

THE OCCURRENCE OF BRITISH *APLYSIA*

By Ursula M. Grigg¹

From the Plymouth Laboratory

(Plates I and II and Text-figs. 1-3)

INTRODUCTION

On 13 November 1947 a specimen of the sea hare, *Aplysia depilans* L., which had been trawled in Babbacombe Bay, was sent to the Plymouth Laboratory. When it was realized that the animal was not the common *A. punctata* Cuv., collecting trips to likely places were undertaken in the hope of finding more. No others were found, but on one of the expeditions Dr D. P. Wilson picked up a specimen of *A. limacina* L.

Both *A. depilans* and *A. limacina* are found in the Mediterranean and on the west coast of Europe: *A. depilans* has been found in British seas before, but so far as is known *A. limacina* has not.

These occurrences provide the main reason for publishing this study. The paper also includes an account of the distribution of aplysiids in British waters and a review of the controversy over the identity of large specimens. As the animals are not usually described in natural history books, notes on the field characters are added.

I would like to thank the Director of the Plymouth Laboratory for affording me laboratory and collecting facilities and for his interest in the work. I am most grateful to Dr G. Bacci, who went to much trouble to send me specimens from Naples; to Dr W. J. Rees, who arranged for me to have access to the British Museum collection; to Dr D. P. Wilson, who has provided the photographs of *A. punctata* (Pl. I) and *A. limacina* (Pl. II); and to D. J. Slinn, who prepared the map. The distribution records were compiled with the help of many members of other marine laboratories and university zoology departments, and I am indebted to them for their kind co-operation in answering my queries.

I am greatly indebted to the Director of the Stazione Zoologica, Naples, for allowing me to spend a fortnight at the Stazione in September 1949, and providing me with living specimens of *A. limacina*.

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RECENT OBSERVATIONS

Aplysia depilans

The specimen of *A. depilans* was trawled by a Teignmouth fishing vessel in Babbacombe Bay on 12 November 1947. It was brought to the Plymouth Laboratory on 13 November in a rather damaged condition.

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When crawling the animal measured 24 cm. and was therefore a large specimen. It was a purplish fawn colour, with darker and lighter mottlings. The lips, gills and genital aperture were pale fawn. The eyes were very small and black, each surrounded by an area of pale blue. No dye was ejected, even when the animal was handled. It was put in a tank with circulating seawater, and crawled a short distance very slowly, without attempting to feed. The footsole was broad and non-contractile, and the head was not lifted or stretched out. The parapodia, which were low and exposed the visceral hump, were not undulated. The slight side to side swaying of the head and neck as the animal advanced was more reminiscent of a hippopotamus than a hare.

After the death of the specimen two days later, dissections showed that the head and visceral mass were much bruised. The shell was torn at the apex, which did not appear to have been pronounced. The anal indentation was also shallow. The shell was 5.7 cm. long and 4.5 cm. broad, measurements being taken from the apex to the farthest margin, and from the shoulder to the opposite margin at right angles to the first measurement. Only the hyaline layer of the shell was present. The radula was of the spade-shape characteristic of the species and carried over 70 rows of teeth; the formula was not determined. There was no recognizable food in the oesophagous or gizzard.

The photograph (Pl. I), which was taken when the animal was dying, is included to show the shape of the head and parapodia. The bloating of the footsole is not characteristic of a healthy specimen.

Aplysia limacina

The specimen of *A. limacina* was collected at L.W.S.T. on the Salstone, Salcombe Estuary, on 15 February 1949. It measured 20 cm. extended, which is small for the species.

The animal was a dark purple, the skin having a velvet lustre. The edges of the parapodia, tentacles and mouth-lappets were violet, as was the dye, which was ejected copiously whenever the animal was disturbed. The eyes were black.

This *Aplysia*, though sluggish, could be made to crawl by handling or by warming the water slightly. When it was at rest, the parapodia were folded over one another, and exhibited slow waving movements. A water current flowed from front to back through the cavity thus formed above the mantle. When crawling, the animal held the parapodia partially or fully stretched up, undulating the edges. The mouth-lappets and rhinophores were also in constant motion, but the head was never lifted and held out as in *A. punctata*. The footsole was narrow and the animal sometimes gripped the substratum with the posterior end only, as *A. punctata* does, but was not capable of the active extension and contraction of that species.

