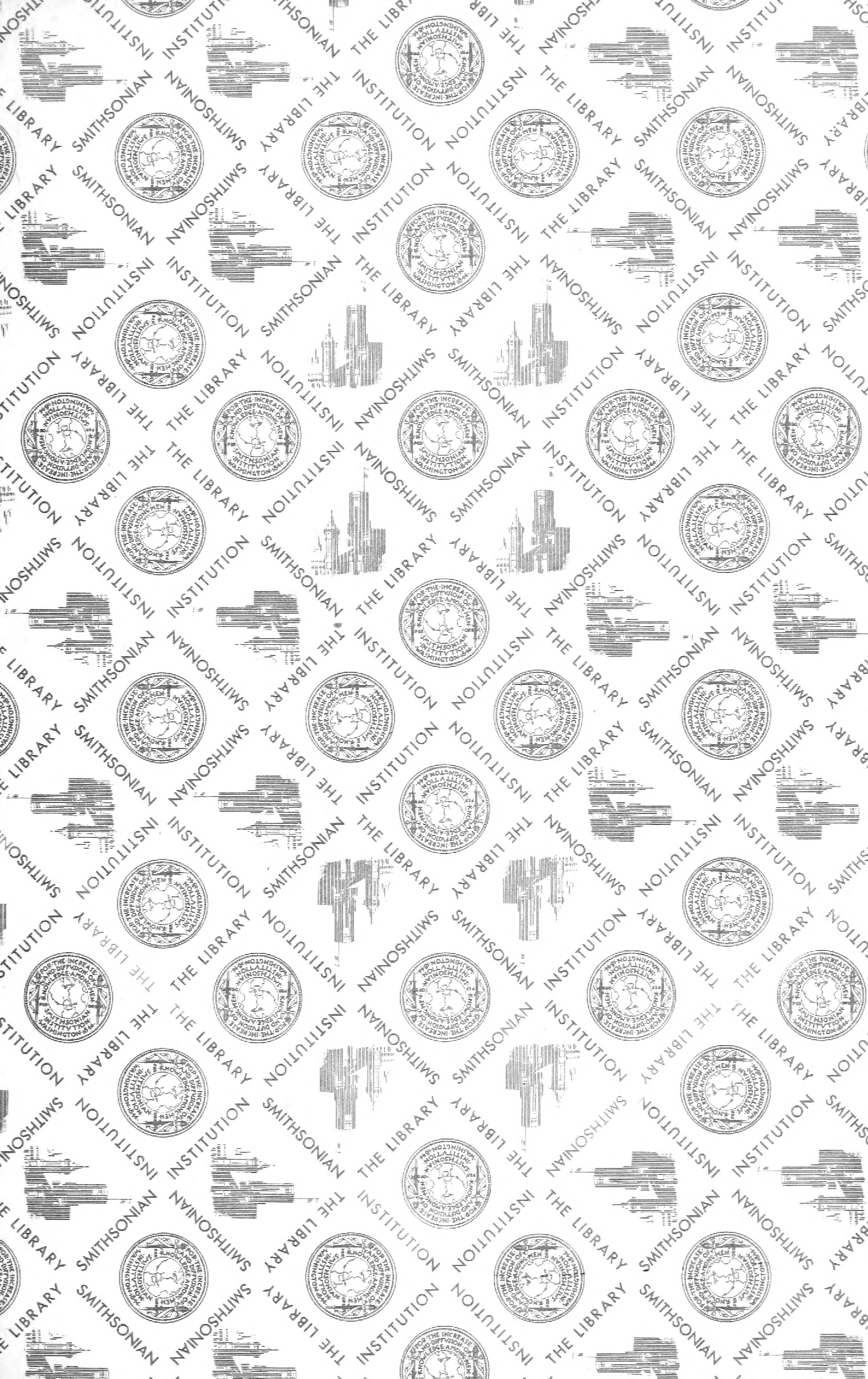
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VOLUME XLVI

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ANNALS
OF THE
SOUTH AFRICAN MUSEUM

VOLUME XLVI

PART I

NEW CERCOPITHECOID FOSSILS, INCLUDING A NEW SPECIES, FROM TAUNG, CAPE PROVINCE, SOUTH AFRICA

By

Leonard Freedman

Department of Anatomy, University of the Witwatersrand, Johannesburg

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[CONTINUED ON INSIDE BACK COVER

NEW CERCOPITHECOID FOSSILS, INCLUDING A NEW SPECIES, FROM TAUNG, CAPE PROVINCE, SOUTH AFRICA

By

LEONARD FREEDMAN
Department of Anatomy, University of the Witwatersrand, Johannesburg

(With 2 figures in the text and plates I–X)

INTRODUCTION

In the collection of the Department of Anatomy, University of Cape Town, Professor L. H. Wells recently found a number of blocks of breccia and partially developed fossils from Taung, Cape Province, South Africa. These had been collected by Professor M. R. Drennan in 1925, a few months after the discovery of the type skull of *Australopithecus africanus*, and are almost certainly derived from the same cave deposit as the *Australopithecus* skull. Professor Wells arranged for some of this material to be further developed by Mr. J. W. Kitching of the Bernard Price Institute for Palaeontological Research, Johannesburg. The only identifiable non-primate fossil recovered from this material by Professor Wells is a juvenile lower jaw of a large antelope most nearly resembling the kudu (*Strepsiceros strepsiceros*). Five cercopithecoid specimens from this collection which have been transferred to the South African Museum, Cape Town, have been handed on to me for description. These constitute a significant addition to the cercopithecoid material available from Taung.

The new cercopithecoid specimens comprise a fairly complete skull, with some upper teeth, of a female (S.A.M.11728); most of the right half of a juvenile skull, with two molars (S.A.M.11729); the damaged lower part of a calvaria and the left posterior part of a palate and maxilla, with one molar, of an individual of unknown sex (S.A.M.11730); a bilaterally crushed but almost complete immature female mandible with teeth (S.A.M.11731); three upper incisors in a small anterior fragment of premaxilla (S.A.M.11732).

Two of these specimens (S.A.M.11728 and S.A.M.11730) appear to represent a hitherto unrecorded species. A reconsideration of the material from Taung previously studied (Freedman, 1957) has led to the conclusion that two other specimens (T.10 and T.13, Transvaal Museum, Pretoria), may now be assigned to this species.

SPECIMENS S.A.M. 11728 AND S.A.M. 11730

Papio wellsi sp. nov.

Parapapio antiquus (*non* Haughton) Freedman, 1957 (*partim:* T.10). p. 174.
Papio izodi (*non* Gear) Freedman, 1957 (*partim:* T.13). p. 180, pl. 27, fig 56.

Holotype. A fairly complete female skull (S.A.M.11728), with only the right P^3, P^4, M^2 and M^3 present.

Ann. S. Afr. Mus. **46** (1), 1–14, pls. 1–10, 2 figs.

Repository of type. South African Museum, Cape Town, South Africa.

Type site. Limestone Deposits, Taung, Cape Province, South Africa.

Referred Material. The following specimens from Taung are referred to *P. wellsi*:

Specimen T.13: The left half of a skull with M^1–M^3, and also the right M^3 in a small piece of maxilla, probably of a female.

Specimen T.10: A damaged calvaria and posterior part of the muzzle, with the left P^4–M^2 and right M^2, of a juvenile—probably male.

Specimen S.A.M.11730: The badly damaged base of a calvaria and left maxilla with a molar (probably M^2) of unknown sex but most likely a male.

Diagnosis. P. wellsi is a small species of *Papio* which in norma lateralis shows a deep concavity between glabella and rhinion. The muzzle is characterized by fairly well-developed maxillary ridges and large maxillary fossae of variable depth. The calvaria is considerably flattened and there appears to be appreciable sexual dimorphism in skull size. The teeth are of the *Papio-Parapapio* type; all female teeth are smaller than their male equivalents. M^3 shows some reduction of the disto-buccal cusp (metacone).

Description. For purposes of description, skulls have been oriented so that the occlusal plane is horizontal.

The type specimen of *P. wellsi* consists of a fairly complete female skull of a small baboon-like species. The skull lacks the anterior tip of the muzzle, the left orbit and both zygomatic arches. Also, the muzzle is bent at an angle to the calvaria. Much bone has been lost from the calvaria—particularly the posterior, left parietal and basal portions—but a good endocranial cast has been exposed in most of these areas. From the almost unworn state of M^3, it would appear as if this tooth had only just come into functional position and the individual had thus only just become fully adult. The other good female specimen, T.13, consists of most of the left half of the skull but lacks the anterior tip of the muzzle, most of the nasal bones and the top of the calvaria.

Viewed in profile (Plate I) the muzzle of S.A.M.11728 is seen to be elongated and of about the same length as the calvaria. The region between glabella and rhinion forms a deep concavity and the reduction in height is particularly rapid in the inter-orbital region. The portion of the nasal profile just posterior to the nasal aperture is almost horizontal and slopes inferiorly only very slightly. Specimen T.13 (Plate II) has lost most of both nasal bones, but it seems clear that the profile shape was very similar to that of the type specimen.

The muzzle dorsum of the type specimen is short antero-posteriorly and slopes down steeply from either side of the rounded nasal bones to the maxillary ridges. From these ridges, which are not particularly well developed in this specimen, the maxillae slope down almost vertically to the alveolar margin, forming large but only slightly excavated bilateral maxillary fossae. In T.13

the shape of the muzzle dorsum is similar to that of the type but, on the sides of the muzzle, there are very large, deeply excavated maxillary fossae.

Both S.A.M.11728 and T.13 present fairly large orbits. The supra-orbital tori are only slightly developed in the type specimen but well developed in T.13. In S.A.M.11728, the palate is relatively long and narrow, with fairly deep sides and a flat roof (Plate III); the posterior palatine foramina are large. The palate in T.13 is damaged but its shape appears similar to that of the type (Plate IV).

The calvaria of the type specimen is considerably flattened (Plate I). The supra-orbital tori are slightly raised anteriorly and there is a slight ophryonic groove running across the calvaria posterior to them. The post-glenoid process of this specimen is broad mesio-laterally. Anterior to it there is a prominent groove which is deep laterally but becomes shallower medially (Plate III). Anteriorly this groove is bounded by the posterior edge of the inferiorly projecting root of the zygomatic process of the temporal bone. The post-glenoid process, the root of the zygomatic process of the temporal bone and the glenoid fossa are all situated relatively high above the level of the occlusal plane (Plate I). In T.13, the calvaria also appears to have been flattened (Plate II) but the glenoid fossa region is not present for comparison with that of S.A.M.11728.

The nasal bones of the probable male, T.10, are considerably damaged but its profile contour (Plate V) must have been of the *Papio* type (see 'Discussion' below) and similar to that of the type specimen. In spite of considerable damage to this general region, the muzzle dorsum would appear to have been flattened and have had almost vertical lateral surfaces. On the left side, the vertical surface of the maxilla appears to have been pushed in, but from the small posterior part of the right side preserved, it seems clear that an excavated maxillary fossa was present. The calvaria is flattened supero-inferiorly and of very similar shape to that of the type specimen. Although immature, T.10 is considerably larger than the females S.A.M.11728 and T.13. The other probable immature male, S.A.M.11730, has only a small portion of the palate and left maxilla present (Plate VI) but the very deep maxillary excavation and the tooth size (see 'Discussion' below) suggest that it belongs in this species.

In the females S.A.M.11728 and T.13 the dental arcade is horseshoe-shaped but elongated antero-posteriorly (Plates III and IV); the male shape cannot be determined. The male P^4 of T.10 (Plate VII) is very well preserved and almost unworn. It is a typical bicuspid cercopithecoid premolar and has a faint disto-lingual vertical groove. The two female premolars of the type specimen are considerably worn and damaged and little can be seen of their structure. The male and female molars are all typical bilophodont teeth of the *Papio-Parapapio* type and several have grooves marking off mesio-lingual cuspules (Plates III, IV and VII). The disto-buccal cusps of M^3 on both female specimens show signs of reduction. (No male M^3 is known). On size (table 3) the molars of the female, T.13, are considerably larger than those of the other female, S.A.M.11728. Nevertheless, it is apparent that the female teeth of *P. wellsi* are considerably smaller than those of the males (table 2), the difference being of the order usually found in the genus *Papio.*

The question of possible mandibular fragments and teeth of this species is dealt with in the 'Discussion' below.

Measurements. The measurements of the female skull and the male and female upper teeth of this species are given in tables 1, 2 and 3 respectively.

Discussion. In previous studies two baboon-like species, *Parapapio antiquus* (Haughton) and *Papio izodi* Gear, and possibly a third, *Parapapio jonesi* Broom, have been recorded from Taung, together with a fourth species of considerably different character, *Cercopithecoides williamsi* Mollet. The material assigned to *P. wellsi* must therefore be compared with the material which has been referred to the first three of these species (Freedman, 1957).

The two known male individuals of *P. wellsi* are immature as well as damaged and fragmentary. They appear to agree with the females in general

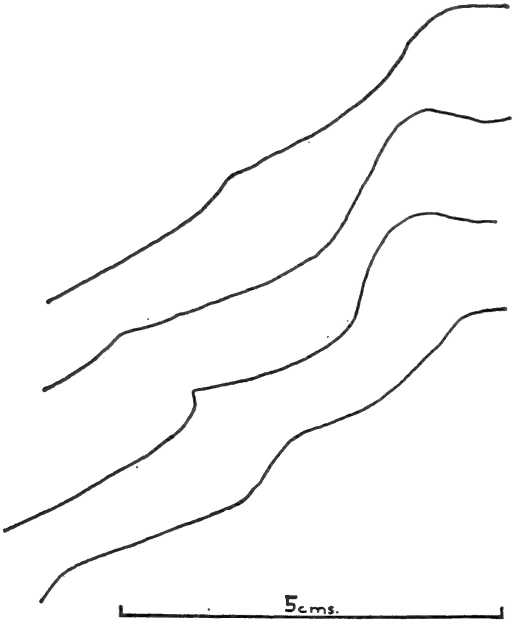

Fig. 1

Figure 1. Pantograph tracings of the muzzle profile shapes of females of (from above downwards): *Parapapio antiquus* (Tvl.639), *Papio izodi* (AD.992), *Papio wellsi* (S.A.M.11728) and *Parapapio jonesi* (STS.565). × 1.

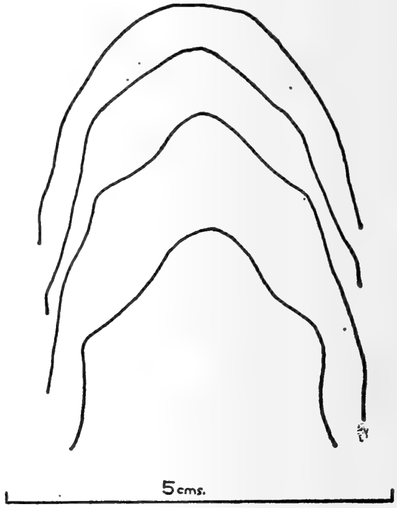

Fig. 2

Figure 2. Pantograph tracings of the muzzle coronal section shapes (taken midway between glabella and rhinion) of females of (from above downwards): *Papio izodi* (AD.992), *Parapapio jonesi* (STS.568), *Parapapio antiquus* (Tvl.639) and *Papio wellsi* (S.A.M.11728). × 1.

morphology but (as described above) they differ in size to the degree usual in *Papio*. Insufficient is thus known of them—and also of the males of some of the species referred to—to make comparisons between the males of value at present. The comparisons made below between *P. wellsi* and other known cercopithecoid species will thus depend mainly on comparisons between females.

Both *Parapapio antiquus* and *Papio izodi* are larger than *P. wellsi* in most skull and some dental measurements (tables 1 and 3), *P. izodi* being the largest. In morphology *P. wellsi* shows important resemblances to both *P. antiquus* and *P. izodi*. Thus, in profile shape of the muzzle *P. wellsi* is clearly of the *Papio* type, with a steep drop in the inter-orbital region similar to that seen in *P. izodi* (fig. 1). On the other hand, the muzzle shape of the new species in coronal section (fig. 2) is very similar to that of *P. antiquus*. *P. wellsi* and *P. antiquus* both have definite maxillary ridges and maxillary fossae, whereas neither is present in *P. izodi*. The new species differs from both *P. izodi* and *P. antiquus* in its generally smaller skull and dental size, its flatter calvaria and the shape and situation of the structures in the glenoid fossa region as described above. On muzzle profile shape and sexual dimorphism the group of specimens referred to *P. wellsi* (S.A.M.11728, T.13, T.10 and S.A.M.11730) must clearly be placed in the genus *Papio*. However, to suggest including them in the species *P. izodi* would be to increase the range of variation, particularly morphological, beyond reasonable limits.

P. wellsi is similar to *Parapapio jonesi* in skull size (table 1) and in muzzle coronal section shape (fig. 2). However, it differs considerably from that species in muzzle profile shape (fig. 1) and also in the shape and relative height of the calvaria. In the teeth (table 3), the morphology of the two species is similar but on size, particularly in the length dimensions, the *P. wellsi* molar measurements are considerably larger.

Before this new species was established, T.13 was referred to *P. izodi* (Freedman, 1957). The presence, in a single specimen, of very large, deep maxillary fossae and a slightly different muzzle dorsum shape, were not felt to be sufficient grounds for the creation of a new species. Despite the size and morphological differences from the type specimen, described above, it now appears that this specimen is a female of the new species, *P. wellsi*. The main difference between T.13 and the type specimen of *P. wellsi* lies in the size and depth of the maxillary fossae. In a large number of skulls of *Papio ursinus* and *Papio cynocephalus* which were examined for this feature, maxillary fossae were found to be of very variable size and depth.

In that same study (Freedman, 1957) it was also suggested that the muzzle shape of T.10, in profile, was probably that of a *Parapapio*. The profile shape appeared to be of the *Papio* type but the inter-orbital region was considerably damaged and the individual from which it came, immature. On the shape of the muzzle in coronal section this specimen agreed with the *Parapapio* described from Taung (*P. antiquus*) and disagreed with *P. izodi*, the only *Papio* then known from Taung. It was thus decided that the shape in an undamaged adult of this type might well be similar to that of a *Parapapio* and the specimen was referred to *P. antiquus*. The new species now being described is a *Papio* but has a muzzle which, in coronal section, is similar to that of *Parapapio antiquus*. The apparent contradiction of profile and coronal section muzzle shapes is now resolved and T.10 can, with reasonable certainty, be referred to *P. wellsi*. On the size of the skull and teeth the specimen seems clearly to be from a male.

TABLE 1. Comparison of the skull measurements (in mm.) of *Papio wellsi* females with those of similar female cercopithecoid specimens.*

	Papio wellsi		*Parapapio jonesi*	*Parapapio antiquus*		*Papio izodi*		*Papio angusticeps*
	S.A.M. 11728	T.13	STS. 565	TVL. 639	T.17	AD.992	AD.946	K.A.194
General								
Greatest length	(134)	(130)	(135)	(143)		(138)		139
Basal length	(91)							99
Calvaria								
Height								
Basion-bregma	54			58		60		(64)
Basion-glabella	64			70		72		
Breadth								
Greatest temporal	(65)		68	69		72		67
Length								
Inion-glabella	(82)		(88)	(90)		(90)		
Inion-basion	(50)			47		53		48
Foramen magnum								
Length	(18)							
Muzzle								
Height								
Anterior to P^3	16		22		20		17	21
Breadth								
Anterior to M^3	43	45	46		46	42	47	45
Anterior to P^3	29.5		35					36
Dorsal to M^2	37		30	35				31
Length								
Muzzle	(67)		(65)				78	78
Palate	(58)		51	63	(62)			
Orbit								
Inter-orbital	(9)		10	8				
Nasal								
Breadth	15.5			17				15.4

---

* The comparative measurements in this table, and also those in the succeeding tables, are all from Freedman (1957). Professor L. H. Wells has pointed out to me that the figure for the muzzle length of AD.946 was erroneously given in that study as 88 mm. instead of 78 mm.

The new specimen, S.A.M.11730 is only a small maxillary fragment (Plate VI). However, the deeply excavated maxillary fossa is strongly suggestive of *P. wellsi* and, when the single M^2 is compared to its equivalents in tables 2 and 3, it is again seen to fit well as a male in that species.

Because of the resemblances and the small number of specimens of the four baboon-like species from Taung, and particularly with the overlap of characters between *P. wellsi*, and the previously described species *Parapapio jonesi*, *Parapapio antiquus* and *Papio izodi*, it is difficult to identify positively a number of specimens. For example, C.T.5360 and T.22, previously referred to *P. antiquus* (Freedman, 1957), consist of upper teeth only and could, on size, equally well belong in *P. wellsi*. Similarly, T.16 was previously described as a female *P. antiquus* and could now also be referred to *P. wellsi*.

TABLE 2. Comparison of the dimensions (in mm.) of the upper teeth of *Papio wellsi* males with those of similar male cercopithecoid specimens.

	P^4		M^1			M^2		
	b	l	bm	bd	l	bm	bd	l
Papio wellsi								
S.A.M.11730						11·8	10·4	13·2
T.10	7·5	7·6	10·0	9·2	10·5	11·8	10·6	12·8
Parapapio jonesi								
STS.367					(9·3)			10·8
STS.250	7·7	(5·6)	9·0	8·6	7·3	10·4	9·6	9·5
Parapapio antiquus								
CT.5356					9·2	11·6	11·0	11·8
Papio izodi (no males known)								
Papio angusticeps								
Range*	7·9 8·5	6·0 7·4	8·8 10·5	8·4 9·3	9·5 10·8	10·8 12·4	9·7 10·5	11·6 12·7

* The ranges given in this and the succeeding tables are based on very few (mostly 3–6) specimens.

The possibility of even C.T.5356, previously considered a male of *P. antiquus*, being a badly distorted male of *P. wellsi* cannot now be ruled out completely. The distal reduction of M^3 of this specimen is mainly on the buccal side and very similar to that seen in the female *P. wellsi* specimens. If this specimen were referred to *P. wellsi*, this would resolve the apparently anomalous situation of a female *P. antiquus* having an M^3 very considerably reduced distally, and, the male of the same species having the distal portion of that tooth only slightly reduced. However, it does not appear as if the specimen had a *Papio*-like muzzle, although this region is badly distorted and damaged, possibly sufficiently so to be misleading.

Further, the diagnostic features of the above mentioned four species lie mainly in the skull and few specimens are known which include diagnosable skull fragments associated with mandibles with teeth. In particular, no good *P. wellsi* skull is associated with lower teeth. Hence, with the description of the new species *P. wellsi*, the mandibles referred to *P. antiquus* (T.12 and T.23—males; T.18, T.21 and T.27—females; A.D.944—? sex) could all now equally well be referred to *P. wellsi*. AD.943, a male specimen formerly referred to *P. antiquus*, on tooth size and probable muzzle shape, the latter as deduced from the case of the internal surface, should probably now be referred to *P. wellsi*. It is therefore now apparent that the status of a number of specimens from Taung, including almost all of the known mandibles, is best left in abeyance until more material, especially associated skulls and mandibles, is discovered.

The presence at Taung of two similar species of *Papio* might at first glance appear improbable, but it should be recalled that the limestone deposit at this site covers a considerable period of time and the two species might not necessarily have been in the area at the same time. The material described in this paper almost certainly comes from the *Australopithecus africanus* type site, whereas at least some of the material previously described from Taung came from other parts of the deposit and may thus possibly be of different age. Further, a fairly large number of different fossil cercopithecoids (fifteen species of five genera), dating from roughly the same time period as that covered by the Taung deposit, have been described from Southern Africa. From one of these sites (Sterkfontein), three species of one genus (*Parapapio jonesi*, *P. broomi* and *P. whitei*) have been recorded.

With regard to the other species of *Papio* described from Southern Africa, *P. wellsi* shows resemblance to *Papio angusticeps* (known from Kromdraai and Cooper's Quarry, near Krugersdorp, Transvaal, South Africa) in the depth and extent of the maxillary fossae. However, it is a smaller species, has less well-developed maxillary ridges and a flatter calvaria. The teeth of the two species are similar in size and morphology. The new species is very considerably smaller than *Papio robinsoni* (known mainly from Swartkrans, Transvaal, South Africa) and *Papio ursinus* (the extant South African baboon), and also differs from these two species in a number of morphological characters.

Of all the cercopithecoid species known from Southern Africa, *P. wellsi* appears to have its closest affinities with *P. angusticeps*. These two *Papio* species are of generally similar morphology and are both characterized by large and usually deep maxillary fossae. *P. angusticeps* is somewhat larger than *P. wellsi* but it occurs at sites considered to be of more recent date than Taung. However, *P. wellsi* shows differences even to *P. angusticeps*, e.g. in its flattened calvaria, which would appear to rule it out as a direct antecedent of that species.

TABLE 3. Comparison of the dimensions (in mm.) of the upper teeth of *Papio wellsi* females with those of similar female (and ? sex *Parapapio jonesi*) cercopithecoid specimens.

		P^3		M^1			M^2			M^3			P^4–M^3
		b	l(h)	bm	bd	l	bm	bd	l	bm	bd	l	
Papio wellsi	S.A.M.11728	6·7	—	—	—	—	(10·0)	9·0	(11·2)	(9·7)	(8·4)	10·8	36·1
	T.13			9·5	9·1	9·7	11·2	10·2	11·8	11·4	9·4	11·2	(37·5)
Parapapio jonesi	T.14*			8·3	7·9	8·4	9·7	9·4	9·8				
	Range:	6·7 7·6	3·5 6·8	8·6 9·0	7·4 (8·9)	8·2 9·3	10·2 10·7	8·5 9·2	(9·6) (10·6)	9·3 10·1	7·4 8·1	9·0 10·0	32·3 34·2
Parapapio antiquus	Range:			10·0 10·8	8·8 (10·0)	10·3 10·8	10·7 11·5	9·0 9·5	11·6 11·9	10·4 11·4	7·2 (9·5)	10·4 11·3	37·0 (38·8)
Papio izodi	AD.946					(10·5)			(12·0)				(41·0)
	AD.992								(12·0)				
Papio angusticeps	Range:	7·0 7·4	3·8 10·0	8·7 9·9	7·5 8·7	9·0 10·3	10·4 11·6	9·4 11·0	11·0 12·6	10·3 12·0	8·0 9·0	10·6 12·0	35·7 38·5

* This is the only specimen of this species known from Taung; its sex is unknown.

SPECIMEN S.A.M.11729

Description. This specimen (Plate VIII) consists of the right half of the skull of a juvenile baboon of unknown sex. Most of the nasal and frontal bones are missing and there are a number of fractures and slightly weathered areas on the calvaria and muzzle. The base of the calvaria is considerably damaged but the palate is well preserved. Of the dentition, only the right M^1 and the buccal half of the right dm^2 are present.

The muzzle dorsum, on each side, is triangular in shape and slightly concave. It slopes down rather steeply from the lateral edge of the rounded nasal to the clearly marked maxillary ridge. From the maxillary ridge, the maxilla slopes down even more steeply to the alveolar margin and a large, slightly excavated, maxillary fossa is formed.

Features of note when this specimen is compared with *Papio* (*P. ursinus* and *P. cynocephalus*) and *Parapapio* (M.3004, *Parapapio* sp.) specimens of approximately the same dental age are:

(1) The size of the orbit is relatively large.
(2) The zygomatic arch is considerably better developed.
(3) The anterior part of the temporal line is rather well defined. (The posterior part of this line is weathered away.)
(4) The mastoid region is well developed.
(5) The supramastoid crest leads to an occipital crest.
(6) The planum occipitale is more vertical than usual.

These differences may, in some of the above instances, be more apparent than real as it is very difficult to get comparative specimens of precisely the same age. Considerable time periods elapse between the eruption of successive teeth in the cercopithecoids. However, morphologically the skull of this specimen does give the impression of being robust and adult for its age.

The palate of S.A.M.11729 is fairly deep and smoothly concave from the alveolar margin to the midline, which is raised into a crest anteriorly. The posterior palatine foramen is situated in a deep recess. The fragment of dm^2 appears similar to its equivalents in *Papio* and *Parapapio*; the single M^1 is well preserved, almost unworn and of the *Papio-Parapapio* type.

Measurements. As the specimen is juvenile, no skull measurements were taken. The dimensions of the single M^1 (in mm.) are: breadth (mesial)—8.5, breadth (distal)—8.0 and length—9.5.

Discussion. On the shape in coronal section of the muzzle, S.A.M.11729 is similar to *Papio wellsi*, *Parapapio antiquus* and *Parapapio jonesi.* Reconstructions of the frontal and nasal regions in plasticine to give the probable profile shape did not give wholly satisfactory results, as the damage is so extensive that there is a measure of variation in the shape which can be produced, depending on how far forwards the supra-orbital tori and glabella are produced. However, the angle at which the remaining small portion of the nasal bones lies, and the shape of the small piece of frontal lying at the supero-lateral corner of the orbit, do seem to favour at least a shallow concave type of nasal profile.

The various notable features of S.A.M.11729, to which attention was drawn above, cannot be compared fairly with the equivalents in the three species under consideration. Firstly, usually only female skulls of those species are available and secondly, the known specimens are often damaged in the relevant areas. Further comparative material is necessary for the evaluation of those features in S.A.M.11729. However, the general robustness of the specimen may well be due to the specimen being a juvenile male and may not have any taxonomic significance.

The dimensions of the single M^1 of S.A.M.11729 are similar to those in the males and females of *P. jonesi* (tables 2 and 3). When compared to their equivalents in *P. wellsi* and *P. antiquus*, the dimensions of this tooth are almost all smaller than those of the females of both of those species (table 3), but, of the two, they are appreciably closer to *P. wellsi*. Compared with the male equivalents in those two species (table 2), the tooth is considerably smaller than those of *P. wellsi* (in which there is size sexual dimorphism of the molars) but there is no known male M^1 of *P. antiquus* for comparison. However, as there is little or no sexual dimorphism in the molars of any of the known *Parapapio* species, the size difference should be about the same as for the female of that species.

It is most difficult to come to any definite conclusion about the affinities of S.A.M.11729. From the muzzle coronal shape, the specimen could belong in *P. wellsi*, *P. antiquus* or *P. jonesi*. The reconstruction of the muzzle profile shape is slightly more suggestive of a *Papio* but *P. jonesi* does show some concavity in this region and the juvenile shape of *Parapapio* spp. generally is not well known. The size of the single M^1 is most similar to the equivalent tooth in *P. jonesi* but, it is also not very much smaller than the equivalent tooth in the *P. wellsi* female (T.13) and it should be remembered that only a few specimens are involved in this comparison. On balance of evidence, it would appear that S.A.M.11729 might be a juvenile female of *P. wellsi* or, more likely, a juvenile male or possibly female of *P. jonesi*. However, the provenance of *P. jonesi* at Taung depends on a single specimen, consisting of a small piece of maxilla and damaged teeth, and the possibility of the specimen belonging even in *P. antiquus* cannot be ruled out completely.

SPECIMEN S.A.M.11731

Description. S.A.M.11731 is an almost complete mandible of an immature female cercopithecoid. The specimen has been fractured slightly to the right of the symphysis, and the right half has been pushed to the left and lies close up against, and slightly above, the left half of the mandible (Plate IX).

I_1–M_2 are present on the left side. The premolars and molars are very

TABLE 4. Comparison of the dimensions (in mm.) of the lower teeth of the female mandible, S.A.M.11731, with their equivalents in females of similar species known from Taung.

	I_1			I_2			$\bar{C}$	P_3		P_4		M_1			M_2		
	h	b	l	h	b	l		b	l(h)	b	l	bm	bd	l	bm	bd	l
S.A.M.11731	(11·0)	—	5·6	(10·7)	—	5·7		4·9	11·8	6·5	7·5	(7·0)	—	9·5	8·7	8·2	11·2
Parapapio jonesi Range:	2·0	6·2	4·3	2·5	6·2	3·2		4·4	7·0	5·7	6·0	6·7	6·7	(7·0)	7·6	7·2	9·5
	7·1	6·3	4·9	6·0	6·2	4·3		5·4	10·0	7·5	7·1	7·6	7·9	9·0	9·9	9·4	11·0
Parapapio antiquus (?) T.18								5·7	12·7	—	—	8·3	8·3	10·0	9·6	9·4	12·1
T.21	9·5	6·7	5·1	9·9	6·4	5·9		5·1	10·2	7·1	7·5						
T.27	10·2	6·8	5·8	8·9	6·6	5·9		4·9	11·3	—	8·4	—	—	—	(9·2)	9·5	11·7
Papio izodi AD.946															—	10·1	12·2

well preserved but the incisors and canines are cracked and damaged. On the right, the incisors are also present but very badly damaged. The only other tooth present on this side is M_2 and it is slightly damaged distally. M_3 has not yet erupted on either side but the tooth can be seen, on both sides, lying in its crypt. The tips of the cusps of that tooth are at about the level of the buccal alveolar margin.

Anteriorly, the symphysis slopes down steeply and is flattened. A foramen symphyseosum is present in the midline. The flattened anterior surface of the symphysis is demarcated by a prominent oblique ridge on either side. The body of the mandible is low and thin but shows some thickening posteriorly in the region of M_3. A large but very shallow mandibular fossa is present, on the antero-inferior margin of which is the mental foramen. The ramus is about as vertical as that of *Papio ursinus* but does not rise as high. The gonial angle is inverted. The coronoid process lies slightly above the level of the condyle; the sigmoid notch was probably not very deep. The teeth are all typical of the female *Papio* and *Parapapio* and show no unusual features (Plates IX and X). A small mesio-buccal cuspule is present on both M_2 teeth.

Measurements. As the specimen is immature, no measurements of the mandible itself were taken. The dental dimensions and comparisons are given in table 4.

Discussion. On molar size, which has often proved a most useful taxonomic character in the Cercopithecoidea, S.A.M.11731 is smaller than the few known female specimens previously referred to *P. izodi* and *P. antiquus*, the difference being greater in the former case. In the incisors and premolars, the dimensions of S.A.M.11731 and *P. antiquus* females are similar but there are no comparable teeth of *P. izodi*. As compared to the female *P. jonesi* teeth, the incisors of S.A.M.11731 are larger but the premolars and molars are of about the same size. No lower teeth or mandibles have so far been assigned to *P. wellsi*. It is not possible to assess accurately what the adult dimensions of the mandible of S.A.M.11731 would have been but, as far as can be judged, the size would probably have been about the same as in *P. jonesi* females, slightly smaller than in *P. antiquus* females (assuming T.18 and T.27 to have been correctly assigned) and considerably smaller than in *P. izodi* females.

As concluded above, the Taung mandibles are best left in abeyance until more and better associated skulls and mandibles are recovered. However, it would appear probable that, on size and the presence of a mandibular fossa, the new immature, female, mandibular specimen, S.A.M.11731, might well belong in *P. wellsi*, but it could also reasonably be referred to *P. jonesi*.

SPECIMEN S.A.M.11732

This specimen consists of a small portion of the left premaxilla with I^1 and I^2 and an associated right I^2, almost certainly of the same individual.

The teeth are of the typical cercopithecoid pattern and show no unusual features. Insufficient upper incisors are known from Taung for the affinities of the specimen to be determined.

Summary

1. Five new cercopithecoid fossils are described from Taung. They almost certainly come from the *Australopithecus africanus* type site.

2. Two of these specimens, plus two specimens previously described from Taung, form the basis of a new species, *Papio wellsi.*

3. Because of an overlap in size and morphological characters between the four baboon-like species recorded from Taung, the identity of several specimens, notably mandibles, cannot at present be determined.

Acknowledgements

My thanks are due to Professor L. H. Wells for handing me this material for description and also for his most helpful criticisms of the manuscript. Professor P. V. Tobias, Anatomy Department, University of the Witwatersrand, Johannesburg, and Dr. J. T. Robinson, Transvaal Museum, Pretoria, also kindly read through the manuscript and offered useful suggestions. Messrs. A. R. Hughes and R. Klomfass, both of the Anatomy Department, University of the Witwatersrand, Johannesburg, took the photographs which illustrate this paper. This paper has been published partly with the aid of a grant from the University Council Research Committee, University of the Witwatersrand.

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Papio wellsi, female (S.A.M.11728). Skull, lateral view.

Papio wellsi, female (T.13). Skull, lateral view.

Papio wellsi, female (S.A.M.11728). Skull, basal view.

Ann. S. Afr. Mus., Vol. XLV Plate IV

Papio wellsi, female (T.13). Skull, basal view.

Plate V

Papio wellsi, probable male (T.10). Skull, lateral view.

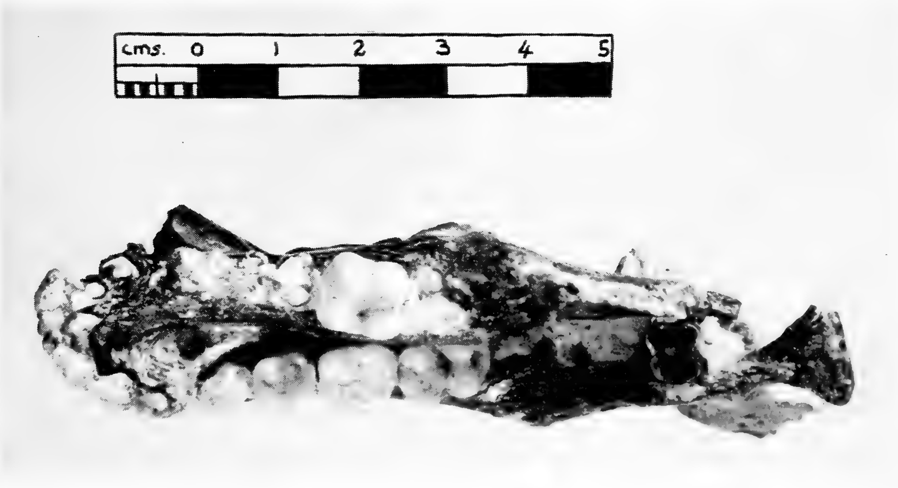
Plate VI

Papio wellsi, probable male (S.A.M. 11730). Skull fragment, antero-lateral view.

Papio wellsi, probable male (T.10). Skull, basal view.

Juvenile cercopithecoid (S.A.M.11729). Skull, lateral view.

Immature female (S.A.M.11731). Mandible, lateral view.



Immature female (S.A.M.11731). Mandible, occlusal view.

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SYNONYMY. arrangement according to Schenk, E. T. & McMaster, J. H.: *Procedure in taxonomy.* 2nd ed. Stanford, Stanford university press, 1948. Bibliographic references modified.

'I. *Synonymy arranged according to chronology of names.*—All published scientific names by which a species has been previously designated (subsequent to 1758) are listed in chronological order, with bibliographical references to all descriptions or descriptive citations following in chronological order after each name. . . .

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Bibliographical references modified to consist of author's name, date of citation, pagination and illustrations (plates and figures).

Example:–

Eulalia (Steggoa) capensis Schmarda

Eulalia capensis Schmarda 1861, p. 86, pl. 29, fig. 231. Willey 1904, p. 259.
Eulalia viridis var. *capensis* McIntosh 1903, p. 34. Day 1953, p. 30.
Eulalia viridis (*non* Muller) Ehlers 1913, p. 455. Day 1934, p. 30.

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SOME NEW CADDIS FLIES (TRICHOPTERA) FROM THE WESTERN CAPE PROVINCE – III

By

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South African Council for Scientific and Industrial Research

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(With 8 figures in the text)

Introduction

This is the third paper in the present series, in which caddis flies from the western Cape are being described. In it an account is given of the larval and pupal stages of the three new species of Leptoceridae described in Part II (*Athripsodes prionii*, *A. bergensis* and *Leptecho helicotheca*); the pupal skin of *Athripsodes tuckeri* (Barnard) ? var. is also described, and all stages of a small species of *Setodes*, *S. barnardi*, from the Great Berg River, which appears to be new. The immature stages have been described in considerable detail with the object of collecting sufficient information to build up keys for the identification of larvae and pupae collected in field surveys.

The methods employed have been the same as in previous papers, and, as before, holotypes will be deposited in the South African Museum, and paratypes will be sent to the British Museum (Natural History). Terminology as before, except that Ross's term 'stridulator' is used instead of the more cumbersome '*plaque d'appui*' (Barnard), or 'process of the trochantin' (Ulmer). A full description of the habitats of the species described will be found in Harrison and Elsworth (1958) and Harrison (1958). (See addendum to the latter paper for names used.)

The author would like to express her grateful thanks to Mr. D. E. Kimmins of the British Museum (Natural History) for much helpful advice, also to Dr. A. D. Harrison of the National Institute for Water Research, and to Professor J. H. Day of the Zoology Department, University of Cape Town, in whose department the work was carried out.

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Description of Immature Stages

Athripsodes prionii Scott

Fig. 1 A–R; Fig. 5 K–Q

Remarks: Larvae were collected from the Palmiet River at Elgin in October and November, and from the Great Berg River near Assegaibos,

Ann. S. Afr. Mus. **46** (2), 15-33, 8 figs.

Driefontein, Groot Drakenstein and Bridgetown between April and October. The only place at which they were common was at Groot Drakenstein in autumn (April and May). The larvae are swimmers and live mainly among the marginal vegetation, particularly the palmiet (*Prionium serratum*).

Larva (Fig. 1 A–M): Described from entire specimens. Case-bearing swimming larvae; eruciform; length up to 8·0 mm. *Head:* hypognathous, oval, clypeus somewhat asymmetrical with 2 pairs of lateral indentations and 10 bristles, a suture-like line present paralleling the epicranial arms; gular sclerite pear-shaped, not fused with genae. Head golden brown with darker brown patterning as indicated in figure 1 A–E. Anteclypeus membranous, pale. Eyes large, black, set in a clear pale area, with 6 raised transparent cuticular plates over each forming hyaline lenses. Antennae conspicuous, with bulbous proximal segment and long distal segment terminating in a sensory bristle. *Mouthparts:* labrum armed with 4 blade-shaped spines and 6 long setae, there are also 2 pairs of very short spines just below the central emargination. Mandibles unequal in size, dark brown, heavily sclerotized; each mandible with 5 teeth, 2 small brushes of stout bristles on the inner face of the larger left mandible. Maxillary palps 3-segmented, 3rd segment bearing several small papillae; maxillary lobe bordered with long blade-like spines, smaller spines and setae. Labium a low cone, labial palps each tipped with a papilla. *Thorax:* pro- and mesonota sclerotized, patterned with darker brown and cream as indicated in figure 1 B; metanotum membranous except for 2 small oval patches bearing setae. The patterning on both head and thoracic nota is variable, as is the ground colour, which varies from dark brown, when the pattern scarcely shows, to pale yellow, when it shows up very clearly. Each half of the pronotum is subdivided by a groove. The mesonota are lightly sclerotized, with a pair of narrow dark bars. The metathorax bears what appear to be 2 small gills on each side (fig. 1 A). *Legs:* prothoracic legs short, stout; tibia and tarsus edged with spines; bristles, spines and hair-like setae fringe the femur. Stridulator stout, with blunt apex. Mesothoracic legs armed with strong spines, interspersed with hair-like setae along edge of femur. Metathoracic legs long, strong, with heavy double fringe of long hairs used in swimming. All leg joints of one segment only except trochanters which have two; femora of mid- and hind-legs also appear to have two segments, though it is not clear whether this division is functional or merely incipient. Coxopleurites, trochantin etc. of legs heavily sclerotized. *Abdomen:* white; on segment 1 lateral humps covered with small scabrosities, and a prominent dorsal hump bearing a patch of spicules; on segment 2 a small sclerite on each side and 3 simple filiform gills (presegmental dorsal and ventrolateral gills, and a postsegmental lateral gill); on segments 3 and 4, 2 gills (presegmental dorsal and ventrolateral); no gills on segments 5–9. Lateral line extends from segment 3 to 7; on segment 8 it is replaced by a row of small bifid tubercles. Segment 9 is membranous but the tergite is bordered posteriorly with a row of 6 strong black bristles. The anal prolegs are fused basally to form a 10th segment; each is short and bulbous with a lateral sclerotized patch and several

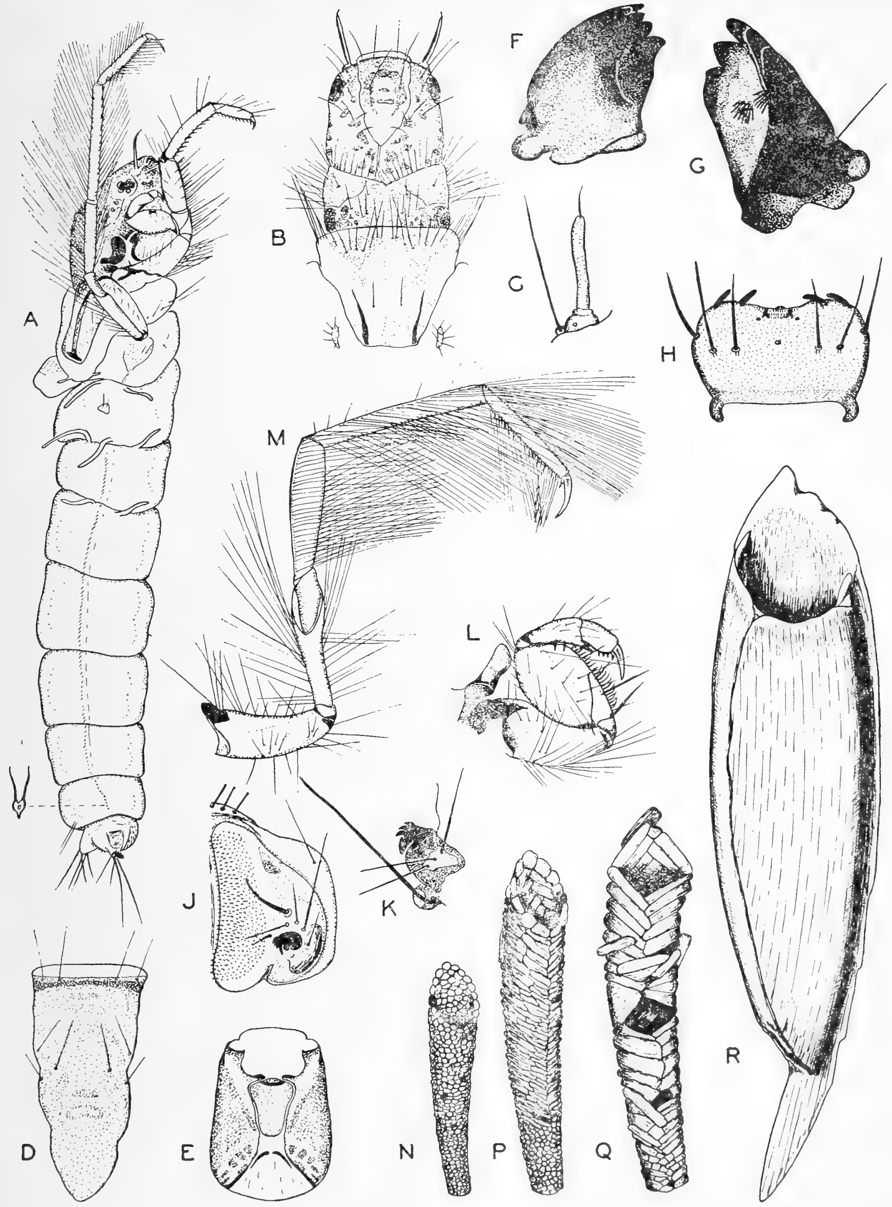


FIG. 1. Larva of *Athripsodes prionii* Scott.

A, lateral view of whole larva, with lateral tubercle enlarged. B, dorsal view of head with pro- and mesonota. C, antenna. D, clypeus. E, head from behind showing gular sclerite. F, right mandible. G, left mandible. H, labrum. J, posterior end of larva (right side). K, anal claw. L, prothoracic leg. M, metathoracic leg. N, case of early instar of larva. P, Q, cases of later instars. R, case of mature larva.

stout black setae; anal claws have 4 barbs (1 large and 3 small); anus flanked by patches of small spicules.

Case (fig. 1 N–R): Tubular, wider at anterior end, with hood. Small larvae make their cases of sand grains, lining them with secretion; older larvae utilize small bits of vegetable debris, charcoal, etc., with a few sand grains at the posterior end; mature larvae make a very characteristic rounded case from 3 neatly shaped pieces of dead leaf (usually of *Prionium serrata*); one piece is always longer than the others and forms a hood at the anterior end of the case and a projecting strip at the posterior end. The case is lined with secretion and may be neatened round the front and hind openings by the addition of a few small bits of leaf glued on with secretion; there is always a neat round hole at the posterior end.

Pupa (fig. 5 K–Q): Labrum rounded, rising to a low point; setae comparatively short, some recurved; mandibles large, strong, inner edge finely serrated, outer edge sinuous, ending in a strong condyle, one pair of lateral setae. Antennae much longer than body, distal ends coiled. Fore-tarsi slightly, mid-tarsi heavily, fringed. Dorsal plates present on abdominal segments as follows: on segment 1, 2 pairs of protuberances covered with small sclerotized points (these point in opposite directions in each pair); on segments 3 and 4, 1 pair of hook-bearing plates; on 5, 2 pairs; on 6, 1 pair. Segment 9 bears a pair of small lappets tipped with forwardly directed setae. The plates on 3 and 4 each have 3 hooks, the anterior plates on 5 and those on 6 each have 2 large hooks and 3–4 smaller ones. There are minute scabrosities scattered on the dorsal surface of the abdomen. Lateral lines extend from segment 3 to 8, where the two curl round and meet ventrally. Anal appendages are long and stout, with rounded tips; along the inner edges are small barbs and a few setae.

Athripsodes bergensis Scott

Fig. 2 A–L; fig. 5 A–J

Remarks: The larvae are common in the Great Berg River near Driefontein and Groot Drakenstein in the late winter and spring (August to October). They are crawlers with long, slender, rough-looking cases of brown sand-grains to which pieces of stick or charcoal are often attached, and they are frequently to be seen crawling actively about on top of the stones seeking food. They are carnivorous and in captivity must be given insect larvae or other small animals to eat to prevent cannibalism. It is possible that the sticks etc. attached to their cases serve to discourage predatory fish, as in the case of *Anabolia nervosa* in Britain. Pupae were found in October, clustered in numbers under marginal stones; some were collected and bred out in the laboratory. The pupal cases are not larval cases sealed off, but each is constructed from small white sand-grains at the end of the old larval case, being first formed as an extension of it. When completed however the pupal case is closed off at each end by a neat lid

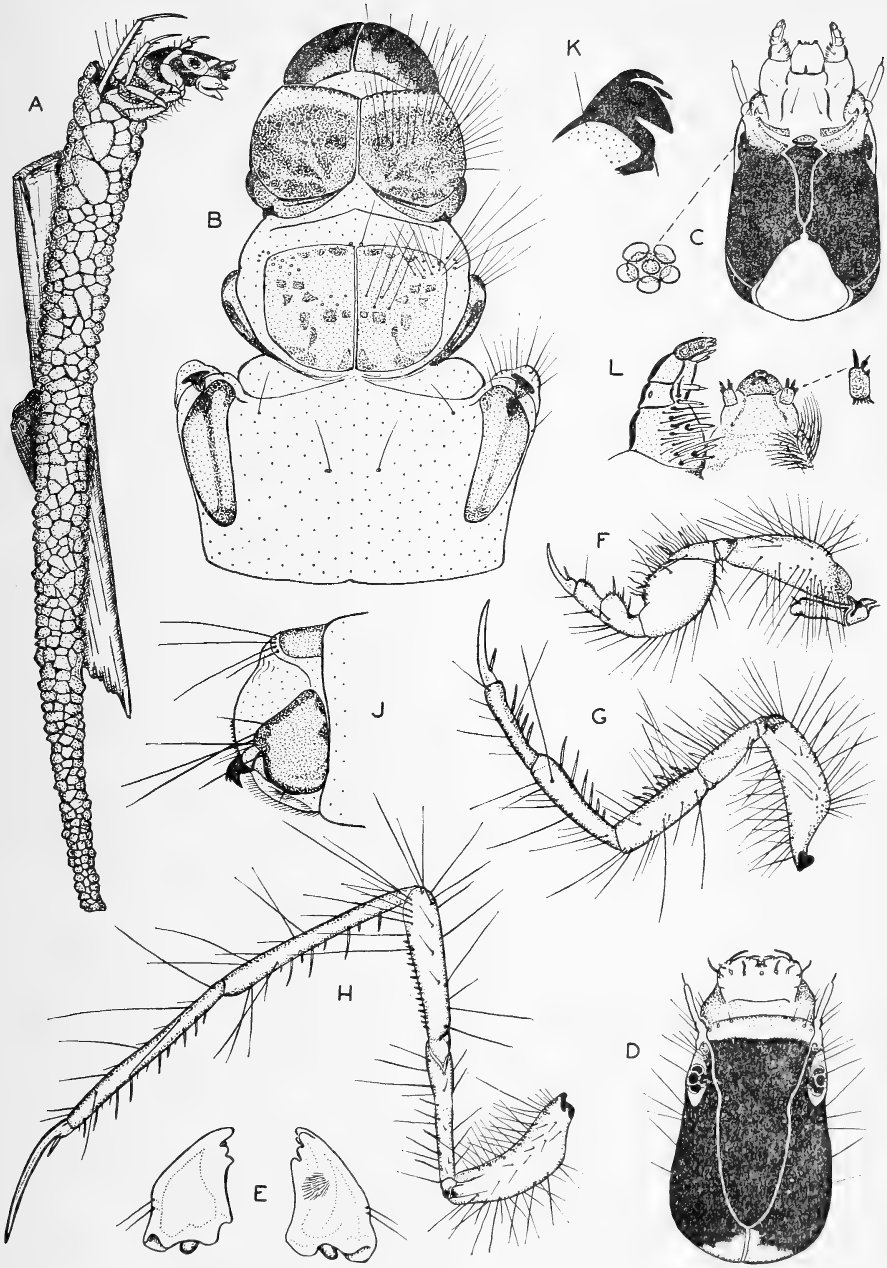


FIG. 2. Larva of *Athripsodes bergensis* Scott.

A, lateral view of larva in case. B, dorsal view of head and thoracic nota. C, head from behind showing gular sclerite, with eye further enlarged. D, dorsal view of head. E, right and left mandibles (ventral view). F, prothoracic leg. G, mesothoracic leg. H, metathoracic leg. J, lateral view of posterior end of larva (right side). K, anal claw. L, left maxilla and labium, with labial palp further enlarged. (Brushes of hair omitted from left side of labium.)

of mesh partly covered by sand-grains, so that the larval sclerites are retained in the pupal case. Ross (1944, p. 210) states that in the entire family (Leptoceridae) the pupal chamber has a slit and not a mesh in the closing cap at both ends; while this no doubt applies to the American members of the group, it is evidently not invariably the case in African species.

Reference to the tables and notes in Harrison and Elsworth (1958) and Harrison (1958) will show that these larvae were apparently much more widespread and common than is indicated here, having been recorded from stations 1 to 9, often at all seasons of the year, and from most types of substratum. It was found however on closer examination that the larvae collected included three slightly different types, probably of different species, though that remains to be proved. Only the records of larvae of the type actually bred out as *A. bergensis* have been given here. It is hoped that the other types will be correlated later on.

Larva (fig. 2 A–L): Described from entire specimens and from larval sclerites in pupal cases. Length of larvae up to 8·0 mm. *Head:* hypognathous, elongate oval, clypeus slightly asymmetrical with a single pair of lateral indentations and 12 setae; gular sclerite long, narrow, widening anteriorly, not fused with genae. Head capsule shining black except for conspicuous white patches surrounding the eyes, along the posterior margin of the head and the anterior border of the clypeus; anteclypeus, antennae and labrum pale yellow to brown in colour. Antennae long, stout, with small rounded basal segment and terminal sensory bristle. Eyes large and black, with 6 raised hyaline lenses as in *A. prionii* (fig. 2 C). Sutures round clypeus and gular sclerite, and suture-line parallel to epicranial arms, white and very conspicuous; maxillae and labium large, also white and very conspicuous. *Mouthparts:* labrum with 2 pairs of long, curved, blade-like marginal spines, also a smaller pair, centrally placed; a row of 6 setae across the upper surface and large brushes of setae on the lower. Mandibles strong, prominent, the left mandible with 5 blunt apical teeth and a brush of bristles on the inner face, the right mandible with 6 blunt apical teeth and no brush. Maxillary palps 3-segmented, with 4 apical papillae; maxillary lobe with a fringe of stout spines and setae along the inner margin. Labium a low cone with silk gland opening at tip; labial palps each tipped with a small distal segment bearing a sensory papilla and two spines. *Thorax:* pro- and mesonota sclerotized; pronotum brown to blackish, showing slight patterning and bearing long setae anteriorly, the posterior border separated by a groove from the rest. Mesonotum yellowish with a brown pattern as shown in figure 2 B. Metanotum membranous. *Legs:* prothoracic legs strong, fringed with spines and setae; stridulator with rounded tip and two small setae; meso- and metathoracic legs with long spines bordering tibia and tarsus, shorter spines along femur. All joints of one segment except trochanters which have two; femora of mid- and hind legs also show signs of division. Tarsal claws very long, specially on metathoracic legs, each claw with a strong basal bristle. *Abdomen:* very long compared with the head and thorax, tapering gradually, 2nd–4th segments widest. Large dorsal and lateral humps on 1st segment, each of the latter bears a lightly sclerotized oval setose plate. Anal sclerite present on 9th segment, and just posterior to it 4 long brown bristles. At the base of each anal appendage there is a large sclerite with 4 strong bristles along its curved posterior edge. Anal appendages fused to form 10th segment. There are small spicules and tracts of hair lateral to the anus. Anal claws stout, each with a pair of auxiliary hooks, and with 2 small sclerites at its base. Feebly developed lateral line present from segment 3 to 7, followed by a row of chitinous points on 8. Gills absent.

Case (fig. 2 A): A long slender tube, length up to 11·0 mm., wider and hooded at the anterior end, rough-looking, made of variously sized brownish sand-grains, with a neat hole at the posterior end. A small stick or one or more pieces of charcoal is frequently attached to the case, making it rather unwieldy. The larva sometimes makes use of a hollow reed or an empty case, adding a hood of sand grains.

Pupa (fig. 5 D–J): Labrum prominent, somewhat angular, with very long, strong setae; mandibles small, slender, inner edge finely serrated, condyle small. Antennae very long, distal ends coiled, fore- and mid-tarsi fringed. Protuberances and dorsal plates present as in *A. prionii*, the presegmental plates usually with 4 teeth, occasionally 5 or 6; a pair of seta-bearing lappets on 9th segment. Strong lateral lines present from segment 3 to 8, where they meet ventrally. Anal appendages long and slender, with bifid tips; near tip of each, 3 long stout setae and several small processes.

Pupal case (fig. 5 A–C): Not an altered larval case, but a new cylindrical case made of small white sand-grains; closed at each end with a grating made of secretion, this is partly covered by two or three sand-grains. The larval sclerites are thus retained within the pupal case. The case is affixed along one side to the lower edge of a stone resting on clean sand near the margin of the stream.

Athripsodes tuckeri Barnard ? var.

Fig. 5 R–X

Pupa (fig. 5 R–X): Described from the pupal skin of the ♂ bred out in January 1955. Labrum low, rounded, with slight anterior point; most setae are missing, but those present are long and strong. Mandibles fairly short, with broad base and tapering blade, inner edge serrulate, outer edge sinuous, ending in a small condyle; one pair of lateral setae. Antennae long, distal ends coiled. Mid-tarsi fringed. Dorsal plates present on abdominal segments as in *A. prionii* and *A. bergensis*; 4–6 teeth on all presegmental plates. On 9th segment 2 small lappets tipped with setae; these lie on rounded lateral protuberances just anterior to each of which, but on the ventral side of the body, there is a patch of small scabrosities (fig. 5 X). Lateral lines extend from segment 3 to 8, where the two curl round and meet ventrally. Anal appendages long and slender, each tip a rounded spatulate lobe with three long setae arising from its base.

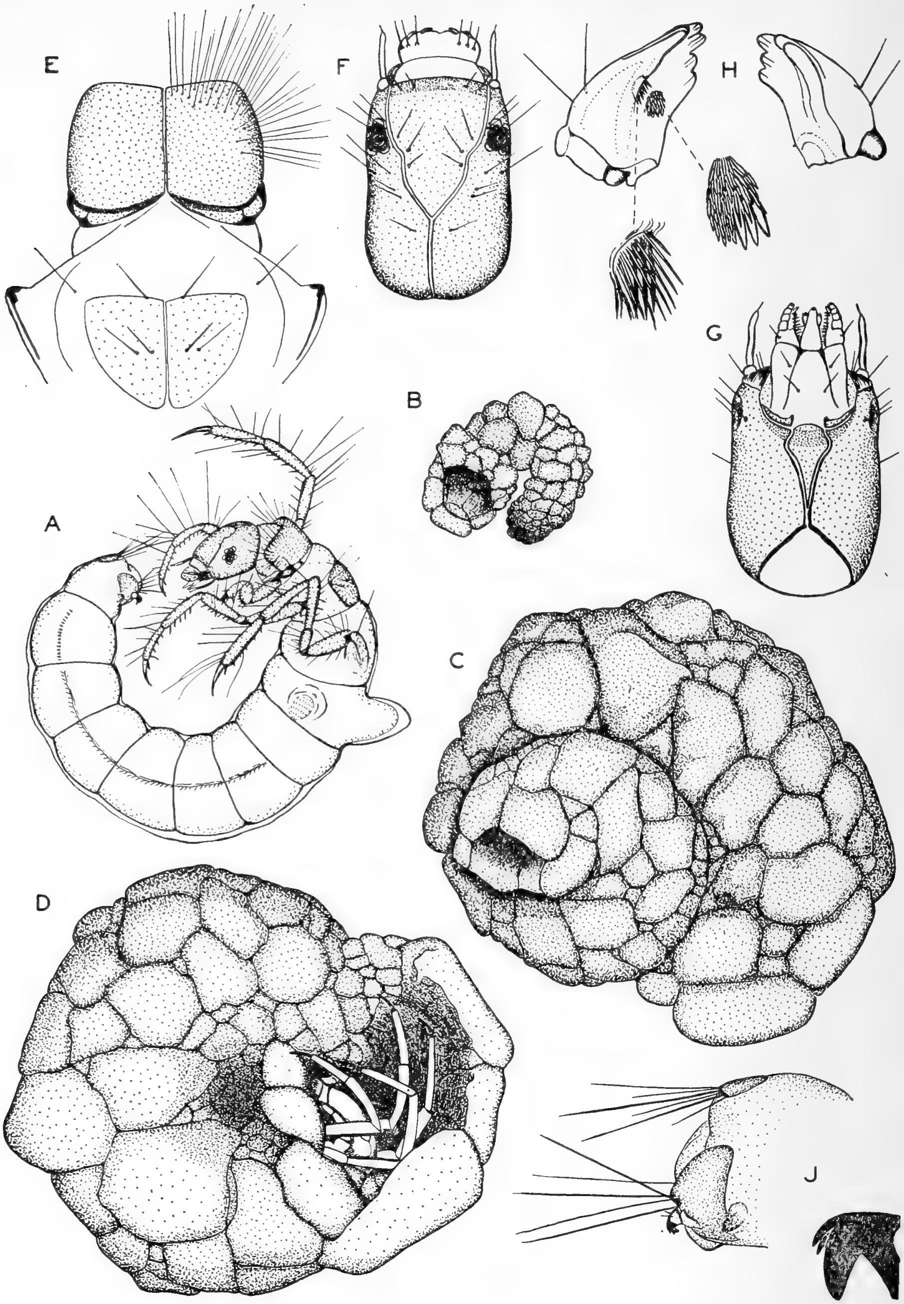


FIG. 3. Larva of *Leptecho helicotheca* Scott.

A, entire larva, mature. B, case of very young larva. C, case of mature larva, dorsal view. D, case of same, ventral view. E, dorsal view of pro- and mesothoracic nota. F, dorsal view of head. G, ventral view of head. H, left and right mandibles (dorsal view), with brushes on left mandible further enlarged. J, lateral view of posterior end of larva (right side), with anal claw further enlarged.

Leptecho helicotheca Scott

Fig. 3 A–J; fig. 4 A–P

Remarks: The larvae are fairly common in the Great Berg River near Driefontein and Groot Drakenstein from late spring to early autumn (November to March); a few were also found in August. Adults were captured or bred out from March to June. The larvae are crawlers with bright brown heads, living in small snail-shaped cases made from sand-grains, the cases being remarkably similar to those of species of *Helicopsyche*. *Leptecho helicotheca* larvae were not found making use of the cases of other Leptocerids, though occasionally other Leptocerid larvae were found inhabiting their discarded snail-shaped cases. *L. helicotheca* larvae appear to feed chiefly on vegetable matter on and under stones in comparatively deep pools and flats in parts of the river where the current is slow and the water clear. In autumn a few are also found living on the marginal vegetation. In captivity they can be reared successfully on alga-covered stones in aquaria, though judging by the size and position of their eyes it seems probable that they are actually omnivorous, including minute animals in their diet as well as algae. When about to pupate the larvae move close inshore; their pupal cases were found in autumn (March to May), clustered under the edges of marginal stones. The pupal cases are initially built as an extension to the larval case, but are straight, not coiled; thus, where they have been left undisturbed, each pupal case still has the larval case situated at one end; this facilitates recognition of the pupal cases, which are outwardly much like those of several species of *Athripsodes*.

Larva (fig. 3 A, E–J; fig. 4 A–D): Described from entire specimens. Length of fully grown larva approximately 3·0 mm., but the larvae are always curled round and not easy to measure accurately. *Head:* hypognathous, almost oblong; clypeus triangular, very wide anteriorly, short, with one pair of lateral indentations and 10 setae. Gular sclerite rounded anteriorly, tapering to a point behind, not fused with genae. Head capsule bright chestnut brown, with a slightly paler patch anterior to each eye; anterior margin of clypeus darker brown; sides of genae thickened and pitted, anteclypeus pale, labrum brown. Antennae long and stout, each with rounded basal segment and tipped with a sensory bristle. Eyes large, black, situated fairly far forward, with hyaline lenses as described in *Athripsodes prionii* and *A. bergensis*; there are however no suture-like lines paralleling the epicranial arms as in those species. *Mouthparts:* labrum with 2 pairs of curved blade-like spines and 3 pairs of long straight setae. Mandibles strong, the left one with 6 blunt apical teeth and two clumps of bristles on the inner face; the right mandible somewhat smaller, with 5 teeth and no bristles. Maxillary palp 4-segmented, with apical papillae; maxillary lobe fringed with stout spines and bristles. Labium a slender cone with silk gland opening at tip, labial palps stout, bearing papillae. *Thorax:* pronotum bright brown, sclerotized, setose, with the posterior border separated by a fracture line from the rest;

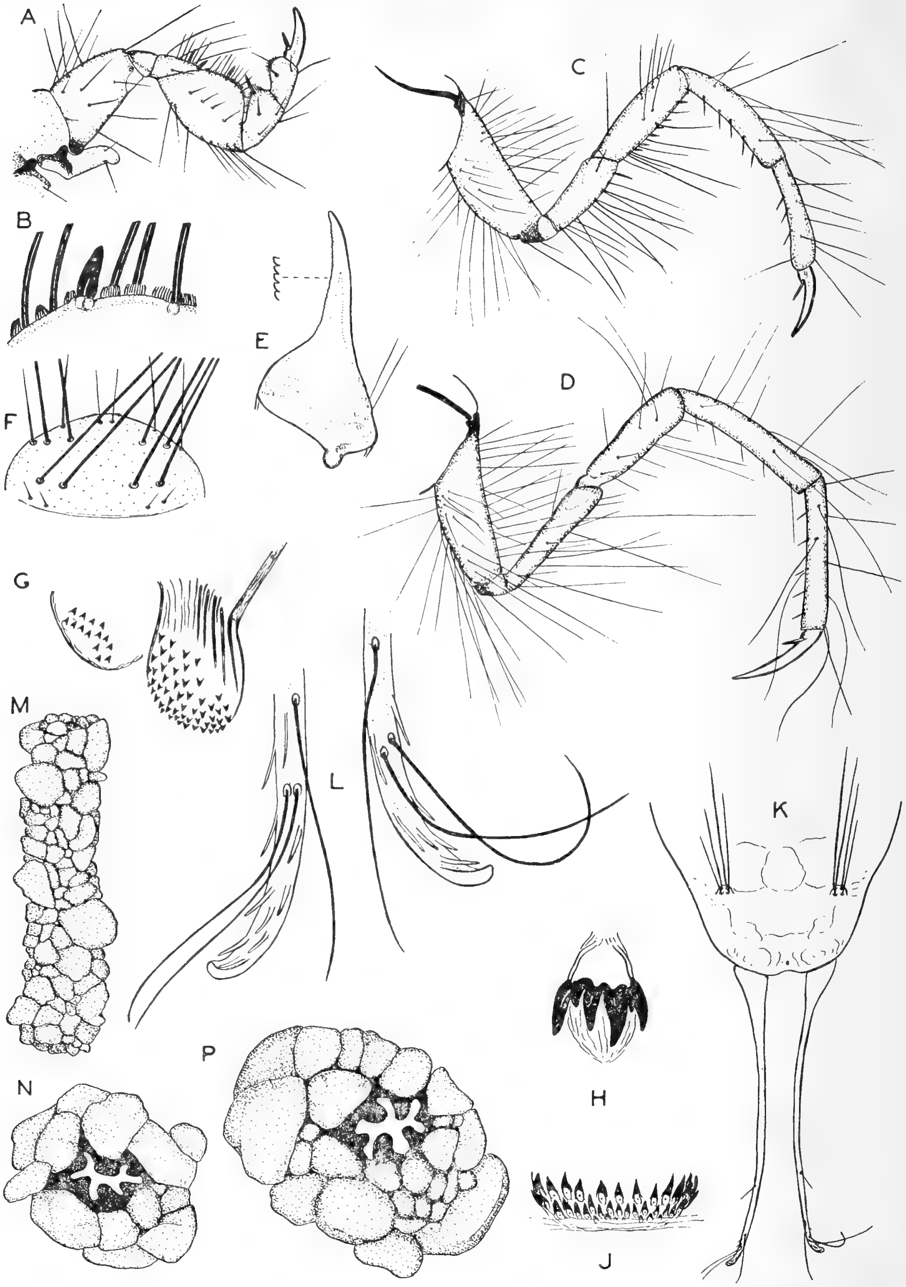


Fig. 4. Larva and pupa of *Leptecho helicotheca* Scott.

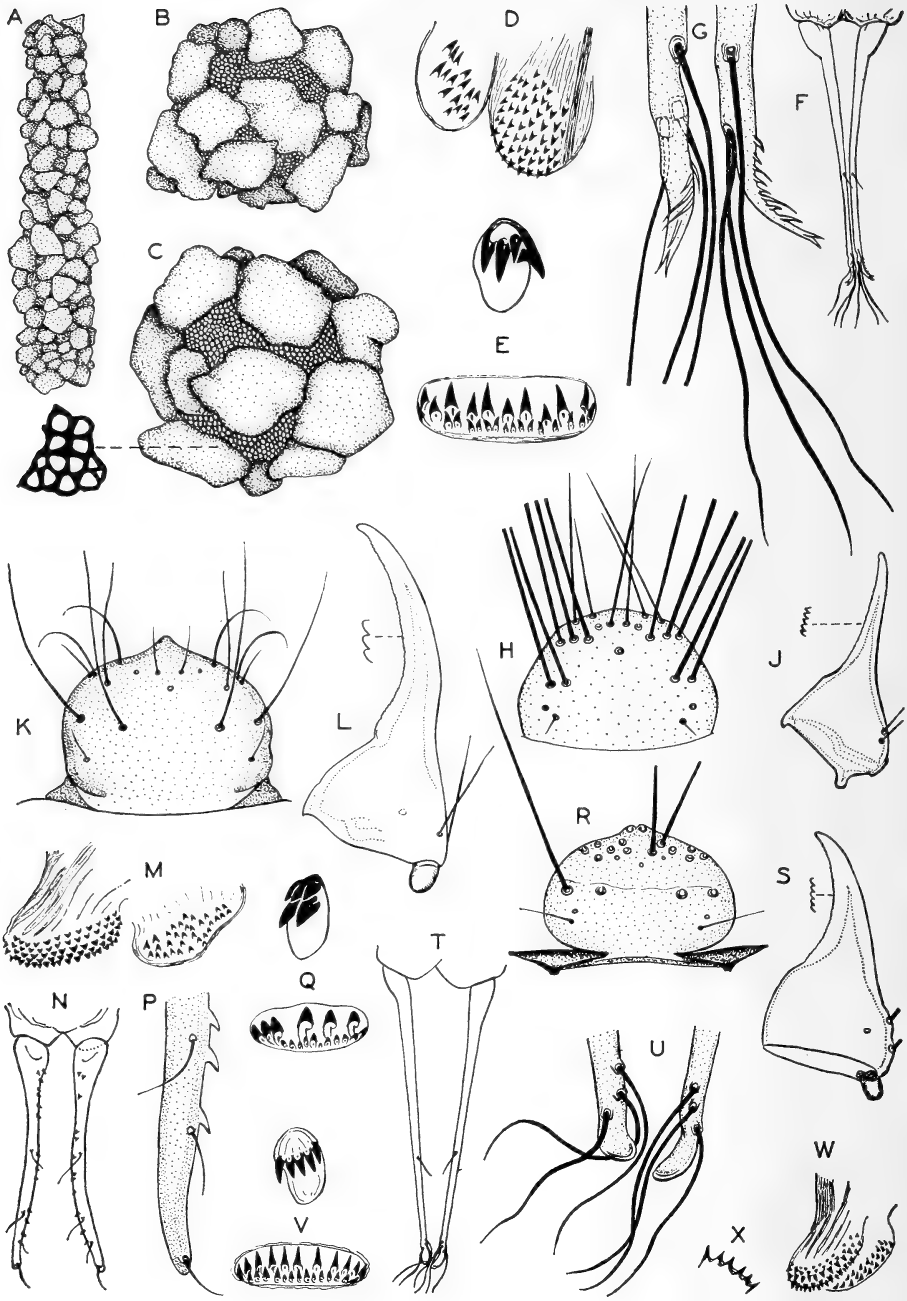
A, prothoracic leg of larva. B, portion of margin of femur further enlarged (long setae shown cut short). C, D, meso- and metathoracic legs of larva. E, mandible of pupa, with portion of serrated edge further enlarged. F, labrum of pupa (long setae shown cut short). G, dorsal lobes from 1st abdominal segment. H, presegmental dorsal plate from 5th segment. J, postsegmental plate from same. K, posterior end of pupal pelt, showing lappets and anal appendages. L, ends of anal appendages further enlarged. M, pupal case. N, lid from anterior end of same. P, posterior end of pupal case.

mesonotum with a pair of thinly sclerotized plates, pale yellow and unpatterned, each with 3 pairs of setae; metanotum membranous. *Legs:* prothoracic legs strong, tarsus and tibia each with a spine and a fringe of small hairs; femur and anterior portion of trochanter bordered with spines, long setae and short hairs (fig. 4 A and B). Stridulator blunt, with an upturned rounded apex and 2 small setae. Meso- and metathoracic legs with a few slender spines and long hair-like setae; metathoracic legs longest. All joints of one segment except the trochanters which have two, the femora of mid- and hind legs do however show a constriction near the proximal end which may indicate a division. Tarsal claws long and stout, each with a strong basal bristle. *Abdomen* light green, coiled round to fit case, with large dorsal and lateral humps on 1st segment, on each of the latter a pubescent, sclerotized plate. On the 9th segment an anal sclerite bordered posteriorly with bristles. Anal appendages fused basally to form 10th segment, a sub-triangular sclerotized plate at the base of each. Anal claws very small, each with a pair of minute auxiliary hooks. Gills absent. Lateral line strongly developed from 3rd to 7th segments, on 8th segment a long row of minute sclerotized points.

Case (fig. 3 B–D): A neat snail-shaped case, 2·5 to 3·0 mm. in diameter, made from variously sized sand-grains. The case is actually a tube, open at both ends, and is always a dextral spiral; the larger opening is neatly finished with smoothly rounded grains, forming a lip, next to which is an umbilicus. The earliest stage collected was just a small twisted tube (fig. 3 B).

Pupa (fig. 4 E–P): Labrum low, rounded, studded with long setae; each mandible with broad base and slender apex, inner margin minutely serrated, condyle small, one pair of lateral bristles. Antennae much longer than body, distal ends coiled; fore-tarsi slightly, mid-tarsi heavily, fringed. Dorsal plates present on abdominal segments as in *Athripsodes prionii*; all presegmental plates have 5–6 hooks. On 9th abdominal segment a pair of small lappets bearing long setae. Lateral lines extend from segment 3 to 8, where they curl round and meet ventrally. Anal appendages long and slender, with rounded recurved tips, set with slender spine-like processes and three long setae.

Pupal case (fig. 4 M–P): A straight cylindrical tube, roughly constructed of white sand-grains and lined with secretion. Length 6·0 to 6·5 mm.; a cap at the anterior end, edged with sand-grains and with a central membranous area perforated by a meandrine slit. There is a slit in the posterior end of the case, through which the larval sclerites can be ejected; this is similar to the slit in the lid. They are not however always ejected, some at least often being retained within the pupal case.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DESCRIPTION

Genus SETODES Rambur

Rambur, 1842, *Hist. nat. Ins. Névr.*: 315.
Milne, 1934, *Stud. N. Amer. Trich.*, 1: 18.
McLachlan, 1879, *Rev. Syn. Eur. Trich.*: 338 (partim).
McLachlan, 1884, 1st Add. Suppl.: 39–40 (group II).
Mosely, 1939, *Brit. Caddis Flies*: 178 (group II).
Kimmins, 1949, *Entomologist*, LXXXII, No. 1036: 201–4.

Setodes barnardi sp. n.

Fig. 6 A–J; fig. 7 A–J; fig. 8 A–L

A very small dusky gold species with narrow, pointed wings and annulate antennae. The larvae are crawlers inhabiting neat tubular sand cases. I have pleasure in naming this species in honour of Dr. K. H. Barnard, pioneer worker on South African caddis flies.

Imago (dry, before putting into alcohol) (fig. 6 A–J): *Head:* dusky gold with pale gold or white tufts of setae, sometimes interspersed with a few black setae; antennae more or less strongly annulate black and white basally, about twice wing length, basal segment as in figure 6 J. Eyes blackish, large. Maxillary and labial palps fuscous. *Thorax:* dusky gold, with paler gold or white shoulder tufts with a few black setae. *Legs:* tibial spurs 1, 2, 2; spur on fore-leg very small, spurs on mid- and hind-legs unequal in size, the outer one on the mid-leg being very short and on the hind leg over half the length of the inner. Fore-legs brownish, mid-legs paler, hind-legs pale gold. *Abdomen* yellowish. *Wings* (fig. 6 A, B): length of ♂ fore-wing 4·0 mm., of ♀ same. ♂ fore-wing long, narrow, apex acute; membrane clear, slightly iridescent, somewhat thickened in the pterostigmal area; pubescence plain dusky gold, a long fringe along the posterior border; apical forks 1 and 5 present, stalk of fork 1 approximately equal to R2; media forks well beyond the anastomosis; thyridial cell long and very narrow, anastomosis irregular, not clearly defined. ♂ hind-wing narrower than the fore-wing, acute, membrane clear, pubescence thin and pale, wing fringes very long (fringe along posterior border nearly as wide as wing); only fork 5 present; base of Rs obsolete. ♀ wings similar, slightly wider.

← FIG. 5. Pupae of *Athripsodes bergensis* Scott (A–J), *A. prionii* Scott (K–Q), *A. tuckeri* (Barnard) ? var. (R–X).

A, pupal case of *A. bergensis*. B, lid of same. C, posterior end of case, with portion of grating further enlarged. D, protuberances on 1st abdominal segment of pupa. E, anterior and posterior dorsal plates of 5th segment. F, anal appendages. G, tips of anal appendages further enlarged (setae of left side cut short). H, labrum (long setae shown cut to half actual length). J, mandible. K, labrum of *A. prionii*. L, mandible of same. M, protuberances on 1st abdominal segment. N, anal appendages. P, tip of anal appendage further enlarged. Q, anterior and posterior dorsal plates of 5th segment. R, labrum of *A. tuckeri* ? var. (most setae missing). S, mandible of same. T, anal appendages. U, tips of same further enlarged. V, anterior and posterior plates of 5th segment. W, protuberances of 1st abdominal segment. X, scabrosity from patch on ventral surface of abdomen.

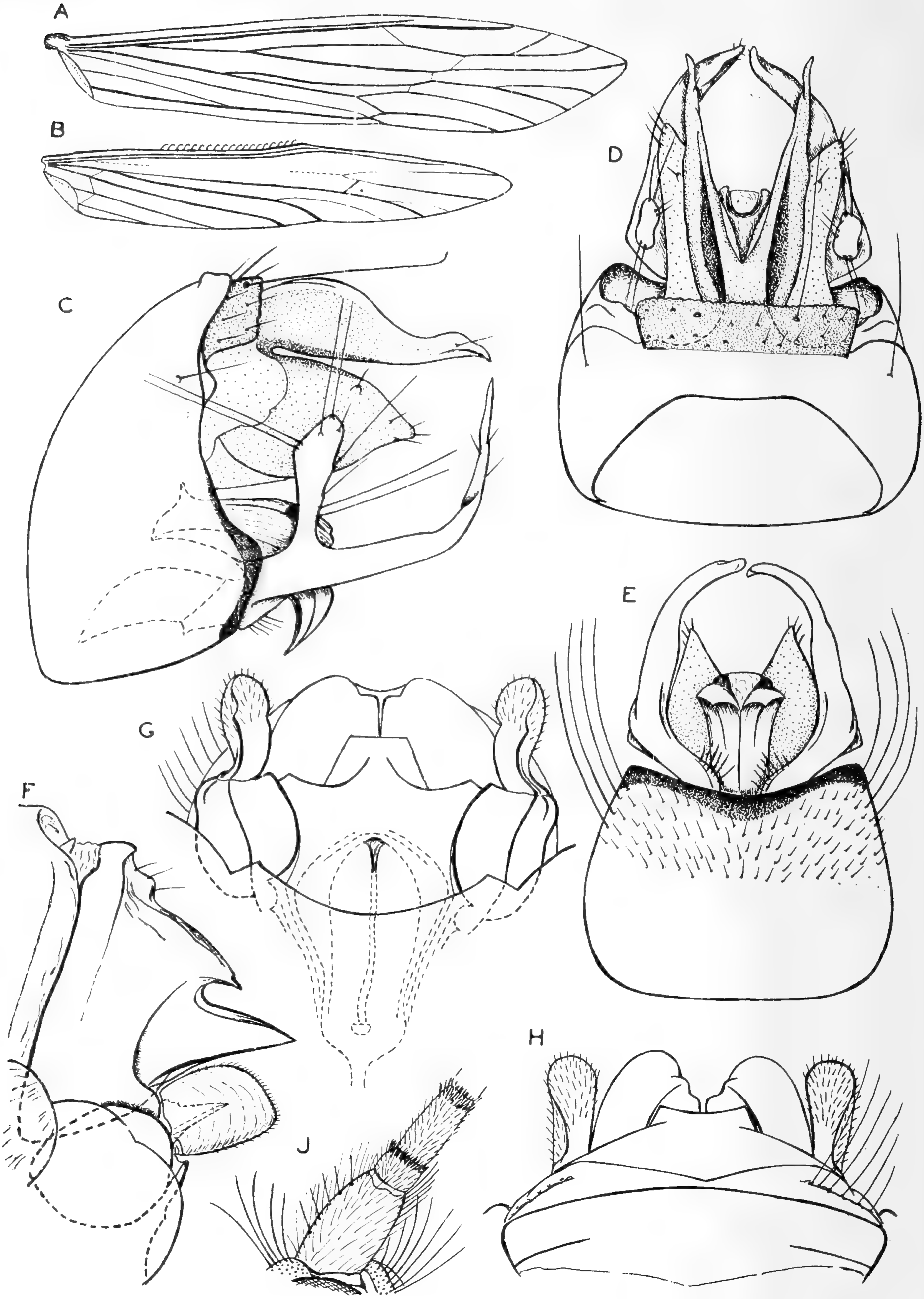

FIG. 6. *Setodes barnardi* sp. n., ♂ and ♀ imagos.

A, B, fore- and hind-wings of ♂. C, D, E, lateral, dorsal and ventral views of ♂ genitalia. F, G, H, lateral, ventral and dorsal views of ♀ genitalia. J, base of ♂ antenna.

Genitalia ♂ (fig. 6 C–E): Ninth segment narrow dorsally, broad ventrally, ventral margin (in lateral view) convex, slightly hairy, side-pieces slightly produced, thickened marginally, set with long coarse setae; in ventral view the posterior margin of the sternite is slightly excised and heavily sclerotized. Dorsal apical margin produced as a narrow transverse band, sparsely setose, which overlies the 10th segment. Apical margin of 10th segment produced to form a pair of long processes; these are joined basally, widely separated apically, with a V-shaped emargination between them. Each process forms a thin, curved, vertical plate, sinuous in lateral view and ending in a sharp beak-like apical point. Beneath these the lower part of the 10th tergite is divided to form a pair of large, deep, transparent upper penis covers; these are sub-triangular in lateral view, and in dorsal view they end in blunt points close to or overlying the claspers. Each bears a few setae and a small dorsal process tipped with a seta.

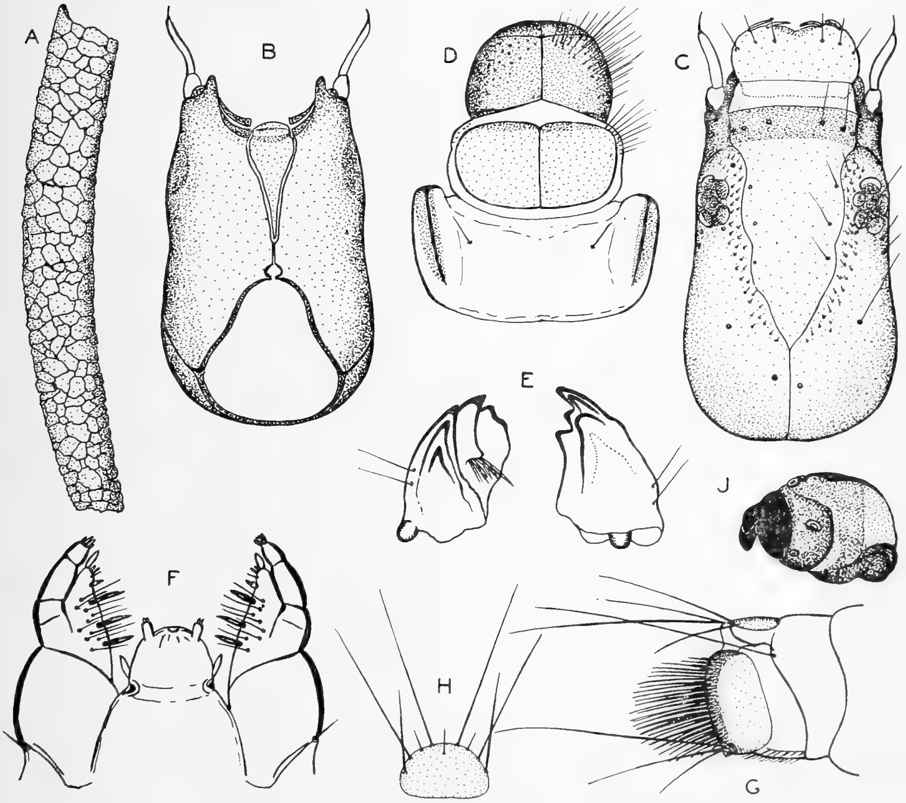

FIG. 7. Larva of *Setodes barnardi* sp. n.

A, larval case. B, head of larva from behind showing gular sclerite. C, dorsal view of head. D, dorsal view of thoracic nota. E, left and right mandibles from above. F, maxillae and labium. G, lateral view of posterior end of larva (right side). H, dorsal sclerite of 9th segment. J, anal claw.

Aedeagus short, stout, downcurved, with a U-shaped sclerotized thickening. Beneath it lie the paired, down-curved lower penis covers, ending in triangular points. Claspers bent inwards, two-branched; the main part extends backwards, then turns sharply inwards and upwards, ending in a sharp point; the branch arises about a third of the way along it, and is upwardly directed, with a narrow base and wider, triangular apex; it bears a number of strong setae.

Genitalia ♀ (fig. 6 F–H): Eighth sternite flattened, ending in a wide shallow excision; ninth sternite hollowed, with lateral margins of tergite forming flaps on each side; ninth tergite transversely ridged, sparsely setose, fused to the 10th tergite which is rounded, with the central third backwardly produced and emarginate; in lateral view it is beak-like. Below this are paired, hollowed out, sclerotized plates, dorsally ridged, sharply triangular as seen from the side. Lateral gonapophyses of 9th segment scoop-shaped, pubescent; between them another plate, in lateral view sharply pointed, in ventral view a truncate triangle.

♂ holotype in alcohol, the genitalia mounted as a microscope preparation. ♀ paratype and ♂ paratypes in alcohol.

This species is easily recognizable by the fact that fork 1 is lacking in the posterior wing, only fork 5 being present, and by the tibial spurs, which are 1, 2, 2, instead of 0, 2, 2; the spur on the fore-tibia is small. The ♂ genitalia also differ considerably from those of other African species of the genus, showing most resemblance to *S. baccata* Kimmins; the ♂ however lacks cerci and shows greater complexity in the development of the 10th tergite, the 9th sternite is much broader and the main branch of the clasper differently shaped.

After much consideration it appeared best to include this species in the genus *Setodes*, in spite of the fact that it differs from the generic diagnosis as given by Kimmins (1949) in two respects, namely the absence of fork 1 in the hind wing, and the presence of a small spur on the fore-tibia. Mr. Kimmins has kindly informed me (personal communication) that his species *S. baccata* also has a minute spur on the fore-tibia. In the other species of *Setodes* (restricted sense) so far described, fork 1 is always present in the hind-wing, although it is often quite small. In all other respects however *S. barnardi* appears to be a typical *Setodes*, so has been included in that genus.

Locality: Larvae were collected from the Great Berg River near Driefontein in October; adults were bred out in the laboratory from some of these larvae as follows: October 1956, 1 ♂, 1 ♀; December 1956, 1 ♂, 1 ♀; January 1957, 1 ♂, 1 ♀. Most of the larvae were collected from the trailing marginal palmiet (*Prionium serratum*), a few were found living under stones in the stickles.

Larva (fig. 7 B–J, fig. 8 A–C): Described from entire specimens. Length of larvae up to 5·0 mm. *Head:* hypognathous, small, almost oblong, clypeus asymmetrical with 2 to 3 pairs of lateral indentations and 12 setae; gular sclerite rounded anteriorly, tapering to a point posteriorly, not fused with genae. Head capsule and labrum light golden brown, set with small setae near the margin of the clypeus. Antennae long, with small basal segment and tipped

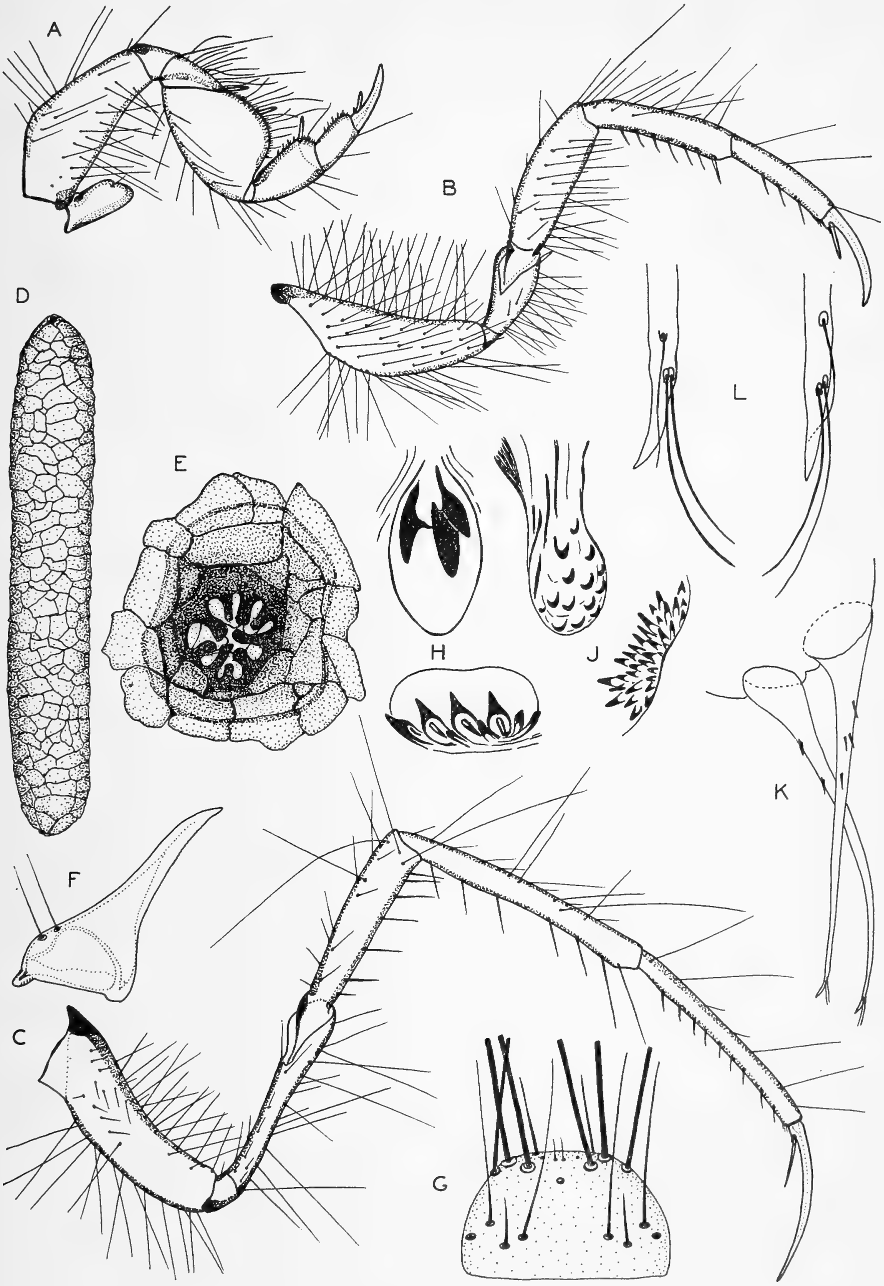

Fig. 8. Larva and pupa of *Setodes barnardi* sp. n.

A, B, C, fore-, mid- and hind-legs of larva. D, pupal case. E, lid of same (inside view). F, mandible of pupa. G, labrum (long setae cut short). H, pre- and postsegmental dorsal plates of 5th abdominal segment. J, protuberances from 1st abdominal segment. K, anal appendages. L, tips of anal appendages further enlarged.

with a sensory bristle. Eyes large, dark, set well forward, with a pale patch just behind each, and beneath hyaline lenses as in the other species described. Suture-like line present paralleling the epicranial arms. *Mouthparts:* labrum with two pairs of blade-like bristles anteriorly and 3 pairs of longer setae across the top. Mandibles strong, short, heavily sclerotized, each with 5 blunt teeth, the left mandible with a brush of strong bristles on the inner side. Maxillary palp 3-segmented, with apical papillae, junction with maxilla indistinct; maxillary lobe fringed with setae and blade-like bristles. Labium rounded, with silk gland opening at tip, labial palps stout, tipped with papillae. *Thorax:* pronotum light brown, sclerotized, setose, with lateral fracture separating posterior edge; mesonotum with a pair of thinly sclerotized yellowish-grey plates; metanotum membranous, with an irregular band of setae across the ventral side. *Legs:* small, slender, yellowish in colour, set with setae and bristles as in figure 8 A–C, but without special swimming hairs. Femora and trochanters of mid- and hind-legs divided, also trochanters of fore-legs; tibiae and tarsi undivided; claws long and strong, each with a basal bristle. Stridulator large, stout, blunt, with a small seta. *Abdomen:* long, white, thick, without gills, lateral line very poorly developed, chitinous points on segment 8 present but minute. On the 9th segment a semicircular dorsal sclerite bordered posteriorly with setae. Anal appendages fused to form 10th segment, anal claws minute, blunt, at the base of each a large rectangular plate which is armed posteriorly with a frieze of strong brownish-black spines set in 5–6 parallel rows. Anus flanked by rows of small colourless setae.

