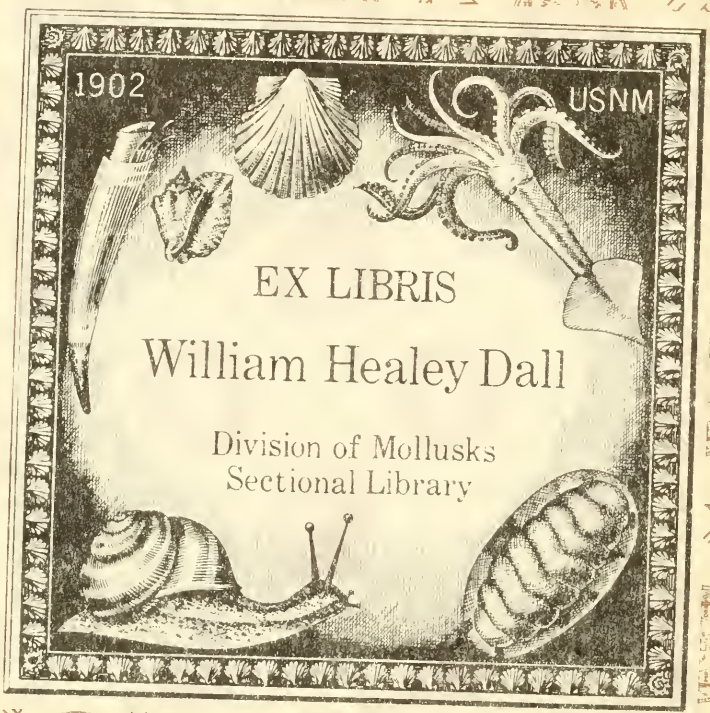
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THE NON-MARINE MOLLUSCA OF PORTUGUESE EAST AFRICA.

By M. Connolly.

(With Plates IV to VIII and thirty Text-figures.)

CONTENTS.

Introduction.

Peculiarly little has hitherto been written about the molluscs inhabiting the large tract of Portuguese territory in East Africa, which is divided into Mozambique, on the north, and Lorenzo Marques, on the south, by the R. Zambesi.

While Portuguese West Africa has been pretty thoroughly searched by various explorers since the days of Welwitsch, and the results fully treated by Morelet and Nobre, hardly any early traveller seems to have done much

collecting on the immediately opposite side of the continent except the Englishman, Sir John Kirk, and the German, Dr. W. Peters.

The latter travelled along the east coast and up the Zambesi between 1843 and 1847, and his collection, lists of which were published by von Martens in 1860, 1869, and 1879, seems to have totalled the thirty-four following non-marine species :—

Ledoulxia mozambicensis (Pfr.).
„ *albopicta* (Mts.).
„ *jenynsi* (Pfr.).
Trachycystis pinguis (Krs.).
Rhachis punctata (Anton).
„ *petersi* (Pfr.).
„ *catenata* (Mts.).
Rhachidina melanacme (Pfr.).
„ *spilogramma* (Mts.).
Rhachistia sticta (Mts.).
Achatina panthera (Fér.).
„ *petersi* Mts. (a synonym of *A. glutinosa* Pfr.).
Urocyclus fasciatus (Mts.).
„ *flavescens* (Kfstn.).
Veronicella petersi (Mts.).
Onchidium peroni Cuv.
Limnaea natalensis Krs.
Physa mosambiquensis Cless.
Physopsis africana Krs.
Tropidophora ligata (Müll.).
Melanoides tuberculatus (Müll.) (cum *M. inhambanicus* (Mts.), a large form of *tuberculatus*).
Tiara vouamica Bgt. (recorded by von Martens under the name of *Melania crenularis* Desh.).
Ampullaria largillierti Phil.
Lanistes ovum (Ptrs.).
„ *purpureus* (Jonas) (a synonym of *L. olivaceus* Sow.).
Theodoxus natalensis (Rve.).
„ *knorri* (Recl.).
Truncatella teres Pfr.
Spatha wahlbergi (Krs.).
„ *petersi* Mts.
Indonaia mossambicensis (Ptrs.).
Mutela coelestis Lea (a synonym of *M. rostrata* Rang).
Corbicula astartina Mts., and
„ *radiata* (Parr.), which must now be known as *africana* Krs.

Kirk, who only died as recently as January 1922, did much exploring on Livingstone's staff between 1858 and 1863, and was subsequently attached to the British Embassy at Zanzibar from 1866 till 1887. His early conchological discoveries were recorded by Dohrn, Gray, Lea, and Prime, and added the 5 following species to the fauna under notice : *Urocyclus kirki* Gray ; *Pseudoglessula kirki* (Dhrn.) ; *Tropidophora calcarea* (Sow.) ; *Cor-*

bicula kirki (Prime); and a shell which Dohrn identified as *Cleopatra bulimoides* (Oliv.).

Achatina panthera (Fer.) and *lamarckiana* Pfr. were both included in Dohrn's list, but as the latter is a synonym of the former it need not enter into consideration.

Only six other expeditions of the nineteenth century added much to our knowledge of Portuguese East African mollusca.

Among shells sent by Plant to Cuming in the early fifties, as from Cape Delagoa, were *Gulella kraussi* (Pfr.) and *wahlbergi* (Krs.); *Trachycystis aenea* (Krs.); *Achatina granulata* and *natalensis* Pfr. He also furnished these species at the same time from "Cape Natal," and as three of them have not been found subsequently near Delagoa Bay, it is not improbable that the records of the localities became mixed.

In 1879 J. S. Gibbons published a list of species collected by himself between Delagoa Bay and Zanzibar, while other of his finds were described by J. W. Taylor and W. Nelson; fresh additions were *Achatina immaculata* (Lam.), *Rhachidina mozambicensis* (Pfr.),* *Pseudoglessula gibbonsi* (Taylor), *Veronicella natalensis* (von Rapp), *Tropidophora zanguebarica* (Petit), and *kraussiana* (probably a misidentification of *insularis*) (Pfr.), while to these must be added a slug which Gibbons considered to be *Urocyclus flavescens*, but which has since been made the type of a new genus under the name of *Kirkia gibbonsi* (see p. 138).

Capello and Ivens travelled across Africa, just north of the Zambesi, in 1884–85, and a first instalment, never continued, of their collection was published by Furtado in 1886. It added nothing in reality, however, to the fauna now under notice, since such new species and varieties as were founded on examples from Portuguese East African territory have subsequently been relegated to synonymy.

Dr. Stuhlmann visited the south-east coast in the spring of 1889, and a list of 10 species, given by von Martens in 1897, added *Isidora forskali* Ehrn., *Tropidophora letourneuxi* (Bgt.), and *Cleopatra ferruginea* (Lea) [recorded as *amoena* Morel.], to the local list.

Dr. Penther collected in South Africa in 1897, and among his valuable acquisitions, recorded by Sturany in 1898, the following additions were ascribed to the Delagoa district:—

Gulella perissodonta (Stur.).
,, *perspicuaeformis* (Stur.).
Natalina caffrula, M. and P.
Pseudoglessula movenensis (Stur.) (a synonym of *boivini*, Morelet).

* Described from the Cuming collection in 1846, but without mention of the collector's name.

Rhachidina dubiosa (Stur.).
,, *pentheri* (Stur.) (a synonym of *R. usagarica* (Smith)).
Conulinus meridionalis (Pfr.).
,, *natalensis var.* (Krs.).
Caecilioides ovampoensis (M. and P.).

Finally, about 1899, the Rev. H. A. Junod sent home some fine material from the same district and Inhambane, but the paper in which it is recorded presents so many instances of obvious misidentification that the list, as published, is of doubtful value. It contained 17 non-marine species, of which 9 had not been previously chronicled from Portuguese East Africa, viz. :—

Natalina caffra, var. *wesseliana* (Maltzan).
Kerkophorus poeppigi (Mke.).
Conulinus conulus (Rve.).
Metachatina kraussi, var. *elongata*, Junod.
Achatina schinziana Mousson.
Limnaea natalensis Krs.
Planorbis rüppelli Dkr.
Isidora natalensis (Krs.).
Vivipara capillata Frnfd.

Of these, although I am rather doubtful as to the correct identification of some of the species which I have not examined, their extension up or down the coast to Delagoa is by no means improbable ; I prove later on, however, that the Kalaharian *A. schinziana* and Abyssinian *P. rüppelli* are misnomers for *A. granulata* Pfr. and *P. pfeifferi* Krs.

In the first decade of the present century the only recorded collection was made by A. Vasse in the Andrada mining district, the list of which, published by Germain in 1918, added *Tropidophora anceps* (Mts.), *Achatina vassei*, and *Rhachistia rhodotaenia*, var. *andradensis* Germain to the local fauna.

In addition to the foregoing, 9 other species have been recorded at various times, by different writers, from Portuguese East Africa, so it will be seen that up to the year 1920 the number of non-marine mollusca known to inhabit the entire territory amounted to only 84 species, of which 55 are terrestrial and 29 aquatic.

During the last ten years, however, I have been extraordinarily fortunate in opportunities of studying much fresh material from all over Lorenzo Marques.

Mr. Bernard Cressy has kindly furnished me with a splendid series of shells from the Macequece District, in which the Andrada Mines are situated, and from other more northerly parts of the country ; through the kindness

of Mr. John Reed, Secretary of the Beira and Mashonaland Railway, I have received two interesting little collections made by B. F. Mcdowell at stations on that line ; while the Rev. H. A. Junod has renewed his valuable researches in the southern portion of the territory, and Miss Wilman, Director of the M'Gregor Museum, Kimberley, most kindly arranged that his fine collection should be submitted to me for examination. Finally, I am much indebted to Messrs. K. H. Barnard and H. C. Burnup for the sight of still further material collected by H. W. Bell Marley in the Magude district, and Dr. F. G. Cawston at Beira and Delagoa Bay.

The natural result is the addition of very many new names to the South African faunal list, as well as to that of Portuguese East Africa ; in fact, the latter is almost doubled by the recent discoveries, the present record comprising 111 land and 43 aquatic species, a total of 154, as against that of 84 just mentioned.

As might be expected, the Portuguese territory is a half-way house between South and Central African forms. From Delagoa Bay, in the south, hardly a species is recorded which is not also common to the Transvaal or Natal, but north of the Beira railway, whence most of the new material is derived, southern forms become inconspicuous or disappear, and the larger species are more characteristic of the fauna of tropical Africa than of the more temperate southern part of the continent, several having already been described from Nyasaland or further north.

An exact analysis shows that, of the 154 species now listed, 68 have not yet been collected outside the latitudes of Portuguese East Africa ; 21 are common to districts both north and south of that territory ; 27 are only recorded otherwise from Central, and 38 from South Africa, but 23 of these hail from the Delagoa district, and some of them are very doubtfully authenticated. Only 35 species are yet chronicled from Mozambique, none of which is a purely South African form, while no fewer than 9 are unknown south of the Zambesi.

In addition to many friends, whose kind assistance in the preparation of this work is acknowledged elsewhere, I must express above all my extreme indebtedness to H. Watson for his great kindness in reporting on the anatomy of many of the species. The whole of the anatomical details are solely from his pen, as are the many text-figures and four beautiful plates in illustration of his letterpress.

The following list sets forth in generic sequence all the land and freshwater mollusca, as far as I can trace the records, which are believed to inhabit Mozambique and Lorenzo Marques. Few references to literature are appended, as these were either given in full in my Revised Reference List,* or will be included in a supplement thereto, now in course of preparation.

* Ann. S. Afr. Mus., xi, 1912, pp. 59–307.

In some cases, therefore, I have not given the earliest reference to a species, when no figure was presented with it, but have given the original date of its description, and a later reference, usually by the same author, to a work in which both description and figure may be found. The letters D, F, L, N, A, R, appended to references, denote respectively Description, Figure of shell or slug, Locality, Note, Anatomy, and Radula.

The rough map on p. 111 shows nearly every locality mentioned in Lorenzo Marques; the few in Mozambique are easily found in any atlas.

Unless otherwise mentioned, the types of all species described by the present author are in his collection.

GASTROPODA.

Family STREPTAXIDAE.

The arrangement which follows of this family is that adopted by Pilsbry in his work on the Belgian Congo, 1919 (Bull. Amer. Mus. N. H. xl.).

Subfamily STREPTAXINAE.

Genus Gonaxis, Taylor, 1877.

Gonaxis gwandaensis (Prest.), 1912.

1912. *Streptaxis gwandaensis* Prest., A.M.N.H. ix, p. 69, f. 1. D.F.

Hab. L. Marques. Wanetsi River, Magude District (Bell Marley).

A very typical example of this rare species, only known hitherto from its original locality in Southern Rhodesia. It is perfectly figured by Preston.

Gonaxis kirki (Dhrn.), 1865.

1865. *Streptaxis kirki* Dhrn., P.Z.S., p. 232. D.

1905. ,, (*Gonaxis*) *kirkii* Dhrn., Kob., Conch. Cab., p. 8, pl. 42, f. 14–15. D.F.

Hab. L. Marques. Mtisherra R. Valley (Cressy).

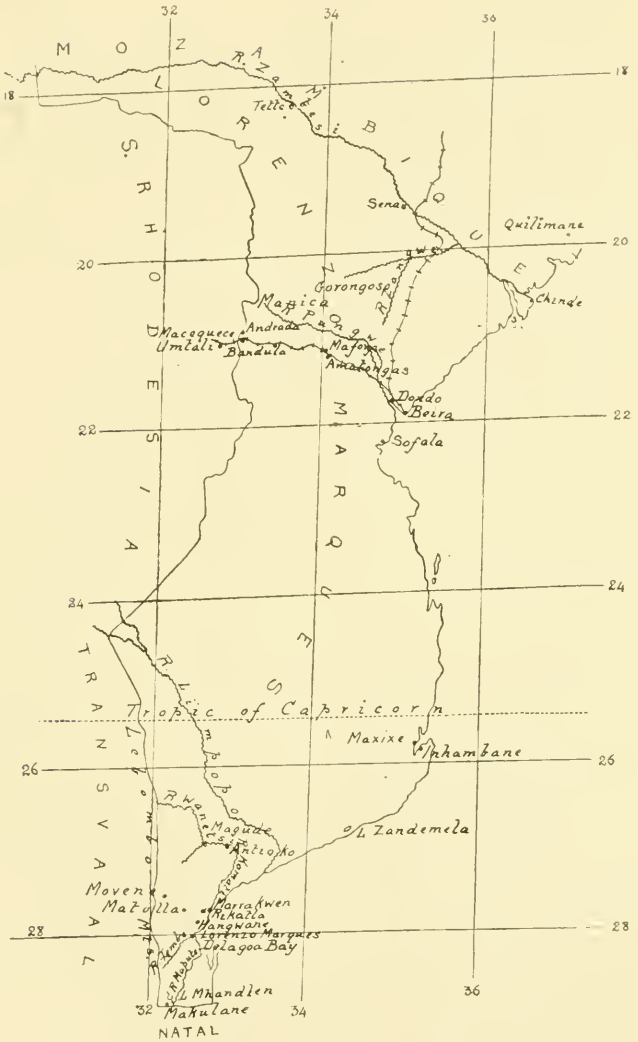
A well-sculptured shell of moderate size, with extremely distorted axis. It was described from Mumba I., Lake Nyasa, and is the first of several species from Nyasaland to be noticed in the following pages.

Gonaxis cressyi Conn., 1922.

(Plate IV, fig. 1.)

1922. *Gonaxis cressyi* Conn., A.M.N.H. x, p. 113. D.

Hab. L. Marques. Mtisherra R. Valley (type); Dondo; Zangwe Basin (Cressy).



Rough Map of Lorenzo Marques.

Showing the approximate position of most of the localities quoted. Of those not shown, Mt. Vengo is about 15 miles north of Macequece; the rivers Tristão and Inyamkarrara are near Andrada; the R. Mtisherra cuts the B. and M. Railway some distance east of Amatongas. I have been unable to find Masiene, Nyiwan, and Mungurumbe on any available atlas, but all three localities are on, or not far from, the coast in the southern portion of the territory.

Nearest to *G. denticulatus* (Dhrn.) (=*ordinarius* Smith) and *G. gibbonsi* Taylor, but differing from both by reason of its rather less distorted axis.

Subgenus EUSTREPTAXIS Pfr., 1878.

Gonaxis (*Eustreptaxis*) *elongatus* (Fulton), 1899.

(Plate V, figs. 1–3.)

1899. *Streptaxis elongatus* Fulton, Proc. Mal. Soc. iii, p. 302, fig. 2. D.F.

Hab. L. MARQUES. District north of Macequece (Cressy).

This fine species was founded on a couple of shells from an unknown locality; it is therefore satisfactory that its true habitat is determined.

The parietal tooth appears to be formed after maturity, as I have seen a specimen in which the reflexion of the peristome is practically complete, but with no sign of the dental process. Young shells are clearly perforate to the apex.

The average size of the species is about 23×14 mm., but I have seen an individual as large as 28×14½ mm., rather suggesting the result of a cross between *elongatus* and *vengoensis*.

Some notes on the anatomy of a young specimen are given below:—

External features and pallial organs.—The foot-sole is undivided, and there are no peripodial grooves. The hind end of the foot is bluntly pointed. There is no keel, but a median posterior groove is present. The two anterior dorsal grooves are rather close together, and, on each side of these, other grooves run forwards and slightly downwards on the neck (Pl. V, fig. 1). The two lower tentacles are apparently bifid, as is sometimes the case in carnivorous snails.

The right body-lobe is rather large; the left is divided into a broad right portion, and a small, triangular left portion, as shown in the upper part of fig. 1.

The main pulmonary vein has a number of slender branches. The kidney seems to be rather short. The ureter arises from the front end of the kidney, runs back along its upper edge, and then curves round and runs forward just below the rectum. It appears to be closed throughout.

Internal characters.—The pedal gland, which lies in the lower part of the body-cavity, is long and somewhat contorted. It is broad for the 3 or 4 mm. of its length that lie in front of the ventral nerve-ganglia; but the remaining portion, about 6 mm. long, is much narrower, although still having some glandular tissue.

The cerebral ganglia are much longer than broad (their length being measured in an antero-posterior direction). They are close together, and in the specimen examined they lay in front of the opening of the oesophagus.

The buccal ganglia are situated some distance further back, at the anterior end of the odontophore, and are also close together, the buccal commissure being unusually short.

The muscular odontophore is about 6 mm. long, and is curved as shown in Pl. V, fig. 3. The following are its principal intrinsic muscles : Externally there is a moderately thick sheath composed almost entirely of muscle-fibres running in a circular direction. When this is cut open, another cylindrical structure is disclosed within the outer sheath, the bottom and sides of which are formed of the semitranslucent odontophoral support or "cartilage," while the top consists of a thick compact layer of transverse muscle-fibres uniting the two edges of the support (text-fig. 1 B). There also arises from the outer edge of the support on each side a longitudinal series of slender muscles, which curve downwards and unite with the outer sheath. Towards the front end of the odontophore other slender muscles arise from the same place, but curve upwards and unite with the top of the sheath. These suspensor muscles are dotted in the diagram. The anterior part of the radula is folded over the front of the odontophoral support, and extends backwards beneath its anterior half, in a posterior ventral pocket of the buccal cavity. A broad longitudinal muscle runs back from the hind end of this pocket, as shown in the section and in Pl. V, fig. 2. The latter figure also shows the powerful longitudinal retractors of the radula-sac, as seen after the removal of the odontophoral support and the transverse muscles connected with it. Most of these retractors are inserted close to the front end of the narrow radula-sac, which they practically surround. Of these the lowest pair of muscles is the largest, while those above the radula-sac consist of a number of small, separate strands. These latter muscles arise all along the edges of the odontophoral support, but the larger muscles below them seem all to have their origin at the posterior end of the support. In addition to these muscles inserted near the front end of the radula-sac, an unusually stout terminal retractor is inserted at its extreme hind end, and this muscle appears to be continuous with the extrinsic buccal retractor.

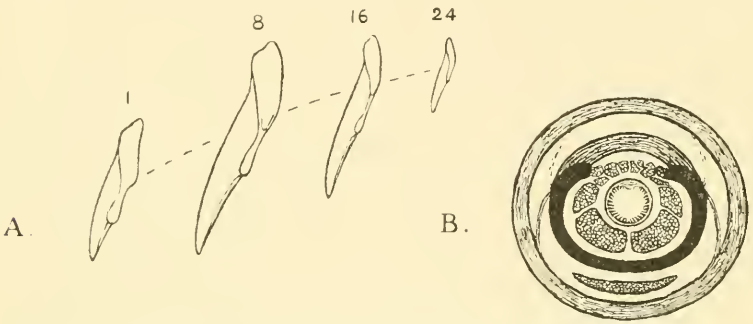
The radula itself is long and rather narrow, measuring about $8{\cdot}4 \times 1{\cdot}4$ mm. when flattened out. The teeth are all unicuspid, being of the aculeate type characteristic of the family, as will be seen from text-fig. 1 A. The rows form a conspicuous angle in the middle, and no central teeth are present. The teeth towards the middle of each row have somewhat shorter cusps than the others, but on the whole the shape of the teeth is fairly uniform. They gradually increase in size from the first until about the sixth on each side, and then become smaller again from about the tenth tooth to the edge of the radula.

Perhaps the most striking feature of the radula, doubtless mainly due

to its immaturity, is the great increase in the size of the teeth as they are followed backwards, those in the last rows of the radula being more than twice as large as those at the front end. Thus the length of the fourth tooth from the centre is ·125 mm. in the first few rows and ·255 mm. in the last. The distance between adjacent rows is proportionately increased towards the hind end, and at the same time the angle in the centre of each row becomes somewhat sharper, decreasing from about 130° in front to about 90° behind.

The radular formula is $(24+0+24)\times 86$.

The buccal mass in front of the odontophore is long and rather narrow, and extends backwards nearly 2 mm. behind the opening of the oesophagus.



Text-fig. 1.—*Gonaxis* (*Eustreptaxis*) *elongatus* Fulton, Macequece.

A. Representative teeth from the radula of a young specimen; ×140.
B. Diagrammatic transverse section through the odontophore of the same specimen.

The odontophore is thus situated much further back than usual (Pl. V, fig. 3). Possibly this elongation of the buccal mass may be in order to enable the odontophore to be thrust out further when the walls of the buccal mass are evaginated. In the specimen examined only the lips and the extreme front end of the buccal mass were protruded (fig. 1).

The oesophagus is not dilated to form a crop. The intestine is straighter, and, consequently, shorter, than usual, a modification often found in carnivorous animals.

The muscular system is also somewhat specialised. The columellar muscle consists of two main divisions, a broad and powerful ventral muscle to the foot, the so-called tail retractor, and another muscle, which first gives off the short, stout buccal retractor, and much further forward divides into both the right and the left tentacular retractors and the other muscles of the front of the head.

As the specimen examined was quite a young example, its reproductive organs were not sufficiently developed for description.

Gonaxis (*Eustreptaxis*) *vengoensis* Conn., 1922.

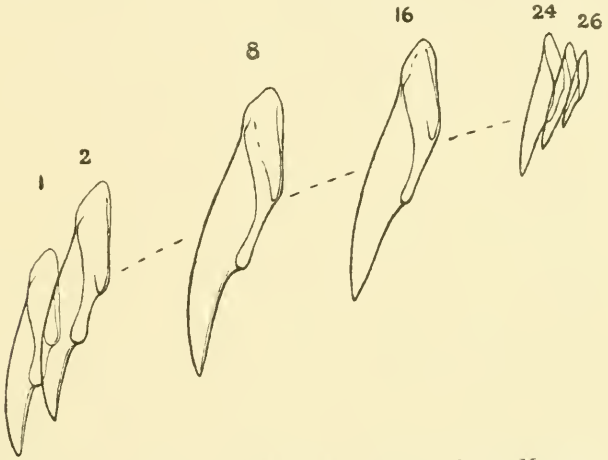
(Plate IV, fig. 2.)

1922. *Gonaxis* (*Eustreptaxis*) *vengoensis* Conn., A.M.N.H. x, p. 114. D.

Hab. L. Marques. District 15 miles N. of Macequece (Cressy).

A fine species, showing little variation in a good series collected at different times in various parts of the district. Immature shells are helicoid in form, roundly umbilicate, and bluntly keeled at the periphery, below which there is hardly any sculpture.

The animal differs from that of *Gonaxis* (*Eustreptaxis*) *elongatus* (Fulton)



Text-fig. 2.—*Gonaxis* (*Eustreptaxis*) *vengoensis* Conn., Macequece. Representative teeth from the radula; ×100.

in having numerous dark spots scattered over the roof of the mantle-cavity, whereas in *S. elongatus* there is only a single dark patch near the respiratory orifice. In most other respects, however, the animals of the two species seem to be very similar, and they are probably fairly closely related. Their radulae are remarkably like each other, although in the present species the cusps of the inner teeth seem to be slightly more curved and somewhat longer relatively to the length of the bases of the teeth. The number of teeth in each transverse row is 26+0+26. They gradually increase in size from the first to the sixth tooth on each side, and diminish again from about the thirteenth tooth to the outer edge of the radula. In a full-grown specimen the sixth to the thirteenth teeth may all attain a length of about ·4 mm. (text-fig. 2).

The character of the radula shows that this species is better placed in the subgenus *Eustreptaxis*, rather than in the closely related genus *Marconia*;

for in the species of *Marconia* that have been examined anatomically it has been found that the radula is of a somewhat specialised type, with two longitudinal zones of large teeth on each side separated by a zone of smaller teeth.*

Subfamily PTYCHOTREMATINAE.

Genus Gulella Pfeiffer, 1856.

Gulella perissodonta (Sturany), 1898.

1898. *Ennea perissodonta* Stur., S.A. Moll., p. 26, pl. 1, fig. 18. D.F.

Hab. L. Marques. Delagoa Bay (Penther).

Founded on a single specimen, which is described as having 9 teeth in the aperture. It is a small form, measuring 4·0×2·0 mm.

Gulella enneodon Conn., 1922.

(Plate IV, fig. 3.)

1922. *Gulella enneadon* Conn., A.M.N.H. x, p. 114. D.

Hab. L. Marques. District N. of Macequece (Cressy).

The type, 6·2×3·3 mm., with 7½ whorls, is of intermediate and, on the whole, average size and shape in a species which varies greatly in these respects, for the largest example seen contains 8 whorls, is cylindrical in form, and measures 8·0×3·5; apert. 1·6×1·6; last whorl 4·1 mm.; while a small one containing 7 whorls is truncate-ovate, and measures 5·8×3; apert. 1·5×1·2; last whorl 3·3 mm.

The sculpture and dentition are remarkably constant throughout a large series, the nine teeth being almost invariably conspicuous, though comparatively weaker in the largest examples; I have, however, seen one curious abnormality, in which the large tooth on the outer lip is single, but there is a second, smaller denticle on the left of the base.

The only close affinity of *G. enneodon* is with *G. perissodonta*, but Dr. Sturany, who has kindly compared them, informs me that they are quite distinct. The presence in both species of the mid-parietal denticle and the two small teeth low on the outer lip draws them very near together, but the sculpture of *enneodon* is finer, the aperture comparatively smaller, the whorls more numerous and the suture less deeply incised, which, together with the smaller size of *perissodonta*, should afford ample means of distinction between them.

* Thiele: Deutsch. Zentral-Afrika-Exped. (1907–08), vol. iii, 1912, p. 183, fig. vii (*Marconia latula* (Marts.)); Pilsbry: Bull. Amer. Mus. Nat. Hist., vol. xl, 1919, pp. 172, 173, fig. 61 (*Marconia lata ruwenzoriensis* Pils.); Peile in Connolly: Ann. and Mag. Nat. Hist., ser. 9, vol. x, 1922, p. 488 (*Marconia margarita* (Preston), a form in which the outer large teeth are not quite so well developed as in the two preceding species).

The specific name was inadvertently misspelt in 1922; the correct rendering is *enneodon*.

Gulella sexdentata (von Martens), 1869.

1869. *Ennea laevigata* Dhrn., var. *sexdentata* Mts., Nachr.-Bl. d. Mal. Ges. i, p. 154. D.

1890. *Ennea hanningtoni* Smith, A.M.N.H. vi, p. 161, pl. 6, fig. 4. D.F.

Hab. L. Marques. Mtisherra R. Valley; Dondo; Zangwe Basin (Cressy).

The smooth northern cousin of the southern *G. gouldi* (Pfr.), to which it bears a close general resemblance except for the lack of visible sculpture. The species was originally founded by von Martens as a six-toothed variety of *laevigata*, so there is small wonder that Smith overlooked it when he described and figured it under the name of *hanningtoni*.

Its distribution extends northward as far as Zanzibar, and it has been recently taken at Gwelo in Southern Rhodesia.

Gulella infans (Crvn.), 1880.

1880. *Ennea infans* Crvn., P.Z.S., p. 616, pl. 57, fig. 6. D.F.

Hab. L. Marques. Masiene (Lawrence).

A single small specimen, differing slightly from typical *infans*, but resembling a set in my collection from Matopos, Rhodesia. The striation is weaker, the sinulus more pronounced, and the tooth on the outer lip a little nearer the paries than in *infans*, but all these discrepancies are very slight. Moreover, Watson reports that there is no marked difference between the male organs in the anatomy of the Matopos animals and those of typical *infans* from Pietersburg, Transvaal; in the radula of the former, the teeth are slightly broader and a little less strongly curved towards their anterior ends, and there are not quite so many of them in each transverse row as in *infans*. These differences, however, are very small, distinctly less than those that separate the radulae of *infans* and *tristãoensis*, and in his opinion do not prove that the Matopos examples belong to a distinct species.

Gulella praelonga Conn., 1922.

(Plate IV, fig. 5.)

1922. *Gulella praelonga* Conn., A.M.N.H. x, p. 115. D.

Hab. L. Marques. Mount Vengo, Macequece (Cressy).

The type contains $7\frac{1}{2}$ whorls and measures $8{\cdot}8\times3{\cdot}5$ mm. The largest example seen, with $8\frac{1}{2}$ whorls, measures $9{\cdot}6\times3{\cdot}4$, and a peculiarly small one, with $7\frac{1}{2}$ whorls, $7{\cdot}2\times3{\cdot}0$ mm.

This giant member of the *infans* group calls to mind the Mascarene

genus *Gonospira* Swainson, but differs from it in the presence of a tooth on the outer lip, a character which also separates it from *Gibbulina expatriata* Preston, from Kenya Colony. In fact, there appears to be nothing much like it among African species.

Gulella tristãoensis Conn., 1922.

(Plate IV, fig. 6.)

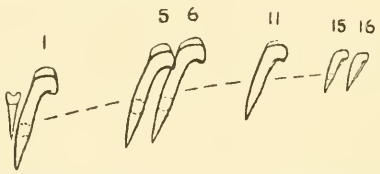
1922. *Gulella tristãoensis* Conn., A.M.N.H. x, p. 115. D.

Hab. L. Marques. District N. of Macequece (Cressy).

The type measures 5·3×2·3 mm.; the last whorl, by which throughout all my works I mean the distance from the extreme base of the aperture to the centre of the suture directly above it, a most important measurement, is 2·8 mm.

The foot of the animal shows distinct peripodial grooves, cutting off a rather broad foot-fringe.

The radula (text-fig. 3) is long and narrow, that of an immature specimen



Text-fig. 3.—*Gulella tristãoensis* Conn., Headwaters of River Tristão. Representative teeth from the radula of an immature specimen; ×500.

measuring 1·9×·25 mm. when flattened out. The teeth are of the aculeate type, and are nearly straight except at the anterior or basal end, where they are abruptly curved outwards as shown in the figure. The central tooth is small and degenerate, although furnished with a distinct, sharply pointed cusp. The other teeth increase very slightly in size from the first to about the fourth on each side, and then diminish again towards the outer margins of the radula, the last two or three teeth being as small as the central tooth, and relatively broader and shorter than the larger teeth, which closely resemble one another in form. The apophyses, which are situated about half-way up the cusps, are extremely low and inconspicuous. The largest teeth in each row measure about ·03 mm. in length, except near the front end of the radula, where they are scarcely ·02 mm. long. In the centre the rows of teeth form an angle of about 120° towards the hinder part of the radula, but the angle becomes more obtuse towards the front end, where the rows are also nearer together, being less than ·01 mm. apart. These differences at the front end of the radula are probably partly due to the immaturity of the specimen. The radular formula is: (17+1+17)×121.

The radula of a specimen of *Gulella infans* (Crvn.), from Pietersburg in the Transvaal, differs somewhat from that described above. The cusps of the teeth are a little shorter relatively to the curved bases ; they point more directly backwards ; the apophyses are more prominent ; and the radula is not so long, the formula being : $(21+1+21)\times 89$.

While disinclined to add another species to the already over-elaborated *infans* group, the Macequece shells differ so greatly from typical *infans* in the appearance of the last whorl that, taking into consideration the difference in the radula, it appears to me that specific, rather than varietal, distinction is advisable.

The measurements of three other shells from Macequece are : shell 4·6, last whorl 2·6 ; shell 5·0, last whorl 2·8 ; and shell 5·4, last whorl 2·9 mm., the last whorl thus considerably exceeding half the total length of the shell, whereas in *infans* it averages about one-half of the total length.

Distributed very sparingly with the foregoing are a few examples which would have been mistaken for a distinct species if encountered alone. They are longer and broader than the majority of the local race, with the appearance of weaker sculpture and dentition, though these features are really normal, the apparent weakness being due to the superior size of the shells.

Two specimens measure $6\cdot7\times 2\cdot9$, last whorl 3·4 ; and $6\cdot3\times 2\cdot6$, last whorl 3 mm., respectively.

Gulella perspicuaeformis (Sturany), 1898.

1898. *Ennea perspicuaeformis* Stur., S.A. Moll., p. 17, pl. 1, fig. 2. D.F.

Hab. L. Marques. Delagoa Bay (Penther).

A minute species well illustrated by its author.

Gulella farquhari (Melv. and Pons.), 1895.

1895. *Ennea farquhari* M. and P., A.M.N.H. xvi, p. 478, pl. 18, figs. 3–5. D.F.

Hab. L. Marques. Mount Vengo, Macequece (Cressy).

One of several instances, to be hereinafter mentioned, of a minute species, only known hitherto from the extreme south of the continent, occurring over 1000 miles to the north without an intermediate locality. The Macequece shells are nearer the type than are either of the varieties *advena* Bnp., or *berthae* M. and P., the most noticeable points of difference lying in the somewhat smoother surface and wider, and therefore less obstructed aperture, while the tooth on the outer lip is usually narrower and less inclined to be bifid than in typical *farquhari* ; they do not appear to me to be varietally distinct.

Gulella kraussi (Pfr.), 1855.

1856. *Ennea kraussi* Pfr., Novit. Conch. i, p. 73, pl. 20, figs. 14–16. D.F.

Hab. L. Marques. Delagoa Bay (in British Museum).

A tablet from the Cuming collection labelled as above bears 3 examples of this species, presumably collected by Plant, as were those on an adjacent tablet, also from the Cuming collection, labelled Natal.

There is nothing inherently improbable in either this or the following species, both prominent Natal forms, extending up the coast to Delagoa Bay, but neither of them has been collected there since the days of Cuming, and it appears questionable whether his locality is correct, or whether the shells may not rather have become accidentally separated from a parcel from Natal.

