

## NOTES ON THE DIDEMNIDAE (ASCIDIACEA)

### III. A COMPARISON OF *DIDEMNUM MACULOSUM*, *D. CANDIDUM*, *D. HELGOLANDICUM*, AND *TRIDIDEMNUM ALLENI*

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(Text-figs. 1-5)

When Michaelsen (1923) described a species of didemnid from Heligoland, he stated that it was very similar to *Leptoclinum maculosum* Milne Edwards (1841), so far as may be judged by external appearance, but since no adequate description of this latter existed he proposed to call his Heligoland form by a new name, *Didemnum helgolandicum*, rather than use an old name which might well be wrong. Neither Michaelsen nor Hartmeyer, who described further details of *D. helgolandicum* (1924), was able to compare it directly with specimens of *D. maculosum* from the Channel coasts whence it was first described by Milne Edwards. Through the kindness of the directors of the Zoological Museum of Copenhagen and of the Biological Station of Roscoff I have been able to obtain specimens of both these forms and to compare them with specimens collected around Plymouth and on the coast of North Wales, and with specimens of *D. candidum* Savigny, collected at Naples, and from the Red Sea, and of *Trididemnum alleni* Berrill, collected around Plymouth.

#### MATERIAL EXAMINED

Three small colonies of *Didemnum helgolandicum* collected by Ørsted in 10-13 fathoms 5 'quarter-miles'<sup>1</sup> north-west of Hirtshals (one of Michaelsen's type localities) and determined by Michaelsen. This is part of the type material.

About twenty colonies of *D. maculosum* collected at Roscoff (one of Milne Edwards's type localities) in the *Laminaria* zone, and one specimen from the same locality determined by Pizon.

Six colonies of *Didemnum maculosum* from various points on the North Wales coast.

About 200 colonies of *D. maculosum* and 100 of *Trididemnum alleni* from the Plymouth area (Berrill's type locality) collected and determined by Miss P. Kott, and in the local collection of the Plymouth Laboratory.

About 600 colonies of *Didemnum* spp. from the Plymouth area collected by myself, the identification of which is discussed below, and about 300 colonies of *Trididemnum alleni*.

<sup>1</sup> If these are Danish miles, since Ørsted collected the specimen, this distance is c. 8.5 km.; if, however, they are German miles, since Michaelsen wrote the present label, then the distance is c. 9.4 km.

Twelve colonies of *Didemnum* sp. collected by me from the Secca di Benda Palummo in 40 m. and from other localities at Naples.

Two colonies of *D. candidum* in the local collection of the Naples Zoological Station determined by Traustedt.

One specimen of *D. candidum* from the Red Sea (Savigny's type locality) determined by Garstang.

Nine specimens of *D. candidum* from the Red Sea, four colonies from the Suez Canal, and thirteen colonies from the Great Barrier Reef (Australia), in the British Museum collection.

#### OBSERVATIONS

When examining specimens of '*D. maculosum*' collected in the Plymouth area I soon realized that I was dealing with two separate species. The difference was most obvious in the larvae, one of which was twice as long as the other. An examination of the specimens in the local collection of the Plymouth Laboratory showed that these too fell into two groups, though unfortunately none of the specimens of one group had any larvae. The larvae and adults of the other group of specimens agreed in general appearance with those described under the name of *D. maculosum* auctt. by Millar (1949).

Here, then, were two species under the name *D. maculosum*. One of them I have identified with *D. candidum* Savigny, the other with *D. helgolandicum* Michaelsen. About one-quarter of the specimens collected in the Plymouth area agreed with Michaelsen's description of *D. helgolandicum* and with the specimens identified by him which I have had the opportunity to examine. All the other specimens from Plymouth, those from North Wales, those from Roscoff, and those from Naples, agreed with Savigny's (1816), van Name's (1945) and Michaelsen's (1920) descriptions of *D. candidum* and with the specimens of this species which I have examined. These latter specimens, especially those from Roscoff, are presumably the *Leptoclinium maculosum* of Milne Edwards, so this name must be abandoned in favour of the older name *Didemnum candidum* Savigny (1816), the type species of the genus. *D. helgolandicum* is different from this, as Michaelsen well knew, for he had the opportunity of examining specimens from near Savigny's type locality (Michaelsen, 1920). Accordingly, Michaelsen's name stands since it is not a synonym of any earlier described species. It is fortunate that the name to be abandoned is that of Milne Edwards with its insufficient description.

The descriptions which follow are based primarily upon the Plymouth material.