Case (fig. 7 A): A neat, slender, curved tube about 5·0 mm. in length, of small yellowish sand-grains, open at the ends and slightly hooded anteriorly.

Pupa (fig. 8 F–L): Labrum rounded, set with long bristles and smaller setae; mandibles small, minutely serrulate along the distal third of the inner border, condyles lateral; one pair of lateral bristles. Antennae much longer than body, distal ends coiled; mid-tarsi broad and heavily fringed. Dorsal plates present on abdominal segments as in *Athripsodes* species described; all pre-segmental plates have 3 teeth. On 9th abdominal segment a pair of setose lappets; these are set on raised humps. Lateral lines extend from segment 3 to 8, where they meet ventrally. Anal appendages slender with a few spines on the proximal half; tips pointed and proximal to them 3 strong setae.

Pupal case (fig. 8 D, E): A cylindrical tube about 5·5 mm. long, neatly made of yellowish sand-grains and pointed at both ends; a small opening is left between the terminal sand-grains at each end, this is guarded by a membrane whose inner edge forms stiffly projecting flaps. The result is rather like the meandrine slit found in *Leptecho helicotheca*, but in *Setodes barnardi* the slit is not visible from outside, being completely roofed over by sloping sand-grains with only narrow cracks between them. In the diagram (fig. 8 E) the lid of the tube is shown from the inside, and the band of secretion which fastened it to the case can be clearly seen. The case is not completely lined by secretion, the secretion merely being used to cement the sand-grains together.

SUMMARY

A new species of caddis, *Setodes barnardi* sp. n. (Trichoptera: Leptoceridae), is described from South Africa, together with its larval and pupal stages; also the larval and pupal stages of *Athripsodes prionii* Scott, *A. bergensis* Scott, and *Leptecho helicotheca* Scott, and the pupal skin of *A. tuckeri* Barnard ? var.

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'I. *Synonymy arranged according to chronology of names.*—All published scientific names by which a species has been previously designated (subsequent to 1758) are listed in chronological order, with bibliographical references to all descriptions or descriptive citations following in chronological order after each name. . . .

B. *Form for bibliographic references to synonymic names.*—The first reference following any name in the synonymy should be to the earliest citation of that name. This should be followed by references to all subsequent citations of the same name, arranged in chronological order. . . .'

Bibliographical references modified to consist of author's name, date of citation, pagination and illustrations (plates and figures).

Example:–

Eulalia (*Steggoa*) *capensis* Schmarda

Eulalia capensis Schmarda 1861, p. 86, pl. 29, fig. 231. Willey 1904, p. 259.
Eulalia viridis var. *capensis* McIntosh 1903, p. 34. Day 1953, p. 30.
Eulalia viridis (*non* Muller) Ehlers 1913, p. 455. Day 1934, p. 30.

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VOLUME XLVI

PART III

SOME SOUTH AFRICAN *CLADOCERA* COLLECTED BY DR. A. D. HARRISON

By

J. P. Harding
British Museum (Natural History)

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SOME SOUTH AFRICAN *CLADOCERA* COLLECTED BY DR. A. D. HARRISON

By

J. P. Harding
British Museum (Natural History)

(With 14 figures in the text)

The material consisted of 61 tubes from the western Cape Province, 45 tubes from the Vaal River, and some of its tributaries, 58 tubes from the Jukskei-Crocodile system, and 21 tubes from other parts of the Transvaal. Dr. Harrison had already sorted the collections into species and made preliminary determinations, very considerably reducing the burden of identification. Thirty-eight species of Cladocera were present, as listed below, those with an asterisk seem to be new to the South African fauna, but some of these may be recorded in the literature under other names.

1. *Diaphanosoma excisum*
2. *Daphnia barbata*
3. *Daphnia dolichocephala*
4. *Daphnia magna*
5. *Daphnia similis**
6. *Daphnia longispina*
7. *Daphnia obtusa*
8. *Daphnia pulex**
9. *Scapholeberis kingi*
10. *Scapholeberis aurita**
11. *Simocephalus exspinosus*
12. *Simocephalus serrulatus*
13. *Simocephalus vetulus*
14. *Ceriodaphnia reticulata*
15. *Ceriodaphnia quadrangula*
16. *Ceriodaphnia rigaudi*
17. *Moina dubia*
18. *Moina belli*
19. *Moina rectirostris**
20. *Bosmina longirostris*
21. *Ilyocryptus acutifrons**
22. *Ilyocryptus sordidus*
23. *Macrothrix spinosa*
24. *Echinisca capensis*
25. *Eurycercus lamellatus**
26. *Camptocercus australis**
27. *Acroperus harpae*
28. *Euryalona colletti*
29. *Alona affinis*
30. *Alona bukobensis*
31. *Alona pulchella*
32. *Alona diaphana**
33. *Leydigia microps*
34. *Leydigia propinqua*
35. *Pleuroxus aduncus**
36. *Chydorus globosus**
37. *Chydorus sphaericus*
38. *Monospilus dispar**

None of the species is new to science, although the form of *D. longispina* is one which seems to be typical for South Africa.

Diaphanosoma excisum Sars

This species was collected from the Vaal River in three places and also from a vlei near Paarl. The specimens were not sufficiently well preserved for the duplicature of the shell to be seen for certain, but the spinules on the edge of the shell and the bristles near the post-dorsal corner leave no doubt of the

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identification. The species was collected from the Steenbras Reservoir by Hutchinson *et al.* (1932) and has been recorded from North, East and West Africa as well. It is also known from Australia and the East Indies.

Daphnia barbata Weltner

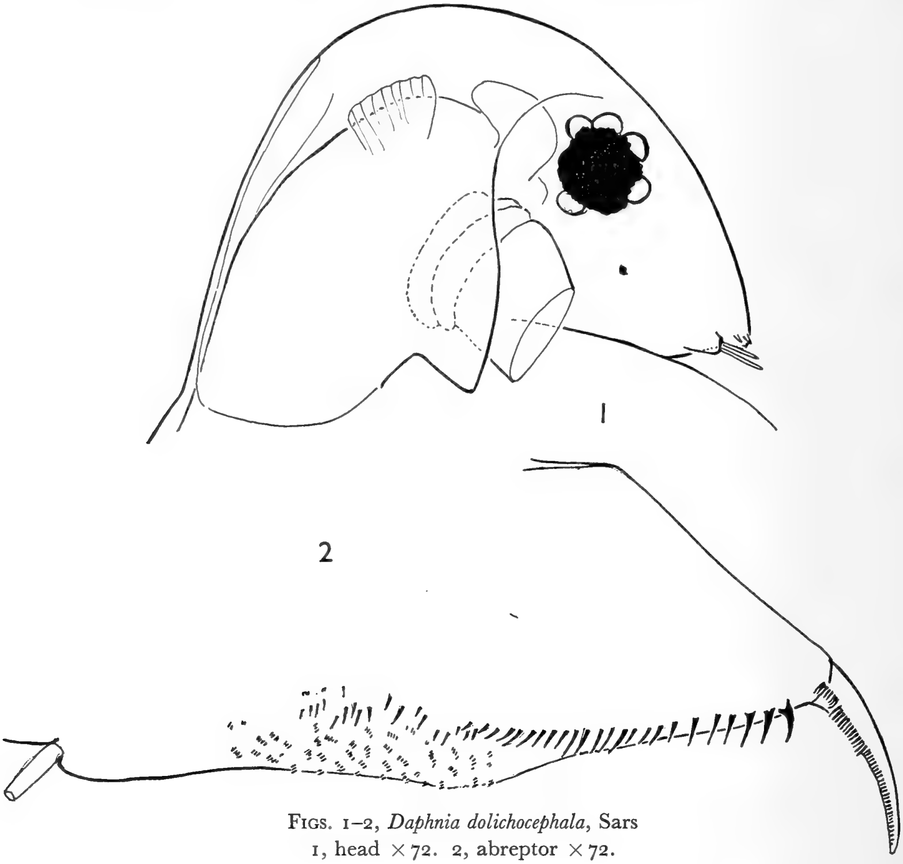
This well-known African species was present in five tubes from the Vaal Barrage, from the river below it, from the Kalkspruit near Balfour, and also from the lower Berg River and the Cape Flats.

Daphnia dolichocephala Sars

Syn.: *D. hodgsoni* Sars

(Figs. 1–2)

Although there were only four specimens of this species from the Riet Vlei off the Diep River, western Cape Province, and four specimens from the Vaal Barrage, there was sufficient variation in the armature of the abreptor for it to be possible to confirm Wagler's (1936, p. 520) suggestion that *D. hodgsoni* and *D. dolichocephala* are one and the same species. The species resembles, in some



Figs. 1–2, *Daphnia dolichocephala*, Sars
1, head × 72. 2, abreptor × 72.

ways, *D. carinata* and *D. similis*, but may be distinguished by the large number of anal spines closely packed together and arising on the side of the abreptor, a short distance from the dorsal edge (compare figs. 2 and 5). The species is known from the Cape (Sars, 1916, p. 306) and from Kenya (Brehm, 1935, p. 144).

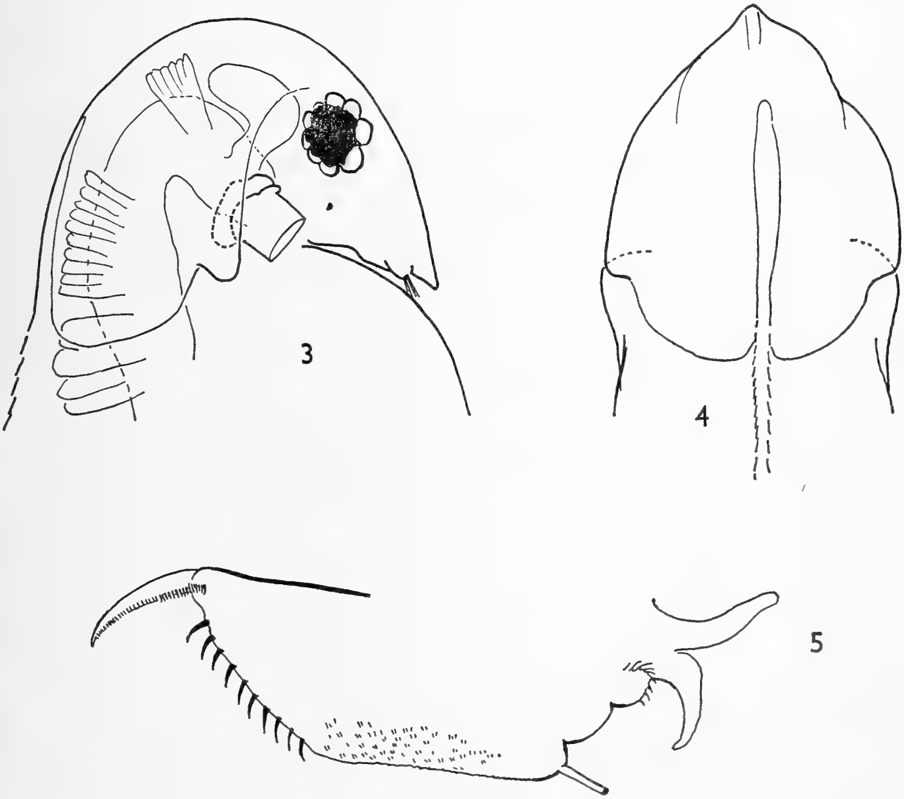
Daphnia magna Strauss

Specimens of this species were collected from a dam at the Benoni sewage works in the Transvaal and from the De Hoop Vlei at Bredasdorp, western Cape Province. The species is widely distributed throughout the Palearctic and Ethiopian regions of the world, and in the northern and western parts of North America.

Daphnia similis King

(Figs. 3–5)

This species was collected in small numbers in two places on the Jukskei River. These specimens are very similar to those from Peru described by me in 1955 (p. 330) as *D. carinata*, as I believed then that *D. similis* and *D. carinata*



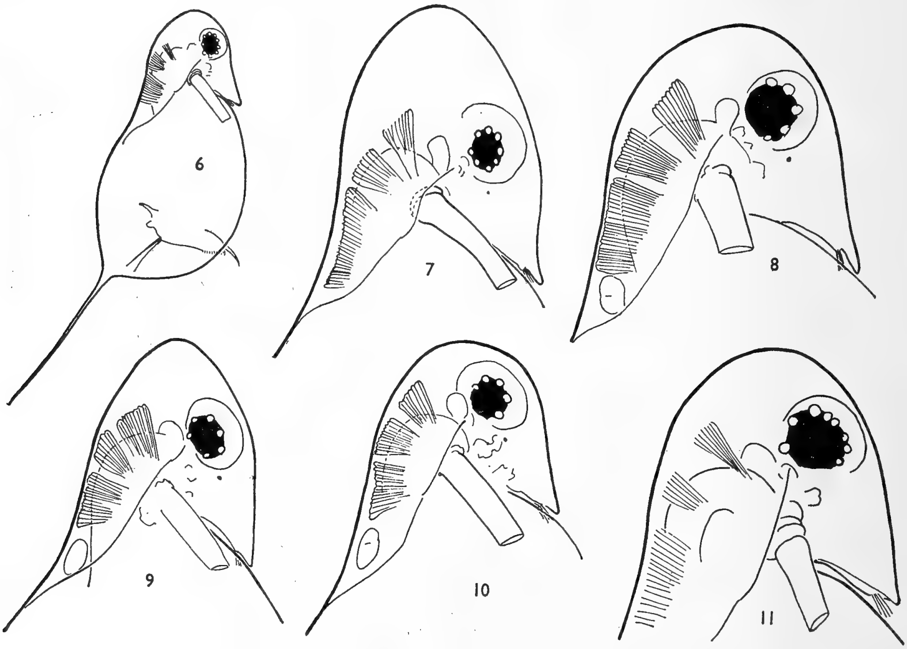
Figs. 3–5, *Daphnia similis* King
3, head, lateral view; 4, head, dorsal view; 5, abreptor; all × 72.

were synonyms. Brooks (1957, p. 32), however, gives reasons for believing that they are distinct species. Certainly the shape of the antennule and rostrum of specimens of *D. carinata* from Australia and Tasmania which I examined are remarkably uniform and similar to Sars's (1914) drawings, and in these respects the South African specimens differ slightly, but I can find no other difference. Brooks gives as an essential difference between *D. carinata* and *D. similis* the different plane in which the dorsal ridge expands when it becomes larger. This feature cannot be used with the present specimens since the dorsal ridge is not expanded.

Daphnia longispina O. F. Müller *sensu lato*

(Figs. 6–13)

About 40 females, some of them carrying ephippia, were collected from a temporary vlei on the Wemmershoek Road, Paarl. These showed an extraordinary range of shape of head (figs. 7–11, all taken from this sample and at the same magnification). Figure 6 gives the general appearance of a whole animal also from this sample at a smaller magnification. About 30 similar specimens, mostly with tall helmets, were present in a sample from a flood-water pool near the Berg River, Bridgetown, and other specimens were found in ones



Figs. 6–11, *Daphnia longispina*, O. F. Müller, *s. lato*
6, female ×25; 7–11, heads of females from the same sample as fig. 6 from a temporary vlei near Paarl, ×45.

and twos at three other places on the Berg River and in a small lake near Paarl. There is no doubt that these all belong to the same form of *D. longispina* as that figured by Wagler (1936, p. 535, figs. 27–30), from the Rietfontein, Brak, and Weltevreden Pans. Brooks (1957) has made a good case for treating *D. longispina*, *D. rosea*, *D. hyalina* and *D. galeata* as separate species, and if more were known about the present form it might be worth a new name. The very variable nature of the shape of the head, however, makes it difficult at present to give a satisfactory definition, and it seems best to treat it as a hyaline planktonic form of *D. longispina*. The following features may be noted:

> The body is colourless and hyaline with a long spine about equal in length to the carapace projecting from the post-dorsal corner. The helmet, if present, may be tall, but is usually evenly rounded. The dorsal outline between the head and body is usually an even concave curve. This is perhaps the most conspicuous feature of this form, and gives the Daphnia a characteristic upright appearance. The eye is of moderate size and usually at some distance from the ventral margin of the head, Spinules are present on the posterior quarter of the dorsal margin and on the posterior half of the ventral margin of the carapace. The ocellus may be small, but is always present. The rostrum is pointed and the antennule is small with sense hairs not reaching to the end of the rostrum. The shape of the abreptor is shown in figure 12. The claw has three fine combs of the typical *longispina* type (fig. 13).

Some juvenile specimens of a form of *D. longispina* were also found below the Vaal Barrage.

Daphnia obtusa Kurz

Specimens of this species were collected from the Blaauwberg road bridge, Milnerton, and from the Berg River at Hermon and Wellington. The specimens from Milnerton had previously been sorted according to the length of the shell spine into *D. propinqua* and *D. tenuispina*, two species erected by Sars (1916, p. 309) for *obtusa*-like Daphnias from the Cape. In this small sample there was a whole range of forms from those without spines on the shell, which would be called *D. obtusa* without question, to those with spines on the tail long enough for *D. tenuispina*. These specimens, however, clearly all belong to the same species and I consider them all to be *D. obtusa*; although there is a tendency for longer spine forms to occur more frequently in South Africa than in Europe, I do not think other names are justified for these forms. These specimens agree in every respect with the description of *D. obtusa* given by Scourfield (1942) and Johnson (1952, p. 446). The species is found in temperate waters in both hemispheres.

Daphnia pulex Leydig

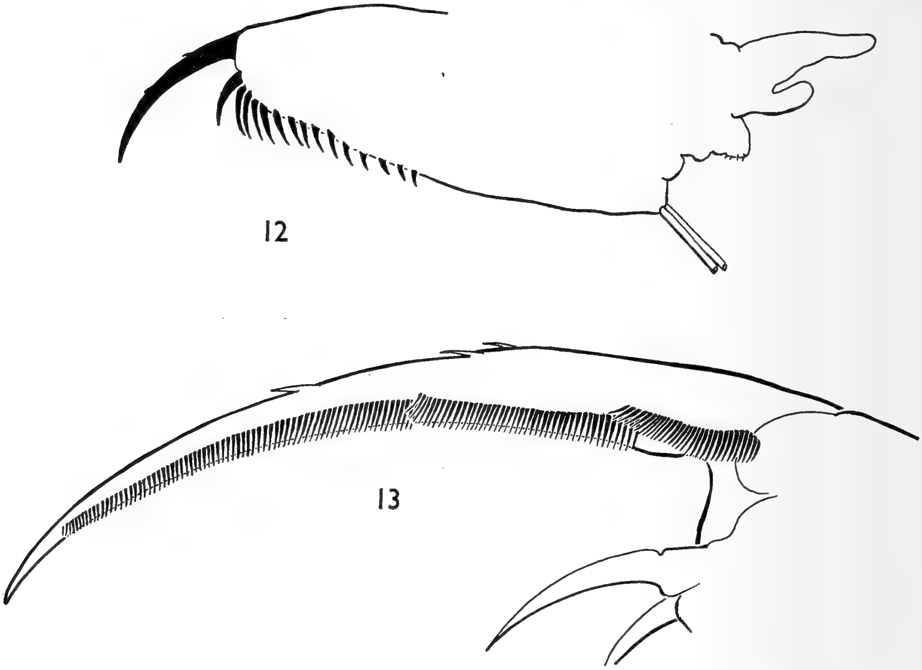
Specimens which agree in every particular with Johnson's (1952, p. 443) description of the female and which run down to this species in Brooks' key

(1957, p. 30) were found at the Upper Laundry Dam at Benoni in the Transvaal, and from the lower Berg River in the Cape at the farm Sanddrift.

This species is now known from all parts of the world except from the Australian and Oriental regions; this is the first record from S. Africa.

Scapholeberis kingi Sars

This species was collected from six places on the Jukskei-Crocodile system among marginal vegetation, and two females were also found in brown and acid water in a vlei at Betty's Bay. Sars (1916, p. 314) described specimens raised from dried mud from Bergvliet.



Figs. 12–13, *Daphnia longispina* O. F. Müller, *s. lato*
12, abreptor, × 150; 13, claw, × 600.

The species has been recorded from Senegal, Corfu, Germany, India, China, Siam, the East Indies and Australia.

Scapholeberis aurita (Fischer)

Three females were collected from the marginal vegetation at the Vaal Barrage, and one from the Riet Vlei off the Diep River.

The species seems to be new to South Africa. It is widely distributed in Europe, Central Asia, North Africa, and North America, but is not a common species anywhere.

Simocephalus exspinosus (Koch)

Syn.: *S. australiensis* Sars

A number of samples from the Transvaal including the sewage works at Benoni and Pretoria, contained this species; it was also collected from the Salt River and from the Riet Vlei in the western Cape Province.

This is a cosmopolitan species and I adhere to the opinion previously expressed (Harding, 1957*a*, p. 62) that there is no justification for regarding specimens from the southern hemisphere as a separate species.

Simocephalus serrulatus (Koch)

Syn.: *Simosa capensis* Sars

A few individuals were found in five samples from the Vaal, the Klein Jukskei, and the lower Berg River; three of these samples also contained *S. vetulus*.

This species is widely distributed in the temperate parts of the world, but has not yet been recorded from Australia or New Zealand.

Simocephalus vetulus (O. F. Müller), *sensu lato* including *S. vetuloides* Sars

(Fig. 14, A–H)

This was the commonest species of *Simocephalus* in the collections, and was present in 12 of the samples and in all the regions investigated. It is very difficult

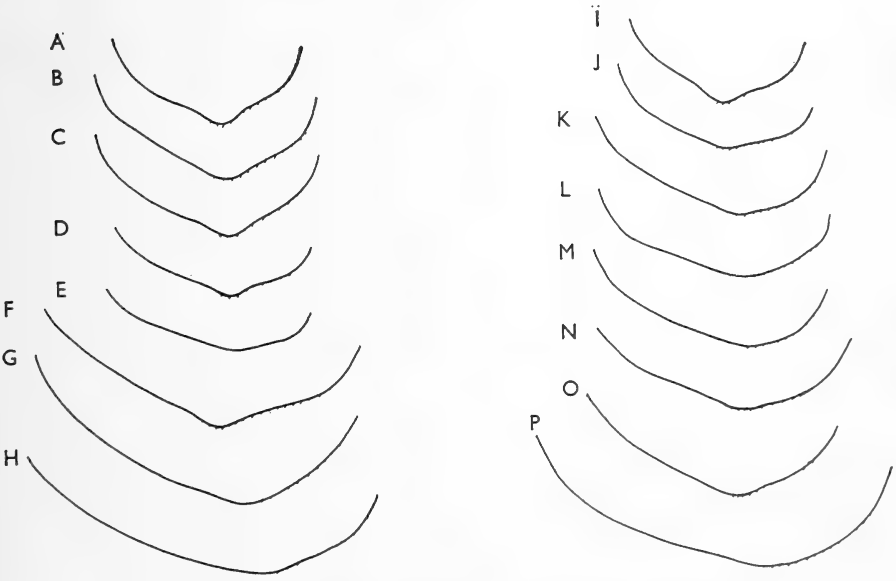


FIG. 14, *Simocephalus vetulus* (O. F. Müller), *s. lato*.
Posterior margin of shell: A–H, South African specimens; I–P, specimens from England. × 30.

to decide whether to recognize *S. vetuloides* as a distinct species from *S. vetulus*. The only difference between the two given by Sars (1916, p. 313) is in the shape of the posterior margin of the shell, *S. vetuloides* having a protuberance which is missing in *S. vetulus*. Most South African specimens have this protuberance as can be seen from the *camera lucida* drawings of the posterior margins of the shells of specimens from various South African localities (fig. 14, A–H). But the specimens shown in figure 14, E, G and H, lack this protuberance. Figures I–P show a similar series of drawings of specimens from various English localities, and while most of the specimens are without a protuberance, those in figures I and O show one. The overlap seems to be too great to justify the separation into two species, but there are samples in which there would be no difficulty in allocating one or other name. Until breeding experiments have been carried out, it will probably be impossible to decide this question.

Ceriodaphnia reticulata (Jurine)

Syn.: *C. natalis* Brady
C. reticulata var. *minor* Sars

Specimens of this species were present in samples from the lower Berg River at Bridgetown, from among Potamogeton at a weir at Olifants Vlei, from the marginal vegetation at the Hartebeestpoort Dam. Sars (1916, p. 316) distinguished a var. *minor* solely on the small size—'reaching 0·9 mm.', and this is about the limit of size for the present specimens. No large specimens of *C. reticulata* seem ever to have been collected from South Africa, but this hardly justifies the use of a separate name. Lilljeborg (1900, p. 184) gives 0·8–1·44 mm. as the range of length of the adult female of this species in Sweden, and refers also to a population of small specimens whose sizes range from 0·5 to 0·8 mm. In a footnote on p. 188 he informs us that he was at first inclined to erect a new species for this population and in a public lecture suggested the name *C. minor*; but that later he considered this to be unjustified.

The species is widely distributed in the Palearctic, Nearctic, Neotropical and Ethiopian regions.

Ceriodaphnia quadrangula (Müller)

Parthenogenetic females and a few males were present in brown and acid water from a vlei at Betty's Bay. The species has the same geographical distribution as *C. reticulata*.

Ceriodaphnia rigaudi Richard

Syn.: *C. cornuta* Sars

About one dozen specimens were collected on different occasions from the Amato Dam, Benoni. The species is found in all the warmer regions of the world.

Moina dubia Guerne and Richard

Moina dubia was collected from the Zeekoe Vlei, Cape Flats; from the Berg River at Wellington, and Piketberg; and from several places in the Transvaal.

Sars (1916, p. 322) described the claw of the abreptor as being without secondary denticles, but this is a very variable character in this species (see Gauthier, 1955, p. 26), and the present specimens showed every gradation. The species is cosmopolitan.

Moina belli Gurney

Five females were collected from the Aapies River at Onderstepoort. Gurney (1905, p. 299) described the species from Kroonstad; Brehm (1938, p. 212) described what is probably the same species under the name *M. ruttneri* from Kurdistan, and Stephanides (1948, p. 17) records the species from Corfu.

Moina rectirostris Leydig

Syn.: *Moina brachiata* Sars not Jurine

This species was present in five tubes from the Transvaal and two tubes from the Milnerton area of Cape Province. It is widely distributed in the Palearctic, Nearctic, and Ethiopian regions. Sars (1916, p. 321) called this species *M. brachiata* as he thought it was the species described by Jurine (1820, p. 131) as *Monoculus brachiatus*; but as Gauthier (1955, p. 15) points out, Jurine described two eggs in the ephippium of the female, which therefore could not have belonged to this species.

Bosmina longirostris O. F. Müller

Samples from the Vaal, Hennops and Berg Rivers contained this cosmopolitan species, which is the *Bosmina* most often found in all parts of Africa.

Ilyocryptus acutifrons Sars

About 30 specimens were collected from the Sirkels Vlei near Cape Point. This is a Palearctic and Nearctic species which seems not to have been recorded from Africa before.

Ilyocryptus sordidus (Liéven)

This common species can probably be found in mud in any part of South Africa, and was present in 12 of the samples. It is cosmopolitan.

Macrothrix spinosa King

This species was found in a number of places in the Transvaal and the Cape, eight samples in all. Sars records it from the Cape and it is known also from Australia and South America.

Echinisca capensis Sars

A few specimens were collected on three occasions from the Riet Vlei and a flooded backwater of the Bushman's River. It seems to be endemic to the Cape Province.

Eurycercus lamellatus (O. F. Müller)

This large cladoceran was found in the vlei near Paarl, in the lower Berg River at Hermon and at Southfield on the Cape Flats. It is common in the Palearctic and Nearctic regions and is known from South America and North and West Africa, but these are the first South African records.

Camptocercus australis Sars

A single female was collected from a vlei near Paarl. *C. australis* is known from Australia, India, and Argentina. It differs from the *C. rectirostris* Schoedler of Palearctic and Nearctic regions only in the absence of small teeth on the post ventral corner of the shell. The latter species has been recorded from North Africa.

Acroperus harpae (Baird)

Over 100 specimens were collected from the Great Usutu River, Transvaal. This species appears to be cosmopolitan except for Australia. Many different forms have been described, of which the form *neglectus* Lilljeborg best fits the present specimens.

Euryalona colletti (Sars)

Only two females were collected, both from the Vaal. One at the Suikerbos pumping station and one below the confluence with the Leeuwspruit. Previous records are from Knysna and Zululand (see Harding, 1957*b*).

Alona affinis (Leydig)

Specimens of this species were found on four occasions on various parts of the Berg River and the Usutu River. It is a well-known cosmopolitan species.

Alona bukobensis Weltner

Considering that this species is known from most parts of Africa it is rather surprising that only one adult female from Benoni and one juvenile from Paarl can be identified as such. Outside Africa, Ekman (1905, p. 8) has described the variety *subantarctica* from South Georgia.

Alona pulchella King

Specimens were found in various parts of the Vaal River and at Benoni. The species, often recorded under the synonyms *A. glabra* or *A. cambouei* (see Harding, 1955; 1957a, p. 76), is known from all tropical and subtropical regions of the world.

Alona diaphana (King)

This variable, but easily recognized, species was found in a number of places on the Vaal River and the Klein Jukskei and at Benoni. It is known from North, East and West Africa, and from South America and Australia, but does not seem to have been recorded from South Africa before.

Leydigia microps Sars

Four females were collected from the Vaal River below its confluence with the Klip River. This seems to be the first record of the species since Sars (1916, p. 330) first described it from three places in the Cape Province.

Leydigia propinqua Sars

This was found in small numbers from a number of places on the Crocodile-Jukskei system, in the Vaal, and in the Krom River at Stellenbosch. Originally described from Sumatra, it has been recorded from South Africa (Sars, 1916, p. 329) and East Africa (Jenkin, 1934, p. 285).

Pleuroxus aduncus (Jurine)

This cosmopolitan species was the most common in the collections and was present in large numbers in 22 of the tubes. These were all from the Vaal and Transvaal except for one sample with 6 specimens from the vlei at Betty's Bay. The specimens have from 1 to 3 teeth on the post ventral corner of the shell, and also have a peg on the antennule as described by Jenkin (1934, p. 296) for the var. *makaliensis*. This peg has been shown to be typical for *P. aduncus* (Harding, 1955, p. 348) and is also present in the type specimens of *P. inermis*, which is the only species of *Pleuroxus* described for South Africa by Sars, and is probably identical with *P. aduncus*.

Chydorus globosus (Baird)

Four females were found in the Klein Jukskei River. Although comparatively rare, this species is probably cosmopolitan.

Chydorus sphaericus (O. F. Müller)

This cosmopolitan species was found in nine of the samples and is clearly present in all the regions investigated.

Monospilus dispar Sars

Three females were found in the vlei at Betty's Bay in brown and acid water. It is widely distributed in the Palearctic, Nearctic and Ethiopian regions, but is not often found.

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'I. *Synonymy arranged according to chronology of names.*—All published scientific names by which a species has been previously designated (subsequent to 1758) are listed in chronological order, with bibliographical references to all descriptions or descriptive citations following in chronological order after each name. . . .

B. *Form for bibliographic references to synonymic names.*—The first reference following any name in the synonymy should be to the earliest citation of that name. This should be followed by references to all subsequent citations of the same name, arranged in chronological order. . . .'

Bibliographical references modified to consist of author's name, date of citation, pagination and illustrations (plates and figures).

Example:–

Eulalia (*Steggoa*) *capensis* Schmarda

Eulalia capensis Schmarda 1861, p. 86, pl. 29, fig. 231. Willey 1904, p. 259.
Eulalia viridis var. *capensis* McIntosh 1903, p. 34. Day 1953, p. 30.
Eulalia viridis (*non* Muller) Ehlers 1913, p. 455. Day 1934, p. 30.

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POGONOPHORA FROM SOUTH AFRICA

By

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POGONOPHORA FROM SOUTH AFRICA

By

Eve C. Southward
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(With 3 figures in the text)

Introduction

The Pogonophora, a group of tubicolous marine animals related to the Hemichordata, have aroused much interest in recent years. A curious feature of the group is the total absence of an internal digestive system, a condition which is unique among non-parasitic Metazoa. The Class name Pogonophora was suggested in 1937 by Johansson who chose the name to describe the beard-like appearance of the tentacles of the only species known to him then (*Lamellisabella zachsi* Uschakov). A new Phylum, Brachiata, was erected for the group by Ivanov (1955*b*), who had already (1951) assigned to the Pogonophora a peculiar animal described much earlier by Caullery (1914, 1944) and described several new genera and species himself (Ivanov, 1949, 1952).

Our knowledge of the distribution of these animals is still very incomplete. They seem to be restricted to soft sediments in deep, or at least cold, water. Ivanov's specimens have come, so far, from the north-west Pacific and Arctic Oceans. Others have been collected in the East Indies and in the east Pacific off the coast of Central America (Caullery, 1944; Kirkegaard, 1956*a* & *b*; Menzies, Ewing, Worzel & Clarke, 1959). The first species was recorded from Europe in 1956 (Jägersten) and more have been found since (Southward & Southward, 1958; Brattström, 1959; Southward, 1959).

A collection of pogonophore tubes made by the R.S. *Africana II*, off the west coast of South Africa, is of great interest as the first record from the south Atlantic and the most southerly record so far.

The deep-trawling was done by courtesy of the Director, Division of Fisheries, Cape Town. The tubes were sent to me by Dr. F. H. Talbot of the South African Museum, to whom I am very grateful for the opportunity to examine the specimens. The tubes seem to belong to three species, but only one tube was occupied by an animal. This one animal, though incomplete, shows enough of the important taxonomic features to allow it to be used as the type specimen of a new species.

The Trustees of the South African Museum wish to acknowledge a grant from the Council for Scientific and Industrial Research towards the purchase of the deep-trawling equipment with which the specimens reported on were collected.

Ann. S. Afr. Mus. **46** (4), 47-52, 3 figs.

Family POLYBRACHIIDAE Ivanov 1952

Heptabrachia talboti n. sp.

Material: One occupied tube (holotype) and 7 empty fragments; position: 33° 26′ S., 16° 33′ E.; depth: 2,268 m.; date of collection: 26.8.59; S.A.M. No. A 19704.

Three empty fragments of tube; position: 33° 50′ S., 17° 21′ E.; depth: 1,097 m.; date of collection: 25.8.59; S.A.M. No. A 19702.

Two empty fragments of tube; position: 33° 50′ S., 16° 30′ E.; depth: 2,750–2,890 m.; date of collection: 27.8.59; S.A.M. No. A 193.

Description: The tubes are brown and stiff anteriorly, white and soft posteriorly. Their diameter is a little greater at the anterior end. The tube of the holotype is 0·46 mm. in diameter at the anterior end and 0·41 mm. posteriorly, while the variation among the empty tubes is from 0·34 to 0·56 mm. The longest tube is not complete and is 13 cm. long. The anterior part of the tube is marked with wide brown rings, separated by narrower yellow rings (fig. 1, A), but towards the middle part of the tube the brown rings become narrower and less distinct (fig. 1, B) and finally disappear. The posterior part of the tube is whitish and its rather thick walls are encircled by slightly wrinkled marks about 1 cm. apart. One short fragment of tube with stiff, transparent, yellow walls may be the extreme anterior end of one of the tubes of this species, although other species of *Heptabrachia* have the anterior end of the tube colourless, with thin, limp walls (Ivanov, 1957).

The animal has lost the distal parts of the tentacles and much of the posterior part of the body. Although parts of the specimen are crushed the following details can be seen. At the anterior end about 15 tentacles were attached to the cephalic lobe of the protosoma, or first segment (fig. 2, A, B), and about half of these tentacles were lying along the mesosoma (an unusual position which may have been produced during fixation). These backward-pointing tentacles had to be removed to expose the mesosoma (fig. 2, A) and this procedure slightly damaged the anterior part of the specimen, so that it is difficult to decide how the bases of the tentacles were arranged. In this specimen it is not possible to see any pinnules on the tentacles, but many pogonophores have them and they may be found in other specimens.

The protosoma is separated from the mesosoma by a circular groove, behind and over which the anterior mesosoma is drawn out into a collar-like flap (fig. 2, A, C). On the tentacular side* the collar is divided by a deep groove which extends back, with a flap on each side, as far as the bridle. This bridle is a ridge of thickened cuticle which encircles the mesosoma except for a small gap on the tentacular side (fig. 2, A, C). Behind the bridle the mesosoma is smooth. Together the protosoma and mesosoma are 1·52 mm. long and the

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* The tentacular side of the animal is ventral according to Ivanov (1955*a*), dorsal according to Jägersten (1956).

greatest width of either is 0·32 mm. The third, last, and longest segment of the body is the metasoma, which in this specimen is 12 mm. long and certainly not complete. The first part (1·7 mm.) is very much contracted and twisted, and the closely packed papillae on the tentacular side (fig. 2, A) are probably normally arranged in two rows separated by a longitudinal groove, as they are in many other pogonophores. The paired arrangement of the papillae on this part of the body in other pogonophores has earned it the name of the 'metameric' region. In the present specimen each papilla is crowned with an oval adhesive plate with one thickened border (fig. 2, A, E). Behind the metameric region is a muscular region bearing a few scattered papillae, with adhesive plates (in a mature specimen this is the region which contains the gonads), extending for about 10 mm. and ending with two girdles of small toothed platelets (fig. 2, D). The specimen is broken off at the second girdle and is also damaged at the level of the first, so that the extent and shape of the girdles in the complete animal are not known. Each girdle is made up of several irregular rows of platelets (fig. 2, F, G), of the shape and form found in many other pogonophores. The part of the metasoma behind the girdles (postannular region) is missing; in other species it is often as long as the preannular region.

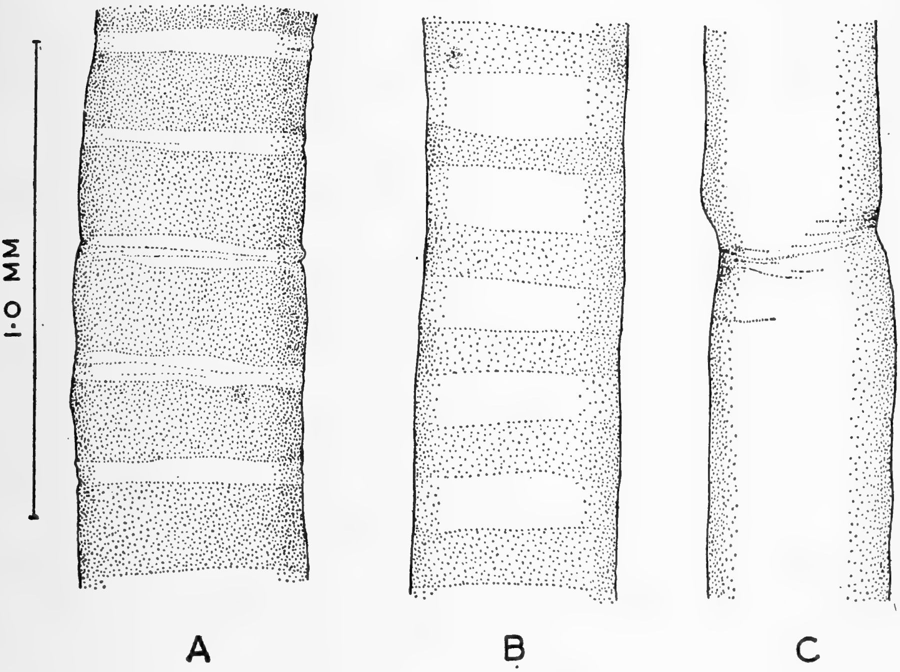

FIG. 1
Tube of *Heptabrachia talboti* n. sp. A, anterior. B, middle. C, posterior.

For a complete description it will be necessary to have a specimen with the metasoma in good condition, in order to discover the true arrangement of the papillae in all parts, and to clarify the arrangement of the girdles. Complete tentacles are needed for measurement of their length and for investigation of their pinnules, if present.

However, with the material available, it is possible to place the species, with reasonable certainty, in the genus *Heptabrachia* Ivanov 1952, and to conclude that it is unlike any of the four species so far known. *H. abyssicola*, *H. gracilis*, *H. beringensis* and *H. subtilis* were all described by Ivanov and he has summarized their characteristics in a table (Ivanov, 1960, p. 214). *H. gracilis* is the closest in

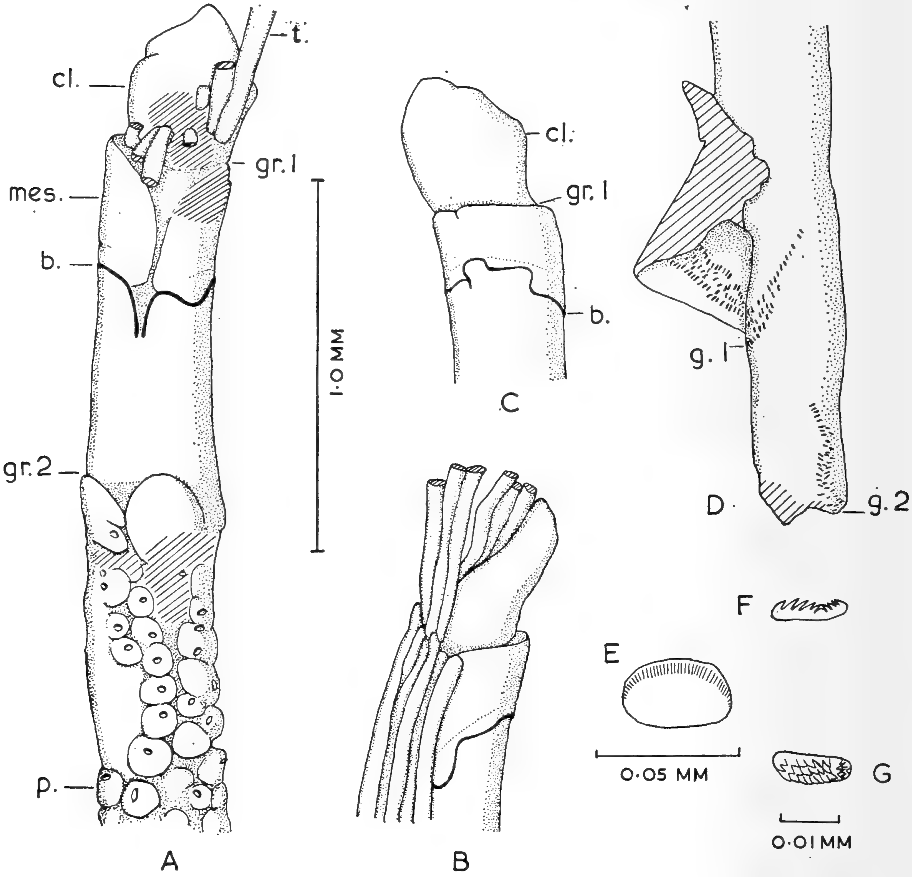

Fig. 2

Heptabrachia talboti n. sp. A, anterior end, tentaculate side, after removal of tentacles. B, anterior end, before removal of tentacles. C, anterior end, non-tentaculate side. D, girdle region of metasoma. E, adhesive plate. F, G, side and surface views of girdle platelet. Diagonal hatching indicates damaged surfaces. Abbreviations: b. bridle, cl. cephalic lobe, g. 1 first girdle, g. 2 second girdle, gr. 1 groove between proto- and mesosoma, gr. 2 groove between meso- and metasoma, mes. mesosoma, p. papilla, t. tentacle.

general appearance to *H. talboti*, but, in addition to differences in size and the number of tentacles, they differ in the size of the adhesive plates which are 15 to 20 μ long in *H. gracilis* and 30 to 40 μ long in *H. talboti*. Examination of more specimens of *H. talboti* might disclose more differences, since all four of Ivanov's species have, on part of the preannular metasoma, an area or row of large papillae set close together, whose arrangement and number varies with the species. In *H. talboti* some large papillae are visible in the correct region but their arrangement cannot be seen clearly. Another useful specific character in this genus is the arrangement of the papillae on the postannular region, which has been lost by the present specimen.

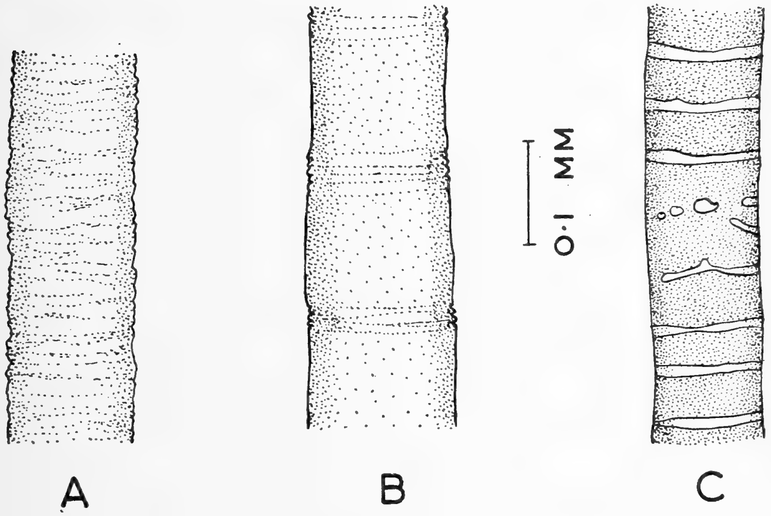

Fig. 3

A & B, two ends of tube type (*a*). C, tube type (*b*).

Empty Tubes of Unknown Genera and Species

Material: Three tubes; position: 34° 05′ S., 16° 58′ E.; depth: 2,690 m.; date of collection: 9.12.59; S.A.M. No. A 319.

The tubes are of two types: (*a*) almost colourless, transparent, with one end slightly wrinkled but not ringed and the other end marked with wide greyish rings (fig. 3, A, B). There are two specimens of this type, one 10 cm. long by 0·195 mm. diameter, the other 2·5 cm. by 0·145 mm. (*b*) reddish brown in colour, with well-marked brown rings, separated by narrow yellow rings (fig. 3, C). The diameter is 0·12 mm. and the length is 2 cm.

The holotype and other specimens of *Heptabrachia talboti*, and the unidentified pogonophore tubes, are all in the collection of the South African Museum, Cape Town.

SUMMARY

The first member of the Pogonophora to be described from the south Atlantic is *Heptabrachia talboti* n. sp., collected off the west coast of South Africa in depths between 1,097 and 2,890 m. Empty tubes of two other pogonophores are also described.

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Eulalia capensis Schmarda 1861, p. 86, pl. 29, fig. 231. Willey 1904, p. 259.
Eulalia viridis var. *capensis* McIntosh 1903, p. 34. Day 1953, p. 30.
Eulalia viridis (*non* Muller) Ehlers 1913, p. 455. Day 1934, p. 30.

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VOLUME XLVI

PART V

A NEW CICHLID FISH IN THE LIMPOPO BASIN

By

Ethelwynn Trewavas
British Museum (Natural History)

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A NEW CICHLID FISH IN THE LIMPOPO BASIN

By

Ethelwynn Trewavas

British Museum (Natural History)

The fish to be described has been known as *Serranochromis thumbergi* (Castelnau), but I recognized it as distinct some years ago when I handled a specimen from the collection of the Transvaal Museum. I was unwilling to describe it from a single specimen, but I have since received five more from Mr. S. S. du Plessis which enable me to characterize the species. Although related to *Serranochromis* it combines characters which suggest an independent though neighbouring point of divergence from *Haplochromis* and I have given it a new generic name.

Acknowledgements

I am grateful to Dr. V. Fitzsimons of the Transvaal Museum for the loan of a specimen of this species and to Mr. S. S. du Plessis for supplying the five which have been described as holotype and paratypes. I acknowledge too the patience of interested fishery research and development officers who have waited while I studied specimens of *Haplochromis* and related genera from the Zambezi and neighbouring basins so that I could judge the systematic position of this species on the broadest basis before naming it. I have seen types of most of the species of this region and am satisfied that it can be identified with none of them.

Chetia gen. n.

Type *C. flaviventris* sp. n.

From *Cheti*, a name given in Nyasaland to a yellow weaver-bird, in reference to the yellow colour on the type species and by analogy with the Afrikaans name *kanariekurper*.

Piscivorous cichlids resembling *Haplochromis*, but without any ventral vertebral apophysis for the attachment of the air-bladder; differing from *Serranochromis* in retaining a minor cusp on at least some of the teeth of the jaws up to a standard length of 70 mm. and in having usually a lower number of vertebrae (31–33) and of soft dorsal rays (11–12). As in both these genera, the apophysis for the upper pharyngeal bones is formed from the parasphenoid in the middle and the basioccipital at the sides. Some of the scales are finely ctenoid in the young, but at the sizes examined most or all are cycloid, often with a small group of fine granulations posteriorly. The caudal fin is truncate.

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Lichnochromis, a monotypic Nyasan genus which also falls within most of this definition, differs in its typical Nyasan colour-pattern of an oblique dark band from nape to caudal, and in the emarginate and heavily scaled caudal fin, as well as in the produced snout (more than half of the length of head) and expanded, beak-like premaxillary bones.

Chetia flaviventris sp. n.

Serranochromis thumbergi (nec Castelnau), du Plessis & Groenewald, 1953, p. 41, 2 figs.

Description of six specimens 71–117 mm. in standard length. The proportions in square brackets are from du Plessis & Groenewald's figure of a male, evidently a larger specimen.

Proportions in hundredths of standard length:

Depth of body 29·6–33·3 [35·5]
Length of head 33·5–35·4 [31·3]
Length of caudal peduncle 15–17
Length of pectoral fin 21·7–24·7

Proportions in hundredths of length of head:

Length of snout 34·0–38·0
Diameter of eye 21·25–26·0 [19·2], negatively allometric
Depth of preorbital 18·0–22·5 [23·1], positively allometric
Interorbital width 18·7–21·1
Length of lower jaw 43·4–47·9
Length of premaxillary pedicels 30·0–33·8
Width of lower pharyngeal bone 25·0 (1 specimen)

Snout weakly and evenly decurved. Cleft of mouth at an angle of 20°–30° with the horizontal; maxillary extending to below some part of anterior half of eye. Five horizontal series of scales on the cheek. Gill-rakers on the anterior arch 3 or 4 + 1 + 9 or 10. Teeth in 2 series with a few anterior teeth forming a third series in upper jaw; in lower jaw in 2 series, the inner of up to 12 teeth; 44–50 teeth in outer series of upper jaw. All teeth conical, curved in the specimens of more than 100 mm. S.L., part conical and part spear-shaped with a single point in two of the others, some spear-shaped and some with a main and a minor cusp in two specimens of 71 and 85 mm. s.l.

Lower pharyngeal narrow, with a short anterior blade and slender pointed teeth with a minor cusp or shoulder.

Dorsal XV 11 (one) or XV 12 (five). Anal III 9 (three) or III 10 (three). Caudal truncate, in larger specimens with rounded corners. Caudal peduncle 1·3 to 1·5 times as long as deep.

Scales 34 in a longitudinal series including the upper lateral line, 5–6 between origin of dorsal and lateral line, 5 or 6 between bases of pectoral and pelvic fins.

Vertebrae 31–33, comprising 15 abdominal and 16–18 caudal.

Colour pattern in preserved specimens: a shadowy mark between the eye and maxillary (lachrymal mark); a dark opercular spot and a series of dark blotches from this to the base of the caudal along the middle of the side, more or less connected posteriorly to form a band; a less complete series on the upper lateral line and a vague series from nape along base of spinous dorsal. [These body-markings commonly appear in dead or dying specimens of *Haplochromis* and its relatives and also in certain physiological or emotional states, and are generally more marked in the young.] Soft dorsal and caudal with series of small dark spots.

Life-colours (du Plessis & Groenewald, 1953): belly bright yellow (giving it the vernacular name of *kanariekurper*); anal fin with bright red dots which are more plentiful in males than in females.

Breeding: a mouth-brooder, the female carrying the eggs (du Plessis & Groenewald, 1953).

Food: the adult dentition is piscivorous and du Plessis & Groenewald report that 'the fish is a predator, thriving on small fish, insects and snails'. Since these authors identified this species with *Serranochromis thumbergi*, which was once mistakenly reported as feeding on snails, this account of the *kanariekurper's* diet should not be accepted without confirmation on the Limpopo populations.

Distribution: known only from the Limpopo basin, 'mostly in the dry western part of the Transvaal', where 'it can withstand the severe cold of the highveld' (du Plessis & Groenewald, 1953).

Size: my largest specimen is about 5¾″ in over all length, and du Plessis & Groenewald (1953) state that it does not grow large enough to be valued for sport. Judging from the relative size of the eye and the depth of body their figured male must be 7″ or 8″.

Material described: B.M. (N.H.) 1957.11.16.1–3. holotype, ♂ 106 + 25 mm.; paratypes, 73 + 18 & 93 + 22 mm.; South African Museum: paratypes 71 + 17 (S.A.M. 23058) & 85 + 21 mm. (S.A.M. 23059); all from Buffelspoort Dam (district of Rustenburg, Transvaal) in the Sterkstroom, tributary of Crocodile R., Limpopo system; presented by Mr. S. S. du Plessis. Transvaal Museum no. 8676, 117 + 30 mm.

Distinguishing characters: this species has hitherto been misidentified as *Serranochromis thumbergi* under which name two other distinct species have been confused, *S. thumbergi* (Castelnau) and *S. robustus* (Günther). Both the latter species are more elongate than *C. flaviventris*, the former having 37 vertebrae of which 18–20 are abdominal, the latter 34–36 vertebrae, of which 16–18 are abdominal. The extra length also shows in the scale-count, 39–40 in *S. thumbergi* and 36–38 (39) in *S. robustus*, and in the dorsal rays, XVII–XVIII 13–14 in *S. thumbergi*, XV–XVI 14–16 in *S. robustus*. The smallest specimens of these species that I have seen, respectively 65 and 54 mm. in standard length, have simple conical teeth as in the adult.

Neither *S. thumbergi* nor *S. robustus* is reliably reported from the Limpopo basin.

The colours of *Serranochromis thumbergi* and *S. robustus* are described by Messrs. G. Bell-Cross and M. A. E. Mortimer in a set of mimeographed notes of which they have kindly sent me a copy. They refer to them respectively as species B and C, but their identity is clear from the accompanying descriptions. *S. thumbergi* is grey-green with no bright yellow colour ventrally. *S. robustus* is much darker, but breeding specimens are described as having 'a deep chrome yellow flush on throat and belly'; Nyasa specimens seen alive by me had not this yellow colour, but were rich green or blue, sometimes with black horizontal bands.

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PART VI

THE DENTITION OF THE TITANOSUCHIAN DINOCEPHALIANS

By

LIEUWE DIRK BOONSTRA
South African Museum, Cape Town

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By

LIEUWE DIRK BOONSTRA
South African Museum, Cape Town

[Accepted January, 1961]

(With 1 plate and 41 figures in the text)

CONTENTS

INTRODUCTION

In the South African Dinocephalia the teeth are but poorly known. The inadequate accounts hitherto given by the authors, who have studied this sub-order, are chiefly due to the nature of the preservation of the studied material and the rather rough methods of preparation hitherto employed.

Many specimens are recovered only when already naturally weathered out of the entombing rock and lying exposed on the eroded surface of the rocks of the *Tapinocephalus* zone as broken-up pieces weathered to various degrees. In the cranial material thus collected the crowns of the teeth are seldom well preserved, but exceptionally such material has yielded isolated well-preserved crowns. Such is the case in specimens which when petrified had full sets of teeth, but it is evident that a large number of skulls had on death lain exposed before entombment and during this time many of the teeth had often either fallen out of their sockets or had their crowns damaged or wholly broken off. This is evident from the fact that in many cases we find empty alveoli filled by matrix and by the fact that loose-lying teeth occur lying near parts of the skull or even unassociated with any other skeletal material, the harder dental substance being preserved and the less hard bone being lost. During thirty-two years of collecting in the *Tapinocephalus* zone I have found that the whole

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teeth—crown plus root—fall out of the alveoli before petrifaction more frequently in the Tapinocephalia than in the other three infra-orders; and in the Titanosuchia the crowns are broken off at the level of the alveolar border either before petrifaction or during the later weathering more frequently than in the other infra-orders. I believe this to be due to the difference in implantation and the mode of replacement of the teeth in these infra-orders.

When crowns are preserved *in situ* the intractable matrix makes good preparation difficult with the older hammer-and-chisel technique employed. Improved newer mechanical methods—vibro-needles and sectioning with rotating diamond-studded saws—and chemical solution now give better results in suitable specimens. If available, radiography would be a further improvement.

General

The dentition of the sub-order Dinocephalia (Anteosauria, Titanosuchia, Tapinocephalia and Styracocephalia) can be readily distinguished from those obtaining in all the other contemporary sub-orders of the order Therapsida by the following distinctive character:

In occlusion the upper and lower incisors intermesh, whereas in all the other contemporary therapsids with incisors (thus excluding the anomodonts) the upper incisors pass labially of the lower incisors. This distinctive intermeshing is developed further in the Titanosuchia, where the lower canine passes in front of the upper canine to intermesh between the last upper incisor and the upper canine (fig. 1). This process is carried still further in the Tapinocephalia and the Styracocephalia where the whole battery of teeth intermesh.

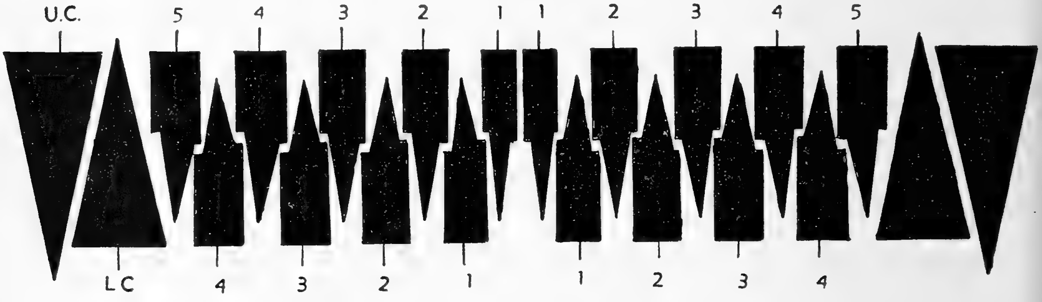


Fig. 1. A diagram to illustrate the intermeshing of the incisors and canines in the Titanosuchia.

Abbreviations used in this and subsequent figures:

1–5 = functional incisors. $1'$–$5'$ = first replacing incisors. $1''$–$5''$ = second replacing incisors. 1°–5° = predecessors to the functional incisors. An = angular. Ar = articular. C = canine. C^1 = replacing canine. Cor = coronoid. D = dentary. F = lingual flange of the dentary. F. Pt. = fossa for the quadrate ramus of the pterygoid. G = groove labial to the flange of the dentary. H = heel of the tooth. I.C. = inner condyle. L.C. = lower canine. M = maxilla. m = maxillary tooth. m^1 = replacing maxillary tooth. N = nasal. O.C. = outer condyle. Pa = prearticular. Pal = palatine. PC = postcanine. PC^1 = replacing postcanine. PC^1a = alveolus for replacing postcanine. Pm = premaxilla. Proc = processus musculus pterygoidus posterius. Pt = pterygoid. Q = quadrate. Q.F. = foramen quadrati. QRPt = quadrate ramus of the pterygoid. R = root of the tooth. Sa = surangular. Sm = septomaxilla. Sp = splenial. St = stapedial recess on the quadrate. T = talon of the tooth. U.C.. = upper canine. V = vomer.

This intermeshing of the teeth is, I believe, a character of sufficient importance, when taken in conjunction with other evidence available from the rest of the dinocephalian skeleton, to validate the old conception of grouping the four infra-orders together in one sub-order—Dinocephalia, and to show that the newer attempts in classification which are intended to refute this close consanguinity are ill-advised and contrary to the facts.

Although the four infra-orders of the Dinocephalia are linked together by this common character of intermeshing, there are certain dental features (together with other skeletal characters) distinctive of each infra-order, but all derivable from one common ancestral condition.

The dentition in the Titanosuchia can be readily distinguished from that of the Tapinocephalia and Styracocephalia by the presence of large specialized canines in both upper and lower jaws; from that in the Anteosauria, which also have large specialized canines, by the fact that in the Titanosuchia the lower canine is directed both outwards and forwards to intermesh between the upper canine and the fifth upper incisor, whereas in the Anteosauria the lower canine is directed upwards to lie inside the upper canine with its point housed in a special recess in the maxilla.

The infra-order Titanosuchia has, on skeletal characters other than those shown by the dentition, been subdivided into the three families Titanosuchidae, Jonkeriidae and Dinartamidae.

The dental material at my disposal has not enabled me to recognize differences in the dentition to substantiate this subdivision into families—a subdivision which is undoubtedly valid for the former two families. The family Dinartamidae founded on a single very poor specimen is of doubtful validity.

MATERIAL

This report on the dentition of the Titanosuchia is based mostly on the material in the collection of the South African Museum. This consists of 37 specimens, from isolated localities situated over the whole of the western fossiliferous part of the *Tapinocephalus* zone, in which adequate evidence of the dentition is preserved. Of these 37 specimens, 1 is from an unknown collector, 1 collected by Cloete, 1 by Cairncross, 1 by Hugo, 3 by Whaits, 3 by Haughton and the other 27 by the author.

Although the majority of these specimens are poorly preserved, the total of the determinable features gives us a fairly complete picture of the nature of the dentition in the infra-order as a whole. The available facts are, however, insufficient as reliable characters employable for taxonomic purposes within the group. Such characters as have been used by previous authors for the establishment of genera and species do not at present appear to be sufficiently distinctive or constant and such classification must at the present stage be considered of doubtful validity.

DESCRIPTIVE

General

Before giving an account of the individual specimens, in an attempted taxonomic order, the general features of the dentition of the infra-order as a whole follows.

In the Titanosuchia a full and mature set of teeth gives the formula:

$$i\,\frac{5}{4},\quad c\,\frac{1}{1},\quad pc\,\frac{19}{18-21}.$$

Where previous authors have given different formulae for their specimens and in the specimens at my disposal, which give a different count, these differences should at present, without further confirmatory evidence, not be attributed to any taxonomic distinction. That the different genera and species may have had different numbers of post-canines cannot, of course, be discounted; but in the light of our present knowledge such differences should rather be considered to be due to imperfect observation, imperfect preservation, age of the animal, or to the stage which the replacement of the teeth happens to have reached in each individual jaw. Noted differences in the left and right sides of the jaws of the same beast bear this out.

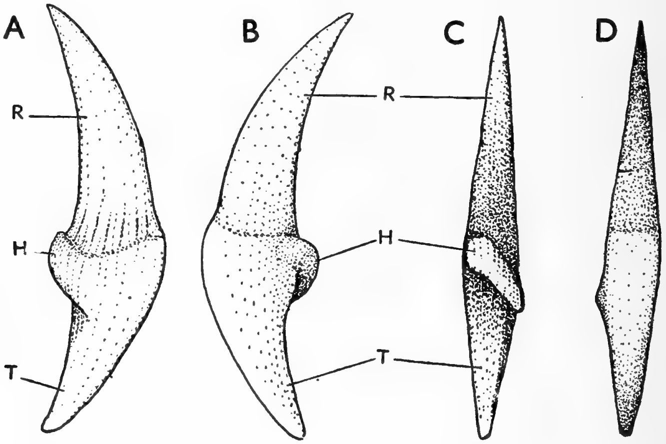


FIG. 2. *Jonkeria.* The left second upper incisor S.A.M. E. $\times\frac{1}{2}$.

A = anterior or inner view.
B = posterior or outer view.
C = lingual view.
D = labial view.

The Incisors

Both the upper and lower incisors have the structure which has been called 'dinocephalian' by various authors. What these authors really mean is that the incisors have the general structure of the teeth of the Tapinocephalia (especially the Russian *Deuterosaurus* and *Ulemosaurus*). Later in this paper it will be shown that the titanosuchian incisor can be readily (figs. 2 and 3) distinguished from the tapinocephalian teeth.

Essentially the distinctive structure of these teeth is the development in the crown of a piercing point separated from a cutting and/or crushing surface. Each tooth consists of a strong, long, curved, conical root; oval in section, and a nearly equally long, curved, claw-like point or talon with a convex labial face and a flattened lingual face with longitudinal striae and fairly flat sides. At the junction of crown and root the crown has on its lingual or inner face an oblique step, heel or cingulum. This heel forms an oblique ledge with its outer part higher than its inner part in the upper incisors and its outer part lower and its inner part higher in the lower incisors. In the unworn tooth the lingual edge of this heel forms a fairly sharp ridge with coarse serrations; after some wear the edge loses its serrations and the sharp edge becomes rounded; when greatly worn the edge is lost and the whole ledge acquires a flat face. Concomitant with this wear of the heel the talon is also worn away lingually to become more and more slender and thereby increasing the size of the crushing flat face of the heel.

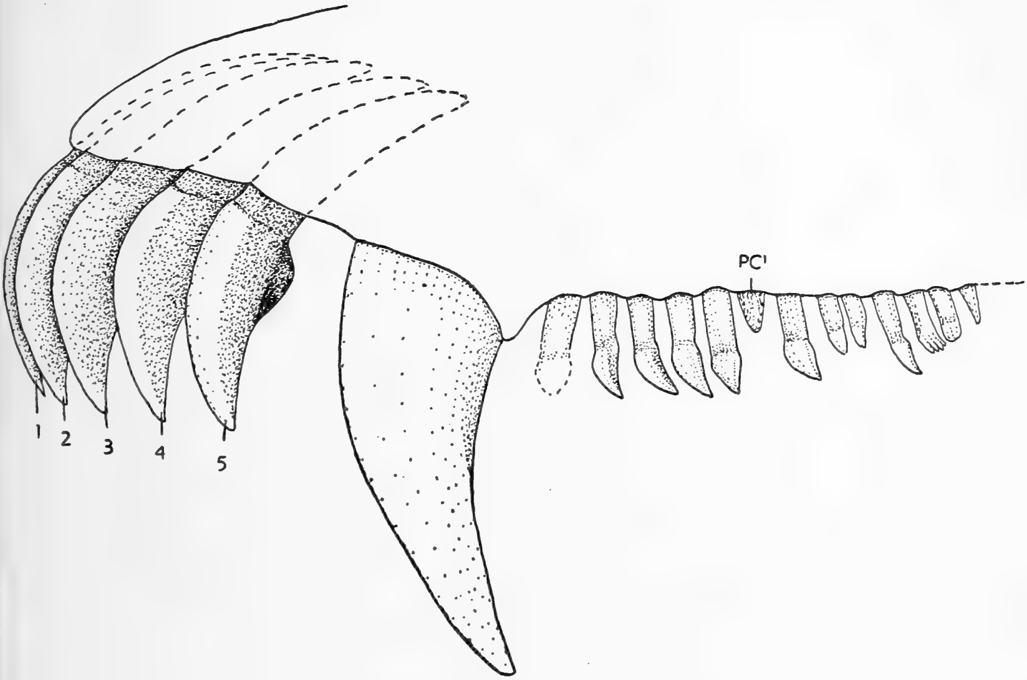


FIG. 3. *Jonkeria.* Lateral view of the upper jaw teeth. S.A.M. E. × ½. Partly restored.

There are certain differences between the five upper *inter se* and between the four lower incisors (fig. 4).

The first pair of upper incisors is more lightly built than all the others; this lightness is mainly due to the fact that the teeth are compressed from side to side, lying close together and, in occlusion, passing their talons in between the pair of lower incisors. The fifth upper incisor has the rear face of the talon modified to receive the lower canine with which it intermeshes. In the lower jaw the fourth incisor is somewhat weaker than the anterior ones. Other differences between the incisors can best be attributed to age or wear, but with more material available some of these differences may prove to be of taxonomic value.

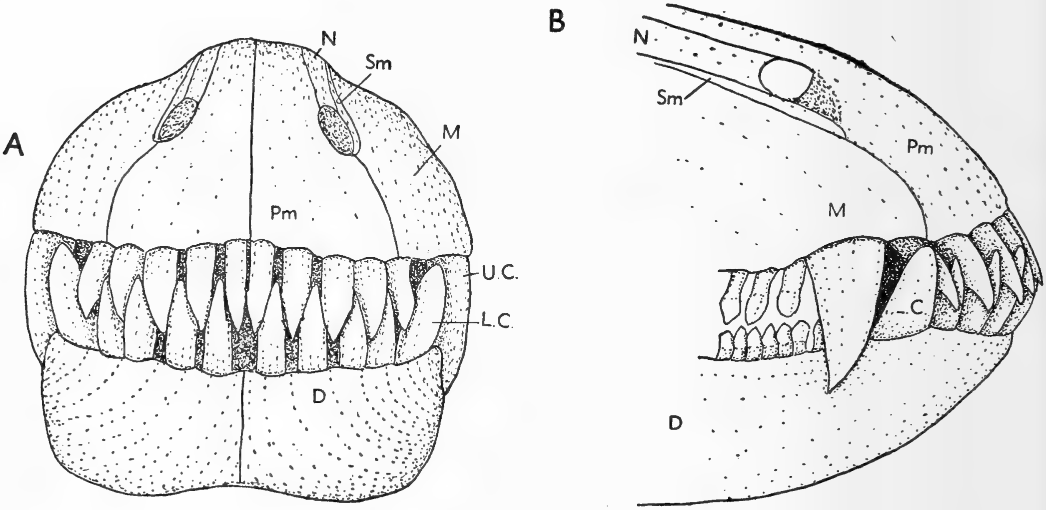


FIG. 4. *Jonkeria*. S.A.M. 9162. ×¼.
A = anterior view. B = lateral view.

The length of the incisor series varies in length: upper 73–106 mm. and lower 68–94 mm., but the variation between the two sides of the jaw is such that these measurements have a doubtful taxonomic value.

In occlusion the incisors of the two jaws intermesh (fig. 1) as follows:

The talons of the upper No. 1 pair lie in between the talons of the lower No. 1 pair.

Upper No. 2 lies between lower Nos. 1 and 2.
Upper No. 3 lies between lower Nos. 2 and 3.
Upper No. 4 lies between lower Nos. 3 and 4.
Upper No. 5 lies between lower No. 4 and the lower canine.

The outer half of the heel of upper No. 1, abuts against the inner half of the heel of lower No. 1; the heel of upper No. 2 has its inner half abutting against the outer half of the heel of lower No. 1 and its outer half against the inner half of lower No. 2; similarly upper No. 3 abuts against the halves of lower 2 and 3; upper No. 4 abuts against the halves of lower 3 and 4; upper No. 5 abuts against the halves of lower 4 and the inner face of the lower canine. The inner face of the lower canine shows in some specimens an oval worn face where attrition by the upper No. 5 incisor takes place.

In both upper and lower jaws the incisors do not stand vertically in the jaws but are directed forwards so that in occlusion the tips of the talons protrude anteriorly.

The Canines

Each maxilla and dentale bears a single robust canine (figs. 3 and 4).

The upper canine has a large conical crown which curves moderately to strongly backwards and is moderately flattened from side to side to present a greater or lesser oval in cross section, its posterior face is rounded with no sharp edge or serrations. The root is large and long and its presence causes the maxilla to bulge both externally as well as internally; internally the root opens on to the inner face of the maxilla, where the large pulp cavity remains open for the passage of nerve and nutrient vessels (fig. 31).

Where it leaves the jaw the canine diameters vary from 35 to 50 mm. antero-posteriorly and from 21 to 36 mm. from side to side. The crown length varies from 60 to 110 mm.

Between the last upper incisor and the canine there is a moderate diastema ±20 mm. which allows the lower canine to pass between these two teeth. In occlusion the upper canine passes behind the lower canine and fits in a hollow in the outer face of the dentale. In place of the lower canine lying lingually of the upper canine in occlusion there are here situated the first 4–5 lower postcanines.

The lower canine is smaller than the upper, shorter and less pointed and curved, with its blunted point directed outwards to pass in between the upper canine and the 5th upper incisor and to pass externally of the edge of the upper jaw. Its intero-anterior face frequently shows an attritional face where the last upper incisor wears against it. The outwardly directed lower canine has by Broom been considered a distinctive character of *Scapanodon*, but it is a feature common to all the known Titanosuchia, which in this character differ from all other contemporary Therapsida.

The Postcanines

The postcanines (fig. 5) form a long series in both jaws. The spacing is close and, except where replacement is taking place, regular. They differ from both the incisors and canines in that the teeth of the upper and lower jaws do not intermesh. In occlusion the lower set lies lingually of the upper set, as is normal, in the contemporary therapsids. The upper set is implanted close to the outer edge of the maxilla, whereas the lower set lies close to the inner edge

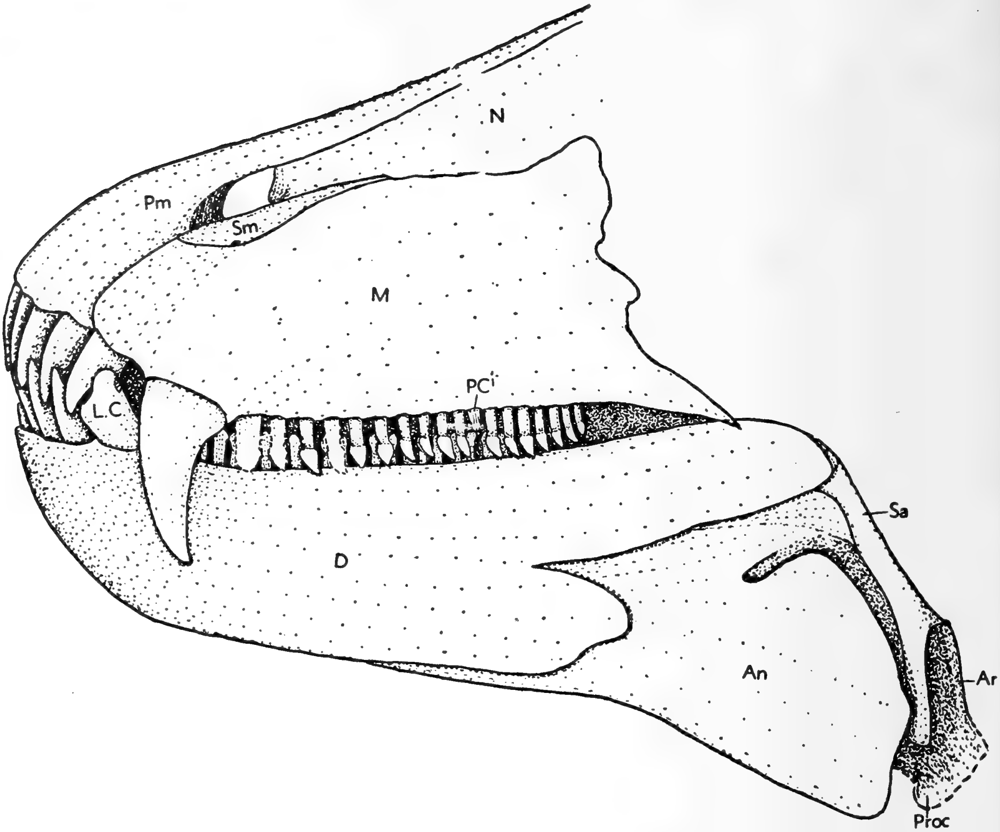


FIG. 5. *Jonkeria truculenta*. S.A.M. 12030. × ¼. Lateral view.

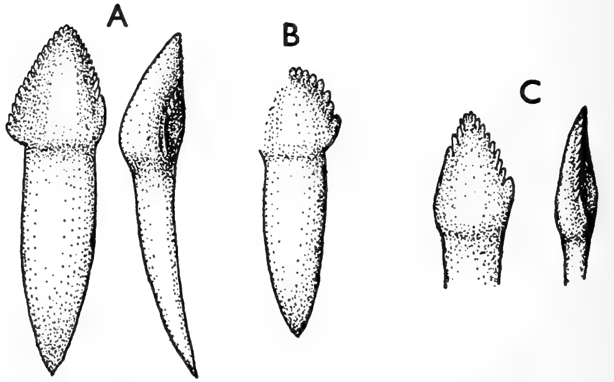


FIG. 6. *Parascapanodon*. S.A.M. 12213 × ½.

A = right upper postcanine in labial and posterior view.
B = a postcanine in labial view.
C = the 11th right lower postcanine in labial and posterior view.

of the dentale, with on their outside, a groove for the reception of the upper set. The upper postcanines are somewhat larger than the lower ones, but built on essentially the same plan. In both jaws the crowns lie obliquely to the long axis at an angle of about 40°, with the anterior edge directed inwards and the posterior edge outwards. The first postcanine in both upper and lower jaws is directed somewhat anteriorly and is usually the largest postcanine, the next four to five are of the same size, and the rest gradually decrease in size backwards. The postcanines in both jaws follow on their respective canines without a diastema. As the lower canine passes anteriorly of the upper canine, and the length of upper and lower series being approximately equal, it follows that the last 4–5 upper postcanines have no lower antagonists. Furthermore in occlusion the first 4–5 lower postcanines lie lingually of the upper canine.

Each postcanine (fig. 6) consists of a long root more or less oval in section, with a spatulate crown roughly triangular in outline; the outer face is moderately convex and the inner face flat to slightly concave. Both inner and outer faces carry fairly coarse striae, which in unworn teeth extend to the edge which thus becomes serrate.

In my specimens the length of the upper series varies from 169 to 188 mm. and the lower set from 165 to 210 mm.

The full set of postcanines numbers 19–21; in those specimens with a shorter set and a lesser number of teeth it would be reasonable to assume juvenility, additional teeth being added posteriorly with increasing age.

Tooth Replacement

In nearly every specimen replacement of teeth can be seen (figs. 7 and 8). Evidence of this is, first, irregularity in the series, the presence of empty alveoli, and, lastly, the presence of crowns in the process of eruption. Replacement occurs in incisors, canines and postcanines, but due to the great mass to be replaced replacement is less frequently seen in the large canines.

There is evidence of at least two sets of canines and postcanines and of at least three sets of incisors. Replacement may thus be a continuous process—there being no positive evidence of it ceasing.

In all the teeth the immediate replacing tooth erupts lingually of its predecessor and is thus a younger member of the same tooth family. In the Titanosuchia functional distichism thus no longer occurs.

Since in each tooth, generation follows generation independently, at any given time the functional teeth are, except initially, never all of the same age or generation. This is specially noticeable in the incisors, where in almost every set of functional teeth very distinct stages of development and subsequent wear can be seen. In many cases, from the stage of wear of the functional incisors, the order of replacement can be deduced and this can then be verified by noting the degree of development of their respective replacing teeth.

Replacement of the Incisors

In the premaxilla (fig. 7) a cavity develops in the bone lingually of the alveolus which houses each functional incisor. This cavity houses the germ from which the replacing incisor develops. By the time the replacing crown reaches a certain stage of development the inner or lingual wall of this cavity develops, by resorption of the bony tissue, a perforation. This opening enlarges to form a long oval fenestra and through this fenestra the crown of the replacing tooth emerges. As the replacing tooth continues its growth it moves labially into the lingual wall of the alveolus of the functional tooth which is gradually reabsorbed, until the new alveolus coalesces with the old alveolus. The old tooth has concomitantly suffered resorption and as it disappears the new tooth takes over its alveolus. In the meantime the fenestra through which the replacing crown can first be seen has closed up from above downwards so that the new tooth when arriving in the old alveolus has its own lingual alveolar wall. The talon of the young tooth, when just emerging, is flattened antero-posteriorly, roughly triangular in outline with its inner face coarsely striate and since these striae extend to the edges these are serrate.

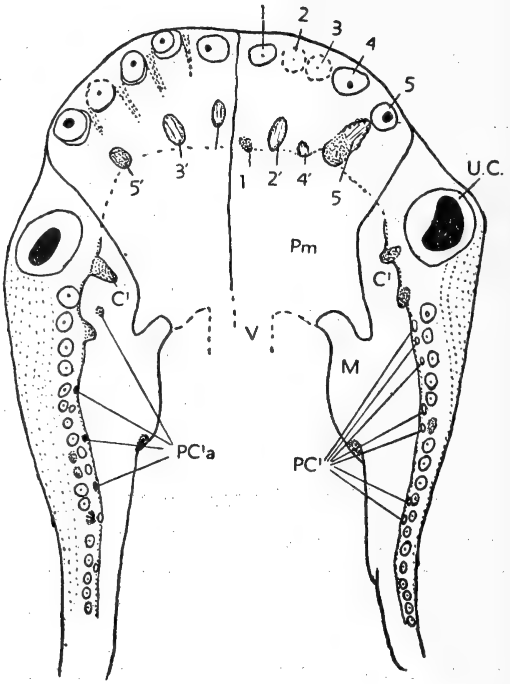


FIG. 7. *Jonkeria boonstrai.* S.A.M. 9079 ×¼.
Ventral view of upper jaws.

Noting the degree to which each replacing incisor crown has developed, I have tried to determine if there is a regular order in the replacement. (This can be controlled by noting the degree of wear in the crowns of the functional incisors.) But as could be expected this was not possible.

In the dentary (fig. 8) the eruption of the replacing incisors appears to follow a different course than noted in the upper incisors. This is due to the fact that in the dentary there lies lingually to the erupting incisors a flange of bone with a free upper edge, which thus forms a groove labially and at first sight it appears as if the replacing incisors emerge from this groove.

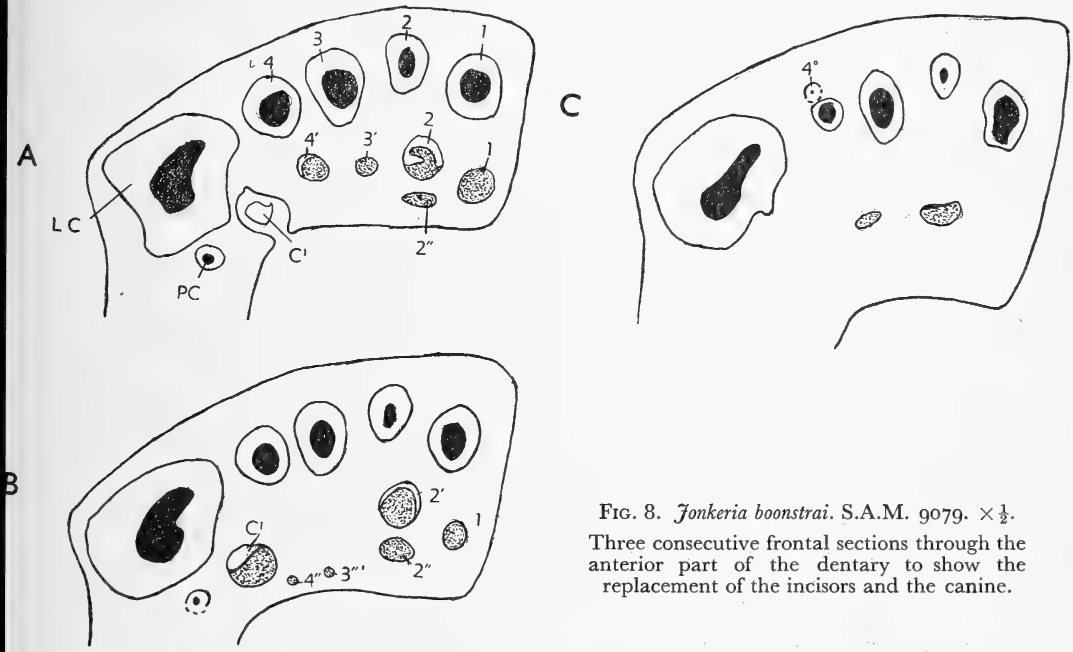


Fig. 8. *Jonkeria boonstrai*. S.A.M. 9079. × ½. Three consecutive frontal sections through the anterior part of the dentary to show the replacement of the incisors and the canine.

When seen in section (fig. 9), however, it is clear that the replacing teeth develop in cavities in the solid dentary labially of this groove. The mode of development is thus similar to that of the upper incisors, viz. lingually of each alveolus housing a functioning incisor a cavity is formed in which the tooth germ develops and the further course of development parallels that already described for the upper incisors.

Replacement of Canines

Little is known of the replacement of the canines (figs. 7 and 8). In the upper jaw there is frequently a small hollow in the lingual wall of the maxilla just above the inner alveolar edge of the functional canine. That this hollow indicates the point of eruption of the replacing canine as do the fenestrae lying lingually of the incisors is proved by the one case (S.A.M. 11884) where on both sides it houses the tip of the replacing canine. In two cases we have an empty canine alveolus, but in neither can a replacing tooth be determined with certainty.

In the lower jaw a hollow lying lingually of the posterior end of the inner free-edged flange of the dentary is frequently present and this in four cases houses a small tip of the replacing canine.

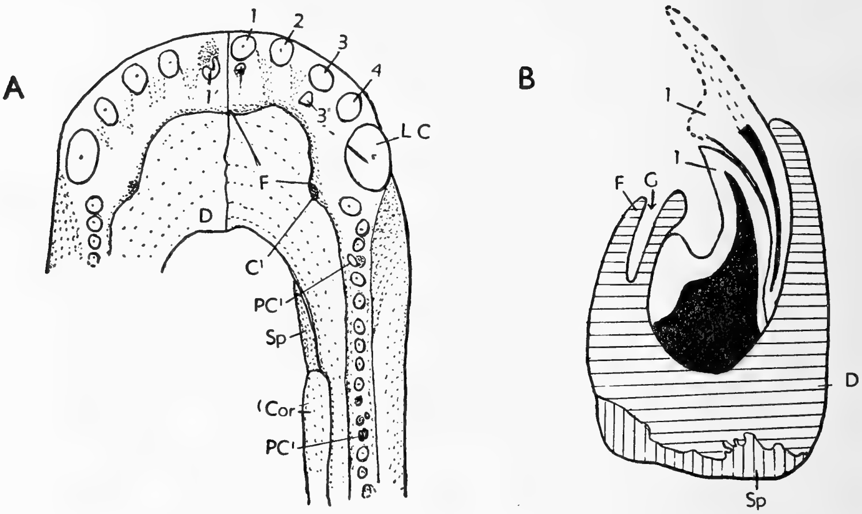


Fig. 9. *Jonkeria.* S.A.M. 9161.

A = dorsal view of mandible ×¼.
B = fracture through the jaw at the level of the first right incisor showing the dental flange (F) with its free upper border and the groove (G) lying labially. ×½.

Replacement of the Postcanines

In both upper and lower jaws the emerging cusps of replacing teeth can frequently be seen, each lying lingually of either a functional tooth of the same family or of an alveolus from which its predecessor has disappeared (fig. 7). The replacing crown-tips appear on the alveolar border without the development of a fenestra in the lingual wall of the jaws as is the case in both incisors and canines. Some, at least, of the replacing postcanines arise in separate alveoli lying lingually of those of the functional teeth and these alveoli coalesce on the loss of the functioning tooth. The erupting teeth appear as striate, serrate tips triangular in outline.

Usually each series of postcanines has only a few replacing tips showing, but in a few specimens a larger number—up to 9—have erupted at more or less the same time. At the most 3 adjacent teeth have been seen erupting together, but mostly the erupting teeth appear at irregular intervals.

DESCRIPTIVE

(Specimens Taxonomically)

Titanosuchidae

Genera ARCHAEOSUCHUS and SCAPANODON

The dental material which constitutes the types of these genera is so poorly preserved that no useful purpose will be served by attempting to add to Broom's descriptions.

Genus PARASCAPANODON

Parascapanodon avifontis

(Fig. 10)

S.A.M. 9127. Type. Voëlfontein, P.A. Collected Boonstra 1929.

This specimen consists of parts of a skull including parts of the upper and lower jaws together with good bones of the postcranial skeleton.

Apart from some roots of the upper incisors there is an incomplete right mandibular ramus showing the roots of most of the teeth.

Of the incisors only the root of the fourth is present. The canine root is oval in section (diams. 28 and 36 mm.) and the lingual wall of the alveolus shows an opening for the replacing canine. The set of postcanines consisted of 21 teeth of which the first is much larger than the rest. Nos. 8, 10, 12 and 15 are replacing teeth lying lingual of alveoli from which the former set has fallen out.

The length of the postcanine series is 180 mm.

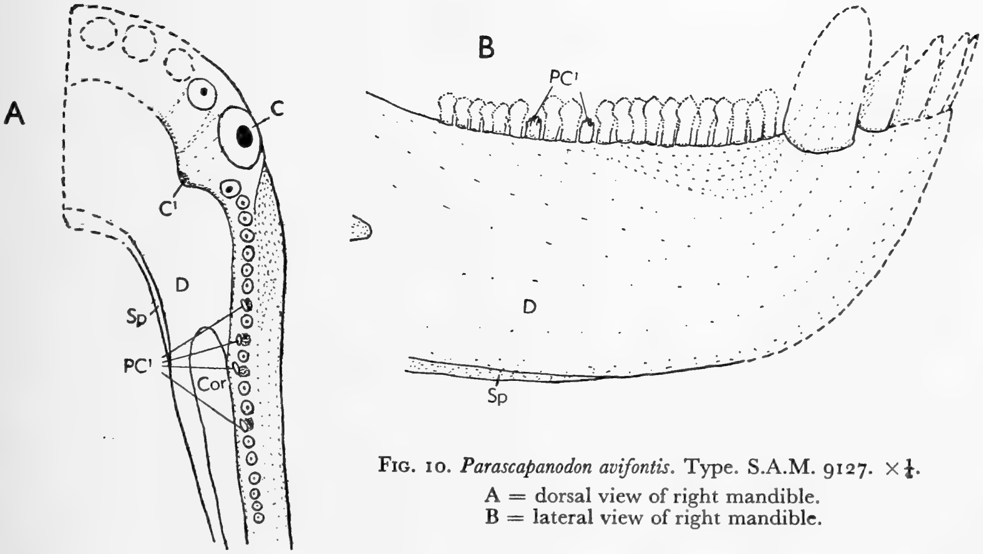


FIG. 10. *Parascapanodon avifontis*. Type. S.A.M. 9127. ×½.
A = dorsal view of right mandible.
B = lateral view of right mandible.

Parascapanodon sp.

S.A.M. 12213. Kroonplaas, B.W. Collected Boonstra 1959.

Under this number there are parts of at least three individuals found together. Besides some skull pieces, a number of isolated loose-lying teeth and a fibula, are preserved:

A (fig. 11). A fairly good anterior two-thirds of a mandibular arch in which crowns of the teeth are preserved in a fair condition. The dental formula is $\overline{\text{i } 4, \text{ c } 1, \text{ pc } 19}$.

Incisors

On the left side the crowns are broken off just below the heel. Lingually of No. 2 lies the erupted crown of its replacement. It lies in the groove just

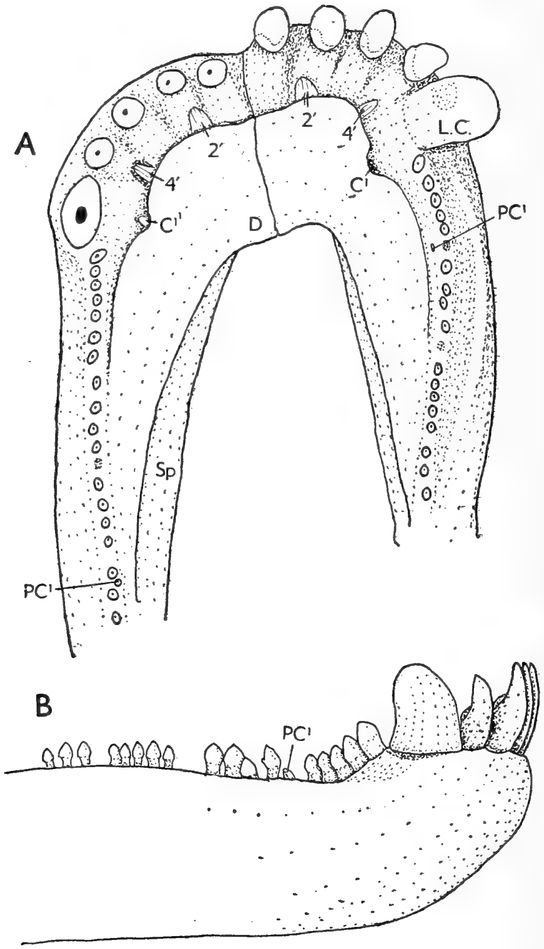


FIG. 11. *Parascapanodon* sp. S.A.M. 12213 A. ×¼.
A = dorsal view of mandibles.
B = lateral view of the right mandible.

anterior to the flange of the dentary and against the lingual alveolar wall of the functioning tooth. Its inner face is striate. Lingually of No. 4 a pocket in the alveolar wall contains the crown of its replacement.

In the right dentary the four incisors are well preserved—only the tips of the talons being lost. The heels of all four are very well preserved, and are very little worn so that the lingual edge still forms a raised edge with a hollow between this edge and the posterior face of the talon; and in No. 4 the posterior surface of the talon still shows fairly coarse striae.

Lingual of Nos. 2 and 4 replacing crowns are present in their respective pockets.

The fact that replacing crowns are already showing, while the functioning crowns are still little worn, indicates that considerable time may elapse before the actual replacement takes place.

Canines

The left canine is broken off at the base of the crown, which is here oval in section with diameters 39 and 28 mm. Of the right canine the tip of the crown is lost. It is a moderately sized tooth (basal diameters 38 × 28 mm.) directed much outwards. On its antero-internal face there is an oblique groove in which the 5th upper incisor fitted in occlusion.

Lingual to both canines there is a notch in the flange of the dentary and a pocket in the internal alveolar wall for the emergence of the replacing canines.

The Postcanines

On the left dentary only a few crowns are preserved—the rest being broken off below the spatulate crown. The presence of 19 postcanines can be determined occupying 197 mm.—No. 12 is represented by an empty alveolus and there is a replacing crown lying postero-lingual to No. 17. No. 1 is large (diams. 9 × 7 mm.), whereas No. 5 is only 7 × 6 mm. and the others approximately of this size.

In the right dentary the crowns of the postcanines are better preserved. The original presence of 19 teeth occupying 188 mm. can be determined. No. 6 and No. 11 are represented by empty alveoli and lingual of alveolus 6 is a replacing crown.

The crown of the 1st postcanine is widely spatulate, with a convex outer and a flattened internal face; the edges are sharp and coarsely serrate. This, as also the other postcanines, have their spatulate crowns lying obliquely to the long axis of the skull, with the anterior edge lingually and the outer labially directed. In lateral view they thus overlap where closely spaced.

The other postcanines are very similar to No. 1, except that their crowns are smaller and the spatula more sharply triangular in outline. There is a gradual decrease in size posteriorly.

The postcanines lie on the inner part of the upper dentary edge; external to the tooth row there is a longitudinal groove for the reception of the upper postcanines.

B (fig. 12). A mandibular arch in somewhat better condition than A.

In the left dentary the four incisors and the canine have the major part of their crowns preserved; of the postcanines only the first five and last two are preserved and they occupied 194 mm.

In the right dentary most of the crowns of the four incisors, canines and the original 18 postcanines are preserved. The postcanine series measures 199 mm. and lingual of No. 7 there is a replacing crown and No. 13 is represented by an empty alveolus.

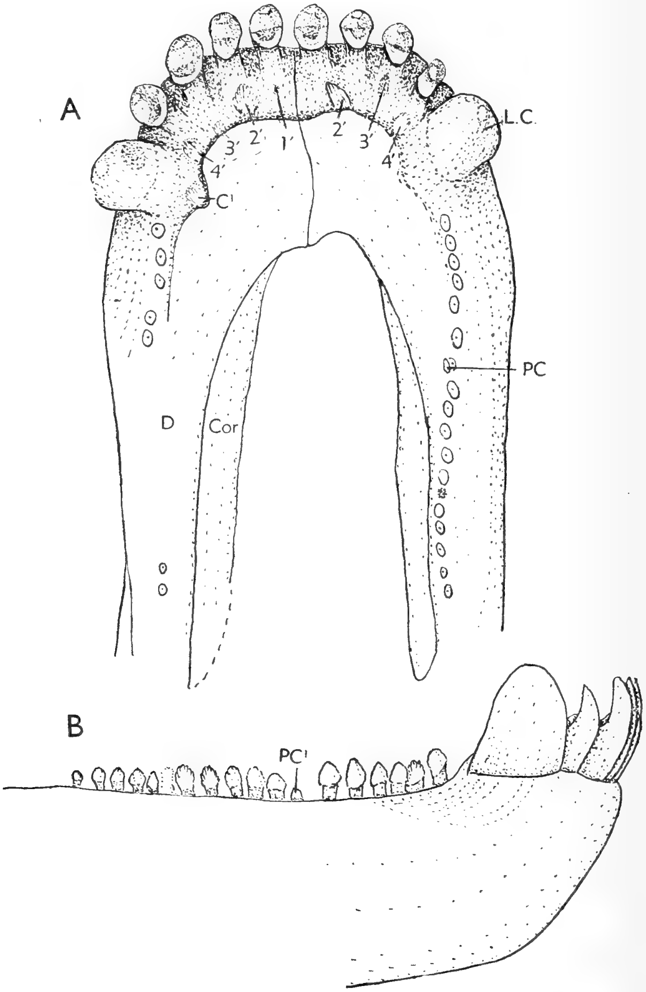


FIG. 12. *Parascapanodon* sp. S.A.M. 12213 B. ×¼.
A = dorsal view of mandibles.
B = lateral view of right mandible.

