

yet they have hitherto always shown some character which has necessitated their being kept separate\*.

#### EXPLANATION OF PLATE I.

*Eusphenopteris tenella*, Brong.

- Fig. 1. Portion of barren frond from Sauchie, near Alloa.  
Fig. 2. Portion of larger form from same locality.  
Fig. 3. Fertile frond, lax form, from same locality.  
Fig. 4. Fertile frond, compact form, from same locality.  
Fig. 5. Sporangia or capsules, magnified, showing the small apical aperture.  
Fig. 6. The same, viewed more obliquely.

*Sphenopteris microcarpa*, Lesq.

- Fig. 7. Portion of barren frond, from near Dollar, collected by Mr. A. E. Grant.  
Fig. 8. Pinnule, enlarged.  
Fig. 9. Portion of fertile frond, from near Dysart.  
Fig. 10. Pinnule of fig. 9, enlarged, showing sporangia arranged in groups of three.  
Fig. 11. Another pinnule, enlarged, more sparsely fruited.  
Fig. 12. Two sporangia, magnified, showing slight indication of a marginal border.  
Fig. 13. Sporangium, magnified, showing a slight obliquity of the arrangement of cells forming the marginal border.  
Fig. 14. Another sporangium, magnified.

*Note.*—In fig. 7 the engraver has missed the character of the plant. The ultimate pinnules are represented as merged together, but should be distinctly separate, as shown in the enlarged figure (8).

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### III.—On certain *Limpets and Chitons from the Deep Waters off the Eastern Coast of the United States*. By W. H. DALL†.

I HAVE received from Prof. Verrill certain limpets or patelliform shells and chitons collected under his supervision off the south-east coast of New England, in deep water, by the United-States Fish-Commission parties in 1881, with his kind permission to describe them. Though without particular beauty and of small size, the hope that these specimens would prove of interest has not been disappointed.

Limpets are generally shore or shallow-water mollusks;

\* Stur, in his 'Culm Flora,' describes a fossil fern (*Todea Lipoldi*), which appears to be similar to *Sphenopteris bifida*, L. & H. As its fruit is unknown, his reason for placing it in the genus *Todea* seems simply to rest on the segmentation of the frond being somewhat of the same nature as that seen in such species as *Todea superba*.

† From the 'Proceedings of the United-States National Museum,' April 24, 1882, p. 400.

the connexion of certain peculiarities of structure in them with their geographical distribution, and the progressive development indicated by the characters of different genera, have already been the subject of comment by me\*.

The forms of lowest organization and least specialized characters among those already known are those which inhabit the deeper water; hence there was reason to suppose that features of much interest would be exhibited by the few specimens which had just been brought up from much greater depths than any from which limpets had hitherto been obtained.

The examination was rendered more complete by the possession of additional specimens, which are contained in the deep-sea collection from the Antilles, made by Prof. Alex. Agassiz and Lieut.-Commander Bartlett, U.S.N., on the United-States Coast-Survey steamer 'Blake.' These afforded valuable confirmation of impressions derived from the study of the material obtained from Prof. Verrill.

Some of the specimens obtained are of unusual interest, as showing a combination of characters which has heretofore been unknown in animals of the same order. While the shells present few salient features, the soft parts show extraordinary and unexpected characters. They are divided into representatives of the orders Rhipidoglossa, Docoglossa, and Polyplacophora. The Docoglossa comprised representatives of both the suborders Abranchiata and Heterobranchiata, but all somewhat anomalous in their characters. It is in the first-mentioned order, however, that the richest results were obtained, since it appears necessary to separate the three species obtained into two genera, representing each a family, which differs by apparently sound characters from any hitherto known, and which it has therefore been necessary to describe as new.

Almost all the species appear to be blind.

### Order RHIPHIDOGLOSSA.

#### Family Cocculinidæ, Dall.

Shell patelliform, not nacreous, symmetrical, with an entire non-sinuated margin, and a posteriorly inclined apex with a deciduous spiral nucleus. Muscular impression horseshoe-shaped, interrupted over the head.

