CIRRIPEDIA

OF THE

TROPICAL SOUTH ATLANTIC COAST OF AFRICA

The collection of Cirripedia contains no unknown species and only one-third of the known West African barnacles are there represented. Of the eighteen species or varieties recorded, three are of particular interest as they clarify or correct previous records and descriptions of species. *Chthamalus stellatus* var. *depressus* of NILSSON-CANTELL (1938), *Ch. cirratus* (KOLOSVARY, 1943), and *Ch. withersi* and *Ch. rhizophorae* (LONGHURST, 1958) may now be dropped from the West African barnacle fauna on the grounds of misidentification. Their place is taken by *Ch. aestuarii* n. sp. *Balanus dybowskii* GRUVEL (1903) is identified with *B. amphitrite pallidus* and the present author's *B. occidentalis* (STUBBINGS, 1961*a*) is reduced to a synonym of *B. fallax* BROCH, the extensive material in this collection having shown a complete gradation between the two forms. The presence of *B. fallax* throughout the tropical West African seaboard is thus established. *B. dollfusi* BROCH from the Atlantic Coast of Morocco (BROCH, 1927*b*), Rio de Oro (NILSSON-CANTELL, 1939) and the Congo (NILSSON-CANTELL, 1938) is considered to be synonymous with *B. spongicola* BROWN.

Of pedunculate Cirripeds the large collection of *Lepas fascicularis* from off the R. Congo establishes this species as West African. Although this was to be expected from general knowledge of the species there appears to be no earlier record from West Africa.

The complete list of eighteen species and varieties in the collection is shown below :

Scalpellum scalpellum (L.).
Lepas anserifera L.
L. fascicularis E. and S.
Chthamalus stellatus var. *stellatus* (POLI).
Ch. aestuarii n. sp.
Ch. dentatus KRAUSS.
Balanus (*Megabalanus*) *tintinnabulum tintinnabulum* (L.).
B. (*M.*) *tulipiformis* DARWIN.
B. (*Balanus*) *amphitrite* var. *communis* DARWIN.

B. (*B.*) *amphitrite* var. *hawaiiensis* BROCH.
B. (*B.*) *amphitrite* var. *pallidus* DARWIN.
B. (*B.*) *amphitrite* var. *stutsburi* DARWIN.
B. (*B.*) *amphitrite* var. *venustus* DARWIN.
B. (*B.*) *trigonus* DARWIN.
B. (*B.*) *spongicola* BROWN.
B. (*B.*) *perforatus* BRUG.
B. (*Hesperibalanus*) *fallax* BROCH.
B. (*Conopea*) *calceolus* DARWIN.

Genus SCALPELLUM LEACH, 1817.

Scalpellum scalpellum (L., 1767).

Lepas scalpellum L., 1767, p. 1109.
Scalpellum vulgare LEACH, 1824.
Scalpellum scalpellum PILSBRY, 1907, p. 16.

Material :

St. **17** : 5°42′ S.-11°31′ E. off Banana, Congo, 250 m, 1 specimen.

St. **154** : 0°15′ S.-8°47′ E. off Port Gentil, Gabon, 239 m, 1 specimen.

St. **166** : 4°57′ S.-11°16′ E. off Pointe Noire, French Equatorial Africa, 170 m, 1 specimen on *Dardanus arrosor*.

The specimens from St. **154**, **166** had a capitular length of **14** mm, that from St. **17**, one of 18 mm.

In the larger specimen the carinal and occludent margins are not quite parallel as the capitulum narrows slightly towards the peduncle. There is also a greater separation between the valves than in the smaller specimens, as is common in this species (BROCH, **1924**). The carinal latera, also, are more protuberant. In the shape of the valves and the position of the umbones, this specimen is typical of *Scalpellum scalpellum*.

Genus LEPAS L., 1767.

Lepas anserifera L., 1767.

Lepas anserifera L., 1767, p. 1109.
Lepas anserifera DARWIN, 1851, p. 81, pl. 1, fig. 4.

Material :

St. **50** : 6°15′ S.-11°37′ E. off Moita Seca, Angola, 11 small specimens on 3 large members of a cluster of *Lepas fascicularis*.

St. **139** : 3°33′ S.-10°35′ E. off Pointe Matouti, Gabon, numerous very small specimens of 2-4 mm capitular length, attached to a cuttlefish « bone ».

St. **171** : 4°48′ S.-11°30′ E. off Pointe Noire, French Equatorial Africa, numerous small specimens attached to grass or reed stems.

St. **178** : 8°29′ S.-13°11′ E. off Pointa do Dandé, Angola, numerous small and recently metamorphosed specimens attached to twigs and woody seeds and a cuttlefish « bone ».

St. **183** : 9°22′ S.-13°01′ E. off Cuanza, Angola, 29 larger and numerous very small specimens on floating wood and two cuttlefish « bones ».

St. **199** : 10°45′ S.-13°31′ E. off Cap Morro, Angola, 15 specimens of capitular length about 12 mm and about 65 smaller ones of capitular length 7 mm or less on floating wood and reeds.

St. **392** (Mission « De Brouwer », 1955) : between Dakar and Cap Blanc, a cluster of 16 specimens of 8-10 mm capitular length and a number of very small ones attached to a floating nut.

St. **418** (Mission « De Moor », 1958) : 6°11′05″ S.-10°39′ E. off R. Congo, 6 clusters of specimens on floating wood totalling 107 adult and 34 young specimens with a solitary *Lepas fascicularis.*

St. ? (label illegible) : about 60 very small specimens 3-4 mm capitular length on bark.

The specimens from St. **199** and **392** and some of those last cited above exhibit some pectination of the carina but in most specimens this is absent. A large number of the specimens listed are juvenile. Those last cited, from an unknown station, whilst preserved in spirit had at some stage been desiccated. The bodies were completely shrivelled and it was not possible to identify filamentary appendages. The specimens have been referred to *anserifera* on Pilsbry's (1916) criteria of the distinctly ribbed scuta and terga and the separation between the occulent margin and the ridge joining umbo to apex of the scutum.

Lepas fascicularis Ellis and Solander, 1786.

Lepas fascicularis Ellis and Solander, 1786, pl. 15, fig. 5.
Lepas fascicularis Darwin, 1851, p. 92, pl. 1, fig. 6.

Material :

St. **3** : 35°44′ N.-12°44′ W., 1 half grown and a number of smaller specimens on a fragment of wood with some epizoic cypris larvae and newly metamorphosed specimens.

St. **31** : 7°16′ S.-12°47′ E. off Ambrizette, Angola, 7 large and 45 smaller clusters of specimens.

St. **34** : 7°16′ S.-12°08′ E. off Ambrizette, Angola, 10 intact specimens and fragments of as many more : also 39 very large clusters numbering probably over 1000 specimens.

St. **50** : 6°15′ S.-11°37′ E. off Moita Seca, Angola, 14 specimens with small epizoic specimens of *Lepas anserifera.*

St. **367** (Mission « De Brouwer », 1955) : 6°56′05″ S.-11°54′ E., numerous juvenile specimens including some cypris and newly metamorphosed individuals on a cuttlefish « bone ».

St. **418bis** (Mission « De Moor », 1958) : 6°11′05″ S.-10°39′ E. off R. Congo, 17 clusters of numerous specimens of all sizes attached to bark, leaves, straws or without obvious external support : also 1 specimen on wood with *Lepas anserifera.*

The specimens from St. 3, were almost all attached to the piece of wood or to the calcareous plates of the largest specimen. Very few were attached to the peduncle or the cuticular parts of the capitulum.

Four of the specimens from St. 50 had a capitular length of more than 30 mm. A number of the largest clusters from St. 34 were examined in more detail. The float was 4-5 cm in diameter and the cluster itself measured

FIG. 1. — *Lepas fascicularis* ELLIS and SOLANDER.
A, right and B, left terga of one specimen showing variability in shape.
St. 34, off Angola (circa ×3-5).

about 12 cm across. The number of large individuals in four clusters was 35, 43, 45 and 63. There were only a few small specimens in any of these large clusters.

In many specimens the margins of the capitular plates were outlined by a thin dark brown line. The specimens are all of the typical variety. The carina is broad and narrowed above the umbonal area. Also the cirri are smooth and glistening when wet and not villose as in either var. *villosa* DARWIN or var. *aurivillii* NILSSON-CANTELL (1921).

There is notable variability in the shape of the tergum. It may be broad, almost filling the space between the upper part of the carina and the scutum or may be narrow with wide spaces between it and adjacent valves. The lower angle may be reduced so that the valve is short from occulent angle to lower angle. The two terga of one individual may differ markedly in this, as in figure 1 of the right and left terga of a specimen from St. 34.

Genus CHTHAMALUS RANZANI, 1817.

Chthamalus stellatus var. **stellatus** (POLI, 1791).

Lepas stellatus POLI, 1791, p. 29, pl. 5, figs. 18-20.
Chthamalus stellatus var. (a) *communis* DARWIN, 1854, p. 455, pl. 18, figs. 1, *a*, *f*.
Chthamalus stellatus stellatus PILSBRY, 1916, p. 302, pl. 71, figs. 1-4*a*.

Material :

St. **394** (Mission « DE BROUWER », 1955) : beach, Estoril, Portugal, 116 specimens and fragments removed from substrate.

All these specimens are small, with vertical walls due to growing closely packed together. The opercular valves and mouth parts agree closely with those figured by PILSBRY (1916, pl. 71, figs. 1 and 2 and text-fig. 84 respectively).

Chthamalus aestuarii sp. nov.

Chthamalus stellatus depressus NILSSON-CANTELL, 1938, p. 177, text-fig. 2.
? *Chthamalus cirratus* KOLOSVARY, 1943, p. 75.
Chthamalus rhizophorae LONGHURST, 1958, pp. 59, 85.
Chthamalus withersi LONGHURST, 1958, pp. 59, 85.

Material :

St. **302** (Mission « DE BROUWER », 1955) : Congo estuary, Banana Creek, Km. 8, about 100 dry specimens on aerial roots of mangrove.

St. **310** (Mission « DE BROUWER », 1955) : Breakwater at Banana, Congo estuary, 29 living and 2 dead specimens with *Balanus amphitrite stutsburi.*

St. **382** (Mission « DE BROUWER », 1955) : Banana peninsula at Muila Binga, Congo estuary, numerous specimens encrusting aerial roots of mangrove with *Balanus amphitrite pallidus* and *Brachyodontes niger.*

The appearance of this species was briefly commented on by NILSSON-CANTELL (1938) who figured internal views of scutum and tergum and also the mandible and maxilla. Believing it to be *Chthamalus stellatus depressus* DARWIN, 1854, the author noted similarities to this species and also to *Ch. fragilis* DARWIN and *Ch. stellatus angustitergum* PILSBRY (1916). In raising this barnacle to species status a complete description will be given here.

The shell (fig. 2 A) is depressed, broadly oval, up to 12,5 mm carino-rostral diameter with a moderately large orifice. The surface is smooth and covered with a persistent thick dark brown cuticle except for the upper part of the parietes which may be somewhat eroded. Many specimens appear a blackish brown due to the development of a variable number of dark, almost black longitudinal stripes. These stripes are more or less confluent in the upper part of the paries. They may be absent from some compartments in some individuals. Internally the compartments vary from fawn or light brown to a grey or dirty white colour. As the specimens are attached to mangrove wood this brown coloration may be due to staining from this source. The compartments are smooth and thin-walled and only weakly sculptured internally. The sutures are simple and weak. The alae are well developed. The membrane of the sheath is smooth with growth lines not prominent and without fine hair-like processes.

