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THE ASCIDIAN FAUNA OF WESTERN PORT, VICTORIA, AND A COMPARISON WITH THAT OF PORT PHILLIP BAY

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Abstract

The taxonomy of 59 species of ascidians from Western Port and Port Phillip Bay, Victoria, is discussed. The ascidian fauna of Western Port is markedly more diverse than that of Port Phillip Bay. The biogeographical affinities of the species are assessed and the implications of the differences in species composition in the two areas are investigated.

Introduction

A previous collection of ascidians from Port Phillip Bay has been reported on by Millar (1966) but prior to that no major work has been devoted to the ascidian fauna of Victoria. The greater part of the present material has been collected for the National Museum of Victoria by the Underwater Research Group (Western Port Survey). Additional records of species occurring in Western Port, available from independent collections made by Mrs. J. Watson and Mr. K. Duke on parts of the adjacent Victorian coast, from Mallacoota near the Victorian—N.S.W. border to Portland Harbour and Cape Nelson, have been included in the present work.

These collections are of particular interest in relation to the fauna of St. Vincent Gulf where large collections have recently been made and reported on (see Kott, 1972 a, b). Information on the better known fauna of Port Jackson and Moreton Bay to the north is also available. (Kott, 1952; 1957; 1962; 1963; 1972 c, d). These locations are all large embayments in the Australian coastline, essentially marine, and tidal. They are, however, all protected from the direct swell of the southern ocean, and receive some fresh-water runoff from the water-ways emptying into them and from the shores surrounding them.

The distribution of this sessile ascidian fauna is limited by the short free-swimming life of the pelagic larvae. Consequently species adapted to protected localities could be restricted in their distribution by lack of suitable sites for settlement on the open coast. The phylogenetic relationships of the ascidian fauna of each of these sheltered embayments are therefore of special zoogeographic and ecological interest in view of the likelihood of isolation of endemic and relict species.

There are 59 species in the collections, of which one, *Ciona intestinalis* is probably introduced. These species, are set out in Tables 1 and 2 together with others previously recorded from Port Phillip Bay and Western Port but not represented in these collection. Aspects concerning the biogeography and habitat of the ascidian fauna of these locations is discussed below.

Species List

APLOUSOBRANCHIA
CIONIDAE
Ciona intestinalis
CLAVELINIDAE
CLAVELININAE
Oxycorynia pseudobaudinensis n. sp.
Podoclavella cylindrica
HOLOZOINAE
Atapozoa mirabilis
Sycozoa pedunculata
Sycozoa cerebriformis
POLYCITORIDAE
Eudistoma pyriforme
POLYCLINIDAE
EUHERDMANIINAE
Pseudodistoma cereum
Dumus areniferus
POLYCLININAE
Polyclinum marsupiale
Aplidium depressum
Aplidium lobatum
Aplidium triggiensis

Synoicum hypurgon
Synoicum sp.?
Sidneyoides tamaramae
DIDEMNIDAE
Trididemnum cerebriforme
Trididemnum cyclops
Didemnum candidum
Didemnum spongioides
Didemnum skeati
Didemnum moseleyi
Didemnum patulum
Didemnum turritum
Didemnum augusti
Didemnum roberti
Didemnum lambitum
Lissoclinum fragile
Lissoclinum ostrearium
Diplosoma translucida
Diplosma rayneri
Polysyncraton orbiculum
Polysyncraton victoriensis n. sp.
PHLEBOBRANCHIA
ASCIDIIDAE
ASCIDIINAE
Phallusia depressiuscula
Ascidia sydneyensis
Ascidia gemmata
STOLIDOBRANCHIA
STYELIDAE
BOTRYLLINAE
Botrylloides leachii
Botrylloides nigrum
POLYZOINAE
Symplegma viride
Amphicarpa diptycha
Polyandrocarpa lapidosa
STYELINAE
Polycarpa thelypanes
Cnemidocarpa etheridgii
PYURIDAE
Pyura australis
Pyura cataphracta
Pyura irregularis
Pyura albanyensis
Pyura lepidoderma
Pyura scoresbiensis
Pyura stolonifera praeputialis
Halocynthia hispida
Herdmania momus
Microcosmus australis
Microcosmus nichollsi
Microcosmus helleri
Microcosmus stolonifera
Microcosmus squamiger
MOLGULIDAE
Molgula mollis
Molgula sabulosa

SYSTEMATICS

Ciona intestinalis Linnaeus

Ciona intestinalis Linneaus, 1767, p. 1087. Kott, 1952, p. 319 for synonymy and description.

New Records: Port Phillip Bay (Oil wharf, Yarra River; artificial reef).

Distribution: See Kott, 1952.

Remarks: Kott (1969) has suggested that the cosmopolitan occurrence of this species, which is recorded from harbours and wharf piles in all regions outside the Antartic, is due to its transport on ships' hulls.

Oxycotynia pseudobaudiensis sp. nov.

(Fig. 1)

Clavelina baudinensis Kott, 1957, p. 87 (part: specimen with larger larvae) ?Millar, 1966, p. 363. Kott, 1972a, p. 4.

Type Locality: Laverton Bay (Victoria)

Holotype: Australian Museum A.M. Y1113.

Paratypes: W. Aust. Rottnest I., AM Y1112 (Kott 1957). S. Aust.: Carickalinga Head, South Australian Museum S.A.M. E876; Rapid Head S.A.M. E 877 (Kott 1972a). Vict. (Western Port): Balnarring Beach, A.M. Y1122 (Kott 1957); Crawfish Rock; Flinders Jetty, N.M.V. (new records).

Description: The colonies are 5-8 cm high and the wider terminal part of the head is 2 cm in diameter terminally. In the upper half of the colonies the test is delicate and sometimes glassy and transparent and encloses the body of the zooids which are never separate. On the upper surface the test forms only slight rounded protruberances over the anterior aspect of the zooids. In some colonies the zooid bearing upper part may be subdivided into several lobes. The slightly bulbous stalk narrows toward the base and is only slightly longer than half the height of the colony. The test of the stalk is firm and opaque and sometimes slightly leathery externally.

Zooids are from six to eight mm. In preservative they are a bluish colour and have dark accumulations of pigment in the mid line dorsal and ventral to the branchial siphon. There are 12 to 20 longitudinal muscles on the thorax and, depending on their degree of coalescence, they may vary in number on each side of the body. From six to eight of the most ventral bands are aligned at a slight angle with the longitudinal axis of the body and break up into branches over the anterior half of the endostyle. Of the remaining longitudinal muscle bands more than half extend into the branchial siphon and the others into the atrial siphon. Posteriorly the bands extend along both sides of the abdomen. There are from 16 to 20 rows each of 20 to 30 rectangular stigmata with a well developed transverse membrane between each row. In the mid dorsal line this membrane is expanded into the usual triangular, pointed languets.

The gut forms a simple and fairly short loop (seldom longer than the thorax), enclosing the gonads. The anus opens at the base of the peribranchial cavity and is bordered with minute rounded lobes. The stomach has no true structural folds. It is present in the middle to posterior one third of the abdomen. There is no prestomach.

Larvae are present only in the colonies from Rottnest Island and Laverton Bay (see Kott, 1957: larger larvae). They are large, 0·9 mm long with the tail wound threequarters of the way around the body. Triradiate papillae are supported around a flattened frontal plate. The adhesive cells rise in a cone from the centre of a depressed area which forms a fairly primitive papillary sucker or cup. The embryos appear to start their development in the proximal part of the oviduct and complete it in the right side of the peribranchial cavity where they demonstrate a wide range in stages of development. The most mature embryos are present anteriorly.

Remarks: The separate identity of the present species was first suggested by the different larvae present in colonies from Rottnest and Victoria which had all been assigned to the species *C. baudinensis* Kott, 1952. Most of the previously described specimens of that species excepting only those recorded by Millar (1966) have been re-examined.

Clavelina baudinensis from Cape Vlamingh, Rottnest Island and from Laverton Bay have small larvae (0·5 mm) in which the simple papillae without accessory suckers are supported around the anterior end of the body which is not separated into a frontal plate. In these larvae the tail completely circles the body. These colonies can be distinguished from the present species mainly by their longer, narrow and cylindrical stalk. The anterior extremity of the zooids project more from the anterior surface of the test than in *O. pseudobaudinensis*. Zooids of *C. baudinensis* examined have a maximum of 12 longitudinal thoracic muscles of which only a single band subdivides across the mid-line, ventral to the branchial aperture. In *C. baudinensis* there appears to be a more restricted range in the stage of development of embryos in the peribranchial cavity. Although some eggs are present in the oviduct they do not appear to start their development there as in the genus *Pycnoclavella*. In its colony and zooid form, *C. baudinensis* does appear to be closely related to *O. pseudobaudinensis;* however, its larvae and the degree to which eggs are apparently fertilised in the atrial cavity suggest that it is a more primitive species.

In *O. pseudobaudinensis* the oblique arrangement of the ventral thoracic muscles effects a depression of the anterior part of the thorax and draws it towards the postero-dorsal part of the thorax. The atrial aperture simultaneously becomes terminal as in *P. cylindrica,* thus facilitating the liberation of large larvae. In *C. baudinensis* larvae are smaller and more easily liberated through the normally oriented aperture; and the more parallel arrangement of longitudinal thoracic muscles does not appear to affect the relative position of the siphons. In neither of these species is the whole ventral surface withdrawn toward the postero-dorsal part of the thorax as is the case in *Podoclavella cylindrica* where there is a special brood pouch ensuring the retention of embryos.

Podoclavella cylindrica (Quoy and Gaimard)

Polyclinum cylindrica Quoy and Gaimard, 1834, p. 618.
Podoclavella cylindrica; Kott, 1972a, p. 5 and synonymy; 1972b, p. 167.

New Records: Western Port (Flinders Jetty, Balnarring Beach). Ram Head (18 mls south of Mallacoota Inlet, 6 m).

Distribution: W. Aust.: Rottnest Island, Fremantle, Albany; S. Aust.: St. Vincent Gulf, West Island, Wright Island; Vict.: Bass Strait, Port Phillip Bay. The greatest recorded depth for the species is 22 metres (West Island, Kott, 1972). The species is known from sheltered caves and under ledges.

Description: The present colonies generally have a firm basal common stalk and zooids are supported in the less firm terminal test and are independent of one another anteriorly. The usual blue pigment spots are present anteriorly and thoracic musculature extends obliquely from the ventral border to the postero-dorsal aspect of the body. Only in specimens from Western Port Bay are the zooids arranged around a central stalk which is 24 cm long and 2-4 cm in diameter, thickest terminally where it breaks into branches. Larvae of the usual form without ampullary lobes, are present in the brood pouches of this colony.

Remarks: In *P. cylindrica* contraction of the oblique thoracic musculature causes the foreshortening of the dorsal length of the thorax by drawing the postero-dorsal corner ventrally and anteriorly. The branchial aperture is simultaneously withdrawn leaving the atrial aperture terminal and anal and gonadial openings adjacent to it. The developing embryos are retained however, in a pouch from the dorsal surface, thus avoiding early liberation which could otherwise result from contraction of the thorax.

The relationship of specimens in which there is a central stalk to those that are supported upright and parallel to one another on a basal membrane is not known. Another specimen of the former type in the collection of the National Museum of Victoria is 60 cm long and resembles *Distaplia cylindrica* from the Antarctic (see Kott, 1969). The zooids in both forms are similar in every respect and the colonies appear to represent the same species. It is possible that the long axial stemmed forms are from deeper water.

Atapazoa mirabilis Kott

(Fig. 2)

Atapazoa mirabilis Kott, 1972b, p. 168.

New Records: Western Port (Tankerton jetty)

Distribution: The species has previously been recorded from S. Aust. (Elliston Bay).

Description: A single colony only is available. It is massive and irregular, 14 cm long and 6 cm wide. It is composed of fairly thin layers of zooid bearing test that coalesce so that the colony is traversed by spaces. The atrial siphon from the postero-dorsal corner of the thorax is characteristically long and posteriorly directed. Both the branchial and atrial apertures are bordered by six distinct lobes. There are three rows each of about 12 stigmata in each row. The horizontal gut-loop consists of a fairly long oesophagus, rounded stomach and wide intestinal loop. There is a single large ovum attached to the zooid from a region in the loop of the gut. The position of the brood pouch is apparently abdominal, rather than thoracic, and is reminescent of the situation in the Didemnidae.

Remarks: The species has been recorded previously only from Elliston Bay in South Australia. It is possible that it is endemic to the southern coast although the type location, on the floor of a cave, is only accessible to collectors equipped with SCUBA.

Sycozoa pedunculata (Quoy and Gaimard)

Aplidie pedunculatum Quoy and Gaimard, 1834, p. 626.
Sycozoa penduculata; Kott, 1972c, p. 234 and synonymy.

New Records: Western Port (Rutherford Channel); Port Phillip Bay (no location, artificial reef). South-east Portland.

Distribution: W. Aust.: Cockburn Sound, King Georges Sound; Tas.: d'Entrecastaeux Channel, Derwent Estuary, Furneaux Group; S. Aust.: St. Vincent Gulf; Vict.: Western Port,

Port Phillip Bay, Lakes Entrance; Qd.: Moreton Bay.

Discription: The usual large inverted conical heads on long slender stalks with basal tufts of roots. There are deep V-shaped furrows between each double row of zooids and the branchial apertures from each row of zooids open into each side wall of these furrows. The branchial openings are thus protected to some extent and the furrow provides an immediate microenvironment outside the openings. The apex of a rounded ridge between two of these furrows lies over the common cloacal canal. There are very large common cloacal openings around the outside of the flattened free ends of the lobes.

Larvae are present in colonies from Southeast Portland. They have the usual anterior papillae, an otolith, but no oecllus, and a short broad tail extending only three quarters of the ways around the body of the larva.

Sycozoa cerebriformis (Quoy and Gaimard)

Aplidie cerebriforma Quoy and Gaimard, 1834, p. 625.

Sycozoa cerebriformis; Kott, 1972a, p. 8 and synonymy.

New Records: Western Port (Crawfish Rock, Tankerton Jetty). Portland Harbour (5-10 m on rocks forming jetty).

Distribution: N.W. Aust.; S. Aust.: St. Vincent Gulf; Vict.: Balnarring Beach (Western Port), Port Phillip Bay; N.S.W.: Jervis Bay, Port Stephens, Port Hacking, Port Jackscn. South Africa. It has been rccorded from 5-40 m.

Description: Specimens are sturdy fan-shaped colonies with short stalks. The fan or zooid bearing portion may extend into a thick undulating lamellae. Common cloacal apertures are present along either side of the flattened free edge of the lamella. The double rows of zooids converge from this outer edge of the lamella down toward the top of the stalk.

Remarks: The specimens from deeper water at Crawfish Rock are larger than the colony taken in shallower water. It has already been observed (Kott, 1972a) that the species favours areas where there are steady but not strong unidirectional currents, and no surge or turbulence. The fan-like colony shape is apparently adapted to take maximum advantage of this type of environment. This species appears to be confined to more sheltered locations than *S. pedunculata,* very often where there is some turbidity and a muddy substrate although in the absence of a larval ocellus the light conditions are not likely to affect its settlement.

It has been recorded from a wider circumpolar range than *S. pedunculata* but although it has been taken from north western Australia it is not recorded from Moreton Bay and it has not been recorded from Tasmania. Its latitudinal range is therefore more limited. It has not been taken from depths greater than 40 metres. Its distribution suggests that it may represent a relict species confined within embayments in relatively shallow water where it can best take advantage of sheltered conditions.

Polycitor giganteum (Herdman)

Polyclinum giganteum Herdman, 1899, p. 79.

Polycitor giganteum; Kott, 1972a, p. 9 and synonymy.

New Records: Western Port (Crawfish Rock, Tankerton Jetty). Ram Head (18 mls south of Mallacoota Inlet, 6 m).

Distribution: A wide circum-Australian distribution from Rottnest Island (W.A.) and across the southern coast to Port Jackson (N. S. W.).

Description: One specimen from Crawfish Rock is more or less flattened and sessile, about 13 cm in diameter but only 5 cm high; another specimen has the usual rounded gelatinous head narrowing to a waist before expanding into a wide sandy base, possibly embedded in the substrate. The test is characteristically transparent and gelatinous and the zooids are large, radiating out from the base of the colony to open by separate apertures around the head.

Remarks: The species appears to favour rocky substrates where a firm adhesion can be effected, thus satisfying the requirements of a large, inflexible colony that is fixed by only a small area of the base. The species is found equally in embayments and on the open coast.

Eudistoma pyriforme (Herdman)
(Fig. 3)

Psammaplidium pyriforme Herdman, 1886, p. 419.
Eudistoma pyriforme; Kott, 1972a, p. 9 and synonymy.

New Records: Western Port (Crawfish Rock). Ram Head (18 mls. south of Mallacoota Inlet, 6 m).

Distribution: Palao and Gilbert Islands. Qd.: The Great Barrier Reef, in the Pacific; S. Aust.: St. Vincent Gulf. Madagascar.

Description: The colony from Mallacoota Inlet is flattened and firm with sand absent only from the surface layer of test which has brownish-purple spherical pigment cells. The colony from Crawfish Rock is irregular and investing, with a dense sand inclusion throughout the test, making it rather hard and obscuring the arrangement of the zooids. There are about 10 fairly wide muscle bands down either side of the thorax and an almost continous layer of circular muscles. The circular muscles on the siphons are well developed but do not form definite sphincters. The oesophagus is of medium length opening into a large shield shaped and smooth stomach halfway down the abdomen; the duodenal area is long, and in a contracted abdomen is bent in an S-shape. The intestine bends anteriorly after leaving a spherical posterior stomach, and forms a loop opposite the duodenum when the abdomen is contracted. The rectum extends anteriorly, to the peribranchial cavity, and is straight.