Specimens in the Naples Aquarium also folded their parapodia across their mantles when at rest and passed water over the visceral mass by undulating

the parapodia. When an animal was crawling the parapodia were partially extended, while in swimming they waved vigorously, propelling the *Aplysia* forward. The long axis of the body was held nearly vertical when the animal swam across the tank with the head slightly advanced and the tail bent back, giving a graceful sigmoid curve to the foot. When the animal swam a short distance over the tank floor the foot was horizontal.

Though the Salcombe specimen browsed on *Ulva lactuca* when first caught, it lost weight rapidly and was killed 3 weeks later. The shell had both hyaline and calcareous layers, and the apex and anal indentation were pronounced. It measured 3.5 cm. long by 2.8 cm. broad. The radula was of the typical square shape with abrupt tip, but was rather short, measuring only 0.8 cm. long by 0.9 cm. broad (Text-fig. 2c). There were 28 rows of teeth, and the formula across the broadest part was 20.1.20. The long dagger-like cusps on the lateral teeth were very well developed, which suggests that it was a young specimen. There was no recognizable food in the gut.

Dr Wilson's photograph (Pl. II) was taken while the animal was crawling with parapodia partially extended.

HISTORY

Although *Aplysia punctata* is the only aplysiid common in British seas, it has been described under several names on account of the great variation between individuals. Owing to their lack of skeletal structure compared with most shell-bearing molluscs, all aplysiids can assume many shapes, a faculty increased in *A. punctata* by its power of extension, which exceeds that of most other members of the family. The colour varies from a dark purple to a pale olive green, always with well-defined spots of black or white, and occasionally with the parapodia bordered with blue. Young specimens may be a delicate leaf-green or rose pink, the latter phase being *A. rosea* of Rathke and *A. nexa* Thompson. These colour variations probably depend upon the colour of the weed on which the individuals are living.

In the radula the number of tooth rows and the number of lateral teeth in each row increase as the animal grows larger. Hunt (1878) gives a table of radula formulae in which the numbers range from 4.1.4 to 15.1.15. Though the shape of the radula does not change, the teeth in large specimens are blunt, and rarely have the regular and distinctive shapes of most published diagrams. The shells of large animals show the same phenomenon, being generally coarser and less easy to define than those of small ones. Comparable changes are found in all members of the family.

All these factors have contributed to confuse the synonymy of *A. punctata*, and it is not surprising that on the rare occasions when extra large specimens appeared some naturalists were unwilling to assign them to another species. It was not until descriptions were published from regions where several species were common that the identifications could be made with certainty.

Pennant (1812) gives two species of *Aplysia* in his British list. These he calls *A. depilans* L. and *A. mustelina* Davies. He separates them on the gill shape, and mentions that *A. mustelina* had a crimson patch on 'that part which by its situation corresponds with what Bohadsch deems the lungs in his subject'. Mazzarelli (1893) considers Pennant's *A. depilans* to be *A. punctata*, and his *A. mustelina* to be *A. depilans* Cuv., presumably on the strength of the crimson patch. *A. mustelina* is usually taken to be a synonym for *A. punctata*.

Forbes & Hanley (1853), in their *British Mollusca*, include only one species, which they call *A. hybrida* Sowerby (= *A. punctata*). Jeffreys (1869), while supporting their view that *A. punctata* is the common species, records two specimens of *A. depilans*, one from Guernsey, and one collected by Gosse in Torbay.

In 1870 Couch described two specimens under the name of *A. melanopus*. His types are in the British Museum and are undoubtedly *A. depilans*.