Incisors

The talons of the incisors are all lost except in No. 4 right. All the heels are very well preserved. The heel of No. 2 left has been worn fairly flat, whereas in all the others the lingual edge of the heel is still sharp; between this sharp ridge and the posterior face of the talon the face of the heel is hollowed out. In all, the inner corner of the heel is higher than the outer corner—the attritional face thus lies obliquely to the frontal plane.

On the left side replacing crowns lie in pockets of the alveolar wall of Nos. 2, 3, 4, and there is an empty pocket behind No. 1.

On the right side a strong replacing talon emerges obliquely from a pocket behind No. 2; the pocket behind No. 4 contains a tip, and empty pockets lie behind Nos. 1 and 3.

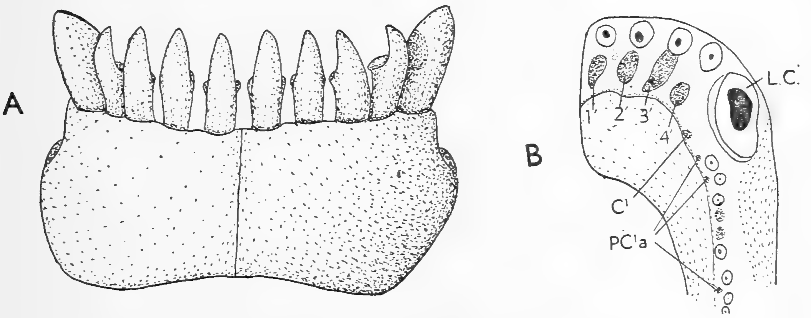


Fig. 13. *Parascapanodon* sp. × ¼.
A = S.A.M. 12213 B. Anterior view of the lower jaw.
B = S.A.M. 12213 C. Dorsal view of dentary.

Canines

All except the tips of both canines is preserved. The canines are large teeth, oval in cross-section. The diameters at the crown base are for the left 37 × 28 mm. and for the right 43 × 28 mm. Both canines are directed outwards. On the antero-internal face of the left canine there is a hollowed-out attritional face against which the upper 5th incisor worked.

The Postcanines

The spatulate crowns stand obliquely to the long axis of the skull; they are triangular in outline with sharp edges and are coarsely serrate. The outer face is convex and the inner fairly flat. The last five are appreciably smaller than their predecessors in the series. The postcanines are implanted on the inner upper edge of the dentary with a shallow groove externally for the reception of the upper postcanines.

C (fig. 13B). A weathered anterior part of the dentary shows the roots of all four functional incisors, but all four have reached the age at which they are to be shed. Lingually of each is a large empty alveolus from which the replacing tooth has been lost. In No. 3 the alveolus, which housed the replacing tooth, has labially become confluent with the older alveolus housing the functional older tooth of the family. In the other three the alveoli of the replacing teeth are still separate from the older alveoli of the still functioning teeth.

The canine crown is broken off at its base where the diameters are 44 × 27 mm. The pulp cavity is large. The inner alveolar wall has a pocket for the replacing canine.

Evidence of nine postcanines is preserved; Nos. 4 and 5 are represented by empty alveoli and pockets for replacing teeth lie lingually of Nos. 1, 2 and 8.

Parascapanodon sp.

(Fig. 14)

S.A.M. 12219. Bosluiskraal, Laingsburg. Collected Boonstra 1959.

This specimen consists of a good left half of a snout and much of the postcranial skeleton.

The snout has its left half preserved in natural occlusion, but upper incisors Nos. 4 and 5 and the upper canine have fallen out of their respective sockets. The intermeshing of the incisors and canines is very clearly shown in this specimen. The first upper incisor is a very slender tooth. The lower canine is directed much outwards to pass outside of the maxillary edge.

A well-developed striate replacing crown lies in a pocket lingual of the right upper No. 1 incisor and a less developed one behind the left No. 1 incisor.

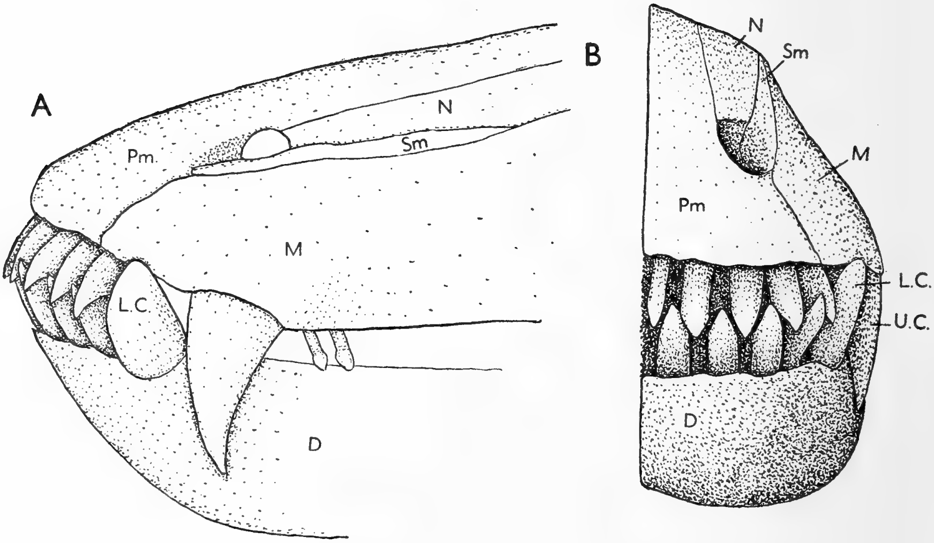


FIG. 14. *Parascapanodon* sp. S.A.M. 12219. × ¼.
A = lateral view of snout. B = anterior view of the left half of snout as partly restored.

Parascapanodon sp.

S.A.M. 1204. Letjiesbos, B.W. Collected Whaits 1908.

This specimen (fig. 15) consists of the mentum of the lower jaw in which the incisors are fairly well preserved together with part of a canine crown and three postcanine crowns.

Incisors

Most of the crowns of the eight incisors are present; the heel is imperfect in one but present in the other seven where only the talons are partly lost, but these can be restored with confidence as is shown in the figures.

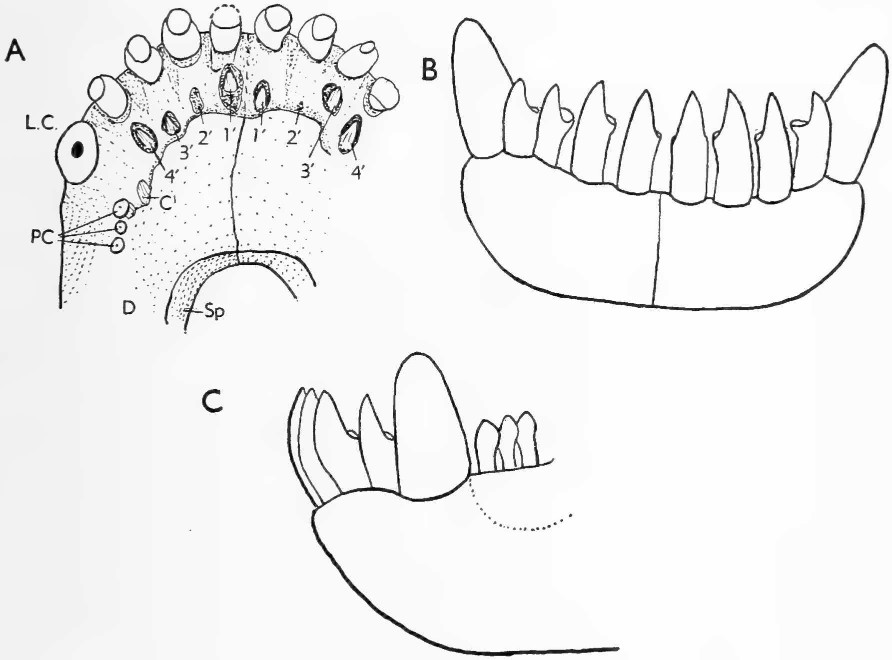


FIG. 15. *Parascapanodon* sp. S.A.M. 1204. × ½.
A = dorsal view of lower jaws. B = anterior view of lower jaws. C = lateral view of the left mandible. Partly restored.

On the left side the four heels are excellently preserved in different stages of wear. No. 1 is worn smooth and nearly flat, in No. 4 there is still an indication of a lingual ridge, whereas in No. 3 and particularly in No. 2 the lingual ridge is still sharp and the face of the heel somewhat hollowed out. If the degree of wear is a criterion of age the order from oldest to youngest would be 1, 4, 3 and 2.

In the lingual wall of the alveolus of each functioning incisor there is a pocket. In pockets Nos. 1, 3 and 4, talons of the replacing incisors are present, whereas that of No. 2 is empty. The replacing talons are in outline isosceles triangles, with longitudinally striate faces. According to the degree of development the order of eruption would be 1, 4, 3 and 2 agreeing with the degree of wear of the functional incisors.

On the right side the heel of No. 4 is damaged, that of No. 3 is worn flat, that of No. 1 fairly flat, and in No. 2 there is still a sharp lingual edge. The order of wear is thus 3, 4, 1, 2.

Lingually there are again four pockets in the alveolar wall. No. 2 is empty, whereas the others house replacing talons. The replacing order is 3, 4, 1 and 2.

Lingual of the replacing teeth the free upper edge of the flange of the dentary forms a high sharp edge.

Canines

The base of the left canine is preserved, with basal diameters of 33 and 25 mm. Lingual of the canine, at the edge of the dentary flange, a pocket contains the replacing canine tip.

Postcanines

Only three spatulate postcanines have their crowns preserved, with a replacing crown lying lingually of No. 1.

Jonkeriidae

Genus JONKERIA

Jonkeria cloetei

S.A.M. 731. Type Gamka River. Presented by Mr. Justice Cloete.

This type (fig. 16) consists of the anterior part of a left dentary, showing in section the roots of 4 incisors, 1 canine and the first four postcanines. The incisors were apparently fairly lightly built teeth. Lingually of each incisor the

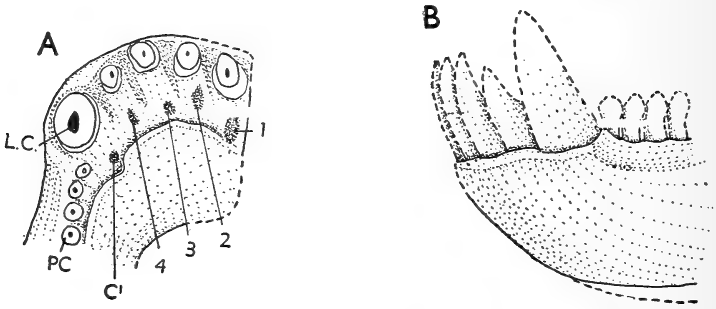


FIG. 16. *Jonkeria cloetei*. Type S.A.M. 731. ×¼.
A = dorsal view of left dentary.
B = lateral view of left dentary.

inner alveolar wall of the functioning incisors has been resorbed to form pockets through which the replacing incisors would in time have appeared. According to the development of these pockets the replacing order would have been 2, 4, 1, 3.

The base of the canine is only slightly oval in outline with diameters of 31 and 25 mm.

Lingually the alveolar wall of the functioning canine also shows a pocket and notch for the emergence of the replacing canine.

The roots of the four postcanines are large, with the first—with diameters of 7 and 10 mm.—smaller than those lying posteriorly.

The flange of the dentary with its free upper edge is well shown.

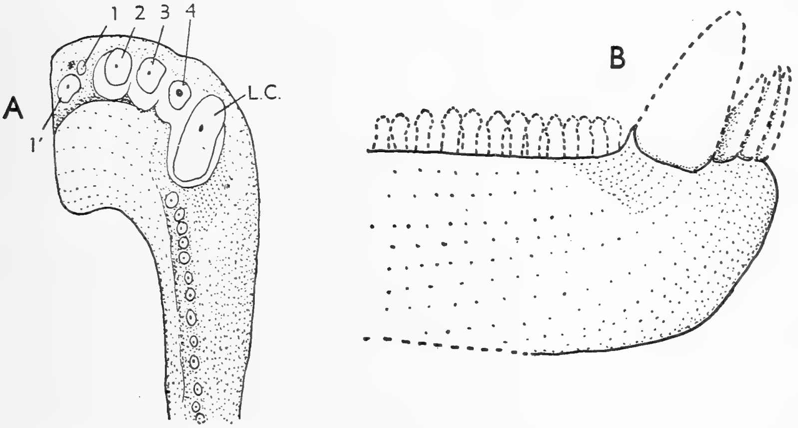


Fig. 17. *Jonkeria dubius*. Type S.A.M. 2759. ×¼.
A = dorsal view of right dentary.
B = lateral view of right dentary.

Jonkeria dubius

S.A.M. 2759. Type Platfontein of Abrahamskraal, P.A. Collected by Haughton 1913.

This type specimen (fig. 17) consists of the anterior part of a right dentary in which only the roots of the teeth are shown in section. There are four roots of functional incisors, No. 1 shows only the tip of a root lying in an alveolus from which it is just about shed, and intero-lingually lies a well-developed replacing incisor already occupying the functional alveolus. The other three incisors, as well as the canine, have the inner alveolar walls strongly developed as encasing sheaths. The flange of the dentary extends high up to almost meet the inner face of the alveolar walls at a high level.

The canine has a large root, which in outline is a long pinched-in oval with diameters 47 and 27 mm.

Of the postcanines the first 13 have their roots preserved. The first is the largest (diameter 9 × 8 mm. whereas the others have on the average diameters of 7 × 7 mm.).

The depression for the reception of the upper canine immediately behind the lower canine forms a deep anteriorly directed groove.

On the inner face of the dentary, where the splenial has fallen away, there are embedded an incisor and two postcanine crowns, possibly from the upper jaw.

Jonkeria haughtoni

S.A.M. 4343. Type Welgemoed, P.A. Collected Haughton 1916.

This type (fig. 18) consists of a fair skull without mandible, but with much of the postcranial skeleton.

Incisors

On the left the tip of the premaxilla has been lost and only sections of the roots of the five incisors can be seen at depth. On the inner alveolar face there are pockets for the replacements of Nos. 2 to 5 with crown tips of Nos. 3 and 4 lying in their pockets. The replacing order appears to be 3, 4, 5, 2, 1.

In the right premaxilla the crowns of Nos. 4 and 5 are very well preserved, whereas the other three are broken off at the alveolar border.

As preserved the incisors are directed very much anteriorly, but most of this is due to the dorso-ventral crushing of the skull after death.

The two preserved crowns differ from those known in other forms. In No. 4 the inner face of the talon runs obliquely from the heel to the tip without the usual distinctive face on the heel itself, which in other forms is either flat or hollowed out. In No. 5 this sloping inner face is also evident, but in this tooth it is bipartite—the outer and greater part is for the reception of the lower canine.

Lingually of the right incisors there are four pockets in the alveolar wall for the replacements 2–5; in Nos. 2 and 4 there lie the striate tips of the talons of the replacing teeth. The replacing order appears to be 4, 2, 5, 3, 1.

Canines

In the left maxilla there is an irregular empty alveolus from which the canine has dropped out and lingually of this there is a shallow pocket for its replacement. As this pocket contains no replacing crown it is reasonable to assume that the functional canine has not been naturally shed but lost *post mortem*, otherwise the animal would have been without a functioning canine for an inconveniently long time.

The right canine has its crown very well preserved. As preserved, it is rather short and greatly recurved and directed much outwards—this may be unnatural and really due to the aforementioned dorso-ventral crushing the skull has undergone. At its base the crown has diameters of 42 and 24 mm. and a crown length of at least 60 mm.

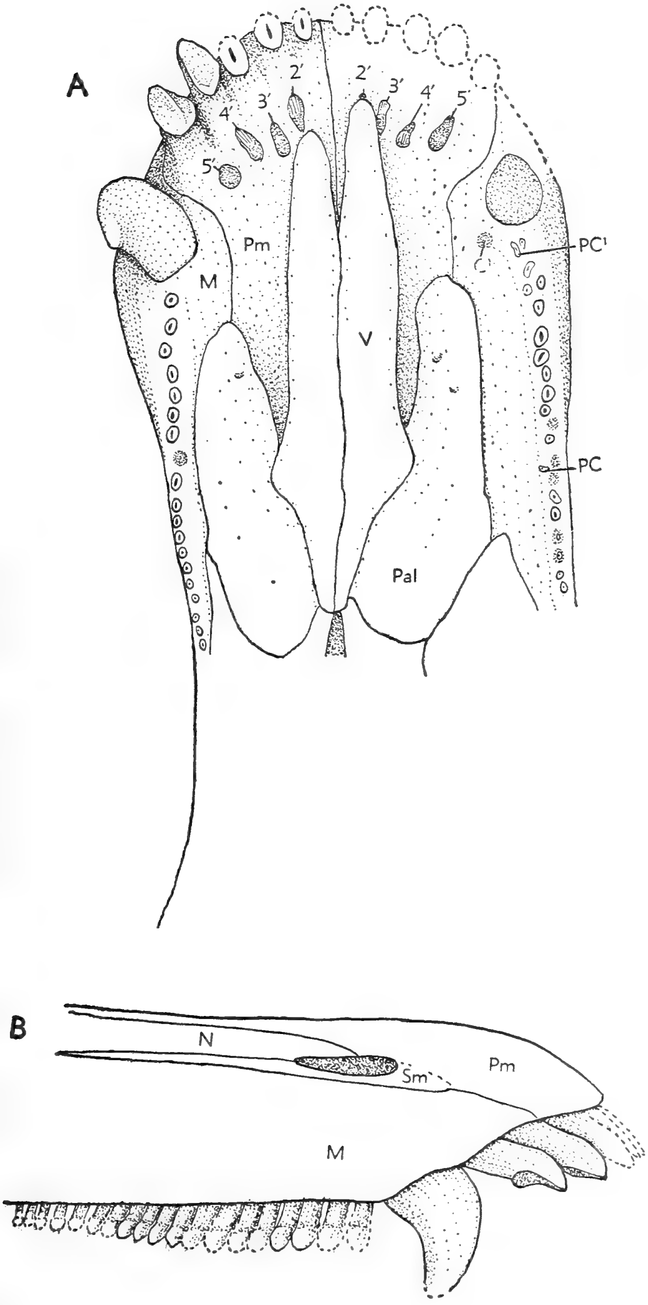


Fig. 18. *Jonkeria haughtoni*. Type S.A.M. 4343. × ¼.

A = ventral view of the anterior half of the palate.
B = lateral view of the right side of the snout.

Postcanines

On the right side some of the crowns are preserved, whereas on the left only the roots are to be seen in section. The backward slant of the preserved crowns is again due to the crushing the skull has undergone.

On both maxillae there is evidence of 19 postcanines, occupying on the right 187 mm. and on the left 188 mm.

On the right side no replacing teeth can be determined and No. 8 is represented by an empty alveolus. On the left there are replacing teeth lingual of Nos. 1 and 3 and lingual to the empty alveoli of Nos. 12 and 13 is another replacement. Alveoli Nos. 16 and 17 contain two small tips and alveoli 10, 12 and 13 are empty.

Jonkeria boonstrai

S.A.M. 9079. Rietkuil, B.W. Collected Boonstra 1929.

This specimen (figs. 7 and 8), which has been referred to Janensch's type, consists of a weathered disarticulated skull, with good upper jaws and part of the mandibular ramus.

Incisors

In the right premaxilla the roots of five incisors are present, with pockets in the inner alveolar walls of Nos. 1, 3 and 5, in which lie the crown tips of replacements 1 and 3, whereas no crown tip has as yet been formed for No. 5. The replacement order is 1, 3, 5, ?, ?.

On the left side the roots of Nos. 1, 4 and 5 are definitely present, whereas those of 2 and 3 are indefinite. Four pockets in the inner alveolar wall can be seen, each housing a tip of the replacing tooth. The replacement order is 5, 2, 4, 1, 3. The lingual face of replacing No. 5, which is well developed, shows coarse striae, and the edge, which in outline is elongated triangular, is coarsely serrate with blunt rounded serrations.

Canines

The canine roots have the following diameters: left 40 × 39 mm., right 40 × 30 mm. Lingually of each canine there is a pocket in the alveolar wall indicating where the replacing canines are to appear.

Postcanines

Both maxillae show a good series of roots of functional postcanines and crowns of the replacing set. On both sides the complete set consisted of 18 teeth, with the first larger than the rest, which gradually decrease in size posteriorly. On the right side the series measures 169 mm. and on the left 170 mm. in length.

On the right side Nos. 9, 10 and 13 are represented by empty alveoli and lingual to Nos. 1, 2, 5, 8 and 11 are pockets for replacements and lingual to 6, 9, 10, 13 and 15 there are tips of the replacing teeth showing.

On the left side No. 6 has an empty alveolus, linguo-anteriorly of No. 1 there is a fairly large pocket for a replacing tooth, and lingually of Nos. 1, 2, 3, 5, 6, 10 and 11 there are replacing crowns. The large pocket may be for a tooth anterior to the one I am considering the first postcanine, which would then be the second.

The erupted crowns of the replacing postcanines are triangular to spatulate in outline with serrate edges composed of blunt rounded cusplets and the inner face is finely striate.

The Lower Jaw

Of the anterior part of the left dentary (fig. 8) I have cut three slabs in frontal section to show the roots of the teeth in use and the stages of development of the replacing tooth.

Section A shows the roots of the four functioning incisors, the canine and the first postcanine. Lingually there are cavities behind Nos. 2 and 4 which contain the beginnings of the cusps of the replacing incisors. Lingually of Nos. 1 and 3 there are empty cavities as yet not showing any dentine of replacing Nos. 1 and 3. Lingual of replacing No. 2 there is an empty cavity presumably for the successor to replacement No. 2.

Lingually of the canine root is a pocket which contains the tip of the crown of the replacing canine lying loosely in the pocket.

Section B still shows the functioning teeth roots; behind No. 2 a crescent of dentine in a large cavity is that of replacement No. 2; replacement No. 1 is represented by an empty cavity and lingual of replacement 2 the cavity for its replacement is also still empty. Two empty cavities situated far lingually may be for the second replacements of 3 and 4.

The replacing canine is here seen to occupy the antero-labial part of a cavity.

Section C. Besides the roots of the functioning teeth this section shows that labially of the root of the functioning No. 4 incisor there lies the still unresorbed root remnant of an older fourth incisor. The two empty cavities are presumably those of replacement No. 4 and the second replacement of No. 2.

Jonkeria vanderbyli

S.A.M. 11884. Skroefpaal, P.A. Collected by Boonstra and Rossouw in 1948.

This fairly well-preserved and complete skull, with the lower jaws preserved in natural occlusion, has been referred to Broom's type (figs. 19 and 20).

In separating the lower jaws from the upper, the crown of the right lower canine has broken off and lies in its occlusional position, viz. between the upper canine and the 5th upper incisor; similarly the crown of the upper right canine is broken off near its base and lies in its occlusional position, viz. labial to the first 4–5 lower postcanines.

Incisors

Both premaxillaries carry five functional incisors. The No. 1 pair are smaller teeth lying close together. On the left side the inner alveolar wall is fenestrated behind Nos. 1, 3, 4 and 5, and in each pocket lies the crown of a replacement tooth, triangular in outline and with its inner face striate. The replacement order is 5, 1, 3, 4, 2.

In the dentaries four incisors are preserved on the left side and three on the right side—No. 1 being lost. No replacements have been exposed.

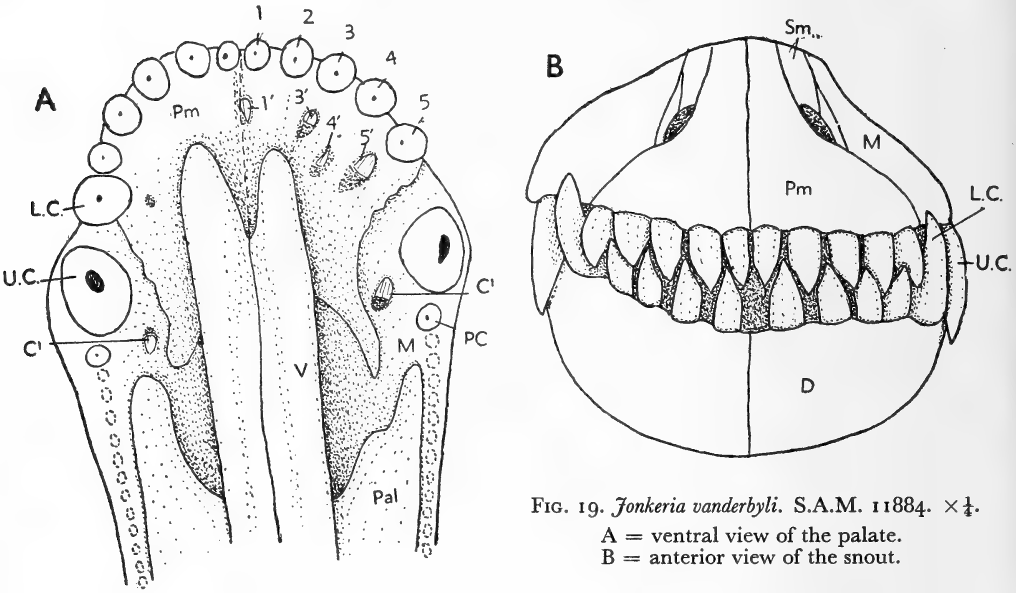


Fig. 19. *Jonkeria vanderbyli.* S.A.M. 11884. × ¼.
A = ventral view of the palate.
B = anterior view of the snout.

This specimen again very clearly shows the intermeshing of the upper and lower incisors. The pair of slender upper Nos. 1 having their talons passing in between the lower Nos. 1, with the outer halves of their heels meeting the inner halves of the heels of the lower incisors; upper No. 2 passes between lower Nos. 1 and 2, and No. 3 between 2 and 3; No. 4 between 3 and 4, and No. 5 between lower 4 and lower canine.

Canines

The upper canines are large, pointed and curve backwards. The length of the crown is at least 90 mm. and the basal diameters are right 49 × 36 mm. and left 45 × 34 mm.

In the pockets lingual of each canine lies the tip of the replacing canine.

The lower canines are smaller than the upper and are directed forwards and outwards. The basal diameters are right 29 × 27 mm. and left 27 × 27 mm., and the lengths 50 mm. and 45 mm.

The lower canines intermesh between the upper fifth incisor and the upper canine.

Postcanines

The upper postcanines are very poorly preserved—in fact, most have fallen out after death and their alveoli are difficult to determine. It is clear, however, that on both sides the first postcanine is much larger than those further back.

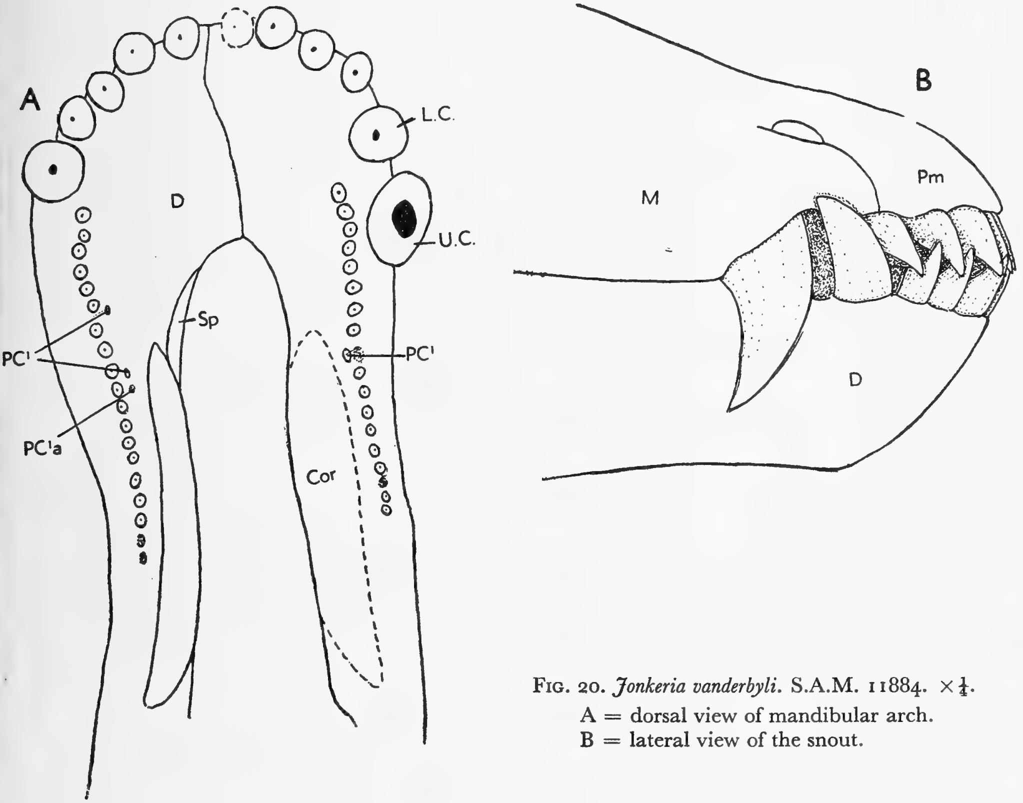


Fig. 20. *Jonkeria vanderbyli*. S.A.M. 11884. × ¼.
A = dorsal view of mandibular arch.
B = lateral view of the snout.

In the dentaries the postcanines are fairly well preserved. On the right side 18 teeth occupy 180 mm.—Nos. 9 and 16 are represented by empty alveoli and lingual of alveolus No. 9 lies a replacing crown. In the left dentary 19 teeth occupy 180 mm. Nos. 18 and 19 are represented by empty alveoli. Lingual to Nos. 6 and 9 lie replacing crowns and lingual to No. 10 is an empty alveolus.

Jonkeria truculenta

S.A.M. 12030. Bosluiskraal, Laingsburg. Collected Boonstra 1956.

This specimen (figs. 5, 21, 22, 23, 24, 40 and 41) consists of a fairly good though somewhat distorted skull, which I am referring to van Hoepen's species.

In both upper and lower jaws of the left side the dentition is particularly well preserved and on the right side sectioning shows complementary features. On the left side the dental formula is: i $\frac{5}{4}$, c $\frac{1}{1}$, pc $\frac{18}{18}$.

Incisors

In the left premaxilla (fig. 21) the root only of No. 1 is preserved, whereas the other four incisors have most of the crowns present. The heels of Nos. 3 and 4 are worn flat, whereas in No. 2 the heel has a fairly sharp ridge, bounding a hollow lying between it and the talon, and in No. 5 the inner face of the talon is bipartite with the outer part, which receives the lower canine, the greater.

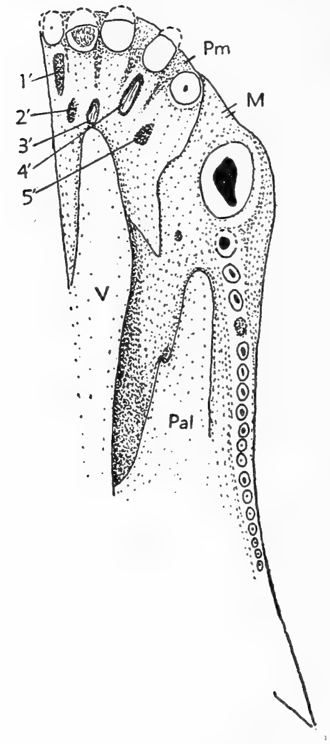


Fig. 21. *Jonkeria truculenta.* S.A.M. 12030. ×¼. Ventral view of left half of snout.

Lingual of each incisor there is a pocket in the inner alveolar wall of the functioning incisors of which Nos. 3 and 4 house replacing tips and the others as yet empty. The replacing order is 1, 4, 3, 5, 2.

In the right premaxilla I have cut two frontal sections (fig. 24B):

1. shows the roots of five incisors with No. 1 a slender tooth. Five lingual pockets are present, of which Nos. 2, 3 and 4 contain the talons of the replacing incisors and the other two are empty.
2. again has the roots of the five functional incisors; cavities 2 and 3 contain replacement teeth and Nos. 1 and 4 are empty.

The replacing order is 2, 4, 3, 1 and 5.

In the left dentary (fig. 23) four incisors are preserved; No. 4 has lost its crown; No. 3 is well worn so that the occlusial surface of the heel is smoothly flat and the talon so worn on its lingual face that all that remains of the talon is a weak cone; No. 2 is much less worn and has a fairly strong talon; No. 1 just shows the tip of a talon which appears to be piercing a plug of cancellous bone filling the alveolus.

Three frontal sections of the right dentary (fig. 24A) show:

1. Just below the alveolar level four incisor roots; lingually of Nos. 2 and 4 there are pockets in whose anterior part lie sections across the talons of the replacing teeth; lingually of No. 3 is an empty pocket. The flange of the dentary lying lingually of these pockets is seen as a loose strip of bone.

2. Lying 9 mm. deeper this section shows replacement No. 2 lying in its pocket, a cavity housed the replacement of No. 3 and cavity No. 4 is empty.

   Lingually of the functional canine root lies a pocket housing the replacing canine.
3. Here an empty cavity for replacement of No. 1 is seen and a replacement of the third postcanine.

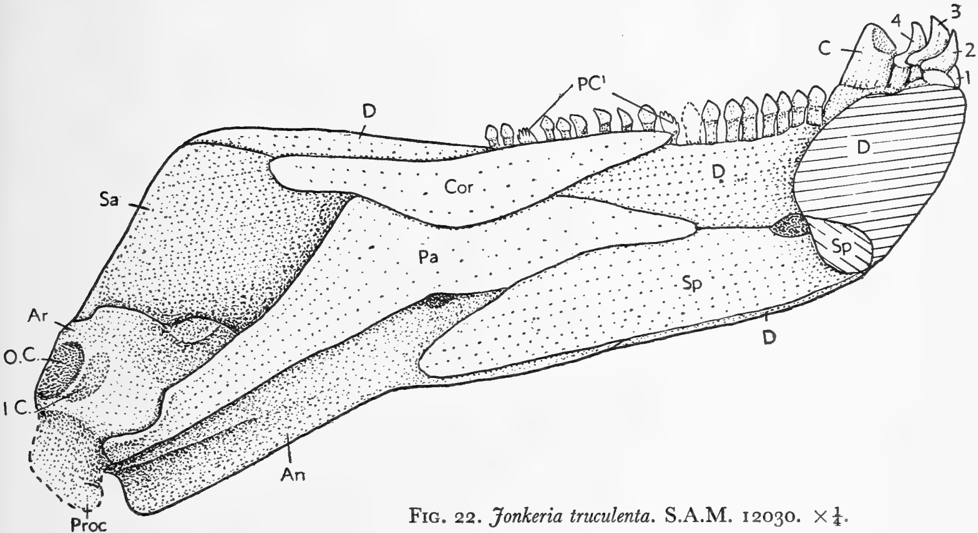


FIG. 22. *Jonkeria truculenta.* S.A.M. 12030. ×¼.
Inner face of left mandible.

Canines

The left upper canine is beautifully preserved. The crown length is 90 mm. and at its base its diameters are 42 and 29 mm. It is thus a long, moderately strong tooth and has only a moderate posterior curvature; its posterior face is rounded with no indication of a cutting edge. The right upper canine has diameters of 50 and 24 mm. A small pocket for the left replacing canine lies linguo-posteriorly of the functional canine.

The left lower canine is fairly well preserved; its length is 41 mm. and its basal diameters are 24 and 31 mm. It is thus quite a moderately sized tooth. It is directed both forwards and outwards. Just behind its tip there is an oval hole which is a result of resorption of the dentine. Its antero-dorsal face is excavated to form a heel bearing some similarity to that typical of the incisors. The fifth upper incisor fits with the postero-external part of its heel into this heel of the lower canine. The mode of intermeshing is thus as is typical of the incisors. Lingually of the canine base there is the usual notch in the flange of the dentary for the replacing canine.

In the right dentary, sectioning shows a canine root with diameters 30 × 20 mm. and a pocket containing the tip of the replacing canine.

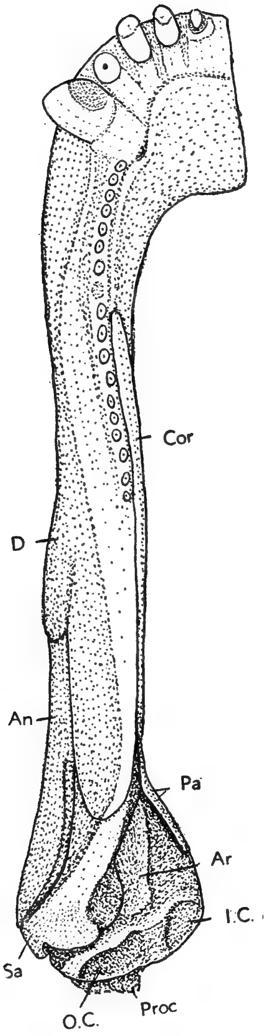


FIG. 23. *Jonkeria truculenta.*
S.A.M. 12030. × ¼.
Dorsal view of left mandible.

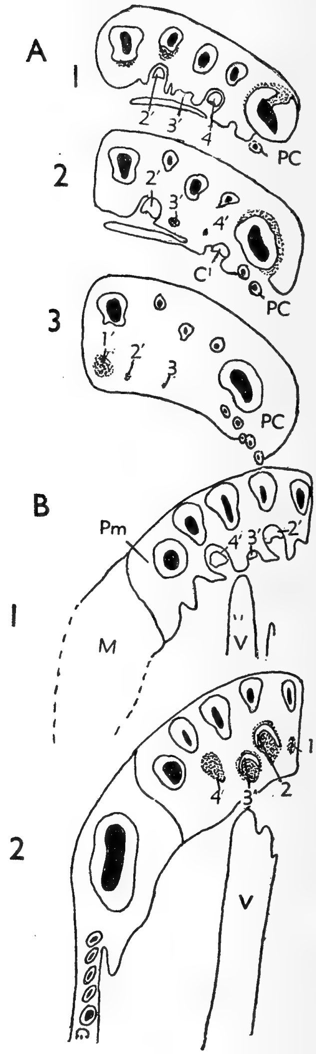


FIG. 24. *Jonkeria truculenta.*
S.A.M. 12030. × ¼.
A = Three consecutive frontal sections through the right dentary.
B = Two frontal sections through the right upper jaw.

Postcanines

In the left upper jaw (fig. 21) a well-preserved series of postcanines follows immediately on the canine without any diastema. The length of the series is 179 mm. and there were 18 teeth. No. 1 is much larger (diameters 13×11 mm.) than its immediate successors (diameters 10×8 mm.) and then the teeth gradually decrease in size posteriorly (the last 5×4 mm.). No. 4 is represented by an empty alveolus and No. 11 by the crown of a replacing tooth.

The bulbously spatulate crown is very well shown in a number of teeth. The crowns lie obliquely to the long axis, with the posterior edge directed outwards and the anterior edge inwards. The posterior edge is sharp and is separated from the main bulbously swollen part of the crown by a shallow longitudinal groove. The inner face of the crown is flattened.

In the left dentary (figs. 22, 23) a good set of crowns has been exposed from the lingual side. The series of 18 teeth occupy a length of 179 mm. No. 8 is represented by an empty alveolus. No. 9 is represented by a nearly fully erupted crown of a replacing tooth and so is No. 16. The functional lower postcanines show on their lingual faces a moderately developed heel forming a cingulum at the junction of crown and root; above this the inner face of the crown is concave with longitudinal striae.

In the unworn replacing teeth those striae are more definite and extend to the edges of the crown, which thus become serrate with rounded cusplets.

The first 4–5 lower postcanines lie lingually of the upper canine in occlusion and the rest lingually of the upper postcanines with no indication of any intermeshing.

As the upper and lower series of postcanines occupy the same length of jaw, follow immediately on their respective canines, and the lower canine lies in front of the upper canine, it follows that the posterior upper postcanines (four of them) have no lower antagonists. The first upper postcanine lies labially of the 6th lower postcanine to constitute its antagonist.

Jonkeria ingens

S.A.M. 11573. Klein-Koedoeskop, B.W. Collected Boonstra 1940.
S.A.M. 11574. Klein-Koedoeskop, B.W. Collected Boonstra 1940.
S.A.M. 11575. Klein-Koedoeskop, B.W. Collected Boonstra 1940.

Twenty years ago I excavated three quite good skulls lying together in a thin sandstone layer. In all three, few of the crowns of the teeth are preserved. Of 11573 (fig. 25) I have cut a frontal section across the premaxillaries and the other two have been serially cross-sectioned for the study of the internal structure which is being published shortly. What has been seen of the teeth confirms what has been described in the foregoing pages for other *Jonkeria* species, with little of taxonomic importance.

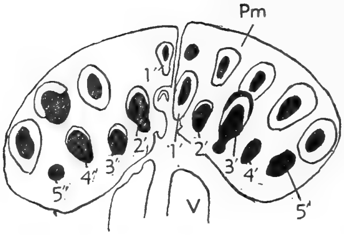
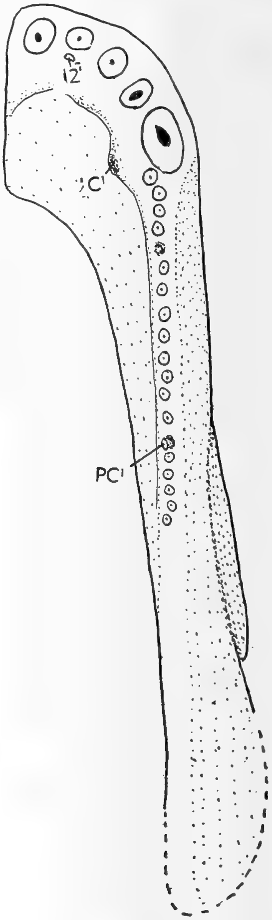


Fig. 25. *Jonkeria ingens.* S.A.M. 11573. ×¼.
Frontal section through the premaxillaries to show the replacing incisors.



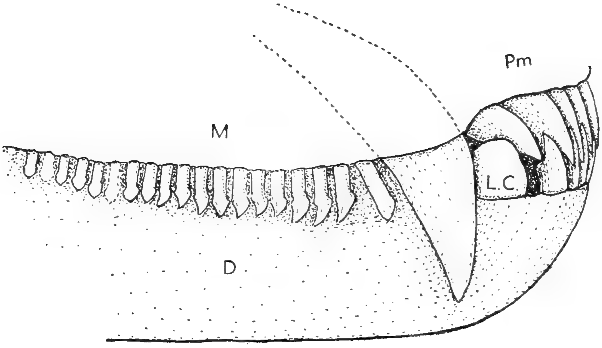


Fig. 27. *Jonkeria* sp. S.A.M. 11486. ×¼.
Lateral view of the right side of the snout.

Fig. 26. *Jonkeria ingens.* S.A.M. 12248. ×¼.
Dorsal view of right dentary.

Upper Incisors

In the right premaxilla the roots of the functional Nos. 2, 3, 4 and 5 are present with No. 1 represented by an empty alveolus. Lingually of these lie a well-developed replacement No. 1 and 3, the former in a separate alveolus and the latter growing into the old alveolus; replacement No. 2 is just developed and for replacements of Nos. 4 and 5 there are empty alveoli.

In the left premaxilla there is no trace of the functional No. 2, and No. 4 is being resorbed, Nos. 3 and 5 have well developed roots and so has the slender No. 1. Replacement No. 1 is seen in its pocket and Nos. 2, 3, 4 in separate cavities, and for No. 5 there is an empty alveolus.

S.A.M. 12248. Skoppelmaaikraal, Laingsburg. Collected Boonstra 1959.

This specimen (fig. 26) consists of the weathered disarticulated bones of both jaws, of which the right dentary is almost complete and shows cross-sections of the roots of the whole set of teeth.

Incisors

There are four functioning incisors and lingual to No. 2 there is an erupting talon of a replacing tooth lying in a separate alveolus.

Canines

At its base the canine has the diameters 37×26 mm. and, lingual to it, above the flange of the dentary, lies the pocket for its replacement.

Postcanines

There were 19 postcanines occupying 189 mm. of the jaw. The first postcanine lies immediately behind the canine. No. 5 is represented by an empty alveolus and lingual to the empty alveolus of No. 14 lies its replacing crown.

Jonkeria sp.

S.A.M. 11486. Mynhardtskraal, B.W. Collected Boonstra 1940.

This specimen (fig. 27) consists of a fair snout of which the left half has been serially cross-sectioned and the right half prepared externally to show the dentition.

Incisors

The crowns of the five right incisors are preserved in a fair state. The postero-lateral face of No. 5 receives the antero-internal attritional face of the lower canine, which clearly intermeshes between it and the upper canine.

In the right dentary the first three incisors are functional, whereas No. 4 has fallen out, but has a well-developed replacement crown occupying the lingual part of the alveolus. The tip of No. 2 replacement is also well erupted and pockets for Nos. 1 and 3 are present. The replacement order is 4, 2, 3 and 1.

Canines

The upper canine is a large conical tooth only slightly recurved. The crown is 82 mm. in length and the basal diameters 50×22 mm. The root is very large with a roomy pulp cavity, its length is at least 100 mm.

The lower canine is short (crown length 32 mm.) and weak with basal diameters 26×21 mm. It is directed outwards to lie between the upper canine and the upper fifth incisor against which it bears.

Postcanines

The upper postcanines follow on the canine without diastema. There is evidence of 19 teeth occupying 183 mm. This specimen clearly shows that the first postcanine differs from the rest; it is directed parallel to the direction of the canine and it appears to be more pointed than spatulate. Its antero-posterior diameter is 14 mm. as against 11 mm. in the second postcanine and 7 mm. in the last postcanine. Nos. 14 and 18 are represented by empty alveoli with presumably replacements lying lingually.

In the dentary there are also 19 postcanines occupying a distance of 176 mm. The postcanines have their crowns situated obliquely to the sagittal plane.

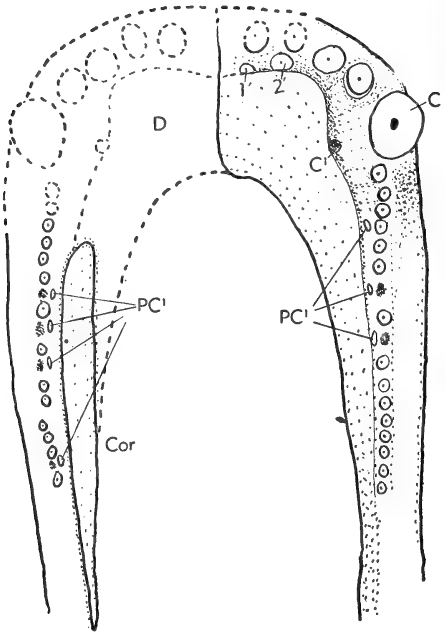


FIG. 28. *Jonkeria* sp. S.A.M. 5017. ×¼.
Dorsal view of mandibular arch.

This specimen again clearly shows that, since the postcanines follow immediately behind both upper and lower canines and the lower canine passes anterior to the upper one, the lower series cannot extend so far posteriorly as the upper series even if they were of the same length. In fact the lower series is 7 mm. shorter and ends 50 mm. anterior to the level of the last upper postcanine. The last 6 upper postcanines thus have no antagonists and the first 4–5 lower postcanines have the upper canine as antagonist.

Jonkeria sp.

S.A.M. 5017. Abrahamskraal, P.A. Collected Haughton 1917.

This specimen (fig. 28) consists of a poorly preserved skull lacking upper jaws and two imperfect mandibular rami.

Incisors

On the right dentary there are roots of the four incisors and lingually of Nos. 1 and 2 replacing talons are developed. The flange of the dentary extends high up behind the replacing teeth as in *Jonkeria dubius.*

Canines

The base of the canine crown is seen in section and the diameters are 35 × 28 mm. Lingually there is a pocket in the alveolar wall and a notch in the flange of the dentary for the emergence of the replacing canine.

Postcanines

On the right side there is evidence of a series of 17 postcanines occupying 173 mm. Nos. 7 and 9 are represented by empty alveoli lingual to which are the crowns of their replacements. A further replacing crown lies lingual of No. 4.

On the left side the dentary is incomplete anteriorly to the 3rd postcanine. Posteriorly there is evidence of 16 postcanines occupying 140 mm. Nos. 7, 9, 11 and 17 are represented by empty alveoli lingual to which lie erupting crowns of their replacements.

Jonkeria sp.

S.A.M. 9161. Wakkerstroom of Wolwefontein, P.A. Collected Boonstra 1929.

The specimen (fig. 9) consists of parts of a broken-up skull, including pieces of the upper jaw and much of the mandibular arch.

Incisors

In the right dentary four functional incisors are present, but both Nos. 1 and 3 are on the point of being shed with their respective replacements already well developed. This is particularly so in No. 1, where a lucky fracture shows the mode of replacement very well (fig. 9B). The root of functional No. 1 is nearly resorbed and in its alveolus lingually to the remains of the root lies the already well-developed replacement. The pulp cavity of functional No. 1 is closed, whereas that of its replacement is large and widely open. The talon of the replacing tooth is well shown as well as the hollowed face of the heel with its rounded lingual ridge. Lingual to the heel the inner alveolar wall is seen in section and is thus a fairly thin sheet of bone; lingual to this there is a deep groove and still further lingually the flange of the dentary with its free upper edge is seen in section.

In the left dentary No. 1 incisor is represented by an empty alveolus in whose lingual part there lies the talon of the replacing tooth.

Canines

On the left a section across the base of the canine crown is seen, which is much laterally compressed with diameters 29 and 19 mm.; on the right there is a broken crown directed much outwards with basal diameters 32 × 24 mm.

Postcanines

On the right a series of 16 postcanines occupying 154 mm. is preserved. No. 1 is much larger (diameters 11 × 8 mm.) than its successors in the series. Nos. 4, 11 and 13 are represented by erupting alveoli with replacing crowns lingual to Nos. 4 and 13. No. 12 is the remains of the root of a functional tooth with an erupting alveolus lingual to it.

Jonkeria sp.

S.A.M. 9162. Wakkerstroom of Wolwefontein, P.A. Collected Boonstra 1929.

This specimen (figs. 4 and 29) consists of the anterior half of a skull in which the bones of the jaws have become partially disarticulated and shifted from their natural position. The figures given here are reconstructions.

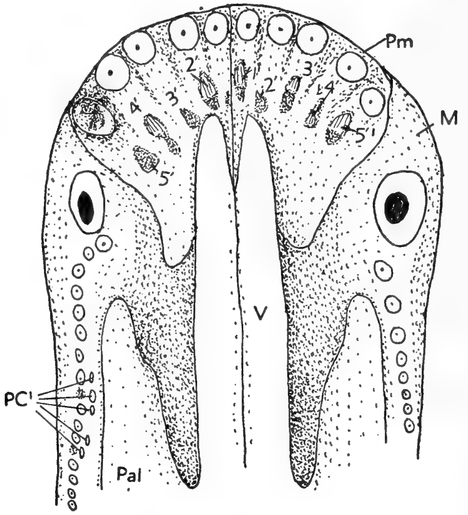


FIG. 29. *Jonkeria* sp. S.A.M. 9162. × ¼.
Ventral view of the anterior part of the palate.

Incisors

In both premaxillaries the crowns of the incisors are considerably damaged; there are five pairs with the first pair slender and situated close together. This specimen shows the intermeshing of the upper incisors with the lower, as already described, very well.

On both sides the five pockets for the replacing incisors have been exposed.

In the right premaxilla the replacing crowns of Nos. 2 and 4 are visible in their pockets and they show the elongate inner face of the talons with the edges coarsely serrate. The replacing order is 2, 4, 5, 3, 1.

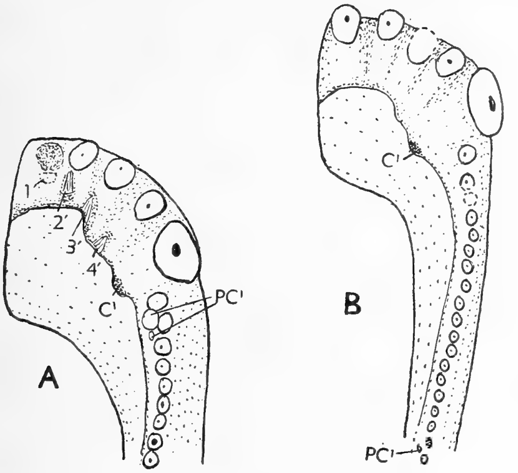


FIG. 30. *Jonkeria* sp. ×¼.
A = S.A.M. 11980. Dorsal view of right dentary.
B = S.A.M. 12021. Dorsal view of right dentary.

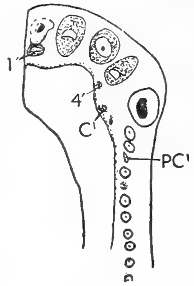


FIG. 32.
Jonkeria sp. Juv.
S.A.M. 12151. ×¼.
Dorsal view of right dentary.

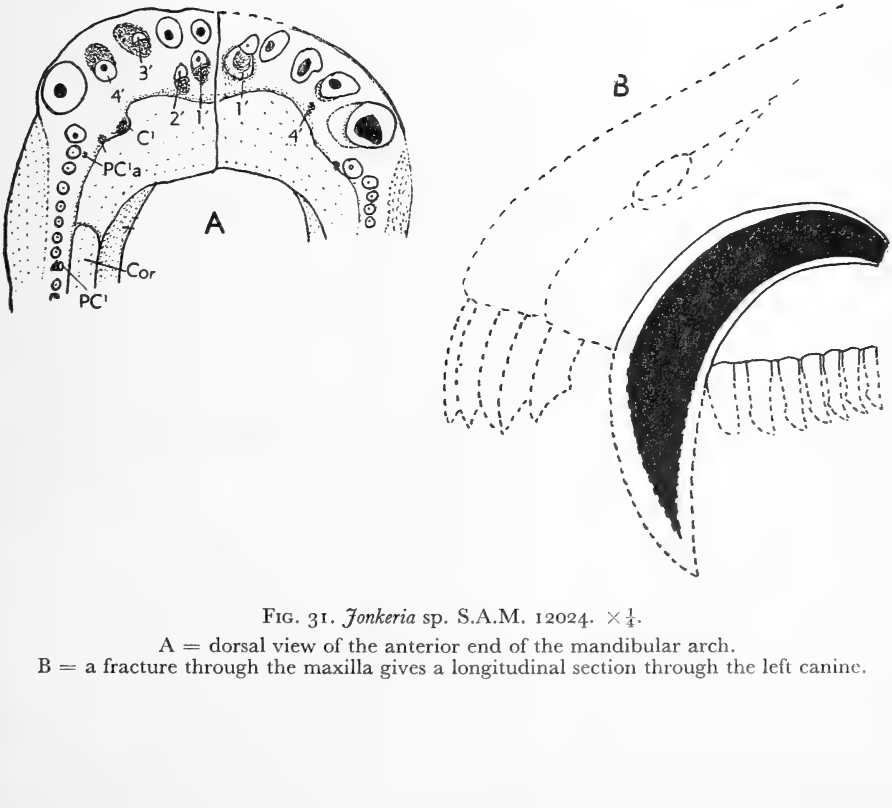


FIG. 31. *Jonkeria* sp. S.A.M. 12024. ×¼.
A = dorsal view of the anterior end of the mandibular arch.
B = a fracture through the maxilla gives a longitudinal section through the left canine.

In the left premaxilla the replacing crowns are visible in pockets Nos. 1, 3, 4 and 5, and the replacing order is 5, 1, 3, 4 and 2.

On the right side the incisors in the dentary are in the natural occlusional position with the upper incisors, and the intermeshing of the four lower with the five upper incisors is very definite.

Canines

The lower canine in occlusion lies in front of the upper canine passing outwards in between this and the upper fifth incisor. It is a moderately sized tooth with its greater basal diameter 29 mm. On the right side there is a large upper canine very little recurved; the length of the crown is at least 80 mm. with basal diameters of 43 and 28 mm.

Postcanines

The crowns of the postcanines are only preserved in some of the more anterior teeth. They have the usual swollen spatulate crowns lying obliquely to the long axis. On the right maxilla there is evidence of 17 teeth occupying 142 mm. Nos. 9 and 10 are represented by empty alveoli and lingual to Nos. 8, 9, 10, 12 and 13 replacing teeth are present.

Jonkeria sp.

S.A.M. 11980. Lammerkraal, P.A. Collected Haughton 1916.

This right dentary (fig. 30A) shows the incisor roots of Nos. 2, 3 and 4 and an empty alveolus for No. 1, lingual of which is a well-developed talon of the replacing tooth; pockets contain the replacements of Nos. 2, 3 and 4.

The canine at its base measures 34×26 mm.

Nine closely packed postcanine roots are preserved with replacements lying lingually of Nos. 1 and 2.

This may be a second specimen of *Jonkeria cloetei*.

Jonkeria sp.

S.A.M. 12021. Skoppelmaaikraal, Laingsburg. Collected Boonstra 1956.

This specimen (fig. 30B) consists of a left premaxilla and a right dentary in which the teeth are seen in cross-section.

Four functioning incisors, a canine and 19 postcanines are evident with a replacing 18th postcanine.

Jonkeria sp.

S.A.M. 12024. Skoppelmaaikraal, Laingsburg. Collected Boonstra 1956.

The specimen (fig. 31) consists of weathered broken pieces of both upper and lower jaws.

The interesting features shown are: in the left dentary incisors Nos. 1 and 2 are functional, with well-developed talons of their replacements lying lingually; in Nos. 3 and 4 well developed replacing talons are visible lying loosely in the alveoli. In the right dentary No. 1 alveolus is occupied by a very well-developed replacing tooth, which is just coming into use. The inner edge of the heel is unworn and is sharp with fine striae and the face of the heel is deeply hollowed out.

In a piece of the left maxilla fracturing has revealed the root of the canine in longitudinal section. The root is curved strongly posteriorly and has a roomy pulp cavity, which opens on to the inner maxillary face just behind the strong internal maxillary bulge.

Jonkeria sp.

S.A.M. 12151. Danskraal of Bloudraai, P.A. Collected Boonstra 1957.

This small dentary (fig. 32) is of interest in that it appears to be that of a young reptile.

The canine is small with basal crown diameters 29 and 22 mm.

Notwithstanding its assumed youth there is already an empty postcanine alveolus (No. 5), but No. 3 is a newly erupted crown.

No. 1 incisor has a pulp cavity widely open at its base, but lingually in the same alveolus there is already a replacing talon with an undeveloped root. One can thus with reason state that in youth the incisor replacement occurs rapidly and probably often. In alveoli Nos. 2 and 4 lie talons just appearing above the alveolar border, and in No. 3 there is a root lying loosely in the alveolus. Lingual to No. 4 there is already a pocket for the next tooth.

Jonkeria sp.

S.A.M. E. This specimen bears a field number E, but both the collector and the locality are unknown.

The specimen (figs. 2 and 3) consists of a left premaxilla and maxilla not in articulation with four incisors broken away from the premaxilla and one root still in the premaxilla.

Incisors

Of the incisors there is preserved: the root of No. 5; No. 4 has part of the root and crown preserved and this is in position in the piece of premaxilla, which also holds Nos. 3 and 2 in natural relation and the latter two consist of good crowns with only the tips missing; No. 1 consists of a detached crown.

All the incisors have the same general build although differing somewhat in size and proportions.

Measurements as reconstructed:

	1	*2*	*3*	*4*	*5*
Total height of crown and root	?	110	110	?	?
Height of crown	45	53	53	?	?
Maximum width of talon	14	15	18	?	?
Maximum width of heel	13	16	17	?	?
Ant.–post. length over heel	31	30	29	24	?
Height of talon	26	32	30	?	?

No. 1 is thus shorter and more slender than the others.

In the incisors the crown and root are roughly two curved cones of about equal size with their bases applied to each other, so that in side view they together have an outline resembling a sickle moon.

At the junction of crown and root there is on the inner face of the crown a ledge, shelf or heel. The inner face of this shelf looks like a cingulum lying obliquely with the outer part situated higher than the inner. This inner face is convex and on the occlusal face presents a rounded edge lying behind the half-moon-shaped depression lying between it and the inner face of the talon.

The roughly conical cusp lying below the heel is here referred to as the talon. The inner face of the talon is flattened with a low median and lateral ridges.

Canines

The canine is a large, somewhat recurved conical tooth, slightly laterally compressed so that its section is oval. The length of the crown is 110 mm. and at its base the diameters are 45 × 30 mm. From about half-way down the crown its postero-external face forms a fairly sharp edge but without any trace of serrations. It thus appears to be a remnant of a truly cutting edge.

Postcanines

The postcanines follow close on the canine without any real diastema. A series of thirteen teeth is preserved of which the first twelve occupy a length of 118 mm. They decrease in size from front to back. The first postcanine has the crown imperfectly preserved; it is directed anteriorly, whereas the others incline posteriorly; it is the largest postcanine and its greater diameter at its base is 12 mm. as against the 8 mm. of No. 2.

The postcanines all have the same general build, viz. a quite long stem oval in section, then a neck followed by a swollen spatulate crown triangular in outline. The crowns lie obliquely to the long axis of the skull, with the anterior edge lying lingually and the posterior edge labially. The outer face of the spatulate crown is convex with longitudinal striae and sharp, somewhat everted external as well as internal edges which are serrate when unworn. The inner face is flattened to concave.

No. 6 has fallen out, but lingually there lies the erupted crown of its replacing tooth with a flattish crown and serrated edges. No. 11 has its outer face coarsely striate and the edge serrate.

Comparison of the Titanosuchian Dentition with that of the Other Dinocephalian Infra-orders

Earlier in this paper I have stressed a distinctive character common to all the infra-orders of the Dinocephalia and mentioned certain striking features in the dentition peculiar to each infra-order. A more detailed consideration is, however, called for.

ANTEOSAURIA

In the mature anteosaurian skull the dental formula is $i\,\frac{5}{4}$, $c\,\frac{1}{1}$, $pc\,\frac{8}{7}$. The postcanine series thus has a small number of teeth.

Incisors

The incisors are long recurved conical teeth, the greatest length encountered being 100 mm. The housing of these greatly lengthened teeth is made possible by a retreat of the premaxillary alveolar border. Although most incisors studied have a simple conical form with an oval cross-section, there is in the South African forms a faint indication in some teeth of a differentiation of a talon and a slight heel, which is apparently more pronounced in some Russian forms. A fact which would strengthen our argument for close consanguinity with the other dinocephalians.

The intermeshing of the incisors is similar to that of the titanosuchians, but the fifth upper incisor is an antagonist of the lower canine by passing labially to it in occlusion and not anteriorly and does thus not intermesh with it. The replacement of the incisors in the Anteosauria has not been adequately studied, but in a series of five frontal sections which I have cut in one specimen (fig. 33) it is evident that the replacing incisor arises lingually of the functioning tooth as it does in the Titanosuchia. The manner of eruption, however, shows certain differences. The development of pockets in the lingual face of the alveolar wall of the functioning incisors for the emergence of the replacing incisors, which is so typical in the premaxillaries of the Titanosuchia, has not been found in the Anteosauria.

In fig. 33 the five sections show:

Sections 1 and 2: The former section passes just below the alveolar border and the latter just above. On the right side the roots of Nos. 2, 3 and 4 are those of functioning incisors. On the left the functioning incisors Nos. 2, 3, 4 and 5 are seen and lingual of No. 5 lies a section cut through the tip of the lower canine.

Section 3: On both sides the young developing crowns of pair No. 1 appear and on the left the remains of the root of an older member of the family of No. 2 incisor is seen as an as yet unresorbed remnant.

Section 4: The developing right No. 5 incisor can now be seen.

Section 5: The replacing tooth of the as yet unerupted right No. 1 incisor is already commencing its development, i.e. before the other older incisors develop any replacements.

Canines

The upper canines are large slightly recurved pointed teeth with crowns up to 120 mm. in height, flattened from side to side with a sharp posterior edge in which no serrations have been seen. The lower canines are not directed outwards to pass in between the upper fifth incisor and the upper canine as they do in the Titanosuchia, but are directed upwards and have their tips received in a hollow in the maxillary surface anterior to the base of the upper canine.

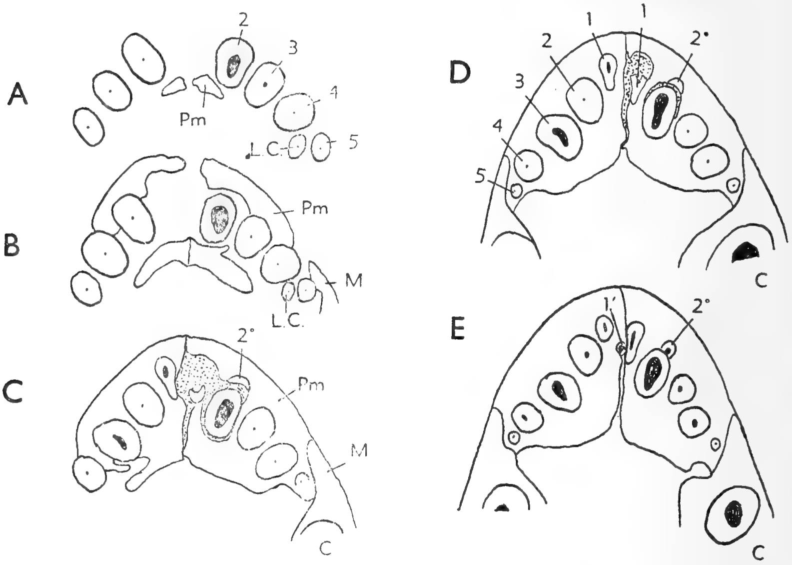


FIG. 33. *Anteosaurus abeli.* S.A.M. 9123. ×¼.
Five consecutive frontal sections through the snout showing the replacement of the incisors.

Practically nothing is known of the replacement of the canines, but in one specimen an upper canine appears to have its crown about to be shed and lying posterior to it is a pointed tooth which may be its replacement. If this observation be correct then the replacement of the anteosaurian canine would be different from that of the Titanosuchia and be similar to that known in the contemporary Therocephalia and Gorgonopsia.

Postcanines

In the Anteosauria the postcanines are inadequately known. They form a short series with at most 8 teeth, irregularly spaced. The crowns are spatulate, bluntly conical in outline and bulbously swollen from side to side.

TAPINOCEPHALIA

The dentition of the South African Tapinocephalia is as yet inadequately known (fig. 34). This is mainly due to the fact that in most of the jaws known the teeth have been lost before entombment, and in many cases where they have been petrified while still in the jaws they have on subsequent erosion dropped out or have had the crowns broken off or otherwise damaged.

As the Tapinocephalia have in neither upper or lower jaw teeth specialized as canines, the usual connotation cannot be employed. The teeth in the premaxilla will be referred to as incisors and the others as maxillary and dentary teeth. A dental formula on this basis for the Tapinocephalia would thus read:

$$\frac{\text{Premaxilla } 3\text{–}5,\ \text{Maxilla } 8\text{–}17}{\text{Dentary } 14\text{–}19}$$

Whether the differences in the count given here have much taxonomic value is to be doubted, and in absence of the necessary facts I am more inclined to suggest inadequate observation coupled with the probability that age is an important factor. It is more than probable that the incisor count of 3–5 may, as is the case in the Anteosauria, only signify a difference in age, with 5 incisors the count for the mature animal.

All the teeth of the mature upper jaw intermesh with those of the mandible, but this intermeshing becomes gradually less definite posteriorly.

All the more anteriorly situated teeth when mature have the same general build, with the crown consisting of a piercing pointed cusp or talon and lingually a cutting and/or crushing heel in general similar to those of the incisors of the Titanosuchia. As will be evident from figure 34 the anterior or incisor teeth of the Tapinocephalia differ, however, in detail from those of the Titanosuchia. Some of the differences in the incisors are here enumerated:

(1) The roots are laterally compressed and the linguo-labial diameter greatly increased thus giving a very flat oval cross-section (diameters 24–40 by 13–19 mm.);

(2) the crowns are similarly laterally compressed and the linguo-labial diameter over the heel greatly increased (diameters 31–43 by 16–20 mm.);

(3) the talons are much shorter; in the Titanosuchia the crown is about the same length as the root, whereas in the tapinocephalian incisors it is about five-eighths;

(4) the nature of the heel shows considerable differences; in the Tapinocephalia the occlusial face of the heel presents a fairly deep oval hollow bounded labially by the talon, anteriorly and posteriorly by a sharp edge with a slight spur lingually. The anterior (or inner) edge lies much higher than the posterior (or outer) edge.

Further back in the series the tapinocephalian teeth gradually lose these incisor characters and begin to look more like titanosuchian incisors, except that the talons remain short. The labio-lingual diameter gradually decreases

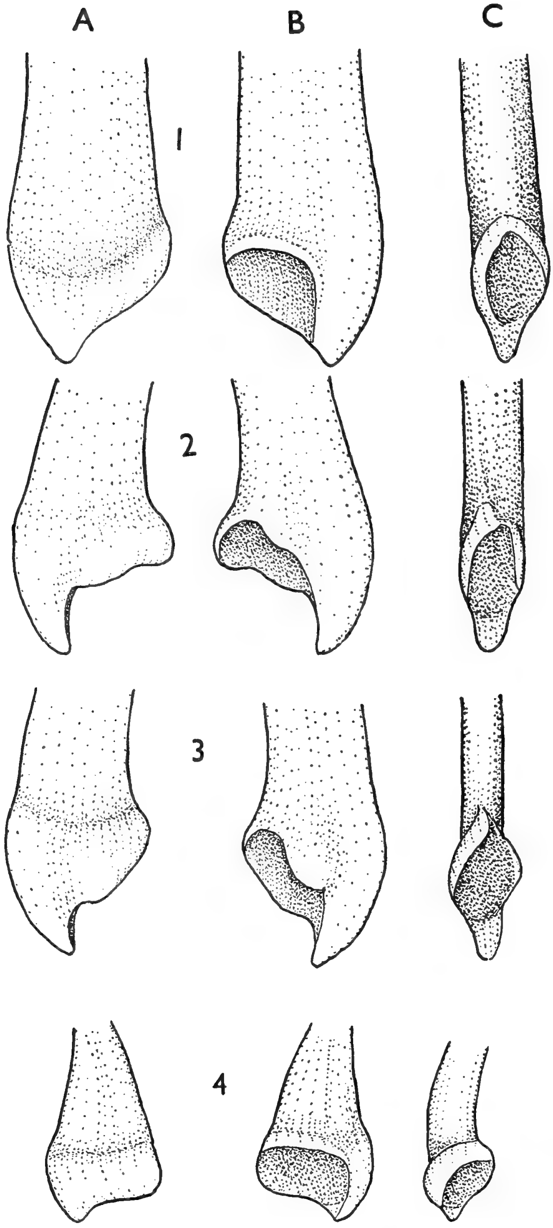


FIG. 34. *Tapinocephalus*. S.A.M. K203. × ½.
Four anterior teeth of the right upper jaw shown:

A = anterior (or inner) view.
B = posterior (or outer) view.
C = lingual view.

in length, the sharp ridges on the heel become lower, the face of the heel loses its concavity and even develops a median ridge. Still further posteriorly the linguo-labial character becomes still less and the lingual edge of the heel begins to look very titanosuchian-like, although much smaller in size.

Near the posterior end of the series the teeth lose the heel altogether and the crown becomes spatulate and looks very like those of the postcanines of the Titanosuchia (fig. 35).

We may summarize the above observations as follows:

In a series of functional teeth in the tapinocephalian jaw the posterior teeth have spatulate crowns, which, as one proceeds anteriorly, step by step develop a pointed talon and a heel, the heel commencing as a lingual thickening, becomes, firstly, a cingulum, then a step; this step develops a bounding edge with a face between it and the talon; the edge becomes sharper and the face hollower and this hollow increases its linguo-labial diameter.

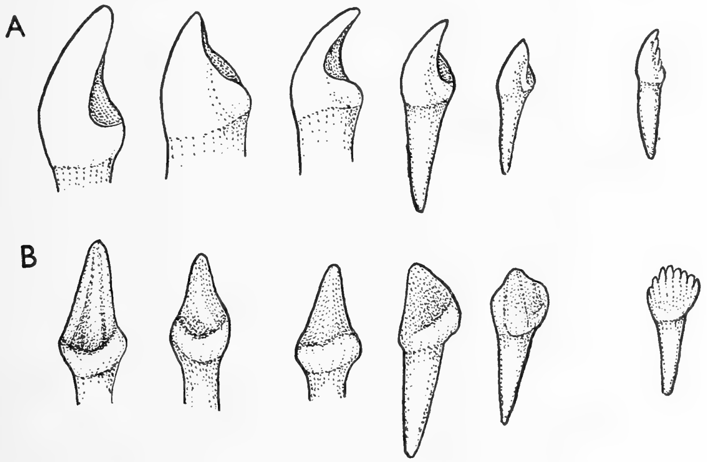


FIG. 35. *Struthiocephalus whaitsi*. S.A.M. 3012. ×½.
Six right upper teeth lying loose under a skull from which they have dropped.
A = posterior (or outer) view. B = lingual view.

In one genus (*Agnosaurus*) evidence is preserved that a set of unerupted small spatulate teeth is being replaced by a younger set, which has crowns composed of a talon and heel. This replacement commences anteriorly and proceeds posteriorly, but is not evident anterior to the 6th or 5th tooth in the dentary.

Tapinocephalus sp.

S.A.M. 12139. Rietfontein, P.A. Collected Boonstra 1957.

In a weathered skull of *Tapinocephalus* (fig. 36), where only roots and empty alveoli are preserved, some features of the replacement of the teeth are shown.

In the left premaxilla the roots of five functioning incisors are preserved. Lingual to No. 5 there is a large replacing root lying in the same alveolus as the functioning root which has been partly resorbed. In No. 4 a functioning root lies loosely in its alveolus and lingual to it in a separate alveolus, a section across the replacing root is present. Lingual of No. 3 there is an empty alveolus and lingual of No. 2 there lies a root of its replacing incisor.

In the right maxilla replacing roots are preserved lying lingual to maxillary teeth Nos. 2 and 10. In the left maxilla the roots of the first two maxillary teeth are seen in section; Nos. 3 and 4 are represented by a large confluent alveolus; of No. 5 the small tip of a root is embedded in the bone. No. 6 is represented by an empty alveolus. No. 7 is again a root-tip embedded in the bone. No. 8 is represented by a small root-tip lying loosely in an alveolus confluent with the

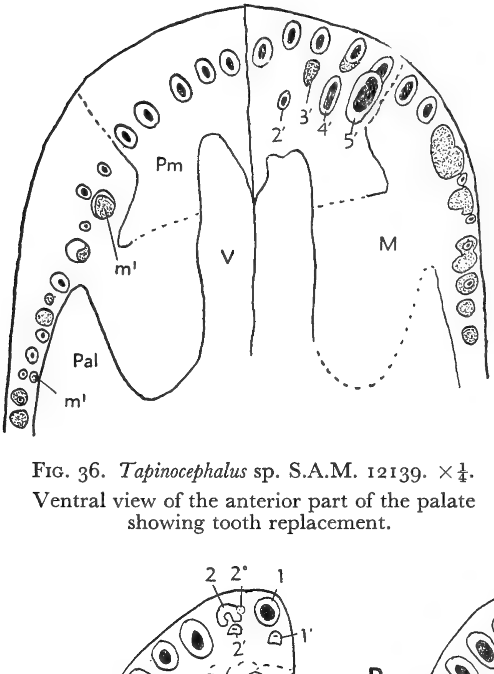


Fig. 36. *Tapinocephalus* sp. S.A.M. 12139. ×¼. Ventral view of the anterior part of the palate showing tooth replacement.

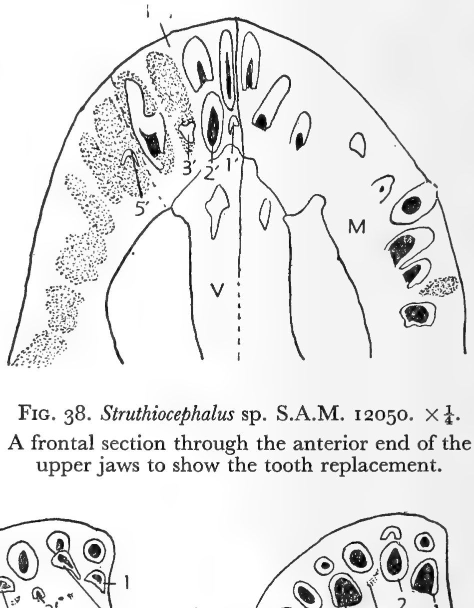


Fig. 38. *Struthiocephalus* sp. S.A.M. 12050. ×¼. A frontal section through the anterior end of the upper jaws to show the tooth replacement.

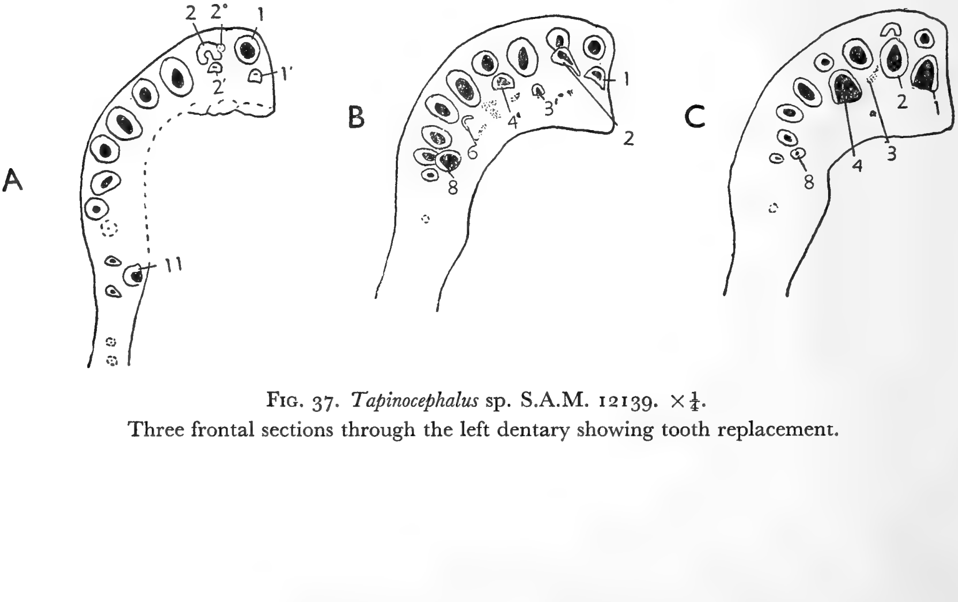


Fig. 37. *Tapinocephalus* sp. S.A.M. 12139. ×¼. Three frontal sections through the left dentary showing tooth replacement.

empty alveolus of No. 9. No. 10 is again a small root-tip lying loosely in the alveolus. Nos. 11 and 12 are represented by empty alveoli.

I have cut three frontal sections through the anterior end of the left dentary to determine the nature of the replacement (fig. 37).

Section 1. The 2nd functioning tooth shows a root being resorbed, with the remnant of a still earlier root lying antero-internally. And lingual to both Nos. 1 and 2 lie sections through the talons of their replacing teeth. Lingually of Nos. 10 and 12 is the tip of the talon of the replacement of No. 11.

Section 2 shows replacements of Nos. 1, 2, 3, 4, 6 and 8 and an empty cavity lingual to No. 5. Further lingually, cavities for a second set of replacements are seen for Nos. 2, 4, 5 and 6.

Section 3 shows replacements of Nos. 1, 2, 4 and 8 and a cavity for No. 3 first replacement and a cavity for No. 3 second replacement.

Struthiocephalus sp.

S.A.M. 12050. Modderfontein, Laingsburg. Collected Boonstra 1957.

I have cut some frontal sections through the snout of a good skull of *Struthiocephalus*, but as most of the teeth have been lost before petrifaction the evidence obtained of the replacement of the teeth is poor (fig. 38).

In the right premaxilla can be seen: a narrow root of No. 1 with lingually to it the tip of the talon of its replacement.

No. 2 shows the partially resorbed root of the functioning tooth with lingual to it a well-developed replacement.

Of No. 3 there is a large oval alveolus from which the functioning tooth has dropped out, and in its lingual end lies the tip of the replacing talon.

No. 4 shows a well-developed, but as yet unerupted, crown with talon and heel.

In the maxilla large irregular alveoli can indistinctly be seen with a section through a replacing talon lying loosely in the first maxillary alveolus.

In the right half of the upper jaw there is evidence of twelve teeth of which Nos. 1, 8, 9, 10 and 12 were functioning, No. 11 is represented by an empty alveolus and Nos. 3, 4, 6 and 7 are represented by replacing teeth. On this scanty evidence we may tentatively state that the replacement in the Tapinocephalia takes place lingually of the functioning teeth as it also does in the Titanosuchia and the Anteosauria. The anterior (incisor) teeth do not emerge through pockets in the alveolar walls of the functioning teeth as they do so typically in the Titanosuchia. In this they agree with the condition, also tentatively, seen in the Anteosauria.

Comparison with the Contemporary Therapsids

The relevant comparative facts are known in a number of the contemporary Therocephalia and Gorgonopsia of the *Tapinocephalus* zone.

In these older therapsids there are usually more (1–2) incisors, but the number of postcanines is always much smaller than in the Dinocephalia. Primitively there were two functional upper canines, but in most the upper canines have been reduced to one only. All the teeth are simple, conical but with serrations developed, usually on the posterior edge, in the incisors and canines.

The dentition in these two sub-orders was thus carnivorous.

As in the Dinocephalia each tooth is replaced lingually by a member of its own family and this replacement occurs more than once.

In the Dinocephalia there is a single alveolus for the upper canine, whereas in these Therocephalia and Gorgonopsia there are two alveoli. Primitively these two alveoli house functional canines at the same time, but in the other forms the functional canine appears alternately in the two alveoli.

PELYCOSAURIA

In the older and more primitive Pelycosauria there may be as many as 9 incisors and up to 45 maxillary teeth. In the later Sphenacodontia a pair of teeth becomes functional canines.

All the teeth are simple, conical, but sometimes become serrate.

Each tooth is replaced lingually by a member of its own family.

Primitively the functional replacement of a tooth is by the replacing member of an adjacent tooth—thus distichially, but in the more advanced Sphenacodontia the functional replacement is by a member of its own family, except in the case of the upper canines which are replaced alternately.

The Origin and Further Development of the Dinocephalian Dentition

The story of the origin and further development of the dinocephalian dentition starts from some such point as seen in the less specialized Pelycosauria.

Both upper and lower jaws have a large number of teeth—all being simple conical structures, with the upper set, in occlusion, passing labially of the lower set. The dentition is of an unspecialized 'carnivorous' nature.

Each functioning tooth is during life replaced a number of times by a tooth, which arises lingually to it, but as each functioning tooth is lost its function is not immediately taken over by the tooth arising lingually to it but this function is assumed by the tooth arising in the adjacent alveolus (distichial replacement).

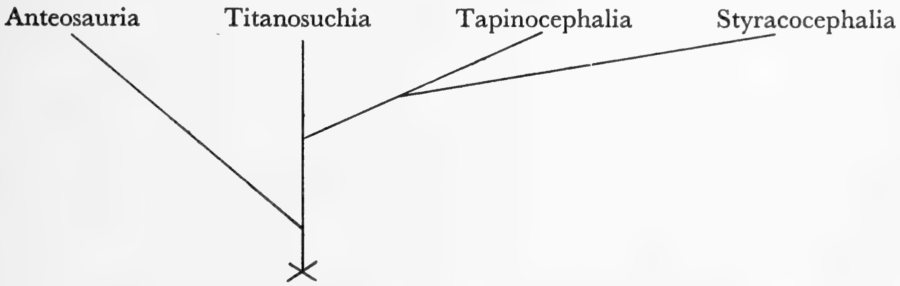
This simple type of dentition is changed, when in the maxilla two of the more anterior maxillary teeth become larger than the rest and are then called 'canines'. Not much later a further change takes place, when each of the teeth, not canines, is functionally as well as actually replaced by the tooth arising in the jaw lingually to it. The pair of canines is replaced alternately, i.e. when both are not functioning at the same time either the anterior or the posterior one assumes the function of both. This is the stage reached by the Sphenacodontia.

The next stage is one to be postulated for the ancestral therapsid or pro-therapsid. Here the dentition would consist of about 7 upper incisors, a pair of canines, which are the first two teeth on the maxilla, numerous postcanines; one incisor less in the dentary, a single lower canine and a long row of postcanines. All the teeth would be simple conical teeth, with probably serrated edges in the incisors and canines.

From some such pro-therapsid stage the various primitive therapsid sub-orders diverged. One of these branches represents the sub-order Dinocephalia. In the ancestral dinocephalian the dentition must have been as follows: 5 upper and 4 lower incisors, a single upper and lower canine and numerous postcanines. All the teeth were still simple conical structures with or without serrated edges. Each functioning tooth was replaced by a tooth arising lingually to it. In occlusion all the teeth of the upper jaw passed labially of the teeth of the lower jaw and the dentition was definitely of a habit usually interpreted as being 'carnivorous'. In the next stage, this carnivorous dentition with upper teeth occluding labially of the lower teeth, changed to a carnivorous dentition in which the incisor teeth commenced to intermesh with each other.

This development of intermeshing incisors was a step which definitely split the Dinocephalia off from the other Therapsida and set them off on their own separate course, and it is the possession of this distinctive character that we consider to be a major justification of our considering the Dinocephalia to constitute a distinct sub-order.

Although continuing to retain this common character the Dinocephalia very soon started to develop divergent features. The first dichotomy appears to have split off the infra-order Anteosauria from the rest; from the latter branch a further dichotomy split off the Titanosuchia and still later the Tapinocephalia and Styracocephalia developed as two divergent branches.



ANTEOSAURIA

In the nature of its dentition the Anteosauria appear to have changed least from the above postulated condition.

The incisors have retained the simple conical structure, the canines are retained and the postcanines are still simple teeth.

But certain specializations have taken place, viz. the original fairly small incisors have become greatly elongated, and this increase in length is made possible by a concomitant upward retreat of the premaxillary edge; the canines have greatly increased in size and provision for the reception of the tip of the lower canine is made by the development of a recess in the lower face of the maxilla antero-internally of the base of the upper canine; the postcanines have been reduced in number (maximum of 8) and the simple pointed crown has become spatulate with a bulbous outer face.

These specializations have changed the original simple carnivores into anteosaurs, with a highly efficient grab, pierce-and-tear dental instrument. With a slinking habit (deduced from the structure of the limbs) such a dentition would allow of a sudden pounce on its prey, and the tearing out of a lump of flesh. The degeneration of the postcanines indicates that no shearing, cutting or grinding took place prior to the deglutition of the lump of flesh helped by the teeth on the palatine boss.

TITANOSUCHIA

In the Titanosuchia the development away from the ancestral condition was much greater and this can be described as follows: The incisors have completely lost their original simple pointed form and have become highly specialized piercing, cutting and crushing teeth. The strong point, cusp or talon situated labially is a highly efficient piercing instrument and it is held very firmly in the jaw by a large strong root. The well-developed heel situated lingually on the crown has a structure adapting it very well for cutting and crushing. Although such incisors could execute a bite into flesh of no mean order they can hardly be considered to be efficient piercing and cutting instruments adapted for biting into flesh and the crushing abilities of the heel would serve no reasonable purpose when applied to meat. For piercing, cutting and crushing hard fibrous vegetable tissue these teeth would be highly efficient and well adapted.

The large canines can reasonably be considered a relict of former carnivorous days, retained and even enlarged to be employed complementary to the incisors for piercing and severing fibrous material. This is most probably the reason why the lower canines have changed their direction to become teeth intermeshing between the last upper incisor and the upper canine and thus really forming part of the incisor-battery.

The postcanines have not been reduced in number and may even have been increased and their serrate spatulate crowns forming a low row along the margins of both jaws could very well have been of use in vegetable feeding.

TAPINOCEPHALIA

In the Tapinocephalia the development away from the ancestral condition has been greater than in both the Anteosauria and the Titanosuchia.

In the former only the incisors intermesh and in the latter the canines are, as a further step, included in this intermeshing, and now as a third step the Tapinocephalia have the maxillary set of teeth intermeshing with the posterior dentary teeth, with a concomitant loss of the specialized canines. The inclusion of the maxillary teeth in this intermeshing commences anteriorly and then gradually extends to the end of the tooth rows. This process includes the change from spatulate teeth to teeth in which a talon and heel is developed. It has been indicated how the change from spatulate teeth to talon-and-heel teeth has taken place in the maxillary and posterior dentary teeth, but in no specimen have we seen any indication that premaxillary and anterior dentary teeth (incisors) were once spatulate and then became tooth-and-heel teeth. Though in some Russian anteosaurs Orlov (1959) found that the conical incisors develop an attrition face that may be the beginning of a heel.

The point now seems to be whether from a simple conical ancestral incisor the Titanosuchia and the Tapinocephalia developed talon-and-heel incisors independently or whether it was the Titanosuchia who took this step and handed the condition on to the Tapinocephalia. If the latter alternative is accepted, then it must be maintained that more or less at the same time, the large titanosuchian canines also became talon-and-heel teeth fitting nicely into the tapinocephalian series. We have noticed the development of attritional faces in the titanosuchian canines which can be interpreted as indicating such a development of talon-and-heel teeth.

Certain differences in the structure of the incisors of respectively Titanosuchia and Tapinocephalia have already been pointed out. Now, do these differences indicate that talon-and-heel teeth have been developed on two separate occasions independently of each other, or do the similarities rather point to a common origin?

The tapinocephalian incisor can be readily derived from the titanosuchian incisor. If in the titanosuchian incisor the length of the talon is reduced, the labio-lingual diameter of the heel increased and the inner edge of the heel raised to form a high and sharp cutting edge then we have a tapinocephalian incisor.

If such a development took place it could have been caused by a change in the nature of the vegetable food. The reduction of the size of the talon of the incisor together with the loss of the specialized canines could be due to the food becoming less hardy and fibrous and thus not necessitating piercing, prising and tearing off. The improved cutting abilities of the heel would at the same time be a better adaptation for the cutting of leafy vegetation.

I am thus of the opinion that the tapinocephalian dentition is a development of that present in the Titanosuchia and that the Tapinocephalia hived off from the Titanosuchia after these had acquired the typical talon and heel incisors.

I have based the above account mainly on the South African material, but hope to correlate with the Russian material in the near future.

The Articulation and Movements of the Lower Jaw

(Figs. 39–41)

The quadrate has on its ventral surface a pair of convex condyles separated by a groove and these fit fairly accurately into two concavities separated by a ridge on the postero-dorsal face of the articular. The quadrate is firmly fixed in the skull, being firmly clasped by the squamosal, braced by the quadratojugal, butted against by the paroccipital and held by the quadrate ramus of the pterygoid.

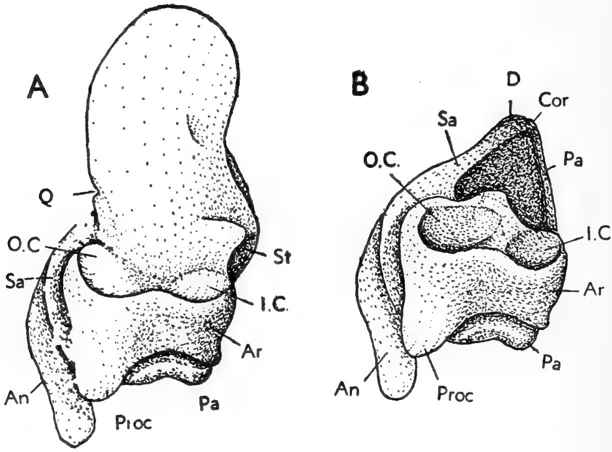


Fig. 40. *Jonkeria truculenta.* S.A.M. 12030. × ¼.
A = posterior view of the jaw articulation.
B = posterior view of the lower jaw.

The articular is also firmly wedged in between the angular and surangular and the prearticular.

The only possible movement is thus at the joint between quadrate and articular.

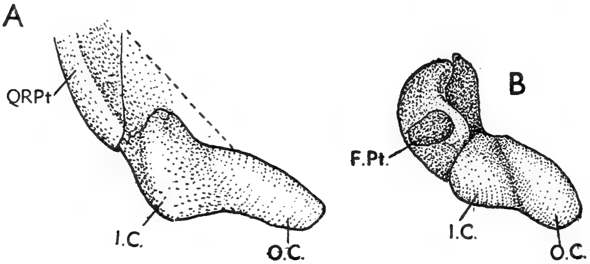


Fig. 39. Ventral view of the quadrate. × ¼.
A = *Parascapanodon avifontis* S.A.M. 9127.
B = *Parascapanodon* sp. S.A.M. 12026.

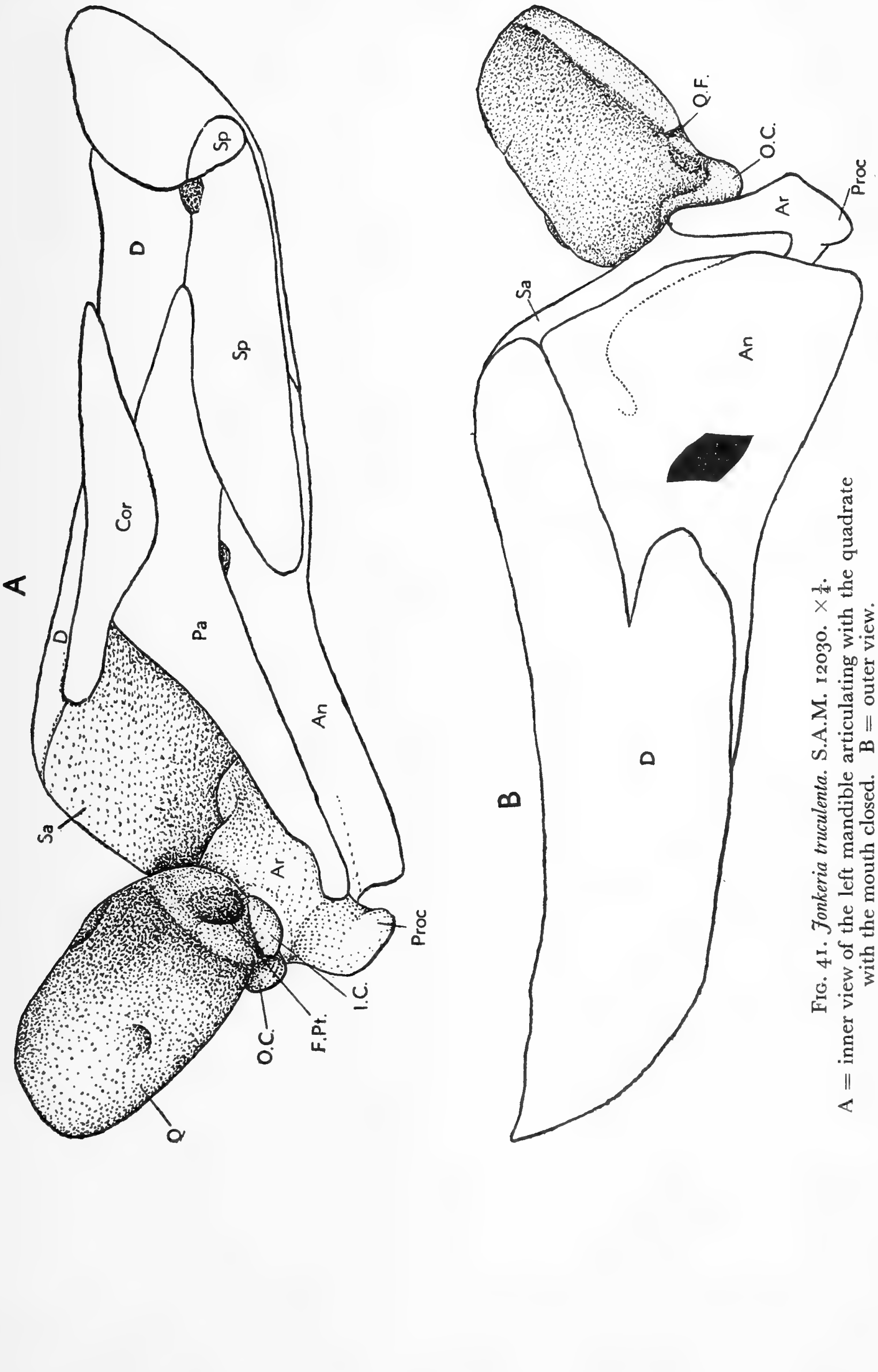


FIG. 41. *Jonkeria truculenta*. S.A.M. 12030. ×¼.
A = inner view of the left mandible articulating with the quadrate with the mouth closed. B = outer view.

