MEDDELANDEN
FRÅN
GÖTEBORGS MUSEI ZOOLOGISKA AVDELNING. 23

CONTRIBUTION TO THE MARINE MOLLUSCAN FAUNAS OF SOUTH AND WEST AFRICA

BY

NILS HJ. ODHNER
(STOCKHOLM)

WITH 1 PLATE

GÖTEBORG 1923
ELANDERS BOKTRYCKERI AKTIEBOLAG

Göteborgs Kungl. Vetenskaps- och Vitterhets-Samhälles Handlingar
Fjärde följden. XXVI: 7.

Inlämnat den 6 mars 1922.

IN this paper there are described some collections of Marine Mollusca brought together by Mr. H. SKOOG, conservator of the Museum of Gothenburg, during a visit to West and South Africa in 1912. The collections are of interest, since they form a valuable contribution to the fauna of these coasts of Africa, which, especially that of Angola, are far from thoroughly investigated. The Mollusc fauna of the South African coast is, certainly, rather well known, thanks to the works of private collectors, as well as to the investigations carried out during the last centuries chiefly in connection with fishing explorations. Nevertheless, Mr. SKOOG's South African collections contain many interesting species — new, or little known —, and they are well worthy of being published.

1. Mollusca from South Africa.

Amphineura.

Acanthochites garnoti BLAINVILLE, Dyer Island, Cape Col. (1/1 1913), 5 sps., max. l. 30 mm. Recorded by BARTSCH, 1915.

Lamellibranchia.

Leda belcheri HINDS, off Cape Infanta, 10 miles off the coast, 40 fms (26/4 1912), 1 right valve, about 13 mm in length (end broken); agrees with the fig. given by SOWERBY, 1904 (pl. VI, fig. 7).

Ostrea cochlear POLI, Cape Infanta, 15 miles off the coast, 45 fms (10/4 1912), 1 sp., l. 54 mm. Shape according with the Mediterranean form, colour bright white with a yellow spot on the inside of the lower valve. New to the district. A second specimen, labelled Cape (G. De Vylder 1872) is to be found in the collections of the Riksmuseum.

Astralium taylorianum SMITH, Walker Bay, 5 miles from land, 24 fms (28/4 1912), 1 sp., d. 65, h. 55 mm. The species is recorded by BARTSCH 1915.

Turritella punctulata SOWERBY, 3 sps., max. l. 40 mm, agreeing with the descriptions and figures given by v. MARTENS, 1903, were dredged at Cape Infanta, 3 miles from land, 34 fms (13/4 1912), one of them with a *Phascolion africanum* FISCHER. BARTSCH (1915) mentions a *T. puncticulata* SOW., which certainly is the same.

Cassis pyrum LAMARCK, Cape Infanta, 3 miles from land, 34 fms (13/4 1912), 1 sh., with a Pagurid, h. 60 mm. Also mentioned by BARTSCH (1915)).

Fusus ocelliferus BORY, off Cape Barraconta, 10 miles from land, 40 fms (27/4 1912), 1 sp., h. 125 mm; Cape Infanta, 3 miles from land, 34 fms (13/4 1912), 1 sp., h. 175 mm, and 10 miles from land, 40 fms, 2 sps., max. h. 140 mm, of a dark-brown colour; Sebastian Bay, 10 miles from land, 40 fms (25/4 1912), 1 sp., h. 140 mm. BARTSCH (1915) includes this species in his report.

Fasciolaria alfredensis BARTSCH, off Cape Infanta, 10 miles from land, 34—40 fms (13 and 26/4 1912), 2 sps., max. h. 145, +2 shs. with Pagurids.

Fasciolaria rutila WATSON, Sebastian Bay, 10 miles from land, 40 fms (25/4 1912), 1 empty and fragmentary shell, h. 150 mm. Previously, this species was known only from a specimen captured by the Challenger Exp. off the Cape of Good Hope, 150 fms (WATSON, Chall. Rep., p. 242, pl. XIII, fig. 6).

Cominella limbosa REEVE, Dyer Island, 17/1 1913, many sps., max. h. 50 mm.

Cominella delalandi KIENER, Dyer Island, 17/1 1913, 4 sps.

Bullia digitalis MEUSCHEN, Hydia Bay, Fransche Kraal, Cape Col., many sps., max. h. 38 mm (27/4 1913).

Nassa (*Alectrion*) *plicosa* DUNKER (= *N. speciosa* A. ADAMS), off Cape Barraconta, 10 miles from land, 40 fms (27/4 1912), 12 sps., max. h. 26 mm; Cape Infanta, 3 miles from land, 34 fms (13/4 1912), 2 sps., h. 26.5 mm; Sebastian Bay, about 10 miles from land, 40 fms (25/4 1912), 1 sh. with a Pagurid. TRYON (Man. of Conch. 3, 1881, p. 216) refers this species to the genus *Phos*, but the animal has the characteristics of *Nassa* with its bifold posterior projection of the foot, and BARTSCH (1915) includes it in *Alectrion*. MELVILL & STANDEN (1907) are also inclined to restore it to the genus *Nassa*.

Nassa trifasciata A. ADAMS, Cape Infanta, 3 miles from land, 34 fms (13/4 1912), 1 sp., h. 21 mm; off Cape Barraconta, 10 miles from land, 40 fms (27/4 1912), 1 sp., h. 21. SOWERBY figures this species (1904, Marine Investigations S. Afr.).

Clavatula (Perrona) taxus CHEMNITZ, Sebastian Bay, 10 miles from land, 40 fms (25/4 1912), 1 sh., h. 50 mm, with a Pagurid.

Clavatula bimarginata LAMARCK, off Cape Barraconta, 10 miles from land, 40 fms (27/4 1912), 2 sps., max. h. 25 mm.

Drillia stolida HINDS, off Cape Barraconta, 10 miles from land, 40 fms (27/4 1912), 1 sp., h. 50 mm. The specimen differs from REEVE's fig. (Conch. Icon. I, Pleurotoma, fig. 152) in being larger and having more oblique costae, as well as fine encircling striae — REEVE describes it as being smooth.

Cephalopoda.

Onychoteuthis banksii LEACH, off Table Bay, 1 sp., l. 200 mm' washed in on board (26/3 1912).

Sepia simoniana THIELE, off Cape Barraconta, 10 miles from land, 40 fms (27/4 1912), 1 sp., l. 240 mm (animal incl. tentacles). The present specimen agrees with THIELE's type in its very small and numerous tentacular suckers, which are set in about 20 rows. It differs in the surface of the body, which is entirely smooth (not papillate), and in the shape of the shell which is rather similar to that of *S. papillata* QUOY & GAIMARD represented by E. A. SMITH 1916 (pl. II, fig. 1). The colour is dark violet on the back and on the upper side of the head, with small, ill-defined, light spots round the eyes; the under side yellowish with a dense sprinkling of minute reddish points, those on the under side of the head, especially on the base of the tentacles, a little larger and more sparse. The German South Polar Expedition 1901—03 caught 5 specimens in Simon's Bay (THIELE 1921).

2. Mollusca from Angola.

Our knowledge of the Marine Mollusc fauna of Angola is chiefly due to the works of v. MARTENS, 1903, NOBRE 1909 and DAUTZENBERG 1912. Mr. SKOOG has found some remarkable novelties and, probably, still more contributions of interest are to be expected from that part. The mollusca collected by Mr. SKOOG are chiefly brought together at Porto Alexander, S. of Mossamedes, and at Cape Negro, somewhat N. of the first-named locality, and contain the following species:

L a m e l l i b r a n c h i a.

Leda bicuspidata GOULD, Porto Alexander, the harbour, 16 fms (21/7 1912), 6 shs., max. l. 15 mm.

Arca senilis LINNÉ, Porto Alexander, Oct. 1912, 2 shs., l. 95 mm.

Mytilus perna LINNÉ, Cape Negro, 17/11 1912, 1 sh., l. 17 mm.

Ostrea cucullata BORN, Porto Alexander, a congregation of 7 shells having the appearance of fig. 34 *a* in REEVE (Conch. Icon. 18).

Lucina (*Cavilucina*) *semilirata* n. sp. Pl. 1, figs. 3—5. — Shell angularly rounded, slightly inflated, frontal part somewhat prolonged, inferior margin sharply rounded in the middle, but gently at the sides, posterior margin almost straight, upper-posterior margin gently curved. Umbones rather acutely prominent. Lunula distinct, ovate, divided by a faint radiating ridge into a median and a surrounding portion. Area lanceolate, margined by a fine furrow. Sculpture: fine concentric riblets in the upper half of the shell, lower half smooth, with obscure lines of growth only (three of them distant and more prominent). A posterior depression of the valve separated by an obsolete angular ridge from the anterior part, and sculptured throughout by short erect rib-like lines of growth which, however, do not reach the escutcheon furrow. Colour grayish-white with a microscopic radiating striation of white lines visible in the median part of the shell. Hinge-plate small, with an obsolete convexity in the right valve, representing a rudimentary cardinal. Ligament short, semi-internal. Dimensions: L. 8; h. 7; crass. 3.7 mm. 1 empty shell from Porto Alexander, 40 fms (11/8 1912).

I place this species in the section *Cavilucina* (FISCHER) COSSMANN 1887, characterized by the small sunk lunula and the toothless hinge. The typical species which COSSMANN refers to this section have, however, a deeper lunula, and the present species thus differs from them, and approaches both in this respect, and in shape, *L. incomposita* v. KOENEN (1893). This is, however, concentrically striated throughout, most sharply towards its under margin. — The section *Cavilucina* is included by DALL (1901) under the genus *Phacoides*.

Tellina madagascariensis GMELIN, Cape Negro, 4 shs., max. l. 82 mm. DAUTZENBERG (1912) records this species from S. Paulo de Loanda, and is in doubt whether the habitat of Madagascar which is assigned to this species is correct. I have compared it to small specimens named by me *T. madagascariensis* (ODHNER 1919, coll. KAUDERN) and found a close resemblance, but the latter, I am convinced now, certainly belong to another, more lengthened species, and DAUTZENBERG's doubt seems to be justified.

Cardium costatum LINNÉ, Cape Negro, 17/11 1912, many shs., max. l. about 130 mm.

Artemis torrida REEVE, Porto Alexander, 15/9 1912, 5 sps., max. d. 40 mm. Previously known from River Gaboon, W. Africa (REEVE, Conch. Icon. 6).

Gastropoda.

1. Opisthobranchia.

Ringuicula conformis MONTEROSATO, Porto Alexander, 16 fms, 21/7 1912, 1 sp., h. 4.1 mm. DAUTZENBERG (1910) records the species from Mauretania.