The colonies of the two species are indistinguishable externally. Both are thin encrusting forms, 1-2 mm. thick, growing on *Laminaria* holdfasts, gorgonians, other ascidians, in fact on any organic substratum and even occasionally on rock. The spicules vary in abundance, but usually it is possible to see the zooids or at least their position. The colour is very variable, whitish, blue-violet, violet, grey, brownish grey, where there is much mud, white,

yellow ochre or orange in cleaner situations. The larger colonies are usually marked with lines of deeper colour, which are usually furrows running over the surface in an irregular reticulum. The deeper colour seems to be a result of the less density of spicules in these furrows. The pigment appears to be free in the test, and is not contained in special pigment cells. It rapidly fades in alcohol, more slowly in formalin. The surface of the colony of each species is marked with small granulations most commonly, though they may be missing; these are wart-like protrusions, one near each branchial opening. There may be a layer of bladder cells at one or both of the surfaces of the colony, but this is not constant in either species.

The spicules are most abundant in the upper layers of the colony, immediately below the layer of bladder cells if these are present, and especially clustered in the wart-like protrusions and around the buccal siphons. They diminish in abundance steadily towards the deeper layers, but in *D. helgolandicum* there is frequently a greater abundance in the basal layer itself. In *D. candidum* there is rarely any special density near the zooids, but in *D. helgolandicum* the test immediately surrounding the zooids and especially that part under the abdomen of each zooid is denser in spicules than the rest of the test. The stippling in Fig. 1 gives an indication of the relative density of spicules in the various areas of the test.

The spicules are rather similar in general form, but rather more variable in *D. candidum*. In this species the rays most commonly have a terminal angle of about  $45^\circ$ , but they may be rounded, almost square-tipped, or even rod-like. The most common formula (see Carlisle, 1953) is 1, 6, 9, but 1, 6, 12, 1, 4, 8, or even 1, 6, 12, 24 may occur. The variability in spicule form is greater at Plymouth than is illustrated by Van Name (1921) for West Indian colonies. In *D. helgolandicum* the most common terminal angle for spicule rays is  $60^\circ$  and variations from this form are few. The formula is most frequently 1, 4, 8, 14, but 1, 6, 12, 1, 4, 8 and 4, 8 occur, or even 1, 4 in the lateral thoracic organs, where smaller spicules tend to accumulate, and around the lobes of the buccal siphon. In both species the size range is 25–45  $\mu$  with a few smaller or larger (absolute limits: 4 and 75  $\mu$ ). Those of *D. candidum* tend to be on the average rather larger than those of *D. helgolandicum*.

In *D. candidum* the zooids are rarely arranged in definite systems except around the edges of young colonies. Where a system is distinguishable the zooids are arranged around a common cloacal aperture with the atrial apertures facing inwards. The ring of zooids thus presents an outer aspect (outer with respect to the ring) of ventral surfaces. In *D. helgolandicum*, in the Plymouth material especially, though also in the material from Hirtshals, systems of zooids are much more definite and more commonly developed. Here, however, they are arranged the other way round, with the atrial apertures turned outwards from the ring of zooids and the ventral sides inwards. The centre of such a ring of zooids is solid test; the common cloacal

system runs between the systems of zooids. I have never seen this type of system developed in any other species of ascidian.

The zooids of both species are arranged nearer to the vertical than is usual in didemnids. They are never quite vertical, and the abdomen is more inclined than the thorax, so that the neck is bent, especially in *D. candidum*. The total