Gulella wahlbergi (Krauss), 1848.

1848. *Pupa wahlbergi* Krs., Südafr. Moll., p. 80, pl. 5, fig. 5. D.F.

1898. *Ennea transiens* Stur., S.A. Moll., p. 19, pl. 1, fig. 4. D.F.

Hab. L. Marques. Delagoa Bay (Plant, in British Museum).

The original figures of *wahlbergi* and *transiens* only differ by the large palatal tooth appearing, in *wahlbergi*, to have the upper cusp more prominent and nearer the surface than the lower one, whereas in *transiens* it is accurately represented, as found in this common Natal species.

However, Dr. Baini Prashad has kindly compared typical examples of *transiens* with the type of *wahlbergi* in the Stuttgart Museum, and writes: "The specimens of *transiens* Stur. do not differ in any way from Krauss' unique type of *wahlbergi*. The outer lip has the big tooth absolutely identical in specimens of *transiens* and *wahlbergi*, and I can see no difference between the two."

Under these circumstances it is evident that Krauss' figure is inaccurate, and Sturany's name must be placed in synonymy.

Gulella cf. *laevigata* (Dhrn.), 1865.

(Plate IV, fig. 4.)

1865. *Ennea laevigata* Dhrn., P.Z.S., p. 232. D.

1881. ,, ,, ,, Smith, P.Z.S., p. 281, pl. 32, fig. 6.* N.F.

1893. ,, *karongana* Smith, P.Z.S., p. 633, pl. 59, fig. 2. D.F.

1899. ,, (*Gulella*) *laevigata* Dhrn., Smith, P.Z.S., p. 580. N.

Hab. L. Marques. Maforga Siding, B. and M. Rly. (Mcdowell).

Described from Mumba I., Lake Nyasa (Kirk), this species was recorded by Smith in 1881 from between L. Nyasa and the east coast (Thomson), and in 1899 from Zomba Plateau; Masuku Plateau; Nyika Range, and Mt. Chiradzulu, all in Southern Nyasaland.

In 1881 he wrote: "Like several species of Ennea, this also varies much in size. Those described by Dohrn were $\frac{5}{16} \times \frac{1}{8}$ in., whilst the specimens collected by Mr. Thomson are $\frac{7}{16} \times \frac{3}{16}$ in."

In 1899 he remarked: "Somewhat variable in size and in the development of the upper of the two labral teeth. This in the type is somewhat bifid or tuberculated, as described by Dohrn, whereas in the specimens in the present collection it is simple, sometimes of the same size as the adjacent tooth, but sometimes a trifle larger."

The Maforga shells agree with those last mentioned by Smith from Chiradzulu and Zomba Plateau; the upper labral tooth is perfectly simple, and I doubt whether they are not distinct from Dohrn's species. However, the group of somewhat ordinary, smooth, 5-toothed shells, which includes *laevigata* Dhrn., *quinquedentata* C. Bttg., and *tudes* and *planidens* Mts., is at present in far too deeply involved condition for me to add another name, until it has been possible to inspect large series of the last three species.

The type of *E. karongana* Smith is an exact representative of typical *laevigata*, showing fully the bifidity of the upper labral tooth, and must be relegated to synonymy.

Gulella nepia sp. n.

(Plate IV, fig. 7.)

Shell small, cylindrical, rimate, smooth, glossy, pale olivaceous. Spire produced, sides straight and parallel, apex very obtusely angulate. Whorls 6, nearly flat, gradually increasing, devoid of sculpture save for a few distant, irregular, oblique growth lines; suture simple, shallow. Aperture subquadrate, peristome reflexed, dentition 3-fold: a protruding, incurved, not deeply entering lamella on the extreme surface of the paries at its junction with the outer lip; a small blunt tubercle, without any external depression, slightly within the margin half-way up the outer lip, and an exactly similar tubercle half-way up the columella; callus rather thick.

Long. 5·3, lat. 2·2; apert. alt. 1·3, lat. 1·1; last whorl 2·75 mm.

Hab. L. Marques. Macequece District (Cressy).

A member of the very small group, in which the principal columellar process is situate half-way down the columella instead of at its upper angle. The Kenyan *G. pervitrea* (Preston), perhaps its nearest ally, is an altogether larger species.

Gulella distincta (Melv. and Pons.), 1893.

1893. *Ennea distincta* M. and P., A.M.N.H. xi, p. 22, pl. 3, fig. 10. D.F.
1898. ,, *eximia* ,, ,, i, p. 28, pl. 8, fig. 8. D.F.

Hab. L. Marques (?). Between Barberton and Delagoa Bay (fide M. and P.).

I have recently * shown that *G. distincta*, originally recorded from Middelburg, Transvaal, is identical with *eximia*, originally recorded from the locality mentioned overleaf, the vagueness of which makes it, of course, doubtful whether the species really extends its range into Portuguese territory; it has recently been rediscovered at Barberton.

Family RHYTIDIDAE.

Genus Natalina Pilsbry, 1893.

Natalina wesseliana (Maltzan), 1876.

1876. *Helix caffra* Fér., var. *wesseliana* Maltz., Kob., Jahrb. D. Mal. Ges., iii, p. 149, pl. 5, fig. 1. D.F.

Hab. L. Marques. Rikatla (Junod).

This species, of which the locality was then unknown, was first differentiated as a variety of *caffra* in the words: "differt a typo testa obtecte perforata, fere exumbilicata, anfr. ult. valde depresso. Alt. 56, lat. 48 mm."

In 1903, when illustrating a similar specimen, also from an unknown locality, von Möllendorff wrote that if its finding-place, and its distribution relative to *N. caffra*, were sufficiently known, it would probably be constituted a distinct species instead of a mere variety.

N. wesseliana is now proved to occur as a constant form in the vicinity of Delagoa Bay, while there are no authentic records of *caffra* from near that locality. The shells differ so greatly in form that von Möllendorff's inference seems fully justified.

Natalina caffrula Melv. and Pons., 1898.

1898. *Natalina caffrula* M. and P., A.M.N.H. i, p. 24, pl. 8, fig. 1. D.F.

Hab. L. Marques. Matolla (Penther).

I have been unable to verify the accuracy of this determination.

Natalina kraussi (Pfeiffer), 1846.

1848. *Helix kraussi* Pfr., Krs., Südafr. Moll., p. 77, pl. 4, fig. 24. D.F.

1851. „ *sturmiana* Pfr., P.Z.S., p. 253. D.

1878. *Macrocystis sturmiana* Pfr., Nomenclator, p. 62. L.

1879. *Ampelita* „ „ „ p. 184. L.

Hab. L. Marques. Delagoa Bay (*sturmiana*, fide Pfeiffer).

The type of *sturmiana*, from the Cuming collection, is in the British Museum. It is from an unknown locality, but in the Nomenclator, where this species is placed in two different genera, it is assigned the locality

* Proc. Mal. Soc. xv, 1922, p. 71.

Delagoa, or Dalagoa, Bay. The type of *sturmiana* agrees almost exactly with authentic examples of *kraussi*, as does Pfeiffer's description of the one with that of the other, and the circumstances under which they were ever separated are inexplicable.

The true home of *kraussi* appears to be in the south of the Cape Province, and it is most unlikely that it occurs in Portuguese East Africa.

Family ZONITIDAE.

Subfamily HELICARIONINAE.

Genus Helicarion Férussac, 1821.

Subgenus gymnarion Pilsbry, 1919.

Helicarion (*Gymnarion*) *nyasanus* Smith, 1899.

(Pl. V, figs. 4–8.)

1899. *Helicarion nyasanus* Smith, P.Z.S., p. 582, pl. 33, figs. 9–10. D.F.

Hab. L. Marques. District north of Macequece (Cressy).

The shells of many members of this subfamily resemble each other so closely that it is almost impossible to identify a species by the shell alone. I can find no material difference between a large series from Macequece and the type of *nyasanus*, a species which appears to be widely diffused throughout Southern Nyasaland, so that its extension to Macequece is by no means improbable. However, the animal of the Nyasaland race is unknown, while that from Macequece has been available for dissection; I therefore append a description of the latter's shell in case some future anatomist finds the animals distinct:—

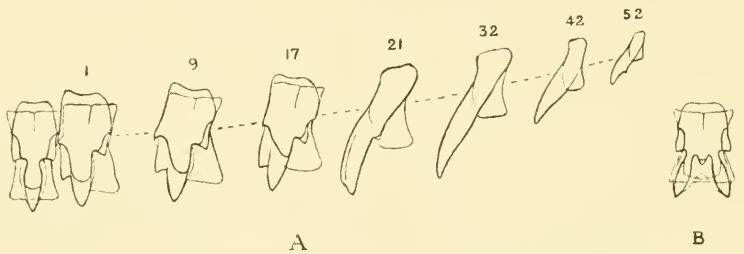
Shell imperforate, subnautiloid, very thin, translucent, dull above, somewhat iridescent beneath, apex light brown, remainder pale olivaceous. Spire flat, apex rounded. Whorls 3, very rapidly increasing, flat above, rather narrowly rounded at the periphery; protoconch, 1½ whorls, engraved with close, microscopic, dotted spiral grooves and showing a few faint transverse wrinkles, remainder rather irregularly sculptured with close, faint striae, following the shape of the outer lip and covered by a very minute microscopical granulation; suture subfiliform. Aperture ovate, peristome thin, simple, straight above until near the periphery, when it recedes sharply; gently curved beneath; columella concave, very weak.

Diam. maj. 17·0, min. 13·3; alt. 7·9; apert. alt. 8·3, lat. 10·5 mm.

The following notes on the anatomy are derived from two examples, neither as large as that described above, but of which one may be considered almost mature.

External features of the animal (Pl. V, figs. 4–6).—The foot-sole is tripartite, owing to the presence of a pair of longitudinal grooves. The foot is truncate at the hind end, and has a caudal mucous pore, over which there projects a short pointed caudal lobe. The foot-fringe is rather broad, and bounded by a conspicuous peripodial groove. Above this there is another peripodial groove, separated from the lower one by a single row of rugae. A rather irregular, median posterior groove is present, and oblique grooves slope down from this to the upper peripodial groove. There is no keel. A well-marked lateral groove runs down on the right side of the head, but the dorsal grooves and the left lateral groove are less conspicuous.

The body-lobes are broad, the left being undivided, and rather narrow shell lobes are also present. The exact form of these pallial lobes will be seen from figures 4 and 5.



Text-fig. 4.—*Helicarion* (*Gymnarion*) *nyasanus* Smith, Macequece.
A. Representative teeth from the radula ; ×250.
B. Central tooth from the radula of another specimen ; ×250.

The animal is of a light colour, except for two dark bands which run for a short distance along the sides of the hind end of the foot. The thin skin over the upper part of the liver and kidney is almost entirely covered with opaque white pigment, and white flecks seem to be scattered over the roof of the lung, and even on the under-side of the kidney. This organ appears to be long and narrow, but unfortunately the pallial organs of the two specimens examined were not sufficiently well preserved for further description.

Digestive system.—The jaw (fig. 8) is very pale brown, and about 2 mm. long. It has a prominent projection in the centre, but is otherwise smooth, excepting for the lines of growth.

The radula of the larger specimen examined (text-fig. 4, A) measures 4·7×2·2 mm. when flattened out. The central and lateral or admedian teeth are tricuspid ; the endocones, however, tend to become united with the mesocones in the outer lateral teeth. The marginal teeth, which are twice as numerous as the laterals, are mostly unicuspid, having single, long, narrow cusps ; but in the three or four transitional teeth next to

the laterals, and in a few of the outer marginals, a more or less vestigial ectocone is present ; and in some of the latter one or two minute additional cusps can also occasionally be seen on the outer side of the mesocone. The rows of teeth curve slightly forwards on each side. The radular formula is $(39+18+1+18+40)\times 114$.

In the smaller specimen the radula measures $4{\cdot}5\times 2$ mm., and its formula is $(39+15+1+15+39)\times 109$. The lateral and marginal teeth are similar to those of the larger specimen, but the centrals are abnormal, having two large cusps and three small ones, as shown in text-fig. 4, B. It is not very uncommon to find similar abnormalities among lateral or marginal teeth, but in such cases it is natural to suppose that two adjacent teeth may have become abnormally united. If, however, the central tooth had become united with the first lateral on one side, we should have expected that this abnormal tooth would have been markedly asymmetrical. As this is not the case, it seems likely that in the present instance we have a mutation in which the central tooth has been almost doubled ; or, if the central tooth be regarded as having been originally formed by the union of two lateral teeth, perhaps we may be dealing with an example of reversion in which this union has been abnormally arrested before becoming complete. That this abnormal tooth is weaker than the others is suggested by the fact that it is missing from several of the rows at the front end of the radula.

The buccal mass is large and muscular, and the radula-sac is completely embedded within it, instead of its hind end projecting as a papilla. The oesophagus leads into a capacious crop (fig. 7). The salivary glands lie on each side of the crop, but are loosely united above it ; they are very large, especially the left one. The nerve-ring surrounds the oesophagus, salivary glands, and buccal retractors, behind the buccal mass. The various ganglia are enclosed in much connective tissue, and are rather closely approximated, the commissures and connectives being short.

Free retractor muscles (fig. 7).—The buccal retractor and the two tentacular retractors are separate almost from their origin. The buccal retractor divides into a right and a left portion, separately innervated, a considerable distance behind the buccal mass. The retractor of the right upper tentacle passes between the penis and the vagina. Another muscle, quite distinct from the last, runs along the right side of the animal to the head. No definite muscle could be found passing from the columella to the foot. The penial retractor arises from the diaphragm.

Reproductive organs (fig. 7).—Unfortunately the reproductive system was not fully developed in either of the specimens examined, but it is evidently of a comparatively simple type. The receptaculum seminis is large and bluntly pointed posteriorly, and is borne on a rather short receptacular duct. The vagina is of no great length, and seems to be without

any accessory organs. The vas deferens becomes slightly convoluted and swollen next to the penis, forming an incipient epiphallus, but no trace of a flagellum could be found. The penis is rather small, but this is probably due to the immaturity of the specimens.

Affinities.—This species appears to belong to the subgenus *Gymnarion* Pilsbry.* It bears a considerable resemblance to *Helicarion gomesianus* Morelet in its radula and in the coloration of the animal, as well as in its reproductive organs being without flagella ; but it differs from that species not only in having a more pronounced caudal lobe, but also in lacking an amatorial organ.† According to Thiele, *H. welwitschi* Morelet appears to resemble the present form more closely in its reproductive system, but in that species the marginal teeth of the radula retain distinct ectocones.‡ The other African species of *Helicarion* that have been dissected seem to differ still more from the present species in their anatomy, notwithstanding the general resemblance of their shells.

Genus Kerkophorus G.-Austen, 1912.

Kerkophorus poeppigi (Menke), 1846.

1854. *Vitrina poeppigii* Mke., Pfr., Conch. Cab., p. 17, pl. 2, figs. 13–15. D.F.

Hab. L. Marques. Rikatla (Junod).

Included in Junod's list of 1899 ; I have not seen examples from the locality.

Genus Gudeëlla Preston, 1913.

(= *Thapsiella* Gude, 1911, non Fischer, 1884.)

This genus was founded for numerous small zonitoid species, originally attributed to *Thapsia* Albers, but very much smaller than the type of the latter, *troglodites* Morelet.

Pilsbry (1919) considered that there was not room for both genera, but it is certainly convenient to have a distinct name for the smaller forms, and the fact that I am able to give some details as to the anatomy of *Gudeëlla* furnishes additional cause for preserving the genus-name until the anatomy of the larger species is known.

* Pilsbry : Bull. Amer. Mus. Nat. Hist., vol. xl, 1919, p. 275 ; Watson : Proc. Malac. Soc., vol. xiv, 1920, p. 112.

† Watson : *ibid.*, pp. 91–96, pl. iii.

‡ Thiele : Deutsch. Zentral-Afrika-Exped. (1907–1908), vol. iii, 1912, pp. 190, 191, 198, text-fig. xii.

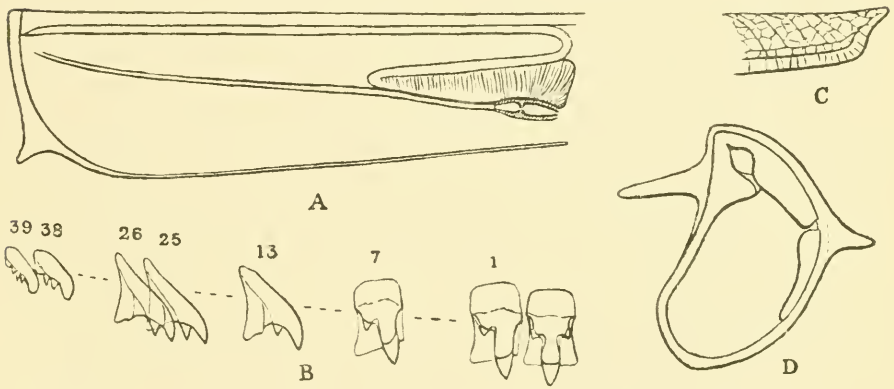
Gudeëlla mixta (Smith), 1899.

1899. *Thapsia mixta* Smith, P.Z.S., p. 582, pl. 33, figs. 13–15. D.F.

Hab. L. Marques. Macequece District ; Dondo ; Mtisherra R. Valley ; Zangwe Basin (Cressy) ; Maforga Siding (Medowell).

Described from Mt. Chiradzulu, this widely distributed species appears to extend northwards to Kenya, where it has been collected by Kemp at Rúmruti, and westwards to the Belgian Congo, whence I can find no valid grounds for separating from it shells collected by Dyke at Boteke and Leverville.

While very constant in form, it varies considerably in colour, which



Text-fig. 5.—*Gudeëlla mixta* (Smith), Macequece.

A. Roof of mantle-cavity seen from the outside, showing kidney, etc. (slightly diagrammatic) ; ×8.
B. Representative teeth from the radula ; × 600.
C. Hind end of foot seen from the left side ; × 10.
D. Mantle-edge seen from the front, showing pallial lobes ; ×13.

may be lacteous, corneous, or even bicoloured, and in the strength of its spiral sculpture on both sides, but every intermediate grade seems to exist, so that it is inadvisable to attempt separation. *Zonitoides cupido* M. and P. appears identical with Smith's species and will probably have to be placed in synonymy.

The foot of the animal of *mixta* (text-fig. 5, C) is narrow, and ends posteriorly in a pointed lobe, overhanging the caudal mucous gland, which opens by a vertical slit. Peripodial grooves cut off a rather broad foot-fringe, and the sole is tripartite.

The mantle-edge (text-fig. 5, D) bears a couple of somewhat pointed shell-lobes. The right one is rather narrow, and nearly 1 mm. long in a dead, contracted animal ; the left is smaller, and somewhat triangular in form.

Well-developed body-lobes are also present, the left being divided into two distinct, but contiguous, portions.

The hinder end of the foot, the mantle-edge, and the roof of the mantle-cavity are all darkly pigmented. The kidney, on the other hand, is yellow, and therefore stands out conspicuously when the animal is extracted from its shell. This organ (text-fig. 5, A) is rather narrow and about 3 mm. in length, being practically three times as long as the pericardium. The ureter is speckled with dark pigment, and arises from the front end of the kidney, running back along its upper edge and then forwards again beside the rectum to the anus. A single pulmonary vein can be seen passing backwards from the neighbourhood of the respiratory orifice to the heart.

The radula (text-fig. 5, B) measures about 1·125×·6 mm. when flattened out. The central and lateral teeth are tricuspid. Their mesocones are rather long, projecting considerably beyond the posterior edges of the basal plates. The endocones of the lateral teeth are narrow and inconspicuous, being attached laterally to the mesocones; the ectocones are short, but quite distinct. The basal plates of these teeth have the usual somewhat quadrate form. The marginal teeth are narrow, and about three times as numerous as the laterals. They have narrow bases, and curved bifid cusps, which are composed of the mesocones and the slightly shorter ectocones.* Towards the edges of the radula the teeth become smaller and shorter, their mesocones become blunter, and their ectocones split up into two or three separate small cusps. The transverse rows of teeth trend slightly forwards on each side, forming an obtuse angle in the centre. The radular formula is: (31+10+1+10+30)×77.

Unfortunately in the only full-grown specimen available the internal organs were in such a bad state of preservation that it is impossible to describe the reproductive system, or to say anything definite about the affinities of this snail, although the character of the pallial lobes suggests that it may possibly be related to the South African forms which Godwin-Austen has placed in the Peltatinae.

Gudeëlla insimulans (Smith), 1899.

1899. *Thapsia insimulans* Smith, Proc. Zool. Soc., p. 583, pl. 33, figs. 16–18. D.F.

Hab. L. Marques. Headwaters of R. Inyamkarrara, 25 miles N.W. of Macequece, 4500 ft. (Cressy); Maforga Siding (Mcdowell).

A flatter, more compact little shell than the preceding, but with somewhat similar distribution, as, in addition to the type locality, Mt. Chiradzulu,

* In one of the two radulae examined the ectocone was absent in the 10th, 11th, 12th, and 18th teeth on the left side, a rather interesting abnormality.

it has been collected by C. Harries in the Darugu River valley, Kenya Colony, and is recorded by Germain from the Krebedje District and Tété, in Oubangui.

Genus Zingis von Martens, 1878.

Zingis morrumbalensis (Melv. and Pons.), 1894.

1894. *Nanina morrumbalensis* M. and P., A.M.N.H. xiv, p. 90, pl. 1, fig. 1. D.F.

Hab. Mozambique. Mt. Morrumbala (type, Layard).

L. Marques. District north of Macequece (Cressy).

The type is somewhat immature, for the largest of Cressy's specimens measures: diam. maj. 30·3; min. 25·2; alt. 17·0 mm.

The shell is remarkable for the sculpture of its apex, which shows low radial folds for the first half whorl and is microscopically spirally striate for about the two succeeding ones, while the post-embryonic whorls are very finely and densely granulate, thus acquiring a dull appearance, which is in great contrast to the glossy apex.

The foot of the animal has well-marked peripodial grooves, curving upwards at the extremity. The skin over the mantle-cavity, etc. (in a young specimen), is spotted with dark pigment and opaque white patches. The kidney is not quite so long and narrow as in *Ledoulxia mozambicensis*, but extends for some distance in front of the pericardium. It forms a yellowish band on the outside, which contrasts with a black band immediately above it, marking the course of the primary ureter.

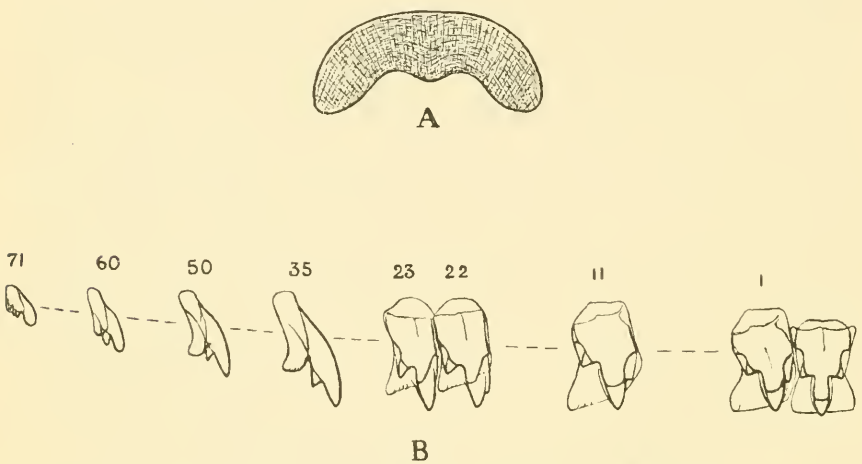
The jaw (text-fig. 6, A) is rather thin, with an obtuse median projection, and is about 3·3 mm. in length. It shows numerous extremely fine lines of growth crossed by equally fine radial striæ.

The radula (text-fig. 6, B) measures about 6·2 × 3·1 mm., when flattened out. The central and lateral teeth are tricuspid; their mesocones project slightly beyond the posterior edges of the basal plates; the endocones are rather narrow and about half the length of the mesocones, to which they are attached laterally; the ectocones are shorter but quite separate from the mesocones. The outline of the basal plates is strongly convex on the inner side and concave on the outer. The marginal teeth are more numerous and more closely crowded. They have narrow curved bases, and rather long bifid cusps, composed of a long curved mesocone and a smaller ectocone borne on its outer side. Towards the edges of the radula the teeth diminish in size, the points of the mesocones become rounded, and in a few of the outer marginals the ectocone becomes split into two, or even three, distinct small cusps. The last four or five teeth on each side are quite vestigial, suggesting that this species may have been evolved from one in which the

marginal teeth were even more numerous. The rows of teeth trend slightly forwards on each side. The radular formula is : (54+22+1+22+53)×128.

The radula of a young specimen measures about 4·8×2·1 mm., and differs slightly from that of the adult in that the ectocones of the marginal teeth are a little longer. Its formula is : (51+18+1+18+49)×132.

The remainder of the anatomy of this species is unfortunately unknown, the specimens examined being in a very bad state of preservation ; but the characters of the foot, jaw, and radula prove that it is rightly assigned to the Zonitidae, and that Möllendorff was wrong in transferring it in 1903 to the Rhytididae. It cannot be retained in the defunct *Nanina*,



Text-fig. 6.—*Zingis morrumbalensis* (M. and P.), Macequece.
A. Jaw ; ×9.
B. Representative teeth from the radula ; ×225.

but it is somewhat doubtful in what genus to place it. The shell, however, is very near akin to that of the common Nyasaland *Helix whytei* of Smith, which that author subsequently attributed to *Zingis* ; it may be well, therefore, to arrange the two species next each other in that genus until more is known of their anatomy.

Subfamily LEDOULXIINAE.

Genus Ledoulxia Bgt., 1885.

Ledoulxia bloyeti (Bgt.), 1889.

1889. *Trochonanina bloyeti* Bgt., Moll. de l'Afr. équat., p. 21, pl. 2, figs. 10–12. D.F.

Hab. L. Marques. Mtisherra R. Valley ; Zangwe Basin (Cressy).

Described from Kondoa, Usambara, and unknown hitherto from any

other locality except Zanzibar. Bourguignat mentions the striae as being spotted with white about the suture, which rather suggests a worn shell; Cressy's examples do not present this feature, but agree so closely in all other respects with the original figure and description that there can be no doubt as to the accuracy of their determination. The shell is remarkable for its flattened spire, with convex sides, and is easily recognisable.

Ledoulxia jenynsi (Pfr.), 1845.

1845. *Helix jenynsi* Pfr., P.Z.S., p. 131. D.

Hab. Mozambique. Querimba I. (Peters).

L. Marques. Tette (Peters). Zangwe Basin (Cressy).

The well-known white-shelled species with brown band at the periphery; its rediscovery in the Zangwe Basin tends to confirm the accuracy of von Martens' doubtful record of Tette.

Ledoulxia mozambicensis (Pfr.), 1855.

(Plate VIII, figs. 1–4.)

1855. *Helix mozambicensis* Pfr., P.Z.S., p. 91, pl. 31, fig. 9. D.F.

Hab. Mozambique (Stuhlmann; Gibbons; Frey).

L. Marques. Tette (type, Peters); Movene (Penther); Wanetsi R., Magude District (Bell Marley); Antioko; under stones in the Lebombo Mountains (Junod); Zangwe Basin; Mtisherra R. Valley (Cressy).

In view of some confusion over this species, for which Bourguignat is mainly responsible, it is necessary to recognise the fact that it was founded on only two shells, which are available for reference in the British Museum. One of these is very young, and the other, Pfeiffer's type, is considerably weathered and by no means full grown, measuring $12 \times 10\frac{1}{2}$ mm. in diameter and $6\frac{1}{2}$ mm. in height.

It is not, however, one of a race of small shells, as Bourguignat has written, but merely an immature example of the larger race which appears to have been rightly accepted by Smith, von Martens, Pilsbry, and Germain, to mention only four leading authorities of different nations, as representing Pfeiffer's species. The series from Lebombo Mountains, of which the anatomy is described below, appear to agree with the type in every respect, except that the aperture is comparatively a little more laterally compressed and slightly greater in altitude. It is therefore the more remarkable that Semper's account of the anatomy of specimens from the type locality shows some important points of difference from that of Watson, who reports as follows:—

Semper * and Godwin-Austen † have already partly described the

* Reis. Arch. Philipp., vol. ii. (3), 1870, p. 42, pl. iii, fig. 5, pl. vi, fig. 15.

† Proc. Malac. Soc., vol. i, 1895, pp. 281, 282, pl. xix, figs. 1–1*c*.

anatomy of specimens said to belong to this species, the German author's examples having been collected at Tette, the type locality; but their descriptions and figures do not altogether agree either with each other or with the anatomy of specimens collected by Junod in the Lebombo Mountains. It therefore seems advisable to give a brief account of the more important organs of the animals from this locality.

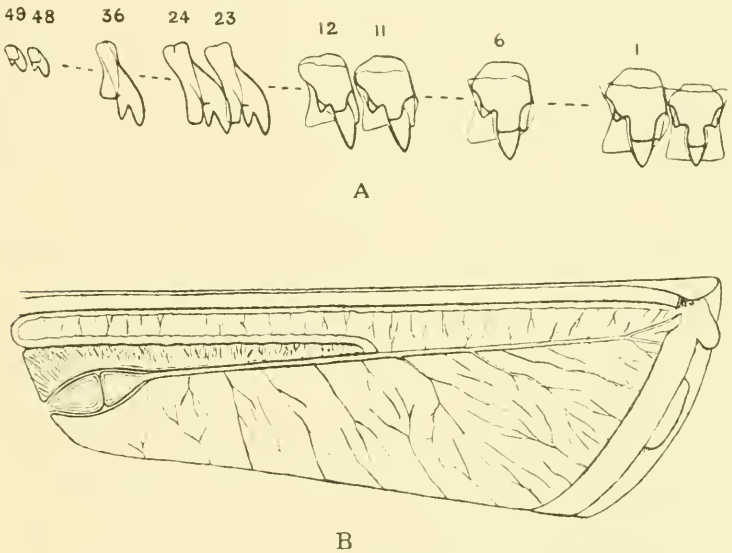
Foot.—The foot-sole is conspicuously tripartite by a pair of deep longitudinal grooves, the median area being of about the same width as the lateral areas towards the anterior end of the foot, but becoming narrower posteriorly. A large caudal mucous pore is present, extending as a vertical slit down to the extremity of the sole, and thus differing from Godwin-Austen's description and fig. 1*a*. The mucous pore is overhung by a pointed, pigmented, caudal process, which was abnormally bifurcated in one of the specimens examined (see Pl. VIII, fig. 2). In the other specimens it was intermediate in length between the long appendage figured by Godwin-Austen and the very short one shown in von Marten's drawings.* The foot-fringe is bounded above by a well-defined peripodial groove on each side, which bends up at the hind end in front of the mucous pore, and then runs along the side of the caudal process in normal specimens. Just above the peripodial groove a second horizontal groove runs along each side of the foot, and this receives oblique grooves, of which the more posterior arise from a median longitudinal groove on the top of the hinder part of the foot. This part of the foot is laterally compressed, but it bears no keel, such as Godwin-Austen mentions.

Mantle and pallial organs.—The mantle-edge bears the usual right and left body-lobes, the left being divided into two separate portions having the form shown in text-fig. 7, B. No shell-lobes are present. The thin skin covering the mantle-cavity and upper whorls is beautifully mottled with dark pigment and opaque white patches after the manner shown in Pl. VIII, fig. 1. The roof of the mantle-cavity or lung does not display a marked pulmonary reticulation, but numerous slender veins can be distinguished in addition to the large pulmonary vein which runs to the heart from the neighbourhood of the respiratory opening (text-fig. 7, B). Semper states that the kidney is short. In the specimens from the Lebombo Mountains it is long and narrow, being about 9 mm. long, that is to say about half the length of the mantle-cavity, with an average breadth of scarcely more than 1 mm. The ureter arises from its extreme front end, passes backwards along its upper edge, and then forwards immediately beneath the rectum as far as the anus, the secondary ureter being closed throughout.

Central nervous system.—The nerve ring (Pl. VIII, fig. 4) is small, and

* Deutsch-Ost-Afrika, vol. iv, 1897, pl. i, figs. 8, 8*a*, 8*b*.

surrounds the oesophagus, salivary ducts, and buccal retractor, being too narrow to allow the buccal mass to be retracted through it. The cerebral ganglia are united by a thick cerebral commissure, and each has a very prominent lateral accessory lobe. The right cerebral ganglion gives rise to the large penial nerve, in addition to the usual paired nerves. The buccal ganglia are rather obscurely bilobed. The cerebro-pedal and cerebro-pleural connectives are short, being considerably shorter than the cerebro-buccal connectives. The pedal ganglia bear the otocysts on their upper



Text-fig. 7.—*Ledoulxia mozambicensis* (Pfr.), Lebombo Mountains.

A. Representative teeth from the radula; ×350.
B. Roof of mantle-cavity seen from within, showing kidney, etc. (slightly diagrammatic); ×5.

surfaces; their ventral surfaces seem to be obscurely divided by slight transverse grooves into about three segments, of which the anterior pair is much the largest. The visceral loop is very asymmetrical, and its ganglia are all distinct from one another, though closely aggregated. The abdominal ganglion is obliquely elongated behind the large right parietal ganglion.

Digestive system.—The jaw measures about 1·5 mm. in length. It is rather thin and practically smooth, with a large median projection.

The radula (text-fig. 7, A) measures about $3{\cdot}\dot{3} \times 1{\cdot}5$ mm. when flattened out. The central and lateral teeth are tricuspid, the central being slightly smaller than the laterals. The endocones of the lateral teeth are not very conspicuous, being rather narrow and attached laterally to the stout

mesocones. The basal plates of these teeth have the usual somewhat quadrate form. The marginal teeth are more than three times as numerous as the laterals, and gradually decrease in size towards the edges of the radula. They have narrow basal plates, and strongly curved bifid cusps, formed of the mesocones and the somewhat shorter ectocones. The rows of teeth trend slightly forwards on each side of the middle line. The radular formula of the specimen figured is: $(42+11+1+11+40)\times 148$. That of another example is: $(35+11+1+11+36)\times 135$.

Semper's figure shows no endocones on the lateral teeth, and not even an ectocone on the tenth tooth, which may have been abnormal in the radula that he examined. He does not depict the marginal teeth, but states that they have typical bifid cusps. Godwin-Austen also shows no endocones on the lateral teeth, which he depicts as smaller than the central tooth and far narrower than they are in the specimens from the Lebombo Mountains. Moreover, he figures the marginal teeth as having very much smaller ectocones. If Godwin-Austen's figures are accurate there can be little doubt that the form he studied is specifically distinct from the one now described.

The crop is narrow, and the salivary glands are united above it.

Free retractor muscles.—The columellar muscle divides almost at its origin into four main branches: a powerful buccal retractor, which lies above the other muscles and is bifurcated in front; the right and left tentacular retractors, each of which gives off a stout branch to the anterior end of the foot before dividing into the retractors of the upper and lower tentacles; and a broad ventral muscle to the posterior part of the foot. The retractor of the right upper tentacle passes between the vagina and the penis. The penial retractor arises from the posterior end of the diaphragm, and is inserted in the epiphallus.

