

PHYLUM MOLLUSCA

Shell-less Opisthobranchia

by George M. Moore

Nudibranchs are the best known of the shell-less opisthobranchiate snails. Thiele (1931) recognized four orders of the subclass Opisthobranchia, placing some of the shell-less forms, along with a few shelled forms, in the order Sacoglossa. Most of the shell-less forms, along with a few shelled forms, were placed in the order Acoela, in two suborders, Notaspidea and Nudibranchia. Odhner (1934, 1936, 1939) recognized seven orders of Opisthobranchia including Notaspidea and Nudibranchia, and the classification adopted in Chapter XIV of this manual gives eight orders. The shell-less opisthobranchs of the Woods Hole fauna belong to three of these orders, with the majority of them in the order Nudibranchia.

Since the time of Alder and Hancock (1845-55) two general types of Nudibranchia have been recognized. One, the Holohepatica (dorids), have the digestive gland (the so-called liver) compact and undivided. The other, the Cladohepatica (eolids), have the digestive gland branched, with the branches extending into special dorsal outgrowths of the mantle (the cerata). Odhner proposed the division of the order Nudibranchia into four suborders, since it appeared to him that the evolution of the branched digestive gland had occurred more than once. Three of the suborders are represented in this key and list.

The suborder Doridacea is characterized principally by a circle of branchial plumes (adaptive or secondary gills) about the anus, which is mid-dorsal on the posterior half of the animal. The digestive gland is compact and does not extend into dorsal extensions of the mantle. In some dorids the mantle is broad and distinct from the foot while in others it is reduced to a ridge or narrow fold. A single pair of tentacles is present, on the dorsal surface a short distance back from the anterior end. These are termed dorsal tentacles or rhinophores, in contrast to the oral tentacles found in certain other nudibranchs. In dorids these dorsal tentacles are delicately sculptured with several diagonal laminae. Typical dorids are represented in the Woods Hole fauna by Palio, Onchidoris, and Acanthodoris. The family Corambidae, although included with the Doridacea, is not typical since its members lack the circlet of branchial plumes. They have a pair of small ctenidia-like gills located one on each side of the anus at the posterior end between mantle and foot.

In the suborder Eolidacea branchial plumes are lacking and the anus is laterally placed on the right side of the body. Typically, in all except the genus Embletonia, there are two pair of tentacles. The branched digestive gland extends into special dorsal processes (cerata; sing. ceras). Many eolids feed on hydroids and sea anemones, and undischarged nematocysts are moved by way of the "liver" canals to the cerata and concentrated in cnidosacs at their tips. A pore connects each cnidosac to the exterior. Eolids are represented in the Woods Hole fauna by nine genera.

The suborder Dendronotacea is represented in the Woods Hole fauna by Dendronotus, Scyllaea, and Idulia. In this suborder the dorsal tentacles are equipped with a basal sheath into which the terminal club can be retracted. Both types of digestive gland organization are found among the genera of this suborder; the holohepatic condition is considered the more primitive.

Nudibranchs, unless carefully anesthetized, contract and distort badly on preservation. Such specimens can be used for radula studies and for certain details of internal anatomy. This key will be of little use when working with such specimens, since it is intended for tentative identification of living specimens and is based entirely on external characteristics. Figure references in this chapter are to Plates 20 to 22.

1. With branchial plumes arranged in circle about the anus; anus located medially on the posterior dorsal half of the body; with single pair of tentacles 2
1. Without circlet of branchial plumes as above; other dorsal processes (pallial outgrowths) present or absent; with one or two pairs of tentacles 5
2. Branchial plumes singly pinnate; mantle distinct from foot 3
2. Branchial plumes doubly pinnate (or imperfectly tripinnate); mantle distinct or reduced to a ridge 4
3. Body white or occasionally slightly yellowish; branchial plumes about 11 and set in circle close to anus; dorsal surface covered with numerous knobbed tubercles of variable size Onchidoris aspera
3. Body dull yellowish-white (sometimes gray) with numerous brown markings; brownish markings form three indistinct interrupted longitudinal bands; branchial plumes up to 20-30 in large specimens, set in elliptical groove around anus, and with an included space covered by several bluntly knobbed tubercles; dorsal surface covered with numerous knobbed tubercles of variable size Onchidoris fusca
4. Mantle distinct from foot; dorsal surface thickly covered with numerous soft, slender, conical papillae of almost uniform size (figs. 3-5) Acanthodoris pilosa
4. Mantle reduced to knobbed ridges extending from sides of head to alongside the circlet of branchiae; body sparsely covered with short, blunt tubercles of variable size Palio lessonii
5. Cerata (dorsal processes which contain as a central core a branch of the digestive gland) absent 6
5. Cerata present 10
6. With distinct mantle; 1 or 2 ctenidia between mantle and foot 7
6. Without distinct mantle; ctenidia absent 8
7. With a single typical gastropod ctenidium on right side between mantle and foot; mantle covers anterior 2/3 of body but not the head (figs. 1, 2) Pleurobranchaea tarda
7. With pair of small ctenidia between mantle and foot at posterior end of body in the midline; mantle covers entire body, including head (figs. 6, 7) Corambella (?) sp.
8. Body compressed; with 2 pairs of strap-like membranous extensions arising from dorso-lateral edges of body; inner surface of dorso-lateral folds and surface between them thickly covered with delicately branched filaments (these filaments may be termed cerata by some authors) (fig. 8) Scyllaea pelagica
8. Body depressed; body with lateral extensions which can be folded towards midline over dorsal surface of body to enclose a dorsal canal 9
9. Lateral folds about 2/3 of length of body, not extending to posterior tip of foot, and not quite meeting when folded over back; foot square in front, with rounded corners; length to 1 cm . . . Elysia catula
9. Lateral folds extending to posterior tip of foot, and overlapping each other when folded over the back; anterior angles of foot strongly extended with acutely angled tips; length to 3 cm Elysia chlorotica

