

ON A NEW LABRADOREAN SPECIES OF ONCHIDIOPSIS,
A GENUS OF MOLLUSKS NEW TO EASTERN NORTH
AMERICA; WITH REMARKS ON ITS RELATIONSHIPS.

By FRANCIS N. BALCH,
Of Boston, Massachusetts.

During the summer of 1908 Mr. Owen Bryant, cruising on the Labrador coast, made opportunity for some dredgings in moderate depths. The resulting mollusks, with the exception of the Nudibranchs, were placed in the hands of Mr. C. W. Johnson, curator of the Boston Society of Natural History. The small collection of Nudibranchs was intrusted to me. In it was included an apparently naked mollusk, which Mr. Bryant took for a dorid form, but which is in fact a fine new species of the internal-shelled genus *Onchidiopsis* belonging to the family Lamellariidæ. Mr. Bryant's mistake was far from unnatural, and it is possibly owing to similar errors on the part of other collectors that we owe almost all our knowledge of the group to specialists on the Opisthobranchiata (especially the Nudibranchs), as will appear from the literature cited at the end of this paper.

The specimen is a fine adult, well preserved in formol, and is of interest from several points of view—first, from the point of view of geographical distribution, the genus being previously unknown from eastern America, though present in Greenland and Alaska; second, from the point of view of systematic morphology, the genus being probably the last term of an extraordinary aberrant series and containing few, perhaps only one, hitherto known species; third, from the point of view of teratology, since the specimen has a bifid left tentacle the abnormal member of which bears what appears externally to be an extra eye resembling the normal, but proves on sectioning to be a group of four eyes apparently proliferating one from the other, in various stages, making a case quite unique so far as the records show.

The present paper contains a description of the specimen, with a brief discussion from the first and second points of view. The teratological aspect was presented in a separate paper read before the American Society of Zoologists (Eastern Branch) during convocation week in Boston, December, 1909, and which, it is expected, will be published in the *American Naturalist*.

Out of a desire not to mutilate the single specimen more than necessary, examination has been confined to external points and to the

internal shell, the radula and pharyngeal bulb, the features of the gill-cavity, and the anatomy and histology of the bifid left tentacle. The material, consisting of the partially dissected body in formol, the shell in formol, and a mount of the radula, has been deposited in the U. S. National Museum.

The description follows:

ONCHIDIOPSIS CORYS,^a new species.

Locality.—Single specimen dredged off Fish Island, outside Hebron Harbor, Labrador, in 75 fathoms, mud, August 26, 1908.

Size.—In formol: Length, 20 mm.; breadth, 16 mm.; height, 14 mm.

Color.—In life: Cream colored, with 8(?) spots of varying shades of brown [Bryant's notes]. In formol: Notæum, ground-color light purplish brown with darker markings on the lower sides, faintly and vaguely reticulated over the top and upper sides, so as to give the effect of about twelve ill-defined blotches of the ground color. Anterior lobes lighter and more yellowish. Head and foot same as ground color of notæum. Eye spots black.

General form.—(Pl. 21, figs. 1, 2, 3.) The notæum, smooth on top and sides, wrinkled or strongly folded and vesiculate elsewhere, rises in a backward-tilted dome, suggesting a Grecian helmet (whence the name chosen), the curiously puffed and wrinkled anterior border projecting visor-fashion. The top and sides of the notæum are closely applied to the thin internal shell, which in turn closely covers the large dome-shaped visceral hump. Below the folded border of the notæum are seen the well-demarcated head and the foot, the former bearing a large proboscis of truncated-cone shape, and two thick tentacles about as long as the proboscis, with conspicuous eye spots about two-thirds way up from their bases. The foot in the preserved specimen is of moderate size, reaching anteriorly only to the level of the tentacles and posteriorly projecting about one-sixth of its length beyond the border of the notæum, the projecting portion sharply upturned. The very large penis, situated on the right side of the neck, comes partially into view below the notæum above the right tentacle.

Notæum.—Smooth to the naked eye (actually finely wrinkled), thin, and closely investing the thin internal shell on the top and sides; the lower sides more wrinkled; the border thickened, strongly folded, and vesiculate or puffy; the anterior border quite specialized, being very strongly folded, and vesiculate or pustulate, so as to present the appearance of a mass of crowded water blisters. This anterior lappet projects like a visor or eye shade over the head and is cut by the deep inspiratory cleft (lying just to the left of the median line) and the less deep expiratory cleft (lying about 65 degrees to the right, and rather a fold than a cleft) into a well-demarcated right and a much less well-marked left lobe. In life these anterior lobes or lappets evidently play an important part, as they are large, muscular, and

^a *Κόρυς*, signifying an homeric helmet.

highly specialized. Probably they are concerned in respiration and also furnish an extensible, thick, and soft sort of cushioned armor for the head, which lacks the ordinary defense of withdrawal under a shell.