Reproductive system (Pl. VIII, fig. 3).—The hermaphrodite gland is embedded in the posterior division of the liver. The hermaphrodite duct is less swollen and convoluted than is often the case; it bears a small oval vesicula seminalis at its junction with the albumen gland. The common duct is of the usual form, as may be seen from the figure. The free oviduct is of moderate length, longer than in Godwin-Austen's figure; the vagina is short; and both are rather narrow. The genital atrium is small, and no dart-sac is present. The receptacular duct has muscular walls and is nearly twice the length of the free oviduct; posteriorly it merges gradually into the club-shaped receptaculum seminis or spermatheca, which has much thinner walls and lies against the common duct. Semper's figure shows an oval spermatheca, with a longer and more slender duct, swollen at its junction with the vagina. Godwin-Austen shows an organ a little less unlike that just described.

The slender vas deferens runs forward beside the female duct almost to the genital atrium ; it then bends round towards the penis and immediately enlarges to form the somewhat broader and extremely long epiphallus. At the junction of the vas deferens and the epiphallus the latter organ bears a minute oval calciferous sac or flagellum, so small that it might easily escape notice if it were not for its opaque white colour. The epiphallus passes backwards for nearly 6 mm. and then bends forwards again, giving off at the angle a rather long slender caecum. The penial retractor unites with the epiphallus just in front of the origin of this caecum, which seems also to be attached to the retractor at two points near its anterior end. The epiphallus then passes forwards to unite with the posterior end of the penis, which is nearly 4 mm. long and somewhat swollen, but has a slight constriction in the middle. Its walls are longitudinally folded within, and lined with very minute papillae. Towards its posterior end the penis bears on one side an oval glandular appendage, enclosed in a very thin sheath which surrounds also the extremity of the penis and the anterior end of the epiphallus. (This sheath is not shown in the figure.)

Semper and Godwin-Austen both figure a somewhat similar penis, but the German author states, possibly in error, that there is a " caecum musculi retractoris penis," in addition to the glandular appendage, the long caecum, and the very small calciferous sac. Godwin-Austen's drawings depict a far larger calciferous sac than that found in the animals from the Lebombo Mountains. Pilsbry's figures of the reproductive system of *Ledoulxia mesogaea* (Mts.) and *L. lessensis* Pilsbry * show that these species have the same type of genital organs as that described above, although they differ in detail.

The shells from the Mtisherra R. Valley differ rather noticeably from type. The whorls are tighter coiled, there being about three-quarters of a whorl more in a diameter of 12 mm. than in *mozambicensis*, and the sides of the spire are a little concave near the apex, so that the 2 apical whorls are somewhat mammillate, whereas in *mozambicensis* the sides are convex ; the transverse striation also appears very slightly stronger than that of *mozambicensis*.

Ledoulxia albopicta (Mts.), 1869.

1869. *Nanina mossambicensis* Pfr., var. *albopicta* Mts., von der Decken's Reisen, iii, p. 56, pl. 1, fig. 2. D.F.

1885. *Trochonanina anceyi* Bgt., Hélixarionidées, p. 9. D.

1897. ,, *jenynsi* Pfr., var. *subjenynsi* Ancey, Mts., D.-O.-A., iv, p. 49. D.

Hab. Mozambique (in coll. Ancey).

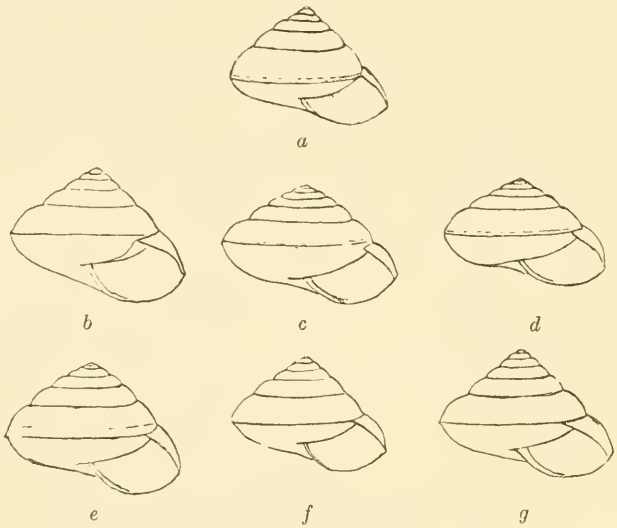
L. Marques. Tette (Peters).

* Bull. Amer. Mus. Nat. Hist., vol. xl, 1919, p. 246, fig. 111, p. 249, fig. 114.

I am not acquainted with authentic examples of von Martens' species, but the German author himself placed *anceyi* in the synonymy of *albopicta*, while *subjenynsi*, as represented in Ancey's collection, is identical with *anceyi*; it is a well-known species, remarkable for its brown and white mottling, quite distinct from *jenynsi* or *mozambicensis*.

Ledoulxia elatior (Mts.), 1866.

1866. *Trochomorpha? mossambicensis* Pfr., var. *elatior* Mts., Mal. Blätt. xiii, p. 92. D.



Text-fig. 8.—*Ledoulxia elatior* (Mts.).

Profile of shells from various localities.
(All figures slightly enlarged.)

a, Mtisherra R. Valley.
b, Bongo.
c, Itschongove.
d, Pangani.
e, Undussuma.
f, Langenberg.
g, Djur Mai.

1869. *Helix mozambicensis*, var. *elatior* Mts., Pfr., Novit. Conch. iii, p. 500, pl. 108, figs. 4–6. D.F.

Hab. L. Marques. Itschongove (Schenck); Mtisherra R. Valley (Cressy).

I am greatly indebted to Dr. J. Thiele, of the Berlin Museum, for the accompanying text-figs. 8*a*–8*g*, and remarks about this dubious species, which are so much to the point that I cannot do better than publish them in full.

"Under the name of *H. mozambicensis*, var. *elatior*, von Martens designated several shells from different localities, which I have drawn by the side of yours from the Mtisherra R. Valley. That from Bongo, Abyssinia, must be regarded as typical; below it is placed the shell figured by von

Martens. That from Langenburg differs through having less swollen whorls. All the shells figured are somewhat different from one another; it appears to me that the material is not extensive enough to decide whether they are varieties, or only local forms, of a single species, or, in part, distinct species. The embryonal sculpture is not always recognisable, since the shells are somewhat weathered, as is the case in that from Bongo; in some it consists of fine spiral striation."

It is clear from the foregoing that not much can be done towards the elucidation of this species until further topo-types from Bongo, in better condition, are available for examination. If Cressy's shells are correctly assigned, *L. elatior* is certainly quite specifically distinct from *mozambicensis*, having weaker sculpture and nearly always a higher spire. The first 2 whorls are rather strongly, closely, microscopically transversely wrinkled and extremely finely, faintly spirally striate; remainder very closely, finely, faintly, transversely striate, the striae being finer, fainter, and closer than in *mozambicensis*.

Subfamily SITALINAE.

Genus Sitala H. Adams, 1865.

Sitala diaphana Conn., 1922.

(Plate IV, fig. 8.)

1922. *Sitala diaphana* Conn., A.M.N.H. x, p. 116. D.

Hab. L. Marques. District N. of Macequece (Cressy).

An extremely thin and fragile shell, unlike anything known to me; the largest example seen measures 4·7 mm. in maximum diameter, but is too much worn to show the spiral sculpture which is characteristic of fresher specimens.

Genus Kaliella Blanford, 1863.

Kaliella barrakporensis (Pfr.), 1852.

1854. *Helix barrakporensis* Pfr., Conch. Cab., p. 415, pl. 147 (1853), figs. 20–22. D.F.

1882. *Kaliella sigurensis* G.-Aust., L. and F. W. Moll. India, i, p. 5, pl. 1, fig. 11. D.F.

1912. *Kaliella sigurensis* G.-Aust., Conn., Ann. S. Afr. Mus. xi, p. 117. N.

1914. ,, *barrakporensis* Pfr. (=*sigurensis*, G.-Aust.), Dautz. and Germ., Rev. Zool. Afr. iv, p. 17.

Hab. L. Marques. District north of Macequece (Cressy).

The type of *K. sigurensis* has not been available for examination, but examples from Pretoria, identified by Godwin-Austen as that species,

certainly appear to be inseparable from *barrakporensis*, and I think that Dautzenberg and Germain's synonymy may be accepted as correct.

The Macequece specimens agree with those from Pretoria; they are very closely, finely transversely striate above, and clearly, rather closely radiate, and with rather close engraved microscopic spiral grooves beneath.

Family UROCYCLIDAE.

Genus Urocyclus Gray, 1864.

Urocyclus fasciatus (Mts.), 1879.

1879. *Aspidoporus fasciatus* Mts., Monatsb. Akad. Wiss. Berlin, p. 736. D.

Hab. Mozambique. Quilimane (Peters).

L. Marques. Andrada (Vasse).

Urocyclus flavescens (Keferstein), 1866.

1866. *Parmarion flavescens* Kfstn., Mal. Blätt. xiii, p. 70, pl. 2, figs. 1–8. D.F.A.R.

Hab. Mozambique. Quilimane (Peters).

L. Marques. Inhambane; Mungurumbe (Peters); Delagoa Bay (Spencer); Mt. Vumba, 4300 ft. (Vasse).

The record of this species by Gibbons, 1879, should be expunged from my Reference List, as it refers to *Kirkia gibbonsi* (v. infra).

Urocyclus kirki Gray, 1864.

1864. *Urocyclus kirkii* Gray, P.Z.S., p. 251. D.F.

Hab. Mozambique. Near the mouth of the Zambesi (Kirk).

L. Marques. Delagoa Bay; Inhambane (fide Sturany); Andrada (Vasse).

Genus Kirkia Pollonera, 1909.

Kirkia gibbonsi nom. nov.

1879. *Urocyclus flavescens* Kfstn., Gibb., Journ. of Conch. ii, p. 138. D.

1879. ,, *kirkii* (?) Gray, Binn., Bull. Mus. Comp. Zool. v, p. 333, pl. 2, fig. C, D. D.R.

1884. *Urocyclus fasciatus* (?) Mts., Heynem., Jahrb. D. Mal. Ges. xi, p. 9, pl. 1, fig. 5. N.R.

1909. *Kirkia flavescens* Gibb., Pollon., Il Ruwenzori, p. 192. N.

Hab. Mozambique (Gibbons).

var. *pallida* Gibb., 1879.

1879. *Urocyclus flavescens* Kfstn., var. *pallida* Gibb., Journ. of Conch. ii, p. 138. D.

Hab. Mozambique (Gibbons).

When Pollonera created a new genus for the slug which Gibbons misidentified as *Urocyclus flavescens* Kfstn., he retained the name *flavescens* for the species, merely transferring its authorship to Gibbons, on the ground that, as it now belongs to a different genus, the name is valid. As, however, Gibbons described the species as an *Urocyclus*, Pollonera's action is contrary to the rules of nomenclature, and a new name is required for his genotype. It may be suggested that Gibbons' own name of *pallida* should be applied to the species, of which, in that case, his *U. flavescens* would become a darker coloured variety, but as it is the radula of the latter that has been published, and there is no certainty that *pallida* is even conspecific, it seems wiser to adopt my procedure.

Family ENDODONTIDAE.

Subfamily ENDODONTINAE.

Genus Endodonta Albers, 1860.

Subgenus afrodonta M. and P., 1908.

Endodonta (*Afrodonta*) *novemlamellaris* Burnup, 1912.

1912. *Endondonta* (*Afrodonta*) *novemlamellaris* Bnp., Ann. Natal Mus. ii, p. 341, pl. 24, figs. 11–13. D.F.

Hab. L. Marques. Mt. Vengo, 5500 ft. (Cressy).

This species had only been collected previously in the Cape Province, but I am now able to record a locality in Natal, Ntimbankulu (Burnup).

Some notes on the anatomy follow :—

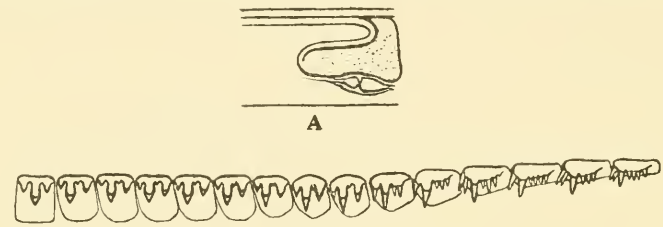
The foot has well-marked peripodial grooves, and is of a light colour. The tentacles are nearly black, and show clearly through the overlying tissues when they are contracted. The roof of the mantle-cavity is pale and translucent.

The kidney (text-fig. 9, A) is rather broad and about twice the length of the pericardium. It extends a little further back than usual, and the posterior part stretches upwards to the rectum, though the upper prolongation between the rectum and the secondary ureter is not developed in this species as it is in *Trach. pura* Conn. The ureter arises from the front end of the kidney and is reflexed in the usual manner.

The jaw measures about 1·1×·18 mm. It is very thin, and is crossed by about twelve narrow vertical folds.

The radula (text-fig. 9, B) measures ·38×·1 mm. when flattened out.

The individual teeth are extremely small. The central teeth are tricuspid, but their mesocones are only about half the length of the quadrate basal plates, and their ectocones are scarcely half the length of the mesocones. In the inner lateral teeth the mesocones are of about the same size as in the central teeth, but they are situated much nearer the inner than the outer sides of the teeth. The endocones of the lateral teeth are very small; the ectocones, on the other hand, are slightly larger than those of the central teeth. An extremely minute additional cusp is inserted between the mesocone and the ectocone of each of the lateral teeth. The basal plates of these teeth are slightly oblique, though of about the same length as in the central teeth. In the transitional teeth the basal plates begin to shorten, and the three principal cusps become longer and more pointed. The marginal teeth are somewhat pectinate in form, the bases being shorter and the



Text-fig. 9.—*Endodonta* (*Afrodonta*) *novemlamellaris* Burnup, Vengo Mountain.
A. Kidney, heart, etc., seen from the outside (slightly diagrammatic); ×17.
B. Half of a transverse row of teeth from the radula; ×1600.

cusps sharply pointed and more numerous, owing to the ectocones having split up into three or four small cusps and the endocones often into two. In these teeth the endocones are better developed than in the laterals, but the mesocones are still the longest of the cusps. The transverse rows of teeth trend very slightly forwards on each side in the region of the lateral teeth, and more decidedly in that of the marginal teeth. The radular formula is: $(7+8+1+8+6)\times 100$.

The radula of this species is specially interesting because, although the marginal teeth scarcely differ from the type most usually found in the Endodontinae, the central and lateral teeth in several features show some approach to the type found in the Punctinae, and thus suggest how this rather peculiar type of radula may have been evolved (compare text-fig. 9, B with text-figs. 15 and 16, B). In Godwin-Austen's figure of the radula of *Endodonta* (*Afrodonta*) *bilamellaris* (M. and P.),* the central and lateral teeth are depicted as of the ordinary type, such as we find in *Trach. vengoensis* Conn. (text-fig. 14).

* Ann. Mag. Nat. Hist., ser. 8, vol. i, 1908, pl. viii, fig. 2*b*.

Genus Trachycystis Pilsbry, 1893.

Trachycystis aenea (Krauss), 1848.

1848. *Helix aenea* Krs., Südafr. Moll., p. 75, pl. 4, fig. 18. D.F.

1892. ,, (*Pella*) *burnupi* M. and P., A.M.N.H. x, p. 239, pl. 13, fig. 6. D.F.

Hab. L. Marques. Cape Delagoa (Plant); Delagoa Bay (Connolly).

The widely distributed Natalian species so well known as *T. burnupi* (M. and P.) can unfortunately no longer retain that name, typical examples from Pietermaritzburg having been compared with the type of *T. aenea* (Krs.), and found to be absolutely identical.

It is interesting to note that all the shells collected at Delagoa Bay, both by Plant and the present writer, have a slightly, but noticeably, more narrow umbilicus than is usually found in specimens from Natal, which suggests that they may have bred true to this small peculiarity for over fifty years.

Trachycystis ambigua Conn., 1922.

(Plate IV, fig. 9.)

1922. *Trachycystis ambigua* Conn., A.M.N.H. x, p. 116. D.

Hab. L. Marques. Headwaters of R. Inyamkarrara, 25 miles N.W. of Macequece (type, Cressy); Lebombo Marsh, Rikatla (Junod).

Nyasaland. Mt. Chiradzulu (Johnston).

S. Rhodesia. Vumbu Range, near Umtali, 7000 ft. (Arnold).

The largest specimen seen is 4·85 mm. in maximum diameter.

A member of the puzzling group which includes *inclara* Morel., *coxi* Preston, and *shilwaneensis* Conn., from the last of which, its nearest ally, it differs in having a very slightly lower spire and narrower whorls, in the spiral striae being a little weaker above and further apart on the base, and in being almost imperforate, whereas in *shilwaneensis* there is a very minute, but clear, umbilicus.

Trachycystis sericea Conn., 1922.

(Plate IV, fig. 10.)

1922. *Trachycystis sericea* Conn., A.M.N.H. x, p. 116. D.

Hab. L. Marques. District 16 miles N. of Macequece, 4500 ft. (Cressy).

S. Rhodesia. Six miles from Penhalonga, 6000 ft. (Miss Grey).

Perhaps nearest to *T. aulacophora* (Ancey) from which it chiefly differs in its deeper suture and more silky appearance; its perforation is much narrower than that of *T. rivularis* (Krs.) or *T. ordinaria* M. and P.

Trachycystis cressyi sp. n.

(Plate IV, fig. 11.)

Shell of moderate size, depressed globose, narrowly umbilicate, thin, somewhat hairy, transparent, corneous, yellow-brown. Spire but little raised, though each whorl is clearly visible in profile above the next; apex obtuse. Whorls 4, regularly increasing, shouldered at the periphery, which is situate well above the median line; the first $1\frac{1}{4}$ microscopically punctate, after which the sculpture consists of rather distant, oblique, transverse costulae, increasing in distance on the later whorls, the intervals between them being filled with close, very faint, regular transverse, and equally faint and close spiral striae; the costulae are sparsely furnished on both sides of the shell with irregular, very deciduous, curved spiny hairs; suture simple, well defined. Aperture $\frac{3}{4}$-lunate, peristome simple, acute; columella weak and concave, margin narrowly reflexed, leaving open the narrow, but deep umbilicus.

Diam. maj. 5·1, min. 4·5; alt. 3·5; apert. alt. 2·2, lat. 2·5 mm.

Hab. L. Marques. District N. of Macequece (type, Cressy).

S. Rhodesia. Six miles from Penhalonga (Miss Grey).

A smaller form than *T. fuscocornea* Smith, or any of the hairy South African *Trachycystes*, while the striation is stronger, the umbilicus narrower, and the hairs fewer than in *T. fusco-olivacea* Smith.

Trachycystis fossula sp. n.

(Plate IV, fig. 12.)

Shell small, depressed orbicular, umbilicate, thin, silky, pale corneous. Spire and apex almost flat. Whorls $4\frac{1}{2}$, moderately convex, gradually and regularly increasing, rounded at the periphery, the first $1\frac{1}{4}$ punctately microscopically corrugate, remainder sculptured all over with close, regular, straight, hardly oblique, transverse costulae, with about 4 microscopic transverse striae in the intervals; suture simple, canaliculate. Aperture $\frac{3}{4}$-lunate, hardly descending at the base, peristome simple, acute; outer lip almost straight in profile, columella short and concave, margin not reflexed, umbilicus rather narrow, but deep.

Diam. maj. 3·3, min. 3·0; alt. 2·0; apert. alt. 1·5, lat. 1·4 mm.

Hab. L. Marques. Mount Vengo, 5500 ft. (Cressy).

More widely umbilicate than *T. sericea*, and differing from other small species, such as *T. rivularis* (Krs.) and *ordinaria* M. and P., which resemble it superficially, in its sculpture, which is almost at right angles to the suture instead of being considerably oblique, and recalls the larger *T. charybdis* (Bs.) rather than any of the smaller forms.

Trachycystis mcdowelli Conn., 1922.

(Plate IV, fig. 13.)

1922. *Trachycystis mcdowelli* Conn., A.M.N.H. x. p. 117. D.

Hab. L. Marques. Maforga Siding. B. and M. Rly. (Mcdowell).

A particularly neat, close-coiled little species, not closely resembling any known to me from Africa.

Trachycystis rudicostata Conn., 1922.

1922. *Trachycystis rudicostata* Conn., A.M.N.H. x, p. 117. D.

Hab. L. Marques. Mt. Vengo (Cressy).

Type in British Museum.

Text-fig. 10.—*Trachycystis rudicostata* Conn., Dargle.

Three individuals, measuring respectively 1·91, 2·02, and 1·8 mm. in maximum diameter, the last, lowest in text-fig., being the type.

This species has been known for many years, and I have retained the unpublished name originally suggested for it by Melvill and Ponsonby. It is widely distributed throughout Natal, having been collected at Dargle (type); Inhluzani Mountain; Nottingham Road; Howick; Hilton Road; Edendale; Pietermaritzburg; Ntimbankulu Hill, Mid-Illovo District; Van Reenen's Pass, Drakensberg (Burnup), and Majuba (Connolly).

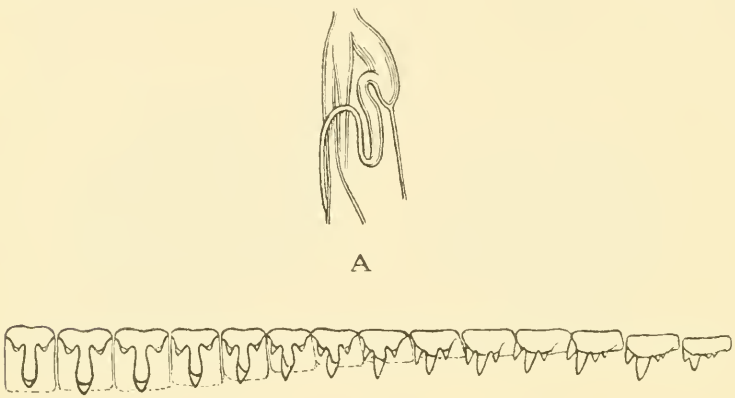
Almost the only difference between it and *T. lamellifera* (Smith) is that the latter appears to be quite destitute of the microscopic spiral striation which is so prominent in *rudicostata*.

The following notes on the animal are taken chiefly from specimens

found at Ntimbankulu, Natal, for which the writer is indebted to Mr. H. C. Burnup of Pietermaritzburg.

The foot has well-marked peripodial grooves. The thin skin of the mantle and visceral hump appears to be unpigmented, but the white posterior aorta stands out conspicuously on the dark liver of the upper whorls.

The radula of a specimen from Ntimbankulu (text-fig. 11, B) measures about ·52×·155 mm. when flattened out. The central and lateral teeth are tricuspid with quadrate bases, the inner lateral teeth being almost symmetrical and closely resembling the central teeth. Their mesocones



Text-fig. 11.—*Trachycystis rudicostata* Conn., Ntimbankulu, Natal.
A. Anterior part of reproductive system ; ×25.
B. Half of a transverse row of teeth from the radula ; ×1200.

are long and rather narrow, although the cutting points are comparatively short ; the ectocones and endocones are rather small. The marginal teeth are more asymmetrical, with broader, shorter bases, and their endocones and mesocones have longer points. The ectocones become split into two very small cusps on the outer marginal teeth. The transverse rows of teeth are straight in the middle, but tend to curve slightly forwards in the region of the inner marginal teeth. The radular formula is : (7+6+1+6+7)×80.

The radula of a specimen from Vengo Mountain is very similar, although the teeth are very slightly smaller, there being 97 transverse rows instead of 80, notwithstanding that the radula is of about the same length as in the specimen from Natal.

It will be seen that the radula of this species is of the same general type that is found in the larger species of *Trachycystis*.

The jaw of the specimen from Vengo Mountain measures about ·16×·02 mm. It is very thin, but seems to be crossed by about ten or twelve weak vertical folds.

The anterior part of the reproductive system of a specimen from Ntimbankulu is shown in text-fig. 11, A. The free oviduct is long and rather narrow; the vagina, on the other hand, is very short; the receptacular duct becomes enlarged anteriorly towards its junction with the vagina. The vas deferens runs forward about half-way along the free oviduct, and then bends back again to enter the posterior end of the well-marked epiphallus. This organ extends forwards for about ½ mm., and then enters laterally into the penis or penis-sheath, which is also about ½ mm. long and rather broad, with the penial retractor inserted in its posterior end.

Trachycystis soror Conn., 1922.

(Plate IV, fig. 14.)

1922. *Trachycystis soror* Conn., A.M.N.H. x. p. 118. D.

Hab. L. Marques. Mount Vengo, 5500 ft. (Cressy).

Another minute species, which might at first sight be mistaken for *T. rudicostata*, but is easily distinguishable under a microscope on account of its apical sculpture being devoid of spiral striation.

The foot of the animal is of a light colour, and has well-marked peripodial grooves. The tentacles are darkly pigmented, and show clearly through the overlying tissues when they are retracted. The roof of the mantle-cavity is unpigmented and translucent.

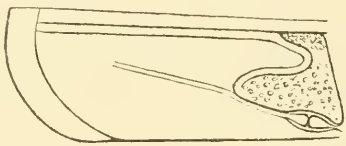
The kidney (text-fig. 12, A) is fully twice the length of the pericardium, and is rather broad, extending upwards to the rectum, where it runs forward for a short distance between the rectum and the beginning of the secondary ureter. Numerous concretions occur in the kidney, especially in its upper part, where some of them attain a diameter of ·017 mm. The ureter is of the reflexed type generally found in the Sigmurethra.

The jaw measures about ·14×·025 mm., and is slightly curved. It is very thin, but shows about eleven weak vertical folds.

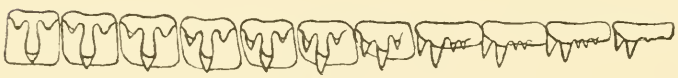
The radula (text-fig. 12, B) measures ·4×·13 mm. when flattened out. The central and lateral teeth are tricuspid, with nearly square basal plates, the inner laterals closely resembling the central teeth. Their mesocones are rather long, reaching the posterior edges of the basal plates; their ectocones and endocones are short. In the marginal teeth the basal plates are much shorter, the mesocones and endocones have longer cutting points, and the ectocones become divided into two or even three small cusps. The transverse rows of teeth are straight in the middle, but tend to curve forwards in the region of the marginal teeth. The following are the

radular formulae of the two specimens examined: (5+5+1+5+6)×82, (6+5+1+5+5)×80.

The radula of this species differs from that of *Trachycystis rudicostata* in the teeth being shorter and relatively broader, and in there being fewer of them in each transverse row. These differences, however, are not very



A



B

Text-fig. 12.—*Trachycystis soror* Conn., Vengo Mountain.

A. Roof of mantle-cavity seen from the outside, showing kidney, etc. (slightly diagrammatic); ×28.

B. Half of a transverse row of teeth from the radula; ×1400.

great, and it is probable that the two species are fairly closely related, notwithstanding the dissimilarity in the apical sculpture of their shells.

Trachycystis pura Conn., 1922.

(Plate IV, fig. 15.)

1922. *Trachycystis pura* Conn., A.M.N.H. x, p. 118. D.

Hab. L. Marques. Mount Vengo, 5500 ft. (type, Cressy).

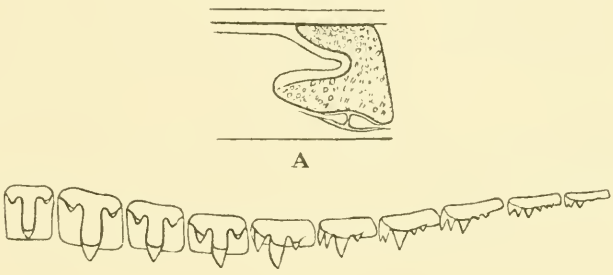
Cape Province. Thomas River, Cathcart (Miss Davidson).

Easily distinguishable from its minute confrères by its milky shell and comparatively strong, close, radial striae.

The kidney (text-fig. 13, A) extends from the pericardium upwards to the rectum, and has two anterior prolongations: a lower one, which is about $\frac{1}{4}$ mm. long, occupying the usual position between the heart and pulmonary vein, and the primary ureter, which arises from its front end; and an upper prolongation, which is nearly as large as the lower one, and is situated between the rectum and the posterior end of the secondary ureter. The kidney contains numerous spherical or oval concretions, which are largest in the upper anterior prolongation, where some of them attain a diameter of ·02 mm.

The jaw is about ·105 mm. long, slightly curved, and very thin, but shows traces of vertical folds.

The radula of the specimen examined (text-fig. 13 B) measures ·32×·105 mm. when flattened out, but the snail may not have been quite full-grown. The central and lateral teeth are tricuspid, with quadrate basal plates. Their mesocones are large, those of the lateral teeth extending a little beyond the posterior edges of the basal plates. Their ectocones and endocones are short, but the endocones of the lateral teeth are slightly larger than the ectocones—an unusual feature. The first lateral teeth on each side are disproportionately large, being much bigger than the central teeth; probably this is connected with the fact that the number of lateral teeth is unusually small. In the marginal teeth the basal plates are much shorter, especially in the outer teeth, which are remarkably short in pro-



A

B

Text-fig. 13.—*Trachycystis pura* Conn., Vengo Mountain.

A. Kidney, heart, etc., seen from the outside (slightly diagrammatic); ×36.
B. Half of a transverse row of teeth from the radula; ×1400.

portion to their breadth. The endocones of the marginal teeth have longer cutting points, but they are often split into two cusps. The ectocones of the marginal teeth also become divided into two, or sometimes three, small cusps, but they are very much shorter than the endocones and mesocones. The transverse rows of teeth are not straight, but slope backwards from the centre in the region of the lateral teeth, and forwards again in the region of the marginal teeth. The radular formula is: (6+3+1+3+6)×66.

It will be seen that in this species the radula, as well as the shell and kidney, is of a slightly specialised type, although it agrees with the other members of the Endodontinae in all its more important characters. The backward trend of the lateral teeth, and the large size of the first one on each side, make this radula easy to distinguish from any of the others illustrated in this paper. In some respects it resembles the radula of the American species *Helicodiscus lineatus* (Say),* although that species has a much smaller and narrower central tooth.

* See Watson: Proc. Malac. Soc., vol. xiv, 1920, p. 12, fig. 4*e*.

Trachycystis vengoensis Conn., 1922.

(Plate IV, fig. 16.)

1922. *Trachycystis vengoensis* Conn., A.M.N.H. x, p. 118. D.

Hab. L. Marques. Mount Vengo, 5500 ft. (Cressy).

The jaw measures about ·1×·02 mm. It is curved, very thin, and has little or no visible sculpture.

The radula (text-fig. 14) measures ·29×·11 mm. when flattened out. The central and lateral teeth are tricuspid, with quadrate basal plates. Their mesocones are rather long, reaching the posterior edges of the basal plates, the cutting points being short in the inner teeth but longer in the transitional teeth. Their ectocones are rather small; their endocones are also small and a little narrower than the ectocones in the inner lateral teeth, but become longer in the transitional teeth, with larger cutting

Text-fig. 14.—*Trachycystis vengoensis* Conn., Vengo Mountain. Half of a transverse row of teeth from the radula; ×1600.

points. The marginal teeth have much shorter bases; their mesocones have rather long points; their ectocones are divided into two or three minute pointed cusps, and their endocones, which are slightly longer than the ectocones, also tend to split into two. In the radula figured the third marginal tooth on the right side is abnormally without an endocone. The transverse rows of teeth are almost straight in the middle, but bend slightly forwards on each side in the region of the marginal teeth. The radular formulae of the two specimens examined are: (6+6+1+6+6)×72, and (6+6+1+6+6)×80. The radula is thus of the normal type found in the Endodontinae, although the teeth are very small.

The nearest relations to this microscopic species have been described under the names of *Pyramidula* (*Gonyodiscus*) *ugandana* Smith,* and *Gonyodiscus smithi* Dautzenberg and Germain,† the shells of both of which so closely resemble that of *vengoensis* that they must surely be congeneric. It differs from the type of *ugandana*, which is a larger shell, in having an infinitesimally sharper and narrower suture, finer sculpture, a narrower

* Journ. of Conch. x (1903), p. 317.

† Rev. Zool. Africaine iv (1914), p. 19.

and deeper umbilicus, and slightly more rapidly increasing whorls; while it appears to be higher in the spire, with weaker sculpture and considerably less rapidly increasing whorls than *smithi*.

Trachycystis pinguis (Krs.), 1848.

1848. *Helix pinguis* Krs., Südafr. Moll., p. 75, pl. 4, fig. 19. D.F.
1879. *Hyalina pinguis* Krs., Mts., Monatsb. Ak. Wiss. Berlin, p. 736. L.
Hab. L. Marques. Tette (Peters).

It is most improbable that the shells cited by von Martens can be the true *pinguis* of Krauss. Dr. Thiele kindly informs me that the set in the Berlin Museum, which probably represents them, consists of rather immature examples, of which the largest measures 4·7×2·9 mm. They are in any case congeneric with *Gudeëlla mixta* Smith, which seems, however, to be proportionately rather greater in diameter and less in altitude.

Subfamily PUNCTINAE.

Genus Punctum Morse, 1864.

Punctum hottentotum (M. and P.), 1891.

1891. *Helix hottentota* M. and P., A.M.N.H. viii, p. 239. D.
1892. ,, ,, ,, ,, ix, p. 94, pl. 4, fig. 6. F.
Hab. L. Marques. Bandula Siding (Medowell).

The shells from this locality agree fully with those of the same species from Jesmond and many other southern districts. It is interesting to set on record that I have recently been shown by Mr. J. Hewitt, Director of the Albany Museum, a living example of *P. hottentotum* which was found among the feathers of a loerie, *Turacus corythaix*, shot by Dr. G. Rattray at Hogsback, Amatola Mts., C.P. From its position, the snail appeared to have adhered there during the bird's lifetime, a fact which may afford some explanation of its comparatively wide distribution.

Some notes on the anatomy of this species are given below.*

The foot has well-marked peripodial grooves. The tentacles are dark, and the top of the head is also more or less pigmented. The posterior aorta and its principal branches, and to some extent the efferent pulmonary vein, are coated with a conspicuous white deposit; and this is also true of the afferent pulmonary vein that runs down the hinder margin of the mantle-edge. The posterior part of the roof of the mantle-cavity shows some streaks of dark pigment.

* These notes are taken from specimens found at Belle Vue, Upper Mooi River, Natal, for which the writer is indebted to Mr. H. C. Burnup of Pietermaritzburg.

The jaw seems to be composed of a number of fibrous plates, as in other species of the Punctinae.