10. Cerata branched and tree-like Dendronotus frondosus
10. Cerata unbranched 11
11. Single pair of tentacles (oral tentacles lacking) 12
11. Two pair of tentacles (both oral and dorsal tentacles present) 13
12. Tentacles arising from trumpet-like sheaths; cerata club shaped and bearing scattered dark colored tubercles Idulia coronata
12. Tentacles arising directly from head (without basal sheaths); cerata simple and without tubercles Embletonia fuscata
13. Anterior lateral corners of foot extended and sharply acute angled 14
13. Anterior lateral corners of foot not much extended and either rounded or bluntly angled 18
14. Dorsal tentacles ringed with alternately larger and smaller rings, producing serrate margins (figs. 24, 25) . . Facelina bostoniensis
14. Dorsal tentacles smooth or slightly wrinkled, not annulated 15
15. Body ovate in outline, broad and somewhat depressed; with numerous cerata (up to 400 on each side) Aeolidia papillosa
15. Body linear, narrow; with fewer cerata (not over 100 on each side) 16
16. Body pale gray with white margins, and with 3 longitudinal reddish to russet interrupted stripes on head and anterior part of body (fig. 23) Cratena pilata
16. Body transparent white (internal organs may be yellowish or reddish), and without colored stripes on head and anterior part of body 17
17. Anterior lateral extensions of the foot about half as long as width of foot; tips of cerata transparent with an opaque white ring just back of tip; anterior cluster of cerata not as distinct and sharply set off as in the following; central core of cerata scarlet to rose red, varying in some specimens to chocolate (figs. 9-11) Coryphella rufibranchialis
17. Anterior lateral extensions of the foot about as long as the width of foot; tips of cerata with patch of opaque white; the anterior cluster of cerata distinctly set off from second cluster forming a "ruff about the shoulders"; central core of cerata carmine red; cerata somewhat longer than in above species (figs. 12-14) Coryphella pellucida
18. Anterior lateral corners of foot bluntly angled (figs. 18, 19) Cuthona concinna
18. Anterior lateral angles of foot rounded 19
19. Cerata very numerous and crowded, irregularly set; lateral edge of each cerata produced into a wide, strongly undulating membrane (figs. 26, 27) Fiona pinnata
19. Cerata not so crowded; cerata set in regularly defined rows; cerata circular in cross section and without lateral membrane 20
20. Cerata fairly numerous (at least 30 to 50 on a side) 21
20. Cerata few (4 to 10 or so on a side) 22

Plate 20

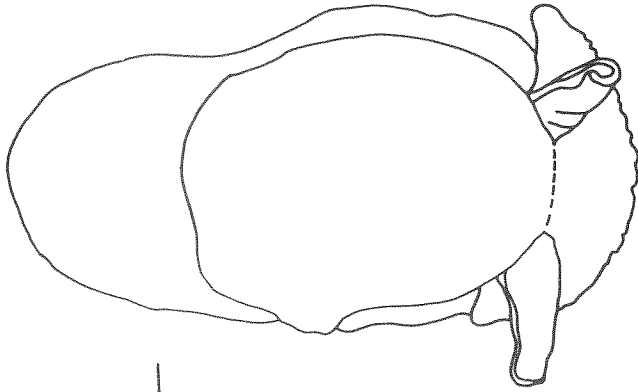
SHELL-LESS OPISTHOBRANCHS

Figures 1, 2, 6-8, 18, 24-27 on Plates 20-22 were drawn from Kodachrome transparencies taken by the author. Grateful acknowledgement is made to Miss M. Patricia Morse for inking most of the drawings. Figure 23 is redrawn from Verrill, the others from Alder and Hancock's Monograph. Figures of species that are satisfactorily illustrated in Miner (1950) have not been included in these plates.