Shell.—(Pl. 21, figs. 4, 5, 6.) On cutting open the notæum the shell appears as a quite transparent whitish film closely applied like a cap to the top and front of the solid dome of the visceral hump. Not being adherent either to the notæum or to the true mantle (which lies below it as a transparent membrane investing the visceral hump) it can be simply lifted out with forceps. It has about the appearance and consistency of a film of collodion. It is not stiff enough to resist the action of gravity in air, but has sufficient elasticity to regain its form when restored to a liquid medium. It is smooth except for rather faint concentric lines of growth. In general shape it may be roughly likened to a very highly arched finger-nail. A peculiar and instructive feature is the infolding of the posterior-inferior portion into the posterior-superior portion. A comparison of Pl. 21, figs. 7, 8, and 9, will make clear what has happened. Figs. 7 and 8 are rough representations of the shells of *Marsenina prodita* (Lovén) and *M. ampla* (Verrill), respectively. The former is lymnoid. The latter is more degenerate and consists of only one whorl, mostly mouth. Fig. 9 is a diagrammatic sketch of our shell represented as a solid object. The homology of the infolded portion is plain. The last whorl, becoming degenerate to the point of abandonment and reduced to a mere posterior wall of the mouth space, has simply collapsed into the spire cavity. This is not, however, a mere accidental collapse, as wet paper might collapse upon itself. It is structural and permanent. The infold, if straightened out, springs smartly back again and the line of folding is clearly marked structurally. The cavity of the last whorl (i. e., the space between the infold and the top of the shell) has been abandoned by the animal and practically obliterated. In this and other obvious respects the infold materially differs from the "deck" or "shelf" of *Crepidula*, with which, however, it is somewhat parallel. In the other species of *Onchidiopsis* there is no such structure, so that in this respect the present species serves to connect the genus as hitherto known with more normal forms and offers an instructive study in the degeneration of shell armor. The shell in the present species differs from those hitherto described in presenting neither lateral emargination nor wing.

Visceral hump.—Next below the thin membranous true mantle already mentioned lies the solid smooth dome of the visceral mass, purplish-yellow in color, the visible portion chiefly consisting of the glands of the genital system. It is larger than the shell, which only partially covers it, but the discrepancy is not so great as in the other species of the genus, where the shell is little more than a scale over the gill-cavity region, while here the whole top and sides of the visceral hump are covered. In the gill-cavity region the black base of the large osphradium showing through the roof of the cavity is conspicuous.

Gill cavity and branchial complex.—The large thin-roofed branchial cavity opens by a long and narrow crescentic horizontal slit just above the nuchal fold. On opening it the most conspicuous object is the osphradium running diagonally across the left side of the roof and consisting of a double series of leaflets (Pl. 21, fig. 10) set on either side of a central rhachis after the usual fashion, but very large and having the side edges and basal edges of the leaflets black. It differs markedly in the shape of the leaflets (which are distinctly bilobed) from the other species of the genus. Beside it, on the right, the gill, though larger, is much less conspicuous. Its thin leaflets, colored like the neighboring tissue, arranged in a single row on the right of the rhachis, are long and narrow compared with those of the other species of the genus, and simply pointed. The anus was not satisfactorily made out, the right-hand part of the roof of the gill cavity (where it doubtless lies, as in the other species) having been disturbed in the examination of other parts.

Genital system.—This was only examined externally, but nothing appears to cast doubt on its substantial conformity with the other species of the genus. The female genital opening was not satisfactorily made out, the region near the anus where it should occur having been disturbed, as above stated. The penis (Pl. 22, fig. 1) is extremely large (quite double, in proportion, that figured or described for the other species) and otherwise peculiar. Arising from the nuchal fold on the right side of the neck, above and just to the left of the base of the right tentacle, is a massive base as thick as the base of the tentacle itself and half again as long as broad, directed backward and slightly outward and upward. Sharply turning more than a right angle (so that it runs forward, and slightly outward and downward) the organ now rapidly diminishes in size to a slender neck of less than a quarter the original diameter. The minimum size is, however, scarcely reached before the organ suddenly swells again (though this time only slightly) at the same time acquiring along its external margin a great crest recalling in form and proportion, the conventional mane of the chess knight. The crest rapidly diminishes and at the point where it is lost the organ suddenly bends directly back upon itself, at the same time diminishing to a point which reaches back to the level where the crest began. A fair idea of the relations of the parts can be given by comparing the whole structure to an arm, the upper arm enormously fat, the forearm starting fat but rapidly dwindling to a thin wrist, the hand and fingers very long, and the back of the hand expanded into a high crest. In attitude the arm must be strongly flexed and the fingers pressed together at the tips and impossibly flexed so as nearly to touch the inside of the wrist. The finer structure was not examined. Bergh has minutely described it for the related species.

Head.—The broadly ovoid body mass is bounded in front by a strong nuchal fold clearly marking the transition to the head region,

which widens again beyond it. The region is about twice as broad as long and is prolonged at its anterior corners into the tentacles, while from its anterior face springs the snout or rostrum.

Tentacles and eyes.—(Pl. 22, fig. 1.) The tentacles are thick, fleshy, and moderately wrinkled, ending in an abrupt taper. In life they are doubtless somewhat longer and thinner, but the contraction in this specimen does not appear to have been extreme. They curve gently outward and upward. Each bears on its external (and slightly superior) surface a large black eye spot, which appears as a lump under the skin, raising the latter into a slight prominence out of which the eye looks forward along the tentacle. In effect the eye is set in the anterior face of a very rudimentary peduncle or ophthalmophore resembling a bracket. On sectioning, the eyes are seen to present no special features, but are well developed and evidently highly functional. There is no appearance of any corneal modification of the skin except a slight thinning. The retina is heavily pigmented; the lens large, filling nearly the whole eye cavity. The left tentacle in this specimen bore an appendage branching off from its base and pointing posteriorly along the left side of the neck, nearly as long as the tentacle itself but less than half as thick. This appendage bore on its exterior face an extra eye, or rather, as heretofore mentioned, a cluster of four extra eyes apparently in various stages of proliferation one from another. Undoubtedly the whole structure (neglecting the feature of the apparent proliferation of eyes in the extra eye spot) is to be interpreted as a case of bifid left tentacle somewhat masked by the turning backward of the external member and its reduction in size and change in proportions. If this member were turned forward and thickened and curved like the normal tentacle, it and its eye spot would bear the relation of a mirror image to the normal tentacle and its eye spot, as is commonly the case with similar bifid structures.^a