The opercular valves are thin in younger specimens, moderately thick in old ones, and coloured like the compartments. The older parts may be eroded. The cuticle is persistent when the valves are not eroded. The scutum (fig. 2, B, C) is triangular, approximately as high as broad with an acute apex. Growth ridges are low but distinct on the uneroded portions and

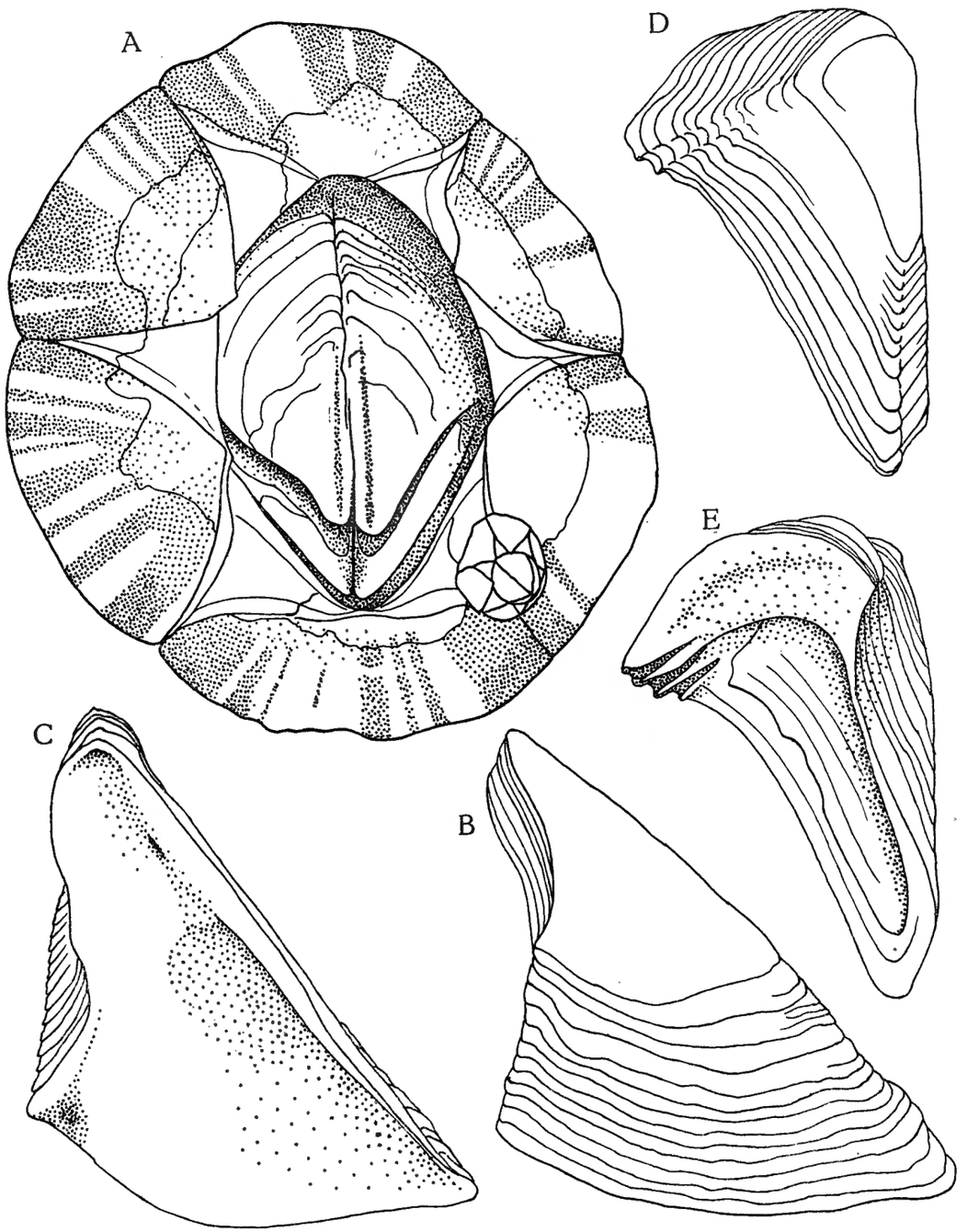

FIG. 2. — *Chthamalus aestuarii* n. sp.
A, intact specimen (×18) from St. **382**; B-E, external and internal views of scutum and tergum of a specimen from St. **302** (all ×21).

without fringing processes on the cuticle. Internally the articular furrow is narrow but distinct. The articular ridge is characteristic being prominent, reflected towards the articular margin and strongly curved near the valve apex where it is broadest and overhangs the articular margin. The occludent margin is inflected so that a groove runs parallel to this margin internally. The basal margin is weakly convex, sometimes slightly hollowed adjacent to the distinct triangular depressor muscle pit. No crests cross this muscle pit. The adductor muscle pit is oval and deep with distinct margins.

The tergum (fig. 2, D, E) is narrow and clubshaped, moderately thick and infolded along the articular margin so that the valve is deeply hollowed out internally. Growth ridges are distinct but low, obliterated on the eroded part of the valve. The carinal lobe is narrow and demarcated by a narrow groove externally. The articular furrow is broad and open, and flat rather than concave in the lower part. It is very broad in older specimens and its surface becomes uneven instead of flat. The articular ridge is very poorly developed projecting over the articular furrow only near the valve apex. The internal surface is strongly concave. Only two or three sharply demarcated crests for the lateral depressor muscles are present. There is no separate spur.

The labrum (fig. 3 A) is smoothly and broadly concave with a long row of small teeth and fine hairs on the border : the palp (fig. 3 B) rectangular, straight or concave on the anterior margin and sparsely setose. The mandible (fig. 3 C) has three teeth, the third with two or more cusps. The pectinate lower lobe has about nine small teeth, the uppermost one or two more or less differentiated as a fourth tooth. One or two of the lower-most teeth on the lower lobe are slightly enlarged. The maxilla (fig. 3 D) bears three smaller spines below the enlarged upper pair and above the small notch. The middle third of the margin bears about 6 or 7 spines and the lower third up to ten or twelve slender spines. The second maxilla is broadly oval with concave anterior margin. There is a group of moderately long setae on the anterior margin and another on the apex and more thinly spaced longer setae on the convex posterior margin.

Cirri I and II are very short and stout with the segments of the rami broader than long. Cirrus III is nearly as long as cirri IV-VI which are of equal length. The segments are as long as broad or slightly longer and armed with three pairs of setae. The proximal pair of setae is slender and short on the lower segments. The segmentation of right and left cirri on a specimen from St. 382 is as follows :

	I	II	III	IV	V	VI
Right	9/6	8/9	16/18	19/21	21/22	23/23
Left	9/6	8/8	18/19	19/21	22/22	23/22

The penis is annulated throughout its length, with few scattered hairs, a little more frequent near the tip, and a thin terminal tuft of hairs.

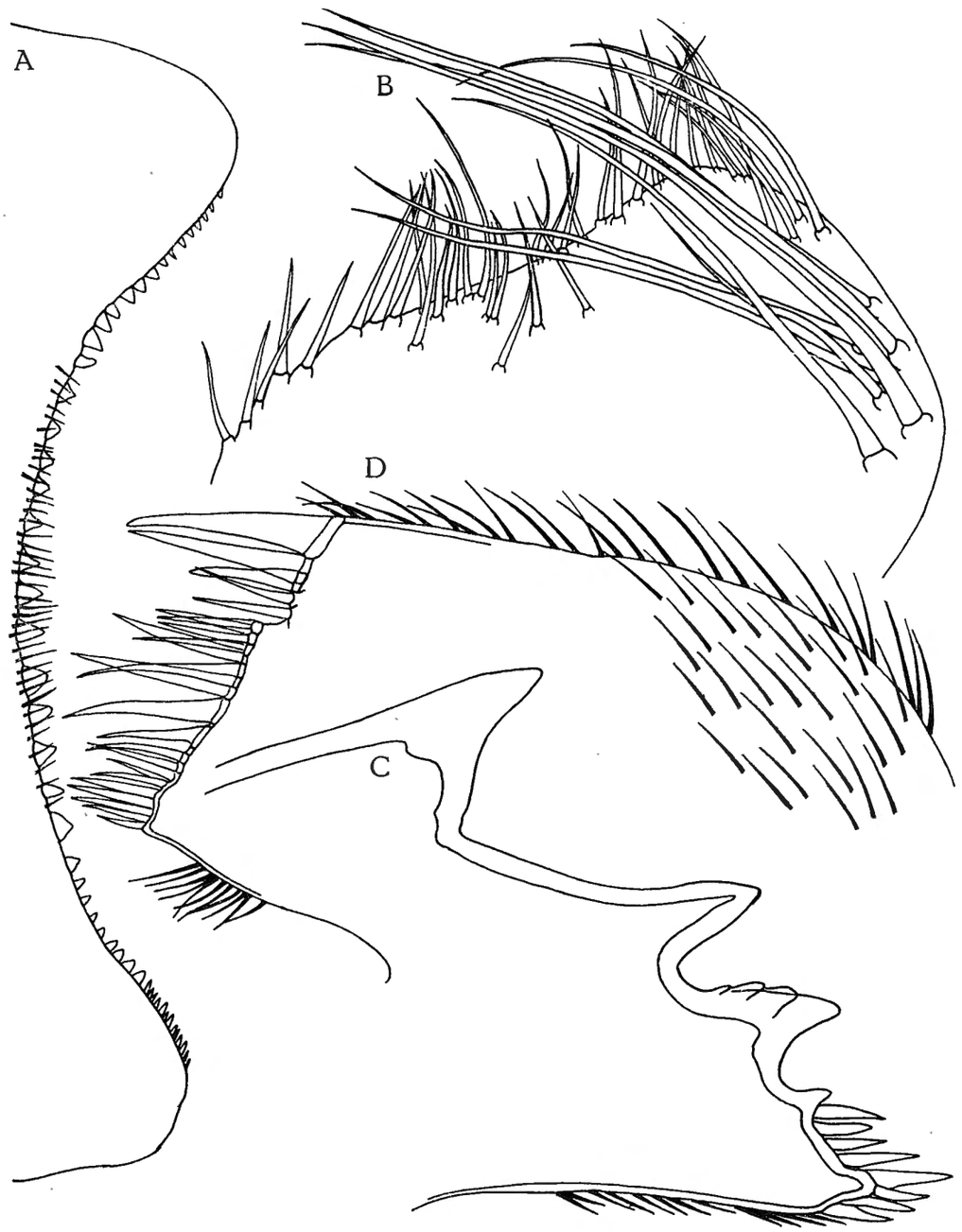

FIG. 3. — *Chthamalus aestuarii* n. sp.
Mouth appendages : A, labrum; B, palp; C, mandible; D, maxilla (all ×270).

This species has been variously indentified in the literature. It is undoubtedly that recorded by NILSSON-CANTELL (1938) from the Congo area and referred to as « *Chthamalus stellatus depressus* (POLI, 1791) DARWIN, 1854 ». It is not DARWIN's var. *depressus* which itself has been shown not to be the true *Lepas depressa* POLI, 1791 (UTINOMI, 1959*a*). UTINOMI has detailed the differences between *Chthamalus stellatus* (POLI) and *Ch. depressus* (POLI). From this data and the accompanying figures and from material from Southern France (Banyuls) kindly supplied by Dr. A. J. SOUTHWARD, Plymouth, it is clear that the present West African material belongs to neither species. UTINOMI (1959*a*, p. 382) in excluding *Ch. stellatus depressus* NILSSON-CANTELL (1938) from the synonymy of the reinstated species *Ch. depressus* (POLI, 1791) evidently recognised the distinctness of *Ch. aestuarii*. There are no ridges or pillars internally on the compartments marking the dividing line between paries and ala, and the adductor and depressor muscle pits of the scutum are distinct, even deep, and not indistinctly marked as described by UTINOMI for *Ch. depressus*. NILSSON-CANTELL remarks (1938, p. 177) on the external resemblance to young *Ch. fragilis*. Confirmation of this resemblance comes from Dr. A. J. SOUTHWARD who states (in litt.) that it resembles *Ch. fragilis* from Trinidad (W. Indies) in his possession. The tall form of the scutum and the shape of its articular ridge, also the narrow and internally concave tergum, all distinguish it from *Ch. fragilis*. This distinction is confirmed by examination of specimens from Trinidad and from Long Island Sound, New York. With regard to *Ch. stellatus angustitergum* PILSBRY the resemblance here is in the narrow tergum and not the scutum which has a very different articular ridge, being broadest at its lower end and not at the apical end as in *Ch. aestuarii*. The form of the articular ridge is very distinctive in *aestuarii* and it is curious that NILSSON-CANTELL (1938) does not draw attention to it though it is clearly shown in his figure 2 (p. 178).