Animal with a prominent head and muzzle, two tentacles, as in Lepetidæ; gill single, plumose, asymmetrical, resembling that of Acmæidæ, extending between the under surface

\* Sci. Results of the Expl. of Alaska, i. art. ii. pp. 41-43 (1876).

of the mantle and the foot (from a point above and behind the head) backward on the right side, attached only at its base. Anus anterior, opening above and behind the head. Mantle-margin plain; sides and margin of the foot without papillæ or ornamental processes excepting two filaments, one on each side of the median line, between the mantle and the foot-disk behind. Radula with a small or moderate rhachidian tooth (in the known species), three inconspicuous laterals with denticulate cusps, and a fourth, dentate, larger outer lateral\*; uncini numerous (50-150), similar, hooked at the tip, those of each lateral series springing from a common base.

Formula:  $\frac{1}{m(1+3.3+1)m}$ .

This family differs from its nearest described allies (the Fissurellidæ) in its single asymmetrical gill, in the absence of appendages to the sides of the foot or on the mantle-edge, and in its patelliform, unfissured, unsinuated, and wholly external shell.

From the succeeding family, Addisoniidae, it is separated by its symmetry, the character of the gills, and by its dentition. By its dentition it is most nearly allied to *Parmophorus* or *Scutus* (if figures be taken as a criterion), and much resembles some species of *Helicina*; but it must be borne in mind that very few species of Fissurellidæ have been figured in proportion to the whole number known. The other characters, however, forbid its incorporation with the Fissurellidæ, as they conflict in nearly every important feature with the definition appropriate to that family.

At first it was thought that *Propilidium* might be incorporated in this family; but an examination of the available data relative to that genus indicates that it belongs rather to the Fissurellidæ, where it, apparently, represents an imperforate *Puncturella*.

#### Genus COCCULINA, Dall.

Animal blind; shell colourless, with radiating and concentric sculpture. For other characters see diagnosis of family.

#### *Cocculina Rathbuni*, n. sp.

Shell depressed, white, thin, with sides nearly parallel, and their slopes lightly flattened, and with ends similarly broadly rounded; sculpture of faint closely (but irregularly) set grooves radiating from a smooth apex (which has originally a subspiral nucleus) and crossed by concentric growth-lines,

\* Much as in *Scutus* as figured by Gray, 'Guide,' p. 163.

which are more or less irregular in different individuals; faint yellowish areas seem to indicate a thin, very closely adherent epidermis; apex prominent, more or less incurved and slightly laterally compressed, usually showing a scar where the embryonic nucleus was attached; inside polished or smooth; length 11.0, width 6.5, altitude 2.75 millim. Another dead specimen is three times as large.

Soft parts: Foot ovate, thin, not very high, somewhat pointed behind; mantle-margin moderately wide, with a thickened plain border; behind, on each side of the "tail," between the mantle and foot, is one cylindrical blunt filament; sinus above the head and neck quite deep; gill exactly as in *Acmæa*, small, hardly projecting out of the sinus; head large, end of muzzle semilunate, with a strongly-marked margin; in the midst of this flat lunate area is a rounded papillose space surrounding the mouth; this organ, if furnished with jaws at all, has them of such soft and cuticular consistency as to show neither under the knife nor under an ordinary dissecting microscope, but it appeared to be without jaws; tentacles moderate, subcylindrical; eyes none; course of the intestine much as in *Patella*, but shorter.

*Dentition*.—Rhachidian tooth squarish, rounded in front, nearly flat, about as long as the two inner laterals; inner three laterals slender, with small denticulate cusps, outer or third usually a little longer than the others, but the proportions slightly different in the less mature part of the radula; fourth or major lateral about twice as long as the others and slightly broader than the rhachidian tooth, rather strongly cusped, the cusp notched into five or six denticles, and the shaft somewhat curved, the shaft and cusp translucent; uncini numerous (100 or more), slender, slightly twisted and hooked, united on each side on a single continuous base, which is a little longer than the width of the radula between the uncini.

*Hab.* Station 937 of the United-States Fish Commission in 1881. This is 102 miles S. by E.  $\frac{1}{2}$  E., by compass, from Gay-Head Light, Martha's Vineyard, the bottom-temperature being 40°·5 F., and that of the surface 72°·0 F. The same species was obtained by the United-States Coast-Survey dredgers on the steamer 'Blake,' Lieut.-Commander J. R. Bartlett commanding, under the supervision of Prof. Alex. Agassiz, on hard bottom (temperature 44°·5 F.), at station 288, in 399 fathoms, off Barbadoes, and off Martinique, in 502½ fathoms sand and ooze, at station 195, bottom-temperature 41°·0 F., the surface in both cases being about 80°·0 F. I take pleasure in naming this species after Mr. R. Rathbun, of the United-States Fish Commission.