Rostrum and mouth.—(Pl. 22, figs. 1, 2, 3.) From the anterior face of the head region, and from under a fold of skin connecting the bases of the tentacles, springs the thick and heavy rostrum in the shape of a truncated cone about once and a half as long as broad. It is only moderately wrinkled and, like the tentacles, is in life probably somewhat but not greatly more protrusible. It may probably be also somewhat more contractible but not greatly. The thick and heavy skin and the rather slight musculature which appear on dissection do not point to an extremely elastic or contractile organ. Its anterior end forms a flat face of oval form, the major axis dorso-ventral. In this axis the mouth appears as a simple slit two-thirds the length of the oval, with wrinkled lips. Unless the rostrum is much more changeable in form than above supposed it differs markedly from the other species of the genus, where it is bulbous. Doubtless the pharyngeal

^a See cases collected in Bateson [1894].

bulb can be pushed forward, but even this could hardly produce such forms as figured by Bergh.

Jaws.—(Pl. 22, figs. 2, 3, 4.) The mouth opens into a narrow tube of oval section, thin walled, and running between the two jaws which arch it over and also partly inclose its sides. The jaws are of brown chitin, thin and delicate, about twice as long as high, serrate on their lower edges, the serrations growing coarser from posterior to anterior. Each jaw is molded to fit along the top and one side of the mouth tube, narrows to a rounded point posteriorly and appears to be squarely and smoothly cut off anteriorly; but about this last there may be some doubt since there is a suspicion that in removing these delicate objects from the tough mouth gristles, serrations or other structures at the point of attachment may have been broken off and lost. To the powers of the dissecting microscope the jaws appear covered with beautifully regular minute transverse (i. e., dorso-ventral) striations corresponding in spacing with the serrations of the ventral edge. The real microscopic structure was not studied. There can be little doubt it is substantially that several times figured by Bergh for similar objects, i. e., a sort of mosaic of minute chitinous bars locked together in a diamond pattern which gives the impression of transverse (i. e., dorso-ventral) lines, the longitudinal (i. e., antero-posterior) lines being broken in the pattern.

Pharyngeal bulb and radula.—(Pl. 22, figs. 2, 3, 5, 6.) Near the posterior end of the jaws the thin-walled mouth tube suddenly swells to more than twice its former diameter to contain the large muscular pharyngeal bulb. The structure of this was not minutely studied as it offered no prospect of material difference from the similar organs so often and fully elucidated by Bergh. Its form sufficiently appears from the figures and must in life vary greatly in the course of the complicated motions of the radula which latter, however, in this species I think is almost certainly not protrusible. I think so, both because the mouth and end of the snout are too small and because there is a pretty clear mutual adjustment of the radula and jaws to trituration of the food between them in the swollen portion of the mouth tube. The radula commences posteriorly in a bulb borne on a long stem which is a prolongation of the posterior base of the pharyngeal bulb but rises sharply upward and to the left, penetrates the dorsal wall of the mouth tube, then curls over forward and outward and lies on top of the mouth tube at its widest part to the left of its center. The radula, starting in this bulb, passes down through its stem and so into the lower posterior part of the pharyngeal bulb, through which it then turns sharply upward, reaching its surface (and so coming into use in the open mouth-cavity) at the highest point of the bulb's top. At the same point the radula attains its own greatest width, for by wearing off of the lateral members and by appression it thence slightly narrows as it runs forward down the anterior slope of the pharyngeal

bulb, ending abruptly shortly after passing within the jaws. It attains a length of 60 transverse rows and is typically taenioglossate, having the usual formula 2-1-1-1-2. The median or rhachidian tooth consists of a base about as wide as high, with slightly convex lower edge and concave sides, the top of which curls over backward to form the dentate functional blade. The latter bears a large central cusp, long and pointed, flanked by very irregular and much smaller denticulations, about eight on each side but varying from six to ten and showing a distinct tendency to alternation of larger and smaller. The whole tooth is arched, with the convexity posterior, so that the functional upper portion as seen from on top has a roughly crescentic form. The laterals, or ad-medians, are on the same general plan, but the basal portion is much narrower and higher, the central (or sub-central) cusp longer in proportion and flanked by about seven denticulations on the external and five on the internal side. They are set on the basal membrane at an angle with the rhachis, so that the central cusps point slightly inward. The uncini have the form of simple smooth arched claws, curving upward, backward, and slightly outward. By folding inward over the admedians they can be laid flat. Possibly they can also be folded outward. The radula presents only minute differences from the other species of the genus so far as comparison with figures shows.

Foot.—(Pl. 21, figs. 2, 3; Pl. 22, fig. 1.) Moderate in size, as before described, anteriorly slightly bowed and concave, posteriorly obtusely pointed. The anterior angles form distinct stout lobes or auricles. The posterior portion, projecting beyond the notaum border, is somewhat specialized, being slightly broader and thicker than at the point where it passes beneath the notaum, and curled sharply upward. This might be thought to be a mere accident of preservation in this specimen, but has been described for other species of the genus. Whether it occurs in life or is due to the strong contraction in death of the structure next mentioned is uncertain. The dorsal surface of the foot is appressed to the edge of the notaum where it passes beneath it, and at and posterior to this point bears a narrow central muscular thickening or pad. Similar structures have been minutely described by Bergh for other species of the genus. The function is unknown but does not its position suggest that it may be merely a vestigial operculiferous lobe?

Parasites.—On sectioning the left tentacle two large encysted parasites were found, complex organisms, probably Trematodes. Prof. Henry B. Ward, of the University of Illinois, is kindly examining them and it is hoped to present further conclusions in connection with the forthcoming paper in the *American Naturalist*. The highly abnormal character of this tentacle and its parasitization may possibly be more than a coincidence. Nematodes have been found with the larvæ of *O. grænlandica* (Bergh [1887], p. 276, note).