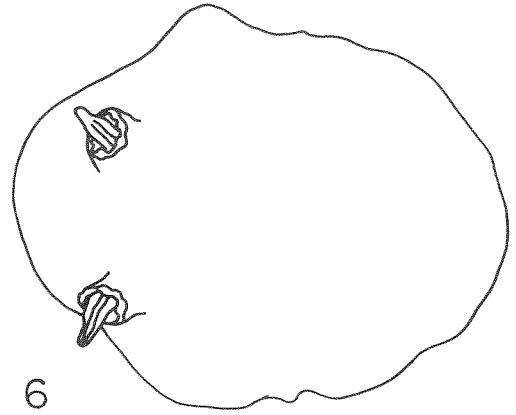
- Figure 1. Pleurobranchaea tarda. Dorsal view of specimen from Sargassum, Vineyard Sound.
2. P. tarda. Ventro-lateral view of same. Ctenidium visible on right side.
 3. Acanthodoris pilosa. Dorso-lateral view.
 4. A. pilosa. Branchial plume.
 5. A. pilosa. Portion of mantle edge, highly magnified, showing the conical papillae.
 6. Corambella (?) sp. Dorsal view of specimen from Sargassum, Vineyard Sound.
 7. Corambella (?) sp. Ventral view of same, showing ctenidia-like gills at posterior end.
 8. Scyllaea pelagica. Lateral view of right side. Specimen from Sargassum, Vineyard Sound.

All scale bars are 5 mm.

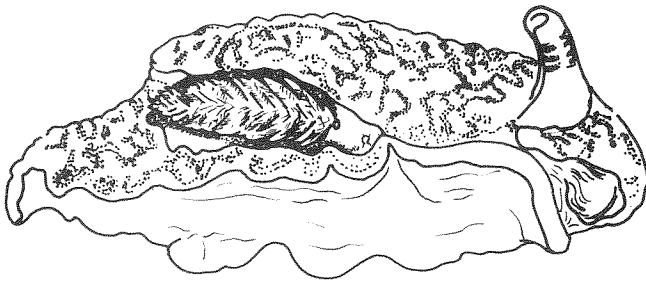
Plate 20



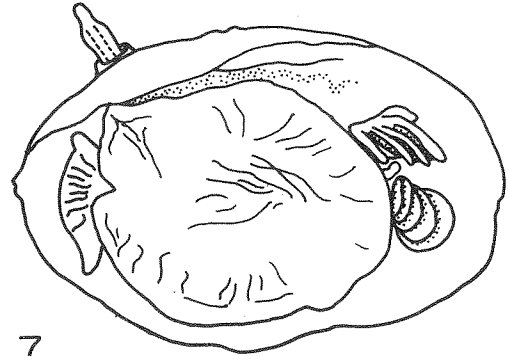
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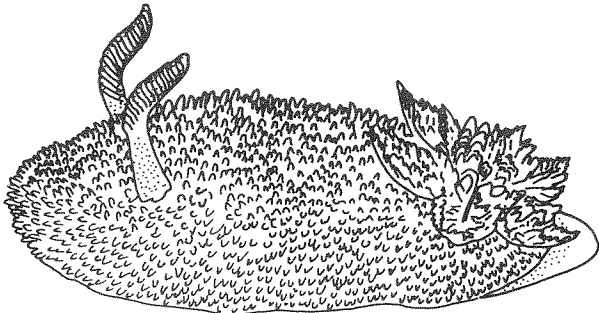
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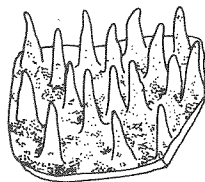
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5



8



Plate 21

SHELL-LESS OPISTHOBRANCHS (continued)

- Figure 9. Coryphella rufibranchialis. Dorso-lateral view.
10. C. rufibranchialis. Ventral view of anterior end.
 11. C. rufibranchialis. Two cerata.
 12. Coryphella pellucida. Dorso-lateral view.
 13. C. pellucida. Ventral view of anterior end.
 14. C. pellucida. Two cerata.
 15. Eubranchus pallidus. Dorso-lateral view.
 16. Eubranchus exiguus. Dorsal view.
 17. Tergipes despectus. Dorsal view. Alder and Hancock noted that "The figures in this plate (Fam. 3, Plate 17) have inadvertently been reversed". The figure shown here is not reversed.
 18. Cuthona concinna. Dorsal view of specimen from Sakonnet Point, Rhode Island.
 19. C. concinna. Ventral view of anterior end.

All scale bars are 5 mm.

