

SYNOPSIS OF THE FAMILY ASTARTIDÆ, WITH A REVIEW
OF THE AMERICAN SPECIES.

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The group of bivalve shells which composes this family is of ancient origin, the *Crassatellitidæ* having diverged from it in the later Mesozoic and taken definite form in the Eocene. The chief characteristic by which the two families are discriminated is found in the ligament, which in *Astartidæ* is external as well as the resilium, while in the *Crassatellitidæ* this organ is separated from the resilium, the latter, except in *Eriphyla*, being deeply immersed. In *Eriphyla* the process has only begun, but the other characteristics of the shell are so close to *Crassinella* that the two must obviously be associated in the same family. In *Lirodiscus* of the *Astartidæ* the resilium is separated from the ligament, but still remains external, while the other characters link it to *Astarte* in a way analogous to those which bind *Eriphyla* to the *Crassinellas*; so each family has an exceptional and peripheral group.

Concentric sculpture, dense periostracum, absence of bright color pattern, and a hinge formula of, in its fullest development, the following elements $\left(\begin{array}{c} L0.101010.1 \\ R1.010101.0 \end{array}\right)$ are characteristic of this family, as is its preference for cold waters, the tropical species keeping chiefly in the cold abysses or being dwarfed in size. The *Crassatellitidæ*, on the other hand, are prevalent in the Tropics and unknown in the cold seas.

I have not found more than three cardinals in either valve, and there are usually several nearly obsolete. The laterals are formed by an extension of the valve margin, which fits into a groove or socket in the opposite valve. These are usually alternated, one lateral and one socket to each valve. The middle cardinals are usually well developed and sometimes bifid, the anterior right and posterior left cardinals always (and the posterior right cardinal often) more or less obsolete. The sides of the cardinal teeth are frequently vertically striated, as in *Crassatellites*, especially in the fossil species.

No *Astarte* has radial ribbing, but many develop in the adult state crenulations on the inner margin of the valves. Some species are crenulate only when fully adult, others develop crenation at resting stages, others are always without them. The teeth of the hinge are frequently reversed as regards the valves. The laterals vary extremely in the fullness of their development, and the outline of the valves is also often very variable, most of the trigonal species having also elongated or oblique varieties. The conditions in the boreal seas, where these animals chiefly abound, seem to make for profusion in individuals and paucity of species, a state of things obviously favorable to individual variation.

The dullness of color characterizing the shells of this group is to some extent made up for by the bright colors of the soft parts which are usually yellow, orange, or vermilion. The anal siphon is short, complete, plain-edged and valvular. The branchial siphon is formed by apposition of the ciliate border of the free mantle edges. The foot is subquadrate, the gills small, reticulate, and free. The eggs are ripe in April in the latitude of Long Island Sound, and are discharged into the water for fertilization. The animals live partly immersed in mud or sand and form a large part of the food supply of the walrus and many fishes. The variability previously alluded to has made the identification of species difficult and their synonymy almost hopeless.

Dr. Jeffreys, who published much about the northern fauna, unfortunately was disposed to lump together rather than discriminate, not having the large series necessary for elucidating our American species. Sowerby's monographs of this group are very unsatisfactory and imperfect, covering less than half the known forms. The most successful attempt at a review of the species is that of Mr. Edgar A. Smith, of the British Museum, in 1881, in the *Journal of Conchology*.

I have found in reviewing our American species that a more narrow specific limitation removes some of the difficulties surrounding the subject. While assenting to many of the views heretofore expressed by naturalists, and disavowing any claim of finality for the decisions arrived at, I have endeavored to discriminate the recognizable American forms whether these be regarded as species or not. By adopting names for them we at least have the satisfaction of knowing what we mean when we employ a name, which is impossible under the system, or want of system, of Dr. Jeffreys. For the same reason I have been unable to avail myself of much work, systematic and distributional, which is in print, since it is impossible to know which of several forms is intended in a given case where a name covering a number of types has been used. The distribution mentioned in my list herewith is taken from actual specimens and only exceptionally from the literature. The collection of *Astartes* from the boreal regions of the New

World in the National Museum is exceptionally large, a fact upon which the possibility of a review of the species is dependent. In a general way the species common to both hemispheres belong to the circumpolar fauna; extremely few if any of the more southern species are common to Europe and America. In a general way each fauna has a set of species in which a given type is represented, but the representatives of the type when compared are found to be similar rather than specifically identical. Thus, the European *A. sulcata*, *compressa*, and *incrassata* do not in my opinion occur at all in America, though the Atlantic and Pacific faunas have analogues which are probably due to filling a particular similar niche in the environment rather than to any close connection with the types of Europe referred to.

The distinctions upon which the subordinate groups of *Astartidæ* are founded are chiefly the greater or less development of the hinge-teeth and modifications of external sculpture. As the type of the hinge formula does not change but merely submits to certain deductions from its possible total, it will be inferred that the subgenera or sections are not very widely separated.

The genus *Goodalliopsis* Munier-Chalmas and De Raincourt, 1863, is a synonym of *Kellia*. *Plesiastarte* Fischer, 1887, which has also been referred to this family, may perhaps be more suitably placed in the *Cyrenidæ*, if not a nepionic shell. *Præconia* Stoliczka, 1871, and *Pachytypus* Munier-Chalmas, 1887, I have not been able to examine; both are fossils. *Parisiella* Cossmann, 1887, from the figures, may be a member of this family and related to *Microstagon*. It is from the French Eocene. Paleozoic forms referred to *Astarte* are dubiously pertinent.

SUBDIVISIONS OF THE FAMILY.

Genus LIRODISCUS Conrad, 1869.

Shell solid, inequilateral, equivalve, the nepionic valves flat, usually concentrically ridged, the later portion of the disk more convex; ligament normal, external; residium separate, situated between the beaks, external, but with its base encroaching on the umbonal ends of the cardinals; dental formula $\frac{L01.1010.01}{R10.0101.10}$, the left anterior lateral often indistinct; inner margins crenate; adductor scars rounded with elevated margins.

Type *Astarte tellinoides* Conrad, Claibornian Eocene. This genus appears in the lowest Eocene and continues to be represented until the Jacksonian.

Genus ASTARTE Sowerby, 1816.

