Papers from Dr. Th. Mortensen's Pacific Expedition 1914—16.

X.

Studies on Pacific Cirripeds.

(With 77 figures in the text.)

By
Hjalmar Broch, Kristiania.

Introduction.

On the following pages I give an account of the Cirriped collections from Dr. Th. Mortensen's Pacific Expedition in 1914—16. The extensive collections afford rich contributions to our knowledge of the Pacific faunistic features and, moreover, contain a series of interesting new species, and developing series of several, especially pedunculated, forms; they thus furnish a good base for phylogenetic and systematic studies, and I am indeed thankful to my friend, Dr. Th. Mortensen that he entrusted me with the treatment of his extensive collections.

Since the days of Darwin our knowledge of this group has been extensively augmented. Nevertheless the systematic arrangement of the group has as yet only undergone few alterations owing to the elaborate working method, and the well founded systematics of Darwin. The large monographs of Hoek have built farther on the foundation laid by Darwin. Gruvel, it is true, has tried to introduce a new systematic grouping; but, as also pointed out by Pilsbry, he has been rather unsuccessful; his system is based mainly upon the numeric occurrence of skeletal plates; no heed being paid to the different origin of the plates, and their phylogenetic value, his system is decidedly a step backwards, as compared with Darwin. Modern systematists have therefore not accepted the systematic lines of Gruvel. — Since Darwin the first real steps forward are due to Pilsbry and Annandale, and especially the first named scientist has shown

us the future lines of study with the cirriped systematics. In the following report I, therefore, mainly follow the lines drawn up by Pilsbry, although with some alterations as to the pedunculated forms. These alterations are mainly based upon studies of development series, and on phenomena of growth, which afford a good base for phylogenetic deductions. An introductory chapter more specially deals with the results of these studies.

The biological station of the Kristiania university,
26th May 1921.

(With exception of fig. 2, a—c, fig. 6, a—c, fig. 15, a—c, fig. 17, a—c, fig. 20a, fig. 21, a—b, fig. 44, a—d, fig. 47, and fig. 66a all figures have been drawn by aid of an Abbé's projecting apparatus at a somewhat larger scale, and then reduced during reproduction so that the enlargements indicated have been arrived at.)

Lepadomorpha Pilsbry,

their phylogeny and system.

The offspring of the cirripeds is like their relations to other crustaceans, wrapped in darkness, and although the pupa-stage occurs with an astonishing uniformity in the whole of the group, it does not give any hold for a judgment as to the origin of the cirripeds. If we study the literature, we moreover find opinions to be rather diverging as to which genus of the recent cirripeds is the most primitive.

Darwin in his classic monograph (1852), does not give any detailed discussion of the phylogeny; nevertheless we can deduce from his remarks that he looked at *Oxynaspis*, or the type represented by this genus, as the most primitive cirriped, and that he thought that the other genera have originated from the named form. Just the opposite opinion was set forth by Hoek (1883); he considers *Mitella* (*Pollicipes*) as the ancestor of all recent cirripeds, and thus comes to the result that all other genera have arisen through a reductive development, as regards the skeleton.

His theory entirely foots on paleontology, and mainly on the fact that *Mitella,* according to the paleontologic finds, seems to be the oldest genus among our recent cirripeds, although only little older than *Scalpellum.*[1]) Most later authors have followed Hoek, and Gruvel in his monograph (1905) adopts his theory, ranging among the ancestors also the extinct genera *Turrilepas,* and *Loricula.* The correctness of this mode of proceeding is not evident from his statements, and seems problematic also if we take into consideration their occurrence in time. In fact his reasoning seems to result in another theory, viz. that the more numerous the plates, the older the genus. –- Neither Pilsbry nor Annandale in their memoirs have taken up a definite position as to the phylogeny; on the other hand, Krüger in his recent paper (1920) decidedly holds to Hoek's theory. I shall return to his reasonings below.

In a previous paper on *Scalpellum* (1912) I came to the conclusion that Darwin's opinions were in better accordance with the postembryonic development than Hoek's theory, and in my preliminary note on the development of *Mitella* (1921) I again came to the same, although somewhat modified result. Studies of the details of the skeletal development of several species are put forth in this paper, and the results of these studies are of such importance from a phylogenetic point of view that I find it correct to give a review of their bearing on classification before entering on the detailed report on the species.

A comparison with other crustaceans shows that the intensive secretion of lime in many cirripeds cannot be a primitive feature, and for this reason it may be doubtful, whether the heavily armoured forms are to be ranged among the „ancestral forms" of the entire group. On the other hand, such forms are more likely to be preserved as fossils than those without calcareous skeleton or with only a thin one. This fact at once weakens the importance of the evidences of paleontology in this case. Other facts likewise speak against the large number of plates as a primitive feature. In every case where we have succeeded in studying the development entirely, the pupa of the pedunculate cirripeds at

[1]) *Scalpellum* even seems to occur earlier than *Mitella* (comp. Eastman, A. M.: Text-Book of Paleontology, Second Ed., Vol. I, London 1913, p. 745); this would deprive Hoek's theory of its last support.

first develops five chitinous — in Darwin's nomenclature „primordial" — valves, viz. carina, terga, and scuta. In the following report more instances of this are given, and, what is of importance in this connection, this also holds good in genera with skeletons consisting of several more plates in the adult, such as in f. inst. *Mitella*, and *Scalpellum*. It is curious, how little attention Hoek and other authors have paid to this fact which is, however, together with the fact that no other plates are preformed as chitinal plates, of great phylogenetic importance. They prove that these five valves have probably been present in the group, before the cirripeds acquired their capacity of producing calcareous plates, and further, that the accessive plates of the animal probably are later acquisitions.

This makes us return to the theory of Darwin, although in a somewhat modified form. The origin of the cirripeds is to be sought in a form with only five primordial, chitinal valves in the mantle, and without calcareous skeleton of the peduncle.

From this point of view we shall have to modify the ideas of relationship and also more or less the systematic arrangements set forth by Hoek, Gruvel, Pilsbry, and Annandale. We are forced to discard the theory of *Mitella* as being a most ancient cirriped with which the other genera have originated. I shall in some words, therefore, discuss the relationships of the pedunculate cirripeds.

We may then, to begin with, also discard the theory of *Oxynaspis* as the primitive genus. On the one hand its special biology, its symbiosis with Antipatharians contradicts this view, and moreover we must point out the fact that the genus is hermaphroditic, with no trace of a male.

Taking the lower crustaceans as a whole, we at once see that hermaphroditism is by no means a common feature; on the contrary, the overwhelming majority has separated sexes, and where hermaphroditism is present, it is evidently a secondary phenomenon, an adaptation to special biological conditions. We are therefore forced to consider the hermaphroditism of the cirripeds as a secondary phenomenon, an adaptation to their fixed mode of living, and we may take it for granted that the ancestors of the group had separate sexes, probably of equally high organisation.

Krüger in his recent paper (1920, p. 46) maintains the old

postulate that „Als ursprüngliche Geschlechtsform müssen wir bei Tieren die hermaphroditische ansehen." This statement, of course, holds great probability;[1]) but it is an error, when it is used as an axiom concerning every animal group in particular. It is commonly presumed that the coelenterates have given rise to all higher groups, directly or indirectly; nevertheless hermaphroditism is already here abandoned in most species, and it is not easily seen, why the ancestral forms of every higher group should have returned to hermaphroditism, as many authors seem to maintain. Especially in the cirripeds nothing speaks in favour of this theory. As above pointed out, hermaphroditism among other crustaceans can always be traced back to special biological conditions, as f. inst. often to parasitism; it is here no doubt a secondary phenomenon. We cannot think that the cirripeds have originated separately; their organisation and development give evidence of a close relationship with the other crustaceans, and they have no doubt originated with some or other of them. We therefore cannot adopt the postulate for this group.

Krüger arrives at the conclusion that the dwarf males are a new acquisition, and he arrives at this conclusion from the theory of *Mitella* as an ancient form, most primitive among recent cirripeds; he here again evidently foots on paleontology. To this we can say that paleontology has shown, mirabile dictu, that remains of *Scalpellum* occur at as early periods as of *Mitella*. Looking at their biology we see how much lesser probability there is that the former genus may be found in the deposits: its species are rather scanty in occurrence, and on the whole live in the deeper parts of the oceans, whereas *Mitella* lives in great communities on the shores, and is thus more likely to be found in the deposits; also this makes the paleontological evidences problematic.

If we now consider the occurrence of males, and compare it with the phylogenetic lines drawn up by Hoek, Gruvel, and Krüger, we arrive at rather inexplicable results. In *Mitella* the male is absent; in *Calantica* and *Smilium* a rather highly organised male of a sudden occurs, to degenerate or even to disappear again in *Scalpellum*. In the aberrant genus *Ibla* a degenerate male again

[1]) Although „indifferent" is a better word in this case than hermaphrodite.

appears. How, and why these sporadic dwarf males arise and again disappear, they cannot say. Krüger therefore must have recourse to yet another theory in order to get out of the difficulty, and formulates it as follows: „Von den heute lebenden Gattungen sind Mitella und Scalpellum schon seit dem Obersilur bekannt. Es waren auch damals festsitzende Geschöpfe, eine Lebensweise, die nach unseren Kenntnissen das Auftreten der Zwittrigkeit begünstigt, so dass sie also schon zu diesen Zeiten wieder hermaphroditisch geworden waren und nun auf den heutigen Tag alle Anklänge an ihren früheren Gonochorismus verloren haben." The last sentence evinces that also Krüger in reality is of opinion that the ancestors of the cirripeds had separate sexes. On the other hand, he has here overlooked the fact that *Scalpellum* has males, and in all probability has not acquired them in later times.

I have gone into details in this question, because the occurrence of males has hitherto been undervalued in the discussion of cirriped phylogeny. We must agree with Krüger in maintaining that the primitive cirripeds have had separate sexes, and that their special biology, their fixed mode of living, makes us understand the disappearance of the male, and the development of hermaphroditism.[1])

If the theory of the gonochoristic ancestors is correct, we shall have to accept a link between *Calantica* and *Mitella*, or rather a *Mitella* with male. So old this genus is that the chance of finding it would seem rather problematic; my surprise therefore was great, as among the material, brought home by Dr. Mortensen from New Zealand, a *Mitella*-like species furnished with dwarf males really occurs. As it is shown in the table on pag. 226 this genus, *Protomitella*, links together the genera with males in a way that makes helping theories completely superfluous.

Next to the parent form the genera in which the males have kept a high organisation most probably must be ranged. Among the recent genera *Calantica* has the highest developed males; in the male of *Calantica Mortenseni* described below, even some of the latera are present in the capitulum skeleton. According to

[1]) Krüger in a letter to the author communicates that his embryologic studies have later on given results which are in better accordance with my theories than with Hoek's.

this, we may conclude that the reduction of the males at all events in some genera has set in at a late period, after the skeleton having reached a high specialisation in both sexes. — The high development of the male, and the variating features of the lower whorl of plates in the capitulum indicate that *Calantica* occupies a low stage in the phylogenetic series. In the nearly related genus *Smilium* the male attains an almost equally high organisation as in *Calantica,* or is a little more reduced; on the other hand, one of the latera — viz. latus superius — has in the hermaphrodite (or female) emancipated itself from the lower whorl of latera and reaches a higher development. In the reduction of its dwarf males the *Euscalpellum*-group (by Pilsbry 1908 separated out as a genus of its own) leads on to *Scalpellum* where the reduction of the male is continued, till in some species it is entirely done away with; moreover the subrostrum and subcarina have disappeared in the skeleton of the great form. The last step in this line of development leads to the new genus *Scalpellopsis* described below; here the anterior latera are also reduced so that only the posterior latera persist.

From *Calantica* the development has taken another course to *Protomitella.* The male is kept here, although it does not seem to occur abundantly; its organisation is the same as in most species of *Calantica.* In the hermaphrodite the upper row of peduncular scales attain a peculiar, high development and join the capitulum skeleton as a lower row of accessory small latera; the constant appearance of a subcarina, and the somewhat variating development of the principal latera known in *Calantica* give evidences of near relationship. From *Protomitella* there is but a short step to *Mitella,* where the male has entirely disappeared, and where an upper row of latera is generally, although not invariably, more developed than the accessory, lower latera, here designated as emancipated upper scales of the peduncle. Nearly related is also *Lithotrya,* in which genus the male is likewise wanting; here it is obvious that the upper row of stalk scales, although highly developed, do not in reality belong to the capitulum skeleton.

Finally also another genus naturally belongs to this group, viz. *Ibla,* in which calcification has been abandoned, and where, accordingly, only the primordial plates persist, with exception of the

carina. It would be of great interest to study the development of this peculiar genus in order to see if the carina is not indicated in the pupa. — The skeleton of the peduncle is in *Ibla* represented by numerous chitinal spines or hairs, in the adult of one species again disappearing. In *Ibla* males are present and attain a comparatively high organisation; the affinity with *Protomitella* is evident, and no heed being paid to the secernation of carbonate of lime, there is no great gap here either.

We shall here have to face the question, whether it is possible to give a plausible explanation of the absence of a male in *Scalpellopsis*, *Mitella*, and *Lithotrya*, as compared with the other genera of this great phylogenetic group. Evidently the biological conditions give us a key. *Calantica*, *Smilium*, and *Scalpellum* are in general deeper living forms, and the individuals are only seldom found living crowded; quite on the contrary, the dredges very seldom catch more than one or some very few specimens of one species at a time. A cross fertilization would here be almost precluded, if no males had been present. *Protomitella*, and *Ibla* are shallow-water genera; *Ibla* is a rare genus, the individuals of which always seem to occur almost singly. The biology of *Protomitella* demands further study; here the male seems to be about to disappear, or it is more numerous at some time of the year than at others; the only species known does not seem to be very abundant.

Turning to the other genera we find that *Mitella* is an inhabitant of shallow water, mostly even of the tidal zone, and its species are generally found in great, crowded assemblies, a cross fertilization thus being secured without males. The same seems to hold good in *Lithotrya*, although the specimens of this genus, owing to their more hidden living places, have not been observed in such great numbers as *Mitella*. The biology of *Scalpellopsis* is unknown; nevertheless the only species known was found in great numbers on a hydroid colony, and thus seems to live in communities. —

The facts here given show that all the genera hitherto spoken of are connected by narrow affinities; on the other hand, they are separated by a rather pronounced gap from the other pedunculated cirripeds in their skeleton as well as in their finer characters, and in the occurrence of a male. They naturally form a family. Common to all of these genera is the skeleton of the peduncle; more-

over the carina has its umbo at or near the apex; in some *Scalpellum*-species the umbo is through growth secondarily removed somewhat down the plate, although never reaching the middle of the plate. In the scuta the umbo is invariably situated at the apex.

The family has evidently been limited in the same way by Pilsbry (1916, p. 14), and there is no reason to change the name *Scalpellidae* given by him already in 1907; nor is the gap between *Ibla* and the other genera large enough to defend the proceeding of Annandale (1909) who places this genus in a family of its own.

The other pedunculated cirripeds show quite different lines of development. The first difficulty arising here, is the question, which genus is the most primitive. Taking again into consideration that the ancestral form of the recent cirripeds has after all had a skeleton of five primordial valves, we can at once discard a theory of the genera with reduced number of plates as primitive. We shall, therefore, have to chose between the genera with five plates i. e. *Oxynaspis*, *Lepas*, *Poecilasma*, *Megalasma*, and *Octolasmis*. As to the last named genus we can at once leave it out of the discussion; the species give clear evidence of the reduction by a splitting up of the plates being due to adaptation: the more specialised the biology (as f. inst. the life in the gill chamber of a crab) the farther the reduction has proceeded; also the special biology of more of the species designates it as a more specialized genus. The same applies to *Oxynaspis*, although this genus by many authors has been considered a very primitive one; its peculiar commensalism with Anthipatharians, which has resulted in the latter enveloping the cirriped in its tissues, decidedly evince the well adapted, i. e. from the parent stock probably more or less different genus.

In *Megalasma* the individual development clearly tells us that the position of the scutal umbo at the occludent margin above the basal angle of the plate is a secondary feature, and that the predecessors of the genus have had basal umbo of their scuta. Thus only two genera are left, viz. *Lepas* and *Poecilasma*, and here we are at a loss. With our present knowledge it is impossible to say

whether one or the other of these two genera is the more primitive, as neither the biology nor other features yield any foothold for a reliable conclusion in that respect. Both genera show the central characters of the group, viz. a naked peduncle, a carina with a basal umbo, and scuta with their umbones where the basal and the occludent margins meet. In both genera there is an evident tendency towards a reduction of the formation of carbonate of lime in the plates, although this feature is a little more pronounced in *Poecilasma* than in *Lepas*. The two genera are closely related, indeed so closely that Darwin (1852) made his excuses, when he introduced *Poecilasma* beside *Lepas*, and with these two forms the other genera with naked peduncles have originated.

According to the theories of previous authors, the scalpelloid group starts from *Oxynaspis* (Darwin), or the forms with naked peduncles are derived from the scapelloid group (Hoek, Gruvel). The males of the primitive Scalpellidae contradict the first theory. The other theory is contradicted by other facts; no trace can be found in adult or juvenile specimens, or during the post-embryonic development of a peduncle skeleton in the Lepadid group, and every trace of accessory capitulum plates is also absent. Stronger weight must however be ascribed to the fundamentally different position of the carinal, and scutal umbones in the groups. As long as the capability of lime secretion is mainly bound to the transition from capitulum to peduncle, the umbones of the five primary valves are apically situated; the formation of accessive plates (both plates of the capitulum, and the scales of the peduncle) is as the investigations have shown, confined to this zone of lime secretion. If now, as in Lepadidae s. str., the capability of lime secretion moves away from the transition to the peduncle, and is confined to the middle part of the capitulum, the umbones of scuta and carina will become basal, and, moreover, the formation of accessive lower capitulum plates and peduncular scales will be precluded. These features indicate that the two groups, or families, viz. the Scalpellidae, and Lepadidae s. str. have arisen separately from the ancestral form.

From *Lepas* the genus *Conchoderma* has evidently arisen; both genera agree in their mouth parts, and show a great development of the filamentary appendages. A further reduction of the skeleton

in *Conchoderma* leads on to *Alepas;* again the mouth feet, especially the peculiar, terraced construction of the cutting edge of the maxilla and the many teeth of the mandible point to a closer relationship with the latter form than with any other genus of the group. *Alepas* has also kept the filamentary appendages.

The other genera, on the other hand, seem to have arisen from *Poecilasma.* The step from this genus to *Megalasma* is indeed so short that we may doubt the correctness of a separation; many of the species of the latter genus have been ranged with *Poecilasma,* till Pilsbry (1907) laid a new foundation for the generic separation; nevertheless, the question whether these genera were not more correctly to be merged into one can by no means be regarded as settled. — In *Megalasma* the scuta tend to bring the basal margin in line with the occludent margin by a rotation round the umbo; this tendency is also seen in *Oxynaspis,* although not so distinctly. Moreover the carinal umbo in this latter genus is moving upwards along the dorsal line, although never passing by the middle of the plate; in some *Poecilasma* — and *Lepas* — species a „basal plate" is indicated in the carina below the umbo, and this has now in *Oxynaspis* attained a rather high development. The maxilla of *Oxynaspis* decidedly point to a nearer relationship with *Poecilasma* than with *Lepas,* and the habitat of the genus is also more in conformity with the deeper living species of *Poecilasma.*

In *Poecilasma* as in *Lepas* some species show a tendency towards a reduction of the calcification, and towards a splitting up of the outer parts of the plates. This leads from *Poecilasma* into *Octolasmis,* in which genus the biological conditions favour a skeletonal reduction. To this generic line — although probably not directly through *Octolasmis* — *Heteralepas* links itself. One might believe in a closer relationship between this genus and *Conchoderma,* when judging by the external appearance. But the mouth parts of *Heteralepas,* and especially of the subgenus *Heteralepas* s. str. are directly identical with those of *Poecilasma* and strikingly in contrast with those of *Lepas,* and *Conchoderma.* Owing to the great conservatism of these organs in the cirripeds we must ascribe a great phylogenetic value to them.

According to this, we find in this family two fine examples of convergence represented by the lines of development of *Poecilasma*

— *Octolasmis* — *Heteralepas*, and of *Lepas* — *Conchoderma* — *Alepas*. Nothing serves better to elucidate the inadequacy of Gruvel's (1905) family Anaspidae.[1]) Nothing speaks in favour of dividing up the group treated above, it forms a natural group, the family Lepadidae sens. str.

I do not here enter into a discussion of the more or less aberrant genera *Chaetolepas*, *Microlepas*, *Anelasma*, and *Koleolepas*. The

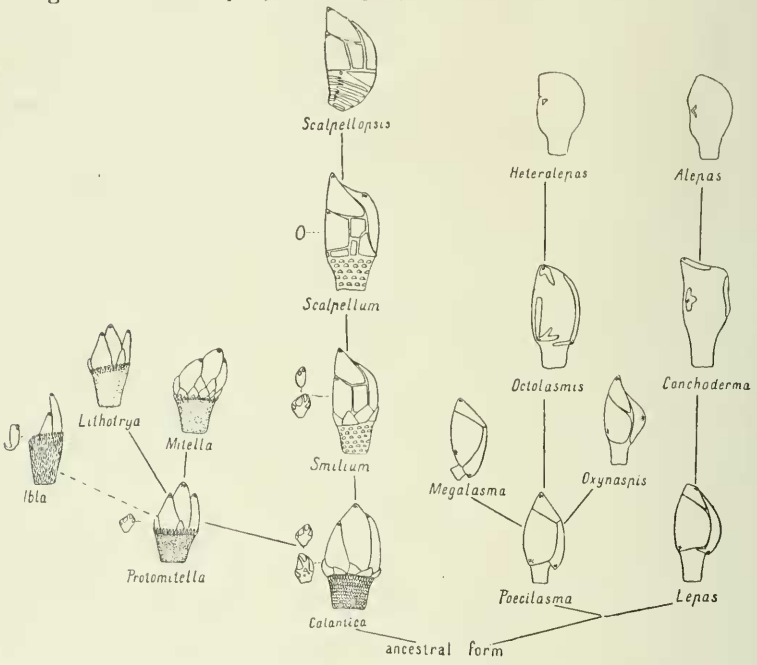


Fig. 1. Diagram showing the phylogenetic affinities of Scalpellidae, and Lepadidae.

first of these genera in some respects seems to occupy a very primitive position, but it has as yet been studied too little to justify any judgement. The other genera are evidently very much transformed or reduced by special biological conditions, and renewed studies are required to settle different questions concerning these enigmatic genera and their relationship with the other pedunculated cirripeds.

[1]) Quite apart from the fact that this name is preoccupied for a family of the Cumacea.

To give a short review of the results arrived at in the discussion of the relationship of the pedunculated cirripeds I add a diagram of their phylogenetic connections, as far as we can construct them with our present knowledge (fig. 1).

Systematic account of the collections.

Family **Scalpellidae** Pilsbry.

According to the introductory chapter, this family, as also evidently maintained by Pilsbry (1916, p. 14), comprises the Pollicipedidae and Iblidae of Annandale (1909, p. 63). As to the name, there is no reason to change it; Scalpellidae was already used by Pilsbry in 1907, and the generic name *Pollicipes* must be dropped, according to the nomenclatory rules, so that nothing is gained by the change proposed by Annandale. The family names introduced by Gruvel (1905) are misleading, and not in accordance with the nomenclatory rules; they are not based on generic names, and come into conflict with names in other groups of animals.[1])

Nothing is gained by a division into subfamilies. In fact the genera of the family are linked together in such a way that it is difficult, if at all possible, to see where the lines of division should be drawn. The only genera, which diverge a little, are *Lithotrya,* and *Ibla,* but it is of no use putting them into subfamilies of their own.

In the collections only *Lithotrya* is wanting.

Genus **Calantica** (Gray) Pilsbry.

Calantica villosa (Leach) Gray.

Halfmoon Bay, Stewart Island. The beach. 19/IX 14. One specimen.
Queen Charlotte Sound, New Zealand, 3—10 fathoms. 19—20/X 14. One specimen.

[1]) Comp. f. inst. Anaspidae, previously preoccupied for Cumacea, Pentameridae, Tetrameridae as used by students of Coleoptera, etc.

Calantica Mortenseni n. sp.

10 miles N. W. of Cape Maria v. Diemen, New Zealand. 50 fathoms; hard bottom. 5 I 15. One specimen.

The species is characterised by its large primary valves, which make a sharp contrast to the small rostrum and latera. The carina and scuta are of almost equal length, and only little shorter than the nailshaped terga.

The carina (Fig. 2) is almost straight, only feebly, but evenly bowed with the apex between tne edges of the terga. Seen from behind it is very slenderly triangular with straight sides.

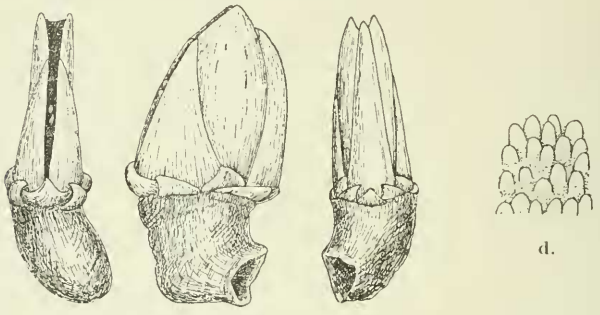


Fig. 2. *Calantica Mortenseni*. a. rostral, b. lateral, c. carinal aspect; d. skeleton of the peduncle. [a.—c. × 2, d. × 12].

The terga are the largest plates of the capitulum, and with their length of 12 mm almost quite as long as the entire capitulum. The plate is nail-shaped, and not very pointed at the apex; it has a rather short and straight occludent margin. The carinal margin is evenly rounded with only a very small part above the apex of the carina; also the scutal margin is evenly rounded, the angle between this latter and the occludent margin very blunt.

The scuta are large, triangular, almost twice as high as broad, with a pointed apex. The length is about the same as that of the carina, or $^5/_6$ of the terga. The tergal margin is feebly concave, the occludent margin all but straight.

Rostrum is the most prominent among the lower row of plates, although its height does not reach 2,5 mm. It is broadly triangular, its apical part recurved.

The latera are low, and triangular, with somewhat recurved apices; whereas the upper latus is almost symmetrical, the apex in the rostral latus is situated near the rostrum, and in the carinal latus oppositely, i. e. at the carinal side. A small, symmetrical subcarina has the same shape as the rostrum, but is much smaller.

The peduncle is a little more than half as long as the capitulum, broad, and laterally feebly compressed. It is covered with densely crowded, calcareous scales.

Fig. 3. *Calantica Mortenseni.* ♂ a. entire animal in lateral aspect. b. mandible. c. maxilla. [a. × 44. b.—c. × 240].

The capitulum is 13 mm long with a width of 11 mm, and a lateral greater breadth of 5,5 mm. The peduncle is 7 mm long. — As only one specimen was present in the material, I would not damage it more than absolutely necessary, and therefore cannot give details as to the anatomy of the animal.

Two males were present at the usual place, and were visible to the naked eye in the female (or hermaphrodite). One of them was sacrificed for closer investigation.

The male in the present species attains a more than usually high development (Fig. 3) having a capitulum skeleton of carina, terga, scuta, rostrum, and three pairs of latera above the distinct peduncle.

The carina is almost triangular, with rather broad base, and does not quite reach the apex of the capitulum; its umbo is apical,

and covered by the chitinal primordial valve. Tergum has a peculiar shape: its lower, greater part is basally narrowly rounded or almost pointed; the upper end, which is covered by the primordial, chitinal plate has its longer axis perpendicular to that of the calcareous valve; an excavation of the scutal margin just below the apex gives the entire plate a characteristic, birdlike shape. — The scuta are slenderly triangular; the tergal margin is concave, forming an angle in the middle part. The primordial plate is /\-shaped and placed on the apex of the scutum; the basal margin of the valve is convex. Rostrum is large, in length about $^2/_3$ of the carina, its basal breadth even larger than that of the carina. The plate is recurved, in ventral aspect broadly triangular. — The upper latus is quadrangular and rather large, the rostral latus broadly triangular, about half as large as the upper latus; the carinal latus is smaller than the rostral latus, but of the same shape.

The distinct peduncle measures between $^1/_6$ and $^1/_7$ of the entire length of the male; it is very broad, and almost cylindrical.

The male has the complete organisation of a fully developed hermaphrodite. Six well developed pairs of bifurcated cirri are present. In cirrus I there are five segments on each ramus, the rami of cirri II and III have six, those of cirri IV to VI show seven segments each. The segments carry the usual armature: on the posterior side the segment distally has one pair of hairs, on the anterior side there are three pairs along the median line, the distal pair being the larger; often a single small hair appears below the three pairs mentioned near the base of the segment.

Caudal appendages are present; they consist of one broad segment carrying two long, distal hairs of unequal size. — The Penis is short, and stout, about half as long as cirrus VI.

The mandible has three teeth, and a broad, pectinate lower angle; the maxilla has a notch below the upper spines.

Calantica Mortenseni is nearly related to *Calantica eos* Pilsbry and *Calantica trispinosa* (Hoek). In *Calantica eos* the scutum is broader and shorter, only being $^2/_3$ of the terga; also the carina is shorter and more straight in *Calantica eos*. The outlines of the capitulum are rounded in *Calantica Mortenseni*; in *Calantica eos* the capitulum is triangular with almost straight sides. To this may

be added that the upper part of the peduncle in *Calantica eos* is nude, whereas the peduncular skeleton covers the entire peduncle in *Calantica Mortenseni*. A comparison of the males is precluded, the male of *Calantica eos* not being described. — *Calantica trispinosa* has an entirely aberrant shape, the apices of the carina, terga, and scuta are pointed, prominent, and free, and there is a great space between the rostrum and the rostral latus. These features seem to demonstrate with certainty, that the specimens from Japan, which Krüger (1911, p. 11) refers to *Calantica trispinosa*, are not at all identical with Hoek's species; although Krüger says that „von der äusseren Gestalt (Taf. I, Fig. 1) giebt Hoek im Challenger-Report eine genaue Beschreibung, zu der ich nur wenig hinzuzufügen habe", his photographs (Taf. I, Fig. 1, l. c.) show such differences from Hoek's drawings and descriptions that the identity is almost entirely out of question with our present knowledge. Krüger's specimens are evidently much more related to *Calantica eos* or *Calantica Mortenseni*. His description of the male shows, that it has a capitulum skeleton of carina, terga, scuta, and rostrum, but no latera; in these features it differs from *Calantica Mortenseni*, so that the identity of the Japanese species remains doubtful. — *Calantica Kempi* (Annandale)[1]) differs from the present species in the presence of a subrostrum, and in the coarsely sculptured plates.

Calantica Mortenseni, owing to the remarkable development of its male, occupies a very interesting position among the Scalpellidae. The most highly developed males hitherto known in the genera *Calantica* and *Smilium* have a capitulum skeleton, consisting of carina, terga, scuta, and rostrum; in *Calantica Mortenseni* also three pairs of latera are present, and among these, curiously enough the upper latus attains a higher development than the others.

The high development of the male gives evidence that we here face a rather primitive species; it stands comparatively near to the ancestors of the entire group, which in all probability have had separate sexes with equally highly developed males and females. The complete organisation of the male in *Calantica Mortenseni* points

[1]) *Scalpellum Kempi* Annandale 1911, p. 589, syn. *Scalpellum Pilsbryi* Gruvel (1912, p. 3).

to its living its own, independent life in the same way as Krüger maintains for *Smilium Peronii*, which he has described in detail (1914, p. 431).

Calantica affinis n. sp.

25 miles E. to S. of Zamboanga; 200 fathoms, on a siliceous sponge. 3 III 14. Several specimens.

The species is characterised by its rather large latera, which overlap each other, and by its nude and short peduncle. (Fig. 4).

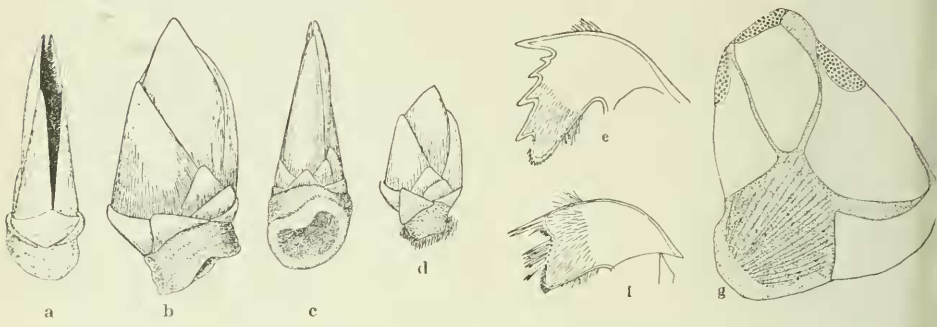


Fig. 4. *Calantica affinis* from 25 miles E. to S. of Zamboanga. a—c —, type in rostral, lateral, and carinal view; d quite young hermaphrodite; e mandible, f maxilla; g complemental male. (a—c × 2,7; d × 5,3; e—g × 33).

The carina is long, and evenly bent; in dorsal aspect it is rather broad, with feebly convex sides; umbo is apical.

Tergum has an arched carinal margin with a stronger bend in the middle; the occludent, and the scutal margins are straight. Among the capitulum plates the tergum attains the greater length, although it does not very much exceed the carina and scuta.

The scutum is triangular with straight occludent, and tergal margins; only the basal margin is convex, and strongly bent.

Rostrum is short and broad with recurved apex; in ventral aspect it is almost rhomboidal, and broader than high.

The latera are broad, and triangular; the superior latus with its distal free portion covers the lower parts of tergum and scutum; its base is overlapped by the carinal, and partly also by the rostral latus. A subcarina is present; it has the same triangular shape as the latera, and partly hides the basal portion of the carinal latera.

The peduncle is short, and broad, covered by a smooth cuticle which exhibits no trace of scales or hairs of any kind. The peduncle even may be shorter than in the specimens figured.

The first cirrus is placed at a little distance from the second; its rami are unequal, the shorter with 10, the longer ramus with 12 segments. The cirri II—VI are long, and strongly curved, with equal rami; in the cirrus V each ramus has about 20 segments. Caudal appendages are present; they are small, consist of one segment with one great hair at the base, and two or three hairs at the distal broad end.

The well developed penis attains a length of $^3/_4$ of cirrus VI; it is not annulated, but has some small hairs scattered all over.

