

Some North Pacific Whale Barnacles

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The littoral and shallow water barnacles of the coast of British Columbia were reviewed in a previous paper (Contrib. to Can. Biol., N.S., Vol. 2, No. 18, 1925), and the present paper deals with those collected from whales taken near Cachalot Whaling Station, Kyuquot Sound, B.C. Three species of whale barnacles were sent to me from this station in 1923; *Conchoderma auritum*, *Coronula diadema*, and a third resembling *C. reginæ*; but the latter varied so much from all descriptions that a positive identification could not be made, and it was not thought advisable to give an account of it till a good series had been collected. This was done in 1925, as the writer visited the whaling station at Cachalot from June 20 to July 16th. During that time thirty-two whales were brought in: fourteen Finbacks, *Balaenoptera velifera* (1); fourteen Sei whales, *B. borealis* (2); and four Humpbacks, *Megaptera nodosa* (3). The Finbacks were remarkably clean, as there were no barnacles, nor external parasites on them. Late in the summer one Finback was taken with a large number of the female parasitic Copepod, *Pennella balaenopterae* (4) attached to its throat and belly. The Sei whales were also clean, only one had a few of the curious little barnacle *Xenobalanus globicipitis* on the ends of its flippers and flukes. All the Humpbacks, as usual, carried heavy loads of barnacles on their throats and corrugated bellies; these were *Coronula diadema*, to many of which were attached the large pedunculated barnacle *Conchoderma auritum*. *Coronula reginæ* was found only on the lips and front edge of the flippers.

Neither of the *Coronulinae* appear to be influenced in their choice of station by the color of the whale's skin, but by the advantages of the situation for obtaining food. The two species are very closely related, and at least one authority regards them as doubtfully distinct (5). But an examination of the shell, and animal, leaves no doubt that they are distinct, though closely related, species. Although their stations are different, a few *C. diadema* may be found on the lips, and a few *C. reginæ* on the throat, but the two species can readily be distinguished by their method of growth. *C. diadema* is not embedded in the skin at any stage of its development, while *C. reginæ* commences its growth below the surface, only the hood projecting above the level of the skin. As the shell grows, the skin is forced back till about a third of the shell is exposed. The shape of the shells of the two species and their orientation on the whale is different. *C. diadema* is barrel-shaped, and its station brings its opening nearly at right-angles to the line of motion of the whale. *C. reginæ* is much depressed, and it is situated in such a way as to bring its opening facing forward. No definite orientation could be found for *Conchoderma auritum*, as it grows in

large numbers on the shell of *Coronula diadema*, forty or more sometimes attached to one shell. All the specimens of *Xenobalanus globicipitis* were attached to the ends of the flippers and flukes in such a way that their openings face backward when the whale is in motion.

Several specimens of each of the four species of whale barnacles are in the Museum of the Pacific Biological Station at Nanaimo.

I take this opportunity of thanking Dr. W. A. Clemens for kindness, and assistance, while at the Nanaimo Station; Dr. Chas. H. O'Donoghue for much assistance; Mr. T. H. Withers, of the British Museum, and Dr. H. A. Pilsbry, of Philadelphia, for comparing specimens of *Coronula reginæ*, from Cachalot, with those from other localities; Dr. W. T. Calman, of the British Museum, for specimens; Dr. K. H. Barnard, of the South African Museum, for descriptions and drawings; and the California Academy of Sciences for the loan of plates for text-figures 4 and 5.

CORONULA DIADEMA (Linnæus) 1767

Plate I, text fig. 1, Nos. 1-18.

- 1767. *Lepas diadema* Linnæus, Systema Naturæ, ed. 12, p. 1109.
- 1789. *Balanus diadema* Bruguiere, Encyclop. Method., pl. 164, figs. 13-14.
- 1824. *Coronula diadema*. De Blainville, Dict. des Sc. Nat. Tab. 117, fig. 4.
- 1824. *Coronula diadema*. Leach, Encyclop. Brit. Suppl. vol. III.
- 1834. *Coronula diadema* Linnæus, Burmeister, Beiträge zur Naturgeschichte der Rankenfüsser, Tab. 2, figs. 1-14, 18.
- 1900. *Coronula diadema* Linnæus, Marloth, Tr. Philos. Soc. S. Africa, vol. XI, pl. 1, p. 1.
- 1905. *Coronula diadema* Linnæus, Gruvel, Monographie des Cirrhipedes ou Thecostraces, p. 273, text fig. 298.
- 1910. *Coronula diadema* Linnæus, Stebbing, Gen. Cat. S. African Crustacea, p. 571.
- 1916. *Coronula diadema* (Linnæus), Pilsbry, U.S. National Museum Bulletin No. 93, p. 273 description and many references, pl. 65, figs. 3-4.
- 1924. *Coronula diadema* (Linnæus), Cornwall, Proc. Calif. Acad. Sci., ser. 4, vol. XIII, No. 26, pp. 421-431, pl. 13.
- 1924. *Coronula diadema* (Linnæus), Barnard, Ann. S. Africa Mus. Vol. XX, p. 94.