Synonyms: *Tridonta* Schumacher, 1817; *Crassinia* Lamarck, 1818; *Triodontia* Agassiz, 1847; *Nicania* Leach, 1819; *Gomilia* Stoliczka, 1871; *Crassinella* Bayle, 1879, not Guppy, 1874; *Neocrassinia* Fischer.

1887; *Grotriania* Speyer, 1860; *Digitaria* S. V. Wood, 1853; *Woodia* Deshayes, 1860; *Rictocyma* Dall, 1872; *Rhectocyma* Von Martens, 1874; *Goodallia* Turton, 1822; *Maetrina* Brown, 1827; *Microstagon* Cossmann, 1896; *Crenimargo* Cossmann, 1903.

Ligament enfolding the resilium, both external, on narrow nymphs.

Section *Astarte* s. s. Dental formula $\frac{L0.101010.1}{R1.010101.0}$, the middle right

and two left anterior cardinals strong, the others obsolete; valves with convex umbones, subequilateral, the inner margins crenate when fully developed. Type, *Astarte sulcata* (Da Costa).

Section *Tridonta* Schumacher. Like *Astarte*, but the inner margins always smooth. Type, *T. borealis* Schumacher, 1817.

? Section *Neocrassina* Fischer. Like *Astarte*, but the umbones nearly terminal in front. Type, *A. obliqua* Deshayes. Bajocien Oolite.

Section *Rictocyma* Dall. Small, like *Astarte*, but the valves with irregular bilid or broken sculpture; inner margins not crenate. Type, *A. esquimalti* (Baird).

Section *Ashtarotha* Dall, 1903. Umbones concentrically sculptured and conspicuously flattened; disk smoother outside of the flattened area; otherwise like *Astarte*. Type, *Astarte undulata* Say, Miocene. *A. bipartita* Sowerby, 1829, appears to belong here.

Section *Gonilia* Stoliczka. Small, lentiform, hinge as in *Astarte*; disk with divaricate ribbing centrally. Type, *Lucina bipartita* Philippi, 1839 (= *Astarte bipartita* Stoliczka, 1871, not of Sowerby; = *Astarte calliglypta* Dall, 1903).

Section *Digitaria* S. V. Wood. Valves rotund, shell small, lentiform, hinge as in *Gonilia*, having the larger cardinals bifid; surface obliquely, arcuately sulcate, the sulci grooving more or less the inner margin tangentially; *Woodia* Deshayes is synonymous. Type, *Tellina digitaria* Linnaeus.

Section *Crenimargo* Cossmann. Shell like *Digitaria*, but the surface smooth; the tangential sulcations of the inner margin are, however, retained as in *Transennella*; hinge as in *Digitaria*. Type, *C. inaequicrenata* Cossman, Parisian Eocene.

Subgenus **Goodallia** Turton. Shell small, smooth, the hinge teeth reduced by the absence of the anterior or posterior right cardinal or both of them; inner margins crenate at resting stages only; dental formula $\frac{L0.101.1}{R1.010.0}$. Type, *Maetra triangularis* Montagu. *Maetrina* Brown is synonymous.

Section *Microstagon* Cossmann. Like *Goodallia*, but the hinge usually with one or both laterals obsolete and a small (usually anterior) right cardinal present, which is not found in *Goodallia* proper.

Formula $\frac{L.1010.}{R.0101.}$ (*herouralensis*) or $\frac{L.1010.1}{R.0101.0}$ (*pernitidum*). Type, *Goodallia herouralensis* Deshayes. Eocene of Paris.

In considering the distribution of the species the following table may aid in grasping its chief features. The East American fauna here is that south of Greenland, the West American that south of Bering Strait. The Arctic fauna includes those north of those limits, an asterisk denoting that the species is confined to the limits of its fauna as above defined.

ARCTIC AMERICAN FAUNA.

<i>A. undata.</i>	<i>T. vernicosa.</i>
<i>A. subequilatera.</i>	<i>T. elliptica.</i>
<i>A. crenata.</i>	<i>T. acuticostata.*</i>
<i>A. polaris.</i>	<i>T. globosa.*</i>
<i>T. arctica.</i>	<i>T. pulchella.*</i>
<i>T. borealis.</i>	<i>T. banksii.*</i>
<i>T. fabula.</i>	<i>T. striata.</i>
<i>T. bennettii.</i>	<i>T. soror.</i>

WEST AMERICAN. EAST AMERICAN.

<i>A. polaris.†</i>	<i>A. subequilatera.†</i>
<i>T. rollandi.*</i>	<i>A. castanea.*</i>
<i>T. arctica.†</i>	<i>A. undata.</i>
<i>T. borealis.†</i>	<i>A. crenata.†</i>
<i>T. alaskensis.*</i>	<i>A. smithii.*</i>
<i>T. compacta.*</i>	<i>A. globula.*</i>
<i>T. fabula.†</i>	<i>A. nana.*</i>
<i>T. bennettii.†</i>	<i>A. biogona.*</i>
<i>T. vernicosa.†</i>	<i>T. borealis.†</i>
<i>R. esquimalti.*</i>	<i>T. elliptica.†</i>
	<i>T. quadrans.*</i>
	<i>T. striata.†</i>
	<i>T. soror.†</i>

ANTARCTIC FAUNA.

Astarte longirostra.

From this it will be observed that the typical *Astartes*, which are rather abundant on the shores of Europe, compared with the *Trilontas*, are in the majority on the Eastern coast, but in the Arctic they form a much smaller proportion, and only one reaches the West American fauna. *Rictocyema* is confined to the latter. In this hemisphere the Arctic fauna has 4 peculiar species, Eastern America 6, and Western America only 4. Only one species, *A. (Trilonta) borealis*, is common to all three of the northern faunas. If we eliminate from the east and west faunas those really arctic species which invade them from the north (and which are marked with a dagger in the table), we find only the peculiar species left, except in the case of *A.*

undata, which occurs in Greenland, but is very rare there, and really is characteristic of the fauna farther south.

The *Astarte* fauna of the American hemisphere thus consists of 27 species, 1 being Antarctic, 16 Arctic, 13 East and 10 West American. Doubtless a more thorough exploration of the arctic and abyssal seas in both oceans might add a few more species and somewhat change the above figures.