I have not examined the *Chthamalus cirratus* recorded from Fernando Po by KOLOSVARY (1943, p. 75), which may exist no longer, but as *Ch. cirratus* is a Pacific coast species from S. America, it is most probable that the specimens there recorded are referrable to the new species. There is a strong resemblance in the articular border of the scutum between the two species. They differ however in that *Ch. aestuarii* has thin compartments and no crests crossing the depressor muscle pit in the scutum, and in that the walls are never ribbed and crenate at the base, but always smooth. Among internal differences cirrus III has more or less equal rami of approximately the same number of segments. Also there are no teeth on the anterior margin of the lower segment of the anterior ramus in cirri I and II as found in *Ch. cirratus*.

The records of *Chthamalus withersi* PILSBRY (1916) and *Ch. rhizophorae* OLIVEIRA (1940) from Sierra Leone reported by LONGHURST (1958) both refer to *Ch. aestuarii*. This material will be reported on elsewhere, together with other cirriped material from Sierra Leone, Ghana and Nigeria. It is mentioned

here to clarify the synonymy. Comparison with material of *Ch. rhizophorae* from Rio de Janeiro and of *Ch. withersi* from Queensland, confirmed the distinctness of these species from the West African species. The new species shows a resemblance to *Ch. rhizophorae* in the shape of the tergum and its very broad articular furrow. The scutum, however, has the articular ridge broadest in the middle and not apically. *Ch. withersi* terga have a much narrower articular furrow and a straight articular ridge. The scutum has the articular ridge most prominent in the middle of its length as in *Ch. rhizophorae* and is likewise distinct on this point.

The three species are separable on a number of points of anatomy of the mouth appendages and cirri : the comparatively short row of teeth on a straight edge in the labrum of *Chthamalus withersi*; in the mandible, the prominent lower lobe of *Ch. rhizophorae* (Oliveira, 1941) and the relatively large 2nd and 3rd teeth in *Ch. withersi*; in the maxilla the almost straight edge in *Ch. aestuarii* as compared with a prominent lower third in *Ch. withersi* and a stepped arrangement of middle and lower thirds in *Ch. rhizophorae*; the much longer cirrus VI in *Ch. rhizophorae*, 32/34 segments as compared with 23/23 in the other two species.

Geographically these three species do not overlap as far as is known. *Chthamalus withersi* is a west Pacific-Australasian form, *Ch. rhizophorae* is confined to the tropical W. Atlantic and *Ch. aestuarii* to the tropical E. Atlantic.

The habitat of *Chthamalus aestuarii* is evidently precisely defined. It is an estuarine intertidal species and normally occurs on the stilt roots of mangroves, being found also on suitably sited piles and concrete structures.

The specimens from St. 382 occupied a vertical zone of 52,5 cm on a mangrove root and were the highest occurring organisms present. Below they were replaced by *Balanus amphitrite* var. *pallidus* with only a narrow overlap of the two barnacle zones of about 7,5 cm. The *B. amphitrite* extended for some 40 cm to the broken lower end of the root. In the upper 20 cm of this Balanus zone a few *Brachyodontes niger* occurred : in the lower 20 cm the Brachyodontes were more abundant than the Balanus.

Nilsson-Cantell (1938) records the species as occurring on the mangrove *Rhizophora* sp. with *Balanus amphitrite stutsburi, Chthamalus dentatus, Balanus perforatus* f. *angusta* and *Ostrea gazor*. Longhurst (1958, p. 59) summarises the habitat in the Sierra Leone estuary succinctly when describing the species as « the dominant upper mid-littoral barnacle on mangroves, ... found to form a dense zone above the Ostrea zone... ». It shares this position with the gastropod *Thais callifera* var. *coronata* which probably preys on it in the same way as *Nucella lapillus* preys on the barnacles of the barnacle zone in temperate waters.

Chthamalus aestuarii would appear to occupy a very similar habitat to *Ch. rhizophorae* Oliveira in the new world. Whilst in Queensland, Australia, *Ch. withersi* also occupies the upper littoral zone (HWS-HWN) (Endean, Kenny and Stephenson, 1956) and also is tolerant of salinity fluctuations

(ENDEAN, STEPHENSON and KENNY, 1956, p. 332) it seems rarely to occur on mangroves (NILSSON-CANTELL, 1921) or mangrove leaves (NILSSON-CANTELL, 1938) but to occur chiefly on rocks and concrete structures.

Chthamalus dentatus KRAUSS, 1848.

Chthamalus dentatus KRAUSS, 1848, p. 135, pl. 6, fig. 27.
Chthamalus dentatus DARWIN, 1854, p. 463, pl. 18, figs. 3, *a-c.*
Chthamalus dentatus GRUVEL, 1912, p. 345.

Material :

St. **81** : 12°20′ S.-13°34′ E., Baie de Lobito, Angola, 12 m, several small specimens on shell conglomerate and *Ostrea tulipa* LAM. with many *Balanus trigonus* and a few *B. perforatus.*

St. **105** : 22°53′ S.-14°30′ E., beach at Walvis Bay, S.W. Africa, about 30 large specimens on *Siphonaria grisea* GMEL., *S. pectinata* L. and *Mytilus perna* L., and numerous smaller detached specimens.

St. **390** (Mission « DE BROUWER », 1955) : Kington Jetty, Freetown, Sierra Leone, 8 specimens attached to *Balanus tintinnabulum tintinnabulum* and *B. amphitrite* probably var. *pallidus.*

The larger specimens from St. **105** and those from St. **390** are up to 10 mm carino-rostral diameter. The Freetown specimens are quite uneroded with regular moderately steeply conical shells with 3 or 4 prominent ribs to the compartments which are covered by a thin fawn cuticle. The Walvis Bay specimens are similar but show white or grey-white shell where the cuticle is worn away. The opercular valves of these shells are more eroded than the parietes. The characteristic dentate sutures are distinct externally. The detached specimens from Walvis Bay had clearly grown under crowded conditions and many are somewhat elongated. Sutures in the lower part of the walls are often only slightly sinuous although in the upper part the typical dentate character reappears.

Genus BALANUS DA COSTA, 1778.

Subgenus MEGABALANUS HOEK, 1913.

Balanus tintinnabulum tintinnabulum (L.), 1758.

Balanus tintinnabulum var. (1) *communis* DARWIN, 1854, p. 195, pl. 1, figs. *a*, *b*, *f supra*; pl. 2, figs. *a*, *c*, *d*, *e*, *i*, *k.*
Balanus tintinnabulum tintinnabulum PILSBRY, 1916, p. 55, pl. 10, figs. 1-1*e.*

Material :

St. **188** : 6°26′ S.-11°40′ E. off Moita Seca, Angola, 156 m, 3 small specimens embedded in a mass of *Balanus trigonus.*

St. **390** (Mission « De Brouwer », 1955) : Kington Jetty, Freetown, Sierra Leone, 6 live specimens and 4 shells with attached *Balanus amphitrite* var. *communis*.

These few specimens are the only representatives of *Balanus tintinnabulum* in the collection.

Balanus tulipiformis Darwin, 1854.

Balanus tulipiformis Ellis, 1758, p. 845, pl. 34, fig. 10.
Balanus tulipiformis Darwin, 1854, p. 204, pl. 2, figs. 2, *a-d*.
Balanus tulipiformis Nilsson-Cantell, 1921, p. 308.

Material :

St. **9** : 6°21′ S.-11°53′12″ E. off Moita Seca, Angola, 100 m, 6 specimens and 2 empty shells on a branching coral.

St. **25** : 4°52′ S.-11°39′30″ E. off Pointe Noire, French Equatorial Africa, 58 m, 9 specimens and 6 empty shells, some on dead coral with a small Brachiopod and epizoic *Balanus fallax*.

St. **39** : 6°06′ S.-12°02′ E. off Moita Seca, Angola, 43 m, 42 specimens and 30 dead shells on a dead, probably Antipatharian, stem with a single *Balanus spongicola* and many *B. fallax*.

St. **89** : 9°40′ S.-13°02′ E. off Cap Ledo, S.W. Africa, 78 m, about 40 live specimens and 15 dead shells of all sizes : one group of 9 large ones with some 30 smaller attached, the remainder on a Gorgonian stem with *Balanus fallax*.

The bared or dead skeletal structures of various coelenterates appear to be the common substrate for *Balanus tulipiformis*. Likewise they are commonly associated with the small species *B. fallax* Broch.

Subgenus BALANUS Da Costa, 1778.

Balanus amphitrite Darwin, 1854.

This species is represented in the collection by five varieties, one of which var. *pallidus* is shown to include the form recorded as *Balanus dybowskii* Gruvel (1903).

Balanus amphitrite var. **communis** Darwin, 1854.

Balanus amphitrite var. (1) *communis* Darwin, 1854, p. 240, pl. 5, figs. 2, *e*, *h*, *l*.
Balanus amphitrite communis Nilsson-Cantell, 1921, p. 311, text-fig. 64.
Balanus amphitrite communis Nilsson-Cantell, 1932, p. 122, text-fig. 3.

Material :

St. **390** (Mission « De Brouwer », 1955) : Kington Jetty, Freetown, Sierra Leone, 6 specimens and 2 dead shells attached to *Balanus tintinnabulum tintinnabulum*.

These specimens conform to UTINOMI's (1960) definition of var. *communis* as distinct from var. *hawaiiensis* in those characters listed by that author, with the exception that there are uncoloured areas between the groups of longitudinal stripes as figured by UTINOMI for var. *hawaiiensis*. In other characters, including the form of labrum they are *communis*. There is some variability in the colour of specimens, some having purplish stripes whilst in others they approach a dark violet colour.

Balanus amphitrite var. **hawaiiensis** BROCH, 1922.

Balanus amphitrite f. *hawaiiensis* BROCH, 1922, p. 314, text-figs. 56, 57.
Balanus amphitrite var. *denticulata* BROCH, 1927 *a*, p. 133, text-fig. 14.
Balanus amphitrite hawaiiensis UTINOMI, 1960, p. 43, text-figs. 1-3.
Balanus amphitrite var. *denticulata* STUBBINGS, 1961 *a*, p. 23, text-fig. 4.

Material :

St. **393** (Mission « DE BROUWER », 1955) : Las Palmas, Gran Canaria, beach, a single specimen on a pebble.

This specimen has the multi-denticulate labrum of varieties *hawaiiensis* BROCH and *denticulata* BROCH. The views of UTINOMI (1960) as to the synonymy of these two varietal names are adhered to here. The variety does not appear to be very frequent on the W. African Coast. The author (1961*a*) has recorded it from four « Atlantide » stations but only one of these was from a natural habitat, and that not African but from Le Havre, France. The remaining three collections were all from ships' hulls, twice from « Atlantide » and once from a tug at Bathurst, Gambia. Only the last named specimens can be regarded with certainty as having settled at or near the point of collection. It may be, therefore, that this variety is to be found as far south as the Gambia, but is rare or absent further south.

Balanus amphitrite var. **pallidus** DARWIN, 1854.