In the autumn of 1875 A. R. Hunt, who had made a collection of shells and radulae of *A. punctata* from Torbay, found several *A. depilans*. He published an account of these (Hunt, 1877), and discussed their identity. While considering the possibility that they might be *A. depilans*, he remarked that 'too much reliance is perhaps placed on specific differences deduced from the very flexible shells and varying odontophores of these gastropods', and pointed out that 'an examination of a series of specimens of different sizes will prove conclusively that the odontophores develop gradually with the growth of their owners'. After collecting more in the winter of 1877-78 he published a paper (Hunt, 1878) on the growth of aplysiids, in which he came to the conclusion that the specimens were overgrown *A. punctata*. This paper includes an ingenious theory to account for the fact that all these large specimens were found in the winter when *A. punctata* was not present, and that there were no specimens within the size range of *A. punctata* which could be considered as the young of another species. He therefore suggested that *A. punctata* could only reach maximum size when protected from rough seas and provided with abundant food. These conditions were fully met near Torquay, which was sheltered naturally from the north and west and where artificial breakwaters of various kinds provided additional protection. Ample food was to be found on the *Ulva* beds growing round the sewage outflow at Tor Abbey. The animals were therefore able to live longer than they would otherwise have done, and to attain a large size. Hunt went on to remark that 'as the large *Aplysiae* have not been taken in deep water . . . it is probable that they do not make their way back to the greater depths from which they originally came and that the race is kept up by partially grown individuals'. Apparently he did not realise that *Aplysia punctata* comes inshore to spawn. He did not comment on the different external appearance and lack of contractility of his large animals as compared with *A. punctata*, though he mentioned that they very rarely ejected dye.

Garstang (1890), who discussed the subject with Hunt and examined his specimens, was equally inclined to regard them all as *A. punctata*, but he said: 'I trust that the subject may receive more conclusive treatment in the hands of a naturalist upon a coast where large Aplysiae are more common than they are with us in England.'

This treatment was supplied when Mazzarelli published his monograph (Mazzarelli, 1893) describing the anatomy, field characters, distribution and habits of six aplysiids including the three considered here. He recognized three records of *A. depilans* for the British coast. These are Gray (reference not given), Pennant (1812), and Couch (1870). He did not include Britain in his list of localities for *A. limacina*.

In the second edition of the list of British marine mollusca published by the Conchological Society of Great Britain and Ireland in 1902, *A. punctata* and *A. depilans* are both included, but in the later list compiled by Winckworth (1932) only *A. punctata* appears.