The radula (text-fig. 15) is long in proportion to its breadth, measuring ·625×·125 mm. when flattened out. The central teeth are tricuspid, but rather narrow, with oblong basal plates. Their mesocones are less than half the length of the basal plates, and their ectocones are extremely small. The lateral teeth are not so narrow as the central teeth. Their mesocones are about half the length of the basal plates, while their ectocones scarcely exceed half the size of the mesocones. In addition to these two principal cusps, each lateral tooth has an exceedingly minute endocone on the inner side of the mesocone, and two other minute cusps, one between the mesocone and the ectocone and one external to the ectocone. The basal plates of the inner lateral teeth are rather long, and taper somewhat posteriorly, their inner edges being oblique, while their outer edges are roughly parallel to the

TEXT-FIG. 15.—*Punctum hottentotum* (M. and P.), Belle Vue, Upper Mooi River, Natal. Half of a transverse row of teeth from the radula; ×1400.

length of the radula. In the outer teeth the basal plates tend to become shorter, and they are broader posteriorly, as their outer as well as their inner edges are oblique. In the central and inner lateral teeth the basal plates are hollowed towards their posterior edges, which are consequently exceedingly thin in the middle. Towards the outer margins of the radula the teeth not only become gradually smaller, but they also become shorter, and their cusps become relatively longer and narrower, the minute endocones being rather more developed. In fact, the last two or three teeth on each side resemble the transitional teeth of such forms as *Endodonta* (*Afrodonta*) *novemlamellaris*; but true marginal teeth can scarcely be said to occur in the present species. The transverse rows of teeth trend slightly forwards on each side. The radular formula is: (15+1+15)×105.

The radula of another specimen is a little smaller, measuring ·525×·115 mm. Its formula is: (14+1+14)×94.

Although this species has hitherto been usually placed in the genus *Trachycystis*, its radula shows that it belongs to the Punctinae. It differs from *Punctum pygmaeum* (Drap.) and *P. pallidum* Conn., in that the mesocones of the lateral teeth are considerably larger than the ectocones; but in this respect it agrees with some of the other members of the group, such

as *Punctum cryophilum* (Mts.), from Abyssinia, of which the radula has been figured by Jickeli.* It is true that Jickeli does not show the three smaller cusps, but these cusps are so minute in *Punctum* and *Laoma* that they can only be clearly seen under a $\frac{1}{12}$-in. oil-immersion objective, and have therefore generally been overlooked until recently.

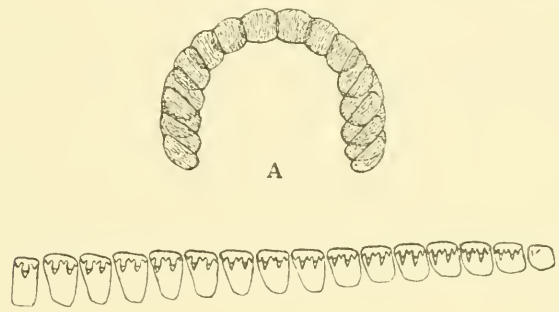
Punctum pallidum Conn., 1922.

(Plate IV, fig. 17.)

1922. *Punctum pallidum* Conn., A.M.N.H. x, p. 119. D.

Hab. L. Marques. Mount Vengo, 5500 ft. (Cressy).

The jaw (text-fig. 16, A) is horse-shoe shaped, and is composed of about



Text-fig. 16.—*Punctum pallidum* Conn., Vengo Mountain.

A. Jaw; ×300.

B. Half of a transverse row of teeth from the radula; ×1600.

eighteen thin imbricating plates, which appear to have a fibrous structure. The plates are largest laterally, where they overlap one another to the extent of about half their width; in the middle of the jaw they only overlap very slightly.

The radula (text-fig. 16, B) measures ·32×·08 mm. when flattened out. The individual teeth are extremely small, with minute cusps. The central teeth are rather narrow, with oblong basal plates. They are tricuspid, but the mesocones are only about one-third the length of the basal plates, and the ectocones about one-third the length of the mesocones. The lateral teeth, which are slightly broader than the central teeth, each have two principal cusps, the mesocone and the ectocone, which are similar to each other and of about the same size as the mesocones of the central teeth. Alternating with these two cusps there are three more, exceedingly minute

* Nova Acta Acad. Cæs. Leop.-Carol., vol. xxxvii, 1874, p. 55, pl. i, fig. 4.

cusps, of which the inner one represents the endocone. The basal plates of the lateral teeth are oblique, although in the inner teeth they taper posteriorly in the same way as in *hottentotum*. Towards the edges of the radula the basal plates become somewhat shorter, and the cusps become a little longer and narrower, but there are no true marginal teeth. The transverse rows of teeth trend forwards a little on each side, forming a slight angle in the centre. The radular formula is $(15+1+15)\times 85$.

The teeth of this little snail closely resemble those of the European species *P. pygmaeum* (Drap.).* The discovery of undoubted members of the Punctinae in this region is of special interest, for although this subfamily is widely distributed, like many groups of minute snails, and has long been known to occur in Abyssinia, as well as in Europe, Asia, North America, Australia, and New Zealand, and has also been found in Juan Fernandez, off the west coast of South America,† it does not seem to have been hitherto definitely recorded from South Africa, notwithstanding that the South African molluscan fauna has many features in common with that of the Australian Region, where this group is well developed.

Family ENIDAE.

Genus Conulinus von Martens, 1895.

(=*Edouardia* Gude, 1914.)

It is now accepted that von Martens' designation of *B. velutinus* Pfr. as type of *Pachnodus* Albers is valid and that Bourguignat was in error in his subsequent substitution of *B. spadiceus* Mke. as genotype. As these two species differ considerably in both conchological and anatomical features, it becomes necessary to find a new generic name for the group to which the last mentioned belongs.

There is a very closely graded chain of links uniting the large carinate species, such as *spadiceus* Mke. and *natalensis* Krs., with the less carinate *conulus* Rve. and *maritzburgensis* M. and P., while from these there is easy transition to the smaller northern forms, *metuloides* Smith, *metula* Mts., etc. Anatomical research tends to prove that all the South African species are congeneric, and that consequently any genus-name already applied to one of them will be applicable to all.

The oldest of such appears to be *Conulinus*, which von Martens founded in 1895 as a subgenus of *Buliminus* for three new species, *ugandae*, *hildebrandti*, and *metula*. He fixed no type, but mentioned that *ugandae* was "verwandt mit *B. conulus* Rv." In 1897 he again dealt with *Conulinus*,

* See Bowell: Proc. Malac. Soc., vol. xi, 1914, p. 159.

† Odhner: Nat. Hist. Juan Fernandez and Easter I., vol. iii, 1922, p. 227.

this time nominating *conulus* "Pfr." (a slip of the pen for Rve.) as genotype.

In 1914 Gude * rejected *Conulinus* Mts. on account of the earlier *Conulina* Bronn, 1835, substituting the name *Edouardia*, with *conulus* "Pfr." (another slip of the pen for Rve.) as type.

As doubt existed both as to whether *Conulinus* Mts. was valid and whether *conulus* was available as genotype, the matter has been submitted to the International Commission on Zoological Nomenclature, whose decision is that "*Conulinus* von Martens, stands, with genotype *Bulimus conulus* Reeve." *Edouardia* Gude must thus be placed in synonymy.

Conulinus conulus (Rve.), 1849.

1849. *Bulimus conulus* Rve., Conch. Icon. pl. 78, fig. 577. D.F.

Hab. L. Marques. Rikatla (Junod).

I have been unable to verify the truth of this record; Reeve's rare species has often been misidentified, and this may be a case in point.

Conulinus meridionalis (Pfeiffer), 1847.

1847. *Bulimus meridionalis* Pfr., P.Z.S., p. 231. D.

1848. ,, ,, ,, Rve., Conch. Icon., pl. 56, fig. 370. D.F.

Hab. L. Marques. Matolla (Penther); Tembe; Magude; Morakwen; gardens in Lorenzo Marques (Junod).

Conulinus natalensis (Krs.), 1846.

1848. *Bulimus natalensis* Krs., Südafr. Moll., p. 78, pl. 5, fig. 1. D.F.

Hab. L. Marques. Rikatla (Junod); Delagoa Bay (smaller variety in Vienna Museum, fide Sturany).

I have been unable to verify either of these records, but do not doubt that that of Sturany refers more nearly to *meridionalis* than to *natalensis*.

Conulinus tumidus (Gibbons), 1877.

(Plate IV, fig. 20.)

1877. *Buliminus tumidus* Gibbons, Taylor, Q.J. of C., i, p. 254, pl. 2, fig. 4. D.F.

Hab. L. Marques. Mtisherra R. Valley (Cressy).

A coastal species described from Zanzibar and known as far north as the Shimbi Hills, Kenya Colony (Kemp). Owing to confusion in the Gibbons collection, as represented in the British Museum, wherein 3 different species were labelled as types of *C. tumidus*, I have referred the matter to Mr. J. W.

* Fauna of Brit. India, Moll., ii, p. 260.

Taylor, who kindly informed me that, to the best of his recollection, the individual which I now figure was that on which his description was based. There is some discrepancy between the photograph and the original engraving, but the dimensions of the former agree exactly with those given in the description, and there can be no doubt but that my figure correctly represents the actual type.

The single example found by Cressy is very slightly more obese, and therefore with slightly less acute spire, than the type, and its umbilicus is nearly twice as narrow, but it is hardly varietally separable.

Conulinus metuloides (Smith), 1899.

1899. *Buliminus* (*Conulinus*) *metuloides* Smith, P.Z.S., p. 587, pl. 33, fig. 43. D.F.

Hab. L. Marques. Mtisherra R. Valley (Cressy).

Conulinus sordidulus (Mts.), 1897.

(Plate IV, fig. 19.)

1897. *Buliminus sordidulus*, Mts., D.-O.-A. iv, p. 65, pl. 3, fig. 30. D.F.

Hab. L. Marques. Wanetsi R., Magude District (Bell Marley).

This Kenyan species is only known to me from the above reference and it is with considerable diffidence that I assign to it the shells from the Wanetsi River. They are about $\frac{3}{4}$ mm. narrower in proportion than von Martens' dimensions, and appear to be more faintly angled at the periphery than the specimen he figures; his illustration, however, may not be quite accurate, since he describes the last whorl as rounded, and the shells agree so closely in all other respects with his description and figure that I do not like to separate them without further knowledge of the species.*

Conulinus transvaalensis (M. and P.), 1893.

1893. *Buliminus transvaalensis* M. and P., A.M.N.H. xii, p. 105, pl. 3, fig. 6. D.F.

Hab. L. Marques. Makulane, under bark (Junod).

Conulinus junodi (Conn.), 1922.

(Plate IV, fig. 18; Plate VIII, figs. 5–7.)

1922. *Edouardia junodi* Conn., A.M.N.H. x, p. 120. D.

Hab. L. Marques. Lebombo Mountains (Junod).

The largest shell in the series was selected as the type; it contains 5

* While revising proofs, I have been able to examine an authentic example of *sordidulus*; it is identical with the Magude shells.

whorls and measures : alt. 10·8, lat. 10·2 mm. A smaller shell, containing nearly 5 whorls, measures 8·6×8·6 mm.

External features of animal.—The foot-sole is bluntly pointed at the hind end, and is inconspicuously divided longitudinally into a median pale area, and lateral more or less pigmented areas, crossed by transverse grooves. Shallow peripodial grooves are present, but as these run along the very edge of the foot there is no distinct foot-fringe. A caudal mucous pore is absent. The top of the hinder end of the foot is bluntly angled or keeled, but the keel is not developed into a serrate crest, as it is stated to be in some species.* A network of irregular grooves divides the skin into numerous small rugae, but larger and more regular grooves are scarcely developed. There is a broad and ill-defined dark band on each side of the head and neck.

Mantle and pallial organs.—The mantle-edge bears a right body-lobe beneath the respiratory orifice, and two widely separated left body-lobes. There are no shell-lobes. The thin skin covering the mantle-cavity and visceral hump is translucent and unpigmented ; but the dark liver of the upper whorls is largely covered by a white network formed by the branches of the posterior aorta (Pl. VIII, fig. 7).

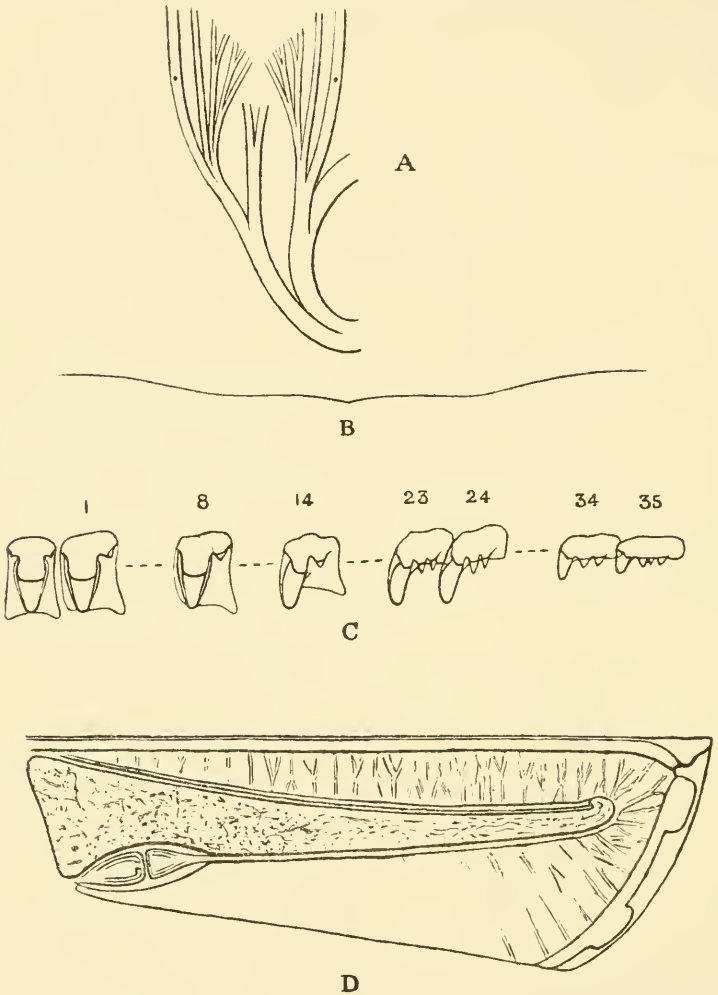
The kidney is long, and gradually merges in front into the ureter, which passes forward to within a short distance of the mantle-edge, and then abruptly bends round and opens (text-fig. 17, D). From this point a fold passes backwards close to the upper edge of the ureter and kidney, overhanging a groove which forms an incipient recurrent ureter. This channel, however, is open throughout its length.

The main pulmonary vein, which runs beneath the ventral edge of the ureter and kidney, receives several short branches at its anterior end ; and other small veins cross the roof of the mantle-cavity below the rectum and near the mantle edge, as shown in the figure.

Central nervous system (Pl. VIII, fig. 6).—The nerve-ring is small and surrounds the oesophagus, salivary ducts, and buccal retractor, being too small to allow the buccal mass to be retracted through it. The large cerebral ganglia are united by a fairly short, but rather narrow, arched cerebral commissure. The buccal commissure is also rather short. The pedal ganglia lie, as usual, close together, and each is obscurely divided by a slight dorsal furrow into a large anterior and a smaller posterior portion. The anterior portions are united by the broad anterior pedal commissure, and bear on their upper sides the otocysts. The posterior portions are united by the narrower posterior commissure. The cerebro-pleural connectives are relatively short, and the visceral ganglia are closely aggregated and somewhat compressed laterally, although they are all quite

* See Pilsbry : Bull. Amer. Mus. Nat. Hist., vol. xl. 1919, p. 306.

distinct from one another, as may be seen from the figure. The right parietal ganglion is, as usual, much larger than the left.



Text-fig. 17.—*Conulinus junodi* (Conn.), Lebombo Mountains.

A. Principal retractor muscles.
B. Course of a transverse row of teeth in the radula.
C. Representative teeth from the radula; ×500.
D. Roof of mantle-cavity seen from within, showing kidney, etc. (slightly diagrammatic); ×8.

Digestive system.—The jaw is regularly arched, and measures about 1·1 mm. in length. It is smooth except for a few slight traces of vertical folds.

The radula (text-fig. 17, C) measures about 2·75×1 mm. when flattened out (the shells of the same specimens measuring about 10×9·5 mm.). The central teeth are tricuspid, and slightly narrower than the lateral teeth, which are bicuspid. The mesocones of the central and lateral teeth are large, with lateral flanges; their points are very blunt, being almost truncated and often minutely notched. The ectocones are small, especially in the central teeth, where they are almost vestigial. The basal plates are quadrate, with thickened outer posterior angles. The marginal teeth have much shorter basal plates, and are nearly all tricuspid, each having a long blunt slightly curved mesocone and two small pointed ectocones. In a few of the marginal teeth, however, there are three ectocones instead of two. The inner marginals are slightly oblique, but this is not the case with the outer teeth, which have shorter cusps and broad short bases. The transverse rows of teeth are not quite straight, but curve forwards a little on each side in the manner shown in text-fig. 17 B. The radular formula of the specimen figured is (21+14+1+14+23)×145; that of another example is (21+14+1+14+21)×140.

The oesophagus, though capable of distension, is normally narrow and folded longitudinally within. The salivary glands almost surround it in the middle. It leads into a large elongated stomach, the hinder end of which is seen in the centre of fig. 7 (Pl. VIII). The intestine, rectum, and liver are of the usual type.

Free retractor muscles (text-fig. 17, A).—The columellar muscle is divided almost from its origin into two main strands. The right divides further forwards into the buccal retractor, which is forked in front, and the left cephalic retractor, which gives branches to the front end of the foot as well as to the upper and lower tentacles on the same side. The right main retractor divides into the broad muscle to the hinder end of the foot and the right cephalic retractor, which branches similarly to the left one, the retractor of the right upper tentacle passing between the penis and vagina.

Reproductive system.—Owing to the immaturity of the specimens the genital organs were in a very rudimentary condition; but the male organs, although extremely small, were sufficiently developed to show that they were of the same type as those of the other South African members of the genus (Pl. VIII, fig. 5). The penis is rather narrow, and bears laterally a long appendix. Posteriorly, where it unites with the rather thick epiphallus, it bears a short and broad, curved caecum, from the side of which there springs a slender flagellum. The penial retractor is forked, one branch being inserted at the junction of the epiphallus and penis, and the other being attached to the penial appendix towards its proximal end.

This species is founded on four examples, none of which are quite mature, and it is obviously nearly related to *C. mcbeanianus* (Bnp.) which it resembles in habit, being an underground, rather than arboreal species. I have only been induced to accord it specific rank after consideration of the evidence adduced by the anatomy, but there are also certain marked points of difference between the shells. *C. mcbeanianus* differs from the present species in that the whorls are considerably less tumid and less rounded at the periphery, there being in young shells of *junodi* hardly a vestige of carination, which is very marked in immature *mcbeanianus*, while in the latter the umbilicus is a little narrower and considerably less open than in the new species ; the roof of the mantle-cavity is ornamented with dark and opaque white patches ; the recurrent ureter forms a closed duct towards its anterior end, instead of being an open groove throughout its length ; the jaw is more strongly folded, and there also seem to be some slight differences in the radula. There can be no doubt therefore that *junodi* is specifically distinct.

Its general anatomy is of the same type as that of the other South African species of *Conulinus* which have been dissected. Hitherto the larger and broader species of this genus have usually been erroneously placed in *Pachnodus*, but in their anatomy these species closely resemble the smaller South African forms, whereas the type of the genus *Pachnodus*—*P. velutinus* (Pfeiffer) from the Seychelles—differs from them considerably in its reproductive organs and still more in its radula.* This group of snails from South and East Africa is also quite distinct anatomically from the Palaearctic genus *Ena* (or *Buliminus*), in which many writers have placed it.

Genus Rhachis Albers, 1850 (*emend*).

(=*Rachisellus* Bourguignat, 1889.)

The necessity for dividing *Rhachis* into three distinct genera† on anatomical grounds raises the determination of its genotype to so high a pitch of importance that it may be well to recount, once again, the whole of the facts concerning it, in hope of settling the question once for all.

In the first edition of Die Heliceen, 1850, Albers proposed the subgenus *Rachis*, with *pallens* Jonas as the first species, and included therein *férussaci* Dkr., but did not nominate a genotype.

In 1855 ‡ Pfeiffer emended Albers' spelling to *Rhachis*, which appears

* See Schacko, in Möbius : Beitr. z. Meeresfauna v. Mauritius u. d. Seychellen, 1880, pp. 337–341, pl. xix, figs. 13–23 ; and Wiegmann : Mitt. Zool. Samml. Mus. Nat. Berlin, vol. i. 1898, pp. 81–85, pl. iv, fig. 8.

† See Thiele, Arch. f. Moll.-k. liii, 1921, pp. 149, 150.

‡ Mal. Blätt. ii, p. 161.

to me to be correct, and further included in the subgenus *B. punctatus* Anton, again without nominating a genotype.

In the second edition of Die Heliceen, 1860, von Martens adopted Pfeiffer's emended spelling of the subgeneric name and designated *punctatus* as type.

In 1889 Bourguignat repudiated von Martens' designation, on the ground that *punctatus* was not included in Albers' original list, and nominated *pallens* as type of *Rachis*, while creating a new genus, *Rachisellus*, with *punctatus* as genotype.

Now, Bourguignat's procedure would have been perfectly correct, were it not possible to prove beyond all doubt that *férussaci* Dkr. is a synonym of *punctatus*, so that, as *férussaci* was included in Albers' original list, *punctatus* is available as type of Albers' genus.

Dunker first published a brief description of *B. férussaci* in 1845, giving the length of the shell as 7 lines, and stating that only 3 specimens, all agreeing well with each other, were collected. Their locality was Loanda.

In 1853 * he repeated the description, adding that the species had also been recently collected on the east coast of Africa, and published a figure of the shell. The length of this is about 9, rather than 7 lines, but the other figures on the plate are natural size, and it appears probable that the numeral 7 in the description is a misprint, such as might easily be made for the numeral 9. The shell figured is remarkable for being considerably above the average size of *punctatus* and for having a few transverse flammules on the last whorl, which are seldom so prominent in that species.

There appears to be no doubt that this original set of *férussaci* were acquired by Hugh Cuming, who was in frequent correspondence with Dunker. The Cuming collection in the British Museum contains a set of 3 shells, labelled "férussaci, Dkr. Loander." They agree well together, being of the same outstanding dimensions as Dunker's figure, which in itself is strong evidence in favour of their being his originals, but one of them (Pl. IV, fig. 22) not only coincides with it in outline, but shows vertical flammules similar to those of the figure on the last whorl. In the front view of the figure, these are spaced a little closer together to the left than in the actual shell, while the back view shows 3 flammules and the shell one more, but the rest of the colour pattern agrees so closely that it is practically impossible not to accept the figure as a fair, but very slightly inaccurate reproduction of the Cumingian shell.

These specimens of *férussaci* are completely identical with Indian examples of *punctatus*, so that the former must be placed in synonymy and *B. punctatus* stands as genotype of *Rhachis*.

* For references see p. 160.

Rhachis punctata (Anton), 1839.

(Plate IV, fig. 22.)

1839 *Bulimus punctatus* Ant., Verz. Conch. Samml., p. 42. D.

1845 ,, *férussaci* Dkr., Zeitschr. f. Malak., ii, p. 164. D.

1853 ,, ,, ,, Novit. Conch., Suppl. ii, p. 6, pl. 1, figs. 35–36. D.F.

1854, 55 *Bulimus punctatus* Ant., Pfr., Conch. Cab., p. 229, pl. 62, figs. 22–24. D.F.

Hab. Mozambique (Gibbons; Frey); Querimba I. (Peters).

L. Marques. Tette (Peters).

The locality Lebombo Mts. (Barber) given in my reference list probably relates to the next species. As mentioned overleaf, I illustrate the putative type of *férussaci*, Dkr., which is an excellent example of mature *punctata*.

Rhachis jejuna (M. and P.), 1893.

(Plate IV, fig. 21.)

1893. *Buliminus* (*Pachnodus*) *jejunus* M. and P., A.M.N.H. xii, p. 106, pl. 3, fig. 7. D.F.

Hab. L. Marques. Lebombo Mts., under bark of dead tree (Junod); Wanetsi R., Magude District (Bell Marley).

This species, described from the Northern Transvaal, was based on very immature examples, whose close resemblance to similar specimens of *punctata* caused me to unite the two species in my Reference List. Now that adult shells are to hand it may be advisable to regard them as distinct. The spire of *jejuna* has slightly convex sides, the aperture is comparatively longer, thus appearing narrower, and the microscopic spiral sculpture is, on the average, stronger than in *punctata*, though the last-mentioned feature is very variable in the latter species.

Rhachis petersi (Pfeiffer), 1855.

1855. *Bulimus petersi* Pfr., P.Z.S., p. 97. D.

Hab. L. Marques. Tette (Peters).

Text-fig. 17, E is a photograph of the type of this hitherto unfigured species.

Text-fig. 17, E.—*Rhachis petersi* (Pfr.), type, ×1.

Rhachis catenata (von Martens), 1860.

1860. *Bulimus* (*Rhachis*) *catenatus* Mts., Mal. Blätt. vi, p. 212, pl. 2, fig. 7. D.F.

Hab. Mozambique. Querimba I. (Peters).

Text-fig. 17, F represents a paratype in the British Museum.

Text-fig. 17, F.—*Rhachis catenata* (Mts.), paratype, ×1.

Genus Rhachidina Thiele, 1911.

Shell usually perforate, comparatively globose, of moderate size and frail texture, with a tendency to expansion of the peristome when fully developed. The radula has been figured by Thiele.*

Rhachidina melanacme (Pfr.), 1855.

1855. *Bulimus melanacme* Pfr., P.Z.S., p. 96, pl. 31, fig. 8. D.F.

1889. *Pachnodus sesamorum* Ancey, Bgt., Moll. Afr. équat., p. 66, pl. 3, figs. 2–3. D.F.

Hab. Mozambique, ex sacks of sesame (*sesamorum*, Ancey). Querimba I. (Peters).

L. Marques. Tette (Peters).

The type of this species in the British Museum appears to be a slightly distorted example, the last whorl being unduly swollen in relation to the earlier ones, which are slightly less in diameter than in *R. usagarica* (Smith). The shell also is a little thicker in texture, white, with a very black apex and one thin dark brown peripheral band ; a few small dark brown spots are irregularly grouped on all the whorls. *Sesamorum*, which I have not seen, is certainly a synonym of this or the next species.

Rhachidina usagarica (Smith), 1890.

1890. *Rhachis usagarica* Smith, A.M.N.H. vi, p. 152. pl. 5, fig. 5. D.F.

1897. *Buliminus* (*Rhachis*) *melanacme* Pfr.. var. *usagaricus* Smith, Mts. D.-O.-A. iv, p. 76. N.

* Arch. f. Moll.-k. liii, 1921, pl. 4, fig. 2.

1898. *Buliminus* (*Rhachis*) *pentheri* Stur., S.A. Moll., p. 65, pl. 2, figs. 47–48. D.F.

Hab. L. Marques. Matolla (*pentheri* Penther); Mtisherra R. Valley; Dondo (Cressy).

This gregarious species, described from Usagara, has a wide distribution, having been collected, like *Conulinus tumidus*, as far north as the Shimbi Hills by Kemp.

The shells are very constant in contour, but vary greatly in fasciation. The typical form has 2 bands, one at the periphery and one below it, and the majority of examples from P.E.A. and the Shimbi Hills are of this pattern, but some are unifasciate, lacking the lower band; some are bandless, approximating very nearly to *melanacme* Pfr., while others are trifasciate, with an additional band midway between periphery and suture. All the bands may vary greatly in breadth.*

In 1897 von Martens listed *usagarica* as a variety of *melanacme*, while in 1889 Smith † stated that he considered it specifically distinct. I have not seen the specimens on which the German author based his opinion, and am fully prepared to admit that the two species may prove to be inseparable when more topotypes of *melanacme* are available for examination, but on the material before me it is certainly desirable to maintain distinction between them.

There is no doubt that *pentheri* must be placed in the synonymy of *usagarica*, Dr. Sturany having kindly compared examples of the latter with the type of the former and confirmed my view as to their identity.

Rhachidina dubiosa (Stur.), 1898.

1898. *Buliminus* (*Rhachis*) *dubiosus* Stur., S.A. Moll., p. 64, pl. 2, figs. 45–46. D.F.

Hab. L. Marques. Matolla (Penther); Dondo (Cressy).

Very closely allied to *R. braunsi* (Mts.), with which a more extensive knowledge of both species may prove it identical.

Rhachidina mozambicensis (Pfr.), 1846.

1846. *Bulimus mozambicensis* Pfr., Symb. iii, p. 85. D.

1849. ,, ,, ,, Rve., Conch. Icon., pl. 58, fig. 328. D.F.

Hab. Mozambique (type in coll. Cuming; Ancey; Gibbons).

L. Marques. Rikatla (Junod).

* Since above was in print, I have seen a rare mutation from the Shimbi Hills, which has no upper bands, but four broadish ones between the periphery and umbilicus.

† P.Z.S., p. 586.

Although the last record is plausible, I suspect that it should refer to one of the two foregoing species. Junod mentions that his shells have two longitudinal bands on the base, a feature very unusual in *mozambicensis*, but nearly always present in *dubiosa* and *usagarica*.

Rhachidina spilogramma (Mts.), 1860.

1860. *Bulimus spilogrammus* Mts., Mal. Blätt. vi, p. 214, pl. 2, fig. 9. D.F.
Hab. L. Marques. Tette (Peters); Mtisherra R. Valley (Cressy).
A beautiful little species, easily recognisable from the author's figure.

Genus Rhachistia, nov.*

Type *Buliminus rhodotaenia* von Martens (Conch. Cab. 1901, p. 750, pl. 110, figs. 12–13).

This new genus is rendered necessary for the reception of the group of species, usually with brightly painted, rather large and solid shells, which cannot now be retained in *Rhachis* with *R. punctata*.

The shells are usually broader than those of *Rhachis*, and grow to a far greater size, becoming more solid in maturity than they do in *Rhachidina*; I have not yet found their peristome expanded, as in the last-mentioned genus.

The radula is of a specialised arboreal type, as will be seen from the figures of Sarasin † and Thiele.‡ It differs considerably from that found in any of the preceding genera, although in some respects the anatomy of *Rhachistia* seems to be very similar to that of *Conulinus*.

Judging from their radula, *abortiva* and *bewsheri* Morel., *erlangeri* Kob., *burnayi* Dhrn., *histrio* Pfr., *moluensis* Kob,. *sanguinolenta* Barcl., *sticta* Mts., and *zonulata* Pfr. belong to this genus, while from the shells alone it probably includes, inter alia, *gomezi*, Sow., *venustus* Morel., *neuricus* Rve., *picturatus* Morel., *ganalensis* Kob., *trichrous* Mts., *pallens* Jonas and *aldabrae* Mts.

Rhachistia rhodotaenia (Mts.), 1869.

var. *andradensis* Germain, 1918.

1918. *Rachis* (*Rachis*) *rhodotaenia* Mts., var. *andradensis* Germ., Bull. Mus. Paris, xxiv, p. 155. D.
Hab. L. Marques. Andrada (Vasse).

* ῥαχιστος, cut or cleft out of.
† Land-Moll. Celebes, 1899, pl. 31, fig. 305.
‡ Arch. f. Moll.-k. liii, 1921, pl. 4, fig. 1.

Rhachistia sticta (Mts.), 1860.

1860. *Bulimus* (*Rhachis*) *stictus* Mts., Mal. Blätt. vi, p. 211, pl. 2, fig. 6. D.F.

Hab. L. Marques. Tette (Peters); Manica Land (Selous); Gorongozo District (Wells Cole); Mtisherra R. Valley; Dondo District; Zangwe Basin (Cressy).

This species attains much greater dimensions than have hitherto been attributed to it, the largest specimen known to me measuring 26·3 × 13·0 mm. The beautiful pink and yellow markings soon fade away in weathered shells, but the black spots usually remain as a fairly safe guide to correct identification.

Family PUPILLIDAE.

The arrangement of the genera here adopted is in accordance with recent volumes of Pilsbry's Manual.

Subfamily PUPILLINAE.

Genus Pupoides Pfr., 1854.

(= *Leucochiloides* Pfr., 1881.)

Pupoides coenopictus (Hutton), 1834.

1834. *Pupa coenopicta* Hutt., J.A.S. Bengal, iii, pp. 85, 93. D.

1912. *Leucochiloides soror* Preston, P.Z.S., p. 188, pl. 31, fig. 17. D.F.

Hab. Mozambique (Layard).

L. Marques. Wanetsi R., Magude District (Bell Marley).

The specimens from both the above localities agree perfectly with *soror*, Preston, which, however, Pilsbry considers synonymous with the Indian *coenopictus*; they certainly do not appear even subspecifically distinct.

Subfamily VERTIGININAE.

Genus Nesopupa Pilsbry, 1900.

Subgenus afripupa Pilsb. and Cooke, 1920.

Nesopupa (*Afripupa*) *corrugata* (Preston), 1912.

Hab. L. Marques. Bandula Siding (Mcdowell).

The local race is slightly shorter than that from the Victoria Falls, the only other known habitat of this species; the shells are perfectly conspecific, however, and remarkable for the peculiar corrugated surface from which they derive their name.

Nesopupa (*Afripupa*) *vengoensis* sp. n.

(Plate IV, fig. 23.)

The minute shell is almost an exact replica of *N. griqualandica* (M. and P.),* but is slightly less strongly striate, and differs clearly and constantly in dentition, the lower palatal fold being absent and the basal tooth so much more deepset that in some specimens it is hardly visible.

Long. 1·6, lat. 0·8 ; apert. alt. 0·5, lat. 0·5 ; last whorl 1·0 mm.

Hab. L. Marques. Mount Vengo, 5500 ft. (Cressy).

I would have been inclined to regard this race as merely a subspecies of *griqualandica*, were it not that the exact number of palatal folds is now considered of sectional importance in the genus *Ptychotrema*, so should presumably be of at least specific importance in the *Pupillidae*.

Nesopupa (*Afripupa*) *bandulana* Conn., 1922.

(Plate IV, fig. 24.)

1922. *Nesopupa bandulana* Conn., A.M.N.H. x, p. 119. D.

Hab. L. Marques. Bandula Siding, B. and M. Rly. (Mcdowell).

Nearly allied to *N. bisulcata rhodesiana* Pilsb.,† but easily separable by having a more prominent sinulus, much fainter sculpture, and the extra denticle on the left of the base.

Genus Truncatellina Lowe, 1852.

Truncatellina sykesi (M. and P.), 1893.

1908. *Pupa sykesii* M. and P., A.M.N.H. i, p. 81, pl. 2, fig. 20. N.F.

Hab. L. Marques. Mount Vengo, 5500 ft. (Cressy).

Of the only two examples, one is immature and the other somewhat abnormal, tapering more noticeably than usual. I do not consider, however, that they are separable from the south-eastern form.

Family ACHATINIDAE.

Subfamily ACHATININAE.

Genus Metachatina Pilsbry, 1904.

Metachatina kraussi (Pfr.), 1846.

var. *elongata* (Junod), 1899.

1899. *Livinhacia kraussi*, var. *elongata* Junod, Bull. Soc. Vaudoise, xxxv, p. 279. N.

Hab. L. Marques. Rikatla (Junod) ; Delagoa Bay (juv., Barnard).

* A.M.N.H. xi, 1893, p. 22, pl. 3, fig. 9.