The two condyles on the quadrate do not lie in the same plane—the outer lying posterior to the inner. In section they present segments of circles with radii of (in S.A.M. 12026) 26 and 32 mm. which are thus not co-centric. The radii lie in a plane diverging from the sagittal plane in posterior direction. The result of this structure is that when the jaws are opened the movement of the jaws is a sliding one in posterior direction of at least 15 mm. and the backs of both jaws at the same time move outwards for at least the same distance. At the same time the lower edge of the jaw appears to move inwards. The latter two movements are rendered possible by the fact that the two rami of the jaws are not firmly fixed to each other at the symphysis.

What effects do these movements of the jaws have on the bite of a titanosuchian?

The forward movement of the jaws when the mouth is closed would push the talons of the lower incisors from behind forwards between those of the upper incisors and the heels of the lower incisors would slide under those of the upper teeth thus executing a crushing and cutting action. The upper and lower canines would move relatively as do the talons of the incisors, and the lower postcanines would have a cutting action when moving past their upper antagonists.

When the jaws are closed the articulars move towards each other with the result that the more posterior postcanines also move inwards and would thus pass inwards of the upper postcanines leaving some space between the upper and lower teeth.

If the lower mandibular edge, when the jaw is closed, moves outwards, the alveolar edge would move inwards and this would still further increase the space between upper and lower postcanines.

This would be functionally disadvantageous!

Faunistic

Hitherto the main elements of the fauna of the *Tapinocephalus* zone were divided into two groups representing the opposing herbivores and carnivores as follows:

herbivores: Pareiasauria, Tapinocephalia and Anomodontia.
carnivores: Titanosuchia (including the Anteosauria), Therocephalia and Gorgonopsia.

This presumed balance always appeared to be loaded in favour of the carnivores, for not only were the Titanosuchia known to be large reptiles but were in addition numerous, as judged by the frequency in which remains (mostly poor, it is true) are encountered in the field.

In the new picture the herbivores are (and this is more natural) better represented, the largest forms of the times being the herbivores. In order of size the herbivores of this zone are: Titanosuchia, Pareiasauria, Tapinocephalia and Anomodontia, and the carnivores: Anteosauria, Therocephalia and Gorgonopsia.

The more marsh-dwelling herbivores were the Pareiasauria and the Tapinocephalia; the more upland-dwelling forms the Titanosuchia and Anomodontia. Of the carnivores the Anteosauria, with large heads, were more of a slinking habit; the Therocephalia more active upland reptiles of prey, and the Gorgonopsia just starting their role as important carnivores.

Acknowledgements

In the collection of the material here described I am pleased to be able to express my gratitude to all those farmers in the Karoo who have so kindly allowed me to work on their property, helped me in various ways, and always been most hospitable. Mr. H. Zinn, technical assistant of the Museum, has accompanied me on many of the collecting trips and has been most helpful.

In recent years C.S.I.R. has given me a grant which covered the current expenses of the collecting trips undertaken.

Mr. C. Gow has during the last year assisted in the preparation of many of the jaws studied. His painstaking work, chiefly with a vibro-tool, has produced some really adequately prepared specimens.

The sections made of a number of specimens were rendered possible by the use of a diamond-studded rotating saw purchased with a grant made by C.S.I.R.

The Trustees of the South African Museum gratefully acknowledge a grant towards the cost of publishing this paper made by the South African Council for Scientific and Industrial Research.

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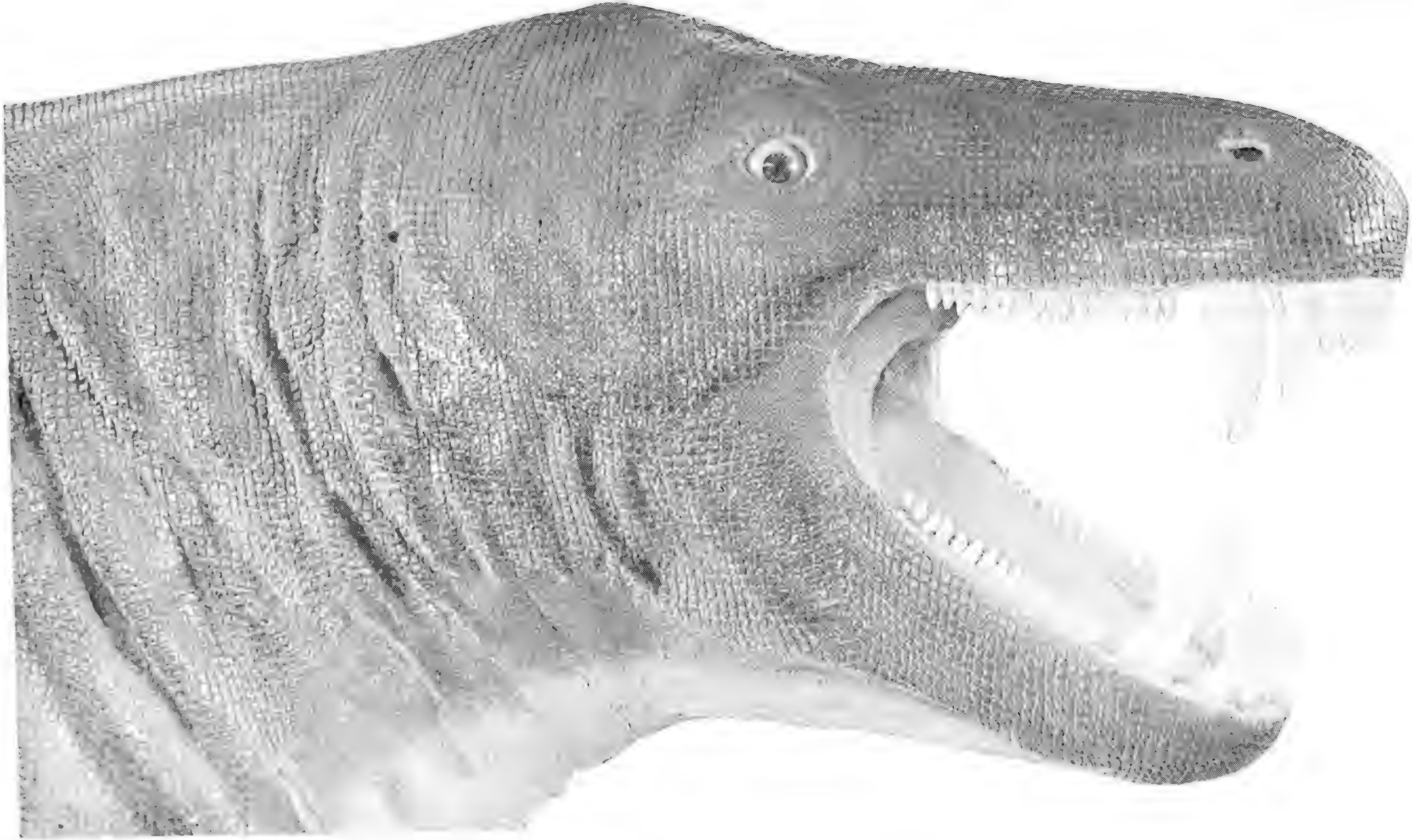

Photograph of the head of *Parascapanodon avifontis*. The head is that of a life-sized reconstruction of the whole reptile as modelled by the author and exhibited dioramically in the South African Museum.

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SYNONYMY. Arrangement according to Schenk, E. T. & McMaster, J. H.: *Procedure in taxonomy.* 2nd ed. Stanford, Stanford university press, 1948. Bibliographic references modified.

'I. *Synonymy arranged according to chronology of names.*—All published scientific names by which a species has been previously designated (subsequent to 1758) are listed in chronological order, with bibliographical references to all descriptions or descriptive citations following in chronological order after each name. . . .

B. *Form of bibliographic references to synonymic names.*—The first reference following any name in the synonymy should be to the earliest citation of that name. This should be followed by references to all subsequent citations of the same name, arranged in chronological order. . . .'

Bibliographical references modified to consist of author's name, date of citation, pagination and illustrations (plates and figures).

Example:—

Eulalia (*Steggoa*) *capensis* Schmarda

Eulalia capensis Schmarda 1861, p. 86, pl. 29, fig. 231. Willey 1904, p. 259.
Eulalia viridis var. *capensis* McIntosh 1903, p. 34. Day 1953, p. 30.
Eulalia viridis (*non* Muller) Ehlers 1913, p. 455. Day 1934, p. 30.

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PART VII

FURTHER DESCRIPTIONS OF SOUTH AFRICAN ASCIDIANS

By

R. H. MILLAR
Marine Station, Millport, Isle of Cumbrae, Scotland

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FURTHER DESCRIPTIONS OF SOUTH AFRICAN ASCIDIANS

By
R. H. Millar
Marine Station, Millport, Isle of Cumbrae, Scotland

[Accepted April 1959]

(With 45 figures in the text)

Contents

Introduction

In a previous paper (Millar, 1955) I described a number of ascidians from the coasts of South Africa, collected during an ecological survey carried out by the Zoology Department of the University of Cape Town. A continuation of this survey has produced more ascidian material, which forms a large part of the subject of the present paper. The principal areas from which this new material was collected (fig. 1) are: Langebaan Lagoon, Table Bay, False Bay, Mossel Bay, Algoa Bay, and Mozambique. Small amounts of material were also taken from several other places. The collecting was mainly from sub-littoral areas, and this makes difficult a strict comparison with the faunistic results obtained from the extensive surveys of Stephenson (1939, 1944, 1948), whose studies refer to littoral areas.

Material is also included from the South African Museum, mainly belonging to the *Pieter Faure* collection, and some South African specimens from the British Museum (Natural History), most of these latter being from Mortensen's Java–South Africa Expedition.

Although most of the specimens formed the material of an ecological survey, the present paper deals with systematics. I have had certain difficulties owing to the still unsatisfactory state of the systematics in some ascidian genera; this is particularly true of *Polyclinum*, *Didemnum* and *Eudistoma*. As I have explained when discussing *Didemnum stilense* I believe that certain species will be defined adequately only when a large series of specimens is available from different areas and seasons, and when the biology is studied in addition to

Ann. S. Afr. Mus. **46** (7), 1962, 113—221, 45 figs.

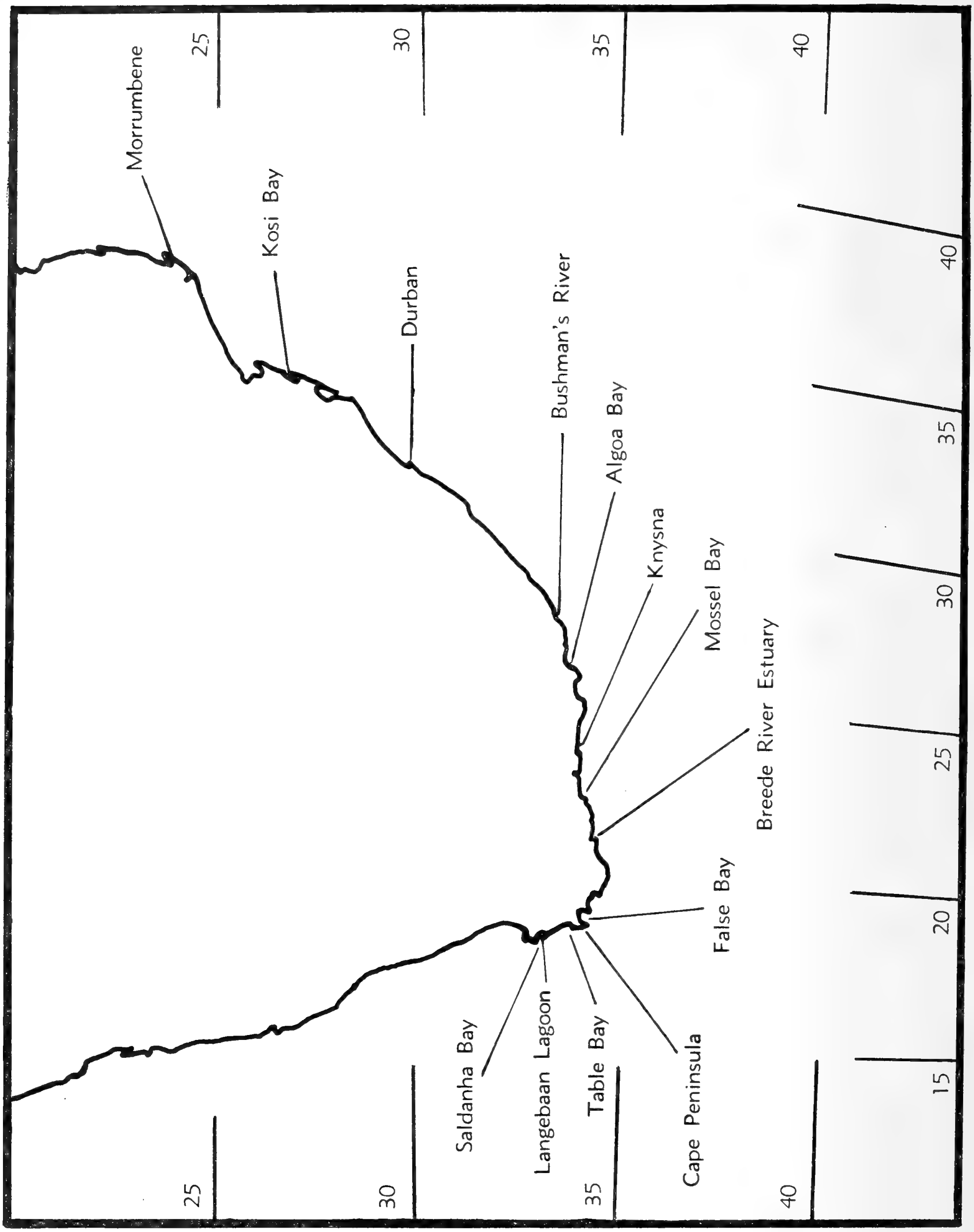

FIG. 1. Sketch map of part of South Africa to show collecting localities.

preserved material. Such needs are, of course, difficult to meet, and impossible in the course of a general ecological survey. For these reasons some of the identifications are provisional, and some material has not been identified even provisionally, as that course might lead to greater confusion.

I am indebted to Professor J. H. Day, of the Zoology Department of the University of Cape Town, and to Dr. J. F. Croil Morgans, formerly of that Department, for information regarding the specimens, and also to the Zoölogisch Museum of Amsterdam for the loan of type specimens of many of Sluiter's South African species.

The Trustees of the Museum gratefully acknowledge the grant in aid of publication of this paper received from the South African Council for Scientific and Industrial Research.

STATION LIST

Most of the material belongs to the ecological survey of the University of Cape Town, and to the *Pieter Faure* collection of the South African Museum. Details of stations relating to these two collections are given below. Collecting details of other material mentioned in this report are given in the text.

UNIVERSITY OF CAPE TOWN ECOLOGICAL SURVEY

SALDANHA BAY

U.C.T., SB 1, Station 3, 13–7–46.
U.C.T., SB 91, Station 13, 14–7–46.
U.C.T., SB 92, Station 8, 14–7–46.
U.C.T., SB 94, Station 3, 13–7–46.
U.C.T., SB 128, Salamander Bay, 7 m., 9–4–53, mud weed and sponge.
U.C.T., SB 130, off Donkergat Point, 7–9 m., 9–4–54.
U.C.T., SB 134, 4–3–37, from bottom of *Signis*.

LANGEBAAN LAGOON

U.C.T., LB 352, Oosterval, balanoid zone, 4–5–53, rocks.
U.C.T., LB 367, Skaapen Island, lower balanoid zone, 7–5–53, weed and stones.
U.C.T., LB 374, south side of Skaapen Island, lower balanoid zone, 7–5–53.
U.C.T., LB 375, Skaapen Island, upper balanoid zone, 7–5–53.
U.C.T., LB 378, Langebaan jetty, 0–1 m., 7–5–53, wooden pilings.
U.C.T., LB 384, Oosterval, L.W.N.T., 7–5–53, sandy limestone.
U.C.T., LB 472, 6–5–55.

TABLE BAY

U.C.T., TB 171, 33° 49·5′ S., 18° 27·5′ E., 9–18 m., 4–8–46, shells or sand and shells with occasional rocks and mussels.
U.C.T., TB 172, Station 3, 33° 50·35′ S., 18° 20′ E., 15·5 m., 3–7–47.
U.C.T., TB 173, Station 5, 35° 52·7′ S., 18° 26·8′ E., 20·5 m., 3–7–47.

CAPE PENINSULA

U.C.T., CP 393, Oatland Point, intertidal, 27–9–54.

U.C.T., CP 425, Oatland Point, 14 inches above low water to below lowest *Pomatoceros*, 12–10–54.

FALSE BAY

U.C.T., FAL 5, Station 3, just south of Seal Island, 35 m., 22–2–52, sand.

U.C.T., FAL 53, Gordon's Bay, 18 m., 25–6–52.

U.C.T., FAL 108, Gordon's Bay, 34° 09·3′ S., 18° 51′ E., 7–11 m., 23–1–53, some sand.

U.C.T., FAL 109, Gordon's Bay, approximately 34° 09·3′ S., 18° 51′ E., 7–11 m., 23–1–53.

U.C.T., FAL 117, Simon's Bay, 23·5 m., 12–2–53, broken branched coralline.

U.C.T., FAL 121, Glencairn power station, rock terraces, 6 m., 17–2–53, scattered rocks next to sand.

U.C.T., FAL 130, Oatland Point, 1–2 m. below L.W.S.T., scattered rocks, 26–2–53.

U.C.T., FAL 136, Oatland Point, 0–2 m., 27–2–53, vertical rock faces.

U.C.T., FAL 137, Gordon's Bay quay, 0–4 m., 4–3–53, rock.

U.C.T., FAL 144, Oatland Point, bottom of *Octomeris* zone to 5 m. below, 9–3–53, rock face.

U.C.T., FAL 145, details as FAL 144.

U.C.T., FAL 152, Oatland Point, 4·5–5·5 m., 12–3–53, stones and rocks on sand.

U.C.T., FAL 158, Oatland Point, 0–3 m., 22–4–53, rocks.

U.C.T., FAL 163, Oatland Point, S.W. face of Big Rock, 0–2 m., 23–5–53, area free of *Pyura* community.

U.C.T., FAL 167, Oatland Point, S.W. face of Big Rock, area free of *Pyura* community, 2–4 m. below *Echlonia* zone, 10–6–53.

U.C.T., FAL 175, Oatland Point, S.W. face of Big Rock, 4–6·5 m. below *Echlonia* zone, 10–6–53.

U.C.T., FAL 176, Oatland Point, S.W. face of Big Rock, from top 2 m. of flourishing *Pyura* community, 10–6–53.

U.C.T., FAL 177, Oatland Point, 9–8–53.

U.C.T., FAL 181, from bottom of ship *General Botha*, Simon's Town, 6–3–37.

U.C.T., FAL 182, Oatland Point, lagoon rocks, 7–9–53.

U.C.T., FAL 208, *Africana*, 34° 0·9′ S., 18° 42·4′ E., 36 m., rock, 10–9–53.

U.C.T., FAL 212, *Africana*, 34° 07·1′ S., 18° 35·6′ E., 21 m., 9–9–53, limestone reefs and sand.

U.C.T., FAL 216, *Africana*, 34° 12·4′ S., 18° 43·5′ E., 42 m., 10–9–53, bottom rocky.

U.C.T., FAL 221, *Africana*, N.W. of Seal Island, 34° 07·0′ S., 18° 32·5′ E., 18 m., 9–9–53, limestone reefs and sand.

U.C.T., FAL 225, off Miller's Point, 34° 13·9′ S., 18° 31·6′ E., 40 m., 9–9–53, coarse sand and finely broken shell.

U.C.T., FAL 229, off Cape Point, 34° 20·27′ S., 18° 31·8′ E., 64 m., 9–9–53, coarse sand.
U.C.T., FAL 232, *Africana*, 34° 17·35′ S., 18° 31·4′ E., off Buffels Bay, 50 m., 9–9–53.
U.C.T., FAL 234, *Africana*, South Kogel Bay, 34° 15·35′ S., 18° 44·8′ E., 47 m., 10–9–53, coarse sand with shell, pebbles and stones.
U.C.T., FAL 256, Oatland Point, 4·0–5·5m., 17–11–53.
U.C.T., FAL 259, Oatland Point, about 80 yards E. of Big Rock, 10·5 m., 21–11–53, coarse shelly sand.
U.C.T., FAL 265, half-way between Seal Island and Strandfontein, 15–25 m., 4–4–54, rock.
U.C.T., FAL 272, Roman Rock, 100 yards ESE. of lighthouse, 14–17 m., 18–9–54, sloping granite rocks.
U.C.T., FAL 277, Roman Rock, 14–17 m., 21–9–54, rocks.
U.C.T., FB 1102, 21–4–47, 0·5 mile east of Seal Island, 27 m., rock.
U.C.T., FB 1105, 28–4–47, 34° 10′ S., 18° 28′ E., 24 m., sand.
U.C.T., FB 1106, 20–8–47, off Somerset Strand, 25 m.

MOSSEL BAY

U.C.T., MB 7, 34° 04′ 17″ S., 22° 13′ 53″ E., 19 m., 12–1–56, rock.
U.C.T., MB 14, 34° 11′ 04″ S., 22° 10′ 09″ E., 16 m., 13–1–56, rock.
U.C.T., MB 18, 34° 08′ 45″ S., 22° 07′ 12″ E., 13 m., 13–1–56, rock.
U.C.T., MB 22, 34° 08′ 50″ S., 22° 07′ 20″ E., 12·5 m., 13–1–56, rock.
U.C.T., MB 27, 34° 11′ 04″ S., 22° 09′ 55″ E., 19 m., 13–1–56, rock.
U.C.T., MB 38, 34° 10′ 07″ S., 22° 07′ 46″ E., 8·5 m., 16–1–56, sand.
U.C.T., MB 39, 34° 10′ 08″ S., 22° 08′ 00″ E., 9 m., 16–1–56, rock.
U.C.T., MB 48, 34° 11′ 19″ S., 22° 09′ 58″ E., 10 m., 17–1–56, rock.
U.C.T., MB 53, 34° 10′ 57″ S., 22° 09′ 55″ E., 14 m., 17–1–56, rock.
U.C.T., MB 55, 34° 10′ 42″ S., 22° 09′ 38″ E., 9 m., 17–1–56, rock.
U.C.T., MB 58, 34° 04′ 18″ S., 22° 13′ 32″ E., 12·5 m., 18–1–56, rock.
U.C.T., MB 59, 34° 04′ 08″ S., 22° 13′ 52″ E., 11·5 m., 18–1–56, rock.
U.C.T., MB 60, 34° 04′ 18″ S., 22° 14′ 10″ E., 17–20 m., 18–1–56.
U.C.T., MB 65, 34° 04′ 47″ S., 22° 13′ 06″ E., 26 m., 18–1–56, rock.
U.C.T., MB 68, 34° 09′ 08″ S., 22° 07′ 19″ E., 13 m., 19–1–56, rock.
U.C.T., MB 69, 34° 08′ 35″ S., 22° 07′ 20″ E., 13·5 m., 19–1–56, rock.
U.C.T., MB 72, 34° 09′ 04″ S., 22° 07′ 10″ E., 12 m., 19–1–56, rock.
U.C.T., MB 84, 34° 11′ 26″ S., 22° 10′ 8″ E., 29 m., 21–1–56, rock.

ALGOA BAY

U.C.T., LIZ 1, Station 1, 33° 55·7′ S., 25° 37·2′ E., 8·5–10·0 m., 5–4–54, mud.
U.C.T., LIZ 2, details as Station 1.
U.C.T., LIZ 3, Station 2, 33° 56·1′ S., 25° 40·0′ E., 17–18 m., 5–4–54, sand.
U.C.T., LIZ 9, Station 3, 33° 58·1′ S., 25° 38·9′ E., 9 m., 6–4–54, stones and rock.

U.C.T., LIZ 11, Station 5, 33° 57·2′ S., 25° 38·0′ E., 9–10 m., 6–4–54, limestone and grey clay.
U.C.T., LIZ 19, Station 8, 33° 58·5′ S., 25° 42·0′ E., 27 m., 7–4–54, sand and shell.
U.C.T., LIZ 25, Station 12, 34° 00·4′ S., 25° 44·5′ E., 39 m., 11–4–54, coarse sand and shell.
U.C.T., LIZ 28, Station 13, 34° 00·8′ S., 25° 42·4′ E., 5–7 m., 11–4–54, rock.
U.C.T., LIZ 32, Station 3, 33° 58·1′ S., 25° 38·9′ E., 6–4–54, stones and rock.
U.C.T., LIZ 34, Station 7, 33° 58·4′ S., 25° 40·5′ E., near charted 'coral' patch, 14 m., 7–4–54, stones.
U.C.T., LIZ 38, Station 8, 33° 58·5′ S., 25° 42·0′ E., 27 m., 6–4–54, sand and shell.

MORRUMBENE ESTUARY

U.C.T., MOR 43, 20–1–54, channel at Linga-linga, 6–9 m.
U.C.T., MOR 50, 20–1–54, channel at mouth of Rio Coche, 3–5 m., sand.
U.C.T., MOR 76, 23–1–54, sand at L.W.S.T., Mongué.
U.C.T., MOR 77, 23–7–53, Linga-linga, 3 m., sand.
U.C.T., MOR 91, 12–7–54, channel at Linga-linga.
U.C.T., MOR 108, 14–7–54, edge of channel, Linga-linga, 1·5–4 m., sand.
U.C.T., MOR 109, 14–7–54, channel at Linga-linga, 4 m., sand.
U.C.T., MOR 122, 15–7–54, off Linga-linga.
U.C.T., MOR 132, 16–7–54, channel opposite Rio Coche, 2 m., sand and shell.
U.C.T., MOR 187, 18–7–54, intertidal mud near L.W., N.W. of Mongué.
U.C.T., MOR 188, 18–7–54, stones at L.W.S.T., Mongué.

OTHER LOCALITIES IN MOZAMBIQUE

U.C.T., PEA 1, 26–7–53, attached to iron railings in bathing-pool.
U.C.T., PEA 3, Linga-Linga, 10 m., 23–7–53, sand and weed.
U.C.T., PEA 4, Maxixe, 24–7–53, low water, sandbank and piles.

COMMERCIAL TRAWLERS

U.C.T., TRA 60, Kaffirkuils Bay, 34° S., 21° E., 62–70 m., 25–11–52.
U.C.T., TRA 62, 4½ miles off Cape Barracouta, 63 m., 25–11–52, covering a dromiid crab.
U.C.T., TRA 71, 32° 05′ S., 18° 14′ E., 66 m., 5–2–53, hard Polyzoa and rock.

SOUTH AFRICAN MUSEUM *Pieter Faure* COLLECTION

(denoted in text by PF)

PF 11, Mossel Bay, 0–55 m.
PF 586, 33° 50′ S., 25° 54′ E., 46–92 m.
PF 673, 33° 45′ S., 26° 44′ E., near Kowie, 73–79 m.
PF 704, 33° 53′ S., 25° 51′ E., 48 m.

PF 739, between Roman Rock and Cape Recife, 31 m.
PF 740, details as PF 739.
PF 895, 32° 47′ S., 28° 16′ E., 50–54 m.
PF 1095, between Bird Island and mainland, Algoa Bay, 18–29 m.
PF 1711, Cape St. Blaize, N. by E ¾ E., 6 miles, 64 m.
PF 1864, Cape St. Blaize, N. 36 miles, 99 m.
PF 2326, Lion's Head, N. 67° E., 25 miles, 248 m.
PF 2348, details as PF 2326.
PF 2361, details as PF 2326.
PF 2531, Lion's Head, N. 63° E., 34 miles, 283 m.
PF 10165, Cape St. Blaize, N. by W. ½ W., 5 miles, 62 m.
PF 10477, Cape St. Blaize, N. by E., 8 miles, 72 m.
PF 10722, Cape Natal, W. by N., 6 miles, 91 m.
PF 12393, Itongazi River mouth, Natal, NW. ¾ W., 3 miles, 46 m.
PF 12943, East London, low tide.
PF 13393, Cape Morgan, NW. ¼ N., 11 miles, 160 m.
PF 13432, Sandy Point, NE. by E. 6 miles, 94 m.
PF 13481, Sandy Point, N. ¼ E., 10 miles, 175 m.
PF 14560, Cape Point, N. 50° E., 18 miles, 341 m.
PF 14582, details as PF 14560.
PF 15584, Rocky Bank, False Bay, 31 m.
PF 15797, off Seal Island, False Bay, 18–19 m.
PF 15984, off Zwartklip, False Bay, 18–22 m.
PF 18785, Cape Seal, W. by N. ½ N., 7 miles, 72 m.

List of new species and forms

Synoicum capense sp. n.
S. australe sp. n.
Polycitorella pallida sp. n.
Tetrazona porrecta sp. n.
Sigillina vasta sp. n.
Eudistoma digitatum sp. n.
Didemnum (*Polysyncraton*) *magnilarvum* sp. n.
Lissoclinum cavum sp. n.
Ascidia stenodes sp. n.
Botryllus anomalus sp. n.
Metandrocarpa fascicularis sp. n.
Cnemidocarpa psammophora sp. n.
Styela radicata sp. n.
Boltenia africana sp. n.
Halocynthia spinosa Sluiter f. *defectiva* n.
Molgula cryptica sp. n.
Eugyra myodes sp. n.
Eugyra macrentera sp. n.

Description of Species

Family **Polyclinidae** Verrill, 1871

Genus APLIDIUM Savigny, 1816

As I have pointed out (Millar, 1960) there seems to be no good reason for separating the genera *Aplidium* Savigny 1816 and *Amaroucium* Milne Edwards 1842, and I am using *Aplidium*, which has priority.

Aplidium flavo-lineatum (Sluiter)

(Fig. 2)

Amaroucium flavo-lineatum Sluiter, 1898, p. 30, pl. 1, fig. 7; pl. 4, fig. 12.
Amaroucium astraeoides Sluiter, 1898, p. 33, pl. 1, fig. 9; pl. 5, figs. 2–5. Hartmeyer, 1912, p. 351, pl. 44, fig. 5, text-fig. 10.
Amaroucium simplex Sluiter, 1898, p. 35, pl. 1, fig. 10; pl. 5, fig. 6.
Amaroucium erythraeum Michaelsen, 1934, p. 137, pl. 7, fig. 1. Millar, 1955, p. 270, fig. 2.

Known distribution

Cape Province.

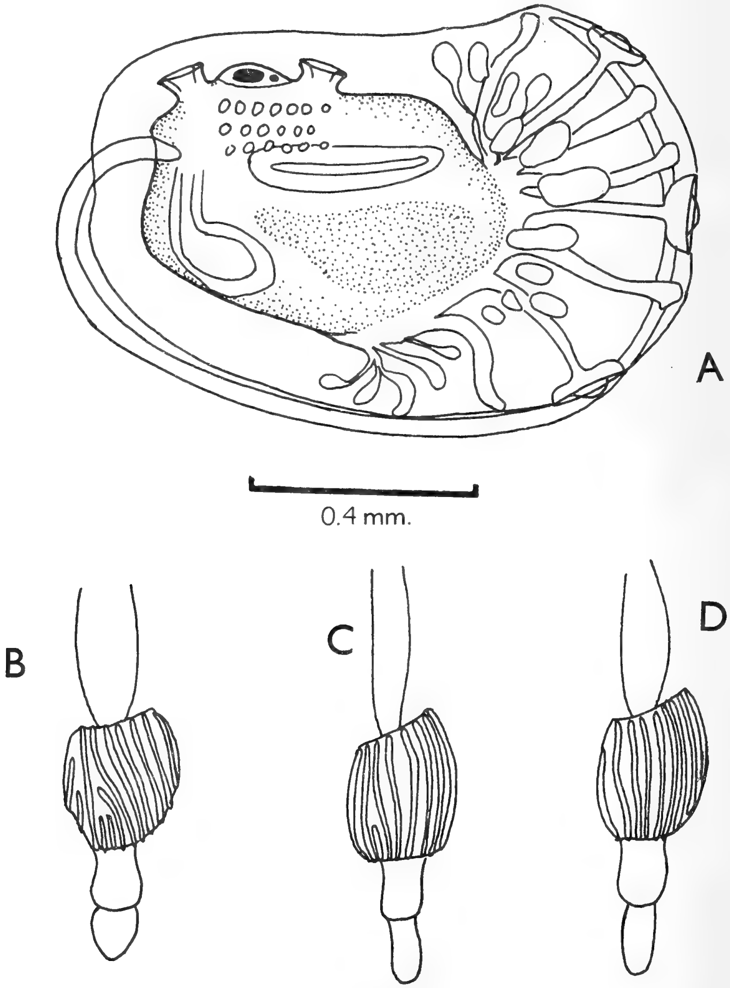

FIG. 2. *Aplidium flavo-lineatum* (Sluiter).

A, larva; B, stomach of type specimen of *Amaroucium flavo-lineatum* Sluiter; C, stomach of type specimen of *Amaroucium astraeoides* Sluiter; D, stomach of type specimen of *Amaroucium simplex* Sluiter.

Localities

Table Bay: U.C.T., TB 171 B.

Cape Peninsula: U.C.T., CP 393 S; U.C.T., CP 425 R.

False Bay: U.C.T., FAL 130 Z; U.C.T., FAL 163 N; U.C.T. FAL 167 Y; U.C.T. FAL 175 K; U.C.T. FAL 182 T; PF 15797 A; Mortensen's Java–South Africa Expedition, Station 65, 19–12–29, B.M.(N.H.) reg. no. 34.2.1.4.

Mossel Bay: U.C.T., MB 18 P; U.C.T., MB 48 A; U.C.T., MB 60 P; U.C.T., MB 65 C.

Algoa Bay: U.C.T., LIZ 28 R; U.C.T., LIZ 32 T; PF 704.

Description

This species is often red in life, the collectors of the present material having noted that the specimens were 'red', 'blood orange', or 'scarlet', but occasionally 'colourless'. The variable amount of sand on the surface and within the colony no doubt determines to a large extent its colour in the field. After preservation the colour of the specimens may change, and the material in this collection shows zooids with red, orange-yellow, sulphur-yellow, yellow-green and, in one colony, bright blue colour in the body wall.

Most of the specimens in the present collection have quite conspicuous small round or oval systems, each with a small common cloacal opening in the centre.

I have examined many colonies and find that the number of folds on the wall of the stomach varies from 19 to 33, but is usually between 25 and 30.

Larva

Larvae were present in colonies collected in January, February, April, June, September, and December. They generally numbered from 1 to 4 in a breeding zooid. Most larvae measure 0·80–1.00 mm. in length from the end of the papillae to the base of the tail, but some were only 0·64 mm. The anterior papillae have long, slender stalks. There is a variable number, generally 4–6, of finger-like median ampullae, and many short lateral ampullae or large vesicles.

Remarks

There has been much confusion in the past over this species, largely owing to the inaccurate description of the type specimens given by Sluiter (1898). Sluiter (1898) also described two other species, *A. astraeoides* and *A. simplex*, the type specimens of which I have been able to examine along with those of *A. flavo-lineatum*. In some important points I find Sluiter's descriptions wrong, and I have no doubt that the three species are synonymous, the name *A. flavo-lineatum* having page priority. In particular the number of folds on the wall of the stomach is not that given by Sluiter. Careful examination of the type specimens (fig. 2, B–D), particularly transverse sections of the stomachs, showed that there are 23–26 narrow folds in each species, although Sluiter gave the following descriptions:—

A. flavo-lineatum—10 folds.
A. astraeoides—areolated stomach.
A. simplex—12 folds.

The discrepancy is difficult to understand, even assuming that Sluiter made only a rough estimate of the total number from the number on one side of the stomach.

This species has also appeared in accounts of South African ascidians under the name *A. erythraeum* Michaelsen (Michaelsen, 1934; Millar, 1955), but *A. erythraeum* was originally described from the Red Sea and I am now doubtful if it is the same as the South African species, although anatomically similar. Michaelsen (1934) also considers *A. phortax* (Michaelsen) from New Zealand to be a synonym. If *A. flavo-lineatum*, *A. erythraeum* and *A. phortax* are synonymous, then we are dealing with a species having an apparently very curious and discontinuous distribution, and I think it more likely that the three species are separate but anatomically similar. It might be possible to distinguish them if the larvae of all three were known.

See below for remarks on the possible identity of *A. circulatum* (Hartmeyer) and *A. flavo-lineatum*.

? *Aplidium circulatum* (Hartmeyer)

Amaroucium circulatum Hartmeyer, 1912, p. 349, pl. 39, fig. 2; pl. 44, fig. 6. Hartmeyer, 1913, p. 130. Michaelsen, 1934, p. 130. Millar, 1955, p. 171.

Known distribution

Cape Province.

Locality

False Bay: U.C.T., FAL 234 W.

Description

The single colony is approximately mushroom-shaped, about 2·2 cm. across the head, and provided with a short stalk. In the preserved state it is buff-coloured, but in life, according to the collector's note, the zooids are 'brick-red'. There is sand within the colony but not on the surface.

The stomach of zooids in this colony has about 16 longitudinal folds, compared with about 24 in the specimen which I previously described from False Bay (Millar, 1955). In his original account Hartmeyer (1912) described the folds as numerous but did not state the number.

Remarks

This specimen agrees in most respects with Hartmeyer's account of *A. circulatum*. But, as Michaelsen (1934) has suggested, that species may be the same as *A. erythraeum* (Michaelsen), and I have accepted *A. erythraeum* as a synonym of *A. flavo-lineatum*.

The distinctions between *A. circulatum* and *A. flavo-lineatum* are not great, the main one being the presence of a stalk on the colony. There may also be fewer stomach folds. A much larger series of specimens will be needed, however, to decide whether *A. circulatum* is a distinct species.

Aplidium pantherinum (Sluiter)

(Fig. 3)

Psammaplidium pantherinum Sluiter, 1898, p. 26, pl. 2, fig. 3; pl. 4, figs. 8, 9.
Psammaplidium obesum Sluiter, 1898, p. 28, pl. 1, fig. 6; pl. 4, figs. 10, 11.
Amaroucium unilarviferum Millar, 1955, p. 172, fig. 4.

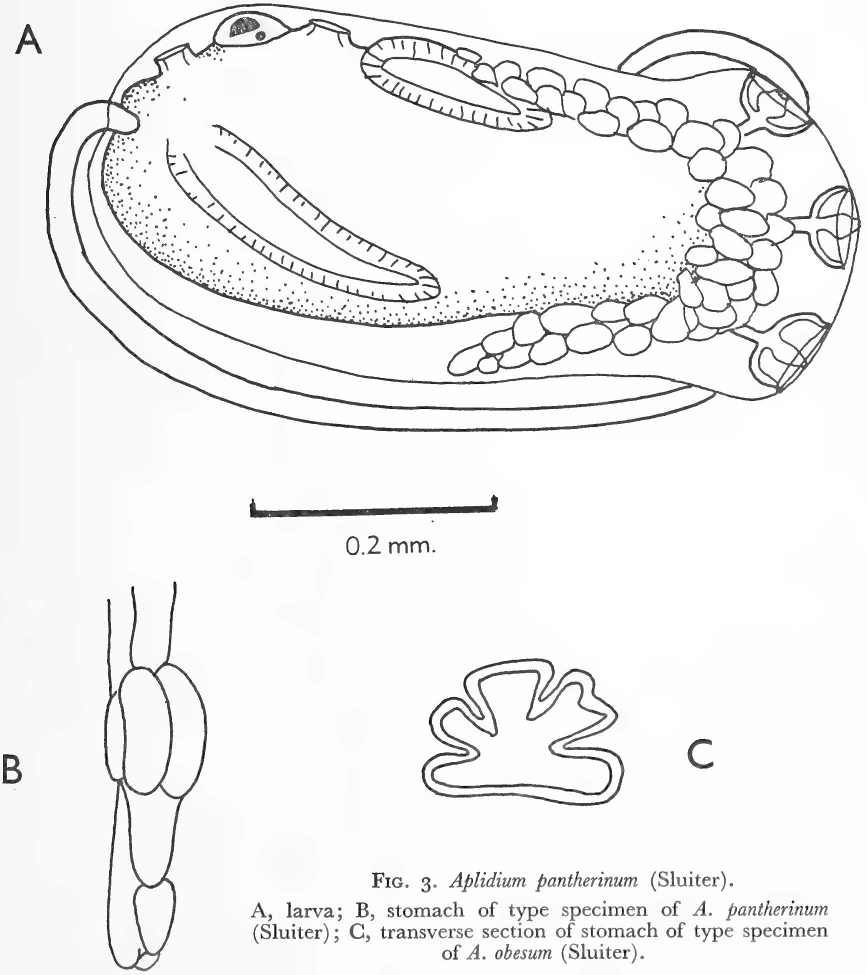

Fig. 3. *Aplidium pantherinum* (Sluiter).
A, larva; B, stomach of type specimen of *A. pantherinum* (Sluiter); C, transverse section of stomach of type specimen of *A. obesum* (Sluiter).

Known distribution

Cape Province and Isipingo, Natal.

Localities

Table Bay: U.C.T., TB 172; U.C.T., TB 173 A.
Off Cape of Good Hope: PF 2361 A.
False Bay: U.C.T., FAL 136 L; U.C.T., FAL 145 A; U.C.T., FAL 152 N; U.C.T., FAL 175 G; U.C.T., FAL 256 Q.
Mossel Bay: U.C.T., MB 69 E.

Remarks

When I described a new species *Amaroucium unilarviferum* (Millar, 1955) from Cape Province I had not examined Sluiter's type specimens of South African material. Having now done so I find such close agreement between *A. unilarviferum* and two species which Sluiter named *Psammaplidium pantherinum* and *P. obesum* that I must regard the three as synonymous. As *Psammaplidium* is a synonym of *Aplidium*, the specific name becomes *Aplidium pantherinum* which has page priority over *A. obesum*.

Only an examination of Sluiter's type specimens shows the identity of these species, as his descriptions are very misleading with regard to the stomach, a key character in the determination of species of *Aplidium*. Careful examination of isolated stomachs and of transverse sections of stomachs of the type specimens of *A. pantherinum* shows 5 folds (fig. 3, B), although Sluiter stated that there were 12 folds. Five or 6 folds are also present in the stomach of the type specimens of *A. obesum* (fig. 3 C), which Sluiter stated had 8 folds.

The type specimens of *A. pantherinum* and *A. obesum* differ from each other principally in external appearance, owing to the peculiar arrangement of sand grains on the surface of the former. This is a character of little or no systematic significance, and the identity of *A. pantherinum*, *A. obesum* and *A. unilarviferum* is shown by the structure of the zooid and of the larva.

Larva (fig. 3 A)

Larvae range in length, measured from the end of the papillae to the base of the tail, from 0·50 mm. (some larvae from type specimens of *A. pantherinum* from Isipingo, Natal) to 0·80 mm. (some larvae from type specimens of *A. obesum* from Sea Point, near Cape Town). The characteristic features of the larva, as shown in all specimens, are the absence of lateral paired ampullae, and the presence of a fringe of small epidermal vesicles round the anterior margin of each side. From 1 to 3 larvae are present in each breeding zooid. The larva which I figured under the name *A. unilarviferum* (Millar, 1955, fig. 4 D) was evidently not fully developed, as the fringe of epidermal vesicles is not shown; I have subsequently found the characteristic arrangement of vesicles in other larvae from the same colony.

The larva can be used to distinguish between *A. pantherinum* and *A. fuegiense* Cunningham, a South American species in which the stomach also has 5 or

6 folds. In *A. fuegiense* the larval trunk is deep, with prominent paired lateral and unpaired median ampullae, but no vesicles (Millar, 1960), and is thus very different from that of *A. pantherinum*.

Aplidium colelloides (Herdman)

(Fig. 4)

Amaroucium colelloides Herdman, 1886, p. 233, pl. 27, figs. 9–12.

Known distribution

Off Cape of Good Hope.

Locality

PF 18785 A.

Description

There are several colonies in the collection, all of a very characteristic shape. The colony is divided into an oval, rounded, or almost triangular head and a long narrow stalk (fig. 4 A). In one typical colony the head is 1·5 cm. long and the stalk 6·0 cm. The head is smooth, free of sand, and dull orange-grey in colour. The zooids are clearly visible and are arranged in long narrow oval systems orientated so that the zooids appear to be in vertical double rows. Common cloacal openings, which Herdman (1886) failed to find in the type specimen, are narrow slits placed among the rows of zooids. The stalk is sharply marked off from the head and has a uniform coating of sand grains. In most specimens the lower end of the stalk is attached to a narrow stem-like object which may be the tube of a polychaete.

The zooids (fig. 4 B) have a short thorax and abdomen which together measure about 1·5 mm. in an average zooid. The post-abdomen is very long and narrow and extends far down into the stalk of the colony. There are 6 pointed lobes on the oral siphon and the atrial opening is surmounted by a triangular languet of moderate length. The body wall of the thorax is thin and transparent, allowing the 9 rows of stigmata to be seen. Muscles on the thorax are so poorly developed as to be scarcely visible. The abdomen is short and the gut has a correspondingly short loop. There are 12 or 13 entire longitudinal folds on the walls of the stomach. In some zooids the post-abdomen contains an accumulation of reserve material, and in others a long series of testis follicles. Although no ovary was seen several zooids were carrying larvae in the atrial cavity.

Larva

The larva (fig. 4 C) measures about 0·70 mm. from the end of the papillae to the base of the tail. The three papillae are borne on long narrow stalks. Large numbers of small epidermal vesicles lie round the anterior end of the trunk in the region of the papillae. Both ocellus and otolith are present, the ocellus, at least in the preserved state, being red, and the otolith black.

Remarks

This is an interesting species and the only previous record is that of Herdman (1886) who described the single type specimen. Herdman's specimen was collected by the *Challenger* from a depth of 150 fathoms, a few miles south of the

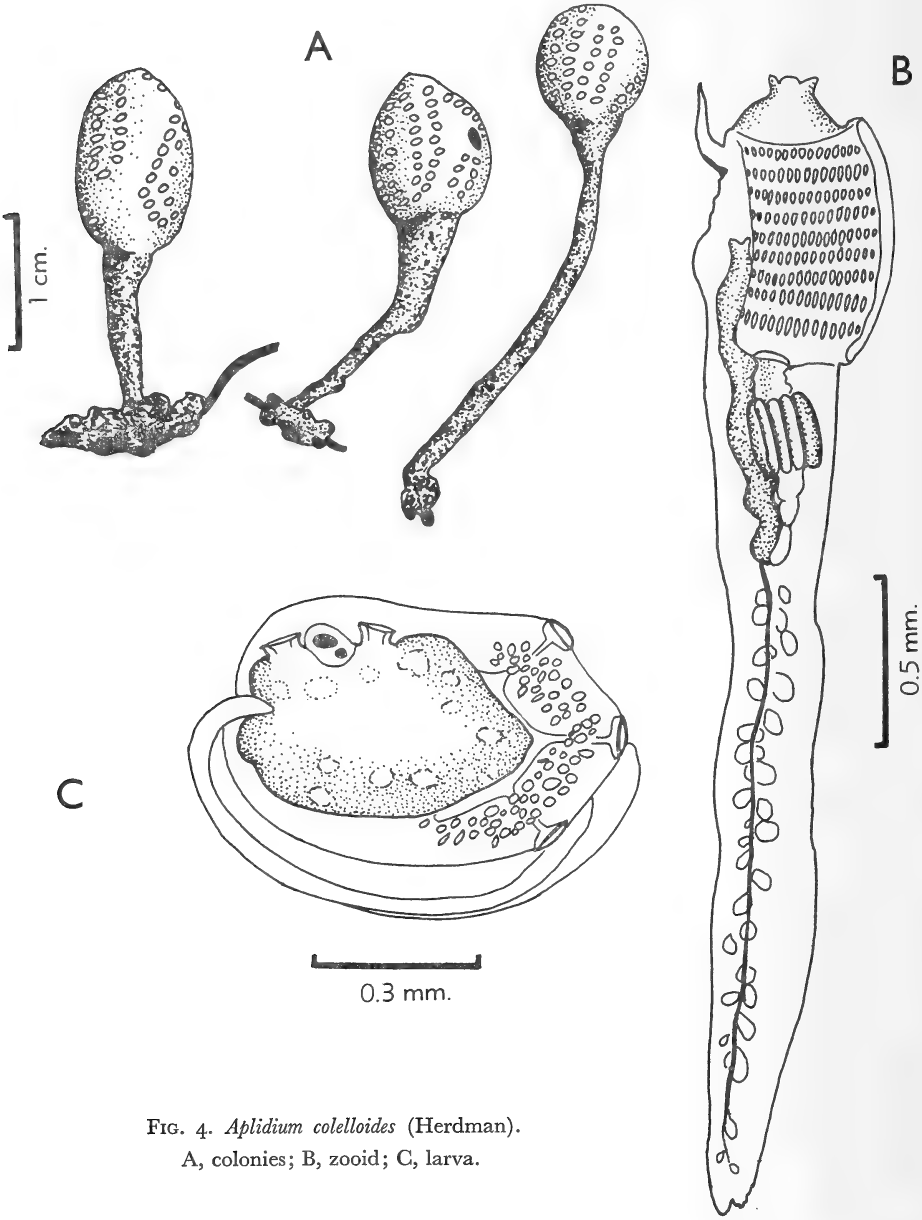

Fig. 4. *Aplidium colelloides* (Herdman).
A, colonies; B, zooid; C, larva.

Cape of Good Hope. This colony was incomplete, and gave little idea of the relatively great length of the stalk which apparently is usual. A long stalked colony is exceptional in the genus *Aplidium.*

The present specimens are identified as *A. colelloides* mainly by the shape of the colony, the proportions of the zooid, and the form of the larva, which Herdman illustrated.

Aplidium retiforme (Herdman)
(Fig. 5)

Psammaplidium retiforme Herdman 1886, pp. 248–9, pl. 32, figs. 8–10.

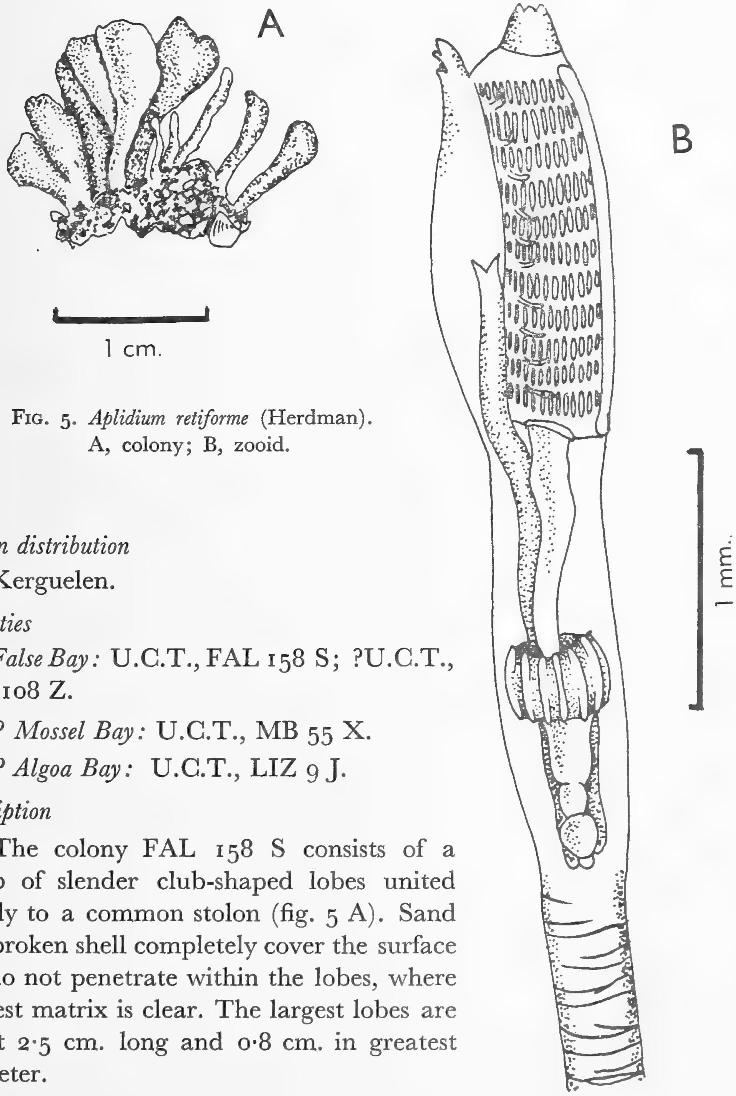

Fig. 5. *Aplidium retiforme* (Herdman). A, colony; B, zooid.

Known distribution

Kerguelen.

Localities

False Bay: U.C.T., FAL 158 S; ?U.C.T., FAL 108 Z.

? Mossel Bay: U.C.T., MB 55 X.

? Algoa Bay: U.C.T., LIZ 9 J.

Description

The colony FAL 158 S consists of a group of slender club-shaped lobes united basally to a common stolon (fig. 5 A). Sand and broken shell completely cover the surface but do not penetrate within the lobes, where the test matrix is clear. The largest lobes are about 2·5 cm. long and 0·8 cm. in greatest diameter.

Each lobe contains only a few zooids, probably constituting a single system, but common cloacal openings were not seen.

The zooids (fig. 5 B) attain a length of 6 mm., or more if the post-abdomen is very long. A layer of quite strong muscles is present on the thorax, which consequently is usually contracted and bent, in the preserved condition. The atrial opening is small and is surmounted by a short languet which has 3 shallow terminal lobes. There are 9 or 10 rows of stigmata. The stigmata are moderately long and narrow, although Herdman (1886) describes those of his specimens as 'not large' and shows them in his figure to be short. There are about 16 undivided longitudinal folds on the wall of the stomach. The post-abdomen contains neither ovary nor testes in the present specimens.

Remarks

This is one of those species which present a problem to the systematist. On the one hand there is close agreement between the structure of the specimen from False Bay and the type specimen from Kerguelen as described by Herdman, although it must be said that Herdman's account lacks some important details. On the other hand there is the great difference in temperature which must raise doubts whether one species exists in both localities.

The specimens from the three queried localities have smaller colonies, but otherwise are similar to the above description and may belong to the same species.

Aplidium sarasinorum (Fiedler)

(Fig. 6)

Heterotrema sarasinorum Fiedler, 1889, pp. 859–78, pl. 25, figs. 1–14.

Known distribution

Ceylon.

Localities

False Bay: U.C.T., FAL 208 S.

Mozambique: U.C.T., PEA 3 K; U.C.T., MOR 77 K; MOR 108 L.

Locality unknown: S.A. Museum.

Description

Most of the colonies are growing on and round the stems of algae or hydroids.

The specimen from False Bay is 4·2 cm. long, narrow, and flattened to a leaf-like shape and divided for half its length into 2 broad lobes. The consistency is firm and the surface almost smooth, but raised into small round swellings which mark the positions of the zooids. The test is impregnated with sand.

Other colonies are more fleshy and less subdivided into lobes, but the shape seems to depend largely on the form of the object to which the colony is attached. Sand is generally present in the matrix of the colony, but is sparse or absent on the surface.

In structure the zooids (fig. 6 A) resemble the type specimen described by Fiedler (1889). The thorax is short, stout, and often bent in the preserved state, owing to muscular contraction. The oral siphon is short and 6-lobed. The atrial opening is a transverse slit with a wide 3-lobed languet (fig. 6 B). About 8 powerful longitudinal muscles are present on each side of the thorax and converge towards the ventral side of the abdomen. There is a band of shining pale gold cells along each side of the endostyle, and although this feature was not mentioned by Fiedler, it is present in all the South African specimens. The gut has the usual subdivisions found in *Aplidium.* The stomach has 5–8 wide and rather indistinct folds. The post-abdomen is generally short, and only indistinctly marked off from the abdomen. In some zooids there are no gonads and in others a compact group of testis follicles immediately below the lower bend of the intestine.

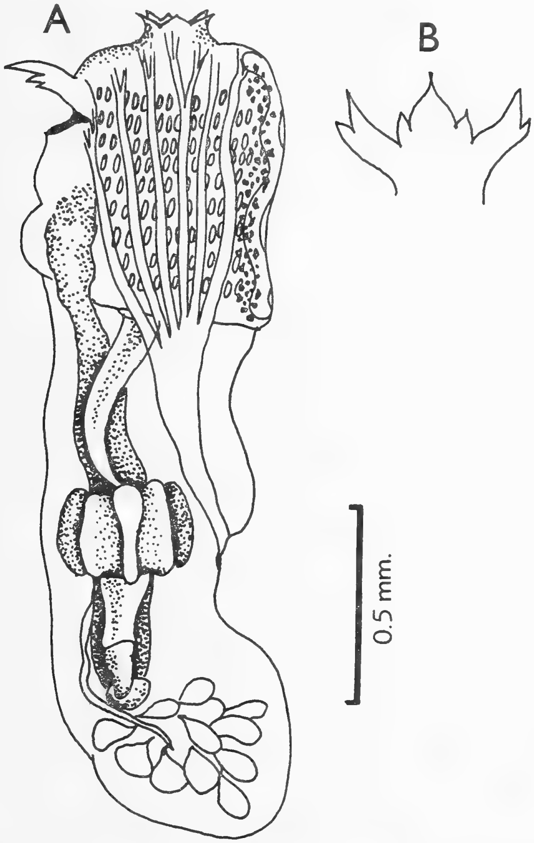

Fig. 6. *Aplidium sarasinorum* (Fiedler).
A, zooid; B, atrial languet.

Remarks

Fiedler (1889) founded his genus *Heterotrema* for a colony collected from Ceylon, but Michaelsen (1923, 1924) pointed out the similarity between *Heterotrema* and certain species of *Aplidium* (*Amaroucium*), and Pérès (1952) regarded *H. sarasinorum* as a variety of *A. circumvolutum* (Sluiter).

A. circumvolutum was originally taken from New Zealand waters and later Pérès (1952) described specimens from Kerguelen as a variety of the same species, *A. circumvolutum* var. *kerguelenense.* Pérès (1952) also described a new species *A. antarcticum* from Kerguelen, but regarded it as very close to *A. circumvolutum* and possibly identical.

I have no doubt that all the South African specimens listed here under 'Localities' are of the same species as Fiedler's colony, but I do not follow Pérès in identifying *Heterotrema sarasinorum* with *Aplidium circumvolutum.*

A. sarasinorum is characterized by the flat, expanded and lobed colony, with zooids on both surfaces, the wide 3-lobed atrial languet, the stomach with about 7 folds, the very compact testis, and the short post-abdomen which is not clearly marked off from the abdomen.

In *A. circumvolutum* the colony is more massive and broadly based, the atrial languet long, the stomach smooth-walled (Sluiter, 1900) or with 5 or 6 folds (Michaelsen, 1934), and the post-abdomen more sharply constricted and longer than in *A. sarasinorum.*

In addition to these distinctions, which are admittedly rather slight, except the different shape of the colony, there is the difference in distribution to separate the species. It seems unlikely that the same species should be found at Ceylon and at Kerguelen, and I believe that we are dealing with two species of similar structure, one distributed from South Africa across the Indian Ocean (*A. sarasinorum*) and the other of wide distribution in southern waters including New Zealand, Kerguelen, and also the Patagonian shelf, Graham Peninsula, and South Georgia (Millar, 1960).

?Aplidium galeritum (Hartmeyer)

Amaroucium galeritum Hartmeyer, 1912, p. 344.

Known distribution

St. Francis Bay, Cape Province.

Locality

False Bay: U.C.T., FAL 225 P_2.

Description

The specimen is slightly lobed and rather flattened, and measures 9·5 cm. by 2·7 cm. by 1·0 cm. It is heavily encrusted on the surface and impregnated throughout with sand and broken shell, so that the consistency is very firm. There is no division of the colony into a softer head with zooids and firmer base without zooids, which Hartmeyer (1912) found in his type specimen, but I do not know if this is an important difference.

As regards the zooids, the structure agrees in most points with *A. galeritum*, but in the specimen from False Bay there is no very distinct atrial siphon, and there are only 10 to 12 folds on the stomach, whereas *A. galeritum* has a short atrial siphon and 14 to 18 folds.

Larva

From 3 to 6 larvae are present in the atrial cavity of breeding zooids. The trunk is about 0·4 mm. long, has the usual 3 papillae of the genus, and a fringe of small epidermal vesicles round the anterior end. Both ocellus and otolith are present.

Remarks

I am not sure that this specimen agrees well enough with *A. galeritum* to be placed in that species, but it may be within the variation to be expected, and I hesitate to add another doubtful species to the South African list.

Genus SYNOICUM Phipps, 1774

Synoicum capense sp. n.

(Fig. 7)

Diagnosis of species

Colony stalked, with a conical or hemispherical head. Surface of head and stalk coated with sand and shell. Inner test matrix clear, without sand. A few systems of zooids in each head. Zooids with 8–10 rows of stigmata, a very short atrial siphon with moderately wide and long upper lip or languet. Stomach smooth. Post-abdomen of variable length, with a long series of testis follicles.

Holotype

In the South African Museum, S.A.M. A25608 (U.C.T., FB. 1106C).

Localities

False Bay: U.C.T., FB 1106 C; U.C.T., FAL 53 L.

Description

The two colonies, which are stalked, are 1·3 cm. and 1·7 cm. long, the head occupying less than half of the total length. The stalk is narrowest at the base and gradually widens towards the upper end (fig. 7 A). The head is almost twice as wide as the upper part of the stalk, and the larger colony is 0·6 cm. in greatest diameter. The head is widest at its junction with the stalk and is either hemispherical or conical. Sand and broken shell fragments cover the whole surface of the colony. Common cloacal openings are not visible, but several must exist on each head, since dissection shows the zooids to be arranged in several systems. Sand and shell are confined to the surface layer of the common test, the inner test matrix of both head and stalk being clear.

The zooids (fig. 7 B) may reach 12 mm. in length, but some are shorter. Only the thorax and abdomen are contained in the head of the colony and the post-abdomen extends some distance down within the stalk.

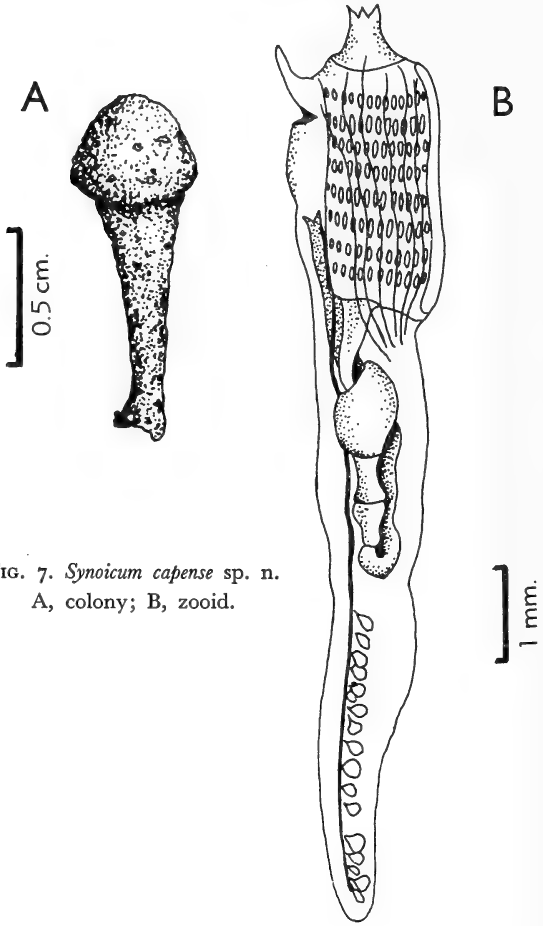

Fig. 7. *Synoicum capense* sp. n.
A, colony; B, zooid.

There are 6 short pointed lobes on the oral siphon. The atrial siphon is very short with the upper margin drawn out into a short languet, which is either quite simple or has 3 small distal lobes. About 6 slender longitudinal muscles pass down each side of the thorax. Eight to 10 rows of stigmata are present in the branchial sac, each row with about 12 stigmata. The oesophagus is of moderate length, and the stomach is ovoid with smooth walls. The post-stomach and the intestine are well-marked. There is little difference in diameter between the abdomen and the post-abdomen, which may however be slightly narrower. Some zooids of the larger colony have a fairly long series of testis follicles in the post-abdomen, but none was found with an ovary. In the smaller colony the zooids were without gonads.

Remarks

This new species perhaps most resembles *S. adareanum* (Herdman), but is distinguished by the more slender club-shaped colony, the complete covering of sand and shell, and the smaller number of rows of stigmata. From *S. arenaceum* (Michaelsen) it differs in having several systems on each head and in lacking a conspicuous rim round the cloacal openings.

Synoicum australe sp. n.

(Fig. 8)

Diagnosis of species

Colony rounded, smooth and moderately firm. Zooids arranged in small round systems. Oral siphon with shallow lobes; atrial siphon tubular with oblique opening and the dorsal margin slightly produced as a short lip. Longitudinal muscles many and narrow. About 20 oral tentacles and 20 rows of stigmata. Dorsal tubercle with a simple transverse oval opening. Oesophagus longer than stomach. Stomach with smooth walls. Anus about half-way along the thorax. Post-abdomen about equal in length to the thorax and abdomen together.

Holotype

In the South African Museum. S.A.M. A25609 (U.C.T., MB 27 H).

Locality

Mossel Bay: U.C.T., MB 27 H.

Description

There is only one specimen, a colony measuring 2·3 cm. by 1·6 cm. by 1·0 cm. The colony is slightly lobed, but there is no obvious area of attachment and it is not apparent how the specimen was fixed to the substratum during life. No foreign matter is present on the surface, which is quite smooth, and there is also none within the colony. The colour, in the preserved state, is translucent grey, with the systems of zooids showing through as paler stellate patterns.

The zooids (fig. 8) reach 6 mm. in length and are divided into a thorax and abdomen of about equal length, and the post-abdomen which is as long as the thorax and abdomen together. The thorax is wider than the other two divisions of the body. The oral siphon is short with 6 shallow rounded lobes, and the atrial siphon tubular with an oblique opening. No well developed languet is generally present but the dorsal margin of the atrial opening is produced to form a rounded lip of variable length. Numerous slender longitudinal muscles pass along each side of the thorax, and circular muscle strands surround the oral siphon. About 20 tentacles stand at the base of the oral siphon. The dorsal tubercle is small with a simple transverse oval opening. There are up to 20 rows of stigmata, but the number in each row is difficult to count owing to contraction of the thorax.

The oesophagus is longer than the stomach, laterally flattened, and slightly curved. It enters the oblique anterior end of the stomach. The stomach is rounded with quite smooth walls. The post-stomach and intestine are together

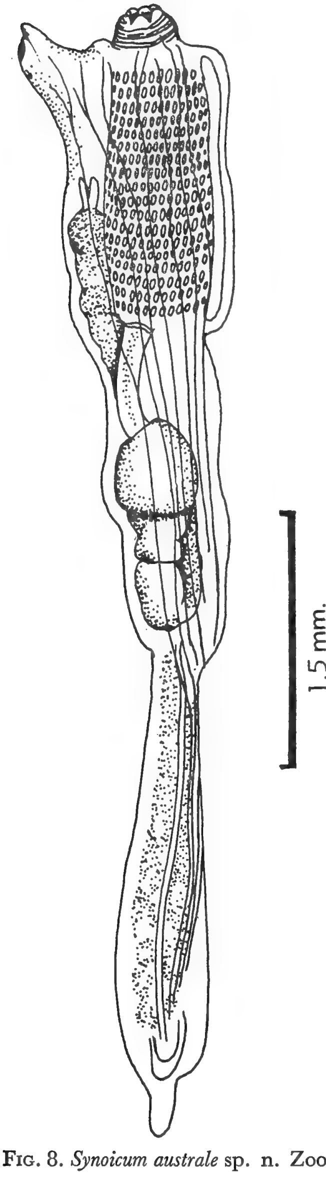

Fig. 8. *Synoicum australe* sp. n. Zoid.

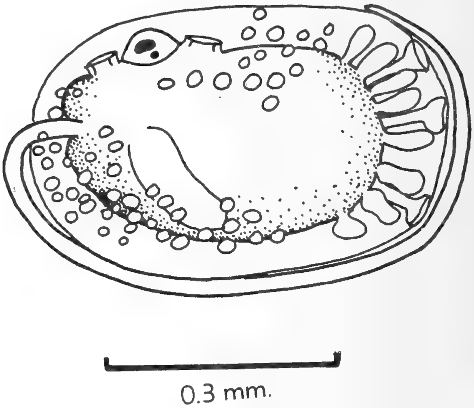

Fig. 9. *Polyclinum arenosum* Sluiter. Larva.

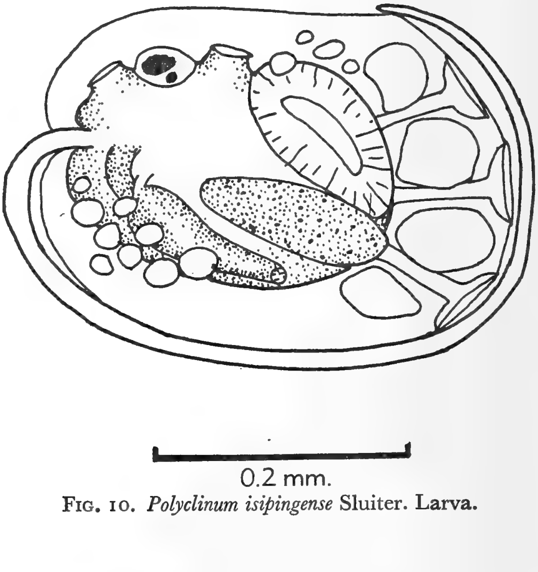

Fig. 10. *Polyclinum isipingense* Sluiter. Larva.

slightly longer than the stomach. The rectum extends about half-way along the thorax, and ends in a 2-lipped anus.

None of the many zooids examined from this colony had any trace of gonads. The post-abdomen contained numerous storage cells.

Remarks

Except for *S. capense* just described, no species of *Synoicum* has yet been recorded from the coast of Cape Province. Michaelsen (1914, 1915) has described *Macroclinum angolanum* from Angola, and this species should probably be referred to the genus *Synoicum*. It differs in many respects from *S. australe*, notably in its much smaller number of rows of stigmata, and much more numerous oral tentacles. Two species described by Sluiter (1898) as *Polyclinum arenosum* and *P. insulsum* were recorded respectively from Natal and Mozambique. These were both regarded by Michaelsen (1919) as belonging to the genus *Macroclinum*, which is now recognized as a synonym of *Synoicum*. I have examined the type material and have no doubt that Sluiter was right in placing both species in the genus *Polyclinum*.

In appearance of the colony the present species resembles *S. giardi* (Herdman), an Antarctic species, but the conspicuously areolated stomach of the latter readily distinguishes it. The zooid of *S. australe* is perhaps most like that of *S. adareanum* (Herdman), a species of the high Antarctic, but the colony formation is quite different.

S. circumvolutum Kott, from Kerguelen and Heard Island, is like *S. australe*, but the colony is sometimes stalked and the zooids have only 12 rows of stigmata. Another Antarctic species, *S. minutum* (Herdman), has a colony somewhat like that of *S. australe*, but the zooids are irregularly scattered and have usually only 7 or 8 rows of stigmata.

Genus POLYCLINUM Savigny, 1816

Polyclinum arenosum Sluiter

(Fig. 9)

Polyclinum arenosum Sluiter, 1898, p. 20, pl. 4, figs. 1, 2. Millar, 1955, p. 174.

Known distribution

Isipingo, Natal; False Bay, Cape Province.

Locality

Algoa Bay: PF 1095 A.

Description

The deep division of the colony into long narrow lobes, which the specimen shows, is typical of the species. The colony is considerably more massive than Sluiter's type specimen, as the lobes attain a length of 4 cm., compared with 1·4 cm. in Sluiter's material.

Larva

In Sluiter's type specimens, which I have examined, larvae are present in some zooids, but are in such a bad state of preservation that few details are visible. They measure from 0·32 to 0·36 mm. in length, from the end of the papillae to the base of the tail. Larvae (fig. 9) are also present in the new material from Algoa Bay. These vary in length from 0·46 to 0·60 mm. They have the usual 3 anterior papillae, an ocellus and otolith. Small epidermal vesicles are grouped along the dorsal and ventral parts of the trunk. Before the larva is fully developed there are 4 pairs of lateral ampullae flanking the papillae, but later they subdivide to give rise to 8 pairs.

Polyclinum isipingense Sluiter
(Fig. 10)

Polyclinum isipingense Sluiter, 1898, p. 21, pl 2, fig. 1, pl. 4, fig. 3. Hartmeyer, 1913, p. 83. Millar, 1955, p. 175.

Known distribution

Isipingo, Natal; False Bay, Cape Province.

Localities

Morrumbene Estuary: U.C.T., MOR 50 J; MOR 76 F; MOR 108 M; MOR 122 F; MOR 132 G; MOR 187 A.

Description

The colonies are of a rather solid appearance, and often reach 2–5 cm. in greatest diameter. They are generally dull purple-brown in colour, and some have a coating of sand and broken shell, but the surface of other colonies is bare. Small common cloacal openings are scattered over the colony, but are not raised on swellings as they were in the type material.

The zooids reach 5 mm. in total length. They are therefore shorter than the zooids of the type material which Sluiter (1898) gives as 9 mm. long, but the length of zooids in *Polyclinum*, as in most genera of the family, changes much during the life of a colony and is a character of little systematic value.

Larva

Larvae (fig. 10) are present in several colonies, and there are usually 2 in each breeding zooid. They range in length from 0·32 to 0·40 mm., measured from the end of the papillae to the base of the tail. There are 3 anterior papillae, and 4 pairs of lateral ampullae. A dorsal and a ventral group of epidermal vesicles is present on each side of the trunk.

Polyclinum neptunium Hartmeyer
(Fig. 11)

Polyclinum neptunium Hartmeyer, 1912, p. 331, pl. 38, fig. 9; pl. 44, figs. 2–4.

Known distribution

Off Cape of Good Hope.

Localities

PF 2326; PF 2428; PF 2531; PF 14560.

Description

There are many colonies of this species in the *Pieter Faure* collection, all of a dull purple-brown colour and fleshy appearance. Some are over 7 cm. in greatest diameter and are thus rather larger than Hartmeyer's type specimens. The surface is generally smooth and free of encrusting matter, except on the basal area of attachment where sand or small stones adhere to the test, but a little sand may also be scattered on the surface. The zooids are arranged in oval or elongated systems, but these are only sometimes visible externally.

In structure the zooids agree closely with Hartmeyer's description.

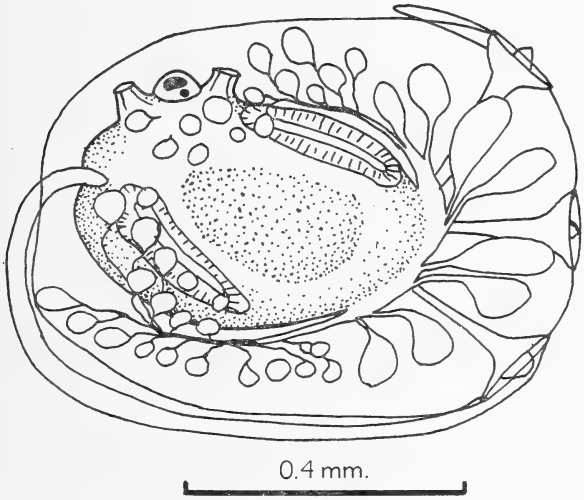

FIG. 11. *Polyclinum neptunium* Hartmeyer. Larva.

Larva (fig. 11)

Larvae are present in several colonies. In length, measured from the end of the papillae to the base of the tail, they range from 0·52 mm. to 0·80 mm. The trunk is rather deep, dorsi-ventrally. The larva has the structure usual in *Polyclinum*, with 3 anterior papillae, a sensory vesicle containing ocellus and otolith, and well developed siphonal rudiments. The ampullary tissue well illustrates the structure pointed out by Carlisle (1952) for *Polyclinum aurantium* Milne Edwards; on each side a lateral ridge arises from the anterior end of the trunk and sends one posterior branch dorsally and one ventrally. It is from these ridges and their branches that the larger anterior ampullae and the smaller dorsal and ventral vesicles arise; both ampullae and vesicles retain their connection with the ridges by slender stalks.

Genus PSEUDODISTOMA Michaelsen, 1924

Pseudodistoma africanum Millar

(Fig. 12)

Pseudodistoma africanum Millar 1954, p. 128.

Known distribution

Cape Province.

Localities

False Bay: U.C.T., FAL 158 L; U.C.T., FAL 175 F; PF 15584.

Mossel Bay: U.C.T., MB 65 D.

Algoa Bay: U.C.T., LIZ 28 V.

Natal: PF 12393 A; off Durban, collection S.S. *Pickle,* B.M. (N.H.) reg. no. 1926. 8.1.4, 29° 31′ 07″ S., 31° 22′ 35″ E., 55 m.

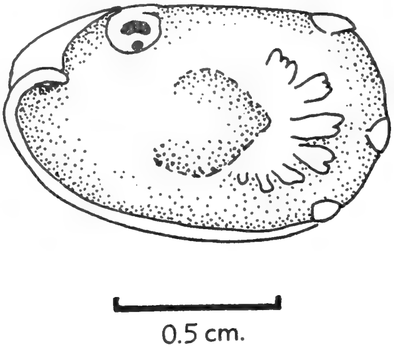

FIG. 12. *Pseudodistoma africanum* Millar. Larva, possibly not fully developed.

Description

Most of the colonies agree well in shape and colour with the type specimens (Millar, 1954). In the present collection the largest specimens are one of 8 cm. length from Mossel Bay (U.C.T., MB 65 D), and a complex colony from Natal (PF 12393 A) in which the head and stalk may reach 8 cm. The colony from Natal is dull purple, unlike the other specimens which are some shade of yellow or grey. The collectors have described the specimens variously as colourless or pink in life.

In structure the zooids are generally typical of the species, and many have a single very large egg in the post-abdomen. The zooids of a colony from Natal (B.M. (N.H.) reg. no. 1926.8.1.4) have up to 20 longitudinal muscles on each side, this being a greater number than in the type specimens.

Larva

Only one colony so far collected has larvae (fig. 12) and these were probably not fully developed. This was the colony from Natal (B.M. (N.H.) reg. no.

1926.8.1.4). In some zooids of this colony there was, in the atrial cavity, one very large embryo or larva occupying the whole length of the thorax. The most advanced larvae were about 1 mm. long from the end of the papillae to the base of the tail. Unfortunately details were not clear, but there are 3 anterior papillae in a vertical row, and both ocellus and otolith in the cerebral vesicle. A series of ampullae is also present at the anterior end of the trunk.

Remarks

Pseudodistoma is somewhat intermediate between the families Polyclinidae and Clavelinidae, having an abdomen and post-abdomen of the *Aplidium*-type and a thorax of the *Eudistoma*-type. Such details of the larva as can be seen suggest *Aplidium* rather than *Eudistoma*, thus confirming the position of the genus in the family Polyclinidae.

Family **Clavelinidae** Forbes and Hanley, 1848

Genus CLAVELINA Savigny, 1816

Clavelina roseola Millar

Clavelina roseola Millar, 1955, p. 183.

Known distribution

False Bay, Cape Province; Red Sea (as *Stomozoa murrayi*, Kott 1957).

Localities

Mossel Bay: U.C.T., MB 60 Q; U.C.T., MB 65 E.

Description

One colony was collected at each station. The larger specimen is 5 cm. long, 3·5 cm. wide, and 2·5 cm. high. The base of the colony is coated with sand, but the heads are not. Some details may be added to those seen in the type specimen. The musculature consists of numerous quite strong longitudinal strands passing mainly from the intersiphonal region, down the sides of the thorax to concentrate in two wide bands on the abdomen. In the new specimens the folds on the stomach are few and have the appearance of artefacts. It is, therefore, probable that the 11 or 12 longitudinal folds described in the type material were also artefacts, and that the stomach in its natural state is smooth. The anus is 2-lipped and lies opposite the 12th or 13th row of stigmata. Subdivisions of the gut below the stomach correspond closely to those in Kott's (1957) figure 3 of *Stomozoa murrayi.*

Remarks

Stomozoa murrayi Kott, collected from the Red Sea by the John Murray Expedition, is evidently the same as *Clavelina roseola* and becomes a synonym. The resemblances are very close, in the general form of the colony and zooid, the gut, and particularly in the peculiar and characteristic siphonal lobes.

The only important difference is the large number of rows of stigmata in *S. murrayi* (26) compared with *C. roseola* (17), but the greater development of the branchial sac in the Red Sea specimens may be due to a more favourable environment in warmer waters.

Kott (1957) accommodated her species in a new subfamily Stomozoinae, but the siphonal lobes constitute the only character differing markedly from the normal structure of *Clavelina*. The species seems to be no more than an aberrant member of the genus *Clavelina*.

Clavelina steenbrasensis Millar

Clavelina steenbrasensis Millar, 1955, p. 185.

Known distribution

False Bay, Cape Province.

Localities

False Bay: U.C.T., FAL 175 E.
Mossel Bay: U.C.T., MB 18 Q; U.C.T., MB 38 D.

Description

There are several specimens in the collection, and these show that the lateral compression of the colony noted in the type specimen is not a common feature of the species. A well-developed colony is about 4 cm. in greatest diameter and consists of a number of upright lobes, the largest about 2 cm. long. The lobes are widest at the top and narrowest at the base where they are united to a small mass of common test. The test is transparent and firm, the dark blue zooids being visible from the outside. A section through the stomach shows only 5 indistinct longitudinal folds, although in the type specimen there were 8 folds. As in other species of *Clavelina*, however, it is often difficult to decide whether or not some of the folds in fixed material are artefacts. Some zooids have a slender posterior vascular process extending downwards from the end of the abdomen.

Remarks

I have already pointed out the general similarity between this species and *C. gigantea* Van Name, but the latter species even if it does not differ in the form of the stomach as I previously believed, is distinguishable by its dark pigmented test and apparently unpigmented zooids, and is recorded from the Gulf of Mexico.

There are other specimens which I include in this species with some hesitation. A single piece of a colony (U.C.T., FB 1106 D, 20–8–47) is solid, smooth, and hyaline, and contains zooids like those of *C. steenbrasensis* but without any pigment. There are also colonies from False Bay (S.A. Museum *Pieter Faure* collection, no. 17458, 17–22 m.), and from an unknown locality

(S.A. Museum *Pieter Faure* collection), which, although having a form of colony resembling the typical specimens of this species, yet have a much softer and more flexible test, and have no pigment on the zooids. It is possible that the consistency of the test depends on the age of the colony, or the conditions of preservation which may also affect the colour of the zooids.

Genus CYSTODITES Von Drasche, 1883

Cystodites roseolus Hartmeyer

(Fig. 13)

Cystodites roseolus Hartmeyer, 1912, p. 310.

Known distribution

Algoa Bay, Cape Province; Gulf of Guinea, west Africa; Seychelles.

Localities

Cape Peninsula: PF No. 2361 B.
Algoa Bay: between Bird Island and mainland, 18–30 m.
East of Algoa Bay: near Kowie, 33° 45′ S., 26° 44′ E., 73–78 m.

Description

The largest specimen is one from east of Algoa Bay, and measures 8 cm. high and about 6 cm. across the base. This colony and the other almost as large, from the same station, are roughly conical with a wide base of attachment (fig. 13 A). All specimens are rather soft, with a smooth surface, and of a dull pink or buff-pink colour. No common cloacal openings could be seen, and no definite arrangement of the zooids, except in one colony from east of Algoa Bay, in which the zooids appeared to be arranged in parallel spiral lines round the colony. Hartmeyer (1912) was uncertain of the arrangement of zooids in his type material, but described an apparently linear alignment of marks on the surface of the colony, which may correspond with the appearance of the present colony.

Spicules are generally absent from the most superficial layer of the common test, but form a narrow layer a little below the surface, about the level of the base of the thoraces. Below this there are scattered irregular masses of calcareous matter, probably representing large groups of spicules. The spicules (fig. 13 B) are mainly of a crude stellate shape with few and rather stout rays. Both the central ball and the rays of the spicules are made up of many needle-like rods. The spicules may attain 130μ in diameter, and are therefore larger than the spicules of Hartmeyer's type specimen. There are also smaller lozenge-shaped or rod-like spicules.

The zooids (fig. 13 C) are contracted and in this state measure about 2 mm. in length. In structure they are very like those of the type specimen, but have well-developed testes in the form of a rosette of follicles at the posterior end of the abdomen. The branchial sac has narrow parastigmatic bars across the rows of stigmata.

Larva

Larvae (fig. 13 D) are present in colonies from Cape Peninsula and Kowie. They measure 0·8–1·2 mm. in length from the end of the papillae to the base of the tail. The 3 vertically arranged papillae arise from within an elliptical band of

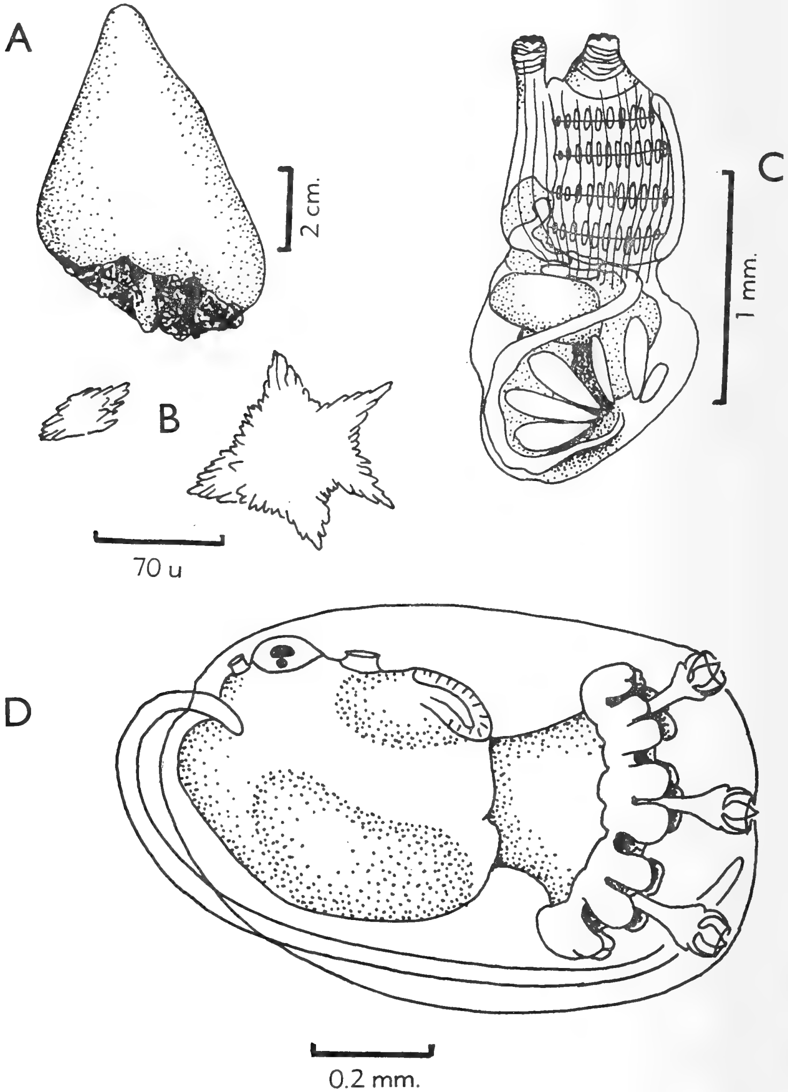

FIG. 13. *Cystodites roseolus* Hartmeyer.
A, colony; B, spicules; C, zooid; D, larva.

about 20 ampullae. In advanced larvae the rudiments of both oral and atrial siphons are present. The sensory vesicle contains a cup-shaped ocellus which is red in these alcohol-preserved specimens, and a spherical black otolith.

Remarks

This species is now known in South African waters from the Cape Peninsula to Algoa Bay. It has also been described from the tropical waters of the Gulf of Guinea and the Seychelles. The distribution thus given is a surprisingly wide one, and the species appears to exist under the very different temperature conditions of Cape Province and the Gulf of Guinea. In cases like this I wonder if we are dealing with two species which are so similar structurally that they cannot be distinguished, at least until many more specimens are available.

Cystodites dellechiajei (Della Valle)

Distoma dellachiajiae Della Valle, 1877, p. 40.

Known distribution

Very widely distributed in warm waters throughout the world, but apparently not known from the West Indian Ocean.

Locality

Morrumbene Estuary, Mozambique: U.C.T., MOR 43 W.

Description

There are several colonies, each investing a specimen of the crab *Pseudodromia integrifrons*. The spicules form close-fitting capsules round the abdomens of the zooids, but not round the thoraces. The convex disc-shaped overlapping spicules of these capsules are about 200μ in diameter and quite characteristic of the species.

Genus POLYCITORELLA Michaelsen, 1924

Polycitorella pallida sp. n.

(Fig. 14)

Diagnosis of species

Colony cushion-like, broadly based, and dull white. Zooids closely spaced and visible on the surface of the colony as small oval areas each with two siphonal openings. Stellate and irregular spicules present in all layers of the test. Zooids divided into thorax and abdomen. No lateral abdominal organs visible. Siphons each with 6 lobes. At least 40 oral tentacles. Dorsal tubercle simple. Thirteen to 15 rows of stigmata. Oesophagus long; stomach smooth-walled; anus 2-lipped.

Holotype

In the South African Museum. S.A.M. A25610 (PF 739).

Locality

Algoa Bay: PF 739.

Description

The single colony is about 12 cm. long, 6·5 cm. wide, and 3·5 cm. thick. It was evidently attached by most of the lower surface. In the preserved state the colour is dirty white. The whole upper surface is marked by many closely spaced low oval swellings, each marking the position of a zooid, and each having the openings of the oral and atrial siphon. There is no encrusting material on the colony.

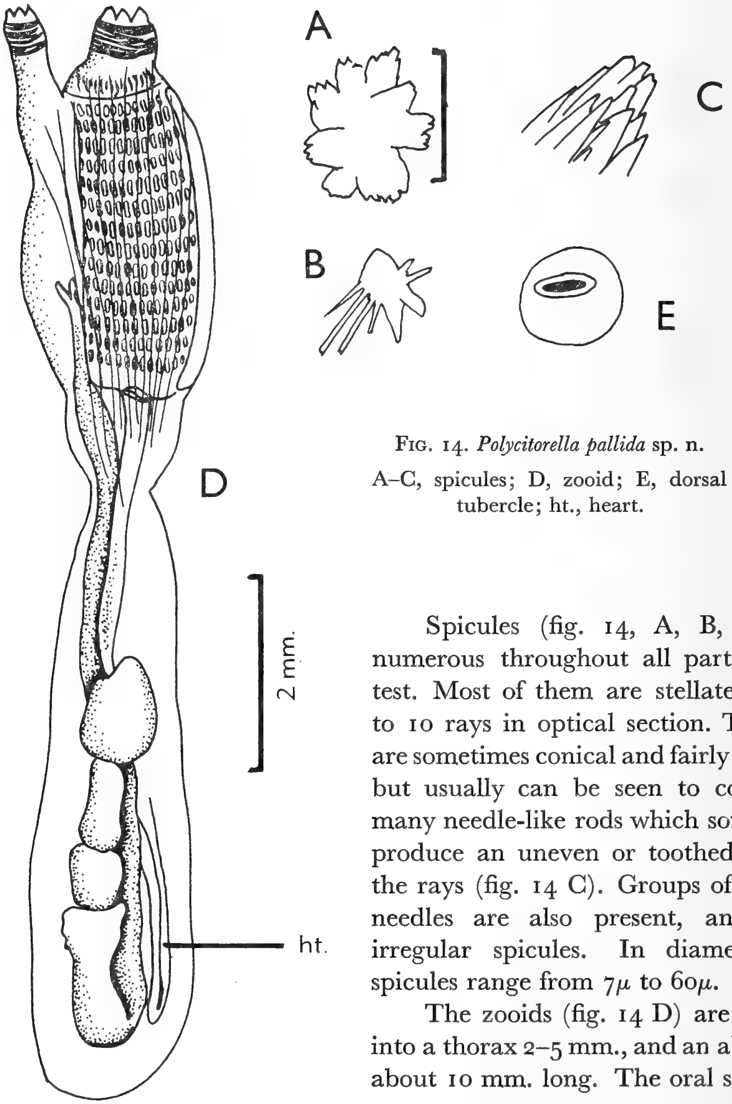

FIG. 14. *Polycitorella pallida* sp. n.
A–C, spicules; D, zooid; E, dorsal tubercle; ht., heart.

Spicules (fig. 14, A, B, C) are numerous throughout all parts of the test. Most of them are stellate with 5 to 10 rays in optical section. The rays are sometimes conical and fairly smooth, but usually can be seen to consist of many needle-like rods which sometimes produce an uneven or toothed end to the rays (fig. 14 C). Groups of rods or needles are also present, and form irregular spicules. In diameter the spicules range from 7μ to 60μ.

The zooids (fig. 14 D) are divided into a thorax 2–5 mm., and an abdomen about 10 mm. long. The oral siphon is short and 6-lobed, and the atrial siphon, which originates a short distance from the anterior end of the thorax, longer and more slender. Both siphons have powerful circular muscles. Narrow closely-spaced longitudinal muscles cover most of the thoracic region and, grouped together as a single narrower band, continue down each side of the abdomen. Circular muscles are not conspicuous on the thorax or abdomen.

The zooids generally show two constrictions, one between the thorax and abdomen and the other about a quarter of the length of the abdomen behind this. The latter constriction corresponds in position with a specially dense accumulation of spicules and a region of tougher test forming a ring round the abdomen at that point. This is the part of the abdomen where Michaelsen (1924) found a pair of lateral abdominal organs in *P. mariae*, but I can find no similar structures in the present species, although it is likely that this is a region specially active in the formation of spicules.

There are at least 40 simple oral tentacles of different sizes. The tentacles seem to be arranged in a single circle, but this is difficult to see. The dorsal tubercle (fig. 14 E) is small with a narrow oval slit placed transversely. There are 13 to 15 rows of stigmata in the branchial sac, each row with at least 12 rather wide and rectangular stigmata. The transverse bars are tall and narrow. The dorsal languets are triangular and quite large. The oesophagus is narrow and long, generally extending almost half the length of the abdomen. In outline the stomach is ovate or somewhat rectangular. Its walls are smooth. The remaining subdivisions of the gut are obscure, but behind the stomach there is a clearly defined section which is probably the post-stomach, and another one or possibly two indistinct chambers representing the mid-gut. The rectum is of uniform diameter and ends in a 2-lipped anus about the level of the 8th row of stigmata.

None of the zooids examined showed any trace of gonads. The heart is a U-shaped tube beside the lower loop of the gut.

Remarks

This genus was established by Michaelsen (1924) for a species *P. mariae* from the extreme northern end of North Island, New Zealand, and differs from the genus *Polycitor* in having spicules in the test and lateral abdominal organs on the zooids. Apart from the New Zealand species the genus probably contains only one known species, described by Savigny (1816) as *Eucoelium hospitiolum*, from the Gulf of Suez.

Savigny's species differs from *P. pallida* in having few rows of stigmata, a very short abdomen, and spicules confined to the surface of the colony. *P. mariae* is much more like the South African species, but has a different form of colony and has zooids with lateral abdominal organs. The wide geographical separation, with no intervening records, is also a reason for separating the species.

Genus TETRAZONA Michaelsen, 1930

Tetrazona porrecta sp. n.

(Fig. 15)

Diagnosis of species

Colony variable but usually long, narrow and lobed. Zooids not in systems. Abdomen about 3 times as long as thorax. Both siphons short and 6-lobed. About 16 oral tentacles. About 30 stigmata in each of the 4 rows. Oesophagus long; stomach rectangular in outline. Testes below gut loop.

Holotype

In the South African Museum. S.A.M. A25611 (PF 1095 B).

Locality

Algoa Bay: PF 1095 B.