DISTRIBUTION

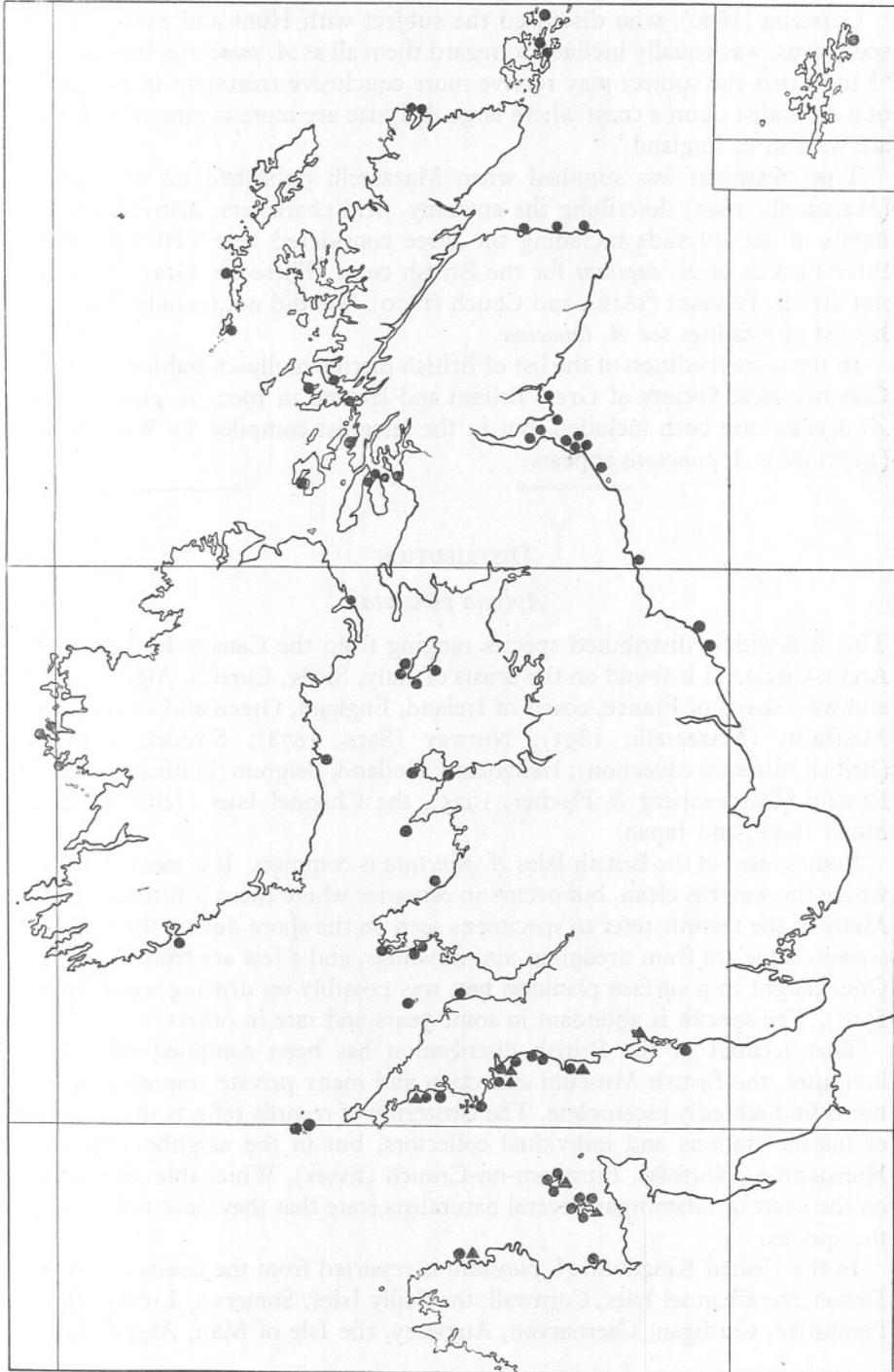
Aplysia punctata

This is a widely distributed species ranging from the Canary Islands to the Arctic Circle. It is found on the coasts of Italy, Sicily, Corsica, Algeria, south and west coasts of France, coasts of Ireland, England, Greenland and possibly Mauritius (Mazzarelli, 1893); Norway (Sars, 1878); Sweden, Portugal (British Museum collection); Heligoland, Holland, Belgium (Hoffmann, 1926); Roscoff (Dautzenberg & Fischer, 1925), the Channel Isles (Jeffreys, 1869; Sinel, 1906), and Japan.

Round most of the British Isles *A. punctata* is common. It is most abundant where the water is clean, but occurs in estuaries where there is little pollution. Many of the records refer to specimens seen on the shore during the breeding season, some are from dredgings and trawlings, and a few are from crab-pots. One, caught in a surface plankton net, was possibly on drifting weed (Sikes, 1905). The species is abundant in some years and rare in others.

This account of the British distribution has been compiled from local literature, the British Museum collection and many private communications, but is undoubtedly incomplete. The clustering of records reflects the activities of marine stations and individual collectors, but in the neighbourhoods of Hunstanton (Norfolk), Burnham-on-Crouch (Essex), Whitstable (Kent) and on the coast of Glamorgan several naturalists state that they have not yet seen the species.

In the United Kingdom, *A. punctata* is reported from the coasts of Dorset, Devon, the Channel Isles, Cornwall, the Scilly Isles, Somerset, Lundy Island, Pembroke, Cardigan, Caernarvon, Anglesey, the Isle of Man, Argyll, Arran,



Text-fig. 1. Records of British *Aplysia*. ●, *A. punctata*; ▲, *A. depilans*; ✕, *A. limacina*.

Islay, Mull, Cumbræ, the Outer Hebrides, Sutherland, the Orkneys, the Shetlands, Moray Firth, Banff, Aberdeen, Fife, the Firth of Forth, East Lothian, Berwick, Northumberland and Yorkshire. For the seas between Scarborough (Yorkshire) and Selsey Bill (Sussex) no records have been found; there is one doubtful record for Hampshire depending on a specimen identified in a boat and subsequently lost. On the French coast of the Channel it certainly occurs at Dinard and Roscoff.

Thompson (1856) says that the species is common all round the coast of Ireland. More explicit records are for Belfast Lough (Thompson, 1856) and the coasts of Dublin (Colgan, 1908), Cork and Galway (Sikes, 1905).