Plate 21

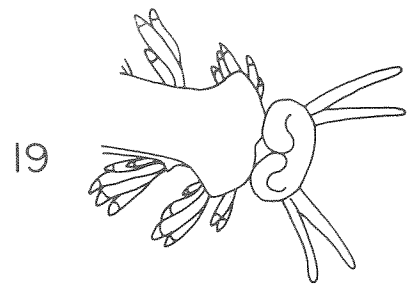
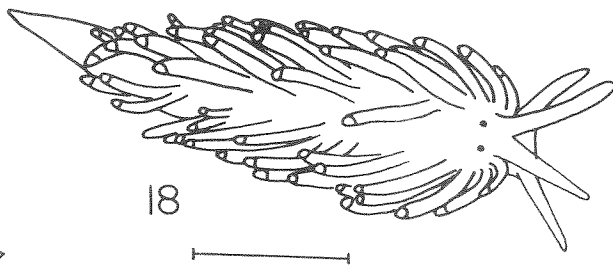
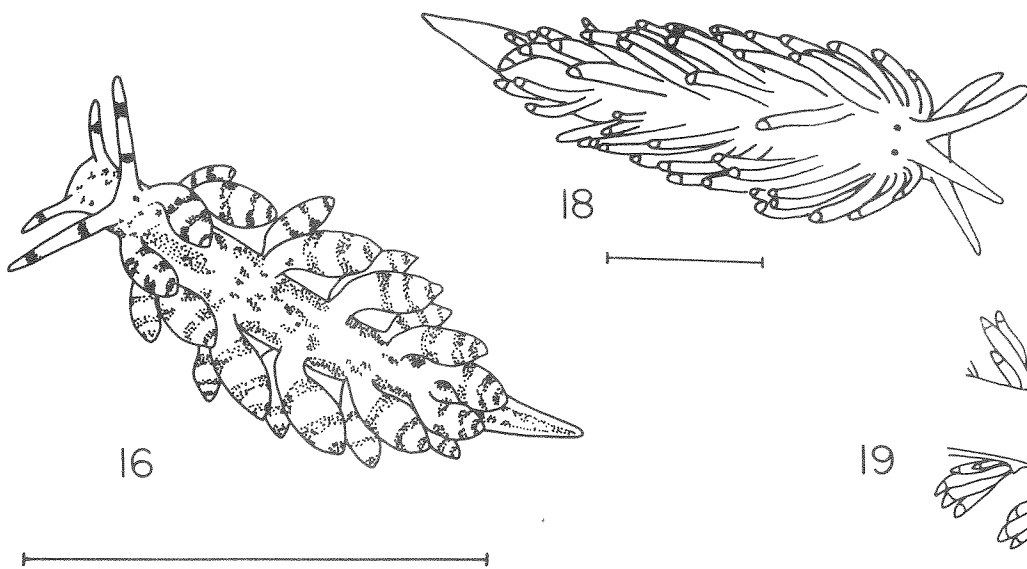
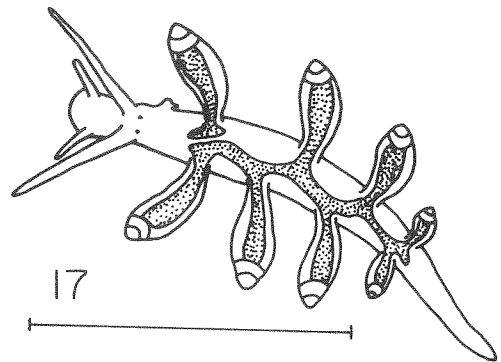
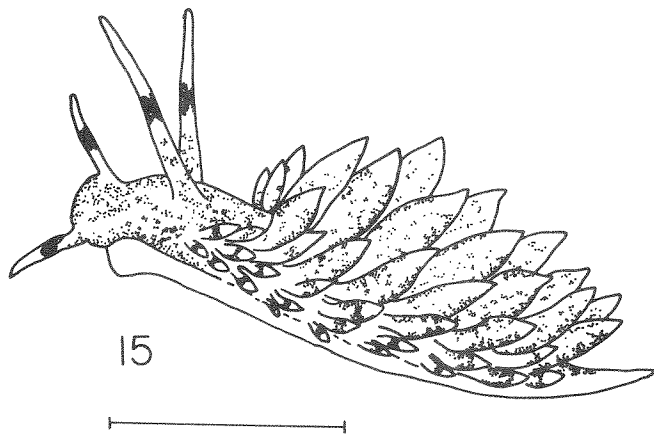
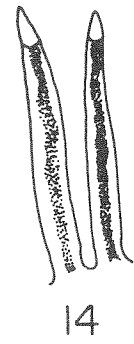
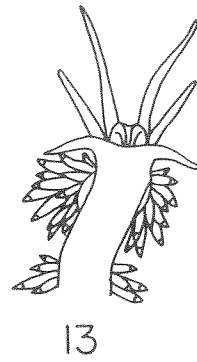
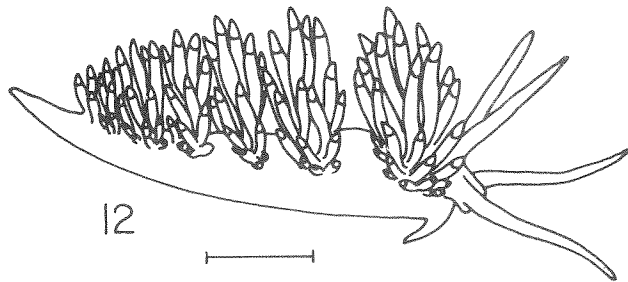
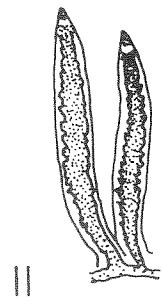
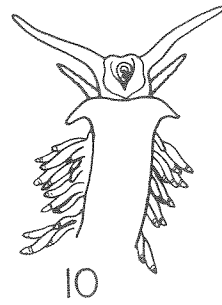
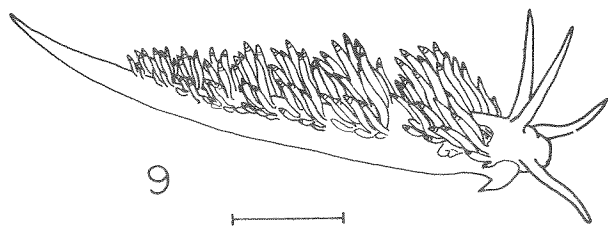