† Man. Conch. xxv, 1920, p. 360, pl. 34, figs. 5–6.

Specimens collected quite recently prove that this elongate race has retained its somewhat specialised form for over 25 years ; an average adult shell measures 145×72 mm., as against 98×76 mm. of typical examples from Natal.

Genus Achatina Lamarck, 1799.

Achatina panthera (Fér.), 1821.

1821. *Helix* (*Cochlitoma*) *panthera* Fer., Tabl. Syst. Moll., pt. 3, p. 53 (or 49).

1846. *Achatina lamarckiana* Pfr., P.Z.S., p. 115. D.

1851. ,, *panthera* Fer., Desh., Hist. Nat. Moll. ii, 2, p. 159, pl. 126, figs. 1–2 ; pl. 132, figs. 1–2. D.F.

1892–3. *Achatina mossambica* Brancsik, Jahresh. Naturw. Ver. Trenc. Com., p. 116, pl. 6, fig. 2 ; pl. 10, fig. 2. D.A.R.

1894. *Achatina lechaptoisi* Ancey, Mem. Soc. Zool. Fr. vii, p. 220. D.

Hab. Mozambique (Kirk ; Gibbons ; *mossambica*, Frey ; *lechaptoisi*, Layard) ; Querimba I. (Peters) ; Quilimane (Stuhlmann).

L. Marques. Tette (Peters ; Kirk) ; Inhambane (Gibbons ; Bowker) ; Rikatla (Junod) ; Andrada (Vasse) ; Amatongas (Arnold) ; Chinde (Miss L. Staunton) ; Headwaters of R. Tristão, Macequece District (Cressy).

Pilsbry (Monograph, xvii, 1904, p. 41, etc.) points out that *A. lechaptoisi* is identical with *mossambica*, and places both in the synonymy of *panthera*. A detailed account of the anatomy of this species by Wiegmann will be found in Mitth. Zool. Samml. Mus. Nat. Hist. Berlin, i, 1898, p. 85, pl. 4, figs. 5–6. Its shell is normally the well-known obese form, usually found along the coast, with blotchy brown and yellow markings and roseate columella, but further inland it is subject to extreme variation in contour, some individuals from Macequece being very much like the coastal race, while others are smaller and more slender, closely resembling the specimen figured by Smith (P.Z.S., 1899, pl. 34, fig. 1). This may be near the var. *minor* mentioned by Junod (Bull. Soc. Vaudoise, xxxv, p. 278) which I have not seen.

Some of the shells from the neighbourhood of Delagoa Bay tend to resemble those of *Achatina immaculata* Lam., for which they have sometimes been mistaken, and from which they scarcely differ except in usually having more distinct dark streaks. Nevertheless the anatomy of a large specimen from the Rikatla district, Delagoa Bay, has been found to agree closely with that of the most slender example from Macequece and the radulae of both these specimens closely resemble Wiegmann's figure. On the other hand, the radulae of two specimens of *A. immaculata* from Zoutpansberg, in the northern Transvaal, differ slightly from those just men-

tioned, the chief points of distinction being that their central teeth are even narrower, and the whole radula is longer, the number of transverse rows being 179 in one specimen and 187 in the other, whereas the radular formula of the Rikatla example is $(88+1+89)\times 143$ and that of the Macequece specimen $(77+1+79)\times 159$. These radular differences between *A. panthera* and *A. immaculata* are not, however, very great, and no marked differences were found in the other organs; it therefore seems not impossible that *immaculata* may eventually prove to be merely a subspecies of *A. panthera* in which the shell and radula have become slightly modified in response to the somewhat different climate and vegetation of the district in which it occurs; both species are remarkable for their roseate columella.

Two examples from Rikatla in the Kimberley Museum show a beautiful variation in colour that is rare in this species. The early whorls are almost colourless, deepening at the 5th into pale buff; in an immature shell, 65×40 mm., possessing 6 whorls and showing marked angulation at the periphery, there are pale rufous flames some distance apart and a few blotches somewhat corresponding to the darker markings of the typical form. In the larger shell, 95×56 mm. with 7 whorls, the streaks have grown nearer together, giving the shell the appearance of having been varnished pale yellow and combed over with a coarse comb.

Achatina immaculata (Lam.), 1821.

1851. *Achatina immaculata* Lam., Desh., Hist. nat. An. s. Vert., II, 2, p. 158, pl. 127, figs. 1–2. D.F.

Hab. L. Marques. Inhambane (Gibbons); Delagoa Bay (fide Pfeiffer).

In view of my note on *A. panthera*, it may be a little doubtful whether these records should not refer to that, rather than to the present species.

The Transvaal form known as *immaculata* is very constant in shape, but variable in colour. The apex is small and acute, and the whorls, about $7\frac{1}{2}$ in number, increase regularly and somewhat rapidly, the last being nearly $\frac{3}{4}$ of the entire length. Immature shells are sometimes almost white, with rare pale rufous streaks; mature examples all shades from pale buff to dull chestnut, sometimes with darker streaks and blotches; columella, paries, and peristome bright rose-red or pink, often showing round the *outside* of the peristome.

It will be observed that some of these colour-schemes practically merge in that of *A. panthera*, and it is almost impossible, in such cases, to separate the species.

Achatina glutinosa Pfr., 1852.

1852 *Achatina glutinosa* Pfr., P.Z.S., p. 86. D.

1860. ., *pe ersi* Mts., Mal. Blätt. vi, p. 214. D.

1869. ,, ,, ,, Pfr., Novit. Conch. iii, p. 452, pl. 99, figs. 13–15. D.F.

Hab. L. Marques. Tette; Sena (Peters); Andrada (Vasse); Macequece District; Mtisherra R. Valley (Cressy).

Described from Tette by von Martens in 1860 under the name of *A. petersi*, this species has since been proved identical with *glutinosa*, whose original locality, "West Africa," is probably erroneous.

Achatina granulata Pfr., 1852.

1852. *Achatina granulata* Pfr., P.Z.S., p. 66. D.

1899. ,, *schinziana* Mouss., Junod, Bull. Soc. Vaudoise, xxxv. p. 278. L.

L. Marques. Cape Delagoa (Plant); Rikatla (Junod).

Dr. Fuhrmann of the Neuchâtel Museum has kindly shown me the actual shells on which the above record of *A. schinziana* was based; they prove to be perfectly normal examples of *granulata*, and it may be accepted that Mousson's species does not occur in Portuguese East Africa.

Achatina nyikaensis Pilsbry, 1909.

1899. *Achatina fragilis* Smith, P.Z.S., p. 591, pl. 35, figs. 3–4. D.F.

1909. ,, *nyikaensis* (=*fragilis* Smith, 1899, non Desh., 1864), Pilsb., Man. Conch. xx, p. 113. N.

Hab. L. Marques. Macequece District (Cressy).

Described from Nyasaland; Smith figures two examples, one of which is flammate and the other unicoloured and rather more noticeably sculptured; both varieties are represented in the series from Macequece.

Achatina jacobi da Costa, 1906.

1906. *Achatina jacobi* da Costa, Proc. Mal. Soc. vii, p. 11. D.F.

Hab. L. Marques. Macequece District (Cressy).

A very variable species, often misidentified as *craveni* Smith, with which it has little in common.

Achatina natalensis Pfr., 1854.

1854. *Acha'ina natalensis* Pfr., P.Z.S., p. 294. D.

Hab. L. Marques. Delagoa Bay (Plant).

The British Museum contains 3 examples of this little known species, of which the type and another are labelled "Cape Natal," and the third as above. It is open to question whether they were really collected in two different localities, but the species does not seem to have been rediscovered since the days of Plant, and its exact habitat cannot therefore be definitely stated. The shells resemble *A. transvaalensis*, Smith, in colour, sculpture, and texture, but are considerably larger and comparatively more obese, measuring respectively 62×30, 64×31, and $65\times29\frac{1}{2}$ mm.

Achatina vassei Germain, 1918.

1918. *Achatina* (*Achatina*) *vassei* Germ., Bull. Mus. Paris, xxiv, p. 161. D.F.

Hab. L. Marques. Andrada (Vasse); Mt. Vengo (Cressy).

A very distinct member of the small group of narrow shells which includes *A. pfeifferi* Dkr. and *ustulata* Lam. The type is immature, the measurements of a full grown adult being $63{\cdot}2\times24{\cdot}3$ mm.

Achatina vestita Pfr., 1854.

1854. *Achatina vestita* Pfr., Novit. Conch. i, p. 35, pl. 9, figs. 8, 9. D.F.

Hab. L. Marques. Near Delagoa Bay (in British Museum).

Achatina fulica (Fér.), 1821.

1849. *Achatina fulica* Fér., Rve., Conch. Icon., pl. 2, fig. 8. D.F.

Hab. Mozambique. Frontier S. of Mt. Dedza, Nyasaland (Mrs. Connolly).

Genus Limicolaria Schumaker, 1817.

Limicolaria sculpturata Ancey, 1890.

1890. *Limicolaria sculpturata* Ancey, Bull. Soc. Mal. Fr. vii, p. 346. D.

Hab. Mozambique, ex sacks of grain (Ancey).

I have been unable to collect any information about this so-called *Limicolaria*, but the description recalls *Ps. boivini* (Morel.), and I suspect that *sculpturata* may be identical with Ancey's unpublished *Limicolaria borellii*, which I show hereafter, p. 171, to be identical with Morelet's species.

Genus Limicena nov.

Shell bulimoid when adult, perforate, columella not truncate, protoconch ($2\frac{1}{2}$ whorls) sculptured with 8 or 9 strong microscopic spiral costulae, remainder weakly transversely striate.

Genotype *Limicena nyasana* (Smith), 1899.

1899. *Buliminus* (*Conulinus*) *nyasanus* Smith, P.Z.S., p. 586, pl. 33, figs. 41–42. D.F.

Hab. L. Marques. Mtisherra R. Valley (Cressy).

Conchological grounds alone amply justify the creation of a new genus for this remarkable species, which was described from Nyasaland and also occurs in the Palm Kloof, Victoria Falls.

The clear strong spiral sculpture of the protoconch, changing abruptly into transverse striation on the later whorls, is only comparable, among the larger African forms, with that of *Krapfiella* Preston, but *Krapfiella* has a broad apex and an elongate shell, while *Limicena* has a narrow apex and a bulimoid shell, so that I hardly think they belong to the same subfamily, and place the new genus provisionally in the Achatininae. Newly hatched specimens, which crawl about together in large numbers, are easily mistakable at first glance for a small form of *Tropidophora*, and only the present writer's field acquaintance with them has prevented others from describing them as a new species of that genus.

Neuville and Anthony have recorded *nyasana* from Abyssinia.

Subfamily STENOGYRINAE.

Genus Pseudoglessula O. Boettger, 1892.

Subgenus pseudocerastus Germain, 1918.

Pseudoglessula (*Pseudocerastus*) *kirki* (Dohrn), 1865.

1865. *Buliminus kirkii* Dhrn., P.Z.S., p. 232. D.

1889. *Bulimus bridouxi* Bgt., Moll. Afr. équat., p. 53, pl. 2, figs. 4–5. D.F.

Hab. Mozambique. Near Cabaceira (type, Kirk).

L. Marques. Amatongas Forest (Arnold); Mtisherra R. Valley (Cressy).

Dr. Germain has pronounced some of the Mtisherra River series to be identical with *bridouxi*; they are also identical with the type specimen of *kirki*, so the synonymy seems firmly established; Bourguignat's species was described from Usagara.

Ps. kirki agrees in sculpture, colour, and texture with *boivini* Morel., but it is a rather more obese form, with a tendency to expansion of the peristome in adult shells, a feature which I have not yet observed in *boivini*.

Pseudoglessula (*Pseudocerastus*) *boivini* (Morel.), 1860.

(Plate VI, figs. 1–4.)

1860. *Glandina boivini* Morel., Séries Conch. ii, p. 72, pl. 5, fig. 5. D.F.

1898. *Buliminus morenensis* Stur., S.A. Moll., p. 66, pl. 2, figs. 44–51. D.F.

Hab. L. Marques. Delagoa Bay (Connolly); Movene (*morenensis*, Penther); Rikatla; under stones in the Lebombo Mts. (Junod): Andrada

Text-fig. 18.—*Pseudoglessula* (*Pseudocerastus*) *boivini* (Morel.). Apical sculpture; ×32.

(Vasse); Maxixe (Lawrence); District N. of Macequece (Cressy); Wanetsi R., Magude District (Bell Marley).

This very widely distributed species varies little in form; the transverse striae of its apex are only very little farther apart than those on the later whorls and it is rather widely umbilicate.

Von Martens (D.-O.-A., p. 62) mentions a *Limicolaria borellii* Ancey, of which I can find no other trace in literature. As represented in the Dautzenberg collection, however, it is identical with the present species.

The following notes on the anatomy of *Ps. boivini* are based on some

slightly immature specimens found under leaves in the bush at Kosi Bay, Zululand, by F. Toppin (Collector for the Natal Museum), and sent to England in spirit by H. C. Burnup, to whom the writer is much indebted.

External features of the animal.—The dermal grooves are similar to those of the next species (Pl. VII, figs. 2, 7), there being, in addition to the usual dorsal and oblique lateral grooves on the neck and the vertical grooves on the front of the head, a conspicuous peripodial groove on each side, the two grooves meeting above a well-marked caudal mucous pore. The hind end of the foot is somewhat truncate in form, and there is no keel.

The dark bands on the sides of the neck seem to be absent, but irregular streaks and spots of dark pigment are scattered over the translucent skin of the mantle and visceral hump, and a larger grey patch occurs just behind the respiratory opening.

The left body-lobe is divided into two widely separated portions, as shown in Pl. VI, fig. 1.

Pallial organs.—The respiratory and excretory organs are shown in the same figure, from which it will be seen that a few small veins occur on the roof of the lung in addition to the main pulmonary vein, which is very prominent. The kidney is long and narrow, with a recurved ureter arising from its front end.

Pedal gland.—This organ is embedded in the muscles of the foot. The glandular tissue completely surrounds the central duct, which is crescentic in transverse section. The gland is simple in structure, and seems to bear some resemblance to that of the Dorcasiinae, as will be seen from Pl. VI, fig. 2.

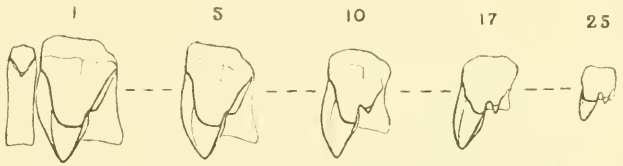
Central nervous system.—The nervous system closely resembles that of the next species (Pl. VII, fig. 3). The nerve-ring may either surround the buccal-mass, or be situated just behind it, as in the specimen shown in Pl. VI, fig. 4. Each cerebral ganglion has a well-marked anterior lobe. The visceral ganglia are rather closely approximated, but not completely united. The buccal ganglia are situated immediately behind the anterior end of the oesophagus, and are oval in form, being joined by a commissure about 0·5 mm. in length.

Digestive system.—The jaw (Pl. VI, fig. 3) is brown, 1·6 mm. long, and transversely striated, the striae being inconspicuous, but a little better developed than in *Ps. cressyi* Conn.

The radula (text-fig. 19) measures 3×1·25 mm., when flattened out. The central teeth are narrow, with single short cusps, but they are not quite so narrow and degenerate as in the next species. The other teeth are also broader and relatively shorter than in *Ps. cressyi*, and the first five on each side are almost unicuspid, the ectocone being reduced to a narrow flange on the outer side of the base of the conical mesocone. They thus

approach the more specialised type found in *Ps. walikalensis* Pilsbry.* In the remaining teeth the ectocones are distinct, though very small in comparison with the large mesocones, which have rather broad inner flanges. No endocones occur, and the marginal teeth are much more asymmetrical than is usual in the Achatinidae. The transverse rows of teeth are almost straight and have not the slight angle in the centre which occurs in the next species. The radular formulae of the two specimens examined were $(25+1+26)\times 76$, and $(25+1+25)\times 73$. The radula-sac projects only a very short distance beyond the muscles of the buccal-mass.

The two salivary glands meet above the oesophagus, which is broad, but does not seem to be dilated sufficiently to form a distinct crop. It continues back into the stomach, whence arises the intestine, which describes



Text-fig. 19.—*Pseudoglessula* (*Pseudocerastus*) *boivini* (Morel.), Kosi Bay, Zululand.
Representative teeth from the radula; ×300.

the usual S-shaped course before finally passing forwards as the rectum (shown on the left of fig. 1, on Pl. VI).

Free retractor muscles.—The arrangement of the principal retractor muscles is shown in Pl. VI, fig. 4, and is similar to that described in the next species. The powerful buccal retractor, which bifurcates in front, is united posteriorly with the left tentacular retractor; while the slender penial retractor and the broad retractor of the foot arise in common with the right tentacular retractor.

Reproductive organs (Pl. VI, fig. 4).—Owing to the fact that the specimens examined were not quite full-grown it is impossible to give a satisfactory description of the reproductive organs of the present species. They appear, however, to resemble those of *Ps. cressyi* in having a rather short free oviduct and receptacular duct, a long vagina, and a penis lined by small papillae and bearing a somewhat swollen terminal appendix, to the posterior end of which the penial retractor and vas deferens are attached, the latter apparently passing forwards to the penis embedded in the outer layers of the wall of the appendix. But the penis and vagina are both much more slender than in the next species, and the receptaculum seminis is also unusually narrow, though it is probable that these features are at least partly due to the immaturity of the specimens.

* Pilsbry: Bull. Amer. Mus. Nat. Hist., vol. xl, 1919, p. 145, fig. 53.

Affinities.—Although originally placed in *Glandina*, this species has usually been assigned to the genus *Buliminus* or *Ena*, and so recently as 1918 Germain made it the type of a new subgenus of *Buliminus* to which he gave the name *Pseudocerastus*.* The present species, however, has certainly no affinities with *Buliminus* or *Ena*, as is evident from the sculpture and form of the shell, the peripodial grooves and caudal mucous pore, the sigmurethrous kidney, the radula with its very narrow central teeth, and the reproductive system in which neither the penis nor the receptacular duct possesses a lateral appendix. Undoubtedly Pilsbry † is right in assigning this species and its allies to the genus *Pseudoglessula*, of which *Pseudocerastus* may be regarded as a subgenus, differing but little from *Pseudoglessula s. s.*, though in some respects more nearly resembling the subgenus *Kempioconcha*.‡

Pseudoglessula is correctly placed in the family Achatinidae; yet it is a decidedly aberrant member of the family, both as regards the radula and the foot with its caudal mucous pore, and so far as we know at present the only other genus to which it seems to be at all closely related is *Krapfiella*.§ It is true that a caudal mucous pore is also found in *Ferussacia* ‖ and *Cryptazeca*, ¶ but while these genera may be more nearly related to the Achatinidae than to the orthurethrous genera with which Pilsbry ** has provisionally associated them,†† it is unlikely that they are at all closely allied to *Pseudoglessula*.

Pseudoglessula (*Pseudocerastus*) *cressyi* sp. n.

(Plate IV, fig. 28; Plate VII, figs. 1–7.)

Shell rather large, turriform, subrimate in the type, but frequently imperforate, thin, silky, nearly transparent, normally corneous violet-brown. Spire produced, apex mammillate. Whorls 8, not very convex, regularly increasing, slightly bluntly angulate at the periphery, except on the last whorl of fully mature examples; the first 2 strongly and rather distantly transversely costulate, with traces of very fine, microscopic spiral striation between the ribs, remainder covered with close, regular, slightly oblique transverse costulae, which become fainter below the periphery so

* Bull. Mus. Hist. Nat. Paris, vol. xxiv, pp. 258, 259.

† Bull. Amer. Mus. Nat. Hist., vol. xl, 1919, pp. 151, 152, 158.

‡ Preston: Rev. Zool. Afric., vol. iii, 1913, pp. 53, 212.

§ See Watson: Proc. Malac. Soc., vol. xiv, 1921, p. 135.

‖ Godwin-Austen and Nevill: Proc. Zool. Soc., 1880, p. 663, pl. lxiv.

¶ Folin and Berillon: Journ. de Conchyl., vol. xxv, 1877, p. 397; Contrib. Faune Malac. Région extrême S.-O. de la France, III^e. fasc., pp. 17–21, pls. iii, iv.

** Man. Conch (2nd ser.), vol. xix, 1908, pp. 211 *et seqq.*

†† Watson: Proc. Malac. Soc., vol. xiv, 1920, p. 26.

long as it still shows trace of keel ; suture simple, well defined. Aperture subovate, peristome simple, acute ; outer lip nearly straight in profile, receding slightly to the base ; columella nearly white, concave in the type, with margin extremely narrowly and shortly reflexed, forming a minute rima, but very variable, as in other specimens it may be either straight or concave, and slightly truncate at the base, without marginal reflection.

Long. 22·0, lat. 8·7 ; apert. alt. 7·7, lat. 4·8 ; last whorl 12·1 mm.

Hab. L. Marques. District north of Macequece (Cressy).

Text-fig. 20.—*Pseudoglessula* (*Pseudocerastus*) *cressyi*, Conn. Apical sculpture ; ×32.

The largest specimen seen measures 26·3 × 9·75 mm.

The distant apical sculpture (text-fig. 22) distinguishes this fine species from all of its allies except *conradti* Mts. and *subcarinifera* Smith, both of which are smaller forms.

The fact of its live animal being available for examination renders it advisable to select as type a shell which is slightly abnormal, since the undue inflation of the outer lip causes the aperture to appear out of line with the axis, a character which, although not unusual, is not general in this species. The rimation, which in this case is of no specific value, is to some extent dependent on this inflation, as when the columella is straight

and outer lip normal there is often no trace of rimation, while the columella is frequently clearly truncate.

External features of animal.—The foot-sole is undivided. The foot-fringe is rather broad, crossed by transverse grooves, and limited above by a conspicuous peripodial groove on each side. Posteriorly the peripodial grooves curve together and unite over a caudal mucous pore, as shown in Pl. VII, fig. 2, which also shows the rounded, almost truncated, form of the posterior extremity of the foot. There is no keel. An oblique lateral groove runs forward on each side of the neck. The dorsal grooves are inconspicuous and rather close together; in front they branch into four or five well-marked vertical grooves on the front of the head. The labial palps are well developed, and the generative opening is situated rather far back on the right side of the head (Pl. VII, fig. 7).

The ground-colour of the skin is light red or salmon, this being the tint of the dermal grooves. Between the grooves, however, the rugae are more or less tinged with dark grey pigment. This dark pigment is most developed on the sides of the animal, leaving a paler dorsal area. On the neck this median dorsal area is lightest towards the edges, which are well-defined and contrast strongly with the dark lateral zones. The entire foot-sole is slightly tinged with the dark grey pigment.

The thin skin of the mantle and visceral hump is largely translucent and colourless, but it is ornamented over the lung, etc., with some vertical or oblique, irregular, brownish grey lines, which are darkest towards the suture, the broadest line being near the respiratory opening; and there are also some vertical, irregular, opaque white streaks over the exposed parts of the liver, stomach, etc. (Pl. VII, fig. 6). These white streaks are most defined and relatively largest towards the apex; and both they and the dark lines on the last whorl show clearly through the translucent brown shell.*

The mantle-edge is whitish, and is provided with the usual right and left body-lobes, the latter being divided into two widely separated portions, one near the respiratory opening, and the other on the left side of the animal.

Pallial organs.—The main pulmonary vein is without important branches, the roof of the lung only showing this single vessel passing forwards. The kidney is long, being about half the length of the lung and extending a considerable distance in front of the heart, as in *Ps. boivini*. The ureter arises from the extreme front end of the kidney, and runs back along its upper edge to the hind end of the lung; it then curves round and runs forward immediately beneath the rectum (Pl. VII, fig. 6).

Central nervous system.—In the specimen examined the cerebral

* Another specimen had more numerous dark lines and spots than the one figured.

ganglia lay above the anterior end of the buccal mass, considerably in front of the oesophagus and buccal ganglia. The arrangement of the ganglia comprised in the nerve-collar, and the relative lengths of the various connectives and commissures, will be seen from fig. 3, and present no unusual features. The otocysts are very prominent.

Digestive system.—The jaw is 1·6 mm. in length, rather thin, and very faintly transversely striated.

The radula measures 3×1·2 mm. when flattened out. The central teeth are very narrow, and each has an extremely short single cusp (Pl. VII, fig. 1). Both the lateral and marginal teeth are bicuspid, no endocones being developed. The mesocones are large, with flanges on their inner sides; and those of the marginal teeth have somewhat rounded points. The ectocones are uniformly small but quite separate from the mesocones. The bases of the teeth are of the usual quadrate form. The transverse rows curve very slightly forwards on each side of the middle line. The radular formula is: (26+1+27)×100.

In another specimen the radula proved to be very similar, except that there were fewer transverse rows of teeth, the formula being (27+1+27)×77.

The two salivary glands are united above the alimentary canal.

Free retractor muscles.—The right and left divisions of the columellar muscle are separate practically from their origin. The right portion divides far forward into a broad ventral muscle to the foot, the so-called tail retractor and two narrower dorsal muscles, the penial retractor and the right tentacular retractor. The latter divides again into the retractor of the lower right tentacle, which passes to the left of the penis, and the retractor of the upper right tentacle, which passes between the penis and the vagina. The left division of the columellar muscle gives rise to the buccal retractor as well as to the left tentacular retractor.

Reproductive organs (Pl. VII, fig. 5).—The hermaphrodite gland consists of a rather small bunch of narrow follicles embedded in the posterior division of the liver. The hermaphrodite duct is somewhat swollen and densely convoluted throughout the greater part of its course. Close to its lower end it takes a sharp bend, and at the angle of this bend there is a very small swelling, which probably represents the vesicula seminalis. The albumen gland is rather small, tapering, and peculiarly sacculated along its sides. The common duct is large but not convoluted. The free oviduct is short. The receptaculum seminis or spermatheca lies against the common duct close to its anterior end. It is borne on a short receptacular duct with an enlarged base, which forms a continuation of the long and broad, thick-walled vagina.

The vas deferens is very slender, and is slightly convoluted near the vagina. It passes into a somewhat reniform structure, which leads into

the hinder end of the penis, and has a narrow ridge running along its posterior convex surface. This structure, like the corresponding one in the last species, is very like a short epiphallus ; but it is more probable that in both species it is really a terminal appendix to the penis, and that the vas deferens does not open into it, but runs forwards embedded in its outer wall, forming the ridge mentioned above, and opens independently into the hinder extremity of the penis. It would be well, however, for any one who may have an opportunity of dissecting more full-grown specimens of either of these species to make a fresh examination of these organs by means of serial sections, so as to remove all doubt as to their exact morphology.

The penis is broad posteriorly, but tapers towards the narrower genital atrium. It is lined by longitudinal rows of small papillae, except on the ventral side towards the posterior end, where there is a thin-walled area without papillae, bounded by two thick folds which converge and meet anteriorly. The penial retractor is inserted at the junction of the vas deferens with the end of the penial appendix ; it arises, as already mentioned, from the retractor of the right tentacles, and not from the diaphragm.

The head of the spermatozoon is pointed in front but somewhat swollen posteriorly, and is scarcely ·004 mm. in length. The tail is remarkably long, attaining a length of about ·37 mm. ; its anterior part has a spiral structure, as shown in Pl. VII, fig. 4.

Affinities.—This species differs considerably from *Ps. boivini* in its radula (compare Pl. VII, fig. 1 with text-fig. 19), as well as in the apical sculpture of its shell, and in the character of the columella, which differs less from that found in *Pseudoglessula s. s.* than does that of *Ps. boivini*. Nevertheless the anatomical as well as the conchological characters of the present form leave little doubt that it is rightly placed in the same section of *Pseudoglessula* as the last species. It is important to notice that in both these forms the penial retractor arises from the columellar muscle, as in so many of the Achatinidae, and not from the diaphragm, as Pilsbry states that it does in *Ps. stuhlmanni* (Mts.),* a species which Germain includes in his subgenus *Pseudocerastus*.

Pseudoglessula (*Pseudocerastus*) *gibbonsi* (Taylor), 1877.

1877. *Buliminus gibbonsi* Taylor, Q.J. of C. i, p. 280, pl. 3, fig. 1. D.F.
1899 ,, *boivini* Morel., var., Smith, P.Z.S., p. 587. N.
Hab. Mozambique (Gibbons).
L. Marques. Mtisherra R. Valley (Cressy).
It is with much diffidence that I assign the series from the Mtisherra

* Bull. Amer. Mus. Nat. Hist., vol. xl, 1919, p. 154.

River to this species. They are identical with a set in the British Museum from the Nyika Range, Nyasaland, which Smith considered might be a variety of *boivini*, than which, however, they are smaller, with shorter whorls. They are very distinctly, though bluntly, angled at the periphery when not quite mature, in which feature they appear to differ from *Ps. kidetensis* (Smith) and typical *gibbonsi*, while of a more obese contour than the former and with slightly more convex, gradate whorls than the latter. They are of smaller, slightly more slender form than *emini* Smith, while the whorls increase a little more slowly than in *lasti* Smith, their paries thus being more horizontal. Further series of all these so-called species are desirable before their exact inter-relationship can be determined.

Genus Homorus Albers, 1850.

Homorus manueli Preston, 1910.

1910. *Homorus manueli* Prest., Proc. Mal. Soc. ix, p. 54. D.F.

Hab. L. Marques. Mtisherra R. Valley; Zangwe Basin (Cressy); Maforga Siding (Mcdowell).

A dark brown shell with rather broad apex, originally described from Angola.

Genus Subuliniscus Pilsbry, 1919.

Subuliniscus chiradzuluensis (Smith), 1899.

(Plate V, figs. 9–16.)

1899. *Subulina chiradzuluensis* Smith, P.Z.S., p. 588, pl. 33, fig. 44. D.F.

Hab. L. Marques. District north of Macequece (Cressy).

The local race is noticeably more obese than the type set from Mt. Chiradzulu, Nyasaland, two average examples measuring 19·8×5·8 and 17·5×5·7, as against 19·2×5·1 and 15·3×5·0 mm., respectively, but the volution and sculpture appear identical, so there seems to be no reason for regarding them as distinct.

The animal is viviparous, and the anatomy differs in several respects from that characteristic of the genus *Subulina*, as will be seen from the following description. Possibly *Subuliniscus* may prove to be more nearly related to the genus *Bocageia*.

External features of the animal.—The foot-sole is undivided, and the hind end of the foot is pointed. There is no caudal mucous pore, but a peripodial groove is present, cutting off a rather narrow foot-fringe (Pl. V, fig. 13). The usual pair of dorsal grooves runs along the neck, but there is no median posterior groove or keel.

The animal is of a pale colour, except that rather small, irregular patches

of black are scattered over the skin lining the shell, chiefly in the region of the liver.

Pallial organs.—The lung is long ; its roof is very thin, and is traversed by a single pulmonary vein without any distinct branches. The kidney is about twice as long as the pericardium. The ureter arises close to the front end of the kidney and is reflexed in the manner usual among sigmurethrous snails. Pl. V, fig. 10, shows the disposition of the pericardium, kidney, and ureter in an embryo taken from the uterus.

Pedal gland.—Instead of being embedded in the muscles of the foot, the pedal gland lies just above them in the lower part of the body-cavity. It is rather long and much flattened, broad in front, but tapering gradually towards the hind end. A brown band runs along the centre of the gland and indicates the position of the duct.

Central nervous system (Pl. V, fig. 16).—The cerebral ganglia are situated above the hind end of the buccal mass. They are broader than long, and are united by a rather thick commissure, the length of which is about equal to the breadth of each ganglion. The buccal ganglia are small and are united by a commissure of about the same length as the cerebral commissure, but much narrower. The cerebro-buccal connectives are long and slender. The cerebral ganglia are united with the pedal and pleural ganglia by two pairs of rather long connectives. As usual, the pedal ganglia are the largest in the ventral group, but the abdominal ganglion is also rather large. The right parietal ganglion, although much larger than the left, is smaller than the abdominal ganglion, with which it is somewhat closely united. The remaining connectives, on the other hand, are rather long, the pleuro-pedal connectives being the longest in the ventral group.

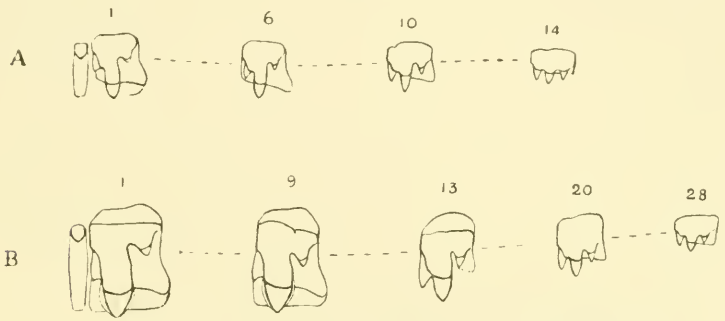
Digestive system.—The jaw (Pl. V, fig. 11) is thin, of the usual crescentic form, and about 1 mm. in length. It is crossed by numerous irregular striae or narrow folds.

The radula (text-fig. 21, B) measures about $2\times\cdot85$ mm. when flattened out. The central teeth are extremely narrow, with single vestigial cusps. The lateral and marginal teeth are tricuspid, with quadrate bases. The mesocones are large in the lateral teeth, but become smaller in the marginals. The ectocones are uniformly small, but are always quite separate from the mesocones. The endocones are also small, and in the lateral teeth they become more or less united with the mesocones, from the sides of which they appear to spring. The transverse rows of teeth curve slightly forwards on each side of the middle line. The formula of the specimen examined is $(32+1+32)\times102$.

The embryonic radula (text-fig. 21, A) measures about $\cdot8\times\cdot35$ mm., and its formula is $(17+1+17)\times68$. The individual teeth are also smaller in the embryo, and a little broader in proportion to their length. The central

teeth, however, are relatively not quite so small as in the adult. The cusps of the other teeth are slightly narrower than they are in the full-grown radula, and the endocones are a little more distinct.

The radula of this species differs from those of *Subulina octona* (Brug.) and allied forms chiefly in the very inconspicuous endocones of the lateral teeth. Since, however, the ndocones are more prominent in the marginal teeth, and are rather better developed in the embryo than in the adult, it seems likely that this species has been evolved from a form having the more obviously tricuspid lateral teeth found in most of the Stenogyrinae. The particularly degenerate central teeth also suggest that in its radula this species is less primitive than many of its allies.



Text-fig. 21.—*Subulina chiradzuluensis* (Smith), Macequece.

A. Representative teeth from the radula of an embryo from the uterus; ×600.
B. Representative teeth from the radula of a mature specimen; ×600.

The course of the alimentary canal will be seen from Pl. V, fig. 14. The crop is unusually narrow, but perhaps this may be due to the relatively large embryos swelling the genital ducts to such an extent as to leave little room for the other organs in this region. The salivary glands are long, and are situated a little further forward than usual. They are united with each other above the alimentary canal.

Free retractor muscles (Pl. V, fig. 15).—The columellar muscle divides not far from its origin into a right and left division. A little further forward the right division gives off a broad "tail retractor" to the foot. The remaining portion of the muscle runs forward as the right tentacular retractor, but just before it divides into the retractors of the upper and lower tentacles, it gives rise to the penial retractor, which, as in most members of this family, does not arise from the diaphragm. The muscles going to the lower tentacle and the front of the head pass to the left of the penis, but the retractor of the right upper tentacle passes between the penis and the vagina.