Remarks: Although Hastings (1931) regarded the loop in the gut as diagnostic of this species it has been observed in other species where the abdomen is contracted. There are few reliable diagnostic characters available in this genus where colony shape is variable, no systems are formed, and where the strong body musculature results in highly contractile zooids. The development of the musculature, the length of the oesophagus and the nature of the common test, therefore, provide the only morphological characters to determine the species, and it is possible that some misidentification occasionally occurs. The recorded distribution of this species also suggests that more than a single species is represented.

Pseudodistoma cereum Michaelsen

Pseudodistoma cereum Michaelsen, 1924, p. 364. Kott, 1972a, p. 12 and synonymy.

New Records: Western Port (Crawfish Rock). Cape Nelson (near Portland, vertical faces and roof of cave, moderate surge, 5 m).

Distribution: The species is apparently common intertidally and from depths down to 70 metres off the South Island of New Zealand. Other records are from the eastern coast of Victoria, and off the South Australian coast and from Dakar.

Description: The colony is very damaged and its form is not discernible. The test is very soft, jelly-like and transparent. Both apertures are 6-lobed, there are 3 rows each of about 20 stigmata. Stomach folds are not apparent externally, however internally its glandular wall is interrupted in 4 places to give, the appearance of folds. The zooids are short and the thorax, abdomen and posterior abdomen are of equal length.

Remarks: Zooids are characteristic. In view of the Australian and New Zealand records suggesting a circum-polar distribution in the southern cold temperate region the record from Dakar (Monniot, 1969) is surprising. Monniot's specimens do, however, agree with the present colonies and with those from New Zealand. The species is delicate and is taken from underneath ledges and in rocky locations where some protection is available.

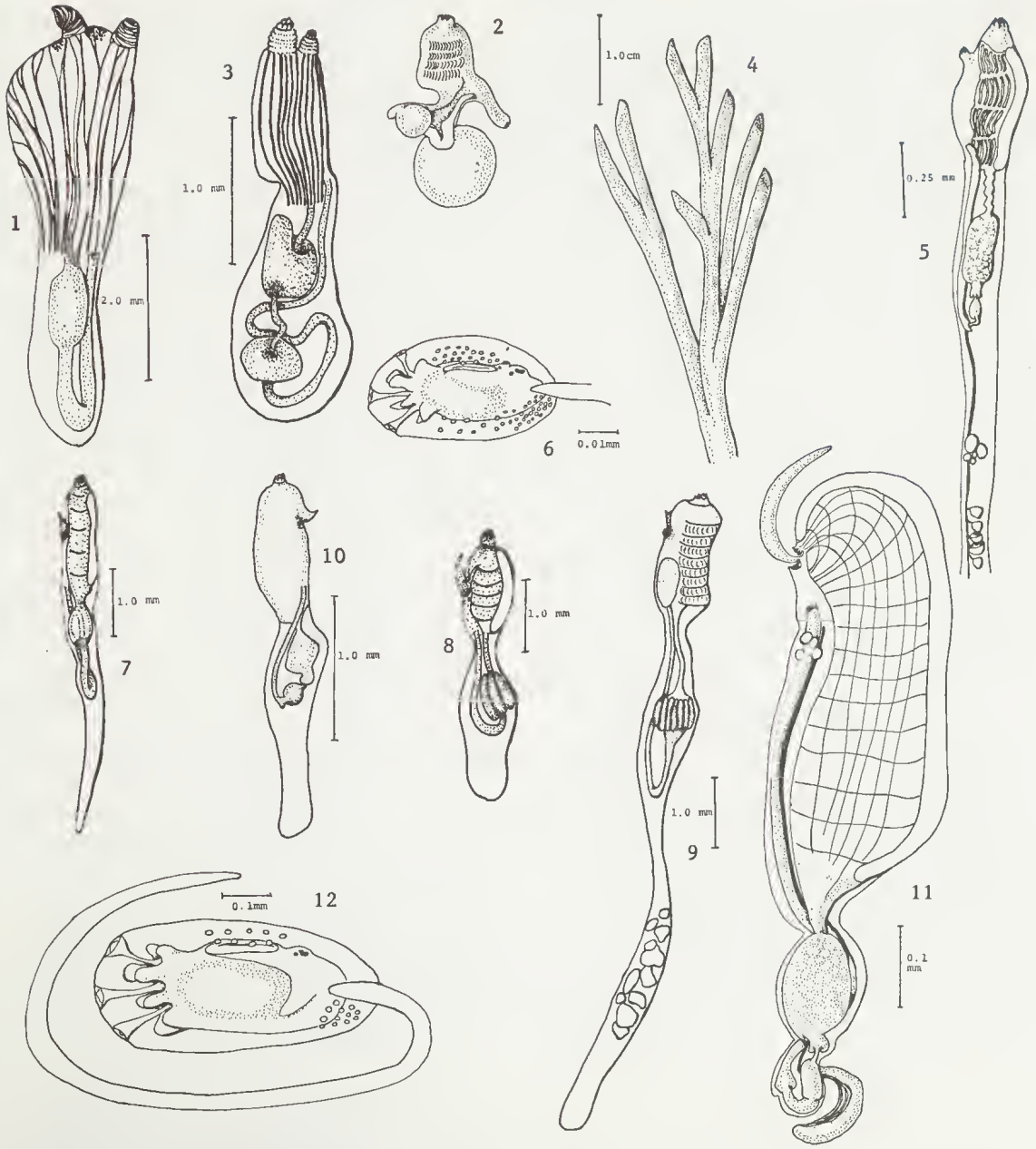
Dumus areniferus Brewin
(Figs. 4, 5, 6)

Dumus areniferus Brewin, 1952, p. 453.

New Records: Western Port Bay (Crawfish Rock).

Distribution: New Zealand: Otago.

Description: The colonies form a thicket of elongate branching stalks, club-shaped terminally with the free end obliquely flattened. The outer test is encrusted with a single layer of sand particles giving rigidity to the otherwise extremely delicate test. Each terminal lobe contains only a single zooid. The maximum length



Oxycorynia pseudobaudinensis
1—contracted zooid, musculature not shown on abdomen.
Eudistoma pyriforme
2—contracted zooid, musculature not shown on abdomen.
Atapozoa mirabilis
3—zooid.
Dumus areniferus
4—colony. 5—zooid. 6—larva.

Aplidium depressum
7—zooid.
Aplidium lobatum
8—zooid.
Aplidium triggiensis
9—zooid.
Synoicum hypurgon
10—zooid
Sidenioides tamaramae
11—zooid. 12—larva.

of the stalks is 6·0 cm. Zooids are about 3 cm long, of which the long thread-like posterior abdomen is about two-thirds of the total length. Both apertures are 6-lobed and open directly onto the surface of the terminal flat surface of the stalks. There are no protective flaps of test protecting the apertures such as are found in *Euherdmania australis*. There are about eight very fine thoracic muscles along each side of the thorax. There are six long stigmata crossed by parastigmatic vessels in each of four rows. The abdomen is approximately the same length as the thorax. The oesophagus is of moderate length, the smooth walled stomach is elongate and there is a posterior stomach and a duodenal region. A mid-intestinal region occupies, with the stomach and oesophagus, the descending limb of the gut loop before it enters the rectum in the pole of the loop. Testis follicles are present in a single row in the posterior abdomen and there is a group of ova anterior to the testis lobes, a little distant from the posterior end of the abdomen. The gonads occupy only the posterior half of the posterior abdomen.

The larvae are 0·5 mm long and there may be up to nine in the peribranchial cavity. They have paired rows of ampullary vesicles dorsally along either side of the endostyle and along either side of the postero-ventral aspect of the larval body. There are the usual three papillae anteriorly and these alternate with median ampulllae. Lateral ampullae are also present either side of the median ampullae.

Remarks: The specimens conform exactly both in colony and zooid form with those described by Brewin from New Zealand. The species resembles both *Euherdmania australis* and *Ritterella herdmania,* both with a similar colony. Externally it is distinguished from *E. australis* by the absence of the flap of test which protects the external aperture in the latter species (see Kott, 1957, 1972b), and from *E. herdmania* by the fan shape of the terminal tip of each lobe. It is possible that the aberrant colonies mentioned by Kott (1957) that were taken with *E. australis* were actually specimens of the present species.

Polyclinum marsupiale Kott

Polyclinum marsupiale Kott, 1963, p. 83.

New Records: Western Port (Crawfish Rock).

Distribution: S. Aust.: Victor Harbour; Tas.: Hunter Island; Qld.: Great Barrier Reef (Heron Island).

Description: Colonies are mushroom-shaped, up to 2 inches in diameter across the upper surface of the head which is supported on a short stalk; or alternatively the colonies may be spherical and sessile, fixed by a small area of the base. There is a dense outer layer of sand on the test absent sometimes from parts of the upper surface. Internally the test is very soft with only very occasional sand grains included. The internal test is traversed by canals in which the zooids are contained, and forms only thin septa between these canals. Preserved colonies are therefore often collapsed and flattened.

The zooids, opening around the upper half of the colony, are very small. The branchial aperture is terminal. The antero-dorsal atrial aperture is on a short siphon with a circular sphincter muscle and the opening is protected by a pointed muscular languet from the body wall anterior to the siphon. There are 14 to 15 rows of 10 to 12 rectangular stigmata with the usual rounded papillae on the transverse vessels. The stomach is smooth externally with an inner glandular wall.

Remarks: The heads of living colonies are apparently distinctively spherical, although in preserved specimens the soft internal test collapses and they are flattened and sometimes appear lobed or folded.

Aplidium depressum Sluiter

(Fig. 7)

Aplidium depressum Sluiter, 1909, p. 102. Kott, 1963, p. 95 and synonymy.

New Records: Western Port (Crawfish Rock, Rutherford Channel)

Distribution: Previously recorded only from Bargara (Queensland) and from Indonesia and the Philippines. The species is common in those locations from which it has been recorded. The reason for these isolated records is not known.

Description: Soft, jelly-like, flat investing colonies that are minute and circular fixed by a small area of their base, or more extensive fixed by the whole extent of the basal surface. The species commonly invests stalks and fronds of weed. Only very sparse sand grains are enclosed in the semitransparent brownish common test through which the zooids are clearly evident. In the smaller colonies the zooids are arranged in two or three circular systems of about six zooids, but in the larger colonies these expand into double row systems.

The zooids are minute with an inconspicuous sessile atrial aperture halfway down the dorsal surface of the thorax. There is a single short, pointed atrial languet from the upper border of the aperture. There are five rows of about eight stigmata. The thorax and abdomen are of equal length and together represent half the length of the zooid. The stomach has 11 distinct folds.

Remarks: The small number of rows of stigmata, with the number of stomach folds, the form of the colony and the nature of the test distinguish the species.

Apldium lobatum Savigny

(Fig. 8)

Aplidium lobatum Savigny, 1816, p. 182. Kott, 1963, p. 97 and synonymy.

Non *Psammaplidium lobatum;* Herdman, 1899, p. 85 (<*Aplidium solidum* Herdman, 1899; Millar 1963; >*A. arboratum* Kott, 1963).

New Records: Western Port (Crawfish Rock).

Distribution: Florida, West Indies, the Mediterranean, Red Sea, Indonesia, Queensland and the Great Barrier Reef and New South Wales. The present record extends the southern range of this species from the east coast of Australia.

Description: The colonies are irregular and investing. The common test is firm and hard with sand throughout. Zooids are minute with the thorax, abdomen and posterior abdomen all of equal length. The sessile atrial aperture has a deeply divided trifid languet from the anterior border of the opening. There are 8 fine longitudinal muscle bands along each side of the thorax extending onto the abdomen and posterior abdomen. There are six rows each of about six stigmata. The four stomach folds are only apparent internally.

Remarks: The species appears to be adapted for a rigorous environment, and is found investing the undersurface of rocks and in the present case, in algal holdfasts. The firm test and zooids with few stomach folds, are similar to the condition found in *A. solidum* Herdman in which zooids open on both sides of flat lamellae.

Aplidium triggiensis Kott

(Fig. 9)

Aplidium triggiensis Kott, 1963, p. 104.

New Records: Western Port (Crawfish Rock).

Distribution: W. Aust.: Rottnest Island, Triggs Island and Nornalup; Vict.: Balnarring Beach.

Description: The colonies are very soft and investing stones, etc. Sometimes they are produced basally into projections which extend into or around the substrate to form a very firm adhesion. Varying quantities of sand are present in the colonies. Posterior abdomina cross one another in the basal test. The zooids are minute, the thorax is 1·3 mm long and generally shorter than the abdomen when contracted; the posterior abdomen is long and thin and up to twice the length of the rest of the body.

There is a sessile atrial aperture about one third of the distance down the dorsal surface of the thorax, with a short, pointed, undivided languet from the upper border of the opening. There are 9 to 10 rows of about 15 stigmata. The oesophagus is long and the stomach, present about half way down the abdomen, is broken up into 14 to 15 distinct folds. A single embryo is present in the peribranchial cavity. It is 0·6 mm long and anteriorly there is a multiplicity of adhesive papillae in the median line around the anterior end of the larva as previously described for this species (Kott, 1963).

Remarks: This species also appears to be adapted for very rigorous conditions, both by the form of the colony and its tendency to produce extensions to fix it firmly to the substrate. The larval form is quite distinctive and is large in relation to the size of the zooid.

Consequently, a maximum of two larvae have been reported as present in the peribranchial cavity. In the absence of this distinctive larval form, these species could be confused with *Aplidium multiplicatum* (Sluiter) which has been recorded from Queensland, Japan, the Philippines, Indonesia and from Broome, North-western Australia (see Millar, 1963). In the latter species, however, the posterior abdomen is relatively short and the testis lobes form bunches in the posterior abdomen, rather than double rows, as in *A. triggiensis*.

Aplidium pliciferum (Redikorzev)

Amaroucium pliciferum Redikorzev, 1927, p. 390. Kott, 1972a, p. 13 and synonymy.

New Record: Western Port (Tankerton Jetty).

Distribution: See Kott, 1972a.

Description: The colony is a firm gelatinous cushion with a flat upper surface. There is a short stalk from the middle of the under surface. The margin of the colony is rounded. The test is semi-transparent and there is neither encrusting nor included sand. The zooids are tightly packed in double rows radiating from common cloacal apertures randomly placed on the upper surface. Anteriorly the zooids are parallel to one another and vertical, although the posterior abdomina may be more irregularly orientated in the basal half of the test. There are 12 fine longitudinal thoracic muscles extending separately along the abdomen and both sides of the posterior abdomen. They are never gathered into a close band. The atrial aperture is sometimes produced into a short siphon and the pointed single bifid lip extends from the upper border of the aperture. There are 11—15 rows each of about eight stigmata. The thorax and abdomen are about the same length and the posterior abdomen is long and threadlike. The stomach has 18 to 20 regular longitudinal folds.

Larvae are present in the peribranchial cavity. They have a double row of ampullary vesicles from the lateral ridges on either side of the median papillae which alternate with median ampullae.

Remarks: Although there is some variation in the number of rows of stigmata, in the number of stomach folds and in the shape of the colony, the firm gelatinous flat-surfaced colony form varies only in relation to the area by which it is fixed. The larvae are also characteristic. The species differs from the closely related *A. flavolineatum* which has more thoracic muscles, more stomach folds, lateral branches on the larval median ampullae and no larval ampullary vesicles.

Synoicium hypurgon (Michaelsen)
(Fig. 10)

Macroclinum hypurgon Michaelsen, 1924, p. 401.
Synocium hypurgon; Kott, 1963, p. 86 and synonymy.

New Records: Western Port (Crawfish Rock).

Distribution: W. Aust.: Rottnest Island, Fremantle; Great Barrier Reef: Heron Island. New Zealand: North Island.

Description: The present specimen consists of three large clavate to mushroom shaped lobes joined basally and to varying extends along their sides to form a large, hemispherical colony, 5 cm in diameter and sessile basally. There is sand around the sides of each lobe but not on the upper surface where the zooids open. The test is soft and gelatinous and has no foreign bodies. The zooids are present in the outer layer of the upper surface. There is a small, sessile atrial aperture one third of the distance down the dorsal surface of the thorax with a large, triangular atrial languet rising from the body wall anterior to the aperture. There are eight longitudinal muscle bands on the thorax. The branchial sac is very long and narrow with 13 rows of eight small oval stigmata in each row. The gut loop is short, about half the length of the thorax. The oesophagus is especially short and the stomach small and smooth. There is a duodenal enlargement and a posterior stomach in the loop of the gut.

Remarks: Although there is considerable variation in the form of colonies of this species and some variation in the amount of sand and other material which is contained in the common test, the small zooids, long, narrow branchial sac and relatively short abdomen, together with the relative position of the atrial tongue from the body wall rather than from

the anterior border of the atrial aperture distinguish it.

Synoicium sp.?

Record: Western Port (Crawfish Rock).

Description: The specimen is damaged and torn, although the fragments appear to represent a fairly thin investing colony. The test is semi-transparent and very soft. Zooids appear to be arranged parallel to one another and vertical to the upper surface. Zooids are fairly small and the thorax and posterior abdomen are about equal in length, while the abdomen is shorter. There are about 10 longitudinal thoracic muscles. The atrial aperture is sessile and there is a single pointed languet from the upper margin of the opening. There are three rows of about 10 long rectangular stigmata, each row crossed by parastigmatic vessels. Dorsal languets are present in the mid-dorsal line opposite both transverse vessels and parastigmatic vessels. The stomach is shield-shaped and smooth without any areolations, although it has a glandular appearance.