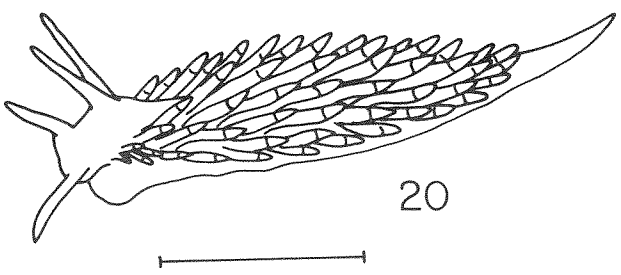
Plate 22

SHELL-LESS OPISTHOBRANCHS (concluded).

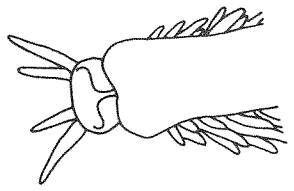
- Figure 20. Cratena aurantia. Dorso-lateral view.
21. C. aurantia. Ventral view of anterior end.
22. C. aurantia. Two cerata.
23. Cratena pilata. Dorsal view.
24. Facelina bostoniensis. Dorsal view of specimen from Tubularia, Woods Hole.
25. F. bostoniensis. Ventral view of same specimen.
26. Fiona pinnata. Dorso-lateral view of specimen from floating timber, Vineyard Sound.
27. F. pinnata. Three cerata showing undulating membranous extensions of same.

All scale bars are 5 mm.