Glaucus atlanticus FORSTÈR, Porto Alexander, 3/7 1912, 6 sps., max. l. 30 mm.

2. Prosobranchia.

Turbo cidaris GMELIN, Porto Alexander, Oct. 1912, 1 sp., d. 36 mm.

Astralium (Bolma) johnsoni n. sp. Pl. 1, figs. 15—17. — Shell trochiform, with convex whorls, slightly contracted below the sutures, not umbilicated, of a light-reddish (rosy) colour, with a nacreous gleam; the apical whorls flattened, the following ones with a suprasutural keel, carrying short vaulted spines, which are striated longitudinally, and turn their excavated sides towards aperture; at the upper part of the whorls, above the spines, 5 squamose spiral keels running obliquely, and ending each behind a spine; the upper spiral with a row of tubercles. Beneath the spines two encircling, somewhat wavy, rounded ridges with a smaller one between them. Base sculptured with 5 sparsely nodulous distant lirae. Aperture very oblique, rounded; umbilicus covered with a large reddish-brown callus spreading over part of the base; columellar margin, a stripe on the parietal wall, as well as the interior of the aperture white and margaritaceous, except the inferior parts of the parietal wall which again acquires the red-brown colour of the umbilical callus. Whorls 7. Operculum ovate, pad-shaped, somewhat swollen on its interior side, with a minute granulose subcentral area: its colour is reddish-brown (darkest at the subcentral area), with white margins, and some white flames across it.

The median teeth of the radula are of the same shape as represented in TRYON's fig. 13, pl. 61 (Man. of Conch. 10, 1888) of *Bolma rugosum*, thus without cusps, and with a prolonged basal plate.

This new species seems to be most akin to *Bolma rugosum* from the Mediterranean and S. Thomé (TOMLIN & SHACKLEFORD 1915); it differs in sculpture, however, inasmuch as the spines of the lower whorls are fewer and longer than in the Mediterranean form, the operculum, too, is different in showing no spiral swelling, this being evidently obliterated by a deposition of a thicker calcareous layer. Seen from the inside, the operculum has a quite similar shape in both species. — Locality: Porto Alexander, 60 fms (11/8 1912), 3 sps.

I have named this beautiful species in honour of Mr. C. O. JOHNSON, director of whale stations in S. Africa and S. Georgia, to whom Mr. SKOOG is indebted for kind and valuable assistance.

Natica fulminea GMELIN, Porto Alexander, Oct. 1912, 1 sp. d. 36 mm.

Natica sagraiana d'ORBIGNY, Porto Alexander, the harbour, 16 fms, 2 sps., h. 10 mm (3 and 21/7 1912).

Natica fanel ADANSON, Porto Alexander, 40 fms (11/8 1912), 1 sh., h. 8 mm.

Sigaretus concavus LAMARCK, Porto Alexander, the shore (15/9 1912), 2 sps., max. l. 43 mm (shell, 115 mm animal). DAUTZENBERG (1910) draws attention to the fact established by WEINKAUFF (1883), that the Peruvian species confused with *S. concavus* is different, and is *S. cymba* MENKE.

Crepidula hepatica DESHAYES, Porto Alexander, the harbour, 16 fms, 1 sp., l. 5 mm (21/7 1912). Known previously from Loanda, Bahia dos Tigres, and S. Africa (v. MARTENS 1903).

Turritella annulata KIENER, Porto Alexander, the harbour, 16 fms (21/7 1912), many sps., max. h. 25 mm. — Gambia; Bahia dos Tigres (v. MARTENS).

Siliquaria senegalensis RECLUZ, Porto Alexander, 60 fms (11/8 1912), 1 sh., about 35 mm, with a Pagurid. Recorded from S. Thomé, Guinea, Cape Verde (TOMLIN & SHACKLEFORD 1914).

Xenophora senegalensis FISCHER, Porto Alexander, 60 fms, 1 sp., + many shs. with Pagurids, max. diam. about 30 mm. Cape Verde Islands — Bahia dos Tigres (v. MARTENS 1903).

Aporrhais senegalensis GRAY, Porto Alexander, the harbour, 16 fms (21/7 1912), 4 sps., max. l. 24 mm. The species is figured by DAUTZENBERG 1891 (pl. 3, fig. 5). Previously known from Senegal only.

Cypraea porcellus BROCCHI (= *C. pyrum* GMELIN), var. *angolensis* n. var., Porto Alexander, 60 fms (11/8 1912), 1 sp. SACCO (1894) reports the species under this name from the Tertiary deposits of Italy; it still is to be found in the Mediterranean, and in the Canaries (WEINKAUFF 1868). The present specimen differs, however, from the type in being relatively shorter and broader (l. 34.5, br. 22.3, height 18 mm), and in having its canal a trifle wider. The dentations at both sides of the aperture are of the same number as in the type, thus about 22 on the outer lip, but they are sharper marked, and farther extended towards the sides. The colour is like that of the type, the under side only a little deeper brown, but there is added a zone of blueish-white on the sides above the brown margins. Further, the columellar margin is gently sloping into the aperture and there is no columellar callus bearing the teeth as in the type. The lower part of the columella shows, as in the type, a slight excavation bearing 5 plicae. The named differences seem so inconsiderable, that I am of the opinion that this form should be referred to the Mediterranean species, at the most as a distinct variety, with reference to its prolonged teeth analogous with *C. orbignyana* var. *colligens* SACCO from the Italian Tertiary (cf. SACCO 1894).

Cypraea utriculata LAMARCK (= *C. physis* BROCCHI), Porto Alexander, 40 and 60 fms (11/8 1912), 1 sp., and 2 empty shells with Pagurids, the first-named measuring l. 32.5, br. 20.7, height 17 mm. This specimen agrees in colour and shape with the figures of *C. physis* in REEVE ((Conch. Icon. 3, fig. 47) and SOWERBY (Thes. Conch. 4, pl. 315, fig. 201); also SACCO (1894, pl. 2, fig. 28) gives a figure agreeing in all respects, even to the number of denticulations, which are 28 in the present specimen at the outer lip. Like the preceding species, this is found fossil in deposits of Miocene, and of later age in the Mediterranean districts, but was not known living out of the Mediterranean Sea.

Janthina globosa SWAINSON, Porto Alexander (3/7 1912), 3 sps., max. h. 40 mm.

Dolium galea LINNÉ, Porto Alexander, 2 sps., max. h. 105 mm. This species, which is not known in a fossil state, is distributed in the Mediterranean, and on the Atlantic coast of Africa as far as S. Thomé (TOMLIN & SHACKLEFORD 1914), as well as in the West Indies.

Triton nodiferus LAMARCK, Cape Negro ?, 1 sh., h. 155 mm.

Cymatium costatum BORN (= *Triton olearium* LINNÉ), Porto Alexander, 60 fms (11/8 1912), 1 sh., h. 30 mm.

Ranella marginata GMELIN, Porto Alexander, 16—60 fms (4/11, 11/8, 17/10 1912), many sps. and empty shs., max. h. 32 mm. Known fossil in Miocene and Pliocene deposits in the Mediterranean districts, but living nowadays only on the West coast of Africa (Rio de Oro, Senegal; Angola—Praya Amelia; DAUTZENBERG 1910, 1912).

Ranella pustulosa REEVE, Porto Alexander, 60 fms, 1 small empty shell, h. 22 mm, somewhat worn. This species has been recorded from the estuary of the river Congo, from Isle of Prince, St. Helena and Ascension as well as Senegal (v. MARTENS 1903).

Fusus appressus v. MARTENS, Porto Alexander, 7—8 fms, sand (9/10 1912), 1 sp., h. 97 mm, differing from the type (from Bahia dos Tigres, Valdivia Exp., 1903, pl. 2, fig. 9) in having its lip lirate on the inside.

Fusus albinus A. ADAMS (= *F. loebbeckei* KOBELT), Porto Alexander, 40 fms (11/8 1912), 1 sp., h. 49 (aperture with canal 29) br. 18 mm; whorls 8. This species has been reported from Mossamedes and Praya Amelia (DAUTZENBERG 1912).

Fusus zebrinus n. sp. Pl. 1, fig. 20. — Shell turreted covered with a thin caducous cuticula, with convex whorls and a moderately deep, simple suture. Sculpture: faint but thick axial ribs, beginning in the 2nd whorl, 14 in the 3rd, and decreasing in the 6th, to become rather obsolete towards the margin, crossed by revolving threads (7 principal ones in the penultimate whorl, and finer ones of alternating strength in the interstices); fine lines of growth make the surface minutely clathrated. Spiral sculpture extending on the canal; this rather long, slightly curved; aperture spoon-shaped, outer lip simple, with a lot of obscure lirae at some distance within the edge; columella smooth, with a thin callous covering; no parietal callus. Colour: upper whorls light-brownish, lower whorls variegated with light-yellowish and longitudinal stripes of reddish-brown, appearing on the costal elevations, and extending down the canal. Dimensions: H. 30, aperture h. 16.5, br. 12 mm. Locality: Porto Alexander, 40 fms (11/8 1912), 1 sp. and 1 sh. (h. 37 mm) with a Pagurid.

Ocinebra angolensis n. sp. Pl. 1, figs. 8—10. — Shell turreted, mouth as high as spire, whorls convex, base openly umbilicated at the canal. Sculpture: strong longitudinal ribs (9 on the penultimate whorl) appearing on the 3rd whorl (the apical ones smooth), becoming irregular towards the aperture; between the ribs fine striae; in the upper whorls 2 principal revolving keels, the upper one in the middle of the whorl; between, above, and below there are a few finer threads, the uppermost forming a subsutural series of small tubercles by crossing the longitudinal costae; body whorl with about 9 principal lirae with smaller ones between them. The growth striae cause an imbricated squamose sculpture on the smaller spiral lists chiefly in the interstices between the costae. Columella with an indistinct fold in front, smooth above, with or without an indistinct callus on the parietal wall. Outer wall with 6 crenelations within. Canal deep, half-closed. Colour pale cream, the spiral lists dark-brownish and white-dotted on the costae. Whorls about 7. Max. dimensions: h. 18, h. of aperture 10, br. 8.6 mm (proportions, however, somewhat varying).

Operculum dark-brown, with sublateral nucleus and slightly marked growth lines, its median part, on the inside, strengthened by means of some thin incumbent plates concentrically arranged as in *O. erinaceus*.

Locality: Porto Alexander, 40 fms (8/11 1912), about 20 sps.