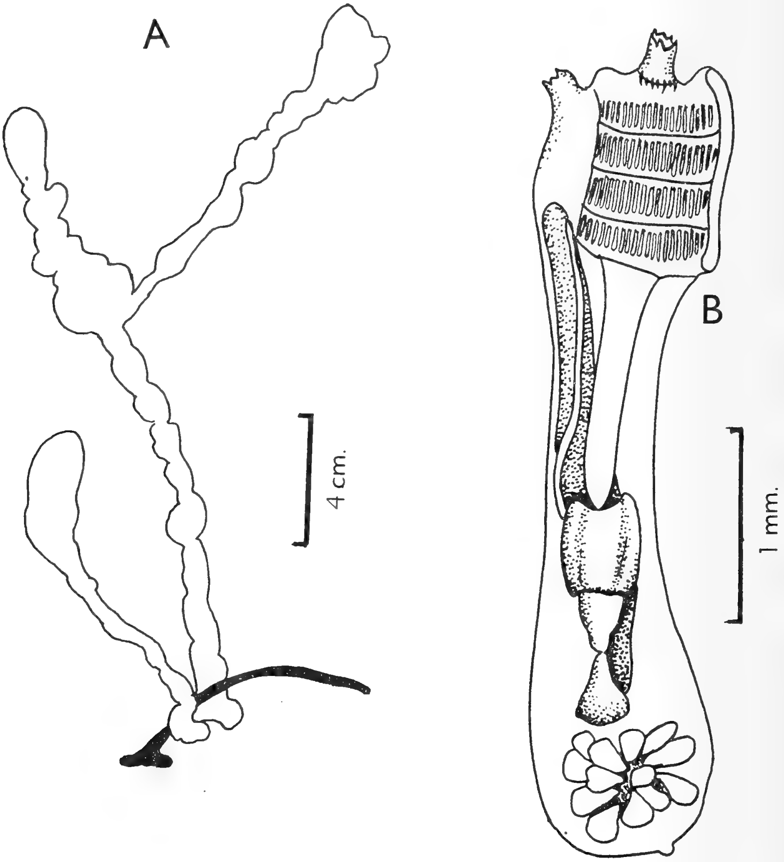

Fig. 15. *Tetrazona porrecta* sp. n.
A, colony; B, zooid.

Description

The colonies vary in size and shape a good deal, but are usually long and relatively narrow with irregular lobes and swellings. As the colony generally seems to have grown on the stem of an alga these swellings give some of the specimens the appearance of a string of beads (fig. 15 A). Specimens of this kind reach a length of at least 24 cm. The colony is firm, and the surface rough owing to the presence of a uniform coating of sand grains. Fewer sand and shell particles are present within the test.

The zooids (fig. 15 B) have an average length of about 4 mm., of which the thorax occupies 1 mm. and the abdomen 3 mm. Both siphons open directly to the surface, and both are short, with 6 sharp lobes. Muscles are not strong on the thoracic wall and the zooids are consequently little contracted. The oral tentacles, about 16 in number, are of moderate length, alternating in size, and arranged in a single circle. Each of the 4 rows of stigmata has about 30 rather narrow slits.

The abdomen is only slightly narrower than the thorax. The oesophagus extends about half the length of the abdomen, and is quite wide, except where it narrows before entering the stomach. In lateral outline the stomach is rectangular and in transverse section there is a suggestion of about 6 indistinct folds, but these, or some of them, may be artefacts. The post-stomach is narrower than the stomach, and the mid-gut, which forms the lower, horizontal part of the gut loop, is wider. The rectum is of nearly uniform diameter.

Of the gonads, only the testis was present in the zooids examined, and this consisted of a quite massive group of pear-shaped follicles lying immediately below the lower bend of the gut loop, with the sperm duct passing straight forwards to the atrial cavity.

Remarks

I am following Huus (1937) in accepting Michaelsen's genus *Tetrazona* for a small group of species differing from *Cystodites* essentially in lacking spicules. The type species was described by Sluiter (1906) as *Distoma glareosus*, and the genus evidently also includes *Polycitor vitreus* (Sars) and probably *Polycitor magalhaensis* (Michaelsen). Removal of this well-defined group of species with four rows of stigmata leaves the genus *Polycitor* with those species having a much larger, but variable, number of rows of stigmata, with the type *P. crystallinus* Renier.

Genus SYCOZOA Lesson, 1830

Sycozoa arborescens Hartmeyer
(Fig. 16)

Sycozoa arborescens Hartmeyer, 1912, p. 316.

Known distribution

Off Cape Town, South Africa.

Localities

False Bay: U.C.T., FAL 234 S.
Mossel Bay: U.C.T., MB 48 B; U.C.T., MB 65 F.
Algoa Bay: PF 586 A.

Description

The colonies which come closest to Hartmeyer's (1912) description of the type specimen are two from Mossel Bay (MB 48 B). These colonies measure respectively 2·0 and 2·2 cm. in greatest diameter (fig. 16 A, B). They consist of a short basal column from the top of which spring several heads, each incompletely divided into two. The heads are fan-shaped and laterally flattened. In colour the colonies are pale grey with the zooids showing as darker marks. The zooids are arranged, as in Hartmeyer's specimen, in vertical double rows. They agree with the description of the type material, and like it, lack gonads.

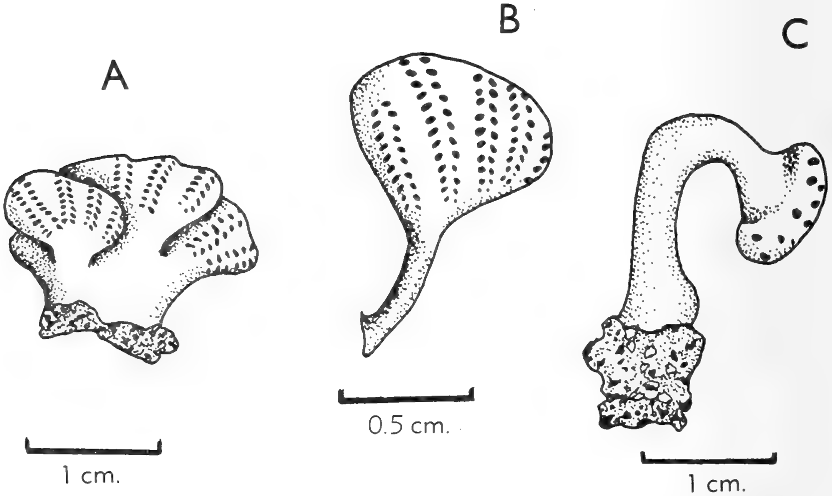

FIG. 16. *Sycozoa arborescens* Hartmeyer.
A–C, colonies.

The three specimens from False Bay do not have the characteristically branched colony. Two of them are single stalked heads (fig. 16 C), and one is a pair of headless stalks joined basally. One of the stalked heads has the flattened fan-shape which is found in the heads of more typical specimens of the species and has the same double linear arrangement of zooids. Some of the zooids of this colony have brood pouches containing a number of developing eggs, but no larvae.

Other specimens, from Mossel Bay (MB 65 F) and Algoa Bay, are less typical, but I am also including them in this species. They are single stalked heads resembling the small specimen shown by Hartmeyer (1912) in his text-figure 5.

Remarks

The form of branching, which was more clearly developed in the type specimen than in any of the present specimens, readily distinguishes this species from others of the genus. It is the only *Sycozoa* known from South African waters.

Genus DISTAPLIA Della Valle, 1881

Distaplia capensis Michaelsen

(Fig. 17)

Distaplia capensis Michaelsen, 1934, p. 141.

Known distribution

False Bay and Still Bay, Cape Province.

Localities

False Bay: U.C.T., FAL 136 M; U.C.T., FAL 158 N; U.C.T., FAL 175 N; U.C.T., FAL 182 W.

?Mossel Bay: U.C.T., MB 27 I.

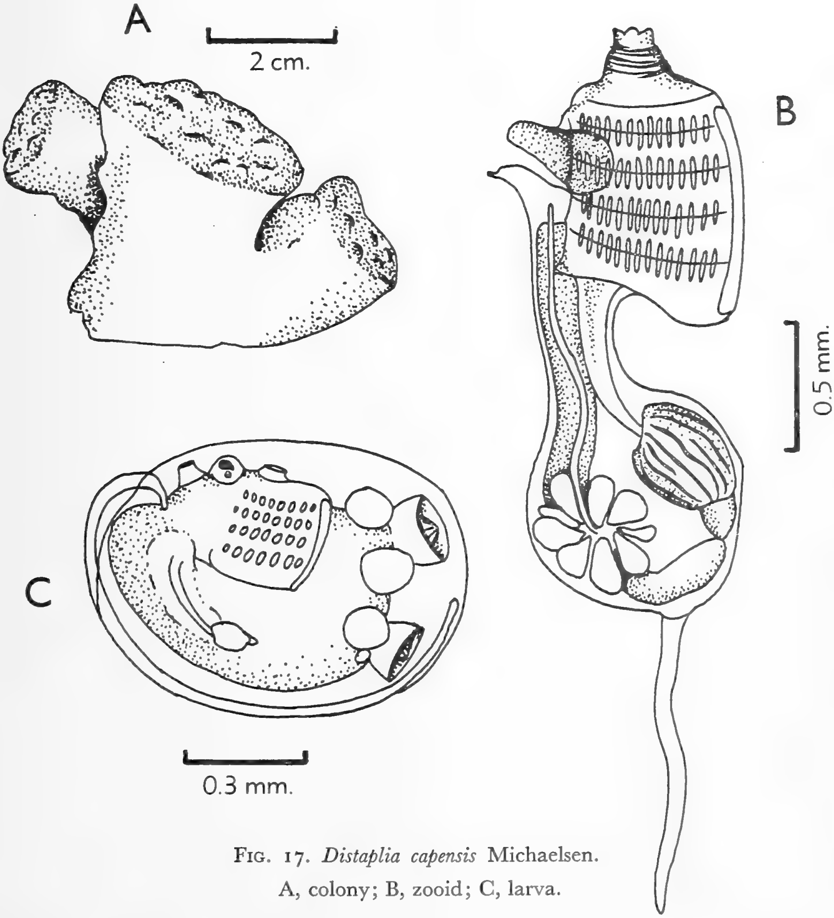

FIG. 17. *Distaplia capensis* Michaelsen.
A, colony; B, zooid; C, larva.

Description

The best-developed and most typical colonies are these from FAL 175 N (fig. 17 A). In these the basal part forms a short squat column and the head, which alone contains the zooids, is slightly wider than the column. The basal column, which Michaelsen (1934) designates the stalk, is white and tough, and the head has clear soft gelatinous test but is red-brown owing to the pigmentation of the thoraces. In the collector's notes the colonies are described as 'purplish, sloppy', or 'off-white, gelatinous'.

I can add little to the detailed description of the zooids, as the present material confirms in every respect the structure of the type specimens. In all zooids the folding of the stomach was distinct. In those sexually mature, only the testis was developed; this consisted of a rosette of about 10 follicles and was situated beside the intestinal loop. The position of the gonad, entirely within the abdomen, is an important point of distinction between the present species and *D. skoogi* (see figs. 17 B and 18 B).

There is one specimen from MB 27 I which I include, with some doubt, in *D. capensis*. This is a single colony of soft consistency and pink-brown colour, with small zooids having nothing to identify them, as the gonads are not developed. The thorax is orange in colour, in the preserved state. Many of the zooids have a single larva, and this seems to differ in some respects from that of *D. skoogi*, in which species the specimen otherwise might be placed. The length, from the end of the papillae to the base of the tail, is 0·8 to 0·9 mm. Compared with the larva of *D. skoogi* the trunk is deep. The arrangement of the papillae and their basal ampullae is similar. On each side of the postero-ventral part of the trunk there is a curved flat structure which partly conceals the oesophagus and rectum, only the stomach and part of the intestine being clearly visible. No structures of this kind were seen in the larva of *D. skoogi*. As far as could be determined these structures appear to be the thickened sides of the abdomen. It is therefore likely that this colony is not of *D. skoogi* and may be of *D. capensis*.

Distaplia skoogi Michaelsen

(Fig. 18)

Distaplia domuncula Michaelsen, 1923, p. 15.
Distaplia skoogi Michaelsen, 1934, p. 131.

Known distribution

Walker Bay and False Bay, Cape Province.

Localities

False Bay: U.C.T., FAL 232 E.
Off Cape St. Blaize: PF 1864.
Algoa Bay: U.C.T., LIZ 34 H.
?Morrumbene Estuary: U.C.T., MOR 43 X.

Description

Some of the colonies of this species in the present collection invested the carapace of crabs, but others were attached to the stems of algae, and it appears that the association with a crab, although common, is not obligatory. The smallest specimen is one of 1·3 cm. diameter, attached to an algal stem, and the largest specimen is 5·2 cm. in length, and is part only of a colony. The colonies are of fairly firm texture and all have clearly visible small round or oval systems of zooids, generally closely crowded together. The common cloacal openings are fairly conspicuous.

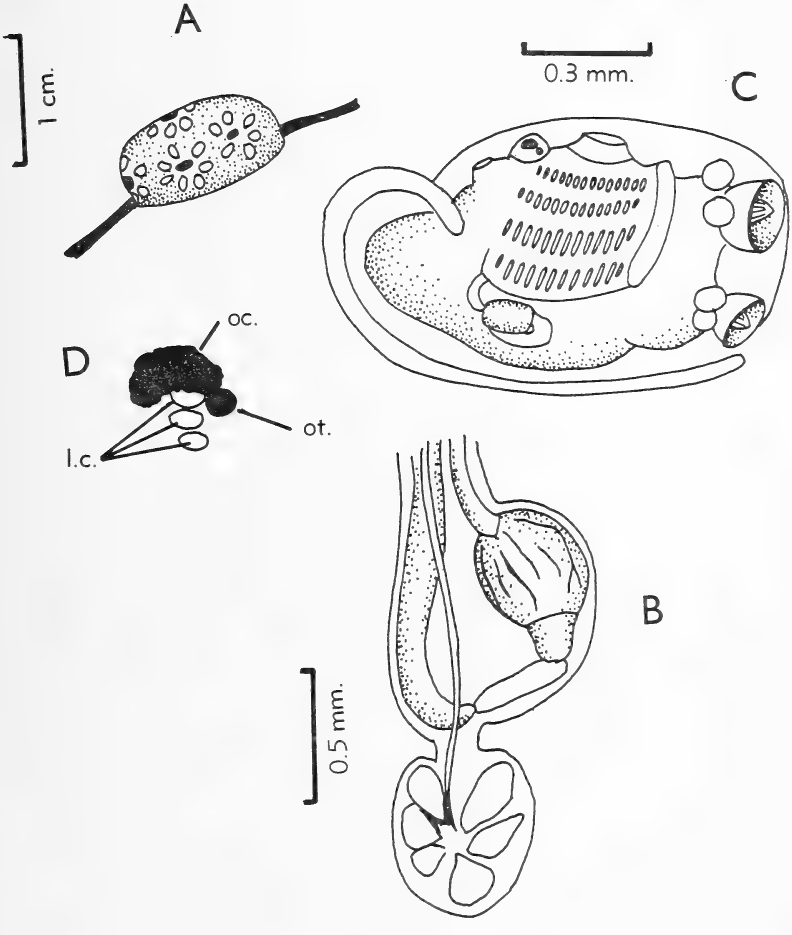

FIG. 18. *Distaplia skoogi* Michaelsen.
A, colony, B, abdomen of zooid; C, larva; D, ocellus and otolith of larva; l.c., lens cells; oc., ocellus; ot., otolith.

The zooids have already been described (Michaelsen, 1923; Millar, 1955). There is rather more variation in the shape of the atrial opening and languet than the previous accounts suggest. In some zooids of some colonies the atrial opening is relatively small and is surmounted by a long languet which has 3 distal lobes; in other colonies the zooids have a wide opening with a short, broad, undivided languet. The most characteristic feature of the zooid is the position of the gonad, which is accommodated in a small pouch projecting from the end of the abdomen (fig. 18 B). This pouch often projects even farther than is shown in Michaelsen's figure.

The colonies from FAL 232 E and LIZ 34 H had fully developed larvae. Not more than one larva was seen in each breeding zooid. The larva (fig. 18 C) measures 1·0 to 1·1 mm. from the end of the papillae to the base of the tail. There are 3 large papillae, two dorsal and one ventral, the ventral papilla lying to the right of the sagittal plane. Each papilla has two round ampullae at its base. The branchial sac and gut are well developed. Both ocellus and otolith are present in the sensory vesicle, but they are so close together that under low magnification it might be thought that only one pigmented organ is present. The ocellus has 3 lens cells, apparently in linear arrangement (fig. 18 D).

Remarks

Michaelsen (1923) described a new species from South Africa and named it *Distaplia domuncula*, and I used the same name for a later record (Millar, 1955). The name, however, was pre-occupied by a species which Hartmeyer (1913) had described, and Michaelsen (1934) gave his own species the new name *Distaplia skoogi*.

Michaelsen (1934) believed *Distaplia skoogi* Michaelsen and *Distaplia domuncula* (Hartmeyer) to be separate. A comparison of the three species recorded from Cape Province is given in Table 1.

TABLE I

	Colony	*Zooids*	*Gonads*	*Stomach*
D. capensis	Slightly stalked.	Unisexual.	Beside gut loop; 10–14 male follicles.	14–16 folds.
D. skoogi	Not stalked; usually investing crabs.	Hermaphrodite.	In sac projecting from abdomen; about 5 male follicles.	Smooth externally; with lines internally.
D. domuncula	Not stalked; investing crabs.	Probably unisexual.	Incompletely known.	Smooth externally; with lines internally.

D. capensis is evidently distinct from *D. skoogi* and *D. domuncula*, but the latter two species are similar and might eventually have to be united.

Genus SIGILLINA Savigny, 1816

I am using the genus *Sigillina* in the wide sense employed by Michaelsen (1930) and Hastings (1931) for the following single species, which does not agree completely with any of the sub-genera which Michaelsen defined.

Sigillina vasta sp. n.
(Fig. 19)

Diagnosis of species

Colony massive, with a system of cloacal canals below the surface, and apparently a few common cloacal openings. Zooids with long oral and atrial

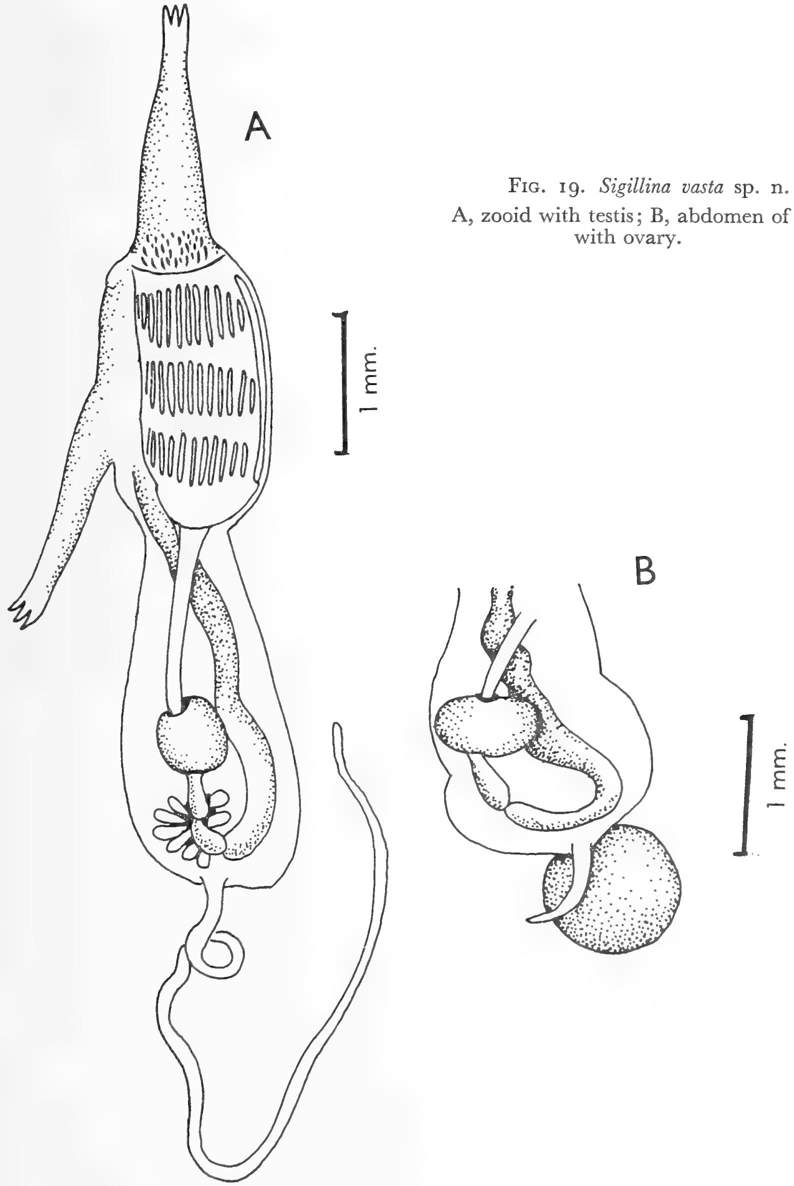

Fig. 19. *Sigillina vasta* sp. n. A, zooid with testis; B, abdomen of zooid with ovary.

siphons, the latter at the posterior end of the thorax opening into a cloacal canal, and usually backwardly directed. Three rows of stigmata. Abdomen about the same length as thorax, and with a long narrow posterior vascular process. Gonad beside intestinal loop, with the ovary sometimes at the extreme posterior end of the abdomen.

Holotype

In the South African Museum. S.A.M. A25612 (U.C.T., TRA 60 E).

Locality

Kaffirkuils Bay: U.C.T., TRA 60 E.

Description

The specimen is part of a colony brought up in the catch of a commercial trawler, and the whole colony was, according to the note accompanying the specimen, a 'large gelatinous mass approximately 3 by 8 by 10 inches (2–3 lbs.)'. In the preserved state the specimen is purple-brown, with a very smooth surface. There is no encrusting material. A few irregular slits were found on the surface, and these are taken to be the external openings of the common cloacal canals which lie a little below the surface. The oral openings are apparently scattered without order and the zooids are therefore apparently not arranged in regular systems.

The zooids (fig. 19 A) are quite large, and may reach 7 mm. in length, with the thorax and abdomen of about equal length. The oral siphon is remarkably long, and may equal or even exceed the thorax in length. Its opening has 6 lobes. The atrial siphon arises from the posterior end of the thorax and is about the same length as the oral siphon. It is generally directed obliquely back, instead of towards the surface of the colony, and leads into one of the common cloacal canals. There are 6 lobes on the opening of the atrial siphon.

At the base of the oral siphon there are about 4 large tentacles and many short ones occupying a zone anterior to the large ones. The dorsal tubercle is small and its opening could not be clearly seen. Three rows of long narrow stigmata are present with at least 12 stigmata per row. The oesophagus is quite long, the stomach almost globular, and the post-stomach and intestine much as in species of *Eudistoma*. Some zooids have a group of about 10 testis follicles arranged in a rosette beside the gut-loop (fig. 19 A), with the sperm duct passing straight forward. In other zooids the ovary is developed, consisting of a small group of oocytes, or sometimes a single large egg projecting from the posterior end of the abdomen (fig. 19, B). There is a posterior vascular process from the end of the abdomen of very variable length.

Remarks

This remarkable species is difficult to place in its right genus. It would fit *Eudistoma* were it not for the presence of common cloacal canals into which the atrial siphons open. Another species, originally described by Sluiter (1895) under the name *Distoma deerratum* and later by Hastings (1931) as *Sigillina* *deerrata* also has a long oral siphon, and a posterior atrial siphon opening into a common cloacal canal. This species, however, which Hastings identifies with *Polycitor coalitus* Sluiter, is known only from the tropical waters of Malaya and north and north-eastern Australia, and in spite of structural similarities it is very unlikely that the South African specimen is of that species.

There may be a case for recognizing a new subgenus of *Sigillina* to accommodate the two species *S. deerrata* and *S. vasta* which differ from *Eudistoma* in having the atrial siphon opening to a cloacal system.

Genus EUDISTOMA Caullery, 1909

Eudistoma digitatum sp. n.

(Fig. 20)

Diagnosis of species

Fully grown colony massive and firm with solid base, and apex divided into a number of finger-like lobes which do not spread, but have a tendency to grow inwards. Test fibrous, with large bladder cells which are few and widely spaced. Zooids with a short wide thorax, a longer but narrower abdomen, and a long posterior process of variable width. Gonads beside intestinal loop.

Holotype

In the British Museum (Nat. Hist.). Bowerbank, 'Cape of Good Hope'.

Localities

Mossel Bay: PF 11 A; U.C.T., MB 48 C.

Algoa Bay: U.C.T., LIZ 32 P; B.M. (N.H.) collection, reg. no. 1852.3.12.81, collected by J. Bowerbank; B.M. (N.H.) collection, reg. no. 1852.3.12.89, collected by J. Bowerbank.

'Cape of Good Hope': B.M. (N.H.) collection, no reg. no., collected by J. Bowerbank.

Description

The colony, when large, has a very characteristic appearance, best shown by the specimens collected by Bowerbank from 'Cape of Good Hope' (fig. 20 A), and Algoa Bay. The 3 largest specimens have the following dimensions:

height (cm.)	14·0	7·6	10·0
width (cm.)	12·5	6·3	5·0

From a solid base there arises an upright portion which is usually stout and columnar, but may be very short. The apex of this portion is divided into a number, up to 12, of characteristic finger-like or wide tongue-like lobes. These lobes are grouped close together and instead of spreading outwards have a tendency to grow inwards at the top, towards the vertical axis of the colony. The whole colony is very massive and firm, and the surface smooth without any encrusting matter. There is no sand within the colony and the common test is fairly homogeneous, except for fibres and a few scattered bladder cells. In well-preserved colonies the zooids are sometimes visible externally; they are mainly confined to the lobes.

The zooids (fig. 20 B) consist of a short wide thorax often about 1 mm. long, and a narrower abdomen about 2 mm. long. A long vascular process projects from the end of the abdomen and extends, often for many mm., downwards towards the base of the colony. Generally this process is very slender, but in some colonies it is almost as wide as the abdomen and contains large quantities of opaque tissue, probably consisting of reserve food cells. The siphons are both short, with 6 indistinct lobes, and open close together on the surface of the colony. The thorax is usually widest at its anterior end. About 16 oral tentacles were counted, but others were present spread over a zone at

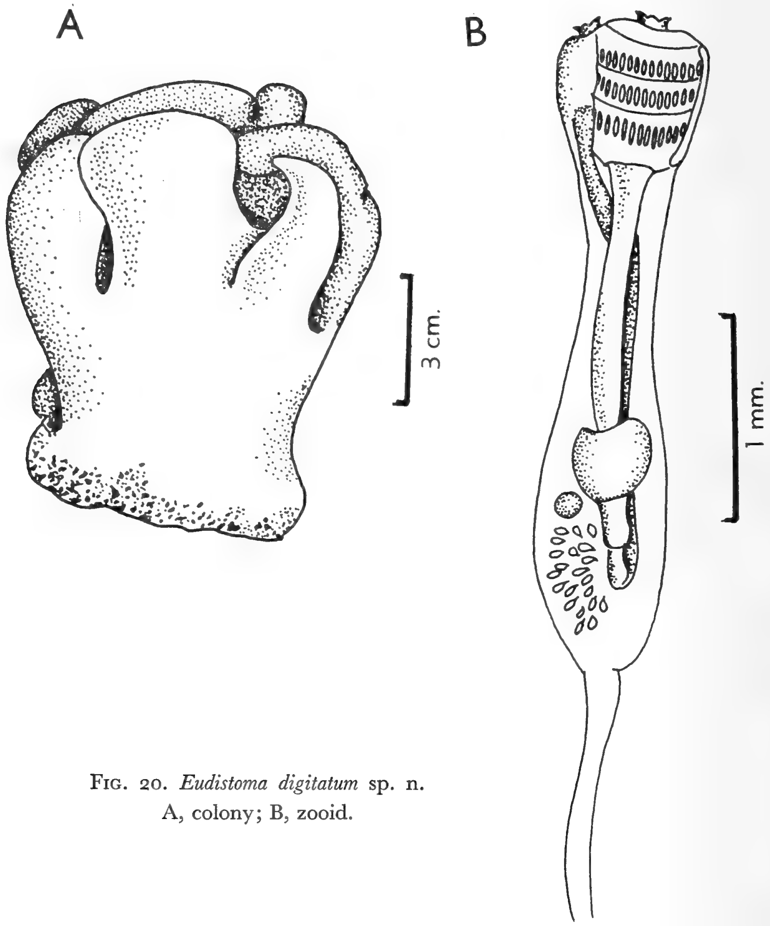

FIG. 20. *Eudistoma digitatum* sp. n.
A, colony; B, zooid.

the base of the siphon. There are about 16 stigmata in each of the 3 rows. The length of the oesophagus varies, but is usually greater than that of the thorax. It is tapered at the lower end where it enters the round or wide smooth-walled stomach. A narrow post-stomach leads to the curved intestine. The rectum is of uniform diameter. In mature zooids there is a group of many small testis follicles situated beside the lower part of the gut loop and sometimes projecting slightly posterior to it. The ovary is represented by one large oocyte, no doubt with other smaller ones not visible.

Remarks

This species, which should not have been mistaken for others, does not seem to have been described, although several species of *Eudistoma* are known from South African waters. It is remarkable for the large and massive appearance of the colonies.

Eudistoma coeruleum (Sluiter)
(Fig. 21)

Distoma coeruleum Sluiter, 1898, p. 14.

Known distribution

Natal; ?Still Bay, Cape Province; Mozambique.

Localities

Natal: Bluff, M.S. *Evans*, British Museum (N.H.) reg. no. 1876.9.3.4; Scottburgh, S.A. Museum, low water level.

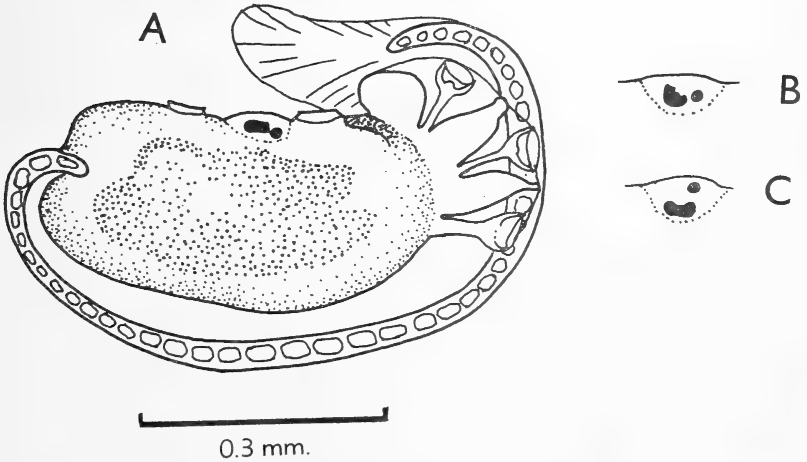

FIG. 21. *Eudistoma coeruleum* (Sluiter).
A, larva; B, C, sensory vesicle of different larvae to show variation in position of ocellus and otolith.

Description

This species is easily recognized by the club-shaped colonies of dark slate-blue or purple colour. Zooids are confined to the expanded head of the colony, and in the present material measured from 1·5 to 2·5 mm. in length; Sluiter (1898) gives 4·5 mm. as the maximum length of zooids. In some of the new material and especially that from Scottburgh, there are moderately powerful longitudinal and transverse muscles on the thorax and the longitudinal ones pass down towards the ventral side of the abdomen. In the branchial sac at least 10 stigmata were counted in each row. The dorsal languets are long and slender.

Larva

Colonies from both stations had larvae, only one to three in the atrial cavity of each breeding zooid. The larva (fig. 21 A) measures 0·5 to 0·6 mm. from the end of the papillae to the base of the tail. The trunk is rather long and narrow, with the sensory vesicle about the middle of the dorsal side. Both a black otolith and a paler ocellus are present, but their relative position varies (fig. 21 B, C). There are three anterior papillae.

Eudistoma modestum (Sluiter)

(Fig. 22)

Distoma modestum Sluiter, 1898, p. 18.

Known distribution

Durban, Natal.

Localities

Algoa Bay: U.C.T., LIZ 1 Z; U.C.T., LIZ 9 M; U.C.T., LIZ 34 M, N; PF 895.

Description

The colonies vary a good deal in appearance, but most are rather soft and gelatinous in texture, and flattened, the flattening perhaps being an artefact. The specimens do not have a definite stalk, as in Sluiter's type material. As Sluiter's specimens did not exceed 1 cm. in diameter, however, they may not have reached the full size of the species; it is possible that further growth would have brought about a change in shape. The colour is brown or semi-transparent with brown zooids showing through.

The zooids (fig. 22) are 2–4 mm. in length, and have a shorter waist than is common in the genus. Although Sluiter described the waist as long and thin, I have found, on examining the type specimens, that in many zooids it is only slightly longer than the thorax. The longitudinal thoracic muscles in the present material are slender and number up to 18. In some colonies the siphons and the anterior end of the thorax are chocolate coloured, and brown spots also mark the rest of the thorax. Zooids of the type material, which I have examined, have the same parts marked with pink. The difference in colour may be due to a difference in the method of preservation. In most other respects the structure of the zooids is like that of the type specimens, but the oral tentacles number at least 30, whereas Sluiter recorded only 16.

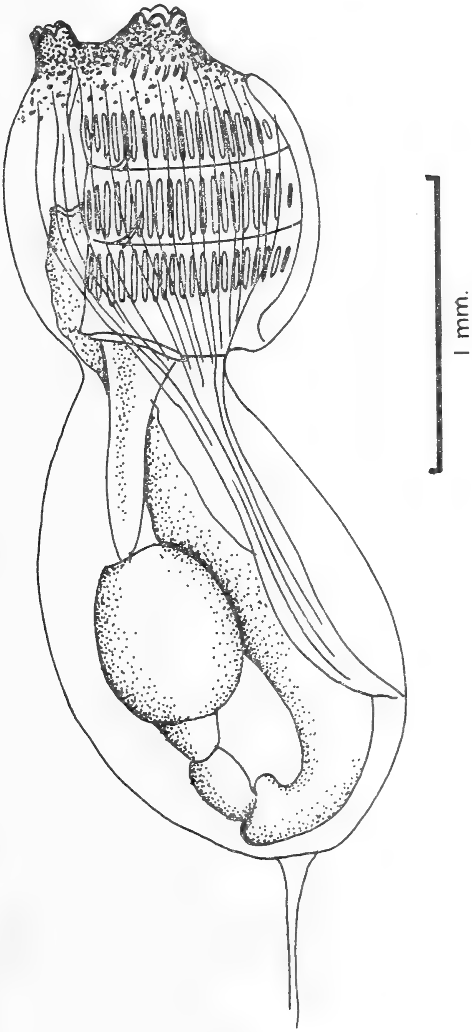

FIG. 22. *Eudistoma modestum* (Sluiter). Zooid.

Remarks

This is one of those cases in which the new specimens agree fairly closely with type material but show such differences as might be expected to result from their having been collected at a different age, or stage of maturity.

Eudistoma renieri (Hartmeyer)
(Fig. 23)

Polycitor (*Distoma*) *renieri* Hartmeyer 1912, p. 309.

Known distribution

St. Francis Bay, Cape Province.

Localities

North of Durban 29° 37′ S., 31° 16′ E., 60 m., 'Gilchrist Collection', British Museum (N.H.) reg. no. 1926.8.1.5.

Description

The single example of this species is a colony of roughly cylindrical form, about 7·5 cm. long and 3·0 cm. in diameter. It is very firm in consistency, partly owing to the sand which encrusts and impregnates the test. There is a small area round each zooid free of sand, and the surface of the colony consequently has a mottled appearance.

The zooids (fig. 23) are about 5 mm. long, and are similar in proportions to those described by Hartmeyer (1912). According to Hartmeyer the lower part of the gut has a twisted loop characteristic of the species. This feature was also noticeable in the material from the British Museum (N.H.). A narrow process of variable length arises from the lower end of the abdomen, but Hartmeyer did not find a similar process in his material.

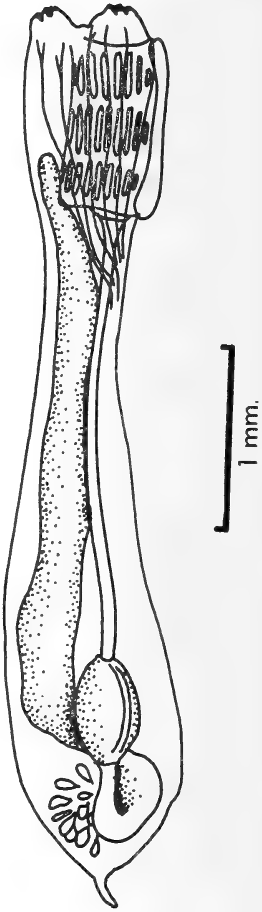

FIG. 23. *Eudistoma renieri* (Hartmeyer). Zooid.

Remarks

The present record extends the known range of this species into the warmer south-eastern waters off the coast of Natal.

Eudistoma illotum (Sluiter)
(Fig. 24)

Distoma illotum Sluiter, 1898, p. 16.

Polycitor (*Distoma*) *illotus* (Sluiter). Hartmeyer, 1912, p. 303.

Known distribution

Cape Town and Simon's Bay, Cape Province.

Localities

False Bay: FAL 175 L.
Mossel Bay: ?MB 7 Q; ?MB 22 F; ?MB 27 J; ?MB 48 D.

Description

Colonies are of rounded, lobed, upright or even slightly stalked, shape. No sand is present either on the surface or within the colony. The test is of a milky or semi-transparent appearance. Large vesicular cells are present in the test and these were noted by Sluiter (1898) as a distinguishing feature of the species.

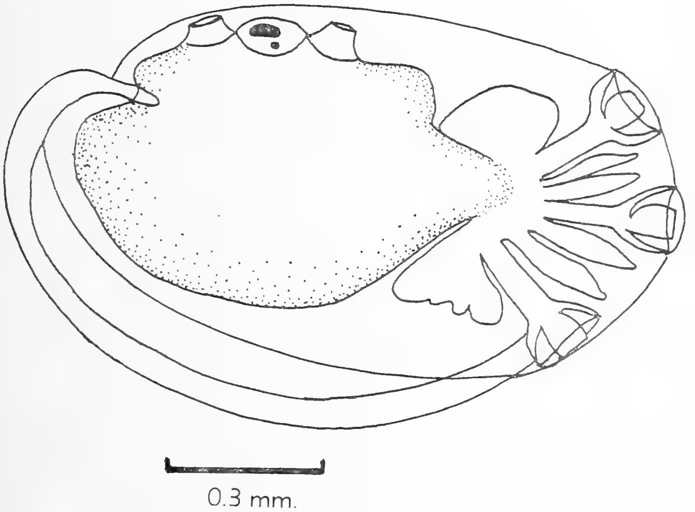

Fig. 24. *Eudistoma illotum* (Sluiter).
Larva.

In the colonies from False Bay the zooids are 3–4 mm. in length, and slender with a long waist as in the type specimens. The zooids in the colonies collected from Mossel Bay range from 2 to 6 mm. in length and have only a short waist. I am therefore a little doubtful of the identification of the material from Mossel Bay.

Larva

No larvae were found in the present material, but Sluiter's type specimens, which I have been able to examine, have larvae (fig. 24). These range from 0·96 to 1·20 mm. in length, from the end of the papillae to the base of the tail. There are 3 anterior papillae with a pair of narrow lateral ampullae between each two adjacent papillae, on each side. Both ocellus and otolith are present. Only one larva was found in each breeding zooid, perhaps owing to the large size of the larvae.

Reliable characters in the genus *Eudistoma* are few, there is considerable similarity in the zooids of different species, and the colony is often variable. For these reasons the identification of a number of specimens is doubtful and I include the following two species with hesitation.

?*Eudistoma angolanum* Michaelsen

Polycitor (*Eudistoma*) *paesslerioides* var. *angolana* Michaelsen, 1914, p. 430.

Known distribution

Gulf of Guinea (W. Africa); NW. and W. Australia.

Localities

False Bay: FAL 158 Q; FAL 208 T.
Mossel Bay: MB 7 P; MB 60 R.
Algoa Bay: LIZ 34 F.

Description

The colonies are usually pillow-shaped, rounded, or slightly lobed. They are coated and impregnated with sand and are consequently hard.

The zooids seldom exceed 6 mm. in length, of which the thorax generally occupies 1·0–1·5 mm. Muscles are well developed, consisting principally of about 10 longitudinal strands on each side of the thorax, and a powerful ring of muscles on each siphon. The waist of the zooids is long, containing the correspondingly long oesophagus and rectum. A short vascular process sometimes extends below the abdomen. Gonads, present in specimens collected in January 1958, consist of a group of 11–20 or more testis follicles beside the lower part of the intestinal loop, and a small ovary.

Remarks

E. angolanum has not been recorded from closer than tropical west Africa, but I can find no important differences between that species and the present specimens. The identification remains doubtful, however, owing to the difficulty of separating species of *Eudistoma*, and to the wide geographical separation of previous records.

?*Eudistoma mobiusi* (Hartmeyer)

Colella mobiusii Hartmeyer, 1905, p. 396.
Polycitor mobiusi Hartmeyer, 1912, p. 305.

Known distribution

Cape Province and Madagascar.

Localities

False Bay: FAL 208 R.
Algoa Bay: LIZ 19 Z 1.

Description

The single colony from False Bay and the two from Algoa Bay are all about the same size, 1·2–1·4 cm. long. There is a rounded or flattened head, and a narrower but slightly longer stalk. Both head and stalk are firm and pale grey to dull yellow in colour. Zooids are visible on the head.

The zooids usually attain a length of up to 7 mm. The oral tentacles are very small and arranged in several circles. There are at least 15 stigmata in each of the three rows. The waist of the zooid is rather short, so that the oesophagus and rectum are not so long as in some species of *Eudistoma*. This is a feature, however, which might change at different periods in the life of the colony. No gonads were present.

Family **Didemnidae** Giard, 1871

Genus DIDEMNUM Savigny, 1816

The genus *Didemnum* has given systematists great trouble and even the most experienced workers have hesitated in deciding specific distinctions. Thus Van Name (1945, p. 80) wrote in his account of the American species 'The treatment of the species that is possible with present information is necessarily somewhat provisional and will doubtless require future revision, but the evidence seems to be that instead of *Didemnum* being one of the largest genera of ascidians, the species are in reality rather few, though in some cases widely distributed geographically.' And again in treating *Didemnum candidum* Savigny he states (p. 86) that 'This is the most difficult of all the American ascidians to deal with from a taxonomic point of view. I am far from being able to overcome the fear that I am confusing more than one species, but after the examination of a large amount of material from various American localities I am at a loss to find a reliable basis for dividing it by studying museum specimens.' The situation is similar with regard to the South African species. Michaelsen (1934, p. 147), in his description of *D. stilense* from Still Bay, Cape Province, had to admit that 'Because of our uncertainty as to the limits of variability and because of the occurrence of so many species insufficiently described, it is hardly possible to say whether *D. stilensis* is indeed a new species, or whether it should be identified with any older species.'

I believe that to try to identify preserved specimens, usually few in number, collected at different seasons and states of their annual cycle, and generally without any biological data, would only add further confusion. A proper taxonomic study of the genus should involve regular collection of specimens throughout the year, in large numbers, together with observation of biological characters such as breeding season. For these reasons I have made a very tentative identification of a number of specimens of the genus *Didemnum*, as *D. stilense*.

?Didemnum stilense Michaelsen

Didemnum stilense Michaelsen 1934, p. 146. Millar, 1955, p. 176.

Known distribution

Cape Province.

Localities

Langebaan Lagoon: U.C.T., LB 367 V.

False Bay: U.C.T., FAL 121 B; U.C.T., FAL 136 N; U.C.T., FAL 152 M; U.C.T., FAL 158 X; U.C.T., FAL 163 P; U.C.T., FAL 175 B; U.C.T., FAL 176 R; U.C.T., FAL 182 U; U.C.T., FAL 216 A; U.C.T., FAL 232 E; U.C.T., FAL 272 F; U.C.T., FAL 277 K; U.C.T., FB 1106 B.

Mossel Bay: U.C.T., MB 18 R.

Algoa Bay: U.C.T., LIZ 9 K; U.C.T., LIZ 28 S; U.C.T., LIZ 34 B; PF 586 B.

Description

Colonies are generally thin and encrusting but otherwise are of very variable appearance. In the preserved state the colour is white, grey, buff, pink or blue, and the collector's notes show that living material is also of various colours, but that these may change considerably on preservation. Spicules are usually many, closely crowded, and present throughout the whole test. They are generally of a regular stellate form with 6–10 conical rays as seen in optical section. Sometimes the rays are more numerous, or small and rounded, or with blunt ends. The larger spicules are generally 20–30μ in diameter and occasionally as large as 40μ or even 70μ.

The thorax of the zooids is rather smaller than the abdomen, and possesses a slender retractor process which may be almost as long as the abdomen. The atrial opening varies in size and depends at least partly on the degree of contraction of the thorax. The gut is divided as usual in the genus. A single large egg generally represents the ovary when this is well developed. The testis has a single large follicle with the proximal part of the sperm duct forming 8–10 coils on its surface.

Larva

Larvae were present in colonies from the following collections:

False Bay, 17–2–53, 20–8–47, 18–9–53.
Mossel Bay, 13–1–51.
Algoa Bay, 7–4–54.

The larva has the general structure commonly found in the family. There are 3 anterior adhesive papillae, 4 lateral ampullae on each side, and a sensory vesicle with ocellus and otolith. Larvae varied considerably in size, the smallest having a length of 0·4 mm. (False Bay, 18–9–53) and the largest a length of

0·95 mm. (Algoa Bay, 7–4–54). This is a large range within one species, but Carlisle (1954*a*, 1954*b*) has shown that didemnid larvae vary in size according to the size of the zooids, which itself is variable.

Remarks

It must be emphasized that the identification of the above specimens as *D. stilense* is tentative.

Subgenus POLYSYNCRATON Nott 1891

Didemnum (*Polysyncraton*) *magnilarvum* sp. n.

(Fig. 25)

Diagnosis of species

Colony flat but rather fleshy. Spicules few, stellate, up to 75μ in diameter. Common cloacal openings numerous. Zooids with wide atrial opening, short atrial languet, slender retractor process, testis of 8 to 10 follicles, and sperm duct of 2 to 3 coils. Larva with trunk about 1·3 mm. long, having a collar of about 30 narrow ampullae surrounding the 3 papillae. Budding is precocious, advanced larvae each having 2 buds.

Holotype

In the South African Museum. S.A.M. A25613 (PF 12393 B).

Locality

Natal: PF 12393 B.

Description

The single colony is 6 cm. by 3·7 cm. in diameter and 0·7 cm. thick. It is flat but of a rather fleshy appearance. In the preserved state the colour is greyish-pink. The upper surface is smooth without any encrusting matter, and the whole colony is soft and flexible. Certain areas of the colony are paler owing to the presence of greater numbers of spicules, which, however, are scarce in most places. The common cloacal openings are numerous and scattered irregularly over the surface. Spicules are nowhere numerous in the common test, but are most plentiful near the upper and lower surfaces and scarcest in the central layers. They are stellate and the largest ones reach 75μ in diameter, but most are smaller.

The zooids (fig. 25 A, B) do not show any obvious arrangement in systems. They are generally about 1 mm. long, the thorax being only slightly longer than the abdomen. The oral siphon is tubular, with 6 rather shallow lobes. The atrial opening is wide and exposes quite a large part of the branchial sac. A short atrial languet is present; it has a narrow base and slightly wider free end which is sometimes indented, giving the languet two shallow lobes. No trace was found of lateral thoracic organs, and there were no accumulations of spicules beside the thorax such as generally mark the position of these organs in species which possess them.

There are 4 rows of stigmata, and a long slender retractor process from the base of the thorax. The oesophagus is of moderate length, leading to the ovate or almost globular stomach. There is a short post-stomach, and simple intestinal loop. The testis consists of a rosette of 8 to 10 follicles, and the sperm duct makes about 2½ spiral turns before passing forward towards the rectum.

Larva

Numerous larvae (fig. 25 C) were embedded in the common test. When fully developed these have a trunk about 1·3 mm. long, measured from the end of the papillae to the base of the tail. The 3 papillae project from the centre of a

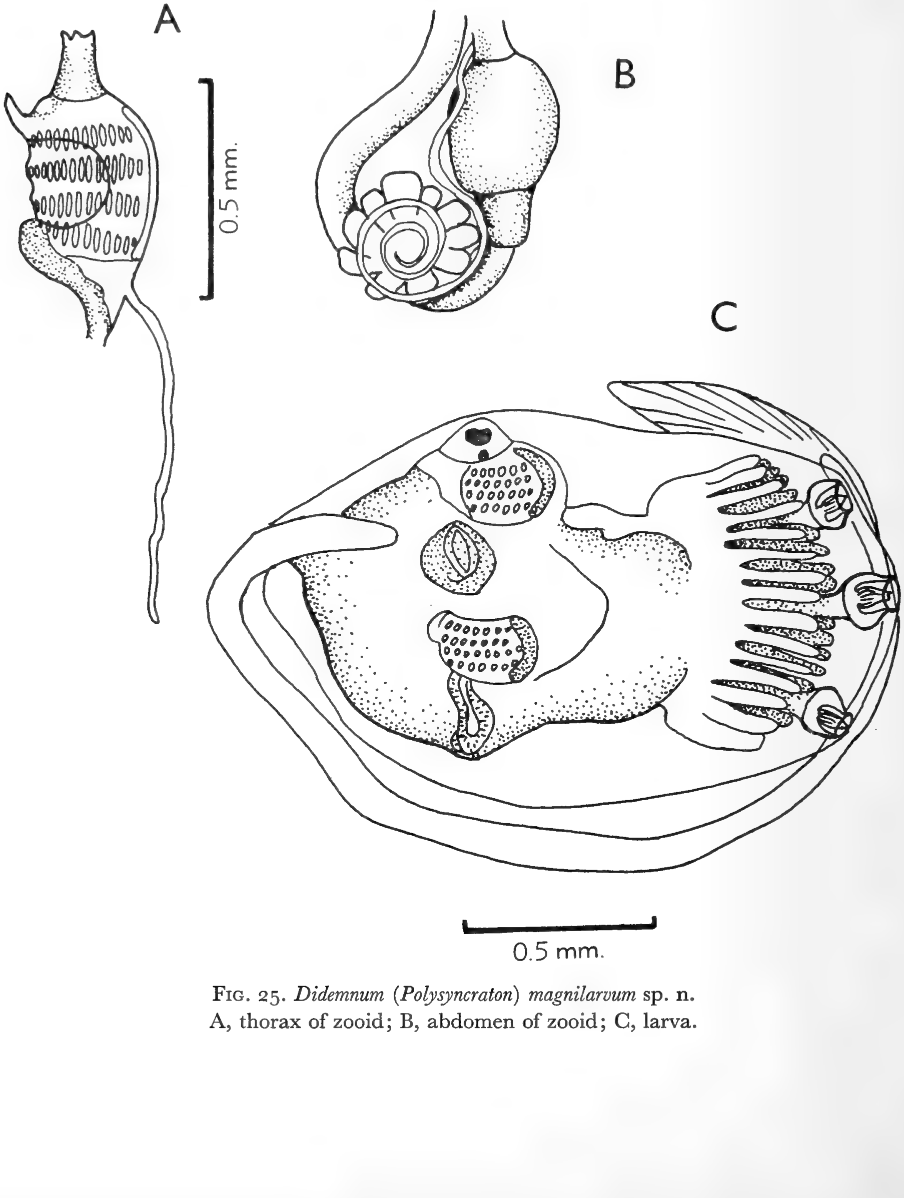

Fig. 25. *Didemnum* (*Polysyncraton*) *magnilarvum* sp. n.
A, thorax of zooid; B, abdomen of zooid; C, larva.

collar of about 30 narrow finger-like ampullae, formed by the subdivision of the paired ampullae generally present in didemnid larvae. The sensory vesicle has both ocellus and otolith. In addition to the branchial sac and gut of the oozoid there is, on each side of the larval trunk, an equally well developed branchial sac and gut representing the first two blastozooids. A similar precocious development was noted by Lahille (1890) in *Didemnum* (*Polysyncraton*) *lacazii*. In the Didemnidae this is characteristic of *Diplosoma* but I do not know of other references to the phenomenon in *Polysyncraton*. The larvae of only a few species are known, however, and I believe that the precocious appearance of blastozooids, together with the subdivided anterior collar, may be found characteristic of larvae in the sub-genus *Polysyncraton*.

Remarks

Few species of the sub-genus are known from the waters of South Africa or the western Indian Ocean. *D.* (*Polysyncraton*) *spongioides* (Hartmeyer) and *D.* (*Polysyncraton*) *chuni* (Hartmeyer), both from 318 m. off Cape of Good Hope, appear to be very closely related to each other, if distinct, but they are clearly distinguished from *D.* (*Polysyncraton*) *magnilarvum* by their small number (3 or 4) of testis follicles. *D.* (*Polysyncraton*) *tubiporae* (Michaelsen) from Zanzibar is distinguished by its characteristic lateral thoracic organs with adjacent masses of spicules. *D.* (*Polysyncraton*) *paradoxum* Nott var. *mahenum* Michaelsen is described from the Seychelles and the species originally from New Zealand. The variety seems to be rather like the present species, but has much smaller spicules and usually only 4 testis follicles. *D.* (*Polysyncraton*) *amethysteum* (Van Name) is known from tropical Atlantic America, tropical west Africa and the eastern Mediterranean; it is therefore a species of widespread occurrence in warm waters and might be expected to occur in the Indian Ocean. It resembles the new species but has smaller spicules, fewer testis follicles and a larva only half as large.

Genus LEPTOCLINIDES Bjerkan, 1905

Leptoclinides capensis Michaelsen

Leptoclinides capensis Michaelsen 1934, p. 151.

Known distribution

Preekstoel, near Still Bay, Cape Province.

Localities

Table Bay: U.C.T., TB 171 A.
False Bay: U.C.T., FAL 117 B.

Description

The specimen from False Bay is a colony 1 cm. in diameter, which had been growing on the carapace of a small dromiid crab, according to the collector's note, but the specimen from Table Bay is incomplete and the substratum unknown. In the colony from False Bay there is a single central common cloacal opening; Michaelsen (1934) also apparently found only one opening in his type specimen. I have found the structure of the common test to agree in general with Michaelsen's description, except in the absence of bladder cells from the whole superficial layer, the type specimen having a narrow subcortical layer without bladder cells. Spicules are few, being concentrated almost entirely near the opening of the oral siphon and at the lateral thoracic organs. The zooids agree well with those of the type specimen, but have rather larger lateral thoracic organs. Six spiral turns of the sperm duct lie over the single testis follicle.

The colony from Table Bay, collected on 8–4–1946, had developing larvae in the common test, but none fully formed.

Genus LISSOCLINUM Verrill, 1871

Lissoclinum cavum sp. n.
(Fig. 26)

Diagnosis of species

Colony consisting of an upper and a lower layer of common test, separated by a large common cloacal space across which the zooids are stretched. Spicules up to 40μ in diameter. Zooids with a very large atrial opening, and two groups of spicules over the postero-ventral corners of the thorax. Testis with about 5 follicles. Sperm duct not coiled.

Holotype

In the South African Museum. S.A.M. A 25614 (U.C.T., LIZ 32 V).

Localities

False Bay: U.C.T., FAL 234 U1.

Algoa Bay: U.C.T., LIZ 32 V.

Description

The specimens from both stations are thin irregular sheets, of a dirty yellow or brown colour. Small darker spots on the surface mark the oral openings. The quite numerous round or oval common cloacal openings are scattered over the surface. The colony consists of an upper thin layer of common test and a lower rather thicker layer. Between these layers is the very large common cloacal cavity. Spicules (fig. 26 A) are numerous and closely packed in the upper and lower layers of the colony, and are also present in the test which covers the abdomen. They are stellate but somewhat irregular with a tendency for the rays to be arranged in pairs, or to be reduced to round swellings. The maximum diameter found was 40μ. In addition there is an ovoid mass of spicules at the postero-ventral corners of the thorax, presumably marking the position of the lateral thoracic organs. The zooids (fig. 26 B), each enclosed in a thin sheath of test material, are suspended between the two layers of test. Most zooids are between 1 and 2 mm. in length. The thorax is generally slightly longer than the abdomen. The oral siphon is tubular, of variable length, and ends in 6 indistinct lobes. Much of the dorsal surface and sides of the thorax are exposed by the very large atrial opening, the anterior border of which has a short projecting lip or languet. There are about 24 long slender oral tentacles which meet across the base of the oral siphon. Each of the four rows has about 14 stigmata. The abdomen lies almost at right angles to the thorax, thus displacing the gut from the attitude normal in didemnids. The stomach, which is ovoid or cylindrical, is followed by a short post-stomach, and an intestine and rectum of almost uniform diameter. No ovary was present in any of the zooids examined. The testis consists of a rosette of 5 or 6 wedge-shaped follicles, and the sperm duct, originating from the centre of the rosette, does not make any spiral turns, but is gently curved near its point of origin.

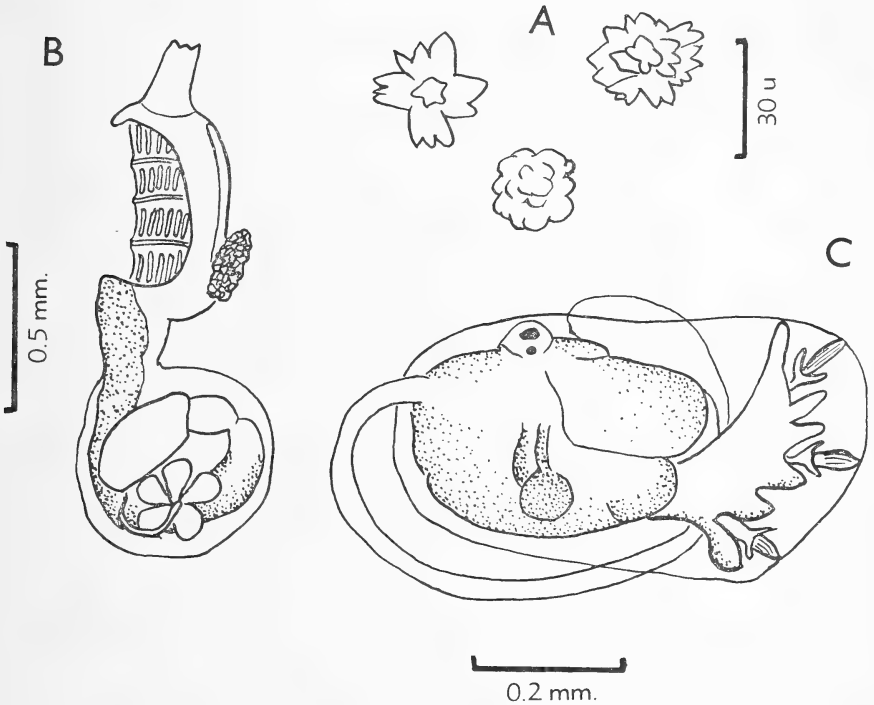

Fig. 26. *Lissoclinum cavum* sp. n.
A, spicules; B, zooid; C, larva.

Larva

The specimen from Algoa Bay, taken on 6–4–1954, contained larvae (fig. 26 C). The trunk of the larva is about 0·6 mm. long from the end of the papillae to the base of the tail. The papillae project from the centre of a group of irregular ampullae. Both ocellus and otolith are present in the sensory vesicle.

Remarks

Lissoclinum bilobatum Millar is perhaps the South African species most like *L. cavum*, but is distinguished by having only 2 testis follicles.

Genus TRIDIDEMNUM Della Valle, 1881

Trididemnum cerebriforme Hartmeyer

Trididemnum cerebriforme Hartmeyer, 1913, p. 139.

Known distribution

Cape Province.

Localities

Saldanha Bay: U.C.T., SB 130 U.

Langebaan Lagoon: U.C.T., LB 352 U; U.C.T., LB 374 F; U.C.T., LB 378 R; U.C.T., LB 384 Y; U.C.T., LB 472 G.

False Bay: U.C.T., FAL 136 S; U.C.T., FAL 144 Z; U.C.T., FAL 216 E; U.C.T., FAL 225 P; U.C.T., FAL 234 U2; U.C.T., FAL 272 G; Mortensen's Java–South Africa Expedition 1929–30. Station 61, B.M. (N.H.) reg. no. 34.2.1.3; Mortensen's Java–South Africa Expedition, 1929–30. Station 65, 19.12.29, B.M. (N.H.) reg. no. 34.2.1.5.

Mossel Bay: U.C.T., MB 59 K; U.C.T. MB 84 S.

Algoa Bay: U.C.T., LIZ 9 L; U.C.T., LIZ 28 T; U.C.T., LIZ 32 U; U.C.T., LIZ 34 E.

Commercial trawlers: U.C.T., TRA 71 F.

Description

The largest of the three specimens on which Hartmeyer (1913) based this species had a much-folded surface but in the smallest the surface was almost plain. The brain-like folding cannot therefore be regarded as a diagnostic character. Among the numerous specimens in the South African collections that I have examined there are many colonies with a smooth surface and only a few which are much convoluted. One of the latter kind, taken by Mortensen's expedition, is folded over so that the anatomically lower surfaces are almost in contact, leaving an extensive but narrow space into which open slits which I take to be the common cloacal openings. These openings are therefore on the under surface of the colony, a condition thought to exist (Michaelsen, 1930) in *Leptoclinides brasiliensis*, but otherwise very rare in the Didemnidae. In all other respects this South African specimen agrees with more typical examples of *T. cerebriforme*. The zooids of various colonies show much variation in the amount of pigment on the thorax. In some there is no pigment, in others a small dark spot over the anterior end of the endostyle, and in many specimens the thorax has a great quantity of dark blue pigment.

Genus DIPLOSOMA Macdonald, 1859

Diplosoma listerianum Milne Edwards

Leptoclinum listerianum Milne Edwards, 1841, p. 84.
Diplosoma listerianum Michaelsen, 1919, p. 42.

Known distribution

West coast of Europe; Mediterranean; Adriatic; Sargasso Sea; west Africa; Luderitz Bay, South West Africa to Durban, Natal.

Localities

Saldanha Bay: U.C.T., SB 92.
False Bay: U.C.T., FAL 109 Y; U.C.T., FAL 272 F.
Algoa Bay: U.C.T., LIZ 1 Y.

Remarks

I can find no constant differences between these specimens and colonies of *D. listerianum* from British waters. There is some doubt, however, regarding the validity of certain species of *Diplosoma*, and it may prove that *D. modestum* described by Michaelsen (1920) from the Seychelles and Zanzibar is identical to *D. listerianum*. The Atlantic American *D. macdonaldi* Herdman also appears to be very similar anatomically, but Van Name (1945) was unwilling to identify it with *D. listerianum* without having examined European material. This is a genus in which anatomical features of colony and zooid are very uniform and specific differences may have to be sought in larval or biological characters.

Family **Cionidae** Lahille, 1887

Genus CIONA Fleming, 1822

Ciona intestinalis (Linnaeus)

Ascidia intestinalis Linnaeus, 1767, vol. 1, pp. 2, 1087.
Ciona intestinalis Fleming, 1822, p. 512.

Known distribution

West coast of Europe, Mediterranean, tropical west Africa, east and west coasts of north America, Malay Archipelago, Japan, Australia, South Africa.

Localities

Saldanha Bay: U.C.T., SB 94; U.C.T., SB 134 A.

Description

The South African specimens are typical of the species as found in European waters. I was able to confirm the distribution of the longitudinal muscles to the siphons, as previously described (Millar, 1953).

Family **Ascidiidae** Adams, 1858

Genus ASCIDIA Linnaeus, 1767

Ascidia stenodes sp. n.
(Fig. 27)

Diagnosis of species

Anterior part of body narrow and elongated, with terminal oral siphon. Atrial siphon posterior to middle of body. Body wall with a sharply defined band of transverse muscles along the dorsal side. Gut small, mainly in the posterior part of the body, and forming a single narrow loop with the anus near the oesophagus.

Holotype

In the South African Museum. S.A.M. A25615 (U.C.T., FAL 259 Q).

Localities

False Bay: U.C.T., FAL 5 J; U.C.T., FAL 259 Q; U.C.T., FB 1102.

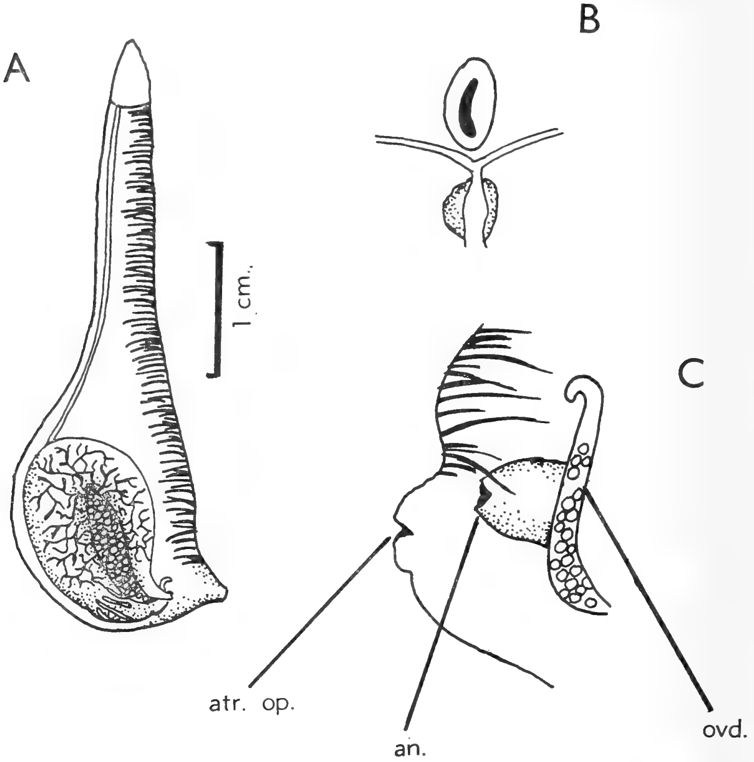

FIG. 27. *Ascidia stenodes* sp. n.

A, specimen with test removed, seen from the left; B, dorsal tubercle; C, region of atrial opening, an., anus; atr.op., atrial opening; ovd., oviduct.

Description

There are 6 specimens in the collections, the largest being about 5·5 cm. long, and the smallest 1·0 cm. long. The surface of all specimens is thickly coated with small stones, pieces of shell and sand which obscure the shape of the body. The test, when freed from adhering particles, is transparent and not very thick. When the body is removed from the test it is seen to consist of a long tapering anterior part terminating in a short narrow oral siphon, and a wider posterior part which accommodates the gut (fig. 27 A). The short inconspicuous atrial siphon is near the posterior end of the body and in young specimens very near it. Most of the body wall of the left side is thin and transparent, without muscles, but a thick narrow band of transverse muscles runs along the dorsal side and extends only a short distance on to the left and right sides; the margins of this band are sharply defined. The left side of large specimens also has a ventral band of transverse muscles, but this is absent in small specimens.

The oral tentacles number about 30 in a specimen of body length 1·3 cm., about 40 in one of 1·7 cm. and 60 in one of 5·5 cm. In two small specimens examined, the opening of the dorsal tubercle is a slightly curved longitudinal slit with the concavity to the left (fig. 27 B). In large specimens it is an irregular C-shaped slit. The small ovoid ganglion is immediately posterior to the tubercle. The branchial sac extends back to the posterior end of the body. The dorsal lamina is a moderately wide smooth-edged membrane. The longitudinal bars are of uniform thickness and number about 40 in the specimen 1·7 cm. long. There are 2–7 stigmata in each mesh according to the size of the specimen. Rather small papillae are present at the intersections of transverse and longitudinal bars, but no intermediate papillae.

The gut is rather small. It starts with the short curved oesophagus lying across the body and leading to the ovoid stomach which passes obliquely forward. A few longitudinal folds are present on the wall of the stomach. The intestine makes a simple loop and the rectum ends near the base of the atrial siphon, in a small two-lipped or simple anus.

The gonad, as usual in the genus, is spread over a large part of the intestinal wall, and the ducts lie beside the intestine and rectum (fig. 27 C).

Remarks

The diagnostic features of this species have already been noted. To them might be added the covering of shell fragments or stones, which was found on all specimens, but this is a character which may depend on the nature of the substratum.

According to the collector's note the specimens FAL 259 Q were lying unattached on the bottom and this may be the usual condition in the species.

Ascidia sydneiensis Stimpson

Ascidia sydneiensis Stimpson, 1855, p. 387.

For synonymy see Kott 1952, pp. 310, 311.

Known distribution

West Indies; Hawaii; Malay Archipelago; Amboina; Japan; Australia; South Africa.

Localities

False Bay: U.C.T., FAL 158 V; U.C.T., FAL 175 Q; U.C.T., FAL 181 A; from catch of a trawler, S.A. Museum, April 1904.

Mossel Bay: U.C.T., MB 18 S.

East London: S.A. Museum no. 12943, low tide.

Algoa Bay: U.C.T., LIZ 32 S.

S.A. Museum (no details).

Description

These specimens agree closely with those which I have already described from South African waters (Millar, 1955). The largest of the present animals is 13 cm. long.

Remarks

Except for the South African records *A. sydneiensis* is known only from warm waters where, however, it is very widely distributed throughout the world.

I am not sure that *A. sydneiensis*, *A. incrassata* Heller, and possibly *A. multitentaculata* Hartmeyer, all recorded from South African waters, might not prove to represent a single species.

Family **Corellidae** Lahille, 1887

Genus CORELLA Alder & Hancock, 1870

Corella eumyota Traustedt

Corella eumyota Traustedt, 1882, pp. 271, 273.

For synonymy see Kott, 1952, pp. 318, 319.

Known distribution

Antarctic; Subantarctic; South Africa; St. Paul (Indian Ocean); New Zealand; Australia.

Localities

Langebaan Lagoon: U.C.T., LB 367 U; U.C.T., LB 374 E; U.C.T., LB 375 X.

Family **Agnesiidae** Huntsman, 1912

Genus AGNESIA Michaelsen, 1898

Agnesia glaciata Michaelsen

Agnesia glaciata Michaelsen, 1898, p. 370.
Agnesia krausei Michaelsen, 1912, p. 181, figs. 24, 25.
Agnesia capensis Millar, 1955, p. 191, fig. 19.

Remarks

No specimens of *A. glaciata* are present in this collection, but material which I previously examined from South Africa contained one specimen of a species which I described as a new species *A. capensis* (Millar, 1955). During examination of the *Discovery* collections I found another specimen, also from False Bay, the same locality as that of the type specimen of *A. capensis*. The *Discovery* specimen was intermediate between *A. capensis* and *A. glaciata*, and I have given reasons (Millar, 1960) for regarding *A. capensis* as a synonym of *A. glaciata*.

Family **Styelidae** Sluiter, 1895

Subfamily **Botryllinae** Adams, 1858

Genus BOTRYLLUS Gaertner, 1774

Botryllus magnicoecus (Hartmeyer)

Botrylloides nigrum var. *magnicoecum* Hartmeyer, 1912, p. 271.
Botryllus magnicoecus (Hartmeyer). Michaelsen and Hartmeyer, 1928, p. 331.

Known distribution

South Africa; Australia; New Zealand.

Localities

False Bay: U.C.T., FAL 109 Z; U.C.T., FAL 158 U; U.C.T., FAL 175 C; U.C.T., FAL 225 M; PF 15797 B; PF 14582.
Table Bay: Woodstock Beach, S.A. Museum, 19–6–14, washed up on beach, collected by K. H. Barnard.
Saldanha Bay: U.C.T., SB 128 P.
Algoa Bay: U.C.T., LIZ 9 H.

Botryllus anomalus sp. n.

(Fig. 28)

Diagnosis of species

Atrial openings of the zooids lead directly to the surface of the colony, instead of into common cloacal chambers. Zooids with 8 rows of stigmata, 5 or 6 folds on the stomach, and a short straight pyloric caecum. A gonad on each side of the body, each gonad consisting of a group of 6 or 7 testis follicles and a single large ovum.

Holotype

In the South African Museum. S.A.M. A25616 (Saldanha Bay, 5–9–12).

Localities

Saldanha Bay: S.A. Museum, level of low water, 5–9–12, collected by K. H. Barnard.
Table Bay, Woodstock Beach: S.A. Museum, washed up on beach, 19–6–14 collected K. H. Barnard.

Description

There are several colonies of this species in the collection. A large specimen is 9 cm. long, 3 cm. wide, and less than 1 mm. thick. All specimens have been growing on thin flat algal fronds. The surface of the colony is smooth and even, without any foreign matter, and the colour of the specimens, in the preserved state, a dull pink. There are no common cloacal cavities in the test and the zooids are not arranged in systems, but are closely and regularly spaced over the colony (fig. 28 A). Each zooid (fig. 28 B) has a pair of small openings on the dorsal side, marking the oral and atrial siphons, both of which open directly on the surface of the colony. Rounded vascular ampullae are present between the zooids.

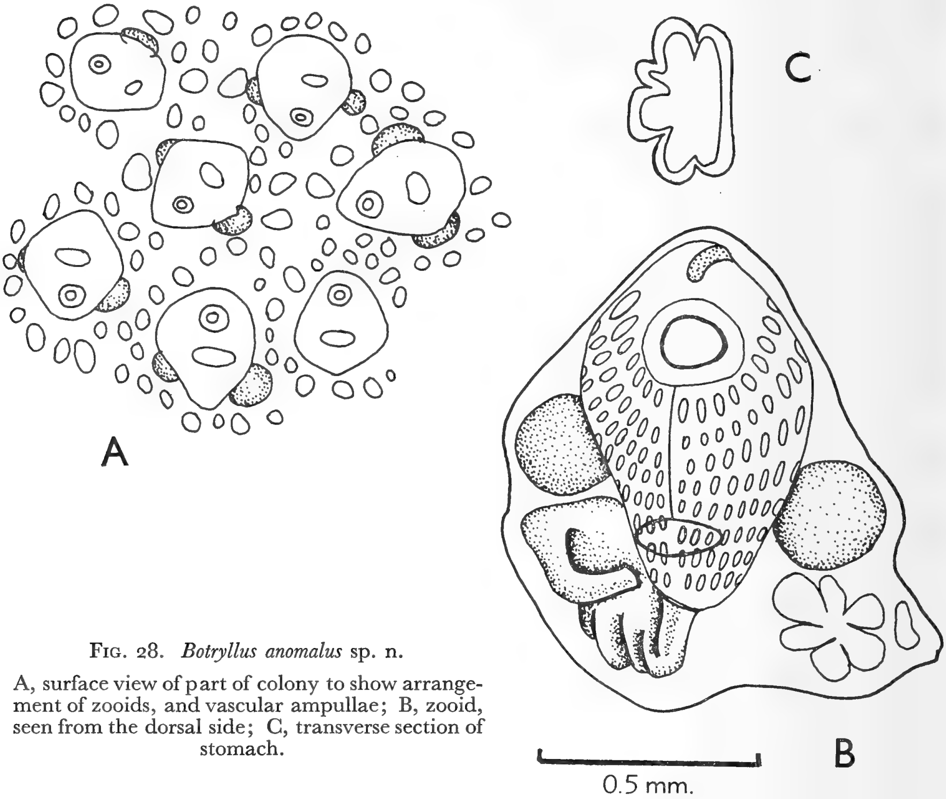

Fig. 28. *Botryllus anomalus* sp. n.
A, surface view of part of colony to show arrangement of zooids, and vascular ampullae; B, zooid, seen from the dorsal side; C, transverse section of stomach.

The zooids are small, rarely exceeding 1 mm. in length. Near the anterior end of the branchial sac is the round oral opening, through which can be seen the 8 tentacles. The branchial sac has 3 inner longitudinal bars on each side, and 8 rows of stigmata along the length of the sac. The digestive system consists of a short oesophagus leading from the posterior end of the branchial sac to the short barrel-shaped stomach. This has 5 or 6 complete folds on the walls (fig. 28 C), and a short straight pyloric caecum with slightly swollen distal end. The intestine makes a sharp bend to the left and upwards to the short rectum which ends in the simple anus below the atrial opening. On each side of the body is a single gonad, each gonad consisting of a group of 6 or 7 pear-shaped testis follicles and one large dark brown ovum. The left gonad is slightly anterior to the right one. No larvae were present in the colonies.

Remarks

This species is chiefly remarkable for the opening of the individual atrial siphons of the zooids directly on the surface of the colony, and the corresponding absence of common cloacal chambers. The same features characterize *Botryllus primigenus* Oka which, however, is distinguished by the presence of only 4 rows of stigmata in the branchial sac, and the rather larger, curved pyloric caecum.

Genus BOTRYLLOIDES Milne Edwards, 1841

?Botrylloides leachi (Savigny)

Botryllus leachii Savigny 1816, p. 199.

Known distribution

Western Europe; Mediterranean; Australia; New Zealand; South Africa.

Localities:

Saldanha Bay: U.C.T., SB 91.

Remarks

This species has already been recorded by Michaelsen (1934) from Table Bay and False Bay. No gonads are developed in the present specimen, and I am identifying it as *B. leachi* because it agrees with that species in other characters. It must be admitted, however, that the distinctions are not entirely satisfactory in a number of species in both *Botrylloides* and *Botryllus*.

A single colony (U.C.T., SB 89, 13–7–46) from the same area is similar but has more circular systems and I am not sure if it is of this species, or possibly *Botryllus schlosseri* (Pallas).

Botrylloides nigrum Herdman var. *giganteum* Pérès

Metrocarpa nigrum var. *giganteum* Pérès, 1949, p. 205.

Known distribution

(Of variety) Senegal, west Africa; Durban, Natal and Knysna, Cape Province.

Locality

Morrumbene Estuary: U.C.T., MOR 122 G.

Description

The colony is dark purple in the preserved state. The zooids are large, with a long narrow thorax containing about 16 rows of stigmata. There is a small pyloric caecum. The gonad consists of an anterior testis with about 12 follicles, and a posterior ovary containing one large ovum.

Subfamily **Polyzoinae** Hartmeyer, 1903

Genus GYNANDROCARPA Michaelsen, 1900

Gynandrocarpa unilateralis (Michaelsen)

(Fig. 29)

Gynandrocarpa placenta (Herdman) var. *unilateralis* Michaelsen 1900, p. 29.
Gynandrocarpa placenta (Herdman). Michaelsen 1904*b*, p. 30.
[*non*] *Goodsiria placenta* Herdman, 1886, p. 328.
Gynandrocarpa domuncula Michaelsen, 1904*a*, p. 247.

Known distribution

South Africa; south-east Africa.

Localities

False Bay: U.C.T., FAL 265 B; U.C.T., TRA 62 J.

Mossel Bay: U.C.T., MB 53 Q; U.C.T., MB 65 G; PF 1711; PF 10165.

Algoa Bay: PF 1095 C; Port Elizabeth, B.M. (N.H.) registered no. 1871–5–12–1; U.C.T., LIZ 28 N.

Description

The colonies are of two types: (1) a flattened upright disc with basal stalk attached to one edge of the disc (fig. 29 A), and (2) a hollow dome-shaped plate with no stalk (fig. 29 B). The stalked type of colony appears to have been attached, during life, to a firm object on the bottom of the sea, but the dome-shaped specimens were taken from the carapace of crabs. These latter colonies were originally considered to be a separate species, *G. domuncula* Michaelsen, but Michaelsen (1934) later regarded them merely as colonies which are modified in shape by their attachment to the crab. Having examined several specimens of both types I entirely agree with this view, as I find no differences in the zooids or larvae of the two types.

Preserved specimens are generally dull buff, grey, or pink-grey in colour, but in some colonies the zooids are quite bright pink, which may have been the colour of the colony in life. One specimen is described in the collector's note as 'strawberry red'.

Michaelsen (1904*a*) has dealt thoroughly with the structure of the zooids of this species under the name *G. domuncula.* The most interesting feature is the gonad (fig. 29 C), which is single and on the right side. Many zooids of the new material had a well-developed gonad. This consists of a sac-like ovary flanked on each side by a rounded or ovoid testis. The oviduct is short and has its distal part expanded to form a brood pouch which lies against the outer surface of the branchial wall. The brood pouch opens into the cavity of the branchial sac by means of an oval slit in the branchial wall, which at this place is devoid of stigmata. In the present material the brood pouch of breeding zooids never contained more than 2 or 3 embryos or larvae. One zooid contained a straight-tailed fully developed larva in the branchial sac, thus confirming that larvae pass from the brood pouch into the branchial sac before escaping to the exterior.

Each testis has many small pear-shaped follicles, the ducts from which unite to form one duct from each follicle, and these join the single sperm duct. The

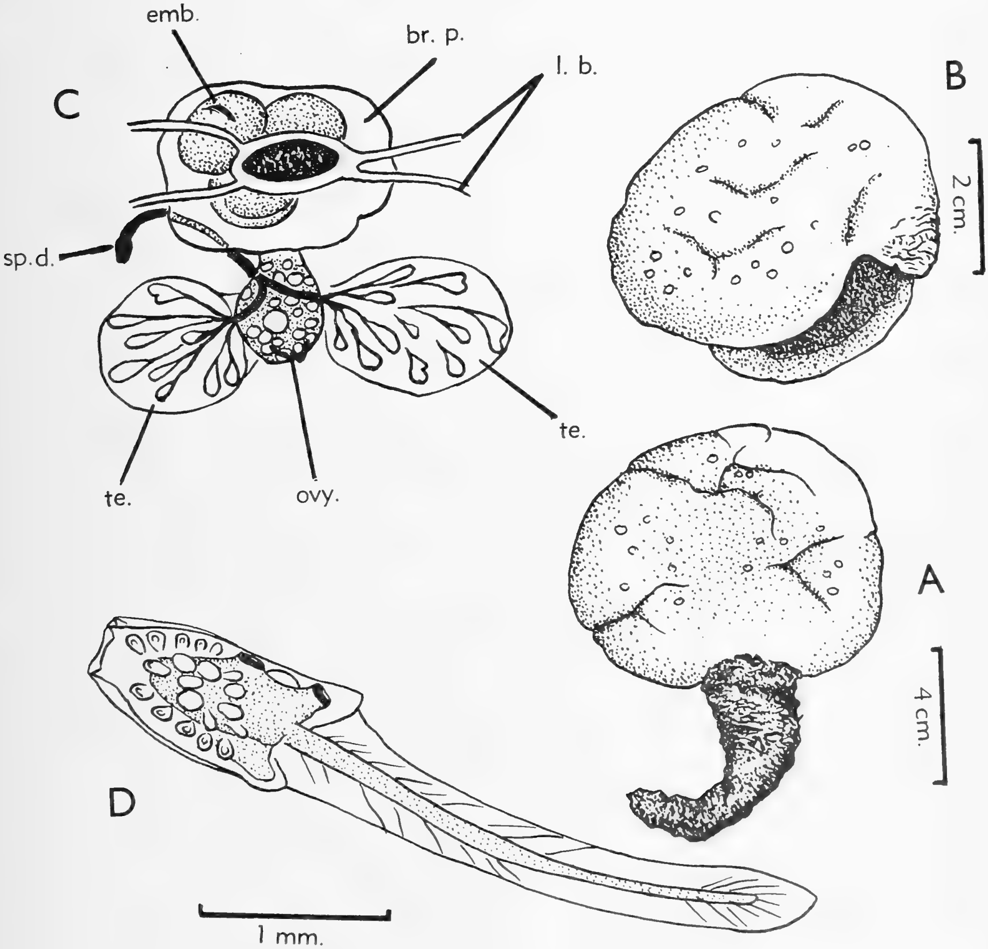

Fig. 29. *Gynandrocarpa unilateralis* (Michaelsen).
A, stalked colony; B, stalkless colony; C, gonad; br.p., brood pouch; emb., embryo; l.b., longitudinal branchial bars; ovy., ovary; sp.d., sperm duct; te., testis; D, larva.

sperm duct opens into the peribranchial cavity. Michaelsen has pointed out that, with the oviduct opening to the branchial sac and the sperm duct to the atrial cavity, there may be obligatory cross-fertilization between zooids.

Larva

The larva (fig. 29 D) is large, having a trunk 1·0 to 1·1 mm. long and a tail of 2·0 to 2·1 mm. Epidermal ampullae almost completely cover the anterior two-thirds of the trunk. There are 2 dorsal and one ventral papillae. The rudiments of the oral and atrial siphons are already present in the larva. A sensory vesicle is present but contains neither ocellus nor otolith. In shape and organization this larva is very similar to that of *Dextrocarpa solitaris* (Millar, 1955), but is more than twice the size. Larvae obtained from the stalked type of colony and from the stalkless ('domuncula') type are indistinguishable.

Remarks

There has been confusion between this species and another South African species of similar shape, *Polyandrocarpa placenta* (Herdman), as I have already pointed out (Millar, 1955). Both the form of the colony and the general structure of the zooids are alike in the two species, which are most clearly separated by the gonads. In *P. placenta* there are several polycarp-type gonads, a condition very different from that described above in *G. unilateralis*. It is remarkable, however, that the larvae of *P. placenta* have, according to Herdman (1886), an 'arrow shaped' trunk about 1·0 mm. long and a tail 2·5 mm. long. They therefore agree well with the larvae of *G. unilateralis*, and also appear to lack both a pigmented ocellus and otolith. But the larvae of *P. placenta* were present in the peribranchial cavities and not, as in *G. unilateralis*, in the brood pouch or branchial sac.

Genus DEXTROCARPA Millar, 1955

Dextrocarpa solitaris Millar

(Fig. 30)

Dextrocarpa solitaris Millar, 1955, p. 200.

Known distribution

False Bay, Cape Province.

Localities

PF 18785 B.

Description

Each specimen consists of a group of pear-shaped individuals joined by a narrow stalk to a basal stolon (fig. 30 A). They therefore have a social rather than a colonial or solitary organization. The whole test is heavily coated with sand and shell fragments. The stalk uniting the individuals with the stolon varies in length, being in some cases much shorter, and in others longer, than the body. Within the stalk there is a short extension of the innermost layer of test which surrounds the body (fig. 30 B, t), but no extension of the body wall, and the individuals therefore do not appear to be in organic connection with each other. In the type specimens I found no connexion between individuals, which were therefore regarded as quite solitary. The present specimens show a condition intermediate between a fully social organization with zooids in organic connexion, and a quite independent organization. It may be that in this species budding is confined to relatively young individuals, and in older ones complete separation may occur, or the apparently social organization may result from the fusion of the test of neighbouring but separate individuals.

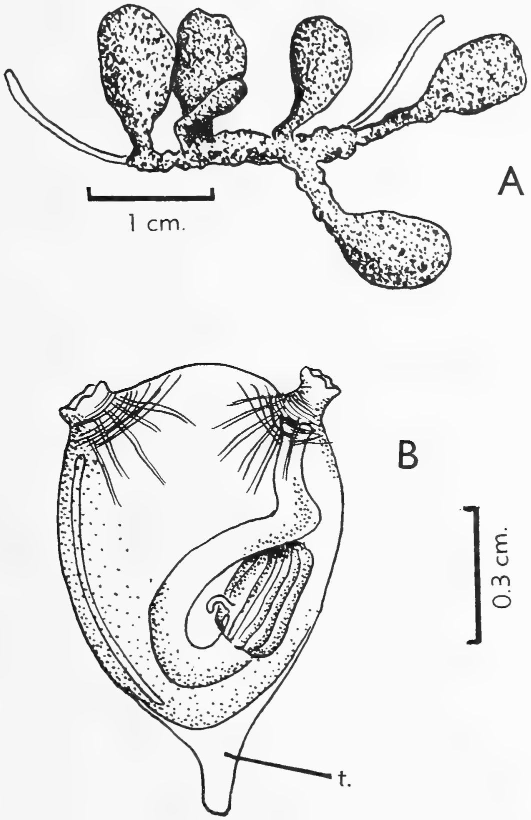

FIG. 30. *Dextrocarpa solitaris* Millar.
A, a group of individuals; B, specimen with test removed, seen from the left; t., test.

I have little to add to my earlier account of the species. A large individual dissected had about 38 oral tentacles, 19 folds on the stomach, and the following arrangement of longitudinal bars in the branchial sac:

dorsal line 0 (8) 2 (7) 3 (8) 3 endostyle.

Breeding individuals had up to 110 eggs each, in various stages of development, contained in the brood pouch. The larvae are as previously described.

Genus ALLOEOCARPA Michaelsen 1900

Alloeocarpa capensis Hartmeyer
(Fig. 31)

Alloeocarpa capensis Hartmeyer, 1912, p. 261.

Known distribution

St. Francis Bay, Cape Province.

Localities

Algoa Bay: PF 740; PF 2348.

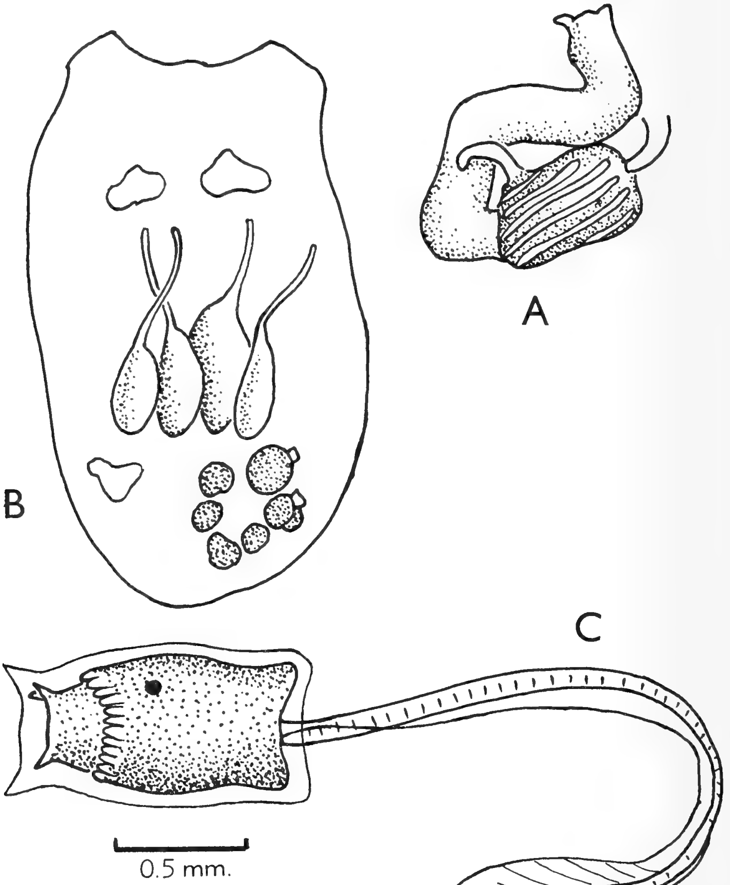

Fig. 31. *Alloeocarpa capensis* Hartmeyer.
A, gut; B, gonads; C, larva.

Description

The collection contains 4 colonies, or pieces of colonies, from Algoa Bay, the largest of which is 10 cm. by 4·5 cm. in diameter. In external appearance these specimens are very like the type material illustrated by Hartmeyer (1912, plate 38, fig. 7). The colonies are attached to shells or algal stems. They are of a dirty grey-brown colour and the surface has low but conspicuous swellings over the zooids.

The specimen collected off Lion's Head has zooids which are more or less free, being united only to a basal sheet of test by their narrow posterior ends.

The zooids, when extracted from the common test, are dull red.

Hartmeyer's (1912) description of the zooids leaves little to be added, but I have found the arrangement of the gonads to be different. According to Hartmeyer the male gonads are on the left half of the body and the female on the right. In all the mature zooids which I have examined, from colonies at both collecting stations, the testes and ovaries were on the left, the testes in the anterior part and the ovaries far back in the posterior part (fig. 31 B). It is a little difficult to determine the exact position of the ovaries relative to the middle line of the body, but careful examination shows them to lie to the left of the membrane which unites the endostyle to the ventral body wall. I have seen no gonads male or female to the right of this membrane, in any of the many zooids dissected. The position of the ovaries is confirmed by the location of larvae, which are in the left peribranchial cavity.

Larva

Only a few zooids had larvae (fig. 31 C), and there were never more than two in a breeding zooid. The larva is large, the trunk being 0·9 to 1·0 mm. long, and the tail about 1·3 mm. long. The trunk is brick-red. There are 3 anterior papillae and, a short distance behind these, a complete ring of about 24 narrow ampullae round the trunk. When the larva has been dehydrated and cleared a single spherical black body is seen, in the sensory vesicle, but is quite hidden by the red pigment of the trunk in the untreated larva. This body is presumably a 'photolith', the compound sensory structure of larvae in several genera of the subfamily Polyzoinae.

Genus METANDROCARPA Michaelsen, 1904*a*

Metandrocarpa fascicularis sp. n.

(Fig. 32)

Diagnosis of species

Zooids separate, with a narrow stalk joining them to the basal common test. About 30 oral tentacles in two circles. Dorsal tubercle with a straight oblique slit. Branchial sac with 7–9 longitudinal bars on each side. Stomach with about 16 folds and a hooked pyloric caecum. Ten to 20 testes on each side, on the posterior part of the body wall. Two to 5 ovaries on each side, on the anterior part of the body wall.

Holotype

In the South African Museum. S.A.M. A25617 (PF 10477).

Locality

Near Mossel Bay: PF 10477.

Description

There are 4 colonies the largest of which is 3·5 cm. by 2·0 cm. in diameter and 1·0 cm. thick. The colonies are attached to pieces of sand-encrusted tubes

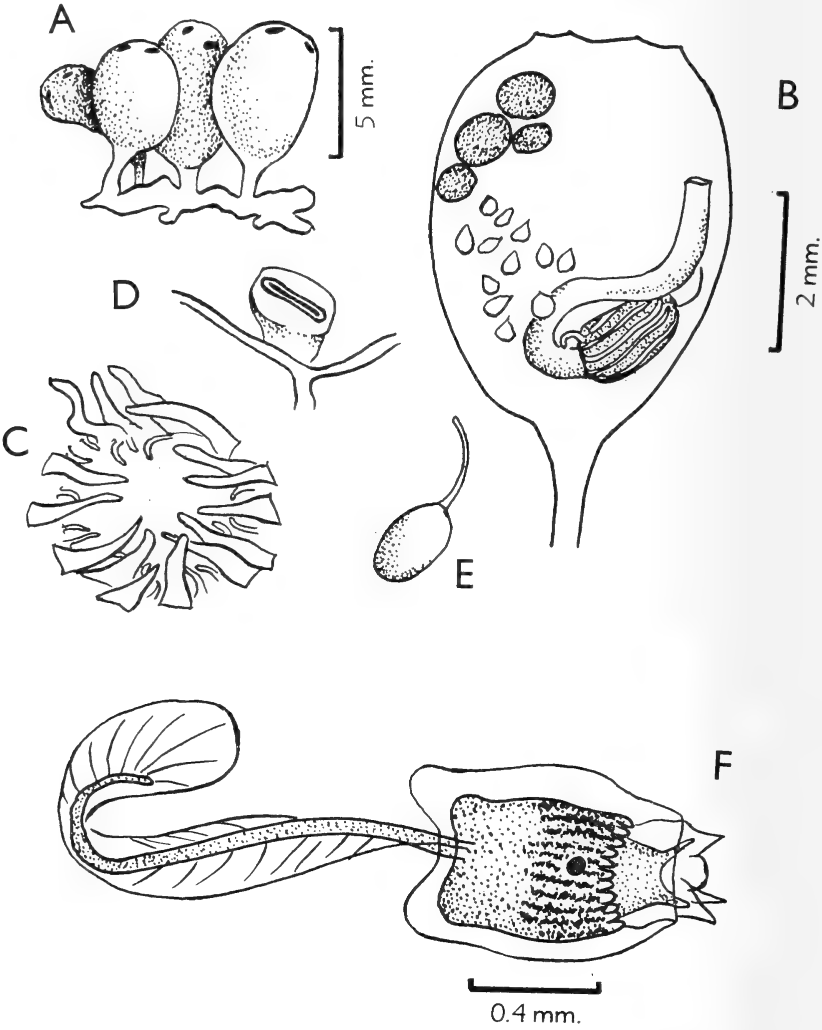

Fig. 32. *Metandrocarpa fascicularis* sp. n.
A, colony; B, zooid, with test removed, seen from the left; C, oral tentacles; D, dorsal tubercle; E, a testis; F, larva.

probably the tubes of polychaete worms. The zooids of a colony are closely crowded together, giving the appearance of a bunch of grapes (fig. 32 A). Large zooids (fig. 32 B) reach a length of 4 or 5 mm. The body of the zooid is pear-shaped, with the lower narrow end produced into a short slender stalk which unites the zooid with the basal creeping stolon of the colony. In some zooids the body is almost sessile on the stolon and in others the stalk is well developed. The oral and atrial openings are small and inconspicuous, situated quite close together on the upper end of the body. In the preserved state the specimens are pale brown, and have no encrusting material, except on the stolon.