Of the mouth feet the mandible has three larger teeth, and between the first and second teeth two smaller ones; the lower angle is rather pointedly rounded and finely pectinate. The inferior part of the mandible is richly furnished with hairs; at the upper side a small tuft of hairs is seen.

The maxilla has two stronger and one smaller spine at the upper angle; there is a distinct notch between the upper spines and the group of large spines which occupy the median third of the cutting edge; the lower third of the edge is armed with short and stiff bristles or hairs. The surface of the maxilla is richly adorned with fine hairs.

The outer maxillae are obovate, with rather pointed ends; the interior margin has large, hairlike spines on its outer part.

Several specimens were found attached to a siliceous sponge which forms a hard crust. The largest specimens had a capitulum length of 12 mm; the width of the capitulum is 7, the lateral axis at the base 4 mm; the peduncle only reaches a length of 2,5 mm.

Complemental males are present. They have a distinct peduncle, and capitulum, the latter with a well developed skeleton, consisting of carina, terga, scuta, and rostrum; the primary valves have the primordial, chitinal plates at the apex. The shape of the terga is peculiar, the primordial valve forming a beak-like process at the anterior side. Carina and rostrum are triangular with

broad base. The peduncle is short and passes rather imperceptibly into the capitulum.

Calantica affinis conspicuously differs from the other species of the genus by its nude peduncle; indeed, this character distinguishes it from all the family, and only the accessory plates of the capitulum show its affinities. The most nearly related species seems to be *Calantica superba* (Pilsbry); in the latter species the latera have rounded apices, and also the scutal apex is bent in over the tergum, and thus decidedly differs from *Calantica affinis*.

Genus **Smilium** (Gray).

Pilsbry (1908), and after him Krüger (1911) make a distinction between the genera *Smilium* and *Euscalpellum* on base of their males; in *Smilium* the males have the same skeleton as in most of the *Calantica*-species, with six well developed capitulum plates, whereas in the genus *Euscalpellum*, the capitulum skeleton of the males consists of only three rudimentary plates. Although this character is of great interest biologically seen, and also secondarily might serve as a strengthening feature to a generic diagnosis, we cannot look upon the character as a generic fundamentum divisionis. In this respect we may point to the male of *Calantica Mortenseni* which logically ought to serve as the base of a new genus, if we were to follow Pilsbry's reasoning; to this must be added that the biologically much more essential feature of the existence, resp. absence of a male in the different species of *Scalpellum* does not come on record in the systematics. Although these features are of great interest and ought to be carefully studied, they must not be overvalued as systematic characters.

In this paper *Smilium* comprises both genera of Pilsbry mentioned above, i. e. all scalpelloid barnacles with subcarina, and with an upper latus pushed in between scutum, tergum, and carina.

Smilium acutum (Hoek) Pilsbry.

32° 15' N. 128° 12' E., 90 fathoms „Hyaton Maru" 15 V 14. Four specimens on a hydroid colony.

Menado Bay: 1° 31' N. 124° 47' E., 250 fathoms. Capt. Christiansen leg 12 III 13. One specimen on a hydroid.

This fine little species was first described by Hoek (1883) as *Scalpellum acutum*, later by Gruvel (1900) as *Scalpellum longirostrum*. Hoek's figure is not quite characteristic because the subcarina is almost invisible, owing to the somewhat oblique projection; it was his figure which led Gruvel to consider his specimens as representatives of another species; also his drawing is somewhat aberrant in the contours of the rostral latus and the subcarina, in comparison with my specimens, and I, therefore, here give a camera drawing of the specimen from Menado Bay (Fig. 5); it evidently agrees the best with Hoek's type.

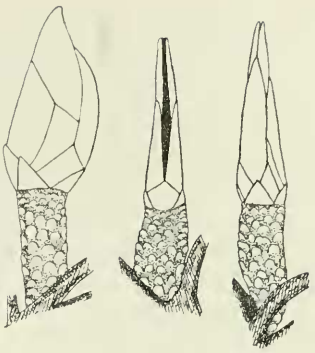


Fig. 5. *Smilium acutum* from the Menado Bay. a. lateral, b. rostral c. carinal view. [× 5,a].

Genus **Scalpellum.**

In the treatment of this difficult genus, Pilsbry (1907) has drawn up new lines, which seem to be of great value. The old classificatory lines drawn up by Hoek, and followed by Gruvel show their inadequacy, nearly related species often being separated and put in distant groups only on behalf of the presence or absence of a rudimentary, often almost invisible rostrum. Rudimentary plates, which always greatly vary in shape and development, cannot serve as a basis for greater systematic groups. — Indeed, a total revision of the genus is necessary; but first of all the development of the species has to be elucidated; probably many of the species have been described from young specimens and ultimately will turn out to be synonyms.

Scalpellum Stearnsii Pilsbry.

15 miles W. 1/2 S. of Jolo, 250 fathoms. 27/III 14. Four specimens.
Sagami Bay, 80—120 fathoms. 6—19/VI 14. One specimen.
Sagami Bay, 400 fathoms. 2/VII 14. One specimen.
32° 17' N., 128° 11' E., 110 fathoms. „Hyaton Maru" 14 V 14. One specimen.

The specimens show the following dimensions in mm:

	I	II	III	IV	V	VI	VII
Capitulum, length .	45	45	44	38	22	20	18
Peduncle, length . .	80	69	50	80	9	13	15

The specimens vary much in their external features, and completely bridge the small gap between the typical form described by Pilsbry (1890), and later by Hoeck (1907) from Sagami, and the var. *robusta* Hoek (1907) from the „Siboga" expedition. There is, indeed, no reason whatever to keep these variants as separate „varieties".

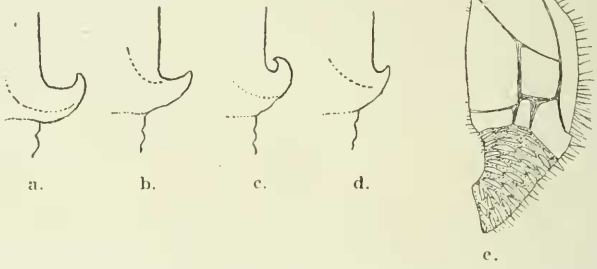


Fig. 6. *Scalpellum Stearnsii*. a.—d. apical projections of the carina a specimen from Sagami, b.—d. specimens from Jolo, e. small specimen from 15 miles W. ½ S. of Jolo. [a.—d. nat. size, e. × 6,7].

The hornlike projection of the carinal latus exhibits great variation (Fig. 6 a.—d.); it can be almost wanting, or it is strongly developed as in one of the Sagami-specimens (nr. III). A parallel variation is shown in Hoek's figure of his var. *genuina* (1907, pl. VI, fig. 4).

In *Scalpellum Stearnsii* the varying extent of the calcification of the valves throws a glaring light on the value of this character as a base for systematic subdivision of the genus. Also Pilsbry (1907) has pointed to the invalidity of the character although he maintains it on behalf of convenience. It would not be surprising indeed if it were to be demonstrated that several of the imperfectly calcified species of *Scalpellum* in reality are variants of species which are normally perfectly calcified. It is in this connection interesting to notice that in *Scalpellum Stearnsii* as in *Scalpellum larvale* (comp. Pilsbry 1907, p. 194, pl. VI, figs. 2—6) — a species with

only very imperfectly calcified valves in the adult — the younger specimens have more extensively calcified plates than the old ones; indeed the youngest stages known of both species have completely calcified capitulum plates (Fig. 6e.). The young specimen of *Scalpellum Stearnsii* figured is indeed so different from the adult that it might be regarded as a representative of another species, were it not for its occurrence; it was found fixed to the stalk of the specimen I (from Jolo), which moreover on its right scutum carries another young, but typical specimen (VII of the table).

An interesting hint as to the enemies of the barnacles is afforded by the specimen V (from „Hyaton Maru"); a little below the middle the carina has a smooth, circular hole like those made by *Lunatia* in mollusc-valves in Northern waters; the capitulum is empty, the animal evidently eaten up by the mollusc. This indicates that molluscs at all events may be enemies of the barnacles, a fact hitherto unknown.

Scalpellum indicum Hoek.

25 miles E. to S. of Zamboanga, 200 fathoms 3 III 14. One specimen on the nude axis of an anthipatharian.

21 miles W. ½ S. of Bonomisaki, 220 fathoms. „Hyaton Maru" 13 V 14. One small specimen on *Megalasma striatum.*

Menado Bay, 1° 31' N., 124° 47' E., 250 fathoms. Captain Christiansen 12 III 13. Two specimens fixed to the cirri of a crinoid.

Scalpellum rubrum Hoek.

Sagami Bay, 80—120 fathoms, sandy bottom. 6—19 VI 14. One specimen.
Okinose, Sagami Sea, 100 fathoms. 26 VI 14. One specimen.

In both specimens the capitulum has a length of 9, the peduncle of 5 mm. In the specimen from Sagami Bay the small rostrum is almost rectangular.

The species is very nearly related to *Scalpellum indicum,* and it might be a question, whether the occurrence of a rudimentary rostrum, and the colour are indeed reliable as specific characters in this case. Moreover much seems to speak in the direction of both species being young *Scalpellum Darwini* Hoek; this question demands closer study.

Scalpellum gruvelianum Pilsbry.

Departure Bay, Nanaimo, 20 fathoms. 8/VI 15. Several specimens.
Strait of Georgia, about 40 fathoms; mud and sponges. 16/VI 15. Several specimens.
Strait of Georgia, about 50 fathoms; mud and stones. 7/VII 15. Two small specimens.

Whereas the latter specimens hold an intermediate position between the typical form and the subspecies *secundum* Pilsbry (1907), the other specimens decidedly belong to the latter sub-

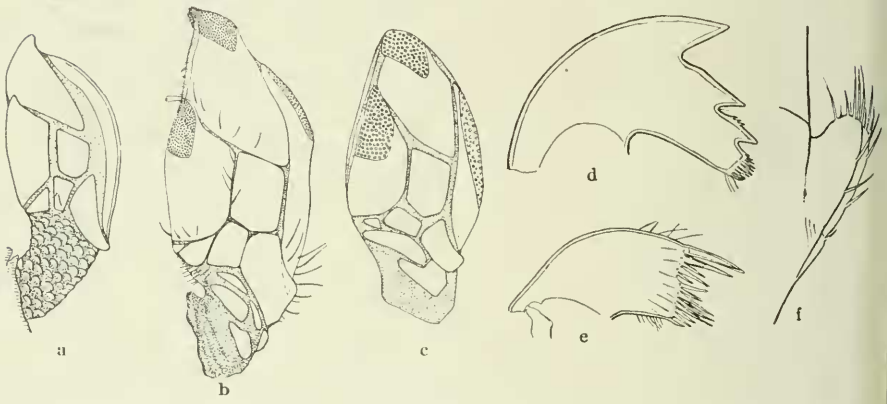


Fig. 7. *Scalpellum gruvelianum*, f. *secundum*. Strait of Georgia. 40 fathoms. a. adult specimen; b. and c. young specimens; d. mandible, e. maxilla, f. caudal appendages of the adult. [a × 4, b × 22, c × 33, d–f × 44].

species, although their inframedian latus seems to be a little more prominent with a somewhat broader upper margin. The larger of the specimens attain an entire length of about 1 cm with capitulums between 6 and 7 mm.

Pilsbry (1907) does not give any details about the body of the animal, although some of the details are rather characteristic.

The mouth feet are only scantily furnished with hairs. The mandible (Fig. 7) has three strong, and rather pointed teeth; the excavation between the first and the second tooth occupies more than half the cutting edge. The lower (third) tooth has three denticles on its upper edge. The inferior angle is rather square cut, and densely pectinate, but almost destitute of finer hairs.

The maxilla has an almost straight cutting edge set with spines all over; only the first two spines are a little more prominent;

the others are rather uniformly developed. Some scanty, fine hairs are seen on the outer part of the maxilla.

In the cirrus I the branches are unequal, the anterior ramus short, with 6 segments, and twice as broad as the posterior ramus which has 8 segments; the basal segment of the posterior ramus is very long, and evidently consists of two or three concrete segments. Cirrus II to VI have all but the same size; their rami have about 13 segments each.

The caudal appendages are short, only consisting of the basal segment (Fig. 7 d.); they are rounded, with two or three short, spinelike hairs along the dorsal side, and four hairs distally.

There is no trace of a penis in the animals dissected. Small oval males are present in the specimens; they display the most reduced type without any trace of skeleton.

Among the specimens from the Strait of Georgia three very small individuals were found; two are represented in fig. 7 b. and c. the third one representing the same stage as the younger of those figured. A comparison with parallel stages of *Scalpellum Strömii* (vide Broch 1912) reveal interesting features of concordance, and of differences.

The youngest stage shows us that in *Scalpellum gruvelianum* as in *Scalpellum Strömii* the superior latus makes its appearance at a very early stage, and the relative size of the plates indicates that also here the two lower pairs of peduncular scales appear before the lower latera. In *Scalpellum gruvelianum* the carinal latus is the first of the lower latera, which makes its appearance at the transition from peduncle to capitulum, immediately followed by the inframedium, and then also by the rostral latus. In *Scalpellum Strömii*, on the contrary, the first plate developed of this row, is the rostrum. The latter plate is rudimentary or absent in *Scalpellum gruvelianum*: herein my specimens confirm Pilsbry's statements (1907); the rostrum may be indicated as a small nodule hardly as large as a scale of the peduncle, or it may be totally absent in the adult. — The other latera are, on the other hand, parallelly developed in both species.

The somewhat older specimen has a small rostrum. This specimen shows us that the same rule holds good in *Scalpellum gru-*

velianum, which was found in *Scalpellum Strömii,* namely that new peduncle scales are only developed at the transition from capitulum to peduncle. The position of the primordial valve shows that the growth of the carina is all but entirely limited to the lower part of the plate.

The specimen exhibits some features which are rather enigmatic. In different parts, especially along the rapidly growing margins of the five primary plates, the epidermis is furnished with scanty, large, and thick hairs, and similar, although somewhat smaller hairs also appear below the rostral latera. Moreover, the apex of the capitulum at the upper end of the occludent margin carries one pair of rather tentacle-like organs covered all over with short hairs. The last features recall the tentacular organs in young *Scalpellum Stearnsii* described by Hoek (1907), although they are smaller, and less numerous in the present species. We must admit with Hoek that nothing can be said as yet about the physiological function of these organs. In *Scalpellum Stearnsii* Hoek observed similar organs in the male; in *Scalpellum gruvelianum* no trace of them was found in the males.

It is surprising that neither hairs nor tentacular organs were found in the smallest specimen, and I shall not venture to give any explanation of the case. Of course, one might think that two different species were represented. This probability must be characterized as very remote; in the rather great assemblage of specimens gathered, no other *Scalpellum* species was represented, and the occurrence of a single, young specimen of another species would then be rather curious. Judging from the occurrence of other species, and their young stages, everything speaks against its belonging to another species than *Scalpellum gruvelianum.* I nevertheless wish to point out that we cannot deny the possibility, however remote it may seem.

Scalpellum californicum Pilsbry.

Off Redondo, California; 30 fathoms. 25/IX 15. Seven specimens.

Pilsbry (1907a) only gives few details as to the animal itself.

The mouth feet are not very hairy. The mandible (Fig. 8) has three teeth, the second being situated at the middle of the cutting edge. The lower angle is rather pointed, and finely pectin-

ate. The lower part of the mandible is covered by small hairs, placed in groups of two or three. — The maxilla has somewhat arched cutting edge with long spines, of which only the upper one is a little more prominent. Only a narrow zone along the edge is hairy.

The rami of the cirrus I are much alike with globose segments, and only differ in their numbers of segments, the anterior having 10 or 11, the posterior 11 or 12 segments. There is a distinct interval between cirrus I and II; also in cirrus II the anterior ramus has somewhat swollen segments. The number of segments in the rami of cirrus II to VI counts from 18 to 22.

The caudal appendages consist of a feeble apophysis and a small globose, distal segment; two larger and four or five smaller hairs are placed distally on the appendage.

The penis is about half as long as the cirrus VI; it is sparsely hairy all over, and has no special tuft at its distal end.

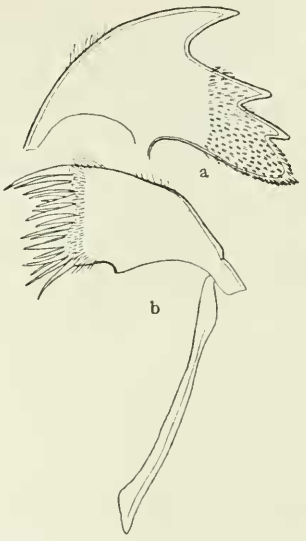


Fig 8. *Scalpellum californicum*, off Redondo. a. mandible, b. maxilla. [× 44].

Scalpellum aff. *salartiæ* Gruvel.

15 miles W. ¼ S. of Jolo; 250 fathoms. 27 III 14. One specimen.

Gruvel (1905, 1901) in his description of *Scalpellum salartiæ* says „Rostre quadrangulaire, légèrement recouvert par les extrémités umbonales des rostro-latérales"; this taken together with his drawings tells us that the rostrum in this species is rudimentary, and therefore probably variable in size and shape. Moreover, the small size of Gruvel's specimen — total length 2,5 mm — seems to indicate that the species has been based on a very young specimen. No weight can therefore be ascribed to the rostrum of the present, larger specimen being very small, and triangular, and not directly covered by the edges of the rostral latera. Also the somewhat irregular, and scantier armature with scales of the peduncle in Gruvel's specimen may be due to its smaller size, as is evident

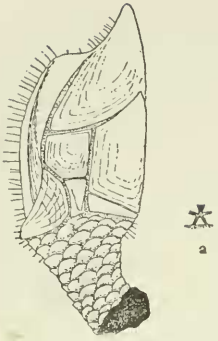


Fig. 9. *Scalpellum* aff. *salartiæ*; W. 1/2 S. off Jolo. a. rostrum. [×5,5].

from the development of other *Scalpellum* species. The present specimen (Fig. 9) has a capitulum length of 5,5 mm with a width of 3,2 mm, and a peduncle length of 3 mm.

More weight might be ascribed to the cuticle which, according to Gruvel, is „mince et glabre", whereas in the present specimen, especially on the carinal side, it is covered with fine and rather long hairs.

Nevertheless I am inclined to refer my specimen to the same species, and do not introduce a new name for it, the more so, as certainly too many species have already been described in the present group, the subgenus *Scalpellum* Pilsbry (1907).

Scalpellum balanoides Hoek.

25 miles E. to S. of Zamboanga; 160 fathoms. 3/III 14. Several specimens, together with *Sc. indicum*.

Menado Bay, 1° 31' N., 124° 47' E. 250 fathoms. Captain Christiansen 13/III 13. Several specimens on the cirri of a crinoid, together with *Megalasma minus*.

The very characteristic species has been carefully described by Hoek (1883). In the present specimens (Fig. 10) the lines of growth are rather distinct; as moreover Hoek's drawings of the habitus are not quite satisfactory, I give a camera drawing of one of the adult specimens.

Among the specimens brought home by Dr. Mortensen also some very young ones were present, the smallest of which is represented in fig. 10b. It differs interestingly from the outgrown form in having a comparatively larger inframedian latus, the apex of which covers the lower, hind angle of the scutum. Also the carinal latus is comparatively much larger than in the adult, and the apex of the carina is free. In the peduncle the regular arrangement of the scales is only seen in the upper part. — Intermediate stages of growth link this specimen to the typical adult form.

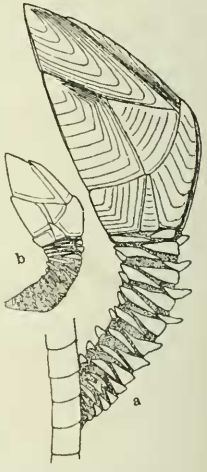


Fig. 10. *Scalpellum balanoides*. a. adult specimen from Menado Bay, b. young specimen from 25 miles E. to S. of Zamboanga. [× 4].

Genus **Scalpellopsis** nov.

Capitulum with 9 or 11 plates: rostrum, and rostral latus absent, inframedian latus rudimentary, carinal latus well developed. Upper latus interposed between carina, tergum, and scutum. Peduncle with scales. — Male absent.

It is not without hesitation that I introduce this new genus. It is closely allied to *Scalpellum*, and we might feel inclined to consider it a subgenus of the latter. Nevertheless the great number of species of that genus, and the dissatisfactory systematic groupings of it made me prefer, at all events provisionally, to introduce a new genus for the species described below. The great reductions in the lower row of latera give it an aspect which differs strikingly from the true *Scalpellum*.

Scalpellopsis striatociliata n. sp.

Near Jolo; 20 to 30 fathoms, on hydroids. 19/III 14. Several specimens.

Valves of the capitulum eleven, covered by a chitinous membrane. Carina simply bent with apical umbo. Terga triangular, scuta quadrangular with apical umbones. Upper latus large, quadrangular. Carinal latus large, triangular, pointed towards the rudimentary inframedian latus. — Scales of the peduncle large, in four longitudinal rows. Cuticle of the capitulum with transverse rows of long hairs. Peduncle with a broad, anterior, longitudinal furrow.

The capitulum (Fig. 11) is broad; its width is about two thirds of its height. It is covered by a pellucid, hairy, chitinous membrane, and the transversal rows of hairs lend a peculiar aspect to the species. The rather long hairs are placed in four or more transverse rows on the terga, scuta, and carina, two or three on the carinal latus, but no distinct rows were observed on the upper latus; at the lower part of this plate, between the plate, the scutum, and the carinal latus a row of hairs is seen. The interspaces between the capitulum plates are very narrow, but of a dark brownish hue.

Scutum is quadrangular with an almost quite straight occludent margin; the umbo is apical. The apical part slightly overlaps

the base of the tergum. The base of the scutum is broad; the plate becomes narrower upwards along the superior latus, so that its shape somewhat tends towards the triangular form; the tergal margin is a little excavated.

The tergum is triangular with a somewhat concave occludent margin; the apex is pointed.

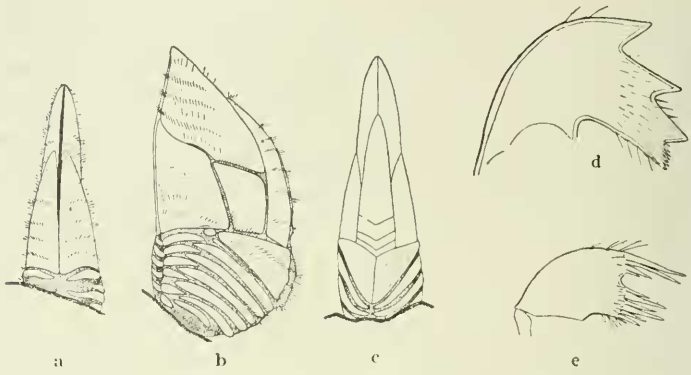


Fig. 11. *Scalpellopsis striatociliata*, off Jolo. a. rostral, b. lateral, c. carinal view of adult specimen (in c. the cuticular hairs are omitted); d. mandible, e. maxilla. [a—c × 17, d—e × 147].

The carina is simply bent with a pointed apex. The plate is narrow, its basal margin is angularly bent, and footing on the carinal latera.

The upper latus is quadrangular with a somewhat pointed apex jutting in between the scutum and tergum. The inframedian latus is rudimentary, only represented by a small, calcareous nodule at the hind part of the basal scutal margin. The carinal latus is large, and triangular. Its upper margin extends from the dorsal, sagittal line past the upper latus and a little beyond the hinder, basal angle of the scutum. The dorsal margins of the carinal latera meet in the sagittal, dorsal line of the capitulum.

The peduncle is short, and thick; it merges evenly into the capitulum. The skeleton of the peduncle consists of four rows of broad, and low scales, the ends of which overlap a little at the sides of the peduncle, whereas there is a distinct interspace present between the scales along the sagittal lines, a little broader on the ventral than on the dorsal side. The broad ventral side of the

peduncle is somewhat excavated by a broad furrow from the capitulum to the base.

Size: the larger of the specimens attain a total length of 2,5 mm wih a capitulum of 1,5 mm.

The mouth feet in their general features agree with the *Scalpellum*-type. They are only scantily adorned with hairs.

The mandible has three strong teeth separated by almost equally great excavations; the lower angle is pointed, almost tooth-shaped, with a strongly pectinate upper edge.

The maxilla has two large, and one or two smaller spines at its upper side; below these spines there is a shallow but well defined excavation; the lower half of the cutting edge is armed with 6 or 8 strong spines.

The cirrus I is placed beside the mouth, and separated from the next cirrus by a small interval; it is only slightly stouter than the other cirri, and has subequal rami. The anterior ramus has 5, the posterior 6 segments. Cirrus II to VI are rather short, slender, and only little curved. Their rami have 8 to 10 segments.

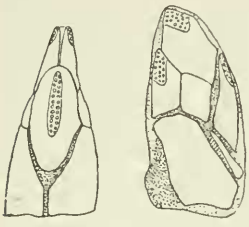
Caudal appendages are absent.

The penis is short, not reaching half the length of the cirrus VI. It has some few, small hairs here and there, and a strong tuft of hairs at the distal end.

More than thirty specimens of this curious little barnacle were brought home by Dr. Mortensen from the Philippines, all of them fixed to one hydroid colony (a *Grammaria* sp.). I was at first inclined to look upon them as young specimens of some species or other of the Scalpellidae, only in this case they would be curiously discordant with all stages of development in the group hitherto known. A closer study revealed the astonishing fact that all larger specimens in their mantle cavity had eggs in different stages of development; the specimens have only 15 to 25 eggs developing at a time. This proves that the animals are outgrown, and we are obliged to consider them as representatives of a new species, which is so aberrant that at present we must even place it in a genus of its own, no other species being known which can be said to be nearly related to this one.

Among the specimens also some few quite young ones are

present. The youngest of them (Fig. 12a) has already a well developed skeleton, which is very characteristic, and strikingly contrasts with the corresponding stages of hitherto investigated *Scalpellum* in having only one pair of peduncular scales developed before the lower latera appear. On the other hand, these first scales of the peduncle are much larger in the young than any plate of the capitulum. In the capitulum carina, terga, scuta, and upper latera are already present in the smallest specimen; the chitinal, primordial valves are extraordinarily small. The shape of the young individual is very characteristic already in this stage, owing to the enormous development of the dorsally situated first pair of peduncular scales; in dorsal aspect the basal breadth measures about one third of the length of the animal. On the ventral side the characteristic broad furrow of the peduncle is already strongly indicated. The all but quadrangular shape of the first pair of peduncle scales strikingly differs from the ribbonlike scales of the adult. But the aspect of the small specimen is already so characteristic that it is easily identified.



a. b.

Fig. 12. *Scalpellopsis striatociliata*, off Jolo. a. younger specimen in carinal view; b. somewhat older specimen in lateral aspect. (× 52).

Genus **Protomitella** nov.

Capitulum plates numerous, of two different kinds. Carina, terga, scuta, and rostrum well developed, often also upper latus, and a subcarina. The lower latera long and narrow, very numerous. Skeleton of the peduncle small, crowded spines. — Males with carina, terga, scuta, and rostrum; accessory plates may occur.

This curious genus links together the genera *Calantica*, *Mitella*, and *Lithotrya*. The males attain the same high development as in *Calantica*; in one case I even found one latus indicated. The irregular, and numerous small, lower latera in the hermaphrodite in regularly shaped specimens recall those of some *Mitella*-species to confusion, and the possibility cannot be denied that the species described below may turn out to be synonymous with *Pol-*

licipes Darwini Hutton. This question cannot be settled from literature. — On the other hand, the reduction of the lower latera to flat scales would give us a *Lithotrya,* and at first sight I was inclined to refer some of the specimens to this genus.

The occurrence of complementary males in *Protomitella* is a primitive feature in comparison with *Mitella* — hence the name —, and strengthens the evidence of the phylogeny of *Mitella* — arrived at on basis of the skeletonal development (comp. Broch 1921). The scanty occurrence of males may be due to the time of the year; but it may also possibly be taken as a proof of the male being about to disappear in the genus.

Protomitella paradoxa n. sp.

Slipper Island, New Zealand; coast at low tide. 20/XII 14. Three specimens.

Plimmerton, New Zealand; on the coast. 15/1 15. Three specimens.

Carina, terga, scuta, and rostrum well developed, generally also an upper latus, although this plate is often almost hidden behind the lower, almost digitiform latera; among these latter a subcarina is often rather prominent, a subrostrum not. The peduncle is armed with densely crowded, calcified, chitinous spines. — Males with carina, terga, scuta, and rostrum; irregularly occurring latera sometimes occur.

The capitulum exhibits a very variable aspect (Fig. 13) owing to the enormous variation in shape and development of the capitulum plates. It is covered by a dirty, yellowish-brown, thick, and hairless cuticle which obscures the delineations of the lower parts of the thick plates, and often almost hides the upper latus.

The carina is straight or feebly arched, with the apical part free: the plate may be as broad at the apex as at the base, and is ornated with prominent lines of growth. The carina may be the largest plate of the capitulum or it only attains two thirds of the length of the terga.

The tergum is more triangular or quadrangular, the apex being pointed or square; it is the largest plate of the capitulum, although it is sometimes surpassed in length by the narrower carina. The growth lines are also here prominent as in all plates of the capitulum.

The scuta are commonly more pointed, and more constantly of a triangular shape; their tergal margin covers the basal part of the tergum. The apex of the scutum is situated at two thirds

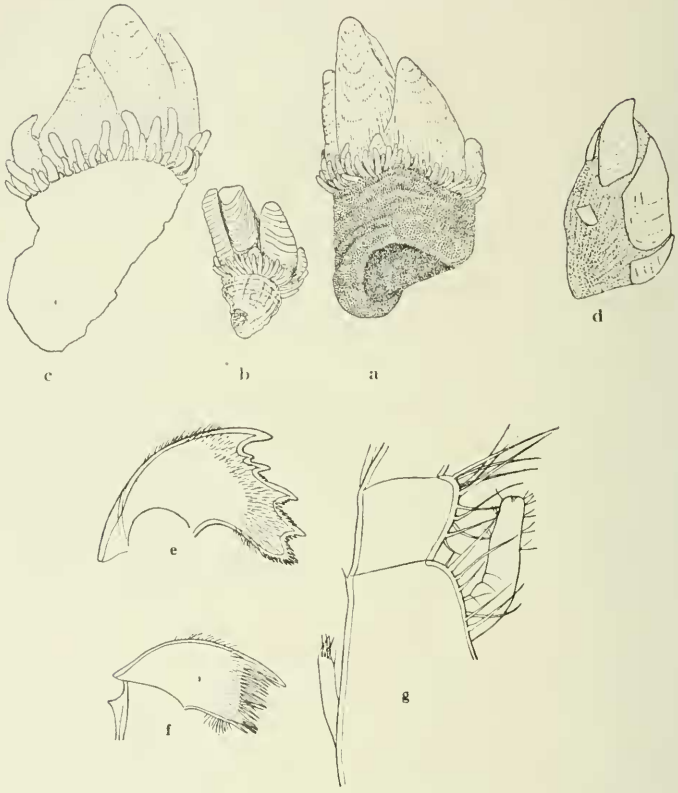


Fig 13. *Protomitella paradoxa.* a type specimen from Plimmerton; b small specimen from the same locality; c outlines of a specimen from Slipper Island; d complementary male of the type specimen; e mandible, f maxilla, g protopodite of cirrus VI with penis and caudal appendage of the hermaphrodite. [a—c × 2,7, d × 13,3 e—g × 33].

the hight of the tergum. The occludent margin is all but straight; the apical part of the plate is free.

Rostrum is short, and broad, of an irregular shape; its length varies from $^1/_5$ to $^1/_3$ of the scuta.

The upper latus is almost hidden in the thick cuticle of the capitulum; it generally only slightly surpasses the lower latera. The same applies to the subcarina. Both plates are irregularly shaped.

The lower latera constitute a single, or an incipient double row at the base of the capitulum. They are present in a great number; in some specimens even more than 60 were counted. Their shape is fingerlike, upwards, and inwards curved, with external, distinct, transverse lines of growth.

The peduncle exhibits a curious, almost velveteen appearance, owing to the crowded, calcified, cuticular, papillæ which cover the entire surface; each spine is comparatively long and slender.

Dimensions of the specimens in mm:

		Plimmerton			Slipper Island		
		I	II	III	IV	V	VI
Capitulum	length	8	6,5	4,5	10,5	10	7
	width	8	7	4,5	11,5	9,5	7,5
Peduncle,	length	7*	9,5	3*	12	9*	8

* Lower end of the peduncle damaged.

The dissection of the Plimmerton specimen II gave the following results as to the animal itself:

The cirri are rather short and stout. Cirrus I is only by a small space separated from the next cirrus; its rami are of equal length, buth they differ in number of segments, the anterior having 10, the posterior ramus 11 segments. The segments of cirrus I are only a little more swollen than in the other cirri. Cirrus II to VI are only a little more slender and large; their rami are of equal length, but in each cirrus the number of segments in the rami differ by one: in all cirri the anterior ramus has 12, the posterior 13 segments. The arrangement of the spines in each segment is almost the same as in *Calantica*.

Filamentary appendages are absent.

The caudal appendages are short, and broad (in fig. 13 g the appendage is seen from the narrow side); on the distal end they have some few, strong, and rather short hairs.

The penis is very short, only as long as the protopodite of cirrus VI. A few scanty hairs, arranged in pairs, are present in the outer part, but no tuft is seen at the distal end.

The labrum is not very bullate; its interior edge has an open row of very fine denticles.

The mandible has three larger teeth, and between the two

first two smaller teeth; the excavation between the lower of these latter and the second large tooth is armed with two or three diminutive spines. The sinus between the lower teeth, and the lower angle of the mandible are strongly pectinate; the lower angle is not very prominent although rather pointed. The sides of the mandible are covered by fine hairs near the cutting edge.

The maxilla has a strong upper spine; there is no notch nor excavation along the cutting edge; this latter is straight and armed with spines, shorter and slenderer than the upper spine. The lower corner is a little prominent and carries a small brush of bristles. Some few fine hairs are seen on the sides of the maxilla near the cutting edge.

In the specimen I from Plimmerton two males were found attached to the inner edge of the scuta at the apex of the rostum. They are both a little damaged from the preparation, but one of them (Fig. 13d) gives a good idea of the general features, being only very little damaged on one side. The male has a capitulum skeleton consisting of carina, terga, scuta, and rostrum; in the specimen figured an accessive latus is present on one side. The latter may of course be an exceptional irregularity, but it also may be regarded as evidence of a tendency to variation. The difference in shape of the uninjured plates of the two males observed evince a tendency towards variation in the capitulum plates quite parallel to that found in the hermaphrodite.