Balanus amphitrite var. (3) *pallidus* DARWIN, 1854, p. 240, pl. 5, figs. 2, *c*, *k*.
Balanus amphitrite pallidus NILSSON-CANTELL, 1932, p. 124, text-fig. 4.
Balanus amphitrite var. *pallidus* STUBBINGS, 1961 *a*, p. 27, text-fig. 6.
Balanus dybowskii GRUVEL, 1903, p. 143, pl. 1, figs. 1-9.

Material :

St. **99** : 6°01′ S.-12°24′15″ E., Banana Creek, Congo, 5-6 m, 18 specimens and 3 dead shells on a stone.

St. **302** (Mission « DE BROUWER », 1955) : Rosa I., Banana Creek, Congo, numerous specimens on stilt-roots of Mangroves and on *Brachyodontes niger* so attached.

St. **390** (Mission « DE BROUWER », 1955) : Kington Jetty, Freetown, Sierra Leone, 1 dead shell probably of this variety, but without opercular valves.

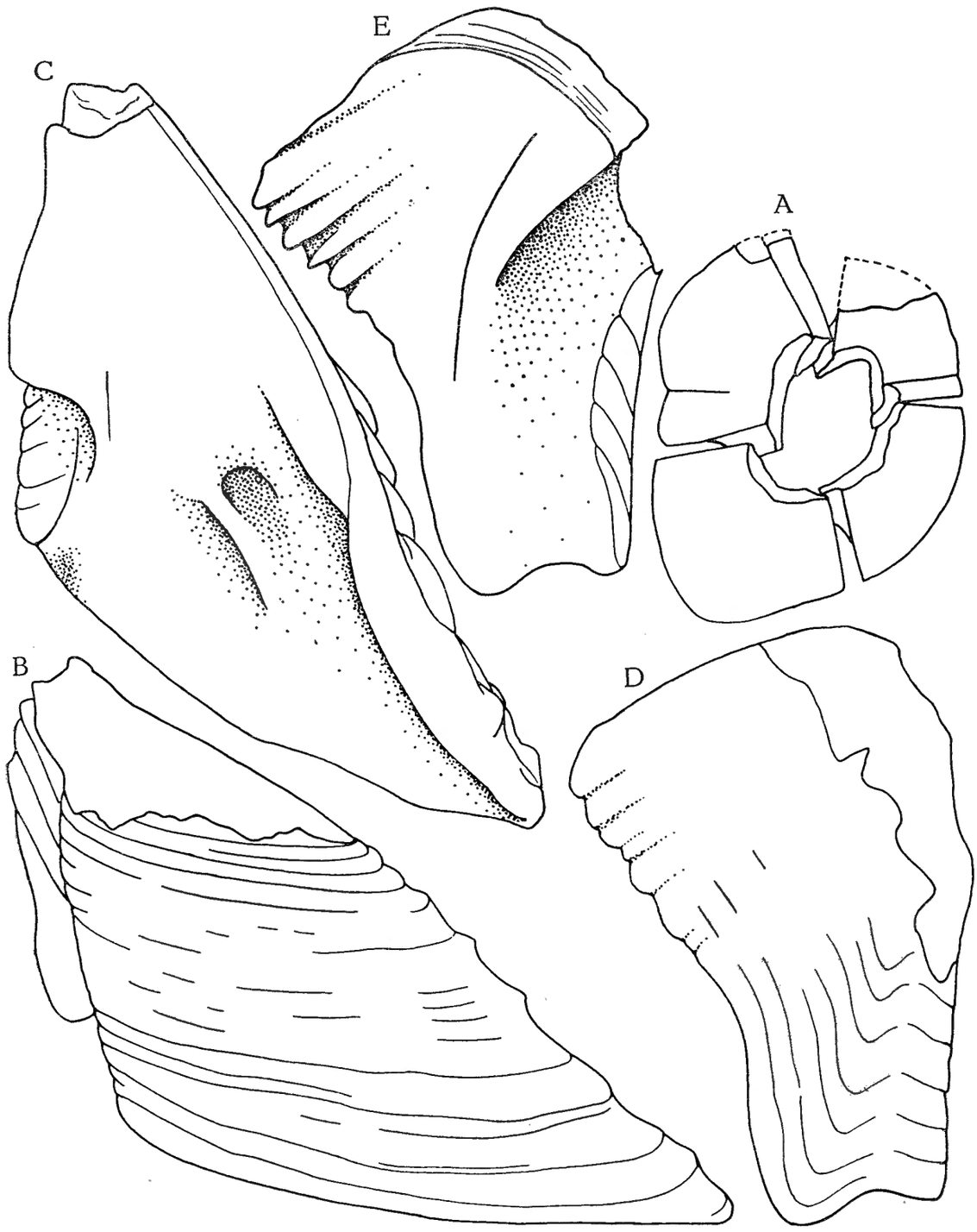

FIG. 4. — *Balanus amphitrite* var. *pallidus* DARWIN from St. **99**.
A, young specimen, 4 mm diameter, without radii (×17);
B-E, external and internal views of the scutum and tergum of the same specimen (×130).

Balanus amphitrite var. *pallidus* occupies a similar intertidal habitat to var. *stutsburi* and because the latter also may be devoid of purple pigment, the two forms are difficult to separate on shell form alone. There do not appear to be external characters affording diagnostic differences. In both the shell may be thin and smooth or more robust : in both the radii may be reduced to, or almost to, vanishing point. The opercular valves probably afford a firm basis of separation though confusion has arisen, in part due to a discrepency in DARWIN's original work in which the tergal spur is referred to as « sharp » in the text (p. 240) but is illustrated as short and broad (pl. 5, fig. 2*k*). NILSSON-CANTELL (1932) followed the figure, I think correctly. The author (1961*a*, p. 28), has inadvertently implied that the spur is long in this variety and in var. *stutsburi*. His figure (fig. 6, p. 29), however, is of a true *B. a. pallidus* tergum and the spur is not of the long *B. a. stutsburi* type, though it is rather an extreme form of *B. a. pallidus*, being tapered and not parallel-sided throughout as figured by DARWIN. In brief it may be said that *B. a. pallidus* has a shorter tergal spur than *B. a. stutsburi*, the basal margin of the tergum on the carinal side is less or not at all excavated and in the scutum the lower area is less flat than in var. *stutsburi*. To this definition the present materials from St. **99** and **302** adhere.

GRUVEL (1903) described *Balanus dybowskii* from specimens from the Congo, basing his species primarily on the absence of radii in the compartments. The specimen described was broadly conical (1903, pl. 1, fig. 1) with heavily eroded compartments and opercular valves. No trace of radii was discernible. In the present material there are young specimens from St. **99** with only slightly eroded compartments and much eroded older specimens from St. **302**. The uneroded specimens show that the radii are minute or absent. Figure 4 A shows the partly disarticulated shell of a specimen 4 mm in diameter and devoid of radii. St. **302** material includes uneroded almost cylindrical shells with very narrow to obsolescent radii and conical forms showing much eroded radii (fig. 5 A) or none at all, the articular surfaces being on the margin of the paries. Thus the absence of radii as a diagnostic character for *B. dybowskii* is not tenable.

Erosion of the compartments, even severe erosion, is not confined to « *Balanus dybowskii* ». It occurs in both *B. a. stutsburi* and *B. a. pallidus* in certain estuarine habitats.

The form of the opercular valves apart from erosion, in *Balanus dybowskii*, was described in detail by GRUVEL (1903). The scutum is smooth externally with only lightly marked growth lines (figs. 4 B, 5 B). The valve has the basitergal angle obtuse (fig. 4, B, C), and only rarely approaching a right angle (fig. 5 C). This is the normal condition in *B. a. pallidus*, which the scutum also resembles in being thickened in the area of the adductor ridge and below it. This is a feature distinguishing *B. a. pallidus* from *B. a. stutsburi*. In the length of articular ridge the valve is of var. *pallidus* form.

The shape of tergum appears at first sight distinctive for *Balanus dybowskii*. The spur (fig. 5, D, E) is moderately long and rounded distally. The basal

FIG. 5. — *Balanus amphitrite* var. *pallidus* DARWIN.
An older specimen with eroded compartments (=*B. dybowskii* GRUVEL, 1903) from St. **302**.
A, entire shell (×18); B-E, external and internal views of scutum and tergum (all ×34).

margin is hollowed out on the carinal side and, in GRUVEL's description and illustration, there is a projection in this hollowed out area. This projection is, however, nothing more than the projecting tip of a depressor muscle crest developed remote from the carinal margin. The presence of one or more extra crests here, in addition to those in the basicarinal area is not infrequent in *B. a. pallidus* and in *B. a. stutsburi*. The emargination of the basal margin is less in young specimens, in which also the spur is shorter (cf. fig. 4, D, E). There are variations in spur and basal margin involving length of spur and degree of emargination. Apparently otherwise typical individually have the short evenly rounded rather truncate spur of *B. a. pallidus* and the margin only sightly emarginate (fig. 4 D). There are others in which the spur is rather longer and the basal margin rather more concave. These are approaching the *B. a. stutsburi* type of tergum though they fall far short of the heavy emargination and very long spur of that variety. The soft parts do not show any distinctive character. Accordingly it is considered that *Balanus dybowskii* GRUVEL is only a heavily eroded *B. a. pallidus* with greatly reduced or non-existent radii and as such the name must be reduced to the synonymy of *B. amphitrite* var. *pallidus* DARWIN.

Balanus amphitrite var. **stutsburi** DARWIN, 1854.

Balanus amphitrite var. (6) *stutsburi* DARWIN, 1854, p. 240, pl. 5, figs. 2, *d*, *i*, *m*, *n*, *o*.
Balanus amphitrite stutsburi NILSSON-CANTELL, 1932, p. 125, text-fig. 5.
Balanus amphitrite var. *stutsburi* STUBBINGS, 1961 *a*, p. 24.

Material :

St. **302** (Mission « DE BROUWER », 1955) : Banana Creek, Rosa I, estuary of R. Congo, many specimens on stilt roots of mangroves with *Chthamalus aestuarii* n. sp. and on *Brachyodontes niger* GMEL. so attached.

St. **310** (Mission « DE BROUWER », 1955) : Beach at Banana, Congo, 23 specimens and 5 dead shells attached to *Brachyodontes niger* GMEL.

St. **384** (Mission « DE BROUWER », 1955) : Tonde Creek, nr. Banana, Congo, numerous specimens on grass stems.