Remarks: The parastigmatic vessels in the branchial sac are unusual, although they have previously been described for *Synoicium atopogaster* Kott, 1962. The small number of rows of stigmata in the branchial sac suggests a relationship with *Synoicium bowerbanki*, which has, however, a longer oesophagus and a distinct atrial siphon. Further, in the present specimen, the dorsal languets opposite the parastigmatic vessels as well as the primary transverse vessels suggests that the rows of stigmata are in the process of subdividing and in fact the most posterior row does contain a few stigmata which are bisected in the region of the parastigmatic vessel. *Synoicium papilliferum* differs from the present specimen in the presence of a long siphon, although it has a short oesophagus, as well as the same number of longitudinal muscles and about the same number of stigmata in each row, as does the present specimen. It is most probable, therefore, that this represents a juvenile of some species of *Synoicium*, rather than a new species characterised by 3 rows of stigmata crossed by parastigmatic vessels.

Sidneioides tamaramae Kesteven
(Figs. 11, 12)

Sidneioides tamaramae Kesteven, 1909, p. 277. Kott, 1957, p. 104.

New Records: Western Port (Crawfish Rock).

Distribution: N.S.W.: Tamaramae Bay.

Description: The colonies are soft and pillar-like lobes. The free end of each lobe is raised into a rounded marginal ridge surrounding a terminal depressed surface from the centre of which there is a protruberant common cloacal aperture. The branchial apertures are made conspicuous by the absence of sand, around them. They open onto rounded swellings on the marginal ridge. The external test is completely encrusted with sand, absent only from the region around the apertures. The test is otherwise very soft. The abdomen is about half the size of the long thorax. The atrial lip is narrow and fleshy but very long with about 10 fine muscles extending along its length. The longitudinal thoracic muscles extend along the ventral side of the abdomen and the dorsum of the posterior abdomen causing it to curve when the muscles are contracted. There are 17 rows of stigmata with 18 stigmata in each row. There is no sign of papillae on the transverse vessels. The stomach is oval with mulberry-like glandular swellings in its wall. There is a duodenal region, a posterior stomach and a mid-intestine which expands into the rectum before it curves into the ascending limb of the gut loop. The ovary is developed in the thoracic wall at about mid-thoracic level and projects into the peribranchial cavity just to the right of the mid-line, the vas deferens and the distal part of the rectum. The anal opening is opposite the 7th row of stigmata.

There are about 18 eggs at varying stages of development in the ovary. Free eggs are also present in the peribranchial cavity together with up to 20 developing embryos. Mature embryos are 0·6 mm long and the tail is wound completely around the body. There is a double row of vesicles along either side of the mid-dorsal line and a cluster of vesicles postero-ventrally on each side of the body. Paired lateral ampullae alternate with the three

anterior papillae but there are no median ampullae.

Remarks: This record has extended the range of this interesting species, previously regarded as endemic to a small region on the coast of New South Wales.

Trididemnum cyclops Michaelsen

(Fig. 13)

Trididemnum cyclops Michaelsen, 1921, p. 19. Kott, 1966, p. 286 and synonymy. Eldredge, 1967: 183.

New Records: Western Port (Flinders Jetty, Eagle Rock).

Distribution: West Indian Ocean. N. Aust.: Darwin, Great Barrier Reef.

Description: Both the present records represent extensive colonies, almost completely investing specimens of *Ascidia sydneyensis*. In both cases the branchial aperture is free, although in one specimen the didemnid has grown over the atrial siphon, leaving a small space between the test of the host through which the excurrent water could flow.

The surface of the colony is smooth with a superficial layer of flat bladder cells and some spherical purple pigment cells. The spicules are dense beneath the layer of bladder cells and in the thoracic region and become less dense toward the base of the colony where they are absent altogether. They are from 0·03—0·05 mm in diameter with up to 12 pointed rays in optical section. There are no zooxanthellae in the common cloacal system of these specimens. There is a very shallow thoracic common cloacal cavity. The zooids have a minute thorax with three rows of stigmata. There is no endostylar pigment cap present in these specimens. The retractor muscle is fairly long. There is no atrial siphon, although there is a well defined and fairly long anterior lip from the border of the aperture. There is a single undivided testis follicle with 8¼ coils of the vas deferens.

Remarks: The surface bladder cell layer, the shallow thoracic common cloacal canal, the absence of an atrial siphon and the form and distribution of the spicules are characteristic of this species. The extensive colonies are different to the typical small colonies of tropical specimens. The absence of zooxanthellae should be especially noted as these are invariably present in specimens previously described. It is possible that the zooxanthellae are associated with a tropical environment and should not be regarded as a specific character. In addition, the endostylar pigment cap has invariably been present in previously described specimens of this species, but it is possible that its presence is a variable character as in *T. cerebriforme* (see below). However, these specimens do diverge from the characteristic facies of this tropical species and it is possible that there is a cline in its characters that is evident at the southern limit of its range.

Trididemnum cerebriforme Hartmeyer

(Fig. 14)

Trididemnum cerebriforme Hartmeyer, 1913, p. 139. Kott, 1972d, p. 247; 1972e, p. 47 and synonymy. non *Trididemnum cebriforme*; Kott, 1972b, p. 178.

New Records: Western Port (Crawfish Rock).

Distribution: South and West Africa; Indian Ocean; S.W. Aust.; S. Aust.; Vict.: Phillip Island; N.S.W.; Qd.; Gulf of Carpentaria. It therefore has a wide distribution in the southern temperate to subtropical regions and is absent only from the eastern Pacific and the Western Atlantic.

Description: The colony is irregularly lobed. Branchial openings are conspicuous and slightly protruberant, owing to the density of spicules filling the branchial lobes. There is the usual posteriorly directed atrial siphon. There is an extensive posterior abdominal cloacal system formed by canals traversing a central core of test. The spicules are less dense than at the surface. They are large, from 0·04 to 0·07 mm in diameter with five conical rays in optical section. The endostylar pigment cap is absent.

Remarks: With the exception of the endostylar pigment cap the zooids and colony of this specimen are identical with those previously described. The pigment cap is also absent from the specimens of *T. cyclops* from this locality. Specimens from South Australia (Kott, 1972b) without a posteriorly directed atrial siphon are incorrectly assigned to this species.

?**Didemnum candidum** Savigny
(Figs. 15, 16)

Didemnum candidum Savigny, 1816, p. 194. Kott, 1972a, p. 19 and synonymy; 1972b, p. 179.

New Records: Western Port (Crawfish Rock).

Distribution: Cosmopolitan (see Kott, 1972a).

Discription: Flat small pinkish colonies, the colour being due to the fairly sparse distribution of spicules allowing the zooids to show through. Spicules are mostly in the surface and basal test. There is an extensive thoracic common cloacal system. Zooids are about one mm long with four rows of stigmata. The anterior border of the atrial aperture is produced into an atrial lip, forked terminally. There is a single testis follicle with 4¼ coils of the vas deferens. Spicules range from 0·02 to 0·05 mm in diameter with conical pointed to needle-like rays.

Remarks: The present young colonies have the spicules typical of this species together with the extensive thoracic common cloacal cavity. Zooids of more typical colonies are brown. The production of the anterior border of the atrial aperture into a lip is another character not usual for the species.

Didemnum moseleyi (Herdman)
(Fig. 17)

Leptoclinium moseleyi Herdman, 1886, p. 272.
Didemnum moselyeyi, Kott, 1972a, p. 19 and synonymy; 1972b, p. 179; 1972d, p. 249.

New Records: Western Port (Crawfish Rock, Eagle Rock).

Distribution: Pacific and Indo-Malayan region; circum-Australian.

Description: Common, although not very numerous. White investing colonies and small circular colonies on weed are available. Spicules are dense throughout the test which is rather brittle. The common cloacal canals are thoracic and zooids are enveloped in an independent thoracic sheath where the thorax crosses the common cloacal cavity. The surface layer of test is very thin indeed. In some colonies there are primary canals extending to abdominal level and surrounding discrete clumps of zooids which are embedded abdominally in the common basal test, although their thoraces are separate, each in a discrete thoracic sheath. The surface layer of test in these colonies is depressed over the deep primary cloacal canals giving a cauliflower appearance to the surface of the colony. Large common cloacal openings are distributed randomly over the surface and some spicule filled papillae are also present on parts of the colony. The spicules are 0·01 to 0·03 mm in diameter with about seven pointed rays in optical section. The common cloacal system in this species does not appear to develop by proliferation of double row systems but by a development of the primary cavity to envelop the thorax of each zooid as it is added to the system. Zooids are minute and colourless in formalin. Small spherical lateral organs are present either side of the thorax opposite the most posterior row of stigmata. There is a long retractor muscle. The vas deferens coils 9½ times around the undivided testis follicle.

In one specimen large spherical vesicular cells are present in the surface test surrounding each branchial opening to form wide intersecting circles that interrupt the dense spicules so that the surface appears to be pitted rather than smooth. The spicules, cloacal system and zooids otherwise conform with *D. moseleyi.*

Remarks: The vas deferns in these colonies has more coils than is usual for the species although a wide range has been reported. The distribution and form of the rather constant spicules and the size and position of the lateral organs have been used to determine this species and to distinguish it from *Didemnum candidum* (see Kott, 1972a) which has a similar cloacal system and a similarly wide range recorded for the spirals of the vas deferens.

Didemnum patulum (Herdman)
(Fig. 18)

Leptoclinum patulum Herdman, 1899, p. 92.
Didemnum patulum Kott, 1972a, p. 18.

New Records: Western Port (Crawfish Rock, on *Ecklonia* holdfasts and investing other ascidians; Eagle Rock).

Distribution: N.S.W.: Port Jackson; S. Aust.: St. Vincent Gulf.

Description: Colonies form large sheets. The surface is smooth. Smaller colonies may be an even, greyish colour, but larger colonies always have grey-blue to black mottled markings. There is a surface layer of bladder cells and beneath these numerous stellate pigment cells are distributed amongst the spicules to form the mottled markings that characterise the species. Spicules gradually become less dense toward the base of the colony. The pigment cells are especially concentrated in the test overlying the cloacal canal; occasionally they may extend into the test beneath the surface layer and beneath the common cloacal cavities and when this occurs the colony is almost black in colour. The spicules are stellate, with pointed or rounded rays. The majority of spicules are 0·03 - 0·04 mm in diameter with about seven rays in cross section. There are, however, less common spicules of similar form but larger diameter, up to 0·05 mm. There are also smaller spicules with up to 12 sharply pointed rays in cross-section similar to those found in *Didemnum candidum*.

The zooids are embedded in the rather solid common test and open on both sides of cloacal canals. Primary cloacal canals sometimes extend the whole length of the zooid and may extend slightly posterior abdominally. The secondary cloacal canals remain at the level of the thoraces. The surface test is thick and there is a long branchial opening. The upper border of the atrial opening is sometimes produced into a lip. There are four rows of about eight stigmata. The basal layer of test in which the abdomina of the zooids are embedded is rather thick and gelatinous.

Remarks: This species is the most common ascidian in the particularly rich ascidian fauna at Crawfish Rock. The characteristic marking caused by greyish-black stellate pigment cells overlying the common cloacal canals and the thick layer of basal test distinguish the species from *Didemnum candidum* in which there is the same variety in form of the spicules. The common cloacal system is also distinctive in that the thoraces of zooids are not completely enveloped by the cloacal cavity as in *D. candidum and D. moseleyi* but remain embedded in common test opening into the cloacal canals from their dorsal surface. Although the species has been recorded from Port Jackson and from St. Vincent Gulf it is never present in the same high density as at Crawfish Rock and it has never been reported from Port Phillip Bay.

Didemnum turritum Michaelsen

(Figs. 19, 20)

Didemnum turritum Michaelsen, 1930, p. 521. Kott, 1962, p. 319.

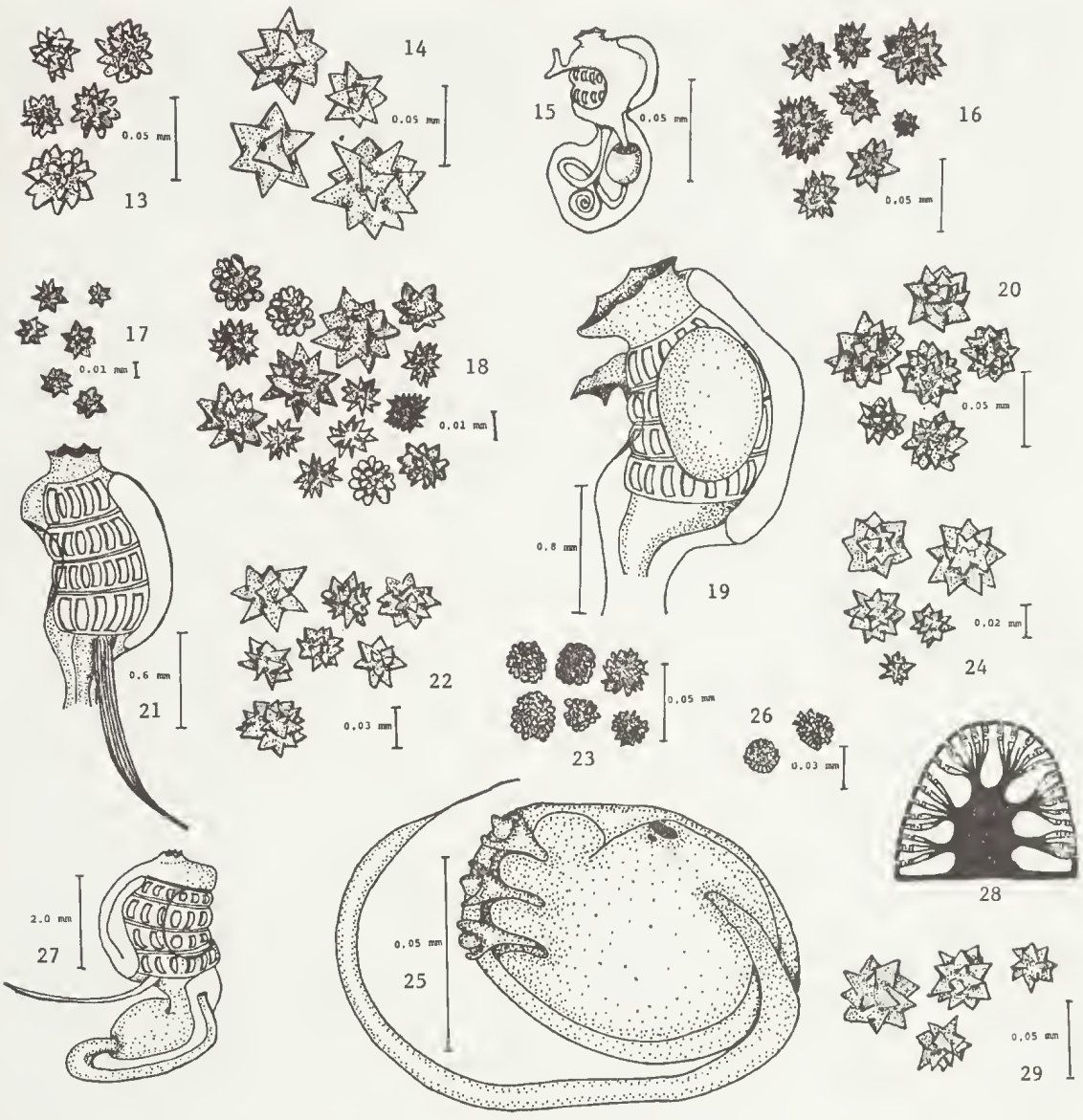
New Records: Western Port (Crawfish Rock; Eagle Rock).

Distribution: S. W. Aust.; S. Aust.: St. Vincent Gulf.

Description: Pinkish investing colonies. Large cloacal apertures are scattered over the surface. The branchial apertures are also conspicuous owing to the density of spicules in the test covering the branchial lobes. A single lobe of the branchial aperture sometimes developes a hollow pointed papilla from its base. Small rounded pigment cells line the common cloacal cavities. The surface of the test may be depressed over the deep primary common cloacal canals to form furrows on the surface. Clumps of zooids are surrounded by these deep primary canals which sometimes extend posterior to the abdomina of zooids. The secondary cloacal cavities are thoracic. The spicules are regularly stellate with about seven conical rays in section and are 0·3 to 0·4 mm in diameter. The thorax of each zooid is about 1·0 mm long with large oval lateral organs which occupy a pronounced pit in the thoracic wall along most of its length. The branchial siphon has a well defined circular sphincter muscle but is not very long although the surface layer of test is thicker than that of either *D. candidum* or *D. moseleyi*. The atrial aperture is extensive exposing most of the dorsal part of the branchial sac and sometimes its anterior border is produced into a pronounced forked lip. The thoracic retractor muscle was not detected.

There are four rows of about eight stigmata. The gonads were not distinguishable.

Remarks: The species is readily recognized by the hollow pointed papillae associated with



Trididemnum cyclops
13—spicules.
Tridemnum cerebriforme
14—spicules.
Didemnum candidum
15—zooid. 16—spicules.
Didemnum moseleyi
17—spicules.
Didemnum patulum
18—spicules.
Didemnum turritum
19—thorax. 20—spicules.
Didemnum augusti
21—thorax. 22—spicules.
Didemnum roberti
23—spicules.
Didemnum spongioides
24—spicules. 25—larva.
Lissoclinum fragile
26—spicules.
Diplosoma translucidum
27—zooid. 28—diagrammatic cross section through colony.
Polysyncraton victoriensis
29—spicules.

one of the branchial lobes of each aperture in certain limited areas. These papillae superficially resemble those sometimes occuring in *D. moseleyi* although in the latter species they are not hollow and are not specifically associated with the apertures. The thicker surface test, the relatively large zooid and the large oval lateral organs also distinguish the species.

The hollow papillae protecting the branchial apertures are reminiscent of those in *D. nekozita* Tokioka, 1967, from the Palau Islands and the Philippines. The latter species, however, has distinctive spicules and a thoracic cloacal system.

Didemnum augusti Michaelsen

(Figs. 21, 22)

Didemnum augusti Michaelsen 1920, p. 39. Kott, 1962, p. 323; 1972d, p. 247.
?*Didemnum partitum* Tokioka, 1953, p. 191.

New Records: Western Port (Crawfish Rock). Ram Head (18 miles south of Mallacoota Inlet).