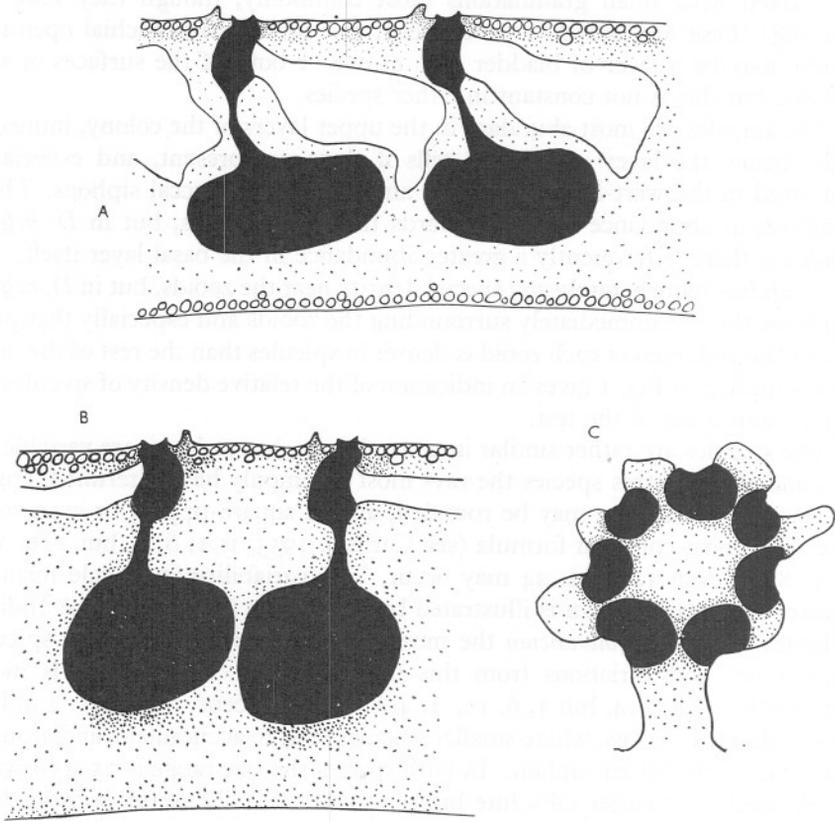


Fig. 1. Sections through colonies of *Didemnum candidum* and *D. helgolandicum*. A, vertical section through part of a colony of *D. candidum*; B, vertical; and C, horizontal section at the thoracic level, through part of a colony of *D. helgolandicum*. The stippling indicates the relative abundance of spicules in the various parts of the colony. Notice the association of the zooids of *D. helgolandicum* into systems with the ventral sides adposed.

length of a zooid of *D. candidum* in the usual contracted condition of preservation is about 1.1 mm.; in the expanded condition it may measure up to 1.6 mm. The corresponding figures for *D. helgolandicum* are 0.9 and 1.3 mm. The difference is chiefly a result of the longer neck and slightly larger abdomen of *D. candidum* (see Fig. 2).

The thorax of both species is smaller than the abdomen. There is a cline in *D. candidum* in this respect; the difference in size between the two parts, in European waters, is more pronounced farther north. It is most pronounced on the coast of North Wales, less so at Plymouth, still less at Roscoff, less again at Naples, while in the Red Sea the thorax is little smaller than the abdomen. This may be, at least partly, a result of temperature or nutrition differences. The difference is least marked in older, larger zooids, and colonies

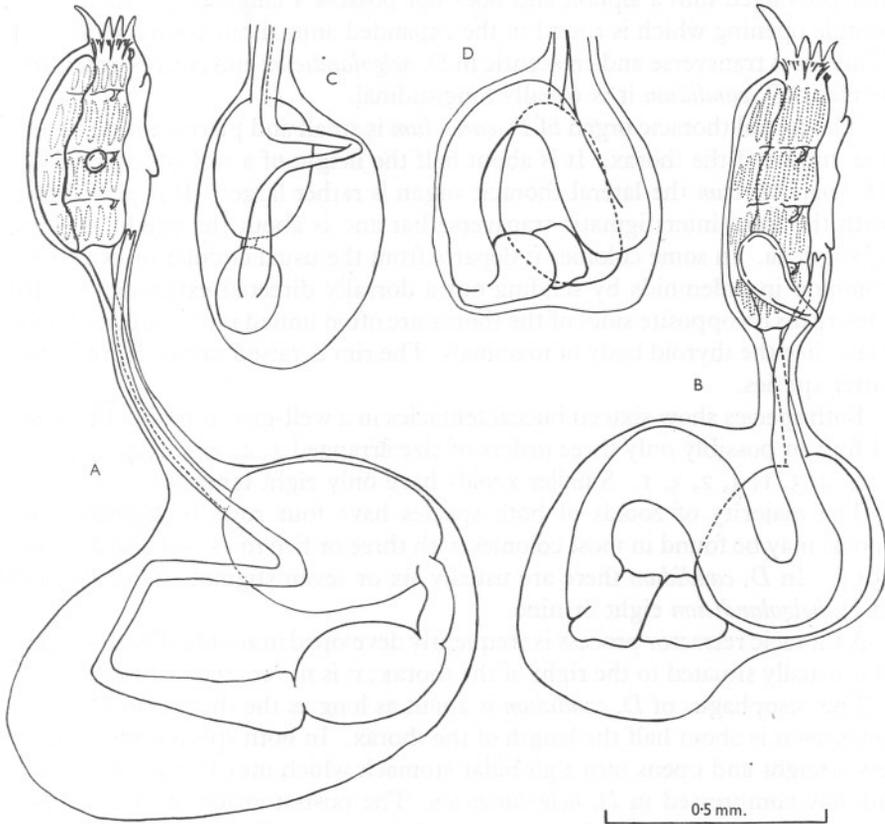


Fig. 2. Drawings from the left sides of zooids of (A) *Didemnum candidum*, and (B) *D. helgolandicum*; and from the ventral of sides of abdomina of (C) *D. candidum*, and (D) *D. helgolandicum*. The entire genital system and pyloric gland are omitted. The buccal lobes and tentacles are drawn only from one side, omitting those of the other.

grown in warmer waters grow faster to a given size so that there is a less proportion of small zooids. This is not, however, the whole explanation for differences in proportion exist even between zooids of the same size from the different localities. The thorax is separated from the abdomen by a long neck, which in *D. candidum* is about the same length as the thorax, sometimes

shorter, sometimes longer, while in *D. helgolandicum* it is always shorter than the thorax, usually less than half. The relative measurements refer especially to the uncontracted condition; the neck suffers more from shrinkage than most other parts of the body, and in a contracted preserved condition it is frequently much shorter.