These shells are predominantly white with or without a varying development of coloured vertical lines. There are very few deep purple shells. The specimens from St. **310** and **384** are all half grown or smaller, and many of those from St. **302** also are juvenile. The smallest shells are wholly white and in many of these the radii are very poorly developed, thus approximating to the shell-form of *Balanus dybowskii* GRUVEL (1903). They have, however, the long spur and concave basal margin of the tergum found in *B. a. stutsburi*. The scutum also is of the flat thin *B. a. stutsburi* form (fig. 6). In many of the St. **302** specimens the compartments are heavily eroded and the radii as well as the parietes are worn down, until they approach the eroded form

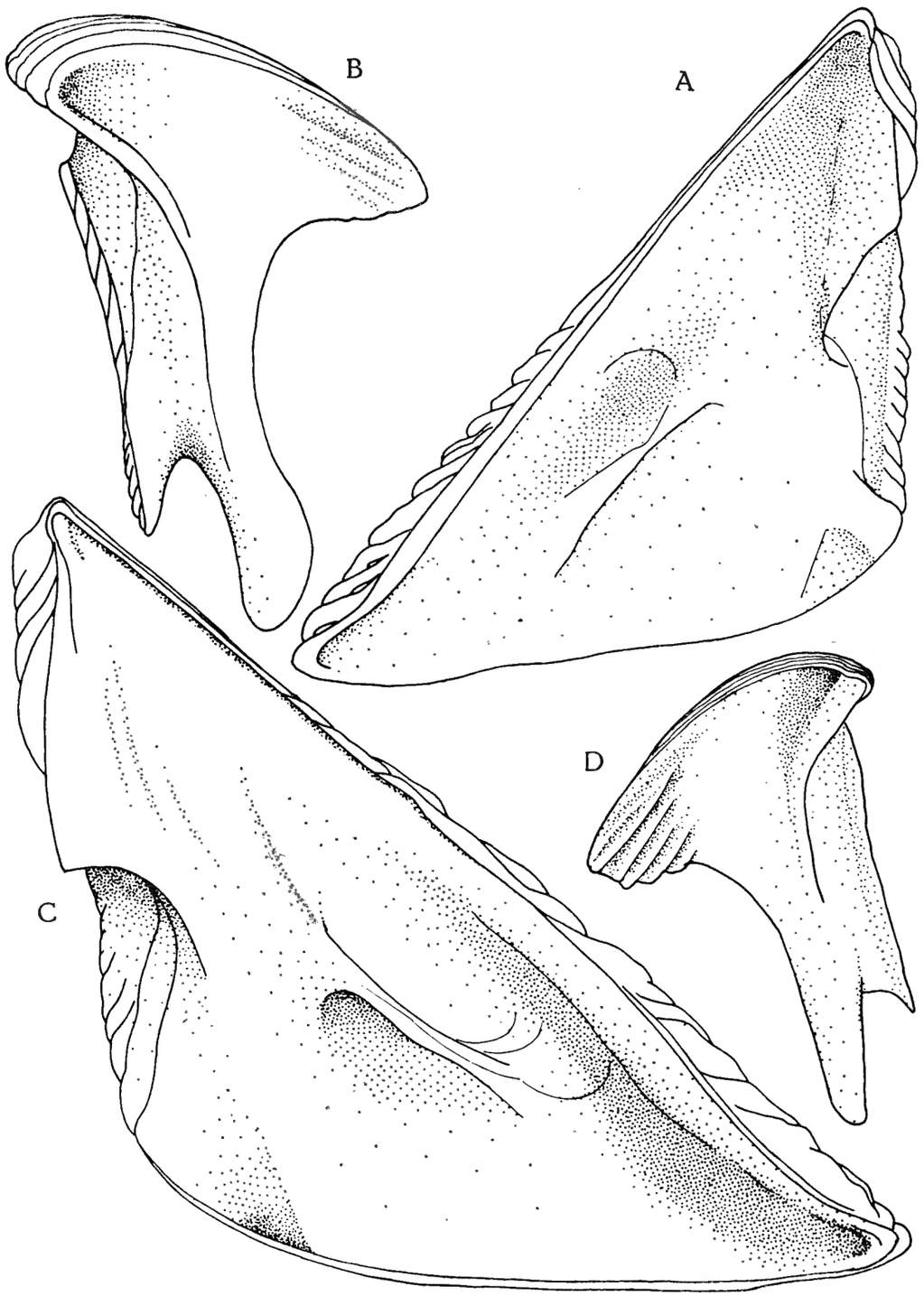

FIG. 6. — *Balanus amphitrite* var. *stutsburi* DARWIN.
Internal views of A, B, scutum and tergum of the same specimen;
C, scutum of a large individual;
D, tergum of a small specimen. All from St. **384** (all ×60).

of shell without apparent radii of *B. dybowskii*. Examination of the opercular valves reveals the var. *stutsburi* form of tergum and they are clearly assignable to this variety.

Nearly all this material has relatively thin-walled compartments and thin opercular valves. The scutum is not heavily sculptured internally, but is rather flat apart from the adductor ridge. The depressor pit is small and not deeply impressed. As a result the area of the scutum between adductor ridge and basitergal angle is uniformly flat. Thin opercular valves, a long-spurred tergum and internally flat scutum are apparently rather constant features of var. *stutsburi*.

The disposition of the species on mangrove roots from St. **302** indicates that *Balanus amphitrite* var. *stutsburi* occupies a lower position in relation to the tidal level than *Chthamalus aestuarii* from the same habitat.

Balanus amphitrite var. **venustus** DARWIN, 1854.

Balanus amphitrite var. (2) *venustus* DARWIN, 1854, p. 240, pl. 5, fig. 2*g*.
Balanus amphitrite var. *venustus* STUBBINGS, 1961 *a*, p. 29.

Material :

St. **30** : 6°07′ S.-12°12′ E. off Moita Seca, Angola, 40 m, about 30 specimens on an arenaceous Polychaet tube and on *Balanus fallax*.

St. **31** : 7°16′ S.-12°47′ E. off Ambrizette, Angola, 35 m, about 70 live specimens and 30 dead shells on *Xenophora* sp., shell fragments, calcareous Polychaet tubes and Gorgonian stems with *Balanus fallax*.

St. **116** : 9°20′ S.-13°04′ E. off Rio Cuanza, Angola, 17 m, 13 small or very small specimens on *Thais haemastoma* L.

St. **183** : 9°22′ S.-13°01′ E. off R. Cuanza, Angola, 50 m, 3 dead shells with numerous *Balanus fallax* on a Polyzoan colony.

These specimens of *Balanus amphitrite* var. *venustus* vary in colour from pure white young specimens, through others with pale pink near the basal margin only to wholly pink individuals. Pale pink vertical lines near the basal margin of the white shell are present on some specimens. In others there are distinct pink vertical lines on a lighter pink ground colour.

Balanus trigonus DARWIN, 1854.

Balanus trigonus DARWIN, 1854, p. 223, pl. 3, figs. 7, *a-f*.
Balanus trigonus STUBBINGS, 1961 *a*, p. 31, text-fig. 7.

Material :

St. **81** : 12°20′ S.-13°34′ E., Lobito Bay, Angola, 12 m, numerous small specimens on *Murex bourgeoisi* TOURNOUËR, *Mytilus perna* L. and on shell conglomerate (*Ostrea tulipa* LAM.) associated with *Balanus perforatus* and *Chthamalus dentatus*.

St. **188** : 6°26′ S.-11°40′ E. off Moita Seca, Angola, 156 m, numerous specimens clustered on *Balanus tintinnabulum tintinnabulum* and on each other.

Luanda, Cacouaco Plage, numerous dead specimens without opercular valves on a living *Murex* sp.

Balanus spongicola Brown, 1844.

Balanus spongicola Brown, 1844, p. 121, pl. 53, figs 14-16.
Balanus spongicola Pilsbry, 1916, p. 115, pl. 25, figs. 2-4*c*, text-figs. 29-31.
Balanus spongicola Barnard, 1924, p. 69.
Balanus spongicola Stubbings, 1961 *a*, p. 32.
Balanus spongicola Stubbings, 1961 *b*, p. 188.
Balanus dollfusi Broch, 1927 *b*, p. 23, pl. 3, figs. 20-24, text-fig. VI.
Balanus dollfusi Nilsson-Cantell, 1938, p. 180.
Balanus dollfusi Nilsson-Cantell, 1939, p. 93.

Material :

St. **31** : 7°16′ S.-12°47′ E. off Ambrizette, Angola, 35 m, 1 large and 1 juvenile specimen alive and 7 shells on the base of a Gorgonian with *Balanus fallax*.

St. **39** : 6°06′ S.-12°02′ E. off Moita Seca, Angola, 43 m, 1 dead specimen with opercular valves, but no soft parts on a dead Gorgonian.

The large specimen from St. **31** is coloured deep pink, the opercular valves white except that the scutum has a central patch of colour and coloured occludent margin and that the beak of the tergum is pink. In the specimen from St. **39** the spur of the tergum is very broad, about two-fifths the width of the basal margin of the valve. The beaded growth ridges on the scutum of this specimen are fringed with cuticular processes curved towards the apex of the valve.

Broch (1927*b*) described a new species *Balanus dollfusi* from Morocco and this species has been twice recorded subsequently from West Africa (Nilsson-Cantell, 1938, 1939). Comparison of Broch's text and figures with Darwin's and Pilsbry's (1916) descriptions of *B. spongicola* Brown shows that the two species are very closely allied if not indentical. Yet it is curious Broch does not mention this similarily but only draws attention to the « treacherous likeness » of the terga to those of *B. balanus* (L.). This is true; but in other respects, in the ribbed shell for example, *B. balanus* is very different. In an attempt to clarify the systematic position *B. spongicola* from the English Channel has been compared with the present specimens and other West African specimens identified as *B. spongicola* (Stubbings, 1961, *a*, *b*). In addition some of those referred to *B. dollfusi* by Nilsson-Cantell (1938, 1939) have been re-examined. Unfortunately Broch's type specimens were not available for examination. The results of this comparative study are given below.

In shape *Balanus spongicola* varies from conical to tubulo-conical and is smooth-walled. Pilsbry (1916) excludes the West Indian forms with folded walls as a separate species, *B. calidus*. Darwin, himself (1854, p. 226) was

doubtful of the propriety of including these under *B. spongicola*. According to BROCH (1927*b*), *B. dollfusi* is feebly conical or tubular and smooth or irregularly folded. In both the orifice is toothed owing to the oblique margins to the radii. PILSBRY makes a point of the large number of parietal pores (29) in the rostrum of *B. spongicola* but BROCH does not comment on this feature in *B. dollfusi*. This appears to be a very variable character in northern *B. spongicola*. Of two specimens examined one had 18 or 19 pores in the rostral paries : the other, a much larger specimen, had 34. In various West African specimens the following numbers were found :

Locality.	N° of Pores.
Atlantique Sud St. **31** (off Ambrizette, Angola)	24
* Calypso St. **17** (Ivory Coast)	22
Calypso St. **1** (Rio de Oro)	20
Atlantique Sud St. **39** (off Moita Seca, Angola)	19
Atlantique Sud St. **145** (off Port Gentil, Fr. Equatorial Africa)	18
Calypso St. **25** (off Ghana)	17

* The Calypso Stations are all from the « Golfe de Guinée » Expedition 1956.

In both « species » the pores are septate, there being « many » septa in *Balanus spongicola* (PILSBRY) and « several » in *B. dollfusi* (BROCH). Internally the compartments are ribbed, « below the sheath » in *B. dollfusi* and « only close to the base » in *B. spongicola*. In the materials here examined the internal ribs on the several parietes extend from one-third to half way up the compartment below the sheath. They are best developed on the carina where they may extend rather further upwards. The degree of development is variable from specimen to specimen as well as between the compartments of an individual.

Balanus spongicola is red or pink varying to nearly white on the rostrum (PILSBRY) or in some cases paling to a wholly white shell (BARNARD, 1924). *B. dollfusi* is also red or pink with pink stripes and paler on the rostral side (BROCH). The West African specimens are small and rather deep but dull pink in colour, compared with which the Channel *spongicola* has a fresh, if paler colour. The dullness of colour is possibly due in part to the shells frequently having thin epizoic growths on them. In all specimens the colour pales from the carina towards the rostrum. The latter may in extreme cases be almost white.

The opercular plates in *Balanus dollfusi* are said to be « darker pink colour », presumably darker than the shell. The scuta of *B. spongicola* usually bear a pink patch darker than the walls, but this covers only part of the valve, the remainder being white. The terga of *B. spongicola* are flushed pink mainly in the apical region.