DISTRIBUTION :—Darwin, p. 419, 1854. "Arctic Seas of Scandinavia; the coast of the United States, and of Britain; and the Gulf Stream."

Pilsbry, p. 275, 1916. "In the Pacific *Coronula diadema* is widely spread from Bering Sea, Japan, and California south to New Zealand, Tonga, Chili—practically the whole Pacific Ocean."

Barnard, p. 94, 1924. "Northern and Southern Hemispheres."

Specimens described and figured were collected from the throat and belly of Humpback whale, *Megaptera nodosa*, taken near Cachalot Whaling Station, Kyuquot Sound, Vancouver Island, B.C., 1925.

GENERAL APPEARANCE :—None of the shells of the many specimens collected were embedded in the skin of the whale, but even the smallest had the skin projecting into the spaces formed by the shell. These spaces are

formed by the greatly developed ribs, each of which has a T-shaped external fold, the transverse portions touch, forming the enclosed spaces between the ribs. The radii are well developed, and are very little below the level of the ribs; they are marked by fine growth-lines, and the exposed surfaces of the T-shaped folds have fine growth-lines crossed by fine longitudinal striæ, giving them a beaded appearance. The shell appears to be formed by triangles fitted together; the radii form one set with their apices down, and the exposed surfaces of the ribs form the other, with their apices up. The orifice is hexagonal, and is formed by the straight edges of the radii, the ribs forming but a small portion of the margin; they usually have their tops sufficiently eroded to expose the skin of the whale. When the barnacle is attached to the black skin these eroded areas appear like groups of three black lines radiating from each corner of the orifice. Darwin described the body-chamber of this species as "cup-formed," and stated that the whole inside could be seen from one point of view; but the many specimens examined all have the diameter of the orifice slightly less than the internal diameter of the body-chamber. The membranous basis is flat; and the bottom of the shell is concave. The sheath is not different from the internal walls of the body-chamber; the opercular membrane is attached a little below the margin of the orifice. The opercular plates are very small, but the scuta are present in specimens of all sizes, and the terga are to be seen in specimens up to 30 mm. in diameter. The slit in the opercular membrane, for the protrusion of the cirri, is in the middle of the orifice, and is protected by a hood which is continuous with the membrane. The opercular membrane is not thrown off at each moult; but the new membrane is added to it, making it tough and thick. Several small specimens of *Balanus trigonus* were growing on the shell of the largest specimen of *C. diadema*, and there was also a growth of the hydroid *Obelia griffini* (6) on it.

Four specimens of *C. diadema* are figured, as it was found that some of the parts show considerable variation in the different sizes, and the description and figuring of any one would be misleading. These four specimens have been selected from a large number as typical specimens of each size. The increase in the number of spines on the cirri is remarkable, and quite different from *C. reginæ* which has the same number of spines in specimens of all sizes.

OPERCULAR PLATES:—Fig. 1, Nos. 1—2. The opercular plates cover a very small portion of the orifice. The scuta are as described by Darwin (p. 418), but the terga are found in all small specimens; the tergum is a narrow line of calcareous matter parallel with the tergal margin of the scutum, and is found in all specimens up to about 20 mm. diameter. The rudimentary terga are rarely found in larger specimens.

OPERCULAR MEMBRANE:—The orifice is closed by the opercular membrane which is "stretched like the skin of a drum, almost horizontally across the top of the shell," (Darwin, p. 407). The aperture for the protrusion of the cirri is protected by a hood. It is evident that the membrane is not thrown off at



Fig. 1. *Coronula diadema* (Linnæus). Four specimens figured, A, 76 mm. dia. B, 39 mm. dia. C, 20 mm. dia. D, 11 mm. dia. No. 1 scutum, No. 2 tergum from C. 3, 4, 5, 6, labra from A, B, C, and D. 7, 8, 9, 10, mandibles from A, B, C, and D. 11, 12, 13, 14, maxillæ from A, B, C, and D. 15, 16, 17, median segments of cirrus VI from A, B, and D. 18, first cirrus of specimen A. I.E.C. Del.

every moult, as it is made up of a number of layers, and these appear to have been formed at rather longer intervals than the growth periods of the shell.

LABRUM:—Fig. 1, Nos. 3–6. The labrum is notched, and there is a small prominence on the outside below the notch. On the edge of the labrum there are many small teeth, these are regular in small specimens, but become very irregular in large ones. Over the teeth there is a growth of fine short hairs. (The hairs are not shown in the figure as they would obscure the outline of the teeth). The palpi are large, and their hairs meet over the labrum.

