

NOTES ON CHRYSODOMUS AND OTHER MOLLUSKS FROM THE NORTH PACIFIC OCEAN.

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During the past year the writer received from Mr. Y. Hirasé, of Japan, a number of shells for identification, with a request that any new species be described. Having given special attention to the Chrysodomoid whelks, the opportunity was taken to revise the grouping of those mollusks as well as to prepare descriptions of a number of new species which occurred in Mr. Hirasé's collection.

The unique types were returned to him, but of several species cotypes were available for the National Collection. A few species of especial interest from the west coast of America are included in this paper.

A prodrome of the proposed classification of *Chrysodomus* and its allies was published¹ but, as this comprised merely a list of genera and subdivisions with designation of types, it was thought best to give herewith the complete discussion of the facts upon which the revision was based. A large number of boreal species from the Bering Sea region remain to be described at a later opportunity.

Genus CHRYSODOMUS Swainson.

The nuclei or larval shells of species belonging to *Chrysodomus* and its allies present several distinct types and numerous mutations.

In many cases, as in *Buccinum* and *Busycon*, it was shown many years ago by Lovén and others that a single ovicapsule contains a number of ova fertile and unfertile. The unfertile eggs serve as food for the larvae developed from the fertile ones and there is a certain amount of competition between the larvae in the capsule which results in the most vigorous larvae getting more food and making a larger growth than the more weakly coinhabitants of the capsule. Thus at the time of leaving the capsule and coming into the outer world, it sometimes happens that there will be perceptible differences between the individuals issuing from a single capsule, not only

¹ Proc. Biol. Soc. Washington, vol. 29, pp. 7-8, January, 1916.

in actual size but in the length of the coil of whorls and the size and compactness of the larval apex.

The most common and typical nucleus comprises one or two whorls of a thin, smooth, more or less inflated character, while the normal sculpture of the adult shell usually commences abruptly at the termination of the nuclear coil. In some cases there are three or more nuclear whorls which are then usually coiled in a subcylindrical fashion.

The apex or initial whorl of the first fundamental type may present either of the following phases: (1) a bulbous appearance at times even larger in diameter than the next succeeding whorl; it may, however, be (2) small and coiled upon itself in a regular manner, gradually increasing in size. It may be (3) tilted obliquely to the axes of the succeeding whorls, or it may be (4) so compactly coiled that the initial cell forms with its first half whorl a little angle or point which forms the actual apex of the spire. Again the initial cell may be (5) quite small and regularly increase, with a low blunt spire recalling the appearance of a small *Turbo* viewed vertically from above. Most of these mutations are incidents of growth, and while the nucleus in a general way remains tolerably constant in form (though varying in size) within the species, I have found cases where from the same bunch of capsules one might select bulbous turbinoid, or laxly coiled nuclei.

These nuclear shells are thin, easily eroded, and it is frequently a matter of no little difficulty to find a single intact nucleus, even in a very large series of specimens of a single species. As the animal grows it either forms septa behind it as the viscera are withdrawn from the nuclear shell or fills the latter solidly up with shelly matter. This septum is often bulbous exactly as in nuclei of the type above mentioned (No. 1) and may later be solidly filled up internally with a shelly deposit. If the species had originally a nucleus of the type about to be described, and this thin shell be eroded away as is common, the septum-tip may remain, and so closely resemble the bulbous type as to deceive the very elect. One must therefore be on the alert for a wholly intact nucleus, and if possible secure it from a very young specimen. The best come from ovicapsules where the young shells are ready to emerge but have not yet been exposed to the erosive properties of seawater.

The third type above referred to¹ so nearly resembles the apex in the genus *Caricella* of the Volutidae, that one suspects the pres-

¹ For illustrations of the different types of nucleus which parallel one another in the Chrysodomiae and Volutidae see Friele in Norwegian North Atlantic expedition, *Mollusca*, pt. 1, pls. 1-3; and Dall, *Trans. Wagner Inst.*, vol. 3, pt. 1, pls. 6 and 7, as follows: No. 1, Friele, pl. 1, fig. 12 *a-b*; No. 2, Dall, pl. 6, fig. 3*a*; No. 3, Dall, pl. 6, fig. 6; No. 5*a*; and Friele, pl. 1, fig. 11*b*; No. 4, Dall, pl. 6, fig. 6, and Friele, pl. 1, fig. 10*b*; No. 5, Dall, pl. 6, fig. 8.

ence in the larva of a cartilaginous primal cell, lost in the ovicapsule before emergence, and of which the shelly pointed apex is the secondary stage.

The first fundamental type may for brevity be termed the Chrysodomoid. The second, after its characteristic genus, the Siphonorboid. The latter may be described as follows: It has a turbinoid aspect when viewed from above and is always depressed or at least blunt; it is regularly coiled; it begins with a smooth minute apical cell which develops a whorl or sometimes a whorl and a half, then assumes a sculptured surface, composed of one or more sharp spirals crossed by rather distant thin sharp axial riblets for two or three regularly enlarging, moderately inflated whorls, usually ending abruptly but sometimes merging gradually into the adult sculpture; and is more or less invested with a distinct, sometimes villous, periostracum. This type of nucleus is common not only to the group, *Siphonorbis*, but also to *Mohnia*, *Kryptos*, and the aberrant *Troschelia*, which, by its dentition, is allied to *Fasciolaria* and *Fusinus*, perhaps indicating a closer relationship between these genera at an earlier period.

The *Siphonorbis* nucleus is figured by Friele on plate 2, figs. 19, 22, 30, and 34; and one with the original sculpture eroded, at fig. 25.

As far as sculpture is concerned the group of *Colus* divides itself naturally into those with spiral sculpture, but without axial riblets (*Colus sensu stricto*), in which the spiral sculpture may be strong or feeble, though in some of the latter it is almost obsolete, the shell without careful and even microscopic scrutiny appearing smooth; and those with axial plications, which are frequently confined to the early whorls and absent or obsolete on the later ones. There is also a small group (*Kryptos*) in which the axial sculpture may be developed only as nodules at the shoulder. The latter has not been examined anatomically and has been claimed as a member of another family.

In general form we have infinite gradations from the elongated type, simulating *Fusinus*, with narrow, nearly straight, and produced canal, to those species in which the canal is short and recurved, or wide and hardly differentiated from the aperture; or Buccinoid and scarcely to be differentiated from *Buccinum* except by the operculum. There is also a small group in which the shell is plicate and usually dark colored and, compared with the typical forms, quite minute in size.

The group of *Chrysodomus* proper has preponderately spiral sculpture sometimes varied by rude axial nodes or projecting lamellae, the shell substance tending to have a translucent outer layer and the

periostracum extremely thin and usually absent except in the most protected places; the color tending in many cases to a purplish tint. In *Colus*, on the other hand, the periostracum is generally conspicuous, strongly adherent, usually smooth or even polished, though occasionally villous; the outer layer of the shell beneath it of an opaque chalky consistency and generally whitish. When the villosity of the periostracum is worn the basis may remain smooth and even acquire a polish. It is usually of a yellowish or greenish brown. The operculum is usually rounded-triangular with apical nucleus, the inner side with a thickened margin of a vitreous appearance. This, however, may be reduced to a thin, hardly perceptible varnish. The operculum may be shortened and the apex curved to the left, a tendency which in *Mohnia* is increased until the operculum assumes a subspiral form. In *Ancistrolepis* it becomes fan shaped, solid, with the apical part much prolonged beyond the attachment to the opercular gland, reminding one of the spurlike end of the operculum in *Strombus*. In *Beringius* it becomes short and rounded-quadrangle, the nucleus at one side.

Whichever set of characters are selected to divide the genera into groups, it will be found that the other characters, each in its own group, will provide a parallel set of forms. Thus it becomes extremely puzzling to decide which characters shall carry most weight, and whatever decision is arrived at there will be a reasonable opportunity for differences of opinion among systematists.

The dentition among the species examined seems to show comparatively little variation, chiefly in the presence or absence of minor cusps.

It is somewhat surprising that some authors, even at this late day, will accept the prelinnean and frankly polynomial names in the work of Klein and oppose the adoption of the binomial and properly proposed names of the Museum Boltenianum. The probable explanation is that the latter until recently has been difficult of access and Klein's miserable Tentamen is comparatively common. At all events Klein's polynomials have fortunately no standing in zoological nomenclature. Mörch in 1852 adopted the name *Sipho* for *Murex islandicus* Gmelin, but it had previously been used by Fabricius and others and was not available. Moreover, the same species had been adopted by Beck as an example of his genus *Tritonofusus*. In my discussion of the history of the generic name *Fusus* in 1906, above cited, I showed that by adopting the name *Colus* Bolten, for the group typified by *M. islandicus*, the name *Fasciolaria* of Lamarek could be conserved. *Colus* being prior to Beck's genus, the name *Tritonofusus*, accepted by me in revising the family in 1902, must be relegated to synonymy.