Aplysia depilans

This species is recorded from the coasts of Italy, Sicily, Corsica, England, Madeira, the west coast of France and the Cape of Good Hope (Mazzarelli, 1893). It is also found on the coasts of Spain and Portugal (British Museum collection), at Roscoff (Dautzenberg & Fischer, 1925), in the Channel Isles (Jeffreys, 1869; Sinel, 1906), and in Torbay (Gosse, recorded by Jeffreys, 1869; A. R. Hunt, 1877, 1878).

British specimens examined during the course of the present study are as follows:

British Museum specimens:

- 1850. 6. 17. 12, from Weymouth. This animal is interesting as it measures 9 cm. preserved, and is therefore small enough to be directly comparable with specimens of *A. punctata*. It shows very clearly the characters which help to distinguish the two species.
- 1860. 11. 28. 1, a very large specimen from Ichen, Southampton [presumably the river Itchen].
- 1870. *A. melanopus* Couch, type specimens, from Polperro.

Other specimens:

- The animal from Babbacombe recorded above (p. 796).

Aplysia limacina

Mazzarelli lists this species from the coasts of Italy, Sicily, Corsica, Algeria and the south and west coasts of France. There are specimens from the coasts of Spain and Portugal in the British Museum.

The only British animal, as far as is known, is the specimen from the Salcombe Estuary, recorded above (p. 796).

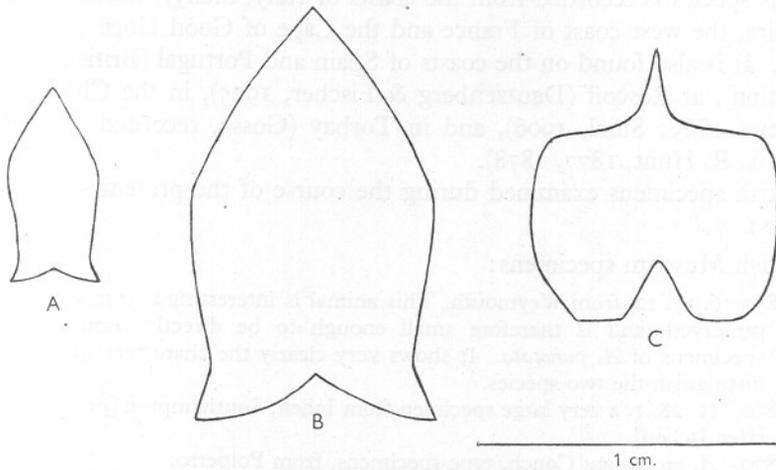
RECOGNITION CHARACTERS

The following characters are included as means of determining the species quickly. Nearly all are external, and have been found to be adequate for the determination of both living and preserved material. The animals from which

the list was made include at least two thousand *A. punctata* brought into the Plymouth Laboratory this year, and preserved material of all three species, including young, from Naples.

Colour, as indicated before, varies considerably and is not reliable. *A. punctata* is the only species which has small well-defined black or white spots, and none of the specimens that have been examined alive lacked them. *A. depilans* and *A. limacina* may be mottled, but the patches do not have such sharp edges. Neapolitan *A. limacina* were sometimes clearly enough marked to be mistaken for *A. punctata* at a first glance. *A. depilans* sometimes has patches of red, blue or yellow round the mouth, penis and gill. All the species go a dirty grey when preserved.

The most easily observed characters refer to the parapodia, mantle and head.