MANDIBLES:—Fig. 1, Nos. 7–10. The outline of the mandibles from different specimens varies greatly, and the number of teeth also varies. Darwin describes them as having five main teeth, some of the specimens examined have four, and others five, but all have small teeth set between the main ones; some of these are set on the sides of the main teeth. Great variation was also found in the outlines of the inferior angles; and there was usually more or less variation between the mandibles from the same specimen. The inferior angles bear an irregular number of minute denticles, some of which have spines on them. Only the smallest specimens have hairs on the upper margin.

MAXILLÆ:—Fig. 1, Nos. 11–14. The outlines of the margins of the maxillæ are variable. The two upper great spines are large; lower one slightly shorter

than the upper, there is a slight notch, in most specimens, below the great spines. The front margin bears many small spines; the upper and lower margins always bear short fine hairs; the lower, or inferior angle is almost square.

CIRRI:—Fig. 1, 15–18. The cirri are very tough and leathery, with short strong spines; these are, as usual, in two rows, and there is a tuft of short fine bristles between the rows. The segments are all protuberant, and are much wider than long. The number of spines on the cirri varies with the size of the specimen, the four figured having spines as follows:—Specimen 11 mm. diameter, three pairs of spines with a minute pair below them; specimen 20 mm. diameter, three pair of spines with a minute pair below them; specimen 39 mm. diameter has four pair of main spines; and specimen 76 mm. diameter has five pair of spines with a small pair below them. The first cirrus shows very little variation in the different sizes, and the anterior ramus is bent over the labrum. All except the first cirri have short claw-like spines on the ends of the terminal segments. The first three cirri are short, and the segments bear many fine spines.

BRANCHIÆ:—The large development of the branchiæ of whale barnacles is very remarkable; those of the *Coronulina* being the largest found in any cirripedes. They are attached to the under side of the opercular membrane, near the edge, in a line extending from the carinal margin nearly to the point of attachment of the animal's body. Beyond their line of attachment they hang loose and extend to the rostral margin of the membrane, where they meet. Each branchia consists of two folds, each of which is deeply plicated; they hang down beyond the body, in small specimens, and in large ones they meet under it. These huge branchiæ probably have been developed to meet the needs of the barnacles while passing through the warm tropical seas during the migrations of the whales. It is well known that the warm water of the tropical seas contains less oxygen than the cooler water of the northern and southern oceans (7); also the increase of temperature causes an increase of the rate of metabolism, and a consequent greater demand for oxygen. The combination of these two factors would explain the great development of the branchiæ of the barnacles, and also those of the amphipod *Paracyamus boopis*, the common "whale louse," which is found in thousands on, and among the barnacles of the whales.

CORONULA REGINÆ Darwin 1854

Plate II. Text figure 2, 1–5.

- 1854. *Coronula reginæ* Darwin, A Monograph on the Sub-Class Cirripedia, Balanidæ, p. 419, pl. 15, fig. 5; pl. 16, fig. 4.
- 1905. *Coronula reginæ* Darwin 1853, Gruvel, Monographie des Cirrhipedes ou Thecostraces, p. 272, text fig. 298.
- 1916. *Coronula reginæ* Darwin, Pilsbry, U.S. National Museum Bulletin 93, p. 275, pl. 64.
- 1924. *Coronula reginæ* Darwin, Barnard, Annals of the South Africa Museum, p. 94, vol. XX.

DISTRIBUTION:—Northern and Southern Atlantic and Pacific Oceans. The specimens figured were taken from a Humpback whale, *Megaptera nodosa*

(Bonaterre), taken near Cachalot Whaling Station, Kyuquot Sound, Vancouver Island, B.C.

Dimensions of specimen figured, height 16 mm., diameter 62 mm.

SHELL:—Pl. II. The outline of the shell, when removed from the whale's skin, is round. It is much depressed, especially when full grown; small specimens are more conical, as the diameter increases more rapidly than the height. When compared with the diameter of the shell the body-chamber is small, as it is surrounded by the greatly developed ribs; these have T-shaped loops at their outer ends, the transverse portions of which are fitted together, but not serrated, as described by Darwin; at least none of the specimens taken at Cachalot were serrated. The T-shaped portion of the ribs form part of the outer surface of the shell; they are equally spaced in six groups round the body-chamber; the spaces between these groups are filled by the radii. The depth of the body-chamber is nearly equal to that of the height of the shell, and its internal diameter is slightly greater than that of the orifice; all portions of the interior of the body-chamber cannot be seen from one point of view, as in the specimens described by Darwin (p. 420). The interior walls of the body-chamber are smooth, and the sheath is not differentiated from the walls of the chamber; the base of the chamber is contracted, and the membranous basis is three-quarters the diameter of the chamber. The radii are thick, very little depressed, and are marked by fine growth lines; they are triangular, with the bases of the triangles forming the margin of the orifice. The transverse portions of the T-shaped ribs, which form the major portion of the exterior, have a beaded appearance, as their fine growth lines are crossed by fine longitudinal striæ. The crenated pattern between the sutural edges of the radii and the ribs is broader than that described by Darwin, but resembles that described by Pilsbry (8). There are large spaces between the radii and the alæ which are filled by the ovarian tubes. As the shell increases in diameter more ribs are added, the ribs nearest the sutures of the compartments divide, as in *C. diadema*. There are fine longitudinal tubes near the external surface of the T-shaped loops of the ribs which are separated by thin septa. The upper ends of the ribs are not worn, exposing the skin of the whale which fills the spaces between them, as in *C. diadema*.