*Cocculina Beanii*, n. sp.

Shell elevated, white, thin, resembling in sculpture and general features the last species, except in the following particulars:—The form of the base is about as in *C. Rathbuni*; but the profile differs widely: the anterior and posterior slopes of the present species, instead of being subequal and nearly similar, are unequal, the anterior being considerably the longer, roundly and conspicuously arched; the posterior slope is about half as long as the other and deeply concavely excavated; this results from the fact that the apex, instead of being depressed and nearly central, is elevated, subposterior, and much incurved; like that of the previous species, it bears a scar where the (probably spiral) embryonic shell was attached. The sculpture resembles that of the preceding species, being stronger and more cancellated in some specimens and nearly obsolete in others. The very young show proportionally stronger sculpture, even slightly spinous at the intersections in some specimens. The surface is generally partly eroded, probably from the same action as that which so rapidly reduces dead shells and corals to a species of grey ooze in the deep sea. There seems to be no indication of epidermis in this species. Length 8.0, breadth 5.0, height 4.0 millim.

Soft parts in general as in the last species, except that the head and muzzle are much elongated, the sinus behind the head deep; gill longer and larger than in *C. Rathbuni*, projecting out on the right side of the head; tentacles longer and foot shorter proportionally than in *C. Rathbuni*; the mantle-margin is much puckered; but this is probably due to the alcohol; the margination, which forms a semilunar area at the end of the muzzle in the preceding species, in *C. Beanii* is interrupted before the papillose area which here distinctly forms the end of the muzzle, the effect of which is to produce two lappets, one on each side, extending from the end of the muzzle to the anterior edge of the foot. There appears to be no jaw.

*Dentition*.—In this species the bands of uncini are proportionally longer and wider, and the rhachidian tooth smaller, than in the preceding. The rhachidian tooth is small, with a tridentate cusp and bifurcate base; it is about half as long as and hardly wider than the first three laterals; the latter are elongate, slender, with denticulate cusps, the outer is rather the shorter in the mature part of the radula; the major lateral is longer, with a more slender shaft than in *C. Rathbuni*, and a proportionally larger, very concave cusp with seven or eight denticulations; the banded uncini are singly

broadier than in *C. Rathbuni*, and collectively about one half longer.

*Hab.* Station 871, U.S. Fish Commission, lat.  $40^{\circ} 02' 54''$  N., long.  $70^{\circ} 23' 40''$  W., in 115 fathoms muddy sand; station 894, U.S. Fish Commission, lat.  $39^{\circ} 53'$  N., long.  $70^{\circ} 58' 30''$  W., 365 fathoms mud and gravel, both in 1880; station 947, 312 fathoms, sandy mud, bottom-temperature  $44^{\circ}$  F.; station 949,  $79\frac{1}{2}$  miles south of Martha's Vineyard, in 100 fathoms, yellow mud, bottom-temperature  $52^{\circ}$ , surface  $66^{\circ}$  F.; station 997, 335 fathoms, yellow mud, bottom-temperature  $40^{\circ}$  F.; these last in 1881 (Verrill); and from the same localities as *C. Rathbuni* in the West Indies (Agassiz), with the additional locality of station 264, 416 fathoms, grey ooze, off Grenada, bottom-temperature  $42^{\circ}.5$  F. \* It is named in honour of Dr. T. H. Bean, of the United-States Fish Commission.

#### Family Addisoniidae, Dall.

Shell asymmetrical, porcellaneous, somewhat like *Capulacmæa*, Sars.

Soft parts much as in the last family, but strongly asymmetrical, with an enormously developed lateral series of separately inserted gill-laminæ, like those of Patellidæ, and without filamentary appendages of any kind. Radula with a large simple rhachidian tooth with, on each side, two large simple transverse laterals, followed by two minute ones, and a large outer lateral with a strong tridentate cusp, outside of which is a single scale-like flat uncinus, bearing an elongated thickened ridge, but no cusp.

Formula:  $\frac{1}{1(\frac{1}{3}+2+2.2+2+\frac{1}{3})}1$ .