In the magnificent volume on the mollusks of the expeditions in northern seas of the *Princess Alice* and *Hirondelle* by Dautzenberg and Fischer, published by the Prince of Monaco in 1912, the authors have utilized Mörch's name for this group of Chrysodominae and have divided it into several subgenera, chiefly on the basis of the relative lengths of the spire and canal. If the learned authors had been able to consult such a collection of boreal Buccinidae as the United States National Museum possesses, it is probable that they would have given less weight to characters of which every gradation may sometimes be observed between species of this group, and which often afford little opportunity of drawing valid distinctions of more than specific rank between them.

Their arrangement is as follows:

Genus SIPHO "Klein, 1753."

- Subgenus *Siphonorbis* Mörch, 1869.....Type, *S. ebur* Mörch.
 Section *Turrisipho* Dautzenberg and Fischer,
 1912.....Type, *S. lachesis* Mörch.
 Subgenus *Anomalosipho* Dautzenberg and Fischer,
 1912.....Type, *S. verkruzeni* "Kobelt."
 Subgenus *Mohnia* Friele, 1879.....Type, *S. mohni* Friele.
 Subgenus *Parasipho* Dautzenberg and Fischer,
 1912.....Type, *S. kroyeri* Möller.

The arrangement adopted by M. Cossmann in his *Essais de Paléoconchologie comparée*, 1901, p. 96, is as follows:

Family CHRYSODOMIDAE.

Genus CHRYSODOMUS Swainson, 1840.

- Subgenus *Chrysodomus* s. s.
 Subgenus *Sipho* "Klein," Cossmann, 1901.¹
 Neotype, *S. gracilis* Da Costa.
 Section *Siphonorbis* Mörch, 1869.
 Type, *Neptunea ebur* Mörch.
 Subgenus *Volutopsis* Mörch, 1857.
 Type, *Neptunea norvegica* Chemnitz.
 Section *Mohnia* Friele, 1879.
 Type, *M. mohni* Friele.

¹M. Cossmann in the "Essais," p. 101, writes: "Le nom Siphon, emprunté à Klein a été admis par les plupart des auteurs bien avant Mörch (v. Herrmannsen, 1845)." On turning to Herrmannsen's volume (of 1847) we find indeed that *Sipho* had been used by Fabricius and Brown before Mörch, but for totally different animals from those now designated *Colus*, while for Klein's *Stipho* Herrmannsen's comment is: "Genus Turbinum, Fusil, Mitrea, Buccini, et Pisaniae species confundens."

Genus PARVISIPHO Cossmann, 1889.

Subgenus *Parvisipho* s. s. 1889.

Type, *Fusus terebralis* Lamarek (Eocene).

Section *Columbellisipho* Cossmann, 1889.

Type, *Fusus hordeolus* Lamarek (Eocene).

Subgenus *Tortisipho* Cossmann, 1889.

Type, *Fusus jucundus* Deshayes (Eocene).

Subgenus *Andonia* Harris and Burrows, 1891.

Type, *Fusus bonelli* Gén  (Pliocene).

Subgenus *Amplosipho* Cossmann, 1901.

Type, *Buccinum rottai* Baudon (Eocene).

Subgenus *Varicosipho* Cossmann, 1901.

Type, *Sipho labrosus* Tate (Eocene).

In the case of the arrangement of Dautzenberg and Fischer, it has already been conclusively shown that *Sipho* can not be used in conformity with the International rules. *Turrisipho* differs from *Siphonorbis* only in the relative height of the spire to the length of the aperture. This character is subject to infinite gradations between related species and in my opinion is of not more than specific value, when the whole series is considered. Take the following series showing the relation between aperture (including the canal) and the whole shell in total length.

S. lachesis has a ratio of 1 to 2.36.

S. tortuosus has a ratio of 1 to 1.93, difference 0.43.

C. islandicus has a ratio of 1 to 1.90, difference 0.03.

C. hirsutus has a ratio of 1 to 1.90, difference 0.03.

C. jeffreysianus has a ratio of 1 to 1.82, difference 0.08.

C. pubescens has a ratio of 1 to 1.68, difference 0.14.

S. sabinii has a ratio of 1 to 1.44, difference 0.24.

Thus the difference between *sabinii* and *tortuosus* equals 0.49, or 0.06 more than between *lachesis* and the species nearest to it.

It is, however, true that the unusually long spire of *S. lachesis* gives it a rather peculiar aspect.

Anomalosipho presents a somewhat different case. The shell so beautifully figured by Messrs. Dautzenberg and Fischer under the name of *Sipho verkruzeni* Kobelt, is difficult to identify with the original figure of that species given by Kobelt in 1876, who says "feinen nur bei starkerer vergrößerung sichtbaren spiralstreifen." This agrees with specimens received from Verkruzen by me and named by Kobelt in 1876. It is possible that Verkruzen, who was not an expert, may have sent out more than one species under that name. At all events Dautzenberg's shell upon which the name

Anomalosipho is based, is very different in form and color from the original *S. verkruzeni*, which is not an *Anomalosipho* as defined. I would therefore propose the name of *Anomalosipho dautzenbergii* for the real type of that subgenus, which has perfectly obvious strong spiral sculpture and is closely related to "*Euthria*" *conulus*, Aurivillius, from the Arctic Ocean near Bering Strait, described and figured in the *Vega* report of 1885 (pl. 13, fig. 6).

Mohnia is generally accepted, and fairly well distinguished from the other groups, though some species of *Plicifusus* have a somewhat incurved nucleus of the operculum. It is notable that shells specifically very unlike agree in having a *Mohnia* operculum.

The subgenus *Parasipho* is founded on the same type as *Plicifusus* proposed 10 years earlier, and which will therefore take precedence.

M. Cossmann's arrangement is peculiar in making *Mohnia* a section of *Volutopsis*, but its principal feature is the combination of a number of small Eocene forms under the generic name of *Parvisipho*. In the absence of specimens of these species, it would be unwise to discuss their relations, especially as M. Cossmann's figures, phototyped from the fossils, are not as clearly defined in minor details as might be desired. One notes, however, the resemblance of *Columbellisipho* to *Aesopus* Gould, and of *Amplosipho* to certain forms which have by others been referred to *Daphnella*. It is also doubtful if any form with a strongly thickened varicose outer lip internally dentate, like *Varicosipho*, can be safely referred to this family. The difficulties of correctly referring fossil forms to their true position in the system without an intimate knowledge of their recent analogues are, however, very great, and the service rendered by M. Cossmann in bringing together scattered material for the use of those of more limited facilities is one deserving of appreciation.

Taking into account the preceding considerations, the following arrangement has been settled on.

Family CHRYSODOMIDAE.

Genus CHRYSODOMUS Swainson.

Murex, sp. LINNAEUS, Syst. Nat., ed. 10, 1758, p. 754.

Fusus, sp. BRUGUIÈRE, Encyl. Meth., vol. 1. 1789, p. xv, pl. 426. Not of Helbling, 1779.

Neptunca, sp. BOLTEN, Mus. Boltinianum, 1798, p. 115.—LINK, Beschr. Rost. Samml., vol. 3. 1807, p. 117.

Chrysodomus SWAINSON, Malacology, 1840, pp. 90, 308. Type, *Murex antiquus* Linnaeus. Not of G. O. Sars, Moll. Reg. Arct. Norv., 1878, p. 269 (= *Beringius* Dall).

Atractus AGASSIZ, Min. Conch., German ed., 1840, p. 44. Types, *Murex striatus* (= *antiquus* Linnaeus) and *M. contrarius* Gmelin. Not *Atractus* Wagler, 1828.

Neptunea MÖRCH, Cat. Yoldi, 1852, p. 104. (First species, *Murex antiquus* Linnaeus). Not of Renier, 1847.

Chrysodomus COSSMANN, Essais de Pal. Comp., livr. 4, 1901, p. 98. Type, *Murex despectus* Linnaeus.—DALL, Proc. U. S. Nat. Mus., No. 1264, p. 520, 1902.

Neptunea DAUTZENBERG AND FISCHER, Res. Camp. Scientifiques de Monaco, livr. 37, 1912, p. 68.—HARMER, Pliocene Moll. Gt. Brit., pt. 1, p. 156, 1915. Not *Neptunia* Renier, 1847 (Coelenterata).

The name *Neptunea* Bolten was given to a heterogeneous collection now divided into eight or more genera of several distinct families. Link in 1807 segregated *Nassa* without accepting Lamarck's name for it, which had already been used by Bolten for a different group. Bolten selected no type and gave no diagnosis. One by one the species included in his genus were used as types for new genera by later authors. The name generally accepted for the present group and including *Fusinus* Rafinesque, was *Fusus* Bruguière, 1789, but not of Helbling, 1779.

In 1840 Swainson instituted the genus *Chrysodomus* and mentioned as typical example (p. 90) the "beautiful orange mouth wilk of England" (*Fusus antiquus*). The first species of his list given on a later page is *C. dispectus* (sic), the second *C. argyrostomus* (= *C. antiquus*). Both are unquestionably congeneric, and the former, *Murex despectus* Linnaeus, has been taken as type by several authors who probably did not notice the selection of a type on the earlier page.