In the geographical lists which follow the names have appended to them the date of description. The more detailed references, if desired, may be had from the bibliography in the *Journal of Conchology* for 1881, given by Mr. Edgar A. Smith, pages 201-204.

The plates contain figures of the newly described or unfigured forms.

LIST OF THE SPECIES OF THE EASTERN COAST.

ASTARTE CASTANEA Say, 1822.

Coast of Nova Scotia and southward to the vicinity of Cape Hatteras, North Carolina, in 5 to 65 fathoms.

A variety, *picca* Gould, 1841, has blackish tarry periostracum. It has been collected at Chelsea Beach, Massachusetts, and Sandy Hook, New Jersey. The typical form is smooth, equilateral, polished, of a rich reddish chestnut brown, and with sharply crenate margins.

Totten described a variety, *proccera*, from Provincetown Harbor, Massachusetts, in 1835. It is characterized by a dull yellow brown periostracum and obliquely produced high beaks. It would seem that the peculiar environment is connected with these characters, as the locality is so isolated as to be almost like an oceanic island, and on the Pacific coast on such islands exclusively a variety of *A. rollandi* is found differing from the type in the same way.

ASTARTE UNDATA Gould, 1841.

Greenland and adjacent arctic waters, and south to Massachusetts Bay, and in deep cold water to the vicinity of Chesapeake Bay. The range in depth is from 5 to 104 fathoms.

Dull chestnut brown, subtrigonal as a rule, but variable in outline, with 10 to 25 concentric ripples, sometimes obsolete near the ventral margin. When the ripples are few, prominent, and distant, we have the variety *latisulca* Hanley, 1843, of which perhaps *A. mortoni* Sowerby, 1874, is a mutation. This species was mistakenly identified with the European *A. sulcata* Da Costa by early American writers and by Jeffreys. A pale variety was named *A. lutea* by Perkins in 1869.

ASTARTE SUBÆQUILATERA Sowerby, 1854.

Davis Strait and southward, usually in rather deep water, along the eastern coast of the United States to the vicinity of Cape Florida, in 22 to 410 fathoms.

This species was named by Stimpson in manuscript *A. lens*, and this name, though never described, has found its way into the literature. Through Dr. Jeffreys it has also been confounded with *A. crenata* Gray and *A. crebricostata* Forbes, neither of which is closely related to it. The shell is ovate, compressed, pale or yellowish brown, the deep-water specimens sometimes nearly white, and it is sculptured with numerous even, low, concentric ripples, which are obsolete in the adult behind. Specimens reach a length of 39, with a height of 31 and a diameter of 10 mm.

ASTARTE (SUBÆQUILATERA var?) WHITEAVESII Dall, 1903.

Gulf of St. Lawrence and south to Long Island Sound, in 67 to 428 fathoms.

This, which is the *crebricostata* of Dawson,^a has also been called *crenata* and *lens*, while I find it labeled by Jeffreys "*sulcata* variety *nana*," though it has no close resemblance to *sulcata* Da Costa. It resembles the young of *subæquilatera*, but is more convex; has the concentric sculpture continued to the margin behind, and is, on the whole, rather darker in color. It was dredged abundantly by Whiteaves at Gaspé, in 200 fathoms.

ASTARTE POLARIS Dall, 1903.

Polar Sea, dredged off Hare Island, Davis Strait, in 90 fathoms, and is also found near Bering Strait.

Plump, subtrigonal, with olive-brown periostracum, thin shell, deeply excavated lunule, and delicate hinge. The sulcation of the margin appears only with complete maturity. The concentric sculpture is fine, close, and low, sometimes degenerating into mere striation. Externally the shell recalls *Corbicula*.

ASTARTE CRENATA Gray, 1824.

Shannon fiord, East Greenland (as *crebricostata* Moebius); Prince Regent Inlet, Melville Island and adjacent waters (Parry); and south to the Gulf of St. Lawrence, in 16 to 200 fathoms.

Some of the specimens collected by the Parry expedition, from which Gray described the species, are fortunately in the Jeffreys collection and enable me to fix this species, which has also been named *A. oblonga* by Sowerby in 1854. It appears to be rare, and is a thin, inflated, elongate-oval shell, delicately, closely, concentrically striated or grooved, with the sculpture often obsolete below and stronger near the beaks. It is a smaller, thinner, and much more inflated shell than *subæquilatera*, and of a pale straw color or light brown color somewhat polished when in fine condition.

^a Can. Nat., 1872.

ASTARTE SMITHII Dall, 1886.

Gulf of Mexico, Cuba, Martinique, Barbados, and Campeche Bank, in 54 to 450 fathoms, bottom temperature 53° to 65° Fahr.

Shorter, more inflated, paler, and with ribs of a different shape from those of *subaequilatera* or *whiteavesii* of about the same size. It is sharply crenate, while the young of the other species referred to, at an equivalent growth, are usually without crenations. The species was named in the Blake report.

ASTARTE GLOBULA Dall, 1886.

Off Fernandina, Florida, in deep water, south to the coast of Cuba, and in the Gulf of Mexico, in 294 to 539 fathoms. One valve, perhaps drifted, in 1,568 fathoms.

Of the same general type as *A. smithii*, but perfectly smooth and attaining a larger size. The margin is sharply crenate and the color grayish white. It was at first supposed to be a smooth variety of *smithii*, but more material indicates that it is distinct.

ASTARTE NANA (Jeffreys MS.) Dall, 1886.

Cape Hatteras, North Carolina, and south to the Florida reefs and Sombrero Island, West Indies, in 6 to 227 fathoms; temperature, 51° Fahr.

This shell is somewhat larger and flatter than *A. smithii*, with more erect and prominent beaks, and the ribs cover the whole shell; it is crenate only when perfectly mature; the color varies from light yellow brown to rose pink. A still more convex and triangular form occurs among the specimens dredged in the Gulf of Mexico, and among the Florida reefs in 25 to 60 fathoms, which was labeled by Jeffreys variety *trigona*.

ASTARTE LIOGONA Dall, 1903.

Near the delta of the Mississippi River, in the Gulf of Mexico, at 118 fathoms, muddy bottom.