When the barnacle first attaches itself it must have some means of burrowing into the skin of the whale, as all small shells are completely covered, only the hood surrounding the opening for the protrusion of the cirri being exposed. The shell reaches nearly its full height before the skin is forced back exposing the upper portion of the shell. Crowded specimens, such as those on the lumps on the lips of the whale, are more steeply conical than those which are not crowded.

OPERCULAR PLATES:—The scuta are the same as those of *C. diadema*, and there are terga in all small specimens; these are rudimentary, and consist of a long narrow line of shell close to the tergal margin of the scuta.

LABRUM:—Fig. 2, No. 4. The labrum is the same as that of *C. diadema*, except that there are usually some larger teeth.

MANDIBLES:—Fig. 2, No. 1. The mandible has five main teeth; there are small teeth between the second and third, third and fourth. The inferior angle is very irregular in outline, and usually bears several small irregular teeth with spinules on them.

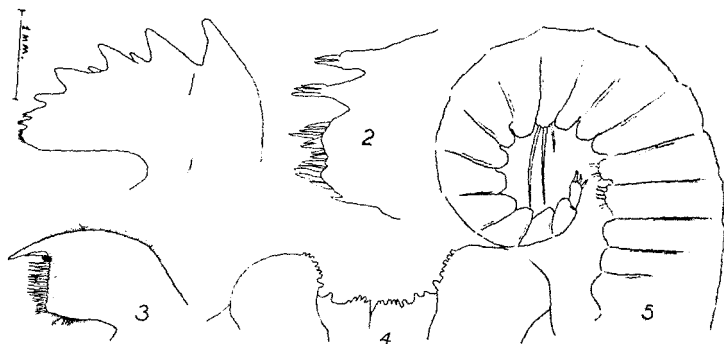


Fig. 2. *Coronula reginae* Darwin. 1, mandible. 2, outline of inferior angle of mandible, enlarged. 3, maxilla. 4, outline of labrum. 5, cirrus VI. I.E.C. Del.

MAXILLÆ:—Fig. 2, No. 3. The front margin of the maxilla is straight, and there is a mere trace of a notch under the two upper great spines; in the notch there are fine spines; the spines on the lower part of the margin are smaller than those above; the fine hairs on the upper margin extend down in a line just behind the front margin. There was no difference in the outlines of maxillæ from different sized specimens.

CIRRI:—Fig. 2, No. 5. The cirri of this species are unlike those of *C. diadema*, and the number of spines on the segments is uniform in all sized specimens. The first cirri are different from those of *C. diadema*, and the posterior cirri are longer.

The first cirri have protuberant segments, and all, except first, have claw-like spines on the terminal segments. The median segment of cirrus VI bears two pair of main spines, with a small pair below them; there is a tuft of fine spines between the main spines, as in *Conchoderma auritum*, fig. 5, D.

Specimen	A	B	C	D
Size	5 by 8 mm.	8 by 18 mm.	14 by 42 mm.	16 by 62 mm.
Cirrus I	7 & 6	9 & 7	9 & 7	9 & 7
" II	7 & 6	8 & 7	8 & 7	9 & 7
" III	7 & 6	8 & 7	8 & 7	9 & 8
" IV	10 & 10	14 & 13	14 & 14	14 & 14
" V	14 & 12	15 & 14	18 & 14	18 & 16
" VI	14 & 13	16 & 15	18 & 17	19 & 17

Table showing the number of segments in the two rami of each cirri from four specimens of *C. reginae*. The mouth parts and cirri from Specimen D are figured.

Darwin states (p. 421) that the sixth cirrus bears three pairs of main spines. All the specimens collected had two pairs of main spines, but some of the specimens sent to the writer in 1923 had three pairs of spines, so it appears that the number of spines is variable, but none have been collected with as great a number of spines as in *C. diadema*.

BRANCHIÆ:—The branchiæ are the same as those of *C. diadema*.

RELATIONSHIP:—While this species is very closely related to *C. diadema* yet the difference in the shape of the shell, the method of growth, and the number of spines on the cirri, are sufficient to show that it is a separate species.

XENOBALANUS GLOBICIPITIS Steenstrup 1851

Figure 3, Nos. 1-9.

