Pa Maori* was first published in 1927 (Best 1975). Since then there have been a number of important contributions of a descriptive and theoretical nature. While much material has been published, however, and some useful analytical ideas introduced yet we remain faced with a fundamental lack of accessible descriptive material on pa. The growing body of knowledge on site record forms has not found its way into published form. Improvements in theoretical discussion of Maori fortifications depends to a large extent on publication of basic descriptive material which may then be used for analysis. The most useful contributions are those which give descriptions of all sites in a particular region. This results in a controlled sample which may be used with confidence in comparative studies at many levels as well as providing a coherent descriptive work of interest in itself.

Taranaki is already the focus of one of the most important studies of pa yet published in New Zealand. In his *Archaeology in North Taranaki, New Zealand* Buist (1964) examined the Maori fortifications of the region between the Onaero River and Paraninihi at the northern margin of the Taranaki lowland. Subsequent unpublished field recording in Taranaki has focussed on the Hawera and Patea districts and the area south of Stoney River. The aim of the present programme is to map all surviving pa between Stoney River and the present New Plymouth urban area and to record those now destroyed.

The region of interest between New Plymouth and Stoney River has a coastline of *ca.* 20 km and extends inland *ca.* 5 km. The coastline is open to the north-west and consists of extensive sand beaches separated by reefs of volcanic rock and boulders which can extend some distance offshore. Behind the coast is a sea cliff or scarp up to 50 m in height rising to a discontinuous terrace which may be traced south from the Omata district as far as Stoney River. In the centre of the survey area the narrowest part of the coastal plain is backed by the steep spurs and ridges of the Kaitake Range which rise to over 680 m. To the north and south the survey area is bordered by broken country which rises to the flanks of the Pouakai Range north of Mt Egmont. A major ridge of this higher broken country reaches the coast north of the Tapuae River.

The survey area comes within the traditional territory of the Taranaki tribe. History records that during part of the 18th century this tribe was on the offensive at the expense of the neighbouring Te Atiawa and that they occupied lands up to about the Waiongana River north of New Plymouth (Smith 1910: 216). Towards the end of the century, however, the Te Atiawa gained ascendancy and drove the Taranaki people southwards, early in the 19th century taking the great citadel of Koru on the south bank of the Oakura River. At the time of European intrusion the boundary of the Taranaki and Te Atiawa tribes had settled just north of the Herekawe Stream (Smith 1910: 117). Thus the survey area extends to what was, for some time at least, an important inter-tribal boundary.

The area was first settled by Europeans with the purchase of the Omata and Tataraimaka Blocks in 1847. The remainder was confiscated and settled in the 1860s. Pakeha settlers found an open countryside under bracken, tree fern and native shrubs and grasses which extended to the forest edge some 2 to 5 km from the coast. Original forest vegetation survived in patches on the terraces and in the narrow river valleys. Almost all Maori fortifications lie within the open and semi-forested coastal belt.

This paper reports the results of three weeks mapping of pa of the Omata and Oakura districts in November and December, 1979. The northern boundary of the work is the Herekawe Stream, the southern boundary is Ahuahu Road. The mapping was carried out by two teams using alidade and plan table or tape and compass and 'dumpy' level according to topography and vegetation cover. A further two weeks in April, 1980, allowed some checking of original work and examination of sites in the area now too badly damaged for useful mapping.

The entire survey area falls within the N.Z.M.S.1 series map N108 (New Plymouth). Map references are from the third edition, 1970. Site numbers refer to the New Zealand Archaeological Association site recording scheme. Names ascribed to pa were obtained from the original Lands and Survey Department blocksheets covering the Paritutu and Wairau Survey Districts which are now in the Lands and Survey Department, New Plymouth. The 1950 aerial photographs referred to are from the New Zealand Aerial Mapping Ltd (Hastings) series, which are held by the Lands and Survey Department.

The distribution of pa within the surveyed area is shown in Fig. 1. Presentation of individual sites is organised geographically by stream or river catchment areas, working in general from north to south through the Omata and then the Oakura district.

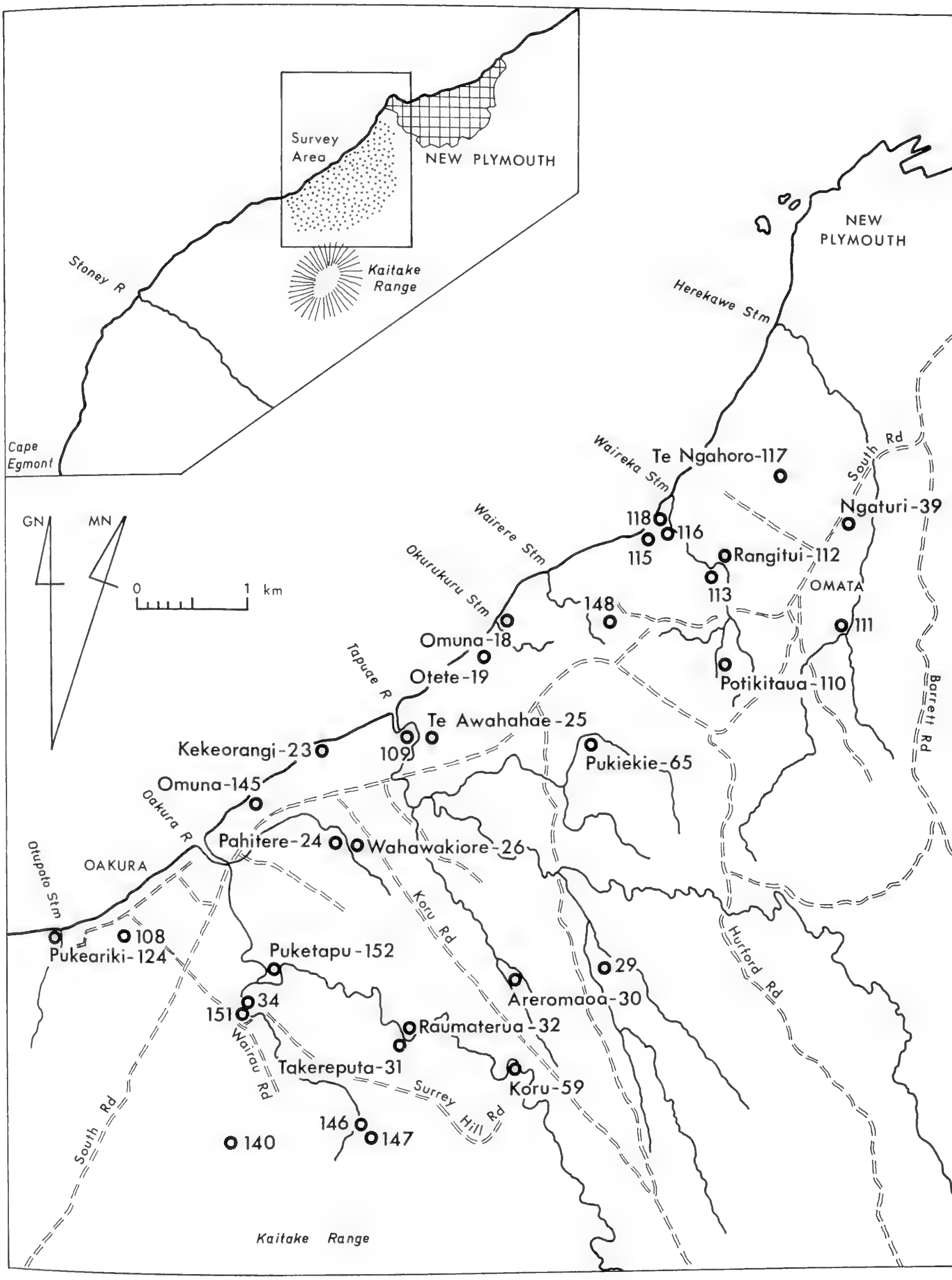
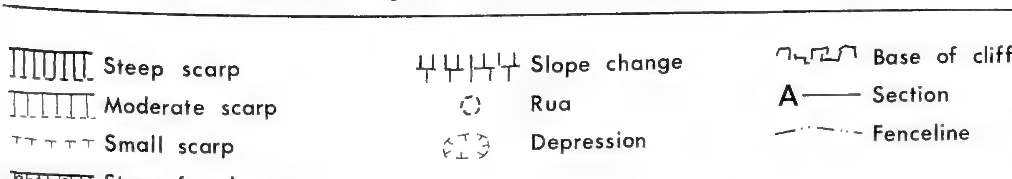


Fig. 1. Distribution of pa in the Omata and Oakura districts, Taranaki.



Key for Figs. 2, 4, 6, 7, 8, 12, 14, 16, 18, 24, 27, 28, 31, 34 and 35.

Te Ngahoro N108/117 (598888) Figs. 2, 3

Te Ngahoro is situated on a prominent hill rising above the surrounding terrace country seaward of the main South Road between Beach Road and Herekawe Stream. It thus commands a wide area northwards to Paritutu and south to Waireka Stream. The site is topped by the 'Lloyd G' trig station, 88.5 m above sea level. Damage has been done by quarrying operations which some time in the past saw the removal of much of one of the two occupation platforms of the pa. The site is now under pasture. Its prominent skyline situation and its location on the outskirts of New Plymouth make Te Ngahoro one of the most visually important archaeological sites in Taranaki.

Defences consist of a single ditch and bank which runs around the site, broken only by road access to the old quarry. Outside the artificial defences further security is given by the steep slope of the hill to the south and east. A slight spur runs down to the west, while to the north there is an easy slope to the level ground below. The scarp from the bottom of the ditch to the rim of the occupation platforms is now about 4 m in height. Within the pa there are two platforms separated by a slight ditch and scarps which presumably indicate additional, internal defence. A slight rim surrounds most of what remains of the circumference of the two platforms.

Of the two platforms, the intact eastern one is the larger, being *ca.* 575 m^2 in area. It is also the higher platform of the two. The lower platform appears to have been *ca.* 450 m^2. The total occupation area including the internal defences is *ca.* 1100 m^2. There is no surface evidence of house terraces or other features on the two platforms. Two slight depressions in the outer bank are suggestive of collapsed *rua*, or underground food storage pits.

According to tradition Te Ngahoro was occupied towards the end of the 18th century (Smith 1910: 237, 242-243). With European settlement it became widely known as 'Major Lloyd's pa' after an early landowner. In February, 1861, the hill was used by a force of Taranaki and other southern tribes as a position from which to fire on the nearby Omata Stockade.

Ngaturi N108/39 (605884)

Early in 1860, European settlers of the Omata district built a stockade on the site of a former Maori pa called Ngaturi. The situation was a commanding one on a hill which rose above the surrounding terrace country in much the same way as nearby Te Ngahoro. The site, which owes its present topography to the settlers' works of 1860, can be seen next to the main road above the left bank of the Herekawe Stream.

It seems likely from its situation that Ngaturi was defended by a single ditch and bank. When excavations were undertaken at the Omata Stockade in January and February, 1977, some evidence was uncovered of the earlier Maori occupation of the hill (see Prickett 1978a). Three *rua* had evidently been cut from different levels of an uneven occupation platform. These were apparently located on the former platform margin. A terrace cut in to the southern side of the hill had been filled in by the settlers in preparing the site for their fortification. The present rectangular platform of 25 x 15 m maximum dimensions gives an area of *ca.* 275 m^2, which may not be substantially altered from the earlier occupation platform of Ngaturi pa.

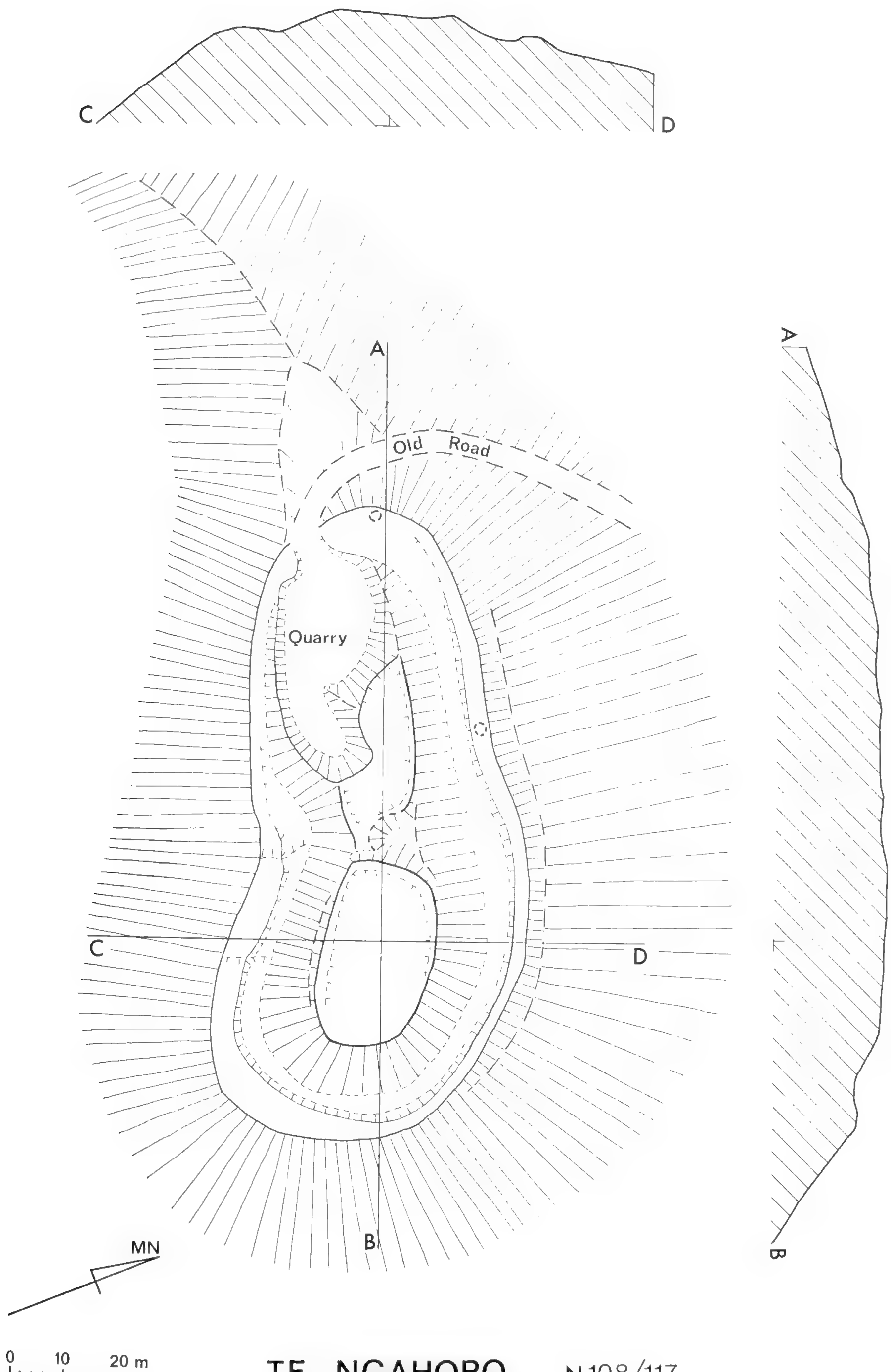


Fig. 2. Plan and sections of Te Ngahoro (N108/117).
(For key to plan figures see below Fig. 1).

Fig. 3. Te Ngahoro from South Road — view from the east.

N108/111 (604873)

This small pa is situated at the confluence of the Herekawe and Mangahererangi Streams, at the end of an undulating spur which extends some 200 m from the south-east margin of the Omata terrace. The fortification is marked on the Lands and Survey Department blocksheet (Paritutu VIII, 36/10) but no name is given. The site is in poor condition under pasture. A blurred defensive ditch, some difficult terraces and a single open pit are all that remain.

The situation on the steep sided spur end allows strong natural defence on three sides. At the east end and south side is a precipitous drop of 30-35 m to the Herekawe Stream. The north side of the spur is slightly less steep and falls away into a side gully. The only artificial defence now apparent is an eroded ditch 12 m long and 5 m wide which cuts the spur at the west end of the site.

The main defended area is *ca.* 34 x 12 m, of an area of *ca.* 300 m^2. A single platform rises slightly to an artificially flattened high point in the centre. Two or three more terraces are cut into the gentle slope which falls from the centre to the platform rim. Below the platform, on the comparatively easy north face of the site are two more artificial terraces. On the precipitous south side of the site a single open pit 5 x 2 m occupies a small natural terrace 10 m above the stream.

Potikitaua N108/110 (592869) Figs. 4, 5

Potikitaua is situated on a spur between two upper branches of the Waireka Stream, between South Road and Waireka Road. It occupies a commanding knoll on a long, generally low, spur which runs down to the north. A deep and narrow saddle gives good natural protection against an advance down the spur, the two flanks offer only precipitous approaches, while the approach from the north is comparatively easy up a gentle slope. Higher ground to the south and west is *ca.* 200 m distant. Some erosion of defences has occurred, especially on the west side. The present landowner reports some filling in of *rua*

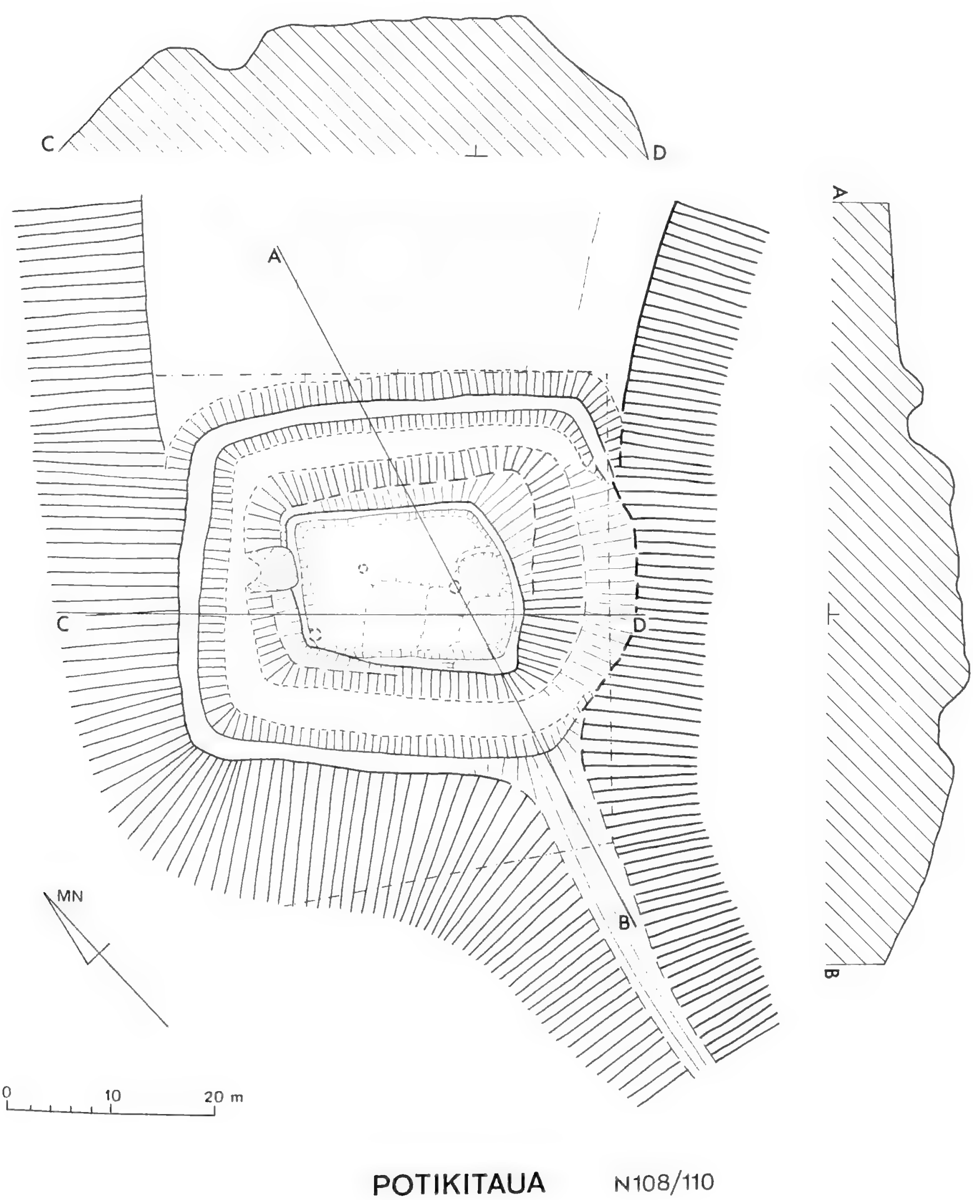


Fig. 4. Plan and sections of Potikitaua (N108/110).

Fig. 5. Potikitaua — aerial view from the south.

pits in the past to prevent stock losses. The site is now under grass with scattered rewarewa outside the defences to the west and other native vegetation clinging to the cliff on the eastern side.

Its difficult natural approaches apart, Potikitaua is defended on three sides by a single strong ditch and bank, with a steep 3-4 m scarp to the occupation platform. On the east side of the pa the ditch and bank is absent, defence here being left to the precipitous natural slope. A pronounced rim surrounds the occupation platform, in places reaching upwards of 50 cm in height. This is especially strong at the southern corner next to the spur which runs away to higher ground.

The occupation platform of Potikitaua gives an available living area of *ca.* 250 m^2. The platform slopes down to the north. Four or five small terraces were presumably designed to accommodate dwellings or other structures. Three characteristic depressions indicate *rua*, although what proportion this is of the original number is not known.

Rangitui N108/112 (593880) Fig. 6

Rangitui occupies a knoll in a low part of the long ridge between Waireka and Waioratoki Streams, *ca.* 700 m from the sea. It is a little up and across the Waireka Stream from N108/113. The situation is low down below the general level of the surrounding countryside. The site is now under grass and scattered native trees and shrubs. A single large karaka tree stands on the south-east end of the platform. The pa is mostly in

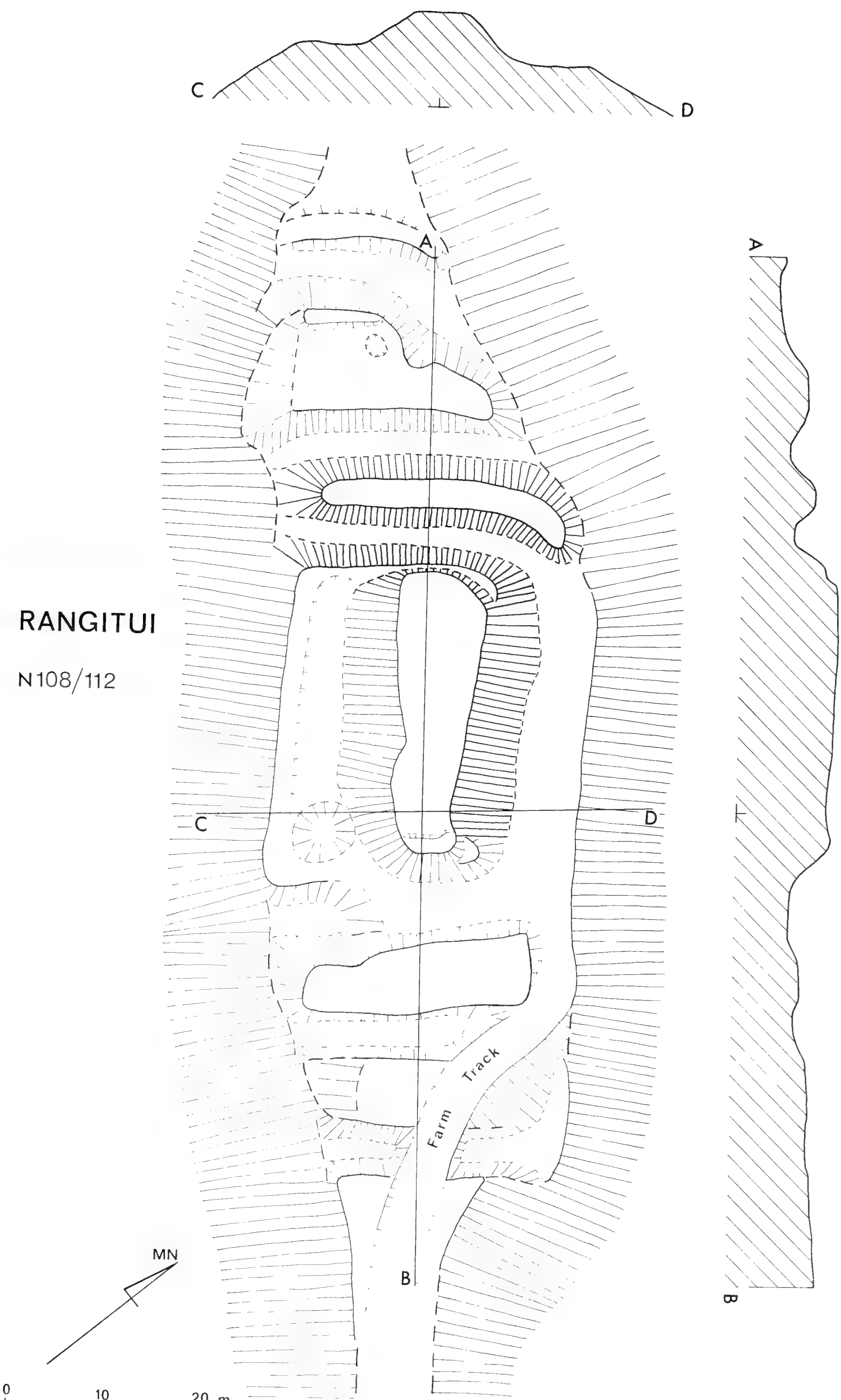


Fig. 6. Plan and sections of Rangitui (N108/112).

good condition, although a plantation of pines has recently been felled and removed from the south-west flank of the site with some damage being done to the earthworks. The defences of the north-east side have suffered considerably from the preparation of a farm track, the same track also having been cut through the successive ditch and bank defences of the south-east end of the site.

Use has been made of a slight knoll for the fortification despite easy approaches from both directions along the ridge. Higher ground is *ca.* 100 m distant along the ridge to the south-east and *ca.* 60 m along the ridge to the west. Neither are the flanks particularly precipitous: to the north-east there is an approximately 10 m drop into the now swampy bottom of the Waioratoki Stream valley, while on the other side the Waireka Stream runs *ca.* 20-25 m below the pa. Very strong ditch and bank defence compensates for the easy natural approaches. In both directions along the ridge are three ditches and intervening banks. A single ditch and bank runs along both sides. The total depth of successive defences at the south-east end (from the counterscarp of the outer ditch to the rim of the occupation platform) is 32 m. At the other end successive defences are even longer. Between the second and third ditch at the north-west end is a broad platform rather than a bank; this has a slight rim on the outer margin and a depression, possibly signifying a *rua*, on it, and may have been used as a living area. The present scarp from the inner occupation platform to the bottom of the ditch is *ca.* 4 m high. The south-east end of the platform is topped by a substantial 50 cm high bank.

The total area occupied by the fortification is *ca.* 2400 m^2. The considerable defences, however, defend only a tiny inner platform of *ca.* 200 m^2. The platform is 28 m long and 5-9 m wide. Successful defences would, of course, have required outer banks to be manned as well as the inner platform, and this would have presented an attacking force with a formidable problem. The size of the defended occupation area, however, meant that only a small number of people not actively engaged in defence could have been accommodated. Thus this pa may have been a forward tactical fortification designed as a battlefield fieldwork rather than as a defended retreat for a local population. The lack of evidence for food storage, however, leaves open the question of how long any defending force could have held out.

N108/113 (591878) Fig. 7

N108/113 is situated low on a spur between two small gullies on the left bank of the Waireka Stream *ca.* 700 m from the sea. The site is clearly visible from Rangitui *ca.* 150 m distant across the stream valley, and from N108/116 at the mouth of the stream. Use is made of a low rise in the spur which is separated from the high terrace edge about 120 m distant by a broad saddle. The site is under grass, with scattered karaka, rewarewa and other native vegetation. Damage has been done by the formation of a farm road which crosses the ditch and continues up the east side to the occupation platform.

The natural defences of this fortification are slight with easy approaches on every side except to the east where a steep slope falls away into the more substantial of the two flanking gullies. Artificial defences are of the single ditch and bank form. The outer bank is incomplete, partly through recent damage and partly also through much older gaps in the defences which presumably date from the period of construction or occupation. The ditch is wide and the scarp to the occupation platform almost 6 m high in places, although

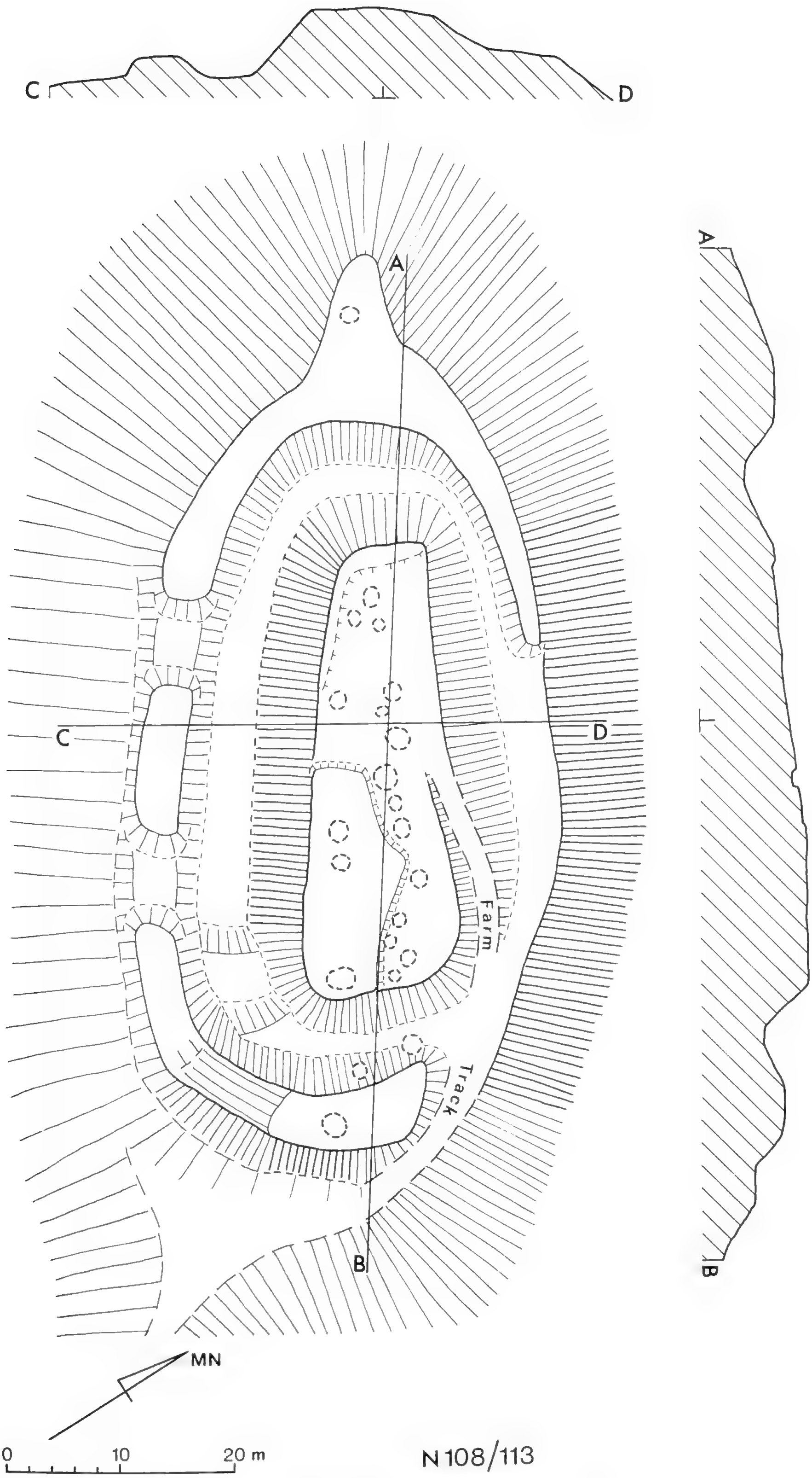


Fig. 7. Plan and sections of N108/113.

only half that at the north-west end. There are two *rua* within the ditch at the south-east end of the site and a further *rua* on top of the outer bank beyond. Another possible *rua* is on the bank at the north-west extremity of the site. On the platform rim at the same end is a substantial bank which presumably added to the defence of the weakest sector of ditch and bank.

The top platform is 38 x 9-13 m in size, *ca.* 400 m^2 in area. The platform is unusual within the survey area in that much of it is taken up by *ca.* 18 *rua*, indicating a great deal of storage for a comparatively small fortification. An area of *ca.* 120 m^2, which occupies much of the higher south-east end of the platform, is separated from the remainder of the broken platform by a slight scarp. The platform as a whole slopes down to the north-west.

N108/116 (586883) Fig. 8

This fortification is marked on the early Lands and Survey Department blocksheet (Paritutu IV, 36/6) but no name is attached. It is located at the northernmost corner of the major terrace now occupied in large part by the Ivon Watkins-Dow research farm, high on the south bank of the Waireka Stream. A slight knoll near the top of a spur leading off the terrace has been strongly fortified. The site commands both the valley of the Waireka Stream to the north and east and the steep face that runs down to low but precipitous sea cliffs to the west. Some damage has been done with use being made of the ditch and bank defence on the east (Waireka Stream) side for a farm track which now runs down the spur. There is also some recent stock damage. The site is under grass.

On the east side of the site a precipitous hillside drops 20 m to the Waireka Stream. To the north and west the approach is up a steep face or slight spur. The southern, vulnerable side of the pa, which faces up the spur, has been strongly fortified. The main defence of the site is a single ditch and bank which encircles the platform. On the uphill side is a second ditch, the counterscarp of which drops straight off the research farm terrace. The bottom of the outer ditch is 2 m lower than the bank within. The main ditch at this uphill side has a scarp now almost 4 m high to the platform rim. For most of the remaining circumference of the platform the scarp is *ca.* 3 m high falling to 2 m at the north side. A slight bank rings the top platform, at the vulnerable southern side rising to more than a metre above the platform level, making it one of the most substantial defensive features of this type in the survey area. On this high section of platform rim are two large holes suggestive of substantial postholes. A gap through the outer bank on the north side, now utilised by stock, may have provided access to the ditch and so into the pa.

The occupation platform of this fortification is only 18 x 13 m maximum dimensions, giving an area of approximately 200 m^2. There is no terracing apparent on the occupation platform which dips slightly to the north and no *rua* were found. On the steep spur below the northern defences are two terraces, from one of which a track appears to run up to the access through the outer bank. Farm roading may have destroyed more evidence of occupation nearby.

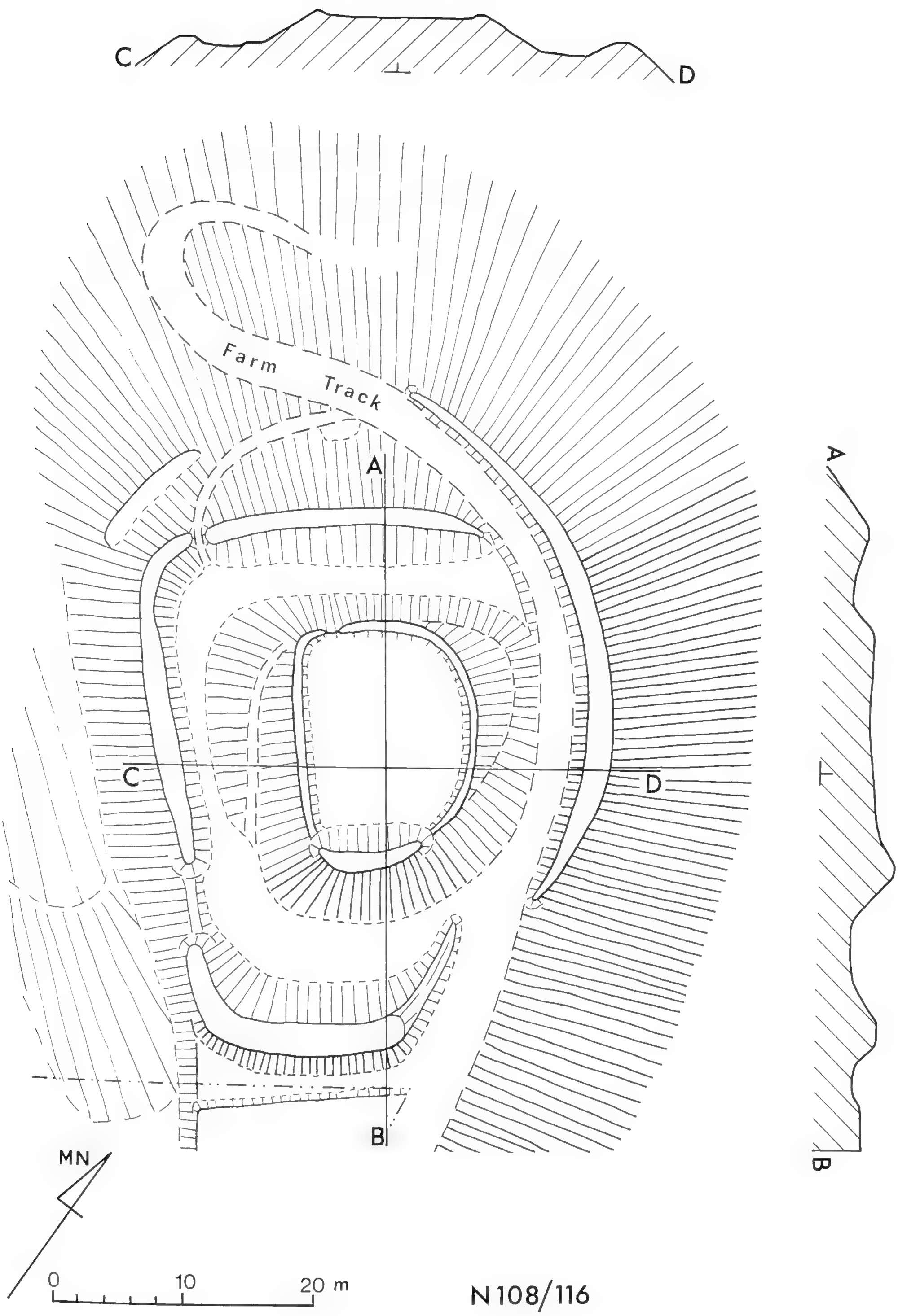


Fig. 8. Plan and sections of N108/116.

N108/118 (586884) Fig. 9

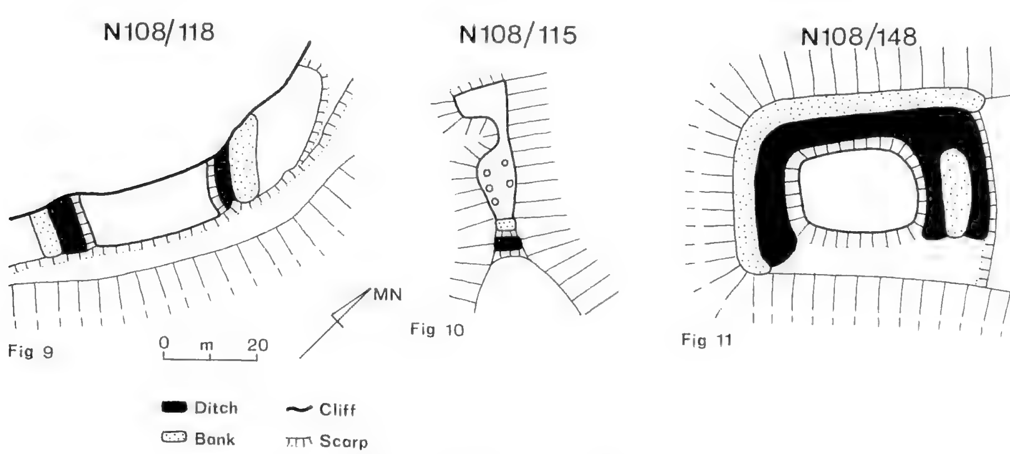
Approximately 100 m north and below the prominent ring-ditch pa N108/116 is the remains of a fortification situated on top of the sea cliff on a low spur which runs northward on the left bank of the Waireka Stream. A farm road makes use of the ditch and bank above the Waireka Stream effectively destroying the defences on this side of the site. Much of the remainder of the site is now vanishing as wind blows away the light soil.

The 1950 aerial photograph (1787/5) shows the four sided fortification standing out fairly clearly under light scrub. The artificial defence consists of a single ditch which runs around three sides with the cliff making the fourth side. Remaining surface evidence indicates a defended platform *ca.* 26 m long, and the 1950 aerial photograph suggests a width of perhaps 20 m. A defended area of *ca.* 500 m^2 is thus indicated. Surface evidence suggests a slight terrace *ca.* 20 m in length outside the defences to the north. Erosion of the sea cliff may have accounted for an unknown amount of the site over the year.

N108/115 (584881) Fig. 10

This tiny fortification is on the sea face *ca.* 100 m from the rim of the Ivon Watkins-Dow research farm terrace and 40 m above the sea. It is 250 m west of the prominent ring-ditch pa N108/116. Use has been made of a very vulnerable situation on a narrow, steeply sloping spur. Much of the bottom end of the site has been entirely removed by the recent preparation of a fence line — what has been lost being barely visible under light scrub in the 1950 aerial photograph (1787/5). What remains is under pasture.

Defences consist of a single ditch which cuts the spur at the uphill end of the site. Beyond it the spur rises to completely command the defended area from only a few metres distance. A bank at the upper end of the defended area takes the usual form. The sides are defended by steep slopes — on the north-east side dropping 8-10 m into a now swampy gully, and on the south-west side dropping 5 m to a terrace now occupied by sheep yards. The 1950 aerial photograph shows what may have been a ditch along the latter side but



Figs. 9-11. Pa plans. 9. N108/118. 10. N108/115. 11. N108/148.

this is now gone. The spur is almost cut through *ca.* 17 m below the upper transverse ditch, perhaps allowing some internal defence. The now vanished defences at the seaward end of the site appear from the aerial photograph to have been another 10 m down the spur.

The steep and narrow occupation area has six *rua* on it. No artificial terraces are evident. The defended area appears to have been less than 200 m^2.

N108/148 (581874) Fig. 11

This pa is located near the headwaters of the Wairere Stream south of Sutton Road. It is situated on a short side spur dominated by the higher ground of the Sutton Road ridge a few metres from the north-east defences. There does not appear to have been any knoll on the spur, but the precipitous hillsides off the end and sides allow good natural defence directed to these approaches — this presumably compensating for the vulnerable north-east end. The site is under grass with some macrocarpa trees off the sides. The topography is blurred and indistinct. Recent tree felling operations have involved some damage to the defences of the uphill side.

Defences consist of an encircling ditch and bank with an additional ditch at the north-east end. This outer ditch is somewhat unusual in that the single encircling ditch continues into both the end ditches rather than, as is usual, for the outer ditch to cut across the ridge quite separately.

The occupation platform has an area of *ca.* 250 m^2. There is no sign of *rua* or other internal features on the platform which dips slightly to the south-west.

Omuna N108/18 (570874) Figs. 12, 13

The name of this pa comes from the Lands and Survey Department blocksheet (Wairau II, 45/4) where it can only be assumed it has not been confused with a second 'Omuna' near the mouth of the Oakura River (N108/145). N108/18 is *ca.* 350 m north of Otete (N108/19) and is situated in a similar unobtrusive situation. The site is close to the north bank of the Okurukuru Stream low down below a scarp which rises steeply *ca.* 120 m away to an extensive terrace, the rim of which completely commands Omuna. The fortification makes use of a slight natural knoll at the seaward margin of a low rolling terrace. It is now under pasture, in generally good order but with stock damage severe in places.

Omuna enjoys good natural defence on three sides — only the inland east side being vulnerable to rising ground beyond the defences. On the north and south sides are slight falls into the heads of short gullies, while to the west is a steep, though not precipitous, drop to the sea beach 25-30 m below. Artificial defences are made up of a single ditch and bank all around. The counterscarp is up to 2 m high while the platform is 3.5-6 m above the ditch.

The occupation platform dips slightly to the west. There are two collapsed *rua* on the platform but no other sign of internal organisation. The platform is 18 x 15 m maximum dimensions, of an area of *ca.* 200 m^2. Approximately 50 m south-west of the pa is a single isolated pit on a steep spur leading down to the Okurukuru Stream.

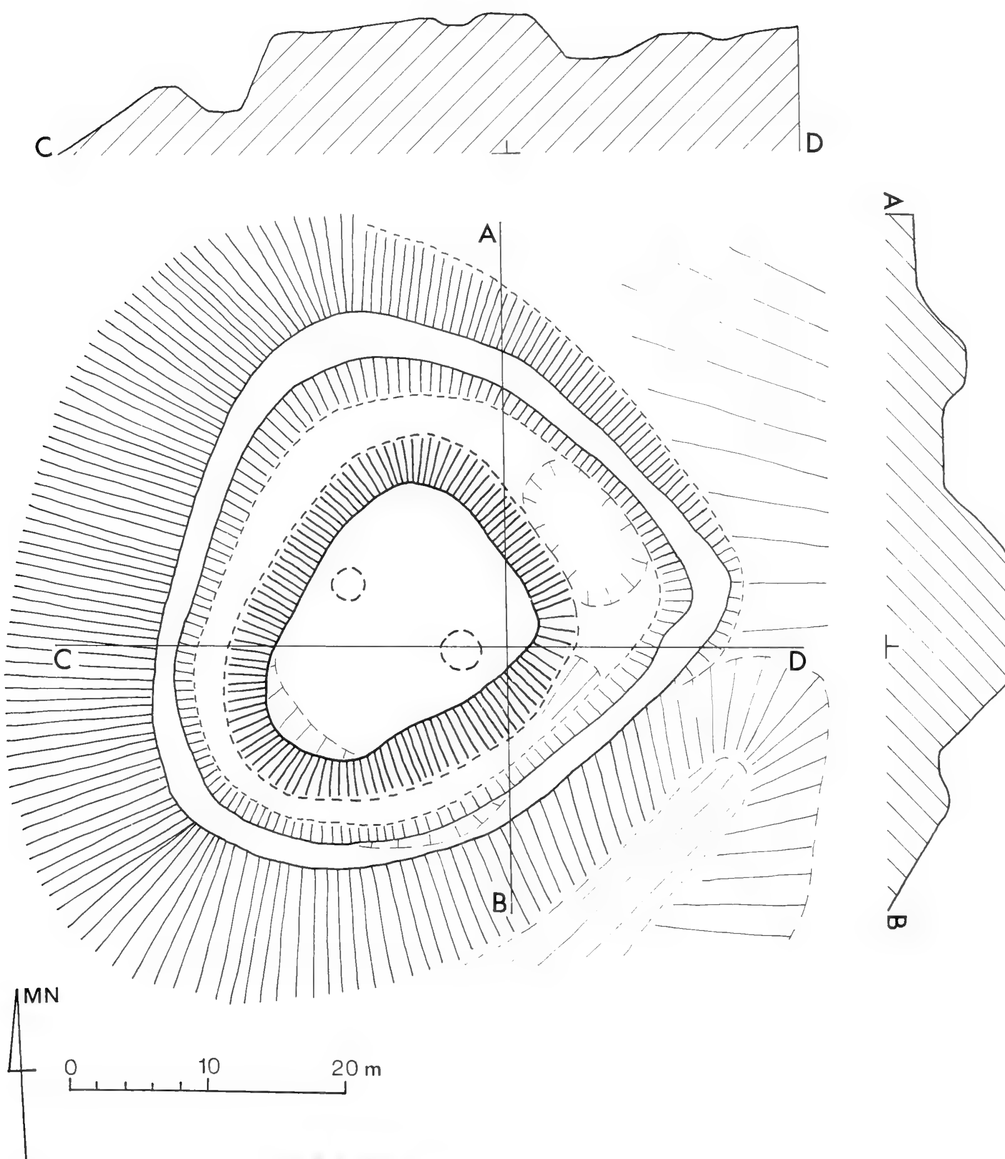


Fig. 12. Plan and sections of Omuna (N108/18).

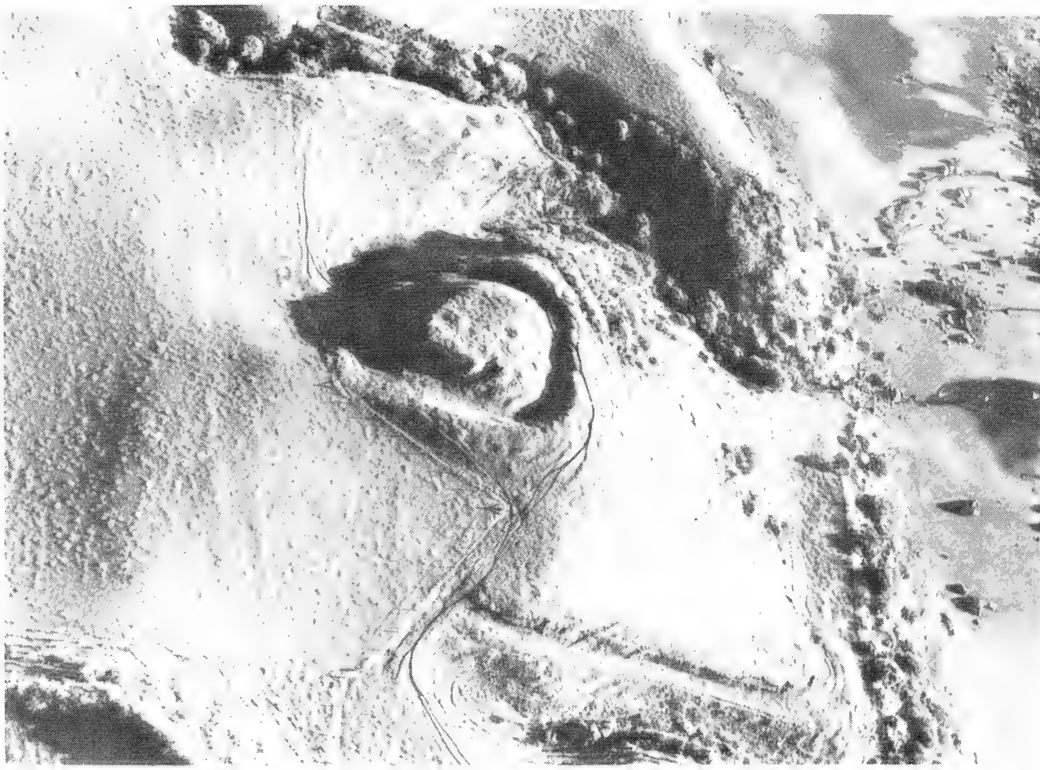


Fig. 13. Omuna (N108/18) — aerial view from the north.

Otete N108/19 (568870) Figs. 14, 15

The Lands and Survey Department blocksheet (Wairau II, 45/4) which gives the name of this pa also gives 'Hakura' as the name of the small watercourse on the site's southern flank. Otete is located on a narrow spur 25-30 m above the beach. The site is dominated by higher spurs only 40-50 m away on both flanks and by steeply rising ground to the south. Considerable damage has been done by initial work for a dam or crossing at the mouth of the short gully to the north and at the two transverse ditches across the site. The scarp defence of the west side is suffering from severe stock damage in places. The site is now under grass.

Artificial defences consist of two ditches crossing the spur, the first is the major defensive ditch presented to the vulnerable southern approach, and the second divides the site in two some 40 m beyond. Flanking defence makes use of steep natural scarps falling some 5-10 m into the now swampy gullies on both sides of the site. The northern occupation platform ends at a precipitous slope to the beach. A slight bank is unusually located, not as is usual at the margin of the occupation platform next to the vulnerable downhill approach, but at the other end of the main platform next to the inner transverse ditch.

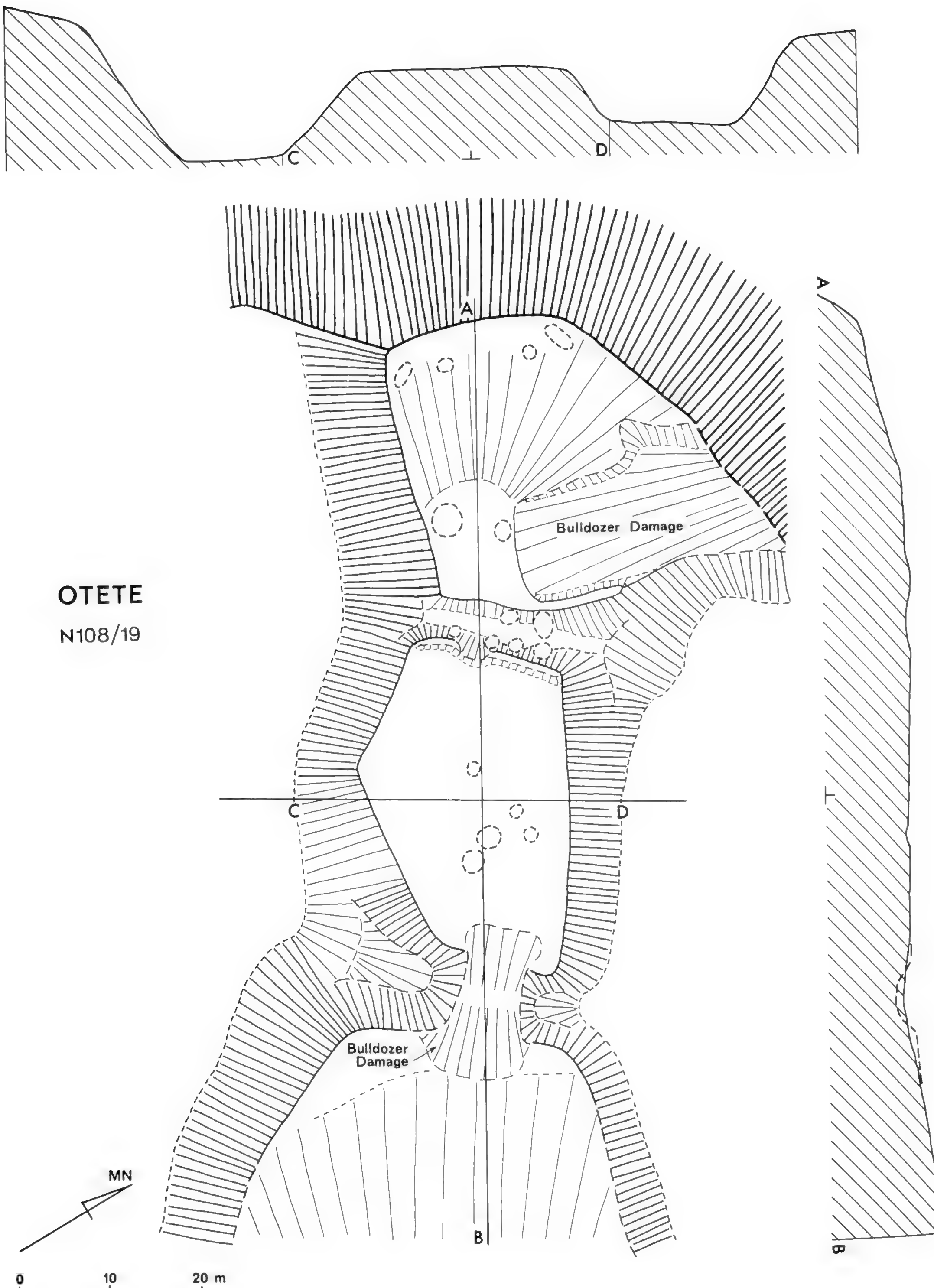


Fig. 14. Plan and sections of Otete (N108/19).

Fig. 15. Otete — aerial view from the north. Two pairs of pits can be seen on the cliff edge in the foreground.

The southerly (main) occupation platform is virtually level and shows no sign of internal organisation except five *rua*. Six more *rua* have been dug into the sides of the inner transverse ditch. What remains of the north sloping seaward occupation area indicates three, or perhaps four, *rua* and some slight scarps suggestive of terracing. Two unusual sharply defined open pits close to the cliff top may belong to the pa or may be later, perhaps even the product of Second World War home guard activity. A similar pit stands isolated on the cliff top *ca*. 100 m north of the fortification, while further north again are two pairs of *rua* situated close to the present cliff top (see Fig. 15). The main platform of Otete is *ca*. 35 x 15-22 m (about 650 m^2), while the seaward platform is 30 x 30 m at its greatest extent giving an area of perhaps 700 m^2. The total area within the outer ditch is *ca*. 1500 m^2 — this including the inner transverse ditch with its important food storage role.

Pukiekie N108/65 (579861) Figs. 16, 17

Pukiekie occupies the top of a prominent hill between Plymouth Road and South Road. Along the northern side the ditch and bank defences have been transformed into a farm road, while some damage is also apparent on the east side. Localised stock damage has also occurred. A boxthorn hedge cuts through the site which is otherwise under grass. Some karaka trees survive on the flanks of the hill below the fortification.

This pa is unusual in the survey area in its use of a commanding natural situation. Elsewhere in the lower Tapuae River valley many high hills with precipitous approaches have been completely neglected, the preferred location even when these superb defensive

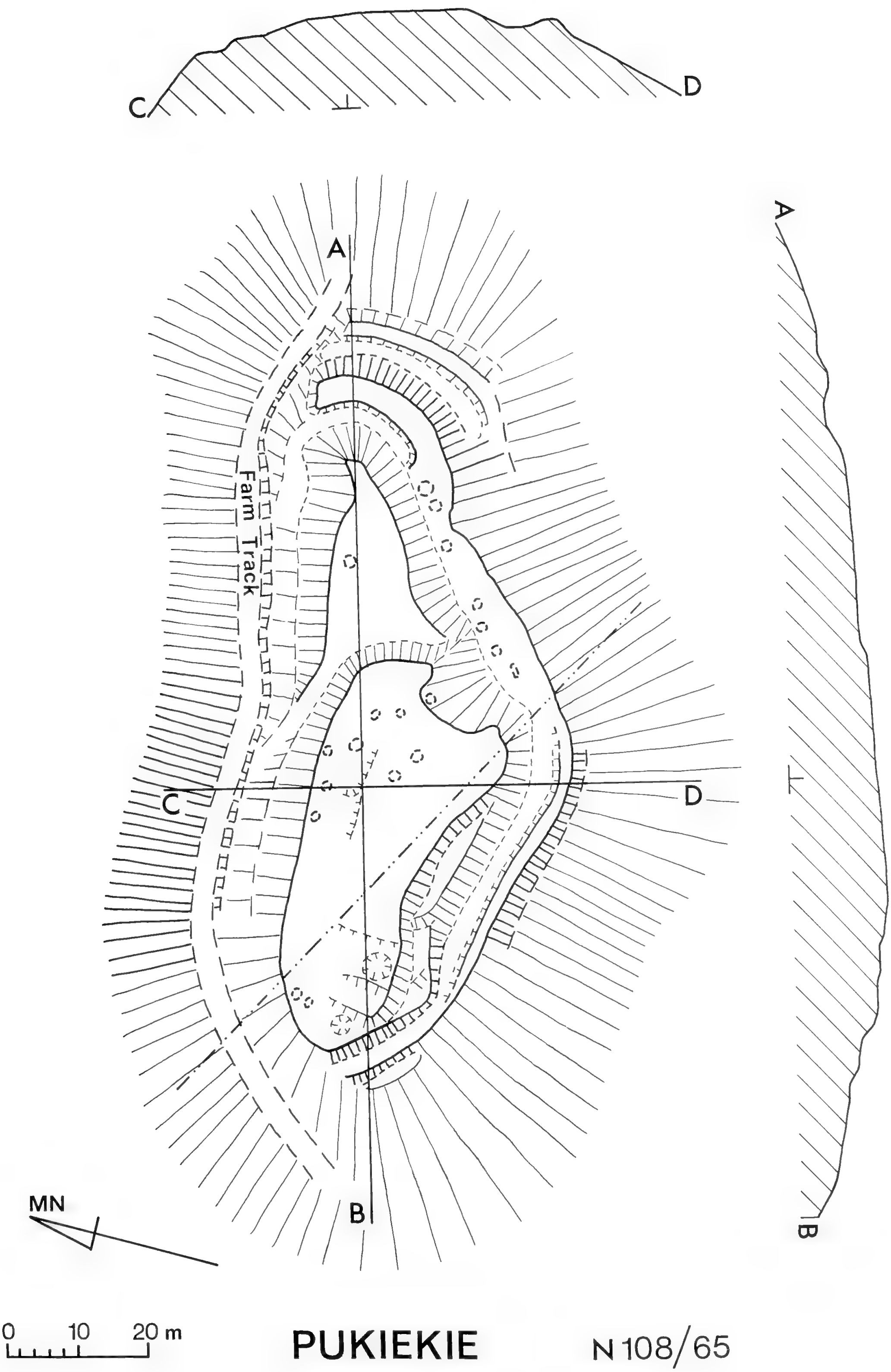


Fig. 16. Plan and sections of Pukiekie (N108/65).