A single specimen of a small olivaceous species was dredged as above. It differs from all those hitherto known on the coast, by having the beaks and main part of the disk smooth, while near the margin are a few distinct narrow concentric ribs. The inner margin is sharply crenate.

Section TRIDONTA Schumacher.

ASTARTE ARCTICA Gray, 1824.

Vadsö, Norway; the Arctic Atlantic, Davis Strait, and Greenland, in 15 to 60 fathoms. Also near Bering Strait.

This convex and smooth form is well distinguished from the *A. borealis*, and is wholly destitute of concentric ribbing. It is a circumpolar

species and of a dark blackish brown color. It has very generally united with *borealis*, doubtless for want of a sufficient series for comparison. It is the *corrugata* and *depressa* of Brown, 1827; according to Sowerby, the *cyprinoides* of Duval, 1841; the *islandica* of Deshayes (MS.), 1867; the *lactea* and *subtrigona* of Sowerby, 1874. It is somewhat variable in outline, but the other characters are fairly constant.

ASTARTE BOREALIS Schumacher, 1817

Bennett Island, Polar Sea; North Europe and the Baltic, Arctic Atlantic, Iceland, and Greenland, and south to Massachusetts Bay, in 15 to 100 fathoms. Also Bering Sea and Strait, etc.

Shell compressed, with the beaks concentrically ribbed; the rest of the disk more or less smooth. This is the *semisulcata* of Leach, 1819; the *veneriformis* Wood, 1828; the *lactea* of Broderip and Sowerby, 1829. According to authors it is the *withami* of J. Smith, 1839; and *producta* Sowerby, 1874, is synonymous. The young have been named *richardsonii* by Reeve, in 1855; *placenta* (Mörch) and *rhomboidalis* Leche, Vega Exp., Lamellibranchiata, 1883.

ASTARTE ELLIPTICA Brown, 1827.

North Europe, Arctic seas near Greenland, and south to Massachusetts Bay, in 8 to 90 fathoms.

An elegantly ovate subcompressed shell, with rather low beaks, the upper half of the disk concentrically rippled, the lower part smooth or feebly striated. The color varies from warm yellow brown through chestnut to blackish. It is the *ovata* of Brown, 1827, the *garrensis* of J. Smith, 1839, and the *intermedia* of Sowerby, 1854. It has sometimes been referred to *Venus compressa* Linnaeus, but this is a mere hypothesis, incapable of verification, and should be rejected.

ASTARTE QUADRANS Gould, 1841.

Gulf of St. Lawrence to Long Island Sound in 6 to 40 fathoms.

A small, smooth, compressed, quadrate species, which has not been characteristically figured. The inner surface of the shell is usually white, but sometimes dark colored. A specimen of this sort was named *A. portlandica* by Dr. Mighels in 1843. I find it labeled "*A. castanea* variety *nana*" by Jeffreys. It is not a common species.

ASTARTE ACUTICOSTATA Jeffreys and Friele, 1877.

Arctic Atlantic, in deep water, Jan Mayen and Novaia Zemlia, in 200 to 649 fathoms.

A small quadrate species, with fine, regular, well-marked, concentric ribbing all over the shell.

ASTARTE GLOBOSA Moller, 1842.

East and West Greenland, and adjacent Arctic waters, in 10 to 150 fathoms.

Small, blunt, ventricose, yellow brown, the anterior end longer, rounded, the posterior end subtruncate, the surface closely, finely, concentrically sulcate all over. The species was identified as *compressa* by Moebius, 1874, and Jeffreys called it *compressa* variety *striata*. It is one of three or four related forms fairly recognizable which have been usually "lumped" under one name. Nothing which can be properly identified with the British *A. compressa* is known from American waters.

ASTARTE FABULA Reeve, 1855.

Franz Josef Land to Greenland and adjacent Arctic waters in 12 to 90 fathoms. Also in the Polar Sea, near Bering Strait.

A thin elongate-ovate, inflated species, with the posterior end slightly longer, the umbonal region peculiarly, squarely, concentrically sulcate, and the basal portion striated. The color is usually dark brown. It was described by Sowerby in 1874, as *A. semilirata*, and has frequently been identified as *A. banksii*, but it is not *A. banksii* of Leach.

ASTARTE PULCHELLA Jonas, 1845.

Hogarth Sound, Cumberland Inlet, and adjacent Arctic waters, also Novaia Zemlia, in 5 to 10 fathoms.

Ovate, thin, polished; evenly, concentrically, elegantly sulcate, with narrow lanceolate lunule; the color light brown, and the beaks nearly central. It is the *A. warhami* Hancock, 1846.

ASTARTE BANKSII Leach, 1819.

Baffin's Bay and adjacent waters to lat. 80° N., also Spitsbergen, in 12 to 60 fathoms.

Mr. E. A. Smith has shown that the numerals of the figures of *striata* and *banksii*, Leach, in Beechey's Zoology of the Voyage of the Blossom, are exchanged and the figure formerly referred to *striata* represents *banksii* and *vice versa*. This confusion runs through much of the literature. Specimens of *A. banksii*, which is a nearly smooth species of a reddish brown or olivaceous tint, were labeled *compressa* variety *striata* by Jeffreys.

ASTARTE STRIATA Leach, 1819.

Baffin's Bay, Davis Strait, and adjacent waters, and south to the Grand Banks, the Gulf of St. Lawrence, and Massachusetts Bay, in 10 to 85 fathoms.

Subtrigonal, with somewhat coarsely sulcate umbonal region, the

ventral margin in the adult merely striated. It is the *banksii* of many authors and is figured under that name in Binney's Gould, 1870, and regarded as a variety of *A. compressa* by Jeffreys.

ASTARTE (LAURENTIANA Lyell, 1845, var.?) **SOROR** Dall.

Type in the Leda clays and other Pleistocene beds of eastern Canada and New England; variety *soror*, from 82° north latitude through the Arctic waters southward to the Gulf of St. Lawrence in 5 to 90 fathoms.

The recent shell is more trigonal, larger, and the concentric sculpture coarser than that of the typical Pleistocene fossil. I adopt the above varietal name for the recent form until more is known, but I suspect the species are distinct.

LIST OF THE SPECIES OF THE WESTERN COAST.