This species is rather like *Murex cristatus* BROCCHI, which has been reported from S. Thomé by NOBRE (1909), and is also similar to *M. edwardsi* MENKE, but its sculpture separates it from both.

Pseudoliva plumbea CHEMNITZ, Porto Alexander, shallow water, sand (7-11/10 1912), 7 sps., max. h. 44 mm. DAUTZENBERG (1912) mentions this species from Angola, and gives a figure of it.

Pseudoliva zebrina ADAMS, Porto Alexander, 16 fms (21/2 1912), 1 sp., h. 23 mm; 40—60 fms (11/8 1912), 5 sps., and some empty shells with Pagurids, max. h. 26 mm (sh.). This species is also recorded from Mossamedes by DAUTZENBERG (1912).

Murex (*Phyllonotus*) *dearmatus* n. sp. Pl. 1, fig. 21. — Shell with a moderate, acute, spire, of about half the length of the shell. Varices 3, rounded (not foliate), and interstices between them with

2 tubercular costae. Spiral sculpture consisting of revolving cords of alternating strength, the largest (on the shoulder) forming short spines on the varices of the upper whorls; spiral cords on the varices broken by the lines of growth into minute, vaulted scales. Whorls 7, the 2 apical ones smooth. Aperture ovate, with somewhat raised simple margins all round, outer lip slightly furrowed on its inside. Canal equalling aperture in length, closed entirely, end abruptly truncate; a short spine on its left side marking the older canal. Colour light-brownish with a dark-brown band below the suture, and some stripes of the same colour on the spiral cords at the varices. L. 23, aperture height (+ canal) 14, br. 11 mm. Locality: Porto Alexander, 40 fms (11/8 1912), 1 sh. (animal and operculum absent).

This species seems to be much alike to a small *M. senegalensis*, but differs in being almost entirely deprived of spines, in being narrower, and in having an entirely closed canal.

Nassa plicatella A. ADAMS, Porto Alexander, the harbour, 16 fms (3 and 22/7 1912), many sps., max. h. 25 mm.

Nassa ambigua MONTAGU, Porto Alexander, 40 fms (11/8 1912), 1 sh., h. 7 mm.

Nassa turbinea GOULD, Porto Alexander, 40—60 fms, a few sps., max. h. 25 mm, and some shs. with Pagurids (11/8 1912). The shape agrees with the figure in TRYON (Man. of Conch. 4, 1882, fig. 329, pl. 17) which was described from Liberia (cf. BARTSCH 1915), but which seems to have not been found again.

Nassa angolensis n. sp. Pl. 1, figs. 6, 7. — Shell similar to *N. plicatella* but smaller; aperture with the canal indistinctly marked off from the outer lip; no denticle on its inside; columellar callus spread far on the body whorl, and wholly smooth (no palatal tooth as in *N. plicatella*). Sculpture: more or less extensive longitudinal costae on the last whorl and the upper ones (which to a great extent may be smooth), crossed by rather distant furrows the uppermost of which, beneath the suture, is most constant even in the upper whorls. Cuticula microscopically striated longitudinally. Outer lip crenated within (all crenelations of a uniform size). Colour grayish-red, appearing generally in the interstices of the costae as two zones of reddish-brown on the upper part of the last whorl (and in the preceding ones); columella with a reddish-brown spot, inside of aperture reddish-white. Dimensions: h. 14.2, h. of aperture 7.6, br. 7.6 mm. Locality: Porto Alexander, the harbour, 16 fms (21/7 1912), numerous sps.

Adinopsis n. gen.

Shell turreted, spirally grooved, with simple, not margined, sutures; apex obtuse, aperture with short canal, columella simple, with a single fold at the lower end, outer lip crenate within: canal bounded by a small callus.

Animal nassoid, with two posterior processes of the foot; eyes present; radula (pl. 1, fig. 14) with curved pectinate median tooth and 2-cusped uncini. Operculum (pl. 1, fig. 13) spiral, ovate, with apical nucleus and entire margin.

Adinopsis skoogi n. sp. Pl. 1, figs. 11—14. — Whorls slightly convex, with shallow sutures, the two apical whorls smooth, inflated, the following ones coarsely lirate (lirae about 12 on the penultimate whorl, and as broad as the interstices); beside them, fine lines of growth. Colour brown, with two lighter (yellowish-white) bands on the body-whorl, one above, one below its middle, the upper band appearing in the upper whorls as a median zone. Aperture brown with a whitish enamel layer, and the white bands shining through. Dimensions: H. 25.2, aperture h. 10.5, br. 10.2; an other sp.: h. 25, ap. h. 11.8, br. 11 mm; these figures, thus, show some formal variation. Locality: Porto Alexander, 16 fms (3 and 21/7 1912), numerous sps.

The crenelation of the outer lip of this new form is a character common to the subgenus *Adinus* of *Bullia*, but the columella is simple, and the sutures are not margined as in *Bullia*; further, they are spirally grooved throughout, and the apex is blunt, not acute, all differences which justify the creation of a genus all its own, for the present species, which I have named after its collector. The systematical position of this genus is in the family Nassidae, and the shape of operculum and radula shows the closest relationship to *Nassa*.

Marginella nodata HINDS, Porto Alexander, 40 fms (11/8 1912) 1 empty sh., h. 21 mm.

Marginella gruveli BAVAY, Porto Alexander, 16 fms (21/7 1912), many sps., max. h. 5.2 mm. This species, which differs from the Mediterranean *M. miliaris* in having a distinct, callous, somewhat flattened, pad on the body-whorl at the upper end of the aperture, beneath which the ventral side is somewhat excavated, was described by BAVAY (in DAUTZENBERG 1912) from many localities of the African coast between Conakry and Mossamedes.

Marginella angolensis n. sp. Pl. 1, figs. 18, 19. — Shell elongate ovoid, almost cylindric, broadest in its upper third, gently tapering toward the apex as well as to its canal end. Outer lip depressed upon the spire, aperture narrow, not much dilated below. Columella with 4 strong plications, well separated throughout; its end encircled by a thin but distinctly defined callus embracing the plicae. Colour yellowish-gray, with two indistinct bands below the middle of the body-whorl. Height 12, aperture h. 11, br. 5 mm. Locality: Porto Alexander, 40 fms (11/8 1912), 2 shs. (the one a trifle broader than the measured one).

This species is very similar to *M. ambigua* BAVAY (in DAUTZENBERG 1912), but the former is larger, and has its lower end of aperture more dilated.

Olivancillaria nana LAMARCK (= *zenopira* DUCLOS), Porto Alexander? some specimens, max. h. 19 mm. Reported, by DAUTZENBERG (1912), from Mossamedes.

Genotia mitraeformis WOOD, Porto Alexander, 60 fms (11/8 1912), 1 sh., h. 53 mm. DAUTZENBERG (1912) records this species from the north coast of the Gulf of Guinea.

Clavatula spirata LAMARCK, Porto Alexander, the harbour, 16 fms (12/7 1912), many sps., max. h. 33 (spire 16) mm; 40—60 fms, a few sps., max. h. 35 mm. In this lot of specimens a vivid variation of sculpture and colour is prevalent. The sharp subsutural keel may be replaced by a broad elevation, or absent. Sometimes one or two angular keels are present to which may be added a weak basal one, or the whole base is encircled by fine threads of alternating strength. The colour is variously streaked, and combined with more or less confluent dots on the subsutural ridge or band, and in the periphery; often, the colour is uniformly olive-brown. The latter variety is without doubt the shell which v. MARTENS (1903) described as *C. subspirata*.

Clavatula filograna n. sp. Pl. 1, fig. 24. — Shell turriform, with convex whorls, and a short and broad canal; aperture narrowly pear-shaped, with a deep sinus above. Sculpture consisting of numeros fine and dense longitudinal costae, some of them bifurcating on the body-whorl, and spiral lirae crossing the costae, and producing small tubercles in the crossing points. Subsutural band with a series of comma-like knobs. Canal encircled by about 5 coarse granular, and beside them some few, narrower, ridges. About 8 principal spiral lirae on the body-whorl. Colour dark-brown (due to the thick cuticula covering the shell). Dimensions (apex broken): h. 47.5, aperture h. 20, br. 17.5 mm; whorls about 12 +. Locality: Porto Alexander, 40 fms (11/8 1912), 1 empty shell.

This species comes very near to the fossil *C. interrupta* Brocchi, from the Miocene and Pliocene deposits of Europe, (cf. Bellardi 1877, pl. 5, fig. 33), but in the present form the suture reaches the median keel of the whorls, so that the sutural coronation coincides with this keel; in the fossil form this is not the case, and thus each whorl is encircled by two revolving ridges.

Drillia angolensis n. sp. Pl. 1, figs. 22, 23. — Shell turriform, with convex whorls, slightly channelled below the suture; aperture about a third of the shell height; canal very short; columellar margin reflected, thick, forming an umbilical rime near the end and a projecting callus at the upper sinus, which is very deep; outer lip simple. Sculpture: 2 apical whorls smooth, the subsequent with thick, oblique longitudinal costae (their number 10 on the penultimate whorl) and revolving cords alternating with thinner threads in the lower whorls; subsutural band with some spiral threads only, and flexuous lines of growth. Colour uniformly grayish, or brownish-white, sometimes with 1—3 obscure revolving bands, often with upper part of body-whorl grayish, lower one white; interior of aperture white. Max. dimensions: h. 41.5, aperture h. 18, br. 14 mm; whorls 11. Locality: Porto Alexander, 40 fms (11/8 1912), many sps.; 16 fms (21/7) 4 sps., max. h. 27 mm (overgrown with a *Suberites*).

There is a close resemblance between this species and *D. clionellaeformis* Weinkauff, but the latter has a strong subsutural cord, and sharply defined and prominent costae.

3. The Relations of the West African Marine Molluscan Fauna.

In order to get an idea of the composition and the relations of the West African Marine Mollusc fauna, I have made a list of all the species that are mentioned in the most comprehensive works on the subject, viz.:

E. A. SMITH, 1871; G. DUNKER, 1853; v. MARTENS 1903; PH. DAUTZENBERG, 1910 and 1912; A. NOBRE, 1909; J. R. le B. TOMLIN & L. J. SHACKLEFORD, 1914—15.

These works (cf. List of Literature) treat with the fauna of different parts of the West African Coast, roughly between Cape Verde in the north and Mossamedes in the south, a region that coincides rather accurately with the West African faunistical Province, as far as its limits can be judged at present.