This family might be incorporated with the last, were it not for the differences in the branchiæ and in its dentition. These latter are of great weight. The dentition of *Addisonia* is like nothing known in the whole group of Rhipidoglossa, but, while it recalls the dentition of the Chitonidæ in some features, has a decidedly Docoglossate aspect. Perhaps the most rational hypothesis is that this group bears to the preceding family much such a relation as in Pulmonata is borne by the Cyclotacea of Troschel towards the Cyclostomacea. Indeed the resemblance of the radula of *Cocculina Rathbuni* to that

\* This is, perhaps, the shell referred to under the name of "*Acmaea rubella*?", Fabr.," Verrill, Proc. U. S. Nat. Mus. iii. p. 391, dredged (dead) at station 894, United-States Fish Commission, 1880, off the S.E. coast of New England, in  $39^{\circ} 53'$  N.,  $70^{\circ} 58' 30''$  W., in 365 fathoms.

of some of the species of *Helicina* figured by Troschel is quite remarkable. This family contains, so far as known, but one genus.

Genus ADDISONIA\*, Dall.

Shell ovate, subconical, strongly asymmetrical, porcellaneous, thin; with a blunt apex curved backward, downward, and to the left, without an epidermis; with an unthickened, simple, entire margin; pedal muscular impression horseshoe-shaped, interrupted in front. Soft parts: head provided with two tentacles, without eyes or eye-tubercles; muzzle plain, simple; foot thin, orbicular, without lateral or posterior tubercles, processes, or fringes; mantle-edge simple, thickened; gill composed of leaflets as in *Patella*, the series starting on the right behind the head and continued within the mantle-edge backward, the body of the animal being asymmetrically placed with regard to the aperture of the shell to afford room for the enormous series of branchial leaflets; anus opening behind and above the head slightly to the right of the median line, and indicated by a small papilla.

Radula: see description of the family.

Type and only species yet known,

*Addisonia paradoxa*, n. sp.

Shell ovate, thin, whitish; apex presenting an appearance as if an embryonic tip (perhaps spiral) had fallen and been replaced by a peculiarly blunt ovate apex, which in the young shell is nearly marginal, posterior, and to the left of the middle line, but in the adult is considerably within the margin, curved downward and backward, and much more asymmetrical; sculpture of faint grooves radiating from the (smooth) apex and reticulated by the stronger concentric lines of growth, besides which the extremely inflated arch of the back is somewhat obscurely concentrically waved; over the sculpture the shell has a polished appearance; margins thin, sharp; interior smooth, somewhat polished; the scar of the pedal muscle narrow, a considerable distance within the margin, the anterior ends of the scar enlarged, hooked backward on their inner edges; these ends connected by a line broadly arched forward and marking the attachment of the mantle to the shell over the head. Soft parts whitish, dotted with fine purple dots; mantle-edge thickened, smooth; muscular base of the

\* In honour of Prof. Addison E. Verrill, of Yale College and the United-States Fish Commission, whose surname has already been applied to more than one group of invertebrates.

foot nearly orbicular, extremely thin and delicate, not high; muzzle short, plain, without any strongly defined margination, with the end finely papillose and a little puckered; mouth small, furnished with two lateral pads covered with a cartilaginous thin coat, which completely dissolves in liquor potassæ, and hence can hardly be termed a jaw, though it occupies the place of the buccal plates in other genera; head moderate, not much produced, broader than long, extended laterally into a single, rather short and stout tentacle on each side; tentacles showing slight transverse ridges (due to contraction?), destitute of any basal elbow or tubercle, such as bears the eye in allied groups, and with no appearance of any organ of vision or bulbous whatever. Behind the head a thickened ridge, containing a large vessel, takes origin and passes backward around the right mantle-edge, reaching nearly to the posterior median line; from this ridge depend fifty or sixty branchial leaflets resembling those of *Patella*, and not like those of *Acmæa* or the Fissurellidæ; these leaflets are very large in proportion to the size of the animal, and gradually diminish posteriorly; they are slightly inclined outward; the anal papilla is very inconspicuous, opening between the line of the branchia and the head, a little to the right of the head; the intestine is much shorter than in the Patellidæ, and coiled in much the same way through the very large greenish hepatic mass; this surrounds the ovary, which rises to the surface of the back in about its centre, and in this individual was crowded with eggs already in various stages of segmentation, and of about the size and general appearance of those of *Acmæa patina*. The ovary appeared to be a single, simple, sac-like body of irregular contour as in *Acmæa*; no crop was noticed; and the stomach seemed of very moderate size.