The test is thin but semi-opaque. The body wall is dull red, but sufficiently thin and transparent to allow the internal organs to show through. Muscles are poorly developed. The oral and atrial siphons are very short and end in simple round openings. There are about 30 oral tentacles arranged in two circles, the outer one consisting of about 16 large tentacles and the inner one of smaller tentacles (fig. 32 C). The dorsal tubercle is small and has a narrow straight slit-like opening which is obliquely placed (fig. 32 D).

In the branchial sac of large zooids there are 9 longitudinal bars on each side and smaller zooids have 7 or 8. There are no folds. The dorsal lamina is a narrow plain-edged membrane. The oesophagus is narrow. The stomach is of a long barrel-shape, with about 16 longitudinal folds and a narrow, hooked pyloric caecum. The intestine forms a flat bend parallel to the stomach, and the rectum ends in a smooth-edged anus.

The female gonads are confined to the anterior part of the body and the male gonads to the posterior part. On each side of the endostyle there are 2 to 5 large spherical ovaries of a dark brown colour. These seem to produce only one mature egg at a time, since ovaries are often seen with a single developing embryo. Embryonic development takes place within the ovary or oviduct instead of freely in the atrial cavity.

The testes are 10 to 20 small pear-shaped glands on the left and right sides of the posterior part of the body, each testis with a very slender sperm duct (fig. 32 E).

Larva

Zooids were never found with more than two larvae. The larva (fig. 32 F) is reddish brown and has a trunk 0·7 to 0·8 mm. long and a tail of about 2·0 mm. There are 3 anterior papillae arranged in a triangle, and a circle of about 24 narrow ampullae round the trunk. From each of these ampullae a line of dark pigment extends back along the trunk. The single black sensory spot ('photolith') can be seen only after dehydration and clearing.

Remarks

No species of *Metandrocarpa* has yet been described from the waters of South Africa or the western Indian Ocean.

There are other specimens in the collection which I cannot definitely identify, but which may belong to this species (e.g. PF 2348).

Genus POLYANDROCARPA Michaelsen, 1904*a*

Polyandrocarpa anguinea (Sluiter)

Styela (*Polycarpa*) *anguinea* Sluiter, 1898, p. 52.

Known distribution

Knysna and False Bay, Cape Province.

Localities

Mossel Bay: U.C.T., MB 18 T; U.C.T., MB 22 G; U.C.T., MB 53 R; U.C.T., MB 55 U; U.C.T., MB 60 S.

Algoa Bay: U.C.T., LIZ 28 Q.

Morrumbene Estuary: U.C.T., MOR 108 N; U.C.T., MOR 132 H.

Remarks

This species has hitherto been placed in the genus *Polycarpa* and was considered as a simple form which grows in close aggregations of individuals. A study of the more numerous specimens now available in the present collection makes it clear that the species is a colonial styelid, to be placed in the genus *Polyandrocarpa*. It is very similar to *P. lapidosa* (Herdman) from south-eastern Australia, but appears to be specifically distinct, and I shall compare the two species in another publication.

Subfamily **Styelinae** Herdman, 1881

Genus POLYCARPA Heller, 1877

Polycarpa rubida (Sluiter)

(Fig. 33)

Styela (*Polycarpa*) *rubida* Sluiter, 1898, p. 53.
Polycarpa rubida (Sluiter). Hartmeyer 1909, p. 1364. Michaelsen, 1918, p. 37.

Known distribution

Mozambique.

Locality

Morrumbene Estuary: U.C.T., MOR 132 I.

Description

The single specimen is 2·3 cm. long and 1·4 cm. wide. It had been basally attached, and is upright with the oral opening terminal and the atrial opening about one-third of the body length from it. Both openings are almost sessile, the siphons being very short. The test is grey with a pink-brown tinge, and has irregular furrows and mounds, but is not further divided into small fields as in the type specimen described by Sluiter (1898). Small rose-coloured marks on the surface of the test may indicate the colour in life; Sluiter's specimen was evidently red and the preserving alcohol had extracted this colour. The test is moderately thick and is tough. Within, it is pearly white. The body wall is dull red-grey, the red colour being most marked round the oral and atrial openings. Circular muscles form a continuous sheet and below these is a layer of longitudinal muscles, the whole set of muscles rendering the body wall thick and opaque.

There are 24 oral tentacles of alternating lengths. The dorsal tubercle is a fairly prominent pad with an angular U-shaped opening facing obliquely forward and to the left (Fig. 33A). Four well-developed folds are present on each side of the branchial sac, with the following arrangement of longitudinal bars:

dorsal line 2 (15) 2 (10) 2 (10) 1 (9)
1 endostyle.

The dorsal lamina is a plain membrane.

Most of the gut is situated in the posterior part of the body (fig. 33 B). The oesophagus is curved and the stomach barrel-shaped with about 20 indistinct longitudinal or slightly oblique folds and a hooked pyloric caecum. The intestine and rectum form an S-shaped bend and the anus has about 15 shallow lobes In Sluiter's specimen the anus was some distance behind the atrial opening, but in the present specimen it lies close to it.

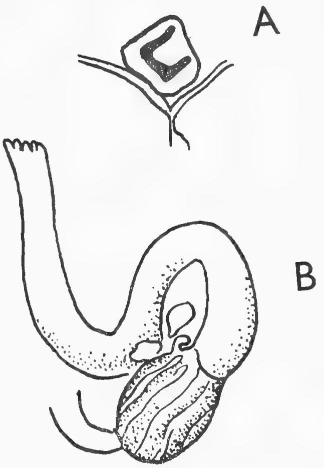

FIG. 33. *Polycarpa rubida* (Sluiter). A, dorsal tubercle; B, gut.

The gonads are small and numerous, about 40 being present on the left side of the body. They are of the type usual in the genus and are scattered over the inner surface of the body wall. Between them are numerous transparent flattened endocarps. A few endocarps are also present within the intestinal loop.

Remarks

This new specimen differs from the type specimen principally in having fewer longitudinal bars between the branchial folds, a character which may be related to the much smaller size of the specimen. The opening of the dorsal tubercle is also different, but as Sluiter remarked, the S-shaped slit of the type specimen is easily derived from a horse-shoe-shaped slit.

Genus CNEMIDOCARPA Huntsman, 1913

Cnemidocarpa asymmetra (Hartmeyer)

Tethyum (*Styela*) *asymmetron* Hartmeyer, 1912, pp. 253–257.
Styela asymmetra (Hartmeyer). Michaelsen, 1915, pp. 394–398.
Cnemidocarpa asymmetra Hartmeyer, 1926, pp. 180–183.
[*non*] *Styela asymmetrica* Sluiter, 1904, p. 87.

Known distribution

Cape Town, Cape Province and Luderitz Bay, South West Africa.

Locality

Langebaan Lagoon: U.C.T., LB 378 Q.

Description

The larger of the 2 specimens in the collection is 5·2 cm. high and 3·0 cm. wide, and the smaller specimen 4·0 cm. high and 3·0 cm. wide. The body is erect with both siphons projecting from the upper end. The test is slightly wrinkled, rather thin but tough, and semi-transparent. In the larger specimen the opening of the tubercle is horse-shoe-shaped with both horns turned outwards, and in the smaller specimen similar but with only the right horn turned outwards. The following is the arrangement of longitudinal bars on one side of the smaller specimen:

dorsal lamina 0 (8) 3 (11) 3 (10) 2 (8) 2 endostyle.

There are 10–14 stigmata per mesh. The gonads form the most characteristic feature of the species. In the present specimens the shape of the gonads does not differ much from Hartmeyer's (1912) original description. It is remarkable, however, that in the new specimens the testis lobes occupy a central position, being largely embedded within the ovary, whereas Hartmeyer (1912) gives the opposite arrangement ('die innere Partie wird vom Ovarium, die aussere von den Hoden gebildet'). The gonoducts are arranged in pairs and are distributed over the inner surface of the gonads. The larger specimen from Langebaan has a total of 7 of these pairs.

Cnemidocarpa psammophora sp. n.

(Fig. 34)

Diagnosis

Surface coated with sand or shell. Test with short hair-like processes over most of the surface and one or a few long root-like basal processes. Many closely spaced flat oral tentacles. Dorsal tubercle with a C-shaped or simple longitudinal slit. Branchial sac with 4 rather low folds. Stomach with about 20 folds and a short, curved pyloric caecum. Five to 8 gonads on the left side and 10 or 11 on the right.

Holotype

In the South African Museum. S.A.M. A25618 (U.C.T., LIZ 25 L).

Localities

Algoa Bay: U.C.T., LIZ 19 Z 2; U.C.T., LIZ 25 L.

Description

All three specimens in the collection have an almost globular body (fig. 34 A, B). In two the diameter is 10 mm. and in the third the body is

15 mm. long and 12 mm. wide. These measurements were made over the coating of sand grains and broken shell which completely covers the body. Two simple openings fairly close together on the upper side mark the positions of the oral and atrial siphons which do not project from the outline of the body. Among the sand grains and broken shell are many short tag-like processes of the test, which are generally distributed over the surface. At the base of the body a few of these tags have been greatly developed as stout rooting processes. Generally about 6 of these are present, and one of them is longer and thicker than the rest. In the largest individual the main process is 24 mm. long.

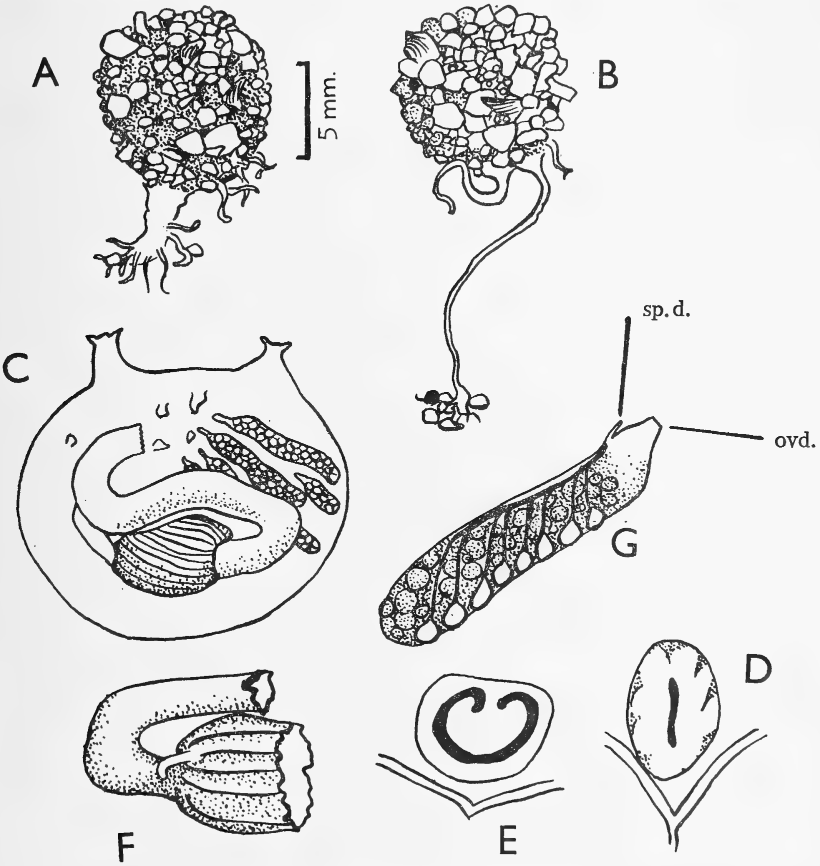

Fig. 34. *Cnemidocarpa psammophora* sp. n.
A, B, two intact specimens; C, specimen with test removed, seen from the right; D, E, dorsal tubercles of two specimens; F, part of stomach and intestine, to show pyloric caecum; G, gonads; ovd., oviduct; sp.d., sperm duct.

When the test is removed the body is seen to be almost globular or a little elongated, with the siphons projecting as short conical tubes with shallow terminal lobes (fig. 34 C). The body wall is semi-opaque although the muscles are rather poorly developed. On the inner surface of the body wall are quite numerous small endocarps. The base of the oral siphon is provided with many closely spaced slender and flattened tentacles. In two specimens these numbered at least 60 and 80 respectively. The opening of the dorsal tubercle in the largest specimen is a simple narrow longitudinal slit (fig. 34 D), and in one of the smaller specimens dissected a C-shaped slit facing forward, with slightly inrolled horns (fig. 34 E). The dorsal lamina is a moderately wide membrane with smooth margin. There are 4 rather low folds on each side of the branchial sac with the following arrangement of longitudinal bars in the largest specimen:

dorsal lamina 1 (18) 2 (9) 3 (20) 3 (16) 2 endostyle.

The gut consists of the curved oesophagus, the barrel-shaped stomach with about 20 folds and a short pyloric caecum (fig. 34 F), and the S-shaped intestine and rectum. The border of the anus is cut into a large number of very small lobes.

Gonads are present on each side of the body and number on the left from 5 to 8, and on the right 10 or 11. The gonads are tubular and nearly straight, of the kind that characterizes the genus (fig. 34 G). Most of the gonad is occupied by a long tubular ovary, and closely applied to each side of this is a series of small pear-shaped testis follicles. The individual sperm ducts join the common sperm duct which passes along the mesial surface of the gonad. Both the sperm duct and the oviduct project slightly from the end of the gonad.

Remarks

There is no west African or South African species with which *C. psammophora* is likely to be confused. The only species of the genus recorded from the western Indian Ocean is *C. madagascariensis* Hartmeyer, a species incompletely described as the only specimen was damaged. From what is known, however, it is evident that several characters distinguish it from *C. psammophora. C. madagascariensis* has a test divided into areas separated by furrows, and lacks the coating of sand and the tags and rooting processes of *C. psammophora.* Hartmeyer's species also has many fewer oral tentacles and fewer gonads.

Several species of *Cnemidocarpa* are adapted to life on sandy bottoms. *C. psammophora* is one of these and shows the adaptive features of this ecological group, namely, small size, spherical form, and rooting processes of the test.

Genus STYELA Fleming, 1822

Styela angularis (Stimpson)

Cynthia angularis Stimpson, 1855, p. 387.
Tethyum costatum Hartmeyer, 1911, p, 564.

Known distribution

South Africa.

Localities

False Bay: U.C.T., FAL 158 W; U.C.T., FAL 216 G; U.C.T., FAL 225 L; U.C.T., FAL 229 M.

Mossel Bay: U.C.T., MB 7 R; U.C.T., MB 14 Y; U.C.T., MB 18 U; U.C.T., MB 48 E; U.C.T., MB 53 S; U.C.T., MB 55 V; U.C.T., MB 68 F; U.C.T., MB 72 U.

Cape Morgan: PF 13393; PF 13432; PF 13481.

Description

The characteristic shape of this species renders it unmistakable (see Hartmeyer, 1911, Millar, 1955). In the present collections specimens range from a very small size up to 9·5 cm. long.

Styela marquesana Michaelsen

Styela marquesana Michaelsen, 1918, p. 27.

Known distribution

Lourenço Marques, Mozambique and Durban, Natal.

Localities

Morrumbene Estuary: U.C.T., MOR 132 K.

Cape Natal: PF 10722.

Description

Michaelsen's (1918) detailed description leaves little to be added. In the present material specimens have from 22 to 26 folds on the stomach, and the branchial bars vary between the following limits:

dorsal lamina 4 (10) 1 (10) 1 (10) 2 (6) 3 endostyle, and
dorsal lamina 10 (12) 13 (16) 15 (15) 10 (9) 3 endostyle.

Styela radicata sp. n.

(Fig. 35)

Diagnosis of species

Surface coated with sand or shell. Test with one or a few basal processes. Dorsal tubercle with a simple transverse slit. Stomach with about 15 folds, and a small pyloric caecum. One gonad on each side, with tubular ovary and lobed testis follicles close to the sides of the ovary.

Holotype

In the South African Museum. S.A.M. A25619 (U.C.T., MOR 132 J).

Locality

Morrumbene Estuary: U.C.T., MOR 132 J.

Description

The single specimen (fig. 35 A) is almost spherical, but slightly narrowed at the base, and measures 1·1 cm. in height and 1·0 cm. in width. It is completely covered with sand grains and fragments of shell. The oral and atrial openings are on the upper side and not very far apart. They scarcely project from the surface. On the lower side there is a root-like process of the test about 4 mm. long, and a few much shorter tags. The test is thin, but very firm perhaps owing to the closely adhering sand and shell.

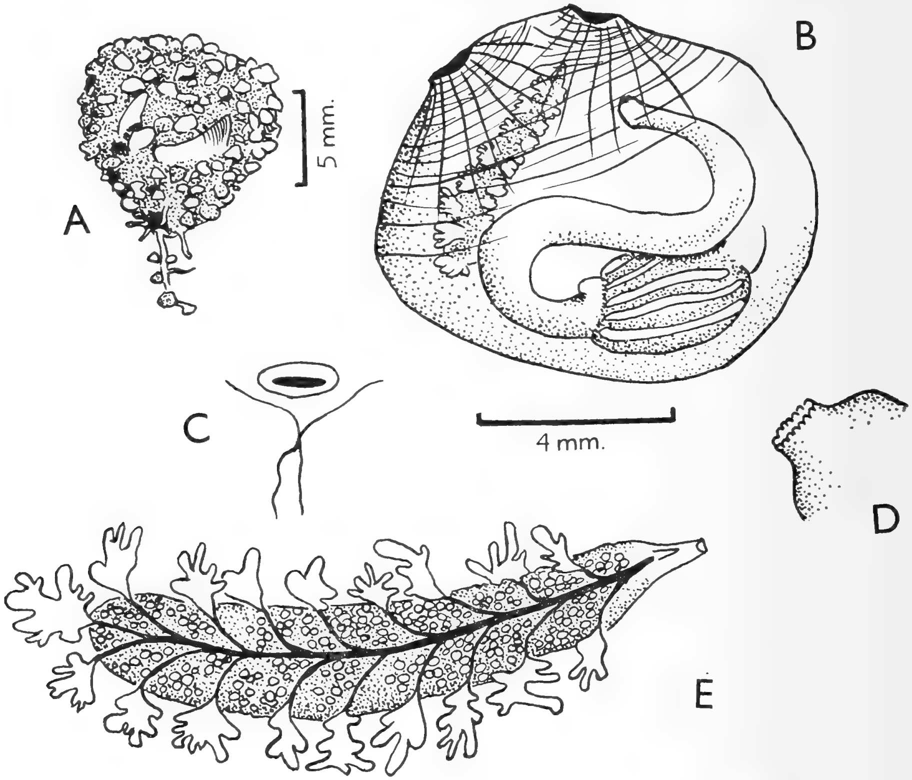

FIG. 35. *Styela radicata* sp. n.
A, intact specimen; B, specimen with test removed, seen from the left; C, dorsal tubercle; D, anus; E, gonad.

Muscles are not strong and consist of radial strands surrounding the two siphons, and a series of circular muscles mainly round the siphons but also spreading downwards over the upper half of the body (fig. 35 B). The body wall is thin and delicate. The internal siphons are very short, and are not lobed. There are 32 oral tentacles, of which about 16 are quite small. The dorsal tubercle is small, with a simple transverse slit (fig. 35 C). The branchial sac is delicate, with 4 well developed folds having the following arrangement of longitudinal bars:

dorsal lamina 2 (16) 4 (7) 4 (11) 5 (7) 2 endostyle.

The dorsal lamina is narrow, with a plain margin. Each mesh of the branchial wall contains an average of 4 stigmata, which are long, narrow and regular.

The short curved oesophagus leads to the barrel-shaped stomach which has about 15 undivided longitudinal folds and a very short rounded caecum. The intestine and rectum make a simple S-shaped bend ending in a narrow anus with minutely lobed margin (fig. 35 D).

One gonad is present on each side of the body. On the left side it is anterior to the intestinal loop and directed obliquely back towards the atrial opening. The right gonad occupies a corresponding position. Each gonad (fig. 35 E) consists of an almost straight tubular ovary ending in a short simple oviduct, and a series of 8 to 10 lobed testis follicles along the whole length of each side of the ovary.

No endocarps are visible on the inner surface of the body wall.

Remarks

This species is quite unlike any other known from the waters of west, South or east Africa. Its closest resemblance is to *S. schmitti* van Name from the southern part of the east coast of South America. The small size, the shape, the coating of foreign particles, and the basal process are similar in the two species, but *S. radicata* differs from *S. schmitti* in having only one gonad on each side and in the structure of the branchial sac. The external similarities probably indicate adaptive convergence rather than systematic affinity.

Family **Pyuridae** Hartmeyer, 1908

Genus PYURA Molina, 1782

Pyura stolonifera (Heller)

(Fig. 36)

Cynthia stolonifera Heller, 1878, p. 92.
Pyura stolonifera (Heller) Hartmeyer, 1911, p. 554.

Known distribution

South Africa; ? east and south Australia.

Localities

False Bay: U.C.T., FAL 144 Y; U.C.T., FAL 163 R; U.C.T., FAL 177 N; U.C.T., FAL 221 S; PF 15984 A.

Mossel Bay: U.C.T., MB 18 V; U.C.T., MB 53 T; PF 11 B.

Algoa Bay: U.C.T., LIZ 1 Y; U.C.T., LIZ 2 B; PF 1095 D.

East London: S.A. Museum (no details).

Description

P. stolonifera is a species which may have to be split, if a critical examination is made of enough material from different places. Most of the specimens listed above are undoubtedly of this species, and have the dorsal tubercle basically in the form of a C opening posteriorly, but with the horns spirally inrolled and contorted to an extent that increases with the size of the animal (fig. 36 A–D). This is the arrangement found by Hartmeyer (1911) both in the specimens taken by the German South-polar Expedition in Simon's Bay, and in Heller's type specimens which Hartmeyer re-examined. Specimens from Australia, however, which have been assigned to this species (Hartmeyer and Michaelsen, 1928) have a dorsal tubercle facing forward. I believe that we may be dealing with two species which are structurally similar except in some characters like the dorsal tubercle. It would be surprising if *P. stolonifera* occurred in Cape Province, South Africa, and on the south coast of Australia but not between these places. Kott (1952), in dealing with the Australian records of the species, admits that 'the nomenclature of the group is still very confused'.

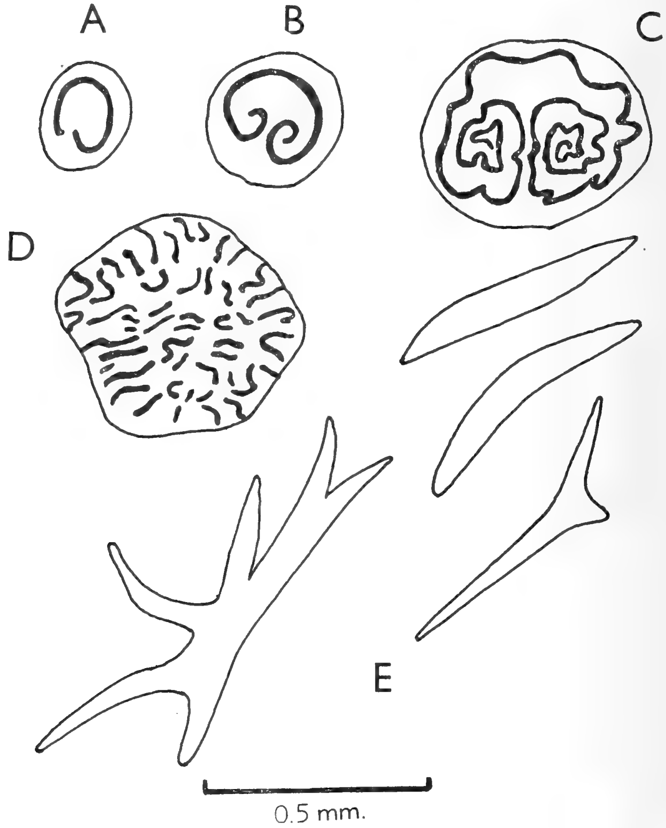

Fig. 36. *Pyura stolonifera* (Heller).
A–D, dorsal tubercles respectively of small (A, B), medium-sized (C) and large (D) specimens; E, spicules.

Some, but not all, of the specimens from False Bay and Mossel Bay have spicules (fig. 36 E) in various body tissues, but not in the test. The spicules are most abundant in one large specimen from Mossel Bay (MB 18 V), in which the walls of the endostyle, the branchial folds, the oral tentacles and the dorsal tubercle have many closely packed simple or branched spicules. Spicules of this kind have been recorded in certain tissues of *Cynthiopsis valdiviae* Michaelsen and spicules of a simple shape in *C. herdmanni* (v. Drasche), and both of these species are regarded as representing *P. stolonifera* (Heller) (Hartmeyer, 1911).

Pyura capensis Hartmeyer
(Fig. 37)

Pyura capensis Hartmeyer, 1911, p. 561.

Known distribution

False Bay, Cape Province.

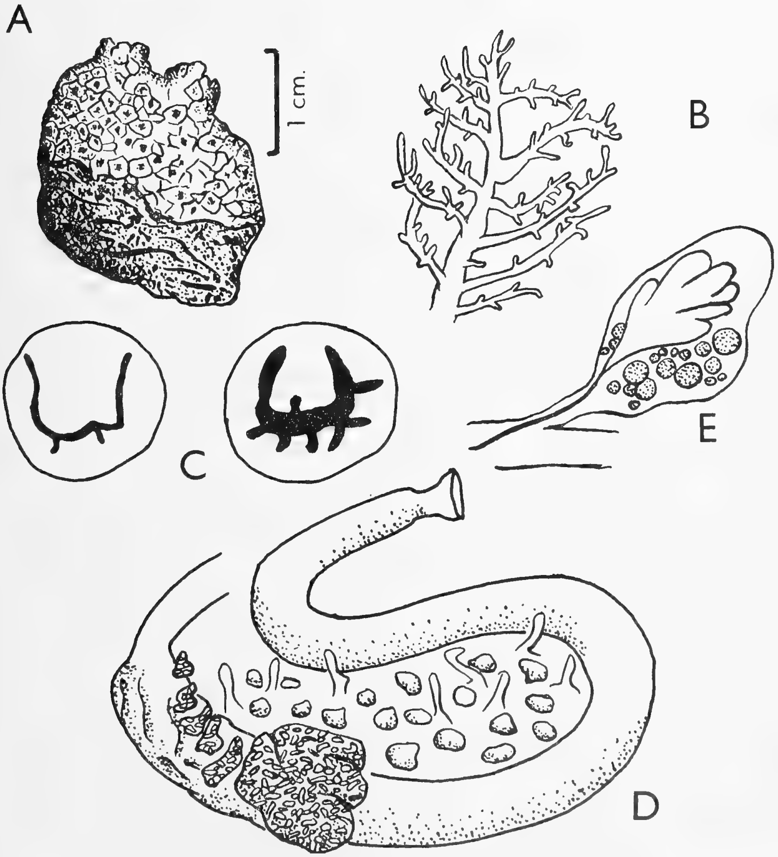

Fig. 37. *Pyura capensis* Hartmeyer.
A, intact specimen; B, oral tentacle; C, dorsal tubercles of two specimens; D, gut; E, one of the gonadial sacs.

Locality

Mossel Bay: U.C.T., MB 18 W.

Description

The largest of the 3 specimens is 2·5 cm. long and 1·6 cm. wide, and the smallest is 1·4 cm. long and 1·3 cm. wide. In all 3 the body is upright and the siphons fairly close together at the upper end. One of the characteristic features of this species, which readily distinguishes it from *P. stolonifera*, is the subdivision of the test into hexagonal or irregular plates, each plate having a red or brown central mark (fig. 37 A). This feature was noted by Hartmeyer (1911) and is distinct in the new specimens. The test is thin but tough.

The oral tentacles (fig. 37 B) number about 16 in the largest specimen. They have slender primary branches with few and small secondary branches. In the two specimens dissected the opening of the dorsal tubercle is a U-shaped slit with a few short straight branches (fig. 37 C). The tubercle illustrated by Hartmeyer (Taf. 57, fig. 8) is more complex but has the same essential features. The 7 branchial folds have the following arrangement of longitudinal bars:

dorsal line 1 (10) 3 (10) 2 (15) 2 (14) 2 (16) 2 (12) 3 (9) 2 endostyle.

A long row of dorsal languets is present.

The gut of the new specimens agrees closely with Hartmeyer's description. The margin of the anus, which Hartmeyer appears not to have seen clearly, is smooth.

In most species of *Pyura* each gonad consists of a compact double row of sacs with central common ducts, but in *P. capensis* the individual gonadial sacs are numerous and scattered so that the gonads have a more diffuse appearance than is usual in the genus.

Remarks

This is a distinctive species, and the present material, the first since the type specimens were described, confirms the account given by Hartmeyer.

Genus MICROCOSMUS Heller, 1878

Microcosmus oligophyllus Heller

(Fig. 38)

Microcosmus oligophyllus Heller, 1878, p. 101.

Known distribution

Cape Province.

Localities

Mossel Bay: U.C.T., MB 22 H.

Saldanha Bay: Hoedjies Bay, low water, S.A. Museum.

Description

This species has already been adequately described (Heller, 1878; Hartmeyer, 1912; Millar, 1955), and only a few points about the new specimens need be noted.

There are many specimens, 17 having been collected at low water from Hoedjies Bay alone. The dorsal tubercle shows some variation in the shape of its opening. In the type specimen re-examined by Hartmeyer (1912) the opening was U-shaped with the right limb longer than the left and slightly inrolled. Another specimen from the same collection as the type had the right limb more markedly inrolled and the left one only slightly so. In the new material this difference in the limbs is sometimes even more obvious, and in some specimens results in the two limbs having well-formed spirals in opposite directions, giving the opening a modified horizontal S-shape (fig. 38).

Fig. 38. *Microcosmus oligophyllus* Heller. Dorsal tubercle.

Microcosmus exasperatus Heller

Microcosmus exasperatus Heller, 1878, p. 99.
For synonymy see Van Name, 1945, pp. 346, 347.

Known distribution

Formosa; China Sea; Malay Archipelago; West Indies; Venezuela; Colombia; Natal; Mozambique.

Localities

Natal: PF 11001.

Mozambique: U.C.T., PEA 1 B; U.C.T., PEA 4 Z; U.C.T., MOR 43 M; U.C.T., MOR 108 O; U.C.T., MOR 109 R; U.C.T., MOR 122 H; U.C.T., MOR 188 M.

?Mossel Bay: U.C.T., MB 22 I.

Remarks

This is a well-known species in many warm areas throughout the world. It seems to be common in coastal waters of Mozambique. There is one doubtful record from Mossel Bay; this specimen is covered with sand, and has only 7 folds on each branchial wall, but in other respects it agrees well with *M. exasperatus*.

Microcosmus pedunculatus Pérès

(Fig. 39)

Microcosmus pedunculatus Pérès, 1951, p. 1062.

Known distribution

Senegal and Sierra Leone, west Africa.

Localities

Mossel Bay: U.C.T., MB 72 V.
Morrumbene Estuary: U.C.T., MOR 91 R; U.C.T., MOR 132 L.

Description

A specimen of average size is 1·6 cm. long and 1·4 cm. across, slightly compressed laterally and triangular in outline with the lower, narrow end produced into one or several root-like processes (fig. 39 A). These processes are whitish and free of sand but the rest of the body is completely coated with sand grains. A narrow ridge which joins the siphons is continued down the sides of the body towards the base.

The internal structure (fig. 39 B) is in complete agreement with the descriptions already published of this species (Pérès, 1951; Millar, 1956).

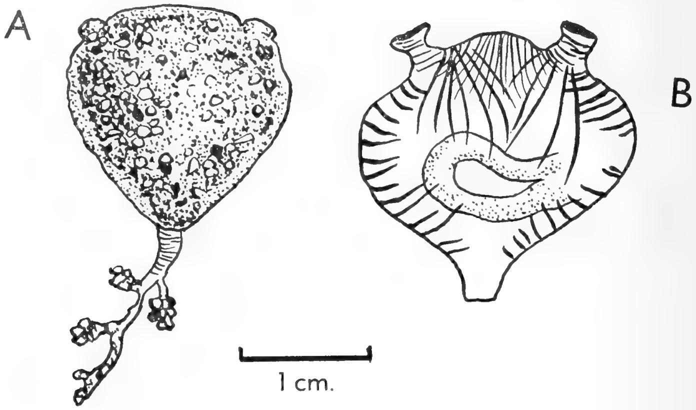

Fig. 39. *Microcosmus pedunculatus* Pérès.
A, intact specimen; B, specimen with test removed, seen from the left.

Remarks

This species apparently presents a remarkable case of discontinuous distribution, since the only previous records are from tropical west Africa north of the equator. The identification of the South African specimens, however, can scarcely be doubted on anatomical grounds. This is either a case of structural convergence of two species, or true discontinuous distribution, or continuous distribution of *M. pedunculatus* masked by the accidental absence of specimens from collections in intermediate areas.

Genus BOLTENIA Savigny, 1816

Boltenia africana sp. n.

(Fig. 40)

Diagnosis of species

Body erect, not stalked, completely covered with sand and shell. About 12 compound oral tentacles. Dorsal tubercle with a straight, C-shaped or

S-shaped slit. Branchial sac with transverse stigmata, and with 6 folds on each side. Stomach with longitudinal folds, and a compact lobed mass of glandular tubules. Intestine and rectum of uniform diameter. Anus with a plain margin. One gonad on each side, the left one in the secondary intestinal loop.

Holotype

In the South African Museum. S.A.M. A25620 (PF 15984 B).

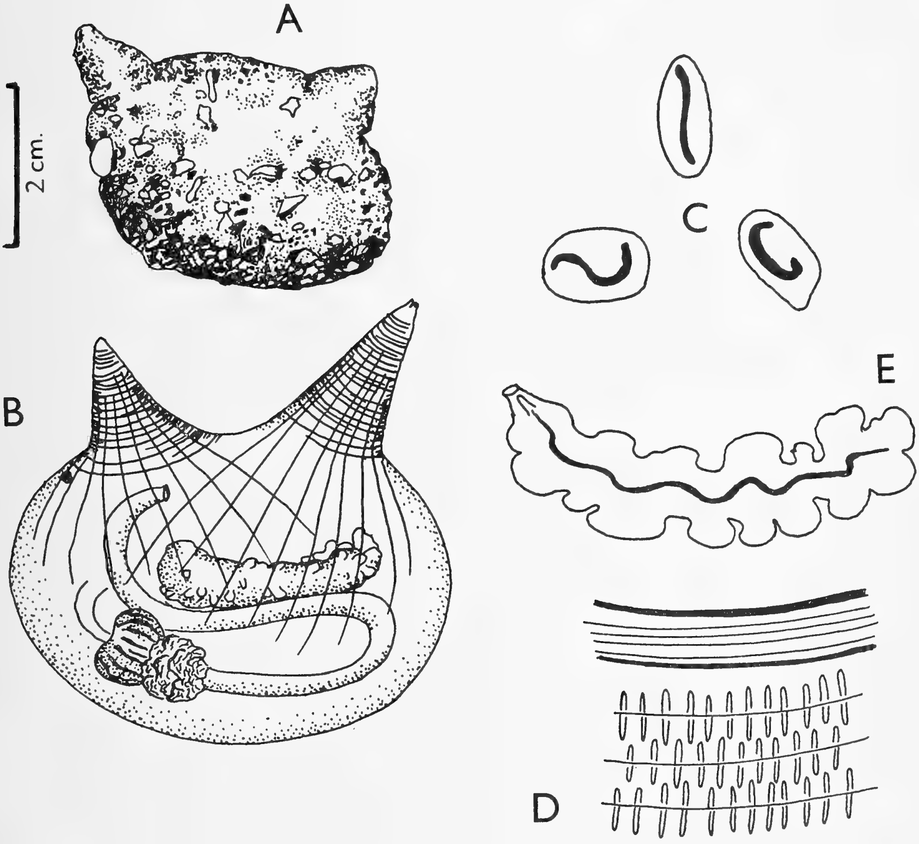

Fig. 40. *Boltenia africana* sp. n.

A, intact specimen; B, specimen with test removed, seen from the right; C, dorsal tubercles of three specimens; D, part of branchial wall; E, gonad.

Localities

False Bay: U.C.T., FAL 212 T; PF 15984 B.
Mossel Bay: U.C.T., MB 55 Y.
Algoa Bay: U.C.T., LIZ 38 G.

Description

A number of the specimens collected from False Bay and from Mossel Bay had been growing closely together and formed compact masses. Large individuals reach 4 cm. in length and 3·5 cm. in breadth. The shape is variable, being cylindrical, squat or irregular (fig. 40 A). The two siphons generally project from the upper end but are sometimes scarcely visible. Sand, broken shell and other debris completely cover the surface and no doubt render the animals very inconspicuous in nature. This may explain why the species has not previously been described. The test is only moderately thick, but is tough. When removed from the test the body is seen to be red-brown. The siphons are quite long, and conical. A set of strong muscles radiates from each siphon over the sides of the body, and circular muscles pass round the siphons. The body wall is rather thin, so that the gut and gonads are visible (fig. 40 B).

There are 11–14 oral tentacles, of alternating sizes. The largest of these are tri-pinnate. The dorsal tubercle varies a good deal, the opening being a simple, almost straight longitudinal slit, or C-shaped, or in the form of a horizontal S (fig. 40 C). On each side of the branchial sac there are 6 folds, of which the ventral 2 or 3 are smaller than the more dorsal ones. A long row of dorsal languets is present. In a specimen of moderate size, and in a large one, the longitudinal bars of the branchial sac had respectively the following arrangement:

dorsal line 4 (8) 1 (14) 3 (15) 3 (12) 4 (6) 5 (3) 2 endostyle.
dorsal line 15 (15) 10 (33) 8 (26) 12 (23) 12 (20) 12 (5) 12 endostyle

The stigmata, as usual in the genus, are transversely placed in longitudinal rows (fig. 40 D). A longitudinal bar passes across the centre of each row of stigmata.

The oesophagus is narrow, curved, and rather short. The stomach is wide at the oesophageal end and tapers towards its junction with the intestine, where there is a conspicuous lobed mass of glandular tubules. Numerous longitudinal folds are present on the walls of the stomach. The intestine forms a flat, horizontal, almost closed loop and the rectum bends upwards and forwards towards the base of the atrial siphon, where it ends in the plain-edged anus. There is little variation in diameter along the whole length of the intestine and rectum.

One gonad is present on each side of the body, that of the left side lying just above the dorsal limb of the intestine, that is in the secondary gut loop (fig. 40 B). On the right side the gonad is in a corresponding position. Each gonad is a long, rather bulky, and slightly curved body (fig. 40 E). The ovary occupies the mesial side and the testis is confined to the parietal side, next to the body wall. Indentations on the margins of the ovary give it a slightly lobed appearance. The testis follicles are round bodies which form a white mass visible from the outside, through the body wall. Both the sperm duct and the oviduct are at the posterior end of the gonads, from which they project only very slightly.

Remarks

No species of *Boltenia*, as characterized by the transverse arrangement of stigmata, has been known hitherto from west, south, or east Africa.

Genus HALOCYNTHIA Verrill, 1879

Halocynthia spinosa Sluiter *f. defectiva n.*

(Fig. 41)

Species *Halocynthia spinosa* Sluiter, 1905, p. 16.

Diagnosis of form

As the typical form of the species, but having 2 gonads on the left side and none on the right.

Holotype

In the South African Museum. S.A.M. A25621 (U.C.T., MB 55 W).

Known distribution

(Of species) Gulf of Aden; Red Sea.

Localities

False Bay: U.C.T., FAL 137 N.

Mossel Bay: U.C.T., MB 55 W; U.C.T., MB 68 G.

Description

The largest specimen in the collection is 4·5 cm. long and 5·0 cm. across. The body is rounded with a narrow base, or roughly hemispherical and broadly based (fig. 41 A). On the upper side the two siphons project prominently. In colour the specimens vary from pale grey to brown and generally have a pink tinge or quite bright red suffusion, especially on and near the siphons. Spines are present on almost all parts of the test usually in groups of one long central spine and several short encircling spines (fig. 41 B). The spines are larger on the siphons than elsewhere, but not so large as those shown by Sluiter (1905) in his figure of the species. The test is fairly thick and is tough. Stout longitudinal and circular muscles render the body wall thick and opaque.

The oral tentacles number 12 to 14 in these specimens, and are tri-pinnate. In form the dorsal tubercle is constant, having a C-shaped slit facing forward and with the horns spirally inrolled (fig. 41 D). The dorsal languets form a long series of slender projections from the roof of the branchial sac. Nine or 10 tall narrow folds are present on each side of the branchial sac, with up to 26 longitudinal bars on the largest folds.

The gut forms a wide loop of almost uniform diameter, except for the stomach which is short and wide with longitudinally pleated walls and a lobed mass of glandular tubules (fig. 41 E).

The gonads constitute the main peculiarity of these specimens. There are two on the left side (fig. 41 C) and none on the right. The gonads are large, and, instead of being parallel are curved so that they meet and fuse at their dorsal and ventral ends, forming what appears to be one ring-shaped body with two pairs of gonoducts.

Remarks

In the type material Sluiter (1905) described the gonads as a lobed mass on each side, but Michaelsen (1919) noted, as an abnormality, the complete absence of gonads on the right side. It is interesting that Van Name (1921) found a similar condition in a specimen of *H. pyriformis* (Rathke) from the Bahamas, although that species normally has 4–7 gonads on each side. There seems to be a tendency to eliminate the gonads of the right side in *Halocynthia*. This tendency has apparently become fixed in the population of *H. spinosa* inhabiting the waters of the Cape Province, and it is perhaps best to recognize the situation by describing that population as a *forma* of the species. Nevertheless, if further collections from intervening waters of the western Indian Ocean make it clear that there is discontinuous distribution of the species, it may be necessary to recognize *f. defectiva* as a new species.

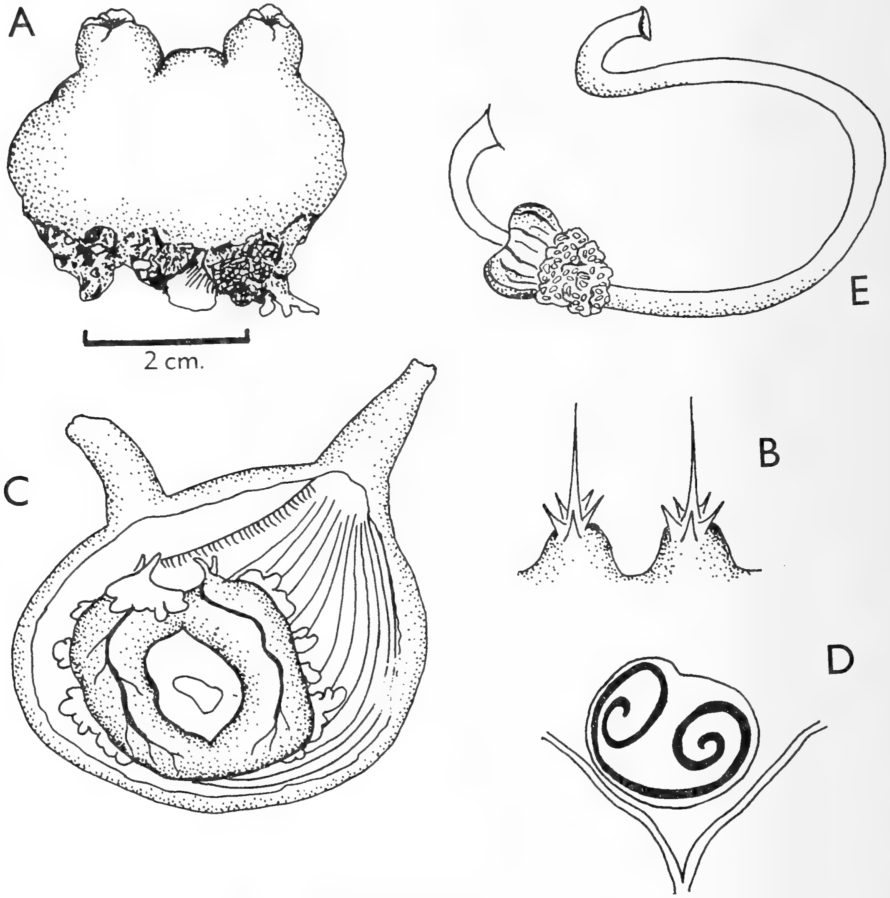

Fig. 41. *Halocynthia spinosa* Sluiter f. *defectiva* n.
A, intact specimen; B, spines of test; C, specimen with test and right body wall removed, seen from the right; D, dorsal tubercle; E, gut.

Family **Molgulidae** Lacaze-Duthiers, 1877

Genus MOLGULA Forbes and Hanley, 1848

Molgula falsensis Millar

Molgula falsensis Millar, 1955, p. 217.

Known distribution

False Bay, Cape Province.

Localities

False Bay: U.C.T., FAL 136 R; U.C.T., FAL 158 Q; U.C.T., FB 1105.

Description

A few specimens of this species are present in the collections. They all confirm the characters which I have described in the type material (Millar, 1955). In some of the new specimens, however, the oviduct although turned up at right angles to the gonad, is quite short and in others it is not bent up from the gonad. In the type specimens I could not see the sperm duct, but in the new specimens it is situated about half-way along the gonad and is a distinct, free, finger-like projection.

The test of some of the new specimens is thicker and much firmer than in the original specimens and approaches in appearance and consistency the condition found in many species of *Ascidia.* Short test projections or hairs are, however, present.

Molgula conchata Sluiter

Molgula conchata, Sluiter, 1898, p. 58.
Ctenicella conchata (Sluiter). Hartmeyer, 1913, p. 128.

Known distribution

Knysna, Cape Province.

Localities

Mossel Bay: U.C.T., MB 7 S; U.C.T., MB 39 M; U.C.T., MB 58 M; U.C.T., MB 60 T; U.C.T., MB 72 W.

Algoa Bay: U.C.T., LIZ 11 Z 1.

Description

Many specimens are contained in the collection, including large ones over 4 cm. long. All of them show the characters which readily distinguish this from other South African species of *Molgula,* namely: the coating of sand, slight lateral compression of the body, horizontal S-shaped slit of the dorsal tubercle, and the form of the gonad and its position relative to the intestinal loop.

Remarks

The present records extend the known range of this species westwards to Mossel Bay and eastwards to Algoa Bay. The geographical distribution nevertheless seems to be very restricted, and *M. conchata* is replaced by allied species in neighbouring areas.

Molgula scutata Millar

Molgula scutata Millar, 1955, p. 215.

Known distribution

Langebaan, Cape Province.

Localities

Saldanha Bay: U.C.T., SB 1.
?Algoa Bay: U.C.T., LIZ 28 U.

Description

The dorsal tubercle of this specimen has an oblique and almost straight slit; the previous examples had a C-shaped or an S-shaped slit.

One specimen from Algoa Bay, which I have provisionally included in this species, is similar in all respects to typical specimens except that each gonad is bent downwards at its dorsal end. This may be an individual peculiarity.

Remarks

This, the second record of the species, scarcely extends its known range.

Molgula cryptica sp. n.

(Fig. 42)

Diagnosis of species

Surface covered with sand. About 18 oral tentacles. Dorsal tubercle with C-shaped opening usually facing to the right. Seven branchial folds, each with 3 longitudinal bars. Primary intestinal loop closed; secondary loop semicircular. Left gonad in secondary loop. Each gonad consisting of a sausage-shaped ovary and a testis of radially disposed follicles surrounding the blind end of the ovary.

Holotype

In the South African Museum. S.A.M. A25622 (U.C.T., FAL 158 R).

Locality

False Bay: U.C.T., FAL 158 R.

Description

The body is generally ovoid, with the short siphons close together at the upper end. Most of the surface is covered with a thin layer of adhering sand grains. The largest specimens in the collection are about 3 cm. long, including the siphons. The test is rather thin and, but for the coating of sand, would be transparent.

When the test is removed the body is seen to be elliptical or almost round in outline, and the tubular siphons close together (fig. 42 A, B). Each of the 6 oral lobes and the 4 atrial lobes has a series of narrow projecting teeth forming a fringe round the openings. The body wall in the preserved state is pale brown but is sufficiently transparent to allow the gut and gonads to be seen. Muscles are mainly confined to the siphons, where circular and longitudinal ones exist, and to the dorsal half of the body which has one set of longitudinal muscles radiating from the base of each siphon.

The oral tentacles generally number about 18 and are of alternating sizes. They are tri-pinnate, but are not particularly bulky (fig. 42 C). The dorsal tubercle is small, with a C-shaped or V-shaped opening. The C-shaped slit is more common and usually faces to the right (fig. 42 D).

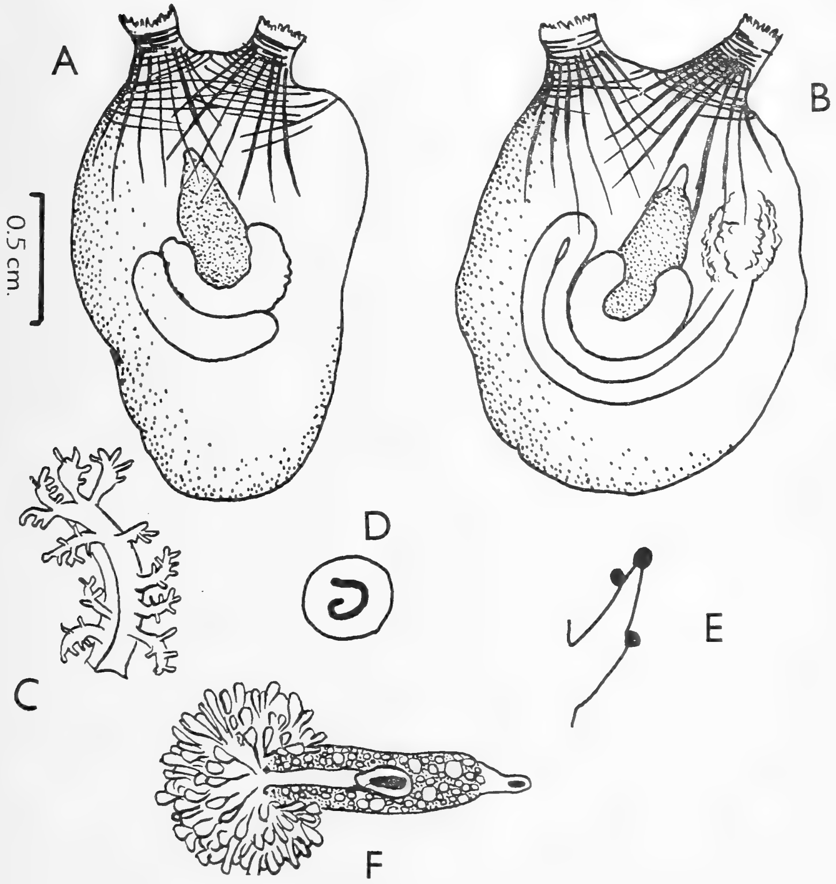

Fig. 42. *Molgula cryptica* sp. n.

A, B, specimens with test removed, seen from the right and left respectively; C, oral tentacle; D, dorsal tubercle; E, branchial fold in transverse section to show the three longitudinal bars (in black); F, gonad.

Seven low folds are present on each branchial wall, with a constant arrangement of 3 longitudinal bars on the folds; this appears to be characteristic of the species. On the ventral face of each fold near the base, there is a single bar, and two bars are present at the summit of the fold (fig. 42 E). The dorsal lamina is quite long and wide with a plain margin which is sometimes inrolled. The stigmata are subdivided into oval or long narrow straight slits which, as they tend to be arranged in regular transverse rows, obscure the spiral pattern.

The oesophagus is short, and it narrows towards its junction with the stomach. A large mass of tubular glandular tissue surrounds and hides the stomach. The intestine and rectum are narrow throughout their length. The primary loop is quite closed and the secondary loop forms a semicircle (fig. 42 B). No incisions are present on the margin of the anus.

On the left side the gonad lies in the secondary intestinal loop, which it largely fills, and on the right side it is immediately dorsal to the renal sac (fig. 42 A, B). The ovary is sausage-shaped or somewhat pear-shaped, with a rather short narrow oviduct directed towards the atrial siphon. Round the ventral, blind end of the ovary the many small testis follicles are radially arranged to form a compact crescentic or rosette-like testis (fig. 42 F). The common sperm duct is wide and extends about half-way along the inner face of the ovary to end in a remarkably large opening. The opening of the sperm duct is, in fact, wider than that of the oviduct.

The renal sac is a large curved body in the lower half of the right side.

Larva

Larvae are present in the atrial cavity of some specimens. The larvae have a trunk about 0·2 mm. long and a tail of about 0·7 mm. There is a single black sensory pigment spot.

Remarks

M. cryptica is most like *M. pulchra*, which has been recorded from sub-Antarctic South America and adjacent parts of the Antarctic. *M. pulchra*, however, has a large number of oral tentacles, and the sperm duct has a characteristic convoluted shape. It seems likely that these two species have diverged from a common ancestral stock.

I have brought together, in fig. 43, those characters of gut and gonad which best distinguish the four species of *Molgula* found in the present South African collections.

Genus EUGYRA Alder and Hancock, 1870

Eugyra myodes sp. n.

(Fig. 44)

Diagnosis of species

Test provided with fine processes, and covered with sand grains. Body wall thin and transparent. Muscles consisting mainly of (1) short transverse bands

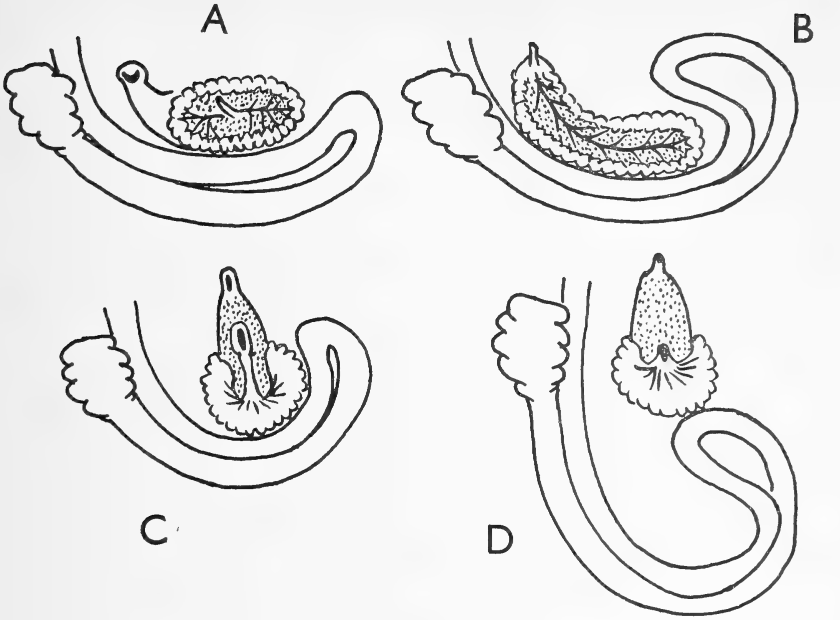

FIG. 43. Comparison of gut loop and gonads of A, *Molgula falsensis;* B, *Molgula scutata;* C, *Molgula cryptica;* and *D*, *Molgula conchata.*

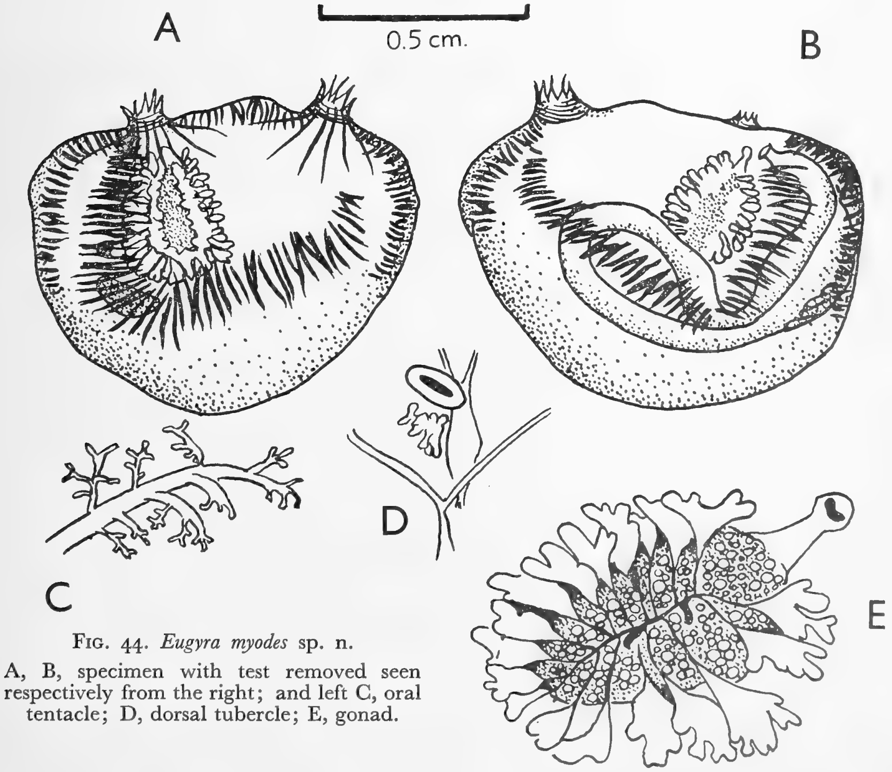

FIG. 44. *Eugyra myodes* sp. n.

A, B, specimen with test removed seen respectively from the right; and left C, oral tentacle; D, dorsal tubercle; E, gonad.

in a line between the siphons and extending down the anterior and posterior margins of the body, and (2) a V-shaped series of bands on each side of the body. About 8 tri-pinnate oral tentacles. Dorsal tubercle with an almost straight oblique slit. Branchial sac with 7 longitudinal bars and regular double spiral stigmata. Primary intestinal loop open at the bend. Right gonad above renal sac. Left gonad in secondary intestinal loop. Gonad consisting of a central sac-like ovary surrounded by lobed testis follicles.

Holotype

In the South African Museum. S.A.M. A25623 (U.C.T., LIZ 3 Q).

Locality

Algoa Bay: U.C.T., LIZ 3 Q.

Description

The larger of the two specimens is about 1·5 cm. in greatest diameter, and the smaller specimen about 1·1 cm. In outline both are almost circular, and at least in the preserved state the body is laterally compressed to some extent. The siphons are not visible externally and the whole body is covered with sand grains. Numerous fine hair-like processes project from the surface of the test. The test, when freed of adhering sand grains, is thin, flexible and transparent.

The internal siphons are separated by a distance equal to about half of the body diameter (fig. 44 A, B). They are short and their margins bear narrow teeth, which on the oral siphon number about 24 and on the atrial siphon about 20. Circular muscles surround each siphon but do not extend beyond their bases. The remaining muscles of the body wall consist of 2 sets. The first set is of short transverse fibres arranged in a line which runs between the siphons and extends in the median plane down the anterior and posterior sides of the body (fig. 44 A, B). The second set is a V-shaped line, on each side of the body, of longer fibres. The body wall is very thin and transparent.

There are 8 or 9 tri-pinnate oral tentacles of alternating sizes (fig. 44 C). The dorsal tubercle is small, with a straight or very slightly curved slit (fig. 44 D). Behind the dorsal tubercle and to the right of the ganglion lies the small branched neural gland.

The branchial sac is delicate. There is quite a long dorsal lamina which increases in width towards the posterior end, and has the margin rolled in. Seven longitudinal bars, only slightly curved, are present on each side, and below each bar a row of stigmata in double spirals. Each component slit of the double spiral makes about 3 coils.

The oesophagus is curved. The stomach is not large and has on its right wall a glandular diverticulum with longitudinally folded walls. The primary loop of the intestine is open in its anterior part but closed in the middle region. The rectum bends up and forward and ends near the base of the atrial siphon in the plain-edged anus (fig. 44 B).

The left gonad lies in the secondary intestinal loop and the right one above the renal sac. In each the ovary is sac-like with a short terminal oviduct. Round the whole margin of the ovary and applied to its mesial face is a series of about 20 lobed testis follicles (fig. 44 E). The ducts of these lead to a main duct which passes along the face of the ovary, to open by a few short slender sperm ducts projecting into the atrial cavity.

On the posterior part of the right side is the small straight renal sac.

Remarks

Few species of *Eugyra* have been recorded from west, South or east African waters, and of those few none is likely to be confused with the present species. From Walvis Bay, South West Africa, Michaelsen (1914, 1915) has described *E. woermanni* which, having a gonad only on the right side, properly belongs to the sub-genus *Gamaster*, and is very distinct from *E. myodes*. No species of *Eugyra* is known from Cape Province or the African waters of the eastern Indian Ocean. *E. kerguelenensis* Herdman is known from Kerguelen, the coastal waters of Argentina, and also the Patagonian Shelf and South Georgia (Millar, 1960). That species bears the closest resemblance to *E. myodes*. It also has bands of short muscles on the body wall but these are differently arranged. The position of left gonad mainly within the primary intestinal loop also distinguishes *E.* short muscles on the body wall but these are differently arranged. The position of the left gonad mainly within the primary intestinal loop also distinguishes *E.* *kerguelenensis*, as does the C-shaped opening of the dorsal tubercle. Nevertheless the similarities are enough to suggest a close relationship between the two species.

Eugyra macrentera sp. n.

(Fig. 45)

Diagnosis of species

Test with hair-like processes, and covered with sand grains. Muscles confined to the siphons, which have circular and radial strands. Eight bipinnate oral tentacles. Dorsal tubercle with a C-shaped opening. Branchial sac with 7 longitudinal bars. Stigmata in uninterrupted double spirals. Gut long, with the primary loop almost completely closed, and the secondary loop also very narrow. Left gonad in secondary intestinal loop. Right gonad oblique. Renal sac small.

Holotype

In the South African Museum. S.A.M. A25624 (U.C.T., LIZ 11 Z2).

Locality

Algoa Bay: U.C.T., LIZ 11 Z 2.

Description

There is only one specimen and this measures 1·2 cm. by 0·6 cm. The body is oval and is covered with a rather thick layer of sand grains. It appears to have been attached to the frond of an alga, part of which is still adhering to the specimen. The test is thin and its surface has numerous fine hair-like processes.

The body wall, in spite of some brown pigmentation, is sufficiently transparent to allow the gut and gonads to be seen when the test is removed. Narrow, closely spaced circular muscles surround the siphons and stouter radial muscles spread out for a short distance from their bases (fig. 45 A, B). The remainder of the body wall, however, lacks muscles. Narrow teeth form a fringe round the margins of both siphons.

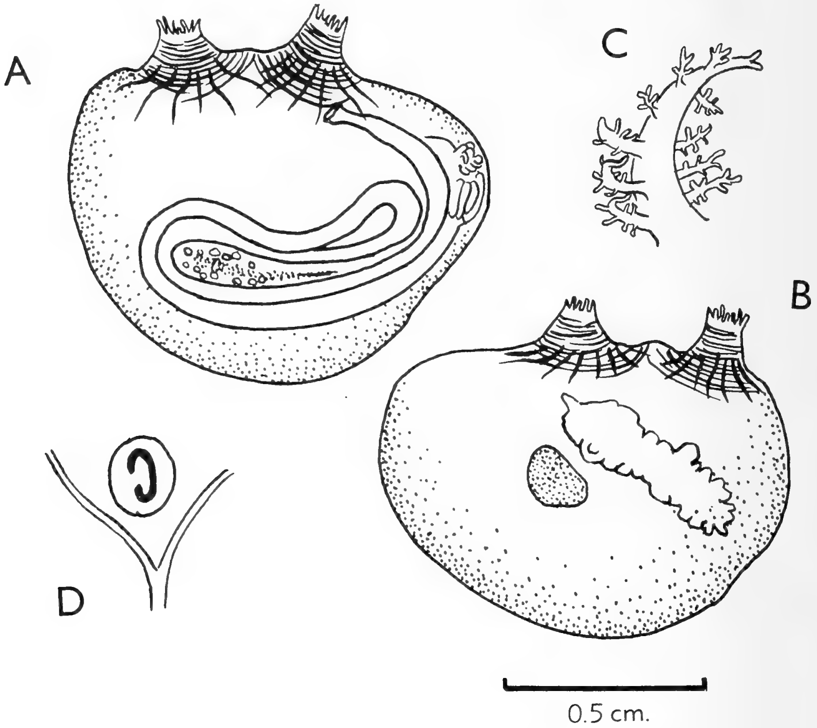

Fig. 45. *Eugyra macrentera* sp. n.

A, B, specimen with test removed, seen respectively from the left and right; C, oral tentacle; D, dorsal tubercle.

Eight bipinnate tentacles are situated at the base of the oral siphon (fig. 45 C). The dorsal tubercle is small, with a C-shaped opening facing towards the right (fig. 45 D). The dorsal lamina is rather narrow but long, and has a plain margin. Seven tall longitudinal bars are situated on each side of the branchial sac. They are less curved than in many species of *Eugyra*. Below each of these bars is a row of infundibula, each with a pair of spiral stigmata. There are, in addition, some smaller accessory infundibula in the spaces between the main ones. Narrow transverse bars separate adjacent transverse rows of infundibula.

The oesophagus is short, narrow and curved, and the small stomach bears a lobed glandular diverticulum. The intestine is long and folded into a flat double loop, making an almost closed primary loop and a narrow secondary loop. The rectum bends forward and upward, to end in a plain anus near the base of the atrial siphon.

In this specimen the gonads are not well developed, and seem to be in a post-spawning state. They are long and rather narrow, consisting of a central tubular ovary fringed by testis lobes. No further details of the gonads could be seen. The left gonad is in the secondary intestinal loop and the right gonad lies obliquely across the centre of the right side, pointing towards the atrial siphon.

The renal sac is a small semi-circular body about the middle of the right side.

Remarks

E. macrentera is remarkable for the length of the intestine and the way in which it is folded. A few species of *Molgula*, notably *M. platei* Hartmeyer and *M. contorta* Sluiter, have a somewhat similar intestinal loop, an arrangement which allows a long intestine to be accommodated in a small space.

TABLE 2

	Saldanha Bay	Langebaan Lagoon	Table Bay	Cape Peninsula	False Bay	Breede River Estuary	Mossel Bay	Knysna	Algoa Bay	Bushman's River	Durban	Kosi Bay	Portuguese East Africa (including Morrumbene)	Other localities (if in South Africa, * indicates nearest collecting station)
Aplidium flavo-lineatum . .			+	+	+		+		+					
A. pantherinum			+	+	+		+				+			
A. colelloides				+				+						
A. circulatum					+				*					St. Francis Bay.*
A. retiforme					+		?		?					Kerguelen.
A. sarasinorum					+								+	Ceylon.
?A. galeritum					+				*					St. Francis Bay.*
Synoicum capense . . .					+									
S. australe							+							
Polyclinum arenosum . . .					+				+		+			
P. isipingense					+						+		+	
P. neptunium				+										
Pseudodistoma africanum . .					+		+		+		*			Itongazi River.*
Clavelina roseola . . .					+		+							
C. steenbrasensis . . .					+		+							

	Saldanha Bay	Langebaan Lagoon	Table Bay	Cape Peninsula	False Bay	Breede River Estuary	Mossel Bay	Knysna	Algoa Bay	Bushman's River	Durban	Kosi Bay	Portuguese East Africa (including Morrumbene)	Other localities (if in South Africa, * indicates nearest collecting station)
Cystodites roseolus				+					+					Gulf of Guinea; Seychelles.
C. dellechiajei													+	Widespread in warm waters.
Polycitorella pallida									+					
Tetrazona porrecta									+					
Sycozoa arborescens			+		+		+		+					
Distaplia capensis					+	*	?*							Still Bay.*
D. skoogi					+*				+				?	Walker Bay*; off Cape St. Blaize.
Sigillina vasta						*	*							Kaffirkuils Bay.*
Eudistoma digitatum							+		+					
E. coeruleum											*		+	Scottburgh*; ?Still Bay.
E. modestum									+*		+*			East London.*
E. renieri									*		+			St. Francis Bay.*
E. illotum			+	+	+									
?E. angolanum				*	+*		+		+					Agulhas Bank;* Gulf of Guinea; N.W. & W. Australia.
?E. mobiusi				+	+				+					Madagascar.
?Didemnum stilense		+			+	*	+*		+					Still Bay.*

	Saldanha Bay	Langebaan Lagoon	Table Bay	Cape Peninsula	False Bay	Breede River Estuary	Mossel Bay	Knysna	Algoa Bay	Bushman's River	Durban	Kosi Bay	Portuguese East Africa (including Morrumbene)	Other localities (if in South Africa, * indicates nearest collecting station)
D. (*Polysyncraton*) *magnilarvum* .											*			Itongazi River.*
Leptoclinides capensis . . .			+		+	*	*							Still Bay.*
Lissoclinum cavum . . .					+				+					
Trididemnum cerebriforme . .	+	+			+		+		+					
Diplosoma listerianum . . .	+				+				+					Europe; W. Africa.
Ciona intestinalis . . .	+													Europe; America, etc.
Ascidia stenodes					+									
A. sydneiensis					+		+		+*					W. Indies; Australia, etc.; East London.*
Corella eumyota		+												Antarctic; Subantarctic; New Zealand, etc.
Botryllus magnicoecus . . .	+		+		+				+					Australia; New Zealand.
B. anomalus	+		+											
?*Botrylloides leachi* . . .	+													Europe; Australia; New Zealand.
B. nigrum var. *giganteum* . .								+			+		+	W. Africa.
Gynandrocarpa unilateralis . .					+*		+		+					Agulhas Bank.*
Dextrocarpa solitaris . . .					+			*						Cape Seal.*

	Saldanha Bay	Langebaan Lagoon	Table Bay	Cape Peninsula	False Bay	Breede River Estuary	Mossel Bay	Knysna	Algoa Bay	Bushman's River	Durban	Kosi Bay	Portuguese East Africa (including Morrumbene)	Other localities (if in South Africa, * indicates nearest collecting station)
Alloeocarpa capensis . . .									+*					St. Francis Bay.*
Metandrocarpa fascicularis . .							+							
Polyandrocarpa anguinea . .					+		+	+	+				+	
Polycarpa rubida . . .													+	
Cnemidocarpa asymmetra . .		+	+											Luderitz Bay.
C. psammophora . . .									+					
Styela angularis. . . .					+			+						Luderitz Bay.
S. marquesana											+		+	Cape Natal.
S. radicata													+	
Pyura stolonifera . . .			+		+		+	+	+					Natal; Port Nolloth; Australia.
P. capensis					+		+							
Microcosmus oligophyllus . .	+						+							
M. exasperatus							?						+	Many warm regions; Natal.
M. pedunculatus . . .							+						+	West Africa.
Boltenia africana . . .					+		+		+					
Halocynthia spinosa f. *defectiva* .					+		+							

	Saldanha Bay	Langebaan Lagoon	Table Bay	Cape Peninsula	False Bay	Breede River Estuary	Mossel Bay	Knysna	Algoa Bay	Bushman's River	Durban	Kosi Bay	Portuguese East Africa (including Morrumbene)	Other localities (if in South Africa, * indicates nearest collecting station)
Molgula falsensis					+									
M. conchata							+	+	+					
M. scutata	+	+							?					
M. cryptica					+									
Eugyra myodes									+					
E. macrentera									+					

Distribution of Species

Geographical components of the ascidian fauna

Stephenson (1944) has analysed the littoral fauna and flora of the South African coast between Port Nolloth on the west and Durban on the east, and recognizes the following components:

(1) the warm-water component,
(2) the cold-water component,
(3) the ubiquitous component,
(4) the south coast component,
(5) the more local components.

The ascidians described in the present paper (Table 2) and in a previous one (Millar, 1955) can be grouped into the first four components defined by Stephenson. Excluding doubtful records and insufficiently known species, the ascidians can be divided as follows:

The warm water component:

Aplidium sarasinorum
Polyclinum isipingense
P. arenosum
P. constellatum
Pseudodistoma africanum
Cystodites dellechiajei
Eudistoma coeruleum
E. modestum
E. renieri
Ascidia pygmaea
Botrylloides nigrum var. *giganteum*
Symplegma viride
Polyandrocarpa anguinea
Polycarpa rubida
Styela plicata
S. aequatorialis
S. marquesana
Microcosmus exasperatus
M. pedunculatus

The cold water component:

Aplidium flavo-lineatum
A. pantherinum
Polyclinum neptunium
Cystodites roseolus
Trididemnum cerebriforme
Leptoclinides capensis

Corella eumyota
Botryllus magnicoecus
Cnemidocarpa asymmetra
Microcosmus oligophyllus
Molgula scutata

The ubiquitous component:

Diplosoma listerianum
Ciona intestinalis

The south coast component:

Aplidium circulatum
A. retiforme
Clavelina roseola
Sycozoa arborescens
Distaplia capensis
Ascidia sydneiensis
Agnesia glaciata
Gynandrocarpa unilateralis
Dextrocarpa solitaris
Alloeocarpa capensis
Styela angularis
S. pupa
Pyura capensis
P. stolonifera
Boltenia africana
Molgula falsensis
M. conchata

Table 3 shows the number of species in each of the four main components, as a percentage of the total number of ascidian species collected, and also shows the comparable percentages obtained from Stephenson's (1944) figures of all species of littoral animals.

TABLE 3

	Percentage of total species	
	Ascidians	*All littoral animals*
Warm water component	39	52
Cold water component	22	18
Ubiquitous component	4	8
South Coast component	35	13

It should be pointed out that the figures are not strictly comparable because the ascidians include both littoral and sublittoral material.

The ascidian fauna compared with the littoral animals as a whole, shows a warm water component almost as important, and a relatively more important south coast component. The cold water component and the ubiquitous component are about the same relative size in ascidians as in the total of littoral animal species in South Africa. There is therefore quite good agreement between ascidians and other groups.

The distribution of South African species in other regions shows some interesting features. Particularly notable is the high proportion of the ascidian fauna which appears to be endemic. Care must be used in comparing the results in the present paper with those of other authors dealing with different areas, owing to the persisting difficulties of ascidian systematics, and the consequent possibility of confusion of species. Nevertheless it appears that more than half of the species described in the present account are endemic. As pointed out by Ekman (1953), however, the faunas of the neighbouring regions, South West and south-east Africa, are very imperfectly known; it is therefore likely that the list of endemic species will shorten as knowledge of these areas increases.

The wider affinities of the South African ascidian fauna appear to be with the adjacent areas of the warmer Indian Ocean. Only *Aplidium retiforme*, *Corella eumyota*, and *Agnesia glaciata* are found also in any of the cooler waters of more southerly regions. In this respect the South African ascidian fauna contrasts markedly with that of southern South America where many species are shared with the Subantarctic and Antarctic regions (Millar, 1960). The temperature regimes of southern South America and southern South Africa are, of course, very different, but it seems likely that the greater geographical isolation of the latter may also have been important in preventing fusion of the faunas of South Africa and more southerly areas.

In other respects also the ascidians of South Africa and South America are dissimilar. Several South American ascidians reach a very great size, as for instance *Distaplia cylindrica* (Lesson), and the molgulids *Ascopera gigantea* Herdman and *Paramolgula gregaria* (Lesson). No species of a comparable size is known from South Africa, except *Sigillina vasta* sp. n., which is known only from the incomplete type specimen. Differences in the abundance of phytoplankton may be responsible for the different sizes of the ascidians in the two areas.

SUMMARY

1. A systematic account is given of the ascidians from South African waters contained in several collections.

2. Sixty-four species are identified, and five are given provisional identifications. Of the total, seventeen are described as new species, and one as a new form of a known species.

3. The distribution of the species is briefly discussed.

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'I. *Synonymy arranged according to chronology of names.*—All published scientific names by which a species has been previously designated (subsequent to 1758) are listed in chronological order, with bibliographical references to all descriptions or descriptive citations following in chronological order after each name. . . .

B. *Form of bibliographic references to synonymic names.*—The first reference following any name in the synonymy should be to the earliest citation of that name. This should be followed by references to all subsequent citations of the same name, arranged in chronological order. . . .'

Bibliographical references modified to consist of author's name, date of citation, pagination and illustrations (plates and figures).

Example:—

Eulalia (*Steggoa*) *capensis* Schmarda

Eulalia capensis Schmarda 1861, p. 86, pl. 29, fig. 231. Willey 1904, p. 259.
Eulalia viridis var. *capensis* McIntosh 1903, p. 34. Day 1953, p. 30.
Eulalia viridis (*non* Muller) Ehlers 1913, p. 455. Day 1934, p. 30.

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DACTYLISPA CAPICOLA (PÉRINGUEY) UND VERWANDTE

(203. Beitrag zur Kenntnis der Hispinae (Coleoptera, Chrysomelidae))

Von

Erich Uhmann

Stollberg-Erzgebirge, Lessingstr. 15. *Deutschland, DDR*

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[CONTINUED ON INSIDE BACK COVER

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Von
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[Angenommen Juli 1961]

(Mit 2 Abbildungen)

Dactylispa capicola (Pér.) 1898

In dem zahlreichen südafrikanischen *Dactylispa*-Material, das mir zur Bearbeitung vorgelegt worden ist, fanden sich immer wieder Stücke, die zur Beschreibung der *D. capicola* passten, aber immer wieder waren die Stücke untereinander verschieden. Durch das freundliche Entgegenkommen der Herren Dr. Hesse und Dr. Andreae vom South African Museum erhielt ich jetzt das gesamte *capicola*-Material des Museums zur Begutachtung. Fast alle 10 Stück weichen mehr oder weniger voneinander ab. Herr Kollege Andreae war so liebenswürdig, mir ausführlich über das Material zu schreiben.

Zunächst hier die Urbeschreibung Péringuey's (1898, p. 121).

„*Hispa capicola* n. sp.

Linear; black, opaque, nearly glabrous; antennae moderately slender, basal joint very thick, the five following narrow, third one a little longer than the fourth, the five ultimate ones moderately thickened and pubescent; discoidal raised parts of the thorax smooth and very distinct; elytra deeply foveate, and with three dorsal series of short spines on each side, and a marginal one, the spines of which are not longer than the dorsal ones; the first interval along the suture has a slightly raised, somewhat spinose line, the spines of which are more developed in the posterior part. Length 4½–5½ mm.; width 2–2¼ mm. *Hab.* Cape Colony (Cape Town, Stellenbosch, Worcester)."

Im Schlüssel (Péringuey, 1898, p. 119) steht die Art neben *D. gracilis* (Pér.), sie wird von ihr getrennt:

„*c*². Black, opaque, nearly glabrous; elytra costulate . . . *capicola*
*c*¹. Black, opaque, pubescent; elytra not costulate . . . *gracilis*".

Wie aus Grössen- und Patriaangabe hervorgeht, haben Péringuey mehrere Stücke vorgelegen, seine Beschreibung wird sich also nicht nur auf *ein* Stück beziehen. Im Material ist nur eines vorhanden, von Cape Town, von Péringuey

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selbst mit *capicola* bezettelt. Dieses Stück hat als Typus, Lectotypus, zu gelten. Leider fehlen ihm die Fühler. Von den beiden anderen Fundorten ist kein Stück vorhanden, wohl aber 1 Stück von Durban, Natal (Py typ.), 2 Stücke von Douglas, Cape Province (Py), 1 Stück von Malvern, Natal (Barker) (Py), 1 Stück von Natal (Barker), 1 Stück von Durban, Natal (——), 2 Stücke von Eshowe, Zululand (——), 1 Stück von George, Cape Province, 7·86 (——).

„Py" bedeutet: Das Stück wurde von Péringuey bezettelt und mit seinem Signum versehen, „typ" bedeutet nicht „type", sondern „typical", denn der Fundort ist nicht in der Beschreibung genannt. Sie wurden augenscheinlich erst später von ihm bestimmt.

Alle diese Stücke und die ähnlichen meiner Sammlung sind vom Typus mehr oder weniger verschieden. Am ähnlichsten ist der Typus der *D. bodongi* Uhm. aus Beira, Moçambique, die ich (1930, p. 130) ausführlich beschrieben habe. *D. bodongi* hat kurze, starke Dornen auf der Deckenscheibe, die dichten Seitenranddornen sind kurz, gerade, die 4 Spitzenranddornen sind etwas länger als die des Seitenrandes, aber immer noch kurz und kräftig. Decken kurz aber deutlich behaart. In meiner deutschen Beschreibung der *D. bodongi* ist zu berichtigen auf Zeile 3: „3. Fühlerglied 1½ mal so *lang* wie *breit*", auf Zeile 4: „so *lang* wie *breit*".

Der Typus von *D. capicola* hat dieselbe Anordnung der Deckenelemente, die Spiesse der Dornen sind aber alle dünner und erscheinen dadurch länger, die Seitenranddornen sind auch dünner, anscheinend etwas länger und nach hinten gekrümmt, die 5 Spitzenranddornen sind auch dünner, deutlich länger als die des Seitenrandes. Decken anscheinend kahl, die Behaarung könnte aber abgerieben sein. In 1931 (32) spreche ich von einem typischen Stück der *D. capicola* aus dem Brüsseler Museum, das nicht so deutlich behaart ist wie *D. bodongi*. Die Dornen erscheinen dadurch etwas länger.

Dass dem Typus die Fühler mit Ausnahme der beiderseitigen beiden Basalglieder fehlen, ist zu bedauern. Es muss aber darauf hingewiesen werden, dass die Länge der einzelnen Fühlerglieder bei vielen *Dactylispa*- (und überhaupt Hispini-) Arten nicht unbedingt als Artmerkmal gelten kann.

Bei 50 × sieht man, dass der Rest der Behaarung, besonders an der Deckenspitze, aus kurzen, *niederliegenden* Härchen besteht, nicht aus ziemlich langen, *aufrechten* Haaren wie bei *D. bodongi*.

Beschreibung des Lectotypus

Länglich, parallel, schwarz, Decken dunkelblau-metallisch. Stirn niedergedrückt, runzlig, mit Mittelfurche, Hals matt, schagriniert. Kopfschild breit, glänzend, sehr fein niederliegend behaart, vor den Fühlern spitz. Halsschild so lang wie breit, Bewehrung kräftig, Vorderdornen weit gespreizt, mit sehr schrägem Vorderast und fast senkrechtem, kürzerem, gebogenem Hinterast, Seitendornen fast 3, 0, der vorderste am längsten, schräg nach vorn gerichtet, der mittlere fast gerade abstehend, der dritte gekrümmt, erst nach hinten, dann nach aussen gerichtet, so lang wie der mittlere. Beide Halsschildflächen durch eine tiefe Mittellinie getrennt, seitlich steil abfallend, glatt, schwach gewölbt, schwach quergerunzelt, vorn neben der Mittellinie schmal, aber ziemlich tief ausgerandet (Abb. 1). Antebasalrand gut entwickelt, scharf. Die vertieften Stellen der Scheibe mit deutlich behaarten Körnchen. Vorderecken völlig verrundet, mit je einem deutlichen Borstenzylinder, Hinterecken seitlich vorgezogen. Decken mit parallelen Seiten, die 10 Punktreihen durch die Basen der Dornen gestört, 9. und 10. in der Mitte vereinigt, „Punkte" viereckig (Grübchenpunkte). Zwischenräume schmal, unregelmässig. Dornen der Decken ziemlich kurz, mit starker Basis und schlankem Spiess, die Spiesse vorm Hinterrande kräftig. Naht mit Schliessdörnchen, erst auf dem Abfall mit einigen Dörnchen. I. Zwischenraum mit einer Reihe von Dörnchen (von Péringuey erwähnt); II. Zwischenraum mit II 1–5, mit II 1b, II 5 stark; IV. Zwischenraum mit IV 1b, IV 1, 2, beide etwas hinter II 2 und II 3, mit IV 3–IV 5, diese Dornen schräg vor den entsprechenden von II; VI. Zwischenraum mit 4 Schulterdornen, VI 2 hinter IV 1, VI 3 schräg hinter IV 2, VI 4 am Ende des kaum angedeuteten Eindruckes, neben IV 4; VIII. Zwischenraum mit einer Reihe van Dörnchen, davon 2 in der Schulterkehle, VIII 5 nicht betont. Zusatzbedornung gering, ausser den erwähnten auf I und im Eindruck, einige auf VIII und vor der Deckenspitze. Behaarung siehe oben. Für ein gutes Unterscheidungsmerkmal halte ich die Bedornung des Seitenrandes im Verhältnis zum Spitzenrande. Die Dichte der Bedornung (ideale Bedornung, siehe unten) bleibt sich gleich, Seitenranddornen nur etwas länger als die der Scheibe, nach hinten gekrümmt, am völlig verrundeten Hinterrand kürzer, am Spitzenrande deutlich länger als an der Seite. Spitzenranddornen etwa 4, sie gehen allmählich in die Seitendornen über. Mittel-

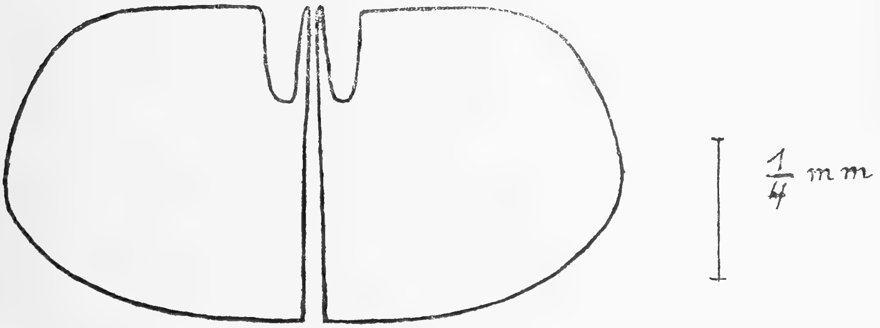

ABB. 1

Abbildung der Halsschildflächen der *D. capicola* (Pér.).

Die Abbildung zeigt die kleinen Ausschnitte vorn an den Flächen. Wenn diese grösser werden, können die schmalen Leisten neben der Mittelrinne abgetrennt werden. Die Furche wird viel feiner, und es entsteht eine vertiefte Mittelfläche wie bei *gracilis*.

schenkel deutlich bedörnelt, Mittelschienen schwach gekrümmt. Rand der Epipleuren hinten gezähnelt. Länge fast 6 mm. (Kopf geneigt). Schulterbreite fast 2 mm.

Dactylispa subcapicola n. sp.

Differt a *D. capicola* (Pér.) elytris evidenter pilosis, spinis lateralibus elytrorum longioribus, fere rectis (spinae apicales spinas laterales parum superantes), femoribus intermediis exilissime granulatis.

Zum Holotypus wähle ich ein Stück, das von Péringuey selbst bezettelt worden ist: „*Hispa capicola* Pér. typ". Fundortszettel: Durban, Natal. C. N. Barker, 1898. Da Péringuey in seiner Beschreibung Natal nicht als Patria aufgeführt hat, kann das Stück nicht als „Cotype" (jetzt „Paratypoid") aufgefasst werden, sondern „typ" muss heissen „typical", wie ich schon oben ausgeführt habe.

Der Holotypus und seine Paratypoide sind dem Typus von *D. capicola* sehr ähnlich, unterscheiden sich von ihm vor allem durch deutliche Behaarung auf den Decken und die Bedornung der Deckenränder: Dornen des Seitenrandes länger, so lang wie die der Scheibe, fast gerade; Dornen des Spitzenrandes nur wenig länger als die des Seitenrandes, nicht so auffallend länger wie bei *D. capicola*.

Holotypus. Gestalt, Farbe und Glanz wie bei *D. capicola*. Stirn eingedrückt, längsrunzlig, hinten mit einer kleinen Grube. Augenränder mit dünnem Härchensaum. Fühler kurz, gerade bis zur Schulter reichend, Schmal- und Breitseite nicht ausgeprägt, Glied 7–11 schwach verdickt, Glied 1 dick, schräg abgeschnitten, unten vorgezogen; Glied 2 rundlich, viel kürzer und dünner als Glied 1; Glied 3 abgerundet-zylindrisch, 1½ mal so lang wie 2; 4–6 einander fast gleich, jedes kürzer als 3; 6 kürzer als 5; 7 zylindrisch, so lang wie 3; 8–10 einander gleich, zylindrisch, fast quer; 11 um die Spitze länger als 10. Glied 2–6 fein behaart, die folgenden tomentiert. Halsschild nur wenig breiter als lang. Bewehrung kräftig, Vorderdornen im rechten Winkel gespreizt, Vorderast nur wenig länger als der hintere. Seitendornen 2, 1, der freie Dorn etwas länger als die beiden mit gemeinsamer Basis, alle an der Spitze etwas zurückgekrümmt. Scheibe mit 2 glatten, scharf abgesetzten Flächen, die durch eine feine Mittelfurche getrennt sind. Vorn sind beide neben der Mittelfurche schmal ausgeschnitten, doch so, dass eine feine Leiste sie von der Mittelfurche trennt wie bei *D. capicola*. Antebasalrand scharf. Die vertieften Stellen mit deutlich behaarten Körnchen. Vorderecken völlig verrundet, mit deutlichen Borstenzylindern. Hinterecken seitlich vorgezogen. Decken mit parallelen Seiten, die 10 Reihen durch die Basen der Dornen gestört, 9. und 10. in der Mitte vereinigt. Die Punktgrübchen unregelmässig viereckig. Dornen der Decken etwas länger und mit kräftigeren Spiessen als bei *D. capicola*. Spiesse der Dornen auf dem Abfall ziemlich lang. Bedornung wie bei *D. capicola*, aber die Deutung der Dornen durch viele den Hauptdornen fast gleiche Zusatzdornen unsicher. Behaarung fein, deutlich, aufrecht. Deckenränder dicht bedornt, zu jedem Querleistchen zwischen den einzelnen Punkten gehört ein Randdorn (ideale Bedornung). Weiteres siehe bei *D. capicola*. Rand der Epipleuren fein bedörnelt. Mittelschenkel fein bedörnelt (50 ×), die anderen Schenkel nicht nennenswert skulptiert. Mittelschienen schwach gebogen, einfach. Länge 5.5 mm., Breite $2\frac{1}{3}$ mm.

MATERIAL

Holotypus, siehe oben.

1. Paratypoid. Durban, Natal (C. N. Barker), *capicola*, Uhmann det.
2. Paratypoid. Durban, Natal (Barker), *Hispa capicola* Pér.
3. Paratypoid. Durban, Natal (Barker 1898), *capicola*, Andreae det.

4., 5. Paratypoid. Douglas, Cape Province, *Dactylispa ?capicola* Pér.

In coll. Uhmann:

6. Paratypoid. Malvern, Natal (Barker), *Dactylispa ?capicola* Pér.

Einschaltung der *D. subcapicola* n. sp. in meinen „Schlüssel der *Dactylispa*-Arten Afrikas . . .“ (1955, p. 160):

8 (11) Seitenranddornen kurz.

9 (10) Deckendornen schlank, so lang oder länger als die sehr kurzen des Seitenrandes. Halsschild nicht breiter als lang.

9a (9b) Oberseite deutlich aufstehend behaart. Bewehrung kurz. Flächen des Halsschildes vorn ziemlich breit ausgeschnitten, dort mit schmaler, vertiefter Mittelfläche (Abb. 1: Legende). Decken mit vielen Zusatzdörnchen. In allen Dingen zierlich.—typ!—4·5 mm. Natal, Sambesia, Zululand (neu) . . . *gracilis* Péringuey

9b (9a) Oberseite auf den Decken kaum sichtbar behaart. Bewehrung kräftiger. Flächen des Halsschildes vorn schmäler ausgeschnitten, ohne schmale, vertiefte Mittelfläche (Abb. 1). Die scharfe Mittelfurche bis über den Ausschnitt verlängert. Decken mit weniger Zusatzdörnchen. In allen Dingen kräftig. Der *D. bodongi* ähnlich.—typ!—6 mm. Cape Town . . . . *capicola* Péringuey

11 (8) Seitenranddornen länger.

12 (13) 3. Fühlerglied kurz, nur wenig länger als die Nachbarglieder. Seitenranddornen etwa halb so lang wie eine Decke breit (in der Quermitte). Seitenbewehrung halb so lang wie der Halsschild breit. Seitenflächen gross, breit, vorn ausgeschnitten, mit durchlaufender Mittelfurche wie bei *capicola*. Decken deutlich aufstehend behaart, mit vielen Zusatzdörnchen.—5.5 mm. Durban, Natal; Douglas, Cape Province . . . *subcapicola* n. sp.

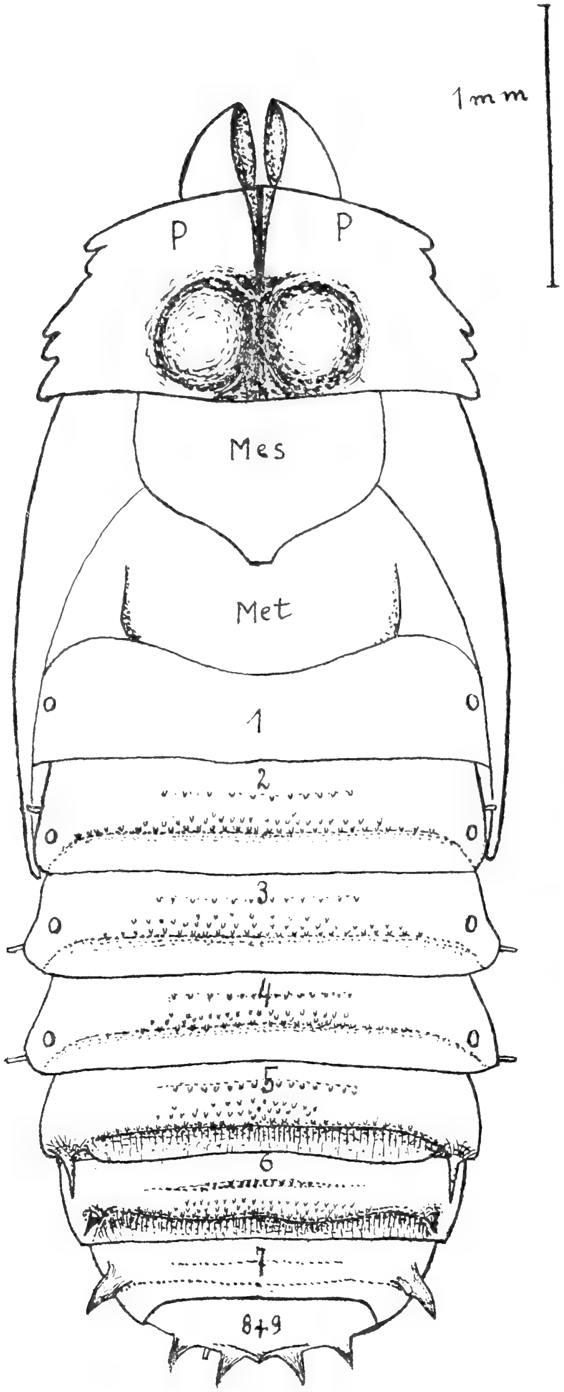

Abb. 2

Oberseite der Puppenhaut von *Dactylispa callosa* Uhm.

Halsschild. Die 5 Erweiterungen des Halsschildes sind hier nach oben gebogen. Er ist in der Vorderhälfte in der Mitte aufgerissen.

P = Prothorax; Mes = Mesothorax; Met = Metathorax.

Dactylispa callosa Uhm. 1935, 1948

Neanotypus (Puppen-Exuvie). Pearly Beach near Quoin Point, District Bredasdorp, Aug. 1958. Zwischen Grasstengeln. (Abb. 2.)

Puppenhaut dunkelbraun, ob durch äussere Einflüsse? 4·25 mm.

Unterseite. Fühlerscheide schwach segmentiert. Deckenscheide mit angedeuteten Rippen, ohne Zähnchen oder Borsten am Rande. Knie ohne Borsten. Bauch sehr fein schagriniert, scheinbar fein punktiert. An Stelle der Querlinien von Körnchen oder Höckerchen finden sich auf dem 4. bis 7. Sternit (1. bis 3. nicht sichtbar) Querleisten, die wohl aus der Verschmelzung der Basen von Erhabenheiten entstanden sind. Die Leiste des 4. Sternites lässt noch einzelne Höckerchen erkennen, an den anderen Sterniten sind die Höckerchen mehr oder weniger erloschen. Vor dem eigentlichen Hinterrande mit starker, nach hinten steiler Querfalte, auf der beiderseits jeder Querleiste 2 sehr kleine Zähnchen stehen.