Of course, this literature is far from exhaustive; a great many species have not been mentioned by the above named authors, but are recorded in other works, e. g. TRYON's Manual of Conchology or REEVE's Conchologia Iconica; many, also, have been established in recent papers. To consider all publications on this subject would be impossible without a comprehensive critical investigation, too thorough for the present purpose, though very much to be desired, and for these reasons, I have based the following survey which may be of interest as an attempt of tracing the elements and the relations of the fauna as a whole, on a few works only which seem suitable for giving a general picture of the fauna, even if this may be incomplete in less essential features.

In the works mentioned there are included about 850 species of marine litoral mollusca — and only the litoral fauna is considered here — which, with respect to their geographical distribution in general, may be divided up into diverse categories, as follows:

1) Species at present exclusively occurring in the African region (endemic species), about 540, or 63.5 %;

2) Species common to the Mediterranean Sea (Mediterranean species), about 175, or 20.6 %;

3) Species common to the West Indies (West Indian species), about 62, or 7.4 %;

4) Species common to South Africa (S. African species), about 35, or 4.1 %;

7) East Indian species, about 15, or 1.7 %;

6) Widely distributed species, about 18, or 2.1 %.

Beside these, three species (*Nassa plicatella* A. ADAMS, *Tellina deltoidalis* LAMARCK, and *Tellina umbonella* LAM.) are said to occur not only on the West African coast, but also in Australia; the statements are certainly erroneous (cf. HEDLEY 1918), and the species endemic.

In the following pages we will devote some discussion to each of these categories.

Among the *endemic* forms the first place, if the quantity of species is to be considered, must be given to the genus *Marginella*, of which the authors mentioned count 40 species in all. The faunistical importance of this genus is expressed in an illustrative manner by TOMLIN, who says (Systematic list of the Marginellidae, Proc. Malac. Soc. 1917, p. 246): »Certain regions are noteworthy as producing an unusual number of species, namely, the West African coast, the Caribbean region, Australia, and the Cape district. Curiously enough, the first three of these, as at present known, have each about seventy four or seventy five species... . On the West African coast the Marginellids form quite an appreciable fraction of the molluscan fauna; the Gruvel Expedition in 1909—10 dredged thirty-four out of a total of 519 species, or $6\,^1/_2$ per cent. The northern and southern limits of the west coast fauna are rather sharply defined, the former being somewhere about the Tropic of Cancer, the latter in the neighbourhood of Mossamedes. A small parcel recently received from Walfish Bay consists entirely of a species either identical with or at most a variety of *M. capensis*, KRAUSS. The 300 miles of coast from Mossamedes to Capetown seems singularly little known, but its fauna will, I think, prove to belong to the Cape.»

These statements show that the genus *Marginella* is a good exponent of the West African mollusc fauna, its character and its geographical extension. The abundance of such a genus as *Marginella* on this coast is not unexpected, since, as TOMLIN states, »the Marginellidae are almost exclusively natives of warm or tropical seas, living as a rule on sand in a few fathoms of water».

For comparison, it deserves to be mentioned that the Marginellidae are, according to TOMLIN, represented by 43 species at the Cape, but only by 4 or 5 on the East African coast, by 56 in the East Indian region, 17 in the Pacific, 75 in Australia, 10 in New Zealand; the coast California-Peru possesses 13—14, Magellan-Falkland 6, S. America south of the Amazon river about 12, the Mediterranean Sea 9—10 species.

Among all the West African Marginellidae, there are but four species which are not strictly endemic but common to neighbouring regions. From the Mediterranean three species (*M. occulta, clandestina* and *philippii*) extend their range southward along the African coast, the latter two as far as S. THOMÉ (TOMLIN & SHACKLEFORD).

Two more, still (*M. exilis* GMELIN = *triticea* LAM.[1]), and *interruptolineata* MEGERLE are common to the Caribbean region. TRYON, in his Man. of Conch., mentions, beside these, also *M. marginata* BORN as occurring in the West Indies, in identifying it with *M. cincta* and *M. storeria,* but these are considered specifically distinct by TOMLIN.

In a fossil state, the genus *Marginella* appears in Tertiary deposits of Europe, America, Australia and Java (COSSMANN, 1899. Essais de Paléoconch. 3). In Sahara and S. Tunis the genus is, however, represented in a layer of the upper Cretaceous system (Maestrichtien) by *M. garamentica* PERVINQUIÈRE (cf. LEMOINE 1913 and OPPENHEIM 1915); if the dating of the deposits in question is correct, which is doubted by OPPENHEIM, this occurrence is the earliest known of the genus. The same deposits are continuous, according to LEMOINE, over a great part of the Sudan to Northern Nigeria, but no evidence has been given whether there existed a communication with the Atlantic, so that the genus, by this way, and at this time, could invade the West African coast.

None of the recent endemic West African Marginellidae are, however, known in fossil state, contrary to other endemic West African forms, e. g. *Ranella marginata,* which appears as early as in the Miocene of Autriche and France (cf. HAUG 1911). Other species fossil in Miocene and Pliocene deposits of S. Europe but living in Senegal are *Fossarus sulcosus* (cf. DAUTZENBERG 1910, 1912), *Oliva flammulata, Cypraea sanguinolenta, Cardium pectinatum* (cf. HOERNES 1856, 1870). The Miocene deposits of France also exhibit many African species, which causes DOLLFUS (1895) to state that »the fauna of these Miocene coasts was warm, and very similar to the existing fauna of Senegal and Guinea».

The fact that not only the named endemic species, but also a great many which are common to West Africa and the Mediterranean, are found in Tertiary deposits (cf. DOLLFUS 1911) makes it probable that many of the indigenous forms now limited to the West African Province have their ancestors, too, in the same deposits. This supposition proves to be true in the case of nearly all the marine genera which are peculiar to the Province, viz. the following:

Yetus ADANSON, earliest appearing possibly in the Eocene of

[1]) This identity is maintained by TOMLIN; DAUTZENBERG (1910, p. 40) has a different opinion.

Switzerland (COSSMANN 1899), or probably not before Pleistocene (DOLLFUS 1911);

Pseudoliva SWAINSON, first occurring in the upper Cretaceous of Hungary (COSSMANN 1901) and Africa (cf. below);

Protoma BAIRD, fossil in the Miocene of Italy (COSSMANN 1912), one recent species, *P. knockeri* BAIRD, from Whydah (TRYON 1886, Man. of Conch. 8);

Pusionella GRAY, fossil in the Miocene of Italy (COSSMANN 1896);

Tugonia GRAY, fossil in the Miocene of France, and Greece (TRYON 1884, Struct. and Syst. Conch.).

As to *Pusionella*, this genus is, according to STREBEL 1914, strictly endemic in the West African Province; *P. rapulum* REEVE, being at home in Java and Malacca (TRYON, Man. of Conch. 6, 1884), and *P. testabilis* JOUSSEAUME, (from Aden), belong to other genera. WEINKAUFF's statement (1868) of the occurrence of *P. nifat* in the Mediterranean has proved to be an error (STUDER, 1889, p. 20); in a fossil state the last-named is, however, found in the Quaternary of Italy (GIGNOUX 1913).

A discontinuous distribution probably explainable by means of the communication which existed between the Mediterranean and the Indian Ocean in an early Miocene time (cf. HAUG 1911, p. 1733) is shown by the genus *Tympanotonus* KLEIN, whose species live in estuaries with salt and fresh water, alternating as to the tides. Beside recent West African species the genus comprises a few ones from the East Indies—Japan and Australia—New Caledonia. It appears as a fossil as early as in the Turonien of Lebanon (COSSMANN 1906) and in the Paleocene of France, but its West African habitat is also of a great age, since it has been found in Paleocene deposits from Landana (VINCENT 1913).

The genus *Pseudoliva* shares this great age of its recent geographic centre: one species has been found in the upper Cretaceous beds (Maestrichtien) together with *Marginella* (LEMOINE 1913), one has been described from the Eocene of Cameroons (OPPENHEIM 1904), and a further species has been made known from Tertiary? deposits of Benguela (VINCENT 1913).

The endemic genera and species, consequently, in most cases, show a close relation to fossil forms from the Mediterranean, or the West African Region — only a few genera are still unknown as fossil, namely, the new *Adinopsis* as well as *Talona*, a Pholadid mussel. Some of the endemic genera show a very old occurrence in Africa, which could motive the supposition that their inhabitance there might be an original phenomenon, and their appearance in Europe perhaps a secondary one but this question is at present impossible to decide, on account of the unsufficient data presented until now about fossil deposits of West Africa, and their faunas.

In spite of this deficiency, it seems, however, justified to explain the relations between the recent West African fauna and the fossil Mediterranean one, not as a result of migration from the latter district to the former (cf. STUDER 1889), but as a reminiscence of a uniform older fauna, dating from the Miocene, and primarily distributed throughout both regions.

Nowadays, this ancient uniformity of the Atlantic and the Mediterranean fauna still expresses itself in the large mass of »Mediterranean» forms on the West African coast, where they have lived ever since the Miocene which is proved by the fossiliferous deposits of this age on the coast.

The »Mediterranean» forms, thus, are certainly not endemic in the Mediterranean district and have certainly not spread southwards along the African coast. A migration in recent times is, otherwise, disfavoured by the actual hydrographic conditions, since no litoral currents emerge from the Mediterranean, by which a transport of larvae along the coast can be effectuated; reversed conditions are prevailing (cf. KRÜMMEL 1911). At least, as far as the most adjacent part of the African coast is concerned, where the percentage of Mediterranean forms is the largest, a recent colonization by means of such a transport seems unlikely. Further towards the South, and especially south of Cape Verde, however, the states may perhaps admit of some transport, by means of the Guinea stream which washes the coast into the Gulf of Guinea, and still farther. But such a transport, by means of the Canaries and the Guinea currents, does not seem to happen. About half the number of »Mediterranean» species (80 species or 45 %) seems to have its boundary at Cape Verde, and to be unable of any advancement in the direction of the Guinea stream. This circumstance shows that other agencies than the actual currents may be responsible, too, for the presence of the Mediterranean elements on the coast, and this supposition is warranted by the fact that even in islands as isolated as St. Helena and Ascension, in spite of their situation far beyond the reach of the Guinea current, the Mediterranean species attain a great percentage (30 % and 20 % resp.) of the marine mollusca (cf. SMITH 1890, and below). Thus the presence of this category may be a reminiscence from an earlier epoch, a supposition supported by further evidences such as the following facts.