Shell large, short-fusiform, smooth or spirally sculptured, sometimes with rude axial ribbing or nodosities or varixlike sharp laminae; outer coat of the shell subtranslucent, the inner layers with a darker, usually purplish tint, the periostracum inconspicuous and dehiscent; last whorl longer than the spire, with a wide aperture, the outer lip in the adult flaring or subreflected, not thickened; pillar flexuous, smooth; labium without callosities or lirae; inner side of the outer lip without liration in the typical group; the canal rather long, wide, open and flexuous; animal short and broad; the penis large, usually sickleshaped and with a small elongate terminal papilla; operculum ovate with apical nucleus, nearly closing the aperture; ovicapsules massed, sessile either in a heap as in *Buccinum*, or in a cylindrical erect group; nucleus submammillary, of the Chrysodomoid type hereinbefore defined; the subsequent whorls rapidly increasing, not numerous. The dental formula 1. 1. 1, the teeth usually tricuspid, the central rhachidian cusp and outer lateral cusps usually larger; the minor cusps often irregular, multiple or obsolete. The habitat of the genus is in cold water of the North temperate or Arctic seas.

Section **SULCOSIPHO** Dall.

Shell like *Chrysodomus* but more slender and elongate and with the whorl in front of the suture conspicuously widely sulcate or tabulate, the nucleus inflated and slightly oblique, the color whitish.

Type.—*Chrysodomus tabulatus* Baird, Puget Sound. *C. adelpicus* Dall, of Japan, appears to belong to this group also.

Subgenus **BARBITONIA** Dall.

Shell short and stout, resembling *Chrysodomus*, smooth or axially ribbed, the outer wall of the aperture in the adult spirally lirated within. Habitat, Northeastern Asia and Japan.

Type.—*Fusus arthriticus* Valenciennes, 1858, Hakodate.

The closely related *Neptunea cumingi* Crosse, 1862, according to Aurivillius, has a radula differing from that of typical *Chrysodomus* in having two rather long cusps on the laterals, the rachidian tooth bearing two curved cusps springing backward from the anterior edge of the basal plate, and between them on the posterior edge of the plate two short triangular cusps with no median denticle. The operculum is large, slightly arched with an apical nucleus. *Fusus bulbaceus* Bernardi, and *vinosus* Dall, have the dentition of *Chrysodomus*, lack axial ribbing and lirations, and, though otherwise similar, do not belong to this group.

Genus **SEARLESIA** Harmer.

Searlesia HARMER, Pliocene Moll. Gt. Britain, vol. 1, 1915, p. 135. Type, *Trophon costifer* S. Wood, Crag of Britain.

Chrysodomus COSSMANN, Essais, vol. 4, 1901, p. 101.

Nucleus (of *S. dirus*) smooth, of two laxly coiled smooth whorls changing abruptly into the adult sculpture of few strong axial ribs crossed by numerous spiral threads. The shell-structure subtranslucent, dark colored; the shell short-fusiform, periostracum inconspicuous; aperture shorter than the spire, the outer lip thickened and internally lirated; the body callous, with a narrow chink between the reflected enamel and the strong siphonal fasciole; canal short, open, slightly recurved. Radular formula $\frac{1}{2} : \frac{1}{3} : \frac{1}{2}$, the median rachidian cusp longer than the others.

The specimens of *T. costifer* at my disposal show the nucleus less perfectly than the recent species from which I have taken the description, but they appear to be essentially similar. The genus is convenient as it takes in several West American and Japanese species for which no satisfactory place had hitherto been found. The operculum is similar to that of *Colus*, long-ovate, arcuate, with apical nucleus and, on the proximal side, a marginal band of vitreous enamel.

Genus ECPHORA Conrad.

Ephora CONRAD, Proc. Acad. Nat. Sci., Phila., vol. 1, 1843, p. 310.—DALL, Trans. Wagner Inst., vol. 3, 1890, p. 124. Type, *Fusus quadricostatus* Say, Miocene, Maryland.

Shell vertically depressed, few whorled, the last much the largest; structure of shell Chrysodomoid; sculpture of few strong spiral ribs; canal short, very deep and narrow with a large, funicular umbilical pit.

Stenomphalus Sandberger, 1853, from the North European Miocene, appears to represent this form on the other side of the Atlantic, but I have not been able to examine a specimen.

Genus COLUS Bolten.

Colus BOLTEN, Mus. Boltenianum, 1798, p. 117, edition of 1819, p. 82. No type selected.

Neptunca B LINK, Besch. Rostock Samml., vol. 3, 1807, p. 117. No type selected.

Tritonofusus BECK, Amtl. Ber. d. 24 Vers. Deutsche Naturf., Kiel, 1847, p. 114. Type, *Fusus islandicus* Chemnitz.—HERRMANNSEN, Ind. Gen. Mal., vol. 2, 1849, p. 611.—DALL, Proc. U. S. Nat. Mus., vol. 24, No. 1264, 1902, p. 522. Not of Mörch, Fort. ov. Grönl. Blöddyr, 1857, p. 13.

Neptunella VERRILL, Inv. An. Vineyard Sound, 1873, p. 637; Amer. Journ. Sci., ser. 3, vol. 6, 1873, p. 439. Type, *Fusus pygmaeus* Gould. Not *Neptunella* Meek, 1864.

Siphonella VERRILL, Checkl. Mar. Inv. Atlantic Coast, 1879, p. 20 (New name for *Neptunella* preoccupied). Not *Siphonella* Hagen, 1851, Insecta.

Sipho MÖRCH, Cat. Yoldi, vol. 1, 1852, p. 104. Not *Sipho* of Fabricius, 1822, or of Brown, 1844, or *Sypho* of Brown, 1827.

Fusus of many AUTHORS, but not of Helbling, 1779.

Colus DALL, Journ. Conch. (Leeds), vol. 11, No. 10, 1906, p. 294. Type, *Murex islandicus* Gmelin.

Sipho DAUTZENBERG AND FISCHER, Res. Camp. Scientifiques de Monaco, livr. 37, 1912, p. 81. Type, *Buccinum gracile* Da Costa.

Shell long-fusiform, slender, with numerous moderately rounded whorls, the nucleus Chrysodomoid, the shell structure usually white, often with a chalky external layer under a conspicuous, usually brownish, adherent periostracum; sculpture spiral, seldom very strong, sometimes nearly obsolete, never axially plicate or ribbed; aperture of moderate size, the outer lip simple, acute, not thickened or reflected, rarely slightly expanded; pillar smooth, the inside of the outer lip not lirate or denticulate; canal varying in length, usually somewhat tortuous or, when short, recurved; operculum filling the aperture, formed as in *Chrysodomus*. Radula like *Chrysodomus*, the minor cusps variable, the rhachidian tooth always cuspidate. Ovicapsules solitary, lentiform or hemispherical, attached by the whole of the flat side, usually with several enclosed young. Nepionic shells

small, generally with the apical whorl inflated, the next succeeding somewhat constricted, and the rest regularly increasing; but the nucleus varies as previously described from inflated and irregular to blunt and regularly coiled, but always smooth.

Type.—*Murex islandicus* Gmelin.

It is questionable whether the small form named by Gould *Fusus pygmaeus* should be separated sectionally from *Colus* proper, or not. The characters of radula and periostracum upon which Verrill based his *Neptunella* are common to species of larger growth which one would not think of separating. The nucleus, however, is peculiar in being strongly spirally keeled clear up to the minute apical cell, thus tabulating the nuclear whorls. The summit, however, is not flat, and there are no such radial riblets as are found in *Siphonorbis*. *Sipho parvus* Verrill, a still smaller and similar species as far as adult characters go, has the nucleus Chrysodomoid, though on a smaller scale.

Another group of species, typified by *Fusus spitzbergensis* Reeve, has a special aspect due to the short canal and the prominence of the spiral ribs separated by channeled interspaces. It may be called *Aulacofusus*.

Subgenus LATISIPHO Dall.

? *Parvisipho* COSSMANN, (part) Cat. Eocene bas. Paris, vol. 4, 1889, p. 147.

Eocene of Paris basin. Type, *Fusus terebralis* Lamarck (not Gould).

Shell of moderate size, Buccinoid in form, with fine spiral striation or none; no axial sculpture; the periostracum persistent, smooth; the spire short, about equal to the aperture; the canal short, markedly recurved; the outer lip ample, simple, slightly reflected in the adult; the body and pillar callous, smooth; the siphonal fasciole strong with no chink between it and the columellar callus. Operculum as in *Colus* with apical nucleus. The nuclear whorls as in *Colus* but small.

Type.—*Chrysodomus hypolispsus* Dall, 1891, U. S. Nat. Mus., No. 122606. Bering Sea.