The males have a well developed peduncle.

None of the descriptions hitherto published of the *Mitella*-species covers the animals brought home by Dr. Mortensen. In some respects it seems to come near to *Mitella (Pollicipes) Darwini* Hutton; the latter species nevertheless apparently differs in the more curved carina; also Gruvel speaks of „écailles pédonculaires" in this species, a designation not likely to cover the spines of *Protomitella paradoxa*. Recently Jennings (1915) has moreover identified *Pollicipes Darwini* as synonymous of *Mitella sertus*, a species which markedly differs from *Protomitella paradoxa*. — Of the Slipper Island specimens, the most regular one (Fig. 13c) decidedly recalls the typical *Mitella*. In this specimen no accessive

upper latus is seen; on the other hand a subcarina is broad, and better developed than in any other of the specimens investigated; in this specimen (nr. V of the table) there is a pronounced tendency towards a development of two distinct rows of small basal latera, the plates of the upper row being a little larger. They all have the typical finger-like shape as in other specimens.

I should probably have regarded the species as a *Mitella*, in spite of the finger-like, smaller latera which, indeed, only show little difference as compared with *Mitella mitella* (Lin.). But the occurrence of a complementary male makes it necessary to place the present species in a genus of its own. The crown of small latera strongly contrasts with *Calantica*, with which genus *Protomitella* is otherwise nearly related.

Genus **Mitella**.

The find of *Protomitella*, and the development of the *Mitella* species described below not only throw new light on the affinity and phylogeny of the genus *Mitella* itself, but also provides us with a base from which we may judge of the phylogenetic affinity of the species within the genus.

The most primitive group among recent species is the *sertus*-group, characterised by a low development of the latera; only the rostrum has attained a higher development as in the preceding genus; the latera do not much surpass the peduncle scales in size. and none of them predominates the others. — The next stage is found in *Mitella mitella* where an upper latus is well developed, and much larger than the other latera, being only a littlle smaller than the rostrum. In the *pollicipes*-group on the other hand, as here illustrated by *Mitella polymerus*, also other latera emancipate themselves from the lower row, and in this way the skeleton of the capitulum becomes more complicated. We are able to characterize an upper latus, a carinal, an inframedian, a median, and a rostral latus; but it is not probable, that these plates really are homologous with the plates of *Scalpellum*, referred to by the same names. Quite on the contrary, the development seems to indicate that here we face a convergency, which cannot be taken as proof of a phylogenetic relation.

In the following report of the species I commence with *Mitella polymerus* as the material gives a most complete picture of this species.

Mitella polymerus (Sowerby) Pilsbry.

La Jolla, California, on the coastal rocks. 21 VII 15. Forma *typica*, in great abundance.

Bird Rock, La Jolla, California. 27 VIII 15. Forma *echinata*, four small specimens on sea weeds.

San Pedro, California. 27 IX 15. Forma *echinata*; some few specimens.

The large material of typical *Mitella polymerus* displays some variation in the lower rows of latera. Gruvel (1905) in his diagnosis gives as characteristic of the genus „Sous-rostre et sous-carène toujours présents". Nevertheless, we cannot always find a subrostrum in the present species; quite on the contrary, in most cases a subrostrum is absent, or at all events so difficult to trace that its presence is in fact very doubtful; the subcarina, on the other hand, is always well developed.

In the material a great many very small stages are found attached to the outgrown specimens, and I was able to find the complete series from pupa to adult. This was indeed of great interest as the informations of the development of the species, which may be gathered from the literature, are very meagre and dissatisfactory. Darwin (1852, p. 310) has studied a young *Mitella polymerus* of 0,018 inches; but in this specimen already 22 or 24 plates were found. Nussbaum (1890) has evidently not laid any stress on the study of the young animals, and his drawings of them are indeed little precise. The deductions, which Gruvel (1905, p. 5) has made on basis of these drawings, therefore cannot hold against critics.

The pupa (Fig. 14 a) is very small; it is often seen crawling among the peduncle scales of outgrown animals, and evidently often fixes itself to them. As soon as it has chosen its place and fixed the antennae, five primordial valves appear; as in *Scalpellum*, and other cirripeds investigated, the primordial valves — the embryonic carina, terga, and scuta — are chitinal with no trace of carbonate of lime, and have the same porous structure. On the interior side of the primordial valves calcification now at once commences; this makes the primordial valve appear as a scale, indicating the umbo

of the plate. It is at once evident that the umbones of the five primary plates are apical, i. e. that calcification is continued only along the lower sides of the plates.

As soon as the calcareous deposits become evident outside of the margins of the primordial valves, the next plate, viz. rostrum,

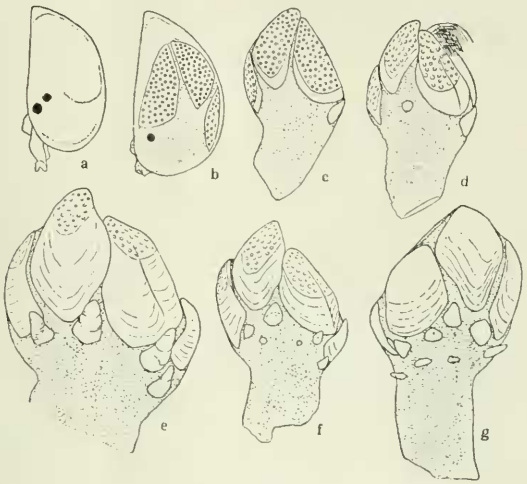


Fig. 14. *Mitella polymerus* f. *typica*, development of the skeleton. La Jolla. a pupa just attached; b pupa with primordial valves; c pupa cover thrown off, rostrum developed; d specimen with upper latus only; e somewhat aberrant specimen with three upper latera and subrostral latus; f normal specimen with two of the lower latera developed; g first peduncular scale appearing below rostrum, subcarina well developed. [All figures × 33].

makes its appearance (Fig. 14c); it is very soon followed by an upper latus, below the interval between tergum and scutum. A little later we can also distinguish a carinal, and a rostral latus; at this time the first plate of the lower row of latera moreover makes its appearance below the interval between rostrum and rostral latus.

Generally the following latera of the lower row appear all but simultaneously with the last named lower latus, and now also the subcarina (Fig. 14g) is observed as a rather obvious plate.

Not until the subcarina is developed do the scales of the peduncle commence their development. First those of the ventral (rostral) side develop; little by little the lateral scales appear, the later the nearer the carino-sagittal line. Owing to the growth of

the peduncle, which is evidently almost limited to the zone where new scales and plates arise, i. e. the transition from capitulum to peduncle, the peduncular scales thus will form oblique series ascending from the ventral (rostral) to the dorsal (carinal) side of the peduncle.

Little by little the lower series of latera now arise, always one new plate below the intervals in the precedent row. Much livelier

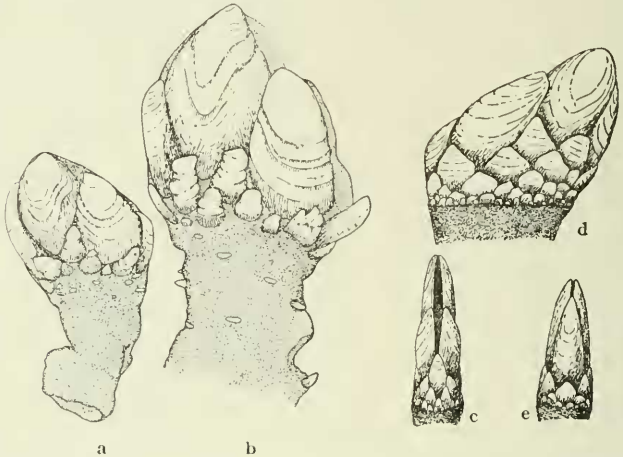


Fig. 15. *Mitella polymerus* f. *typica*; La Jolla. a specimen with peduncle scales only rostrally and laterally; b somewhat older specimen showing the oblique series of developing peduncle scales; c rostral, d lateral, e carinal aspect of the capitulum of an adult specimen. [a—b × 22, c—e natural size].

nevertheless is the formation of peduncular scales, and though the growth of the capitulum now becomes ever more slow, and the formation of new capitulum plates soon finishes, the growth of the stalk, and the development of new peduncle scales just below the capitulum seems to be continued through all the life of the individual, and always according to the same rule. Thus the oblique serial arrangement of the scales is kept, although it sometimes is a little obscured in larger specimens, owing to accidental contractions.

Thus here as in *Scalpellum* we may put down as a fixed rule, that new (accessory) plates are always developed at the transition from capitulum to peduncle. The scales of the peduncle almost entirely abuse their growth, when they have been removed some way from their zone of origin. I have never been able to confirm

the statement of previous authors that new scales normally arise farther down on the peduncle.

The growth of the capitulum plates is due to apposition. New layers of carbonate of lime are deposited along the inner side of the plates, and particularly along the margins of the plates facing the transition from capitulum to peduncle. Umbo of the primary plate thus becomes apically seated. The lines of growth are irregular, and do not stand in any apparent connection to outer

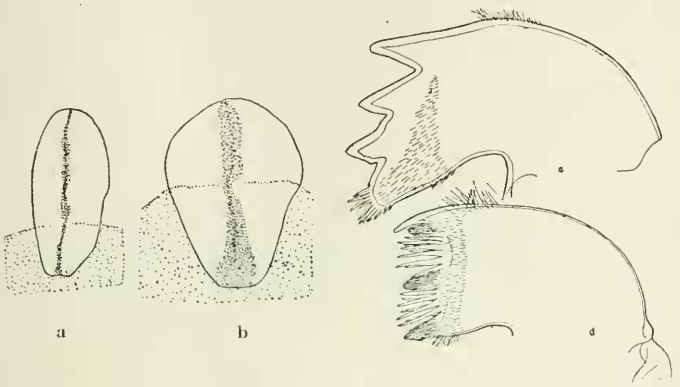


Fig. 16. *Mitella polymerus* f. *typica*; La Jolla. a peduncle scale from the basal part, b from the middle part of the peduncle, c mandible, d maxilla. [a–b × 44, c–d × 22].

circumstances; their numbers therefore also differ in different plates of the same individual, also in the primary plates, and do not afford any base for a judgement as to the age of the specimen.

It is evident from the facts here stated that a great likeness is seen in the skeletonal development of *Mitella* and *Scalpellum* (comp. also Broch 1912, 1921); the main difference is seen in the appearance of the first scales of the peduncle. The first — i. e. the dorso-basal — pairs of peduncle scales in *Scalpellum* appear already at the same time as the superior latus. In *Mitella,* on the other hand, the first peduncle scales are not developed till the subcarinal row of latera have appeared, and the first peduncle scales, which then appear, are the ventro-basal ones.

In his monograph Gruvel (1905, p. 19) says: „Écailles des rangées supérieures aplaties, de couleur gris sombre, petites, en séries circulaires serrées et régulières; sur tout le reste du pédoncule, les écailles prennent la forme d'épines irrégulièrement disposées". In spite of the great number of adult animals of the typical *Mitella polymerus* from La Jolla, it has been impossible to confirm these statements. A closer study without exception reveals the regularly alternating arrangement of the scales all over the peduncle, and no trace of „spines" was found. In typical specimens the scales (Fig. 16) are always broad and rounded, viewed from the

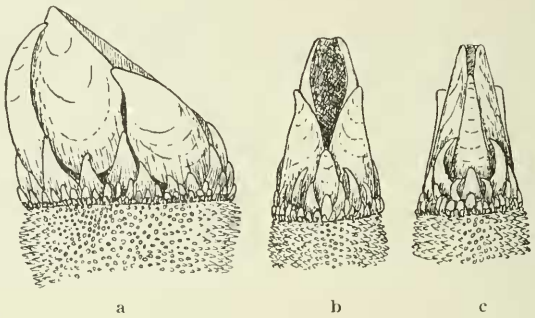


Fig. 17. *Mitella polymerus* f. *echinata* from San Pedro, Calif. Capitulum of adult specimen in a lateral, b rostral, and c carinal aspect. [× 2].

flat side. Nevertheless the animal itself in every detail coincides with the descriptions given by previous authors. I have, therefore, given the name of forma *typica* to the common La Jolla specimens.

The material also contains some specimens of a *Mitella* which at first sight might be considered as another species (Fig. 17). The plates of the capitulum are more slender, and pointed; the intervals, especially between the upper latera, therefore become more conspicuous, and the regular serial arrangement of the plates is less obvious. In smaller specimens these differences from the forma *typica* are very pronounced; in a larger specimen, on the other hand, the differences are somewhat less obvious. Most different is the armature of the peduncle. In the specimens here referred to, the scales of the peduncle (Fig. 18c) are slender, and jut out from

the surface like small spines, somewhat recalling the appearance of the *sertus*-group.

Nevertheless it is not possible to maintain the individual groups, here referred to, as representatives of a separate species besides

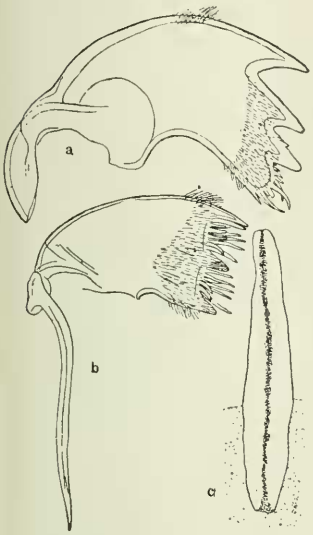
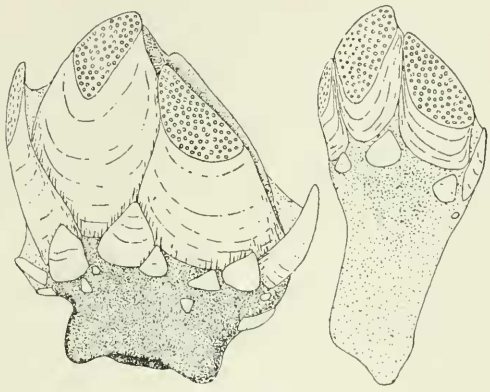


Fig. 18.



b. Fig. 19. a.

Figs. 18 and 19. *Mitella polymerus* f. *echinata* from San Pedro, Calif.
Fig. 18. a mandible, b maxilla, c scale from the middle part of the peduncle. [× 33].
Fig 19. a. small specimen with only the three upper, principal latera developed, b. somewhat older specimen where the peduncle scales are about to appear. [× 44].

Mitella polymerus. The features of the animal, its mouth feet (Fig. 18), cirri, and appendages entirely agree with the forma *typica*. Owing to the external differences they must nevertheless be regarded as a special variant group, which I have given the name of forma *echinata*, owing to its spring appearance. Later investigators shall have to find out the special conditions, under which this form develops. Some few specimens from Bird Rock near La Jolla give evidence that both forms occur near the biological station.

To the peduncle of the greater specimen from San Pedro some small specimens were attached; the youngest two are depicted in fig. 19. Although they do not exhibit principal differences from the

developing stages of the forma *typica*, some difference in shape is evident. Thus f. inst. carina and rostrum of these young individuals of forma *echinata* are a little more diverging than in forma *typica*, and the slender, pointed shape of the plates is already distinct. —

It is possible that the differences between Gruvel's statements and the present results, spoken of under forma *typica* (pag. 256) are due to a confusion of the two forms here described. My material of forma *echinata* is too small to furnish a base for studies of its variations. A study of Nussbaum's paper (1890) seems to reveal that he has had at least both forms before him. Although his drawings of the young specimens are inexact, we can see that fig. 6 of his pl. I is of a young forma *echinata*; we thus at present are able to state its occurrence at San Francisco, at La Jolla, and at San Pedro, California.

Mitella mitella (Linné) Pilsbry.

South of Vitalis Point, Mindanao. Coastal rocks. 7/III 14. Some few specimens.

Curiously enough, Gruvel (1905) has not emphasized the most characteristic feature of this elegant *Mitella*, viz. the enormous development of the upper latus, as compared with the other latera (Fig. 20). This feature indeed so strongly contrasts with the other species of the genus that we may say that *Mitella mitella* is characterized by this feature alone. Because of this character the species moreover holds an intermediate position between the *pollicipes*-group [*Mitella pollicipes* (Gmelin), *Mitella elegans* (Lesson), and *Mitella polymerus* (Sowerby)], and the *sertus*-group [*Mitella spinosus* (Quoy et Gaimard), *Mitella Darwini* (Hutton), and *Mitella sertus* (Darwin)], the *pollicipes*-group is characterized by the higher development of at least upper, carinal, inframedian, and rostral latera; in the *sertus*-group all the latera are uniformly developed, and spine-like. — Besides the extraordinary development of an upper latus *Mitella mitella* presents a rich sculpture of the capitulum plates.

I am not able to agree with Gruvel who states the scales of the peduncle to be more irregularly arranged in *Mitella mitella* than in *Mitella elegans*. All specimens which I have had the opportunity of examining, exhibit an absolutely regular arrangement

of the scales in rings, each scale above or below the interval between two scales of the preceding or the following row, so that regular, transverse, and oblique series are evident, if the arrangement has not become a little obscured by irregular contractions of some part or other of the peduncle.

Also in its mouth feet (Fig. 20 c—d) *Mitella mitella* strikingly differs from the other species of the genus. The mandible has

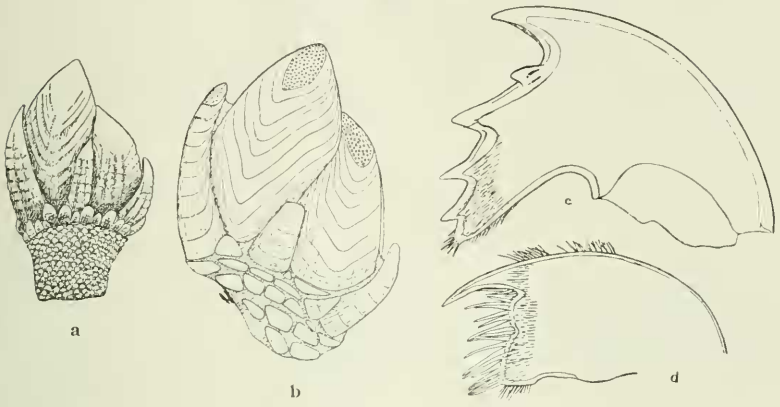


Fig. 20. *Mitella mitella*; South of Vitalis Point, Mindanao. a adult specimen, b capitulum and fragment of peduncle of a quite small specimen; c mandible, d maxilla. [a natural size, b × 22, c—d × 33].

four main teeth, the second being situated in the middle of the cutting edge; in the large excavation between the first and the second tooth, and a little beside the cutting edge, an accessory small tooth is developed. The lower edge of the mandible is armed with a tuft of rather long spines. — The maxilla has an extraordinarily stout and large upper spine; below this a pronounced excavation is found, and halfway down the cutting edge yet another, shallower excavation; the cutting edge is densely armed with strong spines, but has no special tufts of bristles, as other specimens of the genus.

Caudal appendages are present; they have six segments and are richly armed with hairs in their outer parts. The penis is, on the other hand, almost destitute of hairs. —

Only one smaller specimen was observed of *Mitella mitella* (Fig. 20 b); although the skeleton is fairly well developed we can see

that in this species the first scales of the peduncle develop very early, even before the all but single row of smaller latera commence to appear. The primordial plates are a little larger than in the preceding species; this seems to indicate that the pupa of *Mitella mitella* must be a little larger than that of *Mitella polymerus*.

Mitella sertus (Darwin).

Hen and Chicken Islands, Hauraki Gulf, New Zealand. On the coast below the rocks 30/XI 14. Numerous specimens.

The numerous specimens give a rather good idea of the variations of this species; partly the number of lower latera is found

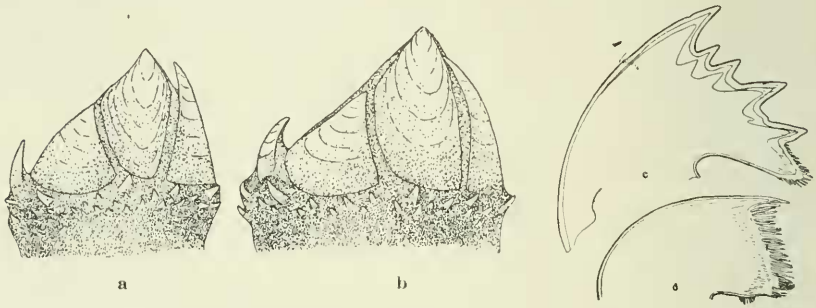


Fig. 21. *Mitella sertus* from Hen and Chicken Island, N. Z. a and b Capitulums of two adult specimens showing variation of the carina; c mandible, d maxilla. [a–b × 1,5, c–d × 15].

to be very different, partly the shape, and arrangement of the capitulum plates also differ in different individuals (Fig. 21). The variations of the carina are especially obvious; in some specimens the carina is almost quite straight, with prominent apical part, in others it may be evenly curved with the apex between the hind margins of the terga. These extreme variants are linked together by a complete series of intermediate stages, and they cannot even be distinguished as different „varieties", being merely accidental variants. — The variations of the present material tell us that Gruvel's characteristic of the species (1905) „la carène qui est droite, à apex saillant en arrière des terga" does not always hold good. This variability also justifies the doubts already uttered by Gruvel on the same occasion, whether *Mitella Darwini* (Hut-

ton) is in reality specifically distinct, and corroborates the statements of Jennings (1915) that *Pollicipes Darwini* is synonymous with *Mitella sertus*. Jennings moreover considers the latter name as a synonym of *Mitella spinosa* (Quoy et Gaimard); my material does not allow me to follow up this question; my specimens quite agree with *Mitella sertus*, and differ from *Mitella spinosa*, according to the dates given by Gruvel and Darwin.

Characteristic of the species are the small latera, which in fact only look like rather well developed peduncle spines. Only the rostrum is very strongly developed, its distal half or more projecting like a horn. — The mouth feet are very characteristic and agree with Darwin's descriptions (Fig. 21c, d). The mandible has three principal teeth, the second standing below the middle of the cutting edge; between this and the first principal tooth two secondary, smaller teeth are inserted, and a very small accessory tooth may also be indicated between the second and third main teeth. The lower angle is strongly pectinate; the entire mandible is almost perfectly destitute of finer hairs. The maxilla has a straight cutting edge without excavations or notches; the upper spine is only little larger than the crowded spines of the edge; just above the lower angle one tuft of bristles is evident. Only very few finer hairs are seen near the cutting edge.

Two quite small specimens were present in the material (Fig. 22). Of the primordial valves scutum has evidently already a characteristic shape; it is typically triangular with a broad, almost straight base, and differs strikingly from the trapezoid scuta of the other species with their strongly curved basal margins. In both specimens the difference between the primary plates

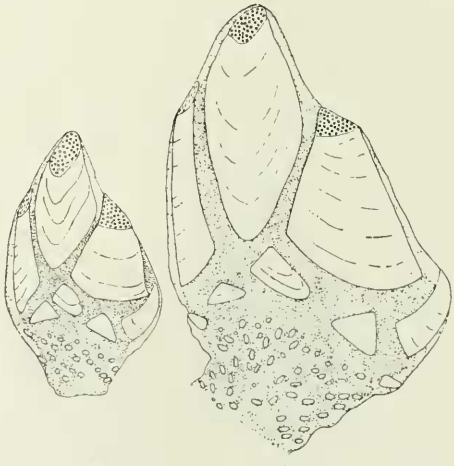


Fig. 22. *Mitella sertus* from Hen and Chicken Island, N. Z. a subcarina only just indicated, complete animal; b also subrostrum well developed (peduncle only partly drawn, of the same length as the capitulum). [× 23].

and the rostrum, and the lower latera is far less than in the adult.

The smallest specimen might very well be taken to be a young *Calantica* with its well developed latera — upper, carinal, and rostral latera are very conspicuous. — Already the next stage is more distant from *Calantica;* the lower latera are here separated by greater intervals and in growth already far behind the primary plates and the rostrum.

A most interesting feature is observed in these two young specimens, viz. the irregular arrangement of the scales of the peduncle. In the smallest individual an arrangement in oblique series, somewhat recalling the small *Mitella polymerus,* is still to be faintly distinguished; but already in the other specimen no regularity can be detected in the arrangement of the peduncle scales, and judging from their size, we moreover must suppose that new scales in *Mitella sertus* are secondarily formed almost all over the peduncle. — In the smallest specimen the peduncle has a length of about one third of the capitulum; in the next specimen the peduncle is much narrower, but of the same length as the capitulum.

Genus **Ibla.**

Ibla quadrivalvis (Cuvier) Gray.

Port Jackson; coastal rocks. 20/X 14. One specimen of 14 mm total length with a furry coat of hairlike spines all over the peduncle.

Ibla pygmæa n. sp.

38° 12' S., 149° 40' E., 100—160 fathoms. „Endeavour" 16/IX 14. Numerous specimens attached to the naked axis of a gorgonarian of the family Isiidae; together with *Heteralepas morula, Oxynaspis celata, Pachylasma scutistriata,* and *Balanus auricoma.*

Small animals with triangular terga and scuta; apex of the terga beaklike pointing forward. Peduncle with low, almost spinelike warts all over; some scattered hairs are especially found dorsally, and a fringe of hairs adorns the peduncle along the margins of the capitulum plates; generally the triangular area between the scuta below the terga on the dorsal side is also somewhat furry.

The capitulum (Fig. 23) is rather distinctly limited from the peduncle owing to the hair fringe. The carinal area is occupied by the peduncle, which extends like a tongue upwards between the scuta to the base of the terga. On account of the entire absence of calcareous substance, and the thinness of the valves, the capitulum is rather pellucid, allowing the outlines of the animal to shine through the plates; it is then easily observed that the animal, when withdrawn, also in this small species occupies the same reverse position as in the other species of the genus.

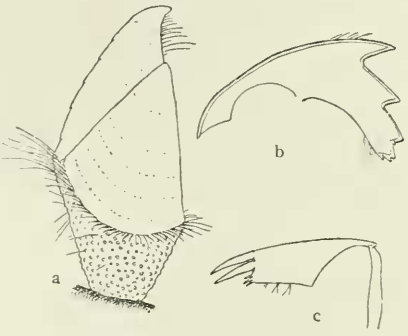


Fig. 23. *Ibla pygmæa* from 38° 12' S., 149° 40' E. a hermaphrodite in side view, b mandible, c maxilla. [a×17. b–c×215].

The tergum is triangular, its upper (carinal) margin convex, the scutal margin straight; the occludent margin is excavated, and more strongly arched in its upper part so that the apex points forward in a curious beak-like manner. The lines of growth are very difficult to observe.

Also in the scuta lines of growth are all but invisible. The scutum is triangular with straight occludent and tergal margins which meet in a pointed apical umbo. The basal margin, on the other hand, is strongly arched, thus lending the species an aberrant aspect, as compared with related species.

No trace of a carina could be detected in the adult.

The peduncle is short, except in the posterior (carinal) side, where it protrudes tongue-like upwards between the scuta to the base of the terga. The surface is covered with warts; these may be more spine-like, although low. Here and there longer hairs occur; in the tongue-like area between the scuta the hairs are more numerous, and they here often appear rather crowded passing into the peculiar single-rowed fringe of long hairs which adorns the limit towards the capitulum. The hairs are rather stout.

This peculiar *Ibla* attains only a small size; the entire length of the greater specimens does not quite reach 3 mm, that of the capitulum seldom exceeding 2 mm. The peduncle (including the dorsal tongue-like area) is about 1,5 mm.

In contracted specimens the position of the body agrees with that of the other *Ibla*-species. A rather broad interval is found between cirrus I and the following cirri.

Cirrus I has very unequal rami, the anterior ramus being a little more than half as long as the posterior one. Only in the outer half of the rami a distinct limitation of the segments is observed, fading away in the basal half. Cirrus II to VI are of almost equal length, slender, and with numerous segments; the rami are all but equal in each cirrus.

The caudal appendages are a little longer than the protopodite of cirrus VI, slender, and consisting of 10 segments; they are adorned with long, delicate hairs which form a tuft at the distal end of the appendage.

The penis is about as long as cirrus VI.

The labrum is not very bullate; its finer structure could not be made out with certainty in the specimens dissected.

The mandible has three almost equidistant teeth; at the base of the inferior one a denticle is present at the lower side. The lower angle of the mandible has three pointed denticles representing the pectination of other species.

The maxilla is curiously slender, with two large upper spines occupying most of the cutting edge; below these spines three fine and short bristles are present. Both the maxilla and the mandible are only sparsely hairy.

Ovigerous specimens have about 16 rather large ova at a time in the mantle cavity, and here also two or three complemental males are present. Their development is arrested in the cypris-stage (Fig. 24) with an entire length of only 0,55 mm, and only by a more thorough study I became sure of their nature. The enormous development of their eyes is most peculiar; they appear as two large, dark brownish pigmented spots, which are observed already externally in the ovigerous hermaphrodite. The elements of these composite eyes are seen as small luminating spots, and the eyes strongly recall the eye of a *Daphnia*. — The antennae are seen originating just below the eye; they have a large basal segment, and two smaller distal ones, but do not seem to have any prehensile function. The cirri keep the shape of the cirri of

other cirriped pupae. Behind the cirri a short penis is seen terminating in two long setae.

In the material also some few younger ones were found. The smallest specimen (Fig. 25) has already passed the cypris stage, but only its primordial valves are developed; these are of a porous structure as in other genera; the scuta are broadly triangular, the terga have a strongly arched carinal margin and attain the shape of a phrygian cap, owing to the projecting apex. The greater upper part of the valves is covered with small hairs, and a similar, hairy

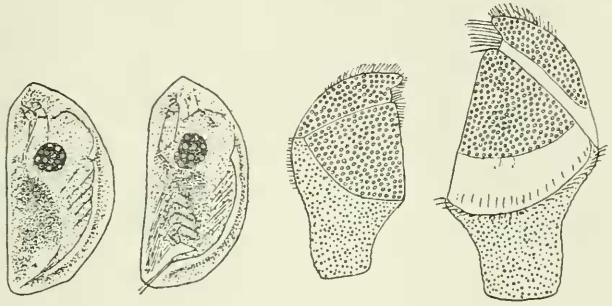


Fig. 24. a. Fig. 25. b.

Figs. 24 and 25. *Ibla pygmæa* from 38° 12' S., 149° 40 E.
Fig. 24. Two complemental males. [× 52']. — Fig. 25. a young specimen with only primordial, porous valves, b somewhat older specimen. [× 52'].

coat covers the area where a carinal plate might be expected. The peduncle is punctuated, and makes an observation of a rudimentary carina almost impossible; in certain oblique light projections sometimes a special area seems to indicate the presence of a rudimentary carinal valve, but it could not be made out with absolute certainty. The same holds good in some other, a little larger specimens; but it may also be due to an optical illusion.

In a somewhat older specimen the embryonic hairs are only kept on top of the terga, and have disappeared in the carinal area; on the other hand, the stouter peduncular hairs commence to appear, and the capitulum plates here show the transition to the adult shape.

The primordial terga generally are not traceable in the adult, whereas the primordial scutum always covers the apical umbo like a somewhat broad nail.

Genus **Lepas**.

Lepas anatifera Linné.

Aburatsubo, Misaki, attached to a well. 29/VI 14. Two specimens.

These two specimens afford great interest; the well had only been in the water one month, so that this is the highest age possible in the specimens. Our knowledge of the growth of the cirripeds is so scanty, that every example is welcome here. The dimensions of the specimens in mm were as follows:

	Capitulum		Peduncle	
	length	greatest width	length	width
I	11,5	7	6	1,5
II	14	10	6	3,5

For comparison we may add that Hoek (1907) under *Lepas anserifera* reports of some specimens attached to the keel of „Siboga" that they had attained a capitulum size of 21 mm 40 days after the ship had been docked in Surabaja. —

The lines of growth are very distinct in the specimens, and were counted in scutum, and tergum of the same side. In the specimen I tergum had 9, scutum 12 zones of growth, in the specimen II the numbers were 15, and 17. This result again confirms the observations on other cirripeds that the lines of growth cannot here correspond to outer circumstances, and afford no base whatever for a judgment of age or growth of the animal.

Lepas pectinata Spengler.

36° 00' S., 150° 20' E., surface. 29/IX 14. „Endeavour". A great many specimens, partly attached to an *Os sepia*, partly to shells of *Janthina*.

37° 05' S., 150° 05' E.; 50 fathoms, sand and mud. 30/IX 14. „Endeavour". One small specimen.

Taboga, Panama; surface. December 1915. A cluster of adult specimens on a piece of drift wood.

Annandale (1909) has given a report of his difficulties in distinguishing between the present species and *Lepas anserifera* Linné. While the specimens from Taboga entirely agree with both Darwin's (1852) and Gruvel's (1905) descriptions of *Lepas pectinata*, the other specimens caused some hesitation, because

their external characters much more agree with the characters emphasized by Gruvel (l. c) for *Lepas anserifera*. Especially the occludent margin in most cases is broadly curved, and separated by a rather broad area from the umbo-apical line. Many of the specimens agree in characters with *Lepas denticulata* Gruvel; this species is evidently based on young specimens apparently very closely related to the forma *squamosa* of *Lepas pectinata*, and cannot be kept up as a separate species, according to the dates hitherto known.

To settle the identity I investigated the animals somewhat closer. Now, informations in detail concerning the mouth feet could not be obtained. On the other hand, statements about the number of filamentary appendages could be found; they are, indeed, not exhilarant: Darwin (1852) records, that the animal has none or one filament on each side of the prosoma, Gruvel (1905), on the other hand, speaks of none to one pair on each side, and Annandale (1909) is inclined to believe that Darwin is right! My specimens indicate that Gruvel nevertheless is right; the number of filamentary appendages on each side of the prosoma varies from none to one pair. *Lepas anserifera*, on the other hand, has five or six appendages on each side, although the posterior one of them may be rather rudimentary as Darwin, and Annandale have found.

According to the filamentary appendages, the specimens from the „Endeavour" must also be referred to *Lepas pectinata*. Their mouth feet are interesting (Fig. 26): The mandible has five teeth of which the upper (first) is much larger than the others, owing to the deep excavation between the first and second tooth; the upper edge of each tooth is finely pectinate, the lower is shorter, straight, and smooth. The lower angle of the mandible is rounded, and strongly pectinate. The maxilla has the characteristic, terraced appearance of the genus; the upper spines are only little prominent; there are three excavations, and indications of a fourth near the inferior angle; the angle is rounded. The maxilla is rather scantily furnished with smaller hairs, and these latter are mostly situated near the cutting edge.