Distribution: S.W. Aust.; S. Aust.: Reevesby Island; Vict.: Balnarring Beach; West Indian Ocean.

Description: Very extensive, thin, investing colonies with dense white spicules, less dense only in the basal test. The spicules are stellate from 0·03 to 0·05 mm with 5 to 7 conical pointed rays in optical cross section. The surface of the test is furrowed and has a cauliflower-like appearance where the surface test is depressed over the deep primary canals. The primary canals extend the whole length of the zooids between pillars of common test in which the abdomina are embedded. Only the dorsal aspect of the thorax is exposed to the common cloacal canals. Some secondary canals are present but the thorax is never enclosed in its own discrete sheath of test. The test along either side of the atrial opening is thickened but there is no lateral organ. The thorax is small, 0·6 mm, with four rows of stigmata. There is a retractor muscle always present.

Remarks: The species is distinguished from *D. turritum* and *D. moseleyi,* which often have the same surface furrows and deep primary canals, by the solid pillars of test in which the zooids are embedded, by the very small thorax, the absence of a distinct lateral organ and by the large spicules with few conical rays.

Didemnum roberti Michaelsen

(Fig. 23)

Didemnum roberti Michaelsen, 1930, p. 516.
Didemnum ternatanum; Kott, 1972b, p. 179.

New Records: Western Port (Crawfish Rock; Eagle Rock).

Distribution: W. Aust.: Shark Bay; S. Aust.: Elliston Bay.

Description: Investing colonies with a smooth surface and dense spicules in the surface and basal layers of test. The common cloacal apertures have their borders stiffened with spicules and are very conspicuous. Some colonies are flattened but in some, rounded lobes are developed by a thickening of the basal test to form a central core of test. There are extensive posterior-abdominal cloacal spaces and the zooids are suspended in clumps between the surface and basal layers of test, anchored basally by a short single strand of test, and at the surface by the branchial lobes of respective zooids. Secondary common cloacal cavities surround the thoraces of the zooid, each surrounded by a discrete layer of test and with a large lateral organ occupying most of each side of the thorax (as in *D. turritum*). The spicules are not so thick in the test surrounding the zooids. The surface test is fairly thick, again resembling *D. turritum.* Spicules are almost spherical, 0·02 to 0·04 mm in diameter with rounded rays. The zooids are small. The testis follicle is undivided and has 7½ coils of the vas deferens around it.

Remarks: The present colonies diverge from Michaelsen's (1930) specimens only in the presence of spicules throughout basal or axial test. In the Shark Bay material the basal layer of spicules was confined to a layer beneath the posterior abdominal canals to form a sort of endoskeleton.

Colonies from Elliston Bay (Kott, 1972b) which are identical with the present colonies from Western Port, were erroneously assigned

to the species *Didemnum ternatanum* Gottschaldt. Although the three-dimensional common cloaca and the size and form of the spicules are similar to those of *D. ternatanum,* the present species is distinguished from it by its external, oval lateral organ, by the more densely distributed spicules; by the multiplicity of common cloacal apertures and extensive colony; and by its firmer consistency. *D. roberti* is distinguished from *D. bistratum* Michaelsen, 1920 from West Africa by the form of its spicules (those of the latter species are spherical and hollow) and by its external lateral organ. *D. spongioides* also has a similarly labyrinthine common cloaca, but its spicules are stellate, with fewer, conical rays, and fewer coils of the vas deferens.

Didemnum roberti has previously been described as yellow, or yellowish—no information is available on the *in vivo* colour of the present colonies.

Didemnum spongioides Sluiter

(Figs. 24, 25)

Didemnum spongioides Sluiter, 1909, p. 67. Kott, 1962, p. 318; Eldredge, 1967, p. 193.

New Records: Western Port (Crawfish Rock).
Distribution: Caroline Is.; Indonesia; W. Aust.: Rottnest Island; Tas.: Oyster Bay. The records suggest a circum-Australian distribution.
Description: Colonies are rounded to conical with a terminal common cloacal cavity. The test is firm. Spicules are present in a layer beneath a surface layer of bladder cells at the level of the branchial siphons. They are less dense beneath this layer and are entirely absent from the test core that occupies the centre of the colony. The surface of the test is covered with minute spicule-filled pointed papillae that project through the bladder cell layer and, when magnified, give to the surface a spotted appearance.

The spicules are stellate with about seven conical rays in cross section, and range from 0·02 to 0·06 mm in diameter. An extensive common cloacal cavity separates the outer spicule and zooid bearing layer of test from the inner spicule free test core in which embryos develop. Cloacal canals extend into the zooid bearing layer but these do not separate clumps of zooids from one another. The openings of the common cloacal canals into the posterior abdominal chamber are shown by Sluiter (1909, Plate 6, fig. 9) and the ridges and trabeculae he describes are formed by the roof of the cloacal chamber enclosing abdomina of zooids projecting into the chamber, between the openings of the canals. These ridges and trabecula are not the imprint of the substrate on the base of the colony as Eldredge (1967) has suggested. Zooids are small. The thorax, when contracted is only 0·5 mm long. There is a wide atrial opening and a small rounded lateral organ opposite the 4th row of stigmata. The vas deferens coils 6½ times around the undivided testis follicle.

Embryos are packed in the central test core at the base of the common cloacal chamber, into which they move through the occasional strands of test that connect the surface layer to the central core. They are 0·9 mm long when mature, have an ocellus and an otolith, and four pairs of lateral ampullae. The tail winds once around the embryo.
Remarks: The species is related to *D. lambitum* in the form of cloacal system and the spicules and is distinguished from that species by the presence of a bladder cell layer and by the larva in which the ampullae are not subdivided.

D. spongioides; Eldredge, 1967, differs from the present specimens in the presence of pigment cells, the even investing form of the colony and in the condition of the cloacal system with well developed thoracic secondary canals and primary canals extending posteroabdominally but not forming a continuous space separating surface from central or basal test. The thickness of the surface layer of test, the arrangement of cloacal canals, the spicule form, size and arrangement, and the presence of pigment cells of Eldredge's specimens are identical with those of *D. turritum* from which they differ only by the absence of hollow pointed papillae on the surface.

The colony is typically "sponge-like" in external appearance, rounded and sessile.

Didemnum lambitum (Sluiter)

Didemnoides lambitum Sluiter, 1900, p. 18.
Didemnum lambitum; Kott, 1962, p. 317 and synonymy; 1971, p. 19; 1972a, p. 18.

New Record: Port Phillip Bay (Hobson's Bay).
Distribution: N. Z.: Chatham Island, North Island, South Island, Stewart Island; Tas.; S. Aust.: St. Vincent Gulf.
Description: The colonies are more or less fan shaped, made up of vertical lamellae or columns. These may fuse for the greater part of their length, or only basally or terminally. The free outer edge of the fan is more or less flattened. Common cloacal apertures are large and rounded and are occasionally but not always found on the free ends of the lobes. The test is firm and gelatinous, without sand. There is a central gelatinous core of test surrounded by specially extensive common cloacal spaces. The zooids are small and numerous, closely packed in the outer layer of test. There are $8\frac{1}{2}$ coils of the vas deferens around a single undivided testis follicle.
Remarks: This species appears to be limited to the more temperate waters of Australia and New Zealand extending north only to N .S. W. on the east coast of Australia. The spicules are usually present in the surface test at the level of the zooids but are often absent in the remainder of the test. In one of the present colonies spicules are absent entirely. The relationship of the present species to *D. spongioides* is close. Both have a firm gelatinous test and a similar common cloacal system. In both the spicules are usually absent from the central test core and form a layer only at the level of the branchial siphons. In both they are stellate with about seven conical pointed rays. The species appear to be distinguished only by the absence of a superficial bladder cell layer in *D. lambitum* and by the larvae which, in the latter species, has subdivided lateral ampullae. Generally the colonies of *D. lambitum* are higher than those of *D. spongioides*. *D. spongioides* has been recorded from the tropics but *D. lambitum* has not. It is possible that both species represent different stages in development of a single species, however, additional specimens, together with larvae will be needed to resolve the question.

Didemnum skeati (Sollas)

Hypurgon skeati Sollas, 1903, p. 729.
Didemnum psammatodes var. *skeati;* Michaelsen, 1920, pp. 22, 27 and synonymy. Hastings, 1931, p. 95, Kott, 1962, p. 326.

New Records: Western Port (Crawfish Rock; Eagle Rock).
Distribution: Malaysia; Indian Ocean; Vict.: Flinders; Qd.: Moreton Bay, Sarina, Low Isles; Torres Strait: Possession Island. The species has not been recorded from Western Australia but in view of its Indian Ocean occurrence could be expected to occur there.
Description: A large number of extensive sheets, blackish in colour owing to embedded balls of mud throughout the test. Small groups of spicules, as previously described, are present over each branchial aperture. The cloacal canals are thoracic. Zooids are very small.
Remarks: The specimens conform completely with previous descriptions. In view of the constant nature of this form and its consistent differences from *D. psammatodes,* it has been elevated to specific rank.

Lissoclinum fragile (Van Name)

(Fig. 26)

Diplosomoides fragile Van Name, 1902, p. 570.
Lissoclinum fragile; Eldredge, 1967, p. 245 and synonymy.
? *Diplosoma* (sic) *caulleryi* Ritter and Forsyth, 1917, p. 489.
? *Lissoclinum caulleyri;* Van Name, 1945, p. 114.
? *Lissoclinum marpuni* Millar, 1953, p. 301.
? *Lissoclinum bilobatum* Millar, 1955, p. 180.
? *Lissoclinum japonicum* Tokioka, 1958, p. 73.
? *Lissoclinum notti* Brewin, 1958, p. 457.

New Records: Western Port (Eagle Rock)
Distribution: West Indies; ? East Africa; ? South Africa; ? Japan; Pacific; ? California; ? New Zealand. Except for *Lissoclinum fragile* Van Name and *Lissoclinum caulleryi* Ritter and Forsyth, the suggested synonyms are known only from single records. The present specimen is the only record from Australia. The lack of records may be explained by the brittle nature of the very thin investing colony which is removed from the substrate only with the greatest difficulty. The species is probably

circum-tropical and extends into temperate regions of both the northern and southern hemispheres.

Description: The colony is thin and extensive, investing a very large specimen of *Ascidia sydneysis*. There are pinkish brown pigment cells in the surface test. Spicules are very dense throughout, and the colony is very brittle. Spicules do not line the branchial lobes and are absent from a circular area in the region of the branchial aperture through which the interior of the colony is visible. They are small, 0·02 to 0·03 mm in diameter, burr-like with many flat ended rays. The cloacal cavity is mainly thoracic, primary canals sometimes extend to the abdominal level but never posterior to the zooids. The abdominal portion of the zooids is embedded in the basal test which is very solid and hard owing to the density of spicules. The thoraces cross the cloacal cavity in independent test sheaths that are interrupted over the dorsal surface and most of each side of the thoraces they envelope. A very large 'flap like' lateral organ is present supported on the edge of the test sheath near the ventral border of the zooid and overlapping the branchial sac opposite the interval between the third and fourth rows of stigmata. There are four rows of stigmata with eight stigmata in each row. There are two testis follicles with a straight vas deferens, hooked proximally around between the two testis follicles.

Remarks: The synonymy suggested above was first indicated by Kott (1962). The specimens all have a deeply indented atrial aperture, a similar two dimensional cloacal system, and similar spicules within the same size range although there is some variation in their density and arrangement. The lateral organ is usually present and is flap-like and opposite the third to fourth rows of stigmata in all cases except in *L. fragile;* Tokioka, where it appears to be elliptical, not supported on the edge of the test sheath and opposite the second row of stigmata. In *L. fragile;* Eldredge, it is described as a "small flap-like" organ and in *L. marpum* Millar it is also small. In *L. fragile* Van Name it is not always present and has not been described at all for *L. notti* Brewin.

Its presence and degree of development is, therefore, apparently variable and its use as a distinguishing character would not in any case resolve the taxonomy of the forms indicated above on any rational geographic ground.

Larvae have been described for *L. notti* Brewin and *L. fragile;* Eldredge. They are identical in size and form although some of Eldredge's specimens had a layer of small opaque particles surrounding the larval body similar to the particles described for *L. ostrearium;* Kott (1962).

The present species differs from *L. ostrearium* Michaelsen and *L. molle* Herdman in the absence of a three dimensional cloacal system.

Lissoclinum ostrearium Michaelsen

Lissoclinum ostrearium Michaelsen, 1930, p. 526. Kott, 1962, p. 308 and synonymy.

New Records: Western Port (Crawfish Rock; Flinders Jetty).

Distribution: W. Aust.: Rottnest Island; S. Aust.: St. Vincent Gulf; Qd.: Great Barrier Reef.

Description: The colonies are very thin investing and rather delicate. There are some black pigment particles in some parts of the colony. There is a thin layer of surface test. The basal test is thicker, sometimes enclosing abdomina but more often clumps of zooids are anchored to the basal test by a single narrow strand of test. The common test then subdivides to enclose each zooid in an independent test sheath for almost its whole extent and anchoring it anteriorly to the surface test. Each individual test sheath is interrupted dorsally to expose a large part of the dorsal surface and sides of the branchial sac to the extensive common cloacal cavity. The spicules are distributed in varying density in different parts of the colony and are often almost entirely absent. They are less dense in the surface layer than in the remainder of the test. The spicules are 0·025 to 0·03 mm in diameter and are characteristic, with a large number of flat-ended rays. There is a small, flap-like lateral organ opposite the interval between

the third and fourth rows of stigmata. No embryos are present in these Victorian colonies.
Remarks: The atrial aperture and the lateral organ are similar to those of *L. fragile*. They are distinguished only by the colony which demonstrates a maximum development of the cloacal system as in other species of *Lissoclinum* and *Diplosoma*.

Eldredge (1967) drew attention to the fact that the difference in the shape of the stigmata is probably not a valid character to distinguish *L. fragile* and *L. ostrearium*. It is possible that the shape of the stigmata is affected by the extent to which colonies with dense spicules retain their original shape when preserved in formalin so that the branchial sac is maintained in an extended condition by the rigid test.

Diplosoma translucidum (Hartmeyer)

(Figs. 27, 28)

Leptoclinum translucidum Hartmeyer, 1909, p. 1490.
Diplosoma translucidum; Kott, 1962, p. 306 and synonymy.

New Records: Western Port (Eagle Rock).
Distribution: W. Aust.; Oyster Harbour, Albany; N. W. Aust.; Indonesia.
Description: The colony is long, narrow and irregular investing a worm tube. It has a transparent test that is fairly soft but tough and not jelly-like. The basal test is extended upwards in a lamella along the mid-longitudinal axis of the colony. Strands of test from both sides of this lamella support clumps of zooids. The common test then subdivides to form test sheaths supporting the thorax of each zooid independently at the surface. The zooids are fairly large with the thorax about 2 mm long. There are four rows of about 10 stigmata. A large part of the branchial sac is exposed through the wide atrial opening. There is a long rectum. Oesophageal buds are present, but gonads were not distinguished.
Remarks: The species is distinguished from *D. rayneri* by its firmer test and, although the cloacal system is typical of the genus with long test strands anchoring the zooids basally, the secondary cloacal spaces are not so well developed and zooids tend to remain in clumps. This also gives the colony a firmer consistency.

Diplosoma rayneri MacDonald

Diplosoma rayneri MacDonald, 1859, p. 373.
Leptoclinum (Leptoclinum) rayneri; Kott, 1966, p. 290.
Diplosoma listeranum; Rowe, 1966, p. 458 and synonymy.
Diplosoma macdonaldi; Eldredge, 1967, p. 231.

New Records: Western Port (Crawfish Rock).
Distribution: Cosmopolitan (see Rowe, 1966).
Description: Typical delicate colonies. Vegetative reproduction in progress. No mature gonads observed.

Polysyncraton orbiculum Kott

Polysyncraton orbiculum Kott, 1962, p. 301. Kott, 1872a, p. 21.

New Records: Western Port (Crawfish Rock).
Distribution: W. Aust.: Rottnest Island; S. Aust.: St. Vincent Gulf.
Description: The colonies are small and investing with the usual circle of large vesicular cells around each branchial aperture. There is a single layer of spicules in the surface test, interrupted by these large vesicular cells. The zooids, with the red brown pigment in them, give to the colony a pinkish brown colour. Sometimes the vesicular cells are so large that they are almost confluent. Because these cells are transparent and interrupt the distribution of spicules the surface of the test appears to be pitted, or, when they are almost confluent, it appears to be depressed into a narrow trough or furrow around each opening so that the apertures are at the apices of apparent mounds over each zooid. The spicules are 0·02 to 0·03 mm in diameter and are regularly stellate with about eight conical rays in optical section.

The cloacal canal is shallow and thoracic, the zooids small and completely embedded. Gonads were not detected.
Remarks: The form of the colony and arrangement of spicules has been used to determine this species.

Polysyncraton victoriensis n. sp.

(Fig. 29)

Type location: Western Port (Crawfish Rock, 8 m, on *Ecklonia* holdfasts) *Holotype,* National Museum of Victoria No. H. 171.

Description: The colony forms a thin investment over weed. It is a rather dirty whitish colour in formalin. There is a layer of bladder cells superficially over the top of each zooid. Between the zooids, however, spicules invade the superficial layer of test which stands out as spicule filled ridges between the zooids and gives an irregular and rather angular appearance to the colony. Zooids thus appear to open into the base of furrows on the surface. There is a very shallow common cloacal cavity. Spicules are stellate, 0·03 to 0·06 mm in diameter with only five conical rays in section. They are arranged evenly throughout the test. Zooids are small. There are four rows each of six stigmata in the branchial sac. There are 4½ coils of the vas deferens around three to four testis follicles.

Remarks: The arrangement of spicules is the same as that described by Hastings, 1931 for *P. magnetae.* Hastings species, however, has smaller spicules, fewer turns of the vas deferens, more testis follicles and more stigmata.