Most of these Mediterranean species which are spread southward along the African coast, are limited to the West African Province proper, and do not reach the South African Province, but a few have got their range extended even so far. Thus we find as ingredients in the Cape fauna the following species:

Mytilus pictus, *Arca lactea*, *Tapes pullastra* var. *corrugata*, *Macoma cumana*, *Ostrea cochlear* (cf. above), *Triphora perversa*, *Cerithiopsis tubercularis*, *Littorina punctata*, *Fissurella nubecula*, *Pseudomurex middendorffi*. [1])

More peculiar is, however, the fact that a few Mediterranean mollusca whose southern limit or entire habitat in West Africa is the tract of Cape Verde, appear again in S. Africa in spite of their absence from the intervening stretch of coast. The most striking of these are *Venus verrucosa* and *Cerithium vulgatum*; others are: *Gastrana guinaica*, *Lucina columbella*, *Kellya mactroides*, *Retusa truncatula* (cf. BARTSCH 1915), *Nassa incrassata*, *Dentalium dentalis*, *Lasaea rubra* (cf. SMITH 1903). [2]) This fact is of interest, and cannot be explained otherwise than that the species in question have had a continuous distribution in a remote geological period, but died out in the median part of their area. Both *Venus verrucosa* and *Cerithium vulgatum* are large and characteristic shells, and could not be overlooked. They are common in Miocene and Pleistocene deposits in Southern Europe.

An analogous distribution has been maintained for a lot of other European mollusca, even a few which do not occur at all on the West African coast, for instance *Nucula nucleus* and *Anomia patelliformis* (cf. BARTSCH 1915). Whether the identification is correct, may, perhaps, be doubted. SOWERBY has made a list of further species which have been partly quoted by COOKE (1895, Cambridge Natural History, Moll.), but v. MARTENS (1903) has expressed his doubts whether SOWERBY's shells have in reality a S. African origin.

Mediterranean and North Atlantic species of marine mollusca have been found even as far south as Tristan da Cunha and Gough

---

[1]) *Solen marginatus* PULTENEY, which is mentioned by SOWERBY (1892) from Port Elizabeth, has been shown by SMITH (1903) to be a different species.

[2]) *Loripes lacteus* is often quoted from SOWERBY as belonging to the S. African fauna but his form is a different species, *L. clausus* (cf. SOWERBY, 1897, »Appendix«).

Isl., viz. *Tellina pusilla*, *Anomia ephippium*, *Lima loscombi* (MELVILL & STANDEN 1907, SMITH 1885), and even in the Falkland Islands (MELVILL & STANDEN 1912).

On the other hand, we find that a few S. African forms may have propagated northward along the West African coast. It is, of course, the most southern part of the W. African Province bounded immediately by the S. African one, which has been invaded in the first line; thus, from Mossamedes there are for instance reported *Dorsanum callosum*, *Nassa poecilosticta*, *Patella natalensis*, *P. parbara*. The region of Mossamedes and Angola, in general, seems to be a district of intermingling where the two faunas meet; NOBRE (1909) reports from Benguela the S. African *Clavatula taxus* (this is perhaps rather W. African, like the remaining species of the genus), and from Angola *Arca obliquata*, an Indo-Pacific species which also occurs in the Cape Colony.

Angola seems to be a definite border for most of the S. African marine mollusca, but a few have penetrated still more northwards; thus, for instance, *Marginella rosea* is cited by NOBRE (1909) from the Cape Verde Islands and STEARNS (1893) reports *Cominella limbosa* from the same district; a similar discontinuous distribution has *Imbricaria carbonacea* (Agulhas Bank, SOWERBY; Mossamedes, Senegal, DAUTZENBERG 1910, 1912). This latter genus is Indo-Pacific in its general distribution, and is not known in a fossil state (cf. COSSMANN 1899).

This last-named species indicates that even an Indo-Pacific fraction may be traced in the West African fauna, and further evidence has been given of its existence. From Angola and Benguela, where the Indian influence is to be expected as most obvious, NOBRE (1909) has recorded the Indo-Pacific species *Murex anguliferus*, *Purpura hippocastanum*, *Cassis rufa* and *Cypraea tigris*. These are all unknown from the Cape. *P. hippocastanum* and *C. tigris* are also mentioned from the Cape Verde Islands. *Cardium lyratum* is mentioned from Angola, and from Cape Verde; here it was found by the Talisman Expedition (cf. LOCARD 1898). The same expedition, beside this one, dredged other East Indian mollusca at Cape Verde Islands, as *Cerithium tuberculatum* and *Cypraea gangrenosa*. It is remarkable that forms like these appear in Angola and Cape Verde districts, but are absent in the intervening stretch of coast.

It is not easy to explain the occurrence of this group of species in West Africa. Their identity to actual East Indian species, as well as their presence in the southernmost part of the province, seems to speak of an immigration round the Cape, a possibility which STUDER (1889) admits. Such an immigration might have been effectuated during some period when the hydrographical conditions were different from the actual ones, that is when the Agulhas current penetrated farther westwards, and passed on towards the north beyond the Cape. We cannot get any geological evidence of this supposition, since there does not exist, in South Africa, any raised beach with tropical fossils. The single marine deposits, hitherto described, are some of Pleistocene age with mollusca of recent species, only five of which are indigenous in warmer water (cf. SCHWARZ 1910). STUDER seems, however, to prefer another explanation, inasmuch as he holds the East Indian species as a survival from a pre-miocene epoch, when a direct communication existed from the Indian Ocean via the Mediterranean to the Atlantic. The species mentioned are, however, not known as fossils. The existence of rather a great number of East Indian species at St. Helena, and two at Ascension (cf. SMITH 1890), indicates, too, a probable migration from the Cape, which we will treat further in the following page.

STUDER is of opinion that a similar survival is the cause of a lot of species having got a world-wide distribution, and, indeed, we already find in Miocene deposits actual species with a cosmopolitan range (e. g. *Purpura haemastoma*). In these cases a migration directly from the Atlantic into the Pacific was possible, before the isthmus of Panama had originated. A great many Atlantic mollusca may have spread by means of this way, and, indeed, there are still reminiscences of a relation between the West African and the Peruvian regions in the existence of the large, closely akin, species of *Sigaretus*, as well as of *Trochita radians* (cf. DAUTZENBERG 1912). None of the actual wide-spread African species, however, have been found in the Miocene Navidad beds in Chile (cf. MÖRICKE 1896), though this fauna has, in general, Atlantic features, and even contains forms identic or corresponding with Miocene European mollusca. Another species the distribution of which recalls this old relation, is *Lamellaria perspicua*, which occurs at the African coast southwards to Cape Verde, and in Cape Colony (Port Alfred; BARTSCH 1915), and which is recorded also from Punta Arenas, Magellan Strait (BERGH 1898), the single locality of its occurrence in the Western Hemisphere.

As further examples of species belonging to the West African fauna and having a world-wide distribution, may be named *Cyma-*

tium costatum, Hipponyx antiquatus, Natica marochiensis, Scalaria commutata. These all also occur on the Western side of the Atlantic, and it is more than probable that they have crossed the Ocean from the one side to the other. This is likely with regard to the more striking fact that there exist species which are common to both sides of the Atlantic without extending their range beyond this area. LOCARD (1898) gives a survey of this state of distribution with regard to North Atlantic species, and states 71 species to be common to both regions, and STUDER (1889) has compared the West African fauna with the West Indian one, and found 54 species common to both, and this number has been increased by subsequent investigations. In this group of mollusca, we find the same degrees of range as regards the Mediterranean forms, viz. that part of them do not exceed beyond the Cape Verde district, others have a wider range towards the South along the African coast, even as far as S. Africa, as for instance *Cassis testiculus* (cf. TOMLIN & SHACKLEFORD 1914). Some of these West Indian species are common, also, to the Mediterranean, e. g. *Dolium galea, Arca noae,* whereas others, e. g. *Smaragdia viridis, Divaricella divaricata,* are absent in the European seas; interesting in its distribution is *Petricola pholadiformis,* which occurs in the West Indies, in Senegal (DAUTZENBERG 1912), and in Loanda (DUNKER 1853), and which has spread northwards as far as England and Denmark in most recent times, but which is absent in the Mediterranean.

Some of these West-Atlantic forms have extended their range southwards along the Brazilian coast, as, for instance, *Semifusus morio, Arca deshayesi,* and others (*Leucozonia triserialis* and *Murex senegalensis*) are entirely restricted to the Brazilian and the West African coasts, and absent in the central Caribbean region.

It seems as if this West Indian fraction would be more abundantly present in West Africa than is generally supposed; a great many species of this group have been mentioned by TOMLIN & SHACKLEFORD (1914) from S. Thomé, which have not been reported before from the coast at all, or only in a few cases; as examples may be named *Architectonica nobilis* BOLTEN = *Solarium verrucosum* PHILIPPI, and *Pecten nodosus* L.

Their occurrence cannot, therefore, be merely an accidental one, but is a characteristic and important feature of the West African fauna, which has been explained in different ways.

STUDER (1889, p. 31) is of the opinion that these West Atlantic forms, same as the Mediterranean ones, »dürften zum Teil ebenfalls tertiären Ursprung haben. Wenn der Atlantische Ocean zur Miocänzeit im Norden durch die europäisch-amerikanische Landbrücke in der Breite von 60° Nord abgeschlossen war und eine der jetzigen westafrikanischen Meeresfauna ähnliche Lebewelt deren Südküste bewohnte, so konnten sich Arten von da nach beiden atlantischen Küsten südwärts ausdehnen, wie dieses seither bei arktischen Arten der Fall war, andererseits konnten und können noch heutzutage schwimmende Larven von Küstenthieren eine Mischung der Faunen beider atlantischen Küsten vermitteln.»

DAUTZENBERG (1910, p. 7) says: »La présence sur la côte d'Afrique de ces espèces américaines ne nous semble pouvoir s'expliquer que par le transport d'embryons pélagiques, charriés par le grand embranchement du Gulf Stream, connu sous le nom de courant des Canaries, qui part du golfe du Mexique, traverse l'Atlantique et descend le long de la côte d'Afrique, après avoir baigné celle du Portugal.»

TOMLIN & SHACKLEFORD (1914, p. 239) object against DAUTZENBERG's view: »We do not, however, recollect reading of the occurrence of any West Indian shells on the Portuguese coast», which is, as stated, reached before West Africa by the Canaries current.

v. IHERING (1907, p. 312) speaks decidedly against the current theory, and bases his opinion on facts shown up from plankton investigations.