In the material from the „Endeavour" complete series were present of the stages from the only just fixed pupa with no trace of skeletonal plates whatever to the outgrown barnacle.

At the time of fixation the pupa is rather slender (Fig. 27 a) with stout and strong prehensile antennae; the animal is now dark brownish pigmented, with a lighter area in the eye region. Very soon a curious metamorphosis of the pupa is observed: the animal (Fig. 27 b) attains a quite different shape with a straight occludent margin, a spine at the posterior (upper) end of each pupa-valve,

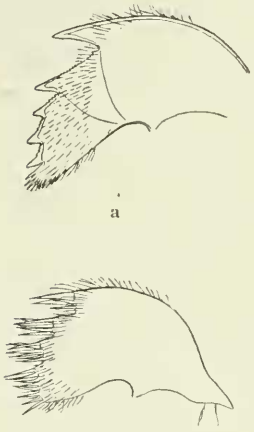


Fig 26.

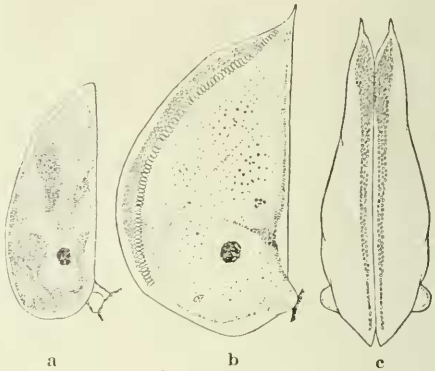


Fig. 27.

Figs. 26 and 27. *Lepas pectinata* from 36° 00' S., 150° 20' E.
Fig. 26. a mandible, b maxilla. [× 44]. — Fig. 27. a pupa just attached; b older pupa about to develop the primordial valves: c the same in the dorsal aspect. [×22].

and a highly arched dorsal line. Round the prehensile antennae the pupa-cover bulges out so that the antennae are invisible in side view. In dorsal aspect the pupa is now broad, and the bulgings at the antennae are seen as well-defined, almost mamillate prominences standing out from the sides of the animal near its anterior end. The curious dorsal double row of cellular formations inside the pupa cover, only seen in the large pupa, probably is in some connection with the coming moulting. Unfortunately the material could not solve the question as to the deeper meaning of these structures; it shall be an interesting task for a student at a biological station of the Tropical seas to solve the physiological questions concerning the floating barnacles, and especially their metamorphoses.

Within the singular, large pupa described the last metamor-

phosis into the typical *Lepas* now takes place. The primordial plates are developed, and exhibit a peculiar shape, very different from that of the capitulum plates of the outgrown *Lepas.* The carina is boat-shaped, and long; tergum is quadrangular with a short occludent margin, a long, feebly concave scutal margin, and strongly excavated carinal and free dorsal margins of almost equal lengths. The scuta are triangular with almost straight occludent margin, convex tergo-carinal margin, and concave basal margin, so that the posterior basal angle is rather pointed.

Generally also the incipient calcification can be observed in the small cirriped within the pupa cover. The cover then splits along the dorsal line, commencing at its upper (posterior) end; the small *Lepas* now extends its peduncle till it attains almost the same length as the capitulum. The pupa cover yet often for a while adheres to the peduncle, to be thrown off when the calcification of the capitulum plates is more obvious, and the formation of growth lines has commenced.

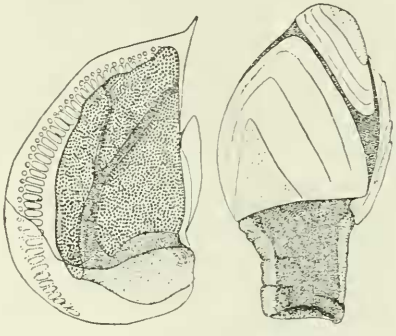


Fig. 28. *Lepas pectinata* from 36° 00' S., 150° 20' E. a specimen with primordial valves developed, left half of the pupa cover partly flared off; b young specimen with primordial valves yet preserved on the umbones of the calcified plates. [a × 25, b × 12.5].

During growth the peduncle and the capitulum add to their dimensions after a proportionate scale. The calcification of the plates gives evidence that in *Lepas,* in contradistinction to *Scalpellum,* and *Pollicipes,* the greater capacity of lime secretion is localized to the central areas of the capitulum sides, and the umbones of the plates, as indicated by the primordial valves, are situated correspondingly, the umbo of the terga apically, that of the carina, and scuta basally (Fig. 28). —

In the material of young stages from the os sepium the forma *squamosa* Fischer with its spiny plates prevails; some of the specimens apparently little by little lose their spiny appearance. Among the still more numerous specimens of the *Janthina* shells

not a single specimen of the forma *squamosa* occurs. It must remain open to future investigations, which factors determine the development into the forma *squamosa*, or into the forma *typica*.

Another feature of great biological interest is the fact that the pupas of the species settle down in crowded assemblies, evidently not determined by the characters of the substratum. In *Janthina* f. inst. no special part of the shell is preferred; but where the pupas fix themselves, they do so in great numbers, and closely crowded. The youngest stages therefore are curiously homogeneous, as to the development of the individuals.

Very soon the aspect of a group changes. Some of the animals develop at a great speed, whereas others seem to be checked in their development at one stage or other, or even to be outnumbered, and the larger the best developed specimens of a group become, the fewer animals the group contains. This may of course be due to cannibalism, although this factor, especially in younger specimens, hardly can be of any consequence, and I am inclined to believe that other circumstances play a prominent part in the fate of the individuals. This question cannot of course be definitly settled by preserved specimens.

Genus **Poecilasma** Darwin.

Poecilasma Kaempferi Darwin.

37° 45' S, 150° 10' E., 150—260 fathoms. „Endeavour" 14/IX 14. One specimen (together with *Heteralepas Dannevigi*).

The specimen belongs to the subsp. *litum* Pilsbry. It has a capitulum length of 9, width 6 mm, a peduncle length of 2,5 mm.

Genus **Megalasma** (Hoek) Pilsbry.

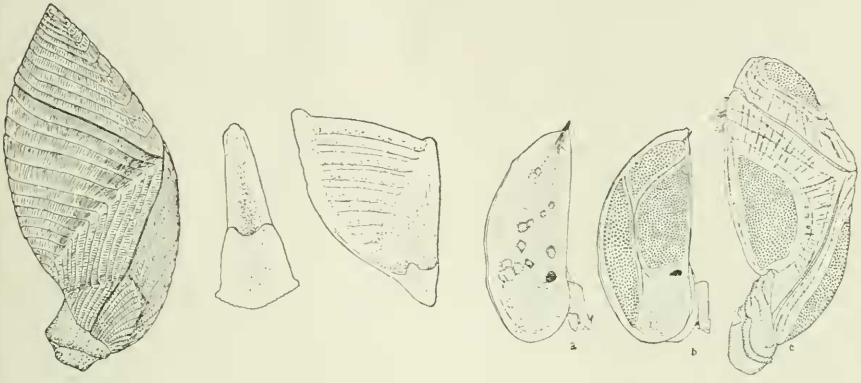
Megalasma striatum Hoek.

3 miles S. W. of Tucuran, 300 fathoms. 10/III 14. Several specimens on the spines of a *Cidaris*.

21 miles W. 1/2 S. of Bonomisaki, 220 fathoms. „Hyaton Maru" 13/V 14. One large specimen.

The specimens in some cases differ from Hoek's description (1883) in having an externally visible, short peduncle (Fig. 29).

This character, which has even been uncritically inserted among the generic features, cannot serve as specifically distinguishing criterion, because of the contractions and extensions of the peduncle, easily observed in living barnacles. I also present a drawing of the internal aspects of carina and scutum to show the differences from the following species.



Figs. 29 and 30. *Megalasma striatum*, S. W. of Tucuran.
Fig. 29. a adult specimen in side view, b internal aspect of the carina, c of the left scutum. [× 5,3]. — Fig. 30. a pupa just attached, b pupa with primordial valves developed, c young specimen showing the transformation of the basal part of the scutum by calcification. [× 22].

An interesting feature of the animal seems to have escaped the attention of previous investigators. One pair of dorsal filamentary appendages are placed close together, almost in the dorsal line of the animal above the first pair of cirri; their length is about one third of cirrus I.

Specimens of all stages from the pupa stage onwards were found on the *Cidaris*-spines. The pupa (Fig. 30a) is large, much larger than the pupas of the Scalpellidae, and corresponds in size with the *Lepas*-pupa. Whether this is a constant feature distinguishing the families, future investigations must disclose. — The pupa is slender, with a shallow, dorsal excavation corresponding to the furrow of the body between the larval regions which later on constitute the capitulum and peduncle. The ventral (occludent)

margin is straight but for its foremost part which is a little convex in the region of the large prehensile antennae; the anterior part of the pupa has an evenly rounded outline. The pigmentation is feeble, and irregular. The nauplius-eye is very conspicuous, evidently with its typical three elements. Soon after the settling down of the pupa the eye becomes smaller, more concentrated, and its pigment quite black.

Now the pupa becomes a little broader and attains somewhat rounded outlines, and the primordial valves appear. Their shape and size are characteristically different from other genera known: tergum is by far the smallest of the plates, and somewhat approaches the outlines of a parallelogram, but for the rounded anterior part. Scutum is more than twice as large as tergum, approaching a trapezoid in shape, with a square basal margin just above (behind) the eye of the animal; the occludent margin is long and almost straight, the tergal, and carinal margins more rounded, thus somewhat concealing the trapezoidical shape of the entire plate. The carina is by far the longest plate of the capitulum; it covers more than two thirds of the dorsal side and extends down to the foremost edge of the peduncular part of the body; the carina is also extraordinarily broad in comparison with other genera investigated. One more feature seems to be of interest, viz. the small intervals between the plates, which are more in accordance with *Lepas*, and strikingly differing from *Mitella*.

The growth is to begin with characterized by an increase in the length of the peduncle, which also in young *Megalasmae* is comparatively well developed, and only later on again almost concealed by the progressive calcification of the plates (Fig. 30 c). — During the first time of growth the primary valves are very obvious, but comparatively soon they seem somehow to disappear in this species.

The main growth of the plates, and the main power of lime secretion in this species are bound to the zones of the capitulum between the primordial plates. The umbo of the tergum is almost quite apical, more pronounced in the older specimens than in the youngest stages. The carina has a basal umbo. The greatest interest is attached to the development of the scutum. In the primordial valve a decidedly basal margin was evident; this latter is

already somewhat obscured by the first layer of carbonate of lime, although also here a basal margin is clearly seen. But now the plate develops a „spur" from the carinal margin and downwards along the carina at the side of the peduncle; also now the original basal margin is indicated by a notch. The latter is during the following apposition of calcareous substance soon filled up, and the occludent margin secondarily prolonged to meet the carinal margin directly at the side of the peduncle. Thus the scutum attains its triangular shape with its aberrant, long, occludent margin, and loses its basal margin.

At the same time the incipient ridges are already observed, especially the median ridge towards the juncture of carina and tergum, as a radial, prominent stripe. A little later the lower crista of the scutum, and the carinal crista also appear. The lower crista of the scutum rather often may be somewhat feebly developed even in adult specimens which are therefore on external examination sometimes only with difficulty distinguished from the following species.

Megalasma minus Annandale.

Syn.: *Megalasma bellum* Pilsbry 1907.
„ *Megalasma lineatum* Hoek 1907.

7 miles S. of Olutanga, about 300 fathoms 8 III 14. Four specimens on the spine of a sea urchin.

7° 25' N., 123° 14' E.; 250 fathoms. 9 III 14. Two specimens on spines of a sea urchin.

Menado Bay, 1° 31' N., 124° 47' E.; 250 fathoms. Captain Christiansen 12 III 13. Three specimens on the cirri of a crinoid, together with *Scalpellum balanoides*.

There is some variation in the species regarding the basal part (Fig. 30a, c); in some specimens the basal margin of the carina forms a direct continuation of the feebly arched occludent margin of the scuta, in other specimens the basal margin of the carina is almost perpendicular to the occludent margin of the scuta. In the latter case the lower part of the occludent scutal margin may be bowed so as to form an incipient basal margin. The specimens thus link the preceding species to the subgenus *Glyptelasma* of Pilsbry (1907), and the present species indeed so to say stands

with one foot in each of Pilsbry's subgenera, thus clearly illustrating their invalidity.

The internal structure of the lower part of the scutum (Fig. 31 e) affords good specific characters, in contradistinction to the preceding species.

In addition to previous descriptions we may add that the penis is stout, and only about half as long as the cirrus VI; it is almost

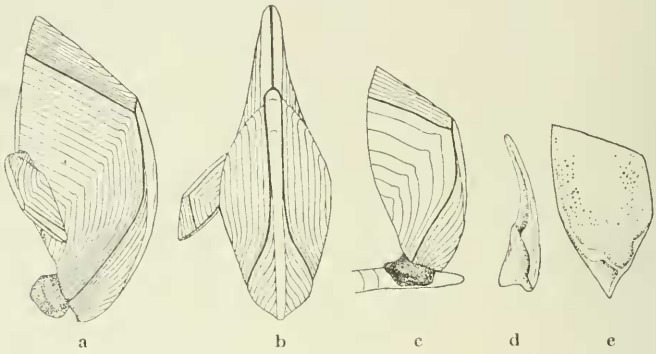


Fig. 31. *Megalasma minus* from Menado Bay (Celebes). a large specimen with a small specimen attached to its scutum, side view, b the same specimen, carinal aspect, c medium sized specimen in lateral aspect, d carina of the latter, obliquely viewed from inside, e interior side of the left scutum. [all figures × 4].

entirely destitute of hairs except at its distal end, where a strong tuft of fine hairs are present.

As in the preceding species we also find in *Megalasma minus* a pair of filamentary appendages seated close together almost in the dorsal sagittal line of the animal above the first pair of cirri; the appendages are half as long as cirrus I.

Genus **Oxynaspis** Darwin.

In his classic monograph Darwin (1852, p. 133) in mentioning this genus says: „As far as the valves are concerned, it is more nearly related to Lepas than to Poecilasma; but taking the entire animal, its relation is much closer to the latter genus than to Lepas; it differs from both these genera in the manner of growth

of the scuta, which is both upwards and downwards, the primordial valve being situated in nearly the middle of the occludent margin. In this respect, and in the shape of the carina and terga, there is an almost absolute identity with Scalpellum; I may, however, remark that in Scalpellum, the scuta first grow downwards, and afterwards in most of the species upwards, whereas here from the beginning, the growth is both upwards and downwards". — My observations have shown that the primordial valve indicating the umbo of the scutum, is in *Scalpellum* without exception apical. The material does not contain quite small specimens of *Oxynaspis*; but the entire structure of the scutum indicates that the growth here somewhat resembles that of *Megalasma*, and that the primordial valve (and the umbo) is secondarily removed by later growth from its basal position. Probably the young will show that the growth downwards commences later than the growth upwards; the umbo of the scuta is in the present specimens evidently a little more basally situated than in Darwin's material.

As regards the carina, its shape is exactly the reverse of that of a *Scalpellum* in which the umbo has been secondarily removed from the apex by growth, and it is easily seen in *Oxynaspis* that the basal part below the umbo in the carina is a secondary formation, and that the original situation of the primordial valve also here is basal.

Oxynaspis celata Darwin.

33° 41' N., 128° 50' E., 75 fathoms. „Hyaton Maru" 17/V 14. 6 specimens of the forma *japonica* on *Anthipathes*.

Nagasaki (no further dates). 6 specimens of the forma *japonica*.

38° 12' S., 149° 40' E., 100–160 fathoms. „Endeavour" 16/IX 14. Several specimens of the forma *nova-zelandica* on anthipatharians, with *Ibla pygmæa*.

Annandale (1909) states that the spiny bark, which covers the animal, belongs to the barnacle, and not to the antipatharian, as maintained by Darwin (1852). It is impossible to follow the statements of Annandale; his remarks about the spineless axis of the Anthipatharian to which his specimens were attached, and his reasoning about the colours are far from convincing. Though the main axis of the antipatharians is black, the horny substance

in thinner layers as is seen f. inst. in its smaller twigs, is darker or lighter brownish, often with a tinge of reddish. A variation in size of the spines is also often to be observed, and in some cases I have furthermore observed an increase of size in the spines when the axis expands over a somewhat flat substratum.

A theoretical reasoning thus decidedly speaks in favour of Darwin's opinion, and a glance at the present specimens (Fig. 32a) strengthens it at once. All the present specimens are not only covered by the horny, and spiny bark mentioned by previous authors; but also the soft parts of the antipatharian spread over the barnacle and, moreover, generally carry well developed polyps in rather great numbers. This is in itself satisfactory evidence of the correctness of Darwin's statement, the soft parts of an antipatharian not exceeding the horny skeletonal parts of the coral; the occurrence of coenosark with polyps thus necessarily demands an underlying layer of coral axis substance. To this may be added that the horny bark covering the cirriped without any demonstrable boarder passes into the horny axis of the antipatharian, as is seen in sections.

Annandale has observed calcareous spines of the scales fitting into the thorns of the bark; no such spines could be traced in the present specimens. On the other hand, a peculiarly regular arrangement of the spines is obvious: a study of the plates of the barnacle reveals rings of growth, more whitish zones alternating with darker, or rather more pellucid narrower zones; in analogy with other animals, we may conclude that the latter zones only contain little organic matter and represent a period of slow growth in the scale, whereas the more whitish, opaque areas contain much organic substance and exhibit a rapid growth. Now the spines of the horny bark always gather along the pellucid (inorganic) zones and almost entirely fail in the opaque areas, thus accentuating the zonar structure of the plates.

The specimens from Japan stand near the subspecies *indica* Annandale (1909) and their external aspect exactly corresponds with this subspecies. As far as it is possible to discern, there are nevertheless differences present in the animal which cause us to regard them as representatives of a forma *japonica* nov. As

there are no detailed descriptions given of the animal I shall begin by giving a description of it before I discuss the differences from subsp. *indica*.

The cirri in their armature show two different types. Cirrus I and II have somewhat swollen segments armed with transverse rows of large spines, and are thus of the same type as the cirri of *Lepas*. In the rami of cirrus III to VI on the other hand, the

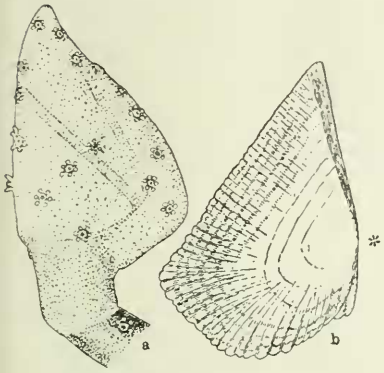


Fig. 32.

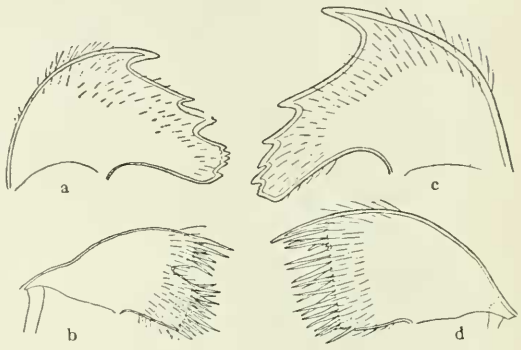


Fig. 33.

Figs. 32 and 33. *Oxynaspis celata* f. *japonica* from Nagasaki.
Fig. 32. a specimen showing antipatharian polyps all over its surface; b external side of left scutum, at * umbo. [a × 4, b × 5]. — Fig. 33. a—b mandible and maxilla of a specimen from Nagasaki, c—d mandible and maxilla of a specimen from 33° 41' N., 128° 50' E. [× 44].

segments are cylindrical with an anterior row of paired spines; of these pairs the four are well developed, the basal fifth pair is generally very feebly developed; the larger spines are those distally seated on the segment.

The rami are always a little unequal in length on the cirrus, and also differ in number of segments. In cirrus I the anterior ramus has 10, the posterior 14 segments; in cirrus II the corresponding numbers are 13 and 15. Also in cirrus III to VI the numbers of segments of the rami in the same way differ by two in the cirrus; the number of segments in the anterior ramus increases from 18 in cirrus III to 21 in cirrus VI. — The interval between cirrus I and II is only little larger than the other intervals.

Filamentary appendages are absent. Also real caudal

appendages fail; but their place is indicated by three long hairs in a tuft on each side.

The penis is about half as long or almost as long as cirrus VI, slender, and pointed, without any trace of annulations or ridges. Some few scattered hairs are seen, and a tuft of hairs at the distal end of the penis.

The labrum is very characteristic. Annandale mentions its curiously prolonged and pointed shape; in the Japanese specimens a deep and broad median furrow extends from between the palpi to its extreme tip and makes the projecting (anterior) end of the labrum appear a little cleft.

The mandible (Fig. 33) is somewhat variable with three to five teeth, the second tooth being situated at the middle of the cutting edge. The lower angle is square cut and often, although not always, armed with some few, coarse denticles representing the pectination of other barnacles.

Also the maxilla is variating in shape; generally there is a deep excavation or cleft, almost in the middle of the cutting edge; in this case there are twice as many spines above the excavation as in susp. *indica*. In extreme cases, on the other hand, the cutting edge may be quite straight with only an indication of a notch.

A comparison between Annandale's dates and the present specimens results in the following differences between subspecies *indica* and forma *japonica*: In subsp. *indica* the penis is annulated and ridged in its outer part, the mandible has four (five) teeth, and the maxilla three spines above the excavation. In forma *japonica* the labrum has a deep, longitudinal, ventral furrow, and its distal end is a little bilobed, the penis is without annulations and ridges, the mandible has two to five teeth, and the maxilla has 5 or 6 spines above the excavation. —

The specimens from the „Endeavour" again come near the subspecies *indica*, but differ in some respects so that I prefer, at any rate provisionally, to single them out as representatives of a forma *nova-zelandica* nov. They come near to subspecies *indica* in having a labrum without any longitudinal furrow, and their maxilla has only three spines above the excavation; the excavation on the other hand is very broad, occupying almost half the cutting edge, and in the middle of the broad excavation a group of three short thorn-

like spines is situated. To this must be added that the mandible has only three teeth, and a pointed lower angle, and that the penis is again without rings or ridges.

Oxynaspis celata is evidently a highly variating species, and the range of the species, and its local subspecies and races or forms ought to be subject to a thorough study on large material from different localities.

Genus **Octolasmis** (Gray) Pilsbry.

[*Dichelaspis* Darwin].

Octolasmis orthogonia (Darwin).

Cebu, at low tide on muddy beach. 21/II 14. Four specimens attached to the naked upper part of the axis of a *Virgularia*.

The specimens entirely agree with the descriptions given by Darwin (1852), and Hoek (1907), but their size far surpasses that of previously known specimens, and also gives an evidence of the variating length of the peduncle owing to different states of contraction. The following table gives the measures in millimeters:

		I	II	III	IV
Capitulum	length	13	10	10	9
	width	7	6,5	6	4
Peduncle	length	6	6,5	4	3

Genus **Heteralepas** Pilsbry.

In instituting the genus Pilsbry (1907) at once calls our attention to the fact that the genus contains two very different groups of species, and he accordingly divides the genus into two subgenera *Paralepas,* and *Heteralepas* s. str.[1]) Indeed as he states, much speaks in favour of raising the two subgenera to generic rank.

[1]) It is indeed unpractical to use the same name for two different cathegories as is done here for a genus and one of its subgenera, or groups of species, a course often followed by Pilsbry. We had better follow the use of the botanists who give the prefix *Eu-* to the central group of the genus, thus avoiding confusion. In the present case the subgenus ought to have had the name *Euheteralepas* instead of *Heteralepas* s. str. I shall nevertheless not now make any change in the nomenclature instituted by Pilsbry for the above-named genus.

Nevertheless a step like that is not justifiable for the present. A study of the many specific descriptions of the literature, and the curious fact that also in the present material several „nova species", and only two previously described ones could be pointed out, are apt to awake suspicion as to the base of the specific systematic of the genus. No doubt several of the species shall have to disappear, on account of deficient description; I shall here f. inst. point to *Alepas tubulosa* Quoy et Gaimard of the investigated waters; it cannot be reidentified, and the name should be dropped. It is rather possible that the named species might be identical with some of the species described as new below; but only a reexamination of the type specimen will enable us to settle the identity, the external shape being of no use whatever in this case.

On the other hand, a thorough revision of each character used as specific distinction in this genus, based on the previously described animals as well as on an extensive new material, is greatly desirable, and we must await such a revision before we can hope to get a solution to many questions concerning this intricate genus.

Among the characters not mentioned by Pilsbry (1907) nor by Annandale (1909) I wish to call the attention to some, which seem to be of interest. In the *Heteralepas*-group, as far as can be seen from the literature, the filamentary appendage at the base of cirrus I is small, whereas in *Paralepas* on the contrary it is well developed and obvious. Even more interesting are the maxillae.

Owing to their conservatism in general among the cirripeds, we must ascribe to the mouth feet a great phylogenetic interest. Now, in *Heteralepas* s. str. a great excavation, generally comprising almost one half of the cutting edge, below the upper spine, seems to be found in every species. In *Paralepas* this excavation is reduced to a small, many times even rudimentary notch, and the cutting edge is here often all but entire. On the other hand, *Paralepas* tends to develop two main spines at the middle thirds of the cutting edge, and these spines often attain the same size as the upper spine, and strongly dominate in the row of bristles. This character is not found in *Heteralepas* s. str. We can moreover see, that the maxillae of the genus are of the same construction as in *Poecilasma-Octolasmis*, and totally differ from those of *Conchoderma-*

Lepas, thus giving good base for a judgement of the affinities of the genus as a whole.

Heteralepas (Paralepas) morula (Hoek).

38° 12' S., 149° 40' E., 100—160 fathoms. „Endeavour" 16/IX 14. One specimen attached to the naked axis of an antipatharian together with *Oxynaspis* and *Balanus.*

The specimen is much greater than those described by Hoek (1907). It has a capitulum of 13, a peduncle of 7 mm, and is thus almost exactly twice as large as the largest specimen from the „Siboga", which had a capitulum of 6,5, and a peduncle of 4 mm.

Heteralepas (Paralepas) intermedia (Hoek).

39° 10' S., 149° 55' E., 200—250 fathoms. „Endeavour" 15/IX 14. Several specimens on spines of a *Histocidaris.*

Owing to contractions the external shape of the animals is exceedingly variable. The largest specimen has a capitulum of 13 mm in length; its greater sagittal axis is 10 mm, the transversal 8 mm; the peduncle is only 3 mm long with a width of 6 mm and is strongly contracted and sharply defined from the capitulum. There is a pronounced carinal keel on the capitulum; the aperture is tightly closed and 4 mm long. The smallest of the specimens has only a capitulum length of 1,5 mm with a peduncle of 1 mm in length. Also in the smaller specimens the carinal keel is seen, and often rather pronounced. In intermediate specimens this character with strong contraction almost entirely fades away, and sometimes the peduncle is contracted to such a degree that the entire animal is all but globular. This bids us use characters as length of the peduncle, and greater or lesser prominence of a carinal keel in preserved animals with the utmost cautiousness.

The animal itself on the whole agrees very well with the „Siboga" specimens, although some minute differences could be detected in the mouth feet (Fig. 34). There is a little difference between the description and drawing of the mandible in Hoek's

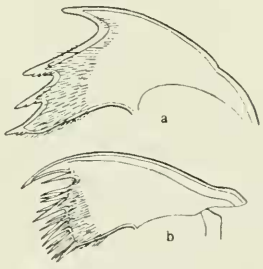


Fig. 34. *Heteralepas intermedia* from 39° 10' S., 149° 55' E. a mandible, b maxilla. [× 33].

paper (1907); his description entirely agrees with the drawing given here. The maxilla shows a small, although distinct notch which is not mentioned by Hoek.

Heteralepas (Paralepas) Dannevigi n. sp.

38° 10' S., 149° 55' E., 190—240 fathoms. „Endeavour" 11/IX 14. One specimen.

38° 05' S., 150° E., 200—260 fathoms. „Endeavour" 12/IX 14. One specimen (type).

37° 45' S., 150° 10' E, 150—260 fathoms. „Endeavour" 14/IX 14. One specimen attached to a gastropode shell.

Capitulum ovoid, laterally somewhat compressed and sharply defined from the rather thin, and cylindric peduncle, with a pronounced carinal keel, gradually disappearing towards the base of the capitulum. The orifice comprises about one third of the ventral side of the capitulum; its margins are little prominent. Small chitinous scuta are present.

The animal is brownish-yellow in alcohol. Its surface is quite smooth with neither wrinkles nor tubercles. The scuta appear as somewhat darker brownish, triangular spots just below the orifice. Owing to contraction the peduncle exhibits tranverse constrictions.

The body of the animal is furnished with one rather large digitiform appendage on each side, at the base of cirrus I.

In the cirri the rami are always well developed and of almost equal size in each cirrus, although always differing in the number of segments. The numbers of segments counted were:

Cirrus	I	II	III	IV	V	VI
Inner ramus	9	20	19	15	18	21
Outer „	8	18	18	18	21	16

To this table we must add the following remark that the basal segment of the rami judging from the armature with spines always consists of two or three coalesced segments. The basal segment of the inner rami consists of three, that of the outer rami of two fused segments; nevertheless the basal segment never exhibits more than twice the length of the following segments. — In the cirri II to VI the posterior thorns as in other *Paralepas*-species have developed into large, rather clawlike spines and cur-

iously contrast with the fine bristles of the anterior side. The posterior spines are as long as or generally even longer than the following segment.

The caudal appendages are slender, and long, about twice as long as the protopodite of cirrus VI, with 12 segments. They have only few hairs.

The penis is stout and short, only about half as long as cirrus VI; it is annulated and carries some few long hairs; at the

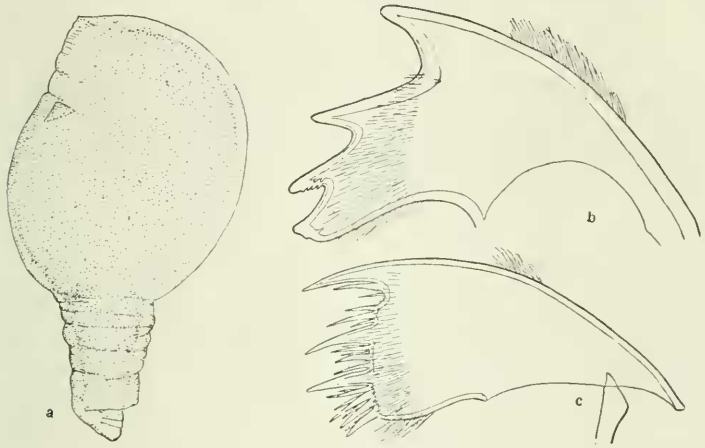


Fig. 35. *Heteralepas Dannevigi* from 38° 05' S., 150° 00 E. a type specimen, lateral aspect; b mandible, c maxilla. [a × 4, b—e × 33].

distal end a tuft of hairs is found. The penis is rapidly tapering towards the distal end.

The labrum has a row of broad, and low, tuberculate denticles along its interior side. It is not bullate nor very prominent.

The mandible (Fig. 35) has four strong teeth, the fourth at its lower angle. Only the third tooth is armed with small denticles at its lower side. The second tooth occupies the middle of the cutting edge. A dense growth of finer hairs covers the lower part of the mandible from the excavation between the first and the second tooth downwards.

The maxilla has a strong spine at its upper edge; between this and a slightly pronounced notch a smaller spine is present. Below the notch the cutting edge is densely armed with spines,

two intermediate ones reaching almost the same size as the upper spine. The sides of the maxilla close by the edge are covered with dense, long hairs.

The size of the specimens in millimeters is as follows (the number of the specimens answers to the succession in the table of localities):

		I	II	III
Capitulum	length	13	9	7,5
	width	12	7,5	6,5
Peduncle,	length	6	4,5*)	3

*) lower end mutilated.

The species somewhat recalls *Heteralepas intermedia* (Hoeck), and *Heteralepas percarinata* Pilsbry, but differs from both of these in the presence of scuta. It also to some degree recalls the enigmatic *Alepas tubulosa* Quoy et Gaimard; but the identification of the latter species is at present impossible, as mentioned above.

I have named the species after the late Captain Dannevig, during many years leader of the investigations with the „Endeavour" till he went down with the ship on its disastrous voyage to the Macquarie islands at New Year 1915.

Heteralepas (Paralepas) scutiger nov. sp.

Sagami Bay, 400 fathoms. 1—7 VI 14. One specimen.

The capitulum is ovoid, or almost globular, without crista along the carinal side, somewhat compressed distally in the part near the orifice. Scuta present as small, chitinous, triangular rudiments. The peduncle is distinctly limited against the capitulum.

The capitulum is all but globular, only in the upper part a little compressed laterally, but without any trace of a carinal crista. The opening occupies about $^2/_5$ of the ventral side of the capitulum. The surface is smooth with neither wrinkles nor tubercles. The scuta are small, triangular, and chitinous without calcareous deposits. The peduncle is round, cylindrical with indistinct transverse wrinkles.

The unique specimen has a capitulum length of 8 mm with a width of 7 mm; the peduncle is 7 mm long.

The body of the animal carries on each side a well developed digitiform filamentary appendage at the base of cirrus I. The latter is situated beside the mouth opening, and separated from the next cirri by a distinct interspace.

The cirri are of the common *Paralepas*-type with five claw-like spines at the posterior side of the segments in cirrus II to VI. The numbers of segments in the rami of the cirri are:

	I	II	III	IV	V	VI
Inner ramus	7	15	13	15	15	16
Outer „	7	14	14	12*)	15	15

*) distal end damaged.

The basal segment of all the rami is very long, almost as long as the protopodite; it evidently consists of several coalesced segments. According to the armature the numbers of coalesced segments are:

Cirrus	I	II	III	IV	V	VI
Basal segment of inner ramus	2	4	4	4	6	6
„ „ „ outer „	3	6	4	5	5	5

The caudal appendages are as long as the protopodite of cirrus VI and have 8 segments; only few hairs are present on the appendage.

The penis is stout, tapering, and annulated all over, with few, rather short hairs elsewhere, and a tuft of hairs at the distal end. It is as long as cirrus VI.

Of the mouth parts the labrum is furnished at its inner side with a single row of rounded denticles. It is not bullate.

The mandible (Fig. 36) has four teeth, the fourth at the lower angle. The second tooth is placed only very little above the middle of the cutting edge. The second and the third tooth have lateral denticles and denticles at their lower edge; at the lower side of the fourth tooth two denticles are present, representing the pectination of the lower angle. The outer and lower part of the mandible is densely hairy.