RELATIONSHIP OF THE PRESENT SPECIES TO THE OTHER SPECIES OF THE GENUS.

The names applied to species now considered to belong to *Onchidiopsis* are few, being in chronological order as follows:

Coriocella carnea Kröyer [1847], p. 115, no. 10.

Coriocella recondita Kröyer [1847], p. 115, no. 11.

Lamellaria glacialis M. Sars [1850], p. 185.

Onchidiopsis granlandica Bergh [1853], p. 346.

Onchidiopsis reinhardi Beck. Mörch [1868], p. 25.

Onchidiopsis granlandica, var. *pacifica* Bergh [1887], p. 278.

Onchidiopsis palliata Lovén (unpublished, a label name, teste Posselt [1898]).

Of these *recondita* is the young of *carnea*; *palliata* and *reinhardi* were both applied to unusually large specimens of *granlandica* (*reinhardi* said to be over three inches long); and *carnea* itself is now treated as a full synonym of *granlandica*.^a

This leaves only *glacialis* Sars, and *granlandica* Bergh with its var. *pacifica* Bergh. The real status of these forms is in the highest degree problematical. All are strictly boreal, and Bergh is the great authority on them. Unfortunately his last publication on the group—in his great monograph of the Marseniadae (Bergh [1887])—while very full and elaborate, does not do its author justice. The text and plates are repeatedly in disagreement, and the former has been found blind by others besides the present writer. Among other things, both description and figures appear to show that *granlandica*, var. *pacifica* is in reality nearer to *glacialis* than it is to *granlandica*, being a variant in the same direction as *glacialis* but more extreme. But Bergh himself evidently felt great doubt whether he was in fact dealing with more than one species in all. With the growth of his work on the genus, and the accumulation of more material, his species, at first fairly well distinguished, have approached each other more and more, till he finally relies for the discrimination of *granlandica* from *glacialis* on the fact that in the former the shell is broader behind, the osphradium black on its base, the gill leaflets of "somewhat peculiar form," and the inner members of the pairs of uncinal hooks not denticulate. As to this last character, which seems the best of the lot, *pacifica* (which Bergh treats as a variety of *granlandica*) has the hooks more strongly denticulate than *glacialis* itself!

Bergh says Sars confused the two species. Friele [1901, p. 68] has not hesitated to unite them, though without discussion. Knipowitsch [1902, pp. 361–363] retains them nominally separate, though conclud-

^a Kröyer's name *carnea* is earlier than *granlandica* but is a *nomen nudum* (see remarks in bibliography) and dates only from Bergh's habilitation of it in 1853. This is also the date of the more familiar *granlandica* Bergh, which luckily may be retained as having page priority.

ing, after some discussion based on considerable material (all from one locality, however), that *granlandica* is at most a variety of *glacialis*. He did not have *pacifica* before him. He found that four out of the eight specimens which he separated as *granlandica* from his single specimen of *glacialis* had black osphradia, but one of them had also denticulate uncini.

The present species is evidently fully congeneric, but is much farther from any of the above forms than any of them are from one another. It is impossible to say to which it comes nearest. Like *granlandica*, it has an osphradium with black base and nondenticulate inner uncinal hooks in the radula. In the median tooth ("rhachis" of Bergh), and in the character of the notaum, it is nearer *glacialis*. In the very peculiar penis it is perhaps nearest *pacifica*. But in the smooth notaum with reticulate pattern, the extraordinary penis, the shape of the jaws, the shape of the osphradium leaflets, and above all in the structure of the shell, it is sharply distinguished from any of them; while there are minor points of individuality in the radula, the shape and musculature of the rostrum, the form of the tentacles and proportion of the eyes, the form of the body and notaum (especially the anterior lappets), and the shape of the gill leaflets.

It would seem that the species of the genus should for the present be written as follows:

O. glacialis (Sars, 1850), colorless osphradium, slightly denticulate uncinal hooks, comparatively smooth notaum, gill leaflets not auriculate at tip. Distribution paleo-boreal and arctic.

O. glacialis, var. *granlandica* Bergh, 1853 (syn.: *carnea*, *recondita*, *reihardti*, *palliata*), osphradium with black base, nondenticulate uncinal hooks (occasionally denticulate), warty notaum, gill leaflets auriculate at tip. Distribution paleo-boreal and arctic.

O. glacialis, var. *pacifica* Bergh, 1887, osphradium as in last, uncinal hooks usually strongly denticulate (sometimes smooth), rhachis peculiar, penis peculiar, notaum as in last. Distribution pacifico-boreal.

O. corys, new species, osphradium with black base but peculiar form, uncinal hooks smooth (in the unique specimen), notaum (top) smooth, gill leaflets not auriculate, penis peculiar. Distribution neo-boreal (?). (Further distinguished from the *glacialis* forms by shell, etc., as elsewhere stated.)

THE RELATIONSHIPS OF ONCHIDIOPSIS TO OTHER GENERA OF LAMELLARIIDÆ.^a

The Lamellariidæ constitute a small, highly aberrant, and somewhat heterogeneous family, treated by Bergh as distinct from the Velutinidæ and containing only the genera *Chelynotus*^b (Swainson) Bergh, *Marsenia* Leach [= *Lamellaria* Montagu], *Marseniella* Bergh, *Marseniopsis* Bergh, *Marseniina* Gray, and *Onchidiopsis* (Beck) Bergh. The Velutinidæ, however, are included in the same group

^a Called by Bergh and some others Marseniadæ, but luckily the more familiar name *Lamellaria* for the typical genus appears to be correct under the International Rules, rather than *Marsenia*.