1851. *Xenobalanus globicipitis* Steenstrup, Videnskabelige Meddelelser fra den naturhistoriske Forening i Kjöbenhavn, pl. 3, figs. 11-15.
1854. *Xenobalanus globicipitis* Steenstrup, Darwin, A Monograph on the Sub-Class Cirripedia, Balanoidæ, p. 440, pl. 17, figs. 4a-4c.
1905. *Xenobalanus globicipitis* Steenstrup, Gruvel, Monographie des Cirrhipedes au Thecostraces, p. 281, text figs. 304-305.
1916. *Xenobalanus globicipitis* Steenstrup, Pilsbry, The Sessile Barnacles (Cirripedia) Contained in the Collections of the U.S. National Museum, U.S.N.M. Bull. 93, p. 283, pl. 65, figs. 2, 2a, 2b.
1920. *Xenobalanus globicipitis* Steenstrup, Calman, Ann. Mag. Nat. Hist. (9), vi, p. 165.
1920. *Xenobalanus globicipitis* Steenstrup, Gruvel, Resultats campagnes Scientifiques Prince de Monaco, Face. LIII, p. 55, pl. 1, figs. 1-5; pl. V, fig. 25.
1921. *Xenobalanus globicipitis* Steenstrup, Nilsson-Cantell, Cirrhipedes provenant des campagnes scientifiques de S.A.S. le Prince de Monaco (1885-1913) Res. camp. Scient. accomp. . . . par Albert I Prince Souverain de Monaco 1920 (1-88, pl. 1-VIII. (Xeno. ref. p. 55, pl. I, III, IV, V, X. *globicipitis* Zool. Bidr. Uppsala 1921, p. 375, text-fig.
1923. *Xenobalanus natalensis* Stebbing, Fish. Mar. Surv. S. Africa, Special Report, 3, p. 12, pl. xvi.
1924. *Xenobalanus globicipitis* Steenstrup, H. Broch, Cirripedia Thoracica von Norwegen und der Norwegischen Nordmere Videnska Skrifter I. Math-naturew Klasse No. 17, p. 95, fig. 33; (a, individual, b, labrum, c, mandible, d, maxilla).
1924. *Xenobalanus globicipitis* Steenstrup, K. H. Barnard, Contributions to Crustacea Fauna of South Africa Museum, p. 96.

DISTRIBUTION:—Darwin, p. 439, 1854. "North Atlantic Ocean, attached to Porpoises."

Gruvel, p. 280, 1905. "Ocean Atlantique nord."

Pilsbry, p. 283, 1916. "Northern Atlantic, near the Azores between Madeira and England, and the Faroe Islands; New England, on the fins of the blackfish, *Globiocephalus*."

Barnard, p. 97, 1924. "Northern Atlantic, on the Black Fish (*Globiocephalus*), Finner Whale (*Balaenoptera physalis*); Antarctic (on Finner Whale)".

On the flippers and flukes of a Sei whale, (*Balaenoptera borealis* Lesson), taken at Cachalot Whaling Station, Kyuquot Sound, Vancouver Island, B.C. 1925.

GENERAL APPEARANCE:—At first sight this species has much the appearance of a pedunculate barnacle as the body is enclosed in a tubular membrane, the pseudo-capitulum, the small end of which is firmly attached to the small rudimentary shell; the shell is embedded in the skin of the whale. The opening for the protrusion of the cirri is in the upper, or large end of the pseudo-capitulum, and is surrounded by a reflexed collar, or hood. This hood is narrow at the front, but much wider at the carinal end of the opening.

All the specimens on the whale were collected, and examined; they were of uniform size, and the mouth parts were different from any described. Darwin found five teeth on the mandibles of his two inch specimens (p. 441). Stebbing found four teeth (p. 12). The specimens examined were about one inch long, and there were three teeth on the mandible. It is evident that the number of teeth varies with the size, as in *Coronula diadema*.