Oberseite. Kopf durch das Schlüpfen zerstört. Halsschild quer, beiderseits am Rande mit 5 Zapfen. Der zweite von vorn nur kurz, die anderen fast gleich; der 1. in den Vorder-, der 5. in den Hinterecken. Scheibe durch das Schlüpfen vielleicht verändert: mit stark vertiefter Mittellinie, beiderseits mit einer erhabenen Beule, die durch eine vertiefte Furche rings von der Scheibe abgesetzt ist.

Mesonotum quer, doppelt so breit wie lang, mit S-förmig geschwungenen Seiten und vorgezogener, abgestumpfter Spitze, beiderseits etwas eingedrückt.

Metanotum glatt, beiderseits zu einer schwachen Längsfurche vertieft. Seiten des 1. Tergites einfach, die des 2. bis 4. Tergites etwas lappenartig erweitert und dort mit je einem kurzen, feinen Zylinder. Endborsten sind auch bei 100facher Vergrösserung nicht zu erkennen gewesen. In 1958 (p. 215) sprach ich die Vermutung aus, dass die Anhänge der Segmente 2–5 vielleicht immer in der Dreizahl auftreten würden. Das kann ich an der vorliegenden Puppenhaut wegen der dunklen Färbung und den mir zu Gebote stehenden Mitteln nicht einwandfrei nachweisen. Tergit 5 hat keinen Zylinder beiderseits. Alle vorhandenen Zylinder sind sehr fein und dünn, man kann sie wohl als „hinfällig" bezeichnen. Sonst lässt sich an den Tergiten 2–5 je ein sehr kurzes, feines Börstchen nachweisen, das man wohl als 2. Anhang bezeichnen kann. Der 3. Anhang, wenn vorhanden, müsste ausserordentlich klein sein. Tergit 6 hat einen einfachen Rand, Tergit 7 besitzt am Rande einen grossen, geschwungen-zugespitzten Zahn, der aber anscheinend ein Produkt der Seiten der Scheibe ist. Tergit 8 + 9 trägt 4 gleiche dreieckige Zähne in gleichem Abstande. Auf der linken Seite steht zwischen den Zähnen 1 und 2 ein kurzer Zylinder, der rechts fehlt. Diese 4 Zähne sind etwas nach unten gebogen.

Stigmen auf sehr kurzen Zylindern, die des 5. Tergites zahnartig spitz ausgezogen.

Tergit 2 bis 6 mit zunehmend starker Querfalte (auf 4 und 6 ist der Abfall nach hinten recht steil). Jede biegt sich vor dem Seitenrand rückwärts um.

Auf Tergit 2 bis 4 liegt das Stigma vor der Falte, auf 5 sitzt es auf ihr. Auf 6 befindet sich auf dem rückwärts gerichteten Aste der Falte ein kleines, spitzes Zähnchen auf verdickter Basis. Tergit 7 mit 2 einfachen Querfalten, Tergit 8 + 9 uneben.

Auf Tergit 2 bis 6 liegen die oft beobachteten beiden Querreihen von kleinen Erhabenheiten, aber die Reihen sind nicht so regelmässig und deutlich ausgeprägt und voneinander geschieden. Sie werden gebildet durch sehr viele winzige Erhabenheiten, die ein helles Schüppchen tragen. Auf dem 6. Tergit scheint die dem Hinterrande nächste Reihe aus kleinen, durchsichtigen, stumpfen Zähnchen zu bestehen. Die Hinterreihen sind breit. Tergit 7 ohne die kleinen Rauhigkeiten, dafür sind die Querlinien deutlich.

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SYNONYMY. Arrangement according to Schenk, E. T. & McMaster, J. H.: *Procedure in taxonomy.* 2nd ed. Stanford, Stanford university press, 1948. Bibliographic references modified.

'I. *Synonymy arranged according to chronology of names.*—All published scientific names by which a species has been previously designated (subsequent to 1758) are listed in chronological order, with bibliographical references to all descriptions or descriptive citations following in chronological order after each name. . . .

B. *Form of bibliographic references to synonymic names.*—The first reference following any name in the synonymy should be to the earliest citation of that name. This should be followed by references to all subsequent citations of the same name, arranged in chronological order. . . .'

Bibliographical references modified to consist of author's name, date of citation, pagination and illustrations (plates and figures).

Example:—

Eulalia (*Steggoa*) *capensis* Schmarda

Eulalia capensis Schmarda 1861, p. 86, pl. 29, fig. 231. Willey 1904, p. 259.
Eulalia viridis var. *capensis* McIntosh 1903, p. 34. Day 1953, p. 30.
Eulalia viridis (*non* Muller) Ehlers 1913, p. 455. Day 1934, p. 30.

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PART IX

ON THE DENTITION AND TOOTH REPLACEMENT IN TWO BAURIAMORPH REPTILES

By

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[CONTINUED ON INSIDE BACK COVER

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[Accepted August, 1961]

(With 3 plates and 10 figures in the text)

Contents

Introduction

The bauriamorphs are an advanced group of mammal-like reptiles which have independently developed many mammalian features otherwise found only in the cynodonts and mammals. Broom (1911) suggested that because of their less specialized nature the bauriamorphs are probably more closely allied to the group from which mammals arose than the cynodonts are. He suggested (1932) that the ictidosaurs (including *Diarthrognathus*) probably arose from a small bauriamorph that lived during *Cynognathus* zone times. The structure of the skull of *Diarthrognathus* (Crompton, 1958) confirms this view.

Very little detailed information on the dentition of bauriamorphs is available and the purpose of the present paper is to record information on the dentitions of two, *Ericiolacerta* and *Bauria.*

Recently a detailed study of the dentition of *Diarthrognathus* has been completed by the author; this will be published in the near future. The present study will therefore enable the possible relationships of this advanced mammal-like reptile to be discussed with greater confidence.

Information reported here on *Ericiolacerta parva* is based on the type and only known specimen of this animal and is in addition to that published by Watson (1931) in his excellent description of this animal. As many teeth as possible were exposed and the left mandible was separated from the skull.

The present description of the dentition of *Bauria cynops* is based upon the type skull (S.A.M. 1333) described by Broom (1909). The exposed surface of the skull had been damaged but fortunately little attempt was made to prepare

Ann. S. Afr. Mus. **46**(9), 1962, 231–255, 3 pls., 10 figs.

individual teeth and consequently much useful information could still be obtained. In order that the teeth could be studied in detail the lower jaw was freed from the skull. Unfortunately the matrix does not respond to acetic acid and it was therefore necessary to prepare the teeth mechanically.

Short descriptions of the dentition of *Bauria* have been given by Broom (1909, 1932, 1937), Boonstra (1938) and Brink (1953); these are based upon three skulls and an isolated mandible. Considerable diversity of opinion exists on several important aspects of the dentition. Little detailed information is available on the dentitions of the other bauriamorphs *Bauroides*, *Melinodon*, *Sesamodon* and *Watsoniella*. Seeley (1895) has given a description of the postcanines of *Microgomphodon* and *Microhelodon*. Unfortunately it is difficult to follow, and no illustrations accompany the description.

The importance of *Ericiolacerta* is that it is the earliest theriodont that is known in which the apices of the crowns of marginal teeth occlude and were worn to horizontal or spherical surfaces. In the scaloposaurids and early cynodonts the postcanines are longitudinally ovate and sheared past one another to achieve a scissor-like cutting action. In the *Cynognathus* zone bauriamorphs, the gomphodont cynodonts, and their descendants the tritylodontids, the cheek teeth are transversely widened and occluding crowns met one another. *Ericiolacerta* is therefore an ideal animal to study the shift from a shearing to a crushing or grinding tooth action. A similar shift took place in the early mammals (Patterson, 1956), and an attempt will be made in this paper to compare the jaw action of early mammals with those of some mammal-like reptiles in order to determine whether or not grinding was achieved in the theriodonts with transversely ovate postcanine teeth.

Tooth replacement in the mammal-like reptiles and the origin of the mammalian type of tooth replacement has not received a great deal of attention. Watson (1931) described as unique among mammal-like reptiles the replacement of a maxillary tooth in *Ericiolacerta* vertically from above. He concluded from this study that all the functional teeth belonged to one set and that the replacing tooth observed indicated that tooth change affecting all the teeth was about to set in and that it probably only occurred once. This would mean that in *Ericiolacerta* a mammalian type of replacement had almost been achieved. Boonstra (1938) showed that in both the maxilla and dentary of *Bauria* replacing teeth lay lingual to the functional postcanines, but unfortunately he gave no detailed description. Parrington (1936) showed that in *Dimetrodon*, *Thrinaxodon* and *Tribolodon* replacement was alternate and that it was possible to divide the postcanine teeth into two series that are situated alternately in the jaw. He expressed the view that the number of replacements of each series was reduced in *Thrinaxodon*. He accepted as possible Bolk's theory for the origin of the mammalian type of replacement, viz. that as the teeth crowns became more complex there was no space for teeth of one series to erupt between those of the other and that instead one series replaced the other to form the deciduous and permanent dentitions of mammals.

Romer and Price (1940) confirmed that replacement was alternate in *Dimetrodon*, but that in addition a wave of replacement passed along each alternately numbered series. These waves passed from back to front.

Tooth replacement in gomphodont cynodonts has been described and discussed by Broom (1913), Brink (1955, 1956) and Crompton (1955b, 1958). It is at present also being studied by Mr. S. Fourie. Brink is of the opinion that although forms such as *Diademodon* from the Lower Trias do not have a dental succession identical to that of placental mammals, the incisors and anterior four postcanines were replaced only once, the 12th to 16th teeth never, and the 5th to 11th certainly not more than once. The canine, Brink feels, was probably replaced more than once. This would suggest that gomphodont cynodonts were tending towards a mammalian dental succession. Unfortunately Brink has not described the material upon which these conclusions are based.

Gomphodont cynodonts from the Middle Trias, such as *Scalenodon*, do not confirm this view (Crompton, 1955b, 1958). Here there appears to have been frequent replacement of the incisors and canines, whereas in the postcanine series replacement is limited and is recorded only from the posterior end of the dentition where sectorial teeth were replaced by transversely ovate teeth. With growth, teeth are added to the postcanine row posteriorly, while teeth are lost at the front of the postcanine row. Recent unpublished work on *Diademodon* by Mr. Fourie confirms that postcanine teeth are lost anteriorly and added posteriorly. Similar observations have been made on *Oligokyphus* (Kühne, 1956). The dental succession of gomphodont cynodonts therefore appears to be fundamentally different from that of placental mammals, and the origin of the mammalian pattern must be searched for in other mammal-like reptile groups.

Kermack (1956) has reported on tooth replacement in the Therocephalia and the Gorgonopsia. He claims that alternate replacement (his 'functional distichical replacement') has been lost in the postcanine series in these families. His material was insufficient to enable him to determine the order of replacement except in the case of the canines.

Recently Edmund (1960) has surveyed in great detail tooth replacement in the lower vertebrates. Although mammal-like reptiles are not treated above the pelycosaur level, Edmund's contribution is a most valuable basis for the study of tooth replacement in mammal-like reptiles. In order to explain mammalian tooth replacement, which is so different from the alternating replacement typical of most reptiles, Edmund has suggested that the deciduous and permanent dentitions represent individual *zahnreihen.*

It is hoped that a description given in this paper of the conditions in *Ericiolacerta* and *Bauria* will contribute towards the solution of the problem of the origin of the mammalian dental succession.

I am deeply indebted to Professor D. M. S. Watson for his very kind permission to undertake additional preparation on the type of *Ericiolacerta parva*, and to Dr. K. A. Kermack and Mrs. F. Mussett for their valuable assistance to me during my stay in London. I wish also to record my thanks to Dr. F. R. Parrington for his helpful criticism and encouragement.

DENTITION AND TOOTH REPLACEMENT IN *ERICIOLACERTA*

It is difficult to determine the number of teeth present in the type because the tip of the snout is slightly damaged. Watson (1931) claimed 6 teeth in the premaxilla and 8 in the maxilla and that no canine could be distinguished. Although a total of 14 teeth is probably correct it is difficult to be certain of the exact number in the maxilla and premaxilla.

Cheek teeth in both mandible and maxilla are preserved in various stages of the replacement cycle. These can be conveniently divided into four stages (fig. 1). In stage I a freshly erupted tooth was loosely held in an enlarged alveolus. In a later stage (II) attachment bone (at. bo.) was built up around the neck of the tooth above the longitudinal groove (long. gr.) which extended the length of the tooth row on the lingual side in the maxilla and dentary. Next, replacement teeth developed in pits in the base of the longitudinal groove (stage III), and as the replacing tooth increased in size, it migrated labially and resorbed first the alveolar wall separating it from the alveolus and second the root of the functional tooth (stage IV).

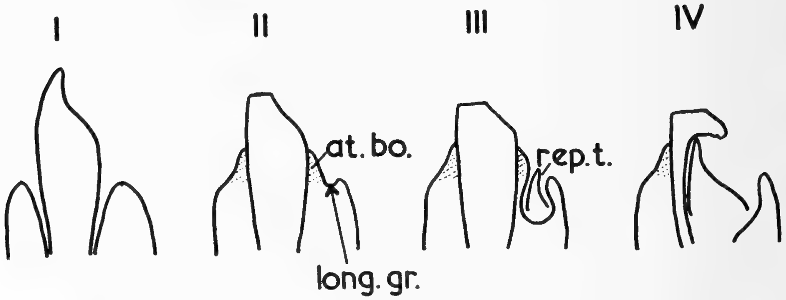

FIG. 1.—*Ericiolacerta parva.* Four stages in the replacement cycle of cheek teeth. (Key to lettering, p. 255.)

For description purposes the teeth are numbered consecutively from the front because no distinct canine is present.

Lower dentition (figs. 2 A, B, 4 C)

The 15th tooth from the front has a well-preserved unworn tricuspid crown. The central cusp is slightly higher than the accessory cusps. The outer surface of the tooth is convex, but due to a slight swelling on the inner surface of the crown a short distance below the apex of the main cusp the upper portion of the inner surface of the upper half of the crown is slightly concave (figs. 2 B, 14). The posterior lower teeth of *Ericiolacerta* behind the 8th all have this characteristic shape. The tooth is firmly held and the longitudinal groove does not extend as far posteriorly as this point. The 14th tooth is less firmly held.

The crown is unworn and in contrast to the 15th is terminated by four small cusps. The second cusp from the anterior border is the largest. Their apices do not lie in the same plane but are arranged to form an arc. A wide gap separates the 12th and 14th teeth. The functional tooth appears to have been lost, although this could not be confirmed beyond doubt. A pit in the base of the longitudinal groove containing a replacing tooth (fig. 2 A, rep. t. 13) is present lingual to this gap. It has been interpreted as a replacing tooth for the 13th.

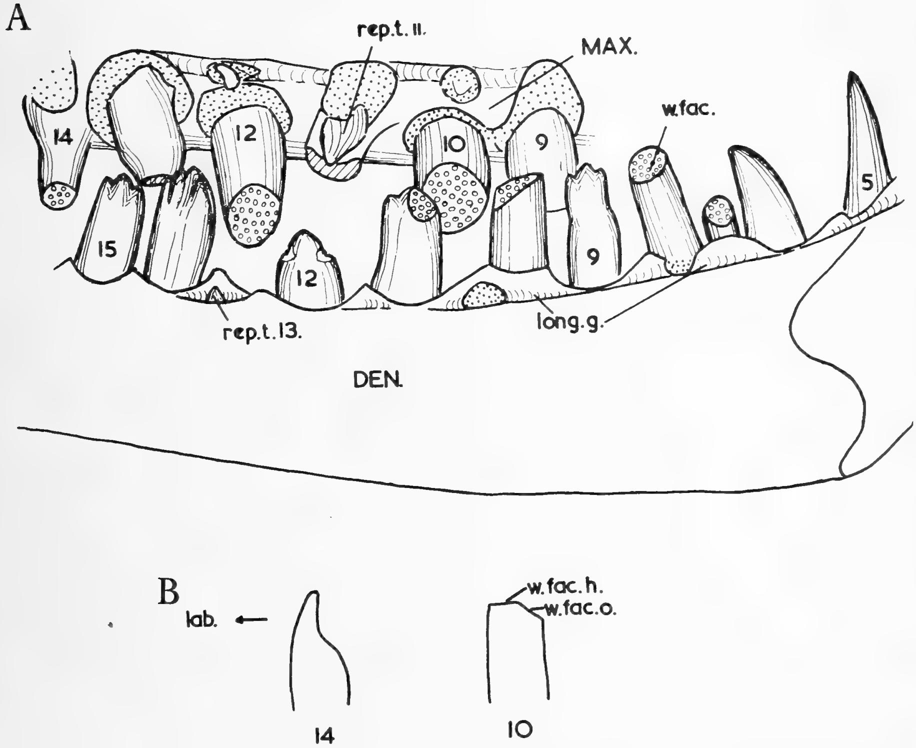

FIG. 2.—*Ericiolacerta parva*. A, medial view of posterior portion of the left upper and lower dentitions, and B, posterior view of 14th and 10th teeth. Both × 10. (Key to lettering, p. 225.)

The 12th tooth is partially erupted (stage I). The accessory cusps have been lost as a result of damage but there is no sign of wear on the remaining central cusp. The 11th is fairly tightly held (stage II) and the longitudinal groove is present lingual to its base. An oblique wear facet sloping inwards and downwards has obliterated all trace of the anterior accessory cusps. The 10th is tightly held and a large pit is present lingual to it in the base of the longitudinal groove (stage III). The matrix was not completely removed from this pit and it presumably contained a replacing tooth in life. The crown is considerably worn and two distinct facets can be identified (fig. 2 B 10): a horizontal facet (w. fac. h.) on the labial side, and an oblique facet (w. fac. o.) on the lingual. The portion of the crown supporting cusps was completely worn away. The 9th tooth is loosely held by its alveolus (stage I). It shows no signs of wear and is terminated by three small cusps. The upper portion of the crown is slightly narrower antero-posteriorly than the lower, and the tooth therefore has a dumb-bell appearance. The 8th tooth is tightly held. A small pit is present in the longitudinal groove lingual to its base (stage III). The crown is worn to two distinct facets, as is the 10th.

It is difficult to interpret the 7th tooth. It is very small; the crown is extensively worn and tightly held by attachment bone. The crown surface is considerably lower than adjacent teeth. No pit is visible at the base of the longitudinal groove. The 7th tooth in the upper jaw is also small and has been considered by Watson (1931) as the first maxillary tooth. No. 6 in the lower jaw is loosely held by its alveolus, indicating that fossilization took place soon after it had erupted (stage I). It is sharply differentiated from the unworn teeth in the posterior portion of the jaw in that the crown is terminated by a single sharp cusp. In view of this it is possible to interpret it as a canine and the 7th as the first postcanine. The crown of the 5th tooth also consists of a single cusp, but it is more tightly held by attachment bone than the 6th. A fairly wide gap separates the 5th and 6th teeth.

The anterior mandibular teeth are only well preserved on the right, where six alveoli, some with and some without teeth, could be counted. The 6th tooth is well worn. The 5th is unworn and, in contrast to conditions on the left, is terminated by 3 cusps as in the left 9th and 15th teeth. The crown of the 4th tooth is extensively worn to two wear facets as in the left 10th. The 3rd alveolus is empty, the 2nd tooth is not well preserved, and the 1st appears to be a replacing tooth.

Upper dentition (Plate XII A; figs. 2 A, 3 A, B, C, 4 A, B)

The teeth of the maxillae are shown in lateral view in Plate XII A, medial view in figs. 2 A and 3 A, and in crown view in fig. 3 B. They vary greatly in size, and as in the lower jaw large spaces separate the individual teeth.

The maxilla medial and posterior to the 14th tooth is damaged, but it appears that this tooth was tightly held and that a large pit (fig. 3 B p.) was present lingual to it (stage III). A single flat wear-facet dipping slightly upwards in a lingual direction is present. The 13th is preserved as it was after it erupted and is loosely held in a large alveolus that extends lingually to the longitudinal groove (stage I). The apex of the crown has unfortunately been damaged and lost, but no signs of wear could be detected on the remaining portion. The crown of the 12th tooth is well worn to a single facet (fig. 3 C 12). The tip of the crown of a replacing tooth is present in a pit lingual to its base (stage III). The 11th tooth and its replacing tooth have been described by Watson (1931). This is the only position where stage IV of the replacement cycle is preserved, viz. in which a replacement tooth is preserved shortly before it was to have erupted. The lingual portion of root of the functional tooth (rem. f. 11) has been resorbed and the crown lost. The crown of the replacing tooth (rep. t. 11) fits closely against the remnant of the root of the functional tooth. The pit containing the replacing tooth is extremely large and confluent with the alveolus. The crown of the replacing tooth is terminated by a single cusp. The tooth as seen in posterior view is illustrated in figure 3 C, 11. A small replacing tooth (rep. t. 10) is present medial to the 10th tooth (stage III). The crown

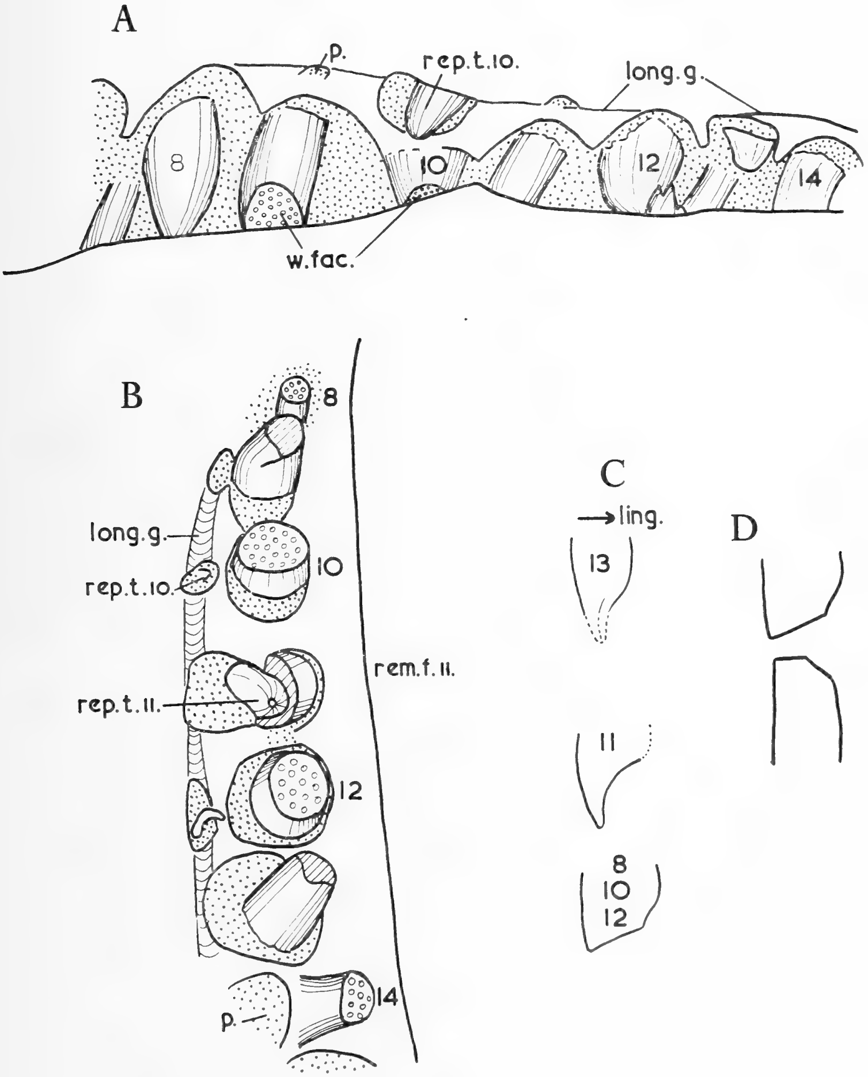

FIG. 3.—*Ericiolacerta parva.* A, medial view of upper right dentition; B, crown view of upper left dentition; C, posterior view of 13th, 11th and 8th, 10th, 12th teeth and D, occlusion of upper and lower teeth. All × 10. (Key to lettering, p. 255.)

is extensively worn to a nearly horizontal wear-facet (fig. 3 C 10). The 9th tooth is preserved as it was shortly after it erupted. The apex of the crown has been damaged but no signs of wear could be detected on the remaining portion. The 8th tooth is much smaller than the 9th, is tightly held and extensively worn, but the matrix medial to it and the three anterior teeth could not be removed without difficulty to determine details of replacement. The 7th tooth (Watson's first maxillary tooth) is smaller than the 8th and has a slightly worn crown. It is separated by a large gap from the 8th. It could not be ascertained whether a tooth has been lost from this gap. No. 6 is sharply pointed and shows no signs of wear whereas the apex of No. 5 is worn to a horizontal facet (Plate XII). No. 6 could possibly be interpreted as a small canine, and this would confirm the findings in the lower jaws.

The crowns of the teeth in the right maxilla (fig. 3 A) could only be seen in lingual view because the right cheek is covered by an articulated hand. Nos. 14, 12 and 8 are preserved as they were shortly after they erupted and no signs of wear could be detected in these teeth (stage I). The 9th and 11th teeth have small pits for replacing teeth at their bases, and the crown of the 9th is worn to an oblique wear-facet. The 13th is preserved with the crown of a well-developed replacing tooth situated in a pit medial to it (stage III). The 10th is very tightly held by attachment bone and has a well-worn crown. The replacement tooth lingual to it is the largest in the right maxilla and at death was presumably about to erupt.

Tooth replacement and tooth wear in ERICIOLACERTA

The teeth are preserved in different stages of replacement, and it is clear that the functional teeth do not belong to one series all of which were about to be replaced by a second set, as suggested by Watson (1931). It is also clear from the above description that replacing teeth developed initially in shallow pits at the base of the longitudinal groove, i.e. lingual to the functional teeth. The longitudinal groove probably supported the dental lamina. As the tooth germs increased in size, a pit developed at the base of the groove to support them. As the tooth enlarged it migrated labially, absorbing first the lingual alveolar wall and later the root of the functional tooth. Only in its final stages was replacement vertically from above or below in the upper and lower jaw respectively.

It remains now to determine the order of replacement. In fig. 4 the various stages of replacement in the left and right maxillae and the left mandible are shown diagrammatically. In the maxilla the order of replacement was clearly alternate. In the left maxilla the odd-numbered teeth, 9 and 13, have unworn crowns and are preserved as they were shortly after they erupted. Replacement of the 11th lagged slightly behind the other odd-numbered teeth, but its replacement tooth is large and in life would have been the next tooth to erupt. On the other hand the even-numbered teeth 14, 12, 10 and 8 all have worn crowns, are firmly held by their alveoli, and have small pits for replacing teeth lingual to them. In the right maxilla the even-numbered series consisting of the 8th, 12th and 14th teeth are preserved recently after they erupted. Eruption of the 10th replacement tooth would have lagged slightly behind these teeth as in the case of the 11th in the left maxilla. It therefore appears that on the left the odd teeth were erupting whereas on the right the even teeth were erupting. This may indicate that the teeth have been incorrectly numbered, but not necessarily because a similar phenomenon was encountered by the author in early cynodonts. A small difference in the degree of development of the replacing teeth is also preserved in the odd-numbered series. The replacing tooth for the 13th is larger than those for the 9th and 11th.

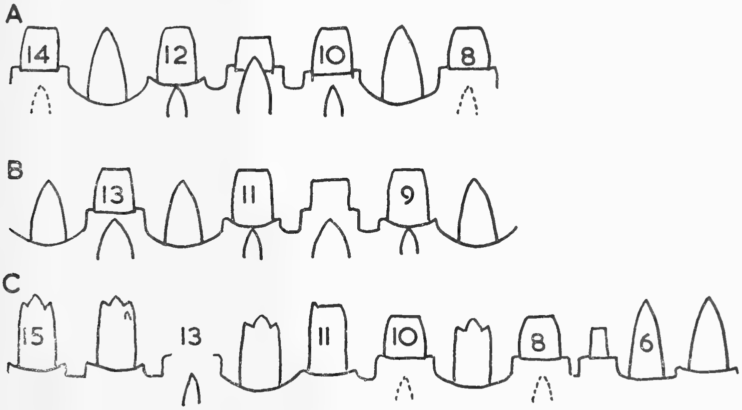

FIG. 4.—*Ericiolacerta parva*. Diagrammatic representation of the order of replacement of the posterior teeth. A, left maxilla; B, right maxilla and C, left dentary.

Except for these minor differences it appears that alternate teeth developed and erupted simultaneously. Similar results were obtained in *Thrinaxodon* (Parrington, 1936). This is in contrast to early *Cistecephalus* zone cynodonts (Crompton, unpublished MS.) and other early therapsids (Romer and Price, 1940), where a wave of replacement passes from back to front along each alternately numbered series.

It is difficult to interpret the order of replacement in the mandible. Replacement does not appear to be of the regular alternate type observed in the maxilla. Over certain short distances there is evidence of alternate replacement, e.g. 10 and 8, while over others there is not. Unfortunately, the right lower dentition could not be studied.

Wear of the teeth

The wear surfaces indicate that the upper and lower teeth must have occluded crown to crown, and opposing upper and lower teeth did not shear past one another. Teeth preserved recently after they erupted show no signs of wear whereas teeth about to be replaced appear to have lost approximately half of their crowns as a result of wear.

It is difficult to interpret the wear-facets of occluding teeth. Upper teeth have a single flat wear-facet sloping upwards and inwards, whereas lower teeth have two distinct facets, a labial horizontal facet and a flat inner facet sloping inwards and downwards. Sharp angles are formed where the facets meet the edges of the crowns and one another (fig. 3 D). It is difficult to determine the jaw actions causing these wear-facets. It is unlikely that a single dorso-ventral movement of the lower jaw would account for their shape. It is also unlikely that the abrasive action of food particles would produce such constant and sharply defined wear-facets. It is possible, therefore, that in *Ericiolacerta* more complex jaw movements were possible.

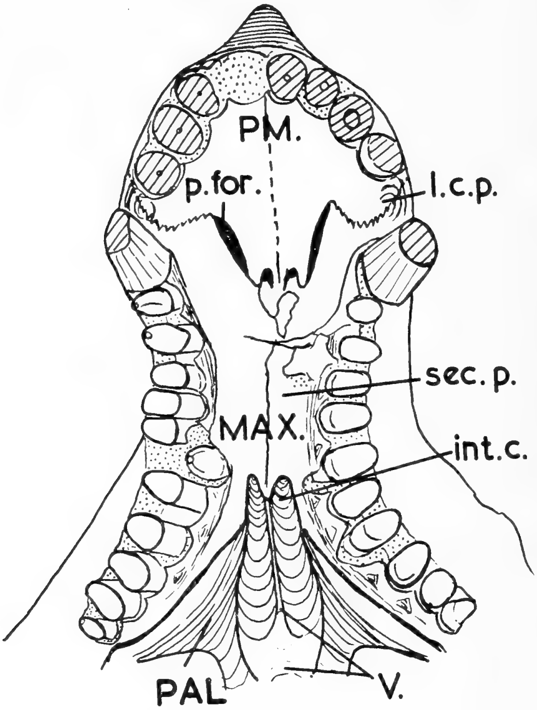

FIG. 5.—*Bauria cynops*. Ventral view of palate × 1½.
(Key to lettering, p. 255.)

Watson (1931) has described upper cheek teeth as '. . . transversely widened, the high original cusp passing on its lingual side into a ridge which separates two concave areas into which grind the posterior and anterior cusps of the two lower molars between which it fits'. The present study does not confirm this arrangement. The wear patterns clearly show that the labial cusps of the uppers did not occlude outside the opposing lowers. On the contrary, the apices of the crowns when present must have met one another. The teeth are not transversely expanded to the extent suggested by Watson, and at their bases the crowns are circular in cross-section.

The Dentition of *Bauria cynops*

The palate (Plate XIII A and fig. 5) has been well described by Boonstra (1938) and Broom (1937). The secondary palate (sec. p.) is formed only by the premaxillae and maxillae. It is narrowest across the posterior border which lies adjacent to the 5th postcanines. Anteriorly to the posterior border of the secondary palate the maxillae curve sharply upwards to their contact with the premaxillae (P.M.). The premaxillae have a broad tongue-shaped process which extends backwards in the mid-line to meet the maxillae. Two ovoid foramina (p. for.) are present between the lateral edges of this structure and the maxillae. These foramina were not reported by Boonstra or Broom. From the anterior edge of these foramina an interdigitated suture between the premaxillae and maxillae passes outwards through the diastema between the last incisor and the canine. No evidence for Broom's view that part of the vomer is visible between the premaxillae and maxillae could be found.

Upper dentition (Plates XII B, XIII, and figs, 5, 6, 8)

There are 4 incisors, 1 canine and 10 postcanines in the upper jaw. This is in agreement with the findings of Broom (1909), Boonstra (1938) and Brink and Kitching (1953). The roof of the diastema between the incisors and canines has the form of a shallow pit and receives the lower canine. A thin strip of the maxilla forms a labial border to this pit and therefore the tip of the lower canine was not visible when the jaws were closed. The crowns of all the incisors and both canines were damaged, but the postcanines are fairly well preserved, except for damage to their outer surfaces. Because of this damage it was essential to prepare both left and right dentitions. The postcanines of each side are arranged to form a curve. In the region of the 5th postcanines the opposing curves are closest to one another, and anterior and posterior to this point they diverge away from each other (fig. 5). Figures of the length of the postcanine series are of little value unless it is clearly stated how the measurements were taken. Measured along the lingual surface of the upper postcanine series they measure 4·1 cm.

In crown view (fig. 6) the postcanines are oval with the lingual side of the crown considerably wider than the labial. Brink and Kitching (1953) claimed that in the third specimen of *Bauria* the crowns of adjacent teeth expand so that they come into contact with one another, but that their necks are separated from one another. It is clear in the type, however, that the majority of the postcanines were separated by narrow gaps with an average width of 0·6 mm., although in some cases teeth have been slightly displaced with the result that consecutive crowns touch one another.

The form of the crowns of the teeth is of great interest because of the marked changes they undergo as a result of wear. These changes are essential for the interpretation of jaw action and tooth replacement, and will therefore be described in detail. Interpretation of the wear pattern is complicated by

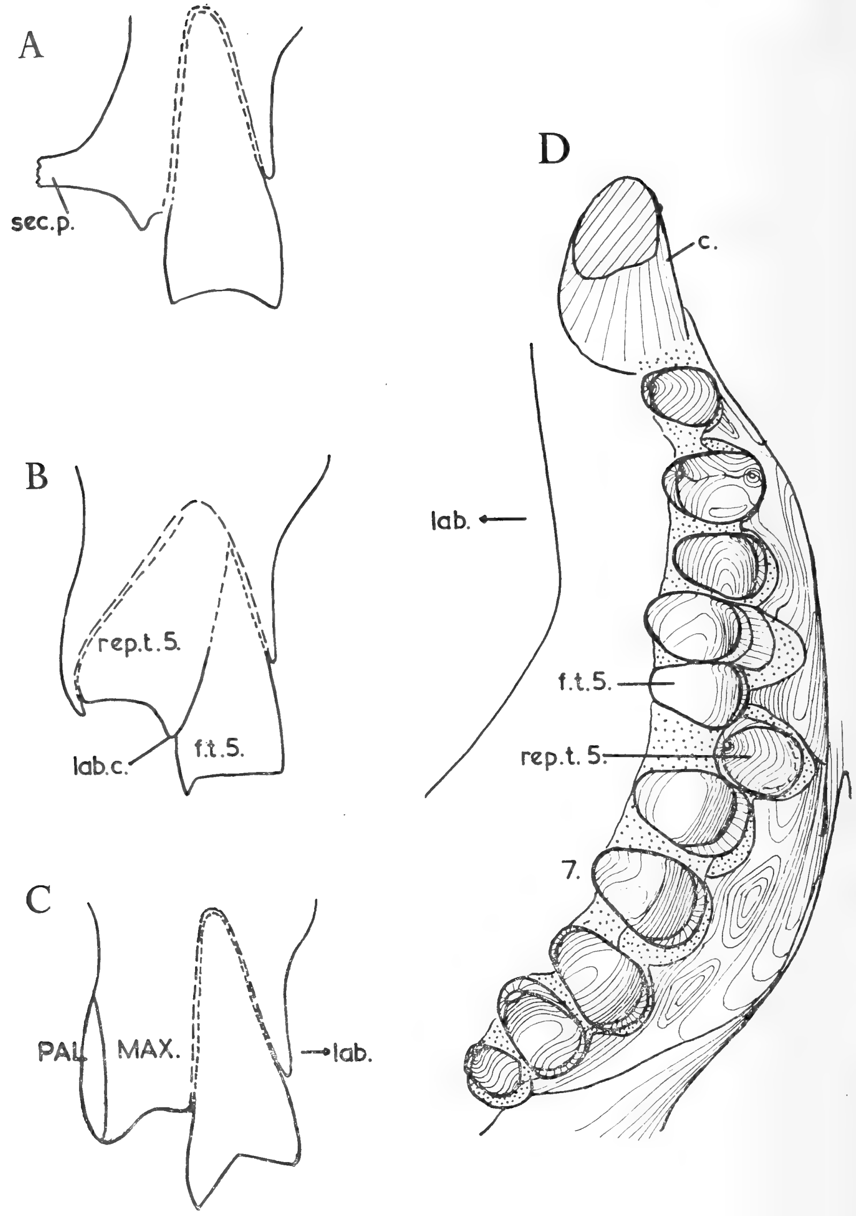

Fig. 6.—*Bauria cynops.* A, B and C, reconstructed sections through the 4th, 5th and 7th right upper postcanines and D, crown view of the upper postcanine dentition. All × 3. (Key to lettering, p. 255.)

the fact that the occluding tooth rows do not lie parallel to one another, but at a small angle to one another. The majority of the upper postcanines lie slightly further lingually to the lowers, but the anterior upper postcanines and canines lie slightly labially of the corresponding lower teeth.

In order to understand the shape of the crowns, outline drawings of the posterior view have been given in addition to the crown views (fig. 8). The 5th postcanine (fig. 6 B, rep. t. 5) on the right side was preserved shortly before it was due to be replaced, and both the replacing and functional teeth are in good condition (Plate XII B). Contrary to all previously published reports, the crown of an unworn upper tooth is not flat. On the contrary, it supports a prominent cusp (lab. c.) on the narrow labial edge of the crown while the wide lingual edge of the crown supports a crenulate ridge. In posterior view the crown has a concave centre, the centre point of the concavity lying towards the labial side of the crown. A broad, ill-defined transverse ridge extends a short distance across the crown from the apex of the main cusp. On either side the crown falls slightly away. On the left side the replacing tooth of the 5th postcanine was preserved shortly after it had fully erupted and become the functional tooth; it has the same crown structure as the incompletely erupted counterpart on the right.

The 9th, 7th and 4th are little worn, and a labial cusp and prominent lingual edge can still be recognized. The 2nd upper postcanine is also little worn and consists of a high labial cusp and small, ill-defined lingual ridge at a much higher level than the labial cusp. Wear is greater on the lingual side in this tooth, whereas in the posterior teeth wear is greatest on the labial side. This is due to the crossing of upper and lower postcanine rows. In the 8th and 6th the crowns show advanced stages of wear. Two prominent wear-facets are visible. The labial cusp has been worn away completely to a flat wear-facet extending lingually and slightly upwards to the centre of the crown where it meets a flat oblique wear-facet extending upwards and inwards from the lingual edge of the crown. The orientation of these wear-facets is best seen in the posterior profiles and stereo-photographs.

In the functional 5th postcanine on the right, wear had proceeded further. The labial wear-facet extends further across the crown. The prominent lingual edge and oblique lingual wear-facet have been considerably reduced in size. In the 3rd tooth the crown is worn to a practically horizontal plane. The 1st and 10th postcanines are considerably smaller than the other postcanines and consist of a high labial cusp lingually of which the crown falls away rapidly. The measurements of the individual postcanines in mm. are as follows:

	1	2	3	4	5	6	7	8	9	10
Max. ant.-post.	2·2	2·4	2·5	2·8	3·0	2·9	3·1	2·7	2·7	2
Max. ling.-lab.	3·8	3·9	4·1	4·7	5·3	4·7	5·1	4·3	2·9	2

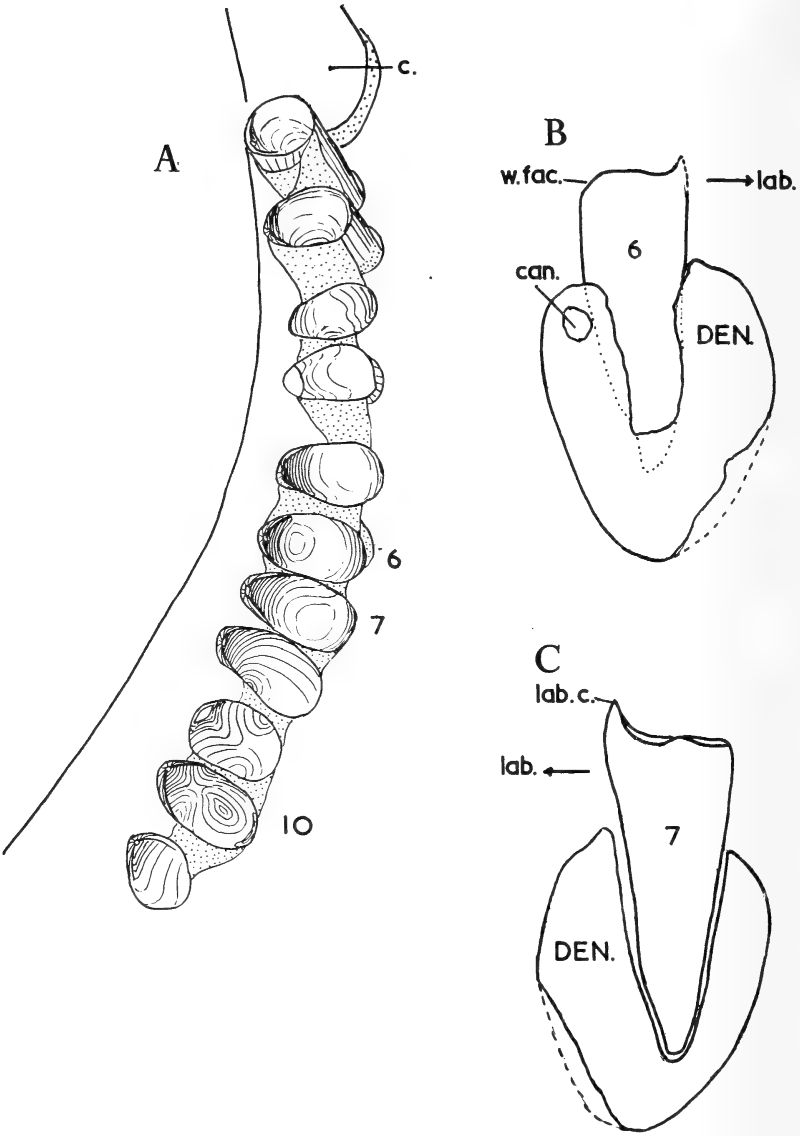

Fig. 7.—*Bauria cynops*. A, crown view of lower postcanines and B and C, sections through mandible to show the roots of the 6th and 7th postcanines. All × 3. (Key to lettering, p. 255.)

Lower dentition (Plate XIV; figs. 7, 8, 9)

There are three lower incisors. This confirms the findings of Brink and Kitching (1953). It is easy to understand why Broom (1909) considered that the type had four. A narrow diastema separates the 3rd lower incisor from the canine. The crown of the 4th upper canine fits into this diastema. The anterior region of the snout is damaged in the type in such a way that the crown of the upper 4th incisor is preserved fitting into this diastema, and is broken off at the same level as the remaining lower incisors so that it can easily be mistaken for a lower incisor.

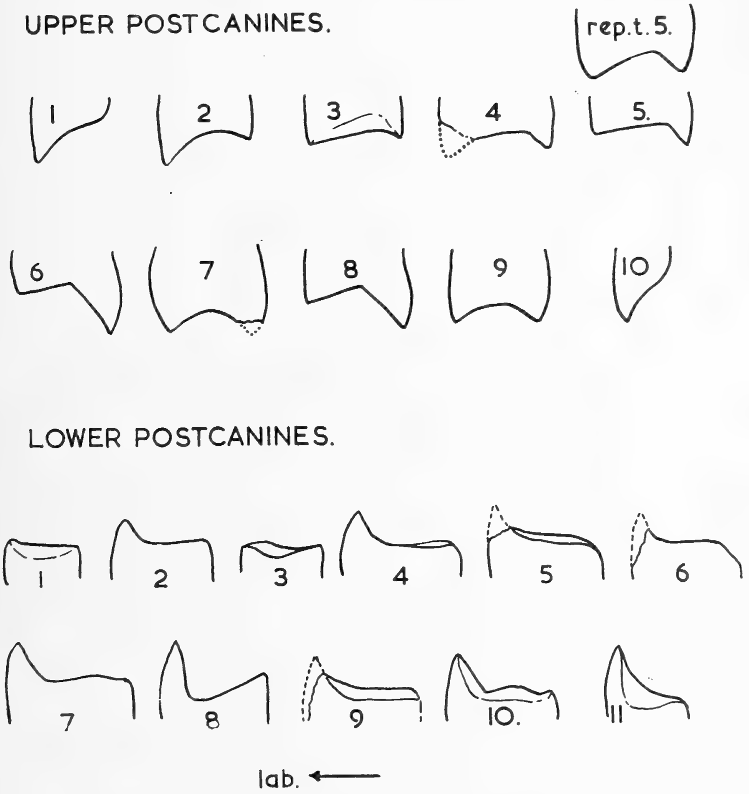

FIG. 8.—*Bauria cynops*. Posterior views of upper and lower postcanines. All × 3.

The postcanine series follow immediately after the canine without an intervening diastema. As in the case of the upper jaw the postcanines of both sides are arranged to form an arc, and the two arcs diverge away from one another in front and behind the 5th postcanine. Eleven postcanines are present on both sides. In crown view the postcanines are transversely ovate but have a greater eccentricity than the corresponding uppers.

The 10th left postcanine shows the least signs of wear (Plate XIV B; fig. 8). It consists of a prominent labial cusp. The remainder of the crown is flat except for a faint ridge along the lingual edge and a prominent medium transverse ridge. This ridge is drawn upwards to form an ill-defined cusp in the centre of the crown. Faint ridges extend from the apex of the main cusp along the anterior and posterior borders of the crown. On the right side the 10th postcanine is an old tooth which had not been replaced before death, and is greatly worn.

In the 9th left postcanine the main cusp has been lost, but the medium transverse ridge, although slightly worn, can still be recognized.

In the 4th, 5th and 7th postcanines initial wear stages are present. The central ridge has been worn away and a basin is present in the centre of the crown lingually to the main cusp. This basin is flanked in front and behind by the two ridges extending inwards from the apex of the main cusp. In the 8th tooth wear is further advanced and this basin has deepened considerably. Consequently the main cusp is more prominent in this tooth than in unworn teeth. In the 6th postcanine wear has advanced further. The main cusp is low and an oblique wear-facet is present on the lingual surface of the crown. The crowns of the 1st and 3rd teeth are smaller than adjacent teeth and are worn to a flat horizontal surface. The 11th postcanine is much smaller than the remaining postcanines; it consists of a prominent labial cusp lingually of which the crown falls rapidly away.

As in the upper postcanines, a small gap separates consecutive crowns. The gaps are larger anteriorly than posteriorly. The measurements of the individual postcanines, given in mm., are as follows:

	1	2	3	4	5	6	7	8	9	10	11
Max. ant.-post.	2·2	2·5	2·2	3·0	3·0	3·2	3·4	3·0	3·3	?	2·8
Max. ling.-lab.	3·2	4·2	3·4	4·8	4·8	4·8	5·4	4·8	5·1	4·2	3·5

Relationship between the wear pattern of upper and lower postcanines

An outstanding characteristic of the dentition is that in the initial wear stages the upper teeth are subject to wear mostly on their labial edge and centre of the crown, whereas in the lower postcanines wear is greater in the centre of the crown and on the lingual edge. It is only in very advanced wear stages that postcanines tend to acquire nearly flat occluding surfaces.

Although an attempt has been made to illustrate (fig. 10) the three progressive stages of wear of *Bauria* postcanines, it is naturally difficult to determine from one specimen the exact changes the postcanine teeth underwent as a result of wear. Careful investigation of other bauriamorph specimens will be necessary to confirm these findings. The initial wear (fig. 10 A, I) in the centre of the lower postcanines, and wearing away of the upper labial cusps, is apparently due to the upper labial cusp meeting the lower postcanine lingually of the lower labial cusp. The lingual edge of the upper tooth occludes lingually of the lingual edge of the lower teeth and this results in the formation of the oblique wear-facet extending upwards and inwards from the lingual edge of the upper postcanines. In a more advanced stage (II) an oblique wear-facet is developed on the lingual edge of the lower teeth where the oblique wear-facet of the uppers meets the lowers. Consequently both upper and lower are worn away on their lingual sides during this phase. In an advanced wear stage (III) all the prominent features of the crown tend to be worn away so that only flat occluding surfaces remain.

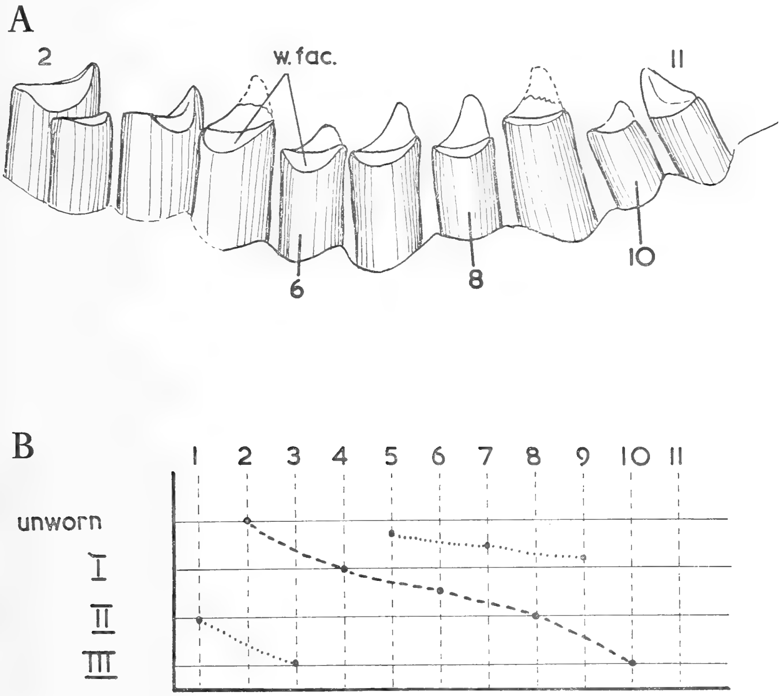

FIG. 9.—*Bauria cynops*. A, medial view of the right lower postcanine series and B, graph to illustrate decrease in extent of wear of odd and even-numbered postcanines. Wear stages I, II, and III correspond to those shown in Fig. 10. A × 3. (Key to lettering, p. 255.)

The height of the crown above the alveoli borders varies greatly in consecutive postcanines. As a general rule the height is greater in unworn teeth than in worn teeth. The result is that wear-facets of consecutive teeth are seldom on the same horizontal plane (fig. 9 A).

The correct interpretation of the degree of wear is of importance in determining the order of tooth replacement in the postcanine series.

Roots of postcanines and alveoli

Several teeth are loosely held in enlarged alveoli whereas others are tightly held by their alveoli. In the latter the alveoli are built up on the lingual side of the tooth in such a way that a horizontal shelf is formed at the base of the lingual side of the postcanines. This is more marked in the upper jaw than in the lower. As a general rule worn teeth are tightly held and unworn teeth loosely.

A fracture through the right ramus of the lower jaw has exposed the roots of the 6th and 7th postcanines (fig. 7 B, C). The single root of the 7th is substantial and tapers gradually to a point. There is no indication of any division of the root. The alveolar bone is closely apposed to the root. A narrow bony transverse septum separates successive teeth. The remnants of the septum between the 6th and 7th obscure part of the root of the 6th postcanine. Preservation of the dentary surrounding the root is not exceptional, but it is possible to recognize large cavities and canals lingually to the apex of the root. In addition the root is slightly resorbed on its lingual side.

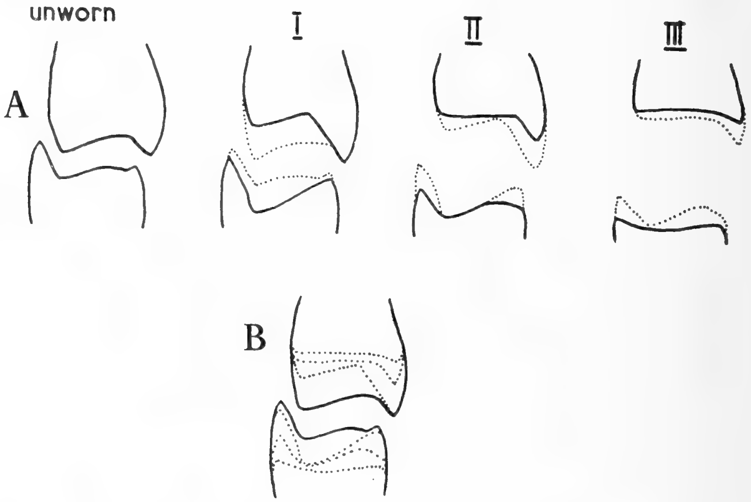

Fig. 10.—*Bauria cynops*. A, occlusal relations of unworn and three wear stages typical postcanine teeth and B, three wear stages compared with unworn upper and lower postcanines. All × 3.

Unfortunately no sections through the root of an upper postcanine exist. Reconstructed sections based on external features only are given in fig. 6 A, B, C. Features that could not be observed are shown in dotted lines. Posterior to the secondary palate a thick mass of bony tissue constituted by the maxilla and a thin plate of the palatine (PAL) lies lingually to the last six teeth (fig. 6 C). The medio-ventral edge of this bony mass is drawn downwards to form a prominent ridge so that a narrow groove separates the outer surface of this ridge from the teeth. A longitudinal section was cut through the bony mass. Numerous cavities and canals are present in it, but their shape and course could only be accurately determined if serial sections were made. Anteriorly this lingual mass of bone is obscured by the presence of secondary palate, but the ridge on the lingual edge of the lingual mass continues forward close to the lingual surface of the teeth.

Tooth replacement

Only in one case are a functional tooth and its successor preserved and visible in a single alveolus. This supplies important information on how tooth replacement actually takes place, and details on the structure of an unworn crown.

The tooth preserved in the act of replacing is the 5th right upper (fig. 6 B). Its alveolus is greatly enlarged. The functional tooth lies hard against its labial edge. The crown of a replacing tooth is situated lingually and slightly behind the functional tooth. The lingual edge of the replacing tooth is preserved at the same level as the edge of the alveolus. The replacement tooth is obliquely orientated and does not, as would be expected, erupt vertically downwards, but rather downwards and inwards. The lingual edge of the root of the functional tooth has been resorbed and the labial edge of the replacing tooth is closely apposed to it. After the functional tooth was lost, the crown of the replacing tooth would presumably have moved in a labial direction to the vertical position. On the left side replacement was in advance of that on the right because the old functional tooth has been shed and an unworn replacement tooth is present. Although the alveolus is still greatly enlarged the new tooth is vertically orientated. Alveoli size is therefore important in determining the order of tooth replacement. Although horizontal sections through the bony mass lingual to the last 7 upper postcanines revealed no additional replacing teeth, the wear patterns of adjacent teeth appear to indicate that active replacement of the postcanines was probably still taking place in both upper and lower jaws although in no case in the lower jaw are both the replacing and old functional teeth preserved in a single alveolus. A probable explanation for this is that the replacing teeth developed initially deep in the maxilla or dentary lingually to the apex of the roots of the functional teeth. An empty cavity in this position alongside the root of the greatly worn 6th lower postcanine appears to confirm this view. Replacing teeth would therefore only become visible lingually to the functional teeth shortly before eruption. It was considered inadvisable to section the type to confirm this view. Boonstra (1938) mentioned a series of replacing teeth lingual to the functional postcanines exposed by grinding in the American Museum specimen, but did not give a detailed description.

In *Ericiolacerta* the replacing teeth are visible throughout their development, and the order of replacement is easily determined. In the present specimen of *Bauria* the order of replacement has to be determined by other criteria such as the degree of wear of the postcanines, size of alveoli, and size of individual teeth. These alone are insufficient because, for example, if replacement in both jaws is not accurately synchronized, occluding teeth of different ages may well produce different wear patterns in teeth of similar age.

It seems clear from the presence of unworn teeth in the postcanine series and the actual replacement observed, that tooth replacement is still taking place throughout the postcanine series. The available evidence suggests that teeth replace alternately in *Bauria* as in *Ericiolacerta*. For example, in *Bauria*, in the right mandible (fig. 9 A), the 6th, 8th and 10th postcanines are slightly smaller, are more tightly held by their alveoli, and are lower in height above the alveolar border than the 5th, 7th or 9th. Wear is certainly further advanced in the former group. Similar conditions can be observed in the left mandible. The 9th, 7th and 5th postcanines are larger, more loosely held in their alveoli, and higher than the 6th and 8th. In the left mandible, replacement is in advance of that of the right.

In the left maxilla the 5th and 7th are large, unworn, loosely held in their alveoli, and high-crowned in contrast to the 6th and 8th.

Replacement in the right maxilla also lagged slightly behind that in the left, and the replacing tooth for the 5th had not yet erupted before death. Alternate teeth throughout the series did not erupt simultaneously. For example, the right 7th upper postcanine already showed signs of wear although the 5th had not yet erupted. On the left the 5th alveolus is larger than the 7th. The 10th postcanine in the left mandible had been replaced only shortly before death, yet the 8th is well worn and in life would presumably have been the next to be replaced. This evidence suggests that a wave of replacement moved forwards along the odd- and even-numbered postcanines. In the case of the maxilla, the wave that affected the odd-numbered postcanines was in advance of that which affected the even-numbered, but the waves are spaced so that alternate replacement is present over short distances.

An expected result of replacement waves moving in an anterior direction would be that the wear of alternate teeth would diminish in an anterior direction. There is some evidence of this (fig. 9 B). In the right mandible the 10th postcanine is greatly worn and was about to be replaced. The 8th and 6th teeth are well worn but the 4th is less worn. The 2nd tooth appears to have erupted shortly before death and shows few signs of wear. The 9th, 7th and 5th, on the other hand, appear also to have erupted shortly before death and are not much worn, whereas the 3rd is small, greatly worn and loosely held in its alveolus, and presumably would have been the next to be replaced. The three wear stages upon which fig. 9 B is based correspond to those shown in fig. 10. Similar facts were observed in the maxilla.

Tooth replacement in occluding upper and lower jaws appears to have been fairly closely correlated, with the result that a recently erupted and unworn tooth of the upper jaw would have met a recently erupted and unworn tooth of the lower jaw. For example, in both upper and lower jaws on the right side the 9th, 7th and 5th postcanines appear to have been replaced shortly before death.

Discussion

In both *Ericiolacerta* and *Scaloposaurus* there was a marked reduction in the size of the canines. The postcanine teeth of both genera are similar. Both are circular in cross-section at the alveolar border and in both there is a tendency to develop small cusps although these are limited to the lower jaw in *Ericiolacerta*. In *Scaloposaurus* the shearing action of the postcanine teeth has been retained, but in *Ericiolacerta* the reduction of the canines has apparently made it possible for the apices of the upper and lower postcanines to meet despite the limited area of contact, and the apices of the crowns are completely worn away in old teeth.

It is not possible to determine whether the shearing action was retained in *Ericiolacerta* or whether a limited amount of lateral and propalinal jaw movement was possible. One of these three movements may account for the wear-facets on the postcanines of *Ericiolacerta* which could not be accounted for only by a simple dorso-ventral movement of the lower jaws relative to the uppers.

In *Bauria* and all bauriamorphs from the *Cynognathus* zone the teeth have expanded transversely to increase the occlusal areas. The crushing action of *Bauria* is therefore much more efficient than that of *Ericiolacerta*, and the latter appears to be very close to ancestral forms which deviated away from a simple sectorial action of apposing dentitions.

A similar shift from a sectorial dentition to a crushing dentition took place in some early mammals (Patterson, 1956), e.g. the dryolestids. Here, too, there has been a reduction in the size of the canines. The development in the bauriamorphs paralleled that of some of the later mammals and consequently there is no question of the known bauriamorphs being ancestral to any known Jurassic or Rhaetic mammal. A possible exception is *Diarthrognathus*. This form may have developed from early bauriamorphs, and because it possesses a squamoso-dentary articulation may therefore be classified as a mammal.

The late cynodonts also developed a crushing dentition, but a reduction of the size of the canines does not appear to have triggered off this development. In cynodonts such as *Diademodon* the sectorial action was retained and a crushing part of the tooth added lingually to the original labial shearing cusps, the apices of which never met.

It has been tacitly assumed that the flat crowns of *Bauria* are the result of a grinding action of the jaws. Because of the mode of replacement in *Bauria* the crowns of the postcanine teeth are of varying heights. Consequently, for individual teeth of the upper and lower jaws to have met it is necessary for the teeth to intermesh. This would appear to have ruled out any significant propalinal movement of the mandible. The large upper canine, the pit for the lower canine, the large lingual cusps of the lower postcanines, and the transverse processes of the pterygoid would probably eliminate any significant lateral movement of the mandible. For this reason it is unlikely that true grinding was developed in *Bauria* but that the upper and lower teeth could only crush food as the result of a simple pounding action. Unfortunately details of the nature of the mandibular joint in *Bauria* are not available. Recent work to be published shortly on the jaw action of gomphodont cynodonts has indicated that it is unlikely that any propalinal movement was present in these forms and that the wear pattern of the postcanines which suggest propalinal movement are due to other factors.

In *Ericiolacerta* and *Bauria* it has been shown that the teeth replaced alternately. There is no question, therefore, that a mammalian type of dental succession was present in either of these bauriamorphs. In *Ericiolacerta* it has been shown that the replacing teeth developed initially in distinct pits in the dentigerous bones and lie lingually to the functional dentition. The pits were connected by a shallow longitudinal groove, which presumably housed the dental lamina. As the replacing teeth increased in size their pits enlarged and became confluent with the alveoli of the functional teeth, and the replacing teeth moved labiad. Recent work to be published in the near future has shown that in the *Cistecephalus* zone cynodonts, in *Thrinaxodon* and in *Tribolodon*, the replacement teeth developed in a similar fashion. This type of replacement was not confined to mammal-like reptiles. In his excellent résumé on tooth replacement Edmund (1960) has cited the relevant literature and has pointed out that in *Nothosaurus* and *Pleisiosaurus* replacing teeth developed in an almost identical fashion to that described above. Edmund (1957) has shown that in ornithischian dinosaurs a groove for the dental lamina connected a series of foramina which penetrated the dentigerous bone and opened into the alveoli of the functional teeth. Tooth germs budded off from the dental lamina and passed through these foramina into the base of the alveoli.

In *Bauria* the teeth did not develop in superficial pits, but apparently deep in the dentigerous bones lingually to the base of the roots of the functional teeth. No indication of a groove for the dental lamina or any foramina (gubernacular canals) which connected the developing teeth with the oral epithelium could be observed, but better material is necessary to confirm this point. This may be interpreted to mean that tooth replacement has ceased in the particular specimen of *Bauria* described above, but this is unlikely. To obtain the type of replacement found in *Bauria* and in mammals it was necessary for the dental lamina or remnants of it to lie not superficially but to be buried within the dentigerous bones. A similar development has taken place in the crocodiles (Edmund, 1960), where remnants of the dental lamina remain in each alveolus and retain their capacity to form teeth. The reason for the shift in *Bauria* to a deep site for the development of the replacing teeth was presumably correlated with the transverse widening of the teeth in this form. If the developing teeth were to have developed in superficial pits they would have projected into the oral cavity and either been damaged by or hindered mastication. A similar shift from a superficial to deep-lying position took place in other groups which have transversely widened teeth, e.g. *Diadectes*, Watson (1954). In *Diademodon* replacing teeth also developed deep in the dentigerous bones below the functional teeth, but the groove for the dental lamina remained in the superficial position lingually to the bases of the postcanines. A similar shift from a superficial site for replacing teeth to a site deep in the dentigerous bones probably took place in the ancestors of mammals. In mammals, in contrast to

Bauria and *Diademodon*, developing permanent teeth retain their contact with the oral epithelium through their gubernacular canals.

The origin of the mammalian dental succession from the types of dental succession reported in mammal-like reptiles remains an unsolved problem. *Bauria* shows that alternate replacement was present in advanced mammal-like reptiles and that teeth did replace alternately even though expanded transversely. It is pertinent to mention that alternate replacement was also still present in the advanced mammal-like reptile (or early mammal) *Diarthrognathus* from the late Trias. This does not support the view of Bolk (1922) that as the postcanines became more complex they would no longer erupt alternately but that one of the alternate-numbered series would actually replace the other series, one becoming the deciduous and the other the permanent. The specialized conditions in gomphodont cynodonts do not help to solve the problem of the origin of the mammalian succession. An alternate explanation for the mammalian dental succession has been suggested by Edmund (1960). Edmund has shown that in early tetrapods such as *Captorhinus* the teeth of a single *zahnreihe* erupt as a unit and are ankylosed to the dentigerous bones. Edmund has suggested that in mammals the deciduous teeth represent the remnants of one *zahnreihe* and permanent dentition a second anterior *zahnreihe*. This theory also explains the front-to-back order of replacement in mammals and, because of its simplicity, is extremely attractive. But certain problems present themselves. Edmund made no attempt to correlate his theory with palaeontological evidence. Eruption and functioning of teeth in a complete *zahnreihe* is known only in a few specialized groups such as the captorhinids. In mammal-like reptiles alternate tooth replacement similar to that of typical reptiles is present except in the specialized gomphodont cynodonts, where the position is difficult to ascertain.

Edmund's theory would imply that in the late mammal-like reptiles there should be a tendency to reduce the number of teeth to two *zahnreihen*, but no tendency in this direction has been reported.

Although these facts alone do not disprove Edmund's view they certainly do not confirm it. An alternative explanation for the origin of the mammalian conditions is worth while considering. It is possible to derive the mammalian succession from forms in which the time lag between the budding-off of the even- and odd-numbered tooth germs from the dental lamina is reduced so that odd- and even-numbered teeth can erupt consecutively and function simultaneously. Even in mammals consecutive teeth in the series do not erupt one after the other in an orderly fashion; e.g. in man the first deciduous molar erupts before the deciduous canine, and the first molar erupts before the second premolar. Compared with the pelycosaurs there appears to be a tendency to reduce the relative time-interval between the eruption of alternate teeth in later mammal-like reptiles. In pelycosaurs there is a tendency for the odd- and even-numbered teeth not to function simultaneously. This has been termed 'functional distichial replacement' by Kermack (1956). He has pointed out that functional distichial replacement is not present in the therocephalians and gorgonopsians studied by him. On the other hand, although alternate tooth replacement is present in *Thrinaxodon* and *Bauria*, the functional periods of odd- and even-numbered teeth overlap considerably. A reduction of the time-lag between the formation of odd and even teeth together with a lengthening of the time between eruption and replacement of individual teeth would be expected if the form were moving towards the mammalian type of replacement. It is difficult because of lack of reliable evidence on tooth replacement in mammal-like reptiles to determine a trend of this nature, but tooth replacement was apparently far less frequent in a form such as *Bauria* than in *Ericiolacerta*. A similar reduction of the frequency of replacement can be traced in the later cynodonts compared with those of the *Cistecephalus* and *Lystrosaurus* zones. What is urgently required is further growth series of individual mammal-like reptiles.

Summary

(1) The dentition, tooth replacement and wear stages of the postcanine teeth of the type specimens of *Ericiolacerta parva* and *Bauria cynops* are described.

(2) In both genera alternate tooth replacement was present. In *Ericiolacerta* the replacing teeth developed initially in pits in the base of the superficial groove which supported the dental lamina. In *Bauria* replacing teeth appear to have developed deep in the dentigerous bones. The origin of the mammalian order of replacement is briefly discussed.

(3) *Ericiolacerta* represents an early stage in the transition from a sectorial to a pounding or crushing dentition. This transition was probably correlated with reduction of size of the canines in this form. In *Bauria* a crushing dentition is better developed than in *Ericiolacerta*.

(4) It is doubted whether a true grinding action was present in *Bauria*. Wear of the postcanines could be accounted for solely by a simple pounding action.

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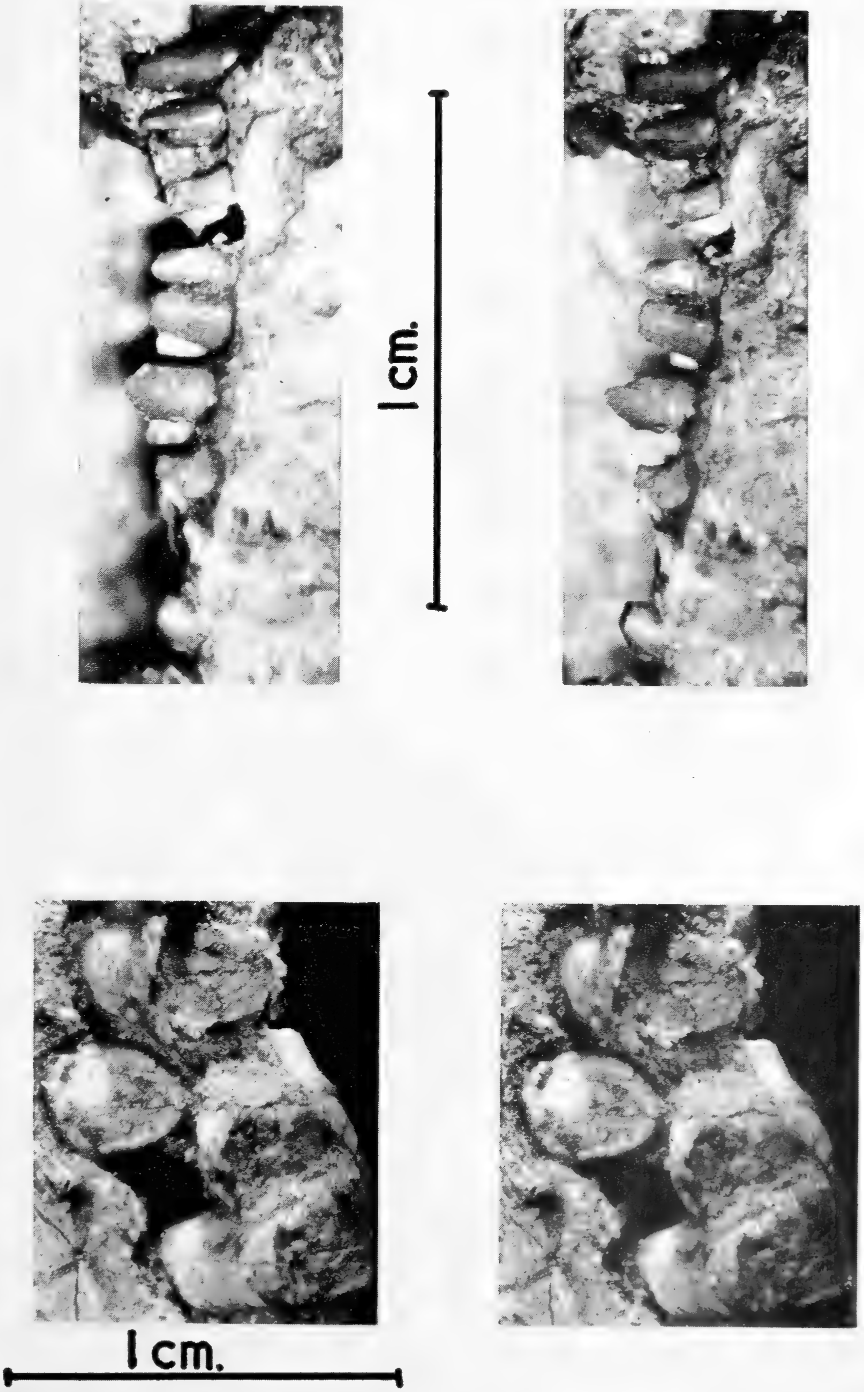
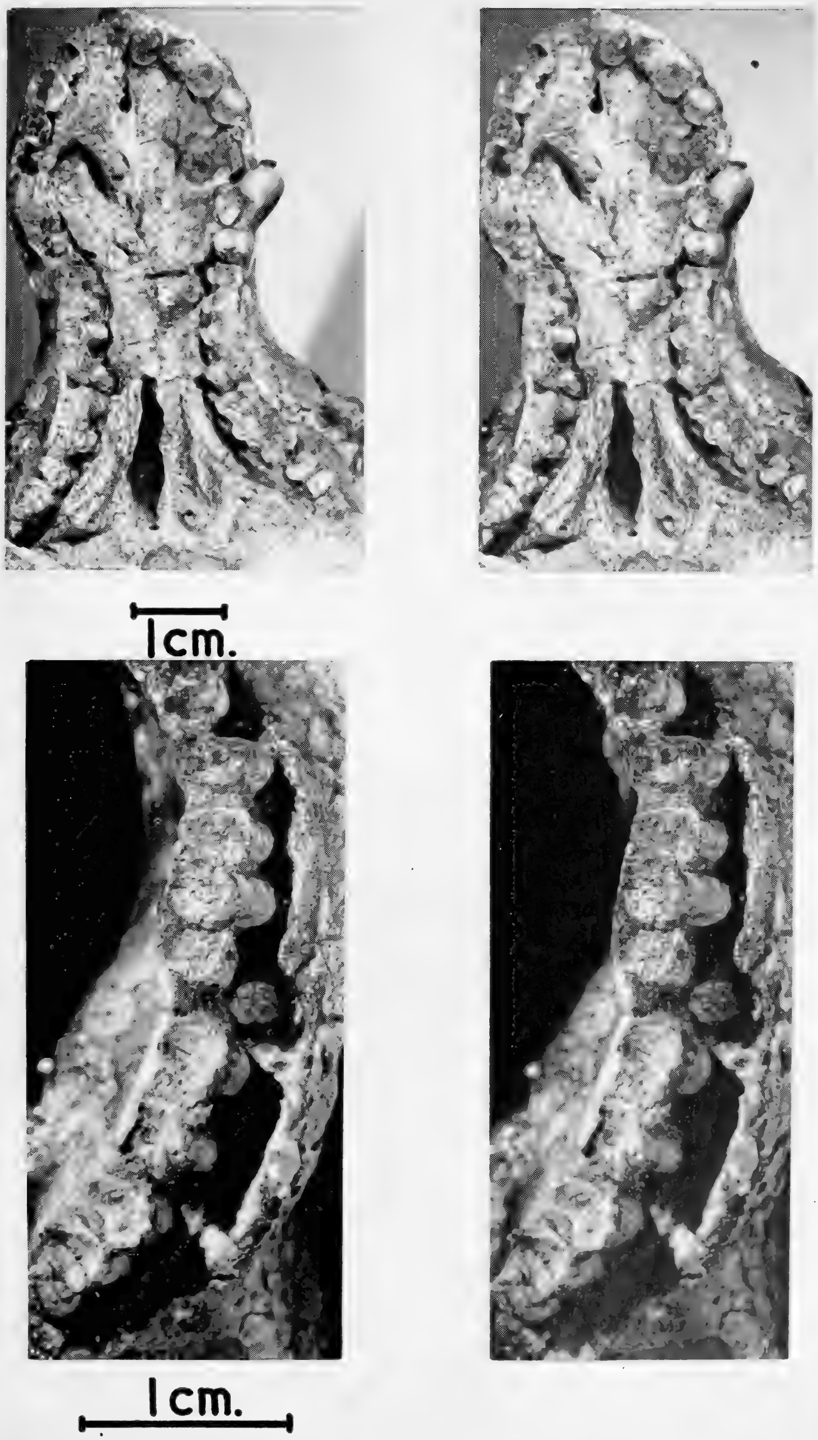
KEY TO LETTERING

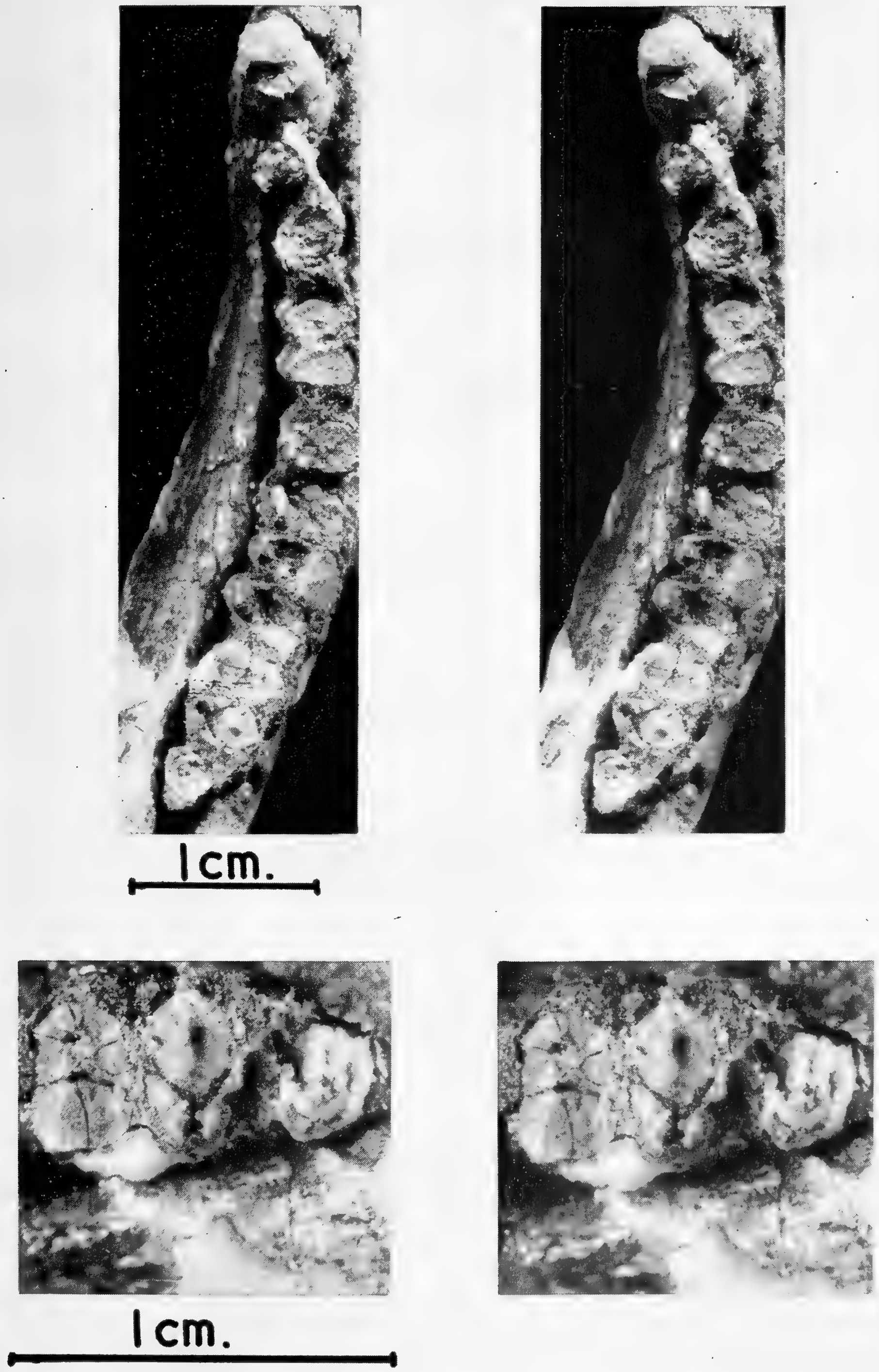
at. bo.	Attachment bone.
c.	Canine.
can.	Canal in dentary.
DEN.	Dentary.
f. t. 5	Functional 5th postcanine.
lab.	Labial.
lab. c.	Labial cusp.
l. c. p.	Pit for lower canine.
ling.	Lingual.
long. gr.	Longitudinal groove.
MAX.	Maxilla.
p.	Pit for replacing tooth.
PAL.	Palatine.
p. for.	Palatal foramen.
rem. f. 11	Remnant of 11th functional tooth.
rep. t.	Replacing tooth.
rep. t. 11	11th replacing tooth.
sec. p.	Secondary palate.
V.	Vomer.
w. fac.	Wear-facet.
w. fac. h.	Horizontal wear-facet.
w. fac. o.	Oblique wear-facet.



A (top): *Ericiolacerta parva*. Left maxilla. B (bottom): *Bauria cynops*. Detail of replacement of 5th postcanine.



A (top): *Bauria cynops*. Ventral view of palate. B (bottom): *Bauria cynops*. Right postcanine dentition.



A (top): *Bauria cynops*. Crown view of left postcanine series. B (bottom): *Bauria cynops*. Detail of posterior three postcanines.

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SYNONYMY. Arrangement according to Schenk, E. T. & McMaster, J. H.: *Procedure in taxonomy.* 2nd ed. Stanford, Stanford university press, 1948. Bibliographic references modified.

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Eulalia capensis Schmarda 1861, p. 86, pl. 29, fig. 231. Willey 1904, p. 259.
Eulalia viridis var. *capensis* McIntosh 1903, p. 34. Day 1953, p. 30.
Eulalia viridis (*non* Muller) Ehlers 1913, p. 455. Day 1934, p. 30.

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[CONTINUED ON INSIDE BACK COVER

NOMENCLATORIAL CHANGE FOR A LONG-KNOWN SOUTH AFRICAN FISH

By

J. L. B. Smith

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[Accepted September 1961]

(With 1 plate)

More than sketchy knowledge of the shore fishes of southern Africa came only long after that of most other parts. This was a result of various unusual circumstances, stormy seas, poor harbours and hostile natives, all of which retarded European settlement, so that long after early voyagers and travellers had gained fairly extensive knowledge of the fishes of parts as remote as Australia, Cape fishes remained poorly known. While certain early travellers and collectors visited the Cape, more active and able exponents operated in the Mauritius and Madagascar area, with the result that many species from there were described and named in quite early times. As it has been found that many fishes of the Indo-Pacific cover vast areas, one result has been that certain species named as new in the Pacific I have since found to have been described before from Mauritius and other near-by parts of the western Indian Ocean.

Family **Pomadasyidae**

A well-known South African fish whose habits and nature have proved most interesting from many aspects (Smith, 1935, p. 201; 1950) is the so-called Spotted Grunter, long known as *Pomadasys operculare* Playfair, 1866, the type from Zanzibar. This fish is widely distributed in the Indian Ocean, being common about India and Madagascar, where all available evidence indicates clearly that in both countries it has been caught by and was well known to the natives from quite early times. In Madagascar it is one of the best-known inshore fishes (I have photographs of catches by native fishermen there) and as it is not only of striking appearance but an excellent table fish, it seemed likely that it must have been noticed by earlier travellers and collectors in the Mauritius-Madagascar area. I therefore set out to see if it had not been

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described before Playfair, and soon discovered that it had. There is no doubt that Playfair's name must yield by priority to *commersonni* Lacépède, 1802, the type from Madagascar, collected and described by Commerson in the previous century. Lacépède (1802*a*, p. 431), on a drawing by Commerson of a fish from Madagascar, describes as follows (names as in original, description translated): 'Le LABRE COMMERSONNIEN (*Labrus commersonnii*). Nine sharp rays and 16 articulated rays in dorsal fin. Teeth in both jaws about equal. One sharp ray and 17 articulated rays in anal. The back and a great part of the sides of the fish sprinkled with equal round small spots.' Then Lacépède (1802*a*, in pl. 23, fig. 1, LABRE *commersonnien*) shows D IX 15, and anal with one spine and about 16 rays, pelvics with at least 7 soft rays, and deeply lunate caudal. Lacépède's artist Desève was often impressionistic and inaccurate by present standards, but the drawing could have been based on the species now under review.

Lacépède (1802*b*, p. 181, no. 26) also describes LUTJAN MICROSTOME (*Lutjanus microstomus*), also on a drawing by Commerson of a Madagascar fish, as follows: 'Nine spines and 16 articulated rays in the dorsal: the anal sickle-shaped; the head conical and long: the opening of the mouth small: a denticulation (serration) near the nape: the pectoral narrow: a great number of dark spots, irregular and small, on the body and tail.' Also Lacépède (1802*a*, pl. 34, fig. 2) shows LUTJAN MICROSTOME with D IX 16, anal total about 16, and a serrated preopercle margin; the body with small spots, and unmistakably the species here under review. Lacépède (1802*b*, p. 216) states: 'Nobody has yet published the description of (LUTJAN) *microstome*, a drawing of which we have seen among the manuscripts of Commerson, and which lives in the great Equinoxial Ocean or in parts of the Great Ocean near the tropics. The teeth of *microstome* are small and slender and the anus is nearer the head than the tail.'

Cuvier & Valenciennes (1830, p. 252) describe 'Le PRISTIPOME COMMERSONIEN (*Pristipoma Commersonii*, nob.; *Labre Commersonien* et *Lutjan microstome*, Lacép.)' as follows (names as in original, description translated):

'Among the papers of Commerson is a drawing which has been shown twice in the work of M. de Lacépède, the first time (vol. III, pl. 23, fig. 1) with the name *Labre Commersonien* (pp. 431 and 477)' (to which Cuvier & Valenciennes give the footnote: 'The characters of *Labre Commersonien* ([Lacépède] p. 431) and notably the 17 rays in the anal, are taken from the figure ([Lacépède] pl. 23) which has been distorted by [the artist] Desève.'); 'the second time (vol. III, pl. 34, fig. 2) with the name *Lutjan microstome* (vol. IV, pp. 181 and 216)' (to which Cuvier & Valenciennes give the footnote: 'The characters of *Labre microstome* ([Lacépède] p. 181) are taken from the other copy, also made by Desève, and conform better with the original, but again he distorts the anal.'). '. . . It [is a fish that] was found, says the traveller [Commerson], in the mouth of small rivers in the south of Madagascar. The specimen described weighs about 5–6 ounces, and is about 8–9 inches long, but it grows larger and reaches about 2 pounds in weight. The colour is a blue silvery white, covered with brown-black spots. The dorsal, anal and caudal are brownish, the other fins whitish or transparent. The teeth are very small, like a file. The margin of the preopercle is denticulate, no marked spine on opercle. The dorsal is deeply cleft. The pectorals are long and pointed. The first anal spine is very short, the second abruptly longer, very strong, the third much less. The caudal is forked. B. 7; D. 10/16; A. 3/9; p. 17; V. 1/5.'

In view of this unmistakable designation of the species, it is plainly the fish that has been known all this time under the name of *P. operculare* Plyfr.

It is curious that Lacépède's name has not before been revived. That this has not been done appears to be due chiefly to Günther, who in 1859 (p. 289) synonymized *commersonni* Lacépède, 1802, *microstoma* Lacépède, 1802 and *commersoni* as described by Cuvier & Valenciennes (1830, p. 252) all with *hasta* Bloch, 1790. Günther's commanding position caused this opinion to be accepted, uncritically, by all later workers on the Indian Ocean fauna. The following table shows the difference between *hasta* Bloch and *operculare* Playfair, and the correspondence of the latter with *commersonni* Lacépède.

	hasta	*operculare*	*commersonni*
Dorsal	D XII–XIII 13–15	D X (–XI) 13–16	X 16
Anal	A III 6–7	A III 8–10	III 9
Gillrakers	12–13	15–17	—
Markings	Interrupted crossbars	Many small dark spots	Many small dark spot

In order to make quite certain I wrote to the Natural History Museum in Paris to ask if they had Commerson's Madagascar specimen. Dr. M. Bauchot replied to say that the specimen (like most of Commerson's fishes) cannot be found, and that Commerson's original drawing is apparently lost, but on going through Cuvier's papers there was found a copy by Cuvier's artist of Commerson's original 1768 drawing with notes copied from Commerson's manuscript; of this they kindly sent me a photograph (shown here). Also pinned to the drawing was a copy of Lacépède's illustration. This figure leaves no doubt about the identity of Commerson's fish from Madagascar, and the name *Pomadasys operculare* Playfair, 1866 used for close on a century must yield by priority to *Pomadasys commersonni* Lacépède, 1802.* A photograph of a specimen from the Transkei of *Pomadasys commersonni* of size comparable with Commerson's fish is shown here (pl. XV).

I wish to record my gratitude to the South African Council for Scientific and Industrial Research for financial assistance, and to Dr. M. Bauchot of Paris for valuable assistance rendered in searching their archives, and for the photograph reproduced in Plate XV.

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* The original spelling with double "n" by Lacépède is used here.

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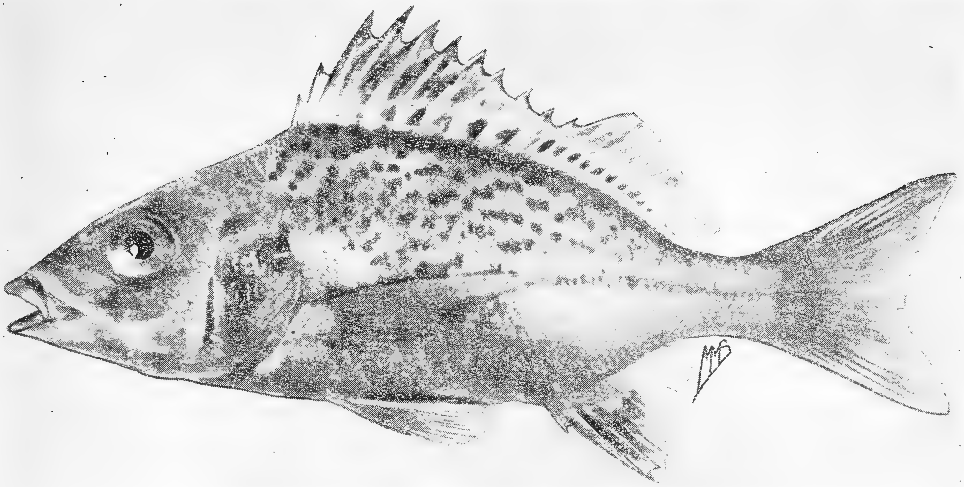
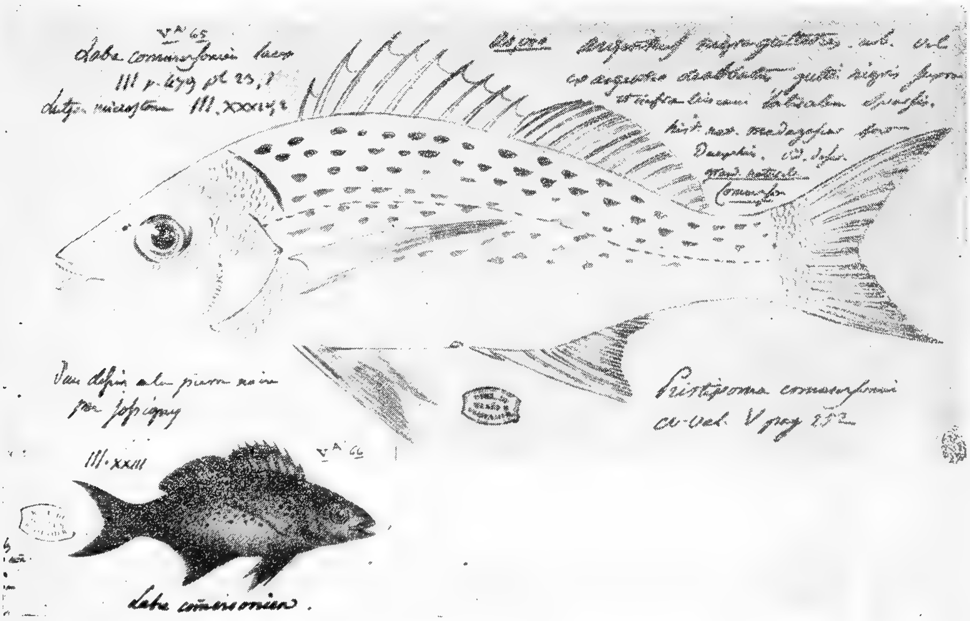


Above: *Pomadasys commersonni* (Lacépède). 150 mm. (Transkei).

Below: A copy by Cuvier's artist of a drawing by Commerson of a fish about 8 inches in length from Madagascar. Below, left, pinned to the drawing, is a copy of Lacépède's drawing published in 1802, III, pl. 23, fig. 1. Also notes copied from Commerson's original manuscript are written above, indicating Fort Dauphin, Madagascar, as locality. (Photo: Museum, Paris.)



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SYNONYMY. Arrangement according to Schenk, E. T. & McMaster, J. H.: *Procedure in taxonomy.* 2nd ed. Stanford, Stanford university press, 1948. Bibliographic references modified.

'I. *Synonymy arranged according to chronology of names.*—All published scientific names by which a species has been previously designated (subsequent to 1758) are listed in chronological order, with bibliographical references to all descriptions or descriptive citations following in chronological order after each name. . . .

B. *Form of bibliographic references to synonymic names.*—The first reference following any name in the synonymy should be to the earliest citation of that name. This should be followed by references to all subsequent citations of the same name, arranged in chronological order. . . .'

Bibliographical references modified to consist of author's name, date of citation, pagination and illustrations (plates and figures).

Example:—

Eulalia (*Steggoa*) *capensis* Schmarda

Eulalia capensis Schmarda 1861, p. 86, pl. 29, fig. 231. Willey 1904, p. 259.
Eulalia viridis var. *capensis* McIntosh 1903, p. 34. Day 1953, p. 30.
Eulalia viridis (*non* Muller) Ehlers 1913, p. 455. Day 1934, p. 30.

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SOUTH AFRICAN MUSEUM

VOLUME XLVI

PART XI

THE HYDROZOA OF THE SOUTH AND WEST COASTS OF SOUTH AFRICA

PART I. THE PLUMULARIIDAE

By

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Zoology Department, University of Cape Town

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THE HYDROZOA OF THE SOUTH AND WEST COASTS OF SOUTH AFRICA

PART I. THE PLUMULARIIDAE

By

N. A. H. Millard

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[Accepted April, 1961]

(With 12 figures in the text)

Contents

Introduction

This paper is the continuation of a series on the systematics of the hydroid coelenterates of the South African coasts. The hydroids of False Bay, near Cape Town, and those of the east coast (Natal and Portuguese East Africa) have already been described (Millard, 1957, 1958, 1959a), as have the hydroids from ships' hulls in Table Bay (Millard, 1959b). This leaves the species from the west and south coasts to be dealt with, the latter including very rich collections from the Agulhas Bank. It was found that it is no easy matter to decide on a line of demarcation between the west and south coasts when one is dealing with material dredged off the shore, and also that the distribution of the species does not justify such a division. These coasts are thus dealt with together. However, the hydroids of False Bay, which effectively separates the two coasts as far as the littoral material is concerned, have already been described. This paper, therefore, deals with the west and south coasts from South West Africa on the west to the southern border of Natal on the east, with the exception of False Bay. In a few instances recently collected specimens from False Bay or Natal have been mentioned when they have something of importance to add to the description. These records are quoted within brackets.

It was also found impracticable to separate littoral and estuarine material from that of deeper waters, as the Hydroida are essentially a sublittoral group and only a very small percentage of the population extends its range upwards into the littoral area. The term 'littoral' is used here in preference to 'inter-

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tidal', and is taken to include forms within reach at low water of spring tide even though they are not exposed and thus are not strictly between tide-marks. Since the scope of the paper is thus very large and deals with an enormous amount of material, it is proposed to divide it into parts, this, the first, dealing with the Plumulariidae. *In toto* it should complete the survey of the coast.

An analysis of the geographical distribution is being left to a later date when the descriptions are complete and more records are available, as also keys to the identification of species.

The material described has been obtained from a number of different sources and I am indebted to many bodies and individuals for their co-operation in building up the collection.

Some of the material dates from the time when the late Professor T. A. Stephenson held the chair of Zoology at the University of Cape Town, and was collected by him and his associates during his intertidal survey of the coast. This material is catalogued with a single reference letter.