The left division of the columellar muscle divides rather far forward

into the buccal retractor and the left tentacular retractor, and the latter again divides into branches going to the upper and lower left tentacles and to the front of the head. The asymmetrical origin of the buccal retractor is probably not a primitive feature, as this muscle is innervated by a symmetrical pair of nerves, that to the right side of the retractor arising from the right cerebral ganglion, and that to the left side from the left ganglion.

Although the outer skin of the upper tentacles seems to be devoid of pigment, the retractors of these tentacles are pigmented in the usual manner, which does not appear to be the case in the genus *Subulina*.

Reproductive organs (Pl. V, fig. 15).—The follicles of the hermaphrodite gland are embedded in the posterior division of the liver. The hermaphrodite duct is but slightly swollen and convoluted. No vesicula seminalis was found, unless it is represented by a slightly enlarged and abruptly convoluted portion of the duct close to the albumen gland. The uterine part of the common duct is greatly swollen by the presence of the relatively large embryos within it. One of these embryos is shown in fig. 9. They measure about $3\frac{1}{2} \times 2$ mm., and three of them were found in the uterus of one adult snail, and five in another. As they were not enclosed in any egg-shells, there can be little doubt that this species is viviparous.

The receptaculum seminis or spermatheca is rather small, and lies close to the common duct towards its anterior end; it is borne on a slender receptacular duct of moderate length. The free oviduct is very short, but the vagina is decidedly long, though rather narrow. The genital atrium or vestibule is very short. The vas deferens is slender, and enters the hinder end of the penis beside the insertion of the penial retractor. There is no distinct epiphallus. The penis is rather narrow near the genital atrium, but is broad posteriorly; and although it is of no great size, it is not nearly so small as in *Subulina octona*.*

The spermatozoa have small heads, and very long slender tails, with a spiral filament or flange near the anterior end (Pl. V, fig. 12).

Genus Curvella Chaper, 1885.

Curvella nyasana Smith, 1899.

1899. *Curvella nyasana* Smith, P.Z.S., p. 588, pl. 33, fig. 44. D.F.

Hab. L. Marques. District N. of Macequece, 4500 ft.; Mtisherra R. Valley (Cressy).

This species was described from Mt. Chiradzulu, other Nyasaland localities being Zomba, Masuku Plateau, and the Nyika Range. The series

* See Wiegmann, Beiträge z. Anat. d. Landschnecken d. Indischen Archipels (in Zool. Erg. Niederländisch Ost-Indien, vol. iii.), 1892, pl. xvi, fig. 3.

differ slightly in size and contour, the type set being more slender and that from Zomba more obese, but there is not sufficient difference to merit even varietal distinction between any of them. The shells from Portuguese territory resemble those from Zomba in being larger and slightly more obese than the type, but are quite conspecific with it.

Curvella disparilis (Smith), 1890.

1890. *Bulimus* (*Hapalus*) *disparilis* Smith, A.M.N.H. vi, p. 156, pl. 5, fig. 13. D.F.

Hab. L. Marques. Mtisherra R. Valley; Dondo District; Zangwe Basin (Cressy).

Described from Mamboia and also recorded from Usagara, both localities in Tanganyika Territory.

Curvella quisqualis (M. and P.), 1892.

1892. *Buliminus quisqualis* M. and P., A.M.N.H. ix, p. 90, pl. 5, fig. 10. D.F.

Hab. Mozambique (Layard).

Genus Euonyma M. and P., 1896.

Euonyma lanceolata (Pfr.), 1854.

1854. *Bulimus lanceolatus* Pfr., P.Z.S., p. 292. D.

1910. *Euonyma lanceolata* Pfr., Conn., A.M.N.H. vi, pp. 260–261. N.F.

Hab. L. Marques. Near Delagoa Bay (in British Museum).

Euonyma crystallina (M. and P.), 1896.

1896. *Subulina crystallina* M. and P., A.M.N.H. xviii, p. 316, pl. 16, fig. 4. D.F.

Hab. Lebombo Marsh, Rikatla (Junod); Masiene (Lawrence).

Specimens from the above localities are quite in agreement with this common Natalian species, whose extension northward along the coast is by no means remarkable.

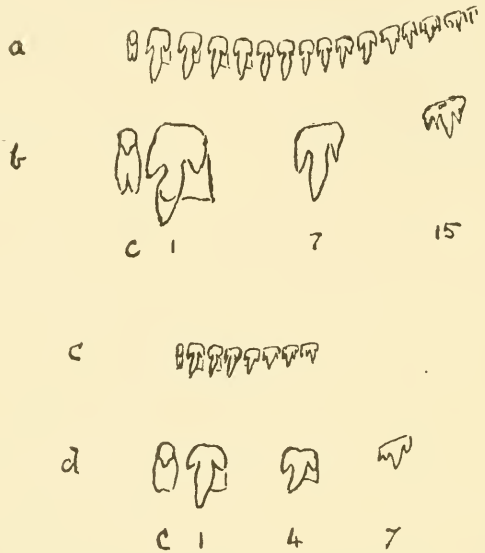
Genus Opeas Albers, 1850.

Opeas praecox sp. n.

(Plate IV, fig. 25.)

Shell of fair size, elongate turriform, narrowly rimate, thin, smooth, glossy, transparent, pale olivaceous. Spire produced, apex narrowly

rounded. Whorls 8, rather flat, regularly increasing, the first 2 practically smooth, remainder sculptured with rather faint, close, fairly regular, curved vertical striae; suture simple, shallow. Aperture subpiriform, peristome simple, acute, outer lip projecting rather sharply forward for about $1\frac{1}{4}$ mm., at which point it is slightly sinuate, and then receding more gently to the base; columella very slightly concave, not truncate, margin very narrowly reflexed, nearly concealing the narrow rima.



Text-fig. 22.—*Opeas praecox* Connolly, Zangwe Basin, Portuguese E. Africa.
a, $\frac{1}{2}$ row of radula of immature but fertile specimen; ×300 (approx.)
b, Individual teeth enlarged.
c, $\frac{1}{2}$ row of radula of embryo; ×300 (approx.).
d, Individual teeth enlarged.

Long. 11·3, lat. 3·0; apert. alt. 3·0, lat. 1·2; last whorl 5·0 mm.

Hab. L. Marques. Zangwe River Basin (type, Cressy).

Nyasaland. Port Herald Hills (Harger).

A puzzling species, varying considerably in contour of spire and slightly in length of whorl between sutures, the type being more slender and slightly shorter-whorled than other individuals, whose greater breadth imparts to them rather a different aspect. However, a considerable series from the type locality exhibits every stage of transition, and some of these exactly match some of those from Port Herald, while others from the latter district show still further slight variation.

Colonel Peile has kindly furnished drawings of the radula (text-fig. 22).

Opeas vengoense Conn., 1922.

(Plate IV, fig. 26.)

1922. *Opeas vengoense* Conn., A.M.N.H. x, p. 120. D.

Hab. L. Marques. Mount Vengo, 5500 ft. (Cressy).

A minute shell, occurring at considerable depth in decaying vegetation. Its smaller form and comparatively longer last whorl distinguish it from the young of the next species.

Opeas cressyi Conn., 1922.

(Plate IV, fig. 27.)

1922. *Opeas cressyi* Conn., A.M.N.H. x, p. 120. D.

Hab. L. Marques. District N. of Macequece (Cressy).

The beautiful little shell selected as type measures long. 10·8, lat. 2·8 ; apert. alt. 3·3, lat. 1·2 ; last whorl 5·7 mm. It is the largest of a bewildering series which may eventually prove to contain more than one species. Egg-holding, and therefore nearly mature, shells range from the type downwards to a length of only 5 mm., while individual examples appear to differ in relative convexity of whorl, distance between sutures, and closeness and depth of striation. There seem, however, to be such exact intermediates between each extreme that I can only conclude that they are all members of one species and that the variation is due partly to local conditions of food and weather and partly, perhaps, to individual reversion to earlier and more distinct types, of whose promiscuous interbreeding the present confused race is the result.

I append rather a lengthy table of measurements of certain specimens, as it appears advisable to show the convergence between extremes of form.

Long.	9·2 ;	lat.	2·8 ;	apert.	3·1 ;	last whorl	5·2	mm.
,,	9·2 ;	,,	2·3 ;	,,	3·1 ;	,,	5·0	,,
,,	9·0 ;	,,	2·5 ;	,,	2·9 ;	,,	4·9	,,
,,	8·8 ;	,,	2·5 ;	,,	3·2 ;	,,	4·9	,,
,,	8·5 ;	,,	2·6 ;	,,	3·0 ;	,,	5·3	,,
,,	8·3 ;	,,	2·2 ;	,,	3·0 ;	,,	4·8	,,
,,	8·0 ;	,,	2·7 ;	,,	3·2 ;	,,	4·9	,,
,,	7·8 ;	,,	2·45 ;	,,	2·75 ;	,,	4·3	,,
,,	6·9 ;	,,	1·95 ;	,,	2·3 ;	,,	4·0	,,
,,	6·4 ;	,,	2·15 ;	,,	2·55 ;	,,	4·3	,,
,,	5·75 ;	,,	1·95 ;	,,	2·50 ;	,,	3·8	,,
,,	5·4 ;	,,	1·7 ;	,,	2·25 ;	,,	3·5	,,

Family FERUSSACIIDAE.

Genus Caecilioides Férussac, 1817.

Caecilioides ovampoensis (M. and P.) 1892.

1892. *Cionella ovampoensis* M. and P., A.M.N.H. ix, p. 91, pl. 6, fig. 1. D.F.

Hab. L. Marques. Matolla (Penther).

I have not seen Penther's shells and have no idea to what species they really belong. Cressy has collected on Mount Vengo specimens of this genus which appear to be quite distinct from *C. acicula* (Müll.) or from any of the African so-called species, but the material so far received from him is not quite sufficient for its exact determination.

Family SUCCINEIDAE.

Genus Succinea Draparnaud, 1801.

Succinea normalis Ancey, 1881.

1881. *Succinea normalis* Ancey, Le Naturaliste, i, p. 484. D.

1923. ,, ,, ,, Dup. and Putz., Ann. Soc. Zool. Belg. liii, p. 72, fig. 6. D.F.

Hab. Interior of Mozambique (fide Ancey).

Founded on a single specimen.

Succinea patentissima Mke., 1853.

1854, 55. *Succinea patentissima* Mke., Pfr., Conch. Cab., p. 55, pl. 6, figs. 26–28. D.F.

Hab. L. Marques. Lebombo Marsh, Rikatla (Junod); Wanetsi R., Magude District (Bell Marley).

Succinea striata Krauss, 1848.

1848. *Succinea striata* Krs., Südafr. Moll., p. 73, pl. 4, fig. 16. D.F.

1856. ,, *planti* Pfr., P.Z.S., p. 326. D.

Hab. L. Marques. Lebombo Mts., under bark of shrubs (Junod); Lake Zandemela (Lawrence).

The type set of *planti* in the British Museum are simply very immature examples of *striata*, which is partial to so many dry and exposed positions that it is far more often found in an immature than a mature stage of growth.

Family VERONICELLIDAE.

Genus Veronicella de Blainville, 1817.

Veronicella maura (Heynem.), 1885.

1885. *Vaginula maura* Heynem., Jahrb. D. Mal. Ges. xii, pp. 7, 104, pl. 1, figs. 6–7. D.F.
Hab. L. Marques. Delagoa Bay (Mrs. Monteiro).

Veronicella natalensis (von Rapp), 1848.

1848. *Vaginulus natalensis* von Rapp, Krs., Südafr. Moll., p. 72. D.
Hab. Mozambique (var., Gibbons).

Veronicella petersi (Mts.). 1879.

1879. *Vaginula petersi* Mts., Monatsb. Akad. Wiss. Berlin, p. 736. D.
Hab. Mozambique. Querimba I. (Peters).
L. Marques. Inhambane (Peters).

Family ONCHIDIIDAE.

Genus Onchidium Buchanan, 1800.

Onchidium peroni Cuv., 1804.

Onchidium peronii Cuv., Ann. Mus. Nat. Hist. Paris, v, p. 38, pl. 6, figs. 1–9. D.A.
Hab. Mozambique. Mozambique ; Ibo (Peters).
L. Marques. Inhambane (Peters).

Family AURICULIDAE.

Subfamily MELAMPINAE.

Genus Melampus Montft., 1810.

Melampus caffer (Küst.). 1844.

1844. *Auricula caffra* Küst., Conch. Cab., p. 36, pl. 5 (1843), fig. 7. D.F.
Hab. L. Marques. Estuary of Nkomati River, Rikatla (Junod).

Melampus semiaratus Conn., 1912.

1912. *Melampus semiaratus* Conn., Ann. S. Afr. Mus. xi, p. 228, pl. 2, fig. 8. D.F.
Hab. L. Marques. Estuary of Nkomati River, Rikatla (Junod).

Melampus küsteri (Krs.) var. *oblongus* Küst., 1844.

1844. *Auricula küsteri* Krs., var. *oblonga* Küst., Conch. Cab., p. 34. D.

Hab. L. Marques. Estuary of Nkomati River, Rikatla (Junod).

The foregoing names are correctly applied to the three forms of *Melampus* from the above locality; but whether the names are good in themselves, or should be merged in the synonymy of older ones, is open to question.

While nearly every species of this genus seems to vary so greatly that each combines the distinctive attributes of others, certain forms which appear almost, if not absolutely, identical in all conchological characters occur throughout nearly the whole expanse of the Pacific and Indian Oceans, so that names originally bestowed on Philippine species have been applied to South African, and *vice versâ*.

Whether such a distribution is possible can only be determined by the anatomist, but it seems so improbable that I prefer to retain, for the present, the names originally created for African species.

Subfamily AURICULINAE.

Genus Auriculastra von Martens, 1880.

Auriculastra acuta Conn., 1922.

(Plate IV, fig. 29.)

1922. *Auriculastra acuta* Conn., A.M.N.H. x, p. 121. D.

Hab. L. Marques. Estuary of Nkomati River (Junod).

Type in Kimberley Museum.

Auriculastra acuta is found in company with the three *Melampi* in the mangrove region in the estuary of the Nkomati River, which can only be approached on foot at low tide, when the mud is exposed and its surface covered by thousands of crabs. Immature examples of all four species were collected alive on the mud under rotten stems, but larger shells were only found in dead condition on its seaward boundary, where they appeared to have been left by the tide.

The type measures 17·8×8·0 mm., and three other examples 17·6×7·2, 16·1×6·2, and 8·8×3·8 mm. respectively.

In all stages of growth the spire of this species is comparatively longer than that of any other African member of the genus.

Family LIMNAEIDAE.

Genus Limnaea Lam., 1799.

Limnaea natalensis Krs., 1848.

1848. *Limnaeus natalensis* Krs., Südafr. Moll., p. 85, pl. 5, fig. 15. D.F.

Hab. Mozambique. R. Quilimane (Peters).

L. Marques. Itschongove (fide von Martens); Lebombo Marsh, Rikatla (a small, acuminate form, somewhat comparable to *L. undussumae*, Mts.); L. Mhandlen; Makulane (Junod).

When we consider the range of variation which is acknowledged in such European species as *Limnaea pereger* and *L. truncatula* without, in many cases, even a varietal name being considered necessary, it is evident that far too many specific names have been bestowed on forms of the African *L. natalensis* which are less worthy of varietal rank than many that occur in the European species. I have not, therefore, attempted to fit any such names to the shells from the above-mentioned localities, which differ a little in comparative breadth and contour, but are certainly not varietally distinct from one another.

Family PHYSIDAE.

Genus Physa Draparnaud, 1801.

Physa mosambiquensis Clessin, 1886.

1886. *Physa mosambiquensis*, Cless., Conch. Cab., p. 366, pl. 54, fig. 4. D.F.

Hab. L. Marques. Tette (Peters).

The subjoined outline, representing the largest example in the Berlin Museum, has been kindly furnished by Dr. Thiele, who informs me that the radula confirms the appearance of the shell as being that of a true *Physa*; a

Text-fig. 23.—*Physa mosambiquensis* Clessin; ×2.

most interesting fact, since only one other species of this genus, *Physa waterloti*, Germain,* has hitherto been recorded from Central or South Africa.

I may mention, however, that I have in my hands for description the shell of a third species, unmistakably that of a *Physa*, from Lake Naivasha.

P. waterloti, originally recorded from Dahomey, has since been collected by Dr. J. W. S. Macfie, of the Liverpool School of Tropical Medicine, at Accra, Gold Coast.

* Bull. Mus. Paris, 1911, p. 322.

Family PLANORBIDAE.

Subfamily ISIDORINAE.

Genus Isidora Ehrenberg, 1831.

I retain this name provisionally in preference to *Bulinus* of Müller because the type of *Isidora* is a known species, whereas no authentic examples of *Bulinus senegalensis* Müller are in scientific circulation. As soon as recognisable topotypes of the latter come to hand, Müller's genus-name will undoubtedly supersede some other, but until they are rediscovered it appears inadvisable to introduce it too hastily into current nomenclature.

Isidora natalensis (Krs.), 1841.

1841, '43. *Physa natalensis* Krs., Küst., Conch. Cab. (Limn.), p. 8, pl. 1, figs. 12–14. D.F.

Hab. L. Marques. Lebombo Marsh, Rikatla; Monguane; Makulane (Junod); Beira (Cawston); L. Zandemela (Lawrence).

The examples from the last two localities are very dwarfed.

Isidora forskali Ehrn., 1831.

1831. *Isidora forskalii* Ehrn., Symb. Phys., Evert. 3rd sp. D.

1848. *Physa wahlbergi* Krs., Südafr. Moll., p. 84, pl. 5, fig. 13. D.F.

Hab. Mozambique. Quilimane (Stuhlmann).

L. Marques. Beira (Cawston).

Subgenus physopsis Krauss, 1848.

Krauss differentiated his *Physopsis africana* generically from other South African species of *Isidora* simply because the latter are perforate, without columellar truncation, while *P. africana* was imperforate, with truncate columella. Although the columella of *Physopsis*, however, is always more or less truncate, the absence of perforation is of no generic value, since even in *africana* clearly perforate examples may be sometimes, though very seldom, found, while other species, such as *globosa* Morelet, are almost invariably perforate. As pointed out hereinafter by Watson, the anatomy of *Physopsis* does not afford sufficient ground for generic distinction from *Isidora*, and it appears more rational to treat it as a subgenus of the last named, separable therefrom by reason of its more or less truncate columella.

Isidora (*Physopsis*) *africana* (Krs.), 1848.

1848. *Physopsis africana* Krs., Südafr. Moll., p. 85, pl. 5, fig. 14. D.F.

Hab. L. Marques. Tette (Peters; Kirk; Penther); Lebombo Marsh, Rikatla (Junod); Wanetsi R., Magude District (Bell Marley).

It is possible that some of the foregoing records refer in reality to the succeeding species.

Isidora (*Physopsis*) *globosa* (Morelet), 1866.

(Plate VIII, figs. 8–15.)

1868. *Physopsis globosa* Morel., Voy. Welwitsch, p. 93, pl. 9, fig. 4. D.F.

Hab. L. Marques. Lebombo Marsh, Rikatla (Junod); Delagoa Bay (Cawston).

The range of this very variable species extends laterally across the continent from Angola, through Rhodesia and Nyasaland, to Delagoa Bay. Some Delagoan examples correspond well with Morelet's type, while others differ considerably *inter se* in length of spire and form of aperture, but all appear to be conspecific. In addition to the slight difference in the radula mentioned later, the shell is practically always to some extent rimate, and can thus be separated without much difficulty from *I.* (*Physopsis*) *africana* (Krs.).

External features of animal and pallial organs.—The foot is broad and bluntly pointed at the hind end. The tentacles are slender and rather long, with the eyes situated at their inner bases (Pl. VIII, fig. 13). At their outer bases there is a rounded, flattened lobe on each side, such as was first described by Adanson in *Bulinus senegalensis* Müll.* The male opening is situated beneath the posterior corner of the lobe on the left side; the female opening is under the mantle-edge.

The orifice of the mantle-cavity is large (Pl. VIII, fig. 8). At its inner or right side, posterior to the anus, there is a large grey pallial lobe, which is thrown into numerous vertical folds, the bigger folds being subdivided by smaller ones. This is the characteristic folded gill of the genus *Isidora*, which is found not only in the various African members of the genus, but also in those occurring in Madagascar, Tasmania, New Zealand, etc., † as well as in the related genus *Miratesta* from Celebes. ‡ Anterior to the anus there is a simple, less prominent, white lobe, which forms the lip of the so-called pulmonary siphon.

The head and foot are rather light grey, the hind end of the foot and the top of the head being the darkest. The mantle-edge is pale, but the roof

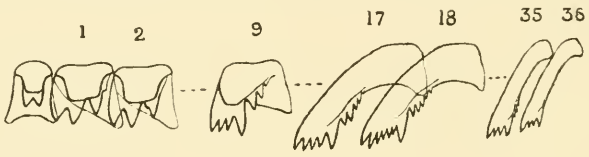
* Hist. Nat. du Sénégal, Hist. des Coquillages, 1757, p. 6, pl. i, fig. J *g*.

† Pelseneer: Arch. de Biol., vol. xiv, 1896, pp. 365, 372, pl. xv, figs. 10–11.

‡ Sarasin: Die Süsswasser Mollusken von Celebes, 1898, p. 76, pl. xii, figs. 165–166.

of the mantle-cavity is covered with numerous dark spots on a light grey ground. In some cases these spots are nearly black; in others they are lighter and only clearly visible near the mantle-edge.

The kidney is long and narrow and extends forwards from above the heart to the mantle-edge just below the pulmonary orifice, where it curves



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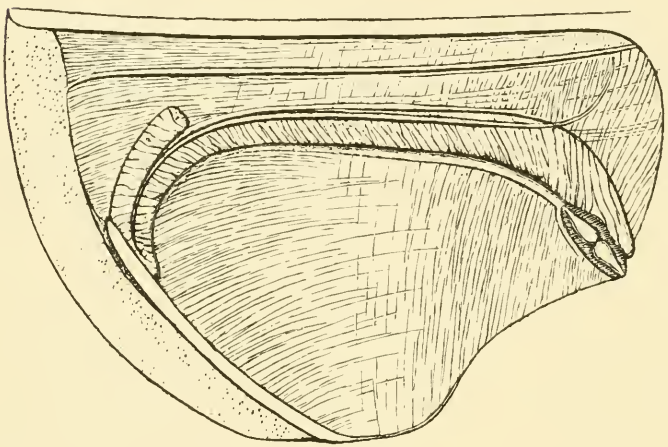


B

TEXT-FIG. 24.—*Isidora* (*Physopsis*) *globosa* (Morel.), Lorenzo Marques.
A. Representative teeth from the radula; ×400.
B. Roof of mantle-cavity seen from within, showing kidney, etc. (slightly diagrammatic); ×7.

downwards, and then abruptly bends round and runs back above its former course to the renal opening, which thus faces backwards about 2 mm. within the pulmonary orifice (text-fig. 24, B). The kidney is therefore of the same type as in *Isidora lamellata*, Smith.* As in that species an afferent renal vein runs back most of the way along the dorsal edge of the kidney, while another vein conveying blood from the kidney to the heart runs along its lower edge. This vessel receives a small pericardial vein just before it reaches the heart, but the network of pulmonary veins which Pelseneer shows beneath the kidney in *I. lamellata* is not apparent in the present

* Pelseneer: *op. cit.*, p. 370.

species. A prominent fold runs along the roof of the mantle-cavity about half-way between the kidney and the rectum, and opposite this there is a similar fold on the rectum itself, the front end of which can be seen below the branchial lobe in Pl. VIII, fig. 8. These folds are also found in related forms. But in the present species, and also in *I.* (*Physopsis*) *africana* (Krs.), another thickened ridge occurs, which runs along the kidney near its upper edge and curves upwards posteriorly on to the roof of the mantle-cavity, where, however, it becomes so low as to be scarcely perceptible. Opposite to this ridge on the kidney there is a slight thickened ridge along the lower edge of the rectum. These two ridges correspond to the much larger ridges which occur in the same positions in *Planorbarius corneus* (Lin.), but they do not seem to occur in the more typical species of *Isidora* such as *I. forskali* Ehrn., *I. contorta* (Mich.), *I. tropica* (Krs.), and *I. lamellata* (Smith). Indeed, the presence of these longitudinal ridges in the mantle-cavity, in addition to the pair of folds above them, seems to be the one marked anatomical feature which distinguishes the subgenus *Physopsis* from *Isidora s.s.*

Central nervous system (Pl. VIII, fig. 9).—The nerve-ring is situated behind the buccal mass, and is very small, the cerebral, pedal, pleural, and visceral ganglia being all closely aggregated owing to the exceptional shortness of the connectives that unite them. The arrangement of these ganglia agrees well with that in *I. lamellata*,* but the left parietal ganglion has a well-marked lateral lobe, external to the origin of the left pallial nerve, which Pelseneer does not show in his figure of the nervous system of that species. The buccal ganglia are moderately large, and are united by a commissure about equal in length to the greatest diameter of the ganglia. Laterally, at their junction with the cerebro-buccal connectives, they each give off two large nerves to the sides of the buccal mass; in front there arise two or three slender nerves to the oesophagus, salivary glands, etc.; while the odontophoral nerves arise at the inner sides of the ganglia, near the ends of the buccal commissure.

Digestive system.—The dorsal jaw is rather thick and dark brown, with an obtuse median projection and fine vertical striae. It measures about ·9 mm. in length, and nearly ·4 mm. broad in the centre, though much narrower towards the ends. The lateral jaws are narrow and weak, and of a much lighter colour.

The radula (text-fig. 24, A) is of the type found not only in *Isidora*, but also in *Miratesta*, *Protancylus*, *Planorbarius*, *Carinifex*, etc. The central teeth are bicuspid, and rather narrow. The lateral teeth, of which there are eight or nine on each side, are broader, and tricuspid, with triangular basal plates; in some of them, however, the ectocone already shows a tendency to divide. There are about thirty-six multicuspid marginal

* Pelseneer: *op. cit.*, p. 369, pl. xvi, fig. 19.

teeth on each side, in which both the endocones and the ectocones are split up into a number of small cusps. The relative length of the teeth gradually increases towards the edges of the radula, and the outer marginals are very narrow with scarcely a trace of the ectocones. The transverse rows of teeth curve slightly forwards on each side. The radula of the present species differs from those of *I.* (*Physopsis africana* and other forms chiefly in the relative narrowness of the outer marginal and central teeth, and the extent to which the ectocones of the marginal teeth are split up into separate cusps.

The salivary glands are very long, narrow, and somewhat convoluted (Pl. VIII, fig. 12). They arise directly from the broad buccal mass on each side of the anterior end of the oesophagus, without the interposition of distinct slender ducts. They are broadest a short distance from their front ends; further back they have a moniliform appearance, being divided by constrictions into a succession of small swellings. The glands pass through the nerve-ring, becoming exceedingly narrow as they do so; but the greater part of each gland lies in front of the central nervous system.

The oesophagus is long and rather narrow, with thin walls which usually show longitudinal lines of dark pigment. The anterior division of the stomach is spherical, with thick muscular walls, and contains grains of sand. The succeeding thin-walled portion of the stomach is much narrower, and bends downwards on the right, where there open into it together the broad hepatic duct and the so-called pyloric caecum, a finger-shaped appendage scarcely 2 mm. in length, like that which is found in most Basommatophora. The intestine curves round the stomach, passing over the oesophagus as it does so, and then describes another loop among the lobes of the liver, before passing forwards as the rectum. The liver lies entirely behind the stomach.

Chief retractor muscles.—The columellar muscle is broad and powerful; its central part is inserted in the foot, while its more lateral strands pass forwards to the sides of the head. From its upper surface arise the rather narrow buccal and penial retractors.

Reproductive organs (Pl. VIII, fig. 14).—The reproductive system is of the same general type as that found in the other species of *Isidora* which have been examined. The hermaphrodite gland is compact, and occupies the apex of the spire posterior to the liver. The hermaphrodite duct is somewhat convoluted, especially in the posterior half of its course, where it is covered with very numerous small vesicular outgrowths. The albumen gland is rather large. The oviduct, which is separate from the male duct throughout its length, is divisible into two parts—a posterior portion which is convoluted and rather narrow and an anterior portion which is more glandular and greatly swollen. An oblique line crosses this anterior portion, the part behind and to the left of the line being trans-

lucent, while that in front and to the right of it is opaque and whitish in alcohol. The receptaculum seminis or spermatheca is broadly oval and nearly 2 mm. long, with very thin walls, and is borne on a short duct. The vagina is rather short.

The vas deferens runs forwards beside the oviduct, and is somewhat convoluted in the posterior part of its course. It bears a nearly circular compact prostate gland, which is situated between the glandular part of the oviduct and the spermatheca, being slightly flattened by the pressure of these organs. The vas deferens passes into the skin beside the female opening, and emerges again into the body-cavity near the male opening, whence it passes backwards to the penis. This organ is nearly three times as broad as the slender vas deferens, and leads into the large penis-sac, which is in turn three times as broad as the penis itself, both organs being nearly 4 mm. in length. The penial retractor is inserted at the junction of the penis and the penis-sac. The end of the penis next to the vas deferens is somewhat swollen ; this is due to the fact that the terminal part of the vas deferens is either contorted within the muscular penis-sheath before opening into the penis itself, as shown in Pl. VIII, fig. 11, or else it is invaginated into the cavity of the penis to form a penis-papilla, as shown in fig. 15. The epithelium lining the penis is furnished with numerous small papillae. Inside the penis-sheath there are two longitudinal folds, approximately opposite to each other, and numerous narrower transverse or circular folds. The positions of the longitudinal folds, and to some extent those of the transverse ones also, are shown by dark lines of pigment on the outside of the penis-sheath. The anterior end of the penis is often invaginated for some distance into the cavity of the penis-sheath.

The spermatozoa (Pl. VIII, fig. 10) have short, spirally twisted heads, ·0033 mm. in length, broad behind but sharply pointed in front. The tails attain a length of more than ·25 mm., and appear to be furnished throughout almost their entire length with two narrow spiral flanges or ridges, which, however, are most distinct close to the head, where one of them becomes markedly broader, as shown in the figure.

Subfamily PLANORBINAE.

Genus Planorbis Geoffroy, 1767.

Subgenus planorbula Haldemann, 1842.

Planorbis (*Planorbula*) *pfeifferi* Krs., 1848.

(Plate VIII, figs. 16–19.)

1848. *Planorbis pfeifferi* Krs., Südafr. Moll., p. 83, pl. 5, fig. 7. D.F.

1899. *Planorbis rüppelli*, " Krs.," Junod, Bull. Soc. Vaudoise, xxxv, p. 279. L.

Hab. L. Marques. Itschongove (fide von Martens); Lebombo Marsh, Rikatla (*rüppelli*); Nyiwan; gardens, Lorenzo Marques; Makulane (Junod).

Long series of large *Planorbes* from the above localities have all proved identical with *Plan. pfeifferi* Krs., and it may be accepted that the inclusion of the Abyssinian *Plan. rüppelli* in Junod's list was due to misidentification; the latter species can therefore be removed from the local and South African lists.

Burnup is the first to have observed that at a certain stage in the growth of *Plan. pfeifferi* the aperture is occasionally denticulate, resembling in this respect that of *Plan. alexandrinus* Ehrn. This phase seems to be most prevalent in examples about 6 mm. in diameter, but is of extremely rare occurrence, a very large number of specimens examined having so far only yielded half a dozen showing the dentition, which appears to become absorbed in more mature shells. Its arrangement is pretty constant in the only 4 examples I have seen. It consists of a small plait in the centre of the paries, with a minute tubercle below it, and 3 small horizontal plaits, of which the lowest is the most prominent, at nearly equal intervals apart, on the interior of the last whorl some distance within the aperture; in one case there is a 4th, very small plait above the others. These 4 shells measure between $5\frac{1}{2}$ and 6 mm. in diameter and hail from such interdistant localities as Umbogintwini, Natal (Burnup); near Victoria Falls, Rhodesia (Soper) and Rikatla (Junod).

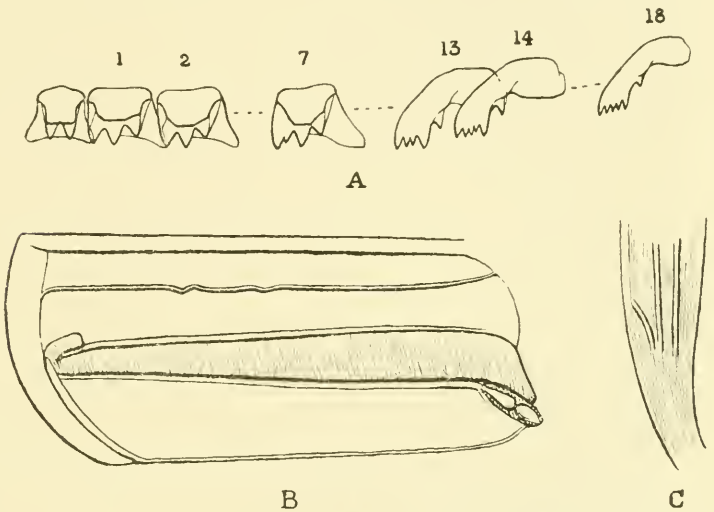
This particular dentition is identical with that sometimes found in *Planorbula alexandrina* (Ehrn.), but in the latter the dentition is far more usual in the immature stage of growth, and is subject to so much variation that it is impossible to deal with it further in this paper.

External features of animal and pallial organs.—The animal is grey, except for a varying number of irregular patches of deep black pigment on the roof of the mantle-cavity. The foot is rather broad, and rounded at the hind end. The eyes are at the inner bases of the tentacles, which are long and slender, with a semicircular flattened lobe on each side at their outer bases. The male opening is situated at the posterior corner of the lobe on the left side, while the female opening is beneath the broad mantle-edge.

Below the orifice of the mantle-cavity, which is situated towards the left side of the animal, there is a broad lobe incompletely divided into two portions (Pl. VIII. fig. 17). The right-hand portion is broadly rounded, and of a paler colour than the other; it forms the lip of the so-called pulmonary siphon. The left-hand portion projects further, and is bluntly pointed; it constitutes the branchial lobe. It is not folded transversely as in *Isidora*, but bears a longitudinal fold on its upper surface, which is a continuation

of the fold on the rectum inside the mantle-cavity described below. The anus is situated to the right of this fold on the top of the lobe.

The kidney is long, rather narrow, and nearly straight except at its front end, which, on reaching the mantle-edge immediately below the pulmonary orifice, bends round abruptly, in the manner shown in text-fig. 25, B. An afferent renal vein runs back along the left edge of the kidney, and another vein conveying blood from the kidney to the heart passes along beside its right edge. No thickened ridge runs along the kidney as



Text-fig. 25.—*Planorbis pfeifferi* Krs., Lorenzo Marques.