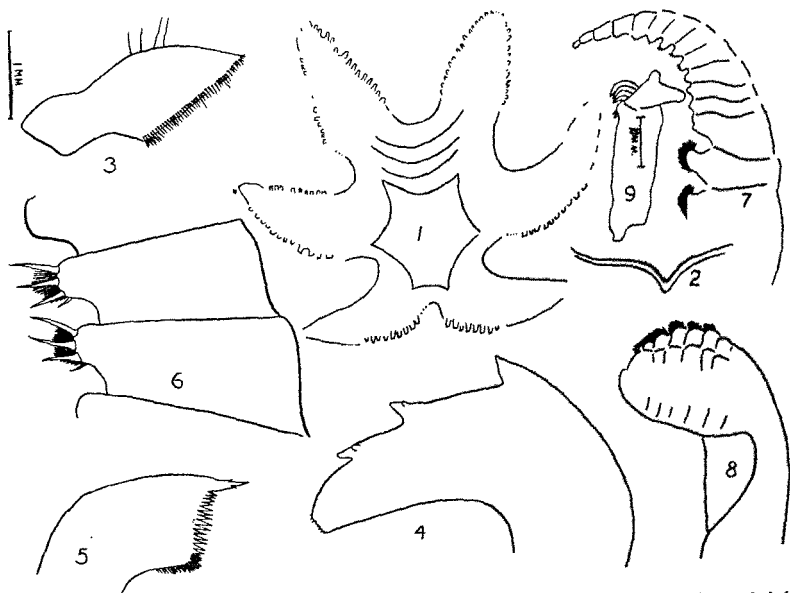


Fig. 3. *Xenobalanus globicipitis* Steenstrup. 1, outline of shell. 2, outline of labrum. 3, palpus. 4, mandible. 5, maxilla. 6, two segments of cirrus VI, showing spines. 7, cirrus VI. 8, cirrus I. 9, outline of specimen of *X. globicipitis*. I.E.C. Del.

SHELL:—Fig. 3, No. 1. The shell is embedded in the skin of the whale, and is formed of six compartments joined together in the form of a six-rayed star; the outer surface of each compartment is concave, and the suture line between them is in the centre of each ray. The proportions of the shell are different from those of sessile barnacles, as the rostrum is smaller than the other

compartments. The edges of the compartments are toothed, and the zones of growth are piled over one another, as described by Darwin, but their obliquity is in the opposite direction. The shell must be variable in form as those described by Pilsbry were quite different, but, as is frequently the case with barnacles, all the members of a group may show the same variations.

BASIS:—The basis appears to be a continuation of the membrane which covers the outside of the shell.

LABRUM:—Fig. 3, No. 2. The labrum is prominent, but not bullate; the centre is notched; margin covered with minute hairs. There are no teeth on the labrum.

MANDIBLES:—Fig. 3, No. 4. It is quite evident that the number of teeth on the mandible is variable. All the specimens collected had three teeth, with a small tooth on the side of both the second and third teeth. The inferior angle is irregular in shape, the outline being different in the two mandibles from the same specimen. There are some small spinules on the sides of the mandible near the inferior angle. Darwin described this species as having five teeth, and Dr. K. H. Barnard has found five teeth on the specimens he has examined.

MAXILLÆ:—Fig. 3, No. 5. The sides of the maxilla are covered with fine spines. The front margin bears many spines which are short, their bases are broad, giving them a cone-like appearance. The front margin is almost straight, and the inferior angle slightly protuberant, and bears many spines. The upper great spines are variable in shape, some have a short stout spine with a smaller slender one above it; others have one great spine with three points (Fig. 3, No. 5), one point about half way down the upper side of the spine, and the other opposite to it on the lower side. The upper and lower margins are villose, and there is no trace of a notch under the great spines.

CIRRI:—Fig. 3, Nos. 6, 7, 8. The cirri are short and much compressed; they have a small number of segments, which are as follows:—

Cirrus	I,	anterior ramus	6;	posterior ramus	6.
"	II,	"	"	6;	" " 6.
"	III,	"	"	6;	" " 6.
"	IV,	"	"	11;	" " 11.
"	V,	"	"	11;	" " 11.
"	VI,	"	"	14;	" " 14.

The segments are very protuberant; the seventh segment of cirrus VI bears four pairs of short thick spines (Fig. 3, No. 6), the lower pair are minute, and set close together; there is a dense tuft of fine spines between the main rows; there are no dorsal spines on any of the segments. The spines on the terminal segments of the posterior cirri are short and claw-like. The pedicle of the first cirrus is twisted in a peculiar manner which brings the cirrus close to the mouth; the second cirrus has several tufts of spines on the pedicle; the pedicle of the third cirrus has the segments produced into rounded protuberances which bear many spines; there are spines on the pedicle of the fourth cirrus, but the seg-

ments are not protuberant; the segments of the fifth cirrus are very protuberant; those of the sixth are produced into rounded knobs covered with spines. The general appearance of the cirri is the same as those of the genera *Coronula*, and *Conchoderma*, and this appears to be the type of cirri developed by all the whale barnacles.

PALPI:—Fig. 3, No. 3. The palpi have several long, fine spines on their outer margins; the inner margins are straight, and covered with short stiff spines evenly arranged.

BRANCHIÆ:—As in all the whale barnacles the branchiæ are greatly developed; they are attached nearly half way down the sack on the carinal margin, and consists of two folds; the outer is slightly larger than the inner.

RELATIONSHIP:—This peculiar barnacle has the general appearance of one of the Lepadidæ, or pedunculate barnacles (Fig. 3, No. 9), but an examination of its internal parts reveals its true relationship. The labrum is not bullate, as in the Lepadidæ; the third cirrus is much shorter than the fourth, and it has branchiæ. These characteristics place it among the sessile barnacles. Darwin has traced its relationship to *Tubicinella*, and also shown some points of resemblance to *Coronula*.