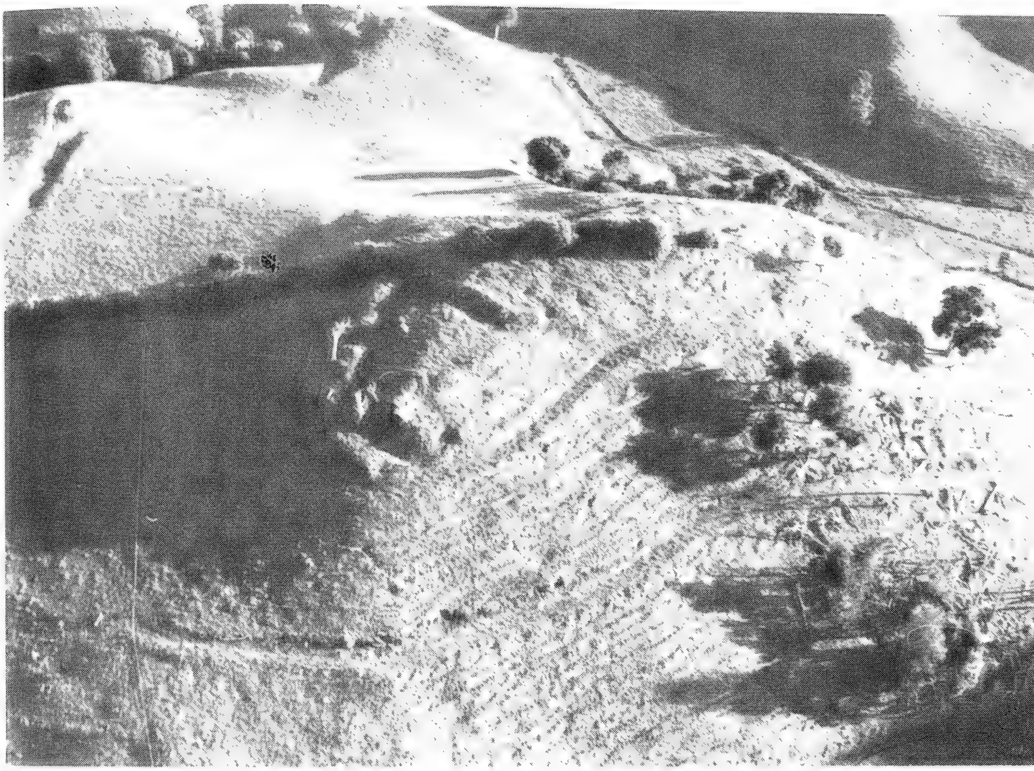


Fig. 17. Pukiekie — aerial view from the north-east.

situations were available remains the unobtrusive spur end low in the stream valleys. Pukiekie is protected to the north, west and south by precipitous natural slopes to the now swampy valley bottoms *ca*. 40-50 m below the defences. To the east is a slight saddle to extensive, slightly lower, rolling country. Artificial defence is made up of a single ditch and bank which was presumably continuous around the site. At the vulnerable east end is a short length of double ditch and bank. A scarp of 1.5 m divides the occupation area in two and may have provided a basis for further internal defences directed at holding the major platform in the face of possession of the lower east end of the pa by an attacking party.

The uneven larger occupation platform has upwards of ten *rua* and several small terraces which together indicate something of the internal organisation. The *rua* cluster at the two ends of the platform. A further six or seven *rua* are located in the defensive ditch of the south-east side of the pa. The lower platform is triangular in plan. Only one *rua* could be located on it. The maximum dimensions of the occupation area within the defences are 80 x 25 m with an area of *ca*. 1350 m^2. The upper platform is *ca*. 1000 m^2 and the lower *ca*. 300 m^2. Immediately outside the defences at the west end of the site is a single terrace 8 x 2 m in size, while three more terraces are further down the steep western spur, *ca*. 20 m below the defences.

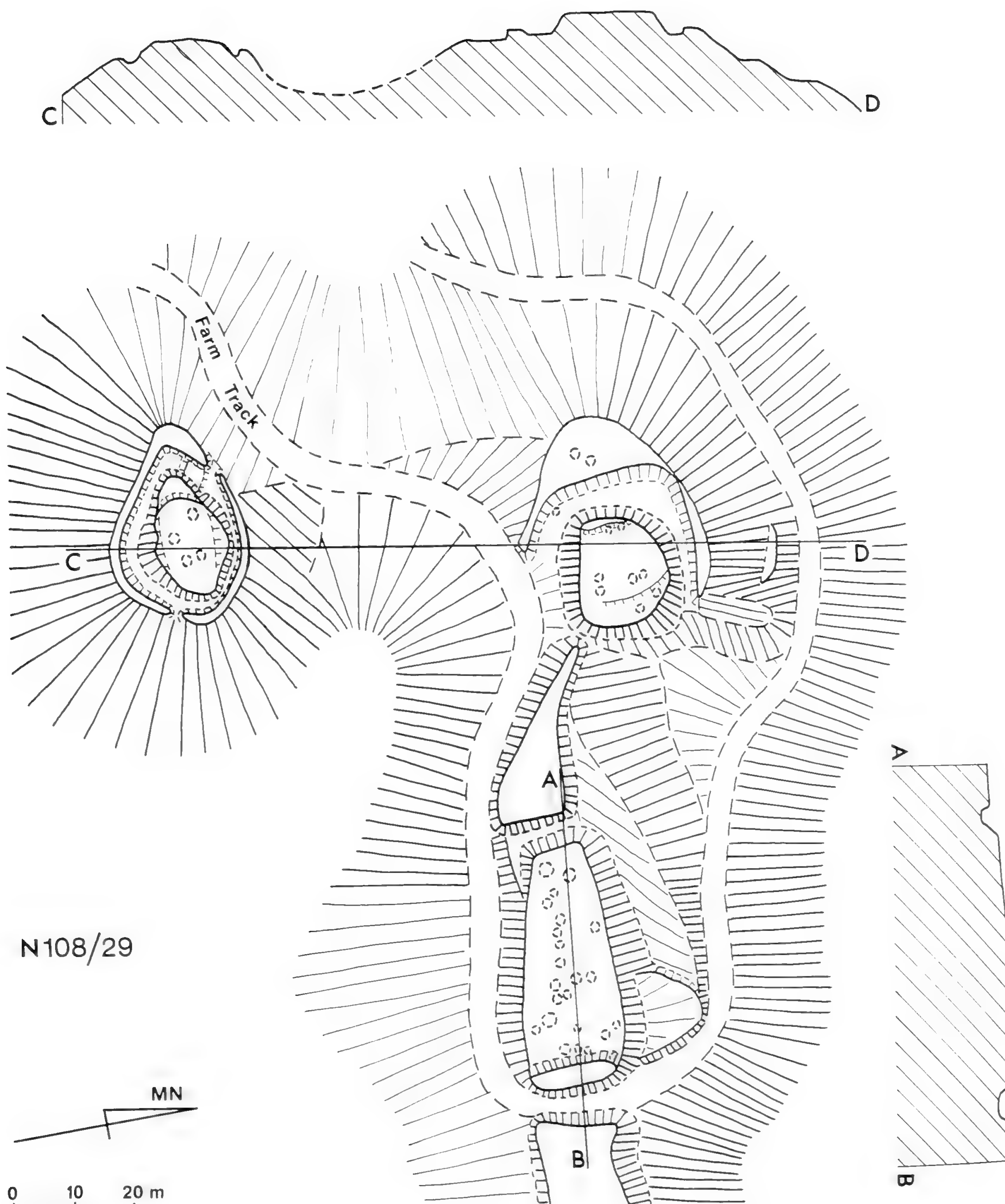


Fig. 18. Plan and sections of N108/29.

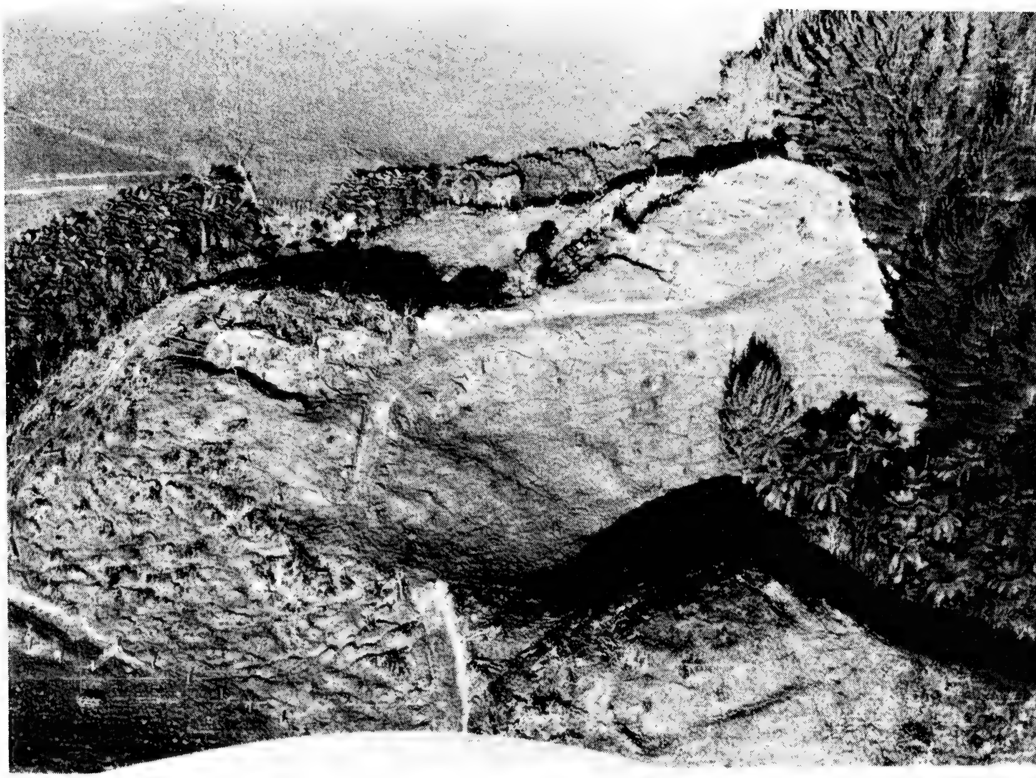


Fig. 19. N108/29 — aerial view from the south-west.

N108/29 (580839) Figs. 18, 19

N108/29 can be seen across a gully 200 m east of Plymouth Road, 2.5 km from the main South Road. It is *ca.* 3 km from the sea and is located on the edge of rolling country broken by the valleys of many small streams which extends east of Plymouth Road to the high ground traversed by Hurford Road. West of Plymouth Road is the extensive terrace country of the Koru Road district. The site is unusual being made up of three small ring-ditch fortifications. Between them they command adjacent gullies and beyond for at least 200 m distance in all directions. N108/29 is now under rough pasture and bracken. Considerable damage has been done to the ditches of two of the defended areas by preparation of a farm track which now winds it way through the site. The site is otherwise in good condition except for local slumping and stock damage.

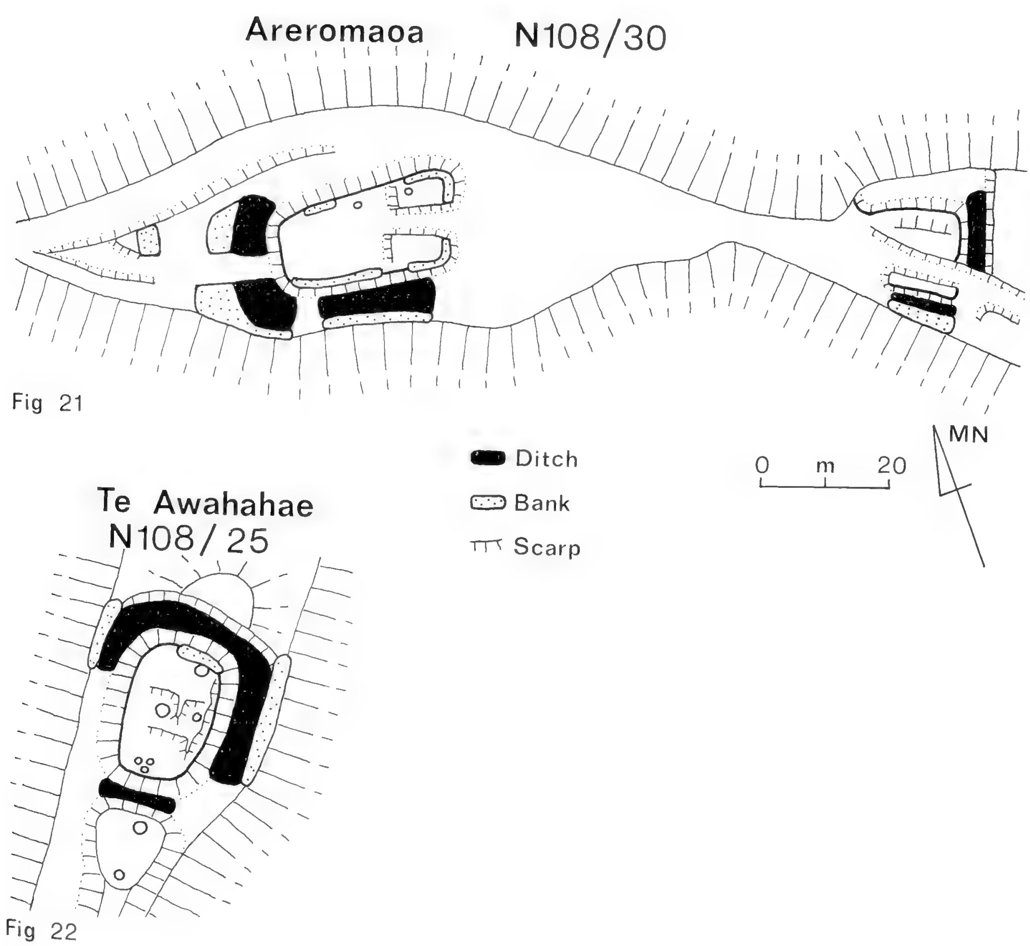
Natural defences of this pa are not strong. The approach from all sides is easy, except to the south side of the smallest strongpoint and from the low ground between the positions which is in any event flanked by fortifications. The hills stand *ca.* 20 m above the bottom of adjacent gullies. The largest defended area is 35 m distant and 5 m higher than its neighbour on the same ridge. The smallest strongpoint is 70 m from the major defended area and 60 m distant and *ca.* 3 m lower than the other. This position commands the valley west of the site which is not covered from the other two strongponts. Platform scarps are *ca.* 3-4 m in height. Defence in the form of banks at the platform rim occurs at the east end of the major platform, where it is up to 3 m across and stands a metre above the adjacent platform level, and at the west end of the neighbouring strongpoint. This indicates that these two fortifications, at least, make up parts of a whole since the platform rim defence is directed outwards at each defended area, the other end of each platform being covered from the neighbouring position.

The occupation platform of the major strongpoint is 38 x 8-16 m in size, with an area of *ca.* 475 m^2. An unusual storage capacity is indicated by at least 23 *rua*, a marked feature of which is their distribution down the centre of the long axis of the platform with areas adjacent to the defensive scarps generally left clear. The second strongpoint has an occupation platform of 17 x 15 m maximum dimensions with an area of *ca.* 200 m^2. A low scarp divides off a 2-3 m wide terrace on the western side. There are two *rua* on this low area, with another six, in three pairs, elsewhere on the platform. Another two *rua* are outside the defences at the west end while one is located inside the ditch nearby. The smallest strongpoint is less distinct than the others having suffered some slumping of the platform margins. It may have been 16 x 8 m in size (*ca* 130 m^2). There is at least one *rua* on the platform with indications of three more. Assuming contemporary occupation, the total defended area of this pa is *ca.* 800 m^2. As many as 36 *rua* give a considerable storage capacity.

Fig. 20. Areromaoa — aerial view from the north. Taken in November 1974, the photograph shows the remains of three defensive ditches east (left) of the occupation platform which have since been destroyed.

Areromaoa N108/30 (571838) Figs. 20, 21

Areromaoa lies on the end of an almost level spur which divides two small tributaries of the Mangaone Stream 300m east of Koru Road and *ca.* 3 km from the sea. Until the early 1970s the earthworks were virtually intact under pine plantation. Not many months before I first visited the site in November, 1974, the pines were removed with extensive damage done to the site. Since then more damage has occurred. What remains is now under pasture with some litter and occasional native understorey vegetation surviving the tree-felling operations.



Figs. 21, 22. Pa plans. 21. Areromaoa (N108/30). 22. Te Awahahae (N108/25).

On the two flanks of the fortification the sides of the spur fall *ca.* 15 m into the adjacent gullies — abruptly to the north and fairly easily on the south side. The fortification is located on the very end of the spur and thus commands the steep approach up from the fork of the stream. The vulnerable quarter is the south-east where there is no natural defence against an approach down the spur. This end of the site formerly exhibited some of the strongest successive defensive arrangements of any pa in the survey area.

Eighty metres from the occupation platform the badly damaged remains of a ditch can be seen cutting across the spur — here about 15 m wide — and turning at both ends to begin flanking defence now 16 m long on one side and 12 m long on the other. It seems unlikely that these flanking ditches ever extended much more as the spur beyond is too narrow and steep sided to accommodate useful flanking defence. Forty metres within the outer ditch, at the narrowest part of the spur, is a faint suggestion of a second transverse ditch. The immediate approach to the occupation platform was barred by three more ditches. These are now totally destroyed, but in 1974 they survived, although cut away on both sides, to indicate a succession of steep sided ditches separated by banks of perhaps 3-5 m width (see Fig. 20). Thus Areromaoa was defended against attack from the vulnerable quarter by at least four, probably five, successive ditches over a distance of 80 m. The ditches were closer together near the occupation platform and, from evidence available in 1974, may have increased in size as well. There is no possibility now of knowing if there was evidence of occupation on intermediate platforms. A noticeable bank at the platform rim completed defence directed against an approach down the spur.

The occupation platform was flanked on both sides by a single ditch and bank — in 1974 already cut away by the bulldozer. At the west end two ditches appear to have secured the pa against an approach up the spur, although the outer one of these is problematical on present surface evidence. Despite damage the platform scarp height may be determined at 3-4 m.

The remains of the occupation platform indicate an inner defended area of 26 x 12-14 m with an area of *ca.* 300 m^2. The higher eastern third of the platform is marked off from the remainder by a slight scarp. In addition to the usual defensive bank at the vulnerable end, a low bank can be picked up at the platform rim down both sides. Since 1974, the occupation platform has been so damaged that 'several *rua*'. then noted on the platform, are now represented by only two, close to the northern margin.

Te Awahahae N108/25 (563863) Figs. 22, 23

Te Awahahae is situated on a spur above the right bank of the Tapuae River between the main South Road and the sea, about 500 m from the river mouth. It is immediately over the river from N108/109. The location is low within the valley but the fortification has an advantage over similarly situated pa in the survey area with natural defences made stronger by a deep saddle to higher ground up the spur. The site is now under pasture with some pine trees encroaching on the west end. It is mostly in good condition although some damage has been done by the formation of a farm track, which makes use of the ditch and bank defences of the north side, and by stock which are breaking down the main occupation platform scarp.

Fig. 23. Te Awahahae — aerial view from the north-west.

Te Awahahae enjoys strong natural defences. On the north and south sides of the spur steep hillsides drop 12-15 m to lower ground. At the upper end of the site is a broad saddle 6-8 m below the platform which is *ca.* 50 m across to higher ground. At the west end of the fortification is a narrow but easy approach up the spur from the river. Artificial defence of the main occupation platform is made up of a single ring-ditch. The original form of the ditch is now unclear on the two flanks of the site: on the north side substantial damage has destroyed much of any outer bank there may have been, while on the south side an outer bank at the high east end now falls away to terrace and scarp defence near the west end. The scarp from the main occupation platform is *ca.* 5 m high on the two flanks. At the two ends, however, the ditch rises steeply from each side to cross the spur and the scarp here is reduced to as little as 2 m height. At the east end in particular a marked high point in the ditch may have provided access to the occupation platform; a bank on the platform rim above adds to defence at this end.

Outside the ditch at the east end of the site is a small area of ground only slightly lower than the upper end of the platform itself. Only a few metres across it the ground falls steeply away into the saddle to higher ground. There are faint indications of modification to the natural topography here, perhaps indicative of occupational use, but there is no sign of artificial defence for this area. An extension of the flanking defence by only a few metres would have brought this potential danger point within the fortification and given command over the approach to this end. At the west end of the site a more substantial, triangular, platform 12 x 10 m in maximum size again lacks artificial defence — except as might be provided by a palisade on the platform rim. This platform has two *rua* on it.

The defended occupation platform of this site is 23 x 13 m, giving an area of somewhat less than 300 m^2. Evidence of internal organisation takes the form of three major terraces dipping to the west. Five or six *rua* on the platform are divided among the terraces, with a group of three clustered together on the lowest. An easy slope extending down the north margin of the platform is suggestive of internal access.

N108/109 (560862)

This artificial ditch is a prominent feature in the landscape on the south bank of the Tapuae River between the main road and the coast. It takes a most unusual form for a Maori fortification but no other origin seems likely. A single ditch extends 45 m across a spur. No other earthworks are in evidence. At both ends of the ditch, cliff or hillside drop precipitously to the river 35-40 m below. Erosion appears to have largely filled in the ditch and the outline is now blurred. From rim to rim it is 7-10 m wide. The ditch is *ca.* 75 m downslope from the top of the spur. Below is an easy north facing slope. On the Lands and Survey Department blocksheet (Wairau II, 45/4) the site's location is marked by the name 'Te Kohanga'.

Kekeorangi N108/23 (551861) Fig. 24

Kekeorangi is located on the sea-cliff between the Tapuae and Oakura Rivers. It takes up all of an extensive terrace cut off from the general terrace country of the surrounding area by the deep gully of the Orahiri Stream. The position is a commanding one: the site rises above the inland terrace country and so has a useful view inland as well as some distance both ways along the coast. Kekeorangi is now under grass with some gorse along the margins. It appears to be in good condition although some damage has been done to the easiest approach at the east end of the site. How much of the site has disappeared through erosion of the sea-cliff is not known.

Natural defences are provided by a sea-cliff at 45-50 m and a steep hillside of *ca.* 35 m into the gully on the southern flank. The weakest point of the perimeter is at the east end where the gully of the Orahiri Stream rises rapidly to only a little below the general level of the site. Access to the pa presumably lay across the narrow saddle between the gully and the sea-cliff. Artificial defence consists of a single ditch which now has gaps in it but may be assumed to have run around the entire site — this is located below the terrace rim at the top of the hill slope. Beyond the slight outer rim of the ditch the hillside drops steeply away. The insubstantial defences are out of scale with the very large defended area and are unusual in the survey area where massive ditch and bank defences are normal. Within the pa a high area on the sea-cliff has been used to provide two adjacent inner defensive platforms or *tihi*. These are divided by a ditch and have terrace and scarp defence directed towards the remainder of the site. The two platforms of the *tihi* area are *ca.* 350 m^2 and 125 m^2 in size.

Kekeorangi is the largest fortified site of the survey area. The total defended area is 260 m in length and up to 100 m wide, with an area of *ca.* 16000 m^2. The occupation area is divided into two by a slight scarp which marks off the higher east end of the site. Elsewhere *rua* are clustered into two areas: four are situated close to the southern margin of the site and another six are strung along the back of a distinct terrace which is cut into the slope rising to the smaller (northern) *tihi*. Further slight dimples over the site will undoubtedly include at least some other *rua*. Much of the site is level or nearly level so

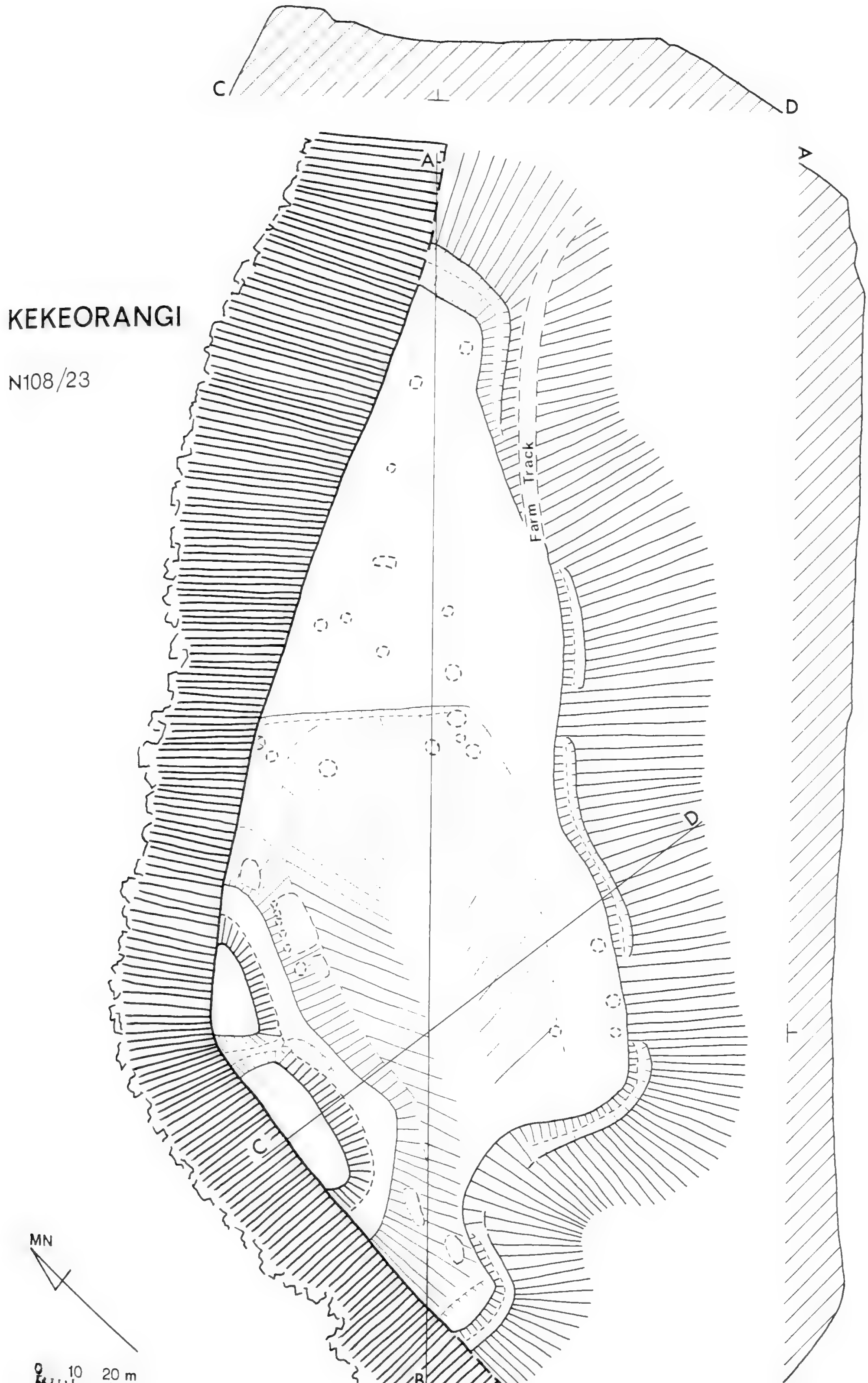


Fig. 24. Plan and sections of Kekeorangi (N108/23).

house platforms are generally invisible; there are, however, five terraces on the sloping lower flanks of the two *tihi*, while another is situated adjacent to the four isolated *rua* just within the defences at the south side.

Omuna N108/145 (545856) Fig. 25

Omuna is situated on top of the 50 m high sea-cliff *ca*. 500 m north of the Oakura River mouth. Its cliff-top location gives command of the sea and beach, and its location on a slight eminence above the neighbouring terrace country allows a useful view inland. The site is now under grass except for the occupation platform which has a thick cover of gorse.

This fortification is defended on one side by the precipitous sea-cliff. The other sides offer easy natural approaches. Artificial defences consist of a single ditch on three sides with the natural hill slope of the long south side allowing an outer bank as well. The platform scarp is *ca*. 2 m high. Erosion over the sea-cliff may have accounted for some of the occupation platform over the years although it is unlikely that it was ever a great deal larger than its present 200 m^2 size (*ca*. 25 x 10 m maximum dimensions).

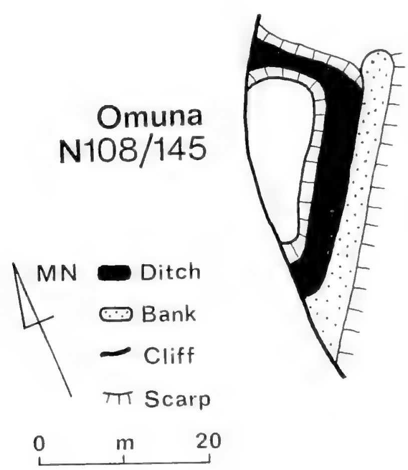


Fig. 25. Plan of Omuna (N108/145).

Pahitere N108/24 (553852) Fig. 26

This fortification is just south of the corner of the main South Road and Koru Road and occupies a prominent hill rising above the general level of the surrounding terrace country. It stands high above the nearby pa, Wahawakiore (N108/26), about 100 m to the east. The site is now mostly under grass with some gorse and bracken which have helped preserve the steep scarps from stock damage.

Pahitere was occupied in 1864 by part of a company of Taranaki Military Settlers and was modified to an unknown extent to accommodate the troops. This occupation has resulted in the very rectangular plan of the top platform and the outer defences as they now appear, in the terraces on the eastern side of the hill and in the slight bank which

Fig. 26. Pahitere (N108/24) — aerial view from the north. Wahawakiore is under bush cover at top left.

encircles the top platform at its rim. Best (1975: 222-224) clearly had no idea of its later military use when he described this site. As a result of the later use it is difficult to make out the form of the earlier Maori fortification. That it was a pa is known from historical references of the 1860s and from the partly destroyed ditch which can be seen outside the Military Settlers' defences. The location of this ditch, together with the apparent lack of later throw-out from the present inner ditch, makes it possible that this was a site unique in the survey area which was defended all around by a double ditch and bank. An easy approach from the south and comparatively easy approaches from the other sides add to the argument for unusually strong defences. The modified top platform has an area of *ca.* 250 m^2.

Wahawakiore N108/26 (555852) Fig. 27

Wahawakiore is located south of Koru Road *ca.* 100 m east of Pahitere. Its situation is singularly unobtrusive — low on a short and narrow spur which drops into the Te Wawa Stream from the extensive terrace country between the Tapuae and Oakura Rivers. It is so completely dominated by nearby Pahitere that it seems improbable that it operated as an independent fortification; its role may therefore have been to provide supplementary accommodation for its larger neighbour. Wahawakiore is now under wattle with an understorey of mahoe and kawakawa. It is in good condition except for the outer defences of the south end which have suffered from fencing and are under grass in a paddock adjacent to most of the site.

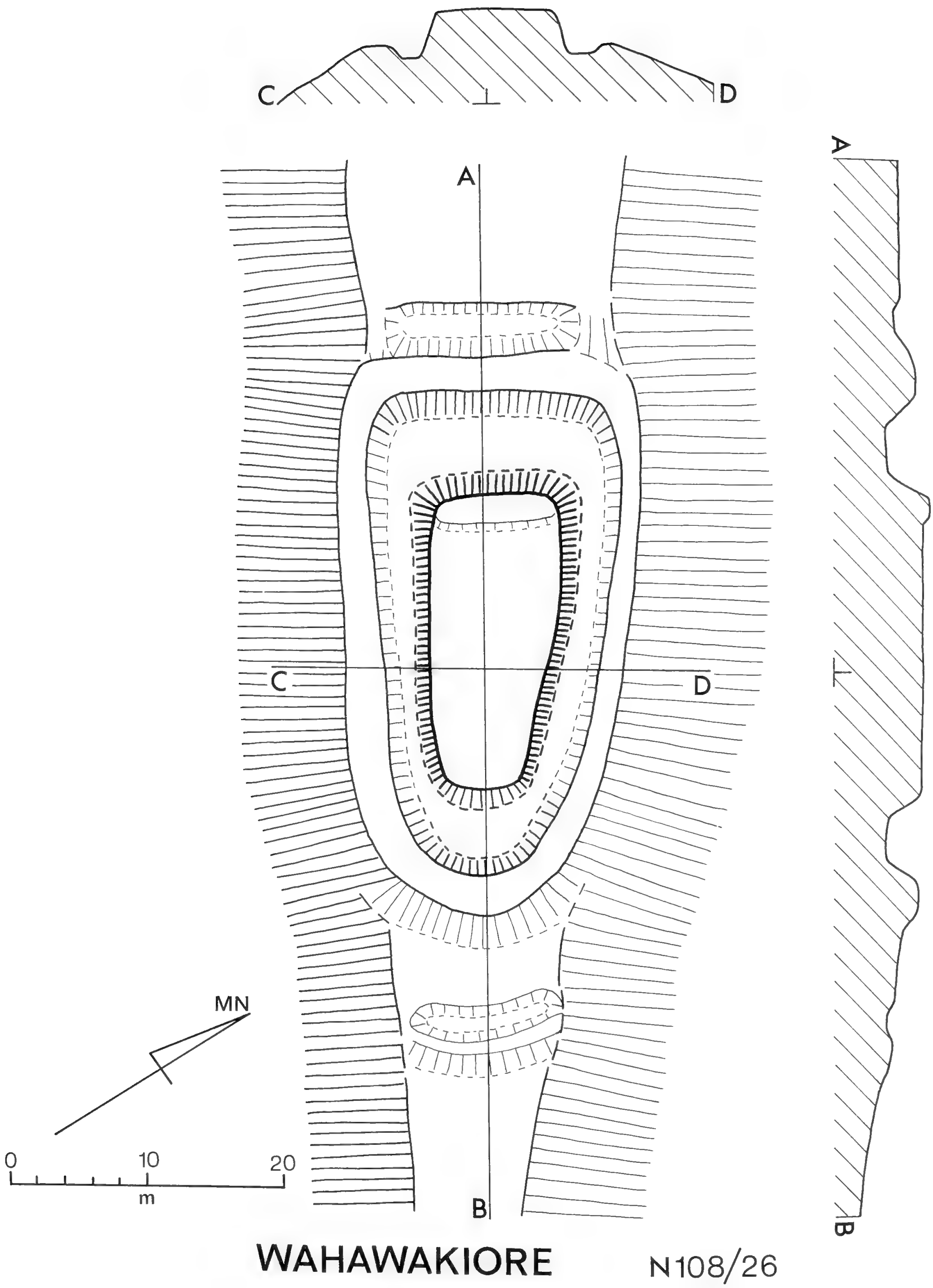
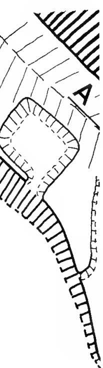


Fig. 27. Plan and sections of Wahawakiore (N108/26).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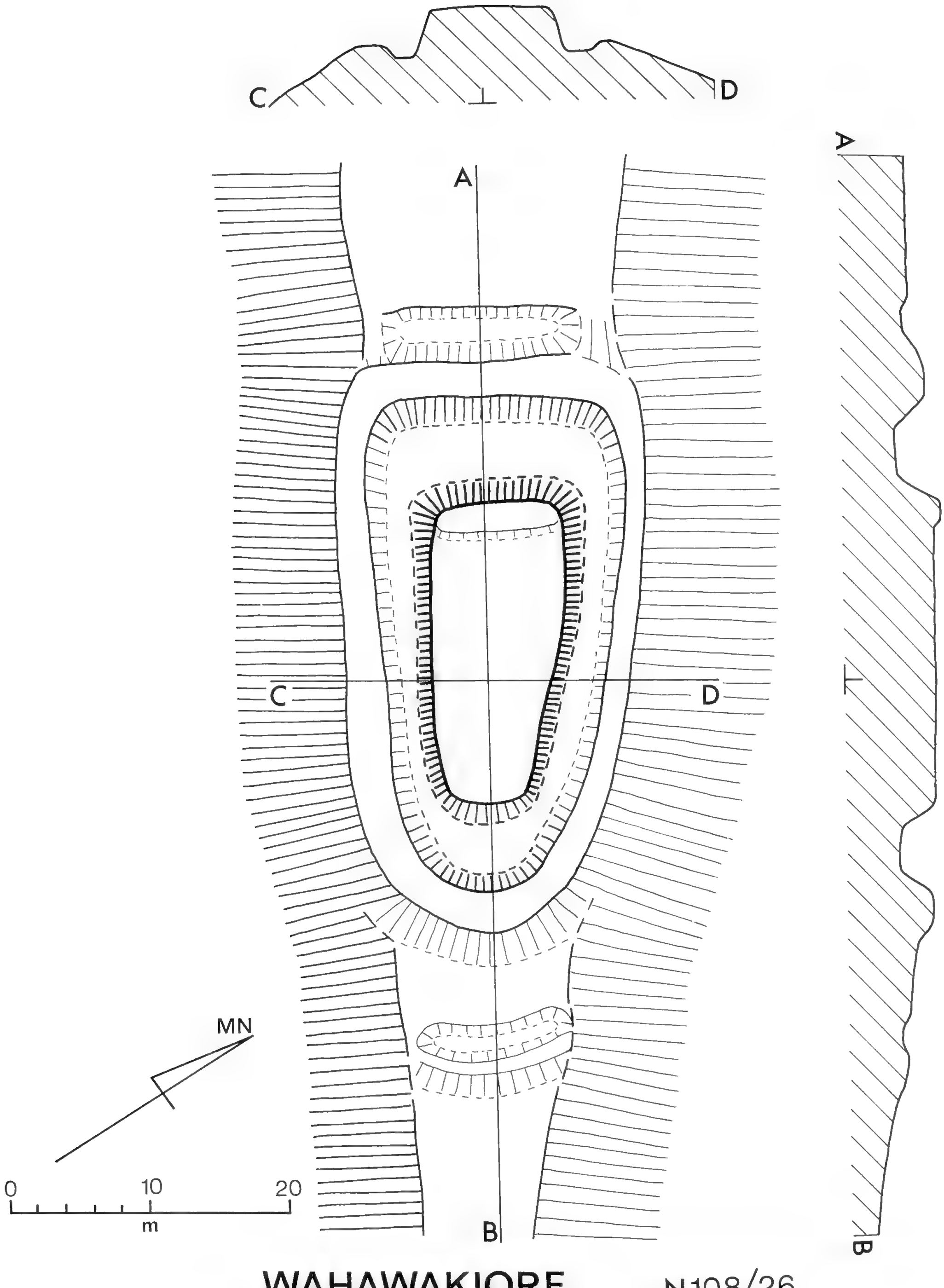


Fig. 27. Plan and sections of Wahawakiore (N108/26).

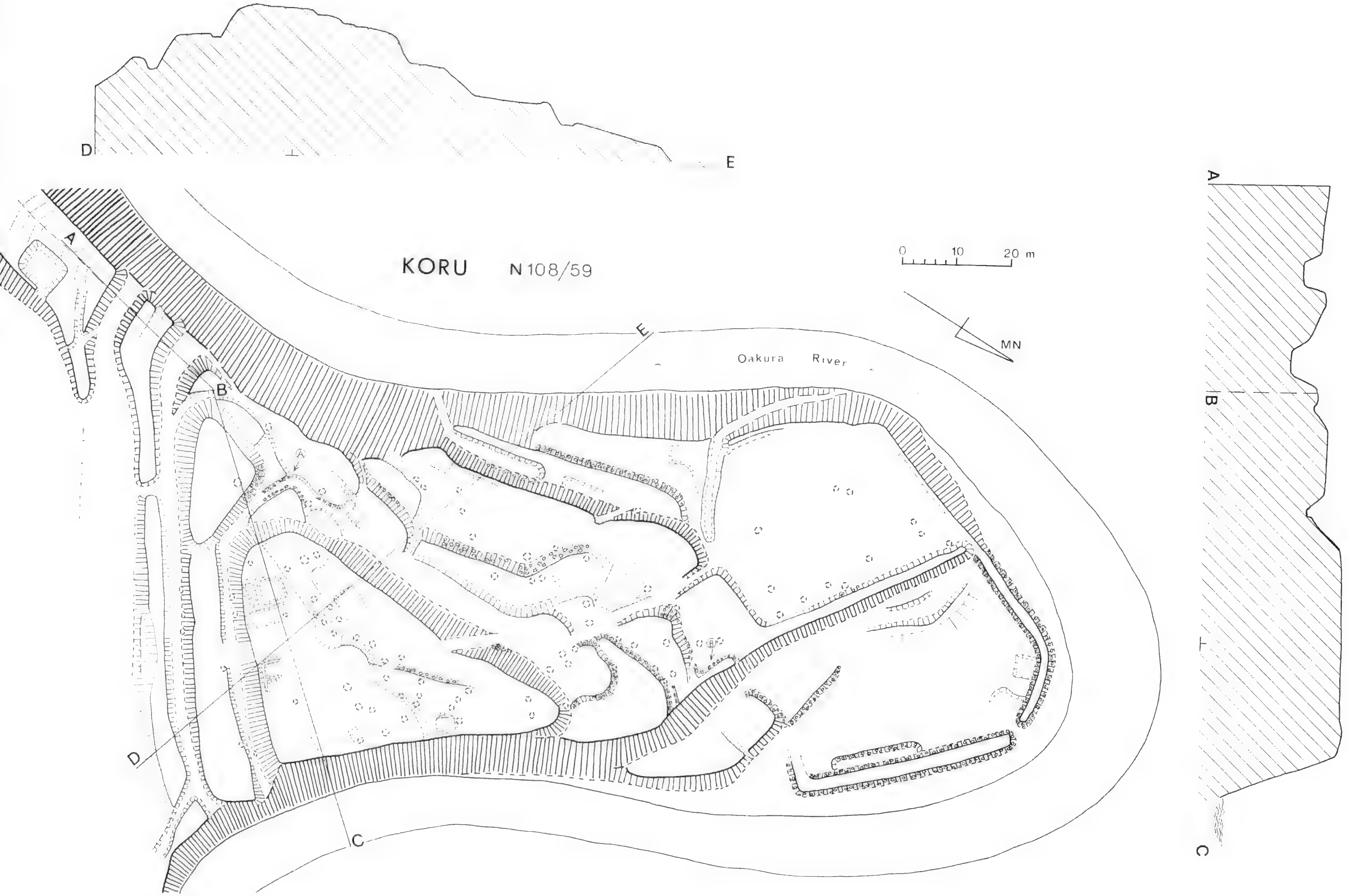


Fig. 28. Plan and sections of Koru (N108/59).

Natural defence for Wahawakiore is provided by steep slopes dropping about 15 m into now swampy gullies on both sides. The site is dominated by high terrace country to the east and west, and by steeply rising ground 50 m over a slight saddle from the southern defences. Artificial defence is provided by a single ditch and bank which rings the defended area and by a second ditch outside this at the north and south ends. The scarp from the ditch to the platform rim is 3 m high throughout. At the south end the outer ditch is *ca.* 9 m beyond the main ditch and appears not to have completely cut the ridge. At the north end of the site the outer ditch is more substantial but again does not quite cross the spur. A bank rises 50 cm at the northern end of the occupation platform.

Within the defences is a single occupation platform 21 x 6-9 m in size giving an area of *ca.* 160 m^2. Outside the northern defences a platform which takes up the whole of the ridge top is virtually level for a distance of 50 m and a width of *ca.* 20 m. This extensive area may have provided an additional undefended occupation area of almost 1000 m^2. The presence of this flat area adjacent to the defences at what is nominally the downhill end of the site provides an explanation for the second ditch and the bank on the platform rim at this end. Despite being the down-spur end this was the vulnerable quarter requiring the major defensive strength.

Koru N108/59 (571828) Figs. 28, 29, 30

Its size, complexity and known history make Koru the most significant pa of the survey area. The fortification occupies a spur on the left bank of the Oakura River almost 4 km from the sea, below the Kaitake Ranges. The spur is surrounded on three sides by a bend of the river which, it has been presumed (Smith 1910:258), gives the pa its name — *koru* meaning loop or bend. The site is a Lands and Survey Department historic reserve. It is in excellent condition under a tall canopy dominated by rewarewa, karaka and kohekohe with an understorey of kawakawa, matipo, mahoe, hangehange and other native species.

Like many smaller pa of the survey area, Koru occupies a site low on a spur, without any command of the surrounding countryside. Use has been made of a steep sided knoll at the end of a spur which rises to higher ground to the south, ultimately to the Kaitake Ranges. Natural defence consists of steep scarps to the river on both sides of the pa with a steep but greatly modified scarp to a small river flat on the south-east side. The north end of the peninsula falls to the river level and has required some assistance from artificial defences. The Oakura River itself, with its rough bed of large rounded boulders completely commanded from within the pa, adds considerably to the natural defence.

Artificial defences may be discussed in two sections: the massive ditch and bank works of the landward south and south-east side, and the successive scarp and terrace defence of the approach up the pa from the vulnerable north end. The chief artificial defence of Koru is a double ditch and bank across the landward end. This is supplemented by a third ditch on the rising spur *ca.* 40 m south of the outer of the two major ditches. Considerable damage has been done to this ditch in the course of preparation of the present fence line; what remains suggests a ditch 8 m across and 3 m deep. Best (1975: 213) states that originally it did not quite cut the spur.

Fig. 29. Koru — showing a sunken pathway with stone revetted walls (view A on Fig. 28).

Across the narrow spur the major defence takes the form of two massive ditches 4-5 m deep and *ca.* 5 m across at the bottom. With the intervening bank the width of these defences is *ca.* 25 m, with a further 50 m up the spur to the outer rim of the third transverse ditch. Just outside the major defence is a terrace or open pit cut 2.5-3 m into the spur and measuring 9 x 7 m in plan. The outer of the two main ditches cuts 10 m through the spur before turning to extend *ca.* 12 m outside the inner ditch and bank. A further slight depression may relate to a former continuation of this ditch. The inner ditch cuts only 5 m across the spur before turning to extend almost 75 m across the rear of the pa to the river at the upstream end of the site. The outer bank here presents a 4 m high obstacle to an attacking party while the counterscarp into the ditch is up to 2 m in height.

From the main ditch which cuts through the isthmus at the rear of the site a scarp rises 6 m to a platform 6 m wide at the rear of which is another ditch below yet another abrupt 5 m scarp to the top platform or *tihi*. The inner ditch in this part of the defences extends *ca.* 40 m from the upstream cliff to the river, across the rear of the *tihi*, before cutting through the site to isolate a secondary triangular platform. Present site access which turns the south-west end of this defence from the main ditch probably reflects an original entrance to the pa since a notable internal access way runs out to this point.

Fig. 30. Koru — a low stone revetted scarp at the rear of a terrace (view B on Fig. 28).

For most of the long circumference of Koru there is no ditch, instead use is made of the high natural scarp to the river as the main defence. At the upstream end of the site the uppermost platform drops directly *ca.* 20 m into the river bed. The scarp to the river becomes progressively lower below this platform. On the west side the scarp again diminishes in height down the successive terraces of the pa. While the rough river bed itself gave some security, yet the low north end of the pa did offer problems for successful defence. The scarp to the river is only 3-5 m high here. For some of the rim of the major terrace in this part of the site there is a slight bank to add to defence. Along the eastern side of this terrace is a steep sided bank almost 40 m in length which is 1-3 m high on the internal (south-west) side and 4-6 m high on the outer (north-east) side. Outside this bank a large area, little higher than the river bed, is enclosed by a remarkable wall stone faced on both sides, which is between one and two metres high and *ca.* 2 m across. This may have been designed for both flood control and defence.

The numerous high scarps within the pa doubtless offered effective secondary defence to any breach of the comparatively weak defences of the low riverside scarps and terraces of the north end. As many as five successive major scarps, sometimes 5 m in height, would each have presented formidable obstacles to an attacking party that gained possession of the lowest terraces.

Koru occupies a total area of *ca.* 160 x 60 m — approximately 10,000 m^2. The area within the major external defences is a little more than 7000 m^2 although massive internal scarps make the actual living area somewhat less. Within the defences Koru consists of a series of major terraces dropping away to the north-west. The highest of these is a triangular platform of *ca.* 1000 m^2 which is divided in two by a scarp of *ca.* 1 m height. Scattered over this *tihi* are more than 30 *rua* and several rectangular depressions suggestive of house floors, one of which has in the centre a stone-lined hearth of four river boulders. Below are three major terraces which extend the width of the site. At the bottom is a further major terrace of *ca.* 1250 m^2. East of this, over the unusual defensive wall, is a similar area of somewhat broken ground little higher than the river bed.

At the north-west corner of the pa is a well graded track which runs up from the river, through the scarp, and across the large bottom terrace to cut through the scarp to the next terrace. A path then runs directly up through successive terraces to the *tihi*. This is presumably the major routeway through the fortified settlement, and for the uppermost platforms it is the only access. Other routes through individual scarps are scattered throughout the site.

It is possible now to count over 80 *rua* on Koru. Doubtless many more are covered by erosion from the steep scarps, especially as a characteristic location at this site is at the rear of terraces. Some pairs of *rua* are connected underground. Many *rua* entrances are in excellent condition having been subject to almost no erosion since abandonment of the site — such entrances are as little as 40 cm square. *Rua* are scattered throughout the site, occurring even at the base of defensive ditches of the south-east side where those now visible almost certainly reflect a greater number now buried. The preferred location of *rua* at the rear of terraces left the major part of a terrace free for surface buildings while it added to the strength of the pit by the depth of naturally compacted soil above.

Perhaps the most remarkable features of Koru are the scarps revetted by round river boulders which occur throughout the site (see Figs. 29, 30). This method of maintaining steep scarps in the light volcanic soils is known elsewhere in Taranaki, for example at Ngaweka on the south bank of Stoney River and Tapuinikau on the Teikaparua River, but nowhere is the work as spectacular as at Koru. It is, however, likely that the stone revetments have suffered some erosion over the years as the 3 m height of such walls depicted by Best (1975: 210-211) cannot be found today. Smith (1910: 258) mentions such walls up to 15 feet (4.5 m) high. The greatest height of such work to have survived is about 2 m; debris at the foot of higher scarps locates Best's illustrations. The stone revetment is mostly used simply to face scarps; in places, however, it is used to face defensive walls (notably on the riverbank at the north end of the site), and to hold the sides of sunken pathways.

Koru is said to have been occupied by people of the Taranaki tribe until the early years of the 19th century. In the first decade of the century it was attacked and taken by a Te Atiawa force (Smith 1910: 258). It is said that the pa was finally abandoned in the 1820s. In 1898 an important wooden door lintel, now in the Taranaki Museum, was found on the site (Skinner 1973: 11).

Takereputa N108/31 (560831) Fig. 31

Takereputa is on the left bank of the Oakura River *ca.* 100 m upstream and across the river from Raumaterua (N108/32). The site is below the general level of the surrounding countryside on a slight spur leading northward down to the river. Much of it is fenced off from surrounding paddocks and is now under gorse, bracken and some large macrocarpa trees. The outer ditch and bank at the northern end and all the defences of the south end are under grass in neighbouring paddocks and have been damaged in places. A farm track cuts through the defences at the south end and destroys much of the defensive bank of the west side of the site. Apart from local damage, however, the site is generally in good condition with many of the scarps close to vertical and *rua* on the occupation platform showing up as open holes rather than the usual greatly modified depressions.

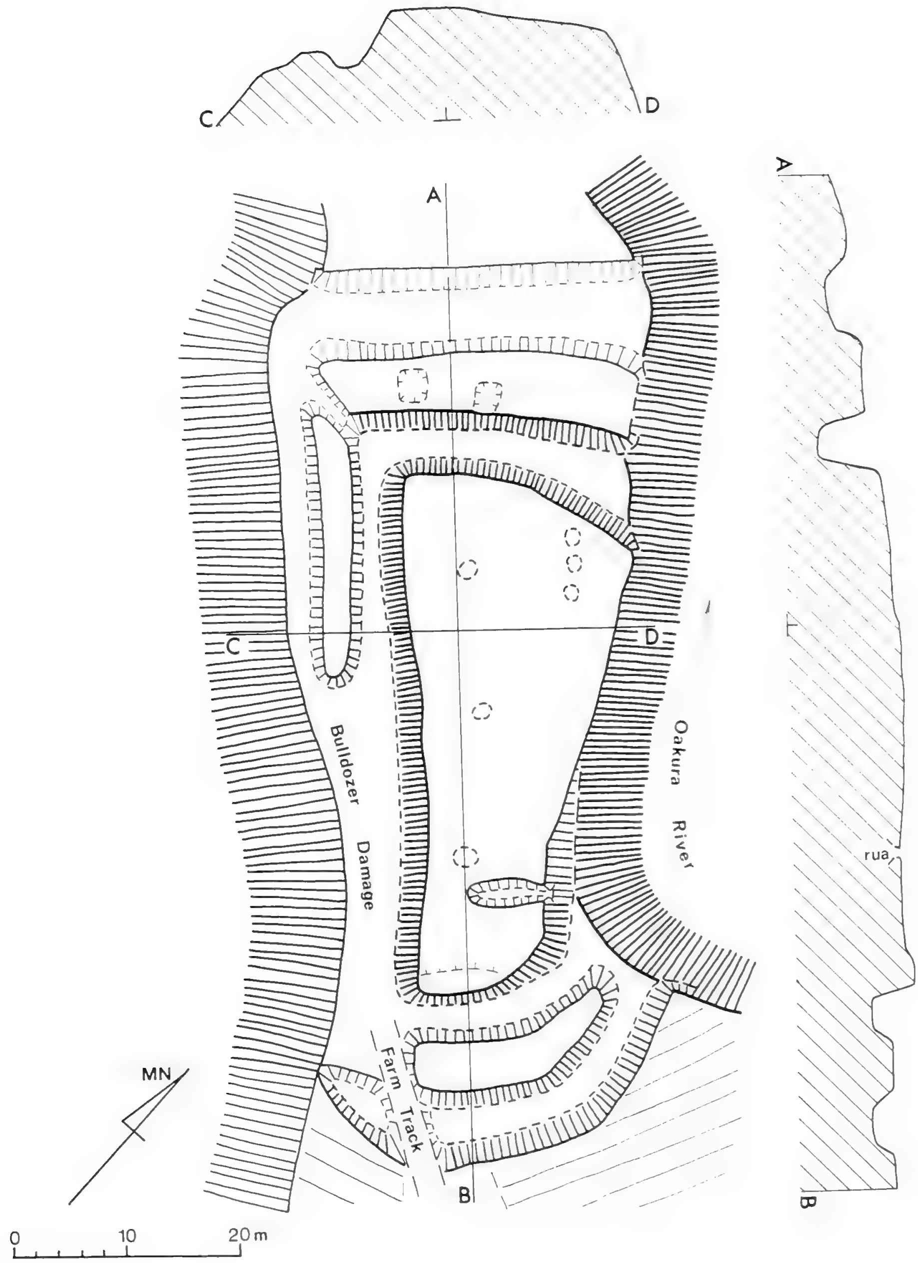
The pa is situated on a narrow spur which runs down beside the Oakura River. Natural defence on the east side is a 15-20 m cliff to the river, while the west side of the site drops away *ca.* 6-10 m into a narrow gully with higher ground on the adjacent spur 40 m away. Up the spur to the south is a slight dip before the ground rises again at *ca.* 50 m distance from the outer defences. Below the fortification to the north the spur falls away only slowly allowing easy access from the downhill end. Artificial defences consist of a double ditch and bank at both ends of the site with a single ditch joining the two inner ditches along the west side. The deep ditches and near vertical scarps make these defences among the most impressive of the survey area. At the downhill (north) end the inner ditch is 5 m deep with the broad outer ditch 2-3 m deep. At the southern end the scarp from the occupation platform is *ca.* 4 m high with the inner ditch counterscarp and the outer ditch *ca.* 2 m deep. On the west side of the pa the platform scarp is *ca.* 4 m high with what remains indicating a comparatively low bank topping the steep rise out of the gully. Slight defensive banks are situated on platform rims at the south end of the main platform and on the north side of the broad bank between the two ditches at the north end.

The occupation platform is 46 x 10-20 m in size giving an area of *ca.* 650 m^2. Six *rua* were discovered on the platform but more are almost certainly present under the dense cover. From the south the main platform rises slightly to the centre before falling away to the north end. The broad defensive bank of the north end includes some evidence of occupational use in the form of a rectangular depression and a large collapsed area which may signify *rua*, in addition to the defensive bank on the outer rim. Approximately 20 m from the outer defences at the north end are two small artificial terraces, while four or more terraces are located *ca.* 100 m from the pa at the foot of the spur next to a broad river flat.

Raumaterua N108/32 (560833) Fig. 32

Raumaterua is located on the right bank of the Oakura River *ca.* 3 km from the sea, across the river from Takereputa. The site is in fair condition with much of the defences under grass and the scarps and platform mostly under dense gorse which, while it makes mapping difficult, has undoubtedly helped in preservation.

The pa is strongly situated on a steep sided spur which runs down to the south-east from the extensive terrace of the Koru Road district. The west side is secured by a 12 m cliff to the river while the north side drops precipitously *ca.* 9 m into a now swampy gully.

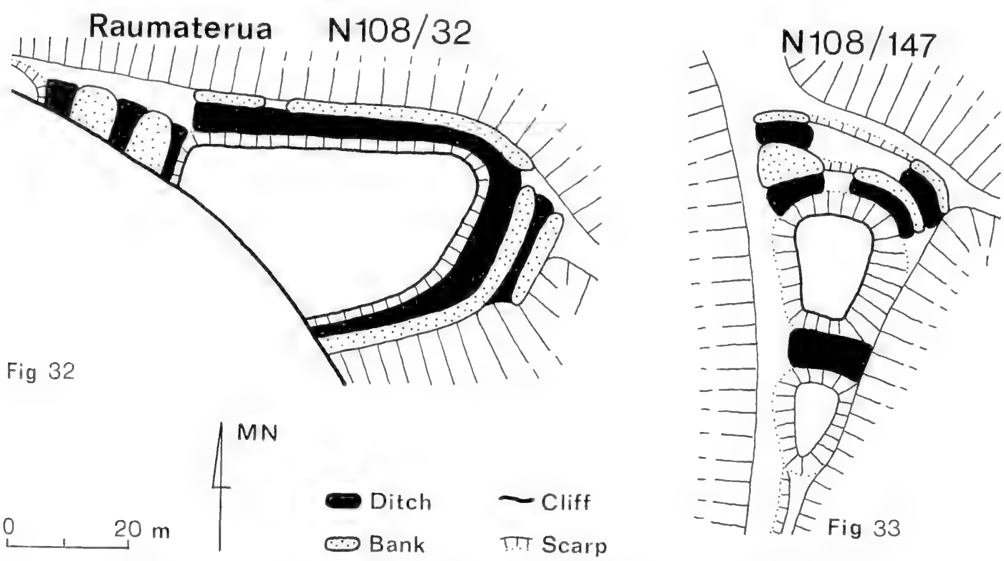


TAKEREPUTA N108/31

Fig. 31. Plan and sections of Takereputa (N108/31).