The group of fossil species, included under *Parvisipho* by its author, from the present writer's point of view appears heterogeneous, including smooth, plicate, and varicose species, some with internal lirae in the aperture. *P. terebralis* Lamarck seems from the figure somewhat like the present group in outline, but, considering its geological remoteness, the boreal habit and buccinoid aspect of the group here assembled under *Latisipho*, it seems that a separation is not unreasonable. The features in *Parvisipho* upon which M. Cossmann lays special stress, such as the pillar without callus, the absence of a siphonal fasciole (bourrelet), etc., are quite the

contrary of those which obtain in *Latisipho*, of which numerous species exist in the Bering Sea region, and which are contrasted with typical *Colus* by their buccinoid form and strongly recurved short canal.

This group is related to *Colus* much as *Latifusus* is to *Plicifusus*.

Curious zigzag ridges, not very prominent, appear behind the shoulder of the last whorl in some specimens of this species, but are absent in others. No explanation of them is obvious, but I suspect them to be pathologic.

Subgenus ANOMALOSIPHO Dautzenberg and Fischer.

Anomalosipho DAUTZENBERG AND FISCHER, Res. Camp. scientifiques de Monaco, livr. 37, 1912, p. 99.

Shell solid, of moderate size, the nucleus unknown, the sculpture exclusively spiral, the sutures not constricted, the aperture shorter than the spire, the canal very short, wide, hardly differentiated from the aperture.

Type.—*Sipho verkruzeni* Dautzenberg and Fischer (not Kobelt) = *Colus dautzenbergii* Dall. Atlantic Ocean; Grand Banks.

The *Sipho verkruzeni*, var. *plicata* figured by Brögger and cited in the work of Dautzenberg and Fischer, appears from the excellent figure to be probably a young specimen of *Plicifusus arcticus* Philippi. *Tritonofusus adonis* Dall, and *Euthria conulus* Aurivillius, are members of this subgenus, but all specimens yet seen have the apices of the shell eroded so that the nuclear characters are unknown. The radula appears to have normally three cusps on the rhachidian tooth and four on the laterals, but one or more cusps are sometimes deficient, according to Aurivillius.

Genus SIPHONORBIS Mörch.

Siphonorbis MÖRCH, Journ. de Conchyl., vol. 17, 1869, p. 397. No type cited. (First species, *Fusus lachesis* Mörch).—FISCHER, Manuel de Conchyl., 1884, p. 624. Type selected, *S. ebur* Mörch, Greenland seas.—DALL, Proc. U. S. Nat. Mus., vol. 24, No. 1264, p. 522.—DAUTZENBERG AND FISCHER, Res. Camp. Scientifiques de Monaco, livr. 37, 1912, pp. 82, 93 (*Fusus ebur* Mörch).

Turrisipho DAUTZENBERG AND FISCHER, Res. Camp. Scientifiques de Monaco, livr. 37, 1912, pp. 82, 97. Type, *S. lachesis* Mörch.

Nucleus siphonorbitoid as before herein described; shell generally like *Colus*, but variable: the canal usually short; the sculpture, if any, spiral; the spire varying in relative length compared with the aperture; the operculum as in *Colus*; the rhachidian tooth with a single cusp, the laterals with two cusps; otherwise as in *Colus*.

The peculiarly depressed, sharply reticulate, nepionic whorls starting from a smooth apical cell form such a contrast to the nucleus in *Colus* that it seems reasonable to separate them generically.

Genus KRYPTOS Jeffreys.

Kryptos (Jeffreys) DAUTZENBERG AND FISCHER, Mém. Soc. Zool. de France, vol. 9, 1896, p. 435. Type, *K. elegans* Jeffreys, Mém. Soc. Zool. de France, vol. 9, 1896, p. 435, pl. 15, fig. 20 (Separate copies, p. 41). Northeastern Atlantic in deep water.

Nucleus initially smooth, then depressed and reticulate as in *Siphonorbis*; shell as in *Siphonorbis* except that axial ribbing is developed over part or the whole of the shell, becoming reticulate or nodulous at intersection with the more prominent spiral sculpture. Operculum rounded-quadrate, short, as in *Beringius*; verge relatively enormous, cylindrical, with conical tip; eyes and radula apparently wanting in the typical species, *K. elegans*.

A manuscript note of Jeffreys states that the type is identical with *Boreofusus nodosus* Jeffreys of the Porcupine Expedition; but I have not found that *B. nodosus* has been published, though we have specimens so labeled in his collection.

The typical species of *Kryptos* has a plain, somewhat concave band in front of the suture and behind the nodosities at the shoulder of the whorl. Locard referred the species to *Pleurotomella*, but the nuclear characters are so obviously Siphonorbitoid that I can not accept this conclusion. *Fusus fenestratus* Turton, (+*fusiforme* Broderip, +*Broderipii* Jeffreys) probably belongs to this genus. Jeffreys' statement that the "top whorl" is smooth results from the fact that Broderip's type-specimen, now in the Jeffreys collection, had been cleaned with acid. Other species are *Fusus abyssorum* Fischer, 1884¹ (*profundicola* Verrill and Smith, April, 1884). *F. sarsi* Jeffreys is not a plicate species and probably = *ebur* Mörch.

This group is related to *Siphonorbis* somewhat as *Plicifusus* is to *Colus*.

Genus PLICIFUSUS Dall.

Plicifusus DALL, Proc. U. S. Nat. Mus., vol. 24, No. 1264, 1902, p. 523.

Type, *Fusus kroyeri* Möller

Parasipho DAUTZENBERG AND FISCHER, Res. Camp. Scientifiques de Monaco, livr. 37, 1912, pp. 82, 100. Type, *F. kroyeri* Möller.

Shell strongly plicate axially, smooth or spirally sculptured, usually with an inconspicuous periostracum; nucleus Chrysodomoid; aperture ample, the outer lip markedly flexuous behind, slightly expanded, simple, sharp; the pillar callous, the canal slightly twisted

¹ Fischer's separate copies of this leaflet were received July 26, 1884; the part of the Journal de Conchyliologie containing it, in November, 1884, at the Smithsonian Institution. I am unable to say when this number of the Journal was published. It is dated 1883 but did not appear until sometime in 1884.

and recurved, moderately long; the aperture (including the canal) about as long as the spire. Operculum as in *Colus*. Dentition (of *P. arcticus* Philippi) $\frac{1}{3}:\frac{1}{3}:\frac{1}{3}$, the cusps of the rhachidian subequal, the middle cusp of the laterals smaller and often variable or bifid. The type of the radular sac is chrysodomoid. Arctic seas.

The small size, livid coloration, and heavy shell of the North Atlantic species described by Möller, is so different from the large, whitish, thin form from the Arctic Ocean and Bering Sea named by Philippi in 1850 *Fusus arcticus*, that I think it best to regard the two as distinct species, though they have generally been regarded as synonymous.

Subgenus RETIFUSUS Dall.

Shell of small or moderate size, with a conspicuous dark usually vernicose periostracum; axially plicate, the surface reticulated by sharply incised spiral grooves; nucleus swollen, chrysodomoid; outer lip flexuous, slightly reflected, sharp, simple, without internal lirae; canal short, recurved, with the siphonal fasciole indistinct; operculum arcuate with apical nucleus. Bering Sea and north Pacific.

Type.—*Tritonium jessoense* Schrenck.

Chrysodomus virens Dall, and several new species belong to this group.

Subgenus LATIFUSUS Dall.

Shell short and broad, whitish, with a dull slightly villous periostracum; arcuately plicate with fine spiral threading; canal and aperture as long as the spire; outer lip strongly flexuous behind, slightly thickened and reflected; pillar short, smooth, with the body coated with callus in the adult; canal short, wide, recurved, with the siphonal fasciole feeble; operculum arcuate, the nucleus apical and in perfect specimens incurved; the apex of all the specimens is more or less eroded, but appears to have been acute and chrysodomoid.

Type.—*Chrysodomus griseus* Dall, Californian coast in deep water. U. S. Nat. Mus. No. 96531.

This is the buccinoid phase of *Plicifusus* as *Latisipho* is of *Colus*.

Subgenus MICROFUSUS Dall.

Shell small, with a somewhat villous, inconspicuous periostracum; nucleus smooth, swollen, obliquely tilted, chrysodomoid; subsequent whorls near the apex axially ribbed, the remainder without axial sculpture; spiral sculpture of fine close threading; suture appressed, spire acute; aperture shorter than the spire, with a wide, very short, recurved canal; outer lip simple, sharp; pillar without callous deposit, or marked siphonal fasciole.

Type.—*Chrysodomus acutispiratus* Sowerby. Japan, U. S. Nat. Mus., No. 274056.

It is possible that some of the species included under *Parvisipho* Cossmann might find a place here.

Section HELICOFUSUS Dall.