CONCHODERMA AURITUM (Linnæus) 1767

Plate III, text figures 4 and 5.

- 1767. *Lepas aurita* Linnæus, Systema Naturæ, 12th edition, p. 1110.
- 1795. *Lepas leporina* Poli, Test. utrisque Siciliæ, pl. vi, fig. 21.
- 1814. *Conchoderma auritum* et *leporinum*. Olfers, Magaz. der Gesell. Freunde zu Berlin. 3d Quartel., p. 177.
- 1815. *Lepas cornuta* Montagu, Lineæ Transactions.
- 1815. *Branta aurita* Oken, Lehrbuch der Naturgesch., Th. 11, p. 362.
- 1817. *Malacotta bivalvis* Schumacher, Essai d'un nouveau syst. des habitations des Vers.
- 1824. *Gymnolepas cuvierii* De Blainville, Dict. des Sc. Nat., Art. Mollusc., Pl., fig. 1.
- 1824. *Otion Cuvierianus* (!) *Blainvillianus* (!) *Bellianus* (!)
- 1825. *Dumerillianus* (!) *Rissoanus* Leach, Encyclop. Brit., vol. III, Supp., and also in the Zoological Journal, vol. ii, p. 208, July 1825.
- 1829. *Otion depressa* et *sacculifera* Coates, Journal Acad. Nat. Sci. of Philadelphia, vol. vi., p. 132.
- 1845. *Otion auritus* Macgillivray, Edinburgh New Phil. Journal, vol. xxxviii.
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DISTRIBUTION:—According to Darwin, mundane, on ships, slow moving fish, and *Coronula* on whales. Pilsbry gives Atlantic and Pacific localities, and Barnard states that some young example of *C. auritum* were taken off the tail of a large eel (*Gymothorax favagineus*) caught at Kowie.

The specimens figured were taken from *Coronula diadema* growing on the humpback whale, *Megaptera nodosa*, taken near Cachalot, B.C., and from the bottom of a ship, where they were associated with *Balanus tintinnabulum californicus*, and *Lepas hillii*.

GENERAL APPEARANCE:—Pl. III, Nos. 1-5. The capitulum is compressed, and two ear-like appendages are set on its top; they are irregular in shape, much folded and bent; usually they point, more or less, backward. In young specimens these appendages do not open into the body-chamber, but in large specimens they communicate with the interior. Their structure seems to indicate that their function is respiratory. The whole surface of the capitulum and peduncle is smooth; the color is variable; some taken from whales are mottled with dark

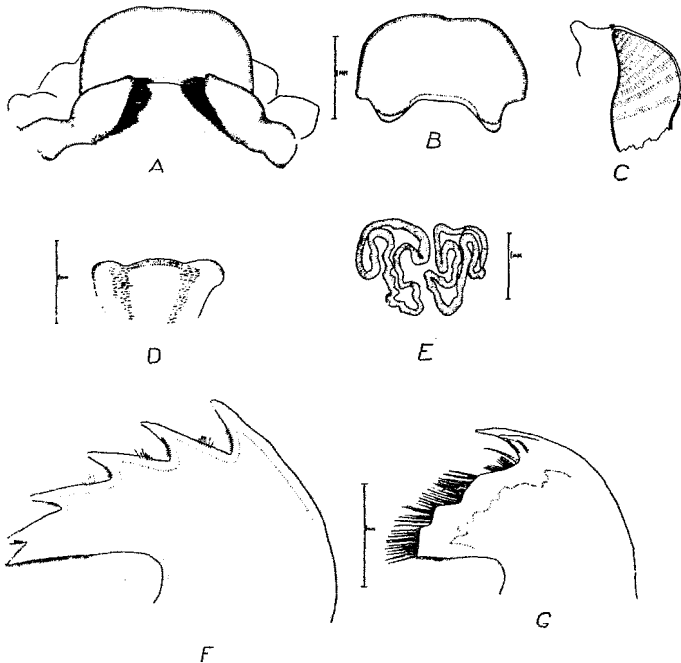


Fig. 4. *Conchoderma auritum* (Linnaeus). A, labrum with palpi in position. B, labrum with palpi removed. C, section through centre of labrum. D, Interior of labrum. E, section of ear-like appendages. F, mandible. G, maxilla. I.E.C. Del.

brown spots, others are striped with dark brown on a brownish yellow; those taken from a ship were uniformly colored a dark purple, almost black. The peduncle is about twice as long as the capitulum, and its base is slightly expanded.

OPERCULAR VALVES:—The scuta are two imperfectly calcified plates, one on each side of the capitulum just below the opening. No trace of terga, or even a rudimentary carina could be found, even in the smallest specimens.