The branchial siphons are six-lobed in both species though occasionally an eight-lobed individual of *D. candidum* may be found. The atrial aperture is not prolonged into a siphon and does not possess a languet. It remains as a simple opening which is round in the expanded animal but contracts to a slit. This slit is transverse and crescentic in *D. helgolandicum* and convex anteriorly, while in *D. candidum* it is usually longitudinal.

The lateral thoracic organ of *D. candidum* is small and placed a little behind the middle of the thorax. It is about half the height of a row of stigmata. In *D. helgolandicum* the lateral thoracic organ is rather larger. It is placed level with the third interstigmatic transverse bar and is about the height of a row of stigmata. In some colonies it departs from the usual circular or oval shape common in didemnids by sending out a dorsally directed extension, so that the organs on opposite sides of the thorax are often united into a saddle-shaped mass, like the thyroid body of mammals. The rim is raised rather more in this latter species.

Both species show sixteen buccal tentacles in a well-grown zooid. These are of four or possibly only three orders of size arranged 1, 4, 3, 4, 2, 4, 3, 4, 1 or 1, 3, 2, 3, 1, 3, 2, 3, 1. Smaller zooids have only eight tentacles.

The majority of zooids of both species have four rows of stigmata, but zooids may be found in most colonies with three or five rows (see also Carlisle, 1954). In *D. candidum* there are usually six or seven stigmata in a half-row; in *D. helgolandicum* eight or nine.

A thoracic retractor process is frequently developed in zooids of both species. It is usually situated to the right of the thorax; it is never attached to the neck.

The oesophagus of *D. candidum* is about as long as the thorax; in *D. helgolandicum* it is about half the length of the thorax. In both species it is more or less straight and opens into a globular stomach which may be rather strongly laterally compressed in *D. helgolandicum*. The post-stomach of *D. candidum* leaves the posterior end of the stomach and runs vertically to the globular mid-intestine, which is the most posterior part of the gut-loop and is sometimes nearly half as large as the stomach though usually no more than one-quarter. In *D. helgolandicum* the post-stomach leaves the ventral side of the stomach and runs horizontally; it is the most posterior part of the gut-loop. It is short and thick and opens into a short, thick mid-intestine which is much smaller than the stomach. From the mid-intestine the rectum, in *D. candidum*, runs ventrally with an enlarged proximal portion, then takes an abrupt turn anteriorly; another abrupt turn to the left produces an elbow which sticks out sharply to the left of the stomach before the rectum comes parallel to the

oesophagus to run up the narrow neck. The anus in this species is level with the middle of the last row of stigmata. In *D. helgolandicum*, on the other hand, all the curves in the course of the rectum are smooth and gradual. It leaves the mid-intestine, with no proximal swelling, in an anterior direction, curves round in a smooth S-shaped curve, lying partly to the left of the stomach, but without any pronounced elbow, and then runs up the neck beside the oesophagus. The anus is level with the hinder end of the third row of stigmata. The tight S-shaped curve of the rectum of *D. helgolandicum* is reminiscent of that of *Trididemnum niveum* (see Carlisle, 1953).

The epidermal ampullae are short and inconspicuous in both species, but rather variable in development, perhaps depending on the stage of growth.

In *Didemnum candidum* the vas deferens makes between seven and ten turns around the testis, with eight perhaps being the commonest number. Zooids may however be found, even within the one colony, with as many as twelve turns of spire, or as few as six. In *D. helgolandicum* there is similar variation with nine as the most common number of turns of spire. The testis itself in both species is a single spherical vesicle about as big as the stomach. The ovary is of the typical didemnid form with one predominant large ovum at a time and a series of progressively smaller ones.

The size of the larva of both species is somewhat variable: as in most species of didemnids the small peripheral zooids of the colony produce smaller ova and hence smaller larvae than do the larger central zooids. But the larvae from a zooid of *D. helgolandicum* is approximately twice the size of one from an equal-sized zooid of *D. candidum*. The body length, excluding tail, of a larva from a medium-sized zooid of *D. candidum* is approximately  $230\mu$ , that from *D. helgolandicum*  $630\mu$ .