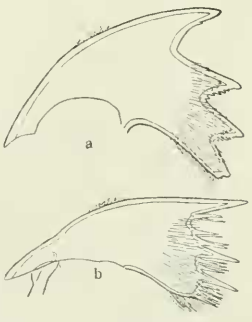


Fig. 36. *Heteralepas scutiger* from Sagami Bay. a mandible, b maxilla. [× 33].

The maxilla has a little distinct notch be-

low the three upper spines, the first (uppermost) of which is very prominent and peculiarly straight. Below the notch the cutting edge is densely armed with spines, two of which are much stouter than the others, and almost reach the size of the upper spine. The lower and outer part of the maxilla is densely furnished with hairs.

The external shape of this species recalls *Heteralepas (Paralepas) pedunculata* (Hoek), and *Heteralepas (Paralepas) percarinata* Pilsbry; but the presence of scuta separates it from both of these forms. It is also nearly related to *Heteralepas (Paralepas) Dannevigi*, with which species it has the scuta in common; but the entire lack of a carinal crista in *Heteralepas scutiger* separates it from the named species, and moreover the structure of the basal segments of the rami of the cirri and the numbers of segments in the cirri, and the caudal appendages besides differ so much that the species must be kept apart.[1])

Heteralepas (Paralepas) nodulosa n. sp.

3 miles S. W. of Tucuran; 300 fathoms. 10/III 14. One specimen on a spine of *Cidaris* sp., together with *Megalasma striatum*, and *Verruca Krugeri*.

The capitulum is globular without carinal crista; the orifice is situated at the upper side of the capitulum and directed obliquely upwards, with feebly lobed margins. Scuta are indicated as triangular rudiments. The peduncle is sharply limited against the broader capitulum. The surface of the animal is finely transversally striped, and set with small, well defined, scanty, almost thornlike warts.

The species (Fig. 37) is at once characterized by its small spines or warts, which are especially found on the capitulum, although they also occur on the peduncle. The animal is in alcohol of a dark brown colour, the peduncle a little lighter in hue. The thick outer layer is more transparent. The cuticle is transversally feebly wrinkled or striated, somewhat more prominently in the peduncle; this may be due to contraction. The peduncle is by an abrupt narrowing distinctly separated from the capitulum.

Scuta are present as small chitinous triangular rudiments just below the orifice. They are only with difficulty traced.

[1]) Possibly identical with *Heteralepas (Paralepas) typica* Nilsson-Cantell (1921).

The capitulum has a length of 6 mm, and its width is also 6 mm; the length of the orifice is 2,5 mm. The peduncle only measures 3 mm.

The filamentary appendages are rather large, digitiform, with a somewhat narrower, almost broadly spinelike distal part occupying the distal fifth of the free filament. It is situated at the base of cirrus I beside the mouth; there is a distinct space of the breadth of one cirrus between cirrus I and II.

The cirri are of the usual *Paralepas*-type, the claw-like spines at the posterior side of cirrus II—VI reaching the length of the following segments. The numbers of segments are:

	I	II	III	IV	V	VI
Inner ramus	9	14	15	14	15	10*)
Outer „	7	13	17	18	18	16

*) distal part damaged.

To this must be added that the basal segments of the rami, although not especially long, consist of coalesced segments; judging by the armature of the named segment, it consists of the following numbers:

	I	II	III	IV	V	VI
Inner ramus	2	4	3	3	2	2
Outer „	3	3	4	4	3	4

If we add these numbers to those given above, the numbers of segments in this species agree rather well with *Heteralepas percarinata* Pilsbry.

The caudal appendages have 11 segments, and are one and a half time as long as the protopodite of cirrus VI. They are slender and almost without hairs.

Penis is short, only half as long as cirrus VI. It is annulated, stout, and tapers rapidly towards the distal end; the latter is furnished with a tuft of hairs; elsewhere only few and scattered hairs are present.

The labrum was damaged in the specimen.

The mandible has four teeth, the fourth forming the lower angle; the second tooth is situated a little above the middle of the cutting edge. The second and the third tooth have denticles along their lower edge; also the inferior margin of the fourth tooth has indistinct denticles, and this tooth moreover carries some small

denticles on its sides, a little above the lower edge. The outer and lower part of the mandible is densely hairy.

The maxilla has one strong spine at the upper angle, and at each side of it one smaller spine; between these three spines and a rudimentary notch a fourth, unpaired, rather long spine is present. Below the notch the cutting edge is densely spiny; among these spines two larger ones are rather prominent and only slightly smaller than the upper spine. The outer part of the maxilla is covered by numerous, rather long hairs.

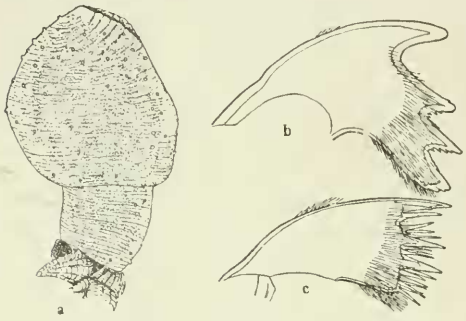


Fig. 37. *Heteralepas nodulosa*, S.W. of Tucuran. a type specimen, lateral view; b mandible, c maxilla. [a × 4, b—c × 33].

Although the specimen in the features of its cirri and mouth parts is very like *Heteralepas (Paralepas) percarinata* (Pilsbry), it must at all events provisionally be regarded as representing another species, owing to the occurrence of rudimentary scuta, granules on the cuticle, and absence of a carinal crista.

Heteralepas (Heteralepas) dubia n. sp.

Disaster Bay, New Zealand, 30—40 fathoms, sand and mud. „Endeavour" 1/X 14. Two specimens.

The capitulum almost insensibly passes into the peduncle. No traces of scuta are found, but the insertion of the adductor muscle is externally visible as a somewhat lighter figure below the aperture. The latter is about half as long as the capitulum. No carinal crista is indicated, but at the juncture of capitulum and peduncle a low and broad, wartlike protuberance of the cuticle is present at the carinal side.

The mantle of the animals is thick, semipellucid, and of a vivid, reddish-brown colour, the internal tissues dark brown in alcohol. The peduncle shows transverse feeble wrinkles, probably due to contractions.

In the larger specimen the capitulum measures 15 mm with a width of 12 mm; the peduncle is 10 mm long. The smaller specimen has a capitulum length of 8 mm, and a width of 6 mm, whereas its peduncle is 5 mm; the latter is not quite intact.

A dissection of the smaller specimen gave the following results.

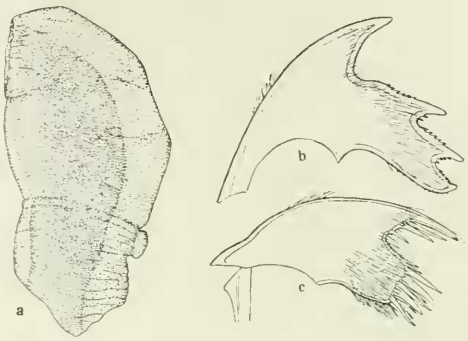


Fig. 38. *Heteralepas dubia*, the smaller specimen from Disaster Bay, N. Z. a animal in lateral view, b mandible, c maxilla. [a × 4, b–c × 33].

The filamentary appendage is short and stout, situated at the base of cirrus I. There is only a narrow interspace between cirrus I and II.

The cirri show the typical *Heteralepas*. In cirrus I the inner ramus has 11, the outer 17 segments, the basal segments evidently representing 2, respectively 3 coalesced but not very long segments. The inner ramus is a little shorter than the outer one, but is of the same width; the segments are bullate in both rami. — In cirrus V the rami are very unequal: the stout outer ramus has 42 segments of which the basal long one evidently consists of 8 coalesced segments; the very slender inner ramus has only 11 segments and is only in the outer segments armed with few hairs. In the same way cirrus VI has an outer ramus of 38 segments, the long basal segment evidently again consisting of 8 coalesced segments; the more threadlike inner ramus consists of only 10 segments.

The caudal appendages are very short, only as long as the basal segment of the protopodite in cirrus VI; they have 7 and 5 segments.

Penis is short and stout, only half as long as cirrus VI, annulated throughout; it has few and scattered hairs, and a tuft of hairs at the distal end.

The labrum is not bullate; it is armed with a single row of rounded denticles along the oral margin.

The mandible (Fig. 38 b) has four teeth, the lower constitut-

ing the inferior angle. The excavation between the first and the second tooth comprises about $^3/_5$ of the entire cutting edge. The second and the third tooth are armed with denticles on the basal parts of their edges, the fourth only at its upper margin. The outer parts of the mandible are richly furnished with finer hairs.

The maxilla has a broad and deep excavation comprising almost half the cutting edge. The upper side runs out into a very strong, and long spine, and on the edge of the excavation next to this spine three large bristles are present, the third, and smallest of them near the bottom of the excavation. Below the excavation the cutting edge is almost straight, and armed with a crowded double row of strong spines. The outer parts of the maxilla are richly covered with fine and long hairs.

In spite of the great series of *Heteralepas*-species hitherto described we must at all events at present consider the specimens here recorded as representatives of a new species, first because of the carinal warty protuberance at the transition from the capitulum to the peduncle, secondly because the numbers of segments in the cirri and the caudal appendages, as well as different smaller features of the mouth parts, differ from all other species previously known.

Family **Verrucidae.**

Genus **Verruca** Schumacher.

Verruca albatrossiana Pilsbry.

25 miles S. of Zamboanga, 250 fathoms. 4/III 14. Numerous specimens on spines of a *Cidaris* sp.

21 miles W. $^1/_2$ S. of Bonomisaki, 220 fathoms. „Hyaton Maru“ 13/V 14. One specimen together with *Megalasma striatum*.

The species has only been provisionally described by Pilsbry (1912) from the sea near Luzon; but as yet no drawing of the species has been published, so that the identification may turn out to be incorrect. „The unusual length of the rostrum and fixed tergum characterize the species“ and are also seen in the present specimens (Fig. 40). The base of the carina is very long, so that the characteristic given by Pilsbry again holds good: „The carina occupies much more of the carino-rostral wall than the rostrum,

which is higher and shorter, the apices of both being marginal." Nevertheless the entire size of the rostrum is larger than the carina, on account of its greater height.

The specimen from Bonomisaki was preserved in alcohol and gave opportunity for a dissection, whereas all the specimens from Zamboanga were dried.

Of the mouth parts the mandible is especially characteristic (Fig. 39). The upper part of the cutting edge is furnished with two rather adjacent strong teeth; the lower half of the edge is strongly pectinate, and in this pectinate part there are two more teeth, although not very strongly indicated by prominences of the margin. The lower angle of the mandible is slender and pointed.

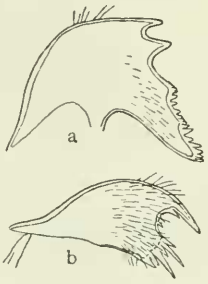


Fig. 39. *Verruca albatrossiana*, 21 miles W. ½ S. of Bonomisaki. a mandible, b maxilla. [× 48].

The maxilla has a very strong upper spine, and below this a small spine at the beginning of the deep excavation which occupies one half of the cutting edge. Below the excavation the edge is armed with two longer and four short, strong spines. The greater part of the blade is covered with rather long hairs.

The cirri are comparatively short. In cirrus I and II the rami are very unequal. In cirrus I the shorter ramus with its 13 segments is half as long as the longer one which has 22 segments; in cirrus II the shorter ramus has only 9 segments, but it is nevertheless also here half as long as the other ramus which counts 23 segments. The other cirri have subequal rami, and their segments are armed with three pairs of spines on their anterior side.

The caudal appendages are slender and extraordinarily long, measuring about $^4/_5$ of the length of cirrus VI; they have 31 segments.

Penis is short, about $^2/_3$ the length of cirrus VI, sparsely hairy except at the distal end, where it has a tuft of rather long hairs.

The large amount of specimens from Zamboanga furnish a good base for a study of the external features of the species, and its variations. In the majority of the specimens the right tergum and scutum are fixed, the left ones movable; this seems to be the

case in two out of three instances: in 50 specimens taken at haphazard 32 had their left scutum and tergum movable, in the other 18 specimens the left scutum and tergum were fixed, the right tergum and scutum being movable.

Also the sculpturation of the plates exhibits great variations. In most specimens radiating ribs are rather prominent in the movable scutum and tergum as also in the rostrum; in some spec-

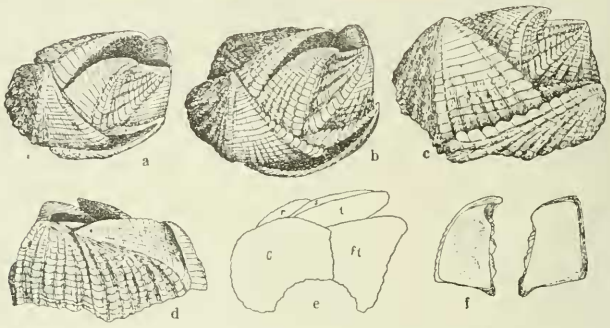


Fig. 40. *Verruca albatrossiana*, 25 miles E. of Zamboanga. a specimen showing no radiating ribs in tergum and scutum, half from above, b common, strongly sculptured specimen, half from above, c the same specimen in side view, rostrum left, d the same facing the fixed tergum and scutum, tergum left, e outlines of the same specimen, carinal view (c carina, r rostrum, ft fixed tergum, s and t movable scutum and tergum), f interior side of right scutum and tergum. [All figures × 4].

imens the radiating ribs have entirely faded away with exception of the diagonal rib, and the articular ribs, and only the transverse ridges of growth are prominent as in the other plates. Between these two extremities every transition is present.

Generally four articular ridges are present in the tergum; sometimes the marginal ridge exhibits a median longitudinal furrow in the lower part thus giving origin to a fifth articular ridge. — The vertical ridges of the parietal areas of the wall vary greatly in numbers.

The size of the greater specimens coincides with the dimensions quoted by Pilsbry (1912).

Verruca cristallina Gruvel.

25 miles E. of Zamboanga, 250 fathoms. 4 III 14. Four specimens of forma *laevis* nov. on large spicules of a siliceous sponge.

Of the four specimens three have their left tergum and scutum fixed, whereas the fourth (Fig. 41) has the right scutum and tergum fixed, the left plates movable.

Carina and rostrum interlock by three ribs: the carina is a little pointed, whereas the rostrum has a rounded and little prominent apex. The movable tergum has only a strongly pronounced diagonal rib; two other ridges, which interlock with the

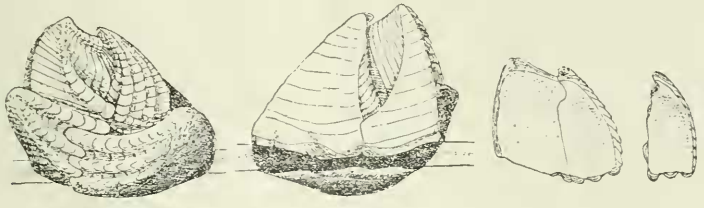


Fig. 41. *Verruca cristallina* f. *laevis*; 25 miles E. of Zamboanga. a specimen from the side of the movable scutum and tergum, b the same from the side of the fixed scutum and tergum, c movable tergum and scutum, d inside of movable tergum. [All figures × 8].

scutum, are only little pronounced. The movable scutum has four strong ribs articulating with the rostrum; only one rib interlocking with the tergum, viz. that next to the diagonal rib, is more prominent. The fixed tergum and scutum have only rather feeble lines of growth; in the tergum a broad ala is developed, whereas in the scutum a narrower radius is present, both with distinct lines of growth.

The internal side of the movable plates is almost sculptureless. No ridge or myophore is seen in the fixed plates.

The mouth feet are very characteristic (Fig. 42). In the mandible a fourth tooth is indicated just above the pectinate lower angle; the upper base of this fourth tooth is denticulated. The maxilla has one short and thick upper spine and at its lower side a longer but somewhat more slender spine. In the broad excavation, which occupies about one half of the entire cutting edge, two minute thorns are seen in the middle; below the excavation two larger and some smaller spines are present. The sides of the outer part of the blade are adorned with short hairs which are placed in groups of two or three.

Cirrus I has on its inner ramus 12, on its outer 13 segments; the basal segment of the outer ramus evidently consists of two coalesced segments. In cirrus II the rami have 11 and 13 segments. In both cirri the outer ramus is longer than the inner ramus by two segments and a half. Cirrus III is damaged in the specimen examined.

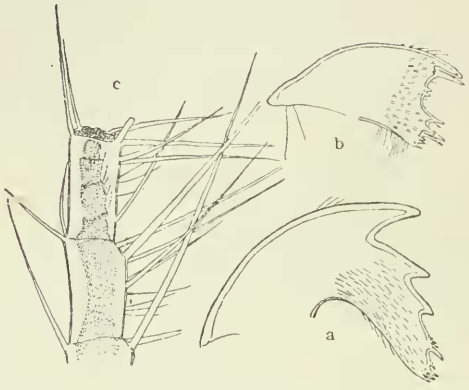


Fig. 42. *Verruca cristallina* f. *laevis*. 25 miles E of Zamboanga. a mandible, b maxilla, c distal two segments of the injured cirrus III showing mode of regeneration. [× 87].

The caudal appendages are short, only little longer than the protopodite of cirrus VI; they consist of 12 segments.

It is not without hesitation that I refer the present specimens to *Verruca cristallina*. According to Gruvel (1917) the specimens from the Andaman Islands have a more heavily sculptured fixed tergum and scutum, each of which moreover is adorned with an interlocking rib. On the other hand, the ribs of the movable scutum are more prominent in the present specimens, and also the small scutal ribs of the rostrum are more numerous. These characters may nevertheless fairly well come within the range of variation in a species.

Also the features of the animal's body seem to differ in some points. Gruvel found in his specimens caudal appendages half as long as cirrus VI with 25 segments, whereas the caudal appendages of the present specimens are only little longer than the protopodite of cirrus VI, and consist of only 12 segments. Also in the mouth feet differences seem to be present, although they cannot be made out with certainty because of the rather schematic drawings of Gruvel.

We are not at present able to judge of the systematic value of the said characters, and I have, therefore, preferred to designate the present specimens as belonging to *Verruca cristallina*, although representing a special forma *laevis*. Later investigations on larger

material shall have to settle the systematic position and value of the group.

The inner ramus of cirrus III on the left side of the animal dissected shows an interesting phase of regeneration (Fig. 42 c). The wound is closed by a chitinal layer, and within the last, undamaged segment the formation of four new, small segments are seen, building the coming outer end of the ramus on exuviation. This lends support to the statements of Darwin (1854, p. 158) as to the reparation of wounds and losses in cirripeds, and points to a pronounced power of regeneration in the cirri.

Verruca Krügeri n. sp.

3 miles S. W. of Tucuran, 300 fathoms. 10/III 14. Several specimens on spines of a *Cidaris*, together with *Megalasma striatum* and *Heteralepas nodulosa*.

Rostrum prominent, rather hornlike, interlocking with the carina by one large upper, and two smaller inferior ribs. Three or four articular ribs on the movable tergum and scutum. Movable tergum with a pronounced diagonal rib and, interlocking with the carina, two lower median and a stronger marginal rib. Fixed scutum and tergum almost without ribs or sculpture, the other plates strongly sculptured.

In the present species (Fig. 43) rostrum is by far the largest of the plates; its umbo is situated almost in the centre of the plate, with numerous ridges radiating in all directions. The stronger ridge, or rather crista, runs in the direction of the carinal umbo, and interlocks with the carina in a very deep sinus of the latter plate. Several ridges (7 or 8) run towards the margin and join the scuta, four of them interlocking with ridges of the movable scutum.

The carina interlocks with the movable tergum by two narrow ribs; a broad third rib has its upper edge in the sinus adjoining the diagonal scutal crista, its lower edge adjacent to the strong crista of the rostrum. On the lower side the carina is less strongly sculpturated.

The fixed tergum and scutum are almost devoid of ridges, but the lines of growth are easily distinguished.

The movable tergum has a strong diagonal rib or crista

pointing from its apex to the juncture of rostrum and carina. Along the margin adjacent to the fixed tergum an almost equally prominent ridge is developed, and between this ridge and the diagonal crista two narrower ridges are found; the four ridges mentioned interlock with ridges of the carina. Above the diagonal crista three or four ridges interlock with as many ridges of the scutum. The

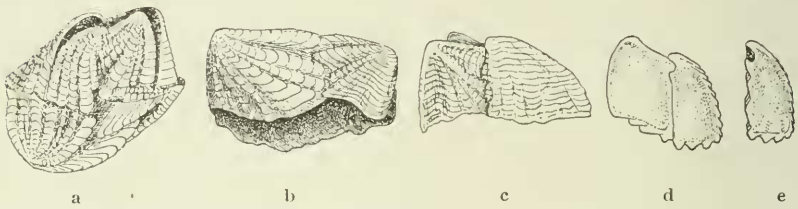


Fig. 43. *Verruca Krügeri*. 3 miles S. W. of Tucuran. a specimen seen half from above (rostrum pointing downwards), b side view, somewhat from below, rostrum (left) and carina, c side aspect of the fixed tergum and scutum, d inside of the movable scutum and tergum, e inside of movable tergum. [All figures × 5,5].

interior side of the plate is somewhat excavated, but otherwise without sculpturation like the movable scutum.

The movable scutum interlocks with the tergum by three or four ridges, and with the rostrum by four regularly developed strong ridges.

The line between the apices of carina and rostrum in the larger specimens measures 4,5 mm, the line from the rostral apex to that of the fixed tergum 5 mm; height of the carina 2 mm.

Of the mouth parts the mandible (Fig. 44) has three teeth, the second placed in the middle of the cutting edge. The lower angle is pointed, its anterior side armed with about six long and slender denticles. The lower half of the mandible is covered with small, fine hairs.

The maxilla has a strong upper spine and below this two more slender and somewhat shorter spines above the great excavation which occupies about half the cutting edge. No shorter spines or thorns are present in the excavation. Below the latter the cutting edge is armed with five or six slender spines. The outer part of the maxilla is hairy.

In cirrus I and II the anterior ramus is much shorter than

the posterior. In cirrus I it is half as long, the numbers of segments being 11 and 15; in cirrus II the anterior ramus measures about $^3/_5$ of the posterior; the numbers of segments are 10 and 16. In cirrus III the rami are subequal with 16 and 21 segments.

The caudal appendages are slender and about half as long as cirrus VI with 19 segments.

The species comes near to *Verruca Koehleri* Gruvel (1907), and *Verruca intexta* Pilsbry (1912). From the first named species the sculpture differs very much, although the number of articular ridges of the tergum and scutum generally coincide. The prominent ridges of the movable tergum between the diagonal crista and the carinal margin, and the rather prominent apex of the tergum are especially characteristic of the present species, whereas they are lacking in *Verruca Koehleri*. Also the rostrum is much larger in *Verruca Krügeri*.

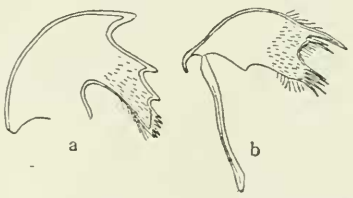


Fig. 44. *Verruca Krügeri*, 3 miles S.W. of Tucuran. a mandible, b maxilla. [× 48].

The sculpture of the tergum in *Verruca intexta* seems to coincide with *Verruca Koehleri*, although the ribs are even less numerous. Moreover the words of Pilsbry (1912): „Carina and rostrum interlocking with numerous teeth", and „beak of carina somewhat produced" do not agree with the features of *Verruca Krügeri*. In its number of articular ribs this species holds an intermediate position between *Verruca intexta* and *Verruca Koehleri* although in most cases it agrees with the latter.

The specimens from Tucuran must, therefore, be taken as representatives of a new species. I have named it after the cirriped investigator Paul Krüger, who has greatly contributed to our knowledge of the group.

Owing to its prominent rostrum, which emancipates itself hornlike from the other plates of the wall, the present species together with *Verruca nexa* Darwin, *Verruca Koehleri* Gruvel, and *Verruca intexta* Pilsbry according to Pilsbry (1916) belong to the group of *Verruca nexa* under his section *Verruca*. I should prefer to separate the *nexa*-group of this section as a section of its own, and

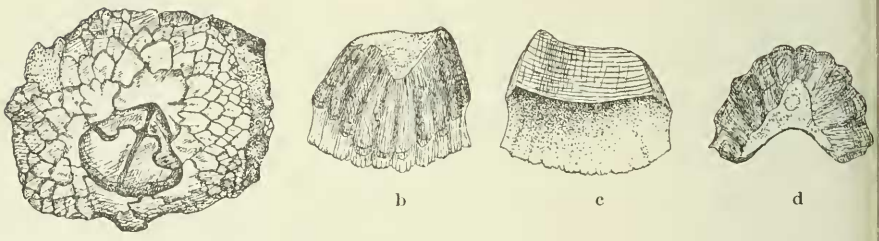
propose to name it sectio *Rostrato-verruca*, owing to its prominent rostrum. Indeed, this character seems to be more important, and lends the species a more aberrant feature than any other of the characters used by Pilsbry as means of distinction between his sections of the genus *Verruca*.

Family **Chtamalidae**.

Genus Catophragmus Sowerby.

Catophragmus Pilsbryi n. sp.

Taboga, Panama, on coastal rocks in the tidal zone. 12 XII 15. Several specimens.



a b c d

Fig. 45. *Catophragmus Pilsbryi* from Taboga, Panama. a type specimen in natural size, b carina of another specimen, outside, c the same, inside, d the same, top view. [b—d × 2].

The eight principal plates of the wall indistinct; supplementary compartments very numerous, irregular, imbricating over the sutures. The chitinal layer not reaching the basal edge of the compartments; all plates of the wall with several longitudinal ridges, with crenulated margins; summits corroded. Caudal appendages present, almost as long as the protopodite of cirrus VI, with 6 segments. Basis unknown. (Subgenus *Catophragmus* Pilsbry).

The shell is broad and low (Fig. 45). The inner whorl of plates is little distinct, generally even less distinctly pronounced than in the specimen figured; especially the rostral latera may be difficult to trace in many cases. Although the outer compartments generally decrease in size towards the periphery of the wall, this is not without exceptions, and the animal thus often attains a rather irregular aspect. From below the appearance is more regular, although

irregularities here also often may be obvious. — The largest plates of the wall are carina and rostrum.

The thick chitinal cuticle is dark chocolate-brownish, but worn off on top of the compartments, which are of dirty whitish colour. — The compartments are symmetrically shaped, their greater part hidden below the outer plates. The lower part is longitudinally regularly ridged in the same way as the carina (Fig. 45 b); the ridges are not seen internally. The basal margin is crenulated, or rather finely denticulated. In the present specimens the prominent part of the compartments is strongly corroded all over and almost flat. Probably the plates in young specimens will turn out to be almost conical with convergent outer ridges.

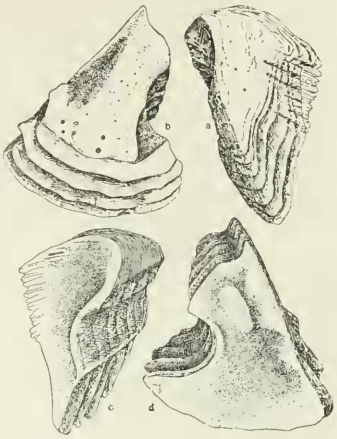


Fig. 46. *Catophragmus Pilsbryi* from Taboga, Panama. a tergum, external side, b scutum, external side, c tergum, inside, d scutum, inside. [× 2,7].

The opercular plates externally exhibit very deep ridges of growth, but their upper parts are strongly corroded; the plates are astonishingly thick.

The scutum (Fig. 46) has a straight occludent margin; no sulcus is present. The articular ridge is very prominent, with a very deep articular furrow below, and a somewhat shallower one above. The internal surface is deeply excavated, with a pit for the adductor, but no crests.

Tergum has a very prominent articular ridge, and a deep articular furrow, but no spur. The inside is deeply excavated with several crests for the depressor.

None of the specimens are intact; in all of them the basal part is wanting, and it must thus remain unsettled whether the basis is calcareous as in *Catophragmus imbricatus* Sowerb. or membraneous as in *Catophragmus polymerus* Darwin. The largest specimen has a greater diameter of 55 mm, but the position of the opening seems to indicate that the width of the entire animal must have been about 70 mm or even more. It is thus by far the largest *Catophragmus* hitherto known.

The investigation of the animal gave the following results as to the body:

The labrum is bullate, but has no furrow nor notch; neither are hairs or denticles present. The palpae are short and truncated (Fig. 47). The mandible has three large, almost equidis-

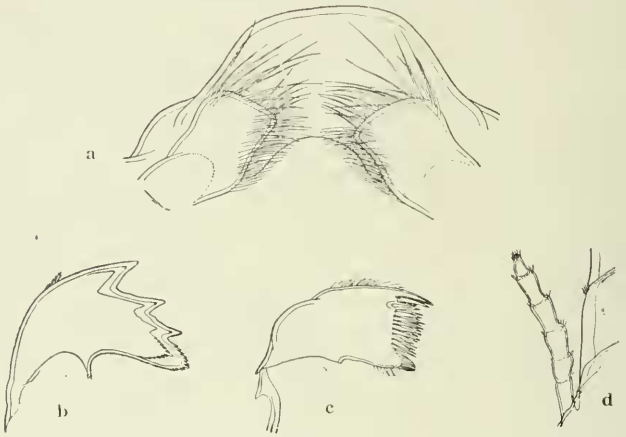


Fig. 47. *Catophragmus Pilsbryi* from Taboga, Panama. a labrum with palpae, from above, b mandible, c maxilla, d caudal appendage. [× 22].

tantly placed teeth; the lower angle is pointed, and strongly pectinate. The surface is all but destitute of finer hairs.

The maxilla has two large upper spines, below these latter one pair of smaller spines, and then a small, but distinct notch. The lower part of the cutting edge is straight, and armed with several strong spines; the lower angle is a little protruded, and armed with a brush of bristles. A crest is seen at the upper margin in the posterior part of the blade. Only some few hairs are present at the upper and lower margins.

Cirrus I and II are short, the posterior cirri longer and of almost equal size; all the cirri are stout. The numbers of segments are:

	Cirrus	I	II	III	IV	V	VI
Cirri of the right side	inner ramus	8	9	19	23	22	22
	outer „	11	11	18	21	22	23
Cirri of the left side	inner „	9	9	21	22	21	21
	outer „	12	10	20	23	23	23

The caudal appendages are only a little shorter than the protopodite of cirrus VI; in the right appendage of one specimen there were 6, in the left one 5 segments, but in the latter the basal segment is twice as long as in the right appendage, thus certainly representing two segments.

The penis is twice as long as cirrus VI, annulated, and only with a tuft of hairs at its distal end.

The branchiae are rather large with plicated surface.

The present species in many respects holds an intermediate position between *Catophragmus imbricatus* and *Catophragmus polymerus*. With the latter it shares the great number of compartments, and the ridged plates, although the arrangement of the ridges is asymmetrical in *Catophragmus polymerus*, but symmetrical in the present species. With *Catophragmus imbricatus* it has the caudal appendages in common, but they are more fully developed in the present species, which also has a greater number of compartments. It must, therefore, be regarded as a separate species, and I have allowed myself to name it *Catophragmus Pilsbryi* after the eminent cirriped investigator Henry A. Pilsbry.

The species seems to be strictly litoral, judging by its finding place; it thus would seem to be possible to get material for a study of its development, a tempting task on account of the supposed primitive position of the genus among the sessile barnacles.

Genus **Pachylasma** Darwin.

Pachylasma scutistriata n. sp.

38° 25' S., 148° 28' E., 70—80 fathoms. „Endeavour" 8/IX 14. Two specimens.

38° 15' S., 148° 43' E., 70—120 fathoms. „Endeavour" 9/IX 14. Several specimens, mostly attached to crinoid stalks, some (without substratum) overgrown with sponges.

38° 12' S., 149° 40' E., 100—160 fathoms. „Endeavour" 16/IX 14. Several specimens on the stem of an antipatharian, together with *Oxynaspis celata*, *Heteralepas morula*, *Ibla pygmæa*, and *Balanus auricoma*.

Compartments pink with whitish alae; radii absent. The alae are very broad, and distinctly striped perpendicularly to their upper

margin. Carina almost keeled, forming an acute angle seen from above. Scuta large, with distinct ridges of growth and radially arranged groves; terga all but invisible in closed specimens. Rostral compartment consisting of three coalesced, but distinctly evident plates.

The six compartments are easily distinguishable owing to the well developed, triangular alae (Fig. 48) which are developed along the carina, the carinal latus, and the median latus. The compart-

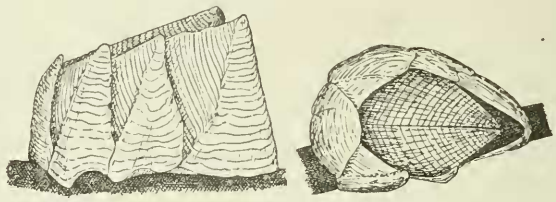


Fig. 48. *Pachylasma scutistriata* from 38° 12' S., 149° 40' E. Type specimen in side view, and from above. [× 1.5].

ments are vividly pinkish, not seldom with vertical darker, and lighter stripes radiating from the apex of the compartment; the alae, on the other hand, are only feebly coloured or almost quite white and thus very conspicuous as against the compartments. The lines of growth are often almost invisible, and very irregular in the compartments, but sometimes they may be somewhat accentuated by their colour and more regularly arranged. In the alae the lines of growth are regular and distinct, parallel with the margin. The sheath has very regular, and well developed lines of growth; the basal part of the compartments has an inner all but porcellaneous surface. No pores are present.

In young specimens the basis is membraneous. In larger specimens, on the other hand, the outer parts of the basis are calcified, whereas the central part remains membraneous. The calcification is rather intense, and the calcified parts of the basis in old specimens attain a fairly conspicuous thickness.

The carina is not very broad, and has a pointed apex; the broad alae form a pointed angle with each other, and the plate is therefore narrowly V-shaped in transverse section, especially in its upper part.