A. Representative teeth from the radula; ×500.
B. Roof of mantle-cavity seen from within, showing kidney, etc. (slightly diagrammatic); ×8.
C. Columellar muscle, with buccal and penial retractors arising from it; ×8.

in *Planorbarius corneus* (Lin.); but between the kidney and the rectum there is a longitudinal fold on the roof of the mantle-cavity, such as we also find in *Planorbarius* and *Isidora*. Opposite to this a similar fold runs along the rectum, curving to the left as it reaches the anus and continuing to the extremity of the branchial lobe.

Central nervous system.—The arrangement of the principal nerve-ganglia resembles that in *Isidora*, *Planorbarius*, and *Physa*,* the nerve-ring being small and the connectives almost as short as in *Isidora* (*Physopsis*) *globosa* (Morel.) (Pl. VIII, fig. 9), although the lateral lobe of the left parietal ganglion is not quite so distinct as in that species The nerve-ring is situated behind the buccal mass, and the buccal ganglia are a little

* See de Lacaze-Duthiers: Arch. Zool. Expér. et Gén., vol. i, 1872, pls. xix, xx.

distance behind the anterior end of the oesophagus. These ganglia are rather large, rounded, and joined by an unusually short buccal commissure.

Digestive system.—The dorsal jaw measures about ·45 mm. long, by nearly ·2 mm. broad in the centre. Its upper margin is arched, while its lower cutting edge is somewhat irregular. It is moderately thick, with faint vertical striae, and is of a brown colour. The lateral jaws are of about the same length as the dorsal jaw, but are narrower and thinner.

The radula (text-fig. 25, A) measures about 1·65 × ·65 mm. when flattened out. The central teeth are bicuspid, and about as broad as they are long. The lateral teeth are broader and tricuspid, the cusps of both central and lateral teeth being rather short in the specimens from Lorenzo Marques, although they are a little longer in examples from near Durban which in other respects agree closely with those from Portuguese East Africa. The marginal teeth are obliquely elongated, their endocones are split up into three or four narrow cusps, and their ectocones tend to become smaller. They are of the same type as the marginal teeth of *Planorbarius*, *Isidora*, etc., and differ widely from those of *Planorbis s.s.* and *Segmentina*. The transverse rows of teeth curve slightly forwards on each side. The radular formula is : (13+8+1+8+13)×125.

The salivary glands are long, rather narrow, and somewhat contorted (Pl. VIII, fig. 19). They do not pass through the nerve-ring, but unite with each other at their posterior ends. The oesophagus is long and narrow, though sometimes a little swollen near its anterior end. The stomach, which contains grains of sand, is rather short, the anterior part with thick muscular walls being much broader than long. The thin-walled posterior division of the stomach bends downwards, and gives off at its lower end the hepatic duct and the small finger-shaped "pyloric caecum," which is about 1 mm. long. The intestine encircles the stomach, and then describes another loop behind it among the lobes of the liver, before passing forwards as the rectum.

Chief retractor muscles (text-fig. 25, C).—The columellar muscle is broad, and passes forwards to the foot and the sides of the head. About the middle of its length it gives off from its upper surface the two rather narrow buccal retractors, which arise separately, and the penial retractor, which arises close to the left buccal retractor.

Reproductive organs (Pl. VIII, fig. 18).—The hermaphrodite gland is compact, and occupies the apex of the spire. The hermaphrodite duct is long, slender, and very little convoluted, but bears towards its posterior end a number of small vesicular outgrowths. The albumen gland is of moderate size. Grains of dark pigment are scattered through the connective tissue which surrounds the hermaphrodite and albumen glands, and these organs are thus easily distinguishable from the more lightly coloured liver which lies

between them. The oviduct, which is separate from the male duct throughout its length, may be divided into three parts—a posterior convoluted portion, narrow near the albumen gland, but becoming broader anteriorly; a median, greatly swollen portion, with translucent glandular walls; and an anterior portion, which is also broad and glandular, but is of an opaque yellow colour and very brittle in alcohol. The receptaculum seminis or spermatheca is oval and about 1 mm. long, with a short duct. The vagina is rather short, and is darkly pigmented.

The vas deferens is slender, and is closely convoluted in the posterior part of its course near the albumen gland. It passes forwards close to the oviduct, occupying a slight groove in the wall of the swollen translucent portion. In front of this, beside the opaque portion of the oviduct, it bears a flattened prostate gland, which is composed of a number of irregular tubules, as shown in the figure. After being embedded in the skin between the female and male openings, the vas deferens emerges again into the body-cavity beside the penis-sac and pursues a sinuous course to the posterior end of the penis, this part of it being very long. The penis itself is narrow, except at the end where the vas deferens enters it, where it is slightly swollen. It is nearly as long as the penis-sac, which, however, is a much broader structure, measuring about $2 \times \cdot 5$ mm. Internally the penis-sac bears two longitudinal folds, as well as numerous smaller transverse or circular folds. The penis bears no flagella, such as occur in the genus *Segmentina*. The penial retractor is inserted where the penis enters the penis-sac.

The spermatozoa (Pl. VIII, fig. 16) have narrow, spirally twisted heads, ·0055 mm. in length, and long slender tails, which have the appearance of being furnished with two extremely fine spiral ridges or striae.

Until more is known about the detailed anatomy of all the species of Planorbinae for which various sectional names have been proposed, I prefer to follow those authors who regard most of them as subgenera of *Planorbis* and *Segmentina* rather than as distinct genera. The apertural dentition of *Planorbula*, however, appears to be merely a passing phase at an early stage of growth, and I think it more logical to retain it in *Planorbis* than in *Segmentina*, while on conchological and, I believe, anatomical grounds, I may be justified in regarding *Hippeutis* as an unsegmented subgenus of *Segmentina*.

Subgenus GYRAULUS Agassiz, 1837.

Planorbis (*Gyraulus*) *costulatus* Krs., 1848.

1848. *Planorbis costulatus* Krs., Südafr. Moll., p. 83, pl. 5, fig. 8. D.F.

Hab. L. MARQUES. Makulane; R. Mitembe, not far from Little Lebombo Hills (Junod).

Several specimens in perfect agreement with the ordinary Natalian form.

Subgenus SPIRALINA Hartmann, 1899.

Planorbis (*Spiralina*) *anderssoni* Ancey, 1890.

1890. *Planorbis anderssoni* Ancey, Bull. Soc. Mal. Fr. vii, p. 161. D.

Hab. L. MARQUES. Hangwane; Nwambukoto, Rikatla (Junod).

Six examples, quite typical of this species as identified by Ancey from Durban.

Genus SEGMENTINA Fleming, 1818.

Subgenus HIPPEUTIS Agassiz, 1837.

Segmentina (*Hippeutis*) *junodi* (Conn.), 1922.

(Plate IV, fig. 30.)

1922. *Hippeutis junodi* Conn., A.M.N.H. x, p. 121. D.

Hab. L. MARQUES. Nwambukoto, Rikatla (type); Hangwane (Junod).

The extreme declivity of the outer lip from suture to periphery seems to distinguish *H. junodi* from other African members of the subgenus.

Cawston has collected some young examples of another species at Beira, but they are too immature for exact identification.

FAMILY ANCYLIDAE.

SUBFAMILY FERRISSIINAE.

Genus FERRISSIA Walker, 1903.

Ferrissia junodi sp. n.

Shell small, conical, rather depressed, irregularly oval, narrowing posteriorly, rather thin, translucent, corneous, brownish black; surface glossy, growth lines regular, rather strong, apex strongly microscopically radially striate, blunt, considerably inclined to the right, situate less than one-fifth of total length from posterior margin. Anterior margin broadly rounded, posterior rather narrowly so; right lateral margin nearly straight, left much curved, both inclined posteriorly towards each other. Anterior slope regular, slightly curved, posterior and right lateral slopes nearly straight and very steep.

Long. 4·1; lat. 2·4; alt. 1·25 mm.

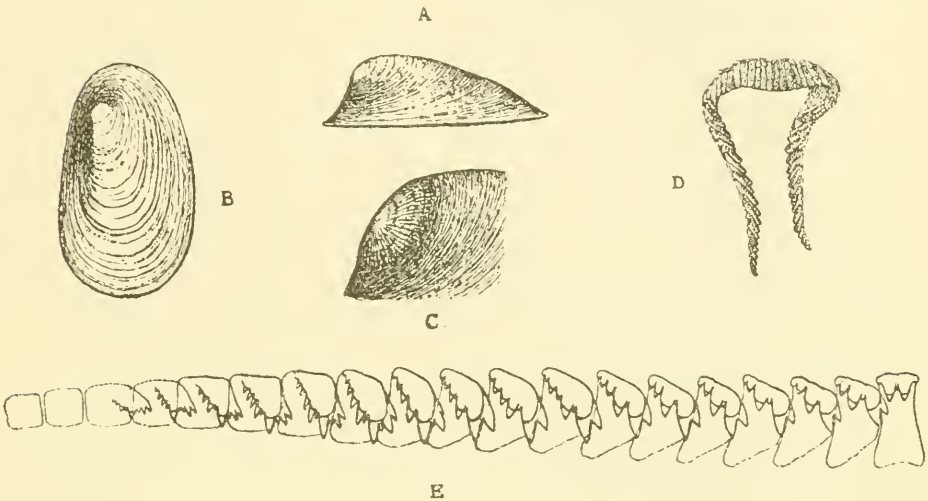
Hab. L. MARQUES. Nwambukoti Pool, Rikatla (Junod).

The animal appears to be sinistral, with a broad pallial lobe on the left side between the mantle and the foot; the soft parts, however, were greatly shrivelled in the only specimen in which they were available for examination.

The jaw (text-fig. 26, D) is brown, and may be said to consist of a median

transverse portion, measuring about ·2×·05 mm., and a pair of elongated lateral portions, measuring about ·3×·03 mm., but tapering below and having their upper ends directly continuous with the outer ends of the median portion. The entire jaw is divided into numerous narrow plates. of which the inner ends, pointing obliquely downwards, strongly denticulate the edges of the lateral portions of the jaw, in which region the plates are transversely striated.

The radula (text-fig. 26, E) seems to be nearly 1 mm. long when flattened



Text-fig. 26.—*Ferrissia junodi* Conn.

A. Shell viewed from the right side ; ×7·5.
B. Shell viewed from above ; ×7·5.
C. Apex of shell viewed from the right side ; ×28.
D. Jaw ; ×80.
E. Half a row of teeth from the radula ; ×1200.

out, but is only ·2 mm. in breadth. The central tooth in each row is rather narrow, with two short, equal mesocones, and on each side a vestige of a very minute ectocone. Its basal plate is long, and broadens a little towards the posterior end. The lateral teeth are wider than the central, and their anterior edges slope obliquely forwards and outwards. Each of them bears a well-marked endocone, uniting at its base with the somewhat larger mesocone, on the outer side of which there are either two or three short ectocones. The basal plates of the lateral teeth have their outer sides somewhat elongated in an oblique direction. In the marginal teeth the basal plates become almost square, the endocones become split into three small cusps, and there are usually four narrow ectocones ; but the mesocones

remain undivided and larger than the other cusps. The transition from the lateral to the marginal type of tooth is gradual and ill defined. The transverse rows of teeth trend very slightly forwards on each side of the middle line. The radular formula is : $(8+10+1+10+8)\times$ more than 90.

The marginal teeth in this species are of a slightly different type from those shown in Bryant Walker's figures of the radulae of other African Ancylidae,* the cusps being farther from the anterior edges of the teeth and the mesocones larger in proportion to the other cusps. Somewhat similar marginal teeth, however, are possessed by some of the American species of *Ferrissia*, such as *F. parallela* (Hald.).

The lateral teeth are a little more like those found in the genus *Burnupia* than are those of most species of *Ferrissia* that have been examined, although the forms of teeth possessed by these two genera seldom differ very greatly from each other. Walker states that in *Ferrissia*, and in the subfamily Ferrissiinae as a whole, endocones are wanting ; † but these statements appear to be erroneous. In *Burnupia*, a genus which is placed in the Ferrissiinae by Walker, he himself states correctly that endocones are present, more or less united with the mesocones in the lateral teeth. In *Ferrissia* the endocones seem to be usually more distinct than in *Burnupia*, being either separate from the mesocones in the lateral, as well as in the marginal teeth, or merely united with them basally, as in the present species.

The nearest recorded approach to this species appears to be a single example from Damar, Transvaal, figured by Walker ‡ as a form of his *F. cawstoni*, from which form it differs chiefly in the curve of the left lateral margin. *F. junodi* differs so widely, however, from typical *cawstoni*, that if it happens to be conspecific with the Damar shell, the latter certainly requires a distinct specific name.

Family POMATIIDAE.

Genus Tropidophora Troschel, 1847.

Subgenus ligatella von Martens, 1880.

Tropidophora (*Ligatella*) *anceps* (Mts.), 1878.

1878. *Cyclostoma anceps* Mts., Monatsb. Ak. Wiss. Berlin, p. 288, pl. 1, fig. 4. D.F.

Hab. L. Marques. Andrada (Vasse).

A large species, described from Taita, Kenya Colony, and fairly common in East Africa.

* "The Ancylidae of South Africa," 1923.

† *Ibid.*, pp. 14, 67.

‡ *Ibid.*, pl. 2, fig. 6.

Tropidophora (*Ligatella*) *calcarea* (Sow.), 1847.

1847. *Cyclostoma calcareum* Sow., Thesaurus Conch. i, p. 118, pl. 26, fig. 113. D.F.

Hab. Mozambique (Gibbons).

L. Marques. Tette (Kirk; Thomson).

A well-known species, easily recognisable on account of its strong spiral costulation.

Tropidophora insularis (?) (Pfr.), 1852.

(Plate VI, figs. 5–9.)

1854. *Cyclostoma insulare* Pfr., Conch. Cab., p. 351, pl. 45, figs. 5, 6. D.F.

Hab. L. Marques. District north of Maccquece (Cressy).

I am unable to find any constant points of distinction between the shells of a large series collected by Cressy and what is generally accepted as the typical form of *insularis* from Natal, but it will be seen that the anatomy differs to a certain extent. Fuller knowledge of the genus is necessary before we can determine whether the Macequece race is varietally or specifically distinct.

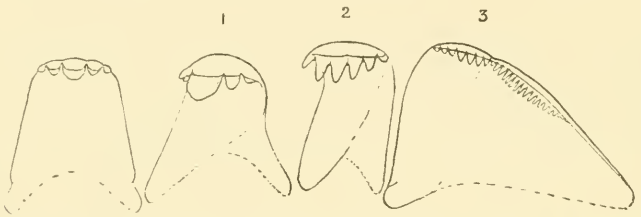
The following are some notes on the anatomy of this form :—

External features of the animal (Pl. VI, figs. 8, 9).—The tentacles are deep yellow, and are very slightly swollen towards their extremities. The conspicuous black eyes are situated on slight prominences at the outer bases of the tentacles. The rest of the animal is of a drab colour, being darkest on the top of the muzzle. This organ is rather long, and is crossed by transverse grooves, except in the centre of its lower surface, where a pair of longitudinal grooves occurs. The sides of the animal are covered by a very fine network of grooves. The foot-sole is cleft longitudinally, and, as the animal moves, the two halves of the foot are used alternately, the end of the muzzle being also applied to the ground at frequent intervals.

Pallial organs, etc. (Pl. VI, fig. 7).—The blood-vessels, which branch over the greater part of the roof of the mantle-cavity, are edged with black pigment, and therefore stand out very prominently, as shown in the figure. Towards the front end, however, they break up into a fine network of veins, and the pigment becomes diffused over the intervening spaces. An osphradium is present at the left side of the mantle-cavity. The kidney is light brown and rounded in outline, although its left side is slightly indented by the pericardium. Posterior to the kidney there is a branched concretionary gland, which was full of opaque white concretions in two of the three specimens examined.

Central nervous system.—The arrangement of the nerve-ganglia in this

species bears a close resemblance to that found in *Pomatias elegans* (Müll.), as described and figured by de Lacaze-Duthiers,* Garnault,† and others. The cerebral ganglia are situated just behind the convoluted salivary glands, and are joined by a commissure which is slightly shorter than the breadth of each ganglion. The buccal ganglia occur farther forwards on the buccal mass, but behind the opening of the oesophagus. The cerebro-buccal connectives and the buccal commissure are very slender. The right pleural ganglion is close to the right cerebral ganglion, but the left is lower down, the left cerebro-pleural connective being about twice as long as the right. The left pallial nerve arises from the left pleural ganglion, but the right pallial nerve arises from the right pleuro-pedal connective close to its union with the right pedal ganglion. Dialyneurous connections



Text-fig. 27.—*Tropidophora* (*Ligatella*) *insularis* (?) (Pfr.), Macequece. Representative teeth from the radula; ×150.

appear to occur between the pallial nerves on each side and the supra-intestinal and sub-intestinal ganglia, but they are so slender as to be difficult to trace. The rounded pedal ganglia are partly covered by the muscles of the foot. The crossed visceral loop is of considerable length. The abdominal nerve-centre comprises two separate ganglia, the right one of which is the larger and sometimes appears to be double.

Digestive system.—The radula (text-fig. 27) is about $6\frac{3}{4}$ mm. long, and has 230 transverse rows of teeth. The central teeth are usually furnished with five short cusps, of which the middle one is the largest. Some of the central teeth, however, have six cusps, one of the small outer cusps being divided into two. The first lateral teeth have five or six cusps, the third from the inner edge being much the largest. The second lateral teeth usually have six or seven rather narrower cusps, and some of them have as many as eight. The marginal teeth are much broader, and may have been formed originally by the union of several narrower teeth similar to those found in the Rhipidoglossa. They may be divided into three portions:

* Arch. Zool. Expér., vol. i, 1872, pl. iii, fig. 8.

† Actes Soc. Lin. Bordeaux, 1887, vol. xli, pl. i.

an inner division with six to nine small cusps or denticles, a middle division with about eighteen or twenty narrow denticles, like the teeth of a comb, and an outer more delicate portion without any denticles. This outer portion is not developed at the hind end of the radula, the teeth in the last thirty-five being without it. The transverse rows are ·03 mm. apart; and as the bases of the teeth are about five times this length, the successive rows overlap to a great extent. In about seventy of the rows towards the hind end of the radula the thicker parts of the teeth are coloured brown.

In its radula this species bears a close resemblance to those of the other South African species of the subgenus *Ligatella*, which seem to have very similar radulae, differing from one another and from the present form only in small details. The radula of *Pomatias elegans* is of a slightly different type, but that of the Mediterranean species, *P. melitensis*, differs but little from those of this African group.

The radula-sac projects a considerable distance from the hind end of the buccal mass, and is bent upwards and forwards (Pl. VI, fig. 5). The salivary glands are long and narrow; but they are much convoluted and twisted, so that they do not extend far back. The oesophagus is narrow except near the salivary glands, where it is slightly swollen. It opens into the stomach in about the middle of this organ, which is long and curved. The posterior part of the stomach, which ends blindly, has a furrow running along its convex surface. The intestine arises from the opposite end, and is folded upon itself twice or thrice before passing forward to the rectum, as shown in the figure. The anus is situated on the right side of the mantle-cavity towards the front end.

Reproductive organs.—Of the three specimens examined one was a male and two were females. The male genital ducts are shown in fig. 6. The upper part of the sperm-duct is convoluted and somewhat swollen. Further forwards it passes into the rather large, oval, prostatic gland, the posterior part of which is pale grey, and the anterior white. The external layer of the gland is formed of small papillae, those on the anterior white portion being best developed. In front of the prostatic gland the vas deferens is very slender. It passes into the large muscular penis, which lies bent upon itself in the mantle-cavity. The penis broadens towards the middle and then narrows considerably, to end in a long, slender point. A number of shallow transverse grooves cross the anterior part on one side.

Unfortunately both the female specimens were slightly immature as regards their reproductive organs as well as in their shells. Nevertheless the full-grown shell of the male was slightly the smallest of the three specimens. This is interesting, as Boycott * has recently shown that in

* Proc. Mal. Soc., vol. xii, 1917, pp. 127–132.

Pomatias elegans the females are on an average decidedly larger than the males. It is probable therefore that the Macequece *Tropidophora* agrees with the European species in this character, as it undoubtedly does in the more important features of its anatomy.

The animals of *Tropidophora* (*Ligatella*) *insularis* (Pfr.), from various localities in Natal, are of a paler colour than those of the form just described, the head and adjacent parts being less darkly pigmented, the tentacles not such a deep yellow, and the pulmonary veins edged with light grey instead of black. Moreover, the anterior edge of the kidney seems to curve forwards a little more above the heart in these specimens of *T. insularis* from Natal; the radula is relatively slightly smaller, and was not bent forwards in the animals dissected; and the denticles on the middle division of the marginal teeth are rather broader and less numerous, their average number being about eleven or twelve.

Tropidophora (*Ligatella*) *kraussiana* (Pfr.), 1852.

1854. *Cyclostoma kraussianum* Pfr., Conch. Cab., p. 334, pl. 43, figs. 17–18. D.F.

Hab. L. Marques. Inhambane (Gibbons).

A record of very doubtful authenticity.

Tropidophora (*Ligatella*) *letourneuxi* (Ancey), 1887.

1887. *Rochebrunia letourneuxi* Ancey, Bgt., Bull. Soc. Mal. Fr. iv, p. 270. D.

Hab. Mozambique coast (Stuhlmann).

Tropidophora (*Ligatella*) *ligata* (Müller), 1774.

1786. *Turbo ligatus* Müll., Chem., Conch. Cab. ix, 2, p. 60, pl. 123, figs. 1071–1072; 3–4. D.F.

Hab. Mozambique coast (Stuhlmann).

L. Marques. Tette (Peters); Rikatla (Junod); Delagoa Bay (Barnard); Wanetsi R., Magude District (Bell Marley); Zangwe Basin (Cressy).

Tropidophora (*Ligatella*) *nyasana* (Smith), 1899.

1899. *Pomatias nyasanus* Smith, P.Z.S., p. 591, pl. 35, fig. 5. D.F.

Hab. Mozambique. Frontier 7 miles south of Mt. Dedza, Nyasaland (Mrs. Connolly).

Tropidophora (*Ligatella*) *zanguebarica* (Petit), 1850.

1850. *Cyclostoma zanguebaricum* Petit., J. de C. i, p. 53, pl. 3, fig. 5. D.F.

Hab. Mozambique (Gibbons; cum mut. *albina*, Frey).

Family AMPULLARIIDAE.

Genus Ampullaria Lamarck, 1799.

Ampullaria largillierti Phil., 1848.

1848. *Ampullaria largillierti* Phil., Zeitschr. f. Malak. v, p. 192. D.
1857. ,, *wernei* Phil., var., Mts., Mal. Blätt. iv, p. 187. N.
1879. ,, *largillierti* Phil., Mts., Monatsb. Ak. Wiss. Berlin, p. 733. L.

Hab. Mozambique. Querimba I. (Peters).

I have not seen Peters' shells, which von Martens first considered to be a variety of the widely diffused African *wernei* and subsequently attributed to *largillierti*, a Madagascan species.

Genus Lanistes de Montfort, 1810.

Lanistes ovum Ptrs., 1845.

1851, 52. *Ampullaria ovum* Ptrs., Phil., Conch. Cab., p. 22, pl. 6, fig. 2. D.F.

1866. *Lanistes ellipticus* Mts., Novit. Conch. ii, p. 294, pl. 70, figs. 9–10. D.F.

1866. *Lanistes ovum*, var. *elatior* Mts., *ibid.*, p. 291, pl. 70, figs. 7, 8. D.F.
,, ,, *olivaceus*, var. *ambiguus* Mts., *ibid.*, p. 292, pl. 71, figs. 3–4. D.F.

1877. *Lanistes affinis* Smith, P.Z.S., p. 716, pl. 74, fig. 7. D.F.
,, ,, *solidus* Smith, P.Z.S., p. 716, pl. 74, figs. 10–11. D.F.

1886. ,, *zambesianus* Furtado, J. de C. xxxiv, p. 148, pl. 7, fig. 1. D.F.

1886. *Lanistes ellipticus*, var. *trapeziformis* Furt., *ibid.*, p. 150. D.

Hab. Mozambique coast (Frey); Mopera, R. Quaqua; Quilimane (Stuhlmann).

L. Marques. Tette (type, Peters; Ivens and Capello); Itschongove, Delagoa Bay (Schenck); L. Pavi; L. Mhandlen; Rikatla (Junod); Wanetsi R., Magude Dist. (Bell Marley); Beira (Cawston; Connolly); Mtisherra R. Valley (Cressy).

In the case of this and the next species I have followed Sowerby's synonymy,* with which I fully agree.

* Proc. Mal. Soc. xii, 1916, pp. 67–68.

Lanistes olivaceus (Sow.), 1834.

1834. *Paludina olivacea* Sow., Gen. Shells, part 41, pl. 183, fig. 3. D.F.

1839. *Ampullaria purpurea* Jonas, Arch. f. Naturg. v, 1, p. 342, pl. 10, fig. 1. D.F.

1839. *Bulimus tristis* Jay, Cat. Shells, p. 121, pl. 7, fig. 1. N.F.

1840. *Meladomus bulimoides* Swains., Treatise Malac., p. 340. D.

1866. *Lanistes olivaceus* Sow., var. *procerus* Mts., Novit. Conch. ii, p. 292, pl. 71, figs. 1–2. D.F.

Hab. Mozambique. Near Cabaceira (Kirk).

L. Marques. Gorongozo Dist. (Wells-Cole).

The shell of this species is usually considerably more elongate than that of *L. ovum*, and easily distinguishable.

Family VIVIPARIDAE.

Genus Vivipara de Montfort, 1810.

Vivipara capillata Frnfd., 1865.

1865. *Vivipara capillata* Frnfd., Verh. Zool. Ges. Wien. xv, p. 533, pl. 22. D.F.

Hab. L. Marques. Rikatla; L. Mhandlen; L. Pavi (Junod).

The single example from L. Pavi is unusually slender, measuring 23·8×16 mm., apert. 11·2×8·8 mm., and thus resembles some of the Nilotic forms of *V. unicolor* (Oliv.) rather than *capillata*, but the material is insufficient to admit of further surmise.

Genus Cleopatra Troschel, 1857.

Cleopatra ferruginea (Lea), 1850.

1850. *Melania ferruginea* Lea, P.Z.S., p. 182. D.

1851. ,, *zanguebarensis* Petit, J. de C. ii, p. 263, pl. 7, fig. 1. D.F.

,, ,, *amaena* Morel., *ibid.*, p. 192, pl. 5, fig. 9. D.F.

1860. ,, *ferruginea* Lea, Rve., Conch. Icon., pl. 21, fig. 147. D.F.

1878. *Paludomus africana* Mts., Monatsb. Ak. Wiss. Berlin, p. 297, pl. 2, figs. 11–13. D.F.

Hab. Mozambique. Mopera, R. Quaqua, near Quilimane (Stuhlmann).

L. Marques. L. Mhandlen; L. Schwabe (Junod).

The limits of variation and distribution of this species are not satisfactorily defined, as many specimens attributed to it in collections are in such poor condition that their exact identification can only be a matter

of conjecture. Into this category fall the 4 shells collected by Junod; they are all much worn, showing the broad brown band which is characteristic of *C. ferruginea*, but with rather more convex whorls than are usually seen in fresh examples of that species.

Cleopatra morrelli Preston, 1905.

1905. *Cleopatra morrelli* Prest., Proc. Mal. Soc., p. 300. D.F.

Hab. L. Marques. Wanetsi R., Magude District (Bell Marley).

Only known previously from the Victoria Falls.

Cleopatra bulimoides (Oliv.), 1804.

1804. *Cyclostoma bulimoides* Oliv., Voy. Emp. Ott. iii, p. 68, pl. 31, fig. 6.

Hab. Mozambique. R. Rovuma (Kirk, fide Dohrn).

I cannot trace Kirk's specimen in the British Museum, where it might be expected to be found. I consider it almost certain, however, that it must have been an immature example of *ferruginea*, rather than Olivier's Egyptian species.

Family TIARIDAE.

Genus Tiara Bolten, 1798.

Tiara vouamica Bgt., 1889.

1879. *Melania crenularis* Desh., Mts., Monatsb. Ak. Wiss. Berlin, p. 733. L.

1889. *Tiara vouamica* Bgt. (=*crenularis* Mts., non Desh.) Bgt., Moll. Afr. équat., p. 183. D.

1897. *Melania coacta* Meusch., Mts., D.-O.-A., p. 197, pl. 6, fig. 36. D.F.

1915. *Tiara coacta* Mts., Conn., Ann. S. Afr. Mus. xiii, p. 100. N.

Hab. Mozambique (Peters).

L. Marques. Estuary of Nkomati R. (Junod).

In 1915 I proved that the name *coacta*, as originally applied by Meuschen, was void, and that the *Melania coacta* quoted by von Martens should bear the latter's name as author. However, on p. 183 of D.-O.-A. von Martens places *vouamica* Bgt. in the synonymy of *coacta* Meusch., while on p. 198 he admits that *coacta* Meusch., not *crenularis* Desh., is the correct identification of the shells collected by Peters in Mozambique. Under these circumstances, *Tiara vouamica* Bgt. (1889) has precedence of *T. coacta* Mts. (1897), which must be relegated to synonymy.

Genus Melanoides Olivier, 1807.

Melanoides tuberculatus (Müller), 1774.

1786. *Nerita tuberculata* Müll., Chem., Conch. Cab. ix, 2, p. 189, pl. 136, figs. 1261–1262. D.F.

1860. *Melania inhambanica* Mts., Mal. Blätt. vi, p. 216, pl. 2, fig. 10. D.F.

Hab. Mozambique. Mopera, R. Quaqua (Stuhlmann).

L. Marques. Tette; Inhambane (Peters); L. Pavi; Lebombo Marsh, Rikatla (Junod); Zangwe Basin (Cressy).

M. inhambanica Mts., which has long been acknowledged as identical with *tuberculatus*, was originally differentiated on account of its greater size, 32×11 mm., while in D.-O.-A., 1897, von Martens mentions examples from the Tanganyika Territory as large as 37×13 mm. These are smaller than the biggest of Cressy's bleached series from the Zangwe Basin, one of which, lacking the apex, measures 41·0×16·1 mm., while a smaller unbroken example is 39·5×14·0 mm.

Family ASSIMINEIDAE.

Genus Assiminea Leach, 1828.

Assiminea bifasciata Nevill, 1880.

1880. *Assiminia bifasciata* Nev., Journ. As. Soc. Bengal, xlix, 2, p. 162. D.

Hab. L. Marques. Estuary of Nkomati River (Junod).

The shells agree in all respects with the typical form from Natal.

The radula * (text-fig. 28) has 58 rows of teeth, and is about 1·35 mm. in length. Each transverse row contains nine teeth. The central tooth has five cusps, borne on a broad but rather short base. The first lateral tooth on each side is larger than the central, with a somewhat oval basal plate; it also has five cusps, the middle one being rather long. Next there is a small, rather narrow tooth, without any distinct cusps, similar to that which occurs in the more typical species of *Assiminea*. The third tooth has about seven cusps, and a long, rather narrow basal plate. In the fourth or marginal tooth the base is also long, but it is somewhat broader, and bears fourteen or fifteen small cusps or denticles. The transverse rows are ·0225 mm. apart, so that while the long bases of the outer teeth overlap one another to a considerable extent, those of the central teeth hardly do so at all.

Although differing from them in detail, the radula of this species is of

* Described from a radula from Isipingo, Natal, mounted by the late Prof. Gwatkin, who received the animal from Mr. H. C. Burnup of Pietermaritzburg.

the same general type as in other specimens of *Assiminea* from Natal identified as *A. sinica* Nevill and *A. ovata* (Krs.). These species all differ from the British form, *A. grayana* Leach, as well as from the Indian species

Text-fig. 28.—*Assiminea bifasciata* Nev., Isipingo, Natal.
Half of a transverse row of teeth from the radula; ×600.

figured by Annandale and Prashad,* and at least some of the Chinese forms,† in having no basal cusps or denticulations on the sides of their central teeth.

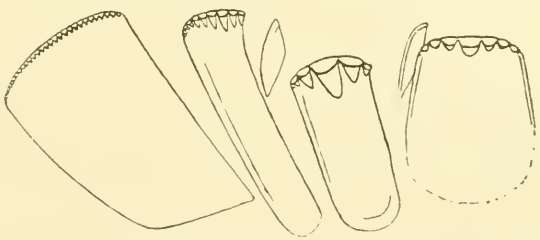
Assiminea leptodonta Conn., 1922.

(Plate IV, fig. 31.)

1922. *Assiminia leptodonta* Conn., A.M.N.H. x, p. 122. D.

Hab. L. Marques. Estuary of Nkomati River (Junod).

The radula (text-fig. 29) measures about ·95 mm. in length, and contains 75 rows of teeth in one specimen and 71 in another. There seem



Text-fig. 29.—*Assiminea leptodonta* Conn., Lebombo Marsh, Rikatla.
Half of a transverse row of teeth from the radula; ×600.

to be eleven teeth in each transverse row, which is more than we usually

* Rec. Ind. Mus., vol. xvi, 1919, p. 249, text-fig. 4.

† Heude: Mem. Hist. Nat. de l'Empire Chinois, vol. i, Moll. Terr., 1882, pl. xxi, figs. 4*c*, 5*c*, 6*c*.

find in the Taenioglossa, but four of the teeth are much smaller than the others. The central tooth has seven short cusps, of which the middle one is the broadest; its basal plate is large but very thin. On each side of the central tooth, but quite separate from it, there is a small narrow tooth, having a curved, thickened edge without any distinct denticulations. Next there is a much bigger tooth, with a long basal plate slightly thickened at the posterior edge, and five cusps, of which the middle one is rather large. On the outer side of this there is another small, somewhat diamond-shaped tooth, without any distinct cusps. The fourth tooth on each side has a very long, rather narrow basal plate, and about nine pointed cusps. Lastly, the marginal tooth has a long and broad, but thin, basal plate, and a row of about thirty minute cusps or denticles. The transverse rows of teeth are only ·0115 mm. apart, and the teeth of one row are therefore very largely overlapped by those of the row behind.

The radula of this species agrees with those of *A. bifasciata* Nev., *A. ovata* (Krs.), etc., in having no basal denticulations on the sides of the central teeth. Nevertheless it differs from the radulae of these species and of the more typical members of the genus in several important respects, such as the presence of small additional teeth on each side of the central tooth, the relatively longer basal plates and smaller and more numerous cusps of most of the teeth, and the much greater extent to which the transverse rows of teeth overlap one another. Indeed, even under the low power of the microscope, the radula of this species has such a different appearance from those of most species of *Assiminea* that it would not be surprising if, when the rest of its anatomy has been studied, this form should prove to belong to a distinct, though probably allied, genus.

Family TRUNCATELLIDAE.

Genus Truncatella Risso, 1826.

Truncatella teres Pfr., 1856.

1856. *Truncatella teres* Pfr., P.Z.S., p. 336. D.
Hab. Mozambique. Querimba I. (Peters).

Family NERITIDAE.

Genus Theodoxus de Montfort, 1810.

Theodoxus knorri (Récl.), 1841.

1849. *Neritina knorri* Recl., Sow., Thesaurus Conch. ii, p. 511, pl. 111, fig. 78; pl. 113, fig. 150. D.F.
Hab. L. Marques. Inhambane (Peters).