The larva of *D. candidum* is unusual in possessing only two suckers set vertically, one above the other. They are cup-shaped with a conical cement gland set in the centre of each. They are flanked by three or four ampullae on each side. There are three suckers in *D. helgolandicum* and these are flanked by six or seven ampullae on each side. The cement glands in the centres of the suckers are rather more obtuse angled than is usual. The ampullae are relatively rather longer than in *D. candidum*. The endostyle is set more vertically in *D. candidum* than in *D. helgolandicum*, where it is inclined at about  $45^\circ$  to the axis of the larva. The branchial sac, at the moment of hatching, is perforated usually with four rows of stigmata, each of four to six stigmata per half row in *D. candidum*, or six to eight in *D. helgolandicum*. In smaller larvae from the periphery of the colony, however, there may be only three rows; in this case a fourth row does not perforate at least up to metamorphosis beyond which stage I have not observed them further. Below the sac is a mass of yolk-laden cells which persists far into free-swimming life. The gut remains as a solid rod, without lumen, up to metamorphosis. In *D. candidum* it lies in the normal position for the family, with a horizontal oesophagus

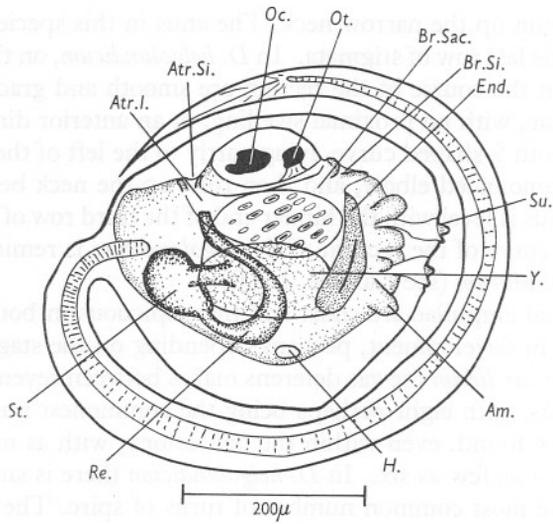


Fig. 3. Larva of *Didemnum candidum* from the right side. *Am.*, ampulla; *Atr.I.*, atrial invagination; *Atr.Si.*, atrial siphon; *Br.Sac.*, branchial sac; *Br.Si.*, branchial siphon; *End.*, endostyle; *H.*, heart; *Oc.*, ocellus; *Ot.*, otolith; *Re.*, rectum; *St.*, stomach; *Su.*, sucker; *Y.*, yolk.

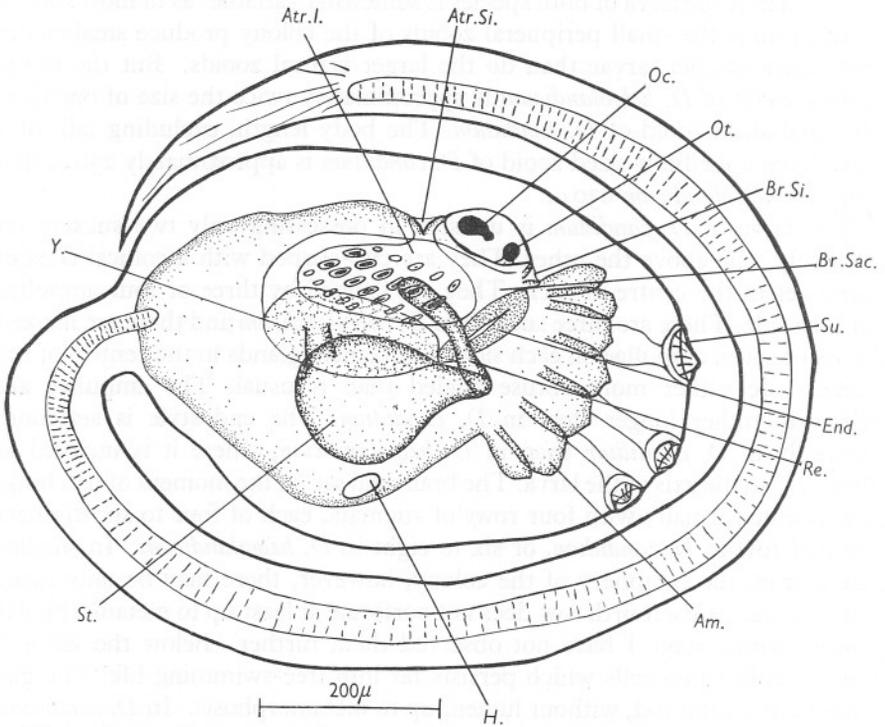


Fig. 4. Larva of *Didemnum helgolandicum* from the right side. Lettering as in Fig. 3.

projecting back from the branchial sac or from the yolk mass, leading to a posteriorly situated (posteriorly with respect to the swimming axis of the larva) globular stomach. The intestine-cum-rectum leaves from the antero-ventral corner of the stomach and sweeps round in a wide S-shaped curve to finish in the atrial cavity above the oesophagus. In *D. helgolandicum* the whole gut is much farther forward than is usual in the family. The oesophagus leaves the branchial sac or yolk mass in a downwards direction and runs into the stomach, which lies below the yolk mass, at its posterior end. The stomach is pyriform with the front end narrower. From this front end, even in front of the endostyle, the intestine-cum-rectum departs at right angles, lying transversely across the body. It then runs up at an angle of  $45^\circ$  almost straight to finish in the atrial cavity. The heart is in the usual position in both species, but in *D. candidum* the gut is entirely behind it, whereas in *D. helgolandicum* it lies beneath the stomach.