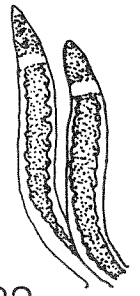
Plate 22



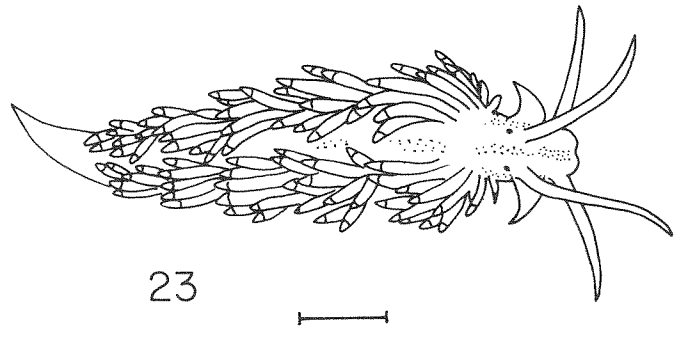
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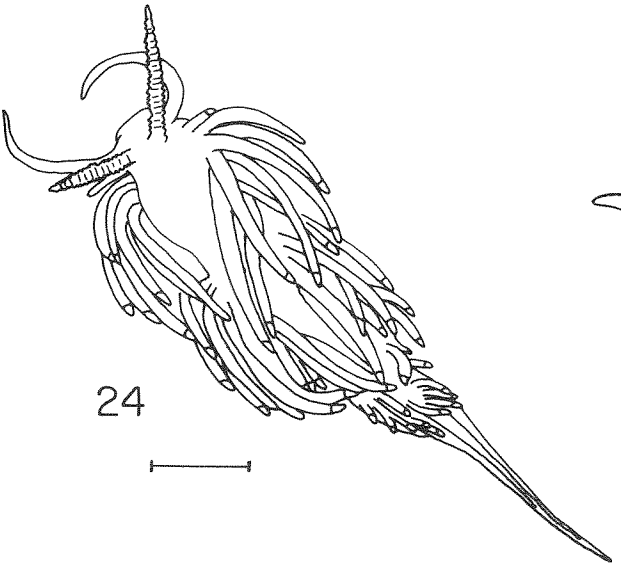
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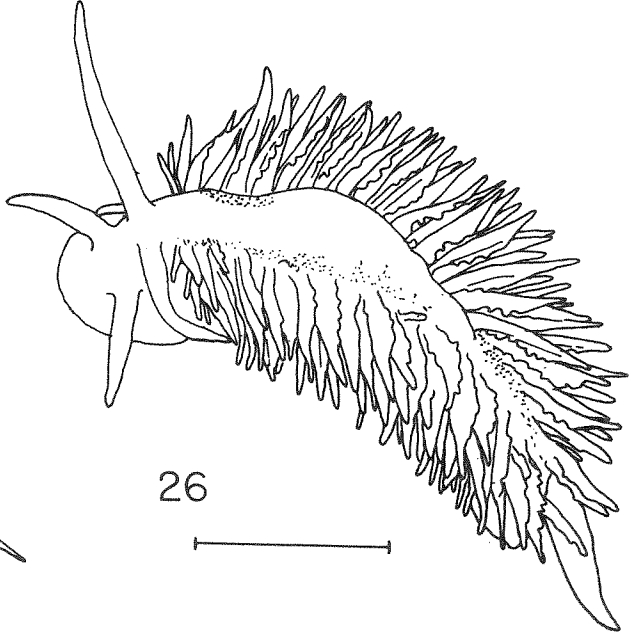
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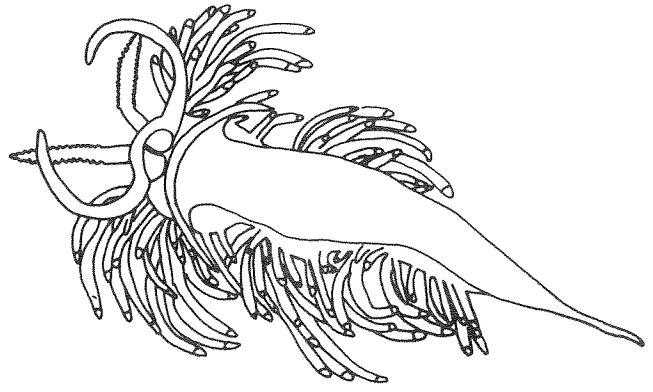
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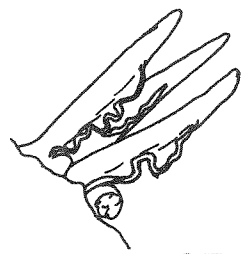
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21. Oral tentacles almost as long as dorsal tentacles; cerata long, cylindrical or slightly conical (figs. 20-22) Cratena aurantia
21. Oral tentacles about half as long as dorsal tentacles; cerata ovoid ovate, much inflated, somewhat compressed (fig. 15) Eubranchus pallidus
22. Cerata 5 to 10 on a side, clavate, large and inflated, tapering abruptly to a point; body spotted with green or brown; tentacles banded with olive or brown (fig. 16) Eubranchus exiguus
22. Cerata 4 (rarely 5) on a side, set in a single longitudinal row on each side; cerata smoothly (i.e. not abruptly) tapering; body transparent white, not spotted, sometimes striped anteriorly with two lateral reddish streaks; tentacles not banded (fig. 17) Tergipes despectus

ANNOTATED LIST OF SHELL-LESS OPISTHBRANCHS INCLUDED IN THE KEY

The list presented here includes most of the shallow water species of shell-less opisthobranchs known from the Woods Hole region, and is based both upon published records of Gould (1870), Verrill (1873), and Johnston (1934), and the collections of the author. Since we lack a monographic treatment of the group in this area, and since figures are helpful in identification, page references are made to Miner (1950) in the cases of species not figured in this manual. The synonymies given are not complete (some deletions in the interests of brevity have gone beyond the author's wishes, and for this the editor accepts responsibility). References to Alder and Hancock (1845-55) are given as A & H; Gould and Binney (1870) as G & B; Verrill and Smith (1873) as V & S. Additional synonymy is given by Johnston (1915), and Iredale and O'Donoghue (1923).

CLASS GASTROPODA

Subclass Opisthobranchia

Order Sacoglossa

Elysia catula (Gould, 1870). As Placobranchus catulus in G & B; as Elysiella catulus in V & S; Miner, p. 674.

Elysia chlorotica Gould, 1870. Miner, p. 674. Found in salt and brackish water marshes.

Order Notaspidea

Pleurobranchaea tarda Verrill, 1880. See Verrill, 1882, Trans. Conn. Acad., 5: 546. Dredged, 60-400 meters; also on floating Sargassum in Vineyard Sound.