At the north-west end of the site a narrow spur dips slightly before rising to dominate the defences from *ca.* 80 m distance. At the south-east end of the site is a spur which provides easy access 100 m down to the river. Artificial defence at the north-west end consists of three ditches cutting the narrow spur; these are now very short and may have been subject to some loss over the cliff into the river. Along the northern side is a single ditch which does not appear ever to have been very deep and may have operated for part of its length simply as terrace and scarp defence. The scarp to the platform is *ca.* 3 m high. At the east end is a short section of double ditch and bank cutting off the downhill spur.

The occupation platform is *ca.* 45 m long and 6-26 m broad. The area is *ca.* 700 m². Dense gorse ruled out a thorough examination and only one *rua* was found at the platform's eastern corner.



Figs. 32, 33. Pa plans. 32. Raumaterua (N108/32). 33. N108/147.

Puketapu N108/152 (546839)

This pa was situated within a major bend of the Oakura River about 1 km from the sea. The location is typically low on a spur commanding little more than the adjacent river flats and itself dominated by the rim of extensive terrace country about 200 m to the north. In the 1950 aerial photograph (1788/6) Puketapu is hidden under bush which occupied the entire peninsula. The site was almost totally destroyed in the early 1950s during bush clearing operations.

Puketapu enjoyed strong natural defence — two sides dropping abruptly some 15-20 m to the river and the spur end also offering a precipitous natural approach. Only the uphill end of the spur lacks natural defence, although even here a high point does allow some command over a slight saddle to the north. A local informant describes very strong artificial defence. All that now remains is *ca.* 5 m of double ditch and bank at the south end between the farm track and the cliff to the river and a single almost completely filled ditch which extends 8 m beyond the track. A slight cut in the eastern margin of the platform *ca.* 40 m from these defences may indicate the end of another defensive ditch. Such defence secured only the high point of the outer end of the isthmus and the defended area would thus have been about 400 m^2. Topography, however, suggests the northern defences may have been another 60 m further on where a knoll would secure the interior and allow command of the saddle to higher ground. If the pa did indeed extend to this knoll an occupation area of 1500-2000 m^2 is indicated. Some four or five depressions on the site may indicate *rua*.

N108/147 (556821) Fig. 33

This small pa is situated about 180 m above sea level on a narrow spur which descends from the northern flanks of the Kaitake Ranges above Surrey Hill Road. Use has been made of a relatively broad part of the ridge to create a small strongly defended position. The site is *ca.* 100 m south-east and 20 m higher than N108/146. Unlike the neighbouring site, however, N108/147 is in very poor condition. Defences of the west side have been used for a farm road to gain access up the spur and macrocarpas have been planted over the site. The tree planting and subsequent stock damage has resulted in scarps being broken down, ditches filled in and the occupation platform itself badly damaged.

Natural defences include a narrow spur and slight saddle to the south, with the ground rising sharply *ca.* 60 m beyond the site. To the east is a precipitous slope dropping away *ca.* 25 m, while to the west a steep drop of 6-8 m leads to an easy slope downhill to N108/146. To the north the spur continues relatively broad and level for *ca.* 50 m before a moderate slope down. The shape of the artificial defences is determined by the unusual circumstance of a relatively easy approach up the spur and difficult approach down. On the south side of the site is a single broad ditch, beyond which is a triangular platform *ca.* 12 m in length which rises to a high point at the outer end and then drops away into the saddle without further artificial defence. At the north end is a 25-30 m long double ditch and bank of which the outer is damaged almost beyond recognition. This relatively strong defence is directed at the easy approach up the spur. On the west end of the intervening bank is a triangular platform *ca.* 5 x 10 m. On the east and west flanks of the pa roading damage and natural erosion have left the defences somewhat unclear. From appearances there was no ditch and bank on the east side and defence seems to have been left to the precipitous natural scarp. The presence of the farm road rules out interpretation of defences on the more vulnerable west side although either a ditch and bank or a terrace presumably would have provided the basis for the present road.

The four-sided occupation platform dips slightly to the north. It measures *ca.* 16 x 7-12 m with an area of *ca.* 160 m^2.

N108/146 (555822) Fig. 34

N108/146 is located on the north flank of the Kaitake Ranges above Surrey Hill Road, in the headwaters of the Wakamure Stream. It is situated on a short steeply sloping spur just east of the major ridge which extends northwards east of Wairau Road and west of the narrow spur on which is located N108/147. It is now under grass with some mahoe, ponga and gorse, mostly on the scarps. It is in excellent order despite damage to the east side for a farm road and some stock damage on the occupation platform scarp. The defensive scarps are high and, for much of the perimeter, close to vertical. The superb surface evidence for internal organisation of the occupation platform makes this one of the outstanding small pa of the survey area.

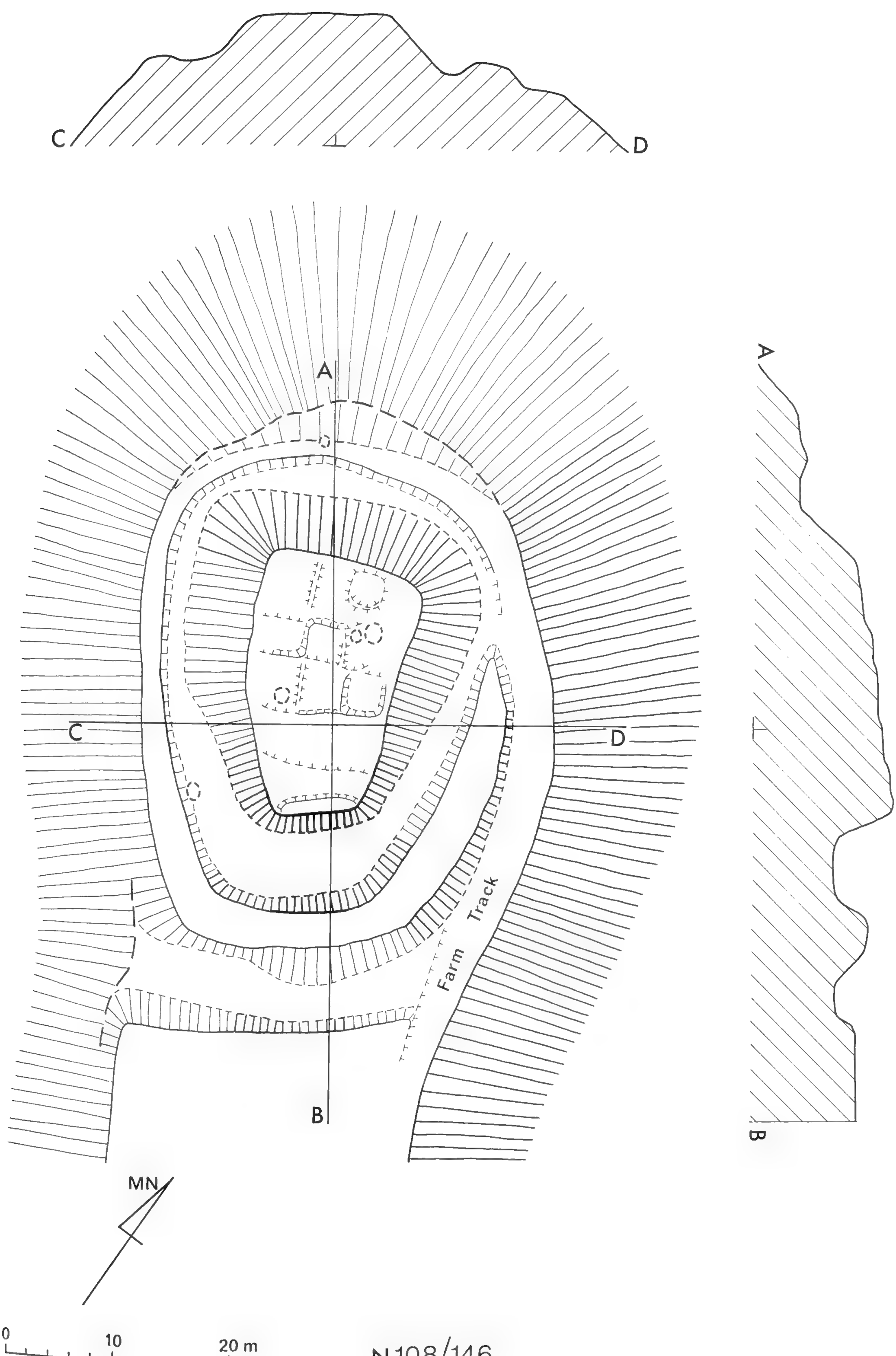


Fig. 34. Plan and sections of N108/146.

N108/146 has strong natural defences on three sides. To the north the broad front of the spur drops sharply *ca.* 30 m to the fork of two small tributaries of the Wakamure Stream. On the two flanks of the site are steep drops 10-15 m into small gullies. Only the south end is vulnerable to attack: here the ground is level outside the defences for *ca.* 20 m before rising quickly to command the site. Artificial defences consist of a single ditch and bank which rings the occupation platform, along with a second ditch across the spur at the vulnerable south end. The platform scarp is 4-5 m high with the greatest height presented at the south end. The bank at the south end is 3 m high from both ditches, with the outer counterscarp here *ca.* 2 m high. On the other three sides the counterscarp of the single ditch is much less substantial at 1-1.5 m. At the high south end of the occupation platform is a pronounced bank *ca.* 1 m wide and 30-40 cm high.

The occupation platform is 21 x 8-13 m giving an area of *ca.* 230 m^2. The marked slope down to the north has led to extensive modification with about twelve small terraces apparent. The two uppermost terraces span the platform, here *ca.* 10 m wide. The greater part of the platform is taken up by three rows of well-defined terraces, some divided off by scarps only and some by low banks. The terraces are presumably designed to accommodate houses or other buildings. On two of the terraces are a total of three *rua*.

A single *rua* is dug into the counterscarp near the south-west corner of the ditch while another possible *rua* is located on the bank at the north end of the site. Below the fortification on the steep hillside to the north are about four terraces.

N108/151 (544835)

On the 1950 aerial photograph (1788/6) a ring-ditch pa in good condition shows up on a knoll north of Surrey Hill Road about 100 m from the Wairau Road corner. The fortification was typically located below the terrace country to the west although it did command a useful view of the lower Wakamure Stream and the Oakura River valley, and down the valley of the Matekai Stream to the north-west. It also completely dominates the site N108/34 across the Wakamure Stream. N108/151 was destroyed in 1970.

The 1950 aerial photograph shows this pa to have been oval in plan of *ca.* 35 x 40 m total size. The present house sits on the occupation platform which may have been *ca.* 400 m^2 in size. A major terrace on north and west sides of the garden probably makes use of the old ditch and bank.

N108/34 (544836) Fig. 35

N108/34 is situated within a major bend of the Wakamure Stream *ca.* 1.5 km from the sea, close to the corner of Wairau and Surrey Hill Roads. Immediately over the stream to the south was the ring-ditch pa N108/151 which dominated its neighbour to such an extent that it seems unlikely N108/34 could have been defended without possession of the other. Indeed, N108/34 occupies a singularly unobtrusive site low in the valley and is commanded not only from N108/151 but from the rim of the rising terrace country to the west as well. The site is in generally good condition under second growth bush.

The chief natural defence of this site is the precipitous slope to the Wakamure Stream which almost completely surrounds it. At the south side the stream is only 3-4 m below the site while just over the narrow isthmus it is 15-20 m below. Artificial defence consists of two substantial ditches which cut the narrow access spur and major scarps within the pa which divide it into a number of defensible areas above the precipitous slopes to the stream. The fortification is unusual in the survey area in the lack of ring-ditch defence and the use of scarps and terraces; the only site it can easily be compared with in this respect is the much larger Koru.

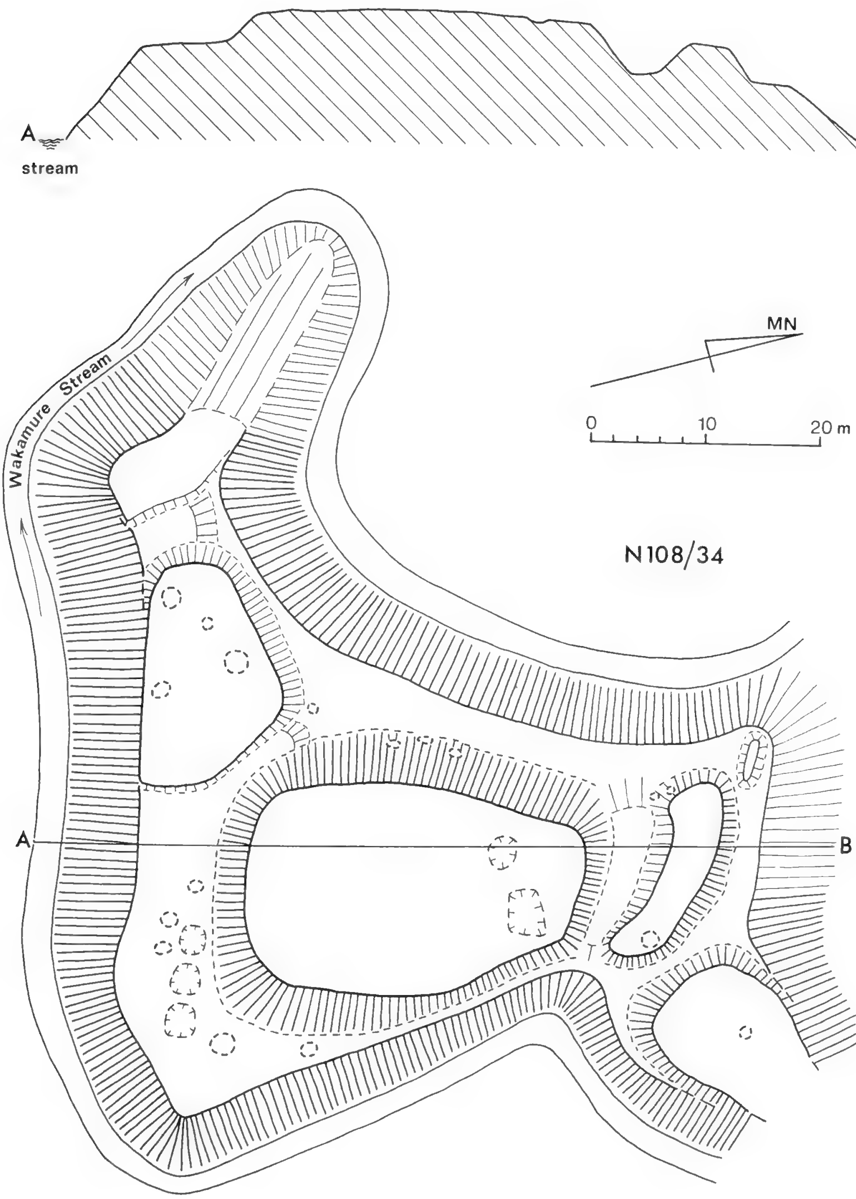


Fig. 35. Plan and section of N108/34.

Within the defences are two large platforms and a major terrace which encircles the larger platform and extends down the side of the other. At the western margin of the site is a third small platform. The occupation area is roughly triangular in shape, of a total area of *ca.* 1300 m^2 (within the double ditch defences, but including internal scarp defence). The major platform is more than 400 m^2 and the smaller is *ca.* 170 m^2. At the west end of the major platform are two larger depressions, while the smaller platform has four *rua*. Another nine *rua* and three depressions are grouped in two areas on the lower terrace while three more *rua* are within the defensive area (two in the inner ditch and one on the broad intervening bank), and one is outside the defences. A total of 17 *rua* indicates substantial storage on the site. The five depressions may also be collapsed *rua*. The siting of *rua* at the foot of scarps is against reminiscent of Koru where this is a preferred location and contrasts with the usual platform location of *rua* on ring-ditch pa within the survey district.

N108/140 (542821) Fig. 36

N108/140 is located *ca.* 180 m above sea level on a spur which runs north from the Kaitake Ranges south of the Wairau Stream. It is *ca.* 200 m within the Egmont National Park boundary up a spur which leads on to the 'Looney D' trig station. It is now under dense gorse, a tangle of felled and standing pine, mahoe, kawakawa and mamaku and other regenerating native species. The site is generally in good condition under the vegetation, with high defensive scarps having undergone little erosion. Along the west side the ditch and bank have been used to form a road for access up the spur, this road also cutting the end of the outer ditch at the uphill end of the site.

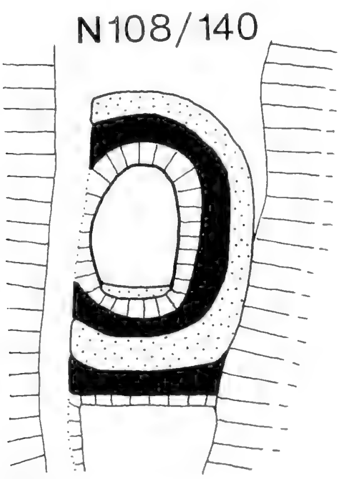
The fortification makes use of a slight knoll located just before the ridge drops away steeply to the north. It is very little higher than the narrow ridge to the south which rises above the pa at *ca.* 50 m distance. The sides of the ridge are steep but not precipitous as they fall away into gullies some 50-60m below the site. Artificial defences are made up of a single continuous ditch and bank surrounding the occupation platform and a second ditch outside at the vulnerable southern end. The defences are strong with a 4m high scarp surrounding the platform, the 4 m high bank giving additional protection to the south end, and 2-3 m deep counterscarps within the outer bank around the site. At the southern rim of the occupation platform is a pronounced bank which adds to the defence of this end of the fortification. A slight rim may be present around some of the remainder of the platform.

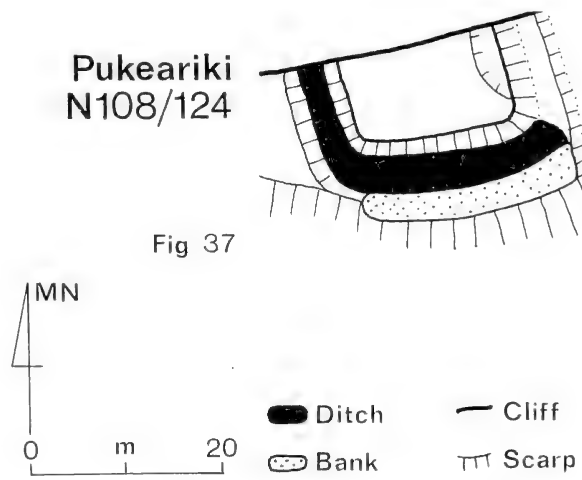
The occupation platform is 20 x 13 m maximum dimensions, of a somewhat rounded plan. The area might be a little more than 200 m^2. There is no sign of *rua*, nor is there any clear indication of internal terracing on the generally level platform. It is likely there are artificial terraces immediately below the pa on the north side but these also are unclear under the present cover.

N108/108 (531842)

N108/108 is located *ca.* 200 m from the Oakura Beach directly behind the present surf lifesaving club building, between the Wairau and Waimoku Streams. The location is typically low-lying: use is made of a slight knoll on the end of an undistinguished spur with an easy approach 100 m down the spur from extensive terrace country to the south. The site was almost completely destroyed during road works for a residential subdivision in late 1977. What remains is now under pasture.

This pa is poorly located for natural defence; the only quarter which offers the slightest assistance to artificial works is the east side where a steep slope of 6-8m drops into the valley of the Wairau Stream. The 1950 aerial photograph (1788/6) shows a roughly four-sided work *ca.* 40 x 30 m in total area, with a possible double ditch and bank on the west side. The defences at the vulnerable south end are obscured beneath trees. All that survives today is a 40 m length of ditch on the east side of the fortification.





Figs. 36, 37. Pa plans. 36. N108/140. 37. Pukeariki (N108/124).

Pukeariki N108/124 (524842) Fig. 37

Pukeariki is located on the sea cliff at the west end of Oakura Beach, on the left bank of Otupoto Stream. The site is generally in good order under grass, with occasional gorse, boxthorn and recently planted pohutukawa. Some large pine trees have undoubtedly done some damage to subsurface deposits.

The fortification makes use of a small spur which extends between the Otupoto Stream and the sea. On the north side defence is provided by a cliff of *ca.* 12 m which drops directly to the stabilised sandy area at the rear of the beach. At the east end of the spur is a vertical drop of *ca.* 6 m to the valley of the Otupoto Stream. The south flank of the spur provides an easy approach as does the slight saddle to higher ground westwards. Artificial defence is confined to three sides. It is indeed surprising that a considerable effort has gone into preparing what now appears as scarp and terrace defence at the east end: the natural cliff here drops away a few metres from the bottom of the artificial scarp to provide potentially much stronger defence. The scarp and terrace defence of the east end is continued along the south and west sides as ditch and bank defences of the usual form. At the west end of the occupation platform is a low bank adding to strength at this end.

The occupation platform is 22 x 9-12 m, giving an area of perhaps 225 m^2. A single slight depression may indicate a collapsed *rua*.

Discussion

The work presented here is part of a larger project and a full examination of the results will follow completion of the project. The following brief discussion will serve simply to point to some of the more salient features of sites examined so far.

The characteristic pa of the surveyed area is the so-called 'ring-ditch' fortification. Of the thirty-two sites examined, eighteen are defended by an encircling ditch and bank while a further seven make use of a cliff on one side. The remainder are defended by a variety of transverse ditch and bank arrangements with natural or modified scarps along the flanks and at the less vulnerable, sometimes precipitous, downhill ends.

Ring ditch pa commonly take the form of a small occupation platform defended by a single massive ditch and bank. Potikitaua (Figs. 4, 5) and Omuna (N108/18 — Figs. 12, 13) illustrate this type. Others, such as N108/116 (Fig. 8) and N108/146 (Fig. 34), have an additional transverse ditch at the vulnerable uphill end. Others again have three or more ditches with intervening banks. Rangitui (Fig. 6) has three ditches defending both approaches along the ridge, while Areromaoa (Figs. 20, 21) may have had as many as five ditches barring the downhill approach. N108/29 (Figs. 18, 19) consists of three adjacent simple ring-ditch fortifications.

Larger and more complex ring-ditch pa are Te Ngahoro (Figs. 2, 3) and Pukiekie (Figs. 16, 17). Te Ngahoro has two platforms defended by a single encircling ditch and bank. Pukiekie also has two main platforms which are defended by one and two ditches.

Seven pa occupy cliff-top situations which allow a modification of the usual ring-ditch form. Most are defended only by a single ditch where needed (examples as N108/118, Fig. 9, and Kekeorangi, Fig. 24). Others are defended by a double ditch and bank against vulnerable approaches (for example Takereputa, Fig. 31), or even three ditches and intervening banks as at one end of Raumaterua (Fig. 32).

Pa defended by transverse ditches and banks and flanking scarps include Koru (Fig. 28), Otete (Figs. 14, 15) and N108/34 (Fig. 35). There may have been an advantage in this form of defence if a large occupation area was needed since a site may be used for living quarters to the natural rim of the terrace or spur with no need to make room for defences. But while the three pa mentioned are among the larger of the surveyed area, two fortifications of this form are very small — N108/111 and N108/115 (Fig. 10).

A feature possessed by a majority of sites still open to careful examination is the bank on the platform rim at the vulnerable end of the fortification — usually the uphill end. At N108/116 and N108/29 the bank stood a metre above the adjacent platform, but this is unusual and the bank is usually very slight, and indeed could sometimes be missed by someone not specifically looking for it. Such banks must be assumed to be defensive features and would certainly have been higher and more massive when originally in use. In addition a number of sites possessed a less conspicuous bank running wholly or partly around the occupation platform rim.

A notable feature of fortifications of the Omata and Oakura districts is their very small size. The ten smallest ring-ditch pa defend an average occupation platform of about 230 m^2. In some instances we are given an idea of the internal organisation of these very small fortifications, for example at N108/146 (Fig. 34) where a number of small terraces cover the occupation platform and may be presumed to have been prepared for dwellings and other structures or activity areas. The siting of *rua* on other occupation platforms (for example at N108/29, see Fig. 18) also gives clues as to the organisation of the inner living areas of these sites.

Defended areas of larger sites cluster between 650 and 800 m^2, and 1100 and 1500 m^2, while the two largest sites dwarf all other in the surveyed area. Indeed, Kekeorangi defends an area greater in extent than the combined occupation area of all other sites except Koru.

Perhaps the most unexpected aspect of the siting of pa is the clear preference for inconspicuous locations. Over half are sited on a knob or rise on a spur below the general level of the surrounding countryside. They are thus dominated from only a short distance outside the defences and frequently overlook only a small area of the valley bottom or sea face in their immediate vicinity. Even the builders of Koru saw no need to occupy a position which offered any command over the surrounding countryside. In the lower Tapuae River valley and on the Hurford Road ridge only Pukiekie takes advantage of one of the many commanding situations which are available. This is in marked contrast to fortifications of the New Zealand Wars when both sides made considerable use of high ground in the district for the siting of fortifications to command an extensive view (Prickett 1978b).

Maori fortifications in Taranaki do not present an unvarying array of ring-ditch pa and other forms. South of Stoney River ring-ditch fortifications are able to make use of the characteristic volcanic hills or lahars of that region and so become relatively more abundant. To the north, Buist (1964) describes a higher proportion of headland and ridge pa defended by transverse ditch and bank arrangements in a landscape which lends itself to such works. In the districts covered here the small ring-ditch form is probably over-represented while the proportion of large fortifications may be comparatively low. In Taranaki as elsewhere in New Zealand the relationship between topographical demands and cultural preference remains to be properly explored.

Acknowledgements. I am indebted to landowners of the Omata and Oakura districts who were unfailingly interested in our work and generous with permission to visit sites. Assistance in the field was given by Joanna Boileau, Kelvin Day, Sheridan Easdale, Roger Fyfe, Robyn Oliver and Max Stevenson to whom I am most grateful. I also owe thanks to Ron Lambert, Director of the Taranaki Museum, to Kathy Prickett for a great deal of help without which the work would have been impossible, and to Mr George Bowen of New Plymouth who provided such marvellous accommodation at Oakura. Thanks are also due to Caroline Phillips who prepared the illustrations. Financial assistance was given by the New Zealand Historic Places Trust.

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SOME DENDROGLYPH STYLES IN THE CHATHAM ISLANDS

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Abstract. Three groups of dendroglyphs in the Chatham Islands are characterised by their main patterns and the stylistic variations between them.

The Chatham Islands are situated some 970 km to the east of New Zealand. They consist of two main islands, Rekohu or Chatham Island and Rangiauria or Pitt Island. Chatham Island (Fig. 1) is *ca.* 60 x 50 km with a large lagoon opening to the east taking up most of the centre of the island. The land area consists of two main blocks north and south of the lagoon, with narrow fingers projecting from each on the eastern side to form the entrance of the lagoon. On the western side a more substantial limestone strip borders the lagoon. Much of the centre of the larger land blocks is peat country. Pitt Island which lies to the south-east has sloping high ground with cliffs up to 300 m high in some places but sloping to the sea in others.

The dominant vegetation cover of the peat lands is either dracophyllum forest or bracken fern. These areas are known as "clears". Along the coasts and the strip of limestone to the west, the dominant forest cover is karaka or kopi bush (*Corynocarpus laevigata*). There are other trees but it is particularly the karaka or kopi which is concerned here. The kopi bush is found where it is protected by the seaward sand dunes or topography. The bush normally has a canopy at 10 m with the projecting dune overtopping this by 4 m in most places. The kopi bush grows in a strip of 50-400 m between the dunes and the peat or in the middle limestone area or sheltered valleys in the tableland (Hamel 1977).

The first human inhabitants of the Chatham Islands could have landed there directly from island Polynesia or by way of New Zealand sometime before A.D. 1200. These people were later called the Moriori from a reduplicated form of the word Maori (ordinary), the word that many of the East Polynesian groups use to refer to themselves. Their origins were in the culture of East Polynesia which is based on a variable economy with agriculture, hunting, fishing and shellfish collecting as components. In a given situation any one of these components may be emphasised almost to the exclusion of the others or they may all be used in a seasonal cycle of activities. In the Chathams, part of the agricultural components, that based on imported cultigens of tropical origin, taro, yam, kumara, arrowroot and plantain was not possible in that the plants if introduced did not survive. However, part of the technology associated with this activity did survive as did the activity itself in a changed form. The rhizome of the bracken fern (*Pteris esculenta*) is edible and was used as a carbohydrate source (Skinner & Baucke 1928: 359). When Broughton in the *Chatham* made the first recorded European visit in 1791 he remarked, (Broughton 1798: 85) "The woods in some spots had the appearance of being cleared, and

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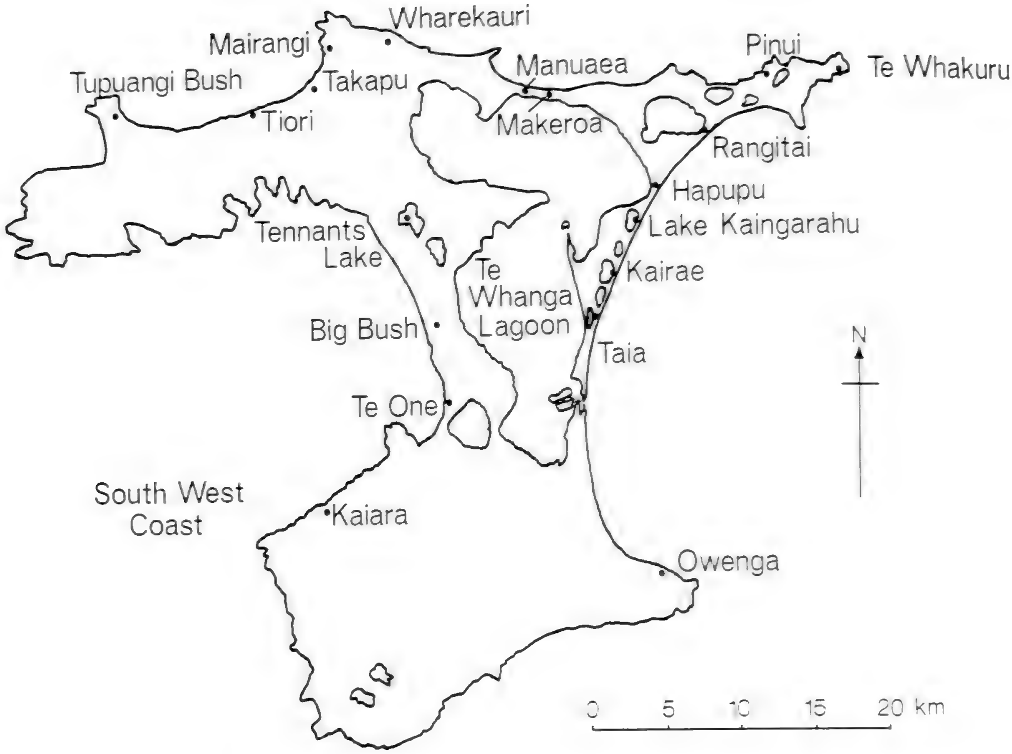

Fig. 1. Map of Chatham I showing localities mentioned.

in several places between the hills smoke was observed". It is likely that some of the kopi bush was cleared by the Moriori seeking to increase their food options by adding a carbohydrate source. However such destruction was not extensive as Broughton in 1791 (ibid) mentioned the area east of Cape Young as "some high land rising gradually from the beach and covered with wood extends 4 miles [6.4 km] to the eastwood of the Cape. After passing this land, we opened the several hills over the low land we had seen in the morning and could discern many of them were covered like our heaths in England, but destitute of trees". This refers to the Mairangi and Wharekauri areas of coast and clears. Before European settlement, Dieffenbach (1841: 158, 159, 160) was able to describe non-peat areas of the island as being "covered with an open forest of trees of moderate dimensions" or "the low hills that border the sea shore, which are wooded and surround the island with a girdle of green verdure. Amongst the trees, the Karakka tree (sic), generally about forty to fifty feet [12-15 m] high, and one to three feet [0.3-0.9 m] in diameter . . . forms the substance of the forest".

The dendroglyph styles

In the kopi bush carvings are present on many trees. There is some evidence from earlier reports (such as Travers 1876, Dendy 1901, Skinner 1923, Jefferson 1956) and from elderly residents that carved kopi were relatively common in areas now entirely devoid of trees. This also applies to some areas where carvings were recorded in 1963-64

(Simmons 1964). The main causes of destruction are clearing, followed by animals. Animals reduce the fringe bush, allowing the karaka roots to dry out, and stifle any regeneration by eating the seedlings.

In the summer of 1963-64 I, and a small team of two or three helpers, worked with a grant from the N.Z. Historic Places Trust to map and record the dendroglyphs and sites of the Chathams. The archaeological side of this work has since been carried on by the University of Otago. Stuart Park, then of Otago Museum, reinvestigated the dendroglyphs in 1975 (Park 1976). During the 1963-64 expedition some six hundred dendroglyphs were mapped and recorded. Finding the carvings was not easy as they were usually covered with lichen. Hundred metre grids were laid out in the bush and every tree inside the grid squares cleaned down with a wire brush. The carvings found were then mapped, drawn, photographed and numbered.

There are many areas now devoid of trees where dendroglyphs have been reported but not well recorded in the past. One such area is that known as Tupuangi Bush on the north-west coast. An excavation at Tupuangi, of a single layer occupation site with a bush soil profile, gave a radiocarbon date of A.D. 1700 (NZ R1379/1 258 ± 55 B.P.). Takapu, along the same coast, still had dead trees and three carved trees with stick-like figures in 1963. A search of the former Maori village area at Mairangi did not reveal any dendroglyphs though they were present if early reports are correct (Jefferson 1956). Similarly at Wharekauri, at the mid-point of the north coast, the trees have now gone but a few fragmentary carvings remained in 1963. A melanised soil horizon in the area suggests that at some stage the 'bush' was an area growing fern (Wright 1959). Jefferson recorded carvings on the north and north-east coasts at Pinui, Okawa and Te Whakaru (Jefferson 1956). Similarly the central limestone country had many carved trees, some of which were sold for garden ornaments in Christchurch when European farms were being cleared. There are still a few carved trees at Tennents Lake on the north of the limestone strip in a sheltered valley, and these are very different in style to any others. Carvings were reported for the south-west coast in the area between sea and uplands around Kaiara which is now grassland. It is possible the dendroglyphs in Canterbury Museum include examples from this area. Auckland Museum equally has examples from the limestone area, as has the National Museum. The dendroglyphs in the British Museum, London, would also seem to be from the limestone strip.

Any study of dendroglyphs is restricted to the few in museums, those recorded and those still remaining on the Chathams, thus any attempt to delineate regional or area styles is necessarily open-ended.

The main areas of recorded carvings are Makeroa, Manauea, Hapupu, Pinui, Okawa, Te Oriori, Taia, Kairae, Kaingarahu, Rangitai, Mairangi and Pitt Island. In 1963-64 some twenty-six groves and remnants of groves were recorded, sixteen have now gone. Some simple carvings have also been reported from South East Island. In this study I have taken only three main and fairly complete groups — Makeroa, Hapupu and Taia — to suggest the stylistic variability between them. These groups include seven distinct groves. The dendroglyphs of the other areas, e.g. Te Oriori, are quite recognizably different but there are too few carvings recorded on which to base a style determination.

The Makeroa style

Makeroa was a small strip of bush which was formerly in the area of the north coast between the lagoon and sea with high dunes protecting it on the sea side. It has now gone. When it was recorded, it was 100 m long and contained one hundred and twenty carved trees which could be separated into one main group and the remains of at least three others (Fig. 2).

The carvings can be divided into:-

(A) Human figures with heart-shaped faces, stick bodies with opposed ribs or bodies framed by the arms and legs of a figure in a crouching position. Some figures are multiple (Figs. 3-6).

(B) A feature of the main group was the number of abstract carvings of figures (Figs. 7, 8).

(C) Vertical lines or geometric patterns (Fig. 9).

Hapupu style

Hapupu is in a similar position to Taia but on the northern head of the lagoon. Again the bush is protected by high dunes. Three hundred carvings were recorded at Hapupu in three main groves and up to eighteen smaller ones. The Hapupu style is altogether bolder than that of Makeroa, though there are some resemblances. A broader tool would seem to have been used.

(A) Human figures show a considerable range of variation in the treatment of the body. The heads are generally broader and rounder than Makeroa and include some semi-cutout or cameo figures. Abstract carvings are rare but not unknown. The only double tier carving, i.e. two areas of carving at different heights on a tree (1-2 m and 3-4 m high) is also in this group (Figs. 10-15).

(B) This is a more complicated design with dumb-bell shaped heads and filled-in bodies. The arms and legs are often unimportant (Figs. 16-18).

(C) This is an abstract form found in one small separate group of six carvings in a two metre ring. One of these is human derived (Figs. 19, 20).

Taia style

Taia is a wedge of bush up to 300 m wide at one end decreasing to a point about a kilometre further south. Within this area are many large shell heaps, three intact groves and the remains of others. One hundred and forty carvings were recorded at Taia. The main group at Taia exemplifies the main style of the area. (Simmons 1965).

(A) Human figures have very simple, sometimes uneven faces, bodies are mostly lines and arms and legs, while in the crouch position, are usually of little importance. Body features of importance, perhaps to a story, are emphasised (Figs. 21-23).

(B) (i) Human figures cut out in cameo form. Many of these have fallen out (Figs. 24, 25).

(ii) Animal forms in cameo or etched onto bark. (Fig. 26).

(C) Figures stippled onto the bark (Figs. 27, 28).

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Figs. 2-4. 2. Makeroa bush in 1963 looking east. 3. Makeroa dendroglyph No. 580 (darkened with kerosene for photography). 4. Makeroa dendroglyph No. 578.

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Figs. 5-8. 5. Makeroa dendroglyph No. 599. 6. Makeroa dendroglyph No. 566. 7. Makeroa dendroglyph No. 626. 8. Makeroa dendroglyph No. 622.

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Figs. 9-12. 9. Makeroa dendroglyph No. 685. 10. Hapupu A dendroglyph No. 417 (in natural state after removal of lichen). 11. Hapupu A dendroglyph No. 107. Combination of surface carving and cameo. 12. Hapupu A dendroglyph No. 115 (outlined with white talcum powder).

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Figs. 13-16. 13. Hapupu A dendroglyph No. 106 (outlined with white talcum powder). 14. Hapupu A dendroglyph No. 104 (outlined with white talcum powder). 15. Hapupu A dendroglyph No. 114 (outlined with white talcum powder). 16. Hapupu B dendroglyph No. 153.

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Figs. 17-19. 17. Hapupu B dendroglyph No. 157. 18. Hapupu B dendroglyph No. 58 (Multiple figures). 19. Hapupu C dendroglyph No. 48.

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Figs. 20-22. 20. Hapupu C dendroglyph No. 47. 21. Taia A dendroglyph No. 329. 22 Taia A dendroglyph No. 366 (outlined with white talcum powder).

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Figs. 23-26. 23. Taia A dendroglyph No. 324. 24. Taia B dendroglyph No. 300. A human figure cameo. 25. Taia B dendroglyph No. 348. Remains of cameo. 26. Taia B dendroglyph No. 377. "Shag" cameo.

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Figs. 27-29. 27. Taia C dendroglyph No. 506. Stippled design. 28. Taia C dendroglyph No. 392. Stippled design. 29. Hapupu dendroglyph No. 138. Grown out dendroglyph.

An excavation in an area between two groves which had only small regrown trees, revealed a series of ovens dated to less than 200 years ago (NZR 1379/3 149 ± 54B.P., NZR 1739/3 88 ± 54 B.P.). A section of a shell heap composed of local shells had paua from the north coast at the base.

Discussion

Makeroa on the centre of the north coast, Hapupu on the north-east of the lagoon and Taia at the entrance of the lagoon are well separated. The three major styles delineated here with their variations would appear to be clearly enough distinguished to be characterized as regional styles. Within each area though, forms and shapes are depicted in a particular way in each grove, even though they are somewhat similar in all the areas studied. Within a grove there is a strong feeling of artistic identity and unity which could suggest that most of the carvings within a grove are the work of an individual artist who was relatively free to utilise varying approaches to similar subjects. This feeling of identity is strongly conveyed within the main grove at Hapupu and becomes clearer when sketching each carving in turn.

There is little to suggest that the variations in area style or between groves are time differences. The surviving dendroglyphs would appear to be late in prehistory or within the post-contact period. Dendroglyphs were seen that may be earlier or contemporary but were now almost unrecognisable due to tree growth (Fig. 29).

The significance of dendroglyphs in Moriori culture

The Morioris positive adaptation of a subantarctic hunting strategy (Sutton & Marshall 1980: 41) did not involve a completely nomadic settlement pattern but a more carefully organised pattern of base village areas occupied for most of the year with a series of out-stations for seasonal exploitation of resources. Such base village areas could have been associated with dendroglyph groves.

Traditionally in the late period the population was divided into tribes exploiting discrete areas with similar resources. Fighting over resources was known until the traditional hero Nunuku is said to have proclaimed the laws of peace, laws which were maintained even in 1835 when they were faced with invading musket armed Maori from New Zealand. The eventual disappearance of the Moriori people stems from this invasion either directly from death during the invasion or later as a result of the despair of an enslaved people forbidden to marry by their conquerors. Most of the available records of the Moriori, either made by outside observers or written by themselves, date from this period (Simmons 1962: 238). The dendroglyphs are not directly mentioned in any of the accounts and seem to belong to an earlier period, even though as Skinner remarked (Skinner 1923: 69) "No feature of Moriori culture has aroused more interest than the tree carvings, and no feature has been more fruitful in theories that attempt to explain their meaning". Jefferson found the carvings were in "groves" (Jefferson 1956: 54). Mapping of the surviving dendroglyph concentrations indicated clearly that where the group was intact they generally tended to face into a common centre and that in an area like Taia, where more than one "grove" survived, these could be separated on this criterion into groves which were confirmed by the presence of shell outside the grove. Food remains are generally absent from the groves though they may be plentiful outside them (Simmons

1964). This would suggest that the groves had a tapu or sacred function associated with the ancestors and mythology. The human figure dendroglyphs recorded would seem to fall into groups.

A Particular human figure forms with marked attributes which occur in more than one area despite any artistic or regional variation. These are about twelve in number.

B Human figures with recognisable attributes which occur only in one area and are not repeated outside of it.

It is suggested that the first group represents ancestors or mythical figures common to the traditions of all areas while the second group represents local beings or ancestors. Traditional records include a vast number of incantations associated with food procurement. This is to be expected in a culture dependent on the natural resources which only the gods and ancestors could control. One cause for despair after 1835 was that, as slaves, the Moriori were moved to new areas and did not know the appropriate prayers to protect themselves. It is perhaps in the context of relationship between men and the natural world that the dendroglyphs were carved, not to take possession of certain trees but to emphasise the interdependance of men, ancestors, gods and the natural world and to symbolize this relationship by either naturalistic or abstract designs on kopi trees. They were probably placed in groves to serve as ceremonial centres.

Conclusion

The dendroglyphs in different places can be established as belonging to different style areas and within these the work of individual artists can be recognised.

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THE ARTEFACT ASSEMBLAGE FROM THE OPITO BEACH MIDDEN, N40/3, COROMANDEL PENINSULA

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Abstract. The artefact assemblage from the Archaic midden site, N40/3, at Opito Bay on the Coromandel Peninsula is described. The assemblage is readily comparable with material from other early sites in the region, notably Hot Water Beach (N44/69) and Harataonga Bay on Great Barrier Island (N30/5).

The excavation of an Archaic midden, now designated site N40/3, at Opito Bay on the Coromandel Peninsula, was carried out as part of a research programme into the New Zealand Archaic, initiated by the Auckland University Archaeological Society in the mid 1950s. In view of the frequent occurrence of 'Moa Hunter' artefacts on the East Coast of the Coromandel Peninsula, field exploration was concentrated in this area, with the aim of discovering and excavating a Moa Hunter site. In the summer of 1956-57 Jack Golson directed the first major excavation in the area, at Sarah's Gully, a short distance from Opito Bay. At the start of the second season's work at Sarah's Gully, in late 1957, Mr R.H. Chapman of Opito Bay reported that artefacts were being eroded by high tides from a dune just north of a large creek running into the bay (for location see Davidson and Green 1975:45 and Fig. 1). The richness of the new site was confirmed by some of the members of the excavation team at Sarah's Gully who tested the area and recovered sufficient evidence that it was worth excavation (Golson 1959b:13).

Two days' excavation of the Opito site was carried out by the full excavation team in January 1958. A trench roughly 12.5 x 3 m, an area of some 37.5 m sq., was cut across the dune to a depth of 1.4 m. This was divided into three 1.8 m, four 1.5 m and one 0.9 m rectangles. The stratigraphy of the deposits was reasonably clear. An overburden of whitish granular sand covered the site to a depth of 0.6-0.8 m. There was evidence of late occupation with few remains at a high level in the dune series, while the main cultural deposit occurred at the base. This consisted of a composite series of three layers 0.4 m thick, very rich in faunal and artefactual remains (layers 4A to 4C). The upper layer of the series was blackened with cooking fires, and a *haangi* was found in Rectangle 2. In some parts of the site the middle layer was associated with a thin spread of small waterworn pumice pebbles. The lowest layer was the richest in artefactual material, and as excavation proceeded, this had all the appearance of a working floor, with stone flakes, broken and half-finished adzes and bone material occurring in a compacted layer just above natural.

A second excavation was carried out in January 1959, primarily to investigate the pumice. During the 1958 season nothing further had been done beyond noting its occurrence, but in the light of Dr Wellman's work on Loisel's or black pumice, it was decided to investigate its occurrence in the Opito site in more detail. A small section was cut adjacent to the 1957-58 excavation to collect pumice from all levels of the site, and subsequently

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excavated down into the underlying beach deposits. White pumice occurred at all levels of the site, but all Loisel's pumice lay above the lower half of the sand layers dividing the two main culture horizons at the base of the deposit.

A third brief excavation was carried out in May 1959. The main aim was to correlate the black pumice of 1958-59 with the radiocarbon date obtained in the first season of excavation. It was also possible to correlate the stratigraphy recorded during the previous two seasons of excavation with greater precision.

The Opito site was reopened in early 1962 by R.G.W. Jolly and D. Trower, who carried out a brief excavation. An area roughly 3 x 1 m was opened, but its precise location in relation to the Golson excavations is not clear. No definite occupation layer was encountered. A brief report of this excavation was published, together with a list of the artefacts recovered (Trower 1962).

FISHING GEAR

Evidence of fishing was present in all layers of the site, in the form of fish-hooks, both finished and unfinished, and the residue of their manufacture. As Table 1 shows, the majority of material came from Layers 4A to 4C, notably Layer 4C. Layer 3 only yielded one finished fish-hook fragment.

Table 1. Fishing gear.

Layer	Finished 1 piece hooks complete	shank leg	point leg	total	Unfinished 1 piece hooks	Lure hooks	Cores	Tabs	Lure shanks
3		1		1					
4A	1	6	8	15	16		20	1	
4B	2	24	10	36	30	1	21	1	1
4C	5	54	23	82	50	3	42	10	4
	8	85	41	134	96	4	83	12	5

Fish-hooks (Figs. 1-11)

All but four of the fish-hooks recovered were one piece oval hooks with incurved points, manufactured from moa bone. Classified by Crosby (1966:187) as Opito type 1, this type of hook is the most common form found in early sites in the north of the North Island (Golson 1959a:45, Nicholls 1963:23). In the following discussion, the descriptive terms used are those adopted by Smart (1961).

A total of 230 one piece fish-hooks and hook fragments were recovered, 134 finished and 96 unfinished. Of the finished hooks, only 8 were complete. The remainder, presumably broken during use, had generally snapped across the grain at the base or the lower part of the point leg. The curve between the shank leg and point leg appears to be the area under greatest stress in bone hooks such as these. Thus, out of 126 fragments of finished hooks, 85, or 69% were broken across the base or the lower part of the point leg, while the shank leg was largely intact.

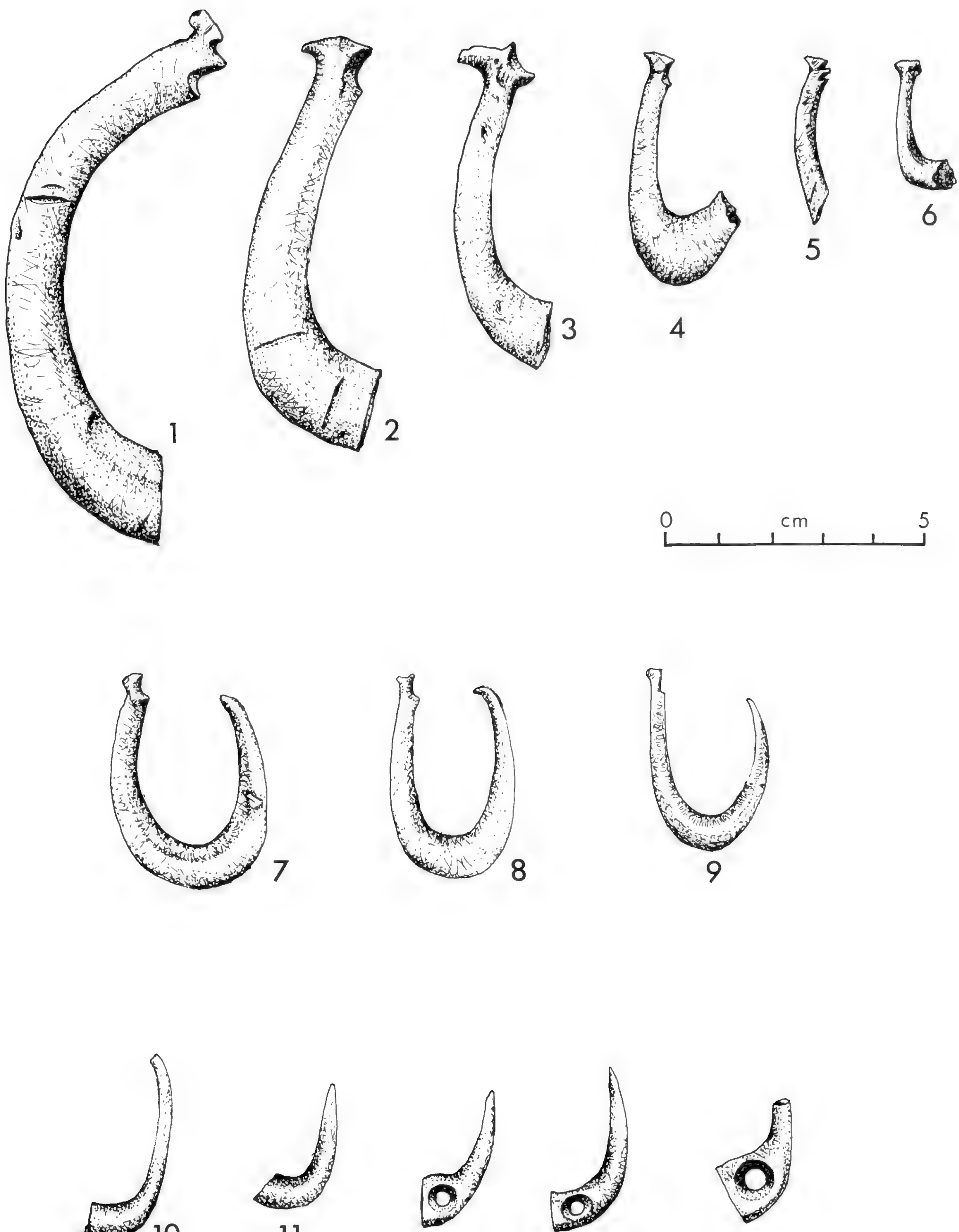
Characteristic of Crosby's Opito type 1, the one piece fish-hooks in this assemblage are oval in outline with the shank head slightly extended above the point. The shank heads show some variety in form, although there is generally a simple step on the inner side and a shallow concavity on the outside for line attachment. The top of the shank head is generally either flat or notched. All the points are unbarbed, and the tips of most are incurved to some degree. Only a few examples have any modification for bait attachment.

Table 2 gives the size of the longest and shortest fish-hooks in each layer, the mean length and the number of hooks measured in each. Although all hook fragments were measured, for the purpose of this table only the complete hooks and those which had broken across the base and had complete shank or point legs have been included. The table reveals a considerable size range of fish-hooks in the site. Layer 4B has the widest range, 1.8-10.4 cm in length, although the average length of hooks is greatest in Layer 4C.

Table 2. Numbers and lengths of finished one piece fish-hooks

Layer	Number	Length (cm) maximum	Length (cm) minimum	Average
3	1	3.7		3.7
4A	11	6.7	2.6	4.4
4B	20	10.4	1.8	4.8
4C	45	8.0	2.6	5.6
	77			

2/4A/20 (Fig. 9) is a slender hook with only slightly incurved point. There is a shallow bait notch halfway up the point leg on the outside. The tip of the lashing head has broken off, but judging by the size of the hook, this would not be very large. 2/4C/113 (Fig. 4) has the flat topped form of lashing head, with the usual simple step on the inside, ending in a small knob. There are two lashing grooves on the head itself, one running horizontally from the step, the other diagonally from the top. The base of this hook is relatively wide, probably to counteract the weakness of bone hooks at this point. The usual oval cross-section is laterally flattened in this area, to give additional strength. 5/4C/65 (Fig. 2) is a much larger example. It has a flat topped lashing head and two bait notches on the shank leg close to the base. 6/4C/40 (Fig. 3) is a very large hook with an extended lashing head. The top of the head is slightly concave, compared to the flat tops of the previous examples. Extended lashing heads are a feature of fish-hooks from Wairau and Shag River; these are slightly larger than Opito type 1 hooks, but otherwise similar in form. Crosby (1966: 191) classifies this form of hook as the Shag variety, a subgroup of the major early group of fish-hooks, Opito type 1. Only the shank leg is intact in X/4B/7 (Fig. 5). However, the lashing head has an unusual double notched profile on the inside. The outside has the common single notch. The inward curve of the tip of the point is particularly marked in 3-4/4C/58 (Fig. 8). There is a shallow notch on the top of the lashing head, similar to the hook illustrated in Fig. 4.



Figs. 1-14. Bone fishing gear. 1-11. One piece hooks and fragments. 12-14. Lure points. 6, 9. Layer 4A. 1, 5, 12. Layer 4B. Remainder, Layer 4C.

6/4A/10 and X/4B/5 (Figs. 6, 1) illustrate the considerable size range of the hooks recovered. The large specimen has two notches for attaching bait, on the outside of the shank leg towards the head. There is a marked notch in the top of the lashing head, in contrast to the flat top of the small hook. The two point legs in Figs. 10 and 11 are examples of two different forms. One has the common slender incurved point while the other has a shorter, facetted point, although the diameter at the base is similar in both. The latter hook conforms to Crosby's Opito II variety, which she interprets as a reused Opito I hook, the broken tip having been refashioned to a simple jabbing point.

Composite lure hooks (Figs. 12-14)

Evidence of trolling is provided by four lure points. Three, all made from bone, were found in Layer 4C. The fourth, from Layer 4B, is made from a tooth, the mandibular canine of the N.Z. fur seal (Fig. 12). Two of the bone points are illustrated in Figs. 13, 14. All four points are unbarbed, and have deeply curved outlines. They are uniperforate, with a wide flat base. Lure points of similar form have been recovered from other early sites in the region, one from Hot Water Beach (Leahy 1974:39) and one from Harataonga Bay on Great Barrier Island (Law 1972:87). The lure points from Opito thus conform to the characteristic pattern for the area. Seven pieces of worked shell were recovered. They are discussed in more detail below, as ornaments, but five of these could also be lure shanks. Although they lack any modification for lashing at the tip, they are of characteristic elongated oval shape with rounded top and single hole (for example, Fig. 29). Crosby (1966:148) notes that the distribution of drilled deep curve points in the North Island corresponds closely to that of the early Dorso-Ventral series of shanks. There is also evidence of association between this type of lure point and another early form of lure shank, the grooved shank. Law (1972:87) describes a grooved lure shank from a Settlement Phase site at Harataonga Bay (site N30/5), the same site from which the uniperforate lure point mentioned above was recovered.

Fish-hook manufacture (Figs. 15-22)

There is ample evidence for the manufacture of fish-hooks on the site. As in the case of finished hooks, this is concentrated in Layers 4A to 4C. All stages of the manufacturing process are represented, from the prepared bone tabs shaped to the desired outline of the hook to the unfinished hooks with scalloped inside curves left by drill holes.

As Table 1 shows, the most common remains of fish-hook manufacture were cores, the waste pieces of bone drilled from the centre of the tab in shaping the inside curve of the hook; a total of 85 were recovered. Ninety-six unfinished hooks were recovered, all from Layers 4A to 4C. Length measurements were made of all the cores and most of the unfinished hooks in order to get an estimate of the size of the original tabs and resulting hook. Some idea of the relative sizes of core and hook can be obtained from two examples of unfinished hooks which still have cores attached. 5/4C/54 (Fig. 18) is 5 cm long, and the attached core 2.8 cm; 5/4A/16 is 4.5 cm long, the core 1.7 cm.

Table 3 gives the number of cores in each layer, the size of the longest and shortest, and the mean length. Similar length measurements are given for unfinished hooks in Table 4. As in Table 2, only those hooks which were broken across the base and thus have complete shank or point legs have been included.

Table 3. Numbers and lengths of bone fish-hook cores.

Layer	Number	Length (cm) maximum	Length (cm) minimum	Average
4A	20	4.4	1.2	2.5
4B	21	3.6	1.3	2.7
4C	42	5.2	1.4	3.1

Table 4. Numbers and lengths of unfinished one piece fish-hooks.