The scutum in both forms has prominent growth ridges cut by grooves radiating from the apex. These are said to be unequal in *Balanus spongicola*. Internally the scuta agree in having a moderately deep adductor pit and a

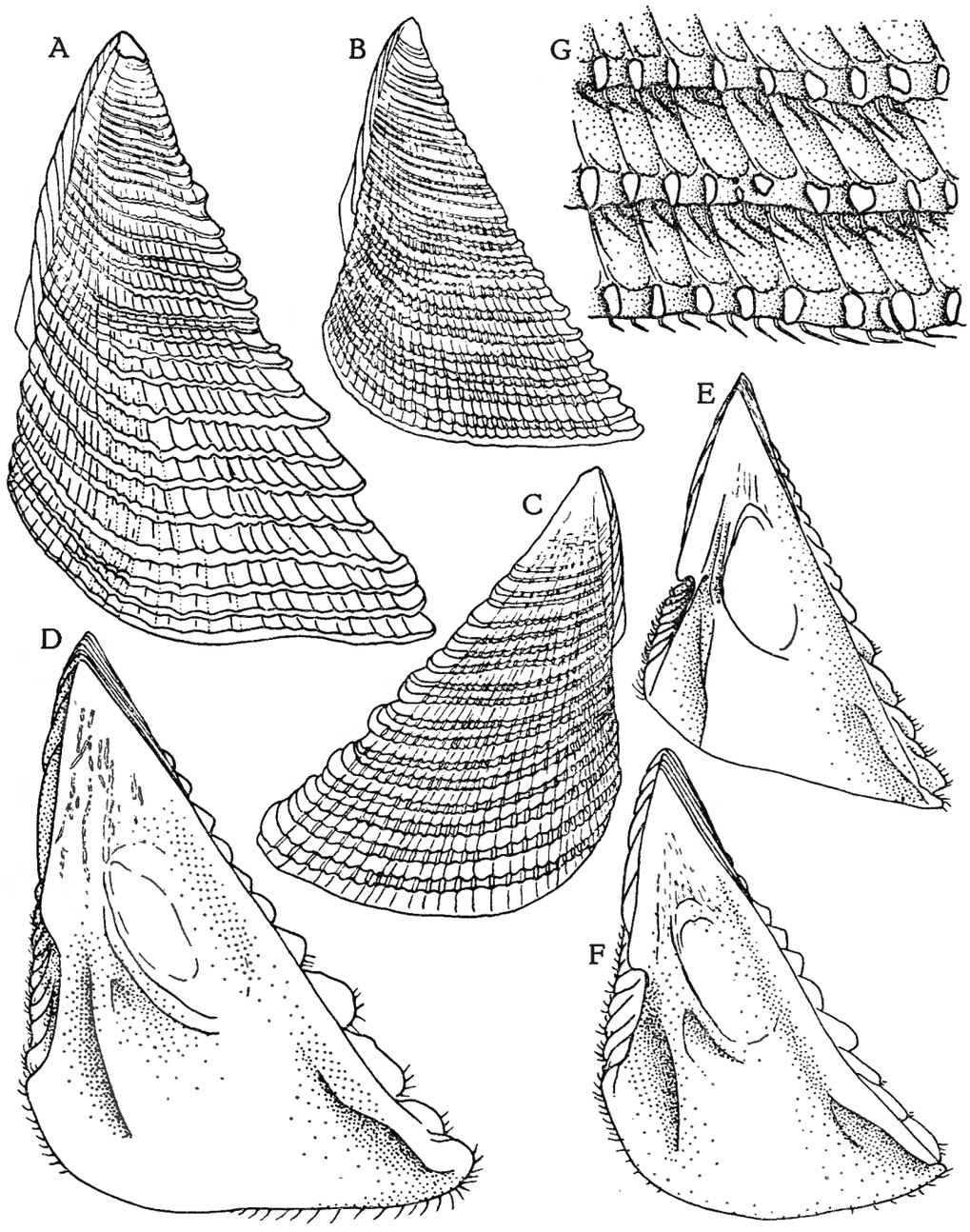

FIG. 7. — *Balanus spongicola* BROWN.

External and internal views of scuta : A, D, from off Looe, English Channel; B, E, from St. **31**, off Angola; C, F, « Mercator » specimen identified as *B. dollfusi* (vide NILSSON-CANTELL, 1939) from Rio de Oro (all ×16); G, a small area from B to show the sculpturing typical of all specimens (×92).

rather small adductor ridge, described as short but sharp and prominent and « extending only halfway down the plate » in *B. dollfusi* : in *B. spongicola* PILSBRY describes it as « small and short, merely forming a raised border of the adductor pit ». The difference here would appear to lie in terminology only, dependent on how much of the raised area internal to the deep furrow behind the articular ridge is regarded as representing the adductor ridge. The depressor muscle pit in each is strongly developed and elongated and the deep furrow prolonging the line of the pit towards the apex of the valve is characteristic of both species.

In figure 7 are shown external and internal views of scuta of *Balanus spongicola* from the English Channel (A, D), a specimen from St. **31** (B, E) and one of the « MERCATOR » specimens identified by NILSSON-CANTELL (1939) as *B. dollfusi* (C, F). There is no clear difference in shape or sculpturing. Figure 7 G is representative of the beaded sculpturing on all three examples. Internally all are characterised by the distinctly marked adductor pit, the short, low adductor ridge and the deep elongated depressor muscle pit extending up between the adductor ridge and the lower end of the articular ridge. In larger specimens a slight depression lies between the adductor ridge and the edge of the depressor pit which is in consequence slightly raised. This depression is only faintly marked in small specimens (e.g., fig. 7 E). The apical part of the valve is lightly ridged internally, this again being more pronounced in older and larger valves.

The terga do not differ. Both have a prolonged acute apex broken or eroded in older specimens. The spur fasciole is scarcely sunken, the spur broad and truncate and separated by about half its width from the basiscutal angle. The basal margin on the carinal side curves smoothly into the spur. Terga of the same three specimens as in figure 7 are shown in figure 8 and to the same scale. In the « MERCATOR » specimen only (fig. 8, C, F) is the valve apex approximately complete. The very thin scutal margin near the valve apex is very liable to disintegrate. This is marked in figure 8 C, this valve appearing rather narrower in censequence than that in figures 8 A or 8 B. There is no real difference in proportion as can be seen by comparing the companion valve (fig. 8 F) with figures 8 D or 8 E.

There is a difference in the labrum of the two species as described. In *Balanus dollfusi* it has a rounded outline and no teeth (BROCH, 1927*b*, fig. VI*a*). In *B. spongicola* it has the more usual angled profile and bears three teeth on either side of the notch. These differences are not, however, constant. Figure 9, A, B, show the labrum and palps of the same channel and « MERCATOR » specimens. Figure 9 C is of another specimen from Rio de Oro. In all three the labrum bears three rather small teeth on each side of the notch. These spines are rather small and not always very clear. The shape of the labrum is variable. That in figure 9 A, from an undoubted *B. spongicola*, has the rounded outline given by BROCH for *B. dollfusi*, whereas the other two (fig. 9, B, C) are of the angular type. The shape of the labrum

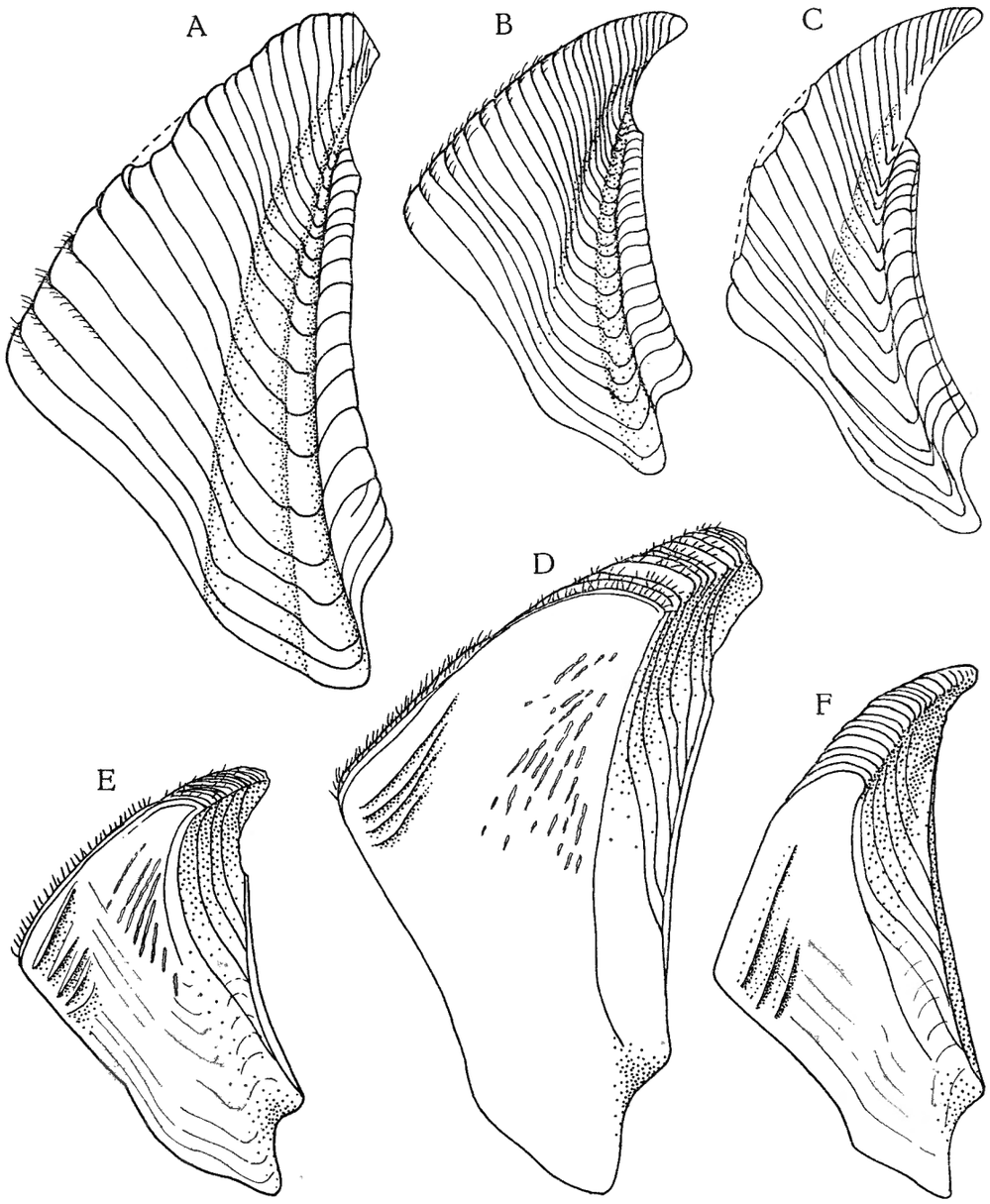

FIG. 8. — *Balanus spongicola* BROWN.
External and internal views of terga of the same individuals as in figure 7 :
A, D, from off Looe, English Channel;
B, E, from St. **31**, off Angola; C, F, « Mercator » specimen (all ×16).

in preparations is often distorted somewhat in mounting and flattening the specimen, particularly if the specimen is small and not heavily chitinised. Hence variations in shape of this structure may not always be reliable. The shape of the palp is rectangular and not as shown in BROCH's figure (BROCH, 1927*b*, fig. VI*a*) which would appear to be distorted.

The mandibles (fig. 9, D-F) are identical. The second tooth is very slightly bifid and the third rather more complex. The lower angle carries an incompletely separated fourth tooth below which the edge is blunt (fig. 9 F) or more finely toothed (fig. 9, D, E) depending on the extent of wear.

The maxillae appear to differ only in the very small notch said to lie below the upper pair of large spines in *Balanus dollfusi* and the presence of only one large spine, not two near the lower angle in the same species. As only two specimens were available when the species was described and no further anatomical data has been published these differences have not been substantiated. Figure 9 H shows the maxilla of a « MERCATOR » *B. dollfusi* prepared by the present author. It bears little resemblance to BROCH's figure VI*c* but has paired upper and lower large spines separated by five smaller ones. There is virtually no notch. A small spine is inserted between the large spines of the lower pair, and another small one below them. The Rio de Oro (« CALYPSO ») specimen (fig. 9 I) agrees with this. Figure 9 G from the English Channel *B. spongicola,* differs only in having nine spines between upper and lower pairs. This is appreciably more than in the other two and is actually one more than the number given by PILSBRY (1916, p. 116). There is evidently some room for variation here.