STUDER's supposition that the West Indian species have migrated to Africa along a North Atlantic land bridge is, however, opposed by the geological facts. No doubt, such a way was used by the more frigid fauna as shown by its distribution on both sides of the Atlantic (cf. LOCARD 1898), but this route was certainly closed to the tropical forms, because the climate during all the Miocene period was steadily getting cooler. Already in the middle Miocene (Vindobonien) the North American fauna (in the Chesapeake Miocene, analogous with the Helvetian of Northern Europe, according to DALL, 1915) contained boreal forms (whereas tropical genera, such as *Melongena* and *Conus*, were represented in Belgium), and in the upper Miocene of Belgium actual species of the North Sea already are present. The earlier subtropical Mediterranean Miocene has, on the North American continent, its analogue, according to DE LAPPARENT 1906, in the Tampa group of Florida (this is Oligocene, according to DALL 1915), and this contains some few actual species now living on the coast of the United States or in the West Indies exclusively, and beside them, only three wide-spread actual species, *Arca umbonata* Lam. = *A. imbricata* Brug., *A. reticulata* Gmel. = *A. plicata* Chemn., and *Lithophaga aristata* Dillw. Only the second of them is, however, found fossil in the European Miocene (Lamy 1907), where otherwise, scarcely anyone of the actual West Indian species is represented, and the latter, only, belongs to the recent Mediterranean fauna, where it seems to be a late immigrant (found, only, in a few localities in the Western Mediterranean, Carus 1893). All three are present on the West African coast (cf. Lamy 1907).

These facts speak against a northern way of dispersal across the Atlantic from the West Indies to Africa, and indicate, on the contrary, a southern route. Such a one may have existed earlier, in the Eocene, according to v. Ihering (1907), in the hypothetical »Archhelenis» S. of the Equator, but no evidences have been brought forth as to its lasting into the later Tertiary.

During these epochs, however, a more northern bridge seems to have existed. According to Gregory (1895), the West Indian marine Miocene fossils show a close relationship to the Mediterranean Miocene fauna, a fact which indicates a communication along a continental coast, or a row of islands. For the probable existence of this so called »Atlantis» Germain (1911 and 1913) and Termier (1913) have adduced a lot of evidence. On the base of zoological and geological facts, Germain draws the conclusion (1913, p. 221) »que les Açores, Madère, les Canaries, et les îles du Cap Vert ont été réunies autrefois en une masse continentale unique qui est l'Atlantide. L'aire continentale ainsi définie se reliait a la Maurétanie et au Portugal et devait avoir pour limite sud une ligne de rivage qui, partant des environs du Cap Vert, traversait l'Atlantique pour se rattacher à un point indeterminé du continent américain, probablement le Venezuela.»

It may be of interest, in this connection, to recall the great percentage of West Indian mollusca at Ascension and St. Helena, here amounting to 50 per cent, reported by Smith (1890). We cannot explain this feature as a result of the actual currents, but are obliged to resort to the hypothesis of a sunk land area. This may have extended from the vicinity of the Atlantis in the North, and by this way accepted not only the West Indies but also its Mediterranean elements. In the terrestrial fauna we find supports for the supposition of a relation to the continental area in the North; the endemic coleopter fauna of St. Helena is said to show a decided affinity to that of the Azores, and the Canaries. KOBELT (1896, p. 200) says about this question: »Schon WOLLASTON hatte die Gattungen *Nesiotes* und *Acarodes* von den Kanaren abgeleitet; WHITE sieht auch in dem Vorwiegen der Rüsselkäfer aus der Familie der Cossonidae einen entschieden makaronesischen Zug und glaubt die endemische Kieferfauna ganz gut von der paläarktischen ableiten zu können.» No direct communication can, however, be taken for granted between the two lands, since the land mollusc fauna is of an entirely unique type; KOBELT, who discusses the fauna described by SMITH (1892), considers it »im höchsten Grade für wahrscheinlich, dass die Landmolluskfauna von St. Helena der letzte Rest der Molluskenfauna eines untergegangenen mesozoischen Südkontinentes ist, deren Ausläufer wir einerseits in Polynesien und einem Teil von Melanesien als Endodontidae, Charopidae, Placostylus etc.[1]), andererseits vielleicht in den Bulimus and Bulimulus Südamerikas vor uns sehen.» FISCHER, also, (1881) has emphasized that »l'ensemble est donc complètement originale et présente un caractère insulaire des plus évidents, indiquant que Saint Hélène est séparée de tout continent depuis une époque très reculée.» Afterwards DALL (1896) and PILSBRY (1905, Man. of Conch. 17) maintained this isolation from a remote time, and showed that part of the subfossil bulimoid mollusca comprised in the genus *Chilonopsis* are »most nearly related to *Pseudoglessula*, *Subulona*, *Trichodina* and their allies», which inhabit Africa, and also in the insect fauna there is, according to WALLACE 1902 (Island Life, p. 302), undoubtedly a South African element. An indication of an ancient connection with Africa thus is exhibited, and it is possible that, as a remnant thereof, even in a later Tertiary time there has existed some submarine series of banks combining the island with the African coast; in such a supposition we find a possibility to explain the East Indian elements announced in the marine fauna of St. Helena.

The East Indian elements of St. Helena and Ascension, which appear to form an important percentage of the marine fauna of these islands (cf. the list compiled by STUDER 1889, p. 50,[2]) from

[1]) This genus does not exist; the intended forms belong to *Chilonopsis* (cf. below).

[2]) The determination of the Echinids seems to be uncertain in some cases; cf KOEHLER 1914.

Ascension, and SMITH, 1890), are considered by E. A. SMITH and BELL (cf. STUDER) to be dependent of the Agulhas current, »welcher um das Kap der guten Hoffnung nordwärts gegen St. Helena und Ascension strömt». That, in reality, a drift from the Indian Ocean to St. Helena may occur is shown by the fact that »large seeds which have floated from Madagascar or Mauritius round the Cape of Good Hope, have been thrown on the shores of St. Helena and have than sometimes germinated» (WALLACE 1902, p. 306). A drift from the Cape to St. Helena is made evident by E. A. SMITH (1890), who states the accidental occurence at St. Helena of »sea-horn» or pieces of a tangle, inhabiting the coast of Cape. Hence, it seems very possible that a colonization of certain species of living animals attached to the sea-weed (e. g. *Patella* forms) has taken place from the Cape fauna. But for the Indo-Pacific forms a drift is very unlikely. »SMITH stösst sich zwar», says STUDER further, »bei dieser Hypothesen an dem Umstand, dass die Arten nicht zugleich am Kap vorkommen. Die niedrige Wassertemperatur, die an den dortigen Küsten herrscht, mag aber die Ansiedlung von Arten verhindern, deren Larven erst wieder an den warmen Ufern der tropischen atlantischen Inseln einen Punkt fanden, an dem sie sich ohne grosse Konkurrenz von Seiten schon vorhandener Arten entwickeln konnten.»

Against this theory of a transport of Indo-Pacific species from the Cape to St. Helena speaks, however, not so much the absence of such species at the Cape[1]) as, moreover, the same circumstance as was laid stress on by treating the West Indian forms, viz. the distance, which is too considerable to allow a colonization of St. Helena by transport of larvae from the adjacent continents. Further, a drift of these species would be effectuated, only, by the cold Benguela current which, alone, reaches the islands, since the Agulhas current bends off south of the Cape. STUDER's supposition of this possibility is against the facts that different sorts of waters are inhabited by different organisms. Thus, it seems necessary to reject the theory of a transport by currents of East Indian forms to St. Helena. Instead, we are brought to the same supposition as in the case of the West Indian mollusca, viz. that they have migrated along an old coast line, or a submarine ridge, or a row of banks ex-

[1]) The bottom Gastropods of the Agulhas Bank still show a greater relation to the tropical Indian fauna than those at the coast of S. Africa S. of Natal (v. MARTENS 1903, p. 59).

tending from the vicinity of the Agulhas bank to the vicinity of St. Helena.

CLARK (1914, p. 310), from his analyses of the Crinoid fauna, arrives at a conclusion much of the same kind in assuming »a path of migration from south-eastern Africa to the Antillean region».

Other faunistical facts mentioned above support the assumption of former land areas with an extension in a north-southern direction, and these may perhaps, in some part, remain as the S. Atlantic threshold, and as the banks off S. W. Africa. Geological facts, also, seem to speak in favour of this hypothesis, which does not reckon with a continental Archhelenis — this may have existed earlier — but with a land extended in a meridional direction, and probably comprising the mid-atlantic islands. Thus, traces of archaic rocks have been found in Ascension and Tristan da Cunha, a fact, which causes this conclusion by SCHWARZ (1906, p. 88; cf. also PENCK, 1921): »As a whole therefore, the evidence of a land connection between Africa and South America afforded by the islands in mid-ocean, is suggestive, but far too little investigated to be worth much at the present time.»

From a geological point of view the nature of the Atlantic ridge has been discussed by JAWORSKI, 1921, and more exhaustively by KOBER 1921. The former comprises the opinions about the problem with the words (p. 73): »Über die Natur der merkwürdigen, mittelatlantischen Schwelle, die, im wesentlichen den Küsten konform, den ganzen Atlantischen Ozean von Norden nach Süden durchzieht und nur im Romanchetief eingebrochen ist, gehen die Ansichten auseinander... Nach DACQUÉ ist sie vulkanischer Entstehung und in der Tat sind ihr die Vulkaninseln Tristan da Cunha, Ascension und St. Paul aufgesetzt, während St. Helena abseits liegt. ANDRÉE dagegen sieht in ihr einen höher stehengebliebenen Rest des alten südatlantischen Kontinents und betont mit Recht, dass der auffallende Parallelismus der südamerikanischen und afrikanischen Küste und der Schwelle auf einen genetischen Zusammenhang bei der Entstehung dieser drei Gebilde hindeutet. Ganz im Gegensatz hierzu vertritt HAUG die allerdings unbewiesene Auffassung, dass die Schwelle eine beginnende Auffaltung des Meeresbodens, ein Faltengebirge in statu nascendi ist.»

KOBER devotes a careful argumentation to the problem and arrives at this conclusion (p. 236): »Der heutige Ozean liegt wahrscheinlich über einem jung versenkten Mesoiden-Orogen. Die Achse dieses Orogen ist der atlantische Rücken.»

KOBELT (1896) was of the opinion that the Mediterranean forms of St. Helena might date from the Glacial epoch, when »die Meeresströmung über einem grossen Teile des atlantischen Ozeans eine nördliche sein musste.... Damit wäre ein Überwandern paläarktischer Formen nach den Capverden und weiter südlich erheblich erleichtert worden, und konnten solche auch St. Helena erreichen, auch wenn wir nicht mit WHITE annehmen wollen, dass damals eine später versunkene Zwischenstation existierte.»