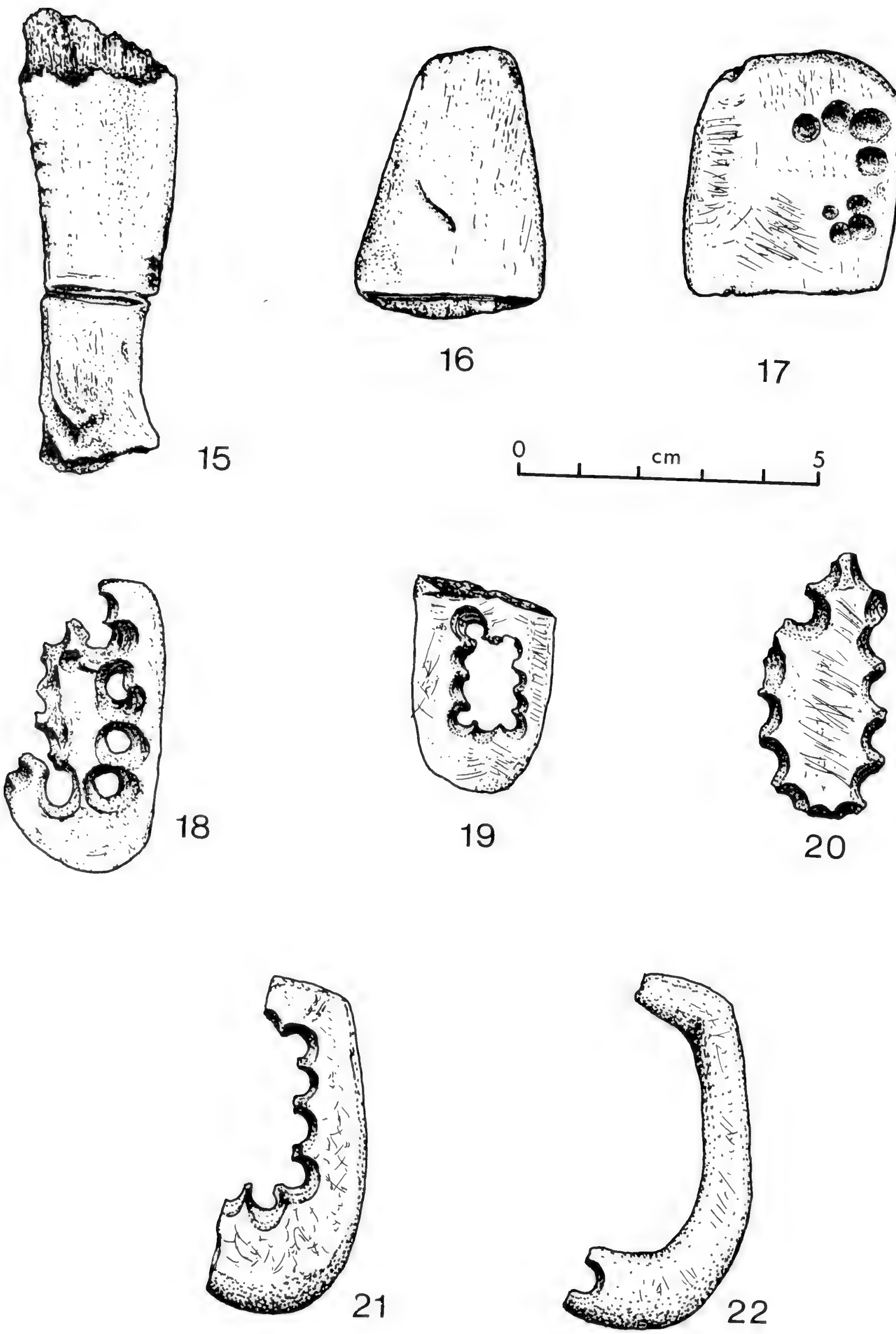
Layer	Number	Length (cm) maximum	Length (cm) minimum	Average
4A	5	5.0	4.2	4.5
4B	18	8.2	3.2	4.5
4C	38	8.4	3.5	4.6

The results for cores parallel the trends evident in the figures for finished hooks. The average length of cores is greatest in Layer 4C and least in Layer 4A, just as the average length of finished hooks is greatest in Layer 4C and least in Layer 4A. This is indicative of a trend towards smaller hooks through time, the fish-hooks in earlier layers being on average larger. The total numbers of both cores and finished hooks also decrease through time, as do those of the unfinished hooks.

The fish-hooks from Opito are relatively large. This can be seen by comparing the sizes of cores from Hot Water Beach with those from Opito. The cores from Hot Water Beach range in length 0.7-3.4 cm, while those from Opito range 1.2-5.2 cm. Leahy (1974:36) considers that any core over 3 cm long would probably produce a large hook for the Hot Water Beach site. In Layer 5 of this site, for example, only 8 out of 96 cores were over 3 cm long. In contrast, 23 out of 42 cores in Layer 4C of the Opito site were over 3 cm long, more than 50%.

Figs. 15-22 illustrate the stages in the manufacture of one piece fish-hooks. First a suitable flat piece of bone was cut, in this case by sawing (Fig. 15). The tab was then shaped to almost the exact outline and thickness desired for the finished hook (Fig. 16). The inside curve was shaped by drilling a series of holes from each side of the tab and knocking out the central core (Figs. 17-21). The hook was finished by smoothing the inside curve and shaping the shank head and point to the desired form. The hook fragment illustrated in Fig. 22, smoothly finished except for the angle formed by the top edge of the original tab, suggests that the shaping of shank head and point was left until last.

The large number of unfinished hooks and cores present in the site relative to the number of tabs (only 12 complete tabs and 13 fragments) suggests that the tabs were prepared elsewhere, and the main activity on the site was the actual shaping of hooks. In addition to the partially cut piece of bone in Fig. 15, there were only two other large pieces of bone which could have provided raw material for the manufacture of fish-hooks, one from Layer 4B and one from Layer 4C. Both are joint heads, cut by drilling holes from



Figs. 15-22. Bone fish-hook manufacture. 15-17, 19. Tabs. 18. Tab and core. 20. Core. 21-22. Partially finished hooks. 20. Layer 4A. 16, 21. Layer 4B. Remainder, Layer 4C.

both sides. Leahy (1974:36) notes that at the Mt. Camel site (N6/4), some large bone tabs were made from the wide flat area just below the joint heads of long bones; Fig. 15 shows just this technique. Of the prepared tabs from Opito, all except one have been shaped, and three have one or two partially drilled holes.

Conclusions

The fishing gear recovered from Opito is indicative of an emphasis on line fishing. In the absence of any other form of small hanging hook, it is probable that the Opito 1 type hook which forms the bulk of the assemblage was used to take a wide variety of sub-surface fish. This interpretation is supported by the wide size range of the hooks recovered, 1.8-10.4 cm. One fish species which has been associated with the Opito 1 hook is snapper. Crosby (1966:208) cites evidence that the point of an oval one piece hook of Opito 1 type was found in apparent primary association with the head bones of a snapper at another site on Opito Bay, N40/2.

The only other type of fishing equipment recovered was the lure or trolling hook point, limited to four examples, and five possible lure shanks. There is no indication of any major change in fishing technology within the main cultural layers. However, the decrease in sizes and numbers of fish-hooks and cores from Layer 4C to 4A points to an increasing scarcity of moa bone through time. A very similar pattern can be seen in the material from Hot Water Beach and Harataonga Bay. In both these sites there is a preponderance of Opito type 1 hooks, and limited evidence for trolling. Moreover, Leahy (1974:36) notes a decrease in cores in the upper layers of Hot Water Beach. When seen in this wider context, the material from Opito clearly forms part of the homogeneous and well established cultural tradition in the Coromandel area.

ORNAMENTS (Figs. 23-31, 35, 36)

A number of artefacts in bone and shell, presumed to be ornaments, were found, all in Layers 4A to 4C. The most commonly occurring forms were plain bone tubes or reels; 78 were recovered. Cut from sections of long bones, these artefacts are unequivocally archaic, similar to those recorded from Wairau Bar (Duff 1956:Fig. 17). In the case of Opito they are mainly manufactured from dog bone; two examples, 5/4C/51 and 2/4C/77, are made from the femur of a dog. Fifty-six of the reels in Layer 4C and five in Layer 4B are dog bone; the remainder, a total of seventeen, are manufactured from bird bone (R. Cassels, pers. comm.). Duff (1956:95) records the use of dog bone, human bone and the bone of the extinct swan in addition to moa bone for the manufacture of bone reels at Wairau Bar. Table 5 gives the number of reels found in each layer and the maximum, minimum and mean values for length and diameter. The overall range in length is 1.8 cm, and the range in diameter rather less, 1.2 cm.

Table 5. Numbers and sizes of bone reels.

Layer	Number	Length (cm)			Diameter (cm)		
		maximum	minimum	mean	maximum	minimum	mean
4A							
4B	9	2.3	1.0	1.6	1.3	0.5	0.8
4C	69	1.9	0.5	1.2	1.6	0.4	0.8

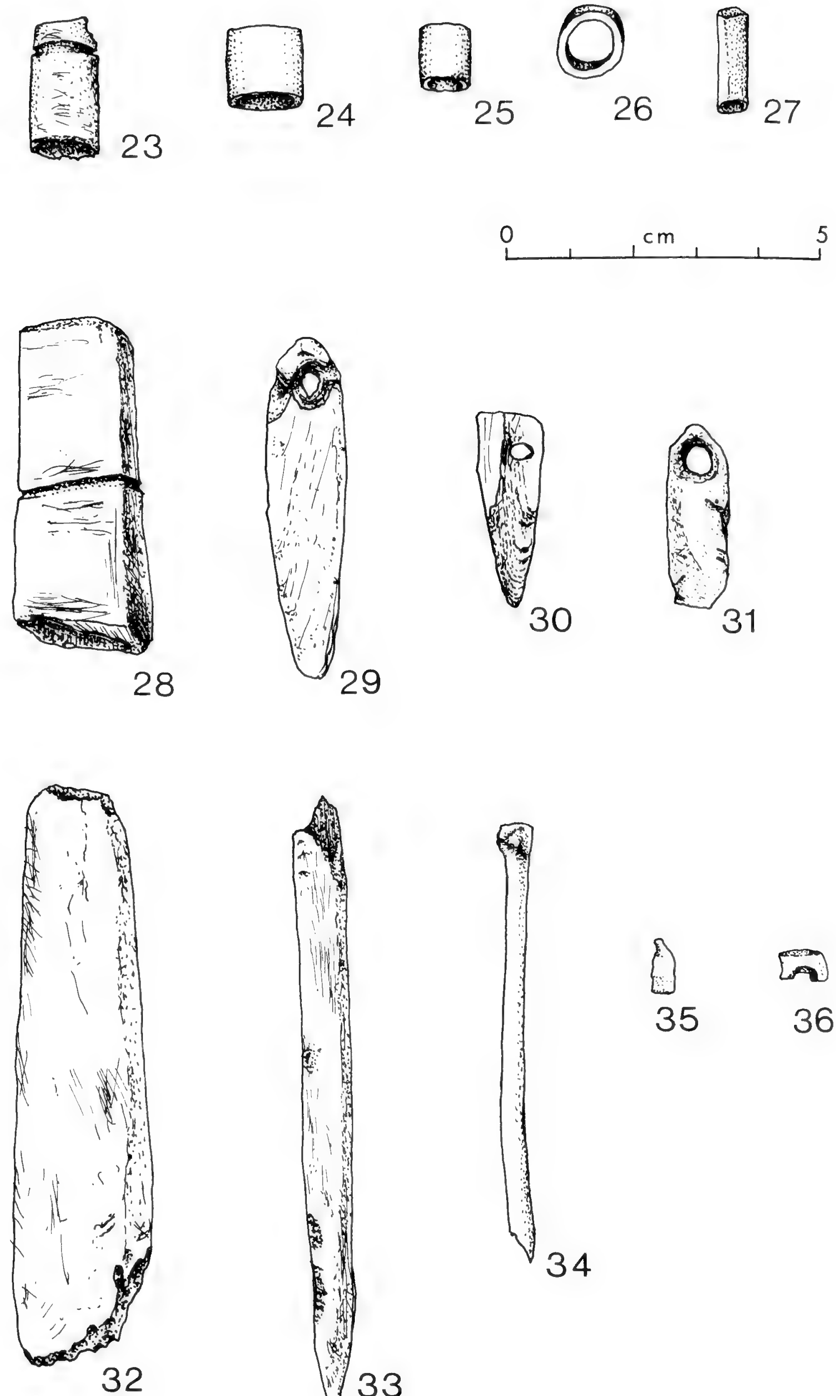
Three unfinished bone reels, found in Layer 4C, provide evidence of techniques used to manufacture this type of ornament. 3/4C/34 (Fig. 28) shows how sections were cut by grooving around the circumference then sawing through. The other two examples have broken during manufacture and been abandoned. In Fig. 23 (5/4C/51) the second reel of the pair has broken off, leaving a jagged point. The other specimen (not figured), also a pair of reels, has split longitudinally. Three heads of small diameter long bones with sawn ends, one from Layer 4C and two from Layer 4B, are probably waste material from the manufacture of bone reels.

A total of 17 tube like sections of *Dentalium nanum* shell were found, 1 in Layer 4A, 9 in Layer 4B and 8 in Layer 4C. They are all small in diameter (0.2-0.3 cm) and range in length 0.7-3 cm. They do not appear to have been worked; it is probable that they would have been cut into small sections to form necklace units. The use of *Dentalium* shell for ornaments, presumably strung as necklaces, has long been regarded as characteristic of Archaic assemblages; Duff (1956:P1.13) illustrates two such necklaces, one from Dunback, North Otago, and one from Wairau. According to Duff (1956:97) these were made by scoring the parent shell then cutting it into thin sections. One other necklace unit, made from ivory was found in Layer 4A (3/4A/18). It is plain, smoothly finished and 1.1 cm in diameter (Fig. 26).

Both Golson (1959a) and Groube (1968), in their discussions of artefact distribution through time place *Dentalium* shell firmly in the Archaic. However, there is evidence that both *Dentalium* shell and cut bone tubes occur right through to the contact period. Orchiston (1972:104) cites evidence for the use of sections of *Dentalium* shell and cut bird bone in necklaces, anklets and bracelets in protohistoric times. Leach (1977) also makes this point, and goes on to detail the different species of *Dentalium* available in New Zealand, their habitats, and the variety of items in which they were used. These range from necklaces, anklets and bracelets to the borders of woven bands and capes.

Seven pieces of worked shell, probably ornaments, were recovered, six from Layer 4C and one from Layer 4B. The specimen from Layer 4B (Fig. 29) is particularly well-preserved. It is an elongated oval shaped ‘pendant’ made of oyster shell (W. Cernohorsky, pers. comm.), with rounded top and single hole. Duff (1956:P1.23) illustrates a shell pendant of very similar form from Wairau Bar. Three of the pieces of worked shell from Layer 4C suggest ornaments of similar form, although two are broken. None are pierced, but one (6/4C/9) has two partially drilled holes on one surface at the wider end. As noted above, these four specimens could also be lure shanks. Indeed, in Duff's description of pendants, he adds that they suggest the form of lure fish-hook shanks (Duff 1956:134).

The three other shell ornaments in Layer 4C, also made of oyster, are smaller specimens. 2/4C/494 (Fig. 30) is thinner than the previous examples; it has a squared off top with a single hole and tapers to a fairly sharp point. 2/4C/493 is similar; the point has broken off in this case. These are presumably the items described by Golson (1959a:45) as shell copies of the *Charcharodon* shark tooth necklace unit. The broken pendant in Fig. 31, 2/4C/492 features a rounded top with quite a large hole. This could also be a lure shank; it is thick and relatively straight sided; the point would probably have been rounded like that of Fig. 29.



Figs. 23-36. Worked bone and shell. 23-27. Bone tubes. 28. Partially cut bone. 29. Shell lure shank or pendant. 30-31. Shell pendants. 32-33. Bone scrapers/burnishers. 34. Awl. 35. Cut tooth. 36. Cut bone. 26. Layer 4A. 29, 33. Layer 4B. Remainder, Layer 4C.

Two fragments which are possibly ornaments also come from Layer 4C. One is a small tooth, split longitudinally (Fig. 35). There is no sign of any suspension hole. The other is a small rectangular sectioned piece of ivory with a single hole, broken across its diameter, and a flat base (3/4C/492, Fig. 36). It is similar in form to the base of a lure hook point, but its small size suggests that it is more likely to be ornamental.

The ornaments from Opito are generally plain and simple. This assemblage lacks the more elaborate bone and stone reel necklace units common in other Archaic sites, although Duff (1956:103) describes a well finished stone reel with six transverse ridges found at Opito Bay. The two bone reels found at Hot Water Beach, for example, were decorated with three external ridges like those from Wairau, and a stone reel of similar form was also found (Leahy 1974:42). At Hahei an archaic burial yielded two distinctive styles of ivory reels, one barrel shaped with single external ridge, the other with a series of pronounced transverse ridges set close together to produce a concertina like effect (Edson & Brown 1977:32-33).

MISCELLANEOUS WORKED BONE (Figs. 32-34)

A bone point, 9.8 cm long, was found in Layer 4B (5/4B/42). Made from the rib bone of the N.Z. fur seal, the point has been fashioned by cutting facets at an angle on two edges; the other end is broken (Fig. 33). The function of this artefact is uncertain; there is no sign of an eyelet hole to suggest a needle. The perforation of skins is one possibility. A slender bone awl 7 cm long was found in Layer 4C. It is made from bird bone, identified as the right ulna of one of the Charadriiformes. The sharp nib-like point has been made by cutting diagonally across the grain (Fig. 34). Awls of similar form are found in other archaic sites: Wairau Bar (Duff 1956:217), Harataonga Bay (Law 1972:88) and Hot Water Beach (Leahy 1974:45). However, as Duff (1956:217) notes, bone awls and needles are commonly found in sites up to the nineteenth century, so they cannot be regarded as distinctively Archaic. Likewise, Golson (1959a:62) includes awls and needles in his list of culture traits common to both Archaic and Classic phases in New Zealand prehistory.

One other piece of worked bone was recovered from Layer 4C. It is a flat piece of bone 9.4 cm long, with a smooth chisel-like point 1.2 cm wide (Fig. 32). Bone artefacts excavated from the Mt. Camel site in Northland have working surfaces with similar rounded chisel-like profile. Roe (1969:69) interprets these as burnishers used in the preparation of skins for clothing. Law (1972:88) describes a similar artefact found at Harataonga Bay as a bone chisel or possibly a skin burnisher.

ADZES (Figs. 37-56)

According to the preliminary report published on the Opito site, the full range of archaic adzes was present, except for the sidehafted form (Duff Type 5) (Golson 1959a:19). On closer inspection the adzes are mostly roughly finished, and many do not fit with any certainty into one or other of Duff's adze types. Only 29 adzes are finished. Table 6 lists the number of adzes and roughouts found in each layer. The roughouts have been divided into lenticular, quadrangular, triangular and miscellaneous (those not fitting any of these categories), on the basis of cross section. Among the roughouts, those with quadrangular cross section are the most numerous; quadrangular and triangular roughouts together form the bulk of the assemblage. In the discussion which follows the descriptive terms used are those recommended by Davidson (1961:6).

Table 6. Adzes and roughouts.

Layer	Finished adzes	Roughouts lenticular	quadrangular	triangular	misc.	total	Total
3			2			2	2
4A	3		10	5		15	18
4B	9		9	7		16	25
4C	17	2	22	21	8	53	70
	29	2	43	33	8	86	115

In Layer 3 two roughouts were found, both broken. These are quadrangular, and are probably both butt ends. Three finished adzes were recovered from Layer 4A, one complete. 1/4A/56 is a triangular sectioned adze fragment 10.5 cm long, with a maximum width of 5.5 cm. It is broken at both ends, making it difficult to assign to a type category. Judging by the cross section it is either a Duff Type 4, or the rarer Type 3. It is well polished on the back and only partially on the front. The single complete adze is 6/4A/50 (Fig. 38). It is 7.7 cm long and has the thin quadrangular cross section and wide front characteristic of a Duff Type 2A. The only polished area is the back of the blade, and there is steep angled flaking around the sides and the evenly rounded butt. There is no marked tang, another characteristic of a 2A adze (Duff 1956:161). SR/4A/111 is a section of a quadrangular adze, broken at both ends. It is well polished on the back, only partially on the front.

In all, 15 roughouts were recovered from Layer 4A. Of these, 10 are quadrangular, and the 7 complete specimens range in length 6.4-10.3 cm. 1/4A/57 (Fig. 37), 8.5 cm long, has the thin cross section and wide front typical of a Type 2A adze. There is steep angled flaking along both sides and an area of cortex is present. SJ/4A/62 is the blade portion of a quadrangular roughout. Of the five triangular roughouts in Layer 4A, four are complete; they range 5.9-11.3 cm in length. For example, SR/4A/110 (Fig. 39) is a triangular roughout 8.9 cm long. The maximum width is at the butt end; it tapers abruptly from a width of 4.5 cm at the butt to 2.5 cm at the cutting edge. The cortex is present in places.

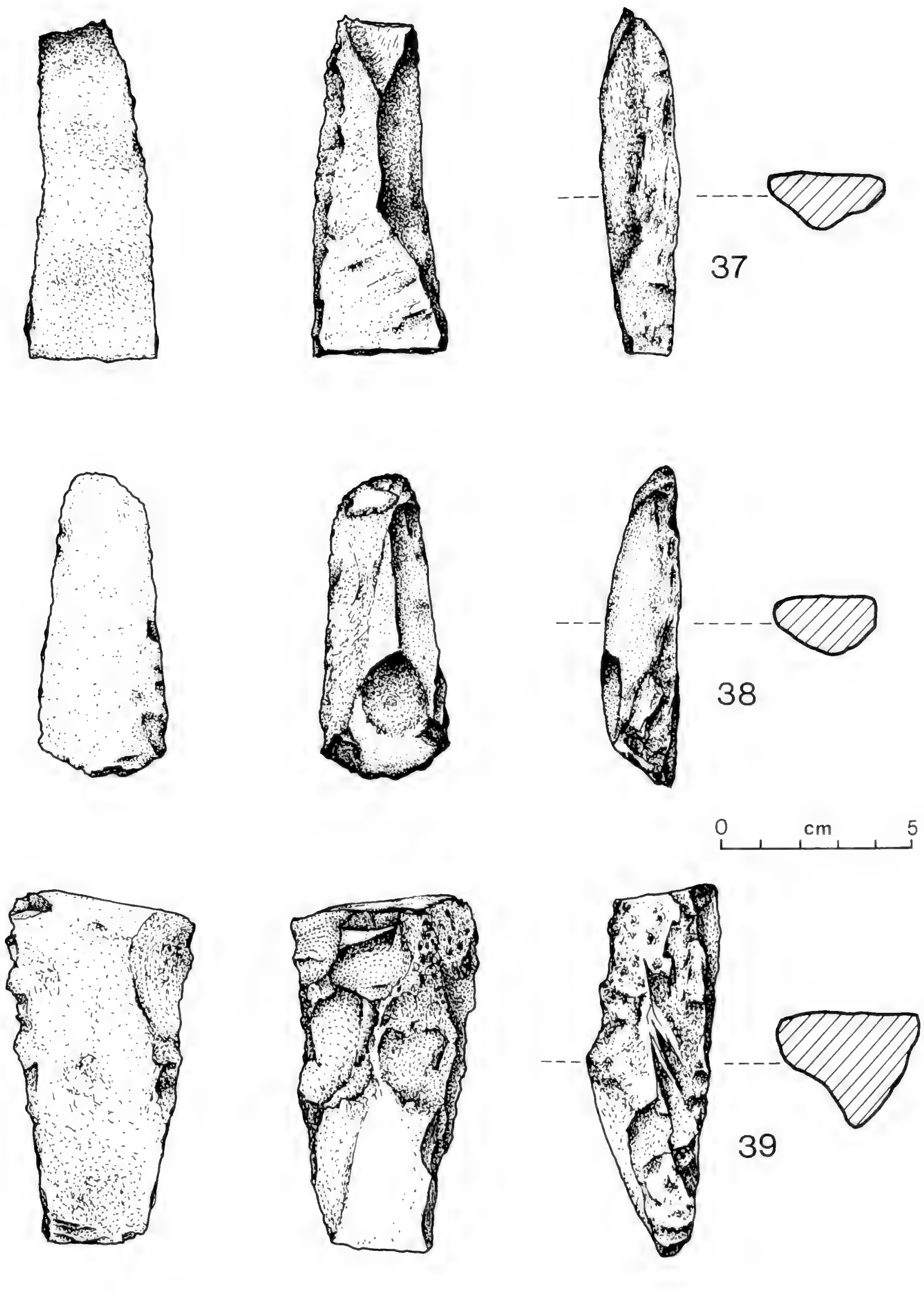
Nine finished adzes were recovered from Layer 4B. Three of these are Duff Type 2A. One complete specimen is 3/4B/84 (Fig. 45). Small (6.5 cm long), thin from front to back and lacking a tang, it fits Duff's type category well. It is in the process of being reworked, and polishing is limited to the blade, on front and back. 5/4B/166 (Fig. 42) is a larger example, 9.1 cm long, also in the process of being reworked. It is well polished on front and back, particularly at the blade, and partially on the sides. The third adze is particularly small and thin. It is 5 cm long and 1 cm thick and well polished on front and sides; the blade has broken off.

Three other finished adzes of quadrangular cross section come from Layer 4B. S/LM/7/5 is a complete example, 7.7 cm long. It has little butt modification; it could be a Type 1A or 2A. The only traces of polishing are along the cutting edge, and there are areas of cortex on the back. S/LM/7/28 (Fig. 56) is the blade end of a quadrangular adze, possibly a 1A, in the process of being reworked. It is partially polished all over. Flakes have been removed from the back of the blade to produce a gouge like cutting edge. S/LM/7/7 is also a blade fragment, probably of a 1A adze, ground on the back only. The other four adzes from Layer 4B have triangular cross sections. 4/4B/216 (Fig. 40) is similar to a Duff Type 4A with its high triangular cross section and marked tang. It is partially polished on sides and back; the blade has broken off. 6/4B/66 and 6/4B/68 are broken sections of triangular adzes, Duff Type 3 or Type 4.

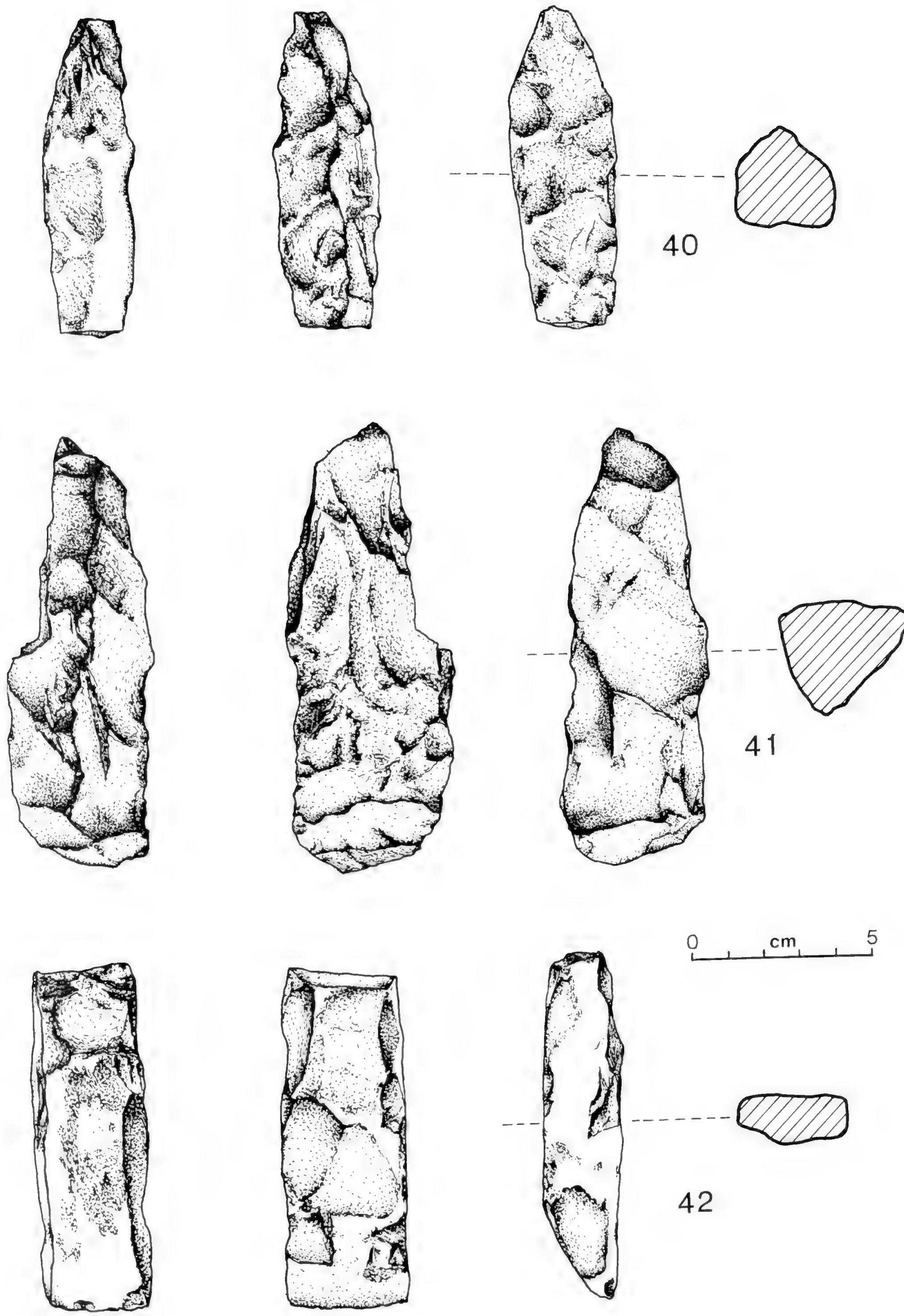
A total of 16 roughouts and roughout fragments were found in Layer 4B, 7 triangular and 9 quadrangular. Four of the quadrangular roughouts are complete: they range in length 9.4-26.8 cm. 1/4B/54 (Fig. 46) is a particularly massive example, 26.8 cm long and a maximum of 9.4 cm wide. It is of classic Duff Type 1A form, with high quadrangular cross section and relatively broad blade (Duff 1956:Pl. 27). Two other quadrangular roughouts, 2/4B/210 and SR/4B/103 also have features of 1A adzes; one of these is broken. Two of the remaining three quadrangular roughouts are probably blade portions. Only one of the triangular roughouts is complete. This is 2/4B/211 (Fig. 41), 11.9 cm long. It has a relatively curved profile and marked tang, similar to a Type 4A adze.

Layer 4C yielded the largest number of adzes and roughouts. A total of 17 finished adzes were recovered, 14 quadrangular and 2 triangular cross sectioned. Of the quadrangular adzes, four could be classified as Type 1A and six as Type 2A. 2/4C/376 and 5/4C/355 (Figs. 50, 51) are two well finished examples of 2A adzes. They measure 11.5 and 8.1 cm in length respectively. The front surfaces are completely polished, the sides and backs partially. 3/4C/269 is a small 2A adze, only partially finished, 6.2 cm long. The front is ground to a flat surface, the sides partially ground. The blade is unground, and the back still has areas of cortex present. 4/4C/675 (Fig. 44) is a typical 2A specimen with wide front and little butt modification. The only traces of polishing are along the cutting edge. 3/4C/262 (Fig. 48) has features of both 1A and 2A adzes. It has the thin quadrangular cross section and wide front of a type 2A adze, and a marked tang, typical of a 1A adze. The back and sides have been reduced by steep angled flaking along the edges. Another well finished 2A adze, 12 cm long, is shown in Fig. 47 (S/LU/7A/1). It is polished on all surfaces, and there is some butt modification. It was in the process of being reworked, particularly the blade, and several large flakes have been removed from the sides.

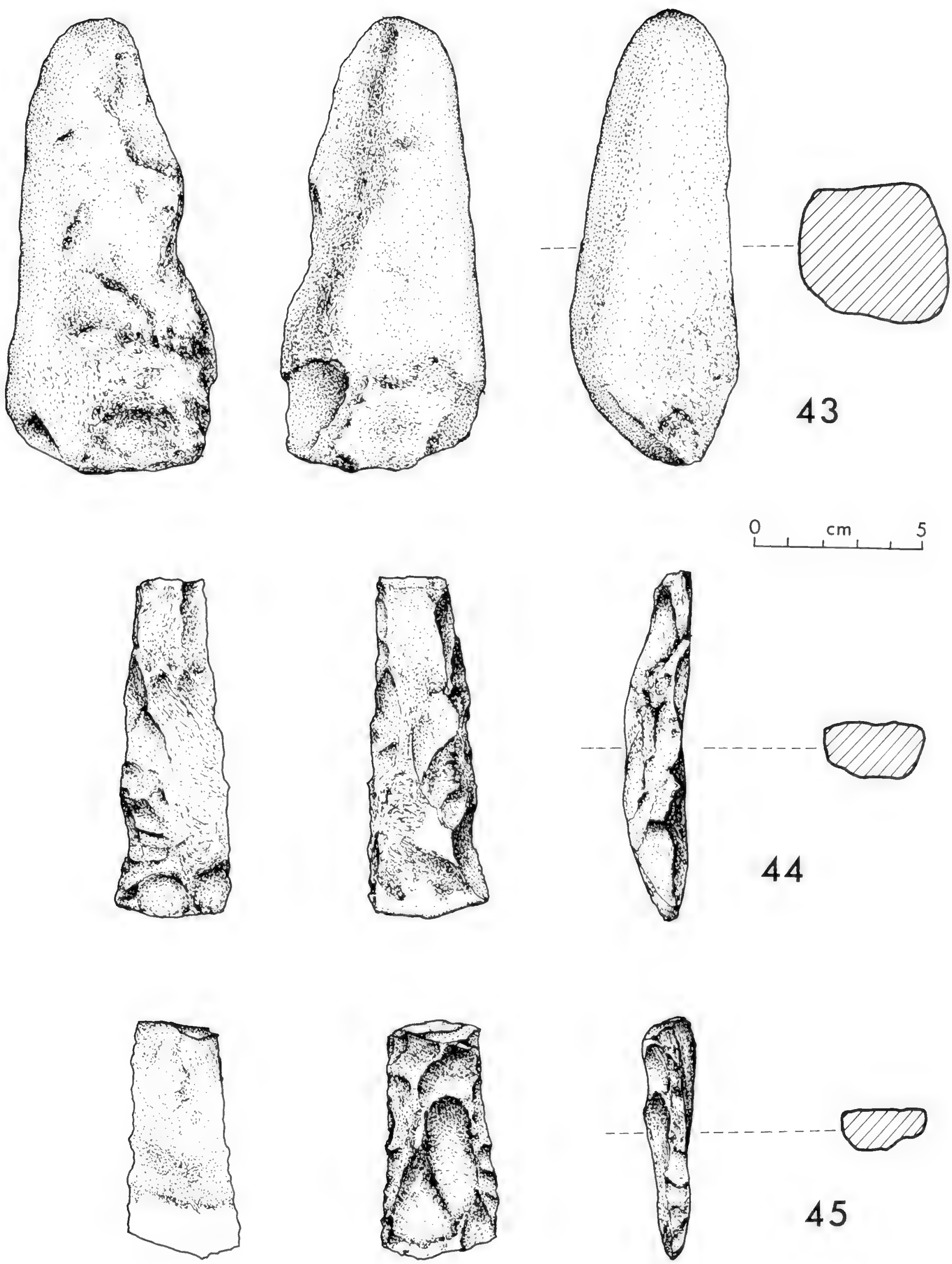
Of the other quadrangular sectioned adzes, four could be classified as Type 1A on the basis of their greater thickness from front to back, and sharper angle between butt and blade (Duff 1956:151). 3/4C/266 is 9.6 cm long; it is well polished on front and back, particularly at the blade, and on one side only. It was being reworked, and has the appearance of being split longitudinally. 3/4C/276 is a complete example, 10.1 cm long, partially polished all over. 3/4C/677 is the broken blade portion of a thick quadrangular sectioned adze, probably a 1A, polished on all surfaces. 4/4C/687 is a similar blade fragment, with partial grinding all over. There are two other blade fragments from this layer, which could be Type 1A or 2A. Both have relatively wide fronts, and steep angled flaking along both sides on the back to form almost a trapezoidal cross section. S/R/4C/129 (Fig. 52) has also been reworked. The angle between sides and back has been reduced by flaking at a shallow angle along both sides, and the front has also had a series of flakes removed along one side to form almost a lenticular cross section. Several deep flakes have been removed from the back of the adze at the blade to form a gouge like cutting edge similar to the example from Layer 4B discussed above.



Figs. 37-39. 37, 39. Roughouts. 38. Adze. All Layer 4A.



Figs. 40-42. 40, 42. Adzes. 41. Roughout. All Layer 4B.



Figs. 43-45. 43. Roughout. 44, 45. Adzes. 43, 44. Layer 4C. 45. Layer 4B.

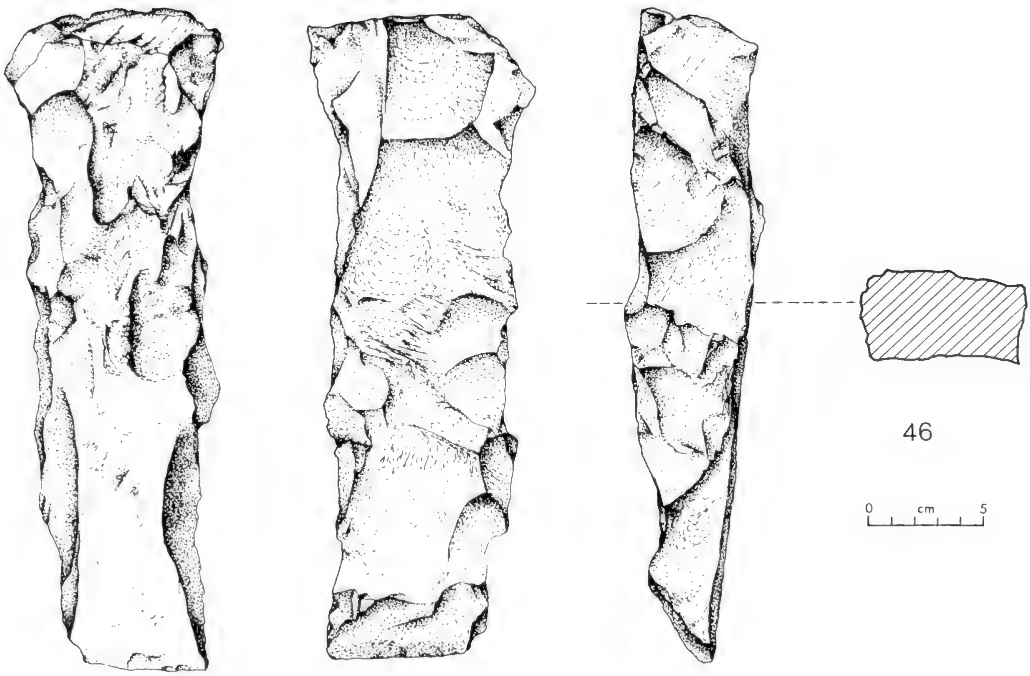


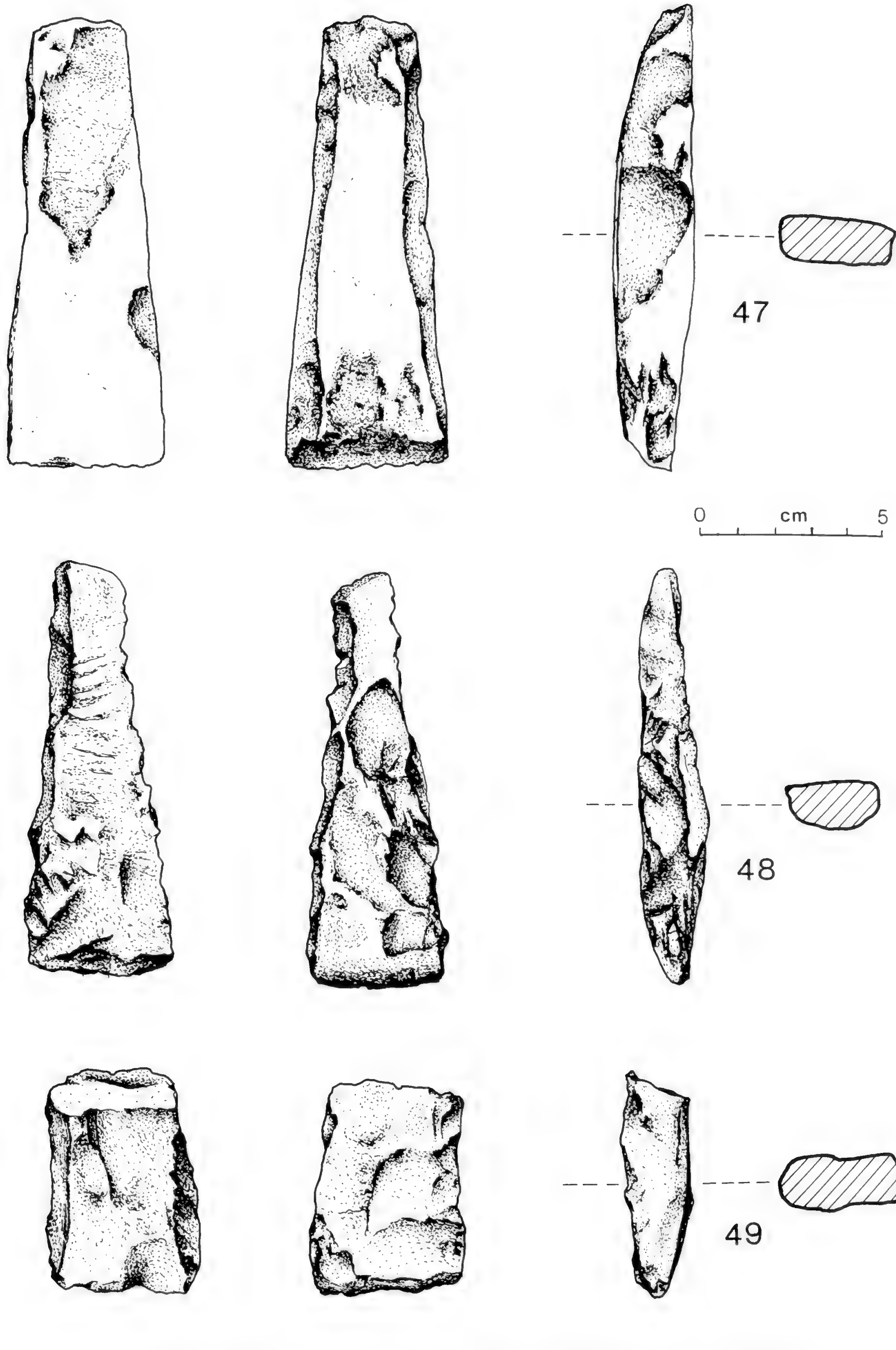
Fig. 46. Large adze roughout, Layer 4B.

Two finished adzes with triangular cross sections were found in Layer 4C. 4/4C/676 is a partially polished example, 11.3 cm long (Fig. 55). It is probably Type 4; since the butt is broken, the form of the tang is uncertain. 4/4C/688 is a narrower form, ground only at the tip of the blade. It is similar to a Type 3A, but again it is broken at the butt.

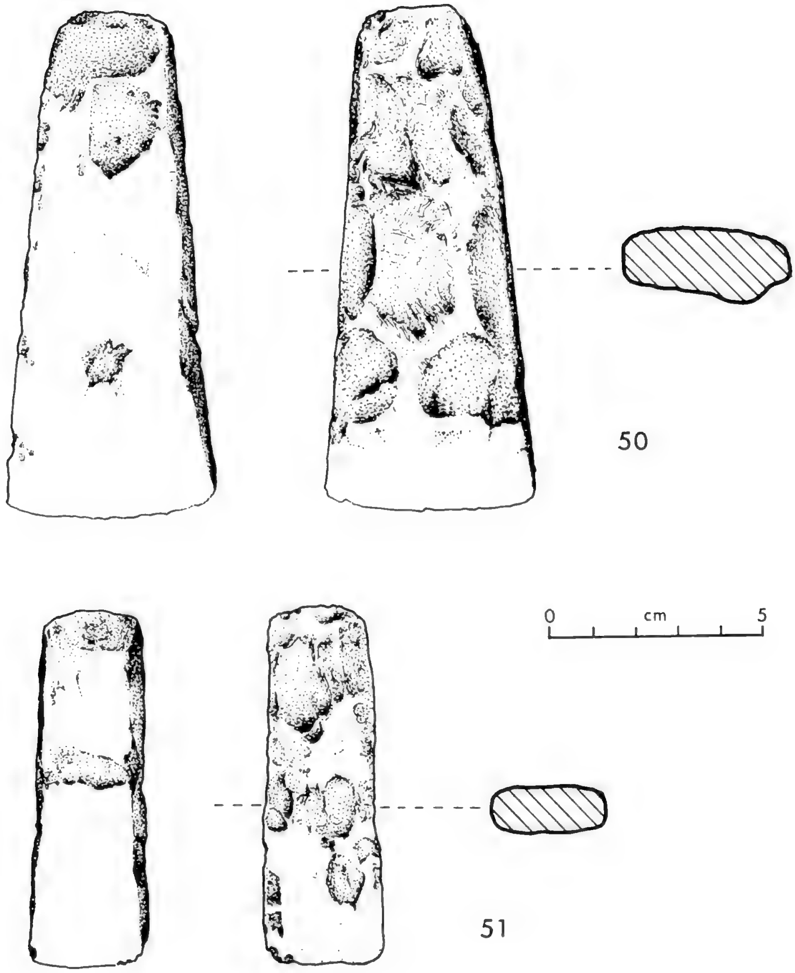
Altogether 53 roughout adzes were recovered in Layer 4C, 22 quadrangular, 21 triangular and 2 lenticular. Of the quadrangular roughouts 14 were complete; they are 6.5-12.6 cm in length. The 14 complete triangular roughouts range in length 7.5-12 cm. Included in the miscellaneous category were 7 roughouts of indeterminate cross section, and one complete specimen, 12.5 cm long, which is only possibly an adze roughout, 3/4C/255. It has an asymmetrical cross section, and is manufactured from a distinctive material unlike that of other adzes and roughouts, possibly greywacke (Fig. 43). Traces of cortex remain over most of the surface. One of the other roughout fragments in the miscellaneous category is also made of this material. Only one of the lenticular roughouts is complete; it is 7.5 cm long.

In Layer 4B was found a roughout of a small narrow chisel, 6.5 cm long and 1.8 cm wide (S/LM/6/16). The blade has not been ground, and steep angled flakes have been struck off each side to form a high quadrangular cross section (Fig. 54). There are traces of grinding on the back.

The great majority of adzes in this assemblage are manufactured from basalt, the most obvious source being the major quarry site of Tahanga (N40/8), less than 2.5 km distant from the Opito site. Tahanga is at present the only source of fine grained basalt



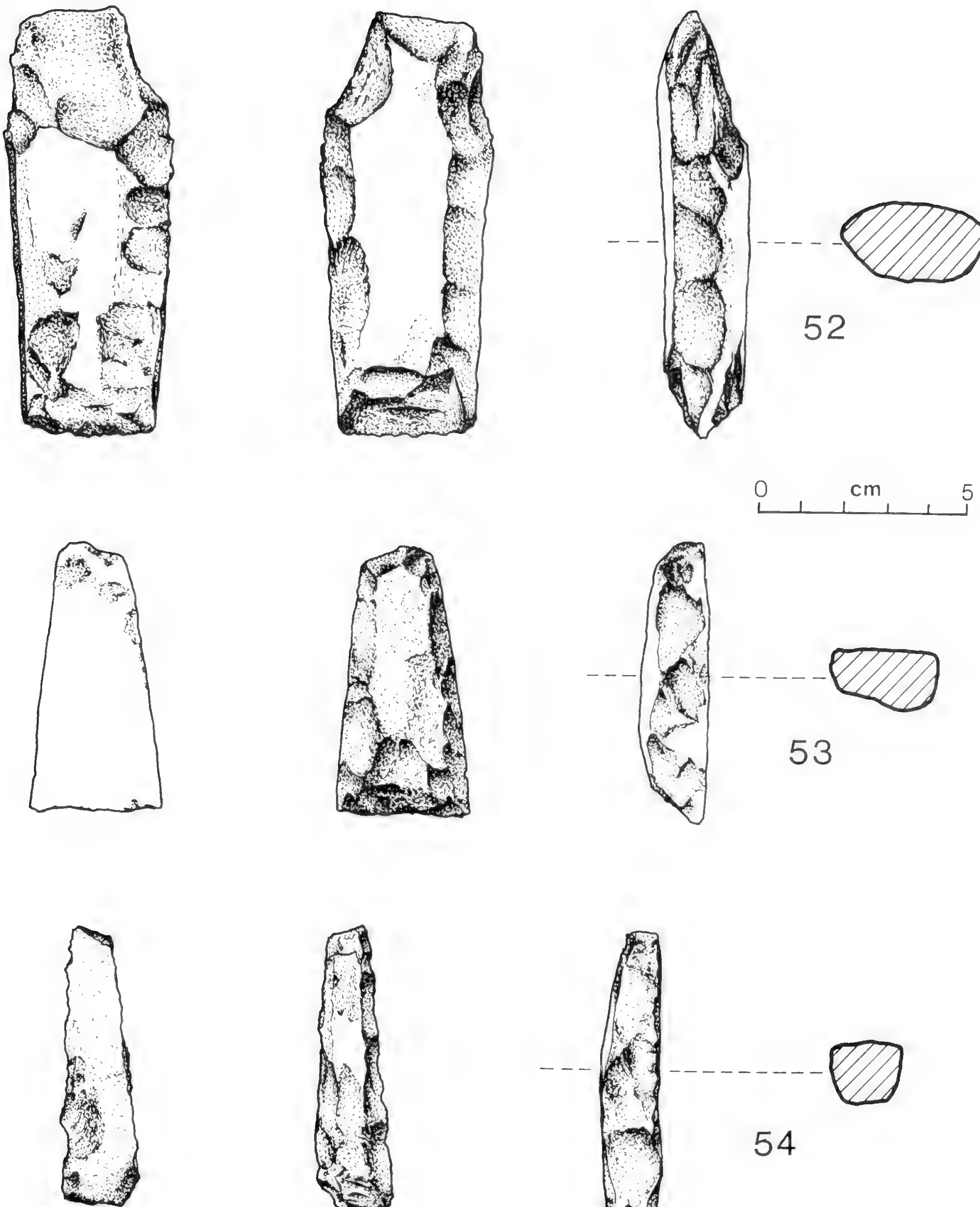
Figs. 47-49. 47, 48. Adzes, Layer 4C. 49. Roughout, Layer 4B.



Figs. 50, 51. Adzes, Layer 4C.

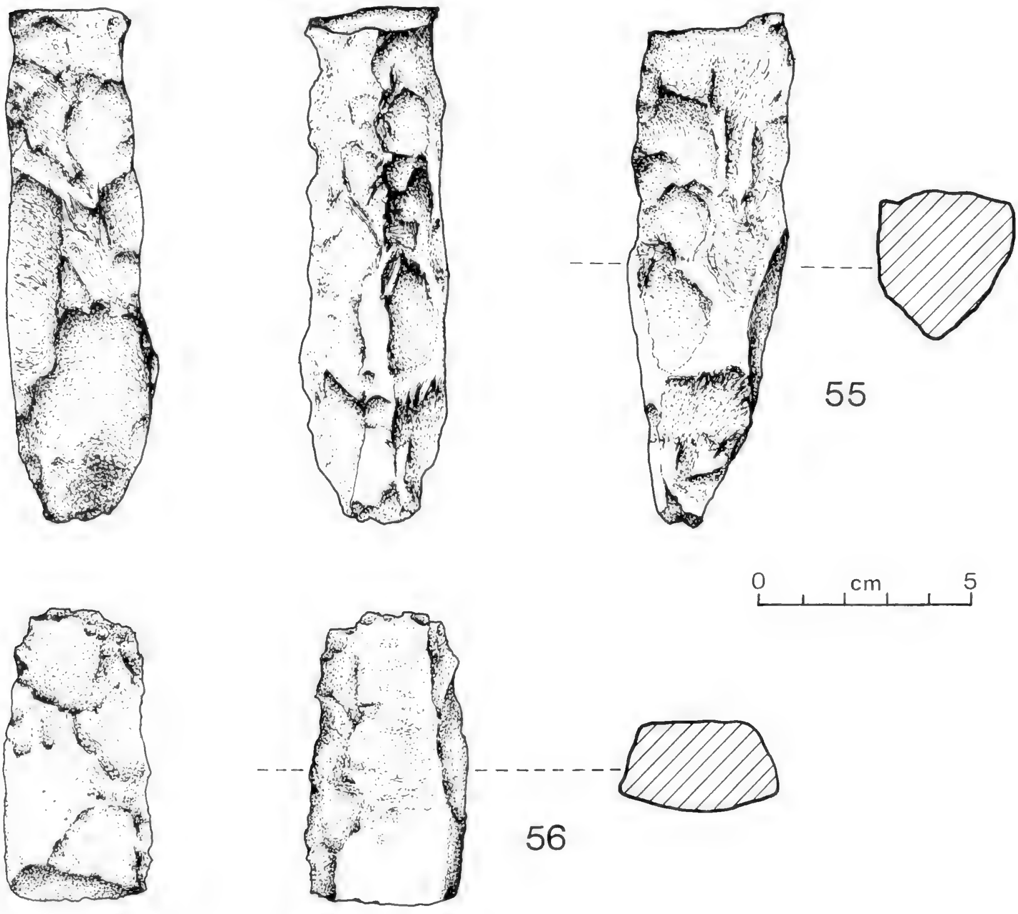
known to have been used extensively in the manufacture of adzes. Green (1963:64) considers it to have been the source of 'most of the material for archaic adzes on the Coromandel coast'. There are widespread basaltic deposits in Northland, but the distribution study of basalt flakes and adzes made by Moore suggests that any such additional sources would have been of only local significance (Moore 1975:34).

A number of roughouts and some of the finished adzes still have areas of cortex present, representing the original breakage plane of the rock, subsequently weathered (S. Best, pers. comm.). Altogether 23 adzes and roughouts have traces of cortex, 6 in Layer 4A, 3 in Layer 4B and 12 in Layer 4C. Two of the possible roughout fragments from Layer 4C, included in the miscellaneous category, are interesting in that they have glossy surfaces indicative of sand blasting. They have thus been exposed on the surface for a considerable period. 4/4C/690 has signs of use polish on one edge, producing two slightly concave areas of wear. It may have been used as an abrader on relatively soft material such as bone or wood.



Figs. 52-54. 52, 53. Adzes, Layer 4C. 54. Chisel, Layer 4B.

Three of the finished adzes, one from Layer 4B and two from Layer 4C, are manufactured from a fine grained greywacke (S. Best, pers. comm.). The two examples from Layer 4C, 2/4C/376 and 5/4C/355 (Figs. 50, 51) are a dark green-grey, and the one from Layer 4B, S/LM/7/28 (Fig. 56) is a dark grey. The two adzes from Layer 4C are particularly well polished.

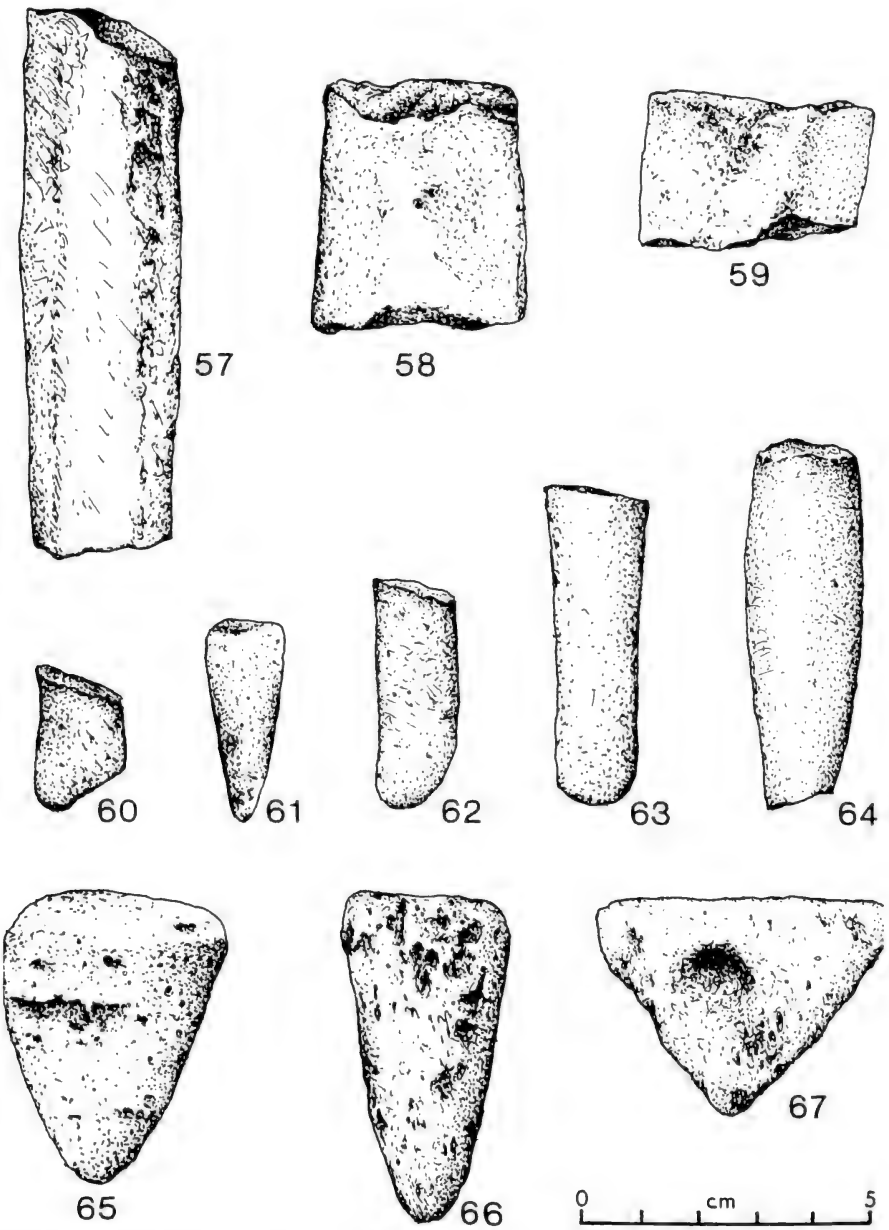


Figs. 55, 56. 55. Adze, Layer 4C. 56. Adze, Layer 4B.

An important feature of the Opito adze assemblage is their small size. The finished adzes average 9.2 cm in length, and they range only 6.2-12.0 cm. The roughouts are slightly larger on average with a mean length of 9.7 cm. The range is somewhat larger than that of the finished adzes, 6.4-26.8 cm. Even among the roughouts, however, there are only three examples over 13 cm long. The small size of the Opito adzes is all the more striking when compared with the average sizes of other Archaic adze assemblages. The adzes from Wairau Bar, for example, range 7-48 cm in length. Simmons (1973), in his study of South Island material culture, provides a useful figure illustrating the range and median length of adze caches from a large number of Archaic and later sites.

FILES AND ABRADERS (Figs. 57-64)

Altogether 25 stone files and file fragments were recovered. One broken file, 5.6 cm long with rectangular cross section was found in Layer 3. From Layer 4A came 5 broken files, ranging in length 8.5-3.3 cm, and two small file fragments. All have lenticular cross sections. The tips have broken off all but one of the files, 1/4A/159 (Fig. 63). They all show wear along the long edges. S/J/4A/164 (Fig. 64) tapers abruptly towards the point from near the break. 1/4A/60 is the tip of a lenticular file, worn at an angle to form a triangular shaped point (Fig. 60).



Figs. 57-67. Files and worked pumice. 57-64. Files and file fragments. 65-67. Worked pumice. 60, 63, 64, 66. Layer 4A. Remainder, Layer 4C.

In Layer 4B was found a broken file, 5.8 cm long, with intact tip. It is worn along one edge to form almost a rectangular cross section. Three file fragments were found, two with evenly rounded tips. This layer also contained an oval sectioned piece of sandstone 5.2 cm long, which could be a file roughout.

Layer 4C contained 15 files and file fragments, 11 with lenticular cross section. Of these, 3 are almost complete files with broken tips, ranging in length 6.5-5.3 cm. Five are broken off file tips. Four of these are relatively flat and evenly rounded, for example 6/4C/165 (Fig. 62). The fifth, 6/4C/155, tapers to a sharp point (Fig. 61). Two fragments have a triangular cross section; they fit together to form the midsection of a triangular sectioned file 7.1 cm long. The final two fragments from Layer 4C have rectangular cross sections. 3/4C/249, 9.5 cm long is worn along one long edge to form almost a polyhedral cross section. Three file roughouts were also found in this layer, and an abrader made from a flat rectangular piece of coarse pumice. It is 8.7 cm long, and has worn concave surfaces on both flat sides. One other pumice abrader made from a flat oval shaped pebble 10.3 cm long was also found in Layer 4C. It fits comfortably in the hand, and has a concave working surface on one side.