The rostrum is broad with a rounded apex. In young specimens two external longitudinal stripes very often are seen indicating that the plate, as already pointed out by Darwin (1853) in other species, and more especially emphasized by Pilsbry (1916), is in fact composed of the rostrum and two rostral latera. In old specimens the external sutural lines fade away because of both the

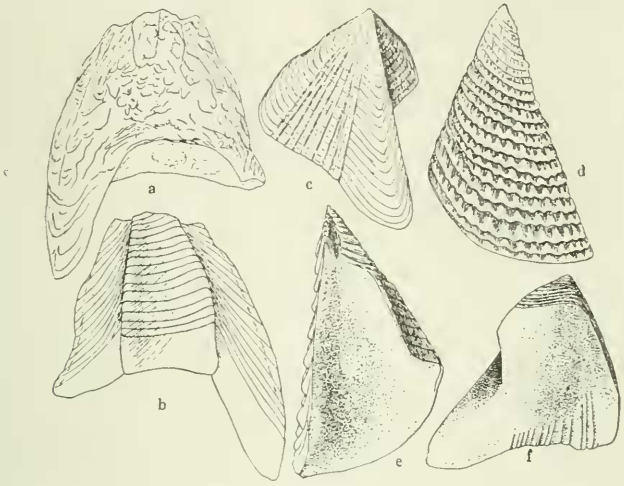


Fig. 49. *Pachylasma scutistriata* from 38° 12' S., 149° 40' E. a rostrum + rostral latera, external aspect, b the same plate in inside view, c external view of tergum, and d of scutum, e and f inside view of scutum and tergum. [All figures × 4].

irregular structure and the corrosion of the surface; but an examination of the interior surface (Fig. 49 b) also now clearly reveals the boarders of the components: the rostral latera at first sight may indeed be taken as radii of the rostrum. In transverse sections the sutures are rather easily traced all through the plate, although the connection is so strong that the suture does not generally form the line of fracture, when the plate is broken to pieces. Probably the plates will turn out to be quite separate in smaller specimens than I had at hand, in the same way as Darwin has observed it in other species of the genus.

The scutum is triangular with distinct lines of growth (Fig. 48 d). The growth zones are groved, and the groves are arranged in lines radiating from the apex, so that the scutum at first sight seems to be regularly radially striped. The interior surface is al-

most quite even, only with a faint pit for the adductor. The articular ridge is rather long, but little prominent.

Tergum has an almost invisible indication of a spur. Externally there is a feeble, longitudinal depression, and the lines of growth are very faint. Internally fine crests are present for the adductor; the short articular ridge is very prominent and strongly projects beyond the scutal margin.

Fig. 50. *Pachylasma scutistriata* from 38° 12' S., 149° 40' E. a mandible, b maxilla. [× 22].

The size of the specimens varies greatly; the smaller specimen basally has a rostro-carinal length of 7,5 with a carinal height of 3 mm, the largest specimen in the same way has a length of 20 mm and a carinal height of 15 mm.

In its internal features the mouth parts of the animal show the typical Chtamalid. The labrum has no teeth nor hairs; it is not bullate, and has neither notch nor median grove.

The mandible (Fig. 50a) has three teeth, the second situated at the middle of the cutting edge. The upper edges of the second and the third tooth are basally finely pectinate. The lower angle of the mandible is armed with rather long bristles which take the place of the usual pectination. Only few finer hairs are present in the lower part of the blade.

The maxilla has a very strong upper spine; between this and a sharply defined notch three or four shorter spines are situated. Below the notch the median third of the cutting edge is armed with four or five pairs of strong spines, and below these spines the edge again carries shorter spines, among which one stouter and more prominent. The sides of the blade are covered with fine hairs near the cutting edge.

The armature of the cirri displays two types. In cirrus I and II the segments are bullate, and armed with numerous spines in transverse belts. In cirrus IV to VI the segments have three pairs of long and strong spines, and basally some few fine hairs on their anterior side; distally 5—6 long hairs are present on the posterior side of the segments.

In cirrus III the basal segments of the rami are armed in the same way as in cirrus I and II; the greater majority of the seg-

ments on the other hand, show the same arrangement of spines as the three posterior cirri.

The caudal appendages are a little longer than the protopodite of cirrus VI, and have 15 to 18 segments; only the distal segments have some few and well developed hairs.

The penis is only little longer than the protopodite of cirrus VI, stout, and annulated all over. Some few and small hairs are scattered on its surface, and at the distal end it has two lateral tufts of long and strong hairs.

The species at hand comes near to *Pachylasma Darwinianum* Pilsbry (1912); the latter has an entirely membraneous basis, and the present species thus bridges the gap between *Pachylasma Darwinianum* and the typical *Pachylasma*-species with their more completely calcified bases in adult specimens. The species with membraneous bases moreover link *Hexelasma* to *Pachylasma*, and leave a sound base for a separation of these genera. The other character, which consists in the presence, resp. absence of caudal appendages, also fails. According to Pilsbry (1916) the caudal appendages in *Pachylasma Darwinianum* consist of „only one extremely minute joint", i. e. they are quite rudimentary. In *Pachylasma scutistriatum* the appendages are, on the other hand, among the best developed in the genus counting up to 18 segments, and thus almost reaching the same number as in Darwin's (1853) specimens of *Pachylasma giganteum* (Philippi) which had 19 segments. Between these extremes the other species hold intermediate positions.

Pachylasma scutistriatum also comes near to *Pachylasma crinoidophilum* Pilsbry (1911), but differs in the width of the carino-lateral compartment; this is in the latter species half as wide as the lateral (mediolateral) compartment, in *Pachylasma scutistriatum*, on the other hand, of the same width as the lateral compartment.

Genus **Chtamalus** Ranzani.

Chtamalus antennatus Darwin.

Port Hacking, N. S. W., on the beach. 10/X 14. Several large specimens together with *Tetraclita squamosa*.

In his monograph on the American barnacles Pilsbry (1916) points to systematic characters in *Chtamalus,* which possibly may be of value as regards an arranging of the species in larger groups within the genus. First he divides the species into two main groups according to the structure of the mandibles: in the *stellatus*-group the lower part of the mandible is comblike with a trispinose lower angle, whereas the *Hembeli*-group has the usual pectinate lower

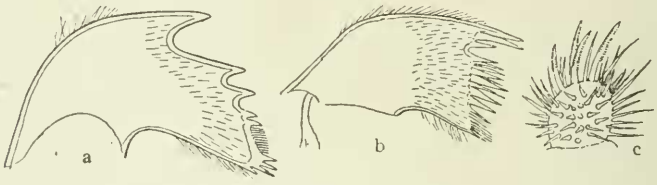


Fig. 51. *Chtamalus antennatus* from Port Hacking. a mandible, b maxilla, c distal segment of cirrus II. [× 68].

angle with no comblike part above it. Pilsbry with a question-mark places *Chtamalus antennatus* in the *Hembeli*-group, not having had access to material of the species. The mandible (Fig. 51 a) nevertheless at once indicates that *Chtamalus antennatus* belongs to the *stellatus*-group: the fourth tooth is small, and double, or we might speak of a fourth and fifth tooth; below these latter a comblike, although much shorter part than in *Chtamalus stellatus,* is developed. The lower angle is armed with three rather large spines and a small fourth one, thus rather distinctly differing from *Chtamalus stellatus.* — In the maxilla the notch is more pronounced than in *Chtamalus stellatus,* but the difference is not very conspicuous.

Cirrus I has 9 and 6 segments in the rami, cirrus II 6 segments in both rami. In cirrus II the terminal segment of both rami has 4 or 5 pectinate spines without larger teeth below the pectinate part, whereas Pilsbry in *Chtamalus stellatus* only in the longer ramus found one serrate spine; moreover the rami of cirrus II are of equal length and width in *Chtamalus antennatus.* — In the cirri III—VI the segments carry three pairs of spines on the anterior side, only in the two posterior cirri a very small fourth proximal pair may also be found. The numbers of spines are thus lower than in the nearly related *Chtamalus stellatus.*

Chtamalus moro Pilsbry.

Zamboanga, from stones on the beach. 25 II 14. Numerous specimens together with *Tetraclita squamosa*, and *Tetraclita vitiata*.

The present specimens differ in colour from Pilsbry's description (1916), most of them being lighter or darker brown with paler ribs; only some few of them are almost white. — Pilsbry only disposed of dried specimens, and I shall, therefore, here give some details as to the body of the animal.

a b

Fig. 52. *Chtamalus moro* from Zamboanga. a mandible, b maxilla. (× 60).

The labrum has an almost straight edge with a single row of small spines occupying the middle half; 35 to 40 spines were counted in the row.

The mandible (Fig. 52c) is of the *stellatus*-type: the fourth tooth is small, although double, the comblike part extraordinarily short, with only five or six bristles; the three terminal spines are all but equal, the median one tending to be the longer one.

The maxilla has a very little conspicuous notch below the upper group of spines; on the other hand a small, but distinct notch is again visible between the stronger spines of the middle part of the cutting edge and the lower group of more hairlike bristles.

The anterior cirri are short. In cirrus I the shorter ramus measures about $^3/_4$ of the longer one, the numbers of the segments being 7 and 8. In cirrus II the rami are all but of equal size with 6 and 7 segments. Pectinate spines are present in great numbers in the two distal segments of both rami of cirrus II, but no large-toothed spines are present. In cirrus III—VI the segments have three pairs of spines on the anterior side.

Chtamalus moro is thus characterized by an unusually short comblike part of the mandible, and by the numerous pectinate

spines which are present in both distal segments of the rami of cirrus II, not only in the last segment, as in other species of the *stellatus*-group hitherto known.

Chtamalus fissus Darwin.

La Jolla, Calif. On the coastal rocks. 21/VIII 15. Numerous corroded specimens on *Tetraclita squamosa*, and *Balanus glandula*.

La Jolla, Calif. The coast. 25 VIII 15. Numerous small specimens together with *Tetraclita squamosa*.

San Pedro, Calif. The coast. 27/IX 15. Numerous specimens together with *Balanus tintinnabulum*, and *Tetraclita squamosa*.

Genus **Chamæsipho** Darwin.

Chamæsipho columna (Spengler) Darwin.

Mahia Peninsula, N. Z. On the coast. 18/XII 14. Several specimens on *Elminius plicatus*.

In his description Darwin (1853) especially calls the attention to the peculiar development of cirrus II and III of the present species; in cirrus II the anterior ramus is generally very much shorter than the posterior ramus, the segments of the first named moreover being bullate, and thickly clothed with spines. In cirrus III the anterior ramus exhibits a composite nature: the basal segments are bullate, and thickly set with spines, whereas the distal segments are slender, more cylindrical, with four or five pairs of spines along the anterior median line. In the present specimens (Fig. 53 c) this structure is strongly pronounced; in the cirrus the posterior ramus is very long, antenniform, and only sparsely furnished with hairs.

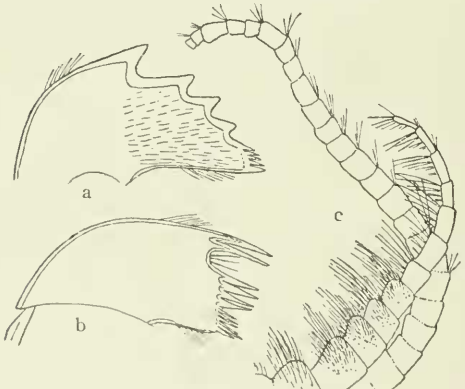


Fig. 53. *Chamæsipho columna* from Mahia Peninsula. a mandible, b maxilla, c cirrus III. (a—b × 150, c × 48).

The mouth feet in structure very much ap-

proach *Chtamalus*. The mandible has four short and broad teeth and a pectinate lower angle. The maxilla has two large upper spines, and below them a distinct and rather broad notch; the middle part of the cutting edge is occupied by a group of four or five strong spines, whereas the lower part of it is armed with much more delicate bristles in great numbers.

Family **Balanidae.**

Genus **Balanus** da Costa.

Although the arrangement of the species in subgenera put forth by Pilsbry (1916) is far from satisfactory, and probably goes a little too far, it is nevertheless a step forward towards a natural dismembering of the genus in lower categories, and is in better agreement with our recent knowledge than earlier groupings. I therefore follow Pilsbry in my arrangement of the species.

As to the nomenclature introduced by Pilsbry, there are several drawbacks in spite of his attempt to defend it by the nomenclatory rules. It is thus inadequate to keep up a name as *Balanus* for one group, or subgenus of *Balanus*; this is not only apt to bring forth confusion, but it may also be a question, whether it is not in fact in strict opposition to the nomenclatory rules accepted by most other scientists, and it would be far better to accept the course of the botanists here and put an *Eu-* before the name of the central group, as long as it is emphasized as a subgenus.

Similar objections may be made regarding the subdivision of species which has become an extreme faculty of Pilsbry, owing to his highly developed systematic abilities: here moreover, another objection may be raised, not to the subdivision, but to the terminology. Without a closer definition of the terms Pilsbry substitutes „subspecies“ for Darwin's „variety“ and again divides subspecies into „formae“. What does a subspecies mean? If we study the results, it ever becomes more evident that the subspecies, as emphasized by Pilsbry, are sharply limited, geographical varieties, i. e. groups of variants evidently determined by narrow biophysical limits; this exactly corresponds to the term „forma“ as used

already for a long time in botany, in biometrical terminology, and for years also by several zoologists. If, on the other hand, a group of special variants is found with no affinity to biophysical factors, and thus not directly geographically bound, this is among the same scientists accepted as a „subspecies", or rather „elementary species". This is the reason why I cannot follow Pilsbry in his nomenclatorial course in his dividing up of the species, although I fully agree with him in his realities. Indeed, his treatment of the finer systematics especially of the *Balani* is masterly and ought to be followed by every systematist.

Subgenus Megabalanus Hoek.

Balanus tintinnabulum Linné.

Forma *coccopoma* Darwin.

Taboga, Panama. On a buoy. 7/XII 15. One cluster consisting of four large specimens.

Forma *californica* Pilsbry.

Off Redondo, Calif. 30 fathoms. 25/IX 15. Several specimens on dead shells of gastropodes, and lamellibranchiates.

San Pedro, Calif. On the coast. 27/IX 15. One small, but typical specimen together with *Tetraclita squamosa*, and *Chtamalus fissus*.

Balanus campbelli Filhol.

Perseverance Harbour, Campbell Island; under stones at low tide. 9/XII 14. One specimen.

The original description of Filhol (1885), cited in extenso by Gruvel (1905), is rather deficient; nevertheless no doubt can arise as to the identity of the present specimen, which, moreover, is from the very same locality as Filhol's originals. The incompleteness of earlier descriptions, and the deficiencies of Gruvel's too small figures make renewed investigations of the species desirable. The basal parts, I am sorry to say, are wanting in the one specimen at hand; it therefore shall be the task of a future student to give the details as to these parts of the barnacle.

The compartments are greyish or dirty brownish-white with prominent, radiating ribs; the upper margin of the radii is parallel

with the basis, and the species exhibits a confusing external similarity with *Balanus balanus* (Lin.); it may indeed be a question, whether the statements as to the Antarctic occurrence of the last-named, Boreal and Arctic species are not due to erroneous identifications of *Balanus campbelli*. — The carina has a more keel-like median ridge; a similar, although less pronounced ridge is

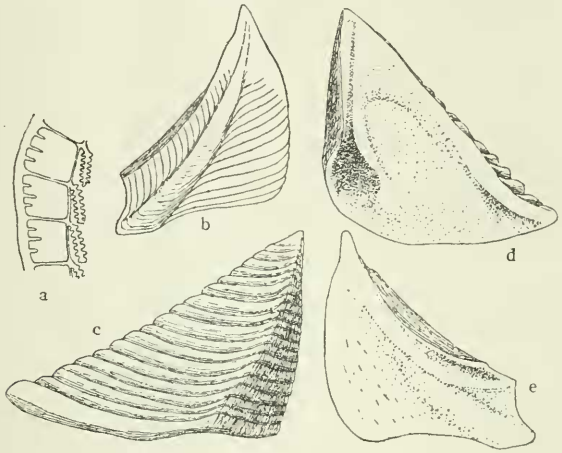


Fig. 54. *Balanus campbelli* from Perseverance Harbour. a diagrammatic transverse section of the lateral compartment near the base, b—c external view of tergum and scutum, d—e internal side of scutum and tergum. [b—d × 5,3].

also observed in the rostrum. The carinal latus is narrow, only one third as broad as the lateral compartment, and about half as wide as the rostral compartment. — The compartments are porous, and the pores are, at any rate until shortly above the basis, covered by a transverse inner septum. In the carinal, and rostral compartments the walls between the pores stand forth as longitudinally striped ribs or fans of the interior lamina; in the lateral, and partly also in the carinolateral compartments these fans are pointing in the direction of the rostral side so that they cover the inner lamina in the basal part of the compartment (Fig. 54 a). — The sheath seems to be about half as long as the compartments; it is white.

The radii are porous, but not very broad, with an upper margin parallel with the basis. The upper margin of the alae is oblique and somewhat convexely arched.

The tergum has a beaklike but not very long apex; the spur fasciole is broad, and distinct, although not very deep; the ridges of growth are clean cut, but there are no longitudinal striæ present. The spur is broad, about one third of the basal margin, and separated from the basiscutal angle by an oblique part of the margin almost as long as the width of the spur. The articular ridge is well developed, but the interior side otherwise only feebly sculpturated; no crests are present for the depressor muscle.

The scutum has no radial stripes nor grooves, but only prominent ridges of growth. It makes a sharp bend along a radial line so that the tergal third stands almost perpendicularly to the rest of the plate. There is a great, and rather deep pit for the adductor muscle; the adductor ridge is short, but prominent, and in its inferior part separated from the very prominent articular ridge by a deep excavation; this excavation upwards passes into a narrow and not very deep furrow running to the apex. The articular furrow is very shallow. There is no pit for the depressor muscle.

The greater diameter of the present specimen is 17 mm between the lateral plates, the rostro-carinal diameter 16 mm, and the height of the carina 10 mm. It ought to be remembered that these dimensions have been somewhat larger in the intact specimen, as the basal part is now wanting.

An examination of the animal showed that the labrum (Fig. 55) has a deep notch; close by the notch the margin has on each side three low transversal ridges, each with a rudimentary denticle at its top.

The mandible has two large upper teeth; near the lower angle two other teeth are indicated; the lower angle has evidently had numerous small, spinelike or hairlike denticles, now worn off. Near the cutting edge, and almost parallel with it runs a narrow belt of rather long hairs.

The maxilla is rather characteristic and aberrant. There are two large upper spines, the lower situated a little obliquely at the lower side of the marginal main spine. Below these two spines three or four pairs of somewhat shorter spines follow and then, along an oblique median part of the cutting edge two or three more slender, but longer single spines. The lower half of the cutting edge is somewhat protruded and armed with four large spines

in a single row; these spines are as large as, or even larger than the upper spines; the lower angle carries some few, more hair-like bristles. On the sides of the blade a single row of somewhat thicker hairs runs parallel with the edge along the part, carrying the paired spines; the outer part of the blade below this row is furnished with finer hairs.

The cirri exhibit the same type as in *Balanus tintinnabulum* Lin., and *Balanus algicola* Pilsbry; cirrus II, and III are short,

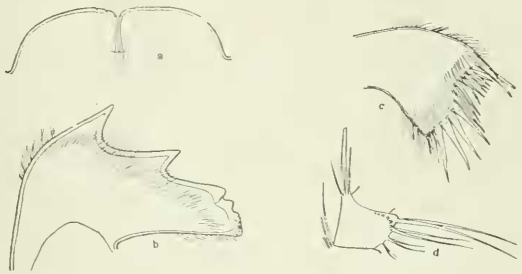


Fig. 55. *Balanus campbelli* from Perseverance Harbour. a labrum, b mandible, c maxilla, d seventeenth segment of cirrus IV.
All figures × 22.

the latter shorter than the other cirri but with a comparatively long pedicel.

In cirrus I the rami have 12 and 18 segments, the shorter ramus being only half as long as the other one. Cirrus II has subequal rami with 12 and 13 segments; the somewhat shorter rami of cirrus III have 13 and 14 segments and are only slightly different in length.

The segments of the three posterior cirri have four pairs of long spines at their anterior side. In cirrus IV the segments however are a little swollen; the segments at their anterior and distal side are armed with a single, arched row of denticles. In the basal segments of the rami the row is doubled, or the denticles even may be found irregularly crowded beside the base of the upper spines.

The penis is annulated and short, not reaching half the length of cirrus VI; it has some 5—6 scattered small hairs on its distal third, but no tuft of hairs at its distal end.

Balanus campbelli is nearly related to *Balanus decorus* Darwin; but the structural differences in the opercular plates and the parieties are so great that they seem to be distinctly separated. As to the body a comparison is not yet possible, as details of *Balanus decorus* are missing.

Subgenus Eubalanus n. nom.
[= Subgenus *Balanus* (Da Costa) Pilsbry].

Balanus amphitrite Darwin.

Forma *communis* Darwin.

Off Cavite, Manila Bay; ab. 5 fathoms. 13/II 14. Four quite small specimens on a small plate of muscovite.

Cebu; muddy beach at low tide. 21/II 14. Several small specimens on gastropode shell inhabited by a hermit crab.

Off Jolo; ab. 20 fathoms, *Lithothamnion*. 17/III 14. Some small specimens on a gastropode shell.

Off Jolo; ab. 25 fathoms, sand and coral. 20/III 14. One specimen on a gastropode shell.

Off Jolo; 20—30 fathoms, sand and corals. 20/III 14. Several specimens together with *Balanus minutus*, *Balanus amaryllis*, and *Acasta conica*.

Some of the latter specimens in colour approach the forma *cirrata* Darwin, but the opercular plates, the mouth parts, and the cirri agree with the typical forma *communis*; there are three denticles on each side of the notch in the labrum.

Forma *hawaiiensis* nov.

Kaladis Point, Mindanao; on the mole. 11/III 14. Two specimens.

Pearl Harbour, Honolulu; on the coast. 5/V 15. Several specimens on broken china.

This form of *Balanus amphitrite* somewhat recalls the forma *albicostata*, and *inexpectata* of Pilsbry (1916).

The shape of the barnacles is rather regular, the rostrum all but straight or with its apical part a little outwards bent, so that the profile is somewhat concave; the other compartments, and especially the carina are rather convex. The parieties are white with dark violet or greyish-blue radiating stripes, sharply defined. Generally a broader white zone runs along the median line of the com-

partment, and sometimes also a similar white area is present along the radii. Radii and alae are greyish or almost quite white. The sheath is dark brownish or violet with narrow whitish stripes.

The compartments only exceptionally show a tendency to develop ribs along the white lines; generally the surface is quite smooth. The pores of the parieties are large, at the base with small septae along the outer lamina; these septae disappear further upwards and do not bifurcate. The basis is almost quite smooth within.

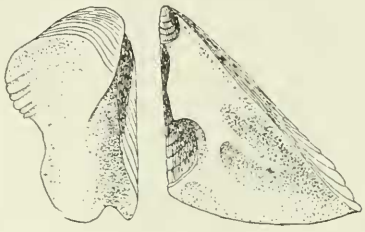


Fig. 56. *Balanus amphitrite* f. *hawaiiensis* from Honolulu. Inside view of the opercular plates. [× 5,3].

In its opercular plates the present form comes near to the forma *inexpecta*. The tergum is flat with a broad spur fasciole outlined by grooves; the spur is moreover very broad, it is rounded or more square. The articular furrow is broad and deep; the crests for the depressor muscles are small and hardly projecting below the margin.

The scuta have only little prominent growth ridges and no longitudinal scratches whatever. The colour is here as in the terga a greyish white. The internal structure in every detail coincides with forma *inexpecta*; also the deep oblong pit is present below the adductor ridge. The greatest difference is found in the shape of the plate: this is in the present form rather narrow; the tergal and basal margins are of all but equal length, and meet in an obtuse angle.

In its anatomical features the present form exhibits so great peculiarities that we cannot deny the possibility that it really represents a species of its own. Especially the armature of the cirri is peculiar. Cirrus I and II are of the common type. In cirrus III, on the other hand, the bullate segments of the rami on their anterior side carry several short and strong, beaklike spines, beside the long bristles which already tend to an arrangement in pairs along the anterior median line. On the posterior side the basal six segments of the rami carry one, the following segments two upwards curved, short and strong spines beside three or four hairs.

In cirrus IV the transition to the shape of the posterior cirri

has proceeded one step further; the bristles are decidely arranged in pairs, generally four or five; but also here the anterior surface is covered with small wharts or denticles, although of a minute size. The posterior short spines are also present here, and are kept in cirrus V and VI, here even increased in numbers to three on each segment.

In its mouth-parts the present form more approaches the forma *albicostata*. The crest of the labrum is armed with num-

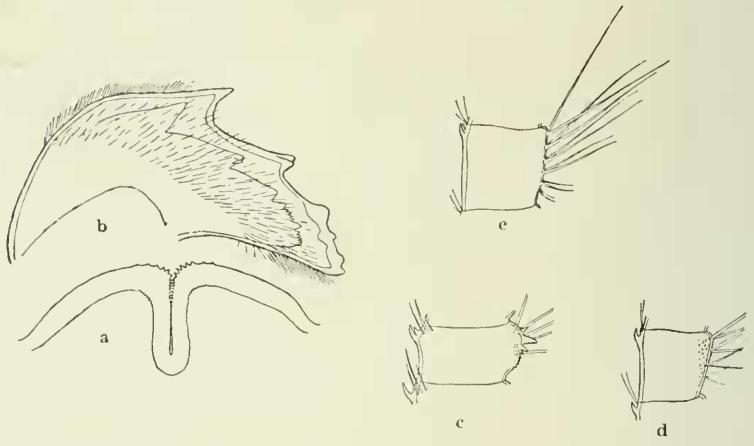


Fig. 57. *Balanus amphitrite* f. *hawaiiensis* from Honolulu. a labrum, b mandible, c seventh segment of cirus III, d sixth segment of cirrus IV, e fifteenth segment of cirrus VI. [a–b × 44, c–e × 67].

erous denticles at the notch, the sides of the latter carrying very short fine hairs. While the maxilla corresponds with the forma *albicostata*, the mandible (Fig. 56 b) differs; the drawing is from a specimen about moulting, and the internal contour gives a fairly good idea of some details of the pectinate lower part, which are all but worn off in the old cuticle: below the small fourth tooth the edge is finely denticled, tending to a comblike structure, with one larger denticle placed in the middle of the pectination. This denticle and the small „fourth tooth" are of the same size.

We might feel inclined to think that these characters are so important that the specimens ought to be taken as the type of a separate species. If on the other hand we take into consideration

the great variability of the *Balani*, and the agreement in most characters with the two forms several times alluded to, very much speaks against our following that course. To settle the question it is moreover necessary to have access to a far larger material also of other forms of *Balanus amphitrite* than that which stands at my disposal.

I have with some doubt referred two specimens from Kaladis Point, Mindanao, to the same form. The calcareous parts entirely agree with the Honolulu-specimens. But in other respects some differences have to be noted: In the labrum there are only three or four a little larger denticles present on each side of the notch; in cirrus III the spines of the anterior side are a little more numerous, and the posterior spines smaller, in cirrus IV the denticulation of the anterior side is absent, and the posterior spines both here and in cirrus V and VI rudimentary. In spite of these differences, which point to a transition to the more common types of *Balanus amphitrite*, I have preferred not to establish a new form for the Mindanao-specimens which are evidently closely related to the Honolulu-specimens.

Balanus minutus Hoek.

Off Jolo; ab. 25 fathoms. 17/III 14. Several specimens attached to gorgonarians etc.

Off Jolo; 20- 30 fathoms. 20 III 14. Several small specimens together with *Balanus amaryllis* and *Balanus amphitrite*, some of them placed on *Telesto* sp.

Off Jolo; ab. 15 fathoms; taken by a diver 21 III 14. Three fine, small specimens on a flat stone, and two small specimens on a bryozoan.

Although much speaks in favour of the opinion uttered by Pilsbry (1916) that *Balanus minutus* should only be regarded as a form of *Balanus amphitrite*, I have provisionally followed the course of Hoek (1913), and treated it as a separate species.

The colours are rather richly varied from almost quite white with only light reddish lines or freckles to dark bluish-red with lighter stripes and spots. — The opercular plates (Fig. 58) indeed differ rather strongly from the common type of *Balanus amphitrite*. In the scuta there is no trace whatever of an adductor ridge, and in smaller specimens every trace of a pit for the adductor muscle

is also often wanting, so that the internal surface of the scutum may be even less sculpturated than in Hoek's drawing. The shape, and sculpturation of the tergum come next to *Balanus amphitrite* forma *nivea* Darwin. — In the mouth parts Hoek found three teeth on each side of the labrum, whereas the present specimens have four; also in the mandibles some small differences from Hoek's drawings may be observed, the inferior part being less protruded in the present specimens. Yet another small difference has to be noted, viz. the constant occurrence of three small spines

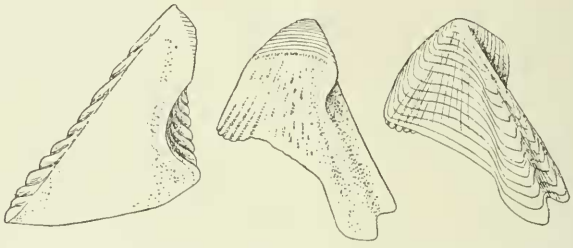


Fig. 58. *Balanus minutus* from 25 fathoms, off Jolo. Opercular plates. [× 15].

instead of one or two in the median segments of the rami of cirrus III.

As to the three specimens from Jolo $^{21}/_{III}$ 14, seated on a flat stone, I was at first in doubt, whether they should be referred to *Balanus minutus*. They exhibit a most extraordinary colour: the compartments have radiating, dark bluish red, strong lines alternating with whitish or bluish lines, and crossed by fine lines of a somewhat lighter hue than the radiating dark lines. The radii are darker bluish red, especially at their summits, whereas the alae are white. In one specimen the carinal latera are white all over with a few, radiating stripes of a darker shade, the specimen thus getting a broad white belt at the carinal third. The scuta have two dark red lines along their occludent margin, and a third red line near the tergal margin. The specimens are the more fascinating, as on account of the even support they are beautifully regularly conical with a regularly ovate basal circumference.

An examination of the opercular plates (Fig. 59) displays the nearest relationship with *Balanus minutus*, although the plates in the present specimens are somewhat broader. Besides this, the

articular crista and furrow in the scutum are extraordinarily strongly developed; we might indeed presume that a concrescence of articular and adductor ridges had taken place. In correspondance with this the articular furrow of the tergum is exceedingly deep and broad, and the apical part extraordinarily compact.

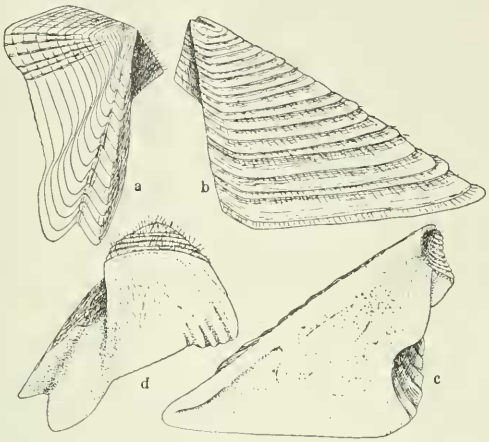


Fig. 59.

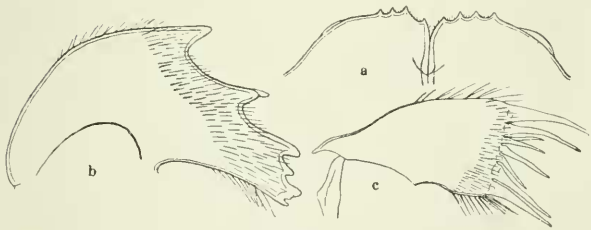


Fig. 60.

Figs. 59 and 60. *Balanus minutus* from 15 fathoms, off Jolo.
Fig. 59. a and b external view of tergum and scutum, c and d inside view of scutum and tergum. [× 25].
Fig. 60. a labrum, b mandible, c maxilla. [× 100].

Among the features of the animal the mouth parts (Fig. 60) of the specimens so entirely agree with the other specimens of *Balanus minutus* that a separation, if reasonable, must be based upon the opercular plates, and upon the fact that the intermediate segments of cirrus III carry four small spines on their anterior side instead of two or three. It is indeed not justifiable to look on the specimens as representatives of another species, and I do not even

find it reasonable to consider them as anything but individual variants which cannot claim the rank of a special form. In reality they point in the direction that *Balanus minutus* is only a Malayisian form of *Balanus amphitrite*.

Balanus trigonus Darwin.

Misaki; on the coast. 30/IV 14 Two clusters of large specimens.

Aburatsubo, Misaki; ab. 3 fathoms. 2/V 14. Three rather large specimens on a rotten wooden twig.

Misaki; ab. 20 fathoms. 25/V 14. Several great and small specimens, partly on dead fragments of mollusk shells.

Misaki, off the station; 25 fathoms 9/VI 14. Several small specimens on a gastropode shell inhabited by a hermit crab.

Off Misaki; 80—120 fathoms, sandy bottom. 10/VI 14. One medium sized specimen.

Misaki; on the coast; June 14. Fine clusters on shell fragments of dead mollusks.

North Channel, Kawaii Island, Hauraki Gulf, N. Z. 29/XII 14. Two medium sized specimens on a dead gastropode shell.

Honolulu; coral reef. 1/V 15. Several specimens on shells of living and dead lamellibranchiates

Balanus rostratus Hoek.

Forma *eurostratus* n. nom.

(= *Balanus rostratus*, Pilsbry 1916).

Departure Bay, Nanaimo; „the brachiopode-cave", on coastal rocks 10/VI 15. Several specimens up to 25 mm in diameter, together with *Balanus crenatus*.

The specimens from Departure Bay quite agree with the Japanese variants which Pilsbry (1916) takes to be the typical *Balanus rostratus* i. e. the forma *eurostratus*; the only difference which may be stated, is the somewhat less sunken radii, but this gives no base for a separation between the present specimens and the forma *eurostratus*.

Forma *heteropus* Pilsbry.

Northumberland Channel, Nanaimo; ab. 25 fathoms. 23/VII 15. Three specimens of ab. 20 mm diameter on a shell fragment of a *Pecten* sp.

Balanus crenatus Bruguière.

Dodds Narrows, Vancouver Island; on the coast at low water 28/V 15. In great numbers covering small stones.

Departure Bay, Nanaimo; „the brachiopode-cave", on coastal rocks 10/VI 15. Several specimens attached to gastropode shells and calcareous worm tubes; together with *Balanus rostratus*.

Balanus glandula Darwin.

Departure Bay, Nanaimo; on the beach at low tide 3/VI 15. Several specimens on small stones; basis extremely thin, all but membraneous.