^b Better treated as a subgenus of *Lamellaria*.

by Woodward [1880], Tryon [1886], Fischer [1887], Cooke [1895], Simroth [1896-1907], and most other systematists, some calling the resulting family Lamellariidæ, some Velutinidæ.

Bergh himself recognized that the genera *Onchidiopsis* and *Marseniina*, at least, might be united with the Velutinidæ were it not that on the other hand they connect through the puzzling genus *Marseniopsis* with the irreconcilable genera *Chelynotus*, *Lamellaria*, and *Marseniella*.

Bergh summarized his views in the following:

CONSPICUUS GENERUM.

Plica expira- toria nulla.	[<i>Armatura lingualis</i>]	1-1-1	Pars inf. vas defer. non libera.....	<i>Chelynotus</i> Sw.	} diœcious.
Plica expira- toria	3-1-3	} monoœcious	Test. int. calcarea.....	<i>Marseniopsis</i> Bergh	
			Test. semi-int. calcarea..	<i>Marseniina</i> Gray	
			Test. int. cornina.....	<i>Onchidiopsis</i> Bergh	

It is apparent that, but for the contradictory characters of *Marseniopsis*, the genera would fall apart in two well-marked groups, which may be called the *Lamellaria* group and the *Onchidiopsis* group, the latter then clearly uniting with the Velutinidæ, which agree in every essential respect, especially dentition and hermaphroditism,^a except that the shell is still external and, of course, the expiratory fold is therefore not developed.^b In short, the group considered as a whole would appear as either monophyletic but sharply divergent, or as di-phyletic and partially convergent.

The introduction of *Marseniopsis* into the scheme makes any orderly phylogenetic interpretation impossible—that is to say, it makes any *true* arrangement impossible. We must, therefore, for any conclusion, await new facts, particularly as to *Marseniopsis*, which it would be desirable to investigate further. The bearing of the new species which is the subject of this paper on the situation is, by its shell structure, to draw *Onchidiopsis* closer to *Marseniina*, partially bridging the gap and indicating in a most interesting way the precise manner in which the still whorled shell of *Marseniina* has degenerated, in this series, to the mere scale of the other species of *Onchidiopsis*.

^aThe hermaphroditism of *Velutina* rests on the bare casual mention of Bergh. So interesting a fact should be verified. The preserved material at my command has not permitted this. There is reason to suspect, as Simroth especially has suggested, that hermaphroditism among the prosobranchs may be much more frequent than commonly supposed.

^bIt is difficult to understand the high morphological significance Bergh appears to attach to this obviously plastic feature. The fold is in fact scarcely so much an anatomical character as an habitual manner of carrying the mantle border. The specimen examined by me suggests the idea that in life it might have been obliterated and re-formed at will. It can at least have no systematic importance in a phylogenetic series commencing with a shell-covered form.

As to the troublesome *Marseniopsis*, it seems closer to the Velutininae than to the Lamellariinae. The extraordinary aberrant radula of the latter is a tangible and strong point of demarcation in which no error of observation or interpretation is likely. It is an unbridged gap, and *Marseniopsis* is here wholly with the Velutininae. As to the two characters which ally it with the Lamellariinae, the expiratory cleft has already been commented on, while for an appreciation of the slight and almost technical character of the line separating androgyny from unisexuality in the gasteropods Pelseneer's paper should be consulted (Pelseneer, 1894).

Since the last of Bergh's writings on the group the Australian genus *Caledoniella* Souverbie 1869, hitherto known only from the shell,^a has been partially elucidated by Basedow [1905]. The shell is wholly internal, thin, incompletely calcified, but otherwise not very degenerate, and consists of 3 + whorls. It is strikingly naticoid in appearance. The radula has the formula 2—1—1—1—2 and in general resembles those found in the Velutininae—i. e., is naticoid. We do not know whether the animal is monœcious or diœcious. Basedow's figures do not show any expiratory cleft or fold, but in his generic diagnosis he says:—"renal aperture on the right, the mantle-border slightly grooved outward from this spot," which may indicate that the fold is present in rudimentary form. The anatomical data are insufficient for placing the genus with entire confidence, but so far as known ally it with *Marseniina* and *Ouchidiopsis* in the Velutininae, where it would lie near the base of the series. Two things, however, throw doubt on the correctness of this disposition. First, if *Marseniina* and *Ouchidiopsis* are really (as believed) derived from the naticoids through velutinoids, then it is difficult to see how *Caledoniella* can be introduced into the series, with a shell which, though more degenerate than any *Velutina*, appears to relate back direct to *Natica*. Second, *Caledoniella* is an Australian form, thus geographically suggesting alliance with the Lamellariinae, which though world-wide are especially tropical and austral, rather than with the Velutininae, which are essentially boreal. It may be suspected that if all the facts were known *Caledoniella* would be seen to be a basal term of the Lamellarioid series, its apparently greater resemblance to the Velutininae being purely negative and due to its not yet having acquired the peculiarities of dentition and generative system which mark the typical Lamellarioids. This implies that the family Lamellariidae is diphyletic, which is probably the case. But such suspicions can not be allowed to override the evidence as it stands and *Caledoniella* must for the present rest among the Velutininae.