HAMMERSTONES AND GRINDSTONES

A grindstone made from a flat oval waterworn stone 15 cm long was found in Layer 3. The concave working surface on one side has longitudinal score marks. A round pebble with traces of ochre, presumably used for grinding, also came from this layer. In Layer 4A were found two round stones, probably both used as grindstones, although only one has traces of ochre.

In Layer 4B were found two more grindstones, both round pebbles with traces of ochre. A larger round stone with bruising consistent with use as a hammerstone also came from this layer. Layer 4B contained a large oval waterworn stone split in two longitudinally, with no evidence of further use or working. The 7 cracked stones recovered from this layer are *haangi* stones. Layer 4C contained 6 round stones with evidence of use. Two are smoothly worn consistent with their being used as grindstones; the other four, which have some bruising, were probably used as hammerstones.

WORKED PUMICE (Figs. 65-67)

Although pumice occurred in quantity throughout the site, little appears to have been used. Apart from the two abraders mentioned above, only four pieces of worked pumice were found, one in Layer 4A and three in Layer 4C. 8/4A/43, from Layer 4A, is a flat triangular shaped piece of pumice with rounded rectangular cross section (Fig. 66). It is smoothly worn and may have been used as an abrader of some description.

The function of two cone shaped pieces of pumice from Layer 4C is uncertain. Both have flat tops and rounded points; one is 5.2 cm long and 3.7 cm in diameter across the top (Fig. 65), the other 4.1 cm long and 3.7 cm in diameter. The larger example has two short transverse grooves around the circumference. Artefacts of similar form have been found in many sites in New Zealand. Trotter (1975:203) in his discussion of an example from Redcliffs in Canterbury suggests that they were possibly stoppers for gourds or similar containers. The third piece of pumice, 3/4C/294 is a flat triangular shape, 4.9 cm long. It has a shallow hole on each side, 1 cm and 0.8 cm in diameter, possibly made by the smoothing off of bone or wooden points (Fig. 67).

STONE POINTS (Figs. 68, 69)

A total of 139 stone points were found. All are made from siliceous material, such as chert, jasper and quartz. The two basic methods of working a flake to a point by flaking either edge from one face only, or from different faces were both used, as at Harataonga Bay (Law 1972:92-93).

The drill points from Opito were initially divided into three groups, complete, broken and unfinished. The complete and broken groups were then subdivided into those with triangular and those with rectangular cross sections. Table 7 lists the numbers and distribution of drill points in each of these categories, and the sizes of the broken and complete points in each layer.

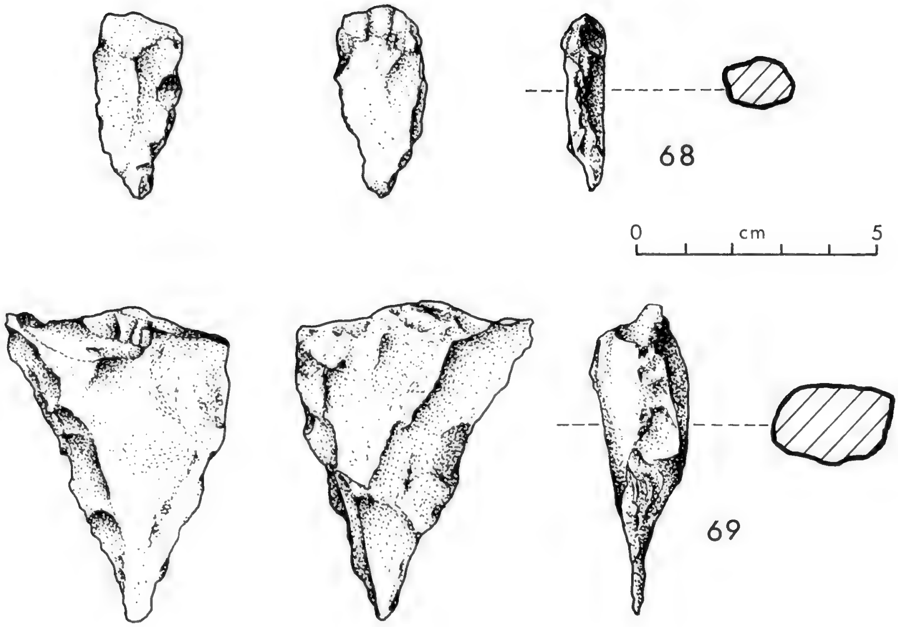
Table 7. Numbers and lengths of stone drill points

	Layer	3	4A	4B	4C	Total
Triangular complete		1	6	10	15	
broken		1	1	6	7	47
Rectangular complete		1	9	10	23	
broken			8	12	11	74
Unfinished		1	4	8	5	18
Total		4	28	46	61	139
Length (cm) maximum		3.8	6.8	7.4	6.2	
minimum		2.6	1.9	2.1	1.8	
mean		3.2	3.4	3.7	3.5	

The majority of drill points come from Layers 4A to 4C. The finished points are 1.8-7.4 cm in length (for example, Figs. 68, 69). The mean lengths, however, do not vary greatly between layers; the range over Layers 4A to 4C is only 0.3 cm. Rectangular cross sectioned points are the most common; of the 121 finished points recovered, 74 are rectangular. This is the reverse of the situation at Hot Water Beach, where triangular sectioned points considerably outnumbered rectangular in all layers. Leahy (1974:50) observes that in most cases triangular points require considerably more flaking and finishing than rectangular ones. This could be a factor in the predominance of rectangular points at Opito. In the case of Hot Water Beach, however, Leahy postulates that the triangular points might be more important or efficient, while the rectangular ones may have been used for a special purpose.

STONE FLAKES

The large number of flakes recovered were divided into basalt, siliceous and obsidian for analysis. These categories were further divided into 'used' (flakes with evidence of use wear) and 'waste' (flakes without such evidence). An additional category of flakes, crosscutting the division according to material, was present. This comprised flakes with evidence of polishing, grinding or hammerdressing, waste material from the reworking of finished adxes or the final stages of adze manufacture. The flake material was not sieved during excavation; thus the extent of the bias in the sample recovered, particularly with



Figs. 68, 69. Drill points, Layer 4C.

regard to size, cannot be determined. Therefore no detailed statistical analysis was undertaken. The flake material was simply treated by layer in terms of total weight and number of pieces in each category.

Adze Flakes

Altogether 49 adze flakes were recovered, the majority from Layers 4B and 4C. They range in length 1.3-7.2 cm, and all are polished on one or two surfaces except for one hammerdressed flake from Layer 4C. Seven flakes are polished on two surfaces, suggesting that they come from the edges of adzes. On one flake, from Layer 4A, the polished surfaces meet at an acute angle; it appears to have come from the blade portion of a quadrangular sectioned adze. The remainder of the flakes are more obtuse angled. Table 8 lists the number and weight of adze flakes found in each layer.

Table 8. Number and weight of adze flakes.

Layer	Number	Weight (g)
3	1	4.6
4A	9	42.0
4B	20	52.0
4C	19	114.8
	49	213.4

It is interesting to note that the adze flakes comprise a variety of material considerably greater than the adzes and roughouts. Only 15 of the 49 flakes are Tahanga basalt; the remainder are varieties of argillite (S. Best, pers. comm.). The argillites range in colour from pale grey-green (16 flakes) and dark grey-green (7 flakes) to grey (5 flakes) and black (1 flake). One or two of the darker specimens may be fine grained Tahanga basalt.

Of the pale grey-green flakes, 12 came from Layer 4B, and 11 of these from Square 5. The remainder came from Layer 4C. It is probable that these flakes, at least those from Layer 4B, originate from the reworking of a single adze, subsequently removed from the site. Two pale grey-green flakes similar to those discussed above, but with distinctive black veining were found, one in Layer 4A and one in Layer 4C. This type of argillite is characteristic of the Nelson-D'Urville Island region, and adzes from this source have been collected all over New Zealand (Walls 1974:37).

The variety of argillites among the adze flakes, some probably from sources as far away as D'Urville Island, suggests that adzes manufactured from this material were brought to the site in finished form, reworked, and subsequently used elsewhere. This interpretation is supported by the fact that no finished argillite adzes or roughouts were found. Only three of the finished adzes are not manufactured from Tahanga basalt, and these have been identified as being fine grained greywacke (S. Best, pers. comm.).

Basalt Flakes

In view of the proximity of the Tahanga basalt quarry and the predominance of Tahanga material among the adzes and roughouts, it is likely that the basalt flake material also comes from this source. A total of 267 basalt flakes were recovered; only 16 of these showed any sign of use. Table 9 gives the number and weight of flakes recovered from each layer. The greatest quantity of material came from Layers 4A to 4C, in particular Layer 4C.

Table 9. Number and weight of basalt flakes.

Layer	Used	Waste	Total	Weight (g)
3	1	2	3	18.8
4A	2	47	49	583.3
4B	8	73	81	1514.1
4C	5	129	134	1818.2
Total	16	251	267	3934.4

Siliceous Material

A large amount of siliceous material, both flakes and cores, was recovered from Opito, mainly in the form of siliceous sinter, with some chalcedony. There is a large deposit of siliceous sinter less than 1 km from the site. Thus it is probable that the majority of the siliceous material comes from this source (S. Best, pers. comm). Table 10 gives the number and total weight of siliceous flakes (excluding cores) in each layer.

Table 10. Number and weight of siliceous flakes and cores.

Layer	Used	Waste	Total	Weight (g)	Cores
3		21	21	160.2	
4A	12	95	107	830.7	8
4B	10	175	185	1224.3	24
4C	15	335	350	2270.0	15
	37	626	663	4485.2	47

A total of 663 siliceous flakes were recovered, over twice the number of basalt flakes. The difference in terms of total weight is not nearly so great, the siliceous flakes tend to be much smaller. Paralleling the distribution of basalt flakes, Layer 4C contained the greatest quantity of material, both in terms of number of flakes and total weight. Layer 4B contained the largest number of cores. Altogether 37 siliceous flakes showed signs of use wear, a similar proportion to the basalt flakes.

Obsidian

The obsidian was divided into two categories on the basis of colour; green, most probably from the Mayor Island source, and grey, from 'other sources'. In all 86 pieces of obsidian were recovered, 78 flakes and 7 cores. The flakes were then divided into 'used' and 'waste' categories; none of the cores showed any sign of use. Table 11 lists the numbers and weight of obsidian material in each of these categories found in each layer.

Table 11. Number and weight of obsidian flakes and cores.

Layer	Mayor Island						Total		Other sources	
	waste		used		cores					
	no.	wt.(g)	no.	wt.(g)	no.	wt.(g)	no.	wt(g)	no.	wt.(g)
3	2						2	5.5		
4A	15	47.1	5	127.9			20	175.0		
4B	10	106.9	4	37.3			14	144.2		
4C	34	184.0	8	173.5	7	755.7	49	1113.2	1	21.2
	61		17		7		85	1437.9		

All the obsidian was green, except for one waste grey flake from Layer 4B. Of the 78 green flakes recovered, only 17 showed signs of use. Layer 4C again contained the greatest amount of material, both in terms of number of pieces and total weight. Of the 7 cores recovered, 6 came from Layer 4C. The total weight of obsidian from Opito, and the total number of pieces, is considerably less than either the siliceous material or basalt.

The hypothesis that Mayor Island was the first obsidian source to be exploited in the early period of Polynesian settlement in New Zealand, and that over time the proportion of obsidian from Mayor Island decreased as other sources were discovered was first put forward by Green (1964), and is widely accepted. However, recent research by Leach &

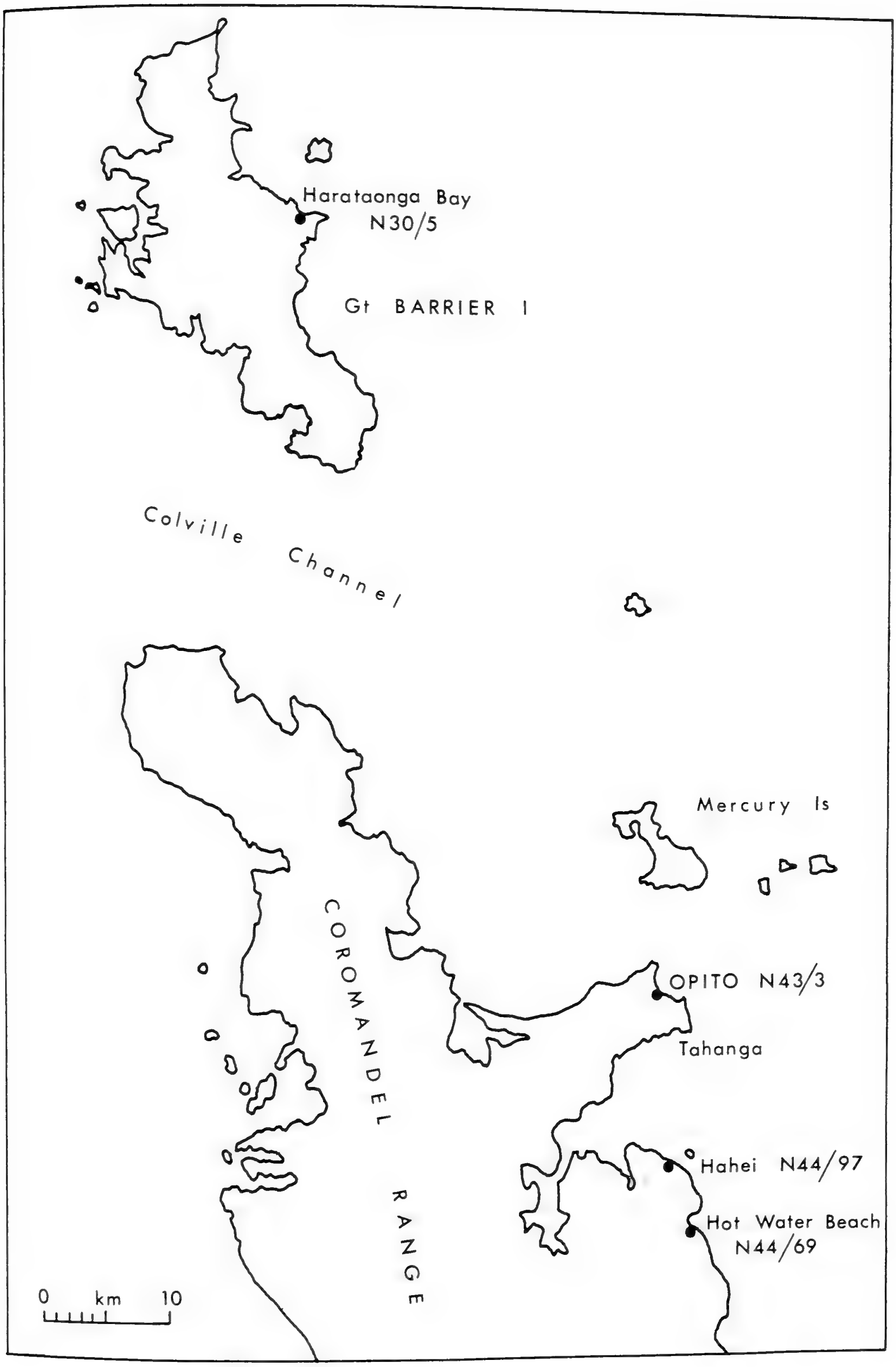
De Souza (1979) throws some doubt on the validity of this theory. The evidence from the earliest known sites suggests extensive geological knowledge by the 12th century A.D. While Mayor Island was clearly the most important source of obsidian for most groups of people throughout New Zealand prehistory (Leach & De Souza 1979:44), it is becoming apparent as more data comes available and sourcing techniques are perfected, that the proportion of Mayor Island obsidian in a site is not a useful guide to its age.

There is indeed a high proportion of obsidian likely to be from Mayor Island in the Opito site. A detrital source of flake quality obsidian occurs near Whitianga, some 20 km away, yet does not appear to have been exploited to any great extent. Green (1964:140) states that this is probably a source of many of the non-Mayor Island obsidian flakes in early sites on the Coromandel coast. The pattern evident in the Opito site parallels that in other early sites in the area. There is a predominance of Mayor Island obsidian in the Harataonga Bay site, for example, despite the presence of an alternative source at Te Ahumata on Great Barrier itself, only 10 km away.

CONCLUSIONS

The material culture of the Opito site is unequivocally Archaic in character, in accord with the early radiocarbon date obtained. This is quoted as 640 ± 50 years B.P. by Green (1963:60). The one piece fish-hooks, and adzes, for example are essentially similar to those varieties well known from the South Island Archaic. The ornaments in bone and shell are also directly comparable with specimens from the major South Island Archaic sites of Wairau Bar and Shag River (Duff: 1956). The dentalium shell and cut bone tubes and other necklace units are all plain. None of the more elaborate Archaic ornaments known from the North Island, such as chevroned amulets, ridged bone reels and whale tooth pendants (Golson 1959a:44) were found in the Opito site.

The standard cultural sequence from Archaic to Classic Maori culture defined by Golson (1959a) is based on material culture. Changes in economy and social structure have not been correlated with this sequence on a New Zealand wide basis with any success. Indeed, as Davidson (1978:1) notes, it is becoming evident that attention should be directed towards regional sequences. On a regional level there is increasing evidence for a distinct regional adaptation centred on the east coast of the Coromandel Peninsula in the early period of Polynesian settlement. On the basis of material culture at least, the Opito site (Fig. 70) forms part of a homogeneous and well established cultural tradition in the Coromandel area. The overall features of the assemblage are readily comparable with the published results from other early sites in the region, notably Hot Water Beach (site N44/69) and Harataonga Bay (site N30/5). Analysis of the material from Hot Water Beach and Opito shows considerable similarities between the two sites. In both there is extensive use of moa bone as raw material, particularly for the manufacture of fish-hooks, and evidence for decreasing supplies of moa bone in later levels. As the evidence of fishing gear suggests, there is an emphasis on line fishing, and there is also a predominance of Mayor Island obsidian in both sites.



Figs. 70. Map of Coromandel Peninsula showing major Archaic sites in the region referred to in text. Drawn by C. Phillips.

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NEW AND INTERESTING RECORDS OF ADVENTIVE PLANTS FROM THE AUCKLAND INSTITUTE AND MUSEUM HERBARIUM 6

E.B. BANGERTER

AUCKLAND INSTITUTE AND MUSEUM

Abstract. This sixth list of some recent additions to the Auckland Institute and Museum Herbarium (AK) and re-examination of earlier gatherings provides new records for some adventive species and further information on the distribution of others.

In addition to material provided as in former years by various collectors, a number of specimens have been obtained by exchange with D.S.I.R., Botany Division, Christchurch (CHR) and the National Museum, Wellington (WELT). In one or two cases, e.g. *Eryngium pandanifolium* cited below, the AK Herbarium has acquired its only gathering and in others gaps noted in my previous papers have been filled in.

The nomenclature adopted in this paper is that published by the New Zealand Weed and Pest Control Society (1969) or that used by the D.S.I.R. staff at Christchurch in the series of checklists published from time to time in the *New Zealand Journal of Botany*. For species not in these works references are given to publications consulted. Specimens are cited by the collector's numbers or in the absence of these by the AK number. Unless otherwise stated the specimens may be regarded as the only material of the species possessed by the Herbarium and, where no previous literature is cited, as first records to the best of my knowledge at the time of writing.

RANUNCULACEAE

Aquilegia vulgaris L.

Wellington, Karori Cemetery, 1978, P.J. Brownsey, AK 149187, (dupl. ex WELT).

Thomson (1922) credited Cheeseman (1883) with the first record, about Auckland, for the columbine; there is, however, a record for Ohariu by Kirk (1878). Smith (1904) listed the species for Ashburton. I have not found any specific localities mentioned since these early publications until recently, although it appears in a number of works as generally distributed in both Islands. Wilson (1978) included it in the flora of Mt. Cook National Park.

Rec. Auckland Inst. Mus. 17: 97-104 17 December 1980

Ranunculus parviflorus L.

Marlborough Co., Pelorus Valley, J.H. MacMahon, AK 12722, as *R. arvensis* L.

Removal of this gathering from the cover of *R. arvensis* deprives the Herbarium of its hitherto sole representative specimen. The label, in Cheeseman's hand, bears no date but a potential early record for *R. arvensis*, first noted by Armstrong (1880) for Canterbury, is also lost. The species has not often been recorded whereas *R. parviflorus* is well represented by both material and records.

PAPAVERACEAE

Papaver rhoeas L.

Auckland, Remuera, T.F. Cheeseman, AK 92383; Auckland, Devonport Borough Council Yards, 1978, A.E. Wright 2760.

The field poppy has been recorded since Kirk (1870) and its general distribution is in Garnock-Jones (1979). It appears to have occurred widely but not commonly in both Islands. It was still regarded as rare by Matthews (1975). The more recent of the specimens above was "locally abundant on scoria flats in former quarry".

CRUCIFERAE

Descurainea sophia (L.) Prantl

Vincent Co., Sowburn, near Cromwell, D. Petrie, AK 64336, as *Sisymbrium sophia* L.

Petrie, as recorded by Kirk (1899) collected flixweed in Otago and later authors have repeated the records. Allan (1940) gave 1895 as a date, having earlier (Allan 1933) described and illustrated the plant. Matthews (1975) simply stated "very localised" and the distribution in Garnock-Jones (1979) goes no further than "Canterbury, Central Otago". Although the above specimen is not dated it is potentially a voucher for a very early record.

Lepidium campestre (L.) R.Br.

Waikato Co., "Alexandra, Waikato, T.F.C.", AK 66757, as *L. hirtum* Sm. = *L. heterophyllym* (DC) Benth.

Cheeseman (1883) published a record for *L. heterophyllum* (under the synonym *L. smithii* Hook.): "pastures near Alexandra". The above specimen, which bears silicules covered with vesicles and short styles, is *L. campestre*, casting some doubt on the validity of the record. Healy (1948) pointed out that the two species were confused and that *L. heterophyllum* must be "regarded as very uncommon to rare", whereas *L. campestre*, according to Garnock-Jones (1979), has a wide distribution, including the Waikato, in both Islands.

CARYOPHYLLACEAE

Saponaria officinalis L.

Inangahua Co., Crushington, *c.*3 km east of Reefton, 1977, A.E. Orchard 4967.

A note on the label of this specimen says "adventive shrub 1m tall on roadside". Smith (1904) recorded soapwort for Ashburton and Healy (1969) included it in his list of Canterbury adventives as rare and local on waste ground, originating as a seed impurity. Mr A.E. Esler knows of it in the Auckland area.

LYTHRACEAE

Peplis portula L.

Dunedin, Waitahuna, D. Petrie, AK 73104; Southland Co., 8 miles [12.9 km] N.W. of Riverdale, by Mataura River, gravel pit, wet mud, 1973, R. Mason & E.M. Chapman 12785 (dupl. ex CHR 243610).

Kirk (1899) recorded "Otago, Petrie" for this species and subsequent authors have also referred to "various places in the east of Otago, Petrie", no other collector being mentioned. Unfortunately it is not possible to suggest a date for the Petrie specimen as it is known that he collected in the Dunedin area for some years before and after Kirk's record. The recent gathering sent by D.S.I.R. Christchurch, is a welcome addition to this Herbarium.

CUCURBITACEAE

Ecballium elaterium (L.) A. Richard

Hauraki Plains Co., 5 miles [8 km] from Ngatea township, 1980, P. Kennedy AK 151508, det. Lynne Scott.

This gathering of the squirting cucumber, made by a Noxious Plants Officer who discovered it growing wild on the perimeter of a farm garden, was presented by Mrs Lynne Scott. A description of the species may be found in Tutin (1968).

EUPHORBIACEAE

Euphorbia segetalis L.

Mangonui Co., Tauroa, H. Carse, AK 74851, 74853; Ahipara, Matthews, 1913?, AK 74850, 74852; Ahipara, Wreck Bay, wet cliff, 1979, N.H. Nickerson & R. Cooper 6314 det. C.J. Webb.

These gatherings indicate a long survival of this spurge in the Ahipara area. It was first recorded there by Cheeseman (1914) to whom Allan (1940) referred, giving the date as 1913. In a later publication, however, Thomson (1922) recorded "Tauroa, Matthews and Carse, 1912", thus providing a potential date for the first specimen above. In the intervening years it was collected in 1964, A.H. Watt and 1971, K. Wood.

Euphorbia serrulata Thuill

In Bangerter (1976) I recorded a gathering of *E. stricta* L. from Whangarei. Dr C.J. Webb has kindly brought to my notice that the correct name of this species is *E. serrulata* Thuill. He also informed me that the D.S.I.R. Herbarium at Christchurch has good material from Oakura Bay, Northland as well as from Whangarei.

PAPILIONACEAE

Lotus tenuis Waldst. & Kit.

Kairanga Co., Palmerston North, Railway Road, roadside drain bank, 1967, A.E. Esler, AK 150607; Waitemata Co., Browns Bay, reserve adjacent to Freyberg Park, 1978, A.E. Wright 2637.

Since my statement in Bangerter (1975) that no specimen of *Lotus tenuis* was in the AK Herbarium the two gatherings above have been kindly presented by the collectors. The species was first recorded by Healy (1957) from Canterbury and later from the same area again by Healy (1969, 1976). Esler (1978) reported its presence "between the airport at Milson and the railway line".

UMBELLIFERAE

Eryngium pandanifolium Cham. & Schlecht.

Taranaki, New Plymouth, bank of river, 1978, M.D. Hampton, AK 149993, (dupl. ex CHR 284597) det. C.J. Webb.

This duplicate specimen was kindly presented by D.S.I.R. Botany Division, Christchurch, as a voucher for the new record published by Webb (1978).

COMPOSITAE

Chondrilla juncea L.

Auckland, New Lynn, on pavement on street margin, 1979, A.E. Esler, AK 149719.

Presented by Mr Esler as a voucher for the record. The plant is noted as "1m high". The species is described by Sell (1976) and according to the N.Z. Weed & Pest Control Society (1969) was formerly known in New Zealand only as an impurity in imported commercial seed.

Gazania rigens R.Br.

Hutt Co., Waikanae, sand-dunes near shore, 1978, P.J. Brownsey, AK 149165. (dupl. ex WELT)

Allan (1940) recorded this species as an occasional escape and Healy (1969) listed it as rare and local in coastal cliff communities in Canterbury.

BORAGINACEAE

Cerinthe major L.

Waitemata Co., Milford, roadside, 1978, E.B. Bangerter 5397.

This species has not been recorded before as a garden escape in New Zealand. The identification was confirmed by Mr W.R. Sykes, who is preparing a description for future publication. In the meantime Domac (1972) may be referred to.

SCOPHULARIACEAE

Antirrhinum majus L.

Auckland, Devonport Borough Council Yards, 1978, A.E. Wright 2755, 2756.

Recorded for the first time by Healy (1946) from Napier, the snapdragon was also included in his accounts of adventives on coastal cliffs, Canterbury and Otago (Healy 1959, 1969, 1973). A patch of fifteen flowering plants was noted by Mason (1974) from a Canterbury cementery. It is known to Mr A.E. Esler in the Auckland area. Of the two gatherings in the AK Herbarium one has crimson flowers and the other white.

VERBENACEAE

Verbena bonariensis var. *conglomerata* Briq.

Hokianga Co., Tahake-Horeke road, 1967, R.C. Cooper, AK 127249; Waitemata Co., Waitakere, Anzac Valley Road, 1978, A.E. Wright 2653; Waitemata Co., Browns, Bay, roadside, 1978, E.B. Bangerter 5373.

These three gatherings answer to the description of a variety of the widespread *V. bonariensis* kindly provided by Mr W.R. Sykes and matched specimens determined by Dr H. Moldenke in the CHR Herbarium. The inflorescence is tightly packed and the corolla tube longer than in type.

LABIATAE

Salvia aurea L.

Coromandel Co., Hahei, 1967, R.C. Cooper, AK 127463.

Sykes (1978) recorded a specimen in the CHR Herbarium collected in 1974 from the Coromandel. The above gathering "naturalised on dunes" constitutes the only other reference to this species in New Zealand that I have found.

GRAMINEAE

Digitaria violascens Link

Waitemata Co., Waitakere Range, Scenic Drive, 1978, R.O. Gardner 1925.

This specimen, presented by Dr Gardner, is noted as growing "in gravelled parking area". Mrs Lynn Scott kindly informed me that J.M. Dingley collected this grass from the same locality in 1975. A description may be found in Veldkamp (1973).

Ehrharta erecta Lam.

Franklin Co., Kariotahi Beach, Waiuku, 1960, P. Hynes, AK 70237, det A.J. Healy; Auckland, Grafton Road, waste ground, 1976, A.E. Wright 1436, det A.E. Esler; Wellington, South Karori Road, garden weed, 1978, P.J. Brownsey, AK 149141, (dupl. ex WELT).

This grass was first recorded by Healy (1944) for Wellington and again mentioned (Healy 1945) among plants for which he was "at a loss to explain their presence". A note with Dr Brownsey's specimen stated "spreading rapidly in recent years". Esler (1978) recorded it from Palmerston North motor camp and he also has it listed for the Auckland area.

Panicum dichotomiflorum Michx.

In Bangerter (1976) I noted that the first published record for this grass was by Healy (1946). Mr A.E. Wright has kindly informed me that there is a specimen in the Herbarium of the National Museum (Wellington) collected by D. Petrie from a roadside in Epsom, Auckland, in 1916.

Acknowledgements. I am grateful as ever to Miss J.H. Goulding for help and encouragement during her last term of office as Botanist at the Auckland Institute and Museum. For the acquisition of voucher specimens I am again indebted to Dr P.J. Brownsey, National Museum of New Zealand, Wellington and to Mr A.E. Esler, Mrs Lynn Scott and Dr R.O. Gardner, D.S.I.R., Auckland. For identification of material and much helpful information thanks are due to Dr P.J. Garnock-Jones, Mr W.R. Sykes and Dr C.J. Webb, D.S.I.R. Christchurch. Mr A.E. Wright, University of Auckland, continues to earn my gratitude for invaluable co-operation.

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SIGNIFICANCE OF CARBONATE CONCRETIONARY GROWTHS ON A MOA BONE IN HOLOCENE TIDAL FLAT DEPOSITS BENEATH AUCKLAND CITY, NEW ZEALAND

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Abstract. A bone of the moa *Anomalopteryx didiformis* (Owen), dated at 7520 ± 150 years B.P. (NZ3088B) and contained in 7500-6500 years B.P. tidal flat deposits beneath down-town Auckland city, had carbonate concretionary growths about its articular ends. The concretions, which are younger than about 6500 years B.P., were formed by precipitation of microgranular, relatively low-magnesian (6-8 mol% $MgCO_3$) calcite cement within pore waters of the sandy mud enclosing the bone, probably associated with bacterial decomposition of associated organic matter. A variety of evidence suggests that generally similar carbonate concretions encasing macrofaunal remains are relatively widespread in Holocene shore-line sediments of Waitemata Harbour, Auckland, especially in the vicinity of old buried stream channels. Precipitation of low-magnesian calcite cement into very early diagenetic concretions appears to be especially characteristic of several Holocene coastal marine deposits in essentially temperate latitude, cool water localities in both southern and northern hemispheres.

During construction of foundations for the South Pacific Hotel, Customs Street, Auckland, in 1969, the building supervisor on the project, Mr K. Goss, retrieved a moa bone from a drag-line bucket excavating in soft, greenish grey, shelly mudstone. He recorded the position of the sample with respect to both present street level and a layer of *in situ* stones in the pit marking the pre-1900 sea bed of the old Customs Street Wharf, which was subsequently buried by land reclamation in 1880-90 (Fig. 1, Barr 1922). The bone was forwarded to Auckland Institute and Museum in 1970 and was identified by Mr R.L. Scarlett (Canterbury Museum) as the femur of one of the most widely distributed Quarternary moa species, *Anomalopteryx didiformis* (Owen). The bone was brought to our attention by the then Director of the Museum, Mr E.G. Turbott, and offered for study. We undertook to investigate the nature of concretionary growths about its articular ends, and to have it dated to help elucidate the stratigraphy of the shallow marine deposits beneath down-town Auckland city.

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Stratigraphy

The general stratigraphic succession beneath the intersection of Customs Street and Queen Street in down-town Auckland is known from drill cores obtained during preliminary site investigations for an underground terminal for a proposed Auckland Rapid Transit scheme (Anon. 1974). A schematic west to east section along Customs Street, in the vicinity of South Pacific Hotel, is presented (Fig. 1) from drill core data.

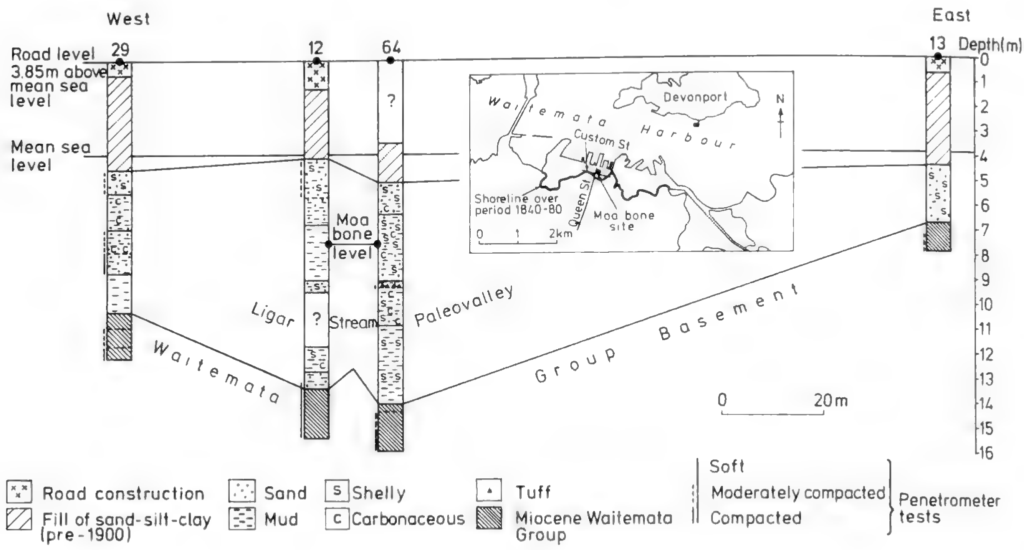

Fig. 1. Subsurface stratigraphy (based on Anon. 1974) in the vicinity of South Pacific Hotel, immediately east of the intersection of Customs Street and Queen Street, down-town Auckland city, showing level from which the moa bone was collected. Inset shows locality map, and heavy line traces the approximate position of Auckland waterfront from 1840-80, prior to major reclamation (after Barr 1922).

Approximately 4 m of road construction materials and pre-1900 fill of clay and blocks of sandstone and mudstone overlie 2-10 m of muds, sandy muds, muddy sands, and sands, commonly shelly and locally carbonaceous or woody, which in turn rest on local basement, Early Miocene flysch deposits of Waitemata Group. Basement topography defines a narrow paleovalley, the Ligar Stream valley, plunging northwards in the sub-surface towards the modern Waitemata Harbour. The fill of shelly muds and sands thins to the east and west away from the axis of the paleovalley and there is also an overall increase in thickness and degree of weathering of the residual soil or regolith capping the basement flysch in the same directions. The approximate stratigraphic level from which the moa bone was collected is marked on Bores 12 and 64 (Fig. 1).

A more detailed examination of the core from Bore 64 indicates that the fauna in the muddy sands beneath the basaltic tuff at 9.3 m depth consists mainly of scattered broken shell fragments, including recognisable *Chione* remains, each only a few millimetres across. Interbedded mud layers preserve rootlet structures. Fragmented shells occurring in layers in muds in the lowest part of the core (10-14 m) are extremely decayed and chalky. The 10 cm thick basaltic tuff is immediately overlain by 20 cm of grey, weakly laminated mud containing rootlets. The sequence of muddy fine sands and sandy muds from 5-9 m, which includes the moa bone, contains considerable plant debris and a moderately rich fauna, dominated completely by the cockle *Chione (Austrovenus) stutchburyi* (Wood), but including *Zeacumantus lutulentus* (Kiener), *Tellina (Macomona) liliana* Iredale, *Cominella adspersa* (Bruguière), and possibly *Nucula hartvigiana* Pfeiffer and *Amphibola crenata* (Gmelin). Shells are generally fresh and retain their coloration, and many are broken but unabraded; some *Chione* valves remain articulated. The fauna is that of a protected mixed sand-mud tidal flat environment, possibly somewhat brackish, not dissimilar to some of the lower energy embayments presently found around the Waitemata Harbour (for example, Shoal Bay and Hobson Bay).

Presumably, the moa bone was washed onto the estuarine paleo-flats by Ligar Stream, or alternatively the moa may have died at the coast line with eventual dispersal of its bones across the embayment by marine currents. Searle (1964) has intimated that fairly large numbers of moa probably lived on the Auckland isthmus during the latest Pleistocene and early Holocene.

Description of bone and concretions

The bone (Fig. 2; fossil record no. N42/f670), was 220 mm long, well preserved, and had a brownish cortical surface due to incipient iron-staining. Nodular, light grey concretionary material, essentially a hard calcareous mudstone, adhered strongly to parts of both ends of the bone (Fig. 2). The concretionary growths roughly paralleled the bulbous outlines of the articular ends of the bone, reached a maximum thickness of 7 mm, and included a few small specimens of the cockle *Chione (Austrovenus) stutchburyi* (Wood).

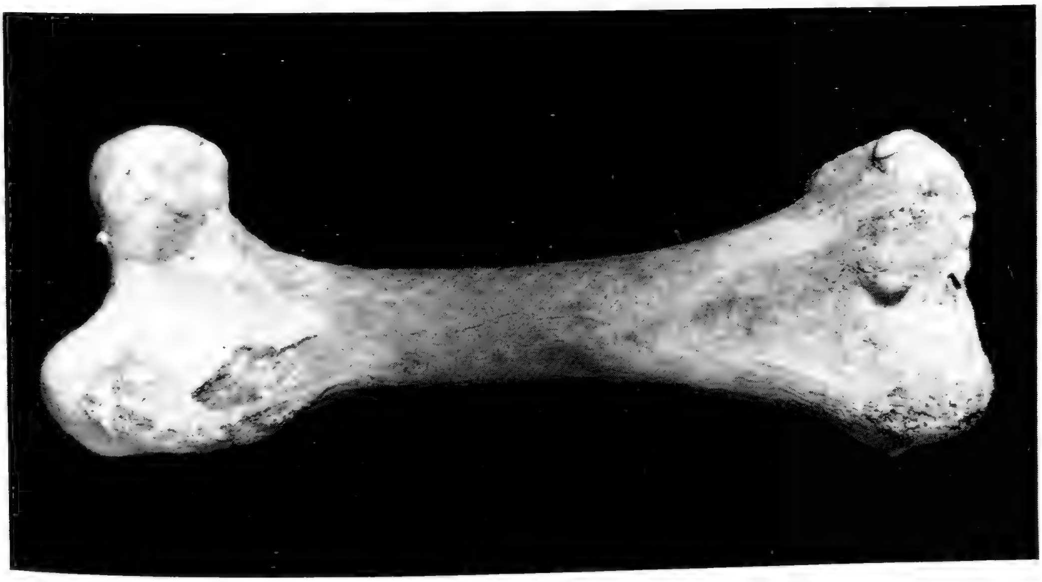

Fig. 2. Femur of the moa *Anomalopteryx didiformis* (Owen) showing carbonate concretionary growths encasing a few small cockles about its articular ends. Length of bone: 220 mm.

X-ray diffraction analysis (Chave 1952, Nelson & Cochrane 1970) indicates that the *Chione*-free concretionary material consists of about 30-40% of the clay minerals illite and chlorite, 30-35% calcite containing some 6-8 mol% $MgCO_3$ (that is, relatively low-magnesian calcite of Friedman & Sanders 1978), 15% quartz, 5% plagioclase feldspar and small amounts of ferromagnesian minerals and carbonate-apatite, the last named component possibly resulting from inclusion of bone fragments in the analysis. Apart from the presence of abundant calcite, the composition is broadly similar to that of the soft shelly mudstone encasing the bone, indicating that the concretionary material owed its existence to the precipitation of calcite within pores of the sediment adjacent to the ends of the bone. In thin-section the calcite appears as a pasty, cryptocrystalline to microcrystalline granular cement which blends into, and is largely irresolvable from, the fine-grained argillaceous matrix of the concretion. Subangular grains of silt to fine sand sized quartz, feldspar, and fine-grained rock fragments, together with small shell chips, are scattered through this matrix.

Origin of concretions

Carbonate concretions commonly develop during early stages of sediment diagenesis about decaying organisms, such as fish, molluscs, or plant fragments (for example, McCunn 1972, Engelhardt 1977, Hayes & Franks 1978). Bacterial decomposition results in formation of amines and ammonia which locally increase the alkalinity of pore waters to a level where carbonate precipitation is possible about the organic nucleus (Berner 1968). Such an origin is tenable for the present case. Preferential development about the articular ends of the bone may be related to accelerated exchange of solutions and gases along the length of the bone shaft via the porous, medial medullary cavity. Most active diffusion of calcium and bicarbonate ions in pore waters of the surrounding sediment would occur along concentration gradients disposed radially about the ends of the bone, leading ultimately to inorganic precipitation of relatively low-magnesian calcite cement in sediment immediately adjacent to the bone ends. The source of dissolved ions was possibly from the selective dissolution of certain metastable aragonitic skeletal fragments in the enclosing or underlying deposits (Nelson 1978), such as is evidenced by the soft, decayed, and generally poorly preserved nature of shells in the lower section of Bore 64 (Fig. 1). Selective alteration of skeletons implies that pore solutions have been locally undersaturated in calcium carbonate, resulting perhaps from the subsurface injection of fresh groundwaters down the Ligar paleovalley and into the coastal marine sediments burying it.

Age of bone and concretions

The entire sample (Fig. 2) was forwarded to Instititute of Nuclear Sciences, Lower Hutt, in the hope that two radiocarbon dates might be obtained, one from the bone collagen and the other from the carbonate concretions. Unfortunately there proved to be insufficient sample to date the carbonate and this material was subsequently inadvertently mislaid at that institute. The moa bone itself yielded a radiocarbon age of 7520 ± 150 years B.P. (NZ3088B) based on new half life data, or 7300 ± 150 years B.P. (NZ3088A) based on old half life calculations (latter age reported also by McCulloch & Trotter 1979).

This bone age places a maximum age on the concretionary growths, but from sea-level evidence it is probable that the carbonate concretions are somewhat younger than 7500 years old. During this period Holocene sea level was rising rapidly (Fairbridge

1961). Most eustatic sea-level curves for the Holocene place sea level of 7500 years ago some 10-20 m below present (for example, Curray *et al.* 1970), while a curve proposed by Schofield (1964) for New Zealand indicates that sea level was down about 12 m at this time, a height supported by recent numerical modelling procedures (Clark & Lingle 1979, fig. 10). These data suggest that Ligar Stream valley is unlikely to have been drowned 7500 years ago and that its fill of marine sediments must post-date this age. There is ample evidence that mean sea level in northern New Zealand some 4000 years ago stood *ca.* 2 m above its present position (Searle 1964, Schofield 1973, 1975, Marks & Nelson 1979). Assuming a linear rate in rise of sea level between the −12 m and +2 m levels, and applying the modern tidal range figure at Auckland of *ca.* 2.5 m, then the intertidal deposits containing the moa bone at 4 m below present mean sea level formed 5500 ± 300 years ago. However, a linear rate of sea level rise from 7500 to 4000 years B.P. is probably an oversimplification. For example, from north of Auckland, Schofield (1973) dated shelly muds of likely intertidal origin, which formed close to modern sea level, at about 6500 years B.P. On this basis the Customs Street moa bone deposits could be as old as 6800 ± 100 years B.P., an age consistent with the predicted −4 m sea level height from numerical modelling (Clark & Lingle 1979), and perhaps more in keeping with the bone date of approximately 7500 years B.P. Until such time as sufficient amounts of well preserved shell material are available from the deposits themselves for radiocarbon dating, it is concluded that their age lies in the range 7000-5000 years B.P., probably closer to the older date. The calcite cement forming the concretions must therefore be younger than about 6500 years B.P.

Discussion

The carbonate concretionary material described here is not an isolated occurrence in the marine Holocene sediments of the Auckland region. Bartrum (1917) described and figured numerous carbonate concretions dredged from comparable depths beneath the bed of the Waitemata Harbour. The concretions formed irregular nodular masses, from 1 to 15 cm or more in size, and included a variety of molluscan shells, small crabs, and wood fragments. Bartrum (1917) argued that the microgranular carbonate cement was precipitated directly from sea water, probably being (p.427) ". . . initiated by the decomposition of the organic matter in the epidermis of molluscs such as *Atrina* and the hard parts of the crabs".

Discussing the results of a marine seismic reflection survey in shallow waters in upper Waitemata Harbour, Hicks & Kibblewhite (1976) recorded two anomalous features associated with the fill of Recent marine sediments: the local occurrence of a strong reflector horizon within the top 2 m of sea bed, which could not be related to any change in physical properties of the sediments as revealed by augering or coring; and occasional acoustically opaque zones, which they interpreted as due to gas bubbles occurring within the sediment. Similar features have also been observed by High & Cornwell (1974) using the same seismic equipment in central Waitemata Harbour. It is interesting to speculate that the unexplained strong reflector horizons recorded by these workers are due to discontinuous layers of carbonate concretions in the Holocene sediments which would not necessarily be tapped or captured by drilling. Hicks & Kibblewhite (1976) further noted that all sites exhibiting the anomalous features are located by old buried stream channels. Significantly, Bartrum (1917) showed that the concretion-bearing sediments he studied (p.428) ". . . occur in a steep-walled narrow gut . . . a continuation of the well-marked gulch spanned by Grafton Bridge'', and our concreted moa bone comes from the marine sediment fill of Ligar Stream paleovalley. The interstitial gases producing the acoustically opaque zones in some estuarine sediments are probably derived from degradation of abundant organic matter in the deposits (Schubel 1974). It is possible that it is these gases which are responsible for selective dissolution of skeletal carbonate materials at certain times, and inorganic precipitation of calcite cement to form concretions at other times, depending on the relative abundances and reactivity of carbon dioxide, ammonia, and amines produced during decomposition of organic matter (Engelhardt 1977). In this manner the association of carbonate concretions with acoustically turbid zones and strong reflector layers in shallow subsurface deposits of coastal embayments at Auckland may not be altogether fortuitous.

Carbonate-rich concretions enclosing a variety of different faunal types, including a moa bone (Fleming 1963), are known from off-shore Quaternary shallow marine and estuarine deposits elsewhere in New Zealand (Finlay & Benson 1950, Fleming 1951, 1963, Pantin 1958, Sherwood & Nelson 1979). Overseas examples of Holocene concretions in shore-line deposits resembling the New Zealand occurrences include those described by Etheridge & McCulloch (1916) from coastal Australia, by Weeks (1957) from coastal Greenland and Canada, by Garrison *et al.* (1969) from west coast of Canada, by Brown & Farrow (1978) from west coast of Scotland, and by Bromley (pers. comm. cited in Brown & Farrow 1978) from Swedish North Sea coast. Common to most of these occurrences is their temperate latitude, cool water aspect, and the presence of calcite rather than aragonite as the calcium carbonate cement in the concretions (cf. Nelson 1978).

Conclusions

1. A femur of the moa *Anomalopteryx didiformis* (Owen) in tidal flat deposits beneath down-town Auckland city has been radiocarbon dated at 7520 ± 150 years B.P. (NZ3088B).
2. The associated sandy muds, which are both shelly and carbonaceous, formed when mean sea level was *ca.* 4 m below present, probably at some time from 7500 to 6500 years B.P.
3. Sometime after 6500 years B.P. carbonate concretions formed about the articular ends of the moa bone by precipitation of relatively low-magnesian (6-8 mol% $MgCO_3$) calcite cement within pore waters of the immediately adjacent sediment, probably associated with bacterial decomposition of organic matter in the bone.
4. Carbonate concretions enclosing a variety of macrofauna are recorded elsewhere from bottom sediments of Waitemata Harbour and probably have a generally similar age and diagenetic origin to the concreted moa bone. Moreover, it is suggested that previously unexplained strong seismic reflector horizons within a couple of metres of the sea bed in Holocene marine sediments in several areas of the harbour, especially in the vicinity of old buried stream channels, may be due to the existence of laterally discontinuous layers of these carbonate concretions.
5. The concretions demonstrate that it is possible for relatively low-magnesian calcite to precipitate directly as a microgranular cement from pore waters in shallow marine deposits at a very early stage of diagenesis. Carbonate concretions of this type,

containing a cement of essentially diagenetically stable low-magnesian calcite, rather than metastable aragonite or high-magnesian calcite, appear to be most characteristic of various Holocene coastal deposits in temperate latitude, cooler water localities in both southern and northern hemispheres.

Acknowledgements. We wish to express thanks to Mr E.G. Turbott for the opportunity to study the bone, to Mr R.J. Scarlett for its identification and to the Institute of Nuclear Sciences, Gracefield, for radiocarbon dates. Mr W.L. Cornwell, Auckland laboratories of Ministry of Works and Development, kindly provided access to reports, cores and bore-logs of the Auckland Rapid Transit scheme. Dr C.S. Nelson gratefully acknowledges the facilities and hospitality of the Department of Geological Sciences, University of British Columbia, Canada, during the writing of this paper.

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TAXONOMIC NOTES ON POLYNESIAN MOLLUSCA WITH DESCRIPTIONS OF NEW SPECIES OF NASSARIIDAE

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Abstract. The type-specimen of *Cantharidus marmoreus* (Pease) is illustrated and the species is reported from Mururoa Atoll, Tuamotus. *Coralliophila porphyroleuca* (Crosse) has been re-discovered in Tahiti and Moorea I, and the radular anatomy of *Peristernia lirata* (Pease) confirms the placement in the genus *Peristernia*. *P. sowerbyi* (Melvill) described from the Galapagos Is actually lives in the Tuamotu Archipelago. The authorship of *Philbertia felina* and *Turridrupa jubata* must be credited to Reeve rather than Hinds, and a range-extension from New Caledonia to the Tuamotus is recorded for *T. jubata*. *Viriola samoana* Cernohorsky, is recorded for the first time from French Polynesia and *Vexillum (Pusia) mediomaculatum* (Sowerby), previously known only from the western Indian Ocean is recorded from the Tuamotus and the Hawaiian Is. The nassarid species *Nassarius troendleorum* and *N. rehderi* are described as new to science.

During a field trip to French Polynesia in August 1979, I had the opportunity to collect some interesting molluscan material and also examined collections from Mururoa Atoll, Anaa I and Tahiti. The results are new records for French Polynesia, descriptions of new species and re-discovery of species described in the last century.

Family TROCHIDAE

Subfamily MONODONTINAE Gray, 1856

The subfamily name Monodontinae is erroneously credited to Cossmann, 1916, in literature.

Genus **Cantharidus** Montfort, 1810

Cantharidus Montfort, 1810, Conchyl. syst. 2: 251. Type species by OD *C. iris* Montfort, 1810 = *Limax opalus* Martyn, 1784 *(nom. conserv.)* Recent, New Zealand.

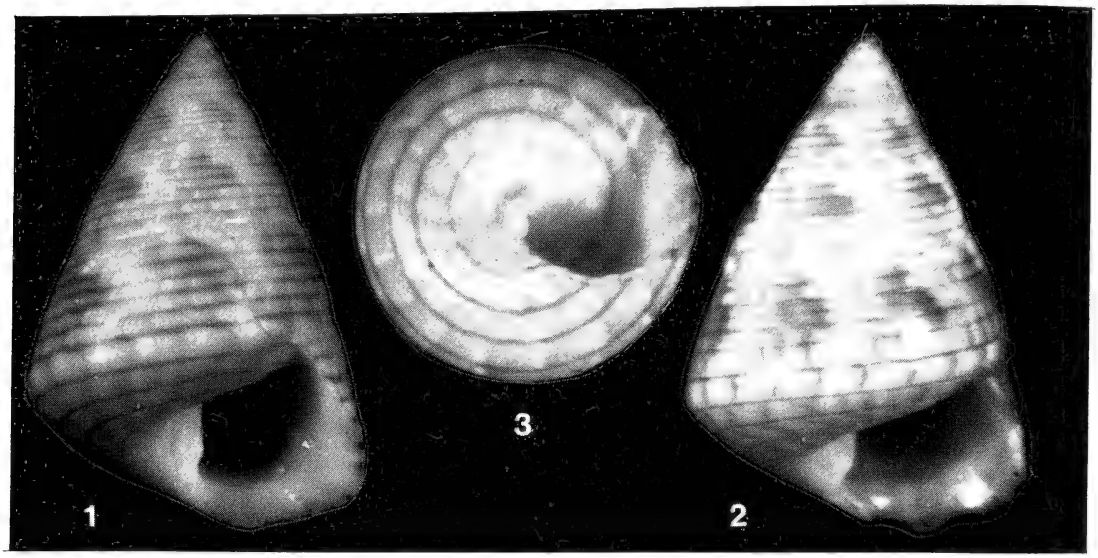
Cantharidus marmoreus (Pease, 1868) (Figs. 1-3)

1868. *Trochus marmoreus* Pease, Americ. J. Conch. 3 (4): 287, pl. 24, fig. 9.
1889. *Calliostoma marmoreum* Pease, Pilsbry, Man. Conch. 11: 360, pl. 39, fig. 33.

TYPE LOCALITY. Tuamotu Archipelago.

Rec. Auckland Inst. Mus. 17: 113-125 17 December 1980

Type specimen. Two syntypes of *C. marmoreus* (Pease) are in the Academy of Natural Sciences, Philadelphia, No. 40614, dimensions of illustrated syntype length 5.8 mm, width 3.9 mm. The syntype has *c*. 7½ whorls, 6 spiral grooves on the penultimate, 6 on the body whorl and 11 on the base, and the umbilicus is almost closed except for a narrow chink. Spiral grooves are stained with reddish-brown and snow-white and chevron-shaped axials connect groove-lines (Fig. 1).



Figs. 1-3. *Cantharidus marmoreus* (Pease). 1. Syntype ANSP No. 40614; 5.8 mm. 2, 3. Specimen from Mururoa Atoll, Tuamotus; 5.7 mm.

The species has not been reported this century and is not listed by Salvat & Rives (1975). Recently several specimens have been collected on Mururoa Atoll, Tuamotu Archipelago (*leg*. C. Beslu — Figs. 2, 3).

Family CORALLIOPHILIDAE

Genus **Coralliophila** H. & A. Adams, 1853

Coralliophila H. & A. Adams, 1853, Gen. Rec. Moll. 1: 135. Type species by SD (Iredale, 1912) "*Murex neritoideus* Chemnitz" = *Purpura violacea* Kiener, 1836. Recent, Indo-Pacific.

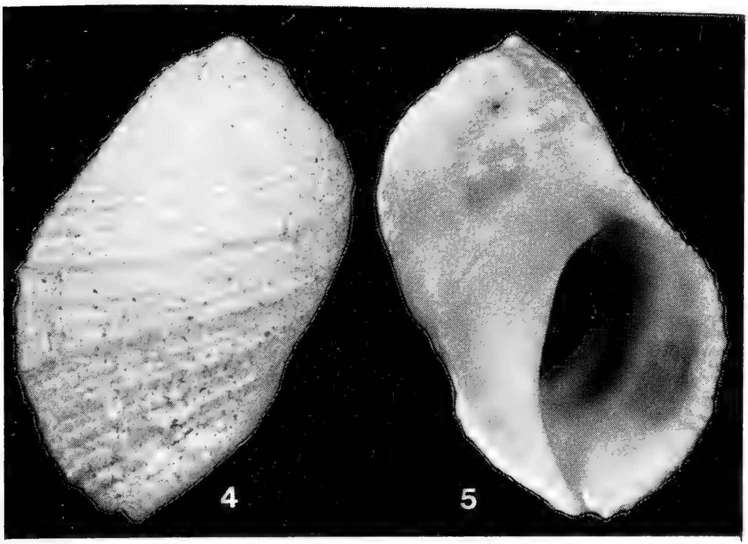
Coralliophila porphyroleuca (Crosse, 1870) (Figs. 4, 5)

1870. *Purpura porphyroleuca* Crosse, J. Conchyl. 18: 302; 1871 Crosse, J. Conchyl. 19: 322, pl. 13, fig. 7.

1880. *Coralliophila porphyroleuca* Crosse, Tryon, Man. Conch. 2:207, pl. 66, figs. 369, 370.

TYPE LOCALITY. Tahiti, Society Is.

The species has not been reported since the time of description but recently several specimens have been collected at Anaa I, Tuamotu Archipelago (*leg*. J. Troendle — Fig. 4) and a large individual was found by this author on Moorea I (Fig. 5). The species is white to cream in colour and stained with rosy-mauve within the aperture and the sculpture consists of coarse, close-set and lamellose spiral cords.



Figs. 4, 5. *Coralliophila porphyroleuca* (Crosse). 4. Anaa I, Tuamotus; 14.7 mm. 5. Ilot Trioa, Moorea I; 26.8 mm.

Family FASCIOLARIIDAE

Subfamily PERISTERNIINAE Tryon, 1881

Genus **Peristernia** Moerch, 1852

Peristernia Moerch, 1852, Cat. Conchyl. Comes de Yoldi 1: 99. Type species by SD (Melvill, 1891) *Turbinella nassatula* Lamarck, 1822. Recent, Indo-Pacific.

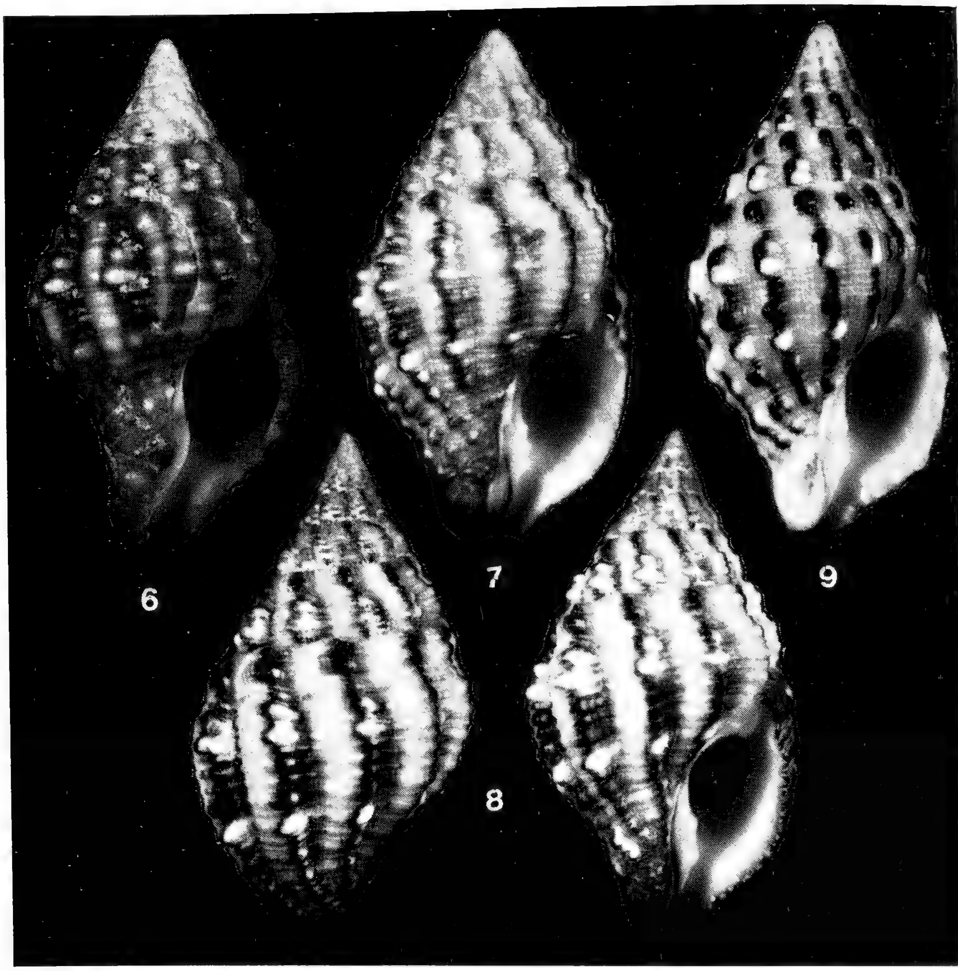
Peristernia lirata (Pease, 1868) (Figs. 6-8, 10-12)

1847. *Turbinella gemmata* Reeve, Conch. Icon. 4: pl. 12, figs. 61 a, b (publ. August, 1847) [*non T. gemmata* Reeve, 1847, pl. 2, fig. 5 — publ. July 1847].
1868. *Latirus liratus* Pease, Americ. J. Conch. 4 (3): 152 (ref. to *Turbinella gemmata* Reeve var. pl. 12, fig. 61).
1881. *Peristernia lirata* (Pease), Tryon, Man. Conch. 3: 82, pl. 65, fig. 71; 1975 Salvat & Rives, Coquill. Polynesie p. 323, fig. 240.