Since but one specimen was available the observations were more or less imperfect, especially since the internal parts were somewhat softened. To obviate the extreme contraction caused by alcohol, the specimen was placed in water, with the result that it almost immediately swelled and became covered with an immense quantity of very slimy mucus, which rendered it almost impossible to handle, being so slippery; and it had to be replaced in alcohol again to harden before the examination could proceed. The edge of the mantle is margined with a rather broad thickened band, apparently without papillæ or other appendages of any kind. The space occupied by the branchiæ is so large that the remainder of the animal is forced a good deal to the left in the aperture of the shell.

The radula has a large, flat, ovate central tooth, with a thickened anterior edge, but no marked cusp; on each side of



this two rhomboidal flat laterals with a similarly thickened anterior margin; the inner is the larger, and the outer somewhat more rounded in form; close to this are two minute narrow laterals with small cusps, hidden partly under the cusps of the next or major lateral, for which reason they cannot well be made out until the radula is partly torn apart or broken up; these two little laterals are the most anterior of the transverse series, which has a form like a very transverse M; the major lateral has strong Docoglossate features, being set on a flat plate whose posterior inner and anterior outer corners are thickened and raised into the likeness of a pseudocusp, the true shaft of the tooth being very short and terminating in a strong tridentate pellucid cusp; the outer tooth is a squarish, plate-like uncinus, exactly as in some Chitons, with a thickened longitudinal ridge near the inner margin.

Length of shell about 10.0, width 7.5, and altitude 4.0 millim.

Dredged by the United-States Fish Commission in 1881 at stations 923, 940, and 950, in 96, 130, and 69 fathoms, sandy bottom, about 75 miles S. and W. from Martha's Vineyard. Bottom-temperature 52°, which belongs to the warmer bottom area. This very remarkable form would have been called a "synthetic type" by Prof. Louis Agassiz. The shell at once recalls *Capulacmæa* (= *Pilidium*, Midd.), which, however, is distinctively Tænioglossate in dentition. The details of the branchial leaves resemble those in *Patella*, the position of the branchiæ and the form of the head resemble *Acmaea*, the smooth, thick, mantle-margin and absence of eyes are characters found in Lepetidæ. Some features in the dentition recall Chitonidæ, and others Cocculinidæ. The position of the animal in its shell is as in the Rhipidoglossa universally.

Nothing of the kind has been recognized in the collection made by Messrs. Sigsbee and Bartlett, of the U.S. Navy, in the Gulf of Mexico and Antilles, under the supervision of Prof. Alex. Agassiz, on the United-States Coast-Survey steamer 'Blake,' leading to the supposition that this may be a rather more northern form, though found in the warm area.

## Order DOCOGLOSSA.

### Suborder ABRANCHIATA.

Animal destitute of external branchiæ. Embryonic shell spiral.

### Family Lepetidæ, Gray.

*Lepetidæ* (Gray), Dall, Ann. & Mag. Nat. Hist. 1871, vii. pp. 286-291.

Subfamily *LEPETINÆ*.

Animal without eyes, without lateral teeth, with a rhachidian tooth, and erect uncini; muzzle with an entire margin, which is extended backward into a tentacle-like filament on each side; shell patelliform, with a subspiral nucleus, which is generally lost in early life, the permanent tip being erect or anteriorly directed. Typical genus *Lepeta*, Gray.

Subfamily *LEPETELLINÆ*, n.

Shell and soft parts as in *Lepetinae*, except that it has distinct eyes and is provided with true lateral teeth, and also with scale-shaped uncini. Typical genus *Lepetella*, Verrill.

Genus *LEPETELLA*, Verrill.

*Lepetella*, Verrill, Am. Journ. Sci. xx. p. 396 (Nov. 1880).

Type *Lepetella tubicola*, Verrill, *l. c.*, also Proc. U.S. Nat. Mus. iii. p. 375 (1881).

*Habitat*. In two to four hundred fathoms off the S.E. coast of New England (stations 869 and 894, U.S. Fish Commission, 1880) in old tubes of *Hyalinæcia artifex*, V. (Coast of Norway, in deep water, Sars?)

Professor Verrill has well described this little shell in the articles referred to, as well as its dentition, which he calls Tænioglossate. It is indeed so in one sense, though not in the technical sense of belonging to the order Tænioglossa, which has a formula  $\frac{1}{3.3}$ , while the formula of *Lepetella* is  $\frac{1}{1(2.2)1}$ , the essential difference being that all Tænioglossa have on each side of the rhachidian tooth three laterals and no uncini, while *Lepetella* has two laterals and an uncinus.