The group considered as a whole is, at all events, a most interesting offshoot from the naticoid stem, representing evolution in the same

^a The animal described by E. A. Smith [1886] as *Lamellaria wilsoni* appears to have been in fact a *Caledoniella*, but the description is not sufficient to be of use.

direction as the nudibranchs among opisthobranchs, and the slugs among pulmonates, the direction, namely, of loss of shell. This loss apparently proceeds by a kind of combination of the methods seen in nudibranchs and slugs, for there is an embryonic "nautiloid" shell afterward shed as in nudibranchs, while the post-embryonic shell is overgrown by a notæum and degenerated as in slugs.^a It may not be wholly a coincidence that the group has developed feeding habits (on compound ascidians) recalling the nudibranchs and has become (at least in part) like them, hermaphroditic. The aberrant character of the group appears in the well-known and extraordinary "nesting" habit in a hole made in the ascidian colony and covered with an "operculum." It further appears in the sudden radical departure of one section of the group from the tænioglossate type of dentition.^b

It would seem that the best provisional treatment of the family is as follows:

Family LAMELLARIIDÆ (various family characters in nervous system, stomach, etc. Consult Bergh).

Subfamily LAMELLARIINÆ (Radula 1-1-1, of aberrant form. Sexes separate. Shell few whorled, wholly internal, but calcareous though sometimes very degenerate.^c No expiratory cleft. Nearly world-wide but especially tropical).

Genus *Lamellaria* Montagu (part), 1815 (syn. includes *Coriocella* Blainville, 1824, *Cryptothyra* Menke, 1830, *Marsenia* Leach, 1847, *Cryptocella* H. and A. Adams, 1853, *Ernuca* Gray, 1857).

Subgenus *Marseniella* Bergh.

Subgenus *Chelymotus* (Swainson, 1849) Bergh.

Subfamily VELUTININÆ. (Radula 2-1-1-1-2, of naticoid form. Sexes united. Shell progressively degenerating from several whorled, external, calcareous though thin, to a mere internal horny scale. Expiratory cleft developed where shell is internal. Boreal except *Caledoniella*.)

^a May it be that the spicules of the dorid nudibranchs represent an exactly similar phenomenon? It has been generally assumed that the loss of the nautiloid embryonic shell ends the shell-history of the individual dorid and that the spicules with which the notæum is so plentifully beset represent a novel formation. The same assumption might have been made for *Onchidiopsis* were not the shell, especially in the species here described, still unmistakable as such. In other words, if we use the history of the shell in *Onchidiopsis*, which is still decipherable, as a key to read the history of the shell in the dorids, where it is not clearly decipherable, we shall conclude that the lost "nautiloid" shell is only the protoconch and shall homologize the spicules of the adult notæum with the adult internal shell of *Onchidiopsis*. There is nothing in the morphological relations of the notæum and mantle to forbid this, and it seems to the writer worthy of serious consideration.

^b The strikingly parallel aberration of the subgenus *Turritellopsis*, in the Turritellidae, should be compared, however, as an illustration of how profoundly and suddenly the tænioglossate type of dentition may be modified without any apparent great change in the rest of the organism. Figures may be found in Tryon's Manual.

^c "Presque membraneuse," *L. leptolemma* Bergh.

Genus *Velutina* Fleming 1822.

Subgenus *Limmeria* H. and A. Adams, 1853 (syn. *Merrillia* Gray 1857).

Subgenus *Velutella* Gray, 1847.

Genus *Caledoniella* Souverbie, 1869.

Genus *Marseniina*, Gray, 1850.

Genus *Onchidiopsis* (Beck) Bergh, 1853.

GENERA OF UNCERTAIN POSITION.

Genus *Marseniopsis* Bergh, 1886. Radula 2-1-1-1-2. Shell internal, calcareous, degenerate. Sexes separate. Strictly austral.

Genus *Lamellariopsis* Vayssière [1906]. Radula 2-1-1-1-2. Shell internal, calcareous, thin, paucispiral. The published "diagnosis" (quite insufficient) does not show any generic difference from *Marseniina*. Austral.

Genera *Leptonotis*, Gray, 1847; *Scærogyna*, Whitfield, 1877; *Lyo-soma*, White, 1883. Fossil.

[In addition numerous names applied to the embryonic shells—see Tryon and Bergh.]

LITERATURE.

BASEDOW, HERBERT.

[1905.] On Naticoid Genera *Lamellaria* and *Caledoniella* from South Australia. Trans. Royal Soc. South Australia, vol. 29, 1905, pp. 181-186, pls. 26-29.

BATESON, WILLIAM.

[1894.] Materials for the Study of Variation treated with especial regard to Discontinuity in the Origin of Species. Macmillan & Co., 1894.

BERGH, RUDOLPH.

[1853.] Bidrag til en Monographi af Marseniaderne, en Familie af de gastræopode Mollusker. En kritisk, zootomisk, zoologisk Undersøgelse. Kongl. Danske Vid. Selsk. Skrift, 5^{te} Række, naturvid. og math. Afd., 3die Bind, 1853, pp. 239-350, pls. 1-5.

Although since corrected and amplified in many respects by the later researches of the author, this work of his youth remains the indispensable storehouse of original observations on the Lamellariidae, and the basis of our modern classification. Unfortunately the plates are poor and the text in Danish only. There is a "separate" issue repaged 1-119. Pages cited in text are from original pagination.

[1857.] Bidrag til en anatomisk Undersøgelse af *Marseniina* prodita (Lovén). Naturh. For. Vid. Medd., Kjöbenhavn, 1857, pp. 1-15, pl. 1.

[1885.] Die Marseniaden. Zoologischen Jahrbüchern, vol. 1, 1885, pp. 165-176, 1 text-fig.

This short but valuable paper was an early announcement of the author's chief generalizations from the *Challenger* material and the material from Semper's Philippine journeys. It need not, however, be consulted by the English student, as a translation has been published practically unchanged in the *Challenger* reports. See next item.

[1886.] Report on the Marseniadae. Voy. *Challenger*, Zool., vol. 15, pt. 41, 1886, pp. 1-24, pl. 1.