Order Nudibranchia

Suborder Doridacea

Acanthodoris pilosa (Abildgaard, 1789). As Doris pilosa in A & H; as Doris bifida in V & S. Color various, white to yellow, brown, or even black. Under rocks, midtidal to laminarian zone; abundant sporadically in spring, also taken in summer and fall; throughout New England.

Corambella (?) sp. Animals figured in figures 6 and 7 have been collected at Woods Hole on pilings and from Sargassum in Vineyard Sound.

Onchidoris aspera (Alder and Hancock, 1842). As Doris aspera in A & H; as Doris pallida in G & B; as Onchidoris pallida in V & S; as Onchidoris aspera in Miner, p. 671. The spelling Onchidoris used by Miner and certain other authors is of incorrect gender, and has been emended by Winckworth (1932, J. Conchol. 19: 234, 251). Under rocks, low intertidal to 60 meters. Probably feeds on encrusting bryozoans. All seasons; Bay of Fundy to Rhode Island.

- Onchidoris fusca (Muller, 1776). As Doris bilamellata in A & H and G & B; as Lamelidoris bilamellata in Miner, p. 672. Midtidal to 8 meters, on barnacle covered rocks; feeds on barnacles; often gregarious, breeding and laying eggs; all seasons, breeding in spring and fall. Bay of Fundy to Rhode Island.
- Palio lessonii (D'Orbigny, 1837). As Polycera lessonii in A & H and V & S; Miner, p. 673. Under stones, low intertidal; New Brunswick to Connecticut.

Suborder Dendronotacea

- Dendronotus frondosus (Ascanius, 1774). As D. arborescens in A & H, G & B, and V & S; Miner, p. 671. Often associated with hydroids, especially Tubularia. Large specimens (up to 8 cm) have been collected by the author from pilings at the east end of the Cape Cod Canal; specimens of 2-3 cm from Bay of Fundy to Long Island Sound at all seasons.
- Idulia coronata (Gmelin, 1791). As Dctocoronata in A & H, G & B, V & S, and Miner, p. 673. Associated with various hydroids, including Sertularia; all seasons; Bay of Fundy to Long Island Sound.
- Scyllaea pelagica Linnaeus, 1761. On floating Sargassum in Vineyard Sound.

Suborder Eolidacea

- Aeolidia papillosa (Linnaeus, 1761). As Eolis papillosa in A & H; as Aeolis papillosa in G & B, and Miner, p. 670. This largest of New England eolids is sometimes called the "common nudibranch", but it is sporadic in occurrence. Found at all seasons, usually associated with sea anemones. Bay of Fundy to Woods Hole.
- Coryphella pellucida (Alder and Hancock, 1847). As Eolis pellucida in A & H. Maine and Woods Hole; winter and spring. Not previously reported from New England.
- Coryphella rufibranchialis (Johnston, 1832). As Eolis rufibranchialis in A & H; as Aeolis rufibranchialis in G & B. Balch's (1909) C. r. chocolata is but a color variety, intergrading with specimens with red cerata in the same area. The most abundant eolid of New England; among hydroids on rocks, intertidal to 200 meters; winter, spring, and early summer; Bay of Fundy to Massachusetts.
- Cratena aurantia (Alder and Hancock, 1842). As Eolis aurantiaca in A & H; as Montagua gouldii in V & S. Associated with Tubularia. Abundant, summer and spring; New Hampshire to Woods Hole.
- Cratena pilata (Gould, 1870). As Aeolis pilata in G & B; as Montagua pilata in V & S. Abundant on Pennaria at Woods Hole in July and August. This is the species used by Kepner (1943, J. Morph., 73: 297-311) in his study of the manipulation of nematocysts by nudibranchs.
- Cuthona concinna (Alder and Hancock, 1843). As Eolis concinna in A & H. A British species not previously reported from America; the author has taken it in Mass. and Rhode Island; Dr. Henry Russell has reported it from Cape Cod.
- Embletonia fuscata Gould, 1870. With red algae; New Hampshire to Woods Hole.
- Eubranchus exiguus (Alder and Hancock, 1848). As Eolis exigua in A & H; as Aeolis despecta (in part) in G & B. Gould apparently confused Tergipes despectus and Aeolis exigua (see Verrill, 1882, Trans. Conn. Acad., 5: 553, under Galvinia exigua). On occasion E. exiguus may lose its oral tentacles in the laboratory, and may then be confused with Embletonia fuscata. Associated with hydroids, Bay of Fundy to Woods Hole. Has been found breeding in MBL live cars in May.
- Eubranchus pallidus (Alder and Hancock, 1842). As Eolis picta in A & H and Aeolis picta in G & B. Associated with hydroids, winter and spring; Bay of Fundy to Rhode Island.
- Facelina bostoniensis Couthouy, 1838. As Aeolis bostoniensis in G & B. Associated with Tubularia; New Hampshire and Woods Hole region.
- Fiona pinnata Eschscholz, 1831. As Fiona nobilis in A & H; also F. marina of authors, and F. atlantica Bergh. Taken in August from Sargassum and floating logs in Vineyard Sound.