The specimens examined by me were dry, or from deterioration of the alcohol had become quite soft; and, for this reason perhaps, I could not detect the eyes seen by Professor Verrill so distinctly in the fresh and living animal\*. So far as the external features could be determined, there was no difference between them and those exhibited by *Lepeta* or *Cryptobranchia*. The dentition is remarkable, both in relative number of teeth and in presenting the only instance of a well-developed distinct scale-like (chitinoid) uncinus yet known in the order. In fact, the radula has throughout dis-

\* I have, however, no doubt of their existence. A letter from Dr. J. Gwyn Jeffreys states that a small limpet like *Lepeta*, but with eyes, has been dredged off the coast of Norway by Prof. G. O. Sars, which may probably prove to be *Lepetella*.

tinctly *Chiton-like* features, and bears additional testimony, if such were needed, to the acuteness of Troschel in combining (dental characters only being considered) both Chitons and Limpets in one dental order. The external form is of course partly due to its peculiar habitat; other specimens will no doubt eventually be found clinging to some flat surface and of normal shape. It seems to be a northern form, and does not occur in the Blake collections.

### Suborder PROTEOBRANCHIATA.

Animal with external branchiæ. Embryonic shell conical.

### Family Acmaëidæ.

Gill plumose, cervical.

### Genus SCUTELLINA, Gray.

*Scutellina*, Gray, P. Z. S. 1847, p. 163, = *Scutella*, Broderip (not Lamarck). Type *S. crenulata*, Broderip.

The animal of the typical species of *Scutellina* is unknown; according to Arthur Adams, that of a closely allied species (*S. ferruginea*) resembles *Acmaea* in its externals, except that the shell is pure white, with prominently reticulated sculpture, and the apex is prominent, pointed, and very anteriorly situated. Mr. Adams distinctly states that the animal has eyes; and it is quite probable that the genus will eventually prove to be a good one.

A specimen was recently obtained, with the dried animal (from some West-Indian corals), of a species which is also represented in the Blake collection, and which would probably be referred, from the shell-characters alone, to *Scutellina*, though it differs from the received diagnosis of that genus in having a blunt subcentral erect apex, much like ordinary *Acmaea*. An examination of the soft parts showed, however, wide differences from any described genus, necessitating the establishment of a new one for its reception:—

### Genus PECTINODONTA, Dall.

Shell resembling *Scutellina*, with a blunt subcentral apex. Soft parts resembling *Acmaea*, except in the following details:—Animal blind, with the front part of the head between the tentacles and above the muzzle much produced upward and forward, extending considerably further forward than the end of the muzzle. Muzzle margined, with lappets at the

outer corners. Jaw thin, translucent. Gill exactly as in *Acmæa*; sides of foot and mantle-edge simple, nearly smooth. Dentition  $\frac{0}{0(1.1)0}$ ; teeth large, with transverse pectinated or denticulate cusps, like those of the large lateral teeth of some Tectibranchs or Nudibranchs.

*Pectinodonta arcuata*, n. sp.

Shell white, elongate-ovate, moderately elevated, with a blunt polished apex, on which in young specimens remain traces of the disk-like chalky embryonic shell; the slopes from the apex to the ends both convexly arched, margin simple or slightly denticulated by the radiating sculpture; within polished; scars as in *Acmæa*; epidermis none; sculpture externally of fine, uniform, rounded, closely-set threads, radiating from near the apex to the margin, and reticulated by the fine, rather prominent, regular, concentric ridges of growth, both ridges and threads averaging near the margin about three and a half to the millimetre. Long. from end to end 14.5 millim., from apex to anterior end 5.5 millim.; lat. 10.0 millim.; alt. 5.5 millim.

*Habitat.* West Indies; St. Thomas, in coral; Santa Lucia, station 215, in 226 fathoms, Blake expedition.

The examination of a well-preserved specimen showed that the end of the muzzle formed a semilunar area with a distinctly-marked margin and lappets at the posterior corners. In the middle of this flat and nearly smooth area is the mouth, surrounded by a small circular papillose area. The jaw is thin and translucent, but sufficiently strong to resist contraction on the drying up of the soft parts. The radula contains about 175 series of teeth, which are large, with strong cusps, which are turned toward the middle line of the radula and strongly denticulate. The denticulate part, as in most *Docoglossa*, is nearly black; the anterior denticles are larger, the posterior nine subequal in size; the whole number of denticles is twelve; the whole tooth has somewhat the appearance of a coarse curry-comb, and suggests that it is due to a consolidation of the normal three *Docoglossal* laterals rather than the suppression of all but one and the modification of that one.