The first, or general part, appears to be a nearly, if not quite, literal translation of the item last above. It will be found the most satisfactory and accessible brief general account for most English readers.

BERGH, RUDOLPH—Continued.

[1886-87.] Die Marseniaden. Malacologische Untersuchungen (in Semper's Reisen nach Philipp., vol. 2, ii), Supplement, hefte 3 and 4, 1886-87, pls. 1-11.

A great monograph of the whole family, summing up and supplementing the author's whole previous work thereon, and practically his last word on the subject—unfortunately, however, not representative of his best work. The same matter as in the last two items once more appears nearly unchanged, but forming only a small part of the whole monograph.

[1893.] Opisthobranches provenant des Campagnes du Yacht *V'Hirondelle*. Resultats des Campagnes scientifiques accomplies sur son yacht, par Albert 1^{er} Prince Souverain de Monaco, publiés sous sa Direction avec le concours du Baron Jules de Guerne chargé des Travaux Zoologiques à bord. Fascie. 4, 1893, pp. 30-32.

[1898.] Die Opisthobranchien der Sammlung Plate, Zoologischen Jahrbüchern, Supplement 4, heft 3, 1898 (Anhang, pp. 562-573, pls. 32-33).

[1899.] Nudibranches et Marsenia provenant des Campagnes de la *Princesse-Alice* (1891-1897). Resultats des Campagnes scientifiques accomplies sur son yacht, par Albert 1^{er}, Prince Souverain de Monaco, publiés sous sa direction avec le concours de M. Jules Richard, Doct. ès-sciences, chargé des Travaux Zoologiques à bord, fascie. 14, 1899, pp. 30-39, pls. 1, 2.

COOKE, Rev. A. H.

[1895.] Molluses (The Cambridge Natural History, vol. 3), pp. 1-459, Macmillan & Co., 1895.

FISCHER, PAUL.

[1881-1887.] Manuel de Conchyliologie et de Paleontologie conchyliologique, ou Histoire naturelle des Mollusques vivants et fossiles. Paris, 1881-1887.

FRIELE, HERMAN.

[1901.] Den Norske Nordhavs-Expedition, 1876-1878, vol. 28, Zoologi, Mollusca, 3, pp. i-viii, 1-129, list of stations and map. Fol., Christiania, 1901.

KNIPOWITSCH, N.

[1902.] Zoologische Ergebnisse der Russischen Expeditionen nach Spitzbergen. Mollusca and Brachiopoda 2 and 3. Ann. Mus. Zool. St. Petersburg, vol. 7, 1902, pp. 355-459, pls. 8-9.

KRÖYER, Dr. H.

[1847.] Verzeichniss der Naturaliensammlung, welche auf Befehl des Königs aus verschiedenen Königlichen Musäen in Kopenhagen, so wie auch aus einigen Privatsammlungen zur 24. Versammlung Deutscher Naturforscher und Aerzte nach Kiel gesandt war. 2. Weichthiere aus der Sammlung der Herrn Dr. Kröyer. a. Von Spitzbergen. b. Von Norwegen und Dänemark. In: Amtlicher Bericht ueber die 24. Versammlung Deutscher Naturforscher und Aerzte in Kiel in September, 1846. Kiel, 1847.

In the list of mollusca from Kröyer's collection, which begins on p. 115, the species are numbered, and on that page, under the caption "*a. Von Spitzbergen*," Nos. 10 and 11 are respectively "*Coriocella carnea* Kr.—1 (exemplar)" and "*Coriocella recondita* Kr.—1 ditto." They are absolutely *nomina nuda*, and could only date from their habilitation by Bergh in 1853.

MÖRCH, O. A. L.

[1868.] Faunula Molluscorum Islandiæ. (Oversigt over Islands Bløddyr.) Videnskab. Meddelelser fra den naturhistoriske Forening i Kjøbenhavn for Aaret 1868, nos. 11-13, pp. 185-229. Copenhagen, 1869.

The entire volume bears date 1869 but apparently the numbers originally issued separately, and this article appeared in 1868.

PELSENEER, PAUL.

[1894.] Hermaphroditism in Mollusca. Quart. Journ. Micr. Sci., vol. 37, 1894, pp. 19-46, pls. 4-6.

POSSELT, HENR. J.

[1898.] Grönlands Brachiopoder og Blöddyr. In: Meddelelser om Grönland, udg. Comm. Ledelsen geol. og. geogr. Undersøgelser i Grönland. Heft XXIII, Afd. i, vol. 1, 1898, pp. i-xix, 1-298, pls. 1-2, Kjöbenhavn, 1898, 8^{vo}.

Often cited as "Conspectus Faunæ Groenlandicæ," a subtitle which seems to have been added in the "separate" issue.

SARS, G. O.

[1878.] Mollusca Regionis Arcticæ Norvegiæ. Bidrag til Kundskaben om Norges Arktiske Fauna, vol. 1, pp. i-xv, 1-466, pls. 1-34 (shells and animals) and 1-18 (dentition and opercula), Christiania, 1878.

SARS, M.

[1850.] Beretning om en i Sommeren 1849 foretagen zoologisk Reise i Lofoten og Finmarken. Nyt Magazin for Naturvidensk., vol. 6, heft 2, 1850, pp. 121-214.

SIMROTH, DR. H.

[1896-1907.] Bronn's Klass. u. Ord. des Tier-Reichs, vol. 3, Mollusca, 2^{te} Abteilung, Gastropoda prosobranchia, pp. i-vii, 1-1056, pls. 1-63, Leipzig. Issued in separate Lieferungen from 1896 to 1907.

SMITH, EDGAR A.