Phallusia depressiuscula (Heller)

Ascidia depressiuscula Heller, 1878, p. 5.
Phallusia; depressiuscula; Kott, 1972a, p. 23 and synonymy.

New Records: Western Port (Flinders Jetty; Tankerton Jetty); Port Phillip Bay (Hobson's Bay; artificial reef). Portland Harbour 6-12 metres, on rocks forming jetty.

Distribution: Ceylon; Indonesia; Arafura Sea, Philippines; circum-Australia.

Description: The present specimens fall within the range previously indicated for this species. Large specimens from Portland Harbour are black; while the smaller specimens and specifrom Flinders jetty, up to 20 cm in length and fixed by the whole of the left side, are brownish and translucent. One of these large specimens is completely invested with *Lissoclinum fragile.*

Ascidia sydneyensis Stimpson

(Fig. 30)

Ascidia sydneyensis Stimpson, 1855 (? part), p. 387. Kott, 1972a, p. 24 and synonymy; 1972, p. 182; 1972c, p. 237; 1972e, p. 49.

New Records: Western Port (Tankerton Jetty, Flinders Jetty, Crawfish Rock, Eagle Rock); Port Phillip Bay (Williamstown, Hobson's Bay; artificial reef).

Distribution: West Indies; South and east Africa; Indian Ocean; Indonesia; circum-Australian. The species is apparently circum-polar in tropical and temperate waters of the southern hemisphere although it extends north of the tropics only to Japan.

Description: Large specimens at least 10 cm long and up to 20 cm are available from all stations, fixed by the whole of the left side. The apertures are on the usual short cylindrical siphons, the branchial aperture is always turned to the left toward the substrate. The atrial aperture from half way down the body is turned to the right or directed anteriorly along the dorsal surface. Sometimes the whole antero-dorsal part of the body is turned over to the left. The test of these large specimens is firm and gelatinous and slightly leathery superficially except along the left side where it is fixed to the substrate and there it is very thin. Two of the four large specimens from Flinders jetty are completely covered by investing didemnids. On one specimen there is a colony of *Didemnum* posteriorly and a colony of *Tridemnum cyclops* anteriorly, which leaves only the branchial aperture free. These colonies overlap one another across the upper surface in a line with the atrial aperture which is also left free. On the other specimen the upper surface is completely invested with a colony of *Tridemnum cyclops.* There the branchial aperture is free but the atrial aperture is covered and the excurrent stream from the *Ascidia* is apparently directed along a groove in its test to the left of the line between the atrial and branchial siphons and underneath the encrusting didemnid. The gut, in all these specimens, is filled with mud and the branchial sac is occluded by the distended gut.

Ascidia gemmata Sluiter

Ascidia gemmata Sluiter, 1895, p. 177. Kott, 1972a, p. 26 and synonymy.
Ascidia thompsoni; Kott, 1975, p. 10.

New Records: Port Phillip Bay (Mornington Pier).

Distribution: Pacific; Malaysia; Indonesia; Arafura Sea; circum-Australia. The species thus appears to have a wide range in the Indo-Pacific area.

Description: Two specimens are available, about 20 cm long. The branchial aperture is terminal on a short siphon. The atrial aperture is sessile, two-thirds of the way along the dorsal surface. There is a long furrow extending along the right side of the body and the atrial aperture is directed into that furrow. The animal is fixed by the whole of the left side. The test is firm, gelatinous and smooth on the surface.

Internally the siphons are more conspicuous. There are 60 branchial tentacles, the dorsal tubercle fills the peritubercular area. The prebranchial region is minutely papillated. The dorsal lamina has the usual strong ribs on both sides, each rib terminating in a minute pointed tongue to form a marginal fringe. The dorsal gland and ganglion are one third of the distance down the body. There are intermediate papillae in some parts of the branchial sac in addition to the papillae at the junction of the transverse and parastigmatic vessels. The oesophageal opening is just posterior to the base of the atrial opening and branchial sac extends posteriorly to it.

Remarks: The species has not yet been recorded from Western Port Bay but will, very likely, be found to occur there.

Botrylloides leachi (Savigny)

Botryllus leachii Savigny, 1810, p. 7.
Botrylloides leachi; Kott, 1972a, p. 29 and synonymy; 1972b, p. 185; 1972d, p. 253.

New Records: Western Port (Crawfish Rock); Portland Harbour (6 metres, on rocks forming jetty).

Distribution: The species is recorded from the north Atlantic the Mediterranean and Red Sea, South Africa, and Indo-Australia to New Zealand. The species does not extend into the south Atlantic. In view of its south African occurrence could be expected to occur more widely in the Indian Ocean than its present records suggest.

Description: As previously described.

Botrylloides nigrum Herdman

Botrylloides nigrum Herdman, 1886, p. 50. Kott, 1972c, p. 238 and synonymy; 1972d, p. 252.

New Records: Western Port (Crawfish Rock; Eagle Rock). Port Phillip Bay (artificial reef; Mordialloc). Cape Nelson (near Portland; 5 metres).

Distribution: West Indies; Red Sea; Ceylon (?); South and East Africa; S. W. Aust.; Vict.; N. S. W.; Qld. The species is not as commonly recorded as other *Botrylloides* spp.

Remarks: The double row systems, widely spaced in irregular lamellae are distinctive and it seems unlikely that the species could be misidentified. Distribution is not circum-polar, as it has not been recorded from the West African coast, nor from the Pacific Ocean.

It may be that there are two species represented, one from the Atlantic and one from Indo-Australian waters.

Symplegma viride Herdman

Symplegma viride Herdman, 1886, p. 144. Michaelsen, 1918, p. 101 and synonymy. Kott, 1952, p. 252 and further synonymy: 1964, p. 129.

New Records: Western Port (Crawfish Rock, growing on basal surface of fronds of *Didemnum patulum*, encrusting a lump of tar).

Distribution: West Indies, Red-Sea, West Indian Ocean, Ceylon, Malaysia, the Philipines and circum-Australian from Shark Bay (W. Aust.) and south across the southern coast to Thursday Island (off N. E. Australia).

Remarks: Colonies of this species appear to compete with didemnids for available space and occasionally overgrow the borders of a didemnid colony.

Amphicarpa diptycha (Hartmeyer)

(Figs. 31-34)

Distomus diptychos Hartmeyer, 1919, p. 87.
Ampicarpa diptycha: 1972e, p. 50 and further synonymy.
Stolonica australis Michaelsen, 1927, p. 202. Kott, 1972a, p. 28 and further synonymy; 1972b, p. 183; 1972c, p. 252.

New Records: Western Port (Crawfish Rock). SSW. of Cape Grant (220 to 275 metres, on a large stone); South-east of Portland (166 to 220 metres).

Distribution: North to south-western Australia; S. Aust.; Vict.; Tas. (d'Entrecasteaux Channel). The speeies is known from 12 to 24 metres depth.

Description: Upright oval to elongate individuals are joined to a basal membrane or on a short stalk from basal stolons investing sponges or stones. In some eolonies individuals are tightly packed to give a cauliflower-like appearance. The test of adjacent zooids is not confluent, however, and the zooids in the colony are connected with one another only by the basal stolon or membrane and by the adherence of adjacent zooids to the same sand particle. The test is covered with sand. Posteriorly where it joins onto the basal membrane, the test may be flattened to form a wide pseudo-stalk. Zooids are up to 8 mm tall and 3 mm in diameter. The branchial apertures are sessile and a short distance down the dorsal surfaee. The musculature of the body wall is strong especially on and around the siphons but posteriorly becomes weaker. The branchial folds are high and overlapping. There are 19 rows of stigmata. The gut forms the usual short loop across the posterior end of the body and the rectum continues anteriorly at right angles to the loop. The stomach is pyriform, expanded towards the pyloric end. There are 18 longitudinal folds in the stomach wall and on the lateral aspect these folds terminate against the sutureline and appear to be oblique rather than longitudinal. The gastric caecum is continuous with the suture. It extends towards the pole of the gut loop and curves around just distal to the pyloric end of the stomach. It is tightly held against the stomach by a body wall membrane. It is of variable length sometimes curved or hooked or forming one complete spiral. There is the usual ligament extending between the intestine and pyloric end of the stomach enclosing a flat topped endocarp in the pole of the gut loop. There is another similar endocarp between the oesophagus and the end of the intestine where the rectum curves anteriorly.

The anus terminates in two rounded lips. Bisexual gonads are present consisting of a large ovum and a wide short oviduct with a small male follicle beneath the ovum and the body wall, the vas deferens curving around to open on top of the oviduct. These gonads extend in a single row along the middle of the right side of the body and occasionally further towards the ventral margin. On the left they usually extend in a line obliquely across the anterior border of the gut loop and along the ventral border of the body. Ovaries only occur together with testis follicles, although occasionally the male gland appears to be spent or not to be mature. Numerous testis follicles, however, are often scattered in clumps antero-ventrally and postero-dorsally at either end of the right row of the bisexual gonads and on the left of the body they extend around the ventral margin anterior to the stomach and ventral to the bisexual gonads. This condition appears to occur in fully developed mature zooids. In less well developed zooids the uniscxual testis follicles are not present and the testes are confined to the bisexual organs as described. Larvae are present in colonies from Crawfish Rock. They have the usual photolith and a circle of 16 ampullae anteriorly from the centre of which three simple papillae diverge. The larval test has a foamy vesicular appearance.

Remarks: A large number of zooids have been examined in order to resolve the confusion between this species and *Stolonica australis* caused by the variable length of the gastric caecum, variation in development and position of the gonads and variation in the development of the colony. The essential differences between *Stolonica australis* and *Amphicarpa diptycha* (viz. the density of the zooids in the colony and the position of gonads on the body wall) are both extremely variable and are related to the condition and age of the colony and the maturity of the gonads, and the zooids. Similarly the extent to which the basal stolons associated with *S. australis* have fused to form a basal membrane and the

stalk of the zooid has expanded to become confluent with that of adjacent zooids probably depends on the maturity of the colony. It is apparent from the zooids in the present collection, all from the same location, that no essential difference separates these species. In the present specimens there is an encapsulated parasitic copepod in the peribranchial cavity of most individuals.

Polyandrocarpa lapidosa (Herdman)

Goodsiria lapidosa Herdman, 1899, p. 99.
Polyandrocarpa lapidosa; Kott, 1952, p. 250; 1972b, p. 184; Millar, 1963, p. 730.

New Records: Port Phillip (Survey area 5; Popes Eye, Port Phillip Heads).

Distribution: Port Phillips Heads, Western Port. New South Wales (Port Jackson).

Description: Colony forms a large flattened lobe with zooids opening around both sides. The zooids conform to previous descriptions of this species.

Polycarpa thelypanes (Sluiter)

Stylea thelypanes Sluiter, 1904, p. 68.
Polycarpa thelypanes; Kott, 1952, p. 238.

New Records: Western Port (Flinders Jetty). South to south-east of Portland Harbour, 166 to 220 metres.

Distribution: Philippines; W. Aust.: Albany. Kott, (1952) suggests that the species might have been introduced to Australia with Japanese oysters *(Ostrea gigas)* with which it was taken. The present records, however, suggest that this sandy inconspicuous species may have a wider range than previously recognised.

Description: One small specimen is available from Flinders Jetty growing on the test of a specimen of *Ascidia sydneyensis*. A single small specimen and four large specimens are available from off Portland Harbour. The test is very stiff and impregnated with sand. The body wall is not very muscular and closely adherent to the inner surface of the thin, brittle test. The specimens are either dorso-ventrally flattened or laterally flattened and lie on the substrate on their right side. They are not, apparently, fixed to the substrate but lie freely on it. The branchial aperture rises from the anterior end of the body and is directed at right angles to its long axis. The atrial aperture rises from about half way along the dorsal surface. The test is tough leathery and whitish. It is impregnated with sand everywhere except on the short cylindrical siphons. The siphons are longitudinally furrowed and entirely free of sand. In laterally flattened specimens the branchial aperture is turned over to the right towards the substrate. There is a simple U-shaped dorsal tubercular opening in a large peritubercular area. The body wall is closely adherent to the test and has very delicate though strong muscles that radiate from the siphons but fade out on the body. The branchial sac has four very low rounded folds on each side of the body with wide spaces between them. There are about 15 internal longitudinal vessels on the folds and 9-12 between the folds. There is a very short, rounded stomach and the gut forms a wide open arc opening by an eight lobed anus into the base of the atrial aperture. The gonads are intermediate between long styelid-type gonads and shorter polycarps. There are about eight on both sides of the body more or less in a row near the endostyle with others irregularly scattered over the body wall. Sometimes the gonads are slightly curved and bent.

Remarks: The form and arrangement of gonads, the course of the gut and the rigid, thin and stiff test characterise this species. It is of interest that the siphons remain the only contractile part of this animal, the remainder of the body wall is closely adherent to the test. The plane along which the animal is flattened also appears to be variable and a consequence of its position on the substrate. The flattening of the body contributes to the orientation of the branchial aperture toward the substrate and the atrial aperture away from the substrate.

Cnemidocarpa etheridgii (Herdman)

(Fig. 35)

Styela etheridgii Herdman, 1899, p. 38.
Cnemidocarpa etheridgii; Kott, 1972a., p. 31 and synonymy; 1972d, p. 253.

New Records: Port Phillip Bay (Mornington;

Port Phillip Heads). South to south-west of Cape Grant, (221 to 275 metres). 280° from Cape Nelson, (220 to 294 metres); Portland Harbour South to south-east of Portland Harbour (166 to 278 metres).

Distribution: W. Aust.: Triggs Island (north of Fremantle); around the south coast of Australia; Tas.: d'Entrecasteaux Channel; N. S. W.: Port Jackson, Port Stephens; Qd.: Moreton Bay.

Description: The test is whitish and tough and leathery, but thin and paperlike in appearance. The branchial aperture is terminal and the atrial aperture one third to half way down the dorsal surface. Both apertures are sessile. The body is more or less conical in outline from the wide rounded basal or posterior portion and narrowing to the terminal branchial aperture terminally. Posteriorly, the test may be produced into numerous tough root-like projections or there may be a single stalk. The test around the apertures is usually longitudinally furrowed or sometimes, when they are withdrawn, is transversely wrinkled. The body wall is closely adherent to the test. The dorsal tubercle is large and protruberant and almost fills the peritubercular area. There is a fairly wide, smooth margined dorsal lamina. The branchial sac has 4 high, almost overlapping folds on each side of the body. There is a single large gonad in the centre of the body wall on both sides of the body, sometimes enclosed in endocarp-like thickening of the body wall. The gut forms the usual long, narrow, curved loop and also encloses an endocarp which may cross from the left to the right side of the body behind the branchial sac.

Remarks: This species demonstrates a wide range in size up to 11 cm in length. It is characteristically large and rounded posteriorly, with a typical tough whitish thin test. Internally the high branchial folds, the narrow curved gut loop and the embedded gonads are distinctive. As with *Ascidia gemmata* this species has surprisingly not yet been recorded from Western Port, but is likely to occur there.

Pyura australis (Quoy and Gaimard)
australis Quoy and Gaimard

(Fig. 36)

Ascidia australis Quoy and Gaimard, 1834, p. 614.
Pyura australis, Kott, 1972b, p. 186 and further synonymy.

New Records: Western Port (Crawfish Rock, some fixed to a scallop shell and some with the stalk encrusted with *Amphicarpa diptycha* or attached to *Ecklonia* holdfasts). Port Phillip Bay (Portsea).

Distribution: N. W. Aust.: Geraldton; around the southern coast of Australia; Tas.: d'Entrecasteaux Channel; S. Aust.: St. Vincent Gulf; Vict.: Flinders.

Description: The present specimens are typical although the projections from the test are sometimes longer and more pointed than is usually the case. The branchial aperture is turned downwards toward the substrate and protected by large tubercular extensions of the test. There are the usual stellate siliceous spicules 0·03 mm in diameter in the test and pointed spines, less than 0·1 mm in length, lining the siphons. The anal border has the usual long, finger-like lobes.

Pyura cataphracta (Herdman)

(Figs. 37, 38, 39)

Cynthia cataphracta Herdman, 1899, p. 31.
Pyura multiradicata; Kott, 1952, p. 269 (part: *not* Herdman's type specimen of *Cynthia multiradicata* < *Pyura spinifera*).

New Records: Western Port (Crawfish Rock). South to south-west of Cape Grant, 220 to 275 metres. South to south-east of Portland Harbour, 160 to 220 metres.

Distribution: Previously recorded only from Port Jackson.

Description: The species is upright, slightly narrowed toward the base. The branchial aperture and atrial aperture are each on a short siphon at opposite extremities of the upper surface. Basally the diameter of the individual is reduced and root-like extensions from the test or a single stalk basally rooted may be produced posteriorly. Externally the test is grooved and furrowed to varying extents and especially anteriorly. The test around the apertures is produced into pointed processes

directed anteriorly around the aperture and depending on the extent to which the siphon is contracted, sometimes extending across the closed aperture. On other parts of the body, the test may be produced into small tubercles. The surface of the test is granular and very hard, impregnated with spherical siliceous bodies. These are 0·30 mm in diameter, have a granular surface, and are densely packed in the superficial test, becoming slightly less dense internally. The test is, however, thin and very tough throughout. Internally the body wall is very thin with very strong longitudinal muscle bands radiating from both siphons and extending posteriorly to break up into an irregular network over the gut-loop and posterior end of the body. Circular muscle bands are thinner but form a more continuous layer outside the longitudinal bands on the upper half of the body. The test is invaginated into the siphonal linings and the same spherical siliceous spicules are present in this siphonal lining. There are also minute pointed spines 0·02 mm long directed toward the aperture. The dorsal tubercle is large, a U-shaped opening directed toward the left with both horns turned anteriorly. The branchial tentacles have primary, secondary and tertiary branches. The prepharyngeal area is fairly narrow. The dorsal lamina has short closely-set pointed languets arising from the border of a narrow membrane. There are six branchial folds on each side of the body with 18-21 internal longitudinal vessels on each fold and two or three vessels between the folds. The gut loop is embedded in the body wall and forms a curved open loop around the posterior end of the body with arborescent liver tubules rising from the pyloric region. The gonads on each side of the body are broken up into about five pairs of polycarp-like sacs either side of a median duct. On the left, the gonad is embedded in the body wall in the primary gut loop; on the right side of the body the gonad occupies a corresponding position. The anal border has six well developed bifid lobes.