La Jolla, Calif.; on coastal rocks 21/VIII 15. Some strongly eroded specimens together with *Tetraclita squamosa*, and *Chtamalus fissus*.

Subgenus Hesperibalanus Pilsbry.

Balanus hesperius Pilsbry.

Nanoose Bay, Nanaimo; ab. 10 fathoms 11/VI 15. Several specimens on gastropode shells, and on calcareous worm tubes.

Pylades channel, Nanaimo; ab. 20 fathoms 6/VII 15. One small specimen.

Some of the specimens from Nanoose Bay are placed on the very apex of snails houses and exhibit an almost globular shape with a small, narrow base.

Subgenus Chirona (Gray) Pilsbry.

Balanus amaryllis Darwin.

Forma *euamaryllis* nov.

Taba Bay, Mindanao; on the coral reefs 12/III 14. Four fine specimens on the naked axis of a gorgonarian.

Off Jolo; 20—30 fathoms 20/III 14. Several specimens together with *Balanus minutus*, and *Balanus amphitrite*.

The variant group which by Darwin (1853) is considered typical is here named forma *euamaryllis*. — The specimens show some variation in as much as the segments of cirrus VI may sometimes have three or four pairs of anterior spines instead of the two pairs mentioned by Darwin; in some specimens the tufts of small hairs between the spines are also absent.

Forma *nivea* Gruvel.

Off Jolo; ab. 20 fathoms, *Lithothamnion*, 17/III 14. Two specimens on a half corroded, dead gastropode shell.

I was at first inclined to refer the present specimens to *Balanus Krügeri* Pilsbry owing to the feeble sculpturation of the internal side of the scuta; but the crenulation of the edge of the radii agrees with *Balanus amaryllis*. The external sculpture of the opercular plates is very delicate and the spur fasciole shallow, although distinct. The labrum has three denticles at each side of the notch, and the mandible has the typical shape of *Balanus amaryllis*, thus distinctly differing from *Balanus Krügeri*. Moreover the cirri correspond with *Balanus amaryllis* in the want of anterior smaller spines in cirrus III and IV. On the other hand, the posterior sides of the basal segments in the rami of cirrus III and IV are finely pectinate, and the pectination may also be traced in cirrus V. The short and rapidly tapering penis has a strongly developed basidorsal protuberance.

Subgenus Austrobalanus Pilsbry.

Balanus vestitus Darwin.

? Masked Island, Carnley Harbour, Auckland Island; below stones at low tide 3/XII 14. The opercular plates being absent the identification is not quite sure here.

Queen Charlotte Sound, N. Z.; 3—10 fathoms, hard bottom intermingled with softer spots, 19—20/1 15. A group of three specimens together with *Calantica villosa*.

Darwin (1853) gives the details of this interesting species although without drawings of the body details. I therefore here give the outlines of the mandible and maxilla (Fig. 61). In the investigated specimen the labrum has only one very small denticle at each side of the deep notch.

Among the cirri of the specimen dissected cirrus I has a shorter ramus of only one third the length of the longer ramus which latter is rather slender; the numbers of segments are 11 and 25. The rami of cirrus II are of equal length with 10 and 11 segments. In cirrus III the rami are subequal with 23 and 26 segments; only the basal segments are broader and bullate; the

outer half of the rami consists of slender segments. The spines are especially developed on the outer 5—6 segments of the inner half of the rami (Fig. 61 c). In cirrus IV and V the rami are of

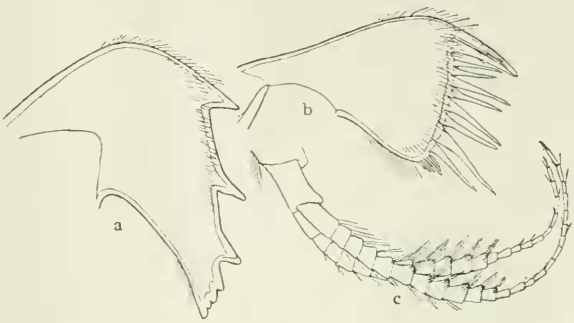


Fig. 61. *Balanus vestitus* from Queen Charlotte Sound. a mandible, b maxilla, c cirrus III. (a—b × 44, c × 13).

equal length, but in cirrus VI there is a shorter ramus measuring $^2/_3$ of the longer one; the numbers of segments are 26 and 32. The segments of cirrus IV to VI carry four pairs of anterior spines; the distal pair is far larger than the other spines.

Subgenus Solidobalanus Hoek.

Balanus auricoma Hoek.

38° 12' S., 149° 40' E., 100—160 fathoms. „Endeavour" 16 IX 14. One specimen on the axis of an antipatharian, together with *Oxynaspis celata*, *Ibla pygmæa*, *Heteralepas morula*, and *Pachylasma scutistriata*.

The specimen from the „Endeavour" is considerably larger than Hoek's specimens from the „Siboga" (1913). He does not give details in the text as to the size; but according to the drawings his „larger" specimen has a greater basal diameter of a little less than 2,5 mm, whereas in a „small" specimen figured at the same plate the diameter is between 2,2 and 2,3 mm. The „Endeavour"-specimen has a greater (rostro-carinal) diameter of 13 mm.

The exterior of the specimen (Fig. 62) comes next to the smaller specimen of Hoek (comp. his fig. 7, pl. XIX, 1913). It is white with irregular fainter or brighter, brownish red, radial lines crossed

by transverse stripes of the same colour, lending the specimen a deceiving similarity with common types of *Balanus amphitrite,* and an examination of the opercular plates also reveals a great likeness in structure with *Balanus minutus.* One difference must be emphasized as at once obvious: the yellowish epidermal hairs shining as gold, mentioned by Hoek, are still more developed in the

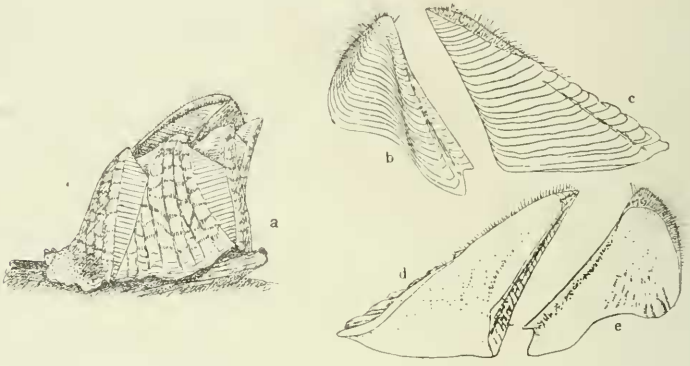


Fig. 62. *Balanus auricoma* from 38° 12' S., 149° 40' E. a entire animal in side view, b and c external view of tergum and scutum, d and e inside view of tergum and scutum. [a × 2, b–d × 6].

large specimen, forming here a furry coating along the occludent margins of the opercular plates. — The interior side of the opercular plates (Fig. 62d, e) is remarkably flat; in the scutum a triangular pit for the adductor is feebly indicated, and in the tergum short crests for the depressor are well developed.

In the maxilla Hoek speaks of „a broad notch behind the upper pair of spines"; this notch is absent in the specimen at hand, and moreover, the smaller bristles at the lower angle are here constituting a brush. The labrum is evidently injured, the lower part of it a little swollen, possibly owing to regeneration; only two very small denticles are seen at one side of the notch. Other differences from Hoek's descriptions are not present, and the identity thus seems to be absolutely certain, in spite of the great differences in size.

Subgenus Armatobalanus Hoek.

Balanus allium Darwin.

Off Jolo; ab. 20 fathoms. 17 III 14. Several small specimens on a caryophyllid, some few placed on a madreporarian together with *Pyrgoma* sp.

Subgenus Conopea (Say) Pilsbry.

Hoek (1913) seems to think that the development of coral polyps in the coenosark covering the barnacle is an exception as is evident from the following remark under *Balanus investitus*: „This remarkable species presents us with an interesting case of commensalism. The cup-formed basis is attached to a part of the bifurcating stem of an *Acanthogorgia,* which is covered by a substance composed of a tissue interwoven with calcareous spiculae and developing here and there into little calyces, from the surface of which numerous spiculae stand off. The shell of the Balanus is covered by the same substance which here also develops into numerous such calyces". Indeed this remark suits any *Conopea* inhabiting octocorals as far as I have had an occasion to study them. The symbiosis of cirripeds and corals is far more common than one might believe from the statements in the special memoirs, as I have pointed out in a previous paper (1916), and especially do the *conopea*-species seem to be common in octocorals of the Indo-pacific regions. Nevertheless they may appear to be scarce, owing to their imbedding which causes them to be overlooked or not payed heed to by coral-investigators in common. Their fixed orientation as to the coral colony, their elasticity in shape according to the coral species, and the specific diversities of skeletonal development and armature of the cirri announce fields of biological study for investigators who are able to study the living animals. We are indeed to-day as ignorant of this symbiosis as we were in the days of Darwin.

? *Balanus calceolus* Darwin.

Off Jolo; ab. 12 fathoms, 17 III 14. Five specimens imbedded in a gorgonarian.

The specimens agree with Darwin's descriptions and drawing, also in having a porous basis. Nevertheless their identity cannot be stated with absolute certainty, as the animals have evidently

been dead for a long time, so that every trace of their bodies, and the opercular plates has disappeared.

Balanus proripiens Hoek.

6 miles N. N. E. of Sacol, Mindanao; ab. 35 fathoms, 6/III 14. One small specimen on a threadlike gorgonarian (probably *Scirpearella* sp.).
Off Jolo; ab. 25 fathoms, 17 III 14. Numerous specimens in a stouter gorgonarian (a red Mopsellid, together with *Smilium acutum*.

While the Sacol-specimen has the same low and stretched shape as Hoek's specimen, the specimens from Jolo are comparatively much shorter and higher (Fig. 63). This evidently depends upon the gorgonarian which in each case serves as participant of the symbiose: a slender gorgonarian with thin coenosarcal layers makes the cirriped develop into a slender and long specimen, whereas the same species in fleshy gorgonarians attains a broader and higher shape.

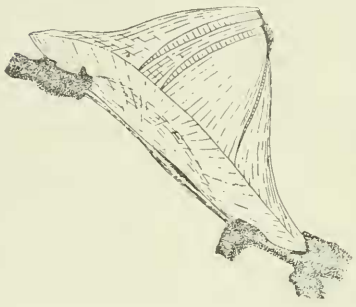


Fig. 63. *Balanus proripiens*, off Jolo. The coenosark of the gorgonarian almost entirely prepared off. [× 4].

The Jolo-specimens are purely white with a rather glossy surface when the covering tissues of the coral are removed, whereas the Sacol-specimen has the reddish colour-tinges mentioned by Hoek in the „Siboga"-specimen (1913). — An examination of the interior parts of the shell reveals the same features as found in *Balanus cymbiformis* by Darwin (1853): „The parietis are strongly ribbed internally, and are not permeated by pores. The basal cup is not porose, but its inner surface is ribbed in lines radiating from the centre." Hoek points to the near relationship between *Balanus proripiens* and *Balanus cymbiformis*, and it may indeed be a question, whether they are specifically separable; a reexamination of Darwin's type specimens will have to settle this question.

Balanus dentifer n. sp.

32° 15' N., 128° 12' E., 90 fathoms. „Hyatori Maru" 15/V 14. Several specimens in octocorals of the families Isiidae, and Muricæidae.

Base and walls not porose; basis cupformed, oval, attached to the gorgonarian axis. Neither carina nor rostrum basally elongated. Carina generally with an exterior digitiform tooth at the apex. Carinolateral compartment at the base $^1/_6$ to $^1/_5$ of the lateral compartment, narrowing upwards. Radii and alae with somewhat oblique margins so that the opening is deeply sinuose. Scutum with radial striae formed by grooves in the ridges of growth.

The specimens are white or sometimes show a faint reddish hue when the coral tissues have been removed. The basis is boat-shaped, although only in the rostral part showing a tendency to elongation; its periphery is therefore almost quite regularly oval. The gorgonarian axis is embedded in a not very deep rostrocarinal furrow, from which radiating, broad, and shallow furrows lead to the base of the carino-lateral compartments; similar furrows are also indicated at the junction of the rostral and lateral compartments; these furrows thus coincide with the radiating furrows of the basis found in some *Acasta*-species. The basis is poreless; the external surface exhibits indications of radiating striae whereas the internal surface is entirely smooth.

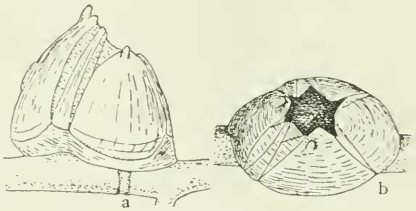


Fig. 64. *Balanus dentifer* from 32° 15' N., 128° 12' E. a side view, b from above. The coenosark of the gorgonarian prepared off [× 5,3].

On their inner surface the compartments have low, but distinct longitudinal ridges below the sheath; the latter extends halfway down the compartment. The external surface exhibits indistinct indications of radial stripes. The compartments are poreless.

The carina is rather broad, tapering upwards; at the apex a prominent tooth is situated externally just below the apex with its summit projecting a little above the margin, and pointing upwards and outwards. In two of the specimens this tooth was not observed, but it seems most likely that it has been broken off, when the dried coenosarkal parts of the corals were prepared off. In two other specimens a similar tooth was again observed near the apex of one of the lateral compartments (Fig. 64).

The carino-lateral compartment is narrow, about $^1/_5$ or $^1/_6$

of the lateral compartment, and a little tapering upwards. The lateral compartment is broadly triangular with arched sides; also rostrum is triangular with pointed apex.

The radii and alae are moderately wide with oblique and smooth margins; the opening of the shell is therefore irregularly star-shaped with 6 points. The radii and alae have no stripes on their external surface.

The opening of the shell is oblique to the basis; the carina and carinolateral compartments are longer than the lateral and rostral compartments. Like other *Conopea*'s also *Balanus dentifer* is situated with its carina upmost as compared with the coral colony, and has its opening facing obliquely downwards, pointing towards the base of the coral colony.

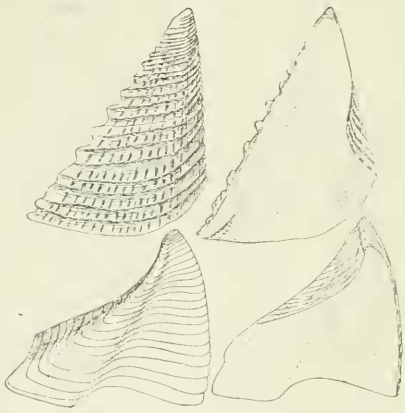


Fig. 65. *Balanus dentifer* from 32° 15' N., 128° 12' E. Opercular valves. [× 17].

At first sight the scutum seems to be longitudinally striate; this is due to small, radially arranged groves in the rather prominent ridges of growth (Fig. 65). The occludent margin has prominent teeth, but these teeth do not correspond with the growth ridges. The plate is a little concave; the tergal third forms an almost right angle with the rest of the plate. The inner side has a feebly developed articular crista, but no ridge whatever for the adductor; on the other hand the pit for the adductor is rather deep although not distinctly limited.

The tergum has feeble although distinct lines of growth. The spur is distinct, twice as broad as long below the margin; the spur fasciole is rather deep. The internal surface exhibits almost no sculpturation; crests for the depressor are only faintly indicated and not distinctly limited. — The opercular plates, and especially the terga are very thin and brittle; this is the more curious as the walls are rather coarsely built and not fragile at all.

The greater specimens have a rostro-carinal basal diameter of 4,5 mm with a carinal height of 4 mm.

In its internal structure the species very much approaches *Acasta,* and is indeed only to be distinguished from this genus by its fixed basis.

The labrum has three denticles at each side of the deep notch. The mandible has three main teeth, and at the lower angle three small teeth. The blade has a narrow belt of rather long hairs along the cutting edge.

The maxilla has at its upper margin two large spines, and below these an indication of a notch; the following five spines of the cutting edge are a little smaller than the upper two, and below the five spines there is one long spine, as long as, or even a little longer than the upper two; below this long spine a somewhat smaller one, and at the lower angle two quite small and delicate spines are placed. The blade has only longer delicate hairs just inside the cutting edge.

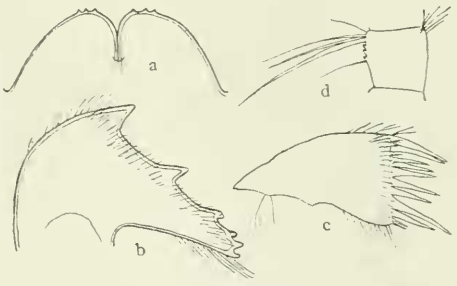


Fig. 66. *Balanus dentifer* from 32° 15' N., 128° 12' E. a labrum. b mandible, c maxilla, d fourth segment of cirrus IV. [a—c × 44, d × 66].

Among the cirri only the shorter ramus of cirrus IV has small spinelike denticles on the anterior side of the basal and median segments; there are three or seldom four denticles present in the segment. Neither denticles nor hooks are found in cirrus III.

Cirrus I has rami with 5 and 11 segments; the shorter ramus is half as long as the longer one. In cirrus II the shorter ramus measures $^2/_3$ of the longer one; the numbers of segments are 5 and 7. Cirrus III has subequal rami with 7 and 8 segments. Also in cirrus IV the rami are subequal, and have 14 and 17 segments; only in the shorter ramus the basal and median segments are armed with small denticles besides the long spines. The posterior cirri have three or exceptionally four pairs of anterior spines on the segments.

The penis is extraordinarily long, more than twice as long as the entire body of the animal including the cirri. It is annulated all over, its distal part furnished with scattered, long hairs.

The most nearly related species is evidently *Balanus navicula*; but the deeply incised marginal edge of the opening, and the external, digitiform tooth of the carina distinguish it from all other species of the group.

Genus **Acasta** Leach.

Acasta cyathus Darwin.

Off Jolo; ab. 12 fathoms, 17/III 14. Several small specimens together with *Acasta Dofleini*.

The specimens are small, the larger ones with a greater basal diameter of only 4,2 mm and a carinal height of 4,2 mm. There is no longitudinal striation in the scuta, but in all other details the specimens agree with Darwin's (1853) and Pilsbry's (1916) descriptions; the armature of the cirri agrees with Pilsbry's specimens.

Acasta japonica Pilsbry.

Sagami Sea; 400 fathoms. 1—7/V 14. Two small, partly broken specimens in a small fragment of a sponge.

Acasta pectinipes Pilsbry (== *Acasta nitida* Hoek 1916).

Off Jolo; ab. 25 fathoms, sand and coral. 20/III 14. One specimen.

Acasta conica Hoek.

Off Jolo; 20—30 fathoms, sand and coral. 20/III 14. One specimen together with *Balanus amphitrite, Balanus minutus*, and *Balanus amaryllis*.

The rostro-carinal basal diameter is only 4 mm. The plates all over their surface show distinct striae of growth, in the basis parallel with the periphery, in the compartments parallel with the basal margins. The radii are densely vertically striped without the feeble horizontal stripes mentioned by Hoek (1913); this is the only difference from Hoek's specimens which could be found in the specimen at hand.

Acasta Dofleini Krüger.

Off Jolo; ab. 12 fathoms, hard bottom. 17/III 14. Three small specimens together with *Acasta cyathus*.

Off Jolo; ab. 20 fathoms, *Lithothamnion*. 17/III 14. One specimen in a siliceous sponge; together with *Balanus amphitrite*.

Off Jolo; ab. 15 fathoms. 21/III 14. One small specimen together with *Balanus minutus*, taken by a diver.

At first sight the greater specimen from 20 fathoms rather differs from Krüger's description (1911), the outlines being much more rounded (Fig. 67) than in Krüger's drawing, the rostrum higher, and the aperture almost regularly triangular. Krüger also

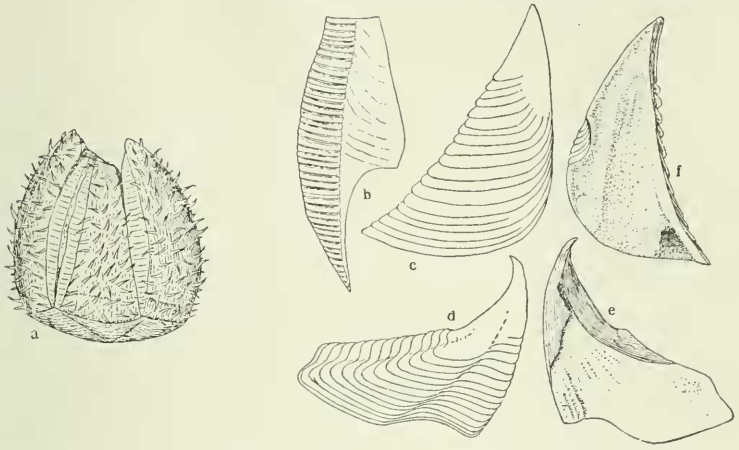


Fig. 67. *Acasta Dofleini*, off Jolo. a entire animal in side view, b carino-lateral compartment, c and d scutum and tergum, external aspect, e and f inside view of tergum and scutum. [a × 2, b—f × 4].

speaks of perforations („Poren") in the parities, except in the carino-lateral one; in the present specimens the cuticle of the compartments develops long and strong hairs, or rather flexible spines, which are embedded in the sponge tissues and evidently serve to fix the cirriped. A closer study reveals that each of these cuticular spines is placed on a perforation of the compartments so that in numbers and arrangement they correspond with the pores mentioned by Krüger.

As cited above, Krüger found that the carino-lateral has no perforations; this is easily explained by a study of the plate: there is in fact no compartment present, but only the ala and radius of the plate, the compartment of which is obliterated (Fig. 67 b); the radius, on the other hand, reaches down to the basis. The latter

has in my specimens a more evenly rounded periphery than in Krüger's figure.

While the tergum in my specimens agrees with Krüger's description, the scutum shows some differences; the plate is strongly bent with a concave outer side adorned with regular ridges of growth; the interior side is only feebly sculptured with a low adductor ridge that does not reach the apex, but makes a bend towards the occludent margin somewhat below it. The pit for the lateral depressor is distinct, and basally situated at the commencement of the adductor ridge. The articular ridge is little prominent, but a narrow, although deep articular furrow is developed; the latter seems to be entirely absent in Krüger's drawing.

Fig. 68. *Acasta Dofleini*, off Jolo. a labrum, b mandible, c maxilla, d basipodite of cirrus IV, e segment 8 and 9 of cirrus IV, f segment 29 and 30 of cirrus VI. [All figures × 33].

In spite of these small differences it seems obvious that the specimens belong to the same species. As Krüger had only access to empty shells, I shall give some details as to the body of the animal.

The labrum (Fig. 68a) is narrow and furnished with one denticle at the side of the deep notch; the crest is here armed with small hairs.

The mandible has three almost equidistant main teeth, the lower two double. The lower angle is pectinate, but the pectination is worn off in older specimens about moulting.

The maxilla is broad; the upper spine is hardly longer than the other ones; a feeble notch is indicated below the upper two

spines. The blade carries here as in the mandible delicate hairs near the cutting edge.

In the cirri the spines are remarkably few in numbers. The rami of cirrus I are very unequal; the shorter ramus has 8 segments and measures only one third of the longer ramus, which has 36 segments. The armature of cirrus IV is very characteristic: the basal and median segments of the anterior ramus have two adjacent, clawlike hooks on their distal half, the lower pointing downwards almost parallel with the axis of the ramus; one long bristle is seated at the distal side of the spines. In the basipodite several clawlike spines are arranged in a single median row, decreasing in size towards the middle of the segment, the basal part of which is devoid of spines.

The segments of cirrus V and VI have only two or three pairs of anterior bristles; the distal pair is very long, the next very small, and the third consisting of only two very short hairs if at all present.

The penis is almost twice as long as cirrus VI, annulated and all but destitute of hairs.

Acasta madreporicola n. sp.

Off Jolo; ab. 25 fathoms. 25 III 14. One specimen embedded in a madreporarian coral.

Compartments feebly granulated with little prominent, radiating ridges externally. Carino-lateral plate only consisting of radius and ala, reaching to the basis; no opening between the basal parts of the coarsely built plates. Radii broad, with a little oblique, crenulated margins; margin of the alae oblique, and smooth. Basis bowlshaped with radiating shallow ridges externally. Shell white. Opercular plates thin; scuta with transversely striated ridges of growth, with prominent long articular ridge and deep pit for the adductor. Tergum with a broad spur confluent with the basi-scutal angle, and with all but invisible crests for the depressor.

The species (Fig. 69) is rather globose with a strongly arched large rostral compartment; the carina is shorter and nearly straight, and the opening of the shell almost parallel with the basis. The lateral compartment is broadly triangular and strongly arched.

These compartments are externally feebly granulated and ribbed, the ribs radiating from the apex. The carino-lateral compartment is obliterated, only leaving behind the broad radius and ala in the same way as in *Acasta Dofleini*. There are no perforations nor pores in the compartments or in the bowlshaped basis. The shell is quite white, and of a strong and rather solid structure, devoid of pores between the basal parts of the compartments. The attachment of the compartments to the basis is very strong. — The radii are delicately transversely striped; the upper margin is

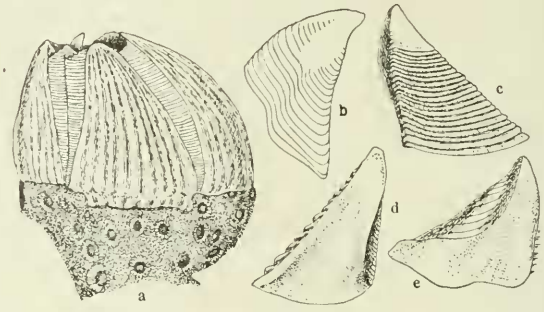


Fig. 69. *Acasta madreporicola*, off Jolo. a entire animal (side view), the coral prepared off above the basis of the cirriped; b and c external view of tergum and scutum, d and e inside view of scutum and tergum. [a × 4, b—e × 6].

crenulated, and oblique in the same way as that of the alae. All radii reach to the basis.

The scuta have strong ridges of growth ornated with very feeble transverse striae, which nevertheless do not lend the plate a radially striped appearance. The articular ridge is very prominent, and almost as long as the entire tergal margin; the articular furrow on the other hand is shallow. There is a deep pit for the lateral depressor. An adductor ridge is only just indicated, whereas the pit for the adductor is very deep although narrow.

The terga are extremely brittle. The spur is about half as wide as the basal margin, or even a little wider; its margin is confluent with the basi-scutal point of the plate. The spur fasciole is almost invisible, and the ridges of growth very feeble. The articular area is very broad and shallow, and ridges for the depres-

sor only faintly indicated. Near the occludent margin the ridges of growth are accentuated by small hairs of the cuticle.

The basal rostro-carinal diameter is 7,5 mm, the height of the carina 5 mm.

The labrum (Fig. 70) is prominent but not bullate, with a deep notch and two or three minute denticles on the crest at the sides of the notch.

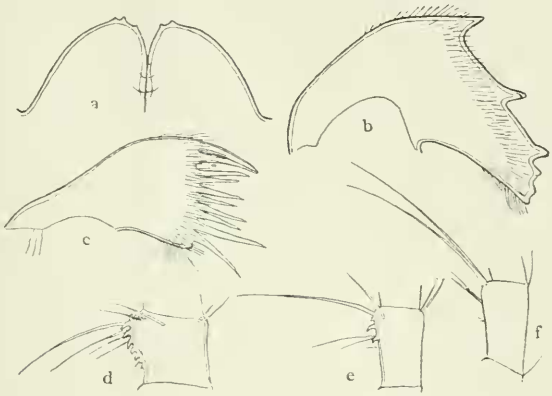


Fig. 70. *Acasta madreporicola*, off Jolo. a labrum, b mandible, c maxilla d fifth segment of cirrus III, e fifth segment of the anterior ramus of cirrus IV, f median segment of cirrus VI. [a–c × 44. d–f × 88].

The mandible has three main teeth and three indistinct warts at the lower angle; delicate long hairs constitute a furry belt along the blade just inside the cutting edge.

In the maxilla a notch is faintly indicated below the two stout upper spines; below this notch the cutting edge is armed with a single row of six somewhat shorter spines, and near the lower angle follow two more prominent spines, which are even longer than the two upper spines. A tuft of short bristles is indicated at the lower angle. The sides of the blade carry long, delicate hairs near the cutting edge.

In the cirri segments of cirrus III are armed with hooks. The two basal segments as well as the two distal ones of the rami in cirrus III are devoid of hooks; the other segments have an anterior median row of 7 or 8 hooks turning their points to-

wards the base of the cirrus, and at the distal end of the row a transverse line of smaller hooks pointing upwards. In the anterior ramus of cirrus IV the median segments are provided with two or three hooks along the anterior median line pointing downwards. — The segments of the posterior cirri carry on their distal half two pairs of anterior spines; the distal pair is far longer than the lower; in many segments also a rudimentary third pair is indicated in the middle of the segment.

The rami of cirrus I are very unequal; the shorter ramus has 8 segments, and is half as long as the other ramus, which has 16 segments. In cirrus II the shorter ramus measures $^3/_4$ of the longer one; the numbers of segments are 6 and 8. In cirrus III the rami are subequal, although both of them have 11 segments. All cirri of the animal are comparatively short.

The penis is annulated, slender, and one and a half time as long as cirrus VI.

Among the *Acasta*-species the most nearly related seems to be *Acasta Dofleini,* in which the carino-lateral compartment has the same rudimentary character as in the present species; but with this character the agreement seems to come to an end. Far nearer the relationship with *Balanus arcuatus* Hoek (1913) seems to be, and I should indeed have hesitated in regarding them as anything else and more than varieties, had not the present species been a distinct *Acasta* with its cupshaped basis. Special interest is afforded by the armature of the cirri, the hooks of which in cirrus III and IV seem to agree in every detail in the two species. This throws an interesting light on the affinities of the *Acasta*-groups.

The present species is the more interesting because it also adds to the list of *Acasta*-species which are not inhabiting sponges. Of such species *Acasta purpurata* Darwin and *Acasta hirsuta* Broch are hitherto known from gorgonarians, *Acasta antipathidis* Broch from antipatharians, and now also the present species inhabiting madreporarians, *Acasta madreporicola.* In all these species the coral entirely surrounds the cirriped but for the aperture; whether the growth of the surrounding coral tissues puts a limit to the lifetime of the cirriped is at present an open question.

An interesting phenomenon in the present species is afforded by the calcareous concrements which occur in great abundance in

the interior soft tissues of the cirri and the penis; we are not at present able to give any satisfactory explanation of this remarkable occurrence.

Genus Tetraclita Schumacher.

Tetraclita squamosa (Bruguière) Schumacher.

(= *Tetraclisa porosa* (Gmelin) Darwin.)

Forma viridis Darwin.

Zamboanga; on stones at the beach. 25/II 14. Several small and medium sized, delicately built specimens together with *Chtamalus moro*.

Port Hacking, N. S. W.; on the beach. 10/X 14. Some few young specimens.

Taboga, Panama Bay; on coastal rocks. 21/XI 15. Several great specimens.

Pilsbry (1916) names this form „subsp. *squamosa* (Bruguière)"; although the nomenclatory rules are not quite clear on this point, it cannot in this case any more than in other cases be in accordance with their meaning that the same name can be used without special suffixes for different systematic categories; it is, therefore, misleading to use Bruguière's name for the subspecies as long as it is also used for the species, and I here prefer to maintain the variety-name *viridis* of Darwin which is used for the main form in all other papers on cirripeds.

Forma rubescens Darwin.

La Jolla, Calif.; on the coastal rocks. 21/VIII 15. Two great specimens together with *Balanus glandula*.

La Jolla, Calif.; on the coastal rocks. 25/VIII 15. Several smaller and larger specimens together with *Chtamalus fissus*.

San Pedro, Calif.; on the beach. 27/IX 15. Three small specimens probably belong to this subspecies; they occur together with *Chtamalus fissus* and *Balanus tintinnabulum*.

Tetraclita purpurascens (Wood) Darwin.

Forma breviscutum nov.

Port Ross, Auckland Island; under stones at low tide. 26/XI 14. Several corroded specimens.

The identification of these specimens caused much trouble; their surface is very much worn off, and the corroded compart-

ments are often very difficult to distinguish. In some of the specimens the alae are rather well developed, but the radii are always rudimentary. The aperture is not large, although irregular owing to corrosion. The colour (in alcohol) is greyish-white.

The apparition corresponds to the figures given by Darwin (1853) of corroded specimens of *Tetraclita purpurascens*, and the specimens on the whole so nearly agree with Darwin's description of this species that they must be referred to it. Nevertheless they also exhibit so marked differences that they must be taken as representatives of a special form.

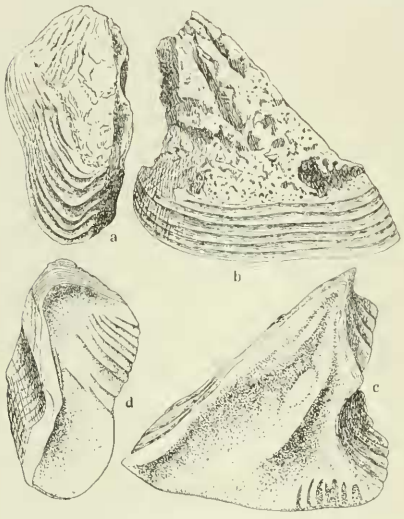


Fig. 71. *Tetraclita purpurasceus* f. *brevi-scutum* from Port Ross. a and b external view of tergum and scutum, c and d internal side of scutum and tergum. [× 4].

One of the characters emphasized by Darwin was the unusually long scutum of the species. In the present specimens (Fig. 71) the scuta are much shorter, their basal margin being of the same length as the tergal margin; hence the name *brevi-scutum*. In other respects the opercular plates fairly well agree with Darwin's description when heed is paid to the corrosion of the apical parts, especially of the tergum.

Dealing with the mouth parts Darwin says that „the labrum is deeply notched and apparently destitute of teeth on the crest". The notch is in the present specimens rather shallow, and on the oral side the labrum is armed with a single row of small, rounded denticles at the notch; the denticles are very small, and only with difficulty observed.

The rudimentary fourth tooth of the mandible is emphasized by Darwin as a distinguishing feature of the species; the character is alo observed in the present specimens (Fig. 72), and separates them from *Tetraclita squamosa*, with which *Tetraclita purpurascens* is closely related. Characteristic of *Tetraclita purpurascens* is

moreover the equidistant position of the three prominent teeth of the mandible as also the broad pectinate part of the lower angle.