Shell small, short, inflated, with an external chalky layer covered with a dark rude periostracum, both usually eroded; the inner shell layer of an orange color; nucleus large for the shell, depressed, dome-like, smooth and of about one whorl; the succeeding whorl or two with short small axial ribs, the later whorls with only fine spiral sculpture, usually eroded; aperture as long as the spire; outer lip sharp, flexuous behind, not reflected; body and pillar with a thin callus; pillar short, twisted, abruptly bent to the left with the wide short canal, no siphonal fasciole present; operculum as in *Plicifusus*.

Type.—*Chrysodomus laticaudatus* Dall. Alaska U. S. Nat. Mus., Nos. 210801 and (nucleus) 213357.

The remarkable way in which the canal is diverted from its normal direction, seems to place this species in a group apart. The large number of specimens collected, though showing some variation, are constant enough to indicate that the deflected canal is a permanent feature. The tendency to superficial erosion is also characteristic.

Genus EXILIA Conrad.

Exilia CONRAD, Journ. Acad. Nat. Sci. Phila., n. ser., vol. 4, p. 291, 1860.

Type. *E. pergracilis* Conrad, Journ. Acad. Nat. Sci. Phila., vol. 4, 1860, pl. 47, fig. 34. Eocene of Texas.

Shell elongate, very slender, with numerous whorls, chrysodomoid nucleus, and a straight canal; periostracum conspicuous, polished; sculpture of numerous fine flexuous axial ribs and spiral striation; aperture small, simple, not lirate within, outer lip thin, sharp, not reflected; inner lip and pillar smooth, without plications or denticles of any sort; operculum long, slightly arcuate, with apical nucleus.

This shell has the nucleus and periostracum of *Plicifusus* but much the form of *Fusinus*, of which Gabb's *Exilifusus* is a synonym. A curious error appears in Cossmann's *Essais de Paléoconchologie comparée*, (livr. 4, 1901, p. 26,) in which *Exilia* is described as having two oblique plaits on the pillar. There are none of any kind whatever. M. Cossmann's specimen was probably wrongly identified with *Exilia*, and may have been a *Fusimitra*.

Chrysodomus rectirostris Carpenter, and *C. kelseyi* Dall, appear to belong to this genus, which is also represented in the Pliocene of California.

Genus VOLUTOPSIUS Mörch.

Volutopsius MÖRCH, Fort. ov. Grönl. Blöddyr., April, 1857, p. 13; Article Manual, 1875, p. 129. *Type*, *Fusus largillierti* Petit. Greenland.

Strombella GRAY, Guide Moll. Brit. Mus., Jan. 1857, p. 13. *Type*, *Strombus norvegicus* Gmelin. Not *Strombella* Schlüter, Syst. Conch. Samml., 1838, p. 22.

Volutopsis DALL, Proc. Cal. Acad. Sci., vol. 5, 1873, p. 57.—G. O. SARS, Moll. Reg. Arct. Norv., 1878, p. 268.—DAUTZENBERG AND FISCHER, Res. Camp. Scientifiques de Monaco, 1912, p. 64.

Shell large, frequently rude or irregular, with the last whorl largest, covered with a thin, inconspicuous more or less dehiscent periostracum; spire short, blunt, beginning with a relatively large smooth bulbous nucleus; sculpture variable, smooth, spirally striate, or with indistinct wavelike axially directed prominences or even with feeble axial ribs; the aperture ample, the canal short, wide, hardly differentiated. Operculum short-ovate or rounded-quadrate, the nucleus at the right anterior corner; dentition: the rhachidian tooth with two to five small cusps, the laterals with two large arcuate cusps. In *V. castanea* Mörch the formula is $\frac{1}{2}:\frac{1}{3}:\frac{1}{2}$; in *V. norvegica* $\frac{1}{2}:\frac{1}{4}:\frac{1}{2}$; in *V. fragilis* $\frac{1}{2}:\frac{1}{5}:\frac{1}{2}$ according to Sars and Hanna. Ovicapsules large, hemispherical, attached by the whole of the flat side, containing several embryos. The species are boreal and Arctic, especially numerous in the Bering Sea region.

Having compared the Newfoundland *V. largillierti* with a large series (35 specimens) of the *V. norvegica*, I am inclined to regard them as distinct though closely related species. Mörch's type was the former; in it the nucleus is large, flattish above and with about a whorl and a half. The shell is thin and of an orange tint. In *norvegica* the enfolding of the apical whorl is almost pointed, and the nepionic shell continues in a subcylindric fashion for three or four whorls. The test is white and heavy.

In accordance with the International rules for nomenclature, I have returned to the original spelling of the name.

A feature which is not confined to this genus and which is foreshadowed in *Ancistrolepis* is that, while the species like *V. castanea* which live in shallow water near shore retain the usual long retractile proboscis and well developed functional radula, other species living in deep water have the radula degenerate in size (*V. fragilis*), the proboscis much shortened and the esophagus enlarged. From dissections made by Mr. G. Dallas Hanna under my supervision, these facts have been demonstrated. It seems that these deep water dwellers live chiefly by swallowing quantities of mud containing minute organisms, with which the stomach and esophagus were found loaded. The radula being no longer required and a long proboscis being inconvenient for the purpose, both appear to have degenerated. Something of the sort was noted by me in connection with *Ancistrolepis* in 1902, and with an abyssal trochoid mollusk (*Turricula bairdii* Dall), in 1889. These adaptations to suit the environment would probably be found on examination of a series of species to gradually merge into one another.

Mr. Hanna finds that in *Volutopsius* and *Pyrolofusus* the radula is contained in a long sac below the esophagus and separated from it by a thick muscular septum. It emerges by a small orifice near the end of the evertible proboscis, so that on splitting open the proboscis no radula is visible. In *Chrysodomus* and *Plicifusus* on the other hand, the radula lies on the lower side of the esophageal tube covered only with a thin, not muscular, membrane. In *Beringius* (*Kennicottii* Dall) the radular sac is of the Chrysodomoid type.

Genus PYRULOFUSUS Mörch.

Pyrolofusus (Beck Ms.) MÖRCH, Mem. Soc. Malac. de Belgique, vol. 4, 1869, p. 20. Sole example, *Fusus deformis* Reeve.

Pirulofusus COSSMANN, Essais Pal. Comp., vol. 4, 1901, p. 98, as synonym of *Chrysodomus*.

Heliotropis DALL, Proc. Cal. Acad. Sci., vol. 5, April, 1873, p. 61. Type. *Neptunca harpa* MÖRCH.

Pyrolofusus FRIELE, Jahrb. Mal. Ges., vol. 6; 1879, p. 280; N. Atl. Exp. 1882, vol. 1, p. 8, pl. 1, fig. 8; pl. 4, figs. 11-13.—FISCHER, Man. de Conchyl, 1884, p. 624.—DAUTZENBERG AND FISCHER, Res. Camp. Scientifiques de Monaco, 1912, p. 67.

Pyrolofusus KRAUSE, Arch. f. Naturg., vol. 51, 1885, p. 282; Zool. Jahrb., vol. 6, 1892, p. 362.—FRIELE AND GREIG, N. Atl. Exp., vol. 3, 1901, p. 102.—DALL, Proc. U. S. Nat. Mus., vol. 24, No. 1264, 1902, p. 523.

Shell large, relatively thin, with a very short spire and large body whorl, usually sinistral but with rare dextral individuals; nucleus very large, smooth, flat-topped, infolded with an apical dimple, subsequently spirally sculptured, with obscure axial folds; periostracum thin, dehiscent; aperture ample, the outer lip expanded and thickened, the body and pillar enameled, often brightly colored; the canal very short, shallow and wide, hardly recurved and with no evident siphonal fasciole; operculum much smaller than the aperture, rounded-quadrate with apical nucleus: radula chrysodomoid but rather irregular, the rhachidian tooth in the typical species tricuspid; the laterals with two large terminal cusps, the median cusp of the central tooth variable. Ovicapsules as in *Volutopsius*, large, solitary, and hemispherical, with few embryos. I have dextral specimens of both the sinistral species; an Arctic Pliocene form is dextral. *P. harpa* Mörch, has two strong cusps on the rhachidian tooth and two on each lateral. According to Friele the middle cusp of the rhachidian tooth in *P. deformis* is quite irregular. The *Fusus contrarius* is not a member of this genus, but merely a reversed species of *Chrysodomus*.

Genus BERINGIUS Dall.

Beringius DALL, Sci. Expl. Alaska, 1879, pl. 2, figs. 1, 1a-c. Sole example.

Chrysodomus crebricostatus Dall, Proc. U. S. Nat. Mus., vol. 9, 1886, p. 304; vol. 7, 1894, p. 710; vol. 24, No. 1264, 1902, p. 529, pl. 35, fig. 1.

Jumala FRIELE, N. Ttl. Exp., vol. 1, 1882, p. 6. Type, *Fusus turtoni* Bean, Ann. Mag. Nat. Hist., Nov. 1893, *olim.*—DAUTZENBERG AND FISCHER, Res Camp. Scientifiques de Monaco, livr. 37, 1912, p. 62.