Remarks: The most outstanding characteristic of this species is the very hard "sandpaper-like" external test, created by the embedded siliceous spicules. The species may also be distinguished by the test extensions which project especially the branchial aperture.

The species appears to be most closely related to *Pyura pachydermatina* sub. sp. *intermedia* Michaelsen (which it resembles in the form of the anal border, the size and shape of the siphonal spines and in the spherical siliceous bodies in the test. It may be distinguished by the absence of the typically long stalk of *P. pachydermatina* and by the shape of the body with the branchial aperture terminal and not adjacent to the stalk as in *Pyura pachydermatina*. The present species may also be distinguished by the absence of rod-shaped spicules in the test and by its simple dorsal tubercular opening which is not convoluted as in *P. pachydermatina*. The body wall is also less muscular and more closely adherent to the test, a condition which may be associated with the very hard and probably more rigid test.

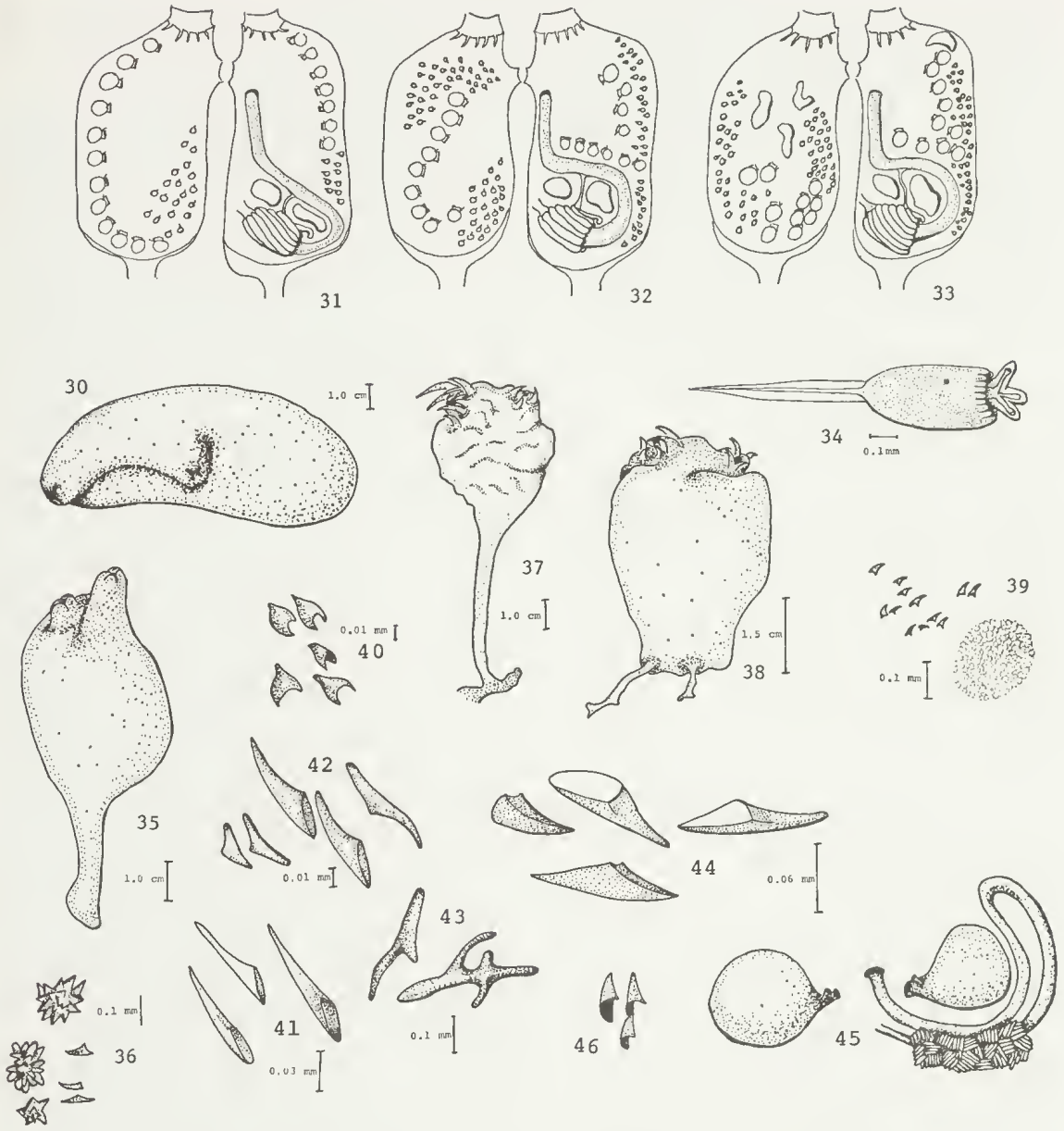
Pyura scoresbiensis Kott

Pyura scoresbiensis Kott, 1972a, p. 36; 1972b, p. 187.

New Records: Western Port (San Remo)

Distribution: S. Aust: St. Vincent Gulf, Spencer Gulf, Investigator Strait.

Description: Specimens comprise an aggregate of sandy spherical zooids on long stalks that taper basally. Both apertures are close together on the upper surface of the individual. The body is about 2 cm in diameter. There is an investment of sand covering the test externally and the bodies of adjacent individuals adhere to one another to form the aggregate where the surface test contacts and adheres to the sand encrusting an adjacent individual. The stalks, however, remain free from one another. There is a slight ridge between the apertures. There are the usual six branchial folds on each side of the body. The gut forms a wide open loop and the rectum extends anteriorly towards the base of the atrial aperture. Arborescent liver lobes are present in the gastric region. The gonads consist of approximately 11 pairs of polycarp sacs on either side of a median duct. They are present in the gut



Ascidia sydneyensis
30—individual showing apertures turned over toward substrate.
Amphicarpa diptycha
31, 32, 33—variable arrangement of gonads on right and left sides of the body. 34—larva.
Cnemidocarpa etheridgii
35—stalked individual.
Pyura australis
36—spicules and siphonal spines.
Pyura cataphracta
37—stalked individual. 38—sessile individual.
39—spicules and siphonal spines.
Pyura irregularis
40—siphonal spines.
Pyura albanyensis
41—siphonal spines.
Pyura stolonifera
42—siphonal spines. 43—spicules from body wall.
Microcosmus stolonifera
44—siphonal spines. 45—gut loop and gonads.
Microcosmus squamiger
46—siphonal scales.

loop on the left side of the body and in a corresponding position on the right.

Remarks: The specimens are smaller than those usually reported for this species. There is also some variation in body shape which is spherical rather than the elongate oval as in the typical specimens described from South Australian locations. Nevertheless, there is no character distinguishing them and it is possible that their small size results from a less favourable location possibly at the eastern extent of the range of this species.

Pyura irregularis (Herdman)

(Fig. 40)

Cynthia irregularis Herdman, 1882, p. 141.
Pyura irregularis; Kott, 1972a, p. 38 and synonymy. 1972b, p. 187.

New Records: Western Port (Crawfish Rock, 8 metres Eeklonia holdfasts; Eagle Rock; Tankerton Jetty); Port Phillip Bay (Mornington Pier).

Distribution: S. Aust.: St. Vincent Gulf; Tas.: d'Entrecasteaux Channel; Vict.: Port Phillip Bay; N. S. W.: Port Jackson.

Description: The present specimens were collected in large aggregates together with *Microcosmus squamiger*. The long siphons are so oriented that they are able to reach the exterior despite the other individuals with which they are so closely aggregated.

Pyura albanyensis Michaelsen and Hartmeyer

Pyura albanyensis Michaelsen and Hartmeyer, 1928, p. 435.
Pyura jacatrensis; Kott, 1952, p. 273.
Pyura vittata; Miller, 1960, p. 126; Tokioka, 1952, p. 134; 1967, p. 202; Kott, 1964, p. 142; 1966, p. 300; 1972a. p. 37; 1972c, p. 243.

New Records: Port Phillip Bay (Mornington)

Distribution: The species has a wide circum-Australian distribution. It has also been recorded from the Palau Is. in the Pacific and from Ascension Is. in the southern Atlantic.

Description: The test is very tough, leathery and wrinkled. There are the usual six high overlapping branchial folds on both sides of the body. The dorsal tubercle is a large, double spiral cone completely filling the peritubercular area. There are needle-like spines lining the siphons about 0·1 mm in length. There are endocarp-like blocks of tissue along the anterior limb of the gut loop. The anal border is bilabiate.

Remarks: This species displays to a very high degree the taxonomic problems that are encountered in the Class Ascidiacea. Species from many localities and with a wide range in characters have been included in the synonymy and Van Name (1921, 1945), Kott (1969, 1972a) and Monniot and Monniot (1972, 1974) have successively made attempts to clarify the situation. Briefly, specimens from the West Indies and the Atlantic, the Indo-Pacific and the sub-Antarctic (Macquarie, Kerguelen and Marion Islands) with siphonal spines variously extending onto the outer wall of the siphons and the gonads separated into polycarp-like sacs along either side of a central duct have been included in the synonymy. Monniot and Monniot (1974) have, most recently, separated the subantarctic form as *Pyura pilosa* characterised by the absence of endocarps on the gut and gonads. In this species the anal border is lobed. The siphonal spines are long and one of its most conspicuous features. Although not described by Monniot and Monniot these spines must be regarded as contributing to the diagnosis of the species.

Indonesian and northern Australian species *P. jacatrensis* Sluiter, 1890; Hartmeyer, 1919; Michaelsen and Hartmeyer, 1928, were included in the synonymy of *P. vittata* by Kott (1969) but were later (1966, 1972a) excluded on the grounds that the branchial spines (0·03 mm) were very much shorter than those of sub-Antarctic and Australian specimens assigned to this species. The anal border in *P. jacatrensis* is simple or very vaguely lobed and there are no endocarps on gut or gonads (Monniot and Monniot, 1974).

The West Indies species share, with specimens from Australia *(P. jacatrensis;* Kott, 1952; *P. vittata;* Kott, 1972a, c), the Arafura Sea (*P. vittata;* Tokioka, 1952), the Palau Islands (*P. vittata* Tokioka, 1967) and Ascension Island (*P. vittata;* Millar 1960), the endocarps along the gut loop that are considered to be characteristic of *P. vittata* by Monniot and Monniot (1974). Other speci-

Pyura albanyensis and related species

	Siphonal spines	Dorsal Tubercle	Colour of Siphon lining	Endocarps on gut and gonads	Anal Border	Range	Synonymy; References
P. vittata (Stimpson, 1852)	?; inconspicuous	medium; horns turned in	red	present	lobed	West Indies; tropical Atlantic; Japan	Van Name, 1945 and synonymy (part: see Monniot and Monniot, 1974)
P. vittata; Tokioka	?; inconspicuous	medium; horns turned in	red	absent	plain	Japan; Palau Is.	Tokioka, 1974b, 1950, 1953
P. pilosa Monniot and Monniot, 1974	needle like 0·1 to 0·2 mm conspicuous	small; crescentic	red	?	lobed	Sub-Antarctic Marion, Kerguelen, Macquarie Is.	*P. jacatrensis*; Kott, 1954, 1969; Millar, 1960
P. albanyensis Michalsen and Hartmeyer, 1928	needle like 0·1 to 0·2 mm conspicuous	large; double spiral cone	greenish	present	plain bilabiate	Palau Is.; Arafura Sea; Darwin; Shark Bay (new record); southern and eastern Australia; Ascension Is., southern Atlantic	*P. jacatrensis*; Kott, 1952. *P. vitatta*; Kott, 1964, 1966, 1972a, c; Tokioka, 1952, 1967; Millar 1960
P. jacatrensis (Sluiter, 1890)	small 0·03 mm inconspicuous			absent	plain	N.W. Australia; Indonesia; Aru Is.	Sluiter, 1904, 1913; Hartmeyer, 1919; Michaelsen and Hartmeyer, 1928

mens from Australia have been re-examined (Pt. Vernon:Kott, 1966; Moreton Bay:Kott, 1964; Ulladulla, N. S. W.: unpublished and Port Gregory, Shark Bay, W. A.: unpublished) and in each case these endocarps are found to be present. All the Australian specimens (Kott 1952, 1964, 1966, 1972a, c) and those from the Arafura Sea and Ascension Island, have siphonal spines of 0·1 to 0·275 mm and these spines confer an irridescent greenish tinge to the siphons of preserved material. In all cases the anal border is bilabate and plain. Specimens from Palau Is. and Japan (Tokioka, 1949b, 1950, 1953) also have a generally plain anal border. However, no endocarps have been described. The spicules have not been described and the siphons are coloured red. The West Indies species differs from the Australian and sub-Antarctic forms in the less conspicuous siphonal spines (for which the length has not been given: Van Name, 1945 p. 322 "minute short spines, visible only on some magnification"), the anal border is lobed, and the siphons are coloured red as in the Japanese specimens. *C. vittata;* Oka and *C. karasboja* Oka (Oka, 1935) are identical with the West Indies form in all characters. It is apparent, therefore, that there are several species involved in this complex each characterised by a reliably constant assemblage of characters and in some cases with an overlapping geographical range, as set out in the following Table.

The specimens set out in the synonymy above conform with the description of *P. albanyensis* Michaelsen and Hartmeyer.

Pyura stolonifera (Heller) subsp. **praeputialis** Heller

(Figs. 42-43)

Cynthia stolonifera Heller, 1878, p. 10.
Cynthia praeputialis Heller, 1878, p. 12.
Pyura stolonifera f. waia Michaelsen and Hartmeyer, 1928, p. 433.
Pyura stolonifera; Sluiter, 1927, p. 43; Kott, 1952, p. 274; MacNae and Kalk, 1958; Kott, 1964, p. 141; Monniot, 1965, p. 100; Day, 1974, p. 35.
Pyura praeputialis; Millar, 1963, p. 738; 1966, p. 372.

New Records: Western Port (Eagle Rock); Port Phillip Bay (Mornington; Hobsons Bay; Prince George Light). Ram Head (18 miles south of Mallacoota, 6 metres).

Distribution: P. stolonifera stolonifera; Cape Province and Natal (South Africa); Mosambique; Dakar; Morocco. *P. stolonifera praeputialis:* S. W. Aust.; S. Aust.: Outer Harbour; Vict.; N. S. W.; Qd.: Noosa. The range around the Australian coast is clearly defined and accompanied by a decrease in the size of the individuals at either end of this range (south-western Australia and Noosa, Queensland).

Description: A single specimen is available from Mornington and a tight aggregate of seven individuals from Ram Head. The specimens are of the usual pillar-like form, maximum height 3-10 cm and maximum diameter, across the top of each individual, 2-4 cm. In the specimen from Mornington the posterior end of the test is produced into irregular processes for adherence to a rocky substrate. The specimens have the usual convoluted double spiral slit on the large hemispherical dorsal tubercle with the open interval directed anteriorly. The dorsal lamina has pointed languets, there are six to seven high overlapping branchial folds on each side of the body and the gut forms the usual curved loop terminating in an anus bordered by three shallow lobes. The liver is large and consists of dense arborescent tubules. The body musculature is strong and branches of the longitudinal muscles from the siphons are inserted into a rim of the body wall around the anterior surface. These muscles effect the anterior depression around the siphons that is characteristic of the species. Strong longitudinal muscles extend only halfway down the body. The siphonal spines are from 0·05 mm to 0·08 mm long, becoming larger toward the aperture. Calcareous spicules (as described by Millar, 1962 for South African specimens) are present in the ventral part of the body wall, in the gut and in the endostyle. Gonads are divided into large paired blocks, densely arranged along either side of a central duct, in the gut loop on the left and in a corresponding position on the right. In older individuals there is a fold of tissue which extends across the body in front of the atrial aperture effectively cutting off the posterior part of the peribranchial cavity as an excurrent

chamber. There is also a dense "fur" of pointed papillae on the body wall of older specimens in which gonads are more or less embedded in the body wall.

Remarks: Kott (1952) has described two environmental forms of this species one from estuarine localities and one from open coast situations. The typical estuarine form is characterised by the presence of a sandy investment on the test and is usually short; and posteriorly the test is produced into a beard of sandy roots; while the open coast form is pillar-like owing to the posterior thickening of the test to form a wide solid gelatinous stand of the same or of only slightly lesser diameter than the rest of the body, thus raising the individual above the substrate. Specimens intermediate between these two forms are known and the present specimen from Mornington Pier in which the test is produced into irregular processes reflects the variability in growth of the test of this species. In the open coast form the gonads are occasionally broken up into a single, rather than double, row of separate sacs. Variations in the length of the branchial tentacles also occur and very small branchial tentacles have been observed in estuarine forms. These characters are variable, however, and cannot be regarded as constant differences between individuals from these two environments. The differences in the test especially appear to result from the individual's response to different sets of conditions, *viz.* the solid gelatinous pillar of test associated with firm fixation to rocky substrates and to adjacent individuals where wave action is strong; the development of long rooting processes fixing rounded solitary individuals in sandy substrates subjected to less turbulent conditions.

There has been considerable discussion in the literature on the relationships between the South African *P. stolonifera* and the Australian *P. praeputialis*. Hartmeyer (1911) suggested that the presence of a seventh branchial fold was exclusive to South African forms. There are, however, seven branchial folds on each side of the body in the present specimens from Ram Head and this character does not provide a distinction.