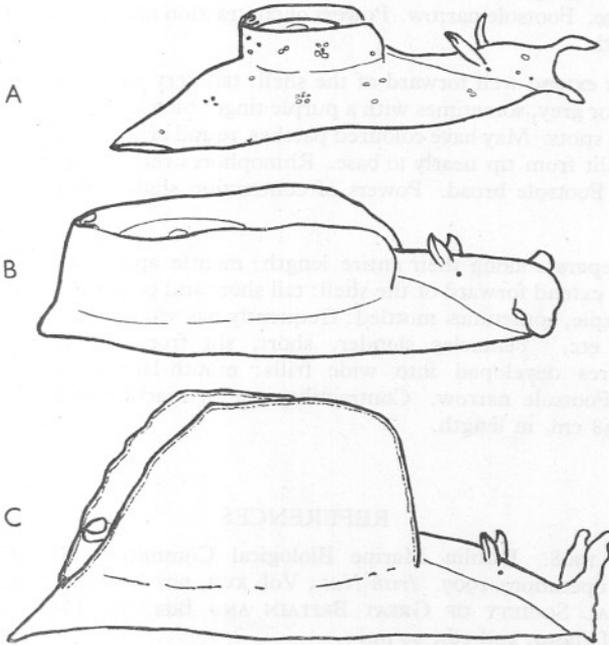


Text-fig. 2. Outlines of radulae of *Aplysia*. A, *A. punctata*; B, *A. depilans*; C, *A. limacina*. From specimens 6, 8.9 and 8 cm. long when preserved, respectively.

A. punctata and *A. depilans* have the parapodia fused at the posterior end. Both have a wide aperture through the mantle above the shell. In *A. punctata* (Text-fig. 3A) the parapodia surround the visceral mass closely and do not extend in front of it to any noticeable degree. As a result the neck is fairly long and there is a long pointed tail posteriorly. In *A. depilans* (Text-fig. 3B) the parapodia stand farther out, along the sides, and extend along the neck for some distance forward of the shell. They are not tall enough to conceal the shell, and the tail is very short and blunt. The parapodia of *A. limacina* (Text-fig. 3C) are separate for the whole of their extent, and there is a gap between the roots of them at the posterior end. They are much larger than in either of the other species, and fold over to conceal the visceral mass completely. The mantle aperture is in the form of a small papilla or siphon which is usually closed in life and has been closed in all preserved specimens examined. In other

respects this species is intermediate between the other two, as the parapodia extend a short way in front of the shell, and there is a short pointed tail.

The mouth-lappets are least developed in *A. depilans*, and both tentacles and rhinophores are short and stout. In *A. punctata* the mouth-lappets are not very large, but the rhinophores and tentacles are slim and are capable of very great extension. The tentacles of *A. punctata* are slit at the tips only, while those of the other two species are slit from the tips nearly to their proximal ends. The mouth-lappets of *A. limacina* form large frills, confluent with similar frills on the rhinophores. The tentacles are short and slender.



Text-fig. 3. General body outlines, showing specific distinctions. A, *A. punctata*; B, *A. depilans*; C, *A. limacina*.

The footsoles of *A. punctata* and *A. limacina* are narrow, while that of *A. depilans* is broad. *A. limacina* can attain 38 cm. in length expanded: *A. depilans* reaches 28–30 cm., and *A. punctata* is generally 15–20 cm. long.

The shape of the radula is characteristic (Text-fig. 2), being long and slim with a gradually tapering tip in *A. punctata*, broader in *A. depilans*, and square with an abrupt tip in *A. limacina*. The numbers of tooth rows and of lateral teeth in each row in the radulae of adult specimens may assist in identification. Mazzarelli (1893) gives these as 38–40 rows with (15–18).I.(15–18) teeth per row for *A. punctata*, 76–80 rows with (30–33).I.(30–33) teeth per row for *A. depilans*, and 82 rows with (40–45).I.(40–45) teeth per row for *A. limacina*.

Fuller descriptions of these animals may be found in Eales (1921), and Mazzarelli (1893). The specific names used in this paper are taken from the latter, which was the original means of identifying the specimens recorded above.

KEY TO SPECIES

Parapodia fused at posterior end: mantle aperture open.