LABRUM:—Fig. 4, A-D. The labrum is bullate, and there are very fine teeth on the margin. On the interior there are two patches of fine hairs (Fig. 4, D). The palpi do not meet over the labrum, and they bear a dense growth of stiff hairs on their margin.

MANDIBLES:—Fig. 4, F. Each mandible has five teeth; inferior angle pointed; the teeth are finely pectinated near their bases, and there are a few

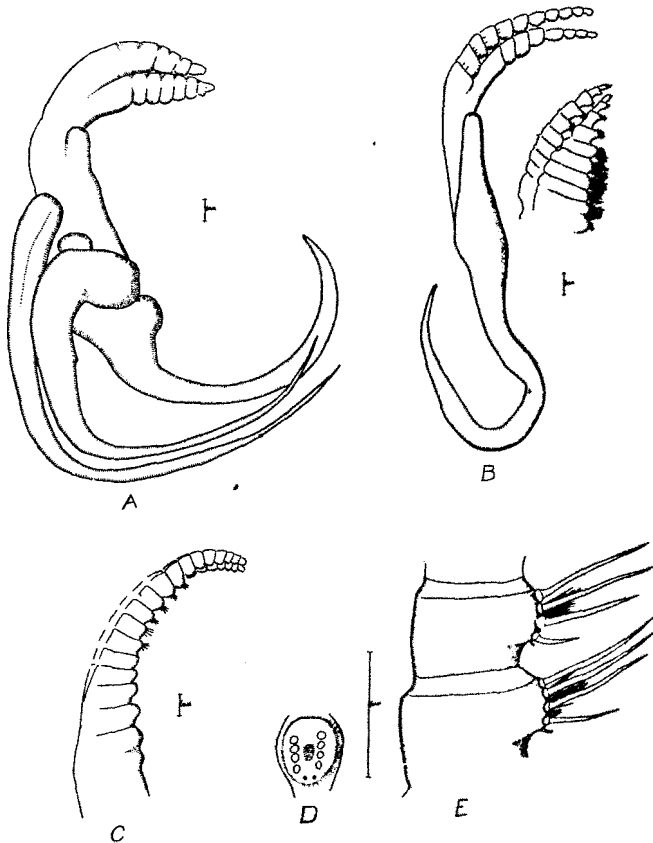


Fig. 5. *Conchoderma auritum* (Linnæus). A, first cirrus with first, second and third filamentary appendages. B, cirrus II with fourth appendage, also side view of cirrus. C, cirrus VI. D, margin of segment of cirrus showing position of spines. E, median segments of cirrus VI, enlarged. I.E.C. Del.

hairs in the spaces between them; lower margin bears fine hairs. The shape of the mandibles show very little variation in different size specimens.

MAXILLÆ:—Fig. 4, G. The maxilla of this species has a very characteristic shape, as the outline of the front margin recedes from the inferior angle to the deep broad notch under the upper great spines. These spines are set well back, and their bases are in line with the front margin of the pedicle of the maxilla. The inferior angle is nearly square, and the front margin forms a series of steps of irregular width, and bears many stout spines. The general shape of the maxillæ of all sized specimens is about the same, and the only variation noted was in the shape of the "steps" forming the margin.

CIRRI:—Fig. 5, A-E. The cirri are much flattened, and the spines short. The sixth cirrus bears four pairs of large spines with a minute pair below them, and there is a tuft of fine spines between the two rows of large ones (Fig. 5, D). In the many specimens, of all sizes, examined, none were found with serrated spines, as described by Darwin (p. 144), but the spines were smooth and round.

FILAMENTARY APPENDAGES:—Fig. 5, A, B. There are seven of these appendages on each side, and they undoubtedly function as branchiæ. They are fully twice as long as the cirri they are attached to, and reach their greatest development in this species. Three are attached to the base of the first cirrus, and one to each of the other cirri, except the sixth.

REMARKS:—This species is related to *Conchoderma virgatum*, but can easily be distinguished from it by having ear-like appendages which are not found on any other species. The absence of the rudimentary carina, and the smooth spines on the cirri are the only variations from Darwin's description.

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EXPLANATION OF PLATES

PLATE I. *Coronula diadema* (Linnæus). Nos. 1, 2, 3, and 4 are the four specimens whose body parts are figured in text fig. 1. No. 1 has the hydroid, *Obelia griffini*, and some small barnacles, *Balanus trigonus*, growing on it. All have their opercular membranes in position.

PLATE II. *Coronula regimæ* Darwin. Two specimens, one with opercular membrane removed to show body-chamber. The dotted line shows the depth to which the shell was embedded in the skin of the whale.

PLATE III. *Conchoderma auritum* (Linnæus). The two specimens, No. 1, were collected from the S.S. Gertrude at William Head, B.C. The other specimens grew on the shell of *Coronula diadema* on a Humpback whale.