In the cirri there is close similarity. Cirrus I has the anterior ramus roughly twice as long as the posterior. The lower segments of the anterior ramus and all those of the posterior are moderately protuberant. In cirrus II the rami are approximately equal and all the segments are somewhat protuberant. The rami of cirrus III are subequal and not much longer than in cirrus II. The segments are not protuberant. According to PILSBRY (1916), in *Balanus spongicola* small teeth occur on segments 3-13 of the anterior ramus and 4-8 of the posterior. BROCH does not mention this feature in *B. dollfusi.* BARNARD (1924) states that in *B. spongicola* such spines occur usually on segments of both rami of cirrus III and on the anterior ramus only of cirrus IV. He says also that they may be absent from one or the other cirrus. I have seen these small spines on both rami of cirrus III only.

The segmentation of the cirri in the three examples cited is as follows :

	I	II	III	IV	V	VI
Looe, Cornwall	16/10	13/12	13/13	15*/21*	28*/32	29*/31
« MERCATOR »	13/8	10/9	11/11	16*/20	20*/26	25/17*
« CALYPSO »	15/8	11/9	12/11	20/21	24/24	26/26

Rami with missing terminal segments are marked by an *.

FIG. 9*a*. — *Balanus spongicola* BROWN.

A-C, Labrum and palp of : A, the same Looe specimen (×59); B, the « Mercator » specimen (×97); C, a specimen from Rio de Oro (« Calypso » Golfe de Guinée Exped. 1956, St. **1**) (×59). — D-F, mandible of : D, Looe specimen (×97); E, « Mercator » specimen; F, « Calypso » specimen (both ×144).—G-I, maxilla of : G, Looe specimen (×97); H, « Mercator » specimen; I, « Calypso » specimen (both ×263).

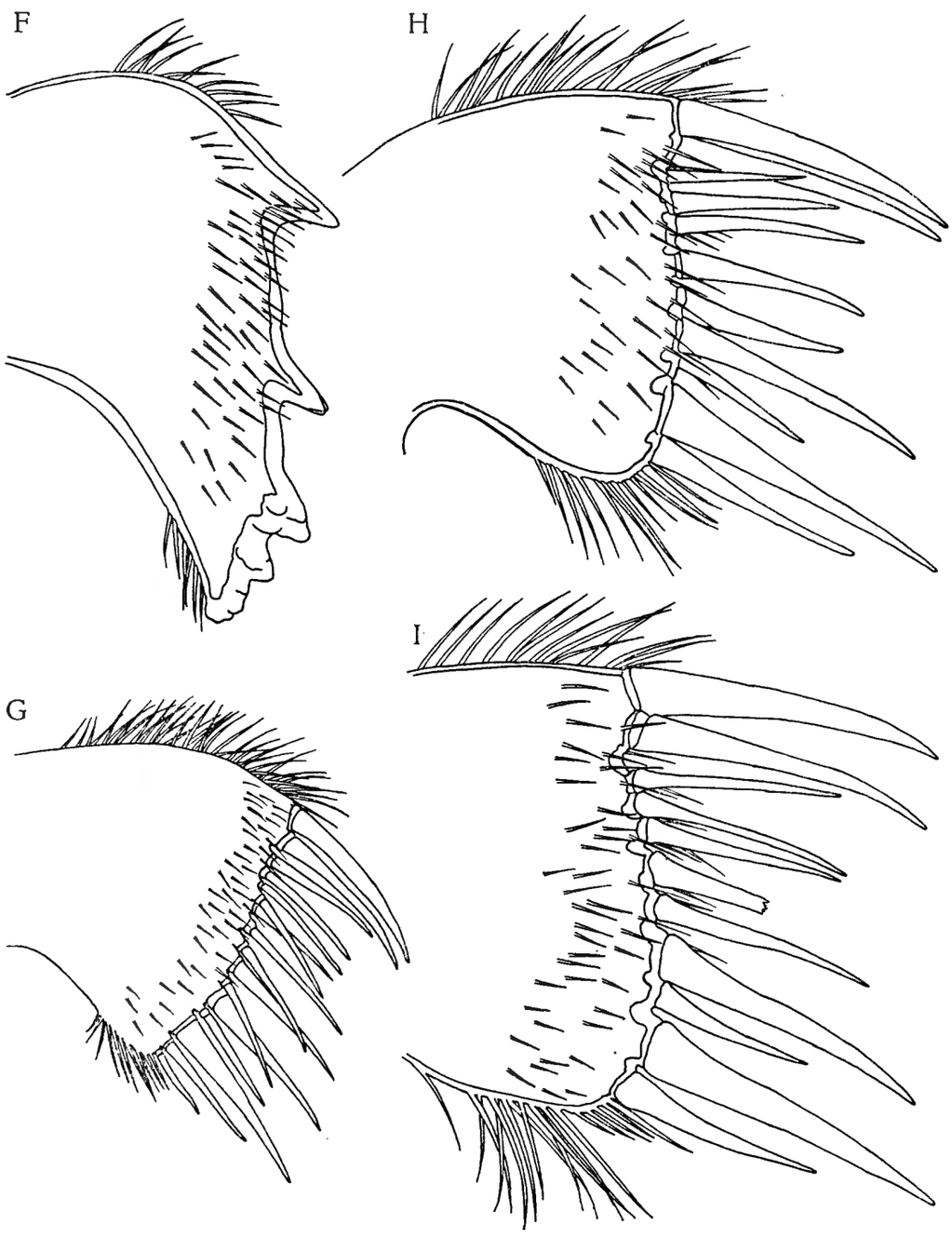

FIG. 9*b*. — *Balanus spongicola* BROWN.

The Looe specimen was larger than the other two which accounts for the consistently higher number of segments in the cirri.

The penis has a rather small and stout dorsal process in all three specimens. It lies close to the origin of the penis and is in consequence not always readily visible in preparations of penis and cirrus VI in which it does not lie clear of the pedicel of the cirrus. There is, however, no doubt of its presence.

In view of the close agreement of West African specimens, which have been variously identified as *Balanus spongicola* Brown and *B. dollfusi* Broch with temperate *B. spongicola* from the English Channel I have no hesitation in regarding these species as one and the same. Accordingly *B. dollfusi* Broch, 1927, is here reduced to a synonym of *B. spongicola* Brown, 1827 (1844).

Balanus perforatus Bruguière, 1789.

Balanus perforatus Bruguière, 1789, p. 167, pl. 164, fig. 12 *infra*.
Balanus perforatus Darwin, 1854, p. 231, pl. 4, figs. 3, *a-c*; pl. 5, figs. 1, *a-d*.
Balanus perforatus Pilsbry, 1916, p. 123, text-fig. 33.

Material :

St. **81** : 12°20′ S.-13°34′ E., Lobito Bay, Angola, 12 m, 4 medium sized and 12 small specimens on *Mytilus perna* L., *Murex bourgeoisi* Tournouër and shell conglomerate, associated with *Balanus trigonus* and *Chthamalus dentatus*.

St. **188** : 6°26′ S.-11°40′ E. off Moita Seca, Angola, 156 m, 1 large live and 4 small dead specimens.

The St. 188 specimens have thinner opercular valves compared with specimens from S. W. Engand, but otherwise the form of these valves is typical of the species.

The collection of this species from Lobito Bay confirms the record of *Balanus perforatus* so far south published by Gruvel (1912).

Subgenus HESPERIBALANUS Pilsbry, 1916.

Balanus fallax Broch.

Balanus (*Hesperibalanus*) *fallax* Broch, 1927 *b*, p. 26, pl. 2, figs. 12-17; pl. 3, figs. 18, 19; text-figs. 7-9.
Balanus (*Hesperibalanus*) *fallax* Nilsson-Cantell, 1939, p. 93.
Balanus (*Hesperibalanus*) *fallax* Utinomi, 1959 *b*, p. 402, text-fig. 1.
Balanus (*Solidobalanus*) *occidentalis* Stubbings, 1961 *a*, p. 34, text-figs. 8-11.
Balanus (*Solidobalanus*) *occidentalis* Stubbings, 1961 *b*, p. 189.

Material :

St. **25** : 4°52′ S.-11°39′30″ E. off Pointe Noire, French Equatorial Africa, 20 small specimens attached to *Balanus tulipiformis*.

St. **30** : 6°07′ S.-12°12′ E. off Moita Seca, Angola, 12 dead shells with *Balanus amphitrite* var. *venustus* on an arenaceous Polychaet tube.

St. **31** : 7°16′ S.-12°47′ E. off Ambrizette, Angola, numerous specimens of all sizes attached to Gorgonians, with small numbers of *Balanus spongicola*, *B. a.* var. *venustus* and *B. calceolus*.

St. **39** : 6°06′ S.-12°02′ E. off Moita Seca, Angola, many specimens of all sizes on *Balanus tulipiformis*.

St. **89** : 9°40′ S.-13°02′ E. off Cap Ledo, Angola, numerous specimens on Gorgonians and on *Pteria atlantica* LAM. so attached, with *Balanus tulipiformis*.

St. **183** : 9°22′ S.-13°01′ E. off Cuanza, Angola, numerous dead, white specimens attached to a Polyzoan colony and over-grown by an encrusting sponge, with a few *Balanus amphitrite* var. *venustus*.

St. **378** (Mission « DE BROUWER », 1955) : 6°15′ S.-12°00′ E., about 50 specimens attached to a Gorgonian colony.

BROCH (1927*b*) described this species from abundant material collected on the Atlantic coast of Morocco. At the time he expressed surprise that so abundant and apparently widely distributed a shallow water barnacle had remained undescribed. This he ascribed to possible confusion with other species. BROCH described the coloration of his species thus (p. 27) : « Generally the parietes are white with radiating vividly pink coloured stripes; the latter are often divided up into spots or stains; in some darker specimens the colour must be characterised as dark pink with lighter radiating lines and whitish spots ». Specimens showing plentiful coloured lines, intact or broken up into spots as described above are in the minority in the « Atlantique-Sud » material. Wholly pink-coloured specimens are even rarer. The material is, in fact, predominantly white without pink markings. This coloration is unexpected from BROCH's description which implies that *Balanus fallax* is a coloured species. However, colour is notoriously variable in barnacles, the varieties of *B. amphitrite* described above, for example. The presence of white forms could, therefore, be anticipated. NILSSON-CANTELL (1939) found that specimens from south of Garnet Head, Rio de Oro, were sometimes all white and sometimes white with radiating pink coloured stripes or spots. But white, or predominantly white, *populations* could not be inferred from these descriptions.

Through the courtesy of Dr. J. FOREST of the Museum National d'Histoire Naturelle, Paris, I have had the opportunity to examine four specimens (three intact and one damaged) of the ten originally designated by BROCH as « types » and to dissect one of these. At his suggestion I propose to designate as the type of *Balanus fallax* one of these three undamaged specimens from Fedhala, Morocco. The dissected specimen did not conform to the original descripiton in several small points, and a description of this paratype with figures is given here. This is also desirable as Professor BROCH (personal communication) has expressed his dissatisfaction with the original figures as published.