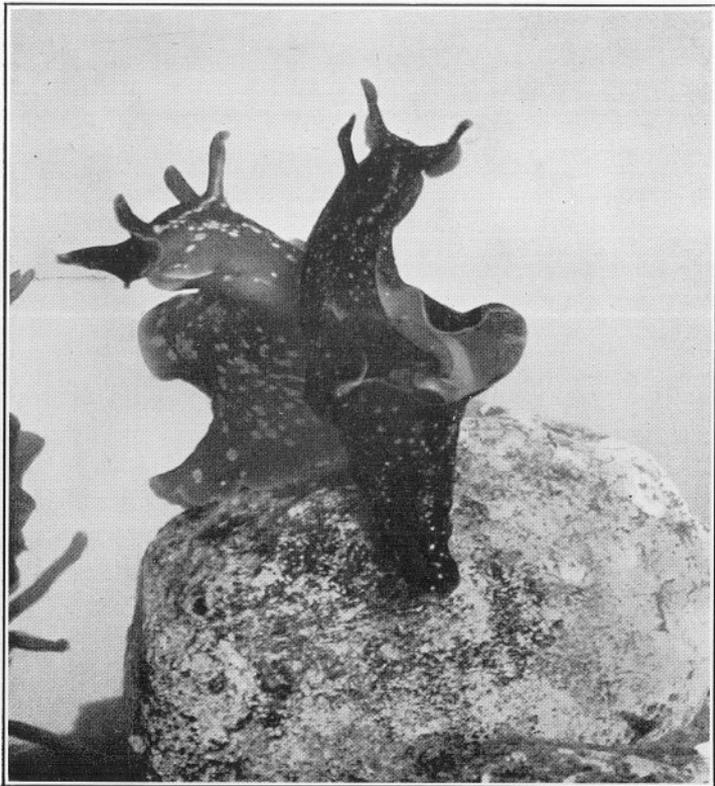
Parapodia do not extend noticeably forward of the shell: tail long. Colour olive green, brown or purple: clusters of well-defined black or white spots. Tentacles long, tubular, each with a slit at the tip. Mouth-lappets distinct, not large. Footsole narrow. Powers of contraction marked. Reaches 20 cm. in length. *A. punctata* Cuv.

Parapodia extend well forward of the shell: tail very short and blunt. Body brown or grey, sometimes with a purple tinge: blotchy but never with well-defined spots. May have coloured patches, round orifices and gill. Tentacles blunt, slit from tip nearly to base. Rhinophores very blunt, mouth-lappets small. Footsole broad. Powers of contraction slight. Reaches 28 cm. in length. *A. depilans* L.

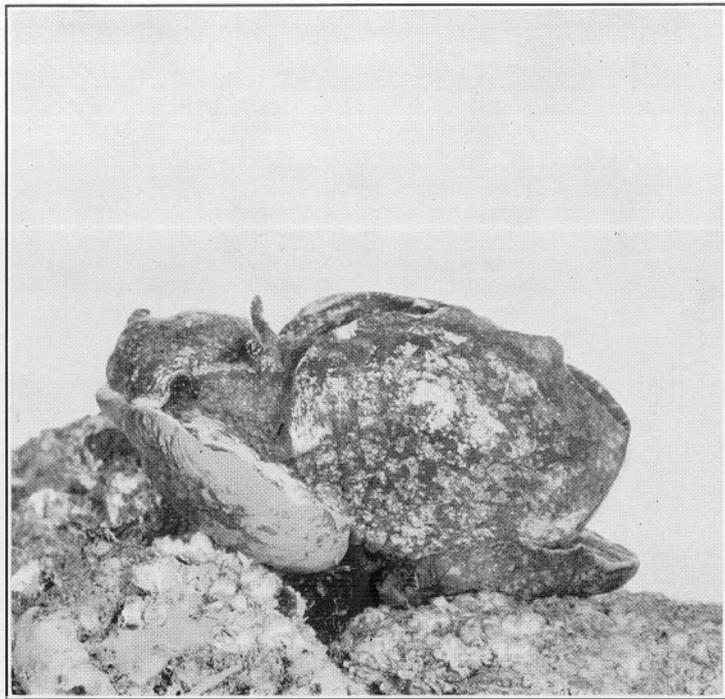
Parapodia separate along their entire length: mantle aperture on a papilla. Parapodia extend forward of the shell: tail short and pointed. Colour usually a dark purple, sometimes mottled: frequently has violet edges to parapodia, tentacles, etc. Tentacles slender, short, slit from tip nearly to base. Rhinophores developed into wide frills: mouth-lappets also long and waving. Footsole narrow. Contractility not so marked as in *A. punctata*. Reaches 38 cm. in length. *A. limacina* L.

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Aplysia punctata



Aplysia depilans



Aplysia limacina

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EXPLANATION OF PLATES

PLATE I

Photographs of living *Aplysia punctata* ($\times \frac{1}{3}$) and *A. depilans* ($\times \frac{3}{8}$).

PLATE II

Photograph of living *Aplysia limacina* ($\times \frac{1}{2}$).