The sensory vesicle contains both ocellus and otolith, which are large and well developed in both species. The tail is of the same relative length in both, extending around the body, just before hatching, almost as far as its own base.

The free-swimming period is about 1 hr. in *D. candidum*, 4 hr. in *D. helgolandicum*.

*Leptoclinum maculosum* Milne Edwards is in some respects different from *Didemnum candidum* Savigny from the type locality, in particular in the relatively larger abdomen and in the swelling of the mid-intestine, but in all other respects they are alike. The 'elbow' which the rectum makes (which can be seen in Savigny's drawing, 1816, pl. XX, fig. 1) occurs in both; this character is quite unlike anything found in other species of *Didemnum*. The larvae of *D. candidum* from the Red Sea share with the specimens of '*D. maculosum* auctt.' the possession of only two suckers, a character which is shared only by *Trididemnum alleni* among ascidians. In fact the larvae from Red Sea specimens and from Plymouth specimens are indistinguishable. If we consider the two characters mentioned above, in which the two forms differ, the relative size of the abdomen and of the mid-intestine, we find that there is a cline in both these characters. Where specimens from Naples differ from those from the Red Sea in these two characters they do not differ enough to justify separate specific rank. Where those from Roscoff differ from those from Naples the difference is again not enough to justify specific separation. Again Roscoff and Plymouth specimens do not differ more than one expects to find within a species, nor do Plymouth and North Wales specimens. But direct comparison of specimens from North Wales with those from the Red Sea would suggest that they might conceivably be different but closely related species, or more likely, geographical subspecies. Since, however, intermediates are provided from the stations in between, I do not propose even subspecific rank for the English forms. I regard them as representatives of the extreme northern end of a cline with a complete range of intermediates down to the type-locality in the

Red Sea. They differ from the Red Sea specimens only in the relatively larger abdomina and in the greater degree of swelling of the mid-intestine. It is to be noted that the Red Sea specimens also show some degree of swelling of the mid-intestine, as may be seen in Savigny's drawing (1816, pl. XX, fig. 1<sup>4</sup>).

*T. alleni* Berrill (1947) is a form described from Plymouth. It seems to represent dwarf or young stages of *Didemnum candidum*. It has already been noted (above and in Carlisle, 1954) that the marginal zooids of *D. candidum*, and indeed of many species of *Didemnum*, have only three rows of stigmata and a simplified gut. Moreover, such zooids produce smaller larvae with only three rows of stigmata. In fact, the marginal zooids of *D. candidum* are identical with the zooids of *Trididemnum alleni*, and so also are the larvae of such zooids. I would suggest that *T. alleni* is the product of such a dwarf larva (or even occasionally of one of the larger larvae), which has settled in a place where there is either little food or little space for expansion. In such a situation the colony is bound to remain small, the zooids are likely to be smallish, hence the simplified gut, and unlikely to produce the larger branchial sacs which are characteristic of flourishing zooids when they replace a worn-out sac by a newly budded one. Direct observation in the field supports this hypothesis. I have on several occasions observed a scatter of young colonies evidently formed from simultaneously released larvae from one parent. Such a scatter settling around the base of a gorgonian or of a *Cystoseira*, some on the rock and some on the organism, consists of identical colonies. If one or two are removed they are usually found to consist of about six to ten zooids, of which one only may have four rows of stigmata; this doubtless is the oozoid. The other zooids are typical *Trididemnum alleni*. But in the course of 2 or 3 months, the colonies growing on the rock and on the larger expanses of substrate have developed into typical *Didemnum candidum* with four rows of stigmata in all but the marginal zooids. The colonies on restricted space have hardly grown at all and have remained in the *Trididemnum* condition with only very few zooids, if any, possessing four rows of stigmata. Such a colony transplanted to a position where feeding is better and where there is room for expansion soon develops into a typical *Didemnum candidum*. *Trididemnum alleni* is thus only one form of *Didemnum candidum*.

#### GEOGRAPHICAL DISTRIBUTION

*D. candidum* is a tropical and temperate species extending from the West Indies to the East Indies, New Zealand and Japan (Fig. 5). It does not apparently occur in the main body of the Pacific, or on the western shores of America. North and south it is bounded more or less exactly by the 15° C. isotherm.

*D. helgolandicum* is only known from Heligoland, the Skagerrak (Michaelsen, 1923), Faeroes (Hartmeyer, 1924) and Plymouth.