TYPE LOCALITY. Marquesas Is.

Type specimens. One remaining juvenile syntype of *Latirus liratus* Pease, is in the Academy of Natural Sciences, Philadelphia, No. 35019 (ex-Pease), length 15.4 mm, width 7.0 mm (Fig. 6). There were originally 2 specimens mounted on the tablet but the other specimen is now missing. The 3 probable syntypes of *Turbinella gemmata* var. Reeve, are in the British Museum (Nat. Hist.) No. 197931, and the syntype which appears to have been illustrated by Reeve (1847, pl. 12, figs. 61 a, b) measures 23.3 x 11.7 mm (Fig. 7).

The radular ribbon of *P. lirata* is 7.1 mm long, *c*. 35% of shell-length, and contains 256 rows + 12 nascentes of teeth. The rachidians are trigonal in outline and tricuspid and the laterals are very broad and multicuspid with a variable arrangement of cusps (Fig. 10). The radula features confirm the species placement in *Peristernia*.



Figs. 6-9. 6-8. *Peristernia lirata* (Pease). 6. Juvenile syntype ANSP No. 35019; 15.4 mm. 7. Probable adult syntype BMNH No. 197931; 23.3 mm. 8. Specimen from Marquesas Is; 21.7 mm. 9. *Peristernia gemmata* (Reeve). Anaa I, Tuamotus; 23.6 mm.

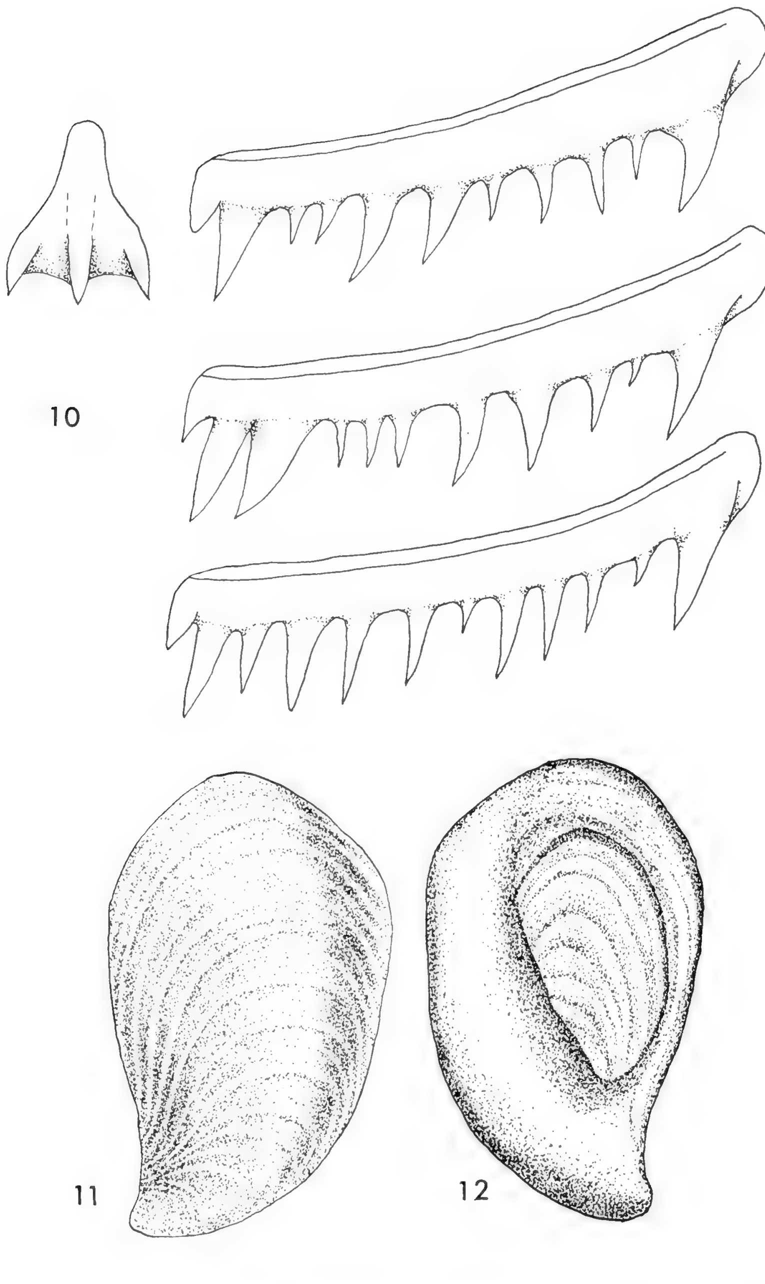
The species is closely similar to *P. gemmata* (Reeve, 1847) which also occurs in Polynesia, and both have the axial ribs lined with blackish-brown and occasional nodules white. The spiral sculpture in *P. gemmata* is considerably finer and consists of finely impressed spiral grooves (Fig. 9) whereas in *P. lirata* prominent spiral cords override the axial ribs.

Peristernia sowerbyi (Melvill, 1907) (Figs. 13, 14)

1907. *Latirus (Peristernia) sowerbyi* Melvill, Proc. Malac. Soc. Lond. 7: 217, textfigs.

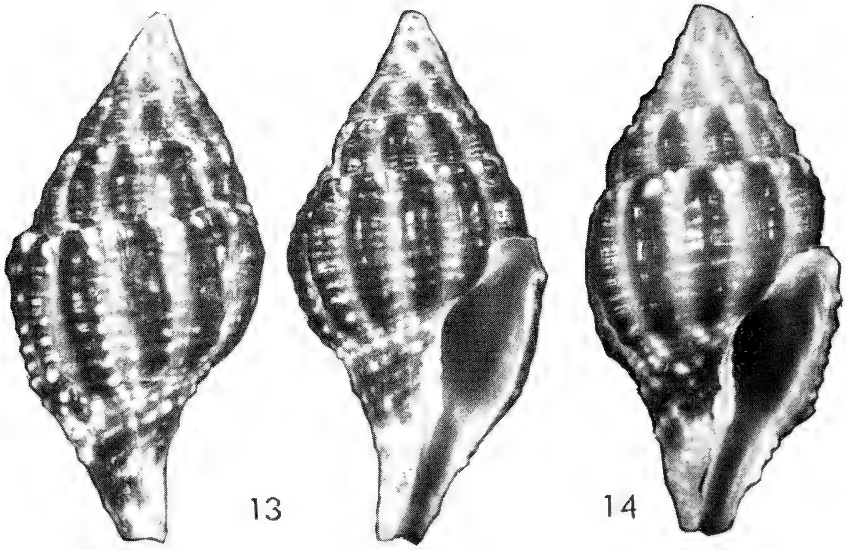
TYPE LOCALITY. Galapagos Isles (= error).

Type specimen. The holotype of *P. sowerbyi* (Melvill) is in the British Museum (Nat. Hist.) No. 1907.2.6.1., dimensions 17.2 x 8.2 mm. There are 10 axial ribs on the penultimate and 11 on the body whorl, sutures have white crenulations, columella with 4 denticles, aperture lirate. Base colour is orange, axial ribs dark reddish-brown, some nodules white, aperture bluish-white (Fig. 13).



Figs. 10-12. *Peristernia lirata* (Pease). Anaa I, Tuamotus. 10. Half-row of radula and 2 lateral teeth, showing variation in denticle pattern. 11, 12. Operculum; 5.1 mm. 11. Front. 12. Obverse attachment side.

The species has not been listed in faunal lists or books dealing with either the fauna of West America or Polynesia. Recently collected specimens from Anaa I, Tuamotu Archipelago (*leg*. J. Troendle — Fig. 14) show the tentative type locality of Galapagos Is to be an error and the species appears to be endemic to French Polynesia.



Figs. 13, 14. *Peristernia sowerbyi* (Melvill). 13. Holotype BMNH No. 1907.2.6.1.; 17.2 mm. 14. Specimen from Anaa I, Tuamotus; 19.2+ mm.

Family NASSARIIDAE

(A decision on the validity of the family-group name is pending by the ICZN, No. Z.N.(S.) 1887).

Genus **Nassarius** Duméril, 1806

Nassarius Duméril, 1806, Zool. analyt. p. 166. Type species by SM (Froriep, 1806) *Buccinum arcularia* Linnaeus, 1758. Recent, Indo-Pacific.

Nassarius troendleorum sp. n. (Figs. 15-17, 25)

Shell moderately small, up to 25.0 mm in length, ovate and solid, width 55%-63% of length, sutures distinct, teleoconch of 5½-6½ almost flat-sided whorls, protoconch of 2¾-3 smooth, embryonic whorls, juvenile specimens with a faint keel on protoconch whorls, keel absent in adults. Sculpture consists of prominent, round nodules which are arranged in 13-17 axial rows and 3-5 spiral rows on the penultimate and in 12-15 axial rows and 9-10 spiral rows on the body whorl; the sutural row of nodules on the body whorl is smaller than the second anterior row which is usually most prominent. Interspaces of nodules are sculptured with finely impressed spiral grooves which number from 3-6 on the penultimate and from 8-15 on the body whorl. Ventral side of body whorl with a large, broad callus which is thinned above the parietal wall revealing the nodulose sculpture but is thickened posteriorly and sometimes reaches the posterior suture of the penultimate whorl; aperture with 11-13 distinct lirae within and with 5 sharp denticles on the anterior edge of the outer lip, columella with 0-4 weak basal denticles, siphonal notch prominent. White in colour, dorsum of body whorl stained with rusty-brown, denticles on outer lip, tip of siphonal canal and edge of siphonal notch blackish-brown, aperture porcellaneous-white.

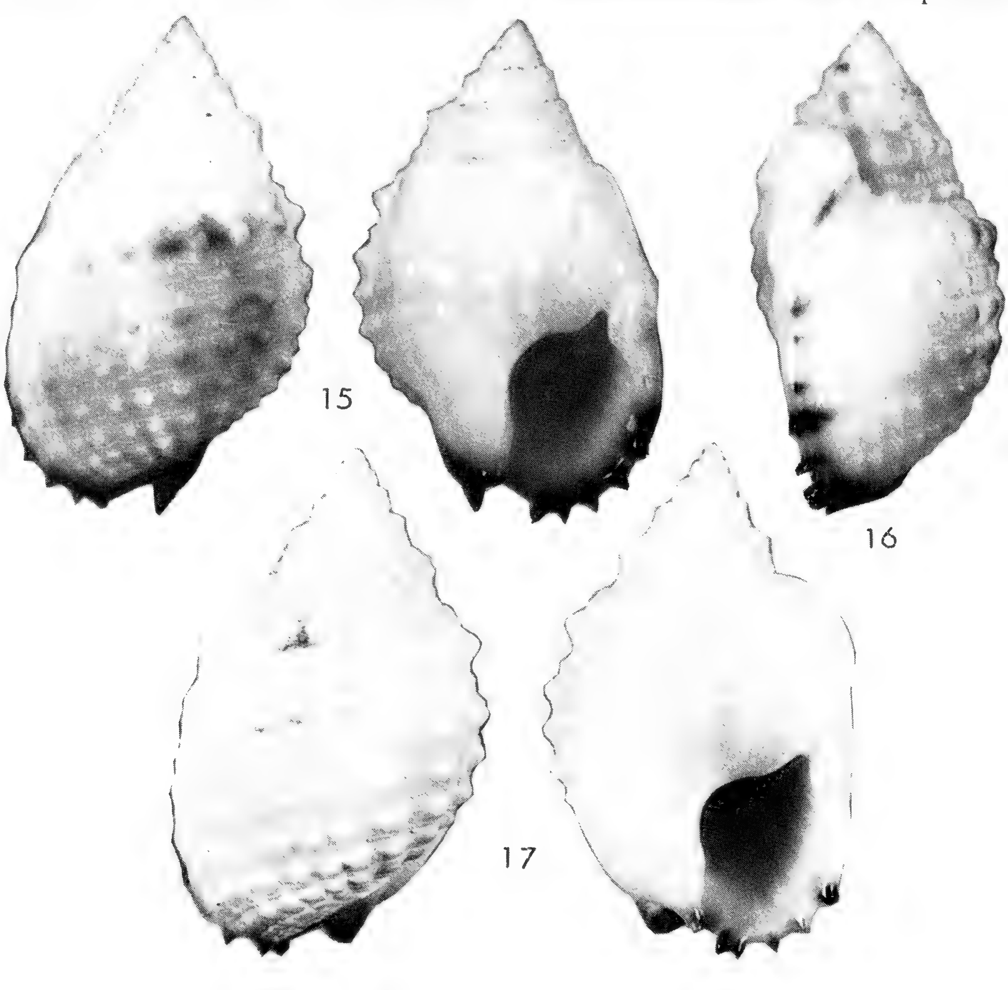
TYPE LOCALITY. Punaauia, Tahiti, French Polynesia.

Distribution. From the Kingsmill group, Gilbert Is to the Tuamotu Archipelago.

Holotype. In AIM No. TM-1365, length 24.5 mm, width 14.8 mm (Fig. 15).

Paratypes. No. 1 from Moorea I in coll. B. Busson (Fig. 16); No. 2 from Anaa I, Tuamotu Archipelago in coll. J. Troendle; No. 3 from Anaa I in the Muséum National d'Histoire Naturelle, Paris; No.'s 4-8 from Anaa I in AIM; No.'s 9-11 from the Kingsmill group, Gilbert Is in the British Museum (Nat. Hist.), London (23.6 mm, 22.4 mm and 18.4 mm) [Fig. 17].

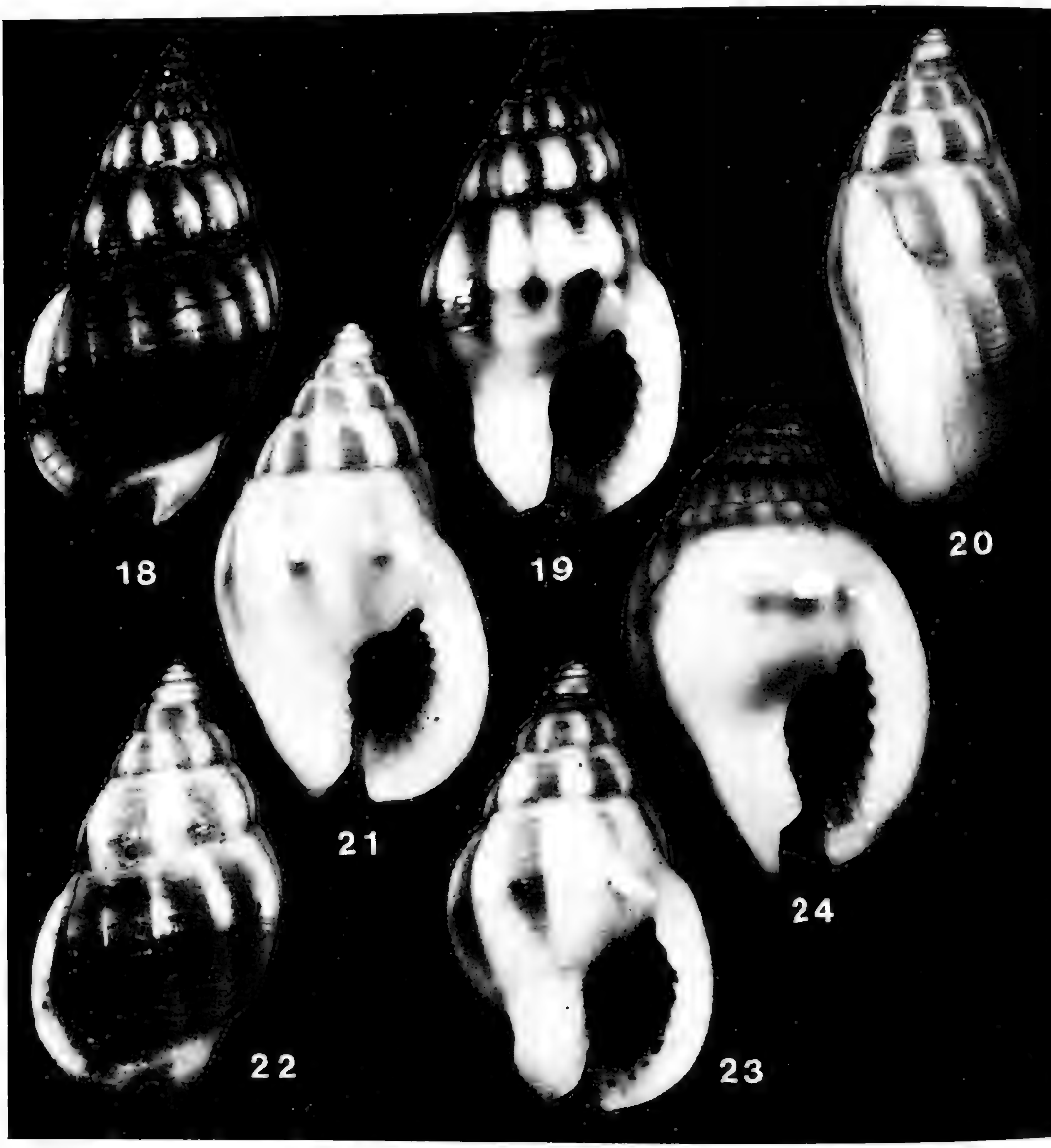
I have seen the first 3 specimens of *N. troendleorum* in the British Museum (Nat. Hist.), and the tablet on which the specimens were mounted bore the inscription "*Nassa serratina* or *N. serrifera* Pease — Kingsmill Ids.". Pease probably intended to describe the species but the description has never been published and remained a manuscript name.



Figs. 15-17. *Nassarius troendleorum* sp. n. 15. Holotype AIM No. TM-1365 from Punaauia, Tahiti; 24.5 mm. 16. Lateral view of paratype No. 1 from Moorea I; 21.9 mm. 17. Paratype No. 11 BMNH from Kingsmill group, Gilbert Is; 18.4 mm.

The species is superficially similar to *N. granifer* (Kiener), but this species has a very large, solid callus which reaches the upper spire whorls, the nodules are larger, fewer and differently arranged and the sharp denticles on the anterior of the outer lip and distinct blackish-brown colouring on the base of the body whorl are absent in *N. granifer*.

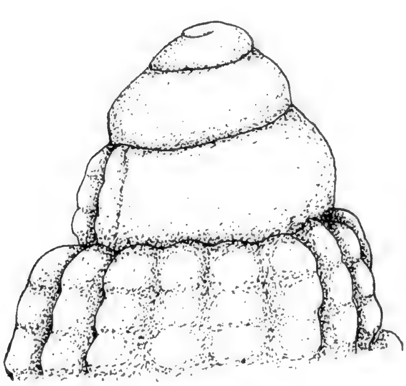
The new species is named for Jean and Hildrun Troendle, Tahiti, who collected the specimens and also in recognition of their diligent collecting which has resulted in numerous new molluscan records from French Polynesia.



Figs. 18-24. 18-23. *Nassarius rehderi* sp. n. Baié de Matavai, Tahiti. 18, 19. Holotype AIM No. TM-1366; 7.8 mm. 20, 21. Paratype, pale colour form; 7.0 mm. 22, 23. Paratype with wide-spaced axial ribs; 5.6 mm. 24. *N. fraudulentus* (Marrat). Mataiea, Tahiti; 7.5 mm.

Nassarius rehderi sp. n. (Figs. 18-23, 26-27)

Shell very small, 5.4-7.8 mm in length, ovate and solid, width 49%-59% of length, sutures distinct, teleoconch of 3¾-4¼ convex whorls, protoconch of 3½-4 glassy, golden coloured and usually brown-banded embryonic whorls, last two whorls of protoconch with an extremely fine spiral keel. Sculptured with thick axial ribs which are frequently wide spaced on spire whorls, penultimate whorl with 7-12 ribs, body whorl with 9-12 ribs; spiral sculpture consists of crisp, overriding spiral threads which are most prominent at posterior half of whorls and number from 8-12 on the penultimate and from 13-23 on the body whorl. Outer lip with a broad, thick varix dorsally and with 8-12 small, lirate denticles on the interior, columella with 2-4 distinct folds basally, anal canal moderately distinct, ventral side of body whorl with a thin, highly glazed callus which does not reach past the body whorl suture and extends usually over 3 axial ribs in width, siphonal canal short and straight, siphonal notch very prominent. Variable in colour, usually brown with white axial ribs and varix, centre of body whorl with a white zone which contains an interrupted spiral band of spots, band occasionally bordered by fine brown lines, some individuals creamy-white and with only the central band of spots; aperture porcellaneous-white, anterior tip of outer lip with a purple-brown blotch which extends onto the back of the varix. Operculum brown, corneous, margins either minutely serrate or simple.



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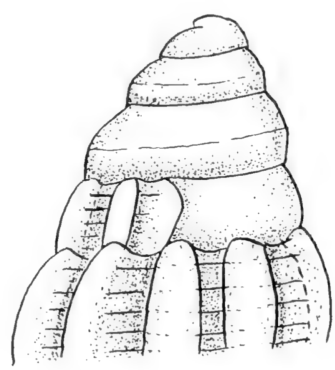

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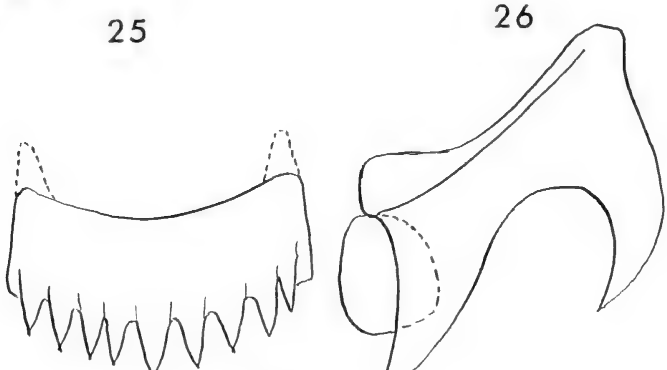

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Figs. 25-27. 25, 26. Protoconchs. 25. *Nassarius troendleorum* sp. n. 26. *N. rehderi* sp. n. 27. Half-row of radula of *N. rehderi* sp. n.

Radula typically nassariine, minute, rachidians with 9 denticles, laterals bicuspid, small oval accessory plate partially covered by lateral tooth (Fig. 27).

TYPE LOCALITY. Baié de Matavai, N.E. Tahiti, French Polynesia 1-12 m.

Distribution. Known only from Baié de Matavai and Hitiaa, Tahiti.

Holotype. In AIM No. TM-1366, length 7.8 mm, width 4.1 mm (Figs. 18, 19).

Paratypes. A total of 37 paratypes have been examined. These have been distributed to the Australian Museum, Sydney, The Museum National d'Histoire Naturelle, Paris, the British Museum (Natural History), London, the National Museum of Natural History, Smithsonian Institution, Washington, the Academy of Sciences, Philadelphia, coll. J. Troendle and coll. G. Lindner.

The species does not closely resemble any known *Nassarius* species and can be compared only with *N. fraudulentus* (Marrat, 1877)l The latter has more slender and considerably more numerous axial ribs, fewer embryonic whorls (2¼-2½), a row of sutural nodules, finely impressed short spiral grooves rather than threads and the callus-pad is large and thick and the purple-brown spot on the base of the outer lip is also lacking (Fig. 24).

The new species is named for Dr Harald A. Rehder, Zoologist Emeritus, Smithsonian Institution, National Museum of Natural History, Washington, for his research over many years on Polynesian molluscs.

Family COSTELLARIIDAE

Genus **Vexillum** Roeding, 1798

Subgenus **Pusia** Swainson, 1840

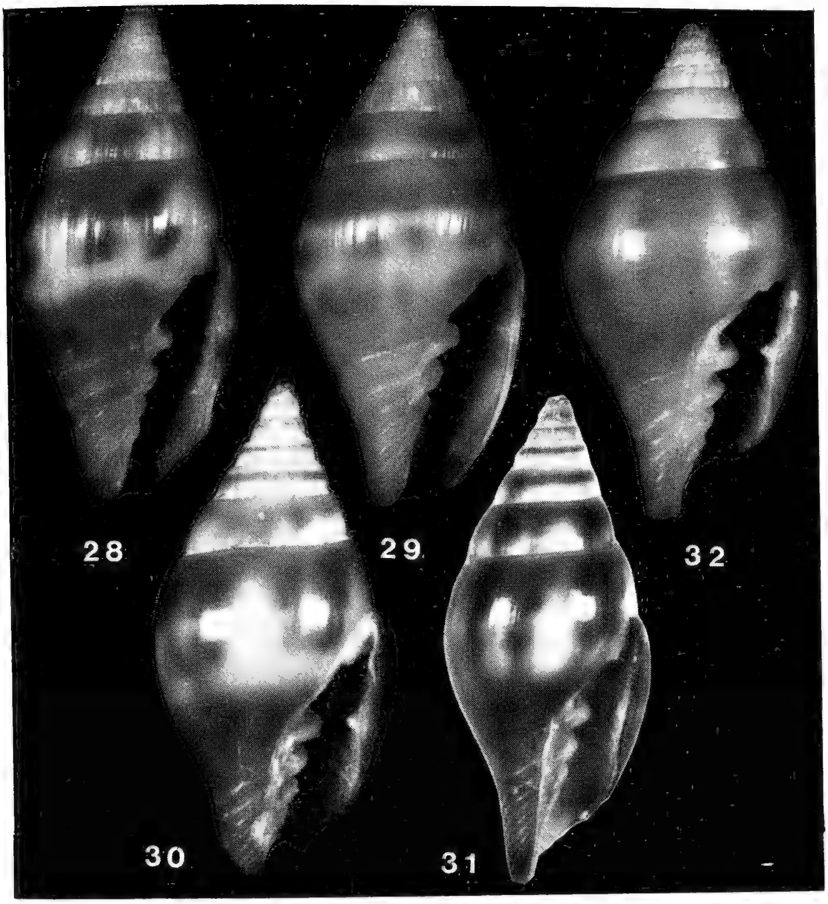
Pusia Swainson, 1840, Treat. Malac. p. 320. Type species by M *P. microzonis* (Lamarck) = *Mitra microzonias* Lamarck, 1811. Recent, Indo-Pacific.

Vexillum (Pusia) mediomaculatum (Sowerby, 1870) (Figs. 28-32)

1870. *Mitra mediomaculata* Sowerby, Proc. Zool. Soc. Lond. p. 255; 1874 Sowerby, Thes. Conchyl. 4: 23, pl. 22, fig. 472.
1874. *Mitra (Pusia) cernica* G. & H. Nevill, J. Asiat. Soc. Bengal 43 (1): 24, pl. 1, fig. 9.
1882. *Turricula (Pusia) mediomaculata* Sowerby, Tryon, Man. Conch. 4: 184, pl. 55, figs. 581, 582.

TYPE LOCALITY. Mauritius (*mediomaculatum* and *cernica*).

Type specimens. Three syntypes of *V. (P.) mediomaculatum* are in the British Museum (Nat. Hist.) No. 1875.4.19.6., dimensions of illustrated syntypes 12.0 x 5.2 x 6.9 mm (Fig. 28) and 13.2 x 6.2 x 7.6 mm (Fig. 29 — immature). Axial ribbing is very variable, ribs become obsolete to absent on the body whorl or even completely absent on the last two whorls. Spire whorls are white and ornamented with brown blotches, body whorl brown with a central, broad or narrow, dilacerated white band which occasionally contains additional squarish spots. In the majority of specimens, the third or fourth apertural lira anterior to the start of the aperture forms a distinct denticle.



Figs. 28-32. *Vexillum (Pusia) mediomaculatum* (Sowerby). 28, 29. Syntypes BMNH No. 1875.4.19.6.; 12.0 mm and 13.2 mm respectively. 30, 31. Specimens from Mururoa Atoll, Tuamotus. 30. Broad form; 11.0 + mm. 31. Slender form; 11.9 + mm. 32. Sand I, Oahu, Hawaiian Is; 12.9 mm.

The species appears to be extremely rare and previous records were known only from Mauritius and Madagascar. The recent collection of specimens from Mururoa Atoll, Tuamotu Archipelago (*leg*. C. Beslu) [Figs. 30, 31] and from Sand I, Oahu, and Nawiliwili, Kauai, Hawaiian Is (*leg*. Dr W.R. Haas) [Fig. 32], considerably extends the species distributional range.

Family TURRIDAE

Genus **Turridrupa** Hedley, 1922

Turridrupa Hedley, 1922, Rec. Austral. Mus. 13 (6): 226. Type species by OD *Pleurotoma acutigemmata* E.A. Smith, 1877. Recent, Indo-Pacific.

Turridrupa jubata (Reeve, 1843) (Fig. 33)

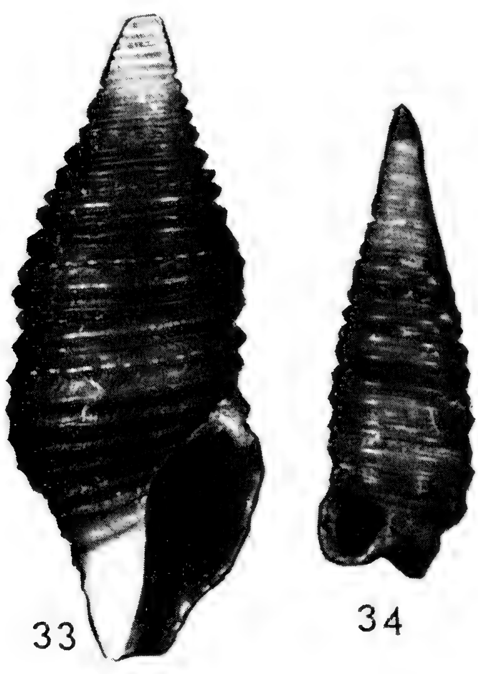
1843. *Pleurotoma jubata* "Hinds", Reeve, Conch. Icon. 1: pl. 7, spec. 52 (publ. March 1843); 1843 Hinds, Proc. Zool. Soc. Lond. Pt. 11: 37 (publ. October 1843); 1844 Hinds, Voy. H.M.S. "Sulphur" 2: 15, pl. 5, fig. 3.

1967. *Turridrupa jubata* (Hinds), Powell, Indo-Pacific Moll. 1 (7): 423, pl. 301, fig. 3.

TYPE LOCALITY. Straits of Malacca, Indonesia, 18 fathoms (33 m).

The species has been previously reported only as far east as New Caledonia and the collection of the species at Mururoa Atoll, Tuamotu Archipelago (*leg.* C. Beslu — Fig. 33) and in Faaa and Faaone, Tahiti (*leg.* J. Troendle) represents a considerable eastward range extension.

The authorship of *T. jubata* has usually been credited to Hinds, but Reeve's publication (1843-1846) has 6 months priority. The other Indo-Pacific species requiring a change in authorship is *Clavatula felina* Hinds, 1843 = *Philbertia (Kermia) felina* (Reeve, 1843).



Figs. 33, 34. 33. *Turridrupa jubata* (Reeve). Mururoa Atoll, Tuamotus; 15.6 mm. 34. *Viriola samoana* Cernohorsky. Faaone, Tahiti; 6.1 mm.

Family TRIPHORIDAE

Genus **Viriola** Jousseaume, 1884

Viriola Jousseaume, 1884, Bull. Soc. malac. France 1: 234, 238. Type species by OD *V. bayani* Jousseaume, 1884. Recent, Indo-Pacific.

Viriola samoana Cernohorsky, 1977 (Fig. 34)

1977. *Viriola samoana* Cernohorsky, Rec. Auckland Inst. Mus. 14: 130, figs. 21-26.

TYPE LOCALITY. Apolima Strait, W. of Upolu I, Western Samoa.

Several specimens of *V. samoana* have been collected at Faaone, Tahiti, and Ilot Trioa, N.W. Moorea I, Society Is (*leg.* J. Troendle). This is the first record of the species outside western Samoa.

Acknowledgements. I would like to thank Dr B. Salvat, Director of the Antenne du Museum et des Hautes Etudes en Polynesie francaise, Paris, for his invitation to the Marine station on Moorea I, and Mr G. Vergonzanne for his kind assistance during my stay at the station. I am grateful to Dr R. Robertson and Ms M.A. Garback, Academy of Natural Sciences of Philadelphia for having made Peases's types available for examination, Ms K. Way, British Museum (Natural History), London, for the loan of Pease's specimens of *N. troendleorum,* Mr C. Beslu, Tahiti, for the loan of molluscan material from Mururoa Atoll, Mr B. Busson for the loan of a paratype of *N. troendleorum,* and Dr W.R. Haas, Lihue, Hawaii, for Hawaiian specimens of *V. (C) mediomaculatum.* I am particularly indebted to Mr & Mrs J. Troendle, Tahiti, for their kind hospitality and untiring assistance during my collecting on Tahiti.

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SYSTEMATICS OF SOME WEST PACIFIC *Lyria* (MOLLUSCA: VOLUTIDAE) WITH DESCRIPTION OF A NEW SPECIES

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Abstract. The taxa *Lyria taiwanica* Lan and *L. kawamurai* Habe, are placed in the synonymy of *L. santoensis* Ladd, and *L. kuniene* Bouchet is a suspected immature individual of the same species. *L. grangei* is described as a new species from the S.W. Pacific and is compared with the fossil *L. mallicki* Ladd.

The discovery during the last 5 years of both fossil and living specimens of new *Lyria* species from the west and southwest Pacific gave rise to several descriptions of new species, all published during the last 3 months of 1975. In this paper the validity of these "species" is evaluated on the basis of their original descriptions, type-figures or type-specimens and subsequently collected material.

Family VOLUTIDAE

Subfamily LYRIINAE Pilsbry & Olsson, 1954

Genus **Lyria** Gray, 1847

Lyria Gray, 1847, Proc. Zool. Soc. Lond. Pt. 15: 141. Type species by OD *Voluta nucleus* Lamarck, 1811. Recent, West Pacific.

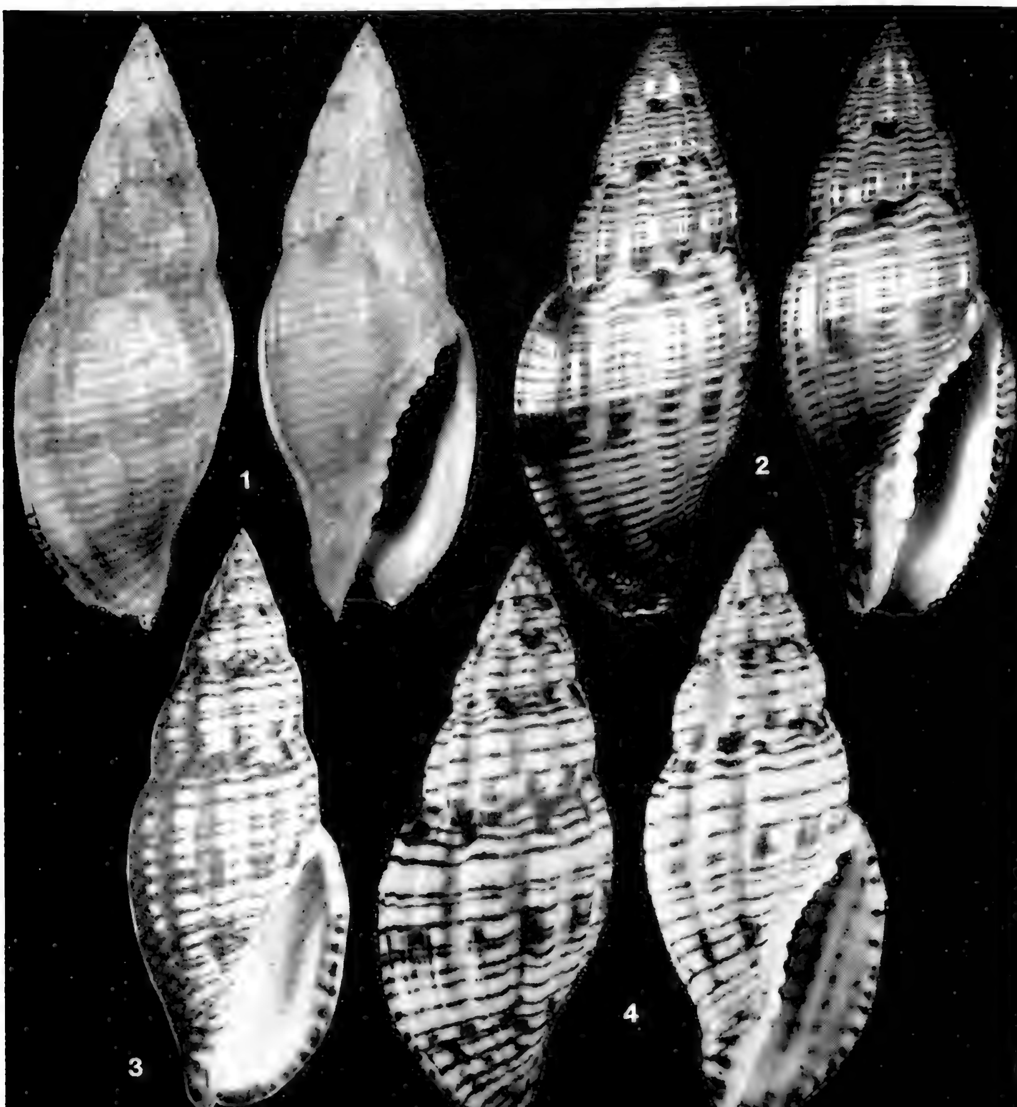
Lyria (Lyria) santoensis Ladd, 1975 (Figs. 1-6)

1974. *Voluta* n.sp. Leehman, Hawaiian Shell News 22 (10): 9, figs. on left.
1975. *Lyria santoensis* Ladd, Veliger 18 (2): 137, figs. 10-15 (publ. 1 October 1975).
1975. *Lyria (Lyria) taiwanica* Lan, Bull. Malac. Soc. China 2: 103, textfigs. (publ. 30 November 1975).
1975. *Lyria (Lyria) kawamurai* Habe, Bull. Nat. Sci. Mus. Tokyo (A), Zool. 1 (4): 195, pl. 1, figs. 1, 2 (publ. 22 December 1975).
1975. *Lyria kawamurai* Habe, Publ. commem. Anniv. R. Kawamura, p. 6, pl. 3, figs. 1, 4 (publ. 31 December 1975).
1977. *Lyria taiwanica* Lan, Weaver, Hawaiian Shell News 25 (11): 1, textfig.
1977. *Lyria kawamurai* Habe, Weaver, ibid. 25 (11): 1, lower figure (synonymized with *L. taiwanica* Lan).

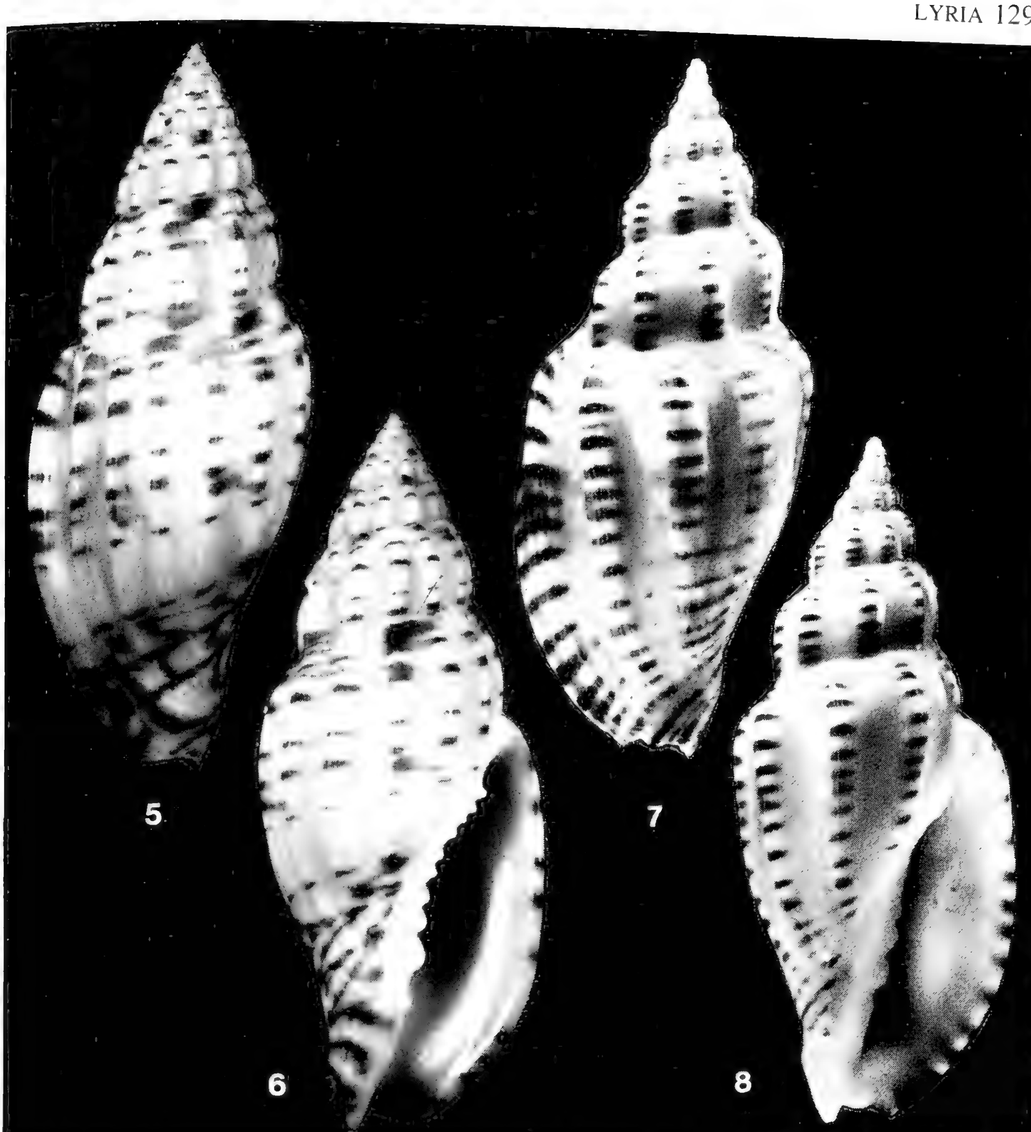
TYPE LOCALITY. Kere River, Santo I, near St. SM 242, 166°56.7'E & 15°34'S, elevation 70 m, Pleistocene/Holocene of New Hebrides (*santoensis*); W. of Tiao-yu-tai Isle, off Taiwan, 96-120 m (*taiwanica*); off Suo, Taiwan (*kawamurai*).

DISTRIBUTION. Fossil from the Pleistocene/Holocene of New Hebrides. Living from Taiwan to the Philippines, Sabah, Indonesia to the Solomon Is.

Type specimens. The holotype of *L. santoensis* Ladd, is in the National Museum of Natural History, Washington, No. USNM 175138, dimensions 87.7 x 29.6 x 48.2 mm, together with the illustrated paratype No. USNM 175139, dimensions 79.7 x 29.3 x 43.0 mm (Fig. 1). The holotype of *L. taiwanica* Lan, dimensions 75.4 x 27.2 mm is in Lan's private collection (Fig. 3). The holotype of *L. kawamurai* Habe, dimensions 65.8 x 27.2 x 44.8 mm, is in Kawamura's private collection (Fig. 4).



Figs. 1-4. *Lyria santoensis* Ladd. 1. Paratype USNM No. 175139; 79.7 mm. 2. Specimen from Russel I, Solomon Is, 24-31 m; 75.0 mm. 3. Holotype of *L. taiwanica* Lan; 75.4 mm (from Lan, 1975, textfig.). 4. Holotype of *L. kawamurai* Habe; 65.8 mm (from Habe, 1975, pl. 1, figs. 1, 2).



Figs. 5-8. 5, 6. *Lyria santoensis* Ladd. Off Kota Kirabalu, Sabah; 55.0 mm. 7, 8. *L. kuniene* Bouchet. Holotype MNHN Paris; 64.0 mm (immature — from Bouchet, 1979, figs. 1, 2).

Ladd (1975) described *Lyria santoensis* from fossiliferous marls of the Kere River on Santo I, Solomon Is, and the age determination yielded a tentative figure of between 14,000 and 25,280 years. Ladd's description appeared in October 1975, and was soon followed by descriptions of living specimens from Taiwan by Lan (30 November 1975) and Habe (22 December 1975).

Weaver (1977) has in the meantime correctly synonymized *L. kawamurai* Habe with *L. taiwanica* Lan, but Ladd's prior description was either overlooked or has not been associated with those of living specimens. The species has, however, been reported from Panlao, Bohol, Philippines (Weaver, 1977) and specimens have been taken in fish-traps at Russel I, Solomon Is, 24-31 m (ex-coll. N. Potter [Fig. 2], off Tulagi I, Solomon Is, 92 m (*leg*. B. Bailey — B. Parkinson, pers. comm.), and off Kota Kinabalu, Sabah, Nth. Borneo (*leg*. V. Wee) [Figs. 5, 6].

Although somewhat variable in colour pattern, *L. santoensis* shows little variation in the number of axial ribs which number from 10-12 on the penultimate and from 9-13 on the body whorl. The chocolate-brown spiral lines number from 4-10 on the penultimate and from 18-26 on the body whorl, and lines are usually more numerous and closer set in specimens from Melanesia. In some individuals the spiral lines are present only on the axial ribs and are faint or absent in the interspaces.

In the accompanying table (Table 1) comparative diagnostic characters are given as described or observed in the type specimens although the actual range of variation is considerably greater. The features present in the three described forms are all well within the range of variation of *Lyria* species, and the taxa *L. santoensis, L. taiwanica* and *L. kawamurai* are considered to be conspecific.

Lyria (Lyria) kuniene Bouchet, 1979 (Figs. 7, 8)

1979. *Lyria kuniene* Bouchet, Veliger, 22 (1): 49, figs. 1-3.

TYPE LOCALITY. West of Isle of Pines, southern New Caledonia, 22°49'S & 167°12'E, in 390-395 m.

Type specimen. The holotype of *L. kuniene* Bouchet is in the Muséum National d'Histoire Naturelle, Paris, dimensions 64.0 x 25.5 x 39.0 mm (Figs. 7, 8).

The species has been described (Bouchet 1979) on the basis of a single specimen which appears to be a very immature individual closely resembling *L. santoensis*. The inflated whorls, broad aperture, unthickened outer lip, weakly calloused columella and incomplete columellar denticles are characters of an immature state. In some specimens of *L. santoensis, e.g.* the specimen from Sabah (Figs. 5, 6), the brown spiral lines do not intrude on to the interspaces of the axial ribs. Further recovery of mature specimens is required before *L. kuniene* can be considered as a valid biospecies.

Lyria (Lyria) mallicki Ladd, 1975 (Fig. 9)

1975. *Lyria mallicki* Ladd, Veliger, 18 (2): 137, figs. 2-9.

TYPE LOCALITY. Kere River, Santo I, near station SM242, 166°56.7'E & 15°34'S, elevation 70 m, Pleistocene/Holocene of the New Hebrides.

Type specimens. The holotype of *L. mallicki* Ladd is in the National Museum of Natural History, Washington, No. USNM 175096, dimensions 48.0 x 19.2 mm, together with the paratype No. USNM 214226, dimensions 45.8 x 16.6 x 26.0 mm (Fig. 9).

Lyria mallicki is similar to *L. planicostata* (Sowerby, 1903) and shares with this species 7 mature whorls and 2 minute, pointed embryonic whorls and yellowish-orange spiral lines and a similar shape, size, formation of aperture and absence of spiral striae in the interspaces. *L. planicostata* has only 3 fewer axial ribs on the penultimate whorl than *L. mallicki* (see Table 1), and the columella is edged with brown. The width-ratio of *L. mallicki* ranges from 36%-47% of length, that of *L. planicostata* is 42% of length.

Table 1. Main characters of some west Pacific *Lyria* species.

Characters	**santoensis***	*taiwanica*	*kawamurai*	**kuniene**	**mallicki**	**planicostata**	**grangei** sp.n.
Size of type (mm)	87.7	75.4	65.8	64.0	48.0	53.0	61.7
Protoconch whorls	1¾-2	1½	2½	2½	2 (conical)	2	1¼-1½ (globose)
Teleoconch whorls	8¾-9	7-8	8	6	7	7	7-7½
Axial ribs on penult whorl	12	—	10-11	9	18	15	17-21
Axial ribs on body whorl	9-12	12-13	11-12	9	20	—	17-20
Spiral striae on penult whorl	none	none	none	none	none	none	23-41
Spiral striae on body whorl	none — only weak basal cords	none — only weak basal cords	none — only weak basal cords	none — only weak basal cords	none — only weak basal cords	none — only weak basal cords	40-58
Columellar folds	10	12-13	12	10	15-22	13-15	10-14
Spiral lines on penult whorl	8	10	4-5	7	traces of spiral lines	spiral lines present (not counted)	17-22
Spiral lines on body whorl	24-26	18-23	19-20	*c*.18	traces of spiral lines	spiral lines present (not counted)	46-51

* Valid and tentatively valid species in bold type

Although Weaver and du Pont (1970) suggest that the unique holotype of *L. planicostata* (Sowerby) may prove to be a synonym of the Caribbean *L. beauii* (Fischer & Bernardi, 1857), it is suspected that the species could be a survivor of the group of species comprising *L. hanzawai* MacNeil, 1960, from Mio/Pliocene deposits of the Ryukyu Is, *L. rex* Hirase, 1908, from the Pliocene of the Ryukyu Is, and *L. mallicki* from the Pleistocene/Holocene of the New Hebrides.

Lyria (Lyria) grangei sp. n. (Figs. 10-13)

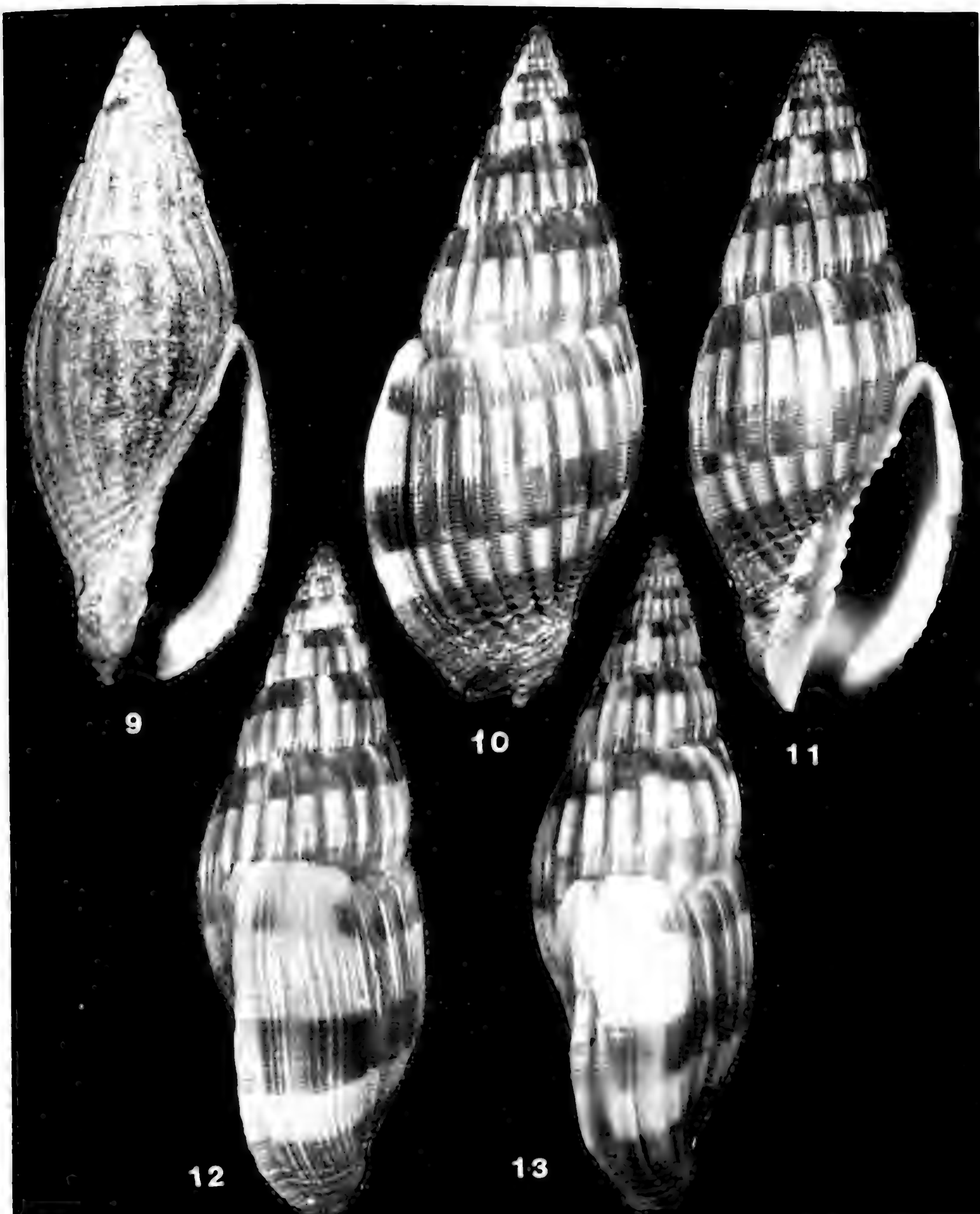
Shell up to 74.0 mm in length, solid and moderately heavy, width 37%-40% of length, teleoconch of 7-7½ convex whorls, protoconch of 1¼-1½ orange-brown, bulbous embryonic whorls, sutures distinct without being canaliculate. Sculptured with close-set, moderately thickened and rounded axial ribs which number from 17-21 on the penultimate and from 17-20 on the body whorl; outer lip with an extremely broad, upswept varix which contains from 7-12 slender axial riblets. Interspaces of axial ribs narrow and containing numerous, very fine and crisp spiral striae which do not quite reach the summits of the axial ribs and which number from 23-41 on the penultimate and from 40-58 on the body whorl; base of body whorl with 5-9 stronger and step-like spiral cords and an additional 6-9 crowded cords on the siphonal fasciole. Aperture moderately wide, height 50%-53% of total length, smooth within, edge of outer lip simple and slightly reflexed, columella calloused and with 10-14 lirate denticles plus 2-5 intercalate denticles, denticles becoming gradually thicker towards the anterior with the ultimate three denticles the largest. Siphonal canal straight, siphonal notch prominent. Base colour cream to fawn, ornamented with 1 broad, orange-brown sutural band on upper spire whorls, 2 sutural bands on the penultimate and three bands on the body whorl; varix yellowish-white to creamy-white, posterior body whorl band extending only a short distance across varix and lower 2 bands extending towards the outer lip. Superimposed over this pattern are numerous, close-set, darker orange-brown spiral lines which are confined to the axial ribs and which number from 17-22 on the penultimate and from 46-51 on the body whorl; aperture cream to pale yellow, columellar denticles white, interspaces pale orange-brown.

TYPE LOCALITY. NZOI station 1763, small pinnacle out from the lagoon on the southern side of the eastern South Bellona reef, between New Caledonia and Queensland, Australia, 21°50.7'S & 159°31.6'E, in 15 m, on sand, water temperature 22.7°C (*leg.* K.R. Grange, 18-5-1979).

Holotype. In the New Zealand Oceanographic Institute, Wellington, No. H-251, length 61.7 mm, width 24.9 mm, height of aperture 33.0 mm (Figs. 10-12).

Paratypes. No. 1 from the same locality as the holotype, dimensions 70.8 x 27.0 x 35.2 mm in the Auckland Institute and Museum No. P-508A (Fig. 13); No. 2 from the outer reef slope on the N.W. side of western South Bellona reef, in 17 m, dimensions 73.4 x 27.6 x 36.8 mm, in the N.Z. Oceanographic Institute No. P-508C; No. 3 from the south side of the lagoon, western South Bellona reef, dimensions 62.7 x 24.3 x 32.7 mm, in the National Museum of New Zealand, Wellington, No. P-508B.

All specimens were collected during the R.V. Tangaroa "Tasman Seamounts 1979" cruise 1093 during May 1979. The isolated position of the Bellona reefs in the Coral Sea may account for the belated discovery of such a large and colourful *Lyria* species. *L. grangei* is perhaps most similar in shape, sculpture and colouring to *L. delessertiana* (Petit de la Saussaye, 1842) [synonym *L. tulearensis* Cosel & Bloecher, 1977], a species which appears to be confined to the Seychelles Is — Madagascar area of the west Indoan Ocean.



Figs. 9-13. 9. *Lyria mallicki* Ladd. Paratype USNM No. 214226; 45.8 mm. 10-13. *L. grangei* sp. n. South Bellona reef, between New Caledonia and Queensland, Australia. 10-12. Holotype NZOI No. H-251; 61.7 mm. 13. Paratype showing broad varix; 70.8 mm.

This species has a considerably broader columellar callus with larger and closer set lirae, a dozen dark brown spiral lines on the edge of the outer lip, and the numerous, crisp spiral striae, broad varix and numerous orange-brown spiral lines are all absent in *L. delessertiana*. *L. grangei* can also be compared with the fossil *L. mallicki* Ladd (Fig. 9), but this species is smaller, considerably less solid and lighter in weight, has a small conical protoconch of 2 whorls, narrower axial ribs and lacks the numerous spiral striae in the interspaces (see Table 1).

The species is named for Mr K.R. Grange, N.Z. Oceanographic Institute, Wellington, who collected the species during the "Tasman Seamounts 1979" cruise to Bellona reef.

Acknowledgements. I would like to thank Dr H. Ladd, U.S. Geological Survey, and Dr F. Collier, Department of Paleobiology, Smithsonian Institution, Washington, for information and loan of types of *L. santoensis* and *L. mallicki*. I am grateful to Mr K.R. Grange, N.Z. Oceanographic Institute, Wellington, for the opportunity to study the new volutid; Mr N. Potter, Auckland, for the loan of specimens of *L. santoensis* and Mr C. Weaver, Kailua, Hawaiian Is, and Mr B. Parkinson, Rabaul, for information in connection with this paper.