ASTARTE POLARIS Dall, 1903.

Kyska Harbor, Aleutians; Constantine Harbor, Amchitka; and near the Shumagin Islands, in 10 to 58 fathoms, mud or sand, bottom temperature 41° to 45° F. Also in Baffin's Bay, on the Greenland coast.

This is the only typical *Astarte* so far identified on the northwest coast.

ASTARTE LONGIROSTRA D'Orbigny, 1847.

Falkland Islands, D'Orbigny; Straits of Magellan, in 20 to 61 fathoms, bottom temperature 48° F.

The *A. magellanica* Smith, 1881, judging from the specimens dredged by the U. S. Fish Commission steamer *Albatross*, varies so that the distinctions relied on to separate it from *A. longirostra* disappear in a good series. The name *magellanica* might, however, be retained in a varietal sense for the specimens with more pronounced sculpture and less protracted beaks. This is the only species recorded from the southern hemisphere.

Section TRIDONTA Schumacher.

ASTARTE ROLLANDI Bernardi, 1858.

Avatcha Bay, Kamchatka, and eastward through the Aleutian and Pribilof Islands, and along the Alaskan coast to Prince William Sound, in 8 to 27 fathoms.

Suborbicular, nearly smooth, large and heavy, with dark chestnut-brown periostracum, which in the adults is dehiscient on drying. This species takes the place in the western fauna occupied by *A. castanea* on the eastern coast, and, like it, has a pale oblique variety (*loria* Dall, 1903), which is found on oceanic islets, Chika, the Semidis, and Middleton, in 12 to 25 fathoms, sand.

ASTARTE ARCTICA Gray, 1824.

Bering Strait, Bering Sea, and the Aleutian Islands from Attu to Unalga Pass east of Unalaska in 15 to 60 fathoms; also in the eastern arctic waters.

See the eastern list for synonymy and further data.

ASTARTE BOREALIS Schumacher, 1817.

Polar Sea, near Bennett Island; *Jeannette* expedition. Macfarlane Bay, near the mouth of the Mackenzie; Bering Strait and southward on the American side to Port Etches, Prince William Sound, and on the Asiatic side to Yokohama.

For synonymy, etc., consult the eastern list. The variety *rhomboidalis* Leche, 1883, as figured, is based on an immature specimen, while the variety *placenta* Mörch is simply the young shell of the normal type. A somewhat elongated specimen figured under the name of *A. scotica* by Middendorff, Plate XVI, figs. 10-12, 1849, may be the young of this species or an unusually strongly ribbed *elliptica*. He gives localities from Lapland to the Okhotsk Sea. The latter were probably *borealis*; the former might have been *elliptica*. His figures on Plate XVII of the same name are probably *A. sulcata*. Figs. 6 to 7 on the same plate under the name of *corrugata* Brown are probably *A. borealis*; figs. 4, 5, 8, 9, and 10, perhaps, are dilapidated *A. rollandi*. In the *Sibirische Reise*, Plate XX, figs. 1 to 4, 1851, which are named *A. scotica*, represent *A. borealis*, and it is evident he regarded the two as synonymous. *A. compressa*, on the other hand, he does not record from eastward of the Taimyr River. The Macfarlane Bay specimens are exceptionally smooth, compressed, and thin.

ASTARTE ALASKENSIS Dall, 1903.

Southern part of Bering Sea, the vicinity of the Shumagin Islands, and eastward along the Alaskan coast and south to Puget Sound in 10 to 70 fathoms. Also in the glacial drift of Sucia Island, Straits of Georgia.

Much resembling *A. elliptica* of the eastern coast, but shorter, heavier, and more trigonal. The periostracum is black or dark brown and dehiscant when dry. It has usually been identified as *undata* but is never crenulated.

ASTARTE COMPACTA Carpenter, 1865.

Puget Sound, Kennerley, and Johnson.

Small, stout, trigonal, like *A. esquimalti*, but with regularly arcuate, uniform concentric ribbing. It was described as a variety of *A. compressa* Montagu, which does not occur on the coast. It appears to be rare, and I have seen only one specimen beside the type. The former is figured, Plate LXIII, fig. 8.

ASTARTE FABULA Reeve, 1855.

Polar Sea, near Point Belcher, and south to the north end of Nunivak Island in 15 to 23 fathoms. Also in the eastern hemisphere at Franz Josef Land, the coast of Greenland, etc.

Leche's figures of "*A. warhami*" in his report on the Vega lamelli-branches indicate that he probably included this species under that name. *A. semilirata* Sowerby, 1874, is synonymous. For other data see eastern list.

ASTARTE BENNETTII Dall, 1903.

Polar Sea at Bennett Island, *Jeannette* expedition; also in Bering Sea, 5 miles west of Nunivak Island, in 24 fathoms, Dall.

Small, solid, rather uniformly concentrically striate; polished, olivaceous, with high beaks. Leche's figures 11 and 12, Plate 32, may have been taken from a specimen of this species, with the posterior end rather blunter than usual, and not full grown. In the Bering Sea specimen the striation is stronger near the beaks.

ASTARTE VERNICOSA Dall, 1903.

Arctic Sea and northern part of Bering Sea, from Icy Cape to Hagemeister Island, in 7 to 28 fathoms, and southern part of Bering Sea, through the Aleutians from Attu to Atka, in 8 to 14 fathoms.

Resembling *A. fabula*, but more coarsely and uniformly sulcate and brilliantly polished, with an olivaceous yellow-brown periostracum, narrower, longer, and less impressed lunule.

Leche's figures 7 to 8, Plate 32, apparently represent this species.

Section RICTOCYMA Dall.

ASTARTE ESQUIMALTI Baird, 1863.

Aleutian Islands from Unalaska eastward along the coast of Alaska and south to Puget Sound in 6 to 80 fathoms.

Recognizable by its irregular sculpture, and reaching a height of 21, with a length of 23 and a diameter of 11 mm. *R. mirabilis* Dall, 1872, was based on a young specimen of this species.

DESCRIPTIONS OF THE FORMS NEWLY NAMED.

ASTARTE POLARIS, new species.

Plate LXIII, fig. 5.