Terqipes despectus (Johnston, 1835). As Aeolis despecta (in part) in G & B; as Eo-
lis despecta in A & H. Associated with hydroids, spring and summer; Bay of
Fundy to Rhode Island.

REFERENCES ON SHELL-LESS OPISTHOBRANCHS

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Onchidoris fusca (Muller, 1776). As Doris bilamellata in A & H and G & B; as Lamelidoris bilamellata in Miner, p. 672. Midtidal to 8 meters, on barnacle covered rocks; feeds on barnacles; often gregarious, breeding and laying eggs; all seasons, breeding in spring and fall. Bay of Fundy to Rhode Island.

Palio lessonii (D'Orbigny, 1837). As Polycera lessonii in A & H and V & S; Miner, p. 673. Under stones, low intertidal; New Brunswick to Connecticut.

Suborder Dendronotacea

Dendronotus frondosus (Ascanius, 1774). As D. arborescens in A & H, G & B, and V & S; Miner, p. 671. Often associated with hydroids, especially Tubularia. Large specimens (up to 8 cm) have been collected by the author from pilings at the east end of the Cape Cod Canal; specimens of 2-3 cm from Bay of Fundy to Long Island Sound at all seasons.

Idulia coronata (Gmelin, 1791). As Dctocoronata in A & H, G & B, V & S, and Miner, p. 673. Associated with various hydroids, including Sertularia; all seasons; Bay of Fundy to Long Island Sound.

Scyllaea pelagica Linnaeus, 1761. On floating Sargassum in Vineyard Sound.

Suborder Eolidacea

Aeolidia papillosa (Linnaeus, 1761). As Eolis papillosa in A & H; as Aeolis papillosa in G & B, and Miner, p. 670. This largest of New England eolids is sometimes called the "common nudibranch", but it is sporadic in occurrence. Found at all seasons, usually associated with sea anemones. Bay of Fundy to Woods Hole.

Coryphella pellucida (Alder and Hancock, 1847). As Eolis pellucida in A & H. Maine and Woods Hole; winter and spring. Not previously reported from New England.

Coryphella rufibranchialis (Johnston, 1832). As Eolis rufibranchialis in A & H; as Aeolis rufibranchialis in G & B. Balch's (1909) C. r. chocolata is but a color variety, intergrading with specimens with red cerata in the same area. The most abundant eolid of New England; among hydroids on rocks, intertidal to 200 meters; winter, spring, and early summer; Bay of Fundy to Massachusetts.

Cratena aurantia (Alder and Hancock, 1842). As Eolis aurantiaca in A & H; as Montaquia gouldii in V & S. Associated with Tubularia. Abundant, summer and spring; New Hampshire to Woods Hole.

Cratena pilata (Gould, 1870). As Aeolis pilata in G & B; as Montaquia pilata in V & S. Abundant on Pennaria at Woods Hole in July and August. This is the species used by Kepner (1943, J. Morph., 73: 297-311) in his study of the manipulation of nematocysts by nudibranchs.

Cuthona concinna (Alder and Hancock, 1843). As Eolis concinna in A & H. A British species not previously reported from America; the author has taken it in Mass. and Rhode Island; Dr. Henry Russell has reported it from Cape Cod.

Embletonia fuscata Gould, 1870. With red algae; New Hampshire to Woods Hole.

Eubranchius exiguus (Alder and Hancock, 1848). As Eolis exigua in A & H; as Aeolis despecta (in part) in G & B. Gould apparently confused Tergipes despectus and Aeolis exigua (see Verrill, 1882, Trans. Conn. Acad., 5: 553, under Galvinia exigua). On occasion E. exiguus may lose its oral tentacles in the laboratory, and may then be confused with Embletonia fuscata. Associated with hydroids, Bay of Fundy to Woods Hole. Has been found breeding in MBL live cars in May.

Eubranchius pallidus (Alder and Hancock, 1842). As Eolis picta in A & H and Aeolis picta in G & B. Associated with hydroids, winter and spring; Bay of Fundy to Rhode Island.

Facelina bostoniensis Couthouy, 1838. As Aeolis bostoniensis in G & B. Associated with Tubularia; New Hampshire and Woods Hole region.

Fiona pinnata Eschscholz, 1831. As Fiona nobilis in A & H; also F. marina of authors, and F. atlantica Bergh. Taken in August from Sargassum and floating logs in Vineyard Sound.

Terqipes despectus (Johnston, 1835). As Aeolis despecta (in part) in G & B; as Eo-
lis despecta in A & H. Associated with hydroids, spring and summer; Bay of
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