Even with the supposition of such currents from the North it seems, however, impossible to explain the presence of Mediterranean forms at St. Helena as a consequence of transport, and this on the same grounds as in the other cases when a transport was assumed. Otherwise, it may be questioned, whether the glaciation could, in reality, produce cold currents with a southern direction running in the surface so long a distance far beyond the Equator. And since we have found it probable that the fauna of the West African coast has been, ever since the Miocene, like that of nowadays — at least, as far as the endemic and the Mediterranean forms are concerned — there is no reason for seeing in the Glacial epoch the fundamental cause of the presence of the latter at St. Helena.

A colonization along the African continent is, however, thoughtable, by which species of a more northern origin may have spread southwards on the coast. But there has been known no support of such a supposition in the shape of marine deposits containing northern forms which are absent in the actual fauna off the coast. The Pleistocene faunas described by DOLLFUS (1911) and CHAUTARD (cf. LEMOINE 1913) are certainly more deficient of species than the actual fauna, but they contain no northern species indicating any decided invasion of those elements towards the South.

There is another circumstance in the character of the West African mollusc fauna which speaks in favour of this hypothesis of a former land, extending in a meridional direction. This is of a negative nature, but, nevertheless, deserves to be observed. In the West African mollusc fauna we lack almost every trace of a Magellanic influence. This circumstance is noteworthy as implying a support of the view represented above about the ineffectiveness of the sea currents for propagating litoral animals across a wide ocean. Although the South Atlantic currents run from the southern end of S. America to S. W. Africa, scarcely any colonization has taken place. Between S. America and S. Africa, there are only some relations in the existence of the genus *Bullia* as well as the circumaustralic species *Mytilus magellanicus* (cf. v. MARTENS 1903, p. 60). The latter has certainly got its great distribution thanks to transport with driving kelp. *Bullia* is considered by v. IHERING (1907) to have immigrated from the subantarctic region, and of late. Beside these both forms, only *Argobuccinum argus* is common to S. America and S. Africa (as well as to the interjacent islands, which, otherwise, seem to lack the characteristic Magellanic mollusca; only two species of *Siphonaria* show some relation; cf. PELSENEER 1903).

A Patagonian fauna first originated in the Paleocene (cf. WINDHAUSEN 1918). »We may draw the inference», says WINDHAUSEN (p. 12), »that the peculiarity of the fauna of the Patagonian Beds and its Australo-Antarctic origin have been caused by restriction towards the north by a barrier like the »Archhelenis» of H. v. IHERING, which separated the South Atlantic basin from the Northern marine provinces, and made impossible a free circulation of streams and currents between this basin and Tethys». Likewise, a barrier seems to have existed against the African waters; otherwise, if the communication was free along the coast of Archhelenis (as is given in the map by IHERING 1907), we might expect a closer relation between both faunas. The same barriers very likely existed in the Miocene, too; it is true, that Atlantic forms appeared in the Miocene Patagonian formation, but their appearance was due to a migration along the west coast of the S. American continent (through the strait which replaced in that time the isthmus of Panama). Not before the Pliocene, according to WINDHAUSEN, was this barrier broken, and the Middle Atlantic basin was formed, which is announced by the Paraná formation containing a fauna which »resembles the Upper Tertiary faunae of Europe and the present molluscan faunas of South America and the Caribbean Sea» (p. 12). Any African elements are, however, not present (cf. COSSMANN).

As the West Indian elements are very rare in the European Tertiary deposits, and seem to occur only in S. America and the regions of the Caribbean Sea — whereas, on the contrary, European influence may be traced widely in West Indies and S. America — one seems justified to assume that the former are indigenous in the American waters and late immigrants to West Africa, and that the dispersion of land and sea, as well as the direction of the currents, have prohibited their propagation to the eastern coasts of the Atlantic until a relatively late time. However, our knowledge of the fossil faunas is still too incomplete to give to this supposition more than hypothetical value.

Also from the West coast of the African continent we have but few documents adopted to throw light upon the geological history and development of its marine fauna. Actual species of mollusca have been found in different places in raised beaches; thus, for instance, DAUTZENBERG has recorded *Arca senilis*, *Conus papilionaceus* and *Strombus bubonius* in Congo at a height of no less than 200 m above sea level (cf. OPPENHEIM 1904, p. 246). Similar deposits are present all along the coast from Mauretania to Angola; in the latter country, they also reach a level of 200 m (cf. LEMOINE 1913). These may be of a Pliocene or Quaternary age. In Senegal deposits with actual species have been recorded which, according to LEMOINE, may be of a Miocene age (Vindobonien). Miocene deposits are, otherwise, mentioned from S. Nigeria (cf. PARKINSON 1913) a dating which has been critizised by OPPENHEIM (1915) and estimated to Eocene, and from Angola (cf. VINCENT 1913, OPPENHEIM 1915) only, and their scantity, or absence, along the coast may perhaps indicate a more western extension of the Miocene coast line than the actual one, even this, thus, offering a means of explaining the discontinuous distribution of the different kinds of fauna elements mentioned above.

From the earlier Tertiary, Eocene and Paleocene, there are known deposits with marine mollusca in Senegal (LEMOINE 1913), the Cameroons (OPPENHEIM 1904), Congo and Angola (VINCENT 1913), and S. W. Africa (OPPENHEIM 1915) but none of them contain actual species. The Eocene fauna of the Cameroons shows a close relation to that of western Europe, whereas the Paleocene of Landana has a more unique character.

Also from the later part of the Cretaceous (Albien to Senonien) there exist deposits with mollusca along the coast of West Africa from Senegal to Angola (LEMOINE, VINCENT), and the cretaceous fauna is closest related to that of northern Africa and the East Indies (SOLGER 1904). From the earlier Mesozoic systems, however, no traces exist in the coast regions of West Africa (LEMOINE).

The existence of Eocene and Cretaceous deposits along the coast of West Africa is emphasized by authors (e. g. PENCK 1921) as an evidence against WEGENER's hypothesis (1920) about a direct connection side by side of Africa and Brazil which was broken not until

Eocene time. WEGENER has even modified his view in this case, and considers the separation of Brazil from Africa to be better set in the Cretaceous than in the Eocene (WEGENER 1921, p. 130). However, according to WEGENER, the separation was introduced by the rise of a median fissure which became the present Atlantic basin in the way that S. America steadily moved away from Africa. The presence of West Atlantic species of marine mollusca on the West African coast, as well as the similarity between the Miocene faunas in the West Indies and in Europe may seem to support WEGENER's hypothesis. But the absence of West African forms on the western side of the Atlantic, as well as the sharp difference between the faunas on each side, seem to be better explained by assuming interjacent land areas which have prohibited their intermingling, as we have tried to show in these pages.

List of Literature

BARTSCH, P., Rep. on the Turton Coll. of S. African Marine Mollusks, with additional Notes on other S. African Shells contained in the U. S. National Museum. Smithsonian Instit., N. S. Nat. Mus., Bull. 91, 1915.

BELLARDI, L., I molluschi dei terreni terz. del Piemonte e della Liguria 1877.

BERGH, R., Die Opisthobranchier der Sammlung Plate. Zool. Jahrb. Suppl. IV (Fauna Chilensis), 1898.

—, The Opisthobranchiata of South Africa. Marine Investig. in S. Africa. Vol. V. Part. I, 1907.

CARUS, J. V., Prodromus faunae mediterraneae. II Mollusca. Stuttgart 1889—93.

CLARK, A. H., Echinoderma II: Crinoidea. Beiträge zur Kenntnis der Meeresfauna Westafrikas. Bd 1, L. 2. Hamburg 1914.

COSSMANN, M., Essais de Paléoconchyliologie comparée. 1—12. Paris 1895—1921.

DALL, W. H., Insular Landshell Faunas, especially as ill. by the data obt. by Dr. G. Baur in the Galapagos Isl. Proc. Ac. N. S. Philadelphia 1896.

—, Synopsis of the Lucinacea, and of the American Species. Proc. U. S. Nat. Mus. XXIII, 1901.

—, A Monograph of the Molluscan Fauna of the Orthaulax pugnax zone of the Oligocene of Tampa, Florida. Smithsonian Instit., N. S. Nat. Mus., Bull. 90, 1915.

DAUTZENBERG, PH., Contribution à la Faune Malacologique de l'Afrique occidentale. Actes Soc. Linn. de Bordeaux 1910.

—, Mollusques marins. Mission GRUVEL sur la côte occidentale d'Afrique (1909—1910). Ann. Inst. Océanographique. Paris 1912.

DOLLFUS, G. F., Probable Extension of the Seas during Upper Tertiary Times in Western Europe. Geol. Mag. 4, 1895.

—, Les coquilles du Quaternaire marin du Sénégal. Mém. Soc. Géol. France. Paléont. T. XVIII, Paris 1911.

DUNKER, G., Index Molluscorum quae in itinere ad Guineam inferiorem collegit G. TAMS. Casellis Cattorum 1853.

FISCHER, P., Manuel de Conchyliologie. Paris 1881—1887.

GERMAIN, L., Le problème de l'Atlantide et la Zoologie. Annales de Géographie 1913.

GIGNOUX, M., Les formations marines Pliocènes et Quaternaires de l'Italie du Sud et de la Sicile. Ann. Univ. Lyon, 36, 1913.

GREGORY, J. W., Contributions to the Palæontology and Physical Geology of the West Indies. Quart. Journ. Geol. Soc. London 1895.

HAUG, E., Traité de Géologie, III, Paris 1911.

HOERNES, M., Die fossilen Mollusken des Tertiärbeckens von Wien. Abh. K. K. Geol. Reichsanstalt Wien, Bd III, 1856, Bd IV, 1870.

IHERING, H. v., Archhelenis und Archinotis. Ges. Beiträge zur Geschichte der neotrop. Region. Leipzig 1908.

HEDLEY, C., A Check-List of the Marine Fauna of New South Wales. P. 1, Mollusca. Journ. Roy. Soc. N. S. Wales, Vol. 51, 1917, Sydney 1918.

JAWORSKI, G., Das Alter des südatlantischen Beckens. Geol. Rundschau XII, 1921.

KOEHLER, R., Echinoderma I: Asteroidea, Ophiuroidea et Echinoidea. Beiträge zur Kenntniss der Meeresfauna Westafrikas, Bd 1, L. 2. Hamburg 1914.

KOBELT, W., Die zoogeographische Stellung der Insel St. Helena. Geographische Zeitschrift 1896.

—, Studien zur Zoogeographie. Bd 2, Die Fauna der meridionalen Subregion. Wiesbaden 1898.