Shell rounded-trigonal, moderately thick, bluish white, covered with a slightly polished light-brown periostracum; valves moderately convex, with the umbones high, somewhat prosogyrate, over a well-impressed lanceolate lunule, which is unequally divided, the right valve bearing the larger share; escutcheon narrower and longer than the lunule, impressed, smooth; sculpture of forty or more small, narrow, regular.

concentric riblets separated by about equal interspaces; in the adult the posterior slope and ventral third of the disk have the riblets replaced by somewhat uneven concentric striation; interior smooth, the inner margins finely evenly crenate; hinge rather solid, the middle cardinal in each valve grooved or bifid. Height, 25; length, 28; diameter, 15 mm.

The type specimen, No. 106859, is from 51 fathoms, sand, near the Shumagin Islands, Alaska. The nearest form to this is *A. sulcata* var. *multicostata* Jeffreys, which in form and outline approaches it very closely, but differs by sparser ribbing, which is also more regular and extends over the whole shell.

ASTARTE ALASKENSIS, new species.

Plate LXIII, fig. 2.

Shell ovate, subcompressed, white, with a dark, strong, caducous periostracum, which, like that of *A. elliptica*, becomes black in the dead or senile shells; valves quite inequilateral, beaks at the anterior third, elevated, slightly compressed, prosogyrate; lunule excavated, sublanceolate, the escutcheon longer and wider; sculpture of about a dozen concentric riblets with wider interspaces, more feeble near the ventral and posterior margins; inner margins entire, smooth; hinge solid, the teeth narrow and entire. Height, 26; length, 31.5; diameter, 14 mm.

Type specimens from northwest of Unimak Island, in the southern part of Bering Sea, at a depth of 70 fathoms; bottom temperature 39° F. U.S.N.M., No. 109274.

ASTARTE BENNETTII, new species.

Plate LXIII, fig. 6.

? *Astarte warhami* LECHE, Vega exped., III, 1883, p. 442, pl. XXXII, figs. 11 and 12 (only).

Shell small, thin, subcuneate, subcompressed, with a polished olivaceous periostracum; posterior end shorter, bluntly rounded; anterior end longer, more sloping and direct dorsally, rounded; base nearly straight in the young; surface finely concentrically striate, or nearly smooth, the striae more apparent on the beaks; lunule narrow, lanceolate, impressed, escutcheon similar, a little longer than the lunule; beaks high, slightly prosogyrate; hinge delicate, the large cardinals slightly grooved above, the laterals apparent; pallial line rather near the margin, which is not crenulate. Height 10.5, length 11.5, diameter 5.0 mm.; Bering Sea specimen height 14.5, length 15.0, diameter 7.0 mm.

In the terrible retreat from the Jeannette over the arctic floes Mr. Newcombe, the naturalist of the expedition, retained a small packet

containing a few specimens of natural history from the most northern land reached, Bennett Island. Among these were a fragment of *Astarte borealis* and a single perfect specimen of the present species, "U.S.N.M., No. 83221. A single other specimen was obtained by me within the limits of the arctic fauna in the northern part of Bering Sea, in 24 fathoms. Leche's figure is slightly more oblique and convex, but very probably represents the same species.

ASTARTE (LAURENTIANA var. ?) SOROR, new species.

Plate LXII, fig. 11.

Shell of moderate size, subequilateral, rounded-trigonal or cythereiform, the beaks moderately elevated, full and prosogyrate; the anterior end slightly shorter, the lunule rather small, lanceolate and impressed, the escutcheon similar but longer; surface covered with fine, rather harsh concentric sulci with subequal interspaces, very uniform over the surface; periostracum dull, of a dark brown color, sometimes paler or olivaceous in the young; hinge delicate, laterals distinct, large cardinals sulcate or striated above; inner margins entire. Height 18.0, length 21.5, diameter 10.0 mm.

This species differs from *A. fabula* by the sculpture of its umbones and the sulcation of the whole disk externally; it has the same kind of sculpture as *A. laurentiana* but coarser and more harsh to the touch; the form in general is more trigonal or rounded than in *A. laurentiana*, but this is variable and some specimens agree well in shape. *A. polaris* is distinguished by deeper excavation of the lunule, smoother and more open sculpture, and the crenation of the inner margins.

This is the species of which young individuals have been taken for recent specimens of *A. laurentiana*, but which I am inclined to regard as distinct, especially since no fossil *laurentiana* approach it in size. Jeffreys included it, with a number of other things which appear to me distinct, under the name of *A. compressa* var. *striata*. The type locality is Godhavn Harbor, Disco Island, Greenland. U.S.N.M., No. 109278.

The typical *A. laurentiana* was described by Lyell in his *Travels in North America* in 1845. In the American edition, published the same year, it can be found figured, page 125, figs. 15a-15c, and described on page 126 of the second volume, a reference which I had some difficulty in finding and which was kindly supplied by Dr. Whiteaves. It is found in the Pleistocene clays of the St. Lawrence Valley.

^aThe other molluscan specimens included egg cases of *Bela* sp., *Chrysodomus* sp., and *Natica* sp., and fragments of *Liocyma fluctuosa* Gould, *Modiolaria nigra* Gray, and *Yoldia abyssicola* Torell; U.S.N.M., Nos. 83220-83227.

ASTARTE SUBÆQUILATERA var. WHITEAVESII Dall.

Plate LXII, figs. 7, 12.

Shell rounded quadrate, plump, inequilateral, the anterior end shorter; concentrically sculptured with 20 to 25 sharply defined rounded ribs with wider channeled interspaces, the ribs continuous over the whole shell; periostracum thin and papery, of a pale yellowish brown; lunule and escutcheon smooth, lanceolate, moderately impressed; inner margins, when adult and at resting stages, crenate, hinge strong, the cardinals entire. Height 12, length 14.5, diameter 6.5 mm.

Type locality, Gaspé, Whiteaves, in 200 fathoms. U.S.N.M., No. 95748.

The continuous ribs behind, more convex valves, and smaller size distinguish this variety from the typical *subæquilatera* of Sowerby or the *levis* of Stimpson.

ASTARTE LIOGONA, new species.

Plate LXII, fig. 9.