In the maxilla a very distinct notch separates the upper two large spines from the lower densely spined part of the cutting edge.

One more difference must be noted as contradictory to Darwin's description. He found that both cirrus II and III are remarkably short, and counted 7 segments in both rami of cirrus III. The specimen dissected of forma *breviscutum* has on the whole more segments in the cirri as shown in the following table.

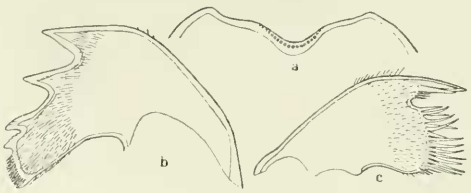


Fig. 72. *Tetraclita purpurascens* f. *breviscutum* from Port Ross. a labrum, b mandible, c maxilla. [× 25].

		Cirrus	I	II	III	IV	V	VI
Numbers of segments	inner	ramus	10	10	21	20	24	23
	outer	„	17	11	22	21	25	28

It will be seen here that cirrus III in numbers of segments joins the posterior three cirri, but its size almost equals that of cirrus II. In cirrus III the larger spines of the median segments of both rami are moreover pectinate, a character not mentioned in this species by Darwin, although he has observed the same feature in *Tetraclita squamosa* (= *porosa*).

The penis is annulated all over, and almost destitute of hairs except at its distal end, where two small tufts are found at the sides of the somewhat bilabiate tip. The penis is a little longer than cirrus VI.

Tetraclita vitiata Darwin.

Zamboanga; on stones on the beach. 25 II 14. Some young specimens together with *Tetraclita squamosa*, and *Chtamalus moro*.

The skeletonal features exactly agree with Darwin's description (1853); the specimens seem to be somewhat smaller than Darwin's specimens, but this may be due to the fact that the basal part is wanting in the present specimens, the sheath in all of them almost reaching the lower margin of the pariety. The only differ-

ence to be noted is that the sheath is white, and not „clouded with chocolate-red“ as in Darwin's specimens.

The specimens of Darwin being badly preserved, he could only make out that the labrum has some strong teeth, the mandible five teeth, and the segments of the posterior cirri four pairs of spines. The Zamboanga specimens are in an excellent state of preservation, and furnish a good idea of the characters of the animal.

The labrum is very characteristic, owing to the strong teeth at both sides of the shallow notch (Fig. 73). The mandible has

Fig. 73. *Tetraclita vitiata* from Zamboanga. a labrum, b mandible, c maxilla. [× 65].

five teeth, and below the lower of them a short and straight, pectinate and comblike part terminating in a strongly projecting spine at the very lower angle. The second and the third main tooth are double. The outer and lower part of the blade is densely hairy, and on the inferior margin some longer and stouter hairs are situated.

The maxilla has a strong, upper spine; between this and a distinct notch there is a pair of somewhat shorter and slenderer spines. Below the notch the cutting edge carries two pairs and four stronger single spines; at the lower angle some short and straight bristles constitute a brush. Below the notch the sides of the blade carry finer hairs near the cutting edge.

The anterior three pairs of cirri have somewhat bullate segments with numerous spines. In cirrus I the shorter ramus with 7 segments is half as long as the other, which has 17 segments. In cirrus II the rami are almost equal with 10 and 11 segments.

Cirrus III again has very unequal rami with 11 and 25 segments, the shorter ramus being half as long as the other one; in the longer ramus the segments of the basal half are bullate, whereas those of the outer half are extended, and armed with only few spines. The segments of the posterior cirri are rather short, and armed with four pairs of anterior spines. — The penis is annulated troughout, and all but destitute of hairs; it attains twice the length of cirrus VI.

Genus **Elminius** Leach.

Elminius plicatus Gray.

Carnley Harbour, Auckland Island; on the beach. 29 XI 14. Some few depressed and corroded specimens.

Mahia Peninsula, N. Z.; under stones at low tide. 18 XII 14. Several specimens together with *Chamæsipho columna*.

Hen & Chicken Island, Hauraki Gulf, N. Z.; 30 XII 14. Some few specimens on the capitulum plates of *Mitella sertus*.

Darwin (1853) has given an elaborate description of the rugged appearance of this species. He also mentions the peculiar, pectinate spines, which occur in such numbers on all segments of the rami of cirrus II as not noticed in any other Balanide.

Also the mouth parts exhibit some peculiarities. The labrum (Fig. 74) has a shallow notch, which has a row of short hairs on its upper crest; the oral side of the notch is adorned with a V-shaped row of 18—20 denticles.

The mandible has four teeth, the median two, being double. There is a short, pectinate part at the lower angle, not extending below the latter. — The maxilla has two large main spines at the upper edge, and below these spines a small notch; the lower part of the cutting edge is armed with a double row of heavy spines, and at the lower angle four or five finer, short bristles indicate a brush. The outer part of the blade is rather hairy.

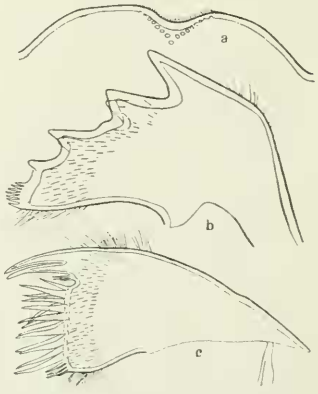


Fig. 74. *Elminius plicatus* from Mahia Peninsula. a labrum, b mandible, c maxilla. [× 33].

Elminius simplex Darwin.

Port Western; Victoria; 3—4 fathoms, hard bottom. 5/IX 14. Two small specimens.

The specimens are only slightly ribbed longitudinally, but in other respects they agree very well with Darwin's description (1853). Nevertheless some differences are found in the structure of the animal, both in the mouth parts and in the cirri.

The labrum (Fig. 75) has somewhat protruded side parts, whereas in the preceding species it has a more evenly rounded outline; the notch is fairly well developed; its crest is destitute of hairs, but adorned with some few, very minute denticles.

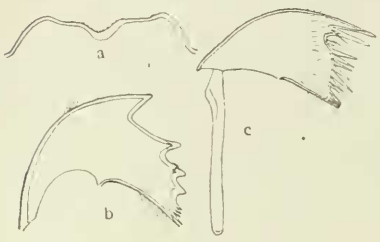


Fig. 75. *Elminius simplex* from Port Western. a labrum, b mandible, c maxilla. [× 44].

In the mandible the interval between the two upper spines is large, almost occupying half the cutting edge; on the other hand, the fourth tooth is rather prominent, and the pectination at the lower angle results in comparatively long spines.

The maxilla has a broad notch below the two upper spines, and the brush at the lower angle is as long as the shorter spines of the edge above it, and thus far better developed than in the preceding species.

Darwin has already pointed to the characteristic features of the cirri: in cirrus III the rami are of equal length, and pectinate spines are wanting in all cirri. The segments of the posterior cirri have only three pairs of spines, and the hair tuft between the spines is only very feebly developed.

Elminius sinuatus Hutton.

Paterson Inlet, Stewart Island, N. Z. 18/XI 14. In great numbers on littoral mollusk shells.

This characteristic small form has never been figured. When symmetrically developed it is easily recognisable owing to the two prominent cristae of each compartment (Fig. 76); on the other hand, when the species occurs in crowded assemblies the cristae are not

always distinctly developed. In this case the opercular plates will be of aid, although according to Hutton (1879) they shall be almost identical with those of *Elminius modestus* Darwin. According to the specimens from Paterson Inlet obvious differences are nevertheless present in the opercular plates: only two or three small crests are developed for the depressor of the tergum, and the spur is confluent with the scutal margin; in the scutum an

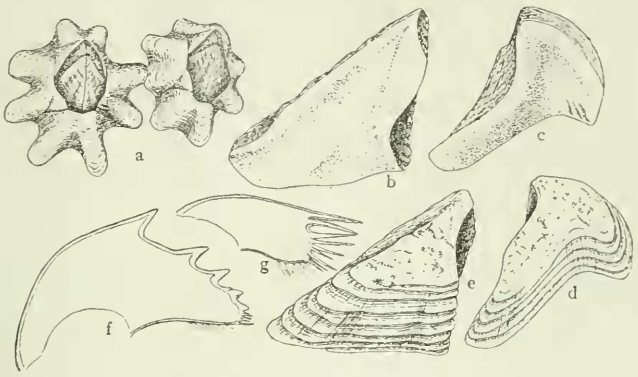


Fig. 76. *Elminius sinuatus* from Paterson Inlet. a two specimens seen from above, b and c inside view of scutum and tergum, d and e external view of tergum and scutum, f mandible, g maxilla. [a × 5.3; b–d × 8; f–g × 240].

adductor ridge is feebly developed and indistinctly limited; the interior side of the scutum is on the whole very feebly sculptured.

The mandible (Fig. 76f) has five teeth, the lower one being very small and almost confluent with the pectination of the lower angle. The maxilla has rather few spines and a short cutting edge; there is a small notch below the upper two spines, and below the notch about 8 spines are present. The maxilla is rather slender and small in comparison with the mandible.

In cirrus I the rami are very unequal, the shorter one only half as long as the other ramus; the numbers of segments are 6 and 13. In cirrus II the rami have 6 and 7 segments and only differ in the length of the distal segment.

Cirrus III has again somewhat more unequal rami with 7 and 10 segments; in shape it holds an intermediate position between the anterior two cirri with their haircovered bullate segments, and the posterior three cirri with their slender and rather long seg-

ments, which carry four or generally five pairs of anterior spines strongly increasing in size towards the distal end of the segment.

Jennings (1918) considers *Elminius sinuatus* as a variety of *Elminius modestus* Darwin; the present specimens nevertheless so closely agree with Hutton's description and so distinctly differ from Darwin's rather scarce dates of *Elminius modestus* that it is at present the most correct to keep the two species apart. Neither have I had any access to indisputable *Elminius modestus* for comparison.

Genus Pyrgoma Leach.

Pyrgoma sp.

Off Jolo; 12—25 fathoms, 17/III 14. One small specimen on a madreporarian coral together with *Balanus allium*.

The specimen seems to be most nearly related to *Pyrgoma conjugatum* Darwin; but a sure identification of the dried specimen is hardly possible.

APPENDIX.

Scalpellum aff. *imbricatum* Hoek.

East of North Island, New Zealand (Cape Kidnappers, 76—82 fathoms, or Cape Runaway, 105 fathoms). The New Zealand Government Trawling Expedition. [No date]. One specimen on a spine of an *Ogmocidaris Benhami* Mrtsn.

The specimen was sent to me by Dr. Mortensen after the closure of the special examination of his collections. It is very interesting owing to the variations in the lower whorl of plates (Fig. 77), although these variations put obstacles in the way of a safe identification. The inframedian plate of the left side is high, rectangular, and slender, that of the right side triangular, short, and with a comparatively broad basal margin. The carinal latus of the left side is broader and lower than the corresponding plate of the right side, and the rostral latus of the left side smaller than that of the right side. A rostrum is present, and corresponds

with the same plate as figured by Pilsbry (1907, p. 39, fig. 10b) in *Scalpellum sanctipetrense*, and by Hoek (1907, pl. VIII, fig. 15a) in *Scalpellum imbricatum*.

The present specimen no doubt belongs to Pilsbry's group of *Scalpellum portoricanum*, as indicated by the shape of the rostral latus, and with this group the American *Scalpellum sanctipetrense* seems to be nearly related. The *portoricanum*-group comprises several commonly distributed Tropic-Subtropical small forms. The present specimen is closely related to *Scalpellum imbricatum* from the Malay Archipelago, but the different length, and the shape of the carina seem to deny an identity with this species.

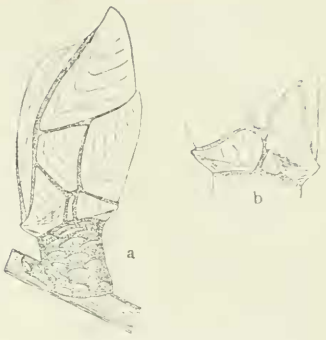


Fig. 77. *Scalpellum* aff. *imbricatum* from the New Zealand Government trawling expedition. a left side of the animal. b lower latera of the right side. [a × 4. b × 5.3].

Some geographical remarks.

The localities from where Dr. Th. Mortensen gathered cirripeds naturally arrange themselves in some larger regional groups, viz. the Philippine Archipelago, the Japanese waters, the waters round New Zealand down to Campbell Island, Hawaii, and the Pacific American coast from Nanaimo to the Bay of Panama. It is most convenient to treat each of these „regions" separately.

From the Philippine Archipelago the localities, and species are arranged in the following table:

Date	Locality	Depth	Species
13 II 14	Off Cavite, Manila Bay	ab. 5 fthms. ..	*Balanus amphitrite* f. *communis*.
21 II 14	Cebu	beach	*Octolasmis orthogonica*; *Balanus amphitrite* f. *communis*.
25 II 14	Zamboanga	beach	*Chtamalus moro*; *Tetraclita squamosa* f. *viridis*; *Tetraclita vitiata*.

Date	Locality	Depth	Species
3 III 14	25 miles E. to S. of Zamboanga	160—200 fthms.	*Calantica affinis*; *Scalpellum indicum*; *Scalpellum balanoides.*
4 III 14	25 miles E. of Zamboanga	250 fthms.	*Verruca albatrossiana*; *Verruca cristallina*, f. *lævis.*
6 III 14	6 miles N. N. E. of Sacol, Mindanao	ab. 35 fthms.	*Balanus proripiens.*
7 III 14	S. of Vitalis Point, Mindanao	beach	*Mitella mitella.*
8 III 14	7 miles S. of Olutanga	300 fthms.	*Megalasma minus.*
9 III 14	7° 25' N., 123° 14' E.	250 fthms.	*Megalasma minus.*
10 III 14	3 miles S. W. of Tucuran	300 fthms.	*Megalasma striatum*; *Heteralepas nodulosa*; *Verruca Krügeri.*
11 III 14	Kaladis Point, Mindanao	beach	*Balanus amphitrite* f. *hawaiiensis.*
12 III 14	Taba Bay, Mindanao	coral reefs	*Balanus amaryllis* f. *euamaryllis.*
17 III 14	Off Jolo	12—25 fthms.	*Balanus amphitrite* f. *communis*; *Balanus minutus*; *Balanus amaryllis* f. *nivea*; *Balanus allium*; *Balanus ceteolus* (?); *Balanus proripiens*; *Acasta cyathus*; *Acasta Dofleini*: *Pyrgoma* sp.
19 III 14	New Jolo	20—30 fthms.	*Scalpellopsis striatociliata.*
20 III 14	Off Jolo	ab. 25 fthms.	*Balanus amphitrite* f. *communis*; *Balanus amaryllis* f. *euamaryllis*; *Acasta pectinipes.*
20 III 14	Off Jolo	20—30 fthms.	*Balanus amphitrite*, f. *communis*; *Balanus minutus*; *Acasta conica.*
21 III 14	Off Jolo	15 fthms.	*Balanus minutus*; *Acasta Dofleini.*
25 III 14	Off Jolo	ab. 25 fthms.	*Acasta madreporicola.*
27 III 14	15 miles W. ½ S. of Jolo	250 fthms.	*Scalpellum Stearnsii*; *Scalpellum asalartiæ.*
12 III 13)	1° 31' N., 124° 47 E. [Menado Bay, Celebes]	250 fthms.	*Scalpellum indicum*, *Scalpellum balanoides*, *Megalasma minus.*

It is obvious that the *Balanus*-species here as elsewhere are dominant in the tidal zone, and a little below it; in 20—30 fathoms the subgenus *Conopea* and the *Acasta*-species seem to play a greater part in the assembly. Observations are evidently lacking in depths between 35 and 150 fathoms; with the last depth the *Balanus*- and *Acasta*-species have disappeared, and here *Scalpellum* is the dominant genus, seconded by *Megalasma* and *Verruca*.[1])

[1]) Krüger (1911) geographically characterises *Verruca* as „Alle Meere; litoral". Hoek (1883, 1913) has nevertheless shown that almost the majority of *Verruca*-species live below 500 m, some of them even descending as far as to 3000 m or more, whereas only very few species are found in shallow waters.

Many previously undescribed species have been found in this region, viz. *Calantica affinis, Scalpellopsis striatociliata, Heteralepas nodulosa, Verruca cristalina* f. *lævis,* and *Acasta madreporicola;* each of these species only being recorded from one locality, it would be premature to try to give their biogeographic characters. On the other hand, a species as f. inst. *Scalpellum balanoides* having previously only once been caught, viz. near the Kei Islands (Hoek, 1883), and which is now found both near Zamboanga, and in the Menado Bay, may be designated as a species characteristic of the Malay Archipelago, this might seem even more justifiable in a species as *Megalasma striatum;* Hoek (1883) described the species after a specimen from the Philippines, and has later (1913) found the species again in the „Siboga"-collections off Luzon, south of Taam Island, south of Kur Island, and east of Kei Islands; in the present material it again turns up south-west of Tucuran. Nevertheless the species also protrudes into Japanese waters, a single specimen occurring in material from the neighbourhood of Bono. On the whole, most of the species which have their geographical centre in, and are characteristic of the Malay Archipelago, have their Northern limits in Japanese waters. To the same biogeographic category as *Megalasma striatum, Scalpellum indicum, Acasta Dofleini,* and probably also *Verruca albatrossiana* belong. The following species are evidently more strictly limited to the Malay Archipelago: *Octolasmis orthogonica, Chtamalus moro, Balanus minutus, Balanus proripiens, Acasta pectinipes. Acasta conica,* and *Tetraclita vitiata.* On the other hand, a species such as *Balanus allium* links the Malay region with the Australian region; we shall on a later occasion return to this affinity, and to that with the Hawaiian Islands.

An interesting biogeographic character of the Malay Archipelago also pointed to by previous authors, is afforded by the abundance of *Conopea-* and *Acasta*-species; they are flourishing here more than in any other place as far as hitherto known, and evidently have their centre of origin in these waters, where also *Scalpellopsis,* the youngest twig of the Scalpellid branch has branched off. In most genera the proliferation of species and varieties also now seems to be more lively in the Malay Archipelago than in most other regions. —

We shall then turn to the material which has been collected in Japanese waters:

Date	Locality	Depth	Species
30 IV 14	Misaki	beach	*Balanus trigonus.*
2 V 14	Aburatsubo, Misaki	3 fthms.	*Balanus trigonus.*
13 V 14	21 miles W. ½ S. of Bonomisaki	220 fthms.	*Scalpellum indicum; Megalasma striatum; Verruca albatrossiana.*
14 V 14	32° 17' N., 128° 11' E.	110 fthms.	*Scalpellum Stearnsii.*
15 V 14	32° 15' N., 128° 12' E.	90 fthms.	*Smilium acutum; Balanus dentifer.*
17 V 14	33° 41' N., 128° 50' E.	75 fthms.	*Oxynaspis celata* f. *japonica.*
25 V 14	Misaki	20 fthms.	*Balanus trigonus.*
1-7 VI 14	Sagami Bay	400 fthms.	*Heteralepas scutiger; Acasta japonica*
6-9 VI 14	Sagami Bay	80—400 fthms.	*Scalpellum Stearnsii; Scalpellum rubrum*
9 VI 14	Misaki	25 fthms.	*Balanus trigonus.*
10 VI 14	Off Misaki	80—120 fthms.	*Balanus trigonus.*
26 VI 14	Okinose, Sagami Sea	100 fthms.	*Scalpellum rubrum.*
29 VI 14	Aburatsubo, Misaki	surface	*Lepas anatifera.*
?	Nagasaki	?	*Oxynaspis celata* f. *japonica.*

The collections are here far less extensive than those from the Philippines; the Japanese waters are obviously less rich in cirripeds, a fact also easily deduced from the literature. Nevertheless, the region is of great interest, and a thorough study especially of the northern parts of the Japanese waters will no doubt yield interesting biographical results.

The southern part of the Japanese region is related to the Malay region, and gives refuge to the foreposts of the Malayisian fauna proper as above mentioned. Sometimes it may be difficult to tell, whether a species has its proper home in Japanese or Malayisian waters, as f. inst. *Scalpellum Stearnsii*: in Dr. Mortensen's collections this species is represented from Japanese waters (Sagami), and from the Philippines (off Jolo); Pilsbry (1907) had at his disposal only Japanese specimens, and Krüger (1911) tells us that the species occurs in abundance in the Sagami Bay; Hoek (1907) on the other hand in the „Siboga"-report mentions it from the Kei Islands, Madura Sea, and west of Makassar. *Scalpellum rubrum* seems to be more abundant in Japanese waters: it was first reported by Hoek (1883) off Luzon, and has later on only been observed by Pilsbry (1911) off Kagoshima; it now again turns up near Sagami. *Acasta japonica* seemingly is a Japanese species,

but has only been found in two places, viz. near Kagoshima (Pilsbry 1911, 1916), and now in the Sagami Bay.

Most of the species brought home from Japan have a very wide distribution; the abundant *Balanus trigonus* might be thought to be characteristic of the region, and seems to be far more common here than in other regions; it is nevertheless recorded from all Tropical and Subtropical coasts, and is also in Dr. Mortensen's collections represented both from Hawaii and from New Zealand. A similar worldwide occurrence is recorded for *Smilium acutum*, *Lepas anatifera*, and *Oxynaspis celata*, but the latter species has developed a special forma *japonica* in the region. — On the other hand the geographical range of the species *Heteralepas japonica*, *Verruca albatrossiana*, and *Balanus dentifer* cannot be given at present.

The find of a Japanese *Verruca* is most interesting, especially when we recall Pilsbry's words (1916): „Southward along the Asiatic coasts we encounter the genus first in the Philippine Archipelago. *The whole North Pacific is therefore without species*". The Northern limit is now removed from the Philippines to Misaki. —

Turning now to the New Zealand waters, we see that by far the richest collections have been made here; it is put down in the following table:

Date	Locality	Depth	Species
5/IX 14	Port Western, Victoria	3—4 fthms....	*Elminius simplex.*
8/IX 14	38° 25' S., 148° 28' E.....	70—80 fthms..	*Pachylasma scutistriatum.*
9/IX 14	38° 15' S., 148° 43' E.....	70—120 fthms	*Pachylasma scutistriatum.*
11/IX 14	38° 10' S., 149° 55' E.....	190—240 ftnms.	*Heteralepas Dannevigi.*
12/IX 14	38° 05' S., 150° 00' E.....	200—260 fthms	*Heteralepas Dannevigi.*
14/IX 14	37° 45' S., 150° 10' E.....	150—260 fthms.	*Poecilasma Kaempferi; Heteralepas Dannevigi.*
15/IX 14	39° 10' S., 149° 55' E.....	200—250 fthms.	*Heteralepas intermedia.*
16/IX 14	38° 12' S., 149° 40' E.....	100—160 fthms.	*Ibla pygmæa; Oxynaspis celata* f. *novazelandica; Heteralepas morula; Pachylasma scutistriata; Balanus auricoma.*
29/IX 14	36° 00' S., 150° 20' E.....	surface	*Lepas pectinata.*
30/IX 14	37° 05' S., 150° 55' E.....	50 fthms.	*Lepas pectinata.*
1/X 14	Disaster Bay, N. Z.....	30—40 fthms..	*Heteralepas dubia.*
10/X 14	Port Hacking, N. S. W.	beach.....	*Chtamalus antennatus; Tetraclita squamosa* f. *viridis.*

Date	Locality	Depth	Species
20/X 14	Port Jackson	beach	*Ibla quadrivalvis.*
18/XI 14	Paterson Inlet, Stewart Island N. Z.	beach	*Elminius sinuatus.*
19/XI 14	Halfmoon Bay, Stewart Island, N. Z.	beach	*Calantica villosa.*
26/XI 14	Port Ross, Auckland Island	beach	*Tetraclita purpurasceus* f. *breviscutum.*
29/XI 14	Carnley Harbour, Auckland Island	beach	*Elminius plicatus.*
3/XII 14	Masked Island, Carnley Harbour, Auckland Island	beach	*Balanus vestitus (?).*
9/XII 14	Perseverance Harbour, Campbell Island	beach	*Balanus Campbelli.*
12/XII 14	Mahia Peninsula, N Z.	beach	*Chamæsipho columna; Elminius plicatus.*
20/XII 14	Slipper Island, N. Z.	beach	*Protomitella paradoxa.*
29/XII 14	North Channel, Kawaii Island, Hauraki Gulf, N. Z.	?	*Balanus trigonus.*
30/XII 14	Hen and Chicken Island, Hauraki Gulf, N. Z.	beach	*Mitella sertus; Elminius plicatus.*
5/I 15	N. W. of Cape Maria v. Diemen, N. Z.	50 fthms.	*Calantica Mortenseni.*
15/I 15	Plimmerton, N. Z.	beach	*Protomitella paradoxa.*
19-20/I 15	Queen Charlotte Sound, N. Z.	3—10 fthms.	*Calantica villosa, Balanus vestitus.*

Among the species hitherto unknown *Heteralepas Dannevigi* and *Pachylasma scutistriatum* seem to be comparatively common in depths of more than 70 fathoms in the region investigated by the „Endeavour“ in september 1914. These regions moreover exhibit a faunistic relation to the Malayisian region, as is demonstrated by the occurrence of *Heteralepas morula, Heteralepas intermedia,* and *Balanus auricoma,* which species previously only have been recorded by Hoek (1907, 1913) from the „Siboga“-expeditions. *Oxynaspis celata* has again developed a local forma *nova-zelandica* in these regions. The assemblage brought home from this voyage by the „Endeavour“ seems to be very characteristic and exclusive, and is almost without intermixture of other „foreign“ species than those mentioned, and a casual *Lepas pectinata,* which was, mirabile dictu, seated on a bottom particle from 50 fathoms' depth.

The littoral fauna of New Zealand is very characteristic as to the cirripeds. Not considering the *Balanus Campbelli* from the remote Campbell Island we find the same characteristic faunistic

features as mentioned by Darwin, and that the New Zealand waters evidently exhibit very aberrant features in comparison with other areas. Primitive and ancient species like *Calantica villosa, Calantica Mortenseni,* and *Protomitella paradoxa* seemingly characterize the region as the cradle of most recent cirripeds; but on the other hand, also highly specialized genera like *Elminius* have here developed into more species than elsewhere, and the peculiar genus *Chamæsipho* in no other place flourishes to an equal degree, although only in a single species. Of the species previously known the following seem to be restricted to the shores of New Zealand: *Calantica villosa,*[1]) *Mitella sertus, Elminius plicatus,* and *Elminius sinuatus.* Other species are common at Australia such as *Chamæsipho columna, Balanus vestitus,* and *Tetraclita purpurascens,* and only comparatively few have like *Ibla quadrivalvis, Balanus trigonus,* and *Tetraclita squamosa* f. *viridis* a more cosmopolitical, Tropic-Subtropical distribution.

A very interesting although negative feature of the New Zealand waters is afforded by the astonishing scarcity of *Scalpellum*-species. Indeed, the *Scalpellum* aff. *imbricatum* mentioned in the appendix to the preceding chapter seems to be the first true *Scalpellum* observed in the coastal waters of New Zealand. —

Dr. Mortensen quite occasionally also gathered two shallow-water *Balanus* species at Hawaii, viz. *Balanus trigonus,* and *Balanus amphitrite* forma *hawaiiensis.* Both species have a world-wide habitat; but the latter is represented by an aberrant variety, that nevertheless again turns up in the Philippines, and thus seems to indicate a closer relationship with the Malay region than with American waters.

We shall then turn to the last greater region investigated by Dr. Mortensen, viz. the Pacific coast of North and Central America. The localities and species are shown in the following table:

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[1]) Darwin (1851) in a footnote says that the mussel, to which his specimens were attached, lives in the waters round India, Timor, and New Holland. Footing on this note Hoek (1907) mentions the species as inhabitant of the Malay Archipelago. Hutton (1879) is the first who gives New Zealand as certain living place, and Jennings (1918) gives the following New Zealand localities: Stewart Island; Port Robinson; God-

Date	Locality	Depth	Species
28/V 15	Dodds Narrows, Vancouver Island	beach	*Balanus crenatus.*
3/VI 15	Departure Bay, Nanaimo	beach	*Balanus glandula.*
8/VI 15	Departure Bay, Nanaimo	20 fthms	*Scalpellum gruvelianum.*
10/VI 15	Departure Bay, Nanaimo	beach	*Balanus rostratus* f. *eurostratus; Balanus crenatus.*
11/VI 15	Nanoose Bay, Nanaimo	ab. 10 fthms.	*Balanus hesperius.*
16/VI 15	Strait of Georgia	40—50 fthms.	*Scalpellum gruvelianum.*
23/VI 15	Northumberland Channel, Nanaimo	ab. 25 fthms.	*Balanus rostratus* f. *heteropus.*
6/VII 15	Pylados Channel, Nanaimo	ab. 20 fthms.	*Balanus hesperius.*
21/VII 15	La Jolla, Calif.	beach	*Mitella polymerus* f. *typica.*
21/VIII 15	La Jolla, Calif.	beach	*Chtamalus fissus; Balanus glandula; Tetraclita squamosa* f. *rubescens.*
25/VIII 15	La Jolla, Calif.	beach	*Chtamalus fissus; Tetraclita squamosa* f. *rubescens.*
27/VIII 15	Bird Rock, La Jolla, Calif.	on sea-weeds	*Mitella polymerus* f. *echinata.*
25/IX 15	Off Redondo, Calif.	30 fthms.	*Scalpellum californicum; Balanus tintinnabulum* f *californica.*
27/IX 15	San Pedro, Calif.	beach	*Mitella polymerus* f. *echinata; Chtamalus fissus; Balanus tintinnabulum* f. *californica; Tetraclita squamosa* f. *rubescens.*
21/XI 15	Taboga, Bay of Panama	beach	*Tetraclita squamosa* f. *viridis.*
7/XII 15	Taboga, Bay of Panama	on a buoy	*Balanus tintinnabulum* f. *coccopoma.*
12/XII 15	Taboga, Bay of Panama	beach	*Catophragmus Pilsbryi.*
Decbr. 15	Bay of Panama	surface	*Lepas pectinata.*

The list is astonishingly different from those from the other side of the Pacific Ocean. Only *Lepas pectinata*, and *Tetraclita squamosa* forma *viridis* also occur in the other lists, these two being common all over the Tropic-Subtropical seas, and sometimes even penetrating into more temperate regions. Also *Balanus tintinnabulum*, it is true, belongs to the same category, and *Balanus rostratus* (forma *eurostratus*) occurs on both sides of the Pacific; but the specimens of the American side mostly represent local variant groups, and are thus characteristic of American waters.

ley Head; Cheltenham Beach; Auckland; Oamaru. — No further evidence as yet given, we can certainly put other regions out of record till new proofs are provided of the occurrence outside of the New Zealand waters.

In the region of Nanaimo, of course, the boreal element is predominant, represented by *Scalpellum gruvelianum, Balanus glandula, Balanus hesperius,* and *Balanus crenatus.* As to the latter I accept Pilsbry's hesitation (1916) in acknowledging the statements from the Tropics and more Southern localities, given by previous authors.[1]) *Balanus glandula* is more eurytherm, going down to Southern California.

In the Californian region we again encounter other characteristic species, viz. *Scalpellum californicum, Mitella polymerus, Chtamalus fissus, Balanus tintinnabulum* forma *californica,* and *Tetraclita squamosa* forma *rubescens;* these seem to be restricted to this region, neither were they met with in the Bay of Panama, where *Balanus tintinnabulum* is instead represented by the beautiful forma *coccopoma.*

In the Panamic region the interesting large *Catophragmus Pilsbryi* was met with for the first time; this species has a close relative in the Antillean region, and seems to contribute to the evidences of the past connection across Central America. —

In papers dealing with the cirripeds it has frequently been stated that this group is of small biogeographical interest, as most of the species only occur in small numbers, and the others mostly have a worldwide distribution. Evidently most students of this group have overlooked the fact, recently so illustriously evinced by Pilsbry (1916), that the widely distributed species tend to an obvious splitting up in local races, when they do not directly live an epibiotic planktonic life like most *Lepas-* and *Conchoderma*-species; and even here sometimes local races may be demonstrated. On the other hand, such forms as several *Elminius*-species, *Chamæsipho columna, Mitella polymerus,* and *Mitella sertus* play a predominent part in the faunistic features, owing to their abundant occurrence in their special regions, and are thus well apt to serve as biogeographic character-animals.

As to the more scantily occurring species, it is true that they play no predominant part in the biogeographical communities; never-

[1]) Darwin (1853) mentions *Balanus crenatus* from the Mediterranean, Algoa Bay (South Africa), and Jamaica, Gruvel (1905) from Ile King (in the Bass Strait), Peru, and Wasin in British East Africa.

theless they very well accentuate the biogeographical characters of the regions, as is evident from the above remarks.

It is interesting to see how the occurrence, when taken together with the phylogenetic relations, seems to indicate that the cirriped centre evidently is situated in the Indomalayisian-Eastaustralian waters; here it seems, as if also to-day the proliferation of new species and genera is most lively, and in these regions the most ancient forms moreover have endured up till our day. Thorough studies regarding the geography of cirripeds should therefore not be omitted; in this respect Dr. Mortensen's collections have given us a more than usually good proof.

During the printing of the present paper an important treatise „Cirripeden-Studien. Zur Kenntnis der Biologie, Anatomie und Systematik dieser Gruppe" by C. A. Nilsson-Cantell was issued in Zoologiska Bidrag från Uppsala, Bd. VII. From a quite different basis Nilsson-Cantell, starting with the mouth parts, arrives at results concerning the relations of the different cirripeds, which remarkably well agree with the present results, although he on this base tends to a splitting up of the groups in small „families". He thus f. inst. maintains the Iblidae, and splits up Lepadidae of the present paper in Lepadidae emend. (*Lepas, Conchoderma, Alepas*), Oxynaspidae (*Oxynaspis*), Poecilasmatidae (*Poecilasma, Megalasma, Octolasmis*), and Heteralepadidae (*Heteralepas*); although these groups fairly well coincide with the diverging phylogenetic branches arrived at in the present study (comp. fig. 1, pag. 2—), I do not think the differences of an importance justifying the groups as families, but in most cases at best as subfamilies. On the other hand, his merging together *Calantica, Smilium,* and *Scalpellum* into the one genus *Scalpellum,* although he maintains them as subgeneric groups, tends to obscure the results arrived at in later papers, especially of Pilsbry, and remarkably contrasts with his tendency to establish families on

characters, which are in some cases only to be regarded as of generic value. The paper of Nilsson-Cantell is nevertheless of great importance, contributing more to our understanding of the cirripeds than most papers of later years.

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