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THE TAXONOMY OF SOME INDO-PACIFIC MOLLUSCA

PART 8

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Abstract. New geographical records are recorded for *Morum exquisitum* (Adams & Reeve), *Pterynotus loebbeckei* (Kobelt), *Latiaxis gyratus* (Hinds), *Ziba cloveri* Cernohorsky, *Vexillum (Pusia) salisburyi* Cernohorsky, *Terebra eburnea* Hinds and *Turris garnonsii* (Reeve). *Peristernia corallina* Melvill & Standen is re-assigned to the Muricidae with *Nassaria mordica* Hedley and *Muricopsis martini* Fischer in Wanner in synonymy, and *Triton carduus* Reeve is re-assigned to the *farinosa-egregia* group of *Engina* in the Buccinidae. *Tritonidea submenkeana* Pilsbry and *Enzinopsis resta* Iredale are synonymized with *Engina menkeana* (Dunker) a species which is now known to live as far south as Lord Howe I, and *Nassarius fontanei* (d'Orbigny) is placed in synonymy of *N. exilis* (Powys). The species *Nassarius fraudator* from Australia and *Mitra deynzeri* and *Thala maxmarrowi* from the Western Pacific are described as new to science.

Family CASSIDAE

Genus **Morum** Roeding, 1798

Morum Roeding, 1798, Mus. Bolten. p.53. Type species by M *M. purpureum* Roeding, 1798 (=*Strombus oniscus* Linnaeus, 1767). Recent, West Atlantic.

Morum exquisitum (Adams & Reeve) (Fig. 1)

1848. *Oniscia exquisita* Adams & Reeve, Zool. voy. H.M.S. "Samarang", Ref. to plates, p.x, pl. 5, figs. 3a, b; 1849 Reeve, Conch. Iconica 5: pl. 1, fig. 3; 1850 Adams & Reeve, Zool. voy. H.M.S. "Samarang", Pt. 2:35.

1977. *Morum (Oniscidia) exquisitum* (Adams & Reeve), Emerson, Nautilus 91 (3): 83, figs. E, F, J (detailed synonymy).

TYPE LOCALITY. Near Sulu City, Sulu Archipelago, Philippine Is, 16-20 fathoms (29-37 m).

Emerson (1977) in a recent paper on Indo-Pacific species of *Morum* gave a review of *M. exquisitum* and stated that records other than those from the Philippines should be rejected. However, recently specimens of the species have been collected on Okinawa I, Ryukyu Is (*leg.* P. Bellin) and a specimen is here illustrated (Fig. 1).

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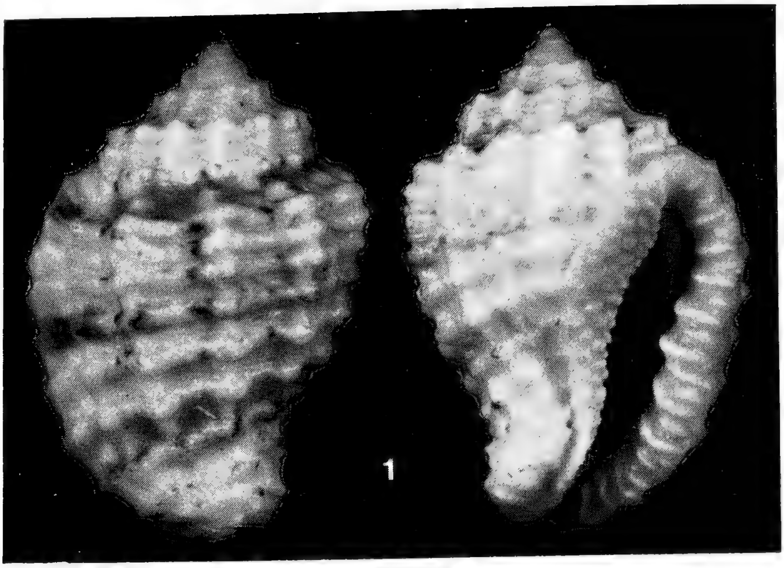


Fig. 1. *Morum exquisitum* (Adams & Reeve). Okinawa, Ryukyu Is; 21.9 mm.

Family MURICIDAE

Genus **Pterynotus** Swainson, 1833

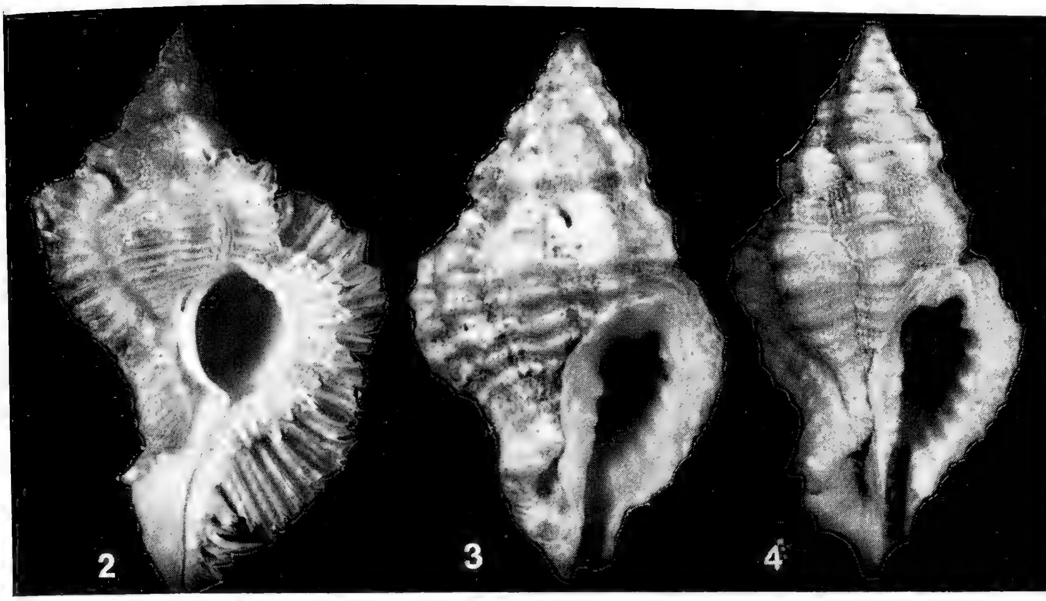
Pterynotus Swainson, 1833, Zool. Illust. (2), 3: expl. to pl. 100. Type species by SM (Swainson, 1833) *Murex pinnatus* Swainson, 1822 = *Purpura alata* Roeding, 1798. Recent, Indo-Pacific.

Pterynotus loebbeckei (Kobelt in Loebbecke & Kobelt, 1879) (Fig. 2)

1879. *Murex (Pteronotus) loebbeckei* Kobelt in Loebbecke & Kobelt, Jahrb. deut. malak. Gesell. 6:78.
1880. *Murex loebbeckei* Kobelt in Loebbecke & Kobelt, Jahrb. deut. malak. Gesell. 7: 80, pl. 3, fig. 2; 1979 Roth, Hawaiian Shell News 27 (11): 8.
1942. *Pterynotus loebbeckei* (Kobelt), Yen, Proc. Malac. Soc. Lond. 24: 223; 1971 E.M. Vokes, Bull. Americ. Paleont. 61 (268): 66; 1976 Radwin & D'Attilio, Murex shells world p. 99, pl. 9, fig. 14.
1963. *Murex (Pterynotus) loebeckii (sic)* Kobelt, Shikama, Sel. shells world col. 1: pl. 54, fig. 3.
1976. *Pterynotus loebbecki (sic)* Kobelt, Fair, The Murex book, p. 55, pl. 13, fig. 153.

TYPE LOCALITY. Seas of Indochina (= South China Sea).

The species is rather variable, especially in the development of the wing-like varices. It has been previously reported from Japan, China, Taiwan and the Philippines, and the specimen taken in a fish-trap at Russel I, Solomon Is, in 24-30 m (Fig. 2), represents a considerable southeastward range extension. A closely similar species (or variant of *P. loebbeckei*) from the Philippine Is has been recently described under the name *Pterynotus miyokoae* Kosuge, 1979.



Figs. 2-4. 2. *Pterynotus loebbeckei* (Kobelt in Loebbecke & Kobelt). Russel I, Solomon Is, 24-30 m; 66.5 mm. 3, 4. *Muricopsis corallinus* (Melvill & Standen). 3. Holotype BMNH No. 1903.12.15.105.; 12.2 mm. 4. Holotype of *Nassaria mordica* Hedley. AMS No. C-27378; 16.0 mm.

Genus **Muricopsis** Bucquoy, Dautzenberg & Dollfus, 1882

Muricopsis Bucquoy, Dautzenberg & Dollfus, 1882, Moll. Mar. Roussillon 1: 16, 19. Type species by OD *Murex blainvillei* Payraudeau, 1826. Recent, Mediterranean.

Muricopsis corallinus (Melvill & Standen, 1903) (Figs. 3, 4)

1903. *Peristernia corallina* Melvill & Standen, Ann. Mag. Nat. Hist. (7), 12: 308, pl. 22, fig. 11.
1909. *Nassaria mordica* Hedley, Proc. Linn. Soc. N.S.W. 34 (3): 462, pl. 44, fig. 100.
1927. *Muricopsis martini* Fischer in Wanner, Palaeont. Timor 15: 80, pl. 213, figs. 53, 54.
1971. *Janiopsis martini* Fischer, E.H. Vokes, Bull. Americ. Paleont. 61 (268): 69.

TYPE LOCALITY. Near Muscat, Gulf of Oman, 10 fathoms (18 m) [*corallinus*]; off Hope I, Queensland, Nth. Australia, 5-10 fathoms (9-18 m) [*mordica*]; Seran, Timor, Pliocene of Indonesia (*martini*).

Type specimens. The holotype of *P. corallina* Melville & Standen is in the British Museum (Nat. Hist.) No. 1903.12.15.105, dimensions 12.2 x 7.2 mm; the holotype has 6½ whorls, 8 axial folds and 3 spiral cords on the penultimate and 7 axials and 7 cords on the body whorl, 7 denticles on the outer lip and 4 on the columella and an additional parietal denticle. The colour is dirty white (Fig. 3).

The holotype of *Nassaria mordica* Hedley, is in the Australian Museum, Sydney, No. C-27378, dimensions 16.0 x 8.6 mm; the holotype has 7 axial ribs on the penultimate and 7 on the body whorl, the outer lip has 7 denticles and the columella 5 and the colour is buff (Fig. 4).

A great deal of confusion has surrounded this species which has been omitted from 2 recent monographs of the Muricinae. The original authors assigned the species to the genus *Peristernia,* Moerch, family Fasciolariidae, and *Nassaria mordica* was placed in *Nassaria* Link, family Buccinidae. The Pliocene species *martini,* which is undoubtedly conspecific with *M. corallinus,* was correctly placed in *Muricopsis* but was re-assigned to *Janiopsis* Rovereto, a Tertiary buccinid genus from European deposits by E.H. Vokes (1971). The species is similar to *M. blainvillei* (Payraudeau), the type species of *Muricopsis* and also closely resembles *M. bombayanus* (Melvill) and other Indo-Pacific species and the assignment of *corallinus* to the muricid genus *Muricopsis* is most appropriate.

Family CORALLIOPHILIDAE

Genus **Latiaxis** Swainson, 1840

Latiaxis Swainson, 1840, Treat. Malac. p. 306. Type species by M *Pyrula mawae* Gray in Griffith & Pidgeon, 1834. Recent, Indo-Pacific.

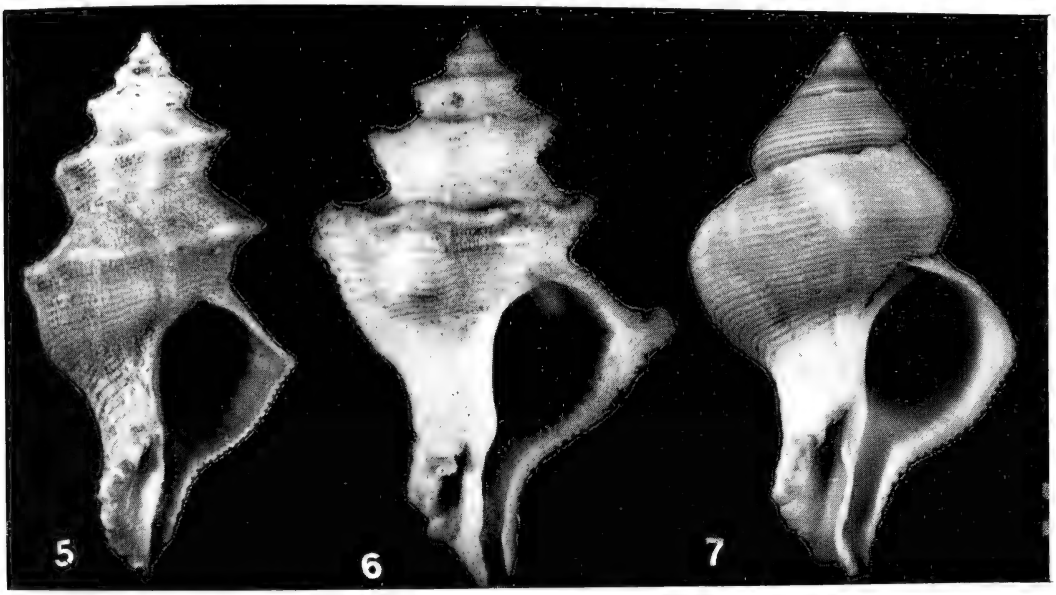
Latiaxis gyratus (Hinds, 1844) (Figs. 5, 6)

1844. *Trophon gyratus* Hinds, Voy. H.M.S. "Sulphur", Zool. 2: 14, pl. 1, figs. 14, 15: 1935 Tomlin, J. Conch. 20 (6): 18.
1845. *Murex gyratus* Hinds, Reeve, Conch. Iconica 3: pl. 26, spec. 109.
1847. *Pyrula idoleum* Jonas, Proc. Zool. Soc. Lond. Pt. 14: 120; 1935 Tomlin, J. Conch. 20 (6): 182.
1847. *"Pyrule fusiforme"* Chenu, Lecons Element. pl. 9, figs. 3, 3a (*nom. nud.*).
1853. *Pyrula fusiformis* Chenu in Roquan, J. Conchyl. 4: 406 (ref. to Chenu, 1847, pl. 9, figs. 3, 3a).
1864. *Latiaxis tortilis* H. & A. Adams, Proc. Zool. Soc. Lond. for 1863: 431; 1882 Sowerby, Thes. Conchyl. 5: 3, pl. 424, fig. 1; 1935 Tomlin, J. Conch 20 (6): 183; 1942 Yen, Proc. Malac. Soc. Lond. 24:225.
1867. *Latiaxis textilis (sic)* Gray, Ann. Mag. Nat. Hist. (3), 20: 78 (error for *tortilis* H. & A. Adams).
1880. *Latiaxis idolea* Jonas *(pars),* Tryon, Man. Conch. 2: 203, pl. 64, fig. 342 only.
1882. *Latiaxis pagodus* "Jonas", Sowerby, Thes. Conchyl. 5: 3, pl. 424, figs. 2, 3 (non *Murex pagodus* A Adams, 1853 = *Latiaxis*).
1882. *Latiaxis gyratus* (Hinds), Sowerby, Thes. Conchyl. 5: 3, pl. 424, fig. 10; 1924 Yen, Proc. Malac. Soc. Lond. 24: 226; 1974 Dance, Encycl. shells p. 137, centre fig. in left column.
1963. *Latiaxis (Mipus) gyratus* (Hinds), Shikama, Select. shells world 1: 77, pl. 60, figs. 5, 6.
1966. *Pseudomurex gyratus* (Hinds), Habe & Kosuge, Shells world col. 2: 56, pl. 20, fig. 18.

TYPE LOCALITY. Straits of Maccassar, Indonesia, 17 fathoms (31 m) [*gyratus*]; none (*idoleum* and *pagoda* Sowerby); China (*tortilis*); probably China (*fusiformis*).

Type specimen. The holotype of *L. tortilis* H. & A. Adams, is in the British Museum (Nat. Hist.), dimensions 38.3 x 25.2 mm; the holotype has 8 coarse axial folds on each of the last 2 whorls, and 11-12 spiral cords on the penultimate and 32 cords on the body whorl (Fig. 6). *L. tortilis* has been based on a mature specimen while the type-figure of *L. gyratus* suggests an immature individual.

Considerable confusion exists as to the specific validity of the names *gyratus, tortilis* and *idoleum*. Tryon (1880) considered *L. gyratus* (Hinds) and the species described as *L. eugeniae* (Bernardi, 1853) to be variants of one of the same species, while Tomlin (1935) and all subsequent authors consider them to be separate species. Recently, however, Dance (1974) applied the name *idoleum* Jonas to the species known as *L. eugeniae* (Bernardi) [Fig. 7], and placed the latter epithet in synonymy. Jonas (1847) in his original description clearly states that the whorls are "centrally acutely angulate" and compares *L. idoleum* to the roofs of a Chinese pagoda. These characters clearly demonstrate that his species was *L. gyratus* and not *L. eugeniae*, and the latter species is accordingly placed in synonymy of *L. gyratus*. Yen (1942) and Barnard (1959) consider *L. gyratus* and *L. tortilis* to be distinct species mainly on the basis of size, while Tomlin (op. cit.) correctly treats both as conspecific.



Figs. 5-7. 5, 6. *Latiaxis gyratus* (Hinds). 5. Simpson Harbour, Rabaul, New Britain, 91 m; 25.9 mm. 6. Holotype of *L. tortilis* H. & A. Adams, BMNH; 38.3 mm. 7. *L. eugeniae* Bernardi. Straits of Taiwan; 46.5 mm.

A small specimen of *L. gyratus* has been recently dredged between Vulcan and Beehives, Simpson Harbour, New Britain, in 91 m (*leg.* B. Parkinson) [Fig. 5]. The specimen measures 25.9 x 12.2 mm, and has 5¾ whorls and 1½ embryonic whorls; the transitional area between protoconch and teleoconch is finely axially ribbed.

Family BUCCINIDAE

Genus **Engina** Gray, 1839

Engina Gray, 1839, Zool. Capt. Beechey's Voy. "Blossom", p. 112. Type species by SD (Gray, 1847) *E. zonata* Gray, 1839 = *Purpura turbinella* Kiener, 1836. Recent, Caribbean.

Engina carduus (Reeve, 1844) (Fig. 8)

1844. *Triton carduus* Reeve, Conch. Iconica 2: pl. 19, fig. 95; 1894 E.A. Smith, Ann. Mag. Nat. Hist. (6), 14: 163.

1859. *Nassaria carduus* Reeve, Sowerby, Thes. Conchyl. 3: 87, pl. 220, fig. 14; 1881 Tryon, Man. Conch. 3: 221, pl. 84, fig. 537 (placed in synonymy of *N. nivea* Gmelin, 1791); 1928 Faustino, Summ. Philippine mar. fresh-water Moll. p. 254.

TYPE LOCALITY. Originally none. (Philippines *fide* Sowerby, 1859).

Type specimen. The holotype of *T. carduus* Reeve is in the British Museum (Nat. Hist.) No. 1967649, dimensions 14.4 x 8.8 mm; the holotype has 6 mature whorls and a protoconch of 2½ small, glassy-brown embryonic whorls, 8 axial ribs and 7 overriding, sharp spiral cords on the penultimate and 12 axial ribs and 14 cords on the body whorl and an additional 9 cords on the siphonal fasciole, the interspaces are finely axially striate, outer lip with 7 denticles, part of the interior of the columella is missing, the parietal region has a glazed, thin and lirate callus and the shell is creamy-white with reddish-brown spots (Fig. 8).

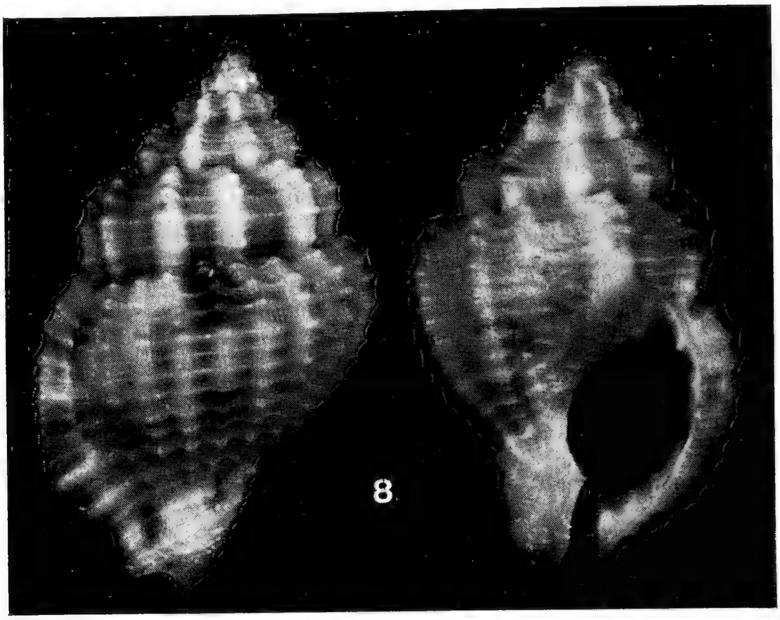


Fig. 8. *Engina carduus* (Reeve). Holotype BMNH No. 1967649; 14.4 mm.

This rather rare species was originally described in the genus *Triton auctt.* and was later re-assigned to the buccinid genus *Nassaria* Link, and even synonymized with *Nassaria nivea* (Gmelin, 1791) [= *N. pusilla* Roeding, 1798] by Tryon (1881). E.A. Smith (1894) considered *Triton carduus* to bear no relationship with *Nassaria nivea* (Gmelin) and suggested a placement in the genus *Colubraria* Schumacher. He further remarked that fine examples of the species have been received from Mauritius by the British Museum (Nat. Hist.).

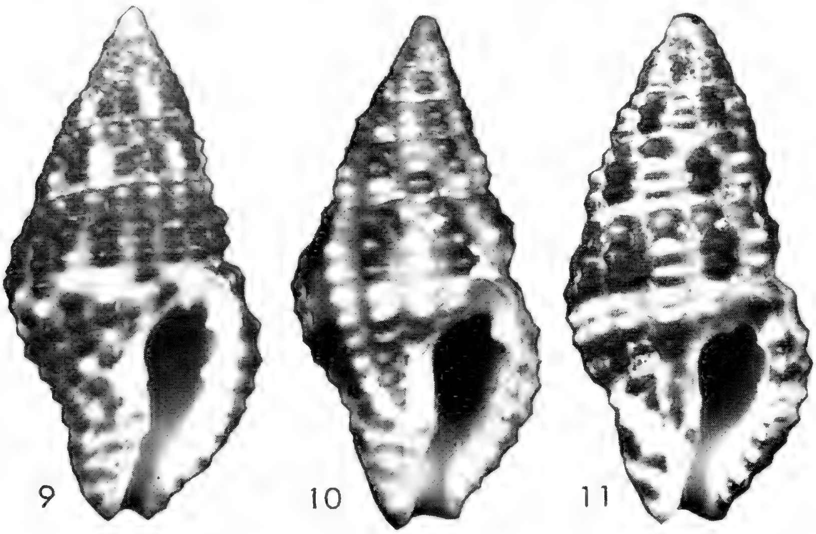
Triton carduus Reeve, would be best assigned to *Engina s.l.*, in the same group of *Engina* containing *E. egregia* (Reeve) and *E. farinosa* (Gould).

Engina menkeana (Dunker, 1860) (Figs. 9-11)

1860. *Cantharus (Pollia) menkeana* Dunker, Malakozool. Blaetter 6: 222.
1861. *Cantharus menkeanus* Dunker, Moll. Japon. p. 7, pl. 1, fig. 7.
1901. *Tritonidea submenkeana* Pilsbry, Proc. Acad. Nat. Sci. Philad. 53: 387, pl. 21, fig. 24.
1940. *Enzinopsis resta* Iredale, Austral. Zool. 9 (4): 434, pl. 32, fig. 11.
1975. *Engina menkeana* (Dunker), Cernohorsky, Rec. Auckland Inst. Mus. 12:184, fig. 21 (extended synonymy).

TYPE LOCALITY. Dejima, Nagasaki City, Kyushu, Japan (*menkeana*); Hirado, Hizen, W. Kiusiu, Japan (*submenkeana*); Lord Howe I (*resta*).

Type specimens. Six syntypes of *Tritonidea submenkeana* Pilsbry, are in the Academy of Natural Sciences, Philadelphia, No. 80538, dimensions of illustrated syntype 12.3 x 6.1 mm (Fig. 9). The holotype of *Enzinopsis resta* Iredale, is in the Australian Museum, Sydney, No. C-59634a, dimensions 11.8 x 5.3 mm (Fig. 10).



Figs. 9-11. *Engina menkeana* (Dunker). 9. Syntype of *Tritonidea submenkeana* Pilsbry, ANSP No. 80538; 12.3 mm. 10. Holotype of *Enzinopsis resta* Iredale, AMS No. C-59634a; 11.8 mm. 11. Specimen from Fukura, Japan; 11.0 mm.

Recent material obtained from the S.W. Pacific contained several species previously thought to have been confined to the Sino-Japanese region. *Engina resta* (Iredale) is another instance of a S.W. Pacific distributin of a Japanese species, and when compared with specimens of *E. menkeana* (Dunker) and types of *E. submenkeana* (Pilsbry), clearly proves to be conspecific. Melvill & Standen (1895) already commented on the occurence of *E. menkeana* in Lifu, Loyalty Is.

Family NASSARIIDAE

(A decision on the validity of the family-group name is pending with the I.C.Z.N., No. Z.N. (S.) 1887).

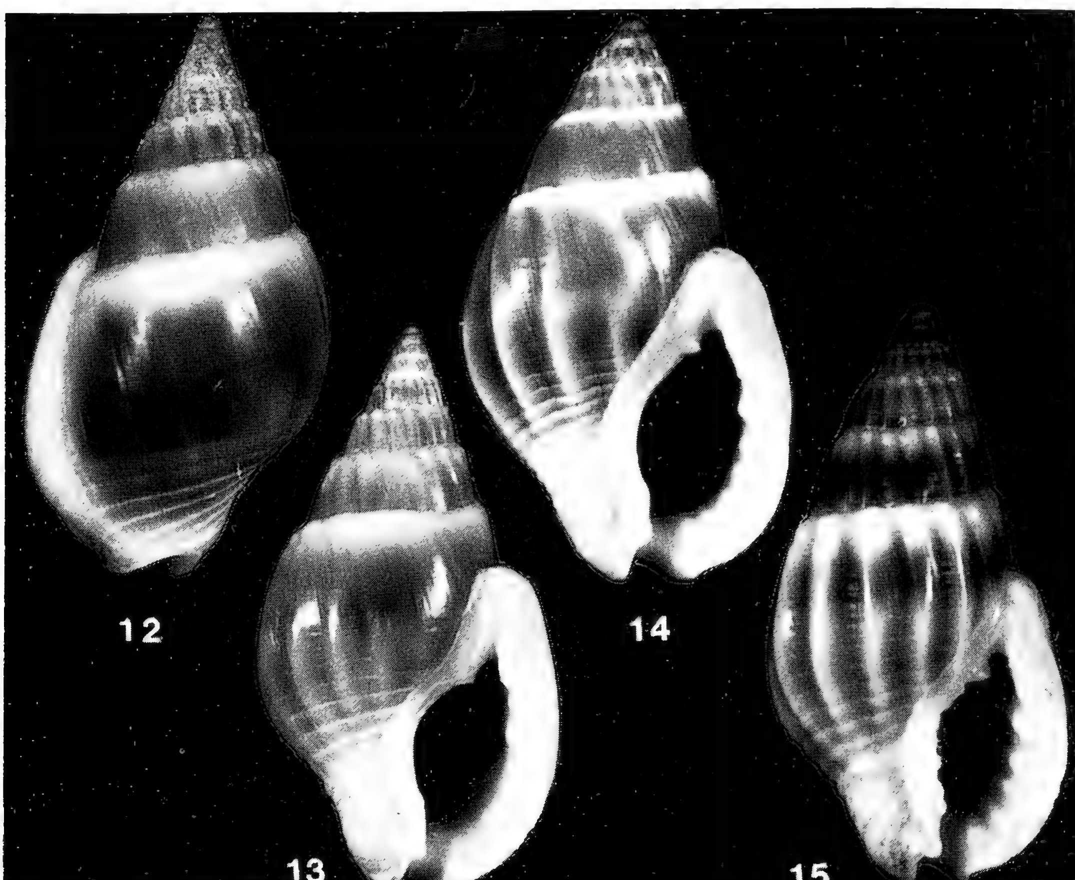
Genus **Nassarius** Duméril, 1806

Nassarius Duméril, 1806, Zool. analyt. p. 166. Type species by SM (Froriep, 1806) *Buccinum arcularia* Linneaus, 1758. Recent, Indo-Pacific.

Nassarius fraudator sp. n. (Figs. 12-17)

Shell up to 18.0 mm in length, elongate-ovate and very solid, teleoconch of 6-7 flat-sided whorls, protoconch incomplete in adults and very worn in juveniles, sutures distinct. Early spire whorls sculptured with strong, angulate axial ribs which are weakly indented at sutures to form a row of not very prominent sutural nodules, last 2 whorls extremely variable in sculpture, penultimate whorl either smooth or with up to 15 axial ribs, ventral side of body whorl with 4-7 strong, sinuous axial ribs, dorsal side without ribs; the sutures of the last 2 whorls have either a shallow spiral groove or a low, ill-defined sutural girdle, varix very strong and with prominent short spiral threads in the depression of the varix. Spiral sculpture usually absent on spire whorls, penultimate whorl usually smooth or rarely with up to 6 finely impressed, short grooves between ribs, body whorl also usually smooth on the upper half or with up to 12 fine grooves between ribs followed by 4-5 cords and another 5-8 cords on the siphonal fasciole. Outer lip varix thick and prominent, interior with 6-8 angulate lirae, columella distinctly calloused and with 4-9 round nodules and a parietal denticle, anal canal well developed. Variable in colour but usually dark brown, tan or grey, sutures and varix white to cream, occasional specimens off-white with only broad brown bands on last 2 whorls, aperture white but brown deep in interior. Operculum corneous, brown, with an apical nucleus (Fig. 17).

Radular ribbon *c.* 21% of shell-length, with 60-70 rows of teeth and 4-5 nascentes. The rachidians with 11 slender cusps, central cuspl larger, laterals bicuspid (Fig. 16).



Figs. 12-15. *Nassarius fraudator* sp. n. 12, 13. Somerset Bay, Cape York Peninsula, Nth. Qld., Australia. Holotype AMS No. C-114468; 17.5 mm. 14. Paratype from Hall Sound near Port Moresby, Papua New Guinea; 16.0 mm. 15. Stronger ribbed paratype from Darwin, Northern Territory, Australia; 12.9 mm.

TYPE LOCALITY Somerset Bay, Cape York Peninsula, Nth. Queensland, Australia, intertidal on sand-flats.

DISTRIBUTION. From Exmouth Gulf, West Australia to Cape York, Nth. Queensland and the southern coast of Papua New Guinea.

Holotype. In the Australian Museum, Sydney, No. C-114468, length 17.5 mm, width 9.3 mm (Figs. 12, 13).

Paratypes. West Australia: S.E. of Exmouth homestead, S. of Learmouth, Exmouth Gulf (AMS No. C-114337, 1 spec.); Broome (AMS No. 114339, 5 spec; AMS No. C-51048, 2 spec.; coll. A.W.B. Powell No. 9010, 10 spec.); Barred Creek, Broome (AIM, 2 spec.); Northern Territory: Darwin (AIM, 1 spec.); Rose River Mission, Arnhem Land, Gulf of Carpentaria (AMS, No. C-114467, 1 spec.); North Queensland: Mud Bay, Cape York (AMS, No. C-114466, 3 spec.; No. C-61515, 4 spec.); Somerset Bay, Cape York, on

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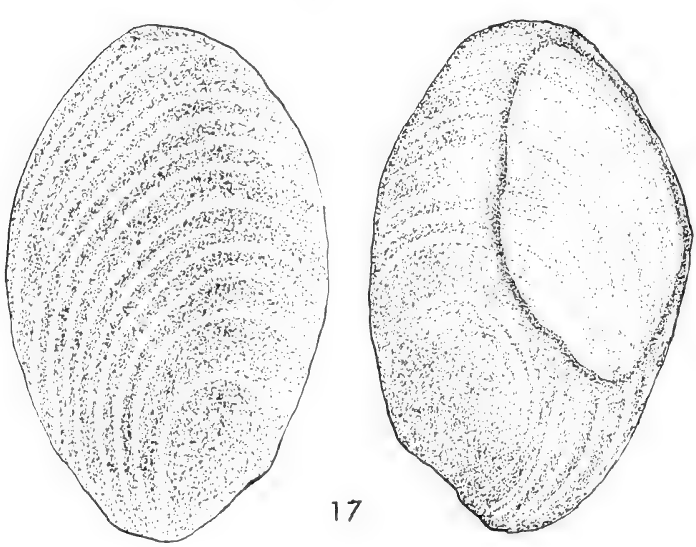

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Figs. 16, 17. *Nassarius fraudator* sp. n. 16. Half-row of radula. 17. Operculum.

sand-flats (AMS, No. C-114468, 1 spec.); near Bamaga, N.W. Cape York Peninsula (AMS, No. C-114340, 1 spec.); Papua New Guinea: Hall Sound, N.W. of Port Moresby (AMS, No. C-54863, 3 spec.).

This new species has been known since last century when John Brazier collected specimens at Mud Bay, Cape York, Nth. Queensland, and labelled them "*Nassa (Alectrion) monile* Kiener var. *jacksoniana* Quoy". The species *Nassarius monile* (Kiener, 1834), which is a primary homonym and has been replaced with *N. distortus* (A. Adams, 1852), is a common tropical Indo-Pacific species which is so appreciably different to *N. fraudator* that no comparison is necessary. However, the new species is indeed similar to *N. jacksonianus* (Quoy & Gaimard, 1833), a species erroneously described from "Port Jackson, Australia", but known to live in a restricted area extending from Java to Malaysia, Thailand and India. *N. jacksonianus* is similar in form to *N. fraudator*, but is smaller, usually between 10.0-12.0 mm in length, the axial ribs are much thicker and terminate in a different fashion at the body whorl, the penultimate whorl never lacks axial ribs and the spiral sculpture is considerably more pronounced; the columella is not as concave as in *N. fraudator* and the columellar callus is broader, thinner, less regular and always thin and translucent above the parietal wall.

Nassarius exilis (Powys, 1836) (Figs. 18, 19)

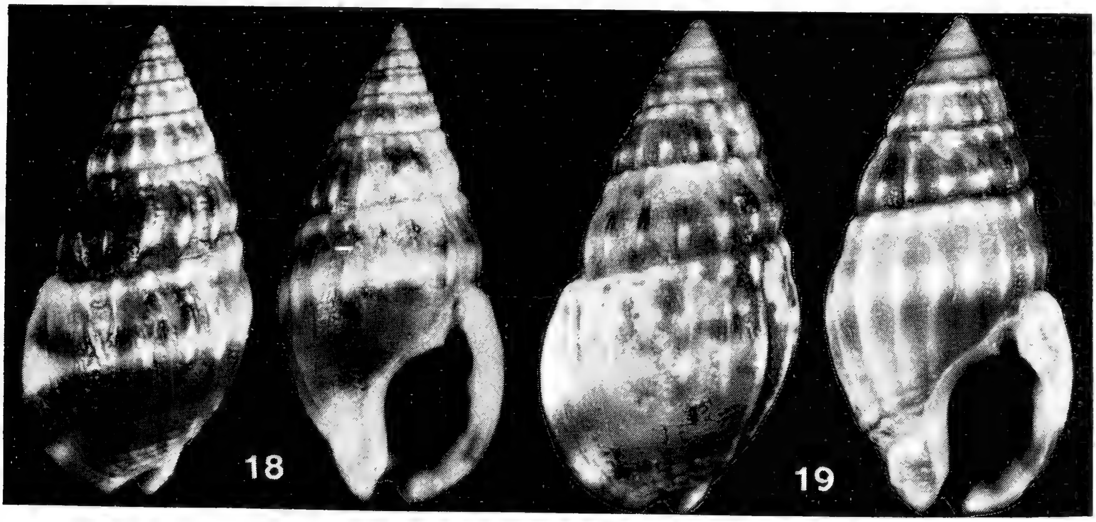
1835. *Nassa exilis* Powys, Proc. Zool. Soc. Lond. Pt. 3: 95.

1841. *Nassa fontanei* d'Orbigny, Voy. L'Amér. Mérid. 5 (3): 433, pl. 77, figs. 5, 6; 1966 Keen, Veliger 9 (1): 4, pl. 1, fig. 3 (figd. lectotype).

1852. *Nassa panamensis* C.B. Adams, Ann. Lyc. Nat. Hist. New York 5: 288 (non *Buccinum panamense* Philippi, 1851 = *Nassarius*).

1975. *Nassarius exilis* (Powys), Cernohorsky, Rec. Auckland Inst. Mus. 12: 138, fig. 38 (extended synonymy).

TYPE LOCALITY. Paita, Peru (*exilis* and *fontanei*); Panama (*panamensis*).



Figs. 18, 19. *Nassarius exilis* (Powys). 18. Syntype BMNH; 15.7 mm. 19. Lectotype of *Nassa fontanei* d'Orbigny, BMNH No. 1854.12.4.456.; 15.7 mm.

Type specimens. Three syntypes of *N. exilis* are in the British Museum (Nat. Hist.), dimensions of illustrated syntype 15.7 x 7.2 x 7.4 mm (width-ratio 46%) [Fig. 18]. The lectotype of *N. fontanei* d'Orbigny is in the same Institution No. 1854.12.4.456., dimensions 15.7 x 7.9 x 7.5 mm (width-ratio 50%) [Fig. 19]. The lectotype of *N. panamensis* C.B. Adams, is in the Museum of Comparative Zoology, Harvard, No. 186283 (width-ratio 49% from lectotype figure).

Keen (1966) selected a lectotype from the 2 extant syntypes of *Nassa fontanei* and separated the taxon from *Nassarius exilis* (Powys) with which it was synonymized by all other authors. The basis for specific separation was the proportionately greater width and the presence of sutural axial beads in *N. fontanei*. As can be seen from the appended measurements for the types of *N. exilis* and *N. fontanei*, the width-ratio is 46% and 50% respectively, and in view of the 10%-15% range in width-ratio in *Nassarius*, the 4% difference is hardly significant. Axial sutural nodules are present in many specimens of *N. exilis* and are also present in one of the syntypes; the dark central band in *N. fontanei* overlaps onto the body whorl varix in the same manner as in *N. exilis*. No constant diagnostic characters could be found which would assist in the separation of the two forms and *N. fontanei* is placed in synonymy of *N. exilis*.

Family MITRIDAE

Genus **Mitra** Lamarck, 1798

Mitra Lamarck, 1798, Tabl. Encycl. Méth. pl. 369. Type species by T *Voluta mitra* Linnaeus, 1758. Recent, Indo-Pacific.

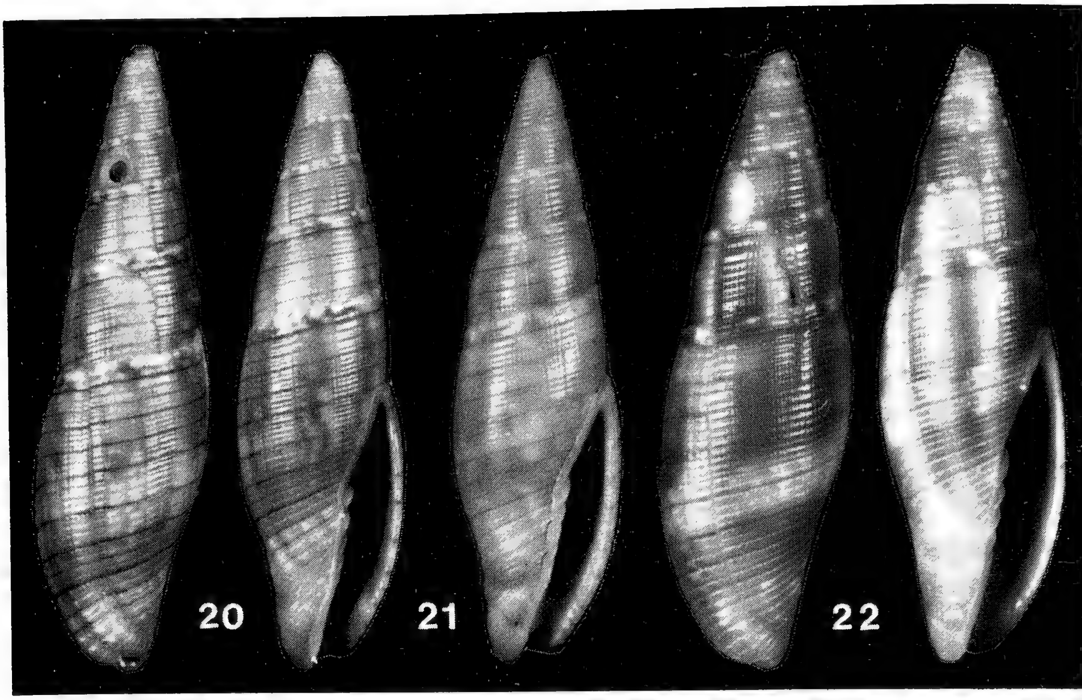
Mitra deynzeri sp. n. (Figs. 20-22)

Shell small, up to 27.0 mm in length but frequently smaller, fusiformly-elongate, width 22%-29% of length, solid, teleoconch of 6-8 weakly convex whorls, protoconch preserved to only 2½ smooth, white embryonic whorls in one paratype but probably conical-multispiral. Early mature whorls granulose, with 3 elevated spiral cords which are rendered granulose by descending axial lirae, sutures with a deeper spiral groove giving the impression of a single or bi-cordate sutural girdle; sculpture on later whorls consists of numerous, close-set, finely punctate or axially striate grooves which number from 7-17 on the penultimate and from 14-29 on the body whorl, siphonal fasciole with an additional 14-16 close-set, oblique cords. Aperture very narrow, about equal in height to the spire, smooth within, outer lip convex, moderately thickened in adult specimens, columella narrowly calloused and with 5-6 oblique, regular folds, siphonal notch distinct, siphonal canal straight. Base colour reddish-brown, body whorl with a broad, white, undefined marbled central band, sutural girdle with white, irregular spots, nebulous white axial streaks present on whorls, base of shell with a few white spots; overlying this pattern are wide-spaced, dark brown spiral lines which number from 4-7 on the penultimate and from 10-15 on the body whorl, aperture tan to orange-brown.

TYPE LOCALITY. Seragaki area of west coast of Okinawa I, Ryukyu Is, Japan, in 37-43 m, rubble-bottom.

DISTRIBUTION. From the Philippines to the Ryukyu Is and Papua New Guinea.

Holotype. In AIM No. TM-1363, length 26.7+ mm, width 7.1 mm, height of aperture 12.6 mm — holed on upper spire whorls (Fig. 20).



Figs. 20-22. *Mitra deynzeri* sp. n. 20, 21. Seragaki, Okinawa, Ryukyu Is.. 20. Holotype AIM No. TM-1363; 26.7 + mm. 21. Paratype, 24.8 mm. 22. Immature paratype from Panlao, Bohol, Philippines; 13.5 mm.

Paratypes. No. 1 from type locality in coll. A. Deynzer (24.8 x 5.5 x 11.6 mm) [Fig. 21]; No. 2 from Panlao, Bohol, Philippines in AIM (immature — 13.5 x 4.1 x 6.9 mm) [Fig. 22]; paratypes No's 3 and 4 from Panlao, Bohol, Philippines in coll. V. Dan (juvenile spec.); paratypes No. 5 from Laing I, Hansa Bay, Papua New Guinea in AIM.

Mitra deynzeri is closest to *M. ancillides* Broderip, 1836, a species which is endemic to the Tuamotu Archipelago, but the latter species has adpressed sutures and lacks the features of sutural girdle, the spiral sculpture is much finer and spiral striae number from 50-60 on the body whorl and the longitudinal sculpture of fine axial striae is also absent. *M. ancillides* is either uniformly fawn or has fawn axial zones and bands but lacks the wide-spaced dark brown lines.

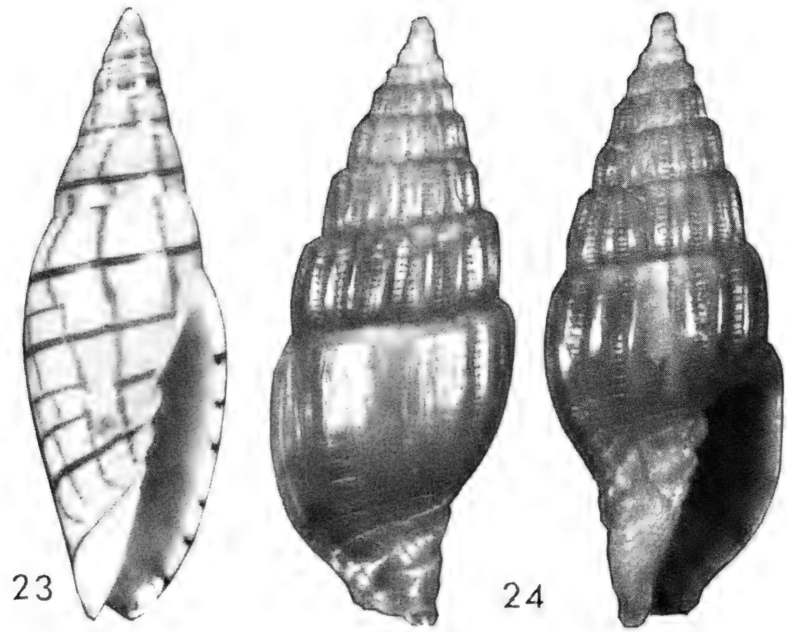
The species is named for Major A. Deynzer, Sanibel I, Florida, who discovered the new species and who for many years has made molluscan material available for scientific research.

Genus **Ziba** H. & A. Adams, 1853

Ziba H. & A. Adams, 1853, Gen. Rec. Moll. 1: 179. Type species by SD (Wenz, 1943) *Mitra carinata* Swainson, 1824. Recent, West Africa.

Ziba cloveri (Cernohorsky, 1971) (Fig. 23)

1971. *Cancilla (Ziba) cloveri* Cernohorsky, Rec. Auckland Inst. Mus. 8: 133, textfigs. 4-8; 1972 Okutani, Bull. Tokai Rg. Fish. Res. Lab. No. 72: 96, textfig. 41.



Figs. 23, 24. 23. *Ziba cloveri* (Cernohorsky). Russel I, Solomon Is, 24-31 m; 18.0 mm. 24. *Vexillum (Pusia) salisburyi* Cernohorsky. Panlao, Bohol, Philippines; 10.6 mm.

TYPE LOCALITY. *c*. 75 miles (121 km) S.W. of Kaushiung, Taiwan Strait, Taiwan, 70 fathoms (128 m).

DISTRIBUTION. From Japan to Taiwan and the Solomon Is, 24-180 m.

The species has been originally described from Taiwan and has later been reported from Takase, near Izu-Shichito Is, Japan, in 140-180 m by Okutani (1972). Recently several specimens have been collected from a fish-trap from the Russel Is, Solomon Is, at a depth of 24-31 m (*ex* — N. Potter) [Fig. 23], and off Tulagi I, Solomon Is (*ex*-B. Parkinson).

Family COSTELLARIIDAE

Genus **Vexillum** Roeding, 1798

Subgenus **Pusia** Swainson, 1840

Pusia Swainson, 1840, Treat. Malac. p. 320. Type species by M *P. microzonis* (Lamarck) = *Mitra microzonias*, Lamarck, 1811. Recent, Indo-Pacific.

Vexillum (Pusia) salisburyi Cernohorsky, 1976 (Fig. 24)

1976. *Vexillum (Pusia) salisburyi* Cernohorsky, Rec. Auckland Inst. Mus. 13:114, figs. 6-11.

TYPE LOCALITY. Pupukea Beach, Oahu, Hawaiian Is.

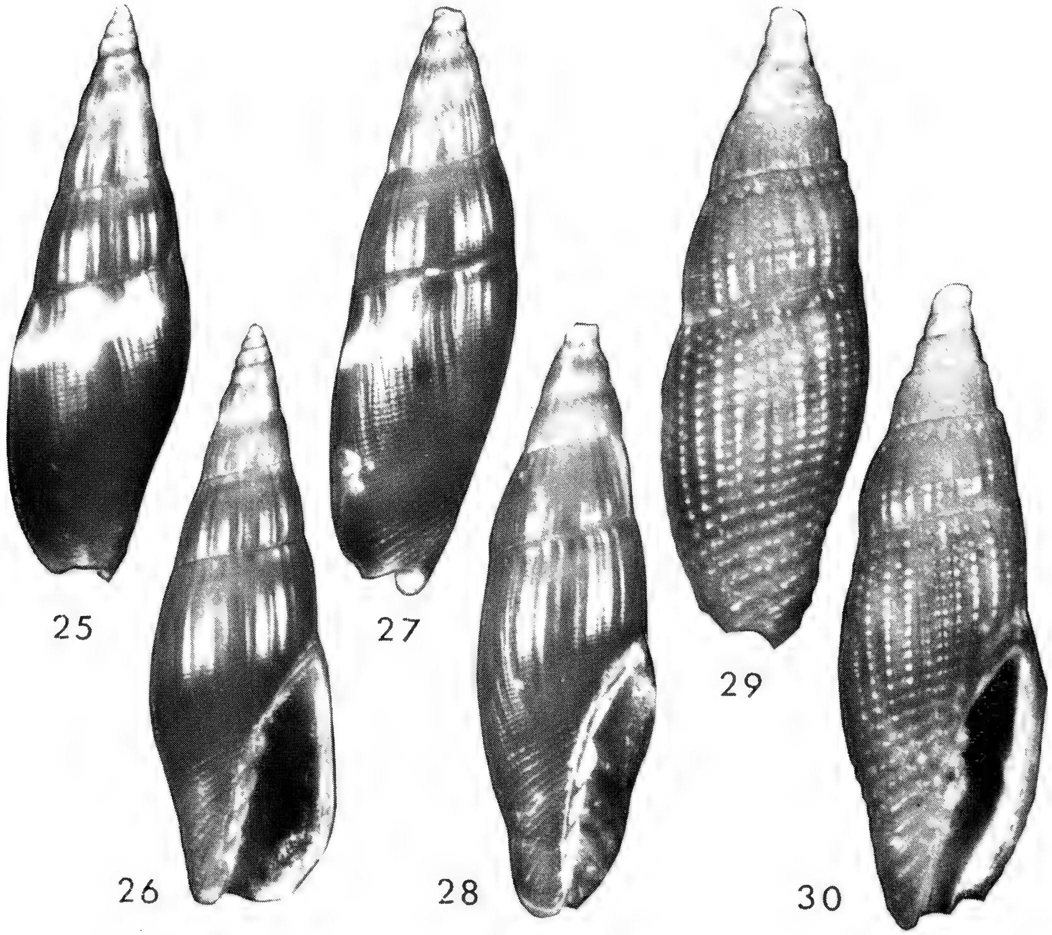
At the time the description the species was known only from the Hawaiian Is and all specimens examined did not exceed 6.0 mm in length. A larger, 10.6 mm specimen has been recently collected at Panlao, Bohol, Philippines (*ex* — A. Deynzer) [Fig. 24], extending the species' distribution considerably westward.

Genus **Thala** H. & A. Adams, 1853

Thala H. & A. Adams, 1853, Gen. Rec. Moll. 1: 178. Type species by SD (Cossmann, 1899) *Mitra mirifica* Reeve, 1845. Recent, Indo-Pacific.

Thala maxmarrowi sp. n. (Figs. 25-28)

Shell very small, up to 10.0 mm in length, fusiformly-elongate, sutures impressed, width 29%-38% of length, solid, teleoconch of 4-4½ weakly to moderately convex whorls, protoconch of 3¼-4 conical, smooth embryonic whorls. Sculptured with numerous, low and slightly irregular thin axial riblets which number up to 40 on the body whorl, and almost equally as numerous, very fine macroscopic spiral striae and 12-14 close-set oblique cords on the siphonal fasciole. Aperture shorter than the spire, lirate within in



Figs. 25-30. 25-28. *Thala maxmarrowi* sp. n. Seragaki, Okinawa, Ryukyu Is. 25, 26. Holotype AIM No. TM-1364; 6.9 mm. 27, 28. Paratype with broken outer lip; 9.7 mm. 29, 30. *Thala illecebra* (Melvill), Straits of Korea. Holotype NMWC; 6.2 mm.

mature specimens, outer lip tending to be patulous anteriorly, columella narrowly calloused and with 4 strong, oblique folds, siphonal canal straight. Shining brown in colour, sutures with a darker, nebulous greyish-brown brand, dorsal side of body whorl anteriorly to the suture with a short, broad white band, band occasionally erupting into 2-3 blotches, aperture brown; an occasional white axial streak may also be present.

TYPE LOCALITY. Seragaki, Okinawa I, Ryukyu Is, Japan, 35 m, bottom of cliff-face (27-XII-1977).

DISTRIBUTION. From the Ryuku Is to off Lord Howe I, S.W. Pacific.

Holotype. In AIM No. TM-1364, length 6.9 mm, width 2.2 mm, height of aperture 3.0 mm (Figs. 25, 26).

Paratypes. No. 1 from the type locality in coll. M. Marrow (9.7 x 2.8 x 3.8 mm) [Figs. 27, 28]; paratype No. 2 from the type locality in AIM (7.7 x 2.8 x 3.5 mm); paratype No. 3 from off Lord Howe I, 31°38.2'S & 159°03.6'E, 44 m, in the Australian Museum, Sydney, No. C-114473 (4.8 x 1.8 x 2.1 mm).

This new species was at first compared with *Thala illecebra* (Melvill, 1927) from the Straits of Korea, holotype in National Museum of Wales, Cardiff, dimensions 6.2 x 1.9 x 2.5 mm (Figs. 29, 30). The latter species has a considerably stronger sculpture of axial riblets studded with granules and the protoconch has only 2 white, pusiine embryonic whorls. The white band on the dorsal side anteriorly to the suture is a distinctive feature and present in all specimens examined.

The species is named for Mr Max P. Marrow, Frankston, Victoria, Australia, a keen student of the Costellariidae, who also collected the specimens at Okinawa.

Family TEREBRIDAE

Genus **Terebra** Bruguière, 1789

Terebra Bruguiere, 1789, Encycl. Méth. Hist. Nat. Vers. 1: xv. Type species by SM (Lamarck, 1799) *Buccinum subulatum* Linnaeus, 1767. Recent, Indo-Pacific.

Terebra eburnea Hinds, 1844 (Figs. 31-33)

1844. *Terebra eburnea* Hinds, Proc. Zool. Soc. Lond. pt. 11: 153; 1845 Hinds in Sowerby, Thes. Conchyl. 1: 166, pl. 45, fig. 123; 1964 Cate & Burch, Veliger 6 (3): 146.

1885. *Terebra affinis* Gray (*pars*), Tryon, Man. Conch. 7: 14, pl. 2, fig. 18 only (non *T. affinis* Gray, 1834).

TYPE LOCALITY. Seychelles Is, Indian Ocean.

This little known species has been erroneously synonymized with *T. affinis* Gray, 1834 by Tryon (1885). The first modern record of *T. eburnea* is the one by Cate & Burch (1964) from Bileau I, Papua New Guinea, but the species has not been illustrated since its description.

The holotype of *T. eburnea* is no longer extant but the original description and illustration enable an easy recognition. I therefore designate figure 123 on plate 45 from Hinds in Sowerby (1845) as the illustrated lectotype of *T. eburnea* Hinds, 1844 (Fig. 31).

Recently 3 specimens of *T. eburnea* have been collected at Sogi, Apia, Western Samoa, 12 m (*leg.* I. Scott). Specimens have 14-15 whorls and a protoconch of 3½-4 smooth embryonic whorls, spire whorls have *c.* 30 axial ribs per whorl but the last 2-3 whorls are smooth apart from 2-8 fine spiral grooves and some axial growth-lines; early whorls show a sutural constriction through a punctate spiral groove between ribs. Shells are white and the protoconch and 4-5 post embryonic whorls are orange (Figs. 32, 33).

Family TURRIDAE

Genus **Turris** Roeding, 1798

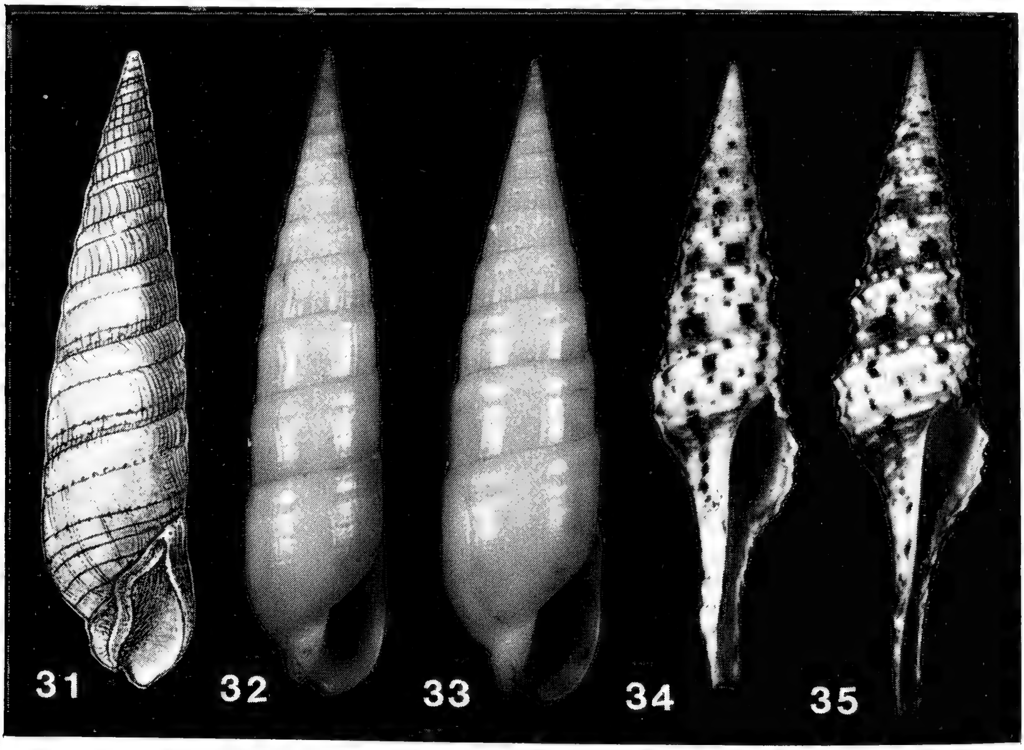
Turris Roeding, 1798, Mus. Bolten. p. 123. Type species by SD (Dall, 1909) *Murex babylonius* Linnaeus, 1758. Recent, Indo-Pacific.

Turris garnonsii (Reeve, 1843) (Figs. 34, 35)

1843. *Pleurotoma garnonsii* Reeve, Conch. Iconica 1: pl. 1, sp. 4.

1964. *Turris garnonsii* (Reeve), Powell, Indo-Pacific Moll. 1 (5): 329, pl. 18, figs. 7, 8, 18; pl. 254, fig. 1; pl. 256 (detailed synonymy).

TYPE LOCALITY. Cebu I, Philippines.