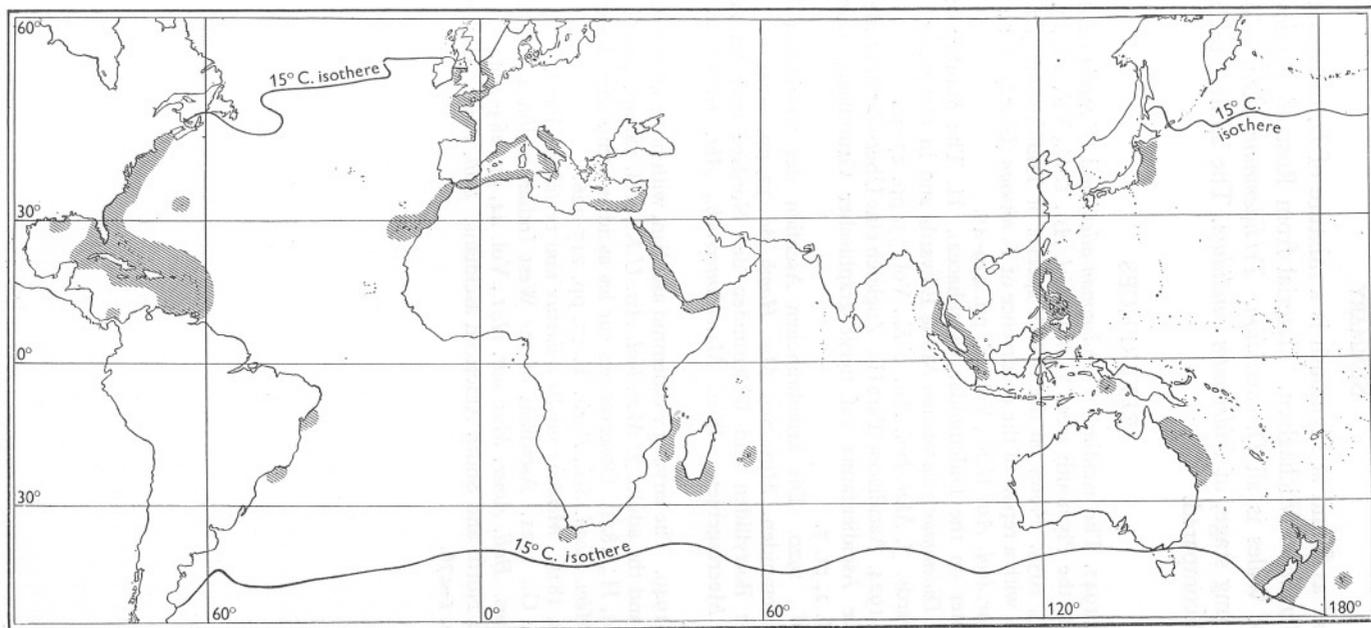


Fig. 5. Map of the distribution of *Didemnum candidum* (including *D. maculosum*, *D. candidum lutarium* and *Trididemnum allenii*).

## SUMMARY

'*D. maculosum*' as found at Plymouth is a mixture of *D. candidum* Savigny and *D. helgolandicum* Michaelsen. Material from Roscoff, Naples and the north coast of Wales is all *D. candidum*. *Trididemnum alleni* is one form, a dwarf or young stage, of *Didemnum candidum*. The adults and larvae are described and compared.

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## NOTES ON THE DIDEMNIDAE (ASCIDIACEA)

### IV. THE INCREASE OF *TRIDIDEMNUM NIVEUM* (GIARD) IN THE PLYMOUTH AREA, AND THE STRUCTURE OF ITS LARVA

By D. B. Carlisle

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(Text-fig. 1)

Since I first found *Trididemnum niveum* (Giard) at Salcombe in the autumn of 1951 (Carlisle, 1953) this species has spread and increased greatly in the Plymouth area. I have found it in abundance at Salcombe (Castle rocks and the Salstone), Wembury, and especially at Looe around the Island. The favourite habitat at all these places is the same as that at Roscoff, on the fronds of *Cystoseira*. It occurs rather less frequently on the holdfasts of *Laminaria ochroleuca* and occasionally on other species of *Laminaria*, but very little on any other substrate. It is not truly intertidal; the majority of specimens are to be found just below low-water mark of spring tides, and very rarely are any seen above low-water mark of even the lowest tides of the year.

In March 1952 a few specimens of *Trididemnum niveum* were found at each of the localities listed above. By June the numbers were greatly increased and by October still further. The following March (1953) the numbers were about the same as in the previous June, greater, that is, than the previous March by a factor of about three times. By midsummer *T. niveum* was the most abundant didemnid, and possibly the most abundant ascidian, at Looe in the neighbourhood of the island. At Salcombe it lagged behind *T. tenerum* and *Didemnum candidum* in abundance; at Wembury it was between *D. candidum* and *Trididemnum tenerum* in numbers, but was perhaps more conspicuous than either. In September 1953 it was still the most abundant didemnid at Looe, the second most abundant at Wembury and the third at Salcombe. In March 1954 it is by far the most abundant ascidian at Looe, forming at least 75% of the total ascidian fauna at low-water mark.