Ukko FRIELE, in Norman, Ann. Mag. Nat. Hist., ser. 6, vol. 2, 1893, p. 352.—FRIELE, Moll. Nordseefahrt *Michael Sars*, 1902, p. 6.

Shell dextral, large, solid, the spire usually longer than the aperture, the sculpture very variable but usually strong; the periostracum thin, dehiscent; the nucleus swollen, with several hardly increasing whorls forming a subcylindrical tip to the spire in most cases; aperture of moderate size, the outer lip slightly expanded and hardly thickened; pillar smooth, short, callous; canal short, wide, hardly recurved; operculum smaller than the aperture, subovate with apical nucleus; radula peculiar, with an edentate rhachidian plate, the laterals formed by single strong cusps with the tip incurved and two or more small blunt denticles on the inner edge near the middle. The ovicapsules are pouch-shaped, pedunculate, attached by the edge of the disk and opening at the upper edge, with few embryos.

None of the other groups here designated, except *Mohnia*, show such variation as this one in types of sculpture among the species; ranging from smooth to strongly axially ribbed, strongly spirally ridged, or finely striated.

The name *Ukko* was substituted for *Jumala* by the author, because it was found that the latter is the name by which the Christian Lapps signify the Deity. Both names are antedated by *Beringius*.

Genus LIOMESUS Stimpson.

Liomesus STIMPSON, Canadian Naturalist, new ser., Oct. 1865, p. 34. Type, *Buccinum dalei* J. Sowerby.

Buccinopsis JEFFREYS, British Conch., vol. 4, 1867, p. 297 (*B. dalei* J. Sowerby); Brit. Assoc. Adv. Sci. Rep. for 1868, p. 244; (not of Conrad, Emory's Rep. Mexican Boundary, vol. 1, p. 158, pl. 13, figs. 4a-4b, 1857).—KOBELT, Conch. Cab., ed. 2; *Buccinum*, p. 99, 1883.

Liomesus HARMER, Brit. Pliocene Moll., p. 115, 1914.

Shell of moderate size, bucciniform, the nucleus minute, with a very short twisted pillar, the outer lip thickened but not reflected; pillar and body smooth; the periostracum conspicuous, often villous; the operculum with apical nucleus; the rhachidian plate edentulous, the lateral teeth thorn-shaped, simple, their apices incurved without accessory denticles; the ovicapsules like those of *Beringius* but smaller.

The typical species is a Crag fossil of England, but it has long been confused with a totally distinct recent form from the Doggerbank, the earliest specific name for which is *Buccinum ovum* Turton, 1825. A later name is *Tritonium eburneum* M. Sars, 1849. The recent species of Bering Sea, like the British Pliocene fossils, are solid heavy shells, while the recent European species is thin and delicate. The radula is very long.

Genus ANCISTROLEPIS Dall.

Ancistrolepis DALL, Proc. U. S. Nat. Mus., vol. 17, 1895, p. 709. Type, *Chrysodomus cucosmius* Dall, Bering Sea; Proc. U. S. Nat. Mus., vol. 24, No. 1264. 1902, p. 523; Smithsonian Misc. Coll., No. 1727, 1907, p. 157.

Shell buccinoid, with the pillar shorter than the aperture, twisted as is usually the canal; suture channelled; nucleus beginning with a small initial cell, a blunt apex and followed by regularly increasing inflated, smooth and polished whorls; the periostracum usually coarse and villous or laminate; operculum straight, concave, fan-shaped with apical nucleus and small area of attachment; penis on a stout stalk with pediform distal extremity without any curved or attenuated terminal papilla; radula degenerate and disproportionately small, rhachidian tooth with three long subequal cusps, the laterals with a larger outer and two smaller inner curved cusps.

All of the species have spiral sculpture, some very strong. None of them has any axial ribbing. In most of them the periostracum is dehiscent and the shell substance white.

Section JAPELION Dall.

Shell with a produced spire, a very wide and sharp-edged channel in front of the suture and the periostracum adherent, polished, conspicuous. Otherwise as in the typical section so far as known.

Type.—*Buccinum hirasei* Pilsbry, 1901. Japan.

It is a remarkable case of convergence which has brought the typical species of this section to a point where in its specific characters it almost reproduces those of *Tritonium pericochlion* Schrenck. A casual inspection would hardly distinguish between them, but *hirasei* has the short pillar of *Ancistrolepis* while *pericochlion* has a straight long pillar and hardly recurved perfectly distinct canal. It is probable that the latter bears a relation to *Colus* such as *Sulcosipho tabulatus* does to *Chrysodomus*. But until the soft parts and operculum are known, I refrain from further action.

There are a number of groups of fossils and a few recent forms which apparently belong to the Chrysodominae, or like *Troschelia* seem to bridge the gap between this subfamily and the Fusinae. In the absence of authentic specimens it has seemed best in this review to restrict myself to the consideration of the boreal and Arctic forms of which the United States National Museum possesses a quite unequalled series.

The position of *Sulcosinus* will remain undetermined until specimens are obtained containing the living animal. Its conspicuously thickened continuous peristome is not paralleled either in the Buccininae or Chrysodominae.

DESCRIPTIONS OF SPECIES.

TURRIS (CRASSISPIRA) RUGITECTA, new species.

Shell solid, moderately large with ten whorls, exclusive of the (lost) nucleus, blackish brown with a broad pale peripheral band; axial sculpture of about (on the penultimate whorl 17) short oblique similar ribs, beginning at the shoulder and on the last whorl gradually becoming obsolete toward the canal, separated by subequal interspaces; spiral sculpture of in front of the suture a prominent blunt keel, in the anal fasciole two or three subequal cords; in front of the shoulder (on the penultimate whorl four, on the last whorl twelve or more) flattish equal cords overrunning the ribs, separated by narrower grooves which toward the canal become gradually wider; apex acute, last whorl more than half of the length of the shell, aperture rather narrow, smooth within, the enamel dark brown except where the pale band reaches the margin of the outer lip; anal sinus wide, not very deep, rounded proximally, canal wide, short, slightly curved to the right, with no siphonal fasciole. Length of shell 30; of last whorl 16; of aperture 12; maximum diameter of shell 10 mm.

Habitat.—Lower California, off San Bartolomé Bay, Dr. Paul Bartsch. U. S. Nat. Mus., Cat. No. 266911.

This is a remarkably fine species, less black than most of the species of *Crassispira*. Toward the upper part of the spire the spaces between the ribs remain brown, but on the later whorls they partake of the waxen pale band as well as the ribs.

PLICIFUSUS (RETIFUSUS) SCISSURATUS, new species.

Shell slender, elongate, acute, with grayish buff colored periostracum and about eight whorls without the (lost) nucleus; suture distinct, slightly appressed; whorls moderately convex; axial sculpture on the penultimate whorl of about thirteen narrow, rounded, retractively arcuate plications extending from suture to suture and on the last whorl over the periphery to become obsolete on the base; spiral sculpture of (on the penultimate whorl 10–11) straplike flattish bands separated by narrow deeply cut grooves, and divided by a shallower groove in the center of each spiral; these bands are practically uniform over the whole surface; aperture sublunate, the canal wide, recurved, half as long as the aperture; outer lip recurved, thin, white, the throat more or less livid; pillar white, erased, arcuate, obliquely truncate in front, the fasciole inconspicuous. Length of shell 55; of last whorl 35; of aperture and canal 25; maximum diameter of last whorl 19 mm.

Habitat.—Nemuro, Japan. Hirasé collection, U. S. Nat. Mus., Cat. No. 274071.

This species belongs to the group of *P. yessoënsis* Schrenck (*manchuricus* E. A. Smith) but is much larger than that species, the periostracum lighter and polished, the canal relatively longer, and the whole shell relatively more slender.

PLICIFUSUS (AULACOFUSUS) RHYSSOIDES, new species.

Shell slender, fusiform, with an olivaceous periostracum, and about seven whorls, nucleus more or less eroded but apparently globose and blunt; penultimate whorl with thirteen retractively arcuate rounded plications with about equal interspaces, extending from suture to suture and obsolete on the periphery of the last whorl; the suture distinct but not constricted; spiral sculpture of fine equal close-set rounded threads, about three to a millimeter, slightly sparser toward the canal; aperture semilunate, white within, the outer lip slightly expanded; canal short, wide, recurved; the pillar white, slightly arcuate, erased, obliquely truncate in front, the siphonal fasciole faint. Length of shell 49; of last whorl 30; of aperture 20; maximum diameter of last whorl 18 mm.

Habitat.—Rikuzen, Japan. Hirasé collection. Cotype, U. S. Nat. Mus., Cat. No. 274069.

The operculum is thin, pale yellowish-brown, the apex strongly incurved. This species is quite close to *P. rhyssus* Dall, from which it differs in its more fusiform shape, less inflated whorls, less constricted suture, and, in the specimens available, lighter colored periostracum. The incurvation of the apex of the operculum suggests an approach toward *Mohnia*.