KOBER, L., Der Bau der Erde. Berlin 1921.

KOENEN, A. v., Das Norddeutsche Unteroligocän und seine Mollusken-Fauna. Lief. V, Pelecypoda. Abh. Preuss. geol. Landesanst. X, 1893.

KRÜMMEL, O., Handbuch der Ozeanographie II. Stuttgart 1911.

LAMY, E., Révision des Arca viv. du Mus. d'Hist. nat. Paris. Journ. de Conch. 55, 1907.

LEMOINE, P., Handbuch der Regionalen Geologie, VII, 6 A. Afrique Occidentale. Heidelberg 1913.

LOCARD, A., Expéd. scient. du Travailleur et du Talisman... . Moll. Testacés, I, 1897, II, 1898.

LAPPARENT, A. de., Traité de Géologie, 1906.

MELVILL, J. C., & STANDEN R., The Marine Moll. of the Scottish National Antarctic Exp. (Issued sep. 1907) Rep. Sci. Res. »Scotia». Edinburgh. Vol. V, 1909.

The Marine Moll. of the Scottish National Antarctic Exp. Part. II. (Issued sep. 1912). Rep. Sci. Res. »Scotia», Vol. VI.

Martens, v., Die beschalten Gastropoden der deutschen Tiefsee-Exp. etc. Wiss. Ergebn. d. Deutsch. Tiefsee-Exp. (Valdivia), Bd 7, Jena 1903.

Möricke, W., Versteinerungen der Tertiärformation von Chile. Neues Jahrb. f. Mineral. u. Paleont. X Beil.-Bd, H. 3, 1896.

Odhner, N. Hj., Contribution à la Faune Malacologique de Madagascar. Arkiv f. Zoologi (K. Sv. Vet. Akad.), 12, Stockholm 1919.

Oppenheim., P., Über Tertiärfossilien, wahrscheinl. Eozänen Alters, von Kamerun. Beiträge zur Geologie von Kamerun. Stuttgart 1904.

—, Die Eocäne Invertebraten-Fauna des Kalksteins in Togo. Beiträge zur geolog. Erforschung d. Deutschen Schutzgebiete, 12, 1915.

Parkinson, J., English Colonies on West Coast of Africa and Liberia. Handbuch d. Reg. Geologie, VII, 6 A, 1913.

Pelseneer, P., Mollusques, Rés. du Voy. du S. Y. Belgica. Expéd. Antarctique Belge. Zool. 49. Anvers 1903.

Penck, A., Wegeners Hypothese der kontinentalen Verschiebungen. Zeitschr. d. Ges. f. Erdkunde, Berlin, 1921.

Sacco, F., I Moll. dei terreni terziarii del Piemonte e della Liguria. Pt. XV (Cypræidæ ed Amphiperasidæ). 1894.

Schwarz, E. H. L., The former Land Connection between Africa and South America. The Journ. of Geology 1906 Chicago.

—, The Pleistocene Deposits of Port Elizabeth. Trans. Geol. Soc. S. Africa, 12, Johannesburg 1910.

Smith, E. A., A List of Species from West Africa etc. Proc. Zool. Soc. 1871.

—, Rep. on the Lamellibranchiata coll. by H. M. S. »Challenger». Rep. Sci. Res. Challenger, Zool. XIII, 1885.

—, Rep. on the Marine Molluscan Fauna of the Island of St. Helena. Proc. Zool. Soc. 1890.

—, On the Marine Mollusca of Ascension Island. Ibidem.

—, On the Land Shells of St. Helena. Proc. Zool. Soc. 1892.

—, A List of Species of Mollusca from South Africa, forming an Appendix to G. B. Sowerby's »Marine Shells of South Africa». Proc. Malac. Soc., V, 1903.

—, On South African Species of Sepiidæ. Proc. Malac. Soc., 1916.

SOLGER, F., Die Fossilien der Mungokreide in Kamerun und ihre geol. Bedeutung mit besonderer Berücksichtigung der Ammoniten. Beiträge zur Geologi von Kamerun. Stuttgart 1904.

SOWERBY, G. B., Marine Shells of South Africa. London 1892. Appendix, 1897.

—, Mollusca of S. Africa (Pelecypoda). Marine Invest. S. Africa, Vol. IV, 1904.

STREBEL, H., Mollusca I, Gen. Pusionella. Beiträge zur Kenntnis der Meeresfauna Westafrikas. Bd 1, L. 2. Hamburg 1914.

STUDER, TH., Die Forschungsreise S. M. S. »Gazelle», III Zoologie und Geologie. Berlin 1889.

TERMIER, P., L'Atlantide. Revue Scientifique 1913.

THIELE, J., Die Cephalopoden der Deutschen Südpolar-Expedition 1901—03. Deutsche Südpolar-Exp. 1901—03, Bd. XVI. Zoologie VIII, 1921.

TOMLIN, J. R. le B., & SHACKLEFORD, L. J., The Marine Mollusca of São Thomé. Journ. of Conch. 1914—15.

VINCENT, E., Contribution à la Paléontologie des Falaises de Landana. Mollusques. Ann. Mus. Congo Belge, Ser. III, Tome l. Bruxelles 1913.

WINDHAUSEN, A., The Problem of the Cretaceous-Tertiary Boundary in South America, and the Stratigraphic Position of the San Jorge-Formation in Patagonia. Amer. Journ. of Sci. Ser. 4, Vol. 45, 1918.

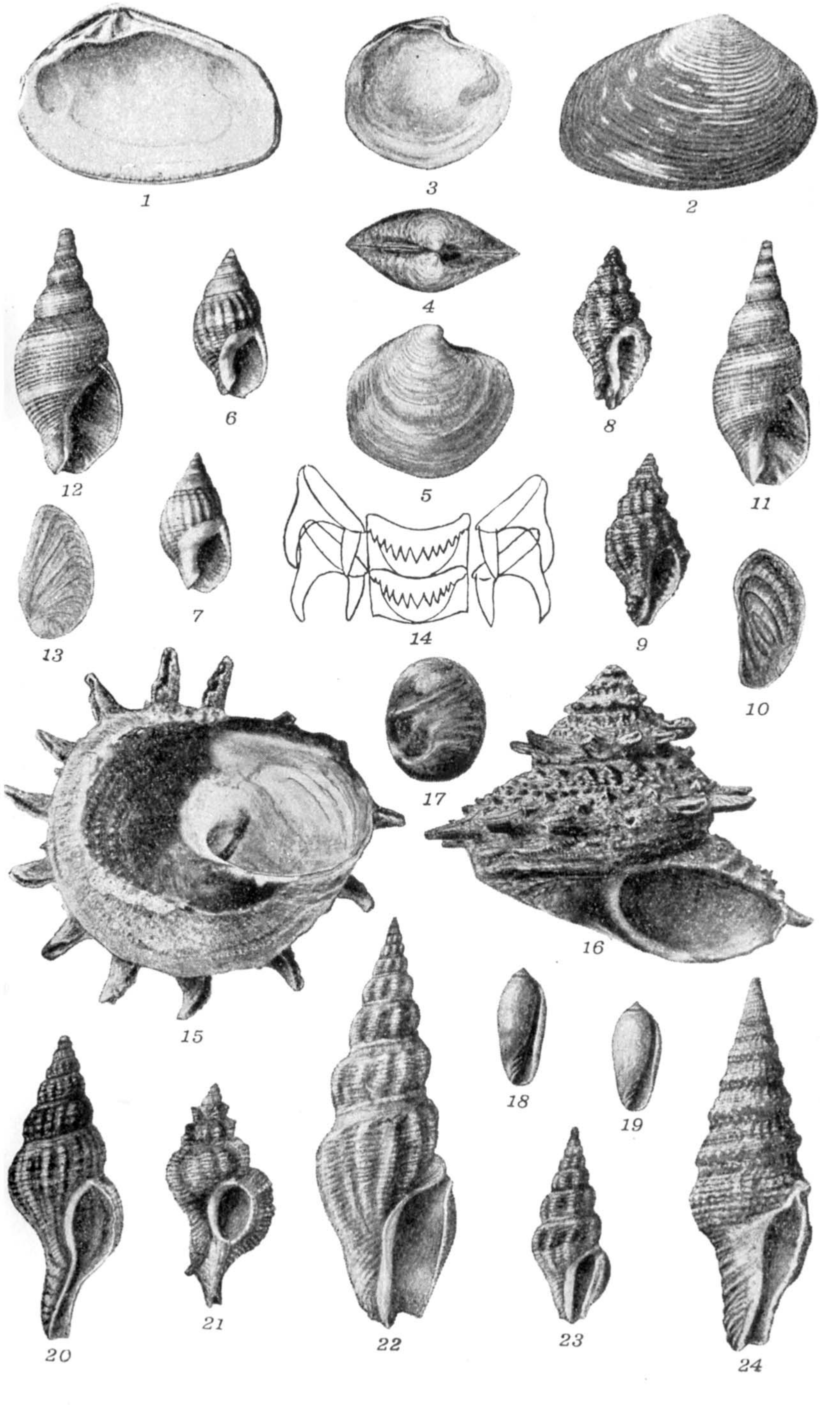
WALLACE, A. R., Island Life. 3rd Edition. London 1902.

WEGENER, A., Schlusswort. Zeitschr. d. Ges. f. Erdkunde, Berlin 1921.

WEINKAUFF, H. C., Die Conchylien des Mittelmeeres. Cassel 1867—68.

Explanation of the Plate

Figs: 1, 2. *Crassatella capensis* n. sp. Nat. size.
» 3—5. *Lucina semilirata* n. sp. × 2.7.
» 6, 7. *Nassa angolensis* n. sp. × 1.3.
» 8, 9. *Ocinebra angolensis* n. sp. × 1.3.
» 10. Operculum of *Ocinebra angolensis*. × 6.
» 11, 12. *Adinopsis skoogi* n. gen. et sp. × 1.3.
» 13. Operculum of *Adinopsis skoogi*. × 4.
» 14. Two rows of teeth from the radula of *Adinopsis skoogi*. × 60.
» 15, 16. *Astralium johnsoni* n. sp. Nat. size.
» 17. Operculum of *Astralium johnsoni*. Nat. size.
» 18, 19. *Marginella angolensis* n. sp. × 1.3.
» 20. *Fusus zebrinus* n. sp. × 1.3.
» 21. *Murex dearmatus* n. sp. × 1.3.
» 22, 23. *Drillia angolensis* n. sp. × 1.3.
» 24. *Clavatula filograna* n. sp. Nat. size.



N. Odhner del.