Figs. 31-35. 31-33. *Terebra eburnea* Hinds. 31. Illustrated lectotype (from Hinds in Sowerby, 1845, pl. 45, fig. 123). 32, 33. Specimen from Sogi, Apia, W. Samoa, 12 m; 37.7 mm and 33.5 mm respectively. 34, 35. *Turris garnonsii* (Reeve). 34. Nordup, Rabaul, New Britain, 24 m; 49.2 mm. 35. Solosolo, Upolu, W. Samoa, 11 m; 50.6 mm.

Powell (1964) monographed this species and according to available records at the time fixed the distributional range from East Africa to the Philippines. A specimen collected at Nordup, Rabaul, New Britain, 24 m, length 49.2 mm (*leg.* B. Parkinson) [Fig. 34], and another specimen from past Solosolo, Upolu, Western Samoa, 11 m, length 50.6 mm (*leg.* I. Scott) [Fig. 35], extend the species range into the central Pacific.

Acknowledgements. I am grateful to Dr W.F. Ponder and staff, Australian Museum, Sydney, for access to the collections and assistance during my recent visit to the Museum. I would like to thank Dr R. Robertson, Academy of Natural Sciences, Philadelphia, Ms K. Way, British Museum (Natural History), London, and Dr G. Oliver, National Museum of Wales, Cardiff, for the loan of molluscan type specimens, and Mrs T. Bratcher, Hollywood, California, for helpful discussions and information concerning *Terebra eburnea* Hinds. I also would like to thank Mr P. Bellin, Okinawa, Mr V. Dan, Manila, Philippines, Major A. Deynzer, Sanibel I, Florida, Mr M. Marrow, Frankston, Victoria, Australia, Mr B. Parkinson, Rabaul, New Britain, Mr N. Potter, Auckland, and Mr I. Scott, Kodaikanal, India, for the loan of molluscan specimens.

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Aega angustata Whitelegge, 1901 (ISOPODA : AEGIDAE), A NEW RECORD FOR NEW ZEALAND WATERS

A.B. STEPHENSON

AUCKLAND INSTITUTE AND MUSEUM

Abstract. The isopod *Aega angustata* Whitelegge is recorded for the first time in New Zealand waters from two male specimens collected as exoparasites of the grey-spiny dogfish *Squalus blainvillei*. Additional details on the morphology of their mouthparts is provided from dissected appendages.

As part of a programme to obtain information on the parasite/host relationship of isopod crustaceans, an examination of mixed fish catches was made during an outer Hauraki Gulf trawl series aboard the *RV. Ikatere*. Two specimens, later identified as *Aega angustata* Whitelegge were located simultaneously on a single specimen of the grey-spiny dogfish *Squalus blainvillei*. These isopods occupied almost adjacent sites of attachment on the lateral skin surface immediately behind the pectoral fin. Host tissue damage was not apparent after their removal.

Family AEGIDAE

Aega angustata Whitelegge, 1901

1901. *Aega angustata* Whitelegge, Mem. Aust. Mus. 4(3): 201-246. 1925 Hale, Trans. R. Soc. S. Aust. 49: 128-185.

Material examined includes two male specimens (Fig. 1) of total lengths 16.0 mm and 19.0 mm, both having well developed appendix masculina on second pleopods. Flagella of first antenna have five segments, those of second antenna have respectively eight segments (smaller specimen), and nine segments (larger specimen); possibly a reflection of body size (cf. Hale 1925, records a specimen of 24 mm total length having eleven segments in the flagella). Maxilliped (Fig. 2) has a helical alignment and is terminated by five stout hooks. Maxilla 2 (Fig. 3) narrows distally, with a terminal cluster of weaker hooks, and its inner basal surface is somewhat roughened by minute hair-like projections. Maxilla 1 (Fig. 4) is slender throughout its length, with hooks arranged almost in series towards the distal tip. Mandible (Fig. 5) is spirally orientated along its axis, with glove-like terminal segments. Mandibular palp has three segments, segment 3 bordered with hairs.

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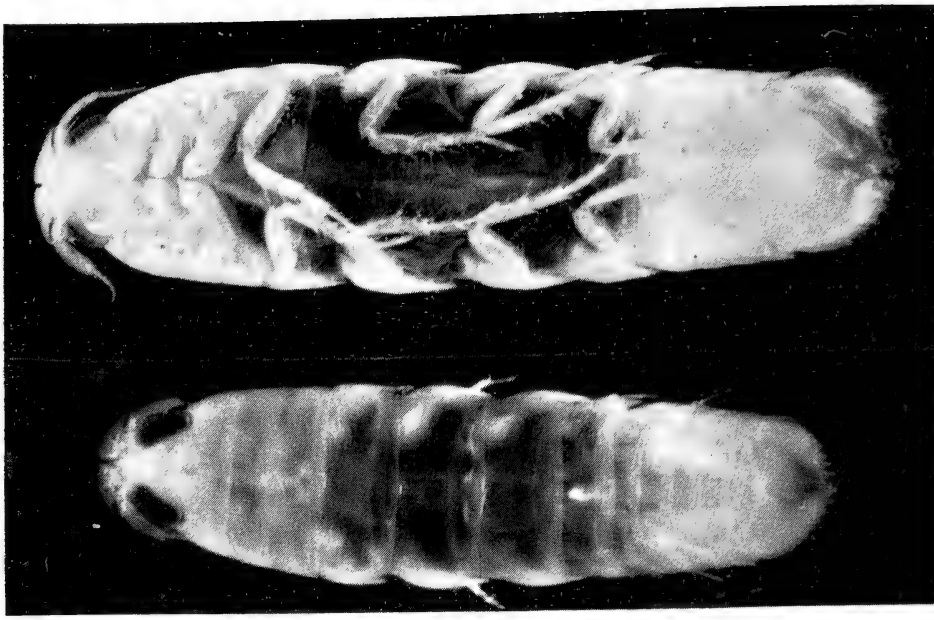
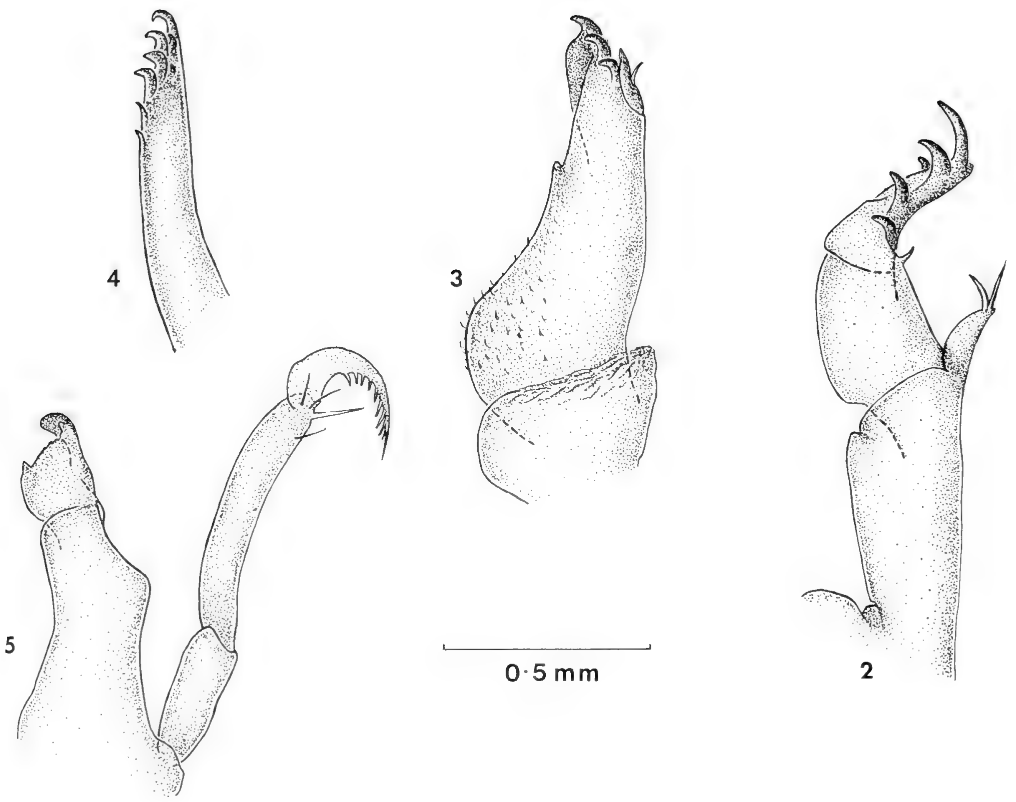


Fig. 1. *Aega angustata*. Two male specimens from the Hauraki Gulf. Upper, ventral view, length 19.0 mm. Lower, dorsal view, length 16.0 mm.

Body profile and shapes of all the appendages largely agree with the description given by Whitelegge (1901). A furrowed or ridged effect over coxal plates is barely discernible, but shape and extent of plates are as otherwise outlined by Hale (1925). Third peraepods, characteristically, have an inferior distal projection of the propodus, which parallels the dactylus, giving a claw-like appearance. Telson and uropods are strongly serrate, spinose and ciliate. Exopod and endopod bear seven marginal spines in each specimen. Spines on the telson are variable in number, thirteen (6.1.6) in the smaller specimen and fifteen (7.1.7) in the larger. In both specimens the central (apical) spine is largest and trifid in shape. When collected the overall body coloration of each specimen was conspicuous, the larger a bright orange-brown, the smaller a paler brown-buff.

Although *Aega angustata* has been previously known only in temperate Australian seas there is nothing unusual about its occurrence in New Zealand waters, and it can be included with a number of isopod species already known to share a common Australasian distribution. However, the lack of records in the literature concerning this species is somewhat surprising. It is distinctively coloured, has easily identifiable taxonomic characters, and there are an abundance of small bottom-feeding elasmobranchs available as potential hosts. To conclude that it is a sparcely distributed species would, nevertheless, seem inappropriate since its existence and efficiency as an ectoparasite would be prejudiced by low fecundity and dispersal.

Acknowledgements. I am grateful to Mr L.J. Paul, Fisheries Research Division, Ministry of Agriculture and Fisheries, for an opportunity to use facilities aboard the *RV. Ikatere*.



Figs. 2-5. *Aega angustata*. Mouthparts. 2. Maxilliped. 3. Maxilla 2. 4. Maxilla 1. 5. Mandible.

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MONARCH BUTTERFLY DISPERSAL IN NEW ZEALAND

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Abstract. Following tagging of Monarch butterflies (*Danaus plexippus* (L.)) in North America and Australia, a tagging project was carried out in New Zealand as part of a study on insect dispersal. The project is described. A corrected overall recovery of 12.4% was achieved from over 6500 releases, during the seasons 1967/68 — 1973/74. Only 28 flights over 20 km were recorded and these are treated in detail. Most of these are accepted as genuine flights but gave no indication of regular long distance movements or migration. Three overwintering colonies are described; seasonal presence ('winter') and absence ('summer') is known but no inward or outward movements were recorded. Adult longevity is compared with time of year. Dispersal information is included. Monarch butterflies are recorded from the length of New Zealand in summer-autumn and are confirmed as spending winter periods locally in the North Island, separate from moving groups which appear in overwintering colonies.

An insect dispersal project, planned in 1967, was begun with the tagging of Monarch butterflies, *Danaus plexippus* (L., 1758) in February, 1968, near Auckland in the North Island, New Zealand (Fig. 1).

The well-known work of Professor F.A. Urquhart on the Monarch butterfly in North America, which included tagging butterflies, was available (Urquhart 1960), and C.N. Smithers, of The Australian Museum, provided information on his butterfly tagging programme then being carried out in Australia. Amongst other butterflies, Smithers was observing, recording and tagging *Danaus plexippus* (known as The Wanderer in Australia) near Sydney (Fig. 1) and elsewhere (Smithers 1965, 1972).

The Monarch butterfly is the largest and often the most obvious butterfly (except for the garden prevalent pest the White butterfly, *Pieris rapae* (L.)) in built-up areas in the north of New Zealand. It is, however, an introduced species, and perhaps an occasional immigrant from Australia as are the Blue Moon butterfly (*Hypolimnas bolina nerina* (Fab.)) and others.

Danaus plexippus is endemic to North America where the larval foodplants are milkweeds of the family Asclepiadaceae. The species has spread or been spread through the Pacific and it has survived where suitable foodplants grow. It is an introduced species or at the least an assisted immigrant in Australia and New Zealand where it has arrived in the last 150 years. In Australia, where introduced milkweed plants grow wild, it is established but in New Zealand it is still largely dependent on milkweeds (particularly *Asclepias fruticosa* L., the Swan plant) grown in home gardens. Foodplants in Australia have been recorded by Smithers (1973a) and in New Zealand have been discussed by Wise (1963) and Ramsay (1964a).

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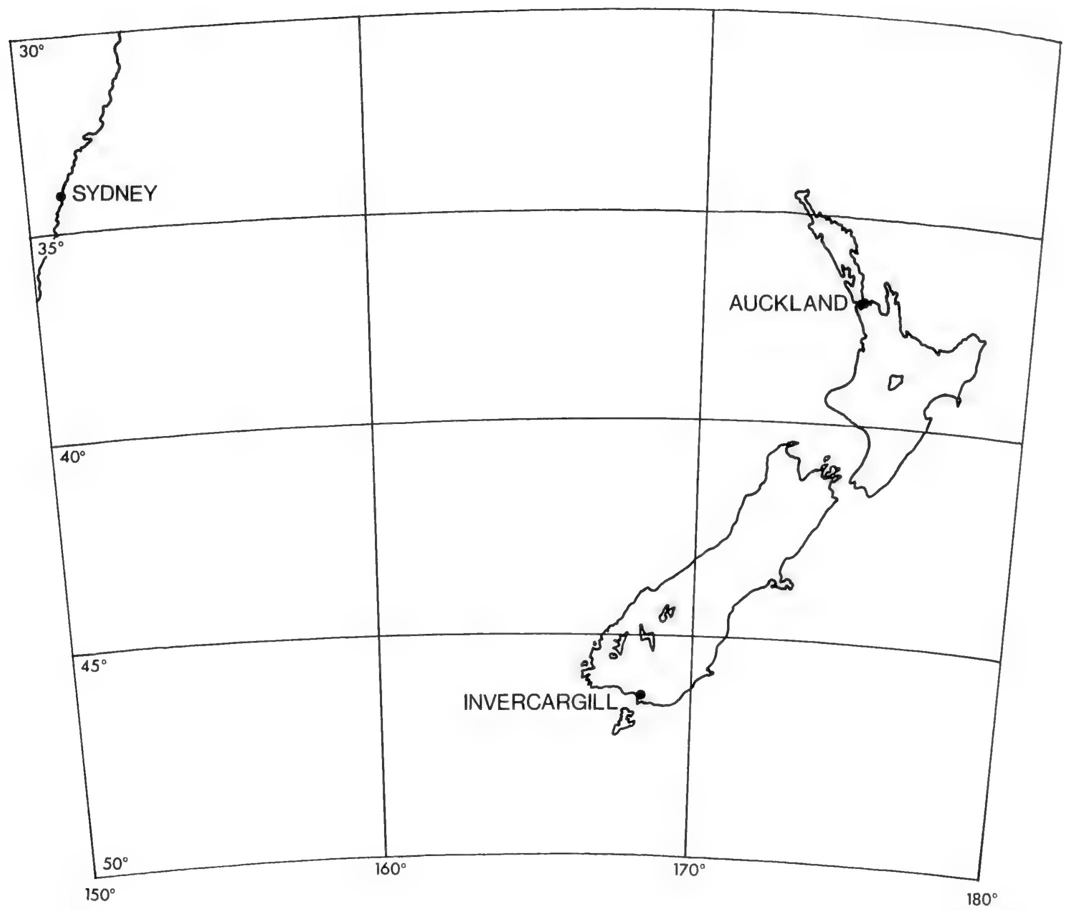

Fig. 1. South-eastern Australia and New Zealand showing the relative southern positions of Sydney, Auckland and Invercargill.

In North America, *Danaus plexippus* overwinters in southern United States areas and Mexico (Urquhart 1960). From there breeding populations migrate and spread northwards, as far as Canada, in the spring and summer, then individuals (of a subsequent brood) migrate southwards to the same overwintering grounds in the autumn. In Australia overwintering clusters and movements were known (Smithers 1965) but not their extent.

In New Zealand little was known of Monarch movements at the time the present project was planned, in 1967. The general impression was that Monarch butterflies spread to various parts of the country during the summer, sometimes as far south as Invercargill (Fig. 1), that they were more common in some summers than others and that sometimes individuals could be seen flying on sunny days during winter. Three overwintering centres were recorded (Ramsay 1964b), a colony in the far north at Tauranga Bay near Whangaroa Harbour on the east coast, one in a park in Hastings and scattered groups in Nelson in the north of the South Island (Fig. 2).

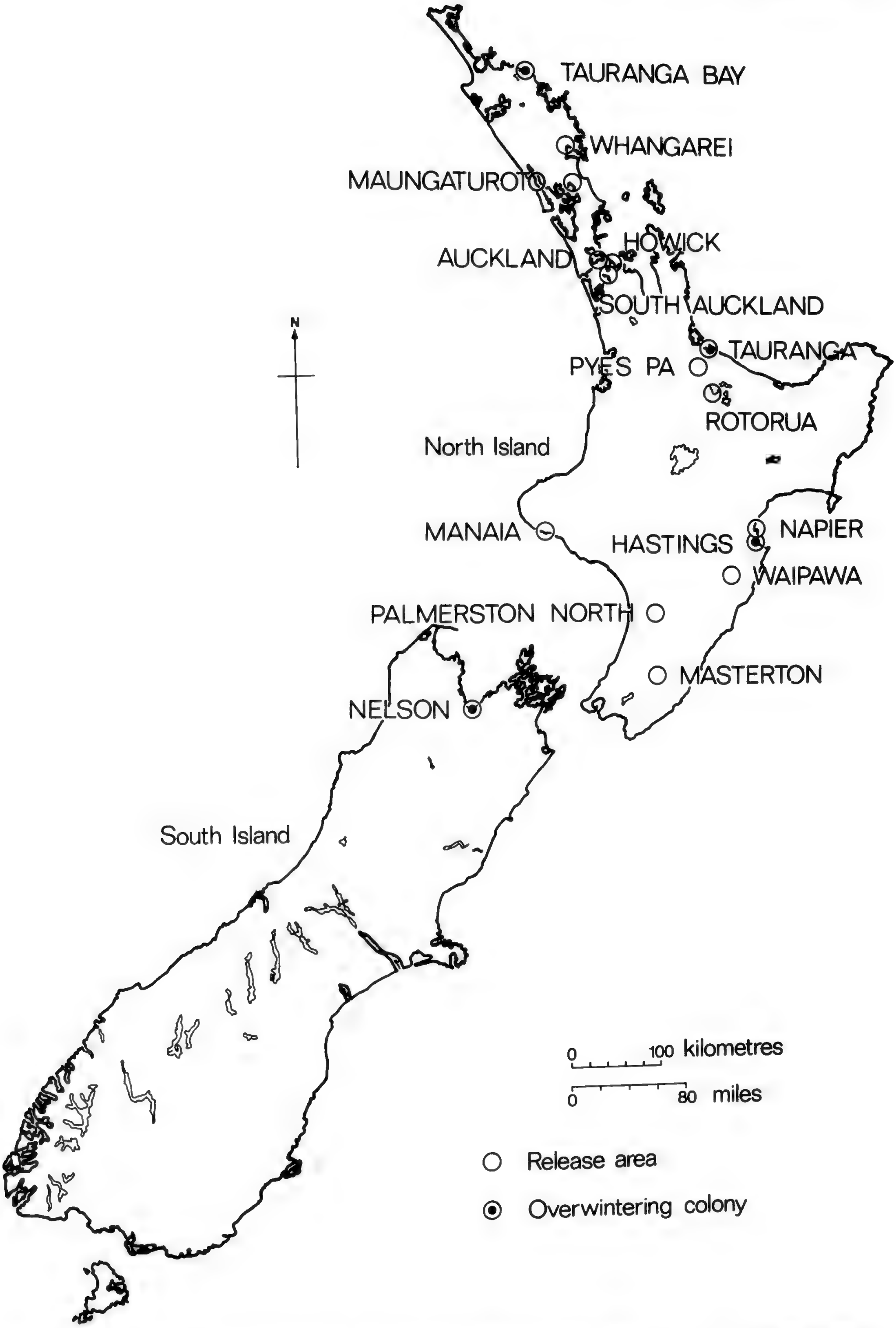

Fig. 2. Map of New Zealand showing main release centres of tagged Monarch butterflies and areas of overwintering colonies.

THE TAGGING PROJECT

The tagging project began with the assistance of an enthusiast, Mrs K.S. Atkinson, of Howick near Auckland, who was breeding Monarch butterflies, and tagging was started in February, 1968. Subsequently many others acted as co-operators in various other parts of New Zealand and the programme was continued until 1974. Most of the tagging was carried out on reared butterflies but others were tagged when caught. In addition, some butterflies were tagged in the overwintering colonies in Nelson and Hastings while many were tagged in the northern colony at Tauranga Bay. The main centres where tagging was done and the three overwintering colony areas are indicated in Fig. 2.

In both Australia and New Zealand, the summer period spans the end of one year and the beginning of the next. However, in New Zealand, while a three-month summer period may be considered to be over December-January-February, the highest temperatures may be in January-February-March or even February-March-April in some years. It seems that adult Monarchs of a new post-winter brood do not appear until November-December and tagging in various places in different years has not begun until November, December or following months in the next year. The adult and consequent tagging season is considered here to begin in November each year so that the seasons of the project are designated 1967/68, 1968/69, through to 1973/74. It must be emphasised that tagging was begun in February, 1968, and that most of the tagging of 'summer' populations was done in the January-May periods (particularly February-April). Overwintering populations were mainly tagged in March-April, also May-June, at Tauranga Bay, in April at Hastings and in June-August at Nelson.

Materials and methods

Tags used for this project are *ca.* 14 x 8 mm, white paper printed on one side "RETURN TO AUCKLAND MUSEUM" with a self-adhesive coating on the other, supplied on rolled strips of backing paper in dispenser boxes. Prior to tagging, the labels were numbered consecutively across one end by hand and the strips cut in lots of 50 tags. Each 50-tag strip was associated with a 50-line record sheet with the same numbers written in the left-hand column. The record sheet contained the name of the marker and columns for label numbers, release sites, dates of release, sex, species and notes. A master record was kept of numbers on 50-tag lots, name of marker for each lot, and dates on which record sheets and tags were sent and returned.

It was thought very important to keep all concerned well-informed and co-operators were first of all supplied with a set of instructions on catching, tagging and recording. A butterfly condition code was introduced for use by co-operators and for recording results, as follows:-
T — Transient (that is, caught in passing), R — Reared, F — Fresh, O — Old, B — Battered, and in addition for use at recovery A — Alive, D — Dead. Thus at release a condition might be T/O or R/F and at recovery F/D or O/B/A, or any other condition.

Recovery of information was often from members of the public, being by return of butterfly plus tag or of tag alone, or by written or verbal (usually per telephone) advice. While it may be thought that such verbal advice may be less reliable than written advice, this was not necessarily the case as it was often possible to have the number checked and the recovery data confirmed at the time. Two standard letters were always used after receiving recovery information. One acknowledged the information received, explained the project and supplied release data as a matter of interest; the other advised the co-operator and supplied both release and recovery data so the co-operator could easily see the results from releases. If the record sheet had not been returned at the time of recovery another standard letter was sent first to obtain the release data from the co-operator. A few newsletters (5 in all) were also sent to co-operators (between May, 1968, and December, 1971) giving relevant interesting information and a list of co-operators at the time.

Occasionally, daily newspapers in various centres ran stories which gave publicity to the project and sometimes helped to retrieve information and to make new contacts.

Release and recovery

During the period of seasons 1967/68 to 1973/74, a total of 25 co-operators plus the author and assistants tagged Monarch butterflies at approximately 35 different sites, mostly in the North Island. The recoveries from these releases were very satisfactory although there was a considerable range of percentage recovery (from nil to 100% when a very few were released and found). In order to indicate the numbers tagged and released and to demonstrate a general range of numbers and percentages of recoveries, records of tagged butterflies given in Table 1 are limited to those when 100 or more butterflies were tagged and released in a season, together with the overall figures for all seasons. These are based on original releases and do not include re-releases and re-recoveries. It is seen that, of over 6500 releases made, more than 1000 were recovered. This is an excellent result but it raises the question of whether too many recoveries too close or too soon may prevent longer flights. This was covered to some extent by allowing the recording of data and re-release when possible.

It should be pointed out that the total recoveries include those of individuals tagged at overwintering sites, where only local flights would be expected because of the cage effect of an overwintering colony in the 'winter'. For this reason a corrected total, excluding such recoveries in overwintering colonies, is given in Table 1 in order to present a more accurate overall recovery percentage.

Flight distances

Concerning the dispersal programme the most important factor arising from the tagging project was that of the distances travelled by tagged butterflies. These can only be recorded as straight-line distance from release point to recovery point and as such represent minimal distances of flight. They do not allow for wandering, doubling back or flights out and back. In order to indicate a general range of distances recorded during this project, Table 2 provides records from the recoveries of Monarch butterflies tagged over several seasons by three co-operators in the three main centres of tagging, Whangarei, Howick and Napier.

From these examples in Table 2, it is seen that the great majority of recorded distances were less than 20 km, which is not far for a recognised migrant and strong-flying species. Even where recovery/release/re-recovery took place flight distances, for the most part, remained short. Out of the total 1011 recoveries from all releases there are only 28 records of flights further than 20 km. For the purpose of this project these 28 are considered as long distance flights and are treated in more detail below.

Table 1. Numbers of Monarch butterflies released* and recovered.

Centre (Co-operator)	Season	No. released	No. recovered	% recovery
Howick (K.S.A.)	1967-68	134	20	14.9
	1968-69	221	7	16.7
	1969-70	291	31	10.7
	1970-71	290	40	13.8
	1971-72	400	3	15.8
Pyes Pa (B.H.B.)	1972-73	153	4	2.6
Waipawa (G.I.)	1967-68	142	7	4.9
Whangarei (W.P.)				
(Maunu)	1970-71	164	14	8.5
	1971-72	177	22	12.4
Rotorua (K.P.R.)	1969-70	103	22	21.4
Napier (S.R.)	1968-69	163	45	27.6
Maungaturoto (M.E.W.)	1971-72	100	6	6.0
Whangarei (C.W.)	1969-70	273	77	28.2
	1970-71	410	125	30.5
	1971-72	173	53	30.6
Howick (D.W.)	1969-70	100	14	14.0
Tauranga Bay (K.A.J.W.)				
(overwintering colony)	1968	191	8	4.2
(overwintering colony)	1969	1634	176	10.8
Overall numbers of releases and recoveries		6506	1011	15.5% recovery overall
Numbers of releases and recoveries with overwintering colony recoveries excluded		6506	809	12.4% recovery overall

*100 or more releases in a season.

Long distance flights

The 28 long distance flights recorded above are here treated in detail as they are considered the most important concerning movement of Monarch butterflies about New Zealand. Information on these flights, which only occurred in the North Island, is given in Table 3 and flight direction lines are shown in Fig. 3.

In cases where the butterfly plus tag or the tag alone were returned, and these are held in the Museum, the reports are considered as confirmed and are so noted in the Table. Those tag numbers received by letter or in record lists and by verbal advice are considered as unconfirmed. For the most part all these records are accepted but two unconfirmed records are considered doubtful and are noted as doubted in the Table.

Table 2. Numbers of Monarch butterflies recovered at various distances from three release sites.

Site (Co-operators)	Season	Distances (km) 0	0-1	1-2	2-3	3-4	4-5	5-10	10-20	20-50	> 50
Howick (K.S.A.)	1967-68	4	10	2	1			1			1
	1968-69	10	18	3	3						1
	1969-70	1	21	6	2			1			
	1970-71	2	21	6	5	2		4			1
	1971-72	14	30	14				2	2		
Napier (S.R.)	1968-69	4	29	9					1		
	1969-70		31	23	4			1	2		1
	1970-71		2	3	2						
Whangarei (C.W.) (Whau Valley)	1968-69		1				1				
	1969-70	7	17	32	9	4	4				3
	1970-71	19	32	26	10	5	3	4	4	7	1
	1971-72	4	20	11	7	2	2	1		2	3
	1972-73		6		1			1			
	1973-74		1	2	1						

The unconfirmed records are as follows.

9/1913 appears to be a flight southward, in autumn, out of an overwintering colony (Tauranga Bay). As such it would be the only ex-colony long flight (192 km) recorded in this study and seems unlikely, particularly at that time of year. The possibility of this being a transported individual also arises and is discussed below. This report is doubted although the presence of the butterfly is accepted as it was re-taken in the recovery area later the same month.

0/284 was carefully recorded 52 km south of the release point in Whangarei and this flight is accepted.

1/217 was a summer flight northward just over 20 km.

1/242 was another northward summer flight and, after re-release, there was a second capture in the same area, so it is accepted.

1/468 was recorded twice north of the release point in the same period as 1/217 and 1/473.

1/601 was sighted on two succeeding days by the same person at the same place. This individual was reported as 1/6001 but this number was not used. It is considered to be 1/601, released in Whangarei a month before, and thus represents a summer southward flight.

1/638 was taken away from the main south road and appears to be an acceptable summer southward flight.

2/221 apparently flew north from Whangarei to Hikurangi, as two separate sightings were reported by telephone advice, then south to Onerahi near the release area. This is a wandering summer flight.

Table 3. Long distance flights* of Monarch butterflies.

Tag no.	Date released	Place released (Co-operator)	Sex	Reared or Transient	Date recovered	Place recovered	Alive or Dead	Recovery data†	Period (days)	Distance (km)	Direction	Status‡
9/1913	5.IV.69	Tauranga Bay (K.A.J.W.)	♂	T	12.V.69	Orewa	A	L	37	192.5	SSE	U-D
					25.V.69	Orewa		LST	13	1		C
0/223	18.I.70	Whangarei (C.W.)	♀	R	28.I.70	Kaitaia		LST	10	115	WNW	C
0/279	23.I.70	Whangarei (C.W.)	♀	R	17.II.70	Orewa	A	LST	25	106	SSE	C
0/284	23.I.70	Whangarei (C.W.)	♀	R	11.II.70	Kaiwaka	A	L	19	52	SSE	U
0/643	22.II.70	Whangarei (W.P.) (Maunu)	♀	T	2.III.70	Titirangi	A	ST	8	135	SSE	C
1/144	27.I.71	Whangarei (W.P.) (Maunu)	♀	T	8.II.71	Tangiteroria		LST	12	21.3	WSW	C
1/212	20.I.71	Whangarei (C.W.)	♀	R	8.II.71	Paparoa		LST	19	45	S	C
1/217	20.I.71	Whangarei (C.W.)	♀	R	8.II.71	Hukerenui	A	V	19	21	NNW	U
1/242	22.I.71	Whangarei (C.W.)	♀	T	29.I.71	Bland Bay	A	L	7	39.5	N	U
					31.I.71	Ohinewai Bay		LST	2	7.5	SSW	C
1/468	30.I.71	Whangarei (C.W.)	♀	R	11.II.71	Hukerenui	A	L	12	21	NNW	U
					12.III.71	Paiaka		L	29	5	W	U
1/473	30.I.71	Whangarei (C.W.)	♀	R	10.III.71	Hukerenui		LST	39	21	NNW	C
1/481	30.I.71	Whangarei (C.W.)	♀	R	27.II.71	Motatau		LT	28	33	NW	C
1/601	31.I.71	Whangarei (C.W.)	♀	T	27.II.71	Matakohe	A	L	27	50	S	U
					28.II.71	Matakohe	A	L	1	0	-	U
1/638	**8.II.71**	Whangarei (C.W.)	♀	T	11.II.71	Waiwera	D	L	3	100	SSE	U
2/213	8.II.72	Whangarei (C.W.)	♀	R	21.II.72	Cable Bay	D	LST	13	107.5	NW	C
2/214	8.II.72	Whangarei (C.W.)	♀	R	16.III.72	Ruawai		LST	37	55	SSW	C
2/221	8.II.72	Whangarei (C.W.)	♀	R	24.II.72	Hikurangi	A	V	16	10.7	N	U
					24.II.72	Hikurangi	A	V	0	6.7	NNE	U
					2.III.72	Onerahi		LST	7	20.3	SSE	C
2/270	11.II.72	Whangarei (C.W.)	♀	T	21.II.72	Cable Bay	D	LST	10	107.5	NW	C
2/280	17.II.72	Whangarei (C.W.)	♀	R	4.III.72	Ohinewai Bay	A	L	16	35	N	U
3/68	10.III.73	Maungaturoto (M.E.W.)	♂	T	15.III.73	Kumeu	A	VST	5	78.5	S	C
9/1265	19.III.69	Auckland (M.B.) (Ellerslie)	♂		30.IV.69	Whangarei	A	L	42	140	NNW	U
68/1	24.II.68	Howick (K.S.A.)		T	4.III.68	Waihi	A	L	9	96	SE	U
9/2379	21.V.69	Howick (K.S.A.)	♀	R	2.VI.69	Tauranga Bay	A	L	12	234	NNW	U
1/377	1.II.71	Howick (K.S.A.)	♀	T	10.II.71	Te Aroha		LT	9	98	SE	C
3/121	27.II.73	Pyes Pa (B.H.B.)	♂	R	7.V.73	Akitio		LST	69	295	S	C
3/181	27.III.73	Pyes Pa (B.H.B.)	♀	R	31.III.73	Rotorua		LST	4	35	SSE	C
0/56	22.I.70	Napier (S.R.)	♂		17.II.70	Whangarei		L	26	465	NNW	U-D
68/372	9.IV.68	Waipawa (G.I.)	♀		12.V.68	Napier	D	LST	33	56	NE	C

*More than 20 km. †ST — Specimen plus tag. T — Tag only. L — Letter or list. V — Verbal advice. ‡C — Confirmed. U — Unconfirmed. D — Doubted

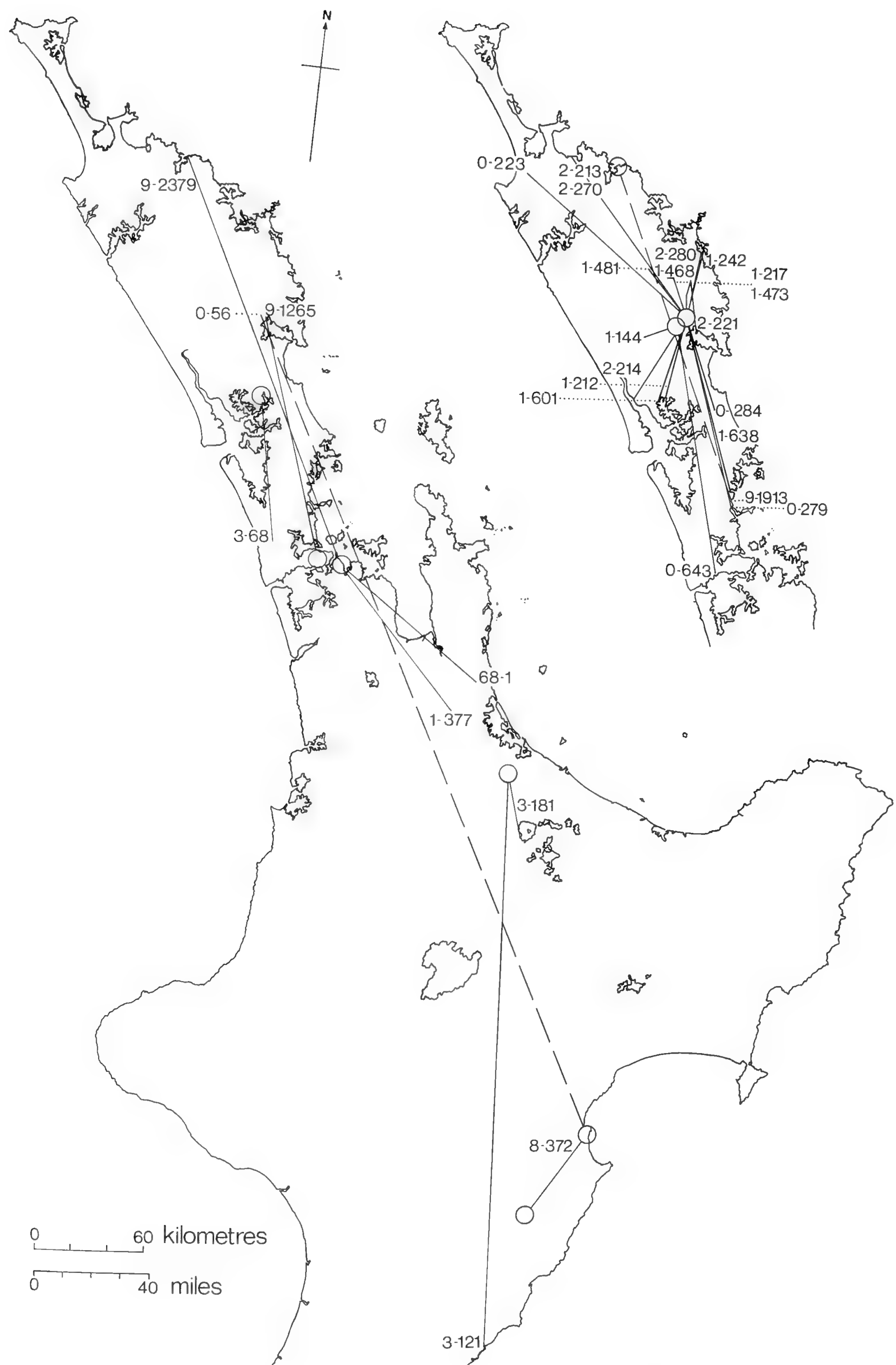

Fig. 3. North Island showing flight direction lines for recoveries of tagged Monarch butterflies over 20 km from release sites. The insert is used to separate flights within Northland from other flights. Numbers are tag numbers; broken lines are doubted flights.

2/280 was carefully recorded 35 km north of the release point and is accepted as a summer flight.

9/1265 was received alive at Whangarei Museum from a local person, and re-released. This is a northward flight from Auckland in late March-April and may be a pre-winter flight.

68/1 was the first release and apparently accomplished a good, long flight in 9 days before collection. The individual was kept for several days by a second person who checked the recovery and sent the advice.

9/2379 was noted at Tauranga Bay overwintering colony and re-released by one of a group there for tagging. If correct it was a late May (autumn-winter) flight from Howick and represents the only record of a movement into an overwintering colony.

0/56 was recorded and re-released in Whangarei at a time when similar numbers were in use there. For example, 0/156 was released within 2 km of the recovery site only a fortnight before. It would have been a very long summer flight northwards, from Napier, which is doubted.

As mentioned above, the only long flight originating from Tauranga Bay (9/1913), and the only one from an overwintering colony, may be invalid as it was tagged at a time when butterflies were entering the colony before the winter (5 April). It is further discussed below.

Of 18 long flights from Whangarei, 10 were northerly and 8 southerly. All were in the 'summer' period January to March, the latest date for a recovery being 16 March. In 1970, one flight (0/223) was 115 km WNW, another (0/279) 106 km S and a third (0/543) 135 km S, while in 1971, one (1/638) was 100 km S. In 1972, two individuals (2/213, 2/270) flew 107 km N. Being summer flights these are all quite possible and likely. Three flights around 50 km (0/284, 1/601, 2/214) were southerly and are accepted as are the remaining shorter flights over 20 km.

One long flight from Maungaturoto (3/68) was 78 km S, another March flight within the period and distance of the flights from Whangarei.

The one long flight recorded from Auckland (9/1265) was a late (March-April) northerly flight to Whangarei (140 km, NNW). Although unconfirmed this flight is complemented by a possible late northward flight (9/2379) from Howick, the same year.

Of the three long flights from Howick, two (68/1, 1/377) were just under 100 km in a south-easterly direction during the 'summer' period (February-March). The third (9/2379) is apparently a very late (May) flight to the northern overwintering colony. As such it represents the only recorded flight into an overwintering colony and would be classed as doubtful if it were not for a complementary late northward flight the previous month (9/1265, see above).

There were two long southerly flights from Pyes Pa although one (3/181), in March, was only 35 km. The other (3/121), however, was one of the longest flights recorded (295 km) and seems valid. It was in the February-May period and is interesting in that it possibly passed the Hastings overwintering colony.

The one long flight from Napier (0/56) was recorded in Whangarei (465 km, NNW) and this does not seem likely in view of the circumstances (see 0/56 above) and the fact that no others from this area were collected elsewhere.

The one long flight from Waipawa (8/372) was a confirmed late northerly flight (April-May, 56 km, NNE) which may not be unlikely. Interestingly, it would have passed the Hastings overwintering colony.

Of interest is the incidence of transient and reared butterflies amongst the 28 long flights, and also their sex. Of the males there were 2 transients (one a doubted flight from an overwintering colony), one reared and two unknown (that is, not recorded in either category by the marker) including one doubtful flight; of the females, 7 transients, 14 reared and one unknown; there was also one unsexed transient. Thus it is seen that the female Monarch butterflies made approximately 79% of the long flights and that twice as many reared females as transients were involved. These results indicate that reared as well as transient individuals do make long flights but it must be remembered that a butterfly recorded as transient by one person may have been reared by another and is not necessarily from a wild population.

As with other scientific projects there is occasionally the possibility of unwanted human intervention either intentional or unintentional. Within the present project the possibility of tagged individual Monarchs being carried and subsequently recorded as a long flight must be remembered. So far as the above recorded long flights are concerned most seem possible and reasonable. The only suspect in the present context is the one butterfly (9/1913) which was tagged in the northern overwintering colony and which was found a month later over 190 km away at a place on the main south road to Auckland. It seems very unlikely that a Monarch would leave an overwintering colony at that time of year (autumn-winter) and conversely it is the best time for visitors to the colony.

Overwintering colonies

A record of releases and recoveries of Monarch butterflies tagged in overwintering colonies is given in Table 4. Most individuals were re-recorded at the same place.

Table 4. Recoveries from releases of Monarch butterflies in overwintering colonies.

Centre (Co-operator)	Year	Released No.	Released Time of year	Recovered No.	Recovered Time of year	Distance (km)	
Tauranga Bay (K.A.J.W.)	1968	191	March-July	8	April-October	0	(6)
						0-1	(1)
						6-7	(1)
	1969	1634	April-June	176	April-September	0	(175)
						192	(1)
	1974	83	June	0	—	—	
Hastings (S.R.)	1969	40	April	11	April-October	0	(9)
						0-1	(1)
						1-2	(1)
Nelson (J.S.D.)	1968	50	June-August	7	June-December	0	(3)
						0-1	(3)
						11-12	(1)

Of the three overwintering colonies recorded by Ramsay (1964b), only the North Auckland colony in an isolated rural area at Tauranga Bay is known to the author. There, hundreds of Monarchs congregated on large pohutukawa trees (*Metrosideros excelsa* Sol.) above the sea-shore in the early years of the investigations. In later years it seemed that numbers were fewer. Only two individuals were recovered outside the site, one less than 7 km and the other a long distance flight which is doubted (see above). From personal observation and various reports, it is known that the colony site is empty in the summer. It is important to note that only a very few swan plants have been seen near the site during the present project and obviously the Monarchs do not continue to go there for breeding (see Ramsay 1964b:14); consequently they are more likely to be a migratory group. Only one butterfly tagged elsewhere was recorded in the northern colony; this unconfirmed flight is discussed above. While the colony is referred to here as being at one site (a small valley at the north end of the bay) other small overwintering groups were sometimes seen (and a few tagged) *ca.* 1 km away in the main valley.

The Hastings colony was sited on large conifer trees in Cornwall Park in the town. Even though tagging was done over several seasons in Napier, *ca.* 17 km away, no tagged butterflies from there or elsewhere were recovered in the Hastings colony. None tagged in the colony was taken more than 1.5 km away from it.

In Nelson, where Monarchs gathered on large conifers in the Queen's Gardens, only one individual was recorded as far as 11-12 km away, others no more than 1 km. None from outside was recovered in the colony. This must have been a relatively new group as Ramsay (1964b) recorded several groups on various trees at other sites but none at this site.

With the situation of the three known overwintering areas (Fig. 2) in New Zealand, being one in the north, one in the middle and one in the south, it was expected that somewhere butterflies would be found moving towards or into at least one of the colonies and would also be found leaving or spreading out from a colony. However, no such movements have been found even though the colonies break up by summer.

Adult longevity and time of year

In a note on the longevity of Monarch butterflies in Australia, Smithers (1973b) recorded adult life periods up to 26 weeks. During the present study, most Monarch butterflies were recaptured within two months; these were maily 'summer' individuals. Others lived more than two months before recapture; of these, individuals definitely recorded as recovered alive are listed in Table 5. It is noteworthy that none of the listed butterflies made long flights unless they left and returned to the release areas which is unlikely as most were 'winter' individuals; some of them were taken near their home sites in each of the months from April to August.

The records in Table 5 indicate that some of the 'summer' individuals (tagged January, February) can live more than two months. Those tagged in March, April, May are also shown to live more than two months and as long as five months; it could be expected that these at least may survive over winter. Of those butterflies taken in July and August, almost all had already lived at least three months.

Table 5. Longevity* and occurrence of Monarch butterflies.

Tag no.	Place released (Co-operator)	Date released	Reared or Transient	Sex	Date recovered	Place recovered	Distance (km)	Period (days)
2/115	Whangarei (C.W.)	31.I.72	R	♂	2.IV.72	Whangarei	0-1	62
0/1338	Howick (D.W.)	17.IV.70	R	♀	20.VI.70	Howick	0-1	64
3/1	Whangarei (C.W.)	23.II.73	T	♂	29.IV.73	Kamo	0-1	65
0/1048	Howick (K.S.A.)	11.III.70	R	♀	17.V.70	Howick	0-1	67
9/2868	Whangarei (S.L.)	24.V.69	T	♀	31.VII.69	Whangarei	0-1	68
2/519	Howick (K.S.A.)	23.II.72	R	♂	4.V.72	Howick	0-1	71
9/1701	Napier (S.R.)	9.IV.69	R	♀	29.VI.69	Napier	0-1	81
2/958	Howick (K.S.A.)	8.IV.72	R	♂	29.VI.72	Howick	0-1	82
0/292	Whangarei (C.W.)	24.I.70	R	♂	21.IV.70	Whangarei	4-5	87
1/287	Whangarei (C.W.)	26.I.71	T	♀	27.IV.71	Whangarei	5-6	91
9/1680	Howick (K.S.A.)	29.IV.69	R	♂	29.VII.69	Howick	0-1	91
9/2858	Whangarei (S.L.)	13.V.69	T	♂	18.VIII.69	Whangarei	0-1	97
1/170	Napier (S.R.)	6.IV.71	T	♀	19.VII.71	Napier	1-2	104
0/514	Whangarei (C.W.)	21.III.70	R	♂	9.VII.70	Whangarei	1-2	110
9/1284	Auckland Ellerslie (M.B.)	8.IV.69	T	♀	3.VIII.69	One Tree Hill	1-2	117
8/43	Howick (K.S.A.)	28.III.68	R	♂	28.VII.68	Howick	0-2	122
9/1664	Howick (K.S.A.)	24.IV.69	R	♀	26.VIII.69	Howick	2-3	124
0/799	Napier (S.R.)	26.II.70	R	♂	1.VII.70	Napier	1-2	125
1/874	Napier (P.D.)	28.III.71	T	♂	27.VIII.71	Napier	0-1	152
9/1328	Napier (S.R.)	13.III.69	T	♀	18.VIII.69	Napier	1-2	158

*More than two months.

The results in Table 5 also confirm the presence of active 'winter' Monarchs (recovered June-August) from Whangarei in the north to Napier in the south, none of which was captured more than 3 km from its release site, and most within 2 km.

DISPERSAL INFORMATION

During the period of the project other information came to hand.

Mr R.B. Sibson, Ornithologist, of Auckland, advised in April, 1970, that Monarch butterflies were drifting northwards over the Kaipara Harbour, north of Auckland on the west coast, on 29 March, 1970, a fine day with a light southerly wind.

The late Dr R.A. Falla, Director and Ornithologist, Dominion Museum, Wellington, advised the author in April, 1970, of the sightings of an observer known to him; in the Kaimanawa Ranges, west of Napier, streams of Monarchs were flying westward against light westerly winds, in the middle of the day, on two or more days in February, 1970.

From Napier, itself, a report sent on 23 May, 1972, was of Monarchs swarming on willows, up to 50 on a branch, at that time. Whether this was a moving group or the beginning of an overwintering group is not recorded.

Concerning records in the South Island, apart from Nelson, there are reports of Monarchs at Gore Bay, south of Kaikoura on the east coast, and in Christchurch. A further report dated 8 April, 1968, was of a Monarch visiting swan plant earlier that season at Mt Pleasant, Christchurch, with subsequent larvae on the plant and, later, butterflies emerging. Two Monarch butterflies were reported in June, 1968, as flying near Waikouiti, north of Dunedin, the previous summer.

From Invercargill, Dr R. Burns Watson advised in June, 1968, of a Monarch butterflv flying in a garden at Riverton Rocks (southern coast) on 15 April, 1967, and another in the same garden on 22 April, 1968. A subsequent newspaper article in Invercargill brought reports of sightings of Monarchs at Colac Bay, Bluff and Invercargill in January-May, 1968, all on or near the southern coast of the South Island.

Some of this information indicates that mass movements of Monarch butterflies may occur at times in New Zealand. The remainder confirms that the species can disperse throughout the length of the country, at least as far as the southern coast of the South Island.

OVERWINTERING

From time to time during the project Monarchs flying in the 'winter' period were seen by the author and were reported by other observers. The inference is that these individuals and others (see above, Table 5 and comments) are able to fly on warm, sunny days at any time during the colder part of the year, although they may be expected not to fly far. For example, two such butterflies were recorded in Whangarei, one tagged on 5 July, 1969, was re-taken at the same place on 19 July, and the other tagged in September, 1970, was recovered at the same place in October.

In Auckland the author has received many reports of 'winter' Monarch butterflies over the years and several, in particular, of small groups in large trees in the city and suburbs, to the south (Papatoetoe) and to the north on the North Shore side of the harbour, as well as in Howick to the east.

These 'winter' occurrences are in accord with the lack of evidence of movements into and out of overwintering colonies. It appears that, at least in the North Island of New Zealand, many Monarchs are not obliged to move into overwintering colonies separate from summer breeding areas. They are capable of overwintering solitarily or in small groups within the breeding areas and, consequently, are available to provide breeding populations for the next season.

DISCUSSION

Although in the early 1970s the project was receiving much assistance and many recoveries were being made, it became obvious that results indicating dispersal or general movements of Monarch butterflies in New Zealand were negligible. Recorded movements across country were few and movements into and out of overwintering colonies had not been traced. In fact, despite several years of work, the project had been singularly unsuccessful. It seemed that tagging (mostly home-reared individuals) and recovery were not enough. A much wider project would be needed, involving the search for butterflies on uni-directional flights and in other congregations both summer and winter, for possible food-plant escapes and consequent wild larval populations and for other sources of adults (? immigrants). In view of the difficulties of widening the scope of the project at that time, and the feeling that any further work on the same lines would involve co-operators in much activity without the prospect of better results, it was decided not to continue.

The project did not produce the information sought on dispersal of Monarch butterflies; no large scale migrations or movements were detected by tagging. The project had, in the main, established that large numbers of Monarch butterflies in the North Island stayed in their home areas both in summer and winter periods, although a small number did make long flights. At the same time the presence of known overwintering colonies was confirmed, particularly one at Tauranga Bay in the far north, but no movements into or out of these were recorded. By the end of the project the author had recognised that the regular seasonal situation for Monarch butterflies in North America did not hold in New Zealand. It appears that in this country there were some Monarchs which moved and some which did not.

CONCLUSION

Since results from tagging and from observation of Monarch butterflies in Australia have been published, the situation in New Zealand can be better compared. Smithers (1965) had remarked that the behaviour pattern of Monarch butterflies in southern Australia was different from that in North America and he later recorded (1972) overwintering clusters and breeding populations close to each other, south of Sydney. Smithers (1977) has subsequently shown that Monarch butterflies occur in both the north and south of eastern Australia in the summer and do not entirely leave the south in the winter (in the latitudes of Sydney, Adelaide and the far north of New Zealand). Detailed observations of individuals and colonies have been made more recently by James who has also recorded and discussed adjacent overwintering clusters and breeding populations in the Sydney area (James 1979). Thus it appears that both in Australia and New Zealand some Monarch butterflies are in moving groups and others remain in one place.

In contrast to Australia, a continent with wide topographic variations reaching from a temperate zone into the tropics, New Zealand is isolated, insular and elongate, orientated in a more or less north-south line and reaching from warm temperate to cold temperate climates. For these reasons it may be more difficult to gather information on Monarch movements in this country and there is still need for further research in an extended but planned and controlled programme. Observations on individual butterflies, such as those made by Smithers and James, and started by Ramsay in New Zealand, are still also needed.

Contrary to those who have postulated west-east flights of insects between Australia and New Zealand, it has long been the author's contention that, because of the circular weather systems moving across (west to east) or through (south-west to north-east) the Tasman Sea area, semicircular, arcuate or sinuous paths are probable for wind-borne insects, with the added possibility of return flights or separate movements from New Zealand to Australia. Is it possible that Monarch butterflies in the northern overwintering colony, for example, might arrive from overseas and might also attempt a return flight?

It is hoped that, in the future, further tagging, trapping and observation, or more sophisticated marking-recovery procedures, will elucidate the trans-Tasman insect flows and the situation concerning movements within New Zealand.

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RECORDS OF SOUTH PACIFIC DRAGONFLIES (HEXAPODA: ODONATA)

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Abstract. Species of South Pacific Odonata represented in the Auckland Museum collections are recorded. Included are species from Norfolk Island, Fiji (particularly the Lau Group) and the Cook Islands.

In this paper, specimens of South Pacific Odonata in the Auckland Museum are recorded; species from Norfolk Island, Fiji and Cook Islands are represented.

Amongst the C.E. Clarke collections in the Museum is a small collection of dragonflies taken in Rarotonga, Cook Islands, in 1937. These were determined by M.A. Lietftinck, at the author's request, in 1966. Subsequently the author has collected during two Royal Society of New Zealand expeditions — the Cook Bicentennial Expedition of 1969 to the Cook Islands (Wise 1971) and the South Pacific Expedition of 1977 to the Lau Group of the Fiji Islands (Wise 1978). A small collection of Norfolk Island specimens was made for the Museum by Mrs Beryl Evans in 1975.

The Odonata of Norfolk Island have been recorded by Kimmins (1941) and Smithers (1976). Tillyard (1924) wrote on the Odonata of Fiji and dealt with all the then known species. Lieftinck (1975) has recorded Norfolk I and Fijian species in relation to the New Caledonia fauna and his nomenclature is followed here for species concerned. Lieftinck (1953) and, more recently, Walker & Deitz (1979) have recorded Odonata in the Cook Islands. Other records, for all island groups, have been listed by Schmidt (1938).

ORDER ODONATA

SUBORDER ZYGOPTERA

Family COENAGRIONIDAE

Genus **Ischnura** de Charpentier, 1840

Ischnura aurora aurora (Brauer, 1865)

COOK IS. Aitutaki: Maungapu, swept by road, *ca.* 1-30 m, 2.IX.1969, (1♀), K.A.J.W. Rarotonga: Avatiu Vy., 13.IX.1969, (2♂♂1♀), K.A.J.W.

Genus **Agriocnemis** de Selys Longchamps, 1877

Agriocnemis exsudans exsudans de Selys Longchamps, 1877

NORFOLK I. Norfolk: Locality 261046, 7.XII.1975, (3♂♂ 1♀), Beryl Evans.

LAU IS. Lakeba: Tubou Vy., swept by stream, 23.VI.1977, (1♂), Waciwaci-Waitabu, over water in ditch, 28.VI.1977, (6♂♂), Top of Tubou Vy., over irrigation ditches, 30.VI.1977, (3♂♂), K.A.J.W.

SUBORDER ANISOPTERA

Family AESHNIDAE

Genus **Aeshna** Fabricius, 1775

Aeshna brevistyla Rambur, 1842

NORFOLK I. Norfolk: Locality 261046, 7.XII.1975, (2♂♂), Beryl Evans.

Genus **Anax** Leach, 1815

Anax guttatus (Burmeister, 1839)

COOK IS. Rarotonga: -.VII.1937, (1♂), 11. XI.1937, (1♂), C.E. Clarke.

Family CORDULIIDAE

Genus **Hemicordulia** de Selys Longchamps, 1870

Hemicordulia australiae (Rambur, 1842)

NORFOLK I. Norfolk: Locality 264043, 7.XII.1975, (5♂♂), Beryl Evans.

Hemicordulia sp.? **hilaris** Lieftinck, 1975

LAU IS. Lakeba: Top of Tubou Vy., flying at dusk, 30.VI.1977, (1♀), K.A.J.W.

Hemicordulia sp. near **hilaris**

COOK IS. Rarotonga: Te Kou, in summit basin *ca.* 558 m, 16.IX.1969, (1♂), K.A.J.W. Atiu: 24.IX.1969, (1♀), K.A.J.W.

Family LIBELLULIDAE

Genus **Lathrecista** Kirby, 1889

Lathrecista asiatica festa (de Selys Longchamps, 1879)

LAU IS. Lakeba: Top of Waitabu Vy., in forest, 28.VI.1977, (1♂), K.A.J.W.

Genus **Orthetrum** Newman, 1833

Orthetrum sabina (Drury, 1770)

LAU IS. Lakeba: Waitabu, over stream, 28.VI.1977, (1♂), K.A.J.W.

Genus **Diplacodes** Kirby, 1889

Diplacodes bipunctata (Brauer, 1865)

LAU IS. Lakeba: Waitabu, over stream, 28.VI.1977, (2♂♂), K.A.J.W.

COOK IS. Rarotonga: 5.IX.1937, (1♂), C.E. Clarke: Takuvaine Vy., 10.IX.1969, (3♂♂), K.A.J.W. Atiu: 24.IX.1969, (1♂), K.A.J.W. Mangaia: 25.IX.1969, (1♂ 1♀), K.A.J.W.

Diplacodes trivialis (Rambur, 1842)

LAU IS. Lakeba: Waitabu, over stream, 28.VI.1977, (4♂♂ 3♀♀), K.A.J.W.

Genus **Tholymis** Hagen, 1867

Tholymis tillarga (Fabricius, 1798)

FIJI. Viti Levu: Suva, 20.VI.1977, (1♂), K.A.J.W.

COOK IS. Rarotonga: -.VII.1937, (1♂), 5.IX.1937 (1♂), C.E. Clarke.

Genus **Pantala** Hagen, 1861

Pantala flavescens (Fabricius, 1798)

LAU IS. Lakeba: Tubou, 29.VI.1977, (2♂♂ 1♀), K.A.J.W.

COOK IS. Aitutaki: Maungapu ridge, *ca.* 91 m, 28.VIII.1969, (1♀), Te Kopua (islet), 29.VIII.1969, (3♂♂), K.A.J.W. Rarotonga: -.VII.1937, (1♀), 5.IX.1937, (1♂), C.E. Clarke; Takuvaine Vy., 10.IX.1969, (1♂), Ngatangiia, 12.IX.1969, (1♀), S. rim Te Kou, *ca*, 588 m, 16.IX.1969, (1♂), Avana Vy., 18.IX.1969, (1♂ 1♀), K.A.J.W.

Genus **Tramea** Hagen, 1861

Tramea transmarina Brauer, 1867

COOK IS. Rarotonga: 16.XII.1937, (1♂), C.E. Clarke.

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