Shell small, compressed, rounded trigonal, beaks erect, somewhat eroded in the type, umbonal region (outside of the eroded tract) smooth or marked only with incremental lines, but near the base there are indications of five narrow rounded concentric ribs, with wider interspaces; periostracum olivaceous, rather dark; lunule lanceolate, moderately impressed, smooth; escutcheon narrower and longer; ligament short; hinge moderately strong, the teeth entire, inner margins strongly crenulate. Height 7.0, length 7.5, diameter 4.0 mm.

Dredged in 118 fathoms, near the delta of the Mississippi, on a muddy bottom. U.S.N.M., No. 64434.

If this specimen is characteristic it differs from any other known to me in having the umbonal region smooth, while the peripheral portion exhibits raised ribbing.

ASTARTE VERNICOSA, new species.

Plate LXIII, fig. 1.

Astarte warhami (Hancock) LECHE, Vega exped., III, 1883, pl. xxxii, figs. 7-8 (only) 1883.

Shell small, subcompressed, subtrigonal, subequilateral, covered with a brilliantly polished olivaceous brown periostracum; beaks rather high, slightly prosogyrate, the lunule narrow, lanceolate, impressed, the escutcheon similar but longer; base arcuate, anterior end rounded, posterior end slightly more produced; hinge delicate, inner margins smooth, hinge teeth much as in *A. bennettii*. Length 17.0, height 15.0, diameter 6.7 mm.

Type locality, off Icy Cape in 15 fathoms sand, W. H. Dall. U.S.N.M., No. 109276.

Our specimens are somewhat more trigonal and attenuated behind than in Leche's figures. The sculpture is of quite even and regular sulcations which usually are somewhat less pronounced on the ventral third of the disk, but never present the striking contrast between the sulcate and unsulcate portions which may be usually noted in *A. fabula*. In many cases, however, the sculpture is continued to the base without obsolescence, almost as evenly as in Hancock's *warhami*, but the shape of the valves is different and the present species is much less inflated. Leche's figures 9 and 10 appear to represent *A. fabula*, of which occasional specimens are sulcate clear to the base, but which can usually be recognized by the squarish and slightly wavy appearance of the concentric umbonal sculpture.

ASTARTE (RICTOCYMA) ESQUIMALTI Baird.

Plate LXIII, figs. 11, 12.

This species having been figured only imperfectly, better figures are now supplied from an adult specimen (U.S.N.M., No. 106862), dredged near the Shumagin islands in 58 fathoms.

VENERICARDIA CRASSIDENS Broderip and Sowerby.

Plate LXIII, fig. 9.

Astarte crassidens BRODERIP and SOWERBY, Zool. Jour., IV, 1829, p. 365.

Icy Cape, Belcher, in Bland's collection (Broderip and Sowerby.)

This species is described as "obsoletely radially sulcate," much eroded at the umbones, with a large striated cardinal in either valve and with the margins coarsely crenulate, the crenulations having "almost the appearance of low embrasures." It is represented as reaching a length of 40, a height of 41, and a diameter of about 21 mm., with a tinge of dull reddish purple in the center of the valves inside and the umbones nearly terminal and anteriorly directed.

Now, these characteristics are not those of an *Astarte*. All our Arctic *Astartes* are white within; none is radiately sulcate; none has embrasure-like crenations. Moreover, the vicinity of Icy Cape has been pretty well dredged at various times, and *Astarte* is a gregarious genus. If a species with such striking characteristics appeared there somebody would have been almost certain to recover it. But no specimen is known, nor what became of that one which served as the type from "Mr. Bland's" collection.

There is a shell which has been more than once obtained at Icy Cape which fulfills the requirements, and that is the species of *Venericardia* identified by Gray with "*Arcturnus rufis*" (Humphrey Ms.) in 1839. The radial sulcation, except on the umbones (which our authors state

were much eroded), is often obsolete, its beaks nearly anterior, its hinge broad, its margin with embrasure-like flutings, and it frequently has the disk tinged inside with a flush of livid purple-brown. I have in my Synopsis of the *Carditacea* called this *Venericardia rudis*, but I am now almost convinced that it is the present shell and should take the name of *V. crassidens*. It has the very markedly broad hinge and large, more or less sulcate cardinals called for by the description, and one of the specimens in the National Museum comes within 2 millimeters of the required dimensions. Mr. Smith has referred this to *Astarte castanea*, but *A. castanea* does not occur in that region, and has quite small though very distinct crenations, which have not the square form recalling embrasures like those of *Venericardia*. Nor does *A. castanea*, as far as known, reach a size comparable with that mentioned for *A. crassidens*. All the other *Astartes* known from the region where Icy Cape is situated which are large enough to fill the requirements of the diagnosis of Broderip and Sowerby have very white shells and perfectly smooth margins. There is only one crenate species there, and it is quite small in comparison and has quite minute crenulations.

The European species which do not appear in the Western Hemisphere are *Astarte sulcata* Da Costa, *A. incrassata* Brocchi (frequently called *A. fusca* Poli), *A. erchricostata* Forbes, *A. compressa* Montagu, *A. pusilla* Forbes, *A. parva* Searles Wood, *A. (Gonilia) calligona* Dall (*A. bipartita* Philippi non Sowerby), *A. (Digitaria) digitaria* Linnaeus, *Goodallia triangularis* Montagu, and *G. macandrewi* Smith. *Astarte triquetra* Conrad is a *Parastarte* and belongs in the *Veneridae*; *A. flubella* Conrad, is a *Venericardia*, and *A. fluctuata* Carpenter, is the nepionic young of *Crassatellites* sp.

Since the figures of the new species do not wholly fill the plates, the figures of some recently described but yet unfigured species are included with those of the *Astartidae*, with references to the place of publication.

EXPLANATION OF PLATES.

PLATE LXII.