Nor can siphonal spines be used to distinguish subspecies. Michaelsen and Hartmeyer (1928) recognised the subspecies *P. stolonifera waia* from Western Australia with siphonal spines 0·09 to 0·1 mm long, and *P. stolonifera typica* from South Africa and *P. stolonifera praeputialis* from New South Wales (Heller's type specimen) with siphonal spines 0·02 to 0·024 mm long. The present specimens demonstrate a wide range in length of siphonal spine between 0·05 and 0·08 mm while the spines of typical specimens collected from Moreton Bay (Queensland) are 0·03 to 0·04 mm long. Spicules (branched) in the branchial sac of South African specimens occur in the present specimens from Victoria.

Millar (1963) distinguished the South African form from the Australian by the absence of a sunken area around the siphons and by the posteriorly directed dorsal tubercle opening. Some South African specimens (Millar, 1955) were also distinct in the presence of four test projections around the apertures. These differences, however, are not constantly expressed (Millar, 1966). In fact Cynthia *valdiviae* Michaelsen and *C. herdmani* Von Drasche (see Michaelsen, 1904), both from South Africa are identical with the Australian form in these characters and in others. Day (1974) has described the depressed area around the siphons in South African specimens. In Australian specimens, the collar of test around the siphons is invariably present when specimens are contracted (i.e. when preserved or exposed intertidally). It is probable that it is not present if individuals are not contracted. It was not observed by the present author in large *in situ* subtidal populations at Noosa (Queensland) in which the siphons of all individuals were fully extended in the feeding position. Day (1974) p. 36, has also observed variations in form for the South African populations that are identical with variations in the Australian forms, viz: "solitary specimens below tide mark are usually hemispherical . . . Specimens from S. African estuaries

which have root like extensions of the test to anchor them in the sand".

It is most probable, therefore, that in view of the general form of the body (and its capacity to respond to a wide range of environments) and the similarities between such features as the dorsal tubercle, the siphonal spines, and the occasional presence of branched spicules, that two separate species cannot be maintained.

Nevertheless, no test projections from the siphonal region have ever been observed in the many Australian specimens that have been examined; and the relationships are most reliably indicated by regarding the Australian and South African forms as separate geographic sub-species, morphologically distinguished only by a degree of variability of certain characters in the South African populations, which are not variable in Australian specimens, i.e. the absence of projections from the siphonal region (sometimes present in S. African specimens).

Pyura lepidoderma Tokioka

Pyura lepidoderma Tokioka, 1949, p. 10. Kott, 1966, p. 299.

New Records: Port Phillip Bay.
Distribution: Qd.: Hervey Bay. Japan.
Description: A single flattened specimen, basal diameter 1 cm, heighth 2 mm is available, fixed to a *Mytilus* shell. The siphons are on the upper surface and are almost sessile. The surface layer of test is marked off into polygonal scale-like thickenings that are most conspicuous around the apertures where they emphasise furrows along the short siphons. The body musculature consists of longitudinal bands from both apertures which cross one another on the body. There are six branchial folds on each side of the body with closely set internal longitudinal vessels. The liver branches off the gut in the pyloric region and divides into arborescent branches along its length. The gut loop is narrow and the anal border has shallow rounded lobes, the rectum turns anteriorly and is very short. The gonads, in the gut loop on the left and in a corresponding position on the right, consist of polycarp-like sacs along either side of common ducts opening at the base of the atrial aperture with the anus.
Remarks: Attention has already been drawn (Kott 1966, 1969) to the similarity between this species and the Antarctic *P. squamata* Hartmeyer (see Kott 1969, p. 136). The occurrence of the species in Port Phillip does to some extent satisfy the discontinuity in the records of the antarctic species and the north-eastern Australian Japanese species respectively. It is possible that further collecting will demonstrate that their ranges are continuous and that only a single species is represented.

Halocynthia hispida (Herdman)

Cynthia hispida Herdman, 1881, p. 61.
Halocynthia hispida; Kott, 1968, p. 77 and synonymy; 1972b, p. 189.

New Records: Western Port (Crawfish Rock; some on *Ecklonia* holdfasts; Eagle Rock).
Distribution: S. Aust.: St. Vincent Gulf; Tas.: Bass Strait, d'Entrecasteaux Channel, Maria Island; N. S. W.: Port Jackson. Ceylon; and off the west coast of North America and Japan. (see Kott, 1968).
Description: The present specimens demonstrate the range from the individuals covered with branched test tubercles to those in which there are no tubercular extensions of the test. (see Kott, 1968).

Herdmania momus (Savigny)

Cynthia momus Savigny, 1816, p. 143.
Herdmania momus; Kott, 1972b, p. 189; 1972c, p. 255 and synonymy.

New Records: Western Port (Flinders Jetty, Eagle Rock).
Distribution: N. W. Aust. (Broome); S. W. Aust.; S. Aust.; Viet.; N. S. W.; Qd., Arafura Sea; Indonesia; Fiji; the Palau Islands; Tahiti; Japan; the Indian Ocean; the Red Sea; South Africa; and the West Indies. Kott (1972) has drawn attention to the lack of distinction between the Indo-Pacific populations of this species and those from the Atlantic, *H. momus pallida* (see Van Name, 1945). It is most probable, therefore, that *H. momus* is a circumtropical species extending into temperate regions in the southern parts of its range. i.e.

around the South African and south Australian coasts.

Description: The specimen from Flinders jetty is 20 cm long and completely invested with a colony of *Didemnum patulum,* leaving only the apertures free.

Microcosmus australis Herdman

Microcosmus australis Herdman, 1889, p. 23. Millar, 1963, p. 741; 1966, p. 373. Kott, 1972e, p. 53.
Microcosmus claudicans sub sp. *australis;* Michaelsen and Hartmeyer, 1928, p. 404 and synonymy. Kott, 1952, p. 288.
?*Cynthia solanoides* Herdman, 1899, p. 29.
?*Microcosmus solanoides*; Kott, 1952, p. 289.

New Records: Western Port (Crawfish Rock).

Distribution: see Kott 1972e

Remarks: There seems little to distinguish this species from *M. solanoides* Herdman except the siphonal denticles which Kott (1952) described as not curved and much smaller than those of the present species. Herdman's type specimen from Port Jackson is the only record of *M. solanoides* and it is likely that it cannot be separated from *M. australis.*

Microcosmus nichollsi Kott

Microcosmus nichollsi Kott, 1952, p. 290; 1972c, p. 245 and synonymy.

New Records: Western Port (Crawfish Rock, 8 metres, on *Ecklonia* holdfasts).

Distribution: S. Aust.: St. Vincent Gulf; Vict.: Flinders.

Description: Only a single specimen is available, 1 cm long. The surface is sandy and both apertures are anterior and almost sessile. The usual pockets or valves are present at the base of the atrial siphon, and the usual spines and scales are present in the siphonal lining. There are seven branchial folds on each side of the body with one or two internal longitudinal vessels between the folds. The gonads are separated into three blocks and on the left the most proximal section of the gonad crosses into the pole of the gut loop.

Microcosmus helleri Herdman

Microcosmus helleri Herdman, 1881, p. 54 Van Name, 1945, p. 349 and synonymy; Kott, 1972e, p. 54 and synonymy.

New Records: Western Port (Crawfish Rock, among *Ecklonia* holdfasts; Eagle Rock).

Distribution: W. Aust.: Cape Jaubert to Fremantle; S. Aust.: St. Vincent Gulf; Qd.: Great Barrier Reef, Gulf of Carpentaria, Torres Strait; Malaysia. Portugese East Africa (Michaelsen 1918). West Indies (Van Name 1945).

Description: The individuals are upright and more or less egg-shaped with a terminal branchial aperture and the atrial aperture about half way down the dorsal surface. Around each opening the test is produced into lobes which fold over when the aperture is contracted. Superficially the test is covered with long branched hairs that are obscured by a coating of sand which they enmesh. Beneath this sandy coating the test is very thin and brittle. There are four, very strong, tongue-like projections into the cavity of the branchial siphon at its base. There are three pockets at the base of the branchial siphon, formed by folds of the siphonal lining and these undoubtedly act as cuspid valves. There are six branchial folds on each side of the body. The dorsal tubercle is U-shaped with both horns turned in and completely fills a fairly shallow peritubercular area. The gut forms the usual narrow loop and in the pyloric region there are dense parallel glandular folds or lamellae, joined together by an external membrane, representing the liver. The long gonad on each side of the body is divided into three separate sections, and on the left crosses the intestine into the pole of the gut loop.

Remarks: The hard cartilage-like projections at the base of the siphon together with relatively small number of wide overlapping branchial folds characterise this species. The test lobes around the apertures are sometimes simple, but often are well developed, tuberculous or branched. In some specimens there is no coating of sand but externally the test is very hard and produced into pointed and sometimes branched papillae.

Microcosmus stolonifera Kott

(Figs. 44, 45)

Microcosmus stolonifera Kott, 1952, p. 291; 1972c, p. 245 and synonymy.

New Records: Western Port (Crawfish Rock).

Distribution: Previously recorded from Qld. (Moreton Bay) S. Aust. (St. Vincent Gulf) and Tas. (Tiny Is.).

Description: Posteriorly the test of these individuals is produced into an irregular root-like structure, sometimes long branched and sturdy, sometimes there is a double projection. Occasionally individuals are aggregated together. Both apertures are depressed into the upper surface and surrounded by a raised, rounded fold of test. The test is very hard, thin and stiff with a dense layer of embedded sand. There are overlapping curved spines lining the branchial siphon 0·06 mm long on their concave side but extending from a long base of about the same length. Short, irregular languets are sometimes present on the prepharyngeal band. The branchial tentacles have primary, secondary and minute tertiary branches. The dorsal tubercle is relatively small in the centre of the peritubercular area and has a simple, U-shaped opening, sometimes with a single horn turned in. There is a long, smooth-edged dorsal lamina. There are seven high and overlapping branchial folds on each side of the body, with 15-20 internal longitudinal vessels per fold and six to eight stigmata per mesh. The gut forms a narrow loop with liver lamellae in the pyloric region. Single rounded or sometimes irregular gonads are present on each side of the body. The gonad on the left is in the secondary gut loop and does not extend into the primary gut loop.

Remarks: The rounded fold of test around the upper surface enclosing the apertures is not always present and depends to some extent on the size of the individual. The species is distinctive, however, in the presence of the gonad outside the primary gut loop and in the size and form of the siphonal spines together with the high overlapping folds in the branchial sac.

Microcosmus squamiger Michaelsen

(Fig. 46)

Microcosmus claudicans sub. s. *squamiger* Michaelsen, 1928, p. 405.

Microcosmus squamiger; Kott, 1972a, p. 43 and synonymy.

New Records: Western Port (Crawfish Rock; Eagle Rock; Rutherford Channel). Port Phillip Bay (Mornington Pier, 9 to 35 metres, dense rock, vertical and horizontal clumps fixed to oyster shells; Williamstown, 5 metres, common on rocks).

Distribution: W. Aust: Shark Bay to Albany; S. Aust.: St. Vincent Gulf; N.S.W.: Port Jackson; Qd.: Bowen and Rockhamton. Red Sea. Undoubetdly there has been great confusion between this and related species (see Michaelsen and Hartmeyer, 1928) and it is probable that there is a wider distribution in the Indian Ocean.

Description: Rounded individuals are present in sometimes very large aggregates. The apertures are about one third of the body length apart and sessile. The animals are whitish to pinkish-brown, sometimes smooth, occasionally with some embedded sand. The surface is often very uneven and wrinkled, especially around the siphons. There are minute overlapping siphonal scales about 0·01 mm long. There are eight to nine overlapping branchial folds on each side of the body. The dorsal tubercle is always a double spiral cone, the gut forms a narrow loop, the gonads are separated into three sections and cross into the primary gut loop.

Remarks: This is a common species in those areas from which it has been recorded and is distinguished by the very small overlapping siphonal scales, the dorsal tubercle, the leathery test and the absence of a dense, sandy coating and the large number of overlapping branchial folds.

Molgula sabulosa Quoy and Gaimard

Ascidia sabulosa Quoy and Gaimard, 1834, p. 613.

Molgula sabulosa; Michaelsen and Hartmeyer, 1928, p. 449 and synonymy. Kott, 1972c, p. 248 and synonymy.

New Records: Western Port (Crawfish Rock, San Remo; Shoreham). Port Phillip Bay.

Distribution: Known only from Albany, (W. Aust.) and Port Phillip Bay (Vict.)

Description: Large spherical specimens with characteristic hollow test lobes formed around the apertures. The individuals often form

aggregates. The test is thin but stiff with adherent sand. The apertures are close together on the upper surface but are not in a depressed pit as in *M. mollis,* and do not have a thickened ridge of test extending along the dorsal line between them. Each aperture is surrounded by a rosette of hollow rounded lips of the test, 6 around the branchial aperture and four around the atrial aperture. These fold inwards over the aperture and each aperture together with its surrounding test projections, occupies a circular depression in the upper surface of the body. The body wall projects into these hollow lobes. The dorsal tubercle occupies the right hand side of the peritubercular area and there is elongate ganglion slightly to the left. The dorsal lamina is rather long. There are seven narrow branchial folds on each side of the body with only three internal longitudinal vessels, one on the edge of the fold and the other two ventrally. Stigmata are irregular between the folds and between the dorsal lamina and the first fold. The infundibula are tightly coiled and bifurcate in the summit of each fold. The gut forms a long narrow curved loop and the plain bordered anal opening is at the base of the atrial siphon. There are many fine longitudinal liver lamellae at the cardiac end of the stomach but at the pyloric end there are minute arborescent lobes. The kidney is long and curved on the right hand side of the body and the long tubular ovary extends parallel to its dorsal surface. Testes follicles are long narrow and deeply lobed at their outer edge tapering to the vasa efferentia at the end of the ovarian tube where they join into the short vas deferens that extends onto the mesial surface of the ovarian tube and opens to the peribranchial cavity there.

Remarks: This species is distinguished from *M. mollis* by the short vas deferens (which in some specimens is turned anteroventrally), by the longer dorsal lamina and by the hollow lobes of test that protect the apertures.

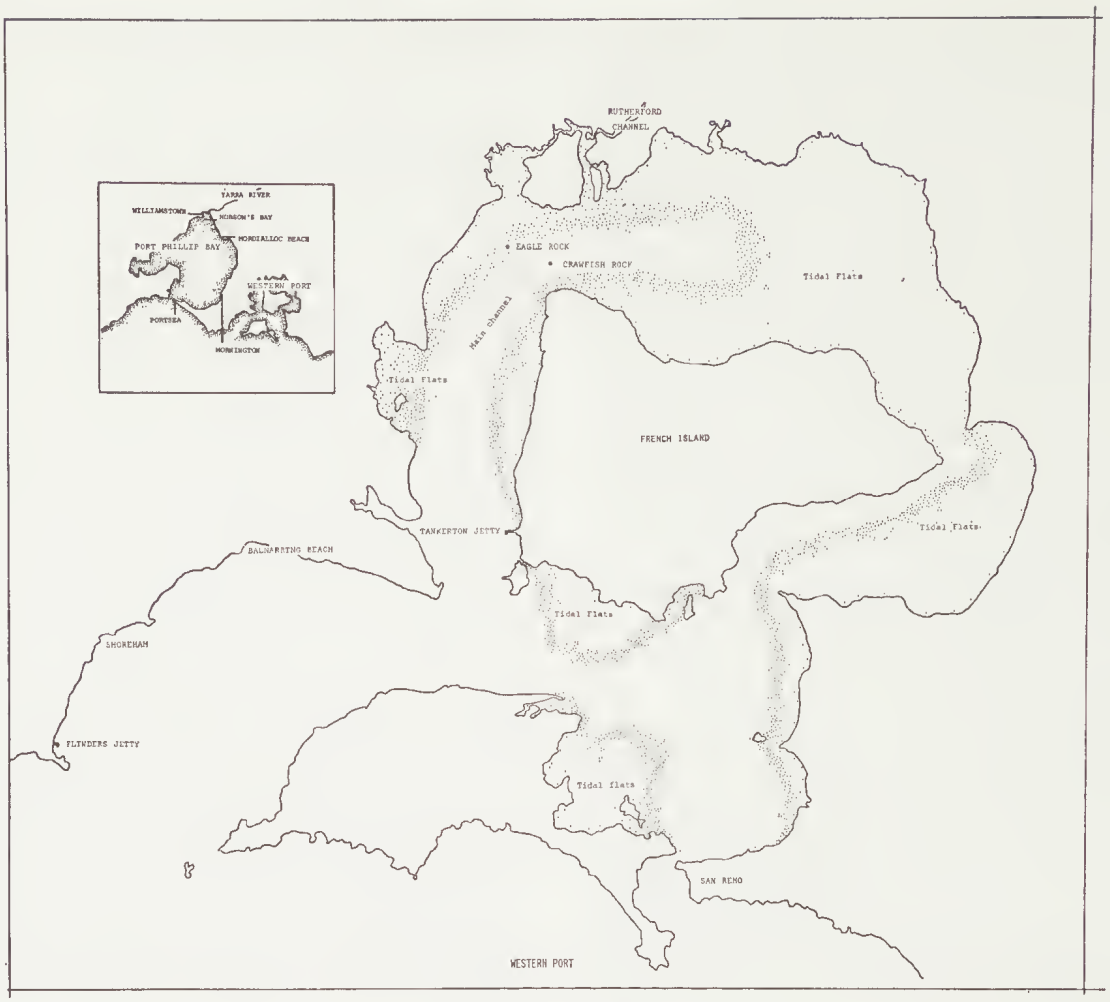
Mogula mollis Herdman

Mogula mollis Herdman, 1899, p. 54; Kott, 1952, p. 298; 1964, p. 144; 1972a, p. 45 and synonymy. *Mogula sabulosa; Kott,* 1972a, p. 190, 1972d, p. 248.

New Records: Western Port (Crawfish Rock).