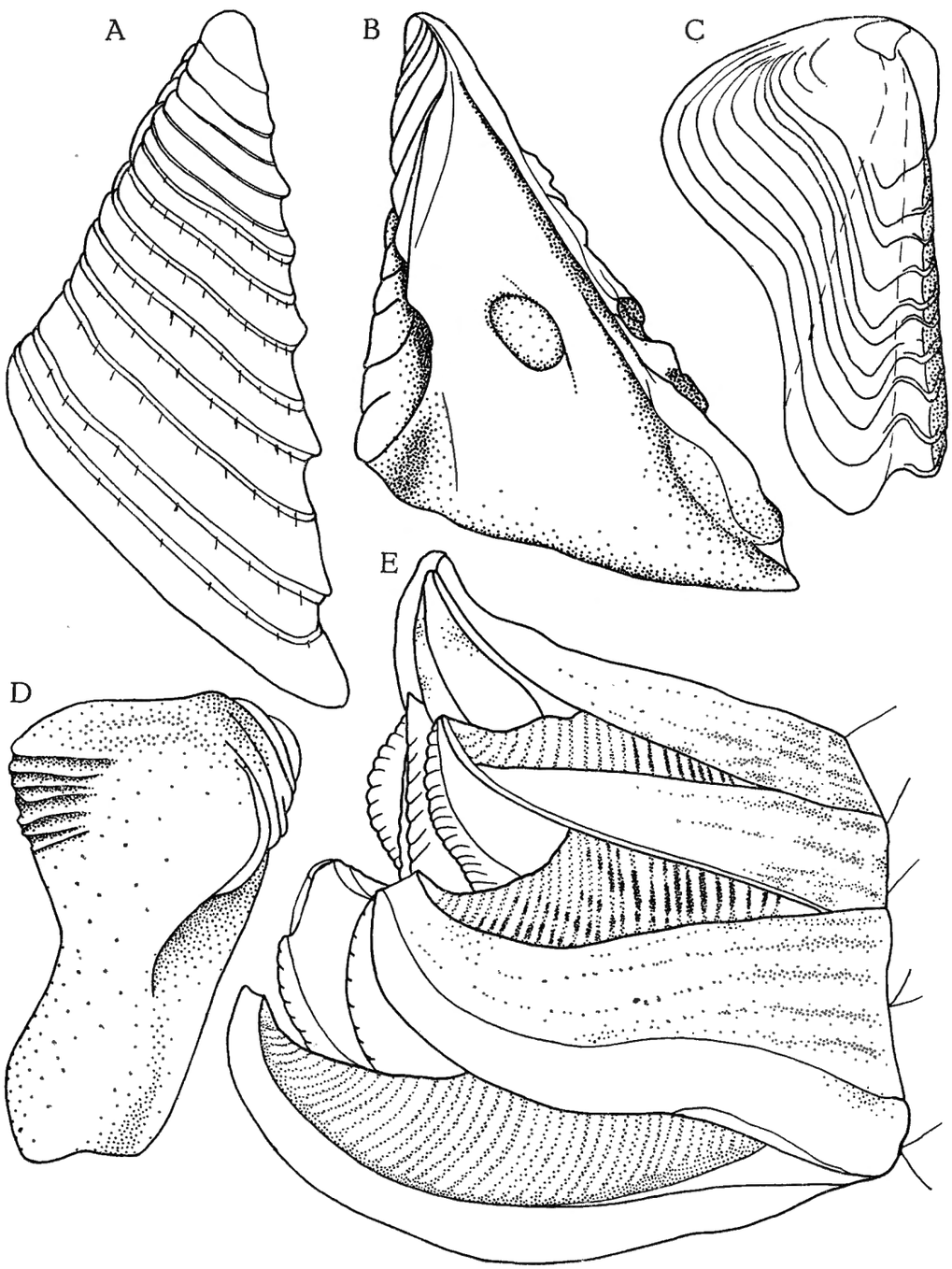

FIG. 10. — *Balanus fallax* BROCH.

A-D, external and internal views of scutum and tergum of a paratype in the Muséum National d'Histoire Naturelle, Paris (all ×40); E, specimen from St. **378** showing curved parietes (×21). Light shading on radii indicates hyaline areas, darker shading, pigmented areas. Shading elsewhere indicates pigmented areas.

Two small photographs of the complete shell were given by BROCH 1927*b*, figs. VII and VIII). The shell is normally steeply conical, often approaching cylindrical in crowded specimens and is deeply toothed when the orifice is undamaged.

The scutum (fig. 10, A, B) is lightly built (« delicately » according to BROCH) with lightly marked growth ridges, only the few latest formed ridges being prominent. The earlier formed part of the valve is almost smooth. There is the merest trace of the fine longitudinal striations described by BROCH. Internally the valve is distinctly thickened below the adductor scar which is a well-marked shallow depression. There is no adductor ridge.

The tergum (fig. 10, C, D) agrees closely with BROCH's description and figures, the apex being rounded as in his figure 18, plate III. This is due at least in part to some erosion of the valve apex. The valve is elongated and narrow with a less prominent carinal lobe and consequently is less triangular than in BROCH's figures. The spur is less clearly demarcated. The crests for the lateral depressor muscles are long as in BROCH's figure 18, plate III, not short as in his figure 14, plate II. Fine hairs are present on the growth ridges near the carinal margin.

With regard to the internal anatomy several points can be clarified. BROCH (fig. IX) gives figures of the labrum, mandible and maxilla which show the general form of these appendages. The labral teeth are not necessarily blunt as figure 11 A shows. It is possible they were worn in the original specimen figured. The form of the labral margin is less protuberant than shown by BROCH.

The mandible has a slightly bifid third tooth, the fourth being more markedly so (fig. 11 B). The lower angle is bluntly toothed as figured, and variable in the complexity of tooth cusps. The lower margin is armed with strong setae. BROCH states (p. 28) that the mandible agrees substantially with that of *Balanus hesperius* PILSBRY, but PILSBRY's figure (1916, fig. 61 D) shows the lower margin of the latter as armed with short hairs, not spines. This is an important point as PILSBRY uses the presence of spines in this position to distinguish his subgenus *Solidobalanus* with spines from *Hesperibalanus* with *hairs* and BROCH assigns his *Balanus fallax* to the latter subgenus.

The maxilla is as described by BROCH (fig. IX*c*). The second maxilla was not mentioned by BROCH. Paired second maxillae of the paratype together with the lower lip are shown in figure 11 C. They are tapering and narrow at the distal extremity. The lower lobe is semicircular and well-developed.

The rami of cirrus III may be slightly unequal by the length of one or two terminal segments. According to BROCH there are no teeth or spines on cirri III and IV, but they are present on a few segments in the specimen examined. On cirrus III recurved teeth or spinules occur on segments 4-6 of the anterior ramus and 1-5 of the posterior (fig. 11 D). The curved teeth are on the anterior margin, the spines on the distal ends of the segments towards the anterior border. On cirrus IV spines only occur, on segments 3-12 of the anterior ramus (fig. 11 E) and 5-13 of the posterior ramus.

FIG. 11. — *Balanus fallax* BROCH.

Appendages of a paratype. A, labrum (×132); B, lower angle of mandible (×545); C, second maxillae and the lower lip (×253); D, cirrus III, posterior ramus, segment 3 (×270); E, cirrus IV, anterior ramus, segment 7 (×290); F, base of penis and dorsal process (×130).

The long spines on the posterior border of segments of cirri IV and V may be considerably longer than the segments (fig. 11 E). Four pairs of setae are present on the segments of the posterior cirri. The segmentation of the cirri is as follows :

	I	II	III	IV	V	VI
Fide Broch (1927 *b*)	15/6	7/8	8/8	?	?	22/22
Paratype.	12/6	8/7	10/7	14/15	17/19	16/17

These figures are in substantial agreement with those given for *Balanus occidentalis* (Stubbings, 1961*a*, p. 37).

The penis is sparsely hairy and, contrary to Broch's statement, a dorsal point is present at its base (fig. 11 F). This process bears a single fine seta.

The new material described here increases our knowledge of the species substantially. The form of the shell is as described above and by Broch but specimens growing on the shells of others may exhibit a twist in growth with the result that the compartments are curved or hooked. Such a specimen is shown in figure 10 E, with carino-lateral, lateral and rostral compartments curving apically towards the carina. In consequence the carina is slightly concave exteriorly and the rostrum strongly convex. The specimen illustrated had partially striped parietes except for the rostrum which was wholly white. The radii showed horizontal hyaline markings, with partially developed pink lines on lateral and carino-lateral compartments. The intact margins of the alae in this particular specimen showed that when entire the free upper edge of the ala is weakly crenulated.

The degree of development of growth ridges and longitudinal striations in the scutum is variable : some specimens show lightly marked striations whereas in others they are scarcely visible. The adductor ridge of the scutum is absent or only faintly marked, but there is a very shallow depression or scar marking the adductor pit. The pit for the lateral depressor muscle of the scutum may be of moderate size, rather larger than implied by the « small » of Broch's original description. The width of the tergum varies somewhat.

The present material makes it evident that *Balanus fallax* exists commonly in a white form with which the coloured form may be intermingled, and that intermediate partially coloured forms also occur. As there are no firm morphological differences between the two colour forms it is clear that only the one species is involved. Furthermore, re-examination of the type material with the consequent amendment of the description of *B. fallax* indicates that the differences originally claimed between this species and *B. occidentalis* Stubbings, 1961, cannot be maintained. The extent to which these supposed differences are now reduced is typified by the illustrations of opercular valves now available. There are material differences between the scutum and tergum of *B. fallax* in Broch (1927*b*, pl. II, figs. 13-16; pl. III, figs. 18, 19) and those of *B. occidentalis* in Stubbings (1961*a*, p. 36, fig. 9). But in figure 10 of this report these valves of a paratype *B. fallax* are much more like those figured as *B. occidentalis*. It is the original illustrations and description which are

at variance with the rest of the material. This suggests that the specimen from which the type description and illustrations were taken may have been somewhat aberrant. *B. occidentalis* STUBBINGS, 1961, must therefore become a junior synonym of *B. fallax* BROCH, 1927.

BROCH placed this species in the subgenus *Hesperibalanus* PILSBRY without discussion except to state that it is closest to *Balanus hesperius* PILSBRY, 1916, from the Pacific. The stronger setae on the lower edge of the mandible and the spinules on cirri III and IV conform with the diagnosis of *Solidobalanus* PILSBRY. But the setae on the mandible of *Balanus hesperius* from an examination of Californian material, are rather more developed than shown in PILSBRY's figure (1916, p. 195, fig. 61), so this difference is unimportant. In the bluntness of the lower mandibular teeth and the feeble striation of the scuta *B. fallax* agrees with PILSBRY's diagnosis of *Hesperibalanus*. BROCH's assignment of *Balanus fallax* to this subgenus is therefore followed here.

Subgenus CONOPEA SAY, 1822.

Balanus calceolus DARWIN, 1854.

Balanus calceolus DARWIN, 1854, p. 218, pl. 3, figs. 3, *a-e.*
Balanus calceolus NILSSON-CANTELL, 1928, p. 34.
Balanus calceolus NILSSON-CANTELL, 1938, p. 180.

Material :

St. **31** : 7°16′ S.-12°47′ E. off Ambrizette, Angola, 35 m, 3 live and 2 dead, small specimens on a white Gorgonian.

St. **378** (Mission « DE BROUWER », 1955) : 6°15′ S.-12°00′ E. off Moita Seca, Angola, 64 m, 2 small specimens.

These small specimens are deficient in colour. One live specimen only from St. **31** was pigmented at the carinal end and had also a horizontal line of dark chocolate brown spots across the base of the carina and carino-lateral plates. The St. **378** specimens were 6 mm and 3,5 mm in carino-rostral diameter. The smaller was colourless and the larger was tinged a pale brownish-pink over the carina, carinal latera and adjacent part of the lateral compartments, and a brighter pink over the area of basis next to the carina.

In one wholly white specimen from St. **31** the spur of the tergum was rounded distally and without the tiny denticles often present.

These records extend the distribution of *Balanus calceolus* in W. Africa south of the estuary of the R. Congo.

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