PLICIFUSUS (LATIFUSUS) WAKASANUS, new species.

Shell of moderate size, thin and light, covered by a yellowish-brown smooth periostracum, with six moderately rounded whorls without the (lacking) nucleus; suture distinct, not appressed; whorls axially sculptured with (on the penultimate whorl 15-18) retractively arcuate plications, strongest near the suture, barely crossing the periphery, and becoming gradually obsolete on the last whorl; the plications are rounded, not sharply defined, and have about equal interspaces; spiral sculpture of numerous equal flattish threads with narrower interspaces, about three threads to a millimeter, this sculpture covering evenly the whole surface; aperture semilunate, interior and pillar white; outer lip slightly expanded, pillar straight, anteriorly obliquely truncate; canal short, recurved, with no marked siphonal fasciole. Length of shell 40; of last whorl 28; of aperture 18; maximum diameter of last whorl 17 mm.

Habitat.—Wakasa, Sea of Japan. Hirasé collection.

This belongs to the group represented on the American coast by *Plicifusus (Latifusus) griseus* Dall.

COLUS (LATISIPHO) LEPIDUS, new species.

Shell very thin, with a strong, smooth, yellowish-brown periostracum which in drying comes away from or cracks the thin calcareous portion of the shell; whorls six without the (deficient) nucleus, moderately inflated, with the appressed suture somewhat constricted; in front of the suture there are whitish radiating ill-defined patches which in some specimens might almost attain to something like a color pattern; the apical whorls of the best preserved specimen are decorticated and slightly eroded, but bear the remains of about seven oblique short plications which apparently did not reach the sutures; the later three whorls are smooth, except for a few very faint irregular indications of spiral threads; the aperture is short, roughly semilunate, with the outer lip slightly expanded and reflected; the pillar is straight, white and somewhat callous; the color within the aperture livid purplish; the canal short, slightly twisted, with no marked siphonal fasciole. Length of shell 40, of last whorl 25, of aperture 15; maximum diameter of last whorl 17 mm. Another specimen increases more rapidly in diameter, that of the last whorl measuring 20 mm.

Habitat.—Iterup Island of the Kuril group. Hirasé collection.

There is nothing on the American coast that resembles this species, and the color painting is unique among the species of the region. Unfortunately both the specimens are more or less broken and eroded.

COLUS (LIMATOFUSUS) TAHWITANUS, new species.

Shell small, buccinoid, with about six whorls; nucleus eroded, suture deep, not appressed; whorls well rounded; sculpture of fine even uniform grooves with wider flat interspaces over the whole shell; periostracum dull, olivaceous; interior white, outer lip reflected, arcuate; pillar and body erased, axis twisted, almost pervious, canal very short and strongly recurved. Height 33; max. diameter 17 mm.

Habitat.—Off Tahwit Head, Washington, in 178 fathoms, mud. U. S. Nat. Mus. Cat. No. 122632.

SEARLESIA CONSTRICTA, new species.

Shell dark purplish brown, strongly constricted and appressed at the suture, rude and with no visible periostracum, with about six prominently rounded whorls without the (decollate) nucleus; axial sculpture of (on the penultimate whorl 12) prominent nearly straight rounded riblets which become obsolete toward the sutures and on the last half of the last whorl; spiral sculpture on the earlier whorls of strong rounded threads overrunning the plications without nodosities, and alternated with one or two intercalary smaller threads all

close-set; this alternation continues over the shell, but is less conspicuous on the last whorl; aperture semilunate, livid brown within, pinched to a notch by the sutural constriction; outer lip somewhat thickened, not reflected, lirate within (with about 15 lirae); inner lip with a thin coating of brownish enamel and three sharp subsutural lirae in the adult, close to the subsutural notch; pillar nearly straight, canal narrow, strongly recurved, short, with a very conspicuous flaring siphonal fasciole, with a chink between it and the reflected enamel of the inner lip; operculum small for the size of the aperture, brownish, with apical nucleus. Length of shell 44; of last whorl 29; of aperture and canal 19; of operculum 7.5; maximum diameter of last whorl 17.5 mm.

Habitat.—Fusan, Korea. Hirasé collection. Cotype, U. S. Nat. Mus., Cat. No. 247072.

This shell belongs to the group of *C. dirus* Reeve (*incisus* Gould), of the west coast of America, and which includes "*Euthria*" *viridula* Dunker (? *ferrea* Reeve) of Japan. The probabilities are against the identification of the northern group, which has received the name of *Searlesia* from Harmer, with the Magellanic *Euthria* typified by *E. plumbea*; so I have accepted Harmer's name for a group which appears to be largely represented by species in the North Atlantic Pliocene, and in regard to the generic affinities of which very diverse opinions have been expressed.

ANCISTROLEPIS LATUS, new species.

Shell large, solid, pale orange color under the (lost) periostracum, with two nuclear and five subsequent whorls rapidly enlarging; nuclear whorls beginning with a minute apex followed by two rounded, smooth, inflated, equal whorls with a deeply constricted suture forming a subcylindrical apex to the mature shell; later whorls with a wide and deep channel in front of the suture bounded in front by a sharp thin elevated keel; the remainder of the surface with numerous, obsolete flat spiral ridges which are larger and more perceptible on the base of the last whorl, where (in the type) six may be discerned, with narrower interspaces; axial sculpture of rather rude incremental lines; aperture wide, notched at the end of the keel; outer lip sharp, rounded; inner lip with a smooth continuous callus, its edge slightly raised; canal very short and wide; siphonal fasciole well marked; interior of the aperture orange and white, concentrically zoned. Length of shell 100; of last whorl 75; of aperture 57; maximum width of shell 70 mm.

Habitat.—Quelpart Island, south of Korea. Hirasé. Type in Hirasé collection.

This species is wider with a wider presutural channel and more elevated keel than *A. magnus* Dall, to which it is of described spe-

cies most nearly allied. The latter has a smaller and shorter nucleus and white shell substance. It is also a lighter and thinner shell. It is possible, judging from some of the other species, that the spiral ridges which are obsolete in the type-specimen, may in other individuals be stronger and more elevated. The operculum is unknown.

ANCISTROLEPIS DAMON Dall.

Chrysodomus (Ancistrolepis) damon DALL, Smithsonian Misc. Coll., No. 1727, p. 157, 1907.

The original specimen of this species from which it was described had a single low keel at the shoulder and half a dozen nearly obsolete ridges on the base. Specimens from Nemuro, Yesso, sent by Mr. Hirasé have five prominent cords on the base with wider interspaces, and the spiral striation quite perceptible over the whole surface. There is also a cord in front of the suture, between it and the shoulder keel. Another specimen from the same locality has in addition two strong equidistant cords on the periphery in front of the keel. For these quite distinct looking forms, I propose the varietal name of *polygramma*.

SIPHONALIA LUBRICA, new species.

Shell slender, acute, with about seven whorls and a nucleus of somewhat less than two additional whorls; with brown flammulations and more or less interrupted spiral rows of brown dots on a yellowish-white ground; nucleus smooth, polished, flat-topped with the whorls inflated; subsequent whorls sculptured with (on the penultimate whorl 12) short rounded axial riblets at the shoulder of the whorl but more or less obsolete above and below, and varying in extent on the spire in different specimens; these are separated by narrower interspaces and may be obsolete on the last whorl and a half; spiral sculpture of close-set inconspicuous threads more or less flattened on the last whorl and rarely with occasional smaller intercalary threads; suture rather constricted and strongly appressed; aperture rounded, the outer lip thin and sharp; when mature (and not worn by hermit crabs) with eight or ten lirations a little within the margin of the outer lip; a small, prominent subsutural callus on the body and another at the margin of the canal on the concavely arcuate pillar-lip; throat and pillar white, the latter slightly erased; canal narrow, long, strongly recurved, the fasciole not prominent. Length of shell 59; of last whorl 40; of aperture 18; of the canal 17; maximum diameter of last whorl 22 mm.

Habitat.—Tosa and Nagasaki, Japan. Hirasé collection.

This species is rather exceptional in its slender form and polished surface. The operculum was not preserved. The prominent callus on the edge of the pillar at the inception of the canal gives it somewhat the aspect of a *Fasciolaria*.

BUCCINUM SIMULATUM Dall.

Buccinum simulatum DALL, Smithsonian Misc. Coll., No. 1727, p. 150, 1907.
Petrel Bank, Bering Sea, in 54 fathoms.

Habitat.—Akkeshi, Yesso. Hirasé collection.

The Japanese specimen differs from that from Bering Sea, in having the sculpture a little more prominent and the axial plications smaller, more distinct, and numerous. These differences, however, are well within specific limits in this genus.

BUCCINUM GLACIALE, var. PARALLELUM Dall.

Tritonium carinatum DUNKER, Novit. Conch. Moll. Marina, p. 1, pl. 2, figs. 3, 4, 1858. Not *Buccinum carinatum* GMELIN, 1792, or Turton, 1819.