Theodoxus natalensis (Rve.), 1855.

1855. *Neritina natalensis* Rve., Conch. Icon., pl. 16, fig. 75. D.F.

Hab. Mozambique. Quilimane (Peters ; Stuhlmann).

L. Marques. Inhambane ; Tette (Peters) ; Delagoa Bay ; Estuary of Nkomati R., Rikatla (Junod).

LAMELLIBRANCHIA.

Family UNIONIDAE.

Genus Indonaia Prashad, 1918.

Indonaia mossambicensis (Ptrs.), 1860.

Unio mossambicensis Ptrs., Mts., Mal. Blätt. vi, p. 218, pl. 3, figs. 3–5. D.F.

Hab. L. Marques. Tette (Peters).

I am indebted to Dr. F. Haas for the correct generic classification of this little known species.

Family MUTELIDAE.

Genus Spatha Lea, 1838.

Spatha petersi Mts., 1860.

1860. *Spatha petersi* Mts., Mal. Blätt. vi, p. 218, pl. 3, figs. 1–2. D.F.

Hab. L. Marques. Tette (Peters) ; Itschongove (Schenck) ; Nkomati River, Rikatla (Junod).

Spatha wahlbergi (Krs.), 1848.

1848. *Iridina wahlbergi* Krs., Südafr. Moll., p. 19, pl. 2, fig. 1. D.F.

Hab. L. Marques. Tette (Peters) ; L. Pavi, Inhambane (Junod).

Junod's shells represent rather an obese form, the measurements being : Long. 87·0 ; alt. 41·5 ; diam. 29·5 ; umbones from anterior border 23·7 mm.
,, 55·5 ; ,, 27·0 ; ,, 16·5 ; ,, ,, ,, ,, 16·0 mm.

var. *dorsalis* Mts., 1897.

1897. *Spatha wahlbergi* Krs., var. *dorsalis*, Mts., D.-O.-Afr. iv, p. 247. D.

Hab. L. Marques. Tette ; Sena (Peters).

Genus Mutelina Bourguignat, 1885.

Mutelina rostrata (Rang), 1835.

1835. *Iridina rostrata* Rang, Nouv. Ann. Mus. Paris, p. 316. D.

1836. *Iridina coelestis* Lea, Syn. Naiades, p. 57. D.

Hab. L. Marques. Tette (Peters).

This species was inadvertently omitted from my Reference List in 1913.

Family CYRENIDAE.

Genus Corbicula von Mühlfeld, 1811.

Corbicula africana (Krs.), 1848.

1846. *Cyrena radiata* Parr., Phil., Abb. u. Beschr. ii, p. 78, pl. 11, 4, fig. 8. D.F.

1848. *Cyrena africana*, var. *olivacea* Krs. (=*gauritziana* Krs. in litt. and *radiata* Parr.) Krs., Südafr. Moll., p. 8, pl. 1, fig. 8. D.F.

Hab. L. Marques. Tette (Peters); Itschongove (Schenck); R. Zambesi (*radiata*, Brancksik); Gorongozo District (Wells Cole); Zangwe Basin (Cressy).

The name *radiata* cannot be retained for this species, as it was first described as a *Cyrena*, and is therefore preoccupied by *Cyrena radiata*, Hanley (P.Z.S. 1844, p. 159). However, a new name is unnecessary, since Krauss bestowed on it in 1848 that of *C. africana* var. *olivacea*. At the same time, he stated that this variety was the typical form of the species, so that the varietal name is not required and *africana* can stand alone. The beautiful little shells with radiate umbones often occur in company with those of duller hue, and appear to be quite inseparable from them except as a colour variety.

Corbicula astartina (Mts.), 1860.

1860. *Cyrena astartina* Mts., Mal. Blätt. vi, p. 219, pl. 3, figs. 6–7. D.F.

Hab. L. Marques. Tette (Peters).

Easily distinguishable from any of the *africana* group by its more elongate form.

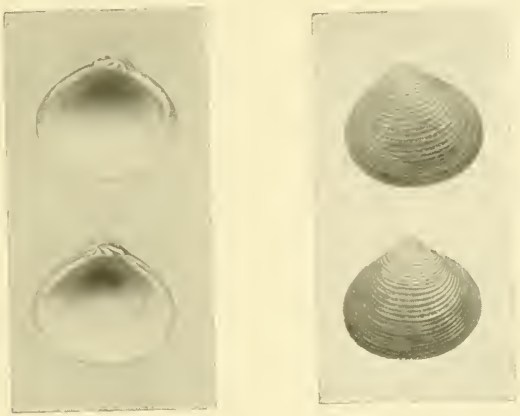
Corbicula kirki Prime, 1864.

1864. *Corbicula kirkii* Prime, Ann Lyc. Nat. Hist. N.Y. viii, pp. 66, 67, fig. 12. D.F.

Hab. Mozambique (Kirk).

In most kindly forwarding me the beautiful photograph, from which the subjoined text-figure has been reproduced, of the type of this species in the United States National Museum, Dr Paul Bartsch remarks: "The type is pale horn coloured on the outside, with the umbones flushed with purple; the interior is very pale purplish, deepening toward the umbones. Another specimen . . . is of much darker colour; in fact, the interior is dark purple."

Prime's original note was "Compared with *Corb. radiata*, this species is less globose, not so inflated, the beaks are not so tumid, the striae are closer, and the colour of the epidermis is different."



TEXT-FIG. 30.—*Corbicula kirki* Prime. Type in U.S. National Museum; ×1.

ALPHABETICAL INDEX OF SPECIES IN ORDER OF GENERA.

Synonyms, and names of species extraneous to P.E.A., are printed in *italics*. The letters L and M after each species denote whether recorded from Lorenzo Marques or Mozambique respectively.

EXPLANATION OF PLATE IV.

Note.—The small outlines given with enlarged figures merely represent the actual size of the shells; they are not to be accepted as accurate in detail.

FIG.

1. *Gonaxis cressyi* Conn. Type. Mtisherra R. Valley.
2. ,, (*Eustreptaxis*) *vengoensis* Conn. Type. Macequece District.
3. *Gulella enneodon* Conn. Type. Macequece District.
4. ,, *laevigata* (?) (Dhrn.). Maforga Siding.
5. ,, *praelonga* Conn. Type. Mount Vengo.
6. ,, *tristãoensis* ,, ,, Macequece District.
7. ,, *nepia* ,, ,, ,, ,,
8. *Sitala diaphana* ,, ,, ,, ,,
9. *Trachycystis ambigua* Conn. Type. Macequece District.
10. ,, *sericea* ,, ,, ,, ,,
11. ,, *cressyi* ,, ,, ,, ,,
12. ,, *fossula* ,, ,, Mt. Vengo.
13. ,, *mcdowelli* ,, ,, Maforga Siding.
14. ,, *soror* ,, ,, Mt. Vengo.
15. ,, *pura* ,, ,, ,, ,,
16. ,, *vengoensis* ,, ,, ,, ,,
17. *Punctum pallidum* ,, ,, ,, ,,
18. *Conulinus junodi* ,, ,, Lebombo Mountains.
19. ,, *sordidulus* Mts. Wanetsi River.
20. ,, *tumidus* (Gibbons) Type. Zanzibar.
21. *Rhachis jejuna* (M. and P.). Lebombo Mountains.
22. ,, *punctata* (Ant.) (Type of *férussaci* Dkr.). Loanda.
23. *Nesopupa vengoensis* Conn. Type. Mt. Vengo.
24. ,, *bandulana* ,, ,, Bandula Siding.
25. *Opeas praecox* ,, ,, Zangwe R. Basin.
26. ,, *vengoense* ,, ,, Mt. Vengo.
27. ,, *cressyi* ,, ,, Macequece District.
28. *Pseudoglessula cressyi* ,, ,, ,, ,,
29. *Auriculastra acuta* ,, ,, Rikatla.
30. *Hippeutis junodi* ,, ,, ,,
31. *Assiminea leptodonta* ,, ,, ,,

EXPLANATION OF PLATE V.

Gonaxis (*Eustreptaxis*) *elongatus* (Fulton) *juv.*, Macequece.

1. Anterior view of head. The upper tentacles are retracted, and the front of the buccal mass is slightly protruded.
2. Retractor muscles of the radula, seen from the right side; $\times 5\frac{1}{2}$. The dotted lines show the outline of the concealed radula-sac and front portion of its terminal retractor.
3. Anterior portion of alimentary canal with odontophore and free retractor muscles, seen from the left side; $\times 5\frac{1}{2}$.

Helicarion (*Gymnarion*) *nyasanus* Smith, Macequece.

FIG.

4. Posterior part of the animal, seen from the right side after the removal of the shell; ×3.
5. Dorsal view of left pallial lobes.
6. Dorsal view of posterior portion of foot.
7. Dorsal view of reproductive system (slightly immature), free retractor muscles, anterior portion of digestive system, and cerebral ganglia; ×5. The penis is displaced towards the right, and the crop, with the salivary glands, towards the left.
8. Jaw; ×12.

Subuliniscus chiradzuluensis (Smith), Macequece.

9. Embryo from uterus, with the mantle-margin and the foot projecting from the aperture of the shell; ×9.
10. External view of kidney, ureter, and heart of embryo; ×12.
11. Jaw (of adult); ×24.
12. Anterior end of spermatozoon; ×1200.
13. Dorsal view of hind end of foot.
14. Dorsal view of alimentary canal with salivary glands; ×5.
15. Dorsal view of free retractor muscles and reproductive system; ×5.
16. Central nervous system.

EXPLANATION OF PLATE VI.

Pseudoglessula (*Pseudocerastus*) *boivini* (Morelet), Kosi Bay, Zululand.

1. Pallial organs seen from within, showing the roof of the lung, with the mantle-edge and left body-lobes above, the heart and kidney below, and the rectum on the left side; ×3.
2. Transverse section through pedal gland slightly in front of the middle of its length; ×11.
3. Jaw; ×13.
4. Free retractor muscles, and genital ducts (slightly immature), with buccal mass, oesophagus, salivary glands, and cerebral ganglia; ×5.

Tropidophora (*Ligatella*) *insularis* (?) (Pfr.), Macequece.

5. Dorsal view of alimentary canal, showing the buccal mass with the recurved radula-sac and convoluted salivary glands above, and the stomach below; ×4½.
6. Male genital duct, showing the large penis above, and the prostatic gland in the middle; ×4½.
7. External view of pallial organs, showing the pulmonary veins, with the heart and kidney below; ×5.
8. Living animal seen from the right side; ×3.
9. Living animal seen from below; ×3.

EXPLANATION OF PLATE VII.

Pseudoglessula (*Pseudocerastus*) *cressyi* Conn., Macequece.

1. Representative teeth from the radula; ×400.
2. Dorsal view of hind end of foot.
3. Nerve-ring; ×12.

FIG.

4. Anterior end of spermatozoon ; ×1000.
5. Reproductive organs ; ×6.
6. Retracted animal without its shell ; ×5.
7. Living animal ; ×2½.

EXPLANATION OF PLATE VIII.

Ledoulxia mozambicensis (Pfeiffer), Lebombo Mountains.

1. Retracted animal without its shell, showing distribution of pigment on mantle, etc. ; ×4.
2. Hind end of foot of an abnormal specimen, seen from above, showing the forked caudal lobe ; ×4.
3. Reproductive organs ; ×5.
4. Central nervous system ; ×10.

Conulinus junodi (Conn.), Lebombo Mountains.

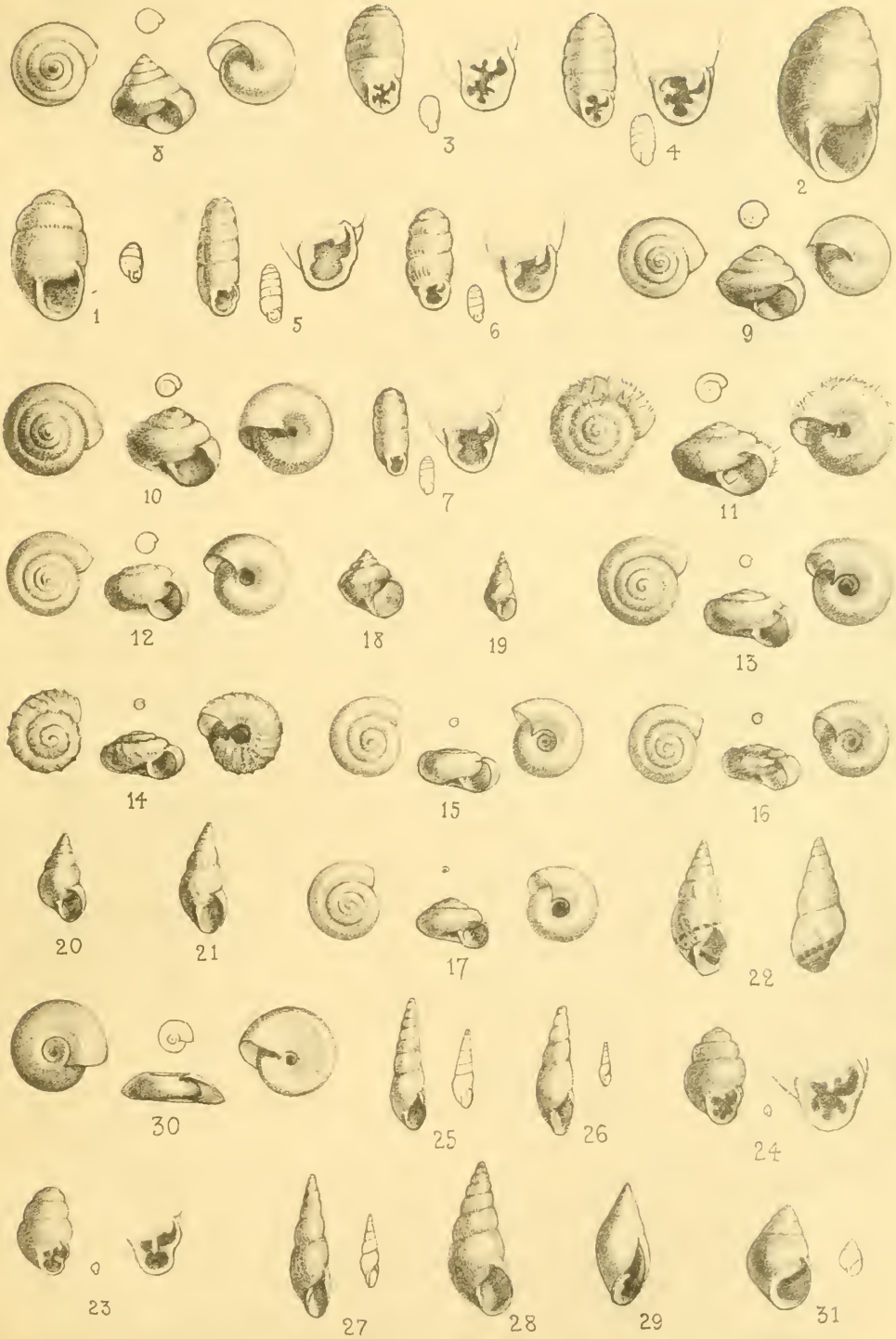
5. Anterior part of immature male genital organs, showing the penis in the centre, the epiphallus on the right, and the penial appendix on the left, with the penial retractor and flagellum below ; ×16.
6. Central nervous system ; ×12.
7. Animal without its shell, showing part of foot, kidney, stomach, liver, etc. ; ×4.

Isidora (*Physopsis*) *globosa* (Morelet), Lorenzo Marques.

8. Pulmonary orifice, with the folded branchial lobe, anus, etc., on the right of it ; ×5.
9. Central nervous system; ×14.
10. Anterior end of spermatozoon ; ×1200.
11. Posterior end of penis with its sheath split open, showing the junction of the vas deferens with the penis ; ×11.
12. Alimentary canal and salivary glands, seen from above ; ×6.
13. Animal without its shell, seen from the left side ; ×3.
14. Reproductive organs ; ×5.
15. Posterior end of penis, showing penis-papilla—this specimen exhibiting a different condition from that seen in fig. 11 ; ×12.

Planorbis (*Planorbula*) *pfeifferi* (Krauss), Lorenzo Marques.

16. Anterior end of spermatozoon ; ×1200.
17. Lobes beneath the pulmonary orifice, seen from above ; ×8.
18. Reproductive organs ; ×8.
19. Buccal mass, salivary glands, œsophagus, stomach, cæcum, and first loop of intestine ; ×6.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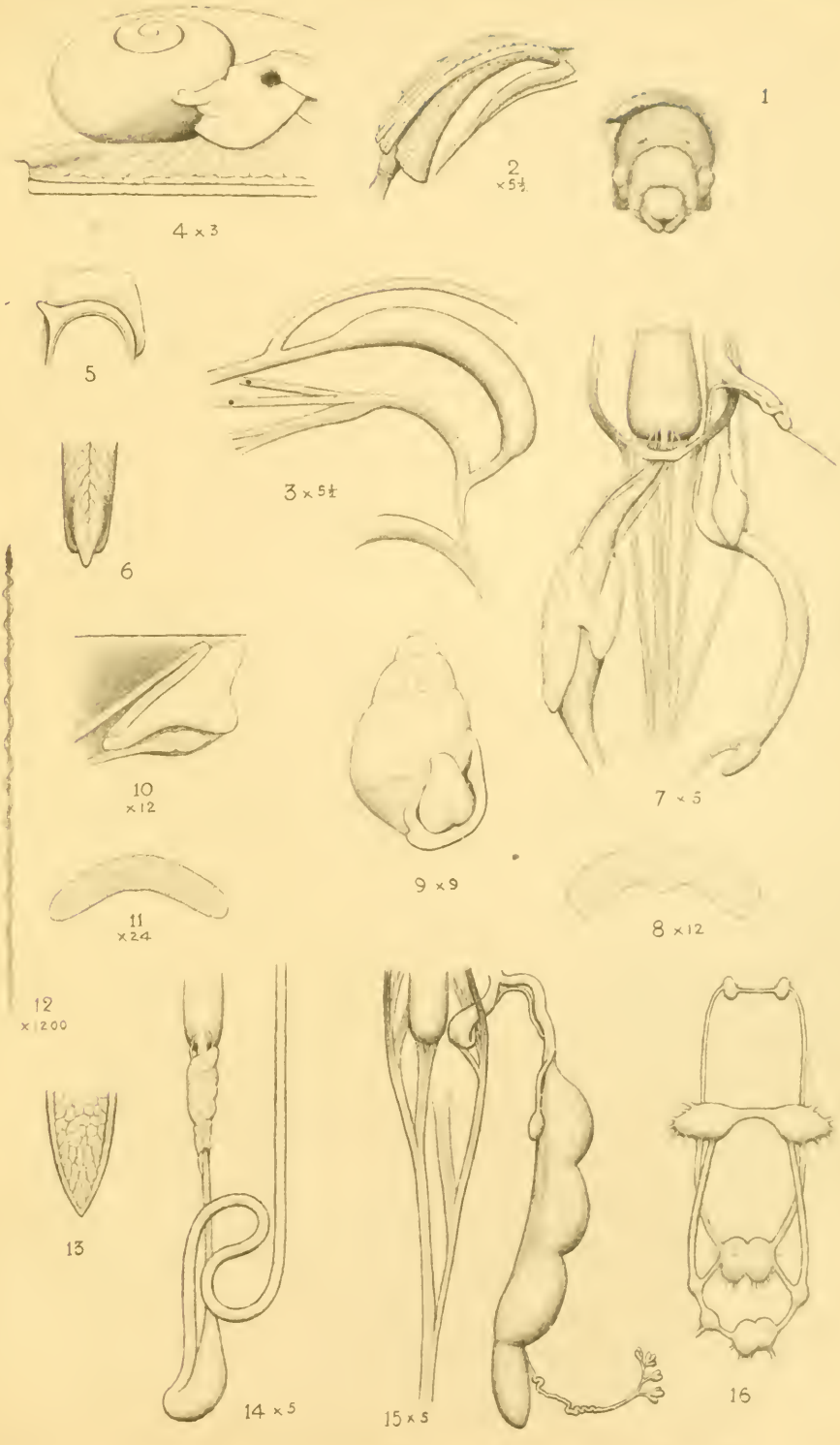
K. Wing, del.



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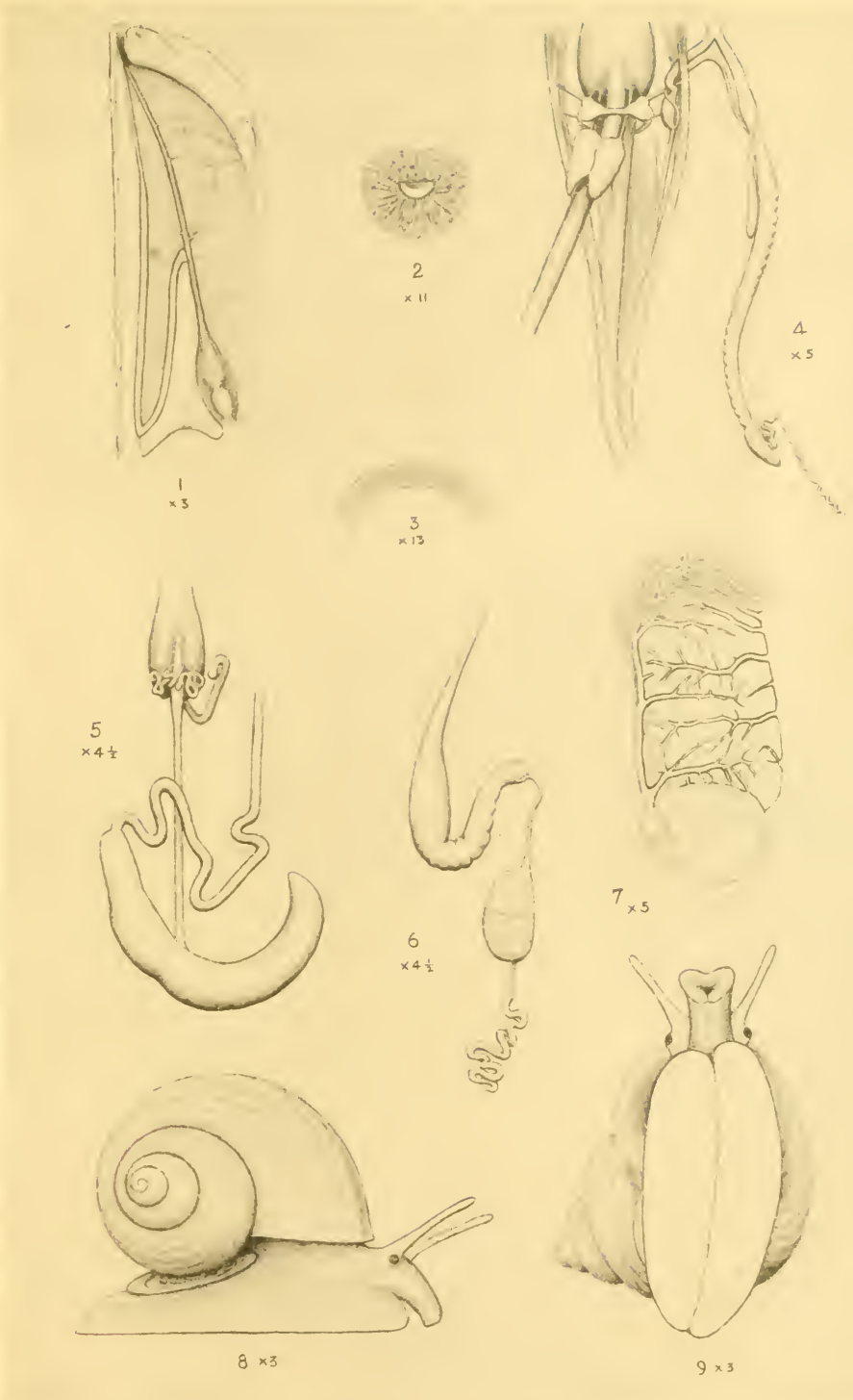

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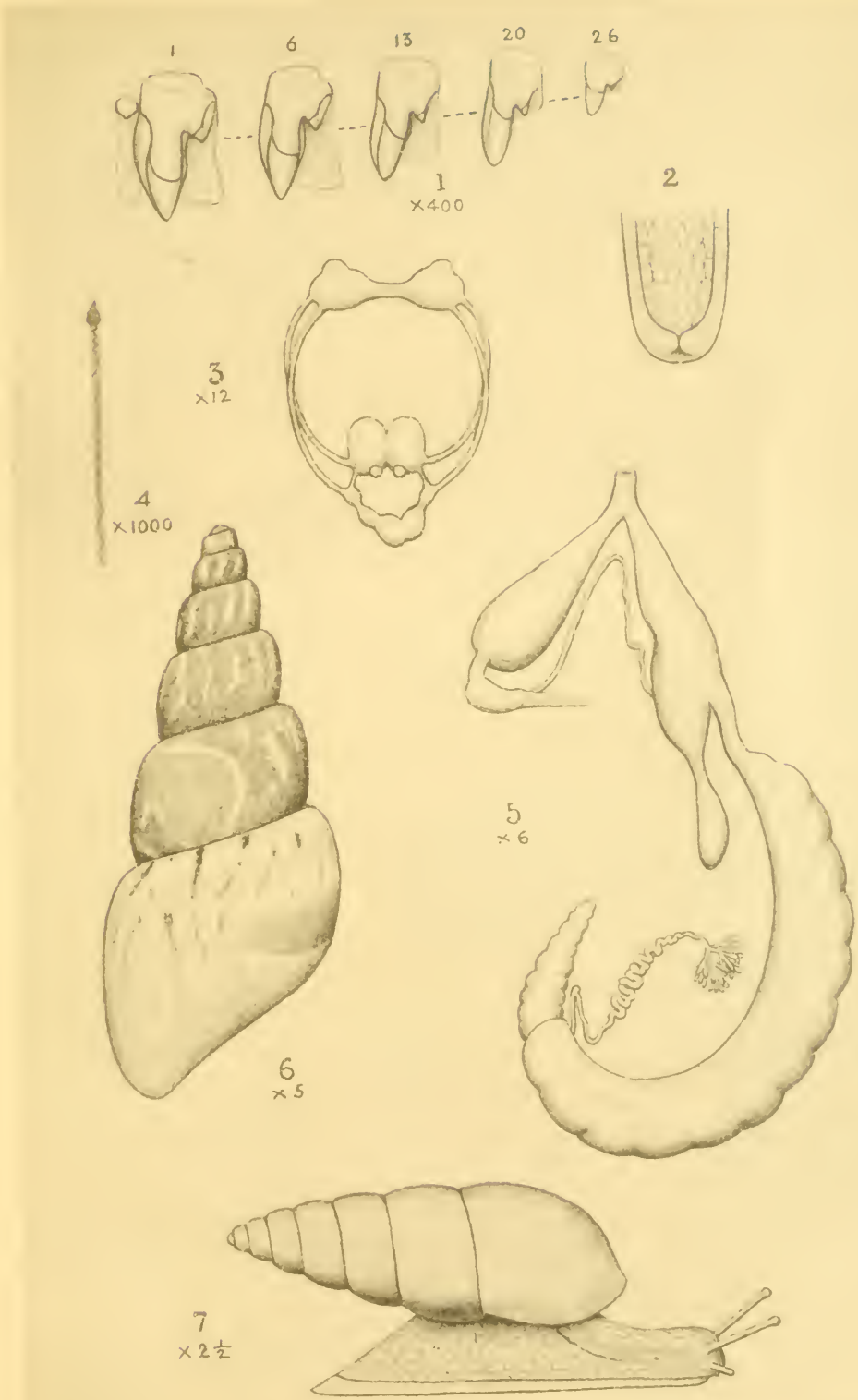

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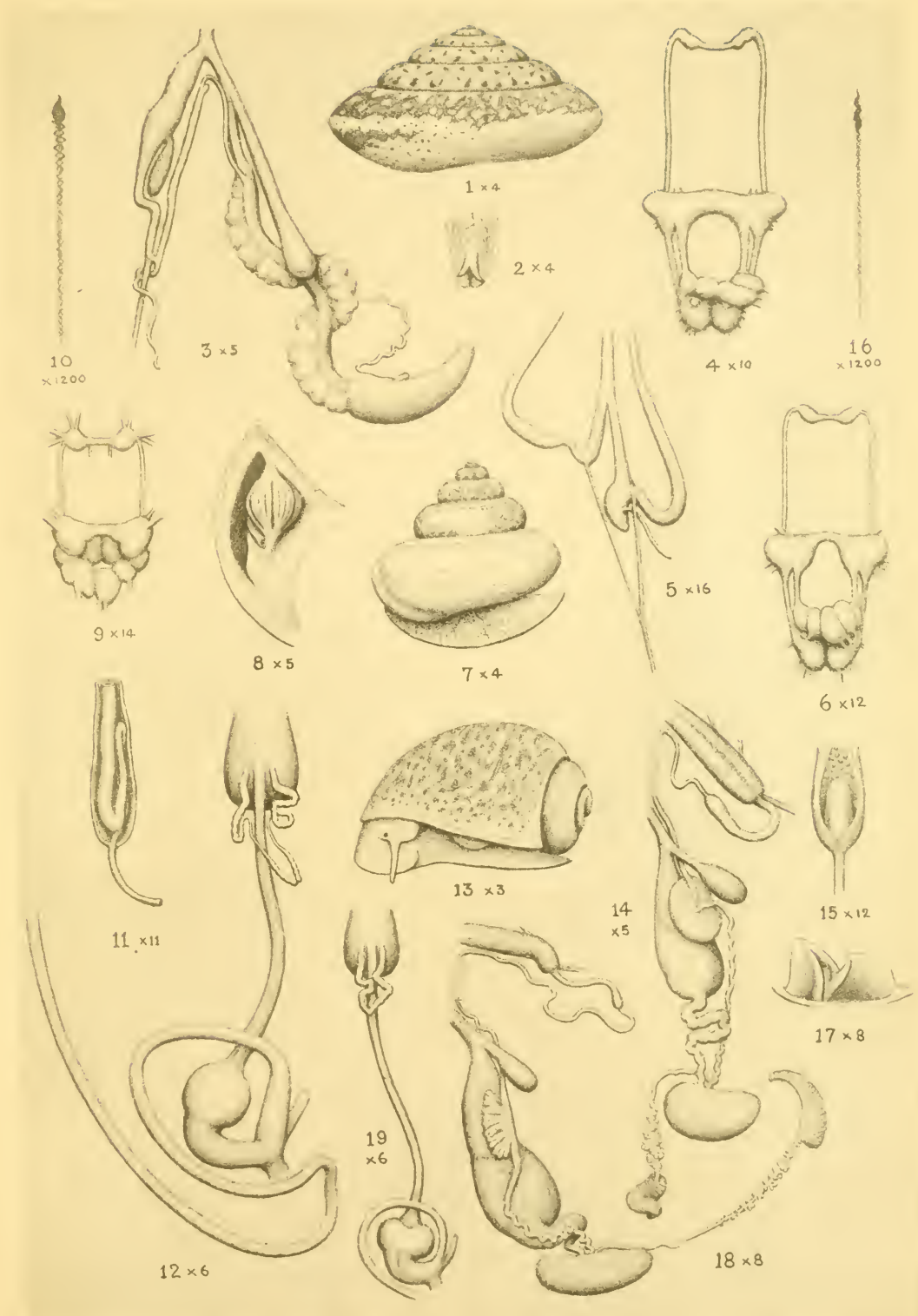
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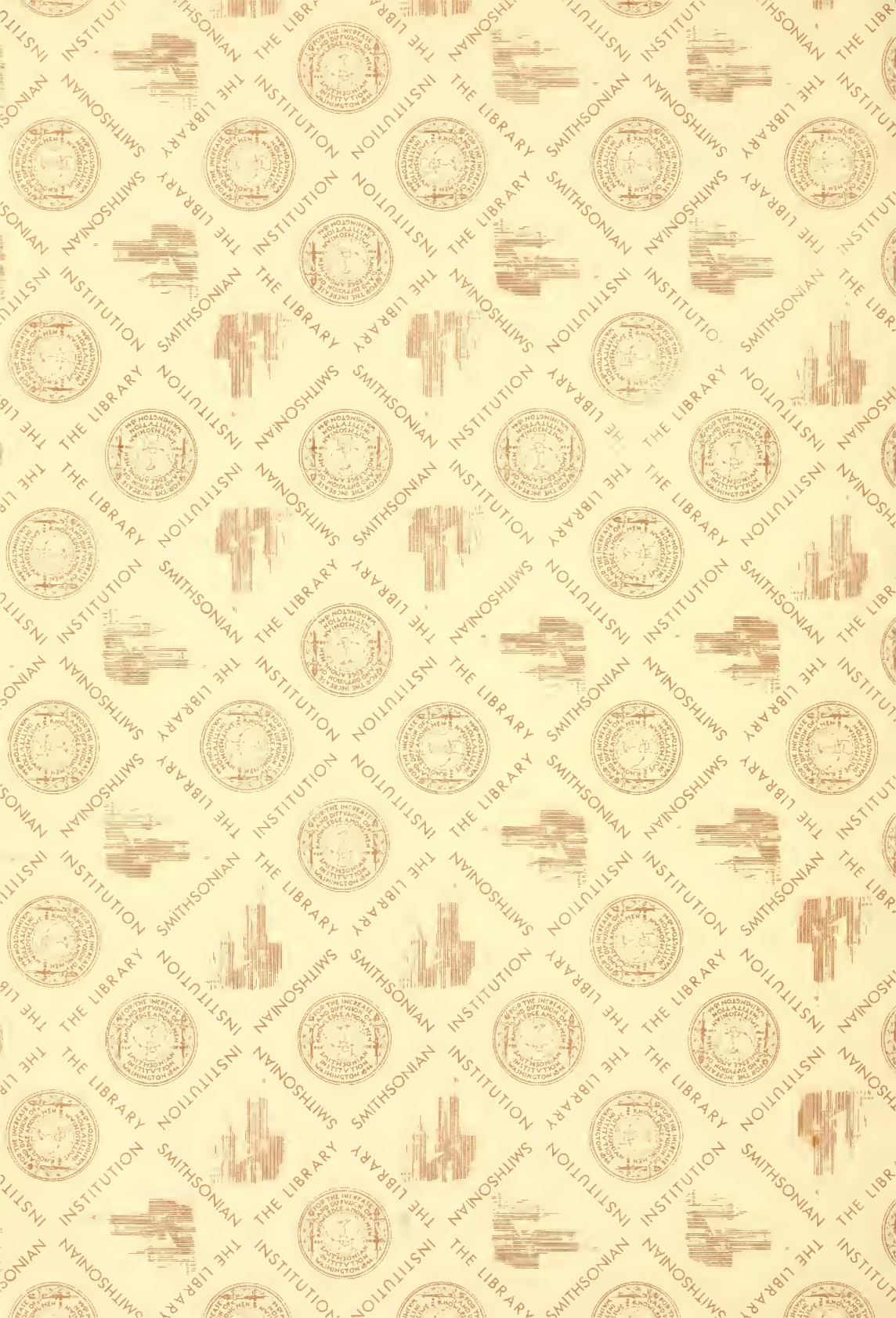
H Watson, del.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