Distribution: S. Aust.: St. Vincent Gulf; eastern Australia to Indonesia.

Description: The specimens are smaller than is usual for *M. sabulosa* and are laterally flattened and covered with delicate hairs to which sand adheres. There are small test projections around the apertures but these are not hollow as in *M. sabulosa.* The apertures are close together on the upper surface of the body both sunk deeply into the surface, with a ridge of slightly thicker test between them along the dorsal line. The apertures are directed away from one another. The body wall has very strong muscles in the siphons and around the anterior part of the body at the base of the siphons but posteriorly the musculature is weaker. The branchial folds are broad, overlapping and deeply curved and the dorsal lamina is very short. There may be as few as 4 internal longitudinal vessels on both sides of each fold. The gut forms a long, very deeply curved loop which enclosed the gonad on the left side of the body. At the cardiac end of the gastric region there are short transversely oriented liver lamellae but at the pyloric end there are longer and longitudinally arranged diverticulae. The testis follicles are grouped around the proximal end of the ovarian tube. They are long narrow and wedged shaped in outline, converging to paired ducts which join into a long vas deferens that extends along the middle of the mesial surface of the ovarian tube and opens at the base of the oviduct. On the right side of the body the testis lobes are accommodated in the curve of the kidney and not anterior to it as in *M. sabulosa.*



47—Map of region.

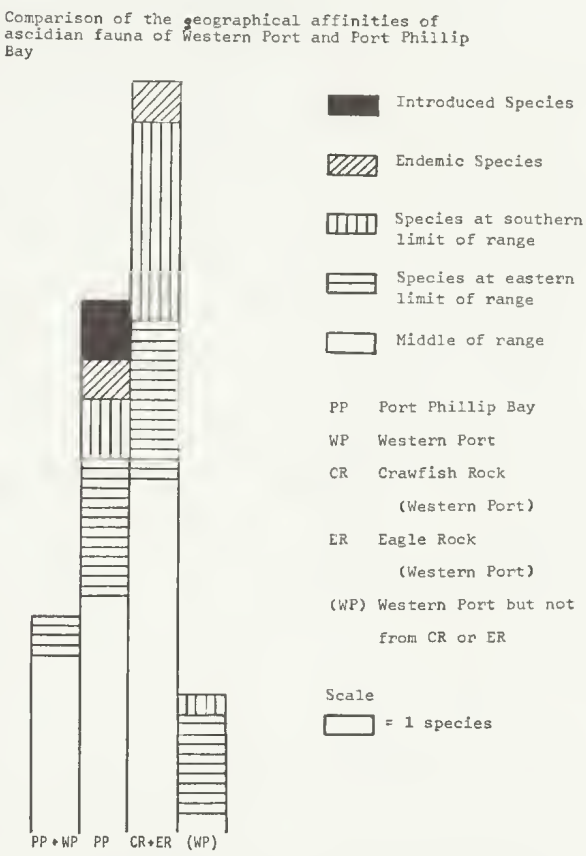
CHARACTERISTICS OF THE ASCIDIAN FAUNA (Fig. 48)

Most collecting of the Victorian ascidian fauna has been done in either Western Port or Port Phillip Bay. It is probable that a proportion of the very large number of species recorded from these two locations also occur on the open coast where a relatively limited range of habitats has been sampled.

The material reported on by Millar (1966) from Port Phillip Bay was collected by bottom sampler and the species taken represent the fauna of the sea floor. Kott (1952, 1957, 1962, 1963) reported largely on intertidal collections; while the present mainly subtidal collections have been taken manually from rock ledges, caves and from the sea floor and represent the larger components of the benthic fauna.

There are 26 species that have been recorded from Port Phillip Bay but do not occur in Western Port. Three are probably introduced (viz. *Ciona intestinalis; Ascidiella aspersa:* Kott, 1952; and *Styela clava:* Holmes, 1976). *Ritterella assymmetrica* Millar, 1966 and *Protopolyclinum sabulosa* (Millar, 1963) are endemic to Port Phillip Bay. Of the remaining 21 species, 12 are within their Australian range; and 7 are temperate species at the eastern or northern extremity of their range (including *Polycitorella mariae;* Millar, 1963, previously recorded from South Africa and New Zealand). For only three of these species does their occurrence in Port Phillip represent the southern limit of their range on the eastern coast of Australia.

There are 45 species that have been recorded from Western Port but have not been taken from Port Phillip. Twenty four of these are recorded only from Crawfish Rock and at no other location and a further 10 occur only at the adjacent Eagle Rock or at both Eagle Rock and Crawfish Rock. Of this 34 species one is endemic *(Polysyncraton victoriensis* sp. nov.); *Dumus areniferus* previously known only from New Zealand is recorded from Australia for the first time; 16 are in the middle of their range; eight are at the southern limit of their range and eight are at the eastern limit of their range. Of the species that are also recorded from other parts of Western Port three are in the middle of their range, five are at the eastern end of their range and three are at the southern end of their range (Fig. 48; Tables 1, 2).



48—Histograms showing geographic affinities of the Western Port and Port Phillip Bay ascidian fauna.

TABLE 1

Geographical affinities of ascidian species from Port Phillip Bay*

Species	Geographical affinity
Ciona intestinalis	Introduced
Protopolyclinum sabulosa (Millar, 1963)	Eastern limit
Polycitorella mariae; Millar, 1963	S. Africa; N.Z.
Distaplia viridis; Kott, 1972a	Eastern limit
Distaplia stylifera; Kott, 1972b	Middle of range

Cystodytes dellechiajei; Kott, 1972b	Middle of range
Ritterella assymmetrica Millar, 1966	Endemic
Euherdmania australis; Kott, 1972b	Middle of range
Aplidium solidum; Millar, 1963	Southern limit
Didemnum lambitum	Eastern limit
Peroplıora hutchisoni; Millar, 1966	Middle of range
Ascidia gemmata	Middle of range
Ascidia aclara; Millar 1963	Middle of range
Ascidiella aspersa; Millar 1966	Introduced
Corella eumyota; Knott, 1972a	Middle of range
Oculinaria australis; Millar, 1966	Eastern limit
Botrylloides magnicoecus; Millar, 1966	Middle of range
Polyandrocarpa lapidosa	Southern limit
Polycarpa pedunculata; Millar, 1966	Middle of range
Cnemidocarpa etheridgii	Middle of range
Styela plicata; Millar, 1966	Middle of range
Styela clava; Holmes, 1976	Introduced
Astereocarpa cerea; Millar, 1966	Eastern limit
Pyura fissa; Millar, 1966	Northern end of range
Pyura albanyensis	Middle of range
Pyura lepidoderma	Southern limit

* A recent reference is given for each species not discussed above.

TABLE 2

Geographical affinities of ascidian species from Western Port*

Species	Crawfish Rock	Eagle Rock	Other location in Western Port	Port Phillip	Geographical affinities
Podoclavella cylindrica			X		Eastern limit
Oxycorynia pseudobaudinensis n. sp.	X				Eastern limit
Eudistoma pyriforme	X				Middle of range
Polycitor giganteum; Kott, 1972b	X		X		Middle of range
Atapozoa mirabilis			X		Eastern limit
Sycozoa cerebriformis	X		X		Middle of range
Sycozoa pedunculata			X	X	Middle of range
Pseudodistoma cereum	X				Middle of range
Dumus areniferus	X				Single Australian record
Polyclinum marsupiale	X				Middle of range
Aplidium australiensis Kott, 1963			X		Eastern limit
Aplidium parvum Kott, 1963			X		Eastern limit
Aplidium pliciferum; Kott, 1972a			X	X	Middle of range
Aplidium depressum	X		X		Southern limit
Aplidium lobatum	X				Southern limit
Aplidium triggiensis	X				Eastern limit
Aplidium opacum Kott, 1963			X		Middle of range
Synoicium hypurgon	X				Middle of range
Sidneyoides tamaramae	X				Southern Limit
Didemnum moselyi	X	X			Middle of range
Didemnum patulum	X	X			Middle of range
Didemnum turritum	X	X			Eastern limit
Didemnum augusti	X				Eastern limit
Didemnum roberti	X	X			Eastern limit
Didemnum spongioides	X				Middle of range

Species	Crawfish Rock	Eagle Rock	Other location in Western Port	Port Phillip	Geographical affinities
Didemnum skeatii	X	X			Southern limit
Didemnum candidum	X				Middle of range
Trididemnum cerebriforme	X				Middle of range
Trididemnum cyclops		X	X		Southern limit
Lissoclinum fragile		X			Southern limit
Lissoclinum ostrearium	X				Southern limit
Diplosoma translucida		X			Southern limit
Diplosoma rayneri	X				Middle of range
Polysyncraton orbiculum	X				Eastern limit
Polysyncraton victoriensis n. sp.	X				Endemic
Phallusia depressiuscula			X	X	Middle of range
Ascidia sydneyensis	X	X		X	Middle of range
Symplegma viride	X				Middle of range
Amphicarpa diptycha	X			X	Eastern limit
Botrylloides nigrum	X	X		X	Middle of range
Botrylloides leachii	X				Middle of range
Polycarpa thelypanes			X		Southern limit
Pyura australis	X				Eastern limit
Pyura cataphracta	X				Southern limit
Pyura irregularis	X	X	X	X	Middle of range
Pyura scoresbiensis			X		Eastern limit
Pyura stolonifera praeputialis		X		X	Middle of range
Halocynthia hispida	X	X			Middle of range
Herdmania momus		X			Middle of range
Microcosmus australis	X				Southern limit
Microcosmus nicholisi	X				Eastern limit
Microcosmus helleri	X	X			Middle of range
Microcosmus stolonifera	X				Middle of range
Microcosmus squamiger	X	X		X	Middle of range
Molgula mollis	X			X	Southern limit
Molgula sabulosa			X	X	Eastern limit

* The most recent reference is given for each species not discussed above.

It is probable that both Port Phillip Bay and Western Port provide different habitats for ascidian species since only a small group of species (the majority of these well within the limits of their geographic range) have sufficiently unrestricted habitat requirements to be present in both locations. Larger numbers of species are recorded from either Port Phillip Bay or Western Port but not from both. The most striking differences in the biogeographic affinities of the ascidian fauna at these two locations is the high diversity of species and the high percentage of northern forms at the southern limits of their range that occur in Western Port. These differences are not associated with a random distribution of habitats since the majority of species have been taken at Crawfish Rock and also at adjacent Eagle Rock and have not been recorded at more southerly locations in Western Port. Both these stations are in the northern section of the bay, where there is complete protection from oceanic swell and where extensive tidal flats draining into the main channel may modify the temperate marine environment. This may contribute to the diversity of environmental conditions that support such a diverse fauna with such a high proportion of northern species.

The most diverse assemblage of species has been taken from Crawfish Rock, on a 30° slope of soft brown coral and occasional sandstone boulders. The species are largely encrusting aplousobranch forms with vivi-

parous larvae but there are also small leathery oviparous stolidobranch species that produce root-like structures and form aggregates. The stalked species *Pyura australis* only rarely occurs here, and large stolidobranch and phlebobranch forms *(Phallusia depressiuscula, Herdmania momus, Cnemidocarpa etheridgii,* etc.) that require smooth and firm surfaces for fixation are not present.

The turbidity of the water and its effect on the light intensity at greater depths does not appear to limit ascidian distribution at this location.

Similar, though not such dense nor diverse associations of species occur at Eagle Rock and in the Rutherford Channel.

It is possible that the less diverse fauna of Port Phillip Bay is a result of environmental disturbance. The presence there of (probably) introduced species *Ciona intestinalis, Ascidiella aspersa* and *Styela clava* (see Holmes, 1976) may be evidence of this disturbance.

The occurrence of *Dumus areniferus* Brewin, previously known only from New Zealand, increases the number of temperate species that are known to occur in both southern Australian and New Zealand waters (Kott, 1974). It is unlikely to have been introduced on ship's hulls and its Australian occurrence may have previously been overlooked.

STATION LISTS

WESTERN PORT

CRAWFISH ROCKS, tidal currents, 5 knots

? metres:

Aplidium triggiensis
Trididemnum cerebriforme

Intertidal:

Microcosmus squamiger
Microcosmus australis

0-15 metres:

Sycozoa cerebriformis
Dumus areniferus
Aplidum lobatum
Sidneoides tamaramae
Didemnum skeati
Didemnum spongioides
Amplicarpa diptycha
Pyura irregularis
Halocynthia hispida
Mogula mollis

8 metres, *Ecklonia* 'holdfasts':

Aplidium lobatum
Didemnum candidum
Didemnum mosleyi
Didemnum patulum
Polysyncraton victoriensis
Botrylloides leachii
Pyura australis
Pyura cataphracta
Pyura irregularis
Halocynthia hispida
Microcosmus helleri
Microcosmus nicholsi
Microcosmus stolonifera
Microcosmus squamiger

12 to 24 metres:

Oxycorynia pseudobaudinensis
Sycozoa cerebriformis
Eudistoma pyriforme
Polycitor giganteum
Pseudodistoma cereum
Synoicium hypurgon
Polyclinum marsupiale
Aplidium lobatum
Aplidium depressum
Didemnum moseleyi
Didemnum patulum
Didemnum turritum
Didemnum augusti
Didemnum skeati
Didemnum spongioides
Didemnum roberti
Polysyncraton orbiculum
Lissoclinum ostrearium
Diplosoma rayneri
Ascidia sydneyensis
Botrylloides nigrum
Symplegma viride
Amplicarpa dytycha
Pyura australis
Halocynthia hispida
Microcosmus helleri
Microcosmus stolonifera
Microcosmus squamiger

13-26 metres:

Amplicarpa dipytcha
Pyura australis

EAGLE ROCK, 15 metres:

Trididemnum cyclops
Didemnum mosleyi
Didemnum patulum
Didemnum turritim
Didemnum roberti
Didemnum skeati
Lissoclinum fragile
Diplosoma translucidum
Ascidia sydneyensis
Botrylloides nigrum
Pyura irregularis
Pyura stolonifera praeptialis
Halocynthia hispida
Herdmania momus
Microcosmus helleri
Microcosmus squamiger

RUTHERFORD CHANNEL, fast current, 5 metres:

Sycozoa penduculata
Aplidium depressum
Microcosmus squamiger

TANKERTON JETTY, 7 metres:

Polycitor giganteum
Atapozoa mirabilis
Sycozoa cerebriformis
Aplidium pliciferum
Phallusia depressiuscula
Pyura irregularis

SHOREHAM:

Ascidia syneyensis
Molgula sabulosa

SAN REMO:

Pyura scoresbiensis
Molgula sabulosa

BALNARRING BEACH:

Podoclavella cylindrica

FLINDERS JETTY, 3 metres:

Oxycorynia pseudobaudinensis
Podoclavella cylindrica
Tridemnum cyclops
Lissoclinum ostrearium
Phallusia depressiuscula
Ascidia sydneyensis
Polycarpa thelypanes
Herdmania momus

PORT PHILLIP BAY

WILLIAMSTOWN, 5 metres (common on rocks):

Ascidia sydneyensis
Microcosmus squamiger

HOBSON'S BAY, 13 metres:

Didemnum lambitum
Ascidia sydneyensis
Phallusia depressiuscula

MORNINGTON, 12/10/69, bottom patchy, rock and sand, coll. Kevin Duke, 1-2 metres:

Pyura albanyensis
Pyura stolonifera praeputialis

MORNINGTON PIER, 12/10/69, sparse rock, calm waters, coll. Kevin Duke:

Ascidia gemmata
Cnemidocarpa etheridgii

MORNINGTON PIER, 12/10/69, dense rock, coll. Kevin Duke, 8-11 metres:

Pyura irregularis
Microcosmus squamiger

YARRA RIVER, 0-3 metres, 28/4/72, No. 3 Oil Wharf, Coll. J. E. Watson.

Ciona intestinalis

PORTSEA, 15/9/1957:

Amphicarpa diptycha

MORDIALLOC BEACH, Nov, 1888, Coll. W.K.:

Aplidium pliciferum
Botrylloides nigrum

ZOOBENTHOS SURVEY, Fisheries and Wildlife Department, Coll. G. Poore: Off BRIGHTON, 21/10/69, Station 906, sandy bottom, 10 metres; middle of northern part of Gulf, 10/2/69, Station 915, silty-clay bottom, 19 metres; off GEELONG, 12/2/70, Station 940, silty clay bottom, 8 metres:

Ascidia sydneyensis

South of POINT WILSON, 12/2/70, Station 942, silty clay bottom, 7 metres:

Ascidia sydneyensis
Molgula sabulosa

North-west of PORT ARLINGTON, 11/2/70, Station 930, silty clay-sand bottom, 10 metres:

Ascidia gemmata

North of PORT ARLINGTON, 18/2/71, Station 931, silty sand-shell bottom, 15 metres; north-west of ROSEBUD, Station 982, sandy bottom, 18 metres:

Sycozoa pedunculata
Cnemidocarpa etheridgii

East of ST. LEONARDS, 16/2/71, Station 960, sandy bottom, 10 metres:

Moluga mollis

Off BRIGHTON, 9/3/71, Station 1218, sandy bottom, 4 metres:

Pyura lepidoderma
Pyura stolonifera praeputialis

Off BRIGHTON, 9/3/71, Station 1226, silty-clay bottom, 8 metres; half-way down eastern shore of the Bay, 10/3/71, Station 1241, sandy bottom; south of SOUTH WERRIBEE, 11/3/71, Station 1252, sand-gravel bottom, 4 metres:

Pyura stolonifera praeputialis

PORT PHILLIP SURVEY:

area 5, POPES EYE, 15/5/63:
Polyandrocarpa lapidosa
area 30, PRINCE GEORGE LIGHT:
Pyura Stolonifera praeputialis

ARTIFICIAL REEF:

Ciona intestinalis
Sycozoa pedunculata
Ascidia syneyensis
Botrylloides nigrum

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