The association with *Laminaria ochroleuca*, which species was first observed in Britain in the Plymouth area in 1946 (Parke, 1948), and which is still spreading steadily, might suggest perhaps that *Trididemnum niveum* has arrived from Brittany with this oar-weed and is spreading along with it, perhaps at a distance of 2 or 3 years behind.

Salensky (1895) described the embryology and the larva of a species which he called *Didemnum niveum* in the title of his paper. On the second page

(p. 289) he states, 'Nach meiner früheren Bestimmung glaubte ich, dass diese dem *D. cereum* angehörten; es waren zwar in der That einige Exemplare von dieser Species dabei, aber die Hauptmasse der Colonien, die ich studiert habe, gehören einer anderen Species an und stehen dem *D. niveum* am nächsten'. Apparently he was not altogether sure of his identification. Whatever his species was it was evidently the most abundant didemnid at Villefranche. Harant & Vernières (1933) state that *Trididemnum niveum* has only once been recorded in the Mediterranean, thus implicitly doubting Salensky's identification. Berrill (1950) includes Salensky's species under the synonyms

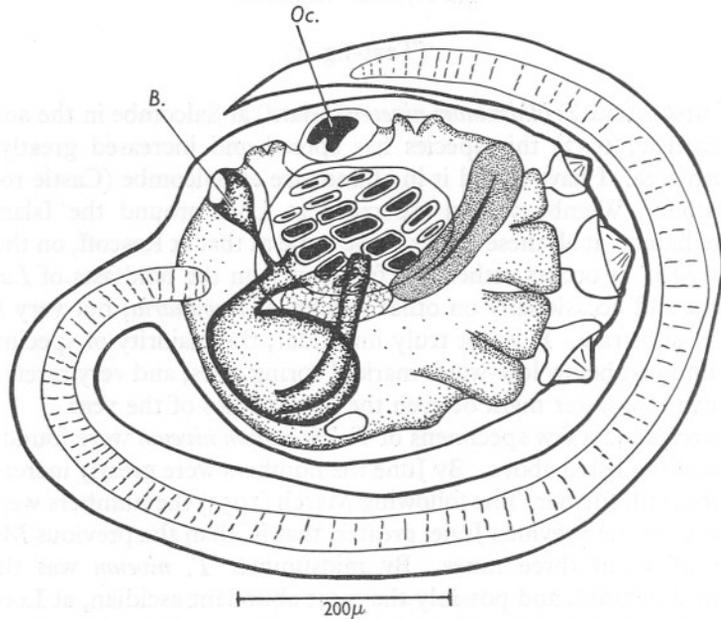


Fig. 1. Drawing from the left side of the larva of *Trididemnum niveum*. Note precocious budding and lack of otolith. B., bud; Oc., ocellus.

of *T. tenerum* (= *T.* or *Didemnum cereum*), but also gives it as a reference for *Trididemnum niveum* with a note (p. 141) suggesting that Salensky may be mistaken in his identification. The larva which Salensky describes is in fact unmistakably that of *T. tenerum* and differs in many points from that of *T. niveum*. Presumably he had two different colour varieties or forms of *T. tenerum*, one of which he recognized as such ('*Didemnum cereum*') while the other he failed to ascribe to its correct species.

Accordingly, the larva of *Trididemnum niveum* has not been described, an omission that can now be remedied.

The length of the body of the larva of *T. niveum* is slightly greater than that of *T. tenerum*, averaging about 480  $\mu$ , while that of *T. tenerum* averages about

430  $\mu$ . Mediterranean specimens of *T. tenerum* tend to have a smaller larva than northern ones, in my experience, and Salensky's figures indicate a length of about 400  $\mu$ . The tail is comparatively longer in *T. niveum*, extending round even past the sensory vesicle as far as the atrial siphon, whereas in *T. tenerum* it rarely passes the branchial siphon, when coiled around the body just before hatching. At the time of hatching the stomach of *T. tenerum* is hardly swollen beyond the thickness of the rest of the gut; in *T. niveum* it is globular. On the other hand, the gut of *T. tenerum* already has its lumen developed by the time of hatching, whereas that of *T. niveum* is solid even up to metamorphosis. There are three suckers in both species. The ampullae number about four pairs, but departures from this number are to three pairs in *T. tenerum* and to five pairs in *T. niveum*. I have been unable to distinguish any signs of the existence of an otolith in the *T. niveum*, a feature which is shared, so far as I know, only with *Pycnoclavella* (Berrill, 1947) and has not been observed in any other didemnid. Quite a number of specimens of larvae of *T. niveum* show precocious budding from the oesophageal region. The precocity is not nearly so pronounced as in *Diplosoma*.

The free-swimming period is about 20 min.

#### SUMMARY

*Trididemnum niveum* has increased in numbers at Plymouth between spring, 1951, and March 1954, until in some localities, the species is the most abundant of ascidians. The larva is described and figured; it lacks an otolith and shows precocious budding, but otherwise is typical for the family.

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