The protrusion of the anterior arch of the head is very peculiar and remarkable; the foot is rather short for the size of the shell; otherwise the features are those of *Acmæa* in general. The gill is rather large and exactly as in *Acmæa*.

The number of teeth is the smallest known in any limpet; and none of the same shape have been recorded in the order.

It is likely, however, that *Scutellina*, when investigated, will prove to have very similar dentition\*.

### Chitonidæ.

Genus CHÆTOPLEURA (Shuttleworth), Cpr.

*Chætopleura apiculata*, Say.

*Habitat.* Station 938, United-States Fish Commission, 1881, being 100 miles S.E. by E.  $\frac{1}{2}$  E. (magnetic) from Gay-Head Light, Martha's Vineyard. The depth was 210 fathoms, green sand and mud, the bottom-temperature  $40^{\circ}5$ , the surface  $72^{\circ}0$  F.

In these researches only two specimens of Chitonidæ were obtained; and these are not of a genus characteristic of the deeps. These specimens were young, but did not differ from young ones of the same species from shallow water. There have been found in depths of 100 fathoms or less along the north-eastern coast of New England, and northward, two other tolerably common Chitons, one of them, *Trachydermon albus*, Linné, which does not go to great depths, as far as known, either in the Atlantic or Pacific. In Alaska it is abundant from low-water to 100 fathoms. The other, *Leptochiton cancellatus*, Sowerby, occurs off the British possessions, and may reach a depth of 300 fathoms. Rarer species, which may be found in deep water are:—*Leptochiton alveolus*, Sars (150 fathoms, Gulf of Maine); *Hanleyia mendicaria*, Mighels and Adams; *H. debilis*, Gray (to 300 fathoms); and *H. tropicalis*, Dall, from southern waters (Sand Key, 128 fathoms).

The greatest depth from which Chitons have been reported is 1006 fathoms, at which the *Leptochiton Belknapi*, Dall, was obtained in the North Pacific. It has since turned up from Kerguelen in the 'Challenger' collections, and, perhaps, may eventually be found in the North Atlantic.

### Notes on the Genera.

The slender side teeth of *Lepeta* are distinguished from true laterals by not being situated on the central longitudinal area of the radula. By their form alone it would be impossible to distinguish them from teeth which are truly laterals, like the inner laterals of *Lepetella*.

Since 1869 (when I revised the classification of the Lepe-tidæ, and, somewhat later, of the order to which they belong)

\* I should be most thankful for a dried or alcoholic specimen of soft parts of the typical species of *Scutellina* (*S. crenulata*, Broderip).

little by little information has been coming in which fills the gap then known to exist in our knowledge of the order. It is now possible to review more understandingly the relations of the dentition of the different groups. It would seem at first sight as if the dentition of *Lepeta* and *Lepetella* differed very widely; but more reflection diminishes the apparent divergences.

It may be suggested that in *Lepeta caeca* the large rhachidian tooth really represents a consolidation of the six laterals characteristic of *Acmæa*, which is supported by the fact that G. O. Sars \* figures the lateral cusps of the rhachidian tooth in *Pilidium fulvum* as accessory rather than inherent parts of that tooth, a view (I find on reference to them) supported in part by my own original drawings, and a condition which, though not universal or necessary, may yet be characteristic of some stages of the development of the individual or of the radula, or perhaps of some individuals merely, while in others the consolidation goes so far that the sutures (as in the bony structures of higher animals) are obliterated. In that case the rhachidian tooth of *Lepetella* would represent the consolidation of the two inner laterals merely, if the number six be taken as typical, which, from its universality elsewhere in the order, we may reasonably assume to be the case. This is the typical number in the *Tænioglossa*, to which (as Professor Verrill indicates in his description) the radula of *Lepetella* is in some respects analogous, though the *Tænioglossa* have no uncini. In the same way, as has before been pointed out, the single large dentate laterals of *Pectinodonta* may represent, in the other division of the order, each a consolidation of the three typical laterals of *Acmæa*.

The name *Onychoglossa* has been used by G. O. Sars (1878) to denominate the same group and as indicative of the same characters as those possessed by the *Docoglossa* (Troschel, 1861), as revised by me eight years previously. I do not see any especial gain which might result to science from substituting the newer for the older name.