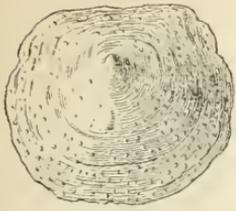
- Fig. 1. *Crania patagonica* Dall, upper valve, diameter 8.5 mm.; Proc. U. S. Nat. Museum, XXIV, 1902, p. 562; Straits of Magellan, U. S. N. M., No. 96913.
2. *Crassatellites brasiliensis* Dall, from off Rio de Janeiro in 59 fathoms; lon. 37 mm.; U. S. N. M., No. 96104; The Nautilus, XVI, p. 101, 1903.
3. *Crania patagonica* Dall, inner face of upper valve showing muscular impressions.
4. *Crenella megas* Dall, height 25 mm.; Proc. U. S. Nat. Mus., XXIV, 1902, p. 559; Panama Bay, in 33 fathoms; U. S. N. M., No. 96256.
5. *Echinochama californica* Dall, new species, from off Cerros Island, Lower California, in 25 fathoms; length exclusive of the spines, 40 mm.; U. S. N. M., No. 96452. The coloration is yellowish white.

- Fig. 6. *Venericardia armilla* Dall, length, 8 mm.; from the Gulf of Mexico; U. S. N. M., No. 93374; Proc. Acad. Nat. Sci. of Philadelphia for 1902, p. 713.
7. *Astarte subæquilatera* Sowerby, var. *whiteavesii* Dall, umbonal view; length, 15 mm.; Gaspé, Gulf of St. Lawrence in 200 fathoms; U. S. N. M., No. 95748; p. 948.
8. *Linopsis panamensis* Dall, length, 6 mm.; Gulf of Panama in 1,030 fathoms; U. S. N. M., No. 109028; Proc. U. S. Nat. Mus., XXIV, 1902, p. 559.
9. *Astarte liogona* Dall, length 7.75 mm.; Gulf of Mexico; U. S. N. M., No. 64439; p. 948.
10. *Venericardia moniliata* Dall, length, 6.5 mm.; off Rio de Janeiro in 59 fathoms; U. S. N. M., No. 96132; Proc. Acad. Nat. Sci. of Philadelphia, for 1902; p. 713.
11. *Astarte soror* Dall; length, 19 mm.; Greenland; U. S. N. M., No. 109278; p. 947.
12. *Astarte subæquilatera* Sowerby, var. *whiteavesii* Dall; lateral view, length, 15 mm.; U. S. N. M., No. 95748; p. 948.
13. *Cetoconcha scapha* Dall, length, 13 mm.; Gulf of Panama in 100 fathoms; U. S. N. M., No. 109026; Proc. U. S. Nat. Mus., XXIV, p. 561, 1902.

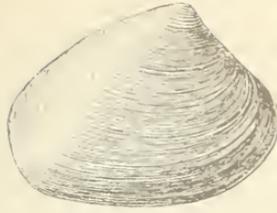
PLATE LXIII.

- Fig. 1. *Astarte verrucosa* Dall, length 17.5 mm.; Icy Cape, Polar Sea; U.S.N.M., No. 109276; p. 948.
2. *Astarte alaskensis* Dall, length 29 mm.; Bering Sea; U.S.N.M., No. 107274; p. 946.
3. *Venericardia gouldii* Dall, length 17 mm.; off San Diego in 823 fathoms; U.S.N.M., No. 109270; Proc. Acad. Nat. Sci. Philadelphia for 1902, p. 714.
4. *Venericardia incisa* Dall, length 9.5 mm.; Unalaska; U.S.N.M., No. 109267; Proc. Acad. Nat. Sci. of Philadelphia for 1902, p. 714.
5. *Astarte polaris* Dall, length 28 mm.; Bering Sea; U.S.N.M., No. 106859; p. 945.
6. *Astarte bennettii* Dall, length 15 mm.; Bering Sea; U.S.N.M., No. 109279; p. 946.
7. *Venericardia alaskana* Dall, length 36 mm.; Nunivak Island, Bering Sea. U.S.N.M., No. 109271; Proc. Acad. Nat. Sci. Philadelphia for 1902, p. 710;
8. *Astarte compacta* Carpenter, length 13.5 mm.; Puget Sound; U.S.N.M., No. 129118; Proc. Acad. Nat. Sci. Philadelphia for 1865, p. 57.
9. *Venericardia crassidens* Broderip and Sowerby (*V. rudis* Gray), length 31 mm.; Kyska Island, Aleutian chain; U.S.N.M., No. 109273; p. 949.
10. *Venericardia ventricosa* Gould, interior of right valve; length 18.5 mm.; California; Proc. Acad. Nat. Sci. Phila., for 1902, p. 709.
11. *Astarte (Rictocyma) esquamalti* Baird, length 15 mm., showing peculiar sculpture; from off Alaska Peninsula; U.S.N.M., No. 106862; p. 949.
12. Another valve of the same species; p. 949.

NOTE.—In the synopsis of the Carditacea, in Proc. Acad. Nat. Sciences of Philadelphia for 1902, p. 700, the name *Miodon* Carpenter, 1864, was adopted for a subgenus of *Venericardia*. It appears that this name was used by Dumeril for a fish before it was proposed by Carpenter for the mollusk, and I have therefore proposed for Carpenter's *Miodon* the new name *Miodontiscus*. For the section of *Ferebra*, commonly called *Acus*, also a preoccupied name, I now suggest the designation of *Orymeris*.



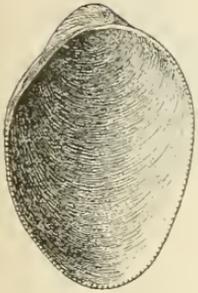
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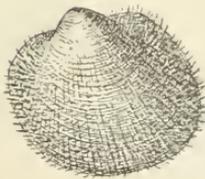
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AMERICAN PELECYPODA.

FOR EXPLANATION OF PLATE SEE PAGES 950, 951.



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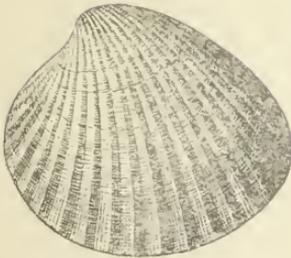
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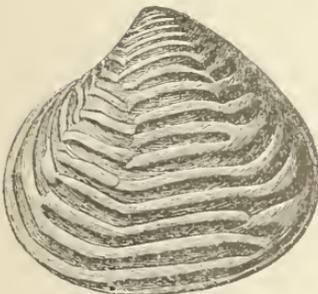
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ASTARTE AND VENERICARDIA.

FOR EXPLANATION OF PLATE SEE PAGE 953.