[1886.] Description of a new species of Lamellaria from South Australia. Ann. and Mag. Nat. Hist., ser. 5, vol. 18, 1886, pp. 270-275, 1 text-fig.

TRYON, GEO. W., JR.

[1886.] Manual of Conchology; structural and systematic, vol. 8. Naticidæ (etc.), Philadelphia, 1886.

VAYSSIÈRE, A.

[1906a.] Diagnoses generiques de Mollusques Gastéropodes nouveaux rapportés par l'Expedition antarctique du Dr. Charcot. Bull. Mus. Hist. Nat. Paris, 1906, pp. 147-149.

[1906b.] Sur les Gastéropodes Nudibranches et sur les Marséniadés de l'Expedition antarctique du Dr. Charcot. Compt. Rend. Acad. Sci. Paris, vol. 142, 1906, pp. 718-719.

WOODWARD, S. P.

[1880.] A Manual of the Mollusca, being a treatise on recent and fossil shells. 4th ed., London, 1880.

DESCRIPTION OF PLATES.

PLATE 21.

- Fig. 1. *Onchidiopsis corys*. Dorsal view; *e.*=eye; *ex. cl.*=expiratory cleft; *in. cl.*=inspiratory cleft; *l. l.*=left lobe of anterior lappet; *l. t.*=left tentacle; *r.*=rostrum; *r. l.*=right lobe of anterior lappet.
2. *Onchidiopsis corys*. Ventral view. Lettering as in fig. 1; also: *ab. c.*=abnormal eye; *m.*=mouth; *m. c.*=mantle cavity.
3. *Onchidiopsis corys*. View from right side. Lettering as in figs. 1 and 2; also: *p.*=penis; *r. t.*=right tentacle.
4. *Onchidiopsis corys*. Shell. View from right side and looking slightly from rear and above. The infolded posterior portion is seen through the anterior portion. *A.*=anterior; *D.*=dorsal; *P.*=posterior; *V.*=ventral. (In this and next two figures the shell appears too solid, being in reality a nearly colorless translucent film.)
5. *Onchidiopsis corys*. Shell. View from right side and looking from rear and below. *L.*=left; *R.*=right. Remarks as in last.
6. *Onchidiopsis corys*. Shell. View from below. Lettering and remarks as in figs. 4 and 5. (The waving of the infolded portion appears exaggerated in this figure.)

- Fig. 7. *Marsenina prodita*. Shell. (This and next two figures are drawn, regardless of scale, for comparison of shell structure, forming a progressive degeneration series.)
8. *Marsenina ampla*. Shell. See remarks under fig. 7.
9. *Onchidiopsis corys*. Shell, represented semidiagrammatically as a solid object, from below. See remarks under fig. 7.
10. *Onchidiopsis corys*. Osphradium and ctenidium, semidiagrammatically represented from an anterior viewpoint. *Ct.*=ctenidium; *D.*=dorsal; *L.*=left; *Os.*=osphradium; *R.*=right; *V.*=ventral. The stippling represents the black-pigmented areas on the roof of the gill cavity and basal surfaces of the lobes of the osphradial leaflets.

PLATE 22.

- Fig. 1. *Onchidiopsis corys*. Dorsal view of head region. Notæum is slightly slit up from inspiratory cleft and the lobes of the anterior lappet turned back. *ab. e.*=abnormal eye; *ab. t.*=abnormal (external) branch of the bifid left tentacle; *b.*=foot; *e.*=eye; *f.*=auricle of foot; *g. c.*=opening of gill cavity; *l. l.*=left lobe of anterior lappet; *l. t.*=left tentacle; *p. bas.*=penis, basal portion; *p. cr.*=penis, crest; *r.*=rostrum; *r. l.*=right lobe of anterior lappet; *r. t.*=right tentacle.
2. Dissection of rostrum. Dorsal view. *b. m.*=buccal mass; *j.*=jaws; *l. t.*=left tentacle; *ph.*=wall of pharynx; *ph. cav.*=pharyngeal cavity; *r.*=rostrum; *rad.*=radula; *rad. sac.*=radula sac; *re. m.*=retractor muscles; *r. t.*=right tentacle. (The walls of the dorsal half of the rostrum are represented as cleanly cut away except at the tip, which is intact. The retractor muscle bundles, which line it, are only partially shown, and some are represented as broken and pushed aside to allow a view of the pharynx. The thin-walled pharynx is represented as partially transparent, and through it, represented in dotted lines, are seen the jaws and the buccal mass, the latter containing the greater portion of the radula. On top of the pharynx and to the left lies the radula sac, a prolongation of the buccal mass the neck of which pierces the pharynx wall. The radula is shown as if the radula sac and buccal mass were semitransparent.)
3. Semidiagrammatic view of rostrum from left side. The wall of the rostrum is supposed to be wholly removed except at the tip, where it is intact. As in the last figure, the jaws and buccal mass are represented as seen through the thin-walled pharynx, and the radula as if seen inside the buccal mass and radula sac; but in this figure their lines are not dotted. Lettering as in last; also, *m.*=mouth.
4. Jaws, seen from left side. *A.*=anterior; *D.*=dorsal; *P.*=posterior; *V.*=ventral.
5. Radula. Dorsal view of three rows from near broadest point (about ten rows from anterior end). Camera lucida drawing. \times oc. 1, obj. 3.
6. Radula. Two uncinial hooks from right side. Camera lucida drawing. \times oc. 1, obj. 7.

Plate 21, figures 1, 2, 3, and 10, and Plate 22, all figures, were drawn by the author from the specimen. Plate 21, figures 4, 5, and 6, were, drawn by Mr. Sergius Morgulis, from the specimen. Plate 21, figures 7 and 8, are copied from figures reproduced in Tryon's Manual of Conchology.