Buccinum angulosum MÖRCH, in Dunker, Novit. Conch. Moll. Marina, pl. 2, figs. 3, 4, explanation on plate. Not *B. angulosum* Gray, 1839.

This variety of *B. glaciale* seems confined to the Bering Sea region and many specimens reach a length of 80–85 mm., while I have one 95 mm. in length from Atka Island, Aleutians. Mr. Hirasé, however, has reached the other extreme by sending a specimen quite mature and characteristic which is probably a male, and measures only 26 millimeters long. It is from Iterup Island of the Kuril group.

Both the names previously given to this variety were preoccupied for other species.

BUCCINUM STRIATISSIMUM Sowerby.

Buccinum striatissimum SOWERBY, Ann. Mag. Nat. Hist., ser. 7, vol. 4, p. 370, fig. 1, 1899.

The typical form of this species is the fine large shell figured by Sowerby. In the northern dredgings there are numerous apparently adult shells of a stout and stumpy character, whose thickset appearance is increased by the fact that the apex is usually eroded. These on examination prove to be nearly all males, a few immature females forming the exceptions. I showed years ago that in certain species of *Buccinum* the males were usually very much smaller than the females, who have to carry the vast mass of material composing their heaps of agglutinated ovicapsules. This does not seem to be true of all the species of *Buccinum*, but is markedly so in *B. cyaneum* and *B. hydrophanum* Hancock, and appears to be so in the case of *B. striatissimum*. The variety of *B. undatum* which lives on the coast of New England has two races of males, one of nearly the size of the average female, and another conspicuously dwarfed.

This small thick male *B. striatissimum* has such a different aspect from that of the large thin females that it might easily be taken for a distinct form.

BOREOTROPHON XESTRA, new species.

Shell fusiform with about six moderately rounded whorls, white with a thin chalky external layer, and distinct suture; last whorl axially sculptured with sixteen sharp elevated laminae, continuous over the whorl but obsolete on the canal, and rising in a short triangular spine at the shoulder; there are also rather strong axial lines of growth irregularly distributed; there is no spiral sculpture; aperture rounded, outer lip sharp, slightly expanded, inner lip smooth, white, with a thin layer of enamel; pillar obliquely truncate at the proximal end of the canal; canal narrow, long, arcuate, slightly recurved. Length of shell 34; of last whorl 27; of canal and aperture 20; maximum diameter of last whorl 19 mm.

Habitat.—Station 4813 of U. S. S. *Albatross*, in 200 fathoms, mud and sand, off Sado Island, Japan, bottom temperature 33°.9 Fahrenheit. U. S. Nat. Mus. Cat. No. 205508. Also at Sagami, Japan, Hirasé collection.

This belongs to the group of *B. cepula* Sowerby, than which it is more delicate, with a longer spire and generally thinner shell. The Hirasé specimens were immature.

BOREOTROPHON ECHINUS, new species.

Shell thin, yellowish white, fusiform, with about six post-nuclear whorls; nucleus small, smooth, with about two laxly coiled whorls; subsequent whorls spirally sculptured with from one to three strong, rather distant cords, the posterior cord being at the shoulder of the whorl; on the last whorl there may be five to eight of these cords, those on the canal being more or less obscure; at their intersection with the varices these cords develop guttered spines, usually only the spine on the posterior cord at the shoulder is prominent and this in a well developed specimen may be long and deeply recurved, even sickle-shaped, while in less well developed specimens there may be only an ordinary triangular anteriorly grooved short spine; the slope between the shoulder and the suture behind it has no spiral sculpture; axial sculpture of thin sharp varices varying from ten to seven, less numerous on the later whorls and more or less spinose at the intersections with the cords; aperture sublunate, outer lip sharp, thin, slightly expanded; canal rather long, sometimes bifurcated by the end of the previously formed canal, rather tortuous, narrow, and recurved; inner lip concavely arcuate, smooth. Length of shell 36; of last whorl 30; of aperture and canal 22; maximum diameter (excluding spines) 13 mm. Another specimen is about one-third longer.

Habitat.—Sagami, Japan. Hirasé collection. Cotype, U. S. Nat. Mus. Cat. No. 274076.

This very elegant species belongs in the group of *B. stuarti* Edgar Smith, of the west American fauna, and is subject to the modifications of sculpture which I have elsewhere discussed in this genus.

ANACHIS BARTSCHII, new species.

Shell small, polished, white, with (on the upper whorls one, on the penultimate whorl two, and on the last whorl one near the suture, two at the periphery, and three to five on the base) narrow brown spiral lines; between the peripheral pair on the ribs is a series of squarish, nearly black spots, about eleven on the last whorl, but sometimes a rib is skipped; whorls seven, spire acute; nucleus white, small, smooth, blunt, of a whorl and a half; axial sculpture of eleven or twelve rounded, nearly vertical, equal and equally spaced ribs, with subequal interspaces, extending from the suture well beyond the periphery; spiral sculpture of a few faint striae near the end of the canal; behind the outer lip is a slight varicose swelling; aperture less than half the length of the shell; outer lip thickened, with a sharp edge, internally with four small denticulations; body erased, pillar smooth, canal short, rather deeply sinuous, the axis minutely pervious. Length of shell 8; of last whorl 4.7; of aperture 3; maximum diameter of shell 3.5 mm.

Habitat.—Mazatlan, Mexico. Dr. Paul Bartsch. Type in United States National Museum, Cat. No. 265463.

This is one of the prettiest species of the group from the Gulf region. The painting recalls that of *A. azora* Duclos, from the Mauritius, but the latter has strong denticulations on the pillar lip.

LEPETA (CRYPTOCTENIDIA) LIMA, new species.

Shell large for the genus, ovate, with a convexly arcuate back, the apex one-fourth the total length from the anterior edge, the anterior slope straight or slightly concave; sculpture of concentric close-set sharp slightly elevated lamellae over-running numerous narrow, elevated, clean-cut threads which radiate from the apex to the periphery with equal or wider interspaces, and scaly at the intersections; the sculpture is uniform over the whole surface and rasplike to the touch; shell white, usually discolored by a ferruginous coating externally, the interior bluish white, more or less translucent. Length of shell 37; width 30; height of apex above the base 10 mm.

Habitat.—Nemuro, Yesso, Japan. Hirasé collection. U. S. Nat. Mus. Cat. No. 274074.

This is sharply distinguished by its size and rasplike surface from any of the other species. The name *Cryptobranchia* having been used by Gray, thirty years before Middendorff's application of it to the present group, I substitute *Cryptoctenidia*.

VENERICARDIA (CYCLOCARDIA) MORSEI, new species.

Shell of moderate size, solid, moderately inflated, covered by a yellowish horny periostracum; the umbones rather acute, prosocoealous, over a short, rounded, deeply impressed lunule; sculpture of 17-18 radiating arcuate ribs, rendered slightly nodulous in places by rude, conspicuous, rather irregular lines of growth, and separated by subequal, almost channelled, interspaces; interior yellowish white, the muscular impressions rather deep, the hinge normal, the margin with squarish crenulations; the ligament as long as the posterior hinge-line. Height of shell 28; width 25; diameter 15 mm.

Habitat.—Sagami, Japan. Hirasé collection. Cotype, U. S. Nat. Mus. Cat. No. 274075.

This species has a remarkable superficial resemblance to *V. borealis* Conrad, of the North Atlantic, and, without careful comparison, would be unhesitatingly referred to that species. The number of rays is the same, the profile is very similar, and the color not very different. However, a close examination shows that in the Japanese species the periostracum is horny, not villous; the lunule is short, rounded and deep, not long, narrow and shallow; the valves are more inflated; the radiating sculpture is more prominent, the interspaces are more sharply defined, and the anterior cardinal tooth averages narrower. The present species is named in honor of Prof. Edward S. Morse, who has published on this genus. There is no closely related species on the Pacific coast of America.

VENERICARDIA HIRASEI, new species.

Shell solid, subquadrate, suffused with light brown and rose color, inflated, equivalve, inequilateral, the beaks high, strongly incurved, prosocoealous; umbones one-sixth the total length from the anterior end, overhanging a deeply impressed short-cordate unsculptured lunule; radial sculpture of 29-30 narrow prominent equal and equally distributed ribs with subequal channelled interspaces; these ribs are spinose with each spine issuing from the interior of its predecessor, the distal margin of the cup of each spine in the middle part of the disk being thickened into a conspicuous ring out of which the next spine issues, as in some *Cardiums*; in the middle of the shell there are about four spines to the length of five millimeters along the rib; interior white, the hinge normal, the lower valve-margin crenate by the sculpture. Length of shell 37; height 30; diameter 30 mm.

Habitat.—Kii, Japan. Hirasé collection.

This very handsome *Venericardia* has no very close relatives in the genus, perhaps the *V. spinosa* Lamarck of the Mediterranean being as near as any. There is nothing like it on the Pacific coast of America.