The relations of the groups may be expressed somewhat as follows:—

#### Order DOCOGLOSSA.

Shell wholly external, dish-shaped, with apex anteriorly directed; animal with two short tentacles, a non-extensible muzzle; branchiæ external or none; renal and anal apertures situated above the neck, between body and mantle-

\* Moll. Reg. Arct. Norveg. tab. ii. fig. 12.

edge; no copulatory or external genital organs; mouth provided with a horny jaw and long radula with peculiar teeth; dental formula not exceeding  $\frac{1}{s(3.3)3}$ ; metamorphosis of the embryo taking place in the egg, which is fertilized in the ovary.

Suborder **ABRANCHIATA**.

Animal without external branchiæ. Embryonic shell spiral.

Family **Lepetidæ**.

Subfamily *Lepetinae*. Without eyes; with a margined muzzle extended (on each side) into a tentacular process. Uncini erect. Dental formula  $\frac{1}{2(0.0)2}$  ( $? = \frac{0}{2(3+3)2}$ ).

*Lepeta*, { *Lepeta*, s. s. (+ *Pilidium*, Forbes non Middendorff).  
Gray { *Cryptobranchia*, Middendorff.

Subfamily *Lepetellinae*. With eyes; other soft parts as in *Lepeta*. Uncinus scale-like. Dental formula  $\frac{1}{1(2.2)1}$  ( $? = \frac{0}{1(3+3)1}$ ).

*Lepetella*, Verrill.

Suborder **PROTEOBRANCHIATA**.

Animal with external branchiæ. Embryonic shell conical.

Family **Acmæidæ**.

With a plumose cervical branchia; with or without a branchial cordon; muzzle frilled; no rhachidian tooth.

A. Without a cordon.

A. Muzzle with lappets.

a. Blind.

*Pectinodonta*, Dall.  $\frac{0}{0(1.1)0}$  ( $? = \frac{0^*}{0(3.3)0}$ ).

b. With eyes.

*Scutellina*, Gray. Typical species not yet examined.

*Acmæa*, Esch.  $\frac{0}{0(3.3)0}$ .

B. Without muzzle-lappets.

*Collisella* { *Collisella*, Dall, s. s.  $\frac{0}{1(2-1.1-2)1}$   
                  { *Collisellina*, Dall.  $\frac{0}{2(2-1.1-2)2}$ .

B. With an interrupted cordon ; no lappets.

*Lottia* (Gray), Cpr.  $\frac{0}{1(2-1.1-2)}1$ .

C. With complete cordon ; no lappets.

*Scurria*, Gray (not Cpr.).  $\frac{0}{1(2-1.1-2)}1$ .

### Family *Patellidæ*.

Without a cervical branchia, but with a more or less complete cordon ; muzzle papillose, not frilled, margined, or with lappets.

A. Branchial cordon complete.

a. With rhachidian tooth ; branchial lamellæ arborescent, produced ; sides of foot smooth. *Ancistromesus*.

*Ancistromesus*, Dall.  $\frac{1}{3(1-2.2-1)}3$ .

b. Without rhachidian tooth ; branchial lamellæ short, linguiform. *Patella*.

*Patella*, Linné. Foot smooth, branchial lamellæ subequal all around.  $\frac{0}{3(1-2.2-1)}3$ .

*Patinella*, Dall. Foot with a scalloped frill, interrupted only in front ; gills as in *Patella*.  $\frac{0}{3(2-1.1-2)}3$ .

*Nacella*, Schumacher. Foot frilled ; gills very small in front ; shell peculiar ; lateral teeth all bidentate.  $\frac{0}{3(2-1.1-2)}3$ .

B. Branchial cordon interrupted in front.

a. Sides of foot smooth. *Helcion*.

*Helcion*, Montfort. Third laterals posterior, bidentate.  $\frac{0}{3(1-2.2-1)}3$ .

*Helcioniscus*, Dall. First laterals anterior.  $\frac{0}{3(2-1.1-2)}3$ .

*Patina*, Gray. Third laterals posterior, denticulate ; shell peculiar.  $\frac{0}{3(1-2.2-1)}3$ .

\* \* \* \* \*

*Metoptoma*, Phillips. Posterior edge emarginate or waved.  
Fossil in Carboniferous of Great Britain.