The bulk of the material has been collected since that date by members of the Zoology Department under the direction of Professor J. H. O. Day, on expeditions to estuaries round the coast, on instructional student camps, and particularly by cruises of the University research vessel, the *John D. Gilchrist.* The Division of Fisheries has contributed material dredged by the R.S. *Africana,* and Messrs. Irvin and Johnson material brought up by commercial trawlers.

Finally there is a fairly bulky collection which was submitted to me for identification by the South African Museum and which was dredged by the s.s. *Pieter Faure* 50–60 years ago. Much of this material has deteriorated during the years, but since most of the Plumulariidae can be identified on their skeletal parts it has proved very useful and provided a number of valuable records, particularly from those regions which were only scantily covered by the *John D. Gilchrist.*

The details of the collecting stations, including date, latitude and longitude, depth, and nature of bottom, are given in the station list in the following section, and only the catalogue numbers are quoted under individual species.

In the description of the species the full synonymy has not been repeated where it has been quoted in previous papers of the series. Instead the latter are referred to.

A visit to the British Museum of Natural History in the latter half of 1960 enabled me to examine many type specimens and confirm identities of various South African species. For this privilege I am most grateful to the director of the museum and to Dr. W. J. Rees and members of his department. It has also made possible the solution of a number of problems of synonymy. I am also indebted to the director of the Munich Museum for the loan of slides of Stechow's collection from South Africa.

Various bodies have contributed either directly or indirectly to the expenses involved, including the South African Council for Scientific and

Industrial Research, the Carnegie Corporation, the Staff Research Fund of the University of Cape Town, and the Publications Fund of the University.

The type specimens of new species will be deposited in the South African Museum, and in these cases the registered museum number is quoted as well as the University catalogue number.

The Trustees of the South African Museum acknowledge with thanks receipt of a grant from the University of Cape Town for this publication.

Station List

A. Littoral material from Oudekraal on the west coast of the Cape Peninsula. Date: 13.5.34. Position: 33°58·5′S./18°22·2′E.

AFR. Material dredged by the government research vessel, R.S. *Africana*.

	Date	*Position*	*Depth (m.)*	*Bottom*
AFR 729	15.8.47	31°22·8′S./16°20·2′E.	366	bk M, R
AFR 736	17.8.47	30°42·4′S./15°59·2′E.	201	co gn S, Sh
AFR 865	8.1.48	34°35·5′S./19°18·2′E.	37	R, S
AFR 945	19.3.48	36°25′S./21°8′E.	177	S, R
AFR 994	19.4.48	34°34·5′S./21°22·5′E.	68	co S, Sh

B. Littoral material from Lambert's Bay on the west coast. Date: 30.7.48. Position: 32°5′S./18°14′E.

BMR. Bushmans River Estuary, on sand and muddy banks. Date: 10.9.50. Position: 33°41′S./26°40′E.

CP. Littoral material from various localities on the west coast of the Cape Peninsula.

	Date	*Locality*	*Position*
CP 17	29.4.38	Kommetje	34°8·5′S./18°19·4′E.
CP 328	31.12.48	Sea Point	33°55·2′S./18°22·6′E.
CP 335	12.9.49	Hout Bay	34°3′S./18°21′E.
CP 646	5.12.60	Oudekraal	33°58·5′S./18°22·2′E.
CP 650	1.2.61	Bakoven	33°57·6′S./18°22·3′E.

CPR. Material from various localities in the Cape Province.

	Date	*Locality*	*Position*	*Depth (m.)*
CPR 1	14.1.49	Cape Agulhas	34°50′S./20°1′E.	littoral
CPR 7	15.1.50	The Haven	32°15′S./28°57′E.	littoral
CPR 9	30.4.50	Glentana Strand	34°4′S./22°20′E.	littoral
CPR 44	–.1.58	Port Nolloth	29°15′S./16°52′E.	littoral
CPR 46	20.6.59	Umgazi Bay	31°43′S./29°26′E.	27

E. Littoral material from Port Elizabeth on the south coast. Date: July 1936. Position: 33°56′S./25°36′E.

FAL. False Bay.

	Date	*Position*	*Depth (m.)*	*Bottom*
FAL 326	10.9.57	34°7·7′S./18°26·9′E.	3–5	R

KNY. Knysna Estuary, on the south coast. Position: 34°5′S./23°4′E. (average).

	Date	*Depth (m.)*	*Bottom*
KNY 22	16.7.47	1–4	M
KNY 28	17.7.47	littoral	wooden pole
KNY 30	16.7.47	5–7	S, M
KNY 57	20.7.47	11·5	R
KNY 70	15.7.47	2–6	S
KNY 71	15.7.47	7	Sh, S, M
KNY 127	15.4.49	0–1	M
KNY 165	9.7.50	littoral	R, Buoy

L. Littoral material from East London, on the south coast. Date: July 1937. Position: 33°1′S./27°54′E.

LAM. Dredged in Lambert's Bay, west coast.

	Date	*Position*	*Depth* (*m.*)	*Bottom*
LAM 2	16.1.57	32°4·5′S./18°18·3′E.	17	S, R
LAM 7	18.1.57	32°5′S./18°17·9′E.	23	R, Sh, S
LAM 9	17.1.57	32°4·7′S./18°17·7′E.	23	S, Sh
LAM 13	19.1.57	32°4′S./18°18·1′E.	18	R
LAM 16	17.1.57	32°4·8′S./18°18·2′E.	11	S
LAM 21	17.1.57	32°7·5′S./18°17·6′E.	20	S, R
LAM 26	18.1.57	32°4·9′S./18°17·5′E.	27	S, R, Sh
LAM 27	16.1.57	32°4·1′S./18°18·4′E.	16	R
LAM 30	19.1.57	32°5·1′S./18°17·7′E.	20	R
LAM 35	19.1.57	32°5·5′S./18°17·7′E.	27·5	R, Sh
LAM 43	21.1.57	32°4·9′S./18°18·2′E.	13·5	S, R
LAM 45	21.1.57	32°5′S./18°18·2′E.	8	S, R
LAM 46	22.1.57	32°4·4′S./18°17·7′E.	23	R
LAM 51	23.1.57	32°8·5′S./18°17·7′E.	16·5	S, R
LAM 59	23.1.57	32°9′S./18°18′E.	16	S, R
LAM 62	23.1.57	32°1·5′S./18°18′E.	25	R, Sh

LB. Material from Langebaan Lagoon, on west coast.

	Date	*Position*	*Depth* (*m.*)	*Bottom*
LB 126	15.7.46	33°7·5′S./18°1·9′E.	4	
LB 152	16.7.46	33°8·3′S./18°3·3′E.	7	
LB 190	26.4.49	33°11·3′S./18°5·5′E.	0–2	f S, M
LB 257	2.5.51	33°7′S./18°3′E.	littoral	S, R
LB 367	7.5.53	33°6′S./18°1·5′E.	littoral	R
LB 378	7.5.53	33°6′S./18°2′E.	0–1	wooden piling
LB 392	8.5.53	33°7·9′S./18°2·1′E.	2·5	S
LB 472	6.5.55	33°7·4′S./18°2·5′E.	3–4	S, Sh
LB 511	23.9.57	33°6′S./18°1·5′E.	littoral	R
LB 513	5.1.58	33°6·5′S./18°2′E.	littoral	R

LIZ. Dredged in Algoa Bay, Port Elizabeth, south coast.

	Date	*Position*	*Depth* (*m.*)	*Bottom*
LIZ 7	6.4.54	33°58·1′S./25°38·9′E.	9	St, R
LIZ 13	6.4.54	33°58·2′S./25°38·8′E.	7–8	S
LIZ 16–17	7.4.54	33°58·4′S./25°40·5′E.	14	St
LIZ 27	11.4.54	34°0·8′S./25°42·4′E.	5–7	R

MB. Dredged in Mossel Bay, south coast.

	Date	*Position*	*Depth* (*m.*)	*Bottom*
MB 5	12.1.56	34°8·0′S./22°8·5′E.	21	S
MB 8, 12	12.1.56	34°4·3′S./22°13·9′E.	19	R
MB 15	13.1.56	34°11·1′S./22°10·1′E.	16	S, R
MB 24	13.1.56	34°11·1′S./22°9·9′E.	19	R
MB 26	13.1.56	34°11.1′S./22°10·1′E.	21	S
MB 34	15.1.56	34°8·3′S./22°9·4′E.	31	S
MB 37	16.1.56	34°9·3′S./22°10·0′E.	31	S
MB 39	16.1.56	34°10·1′S./22°8·0′E.	9	R
MB 42	16.1.56	34°8·5′S./22°8·8′E.	25	S, M
MB 47	17.1.56	34°11·3′S./22°10·0′E.	10	R
MB 52	17.1.56	34°11·0′S./22°9·9′E.	14	R, S
MB 55	17.1.56	34°10·7′S./22°9·6′E.	9	R
MB 58	18.1.56	34°4·3′S./22°13·5′E.	12·5	R
MB 59	18.1.56	34°4·1′S./22°13·9′E.	11·5	R
MB 60	18.1.56	34°4·3′S./22°14·2′E.	17–20	co S, Sh, R
MB 70	19.1.56	34°8·9′S./22°7·9′E.	18	S
MB 72	19.1.56	34°9·1′S./22°7·2′E.	12	R, S, Sh
MB 79	20.1.56	34°5·0′S./22°11·8′E.	19	M
MB 81	20.1.56	34°6·2′S./22°10·9′E.	27·5	M

MB 83	21.1.56	34°11·6′S./22°10·2′E.	29	S, Sh, R
MB 84	21.1.56	34°11·4′S./22°10·1′E.	29	R
MB 88	18.1.56	34°4·8′S./22°13·1′E.	26	co S, Sh, R

N. Littoral material from Port Nolloth, west coast. Date: 11.11.35. Position: 29 15′S./16°52′E.

NAD. Dredged off Natal, east coast.

	Date	*Position*	*Depth (m.)*	*Bottom*
NAD 1	17.5.58	30°47·1′S./30°29·1′E.	44	St
NAD 9	23.4.58	29°46′S./31°17′E.	110–130	
NAD 21, 22	12.8.58	29°58′S./31°2′E.	49	

PP. Littoral material from Paternoster, west coast. Date: 24.9.57. Position: 32°43′S./17°55′E.

S. Littoral material from Still Bay, south coast. Date: January, 1932. Position: 34°23′S./21°26′E.

SAMH. Material dredged by the s.s. *Pieter Faure* and lodged in the South African Museum. (The positions were given in the original records as compass bearings off salient points on the coast, and were probably not very accurate. These have been converted into latitude and longitude and given to the nearest minute.)

	Date	*Position*	*Depth (m.)*	*Bottom*
SAMH 148–153	15.7.1898	34°8′S./22°16′E.		St
SAMH 163	28.10.1898	33°54′S./25°47′E.	40	d S
SAMH 165–169	11.11.1898	33°49′S./25°56′E.		
SAMH 190–194	28.12.1898	33°9′S./28°3′E.	86	S, Sh, R
SAMH 195, 196	15.2.1899	33°53′S./25°45′E.	33–42	
SAMH 197–201	7.3.1899	33°59′S./25°51′E.	24–27	
SAMH 210	15.3.1899	33°47′S./26°19′E.	18–29	S, Sh, St
SAMH 212	24.3.1899	33°50′S./26°35′E.	91	M
SAMH 215–225	19.6.1899	34°26′S./21°42′E.		f S
SAMH 238–241	11.10.1900	34°8′S./22°59·5′E.	73	S, Sh, Crl
SAMH 248	24.10.1900	34°22′S./22°9′E.	71	R
SAMH 249	15.7.1901	33°13·5′S./27°58′E.	89	brk Sh
SAMH 254–277	17.7.1901	33°7′S./27°47·5′E.		f S
SAMH 278–280	25.7.1901	32°50′S./28°18·5′E.	86	brk Sh
SAMH 284	6.8.1901	33°5′S./27°50′E.	7	R, brk Sh
SAMH 285–293	13.8.1901	32°45′S./28°26′E.	53	brk Sh, St
SAMH 297–298	13.8.1901	32°47′S./28°28′E.	82	brk Sh
SAMH 299–304	15.8.1901	32°42′S./28°26′E.	31	R
SAMH 305–309	10.9.1901	33°54′S./26°51′E.	120	brk Sh, St
SAMH 319, 320	23.9.1901	34°5′S./26°34′E.	115	S, Sh, bk Spks
SAMH 322–333	22.9.1904	34°12′S./22°15·5′E.	51	f S
SAMH 344–347	19.10.1904	34°15·5′S./22°14′E.	64	M
SAMH 349	15.8.1905	34°8′S./23°32′E.	73	M
SAMH 353	28.8.1906	33°54·5′S./26°28′E.	104	M
SAMH 355	–.1.1913	29°55′S./31°14′E.	littoral	
SAMH 360	25.7.1901	32°50′S./28°18·5′E.	86	brk Sh

SB. Saldanha Bay, west coast.

	Date	*Position*	*Depth (m.)*	*Bottom*
SB 141	2.5.57	33°2·5′S./18°2′E.	littoral	R
SB 150	22.9.57	33°2·5′S./18°2′E.	littoral	R
SB 168	25.9.57	33°2·5′S./18°2′E.	littoral	R
SB 178	28.4.59	33°3·6′S./18°0·4′E.	15	Sh, kh S, R
SB 194	1.5.59	33°3·5′S./17°59·2′E.	20	R, S
SB 196	1.5.59	33°4·4′S./17°56·4′E.	35	R

SCD. Dredged off the south coast.

	Date	*Position*	*Depth* (*m.*)	*Bottom*
SCD 5	19.4.58	34°15′S./25°5′E.	11	R, Sh
SCD 20	26.5.58	34°7·3′S./23°23·8′E.	46	R
SCD 22	26.5.58	34°26·7′S./23°26·0′E.	114	Sh
SCD 26	23.5.58	33°47′S./26°4′E.	47	M, Sh
SCD 29	22.6.58	33°38·6′S./26°54·7′E.	56	R
SCD 33	21.5.58	35°3′S./27°56·2′E.	65	S, Sh
SCD 36, 37	19.5.58	32°15·2′S./28°57·7′E.	49·5	R
SCD 50	18.5.58	31°38·8′S./29°34·4′E.	33	R
SCD 52	20.8.58	34°1′S./25°45·5′E.	46	R
SCD 61	15.8.58	32°17·7′S./28°54·5′E.	49	
SCD 67	4.7.59	34°20′S./24°22′E.	120	?S
SCD 69	5.7.59	33°31′S./27°14·5′E.	67	?S
SCD 75	16.7.59	32°33′S./28°38′E.	55	S, M
SCD 79–81	16.7.59	32°43′S./28°28′E.	58	St, Sh
SCD 82	17.7.59	33°3·7′S./27°54·7′E.	51	br S, Sh
SCD 84, 85	17.7.59	33°3′S./27°55′E.	27	R
SCD 94	20.7.59	33°55·5′S./25°51′E.	46	bk M, S
SCD 96	20.7.59	34°21′S./25°41′E.	110	Sh
SCD 103	22.7.59	35°7′S./22°15′E.	119	S
SCD 104	23.7.59	34°33′S./21°28′E.	67	co S, brk Sh
SCD 108	23.7.59	34°35′S./21°11′E.	75	co S, Sh, St
SCD 117	14.2.60	34°24′S./21°46′E.	18	R
SCD 122	14.2.60	34°40·5′S./22°0′E.	93	kh S
SCD 126	3.6.60	34°26·5′S./21°48′E.	67	bk M
SCD 138	28.6.60	34°35′S./21°56′E.	77	co & f Sh
SCD 141	28.8.60	34°46′S./22°5′E.	93	kh S
SCD 152	2.6.60	34°55′S./21°26′E.	91	
SCD 153	25.11.60	34°3′S./25°59′E.	84	R
SCD 169	24.11.60	33°58·9′S./25°41·4′E.	4–11	R
SCD 175	30.11.60	34°20′S./23°31′E.	111	R, kh S
SCD 186–8	30.11.60	34°10′S./23°32′E.	97	gn M
SCD 191	29.11.60	34°4·3′S./23°25·8′E.	47	M
SCD 195	29.11.60	34°7·5′S./23°31·7′E.	79	f S
SCD 199	30.11.60	34°10′S./23°32′E.	97	gn M
SCD 201	29.11.60	34°5·8′S./23°23·2′E.	10	f S
SCD 206	30.11.60	34°51′S./23°41′E.	182	kh S
SCD 219	29.11.60	34°2·0′S./23°28·4′E.	49	S, R, M
SCD 234	30.11.60	34°51′S./23°41′E.	182	kh S
SCD 239	29.11.60	34°2·0′S./23°28·4′E.	49	S, R, M

SWA. Littoral material from rocky shore at Luderitz, South West Africa. Date: –.7.57. Position: 26°33′S./15°9′E.

TB. Material dredged from Table Bay.

	Date	*Position*	*Depth* (*m.*)	*Bottom*
TB 1	11.2.47	33°47·5′S./18°24·3′E.	19–20	S, Sh, St
TB 2	25.10.46	33°52·5′S./18°26′E.	22	S
TB 3	4.8.46	33°49·5′S./18°27·5′E.	9–18	S, Sh
TB 4	11.2.47	33°48·3′S./18°24′E.	10–12·5	S, St
TB 5	11.2.47	33°47·5′S./18°24·3′E.	19–20	S, Sh, St
TB 17	26.6.47	33°52·7′S./18°28·7′E.	9	S, St
TB 18	3.7.47	33°52·7′S./18°26·8′E.	20·5	R
TB 21	15.12.57	33°48·6′S./18°24·6′E.	15	St, brk Sh, S

TRA. Material collected by commercial trawlers.

	Date	*Position*	*Depth* (*m.*)	*Bottom*
TRA 35	21.1.50	34°34′S./20°50′E.	70	M, S
TRA 36	21.1.50	34°34′S./20°50′E.	73	St, M
TRA 38	–.7.50	34°30′S./20°56′E.	73	S, M
TRA 42	–.7.51	34°30′S./20°55′E.	70	M, St
TRA 47	24.9.52	31°50′S./16°50′E.	330	gn M

TRA 56	28.11.52	34°40′S./21°35′E.	70–77	R, S
TRA 86	23.3.53	32°41·7′S./17°58·5′E.	9	S
TRA 92	–.1.54	35°3′S./21°50′E.	110	S, R
TRA 99	18.1.56	34°25·5′S./21°50·2′E.	60	S
TRA 134	23.2.57	34°19′S./18°30′E.	52	S, Sh, R
TRA 151	6.3.58	34°51′S./19°55′E.	22	R
TRA 156	15.10.58	34°12′S./18°22′E.	18–27	Cable
TRA 159	6.7.58	33°56′S./25°36′E.		Turtle's back

WCD. Dredged off west coast.

	Date	*Position*	*Depth (m.)*	*Bottom*
WCD 7	24.3.59	34°9·3′S./18°17·5′E.	43	R
WCD 12	24.3.59	34°9·4′S./18°16·5′E.	75	R
WCD 18	29.4.59	33°5·6′S./17°54·5′E.	64	kh M
WCD 20	30.4.59	33°7·5′S./17°52·5′E.	86	R
WCD 32	15.12.59	34°10′S/18°16′E.	93	R
WCD 34	15.12.59	34°11·2′S./18°20·2′E.	27	R
WCD 56	21.9.60	32°4·6′S./18°18′E.	18	S, R
WCD 81	15.9.49	34°5′S./18°21′E.	11	S

Remarks on Classification

In the taxonomy of the Plumulariidae three problems are of recurrent interest, namely:

(1) The validity of fixed or movable nematothecae as a basis for subdivision;
(2) the presence or absence of cauline hydrothecae as a useful diagnostic character, and
(3) the value of the method of branching in the limitation and grouping of genera.

In 1883, Allman, using the type of nematotheca as a basis, divided the Plumulariidae into two large sections: the Eleutheroplea and the Statoplea. However, the presence of certain genera such as *Heteroplon* Allman 1883 and *Heterotheca* Stechow 1921, with two kinds of nematothecae, made this simple division impracticable. In 1923b Stechow made use of 4 sub-families, but also used as his basis the type of nematotheca. Stechow's subfamilies included:

1. Kirchenpaueriinae Stechow 1921. Nematothecae reduced.
2. Plumulariinae Kühn 1913 (= Eleutheroplea). Nematothecae 2-chambered and movable.
3. Acladiinae Stechow 1923b. Intermediate forms.
4. Aglaopheniinae Stechow 1911 (= Statoplea). Nematothecae 1-chambered and immovable.

The Kirchenpaueriinae and the Aglaopheniinae appear to be valid subfamilies representing natural assemblies of genera (in fact the latter is raised to family rank by some systematists), but the other subfamilies need further consideration.

The Acladiinae was created for intermediate forms with fixed mesial nematothecae and fixed or movable lateral nematothecae. It was an unsatisfactory group, as Stechow himself realized, for he abandoned it in 1925, adding its genera to the Plumulariinae. It has in fact been increasingly recognized that in this group the type of nematotheca does not form a good basis for family, or even generic, diagnosis. This was pointed out as early as 1913 by Billard and in 1915 by Bale, and most systematists have dropped the genera *Heteroplon*, *Heterotheca* and *Antennellopsis* Jäderholm 1896 for this reason.

There is, however, a group of genera which are linked by the presence of cauline hydrothecae, including *Thecocaulus* Bale 1915, *Halopteris* Allman 1877, *Gattya* Allman 1886 and *Schizotricha* Allman 1883, genera which Stechow distributed between the Plumulariinae and Acladiinae. Bale was the first to realize the importance of cauline hydrothecae as a diagnostic character when he established the genus *Thecocaulus* in 1915 for 'forms in which hydrothecae are borne on the rachis as well as on the pinnae'. Such genera possess stem internodes which are essentially similar to those of the hydrocladia, and thus differ from the '*Plumularia*' type where the stem internodes lack hydrothecae and thus differ from those of the hydrocladia. This difference is a fundamental one exhibited in the earliest stages of growth, influencing, as it does, the nature of the first upright stem. It is a sound character for generic diagnosis, and under no circumstances should species with cauline hydrothecae be included in the same genus as species without, as has been done by Billard (1913) (i.e. in the genus *Plumularia*). It is also considered to be a sound character on which to group genera, and a new subfamily, the Halopterinae, is proposed for forms with cauline hydrothecae. (Stechow's Acladiinae cannot be retained since *Acladia* is a synonym for *Halopteris*.) The Plumulariinae can be retained in Stechow's sense, though excluding certain genera dealt with below.

Stechow implies that the Kirchenpauerinae is the most primitive subfamily of the Plumulariidae because of the poorly developed nematothecae, but it is maintained here that the arrangement of hydrothecae and hydranths is of far greater fundamental significance. It is rational to assume that a primitive form would be one in which a functional feeding unit (i.e. a portion of stem and a hydranth) is established as rapidly as possible in early development and before budding commences, as in fact occurs in the sympodial growth of primitive Calyptoblast families such as the 'Campanulinidae' and Haleciidae. This arrangement is possible in the Halopterinae but not in the other Plumulariidae where a stem must develop hydrocladia before the formation of hydranths is possible. The Halopterinae is thus considered to contain the primitive stock of the Plumulariidae.

Genera of Halopterinae

The genus *Halopteris* was established by Allman in 1877 for *H. carinata*, which is the type species. Totton in 1930 showed that *Plumularia catherina* Johnston 1833 (the type species for *Thecocaulus*) is congeneric, and thus sinks *Thecocaulus* in the synonymy of *Halopteris*.

Although Allman's conception of *Halopteris* (and also Stechow's) was the presence of fixed nematothecae, its main diagnostic characters are now considered to be the presence of cauline hydrothecae, a pinnate stem with unbranched hydrocladia and an untoothed thecal margin. The genus as thus envisaged includes the following species:

> *Plumularia alternata* Nutting 1900, *P. buski* Bale 1884, *P. campanula* Busk 1852, *Halopteris carinata* Allman 1877, *Plumularia catherina* Johnston 1833, *P. concava* Billard 1911, *Halopteris constricta* Totton 1930, *Plumularia crassa* Billard 1911, *P. diaphana* Heller 1868, *Halopteris gemellipara* n. sp., *Aglaophenia glutinosa* Lamouroux 1816, *Thecocaulus heterogona* Bale 1924, *Plumularia liechtensternii* Marktanner-Turneretscher 1890, *Thecocaulus minutus* Trebilcock 1928, *Plumularia polymorpha* Billard 1913, *P. sulcata* Lamarck 1816, *P. tuba* Kirchenpauer 1876, *Heteroplon valdiviae* Stechow 1923, *Plumularia zygocladia* Bale 1914b, and possibly also *Plumularia diaphragmatica* Billard 1911 and *P. jedani* Billard 1913.

In addition to the characters mentioned above, these species usually have other features in common. Thus, the colonies as a whole tend to resemble *Aglaophenia* in their general appearance rather than *Plumularia*, with robust stems and close-set hydrocladia and hydrothecae. Most of the species possess hinge-joints near the base of the stem or its branches. There is a tendency towards the production of opposite hydrocladia—in *H. gemellipara*, *H. catherina* and *H. zygocladia* the hydrocladia are opposite throughout all or most of the length, and in practically all other species opposite hydrocladia are borne by the first or second thecate internodes. Internodal and intrathecal septa are typically absent. Each hydrocladial internode typically has one median inferior nematotheca and one or two pairs of laterals, and sometimes one or more supracalycines. The cauline internodes have a similar arrangement, though they may possess supernumerary supracalycines as well. The nematothecae may be 1- or 2-chambered, movable or immovable. The gonothecae, where known, are dimorphic, typically with the female seated on the stem and the male on the hydrocladia of the same colony, and they bear nematothecae, at least in the female.

It is not suggested that all these characters are essential for the inclusion of a species in *Halopteris* (in fact there are exceptions as regards most of the characters listed), but that the common possession of most of them links together a group of species which are closely related and can be considered as constituting a single genus. Few hard and fast rules can be laid down, as many of the species appear to be in a state of flux and show surprising variability of structure, even within a single colony. It has already been demonstrated how the segmentation of the hydrocladia, and the structure and arrangement of nematothecae, may vary in *H. glutinosa* (see Millard, 1958, and also Broch, 1933).

It is proposed to include in the same subfamily (i.e. Halopterinae) the genera *Antennella*, *Schizotricha*, and *Monostaechas*, which are clearly related to *Halopteris*, and differ only in their method of branching.

The genus *Antennella* Allman 1877 was created for *A. gracilis* Allman 1877, a form with simple stems similar to hydrocladia, and this is the type species. *Schizotricha* Allman 1883 was created for forms with pinnate stems and branching hydrocladia, and the type species is *S. unifurcata* Allman 1883 according to Totton 1930. Finally *Monostaechas* Allman 1877 was created for *M. dichotoma* Allman 1877 (= *M. quadridens* (McCrady) 1857) in which the hydrocladia branch sympodially from the posterior surface, the resulting 'stem' being formed from the proximal parts of successive hydrocladia (cf. also Billard, 1913, p. 14).

The type of branching, however, forms no inflexible demarcation between the four genera so far mentioned. It is known, for instance, that many species of *Halopteris* may exist in a simple form, and some species of *Antennella* may produce pinnate stems. Thus Broch (1933) has shown that *Antennella secundaria* can produce pinnate stems although the simple form is the more common, and that *Halopteris diaphana* can exist in the simple form although the pinnate form is more common. *H. campanula*, *H. catherina* and *H. constricta* can all exist in the simple form (Bale, 1913, Hincks, 1868, and Millard, 1957, respectively). Accordingly Broch has sunk *Thecocaulus* (= *Halopteris*) in the synonymy of *Antennella*, and this practice has been followed by most Continental systematists. But it has been shown recently (Millard, 1958) that *Monostaechas natalensis*, which has a completely different method of branching, can also exist in the simple form, and Billard 1913 has shown that *A. secundaria* can branch in the *Monostaechas* way. To follow Broch's system we should then sink *Monostaechas* also in the synonymy of *Antennella*. It appears to the present author that within this group of species the simple form is the most primitive type and that from it have led two main evolutionary lines, one leading to *Halopteris* with the tendency towards pinnate branching, and one to *Monostaechas* with branches arising from the posterior surface of the stem, and that since these genera represent grades of evolution it is wise to keep them separate. The placing of intermediate types will always be a matter of opinion, though in general a species should be named according to its dominant form, thus *Antennella secundaria* but *Halopteris diaphana*.

Passing on to forms with branching hydrocladia, these surely represent a further stage of the evolutionary line leading through *Halopteris*, and if we are to retain Halopteris as separate from *Antennella* then we must also retain *Schizotricha*, in spite of intermediate forms.

Another genus to be included in the Halopterinae is *Gattya* Allman 1886 (= *Paragattya* Warren 1908, see p. 281), which was created for *Gattya humilis* Allman 1886, a form with a toothed thecal margin. Whether a toothed hydrotheca is a sufficient character to distinguish a genus is a matter of opinion. In most of their characters the species are closely related to the *Antennella-Halopteris* line (for instance, *G. humilis* possesses hinge-joints and occasionally branching hydrocladia, and the first thecate internode of the stem bears a pair of opposite hydrocladia). Possibly they represent a deviation from the *Halopteris* stock, which is already foreshadowed in *H. carinata* and *H. valdiviae* which have a sinuated hydrothecal margin. At any rate the character is a definite one and useful in distinguishing species, and the genus may be allowed to stand.

The genera NEMERTESIA *and* ANTENNOPSIS

The genus *Antennopsis* was founded by Allman in 1877 for *A. hippuris*, the features distinguishing it from *Nemertesia* Lamouroux 1812 being the 'scattered disposition' of the hydrocladia, and the uncanaliculated coenosarc. The former character has generally been accepted as worthless, and the latter character has also been discredited by many authors (see Bedot, 1921). The

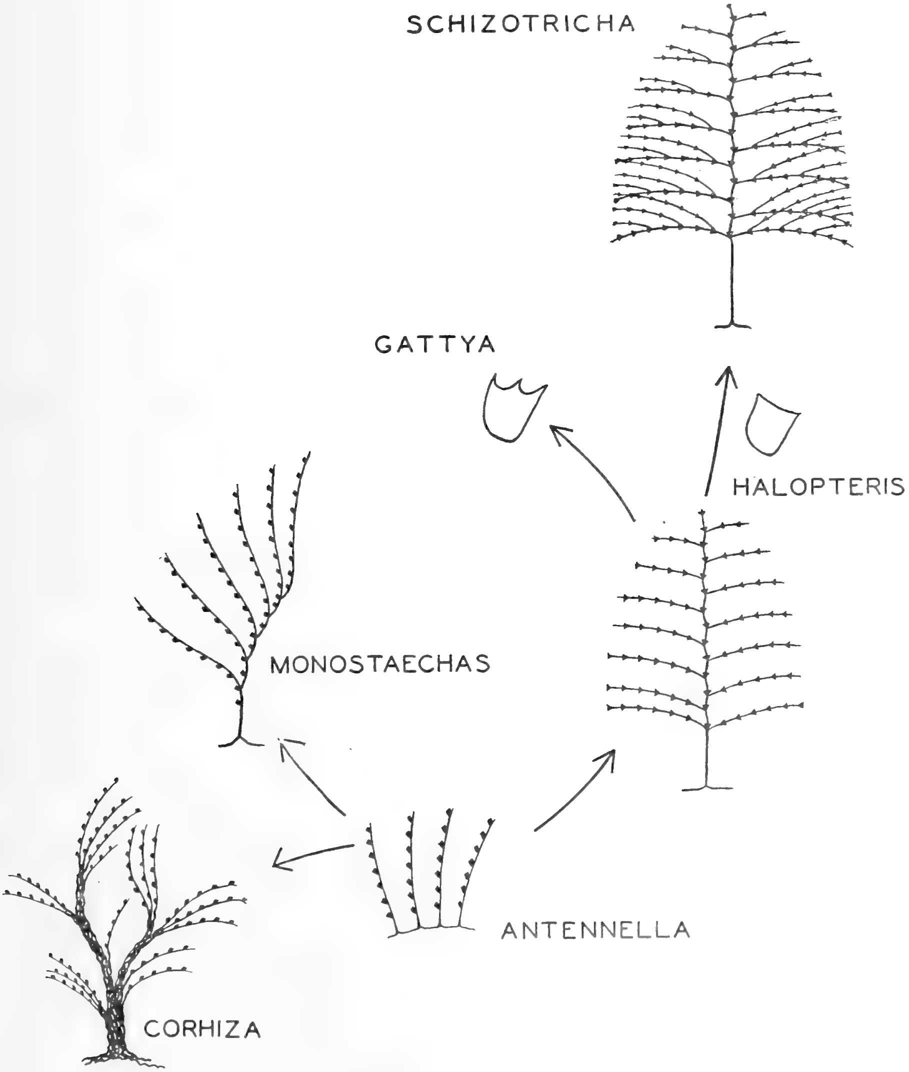

FIG. 1. Diagram showing possible evolutionary trends in the Halopterinae.

author considers that the type species of *Antennopsis* (*A. hippuris* Allman 1877) is congeneric with the type species of *Nemertesia* (*Sertularia antennina* Linnaeus 1758) and consequently sinks *Antennopsis* in the synonymy of *Nemertesia.*

There are, however, certain species (*Antennularia fascicularis* Allman 1883 and *Antennopsis scotiae* Ritchie 1907) included by Bedot in *Antennopsis* which differ markedly from other species of the composite genus *Nemertesia* and from the type species of this genus. In *Nemertesia* the hydrocladia arise from an unfascicled stem, or from the central tube of a fascicled stem, either irregularly or in verticils. In the two species mentioned the hydrocladia arise, quite irregularly, from the *peripheral* tubes of the stem, and there is no recognizable central or main tube. It is just as though the hydrorhizal tubes of a colony of *Antennella* had become bound together to form a fascicled stem, each branching or separating from the others independently to give hydrocladia. This character is, I feel, of generic value, and I propose a new genus *Corhiza* for the reception of the two species mentioned and two new species described below, with *Antennopsis scotiae* Ritchie 1907 as the type species (i.e. *Corhiza scotiae* (Ritchie) 1907).

These four species are also linked by certain less important characters which do not occur in *Nemertesia* and which emphasize the cleavage between the two genera, namely the large hydrothecae, the absence of a mamelon on the base of the hydrocladium, the position of the lateral nematothecae on long supporting processes at the sides of the hydrotheca, and the gonothecae which are borne on the hydrocladia and themselves bear nematothecae.

Further, the author feels that the sum total of the characters of the genus *Corhiza* indicates a closer relationship with the Halopterinae than with the Plumulariinae, and proposes to place it in the former subfamily. The stem of course bears no cauline hydrothecae, but if the stem is considered as a conglomeration of hydrorhizal tubes this becomes understandable.

The genus *Corhiza* appears to be closely related to *Antennella* and *Monostaechas.* In *A. africana* the hydrorhizal tubes often rise up from the substratum in bunches, giving rise to clumps of simple stems (i.e. hydrocladia). A further development of this process would produce a colony of the *Corhiza* type. A fascicled stem similar to that of *Corhiza* is found in some members of *Monostaechas* (*M. natalensis* Millard 1958 and *M. faurei* Millard 1958), and *M. natalensis* appears to occupy an intermediate position between the two genera, where the branching of the hydrocladia has not developed to the same extent as in other species of the genus.

The evolutionary relationships between the genera of Halopterinae as visualized by the author are illustrated in figure 1.

The subfamilies of the Plumulariidae are summarized as follows.

Subfamily 1. **Halopterinae** nov. subfam. Hydrocladia arising independently from hydrorhiza, from a pinnate stem, or from the superficial tubes of a compounded stem. Pinnate stems bearing cauline hydrothecae. Paired lateral nematothecae present, of variable structure.

South African genera: *Antennella* Allman 1877
Corhiza nov. gen.
Gattya Allman 1886
Halopteris Allman 1877
Monostaechas Allman 1877
Schizotricha Allman 1883

Subfamily 2. **Kirchenpauerinae** Stechow 1921. Stem simple or pinnate, the latter without cauline hydrothecae. No paired lateral nematothecae. Median nematothecae poorly developed, seldom 2-chambered, often rudimentary and sometimes represented by naked sarcostyles only.

South African genera: *Kirchenpaueria* Jickeli 1883
Oswaldella Stechow 1919
Pycnotheca Stechow 1919

Subfamily 3. **Plumulariinae** Kühn 1913. Stem upright, giving off hydrocladia pinnately or in verticils. No cauline hydrothecae. Paired lateral or supracalycine nematothecae present. Nematothecae 2-chambered, movable, free from hydrotheca.

South African genera: *Nemertesia* Lamouroux 1812
Plumularia Lamarck 1816

Subfamily 4. **Aglaopheniinae** Stechow 1911. Stem upright and pinnate. No cauline hydrothecae. Hydrocladia with close-set hydrothecae generally facing towards the anterior surface. Paired lateral nematothecae normally present. Nematothecae 1-chambered and immovable, usually adnate to hydrotheca.

South African genera: *Aglaophenia* Lamouroux 1812
Cladocarpus Allman 1874
Halicornaria Allman 1874
Lytocarpus Allman 1883
Thecocarpus Nutting 1900

List of Species

Subfamily 1 **Halopterinae**

Antennella africana Broch 1914
Antennella secundaria (Gmelin) 1788–1793
Corhiza bellicosa n. sp.
Corhiza pannosa n. sp.
Corhiza scotiae (Ritchie) 1907
Gattya humilis Allman 1886
Halopteris constricta Totton 1930
Halopteris gemellipara n. sp.
Halopteris glutinosa (Lamx.) 1816
Halopteris tuba (Kirch.) 1876
Halopteris valdiviae (Stechow) 1923
Monostaechas natalensis Millard 1958
Schizotricha simplex Warren 1914

Subfamily 2 **Kirchenpaueriinae**

Kirchenpaueria pinnata (Linn.) 1758
Kirchenpaueria triangulata (Totton) 1930
Oswaldella nova (Jarvis) 1922

Subfamily 3 **Plumulariinae**

Nemertesia ciliata Bale 1914b
Nemertesia cymodocea (Busk) 1851
Nemertesia ramosa Lamx. 1816
Plumularia filicaulis Kirch. 1876
Plumularia lagenifera Allman 1886
Plumularia pulchella Bale 1882
Plumularia setacea (Ell. & Sol.) 1755
Plumularia spinulosa Bale 1882
Plumularia wasini Jarvis 1922

Subfamily 4 **Aglaopheniinae**

Aglaophenia late-carinata Allman 1877
Aglaophenia pluma (Linn.) 1758
Cladocarpus leloupi n. nom.
Cladocarpus lignosus (Kirch.) 1872
Halicornaria arcuata (Lamx.) 1816
Halicornaria exserta n. sp.
Halicornaria ferlusi Billard 1901
Lytocarpus filamentosus (Lam.) 1816
Thecocarpus flexuosus (Lamx.) 1816
Thecocarpus formosus (Busk) 1851

Systematic Section

Subfamily **Halopterinae**

Antennella africana Broch, 1914

Antennella africana. Millard, 1957, p. 226.

Records. West coast: TB 1A, 17B. TRA 86N, 156E. LAM 30J, 35D. SB 196L. CP 650F. WCD 56K.

South coast: AFR 994L. TRA 38N. MB 8R (pp), 12X, 47S, 52E, 58D, 59E, 60K. LIZ 7V. SCD 5J, 22B, 36U, 81Q, 96G, 152Y, 153E, 175F. SAMH 241, 279, 293, 309.

Remarks. This material includes one specimen (SAMH 309) in which all the dimensions are about double the normal.

The species is common on the west and south coasts of South Africa (from Luderitz Bay on the west (Broch, 1914) to approximately 29°E. on the south) and occurs in the intertidal region down to a depth of 120 m.

Antennella secundaria (Gmelin), 1788–1793

Antennella secundaria. Millard, 1958, p. 199.

Records. South coast: MB 8R (pp), 47S. SAMH 153, 165, 191, 212, 277, 360. LIZ 16G, 27K.

Description. Colonies reaching a height of 1·2 cm. Stems and hydrothecae sturdy and of greater dimensions than the material from Inhaca (Millard, 1958). Athecate internodes comparatively short and only rarely exceeding the neighbouring thecate internodes in length, bearing one or two nematothecae.

Measurements (mm.)

	**Inhaca*	*Mossel Bay*
Hydrocladium, length of basal part	0·99–2·75	1·73–3·27
thecate internode, length	0·26–0·34	0·32–0·43
athecate internode, length	0·26–0·38	0·22–0·45
athecate internode, maximum diameter ..	0·04–0·05	0·08–0·12
Hydrotheca, length abcauline	0·15–0·19	0·20–0·225
diameter at margin	0·15–0·19	0·27–0·32
Gonotheca, male, length (without pedicel) ..		0·32–0·40
maximum diameter		0·22–0·29
Gonotheca, female, length (without pedicel) ..		0·61–0·66
maximum diameter		0·41–0·48

Remarks. In poor material it is difficult to distinguish *A. secundaria* from *A. africana.* The number of nematothecae on the intermediate internodes and the proportionate length of the latter are no criterion, as both are variable characters. The only sure criterion is the presence of supplementary lateral nematothecae in *A. africana* and of a median supracalycine nematotheca in *A. secundaria*, and these are often lost. There appears to be no difference in the structure of the gonophores of the two species.

In South Africa both species are known only in the simple form. *A. secundaria* occasionally gives off one or two branches, but only from the back of the basal part of the stem, as mentioned also by Billard (1913, p. 8). True pinnate branching never occurs.

A. secundaria occurs on the south and east coasts of South Africa (from approximately 19°E. on the south coast (Stechow, 1925) to Inhaca on the east coast), in the littoral region, and down to a depth of 100 m. (Stechow, 1925).

Genus CORHIZA nov. gen.

Type species: *Antennopsis scotiae* Ritchie, 1907

Diagnosis. Plumulariidae with an upright and fascicled stem composed of a number of interwoven and intercommunicating tubes of equal diameter and importance. Hydrocladia arising from the component tubes in a completely irregular fashion, not rebranching. Hydrotheca with untoothed margin. Nematothecae (so far as is known) all bithalamic and movable, including paired laterals. Gonothecae borne on the hydrocladia, bearing nematothecae.

Corhiza bellicosa nov. sp.

(Fig. 2 A–E)

Types and records. Holotype: SCD 84S (South African Museum registered number = SAMH 364). Paratype: SCD 153J. (Both from south coast.)

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* Including material described by Millard, 1958.

Description of holotype. Several short and thick fascicled stems reaching a maximum height of 5·0 cm., a few of which branch irregularly, giving rise to numerous hydrocladia in an irregular fashion from the component tubes in the distal region. The individual tubes of the stem are connected to one another by communicating pores and branch irregularly. In the distal region the tubes usually separate from one another in clumps (the branches), and each one terminates in a hydrocladium. The hydrocladia of a clump or branch tend to face in the same direction, giving a '*Monostaechas*' appearance to the colony.

Hydrocladia unbranched, with proximal region athecate, divided by an irregular number of transverse internodes and bearing a double series of nematothecae. Remainder divided into thecate internodes by oblique nodes.

Hydrotheca borne on a projection near base of internode, with depth exceeding diameter, swollen in basal half, then narrowed slightly and expanding again to margin. Margin smooth, at right angles to internode. Most of adcauline wall adnate, but a small distal portion free.

Nematothecae generally 13 to an internode, including: 1 median inferior borne close to proximal end of internode and not reaching base of hydrotheca; 1 pair lateral inferior borne on base of internode slightly above level of median inferior and just reaching base of hydrotheca; 1 pair lateral borne on long processes arising at the side of the hydrotheca and not quite reaching thecal margin; 1 pair lateral borne on outer surfaces of bases of above processes; 1 pair lateral borne at the side of the hydrotheca about midway between above-mentioned process and thecal margin, overtopping hydrotheca; generally 2 pairs supracalycine borne above thecal margin (1 pair close to the midline and another pair further to the sides and at a slightly higher level).

There is, however, much variation in the number and position of the supracalycine nematothecae, and as few as 2 and as many as 9 have been observed, generally in pairs but often quite irregularly arranged.

All nematothecae bithalamic and movable. Nematotheca large, expanding towards margin, with sides of distal chamber cut right away to level of diaphragm resulting in a margin of 2 flaps—a high abcauline (i.e. outer) one, and a lower adcauline (i.e. inner) one.

Gonophores absent.

→

A–E. *Corhiza bellicosa* n. sp.

A. Two stems from the holotype, SCD 84S. There has probably been some distortion of the hydrocladia during preservation.

B–D. Two lateral views and an anterior view of portions of hydrocladia, from the holotype. B is taken from near the proximal end, and C from near the distal end, of hydrocladia.

E. Different views of the lateral nematothecae, the top one from SCD 153J, the other two from the holotype.

F. *Monostaechas natalensis* Millard. Different views of the nematothecae from SCD 153D (large form).

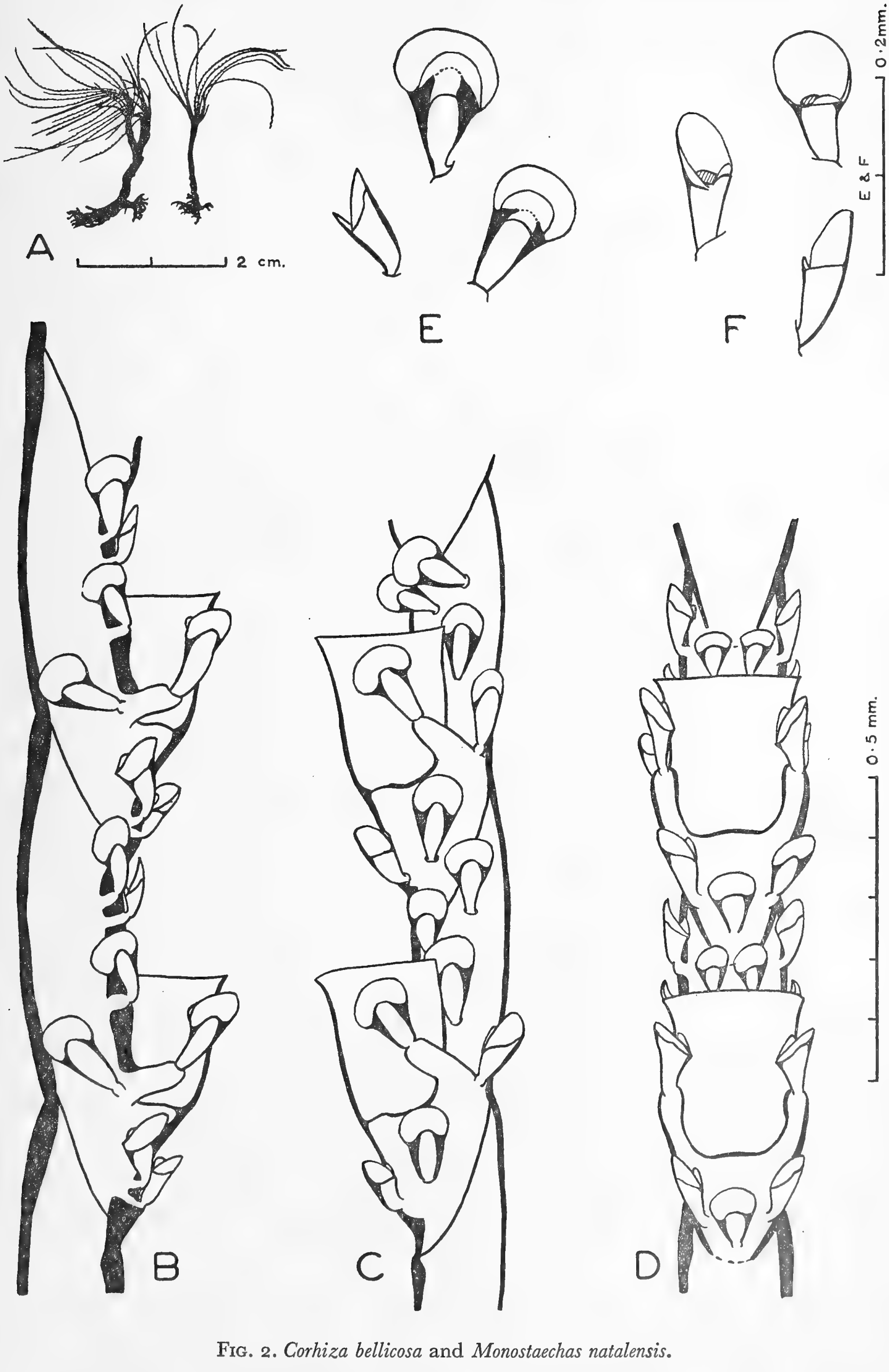

FIG. 2. *Corhiza bellicosa* and *Monostaechas natalensis*.

Measurements (mm.)

	SCD 84S (Holotype)	SCD 153J
Internode length (on posterior surface)	0·49–0·94	0·55–0·80
diameter (above hydrotheca)	0·13–0·18	0·14–0·20
Hydrotheca, height	0·22–0·27	0·23–0·31
diameter at margin	0·17–0·22	0·16–0·24
diameter/height	0·67–0·85	0·70–0·84
Nematotheca, height	0·09–0·15	0·11–0·16

Remarks. This species is very close to *Monostaechas faurei* Millard 1958, differing from it in the unbranched and longer hydrocladia, in the presence of 2 extra pairs of nematothecae to each internode, in the greater measurements of all individual parts, and in the shape of the hydrotheca where the proportion of diameter/height is greater. The shape of the nematotheca is very characteristic of the species.

Corhiza pannosa nov. sp.

(Fig. 3 A–B, D–G)

Types and records. Holotype: SCD 5H (South African Museum registered number = SAMH 362). Other records: SCD 61H, 67M, 186X. SAMH 292. WCD 12G.

Description of holotype. A bushy colony reaching a height of 5·3 cm. Hydrorhiza a matted reticulum. Stem strongly fascicled, branching irregularly, and giving off hydrocladia from its component tubes in a completely irregular fashion. Tubes of stem not canaliculated.

Hydrocladia borne on short apophyses of stem, reaching a maximum length of 2 cm. and bearing up to 20 hydrothecae. Basal 4 or 5 mm. devoid of hydrothecae, but divided by transverse nodes into 2 or more rather long internodes bearing a double series of nematothecae. Remainder of hydrocladium divided into thecate internodes by oblique nodes, though in some parts the distal end of an internode may be cut off by a transverse node.

Hydrotheca large, with almost parallel sides, standing away from hydrocladium at an angle of about 50°, with about half adcauline wall adnate to internode.

Nematothecae generally 7 to each internode, namely: 1 medial inferior; 2 pairs laterals (1 seated on a process arising next to the hydrotheca and not

---

→

A–B, D–G. *Corhiza pannosa* n. sp. A, the whole colony, and B, the lateral and supplementary lateral nematothecae in adcauline view, from the holotype SCD 5H. D–G, portions of hydrocladia from different samples to show variation. (D, the holotype. E, WCD 12G. F, SAMH 292. G, SCD 61H). F shows a gonotheca.

C. *Corhiza scotiae* (Ritchie). The lateral and supplementary lateral nematothecae from TRA 35B as a comparison with B.

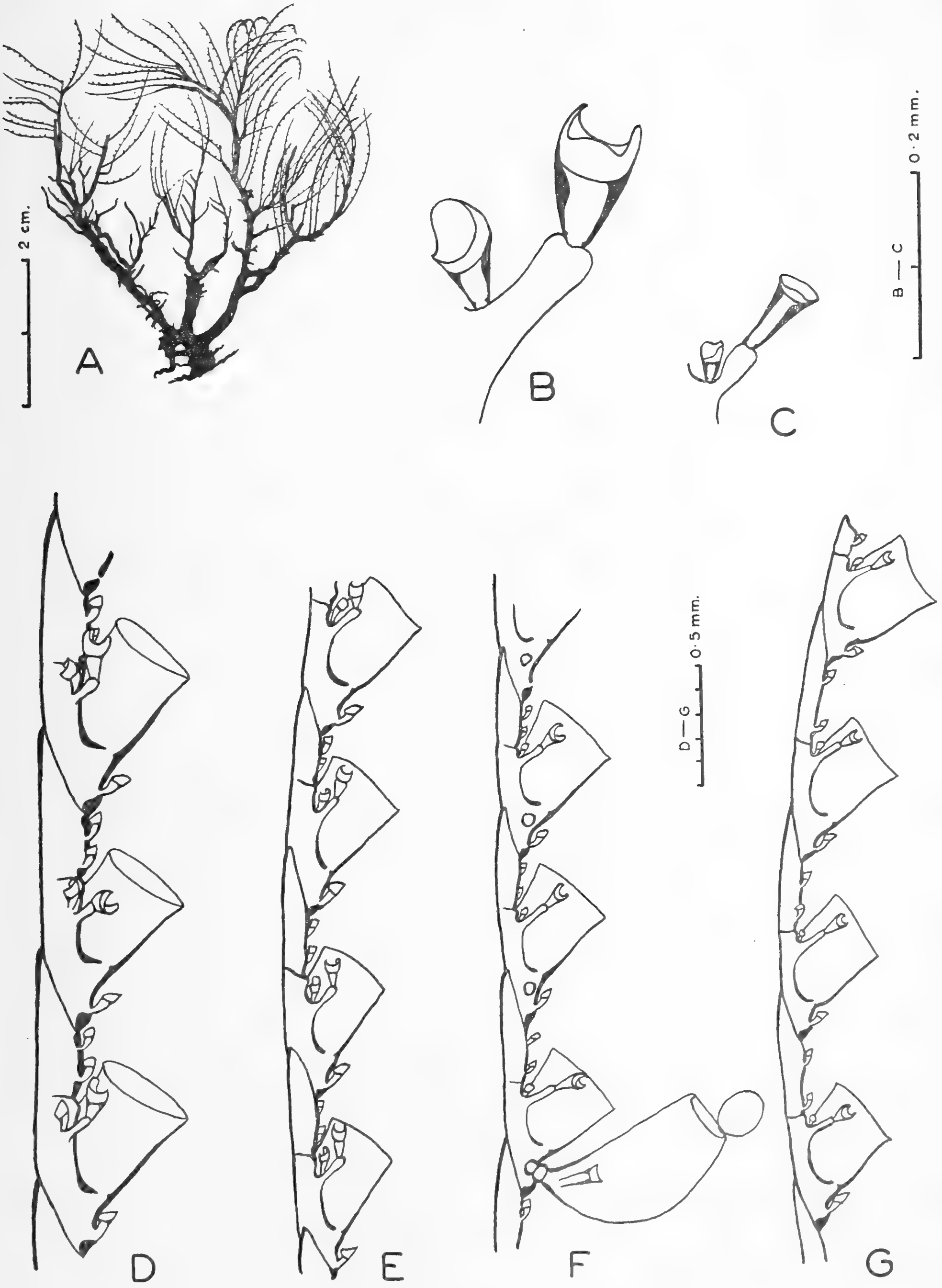

FIG. 3. *Corhiza* spp.

quite reaching margin, and 1 seated in the angle between this process and the internode); 2 (or occasionally 1 or 3) median superior.

Nematothecae all bithalamic and movable. Lateral nematotheca large and of characteristic shape: terminal chamber cup-shaped and deep, and with nearly parallel sides which turn in slightly at margin, with a distinct, deep excavation in adcauline (i.e. mesial) wall. Median nematotheca smaller, with very short adcauline wall.

Gonophores absent.

Measurements (mm.)

	SCD 61H	SAMH 292	SCD 186X	WCD 12G	SCD 5H (holotype)
Internode length (including distal end when cut off)	0·62–0·88	0·62–0·68	0·77–0·95	0·80–1·09	0·70–1·17
diameter, maximum	0·09–0·12	0·11–0·13	0·09–0·14	0·13–0·17	0·18–0·23
Hydrotheca, height abcauline	0·26–0·38	0·34–0·38	0·35–0·46	0·30–0·36	0·34–0·46
height adcauline, free part	0·16–0·245	0·20–0·24	0·20–0·22	0·14–0·20	0·16–0·25
diameter at margin	0·32–0·34	0·345–0·39	0·31–0·43	0·36–0·39	0·37–0·41
free part/abcauline height	0·58–0·71	0·54–0·66	0·50–0·57	0·42–0·58	0·41–0·555
diameter/abcauline height	0·84–1·31	0·99–1·15	0·72–1·06	1·00–1·23	0·87–1·09
Nematotheca height, lateral	0·10–0·11	0·11–0·14	0·11–0·13	0·11–0·16	0·15–0·19
supplementary lateral	0·03–0·08	0·045–0·06	0·07–0·09	0·07–0·12	0·09–0·15
Gonotheca, height		0·80	0·96–1·07		
breadth		0·33	0·36–0·59		

Remarks. In this species the form of the colony resembles closely that of *Corhiza fascicularis* (Allman) 1883 from Tristan da Cunha, the type material of which apparently no longer exists. It can be distinguished from other species of the genus in particular by its distinctive lateral nematothecae, which resemble most those found in *Halopteris glutinosa* (cf. Millard, 1958, figure 10). The details of the hydrocladia resemble those of *Monostaechas natalensis* Millard 1958, from which it is distinguished by its larger hydrothecae which are less adnate, and by the nematothecae.

Remarks on 'other records'. I have included with this species one stem fragment bearing hydrocladia (SCD 67M) exactly like the holotype, and 4 samples of solitary hydrocladia which appear to represent simple forms of the same species. The latter agree in all important features and particularly in the shape of the lateral nematothecae which are identical. A few minor differences do, however, occur. Thus the transverse nodes separating off intermediate internodes are better defined and almost invariably present, and in 3 of the samples (SCD 61H and 186X, and SAMH 292) the processes supporting the lateral nematothecae arise at a slightly higher level on the internode. Also in these simple forms most of the individual parts are smaller, particularly the lateral and supplementary lateral nematothecae. Yet the range of variation in the measurements of the different samples, and the overlapping which occurs, make it impossible to distinguish two species on these grounds.

Two of the simple forms (SAMH 292 and SCD 186X) bear male gonothecae. Each gonotheca arises immediately below a hydrotheca, is roughly pear-shaped but curved towards the hydrocladium, and bears a round operculum at the wide distal end and two large nematothecae near the base.

These simple forms can always be distinguished from South African species of *Antennella* by the characteristic shape of the lateral nematothecae.

Corhiza scotiae (Ritchie), 1907

(Fig. 3 C)

Antennopsis scotiae Ritchie, 1907, p. 543, pl. 3 (fig. 3). Ritchie, 1909, p. 90, fig. 8. Millard, 1957, p. 235.

Records. West coast: WCD 7L, 12F, 18M.

South coast: TRA 35B, 38C, 92D. SCD 26B, 67L, 84R, 153G, 175D, 191Q, 195K. SAMH 307, 323, 331, 345.

Remarks. This endemic species has a somewhat restricted distribution round the South African coast, being found between the lines of 17° and 28°E. longitude and in a depth-range of 18–120 m. It has never been found in the littoral area, and is typical of the Agulhas Bank.

Gattya humilis Allman, 1886

Gattya humilis Allman, 1886, p. 156, pl. 24 (figs. 5–7).
Paragattya intermedia Warren, 1908, p. 323, pl. 47 (fig. 27), fig. 16. Millard, 1957, p. 230. Millard, 1958, p. 209.

Records. West coast: PP 4Z. LAM 27G, 43H. SB 168D (recorded by Day, 1959, as *Paragattya intermedia*). CP 646D, 650E.

South coast: MB 15D, 52G, 60M, 88K. LIZ 27G. SCD 36R, 84Q. SAMH 275.

Remarks. Examination of Allman's type material of *Gattya humilis* in the British Museum of Natural History (reg. no. 86.2.19.41), and a comparison with Warren's cotypes of *Paragattya intermedia*, show that these species are synonymous. The material figured by Allman (pl. 24, fig. 6) includes 3 young stems, but in the same colony branching stems are also present similar to those described by Warren. Allman failed to observe the median superior nematotheca. Allman's material is labelled 'Port Elizabeth (?), Cape of Good Hope', and is almost certainly South African in origin. The genus *Paragattya* Warren 1908 thus becomes sunk in the synonymy of *Gattya* Allman 1886, with *Gattya humilis* Allman 1886 as the type species.

The following points may be added to the published descriptions. Firstly the first two oblique nodes of the stem are extra well defined as hinge-joints, and between them arise not one, but a pair, of opposite hydrocladia. Secondly the hydrocladia occasionally rebranch, the branch being of similar construction to the hydrocladium and bearing 1–3 hydrothecae. Both these features are also characteristic of the closely related genus *Halopteris*.

Halopteris constricta Totton, 1930

(Fig. 4 G)

Halopteris constricta. Millard, 1957, p. 227, fig. 14 A.

Records. South coast: LIZ 27J. MB 55H.
(Additional from False Bay: FAL 326D.)

Description. Two small colonies including simple and pinnate forms. Structure as previously described, except that in some stems the first (and sometimes also the second) segment after the hinge-joint gives rise to a pair of hydrocladia arising one on each side of the cauline hydrotheca.

Female gonothecae (not previously described) borne on thecate internodes of stem, each on a very short pedicel which arises on one side of the internodal projection which supports the hydrotheca. Gonotheca strongly curved towards the stem, with a wide distal aperture facing the stem, bearing 2 bithalamic nematothecae on basal part. (These gonothecae were not present in the samples from the south coast, but on new material from False Bay.)

Halopteris gemellipara nov. sp.

(Fig. 4 A–F)

Types and records. Holotype: SAMH 308. Other records: (NAD 22B). SCD 36P, 153L.

Description. Stem unfascicled, reaching a maximum height of 5·5 cm., bearing pinnately arranged hydrocladia. Basal part without hydrothecae or hydrocladia, divided by irregular transverse nodes, and bearing a median series of nematothecae on the anterior surface. No hinge-joints. Remainder divided into rather long internodes by oblique nodes; each internode bearing a hydrotheca near the base on the anterior surface, and a pair of opposite hydrocladia arising one on each side of the hydrotheca.

Hydrocladium borne on a short apophysis of the stem and separated from it by a transverse node, which, however, is often not clearly visible. Remaining nodes oblique. First internode athecate, bearing one median nematotheca near distal end. Remaining internodes thecate, but with the distal end sometimes cut off by a transverse node situated just above the attachment of the hydrotheca. Hydrothecae not exactly on the distal surface of the hydrocladium, but shifted slightly towards the anterior surface.

→

A–F. *Halopteris gemellipara* n. sp. A and B, two hydrocladial internodes from SAMH 308 (the holotype) and NAD 22B respectively. C, the whole stem; D, a cauline internode in anterior view; E, a lateral nematotheca; F, the median inferior nematotheca, all from the holotype.

G. *Halopteris constricta* Totton. A portion of the stem in lateral view showing female gonothecae, from FAL 326 D.

H, J. *Halopteris valdiviae* (Stechow). H, part of a hydrocladium with 2 male gonothecae; J, a female gonotheca. Both from SAMH 349.

K. *Halopteris glutinosa* (Lamx.), female gonotheca, from SAMH 278.

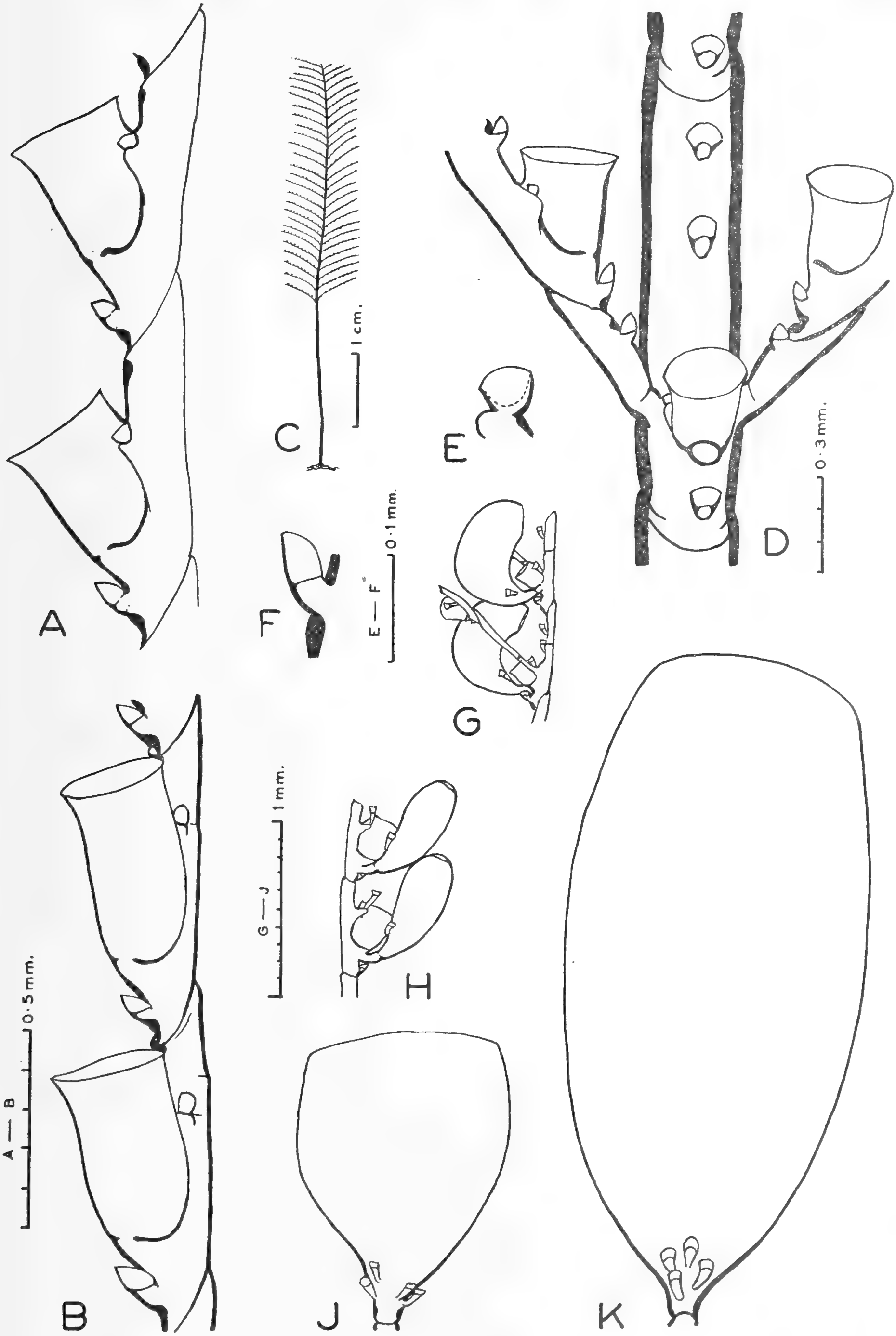

FIG. 4. *Halopteris* spp.

Hydrotheca cylindrical, expanding towards margin; adnate for about ⅔ height, then free; abcauline height exceeding (or rarely equal to or less than) width at margin; margin forming an angle of 55° or more with internode.

Each thecate internode bearing 3 nematothecae, one median inferior seated well below the base of the hydrotheca, and 2 laterals seated on short processes one on each side of the hydrotheca and not reaching margin. A single median supracalycine nematotheca sometimes present on hydrocladial internodes, and 2–4 on cauline internodes.

Median nematotheca short and broad, probably immovable, 2-chambered; with small basal chamber and larger distal chamber separated by transverse septum; with distal chamber cut away on adcauline side and margin facing towards internode. Abcauline wall strongly convex in supracalycine nematothecae, the nematotheca of the first hydrocladial internode, and the median inferior nematothecae on the stem; only slightly convex in the median inferior nematothecae on the hydrocladia.

Lateral nematotheca minute, 1-chambered, immovable, with adcauline wall cut away and margin facing towards internode.

Gonothecae absent.

Measurements (mm.)

	SAMH 308	NAD 22B	SCD 36P
Stem, internode length	1·24–1·69	1·18–1·96	1·00–1·63
diameter	0·28–0·41	0·21–0·32	0·27–0·365
Hydrocladium, internode length, first athecate	0·34–0·55	0·43–0·48	0·39–0·53
normal thecate	0·55–0·71	0·66–0·80	0·53–0·70
Hydrotheca, height abcauline	0·29–0·38	0·40–0·50	0·24–0·50
height, adcauline, free part	0·10–0·16	0·13–0·18	0·08–0·15
diameter at margin	0·29–0·33	0·24–0·29	0·26–0·295
free part/abcauline height	0·29–0·46	0·30–0·36	0·24–0·47
diameter/abcauline height	0·82–1·02	0·51–0·60	0·54–1·17
Nematotheca, height, median cauline	0·095–0·18	0·13–0·16	0·12–0·16
hydrocladial, median inferior	0·09–0·11	0·115–0·135	0·09–0·13
lateral	0·035–0·05	0·05–0·06	0·03–0·06

Remarks. In the measurements and the figure a sample from Natal (NAD 22B) is included, as it illustrates the variation possible in the species. It differs from the holotype in several particulars, mainly in the proportions of the hydrothecae, which are deeper and narrower. As a result the diameter at the margin is little more than half the abcauline height, whereas in the holotype the diameter is practically equal to the height. Further, the axis of the hydrotheca is more nearly parallel to the hydrocladium so that the margin forms an angle of about 70° with it as against about 55° in the holotype (fig. 4B). Intermediate internodes are also more common on the hydrocladia, especially towards their distal ends. Sample SCD 36P contains both forms, though on separate stems. Since the points mentioned are all differences of proportion and degree, and all structural details are exactly the same, and bearing in mind the tendency towards variation in *Halopteris*, I hesitate to separate these two forms as separate species, at least until more material is available.

One stem of the holotype shows a rather unusual abnormality and bears a pair of hydrocladia on the posterior surface in addition to those on the anterior surface.

H. gemellipara resembles *H. catherina* (Johnston) 1833 and *H. zygocladia* Bale 1914a in the possession of opposite hydrocladia, but differs from both in the monothalamic lateral nematothecae. In this respect, and in other structural details, it is very similar to *Antennellopsis integerrima* Jäderholm 1896, from Japan, differing from it in the longer free part of the hydrotheca and the oblique hydrocladial internodes.

Halopteris glutinosa (Lamx.), 1816

(Fig. 4 K)

Heteroplon pluma Allman, 1883, p. 32, pl. 8 (figs. 1–3).
Plumularia glutinosa. Billard, 1910, p. 36, fig. 16. Stechow, 1925, p. 502.
Plumularia alternata (Nutting), 1900. Jarvis, 1922 (pp), p. 345, pl. 25 (fig. 16).
Halopteris glutinosa. Millard, 1958, p. 200, fig. 10 A–D.

Records. South coast: LIZ 16E, 27H. MB 8S, 15E, 24V, 47M, 52D, 60J. SCD 36Q, 84P, 153K, 169U. SAMH 193, 197, 225, 276, 278, 298. TRA 92G.

Description. Colonies altogether more robust than those on the Natal coast (Millard, 1958), most of them reaching a height of 2–3 cm., but three large colonies reaching 10, 12 and 18 cm. (TRA 92G, SCD 84P, and SAMH 278 respectively), thus resembling more closely the colonies described by Allman and Stechow. In the larger colonies the lower regions of the stem have no visible nodes, the hydrocladia are usually lost, and the hydrothecae tend to be eroded and shallow. All measurements exceed those of the east coast material, though the proportions and appearance of the hydrothecae are similar. Hydrocladia may bear up to 15 hydrothecae. Lateral nematothecae with terminal chamber deeply cut away on adcauline (i.e. inner) side.

Stem internodes may bear as many as 3 extra pairs of nematothecae above the margin of the hydrotheca, and occasionally the 1-chambered supracalycine nematotheca is paired in the lower part of the hydrocladium.

Female gonothecae (not previously described) borne on the stem, each on a short pedicel of one segment arising next to a hydrotheca. Very large, flattened, bluntly rounded at distal end, bearing 2–5 2-chambered nematothecae near base, reaching a length of 3·74 mm. and a diameter of 1·70 mm.

Remarks. The material described by Jarvis (1922) from East Africa, and assigned by her to *Plumularia alternata* Nutting, is present in the British Museum of Natural History. On examination the samples from Zanzibar and Wasin both proved to be mixed, with some plumes (those illustrated in pl. 25, fig. 16, of Jarvis) resembling exactly *Halopteris glutinosa* and attributable to this species. In other plumes, however, the stems were more slender and geniculate and possessed athecate intermediate internodes, and the hydrothecae had sinuated margins, each with one distinct anterior lobe and 2 lateral lobes. It was undoubtedly these plumes which led Jarvis to assign the material to *P. alternata*, although the stems do not possess the delicacy of Nutting's material. They possibly represent a separate variety of *H. glutinosa* or a separate species altogether.

Halopteris tuba (Kirch.), 1876

(Fig. 5)

Plumularia tuba Kirchenpauer, 1876, p. 44, pl. 1 (fig. 2), pl. 4 (fig. 2).
Acladia africana Marktanner-Turneretscher, 1890, p. 261, pl. 5 (figs. 11, 11a).
Heteroplon jaederholmi Stechow, 1912, p. 366, figs. F, G.
Plumularia (*Heteroplon*) *africana*. Stechow, 1925, p. 500, figs. 44, 45.
Thecocaulus tuba. Leloup, 1939, p. 12, fig. 8.

Records. South coast: SCD 5M, 52L, 79F, 82K, 84N, 117S, 153F, 175A, 186W, 219U, 234Q, 239A. SAMH 194, 238, 249. AFR 865.O.G.

Description. Colonies of unfascicled, unbranched stems reaching a maximum height of 22 cm.

Basal part of stem without hydrothecae or hydrocladia, with a few irregular transverse nodes and a double row of movable nematothecae on the anterior face. This part usually terminated by 1 or 2 oblique hinge-joints. Where 2 hinge-joints occur the segment between them bears a single median hydrotheca on the anterior face and a pair of hydrocladia arising one on each side of it, also 1 medial inferior nematotheca and 4–8 movable nematothecae rather irregularly arranged above the hydrotheca.

Remainder of stem bearing hydrothecae and hydrocladia on anterior surface, unsegmented except for extreme distal end, where regular, slightly oblique nodes may occur. The first hydrotheca is median, and from the same level arises a pair of hydrocladia, one on each side of it. Thereafter the hydrothecae are displaced alternately to the right and left of the mid-line and the hydrocladia arise singly, alternately from the right and left sides of the hydrothecae (from the right side of a hydrotheca displaced to the right and vice versa). The hydrothecae and hydrocladial origins thus form 2 longitudinal rows on the anterior surface of the stem. Very rarely a pair of hydrocladia arises from the same level. Corresponding to each hydrotheca are 5 cauline nematothecae: 1 inferior, 2 lateral, and 2 minute supracalycine. Of these the inferior nematotheca is not situated immediately below its hydrotheca, but is displaced towards the opposite side of the stem.

Hydrocladia borne on short apophyses of the stem arising next to the cauline hydrothecae (the hydrothecae thus appear to be seated on the apophyses), divided into internodes by distinct oblique nodes. Apophysis without nematothecae. First internode short, athecate, with 1 median movable nematotheca.

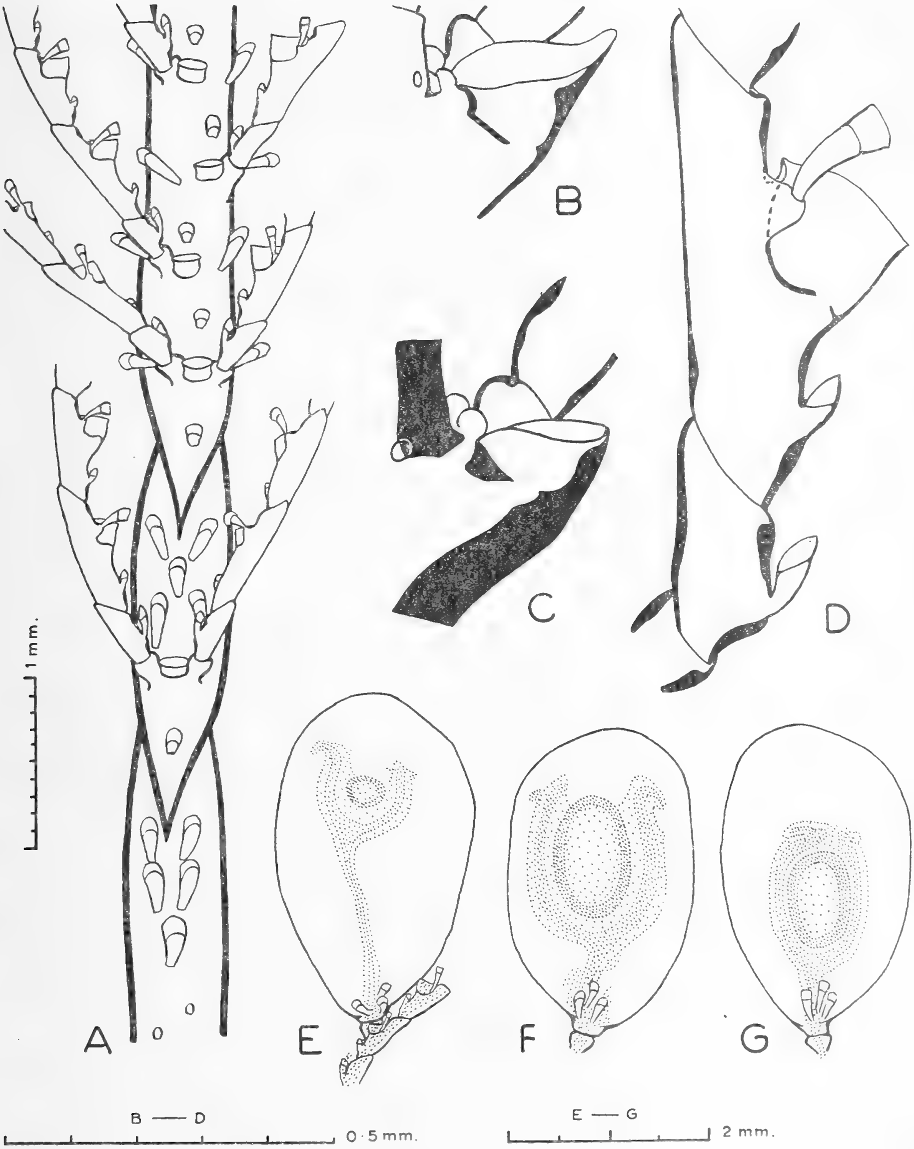

FIG. 5. *Halopteris tuba* (Kirch.).

A. The lower part of the stem in anterior view, showing hinge-joints and arrangement of hydrocladia and cauline nematothecae. From SAMH 238.

B, C. Cauline hydrothecae from SCD 5M to show shape of hydrotheca and supracalycine nematothecae—B from upper region, and C from lower region, of stem. Aperture for lateral nematotheca shown on left of diagram.

D. The first 2 hydrocladial internodes, from SCD 5M.

E–G. Stages in the development of the female gonophore, from SCD 5M.

Remaining internodes (up to 12 in number) each with 1 hydrotheca, 1 median inferior nematotheca, 2 lateral nematothecae, and 1 supracalycine naked sarcophore. Old colonies may have weak internodal septa at the proximal and distal ends of the internodes.

Hydrotheca shallow, with width exceeding (or, rarely, equal to) depth, and with untoothed margin. Hydrocladial hydrotheca adnate to internode to within a short distance of margin, then free. Cauline hydrotheca with abcauline wall greatly thickened, and margin eroded, particularly on adcauline and lateral sides, so that no free part remains. Hydropore very small, circular, close to abcauline side.

Nematophores of 4 types:

(i) Lateral nematothecae: slender, elongated, and movable. Bithalamic, with funnel-shaped distal chamber which is not cut away on adcauline (i.e. inner) side. Those on the hydrocladia arise from short processes of the internodes next to the hydrotheca and usually reach well above the margin. Those on the stem are much larger, and are not seated on processes, but emerge directly from oval openings in the perisarc. They are not contiguous to the hydrotheca but separated from it by a distance equal to about half the thecal width. The median nematotheca of the first hydrocladial internode is very similar, but smaller and with a wider base—it appears to be intermediate between this and the following type.

(ii) Median nematothecae: short, hook-shaped and immovable. With a transverse septum and thus bithalamic. Distal chamber with adcauline wall completely cut away. Situated well below hydrotheca and not reaching to base.

(iii) Supracalycine nematothecae: immovable, hook-shaped, minute, monothalamic. Situated immediately above the eroded adcauline wall of the cauline hydrothecae.

(iv) Naked sarcophores: situated in the angle behind the free part of the adcauline wall of the hydrocladial hydrothecae. It is possible that a nematotheca may be present and fused with the thecal wall, but it is not visible as a separate entity.

Male and female gonothecae (not previously described) borne on the same colony and often on the same hydrocladium with the male more distal than the female.

Female gonotheca arising from a small triangular pedicel attached to the first thecate internode of hydrocladium just below the hydrotheca and slightly to one side. Very large, flattened, rounded distally and tapering proximally. Bearing 3 nematothecae near base on surface facing hydrocladium, these being similar in size and appearance to the laterals of the stem. Containing a single embryo between the arms of a bifurcating blastostyle.

Male gonothecae borne on internodes of hydrocladia other than the first. Smaller than female, elongated-oval, with abcauline side more convex than adcauline, with distal aperture. (Appearance similar to male gonothecae of *H. glutinosa* (see Millard, 1958, fig. 10).)

Measurements (mm.)

	SCD 5M	SCD 79F
Hydrocladial internode, length on posterior surface, athecate	0·21–0·30	0·27–0·30
thecate	0·50–0·64	0·43–0·53
Hydrotheca, cauline, height abcauline	0·19–0·22	
width at mouth	0·22–0·27	
hydrocladial, height abcauline	0·12–0·16	0·16–0·20
width at mouth	0·20–0·27	0·20–0·25
Nematotheca, cauline, lateral	0·26–0·30	
median inferior	0·12–0·13	
supracalycine	0·04–0·06	
hydrocladial, lateral	0·16–0·21	0·11–0·17
median inferior (first)	0·11–0·15	0·11–0·14
median inferior (normal)	0·08–0·15	0·065–0·12
gonothecal	0·24–0·30	0·19–0·26
Gonotheca, female, length without pedicel	2·95–3·36	2·83–3·11
maximum diameter	1·51–1·94	1·40–1·54
Gonotheca, male, length		0·36–0·44
maximum diameter		0·15–0·25

Remarks. I am satisfied that Marktanner-Turneretscher's species *Acladia africana* (redescribed by Stechow, 1925) is a synonym for Kirchenpauer's species *Plumularia tuba*, and have accordingly combined the two. Kirchenpauer's material was re-examined by Leloup in 1939, who testifies to the excellence of Kirchenpauer's description and adds a more accurate diagram of a hydrocladial internode.

The only features distinguishing the two species are (i) the segmentation of the stem which is said to be absent in *A. africana* and present in *P. tuba*, and (ii) the hydrotheca, which is said to be completely adnate in *A. africana* and only partially so in *P. tuba*.

Kirchenpauer's type material has unfortunately been lost, but I have seen a prepared slide of Stechow's material of *A. africana*, and have found that the upper part of the stem is in fact segmented, and that the hydrocladial hydrothecae do have a short region which is not adnate.

There is an apparent variability in the length of the lateral nematothecae on the hydrocladia, which sometimes just overtop the thecal margin (as in Leloup's figure) and sometimes greatly overreach it (as in Stechow's figure, 1925). This appears to be a result of erosion of the thecal margin in the latter case (in deep hydrothecae the margin is sinuated and in shallow hydrothecae the margin is even and worn). Both types may occur on the same stem, but the lateral nematothecae always reach approximately the level of the next node.

A full description of the species has been given, since none of the published descriptions is quite complete. The arrangement of the cauline nematothecae was found to be exactly similar in Stechow's material.

It is evident that, as in all typical species of *Halopteris*, the arrangement of the cauline segments is essentially the same as that of the hydrocladia, differing only in the tendency for nodes to disappear, the lateral displacement of the hydrothecae and the nature of the supracalycine nematophores.

This endemic South African species occurs on the Agulhas Bank east of 19°E., extending round the coast to Natal waters. It is found in depths of 11–130 m.

Halopteris valdiviae (Stechow), 1923

(Fig. 4 H, J)

Thecocaulus(?) valdiviae. Stechow, 1925, p. 495, figs. 42–43.
Halopteris valdiviae. Millard, 1957, p. 228, fig. 14 B.

Records. South coast: SAMH 196, 248, 324, 332, 346, 349. SCD 79G, 169W. West coast: AFR 736X. WCD 7M.

Description. Two magnificent tree-like colonies reaching 35 and 37 cm. in height (SAMH 248 and 349), and a number of smaller colonies and detached portions. A few details may be added to previous descriptions.

Hydrorhiza forming a dense mat 5 cm. wide by 3 cm. high. Stem strongly fascicled, reaching 1 cm. in diameter near base, branching irregularly. Stem and branches giving off hydrocladia-bearing pinnae from the deeper tubes in an irregular fashion and from all surfaces.

Pinnae unfascicled, or very lightly fascicled near base, with basal part terminated by 2 oblique hinge-joints, but occasionally as many as 4, possibly due to regeneration. Segment between hinge-joints bearing 1 median cauline hydrotheca, and 1 pair of opposite hydrocladia on anterior surface. First segment beyond hinge-joints similar, with median hydrotheca and 1 pair of hydrocladia. Remaining segments each bearing 1 cauline hydrotheca, and 1 hydrocladium arising alternately from the right and left of the hydrotheca. Hydrocladia as described by Stechow (1925) and Millard (1957), bearing up to 9 hydrothecae.

Nematothecae as previously described, except that it is now possible to distinguish a pair of minute, monothalamic supracalycine nematothecae behind the free part of the adcauline wall of each cauline hydrotheca.

Gonothecae (not previously described) dimorphic, male and female on same colony, each borne on a small triangular pedicel of 1 segment which arises immediately below a hydrotheca and slightly to one side.

Male gonothecae borne on thecate internodes of hydrocladia, pear-shaped but slightly asymmetrical with the greatest curvature on side away from hydrocladium, with flattened distal end, bearing 2 bithalamic nematothecae near base on side facing hydrocladium.

Female gonothecae borne on internodes of pinnae, very much larger than male, flattened in a plane at right angles to pinna, expanding distally to a wide aperture, bearing 3 or 4 bithalamic nematothecae on side facing pinna.

Measurements (mm.)

Gonotheca, male, length	0·58–0·83
maximum diameter	0·20–0·39
Gonotheca, female, length	1·24–1·55
maximum diameter	1·01–1·22

The measurements of the trophosome agree well with those given by Millard (1957), except that the range is in some cases greater.

Remarks. It is now obvious that the material described by Millard (1957) consisted of 2 detached pinnae bearing hydrocladia.

This endemic South African species occurs on the west and south coasts as far east as 29°E., and in depths of 33–201 m. It is remarkably similar to *H. tuba* in the arrangement and structure of its hydrocladia, differing from it in its fascicled stem, and proportions of hydrotheca in which the depth is almost invariably greater than the width.

Monostaechas natalensis Millard, 1958

(Fig. 2 F)

Monostaechas natalensis Millard, 1958, p. 206, fig. 12.

Records. South coast: CPR 46J. SCD 153D.

Description. The first colony is of small size and similar to the holotype in its appearance and measurements, but the second colony (SCD 153D) is altogether of larger proportions. The fascicled stems branch irregularly and reach a maximum height of 7·6 cm., and individual hydrocladia reach a length of 3–4 cm. All the minute measurements are larger. The proportions of the parts are the same except that a greater part of the adcauline thecal wall is free from the internode. Towards the ends of the hydrocladia there is a tendency for the distal parts of the internodes to be cut off by transverse nodes. No branching hydrocladia were observed—any branching which may occur is obscured in the fasciculation of the stem. The general appearance of the colony is very similar to that of *Corhiza pannosa* n. sp., but it is clearly distinguished from it by the nature of the lateral nematothecae. With the larger size the structure of the latter could be more exactly ascertained. Each nematotheca has the sides deeply cut away to the level of the diaphragm, with a high, bonnet-shaped abcauline (i.e. outer) wall and practically no adcauline (i.e. inner) wall at all. It resembles that of *Corhiza bellicosa* n. sp., except that the adcauline wall is more reduced. In the holotype the structure of the nematothecae was not easy to determine because of the small size and the opacity of the contents, but a re-examination of the material with a phase-contrast microscope shows that they are of a similar nature and that the diagram given by Millard in 1958 (fig. 12E) was not strictly accurate. The measurements of the larger colony are given for comparison with the holotype.

Measurements (mm.)	SCD 153D
Internode length (on posterior surface)	0·71–1·05
diameter (above hydrotheca)	0·14–0·19
Hydrotheca, height	0·34–0·45
height of free part	0·19–0·24
free part/total length	0·44–0·65
diameter at margin	0·27–0·34
Nematotheca, length	0·09–0·17

Remarks. In view of the larger measurements sample SCD 153D might well be included in a separate variety, but one is reluctant to establish a new variety on size alone when little is known about the variation within the species.

Schizotricha simplex Warren, 1914

Schizotricha simplex Warren, 1914, p. 83, pl. 6 (figs. 1–19), figs. 1–4.

Records. S 65B (recorded by Stephenson, Stephenson and du Toit, 1937). L 430. CPR 9A.

Description. Colonies reaching a maximum height of 1·4 cm., agreeing exactly with the beautiful description by Warren, bearing male and female gonophores. In the larger stems practically all the 'pinnae' bear 3 thecate internodes and sometimes even 4, and many of the 'pinnules' bear 2.

Subfamily **Kirchenpaueriinae**

Kirchenpaueria pinnata (Linn.), 1758

Kirchenpaueria pinnata. Millard, 1957, p. 233. Millard, 1959b, p. 252.

Records. West coast: CPR 44A. SB 141U. LB 126, 190Q, 257P, 367X, 378E, 392R, 472H, 513J (recorded by Day, 1959). WCD 18N.

South coast: S 65A (recorded by Stephenson, Stephenson and du Toit (1937) as *K. unilateralis*). KNY 71C, 165A (recorded by Day, Millard and Harrison, 1952). E 83. LIZ 7X, 27F. L 54, 317, 336. CPR 7D, 9B.

Kirchenpaueria triangulata (Totton), 1930

(Fig. 6 E–J)

Plumularia triangulata Totton, 1930, p. 225, fig. 61.

Records. South coast: SCD 175G.

Description. Colony growing on the stems of *Nemertesia ciliata* Bale, and including both simple and pinnate forms.

Pinnate stem reaching a length of 1 cm., and consisting of long internodes separated by transverse nodes which may be indistinct in the lower region. Each internode giving rise to a hydrocladium-bearing apophysis from its distal end. Each internode bearing a well-developed mamelon on the upper surface of the apophysis, and 2–4 cauline nematothecae. The latter including 1 on proximal end immediately above apophysis of last internode, rarely 1 near distal end below the apophysis, and 1 (or rarely 2) on upper surface of apophysis distal to the mamelon.

Hydrocladia alternate, the two rows in one plane or shifted very slightly to one side of the stem. Hydrocladium normally homomerous and consisting of long thecate internodes separated by transverse nodes, but intermediate athecate internodes commonly occur and in quite an irregular fashion. Thus there may be 1–4 or none at all before the first thecate internode, and 1 or 2 of irregular length between successive thecate internodes.

Hydrotheca borne on the proximal half of the internode, which thus has a long distal region; flaring slightly to margin, completely adnate or with a very short free portion, with diameter exceeding depth.

Nematothecae: 1 median inferior and one median supracalycine; with convex abcauline wall and practically straight adcauline wall and oblique margin; movable; monothalamic, or with a very thin septum close to base.

Simple stem reaching a length of about 4 mm., similar to hydrocladium, borne on a long apophysis of hydrorhiza. Measurements of parts slightly smaller than corresponding ones of pinnate stem.

Gonothecae (male) borne by pinnate stem on hydrocladial apophyses to one side of mamelon, elongated, tapering below, truncated above, triangular in section. Pedicel of 2 segments.

Measurements (mm.)

	Pinnate stem	*Simple stem*
Stem internode, length	0·48–0·75	
diameter	0·07–0·16	
Hydrocladium, thecate internode, length	0·66–0·85	0·59–0·81
diameter at distal end	0·055–0·075	0·05–0·07
Hydrotheca, height abcauline	0·07–0·095	0·07–0·08
height of free part	0·00–0·01	0·00–0·01
diameter at mouth	0·10–0·12	0·095–0·11
Nematotheca, length	0·05–0·08	0·05–0·07
Gonotheca, male, length	1·74–2·46	
maximum diameter	0·80–0·85	

Remarks. The author agrees with Bedot (1923) that the main diagnostic character separating *Kirchenpaueria* from *Plumularia* should be the absence of paired nematothecae. Although the nematothecae in *Kirchenpaueria* as a whole are characteristically reduced, any attempt to separate the two genera on the

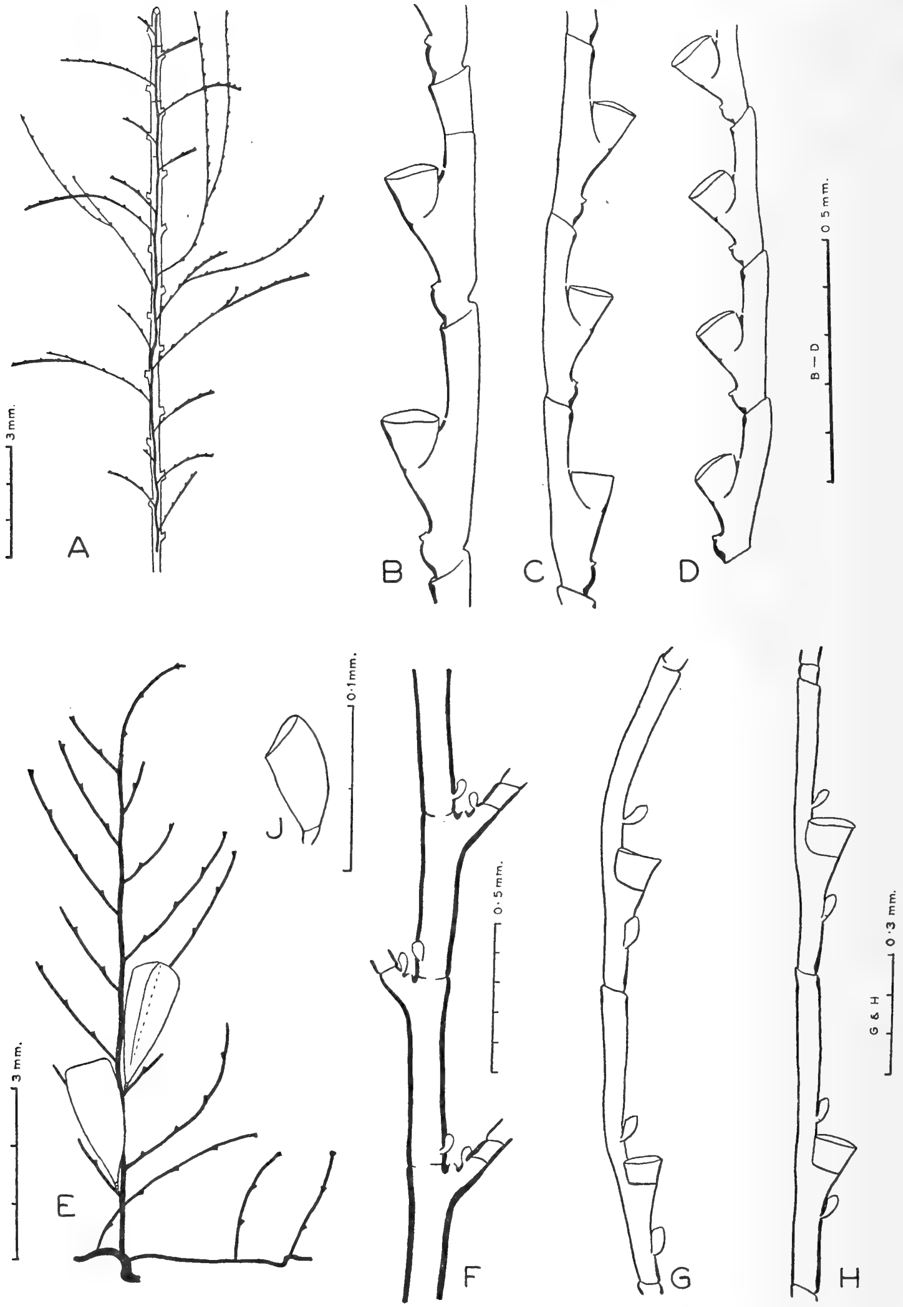

FIG. 6. *Oswaldella nova* (Jarvis) and *Kirchenpaueria triangulata* (Totton).

structure of the nematothecae alone will fail because of the presence of intermediate forms. Thus a group of species with but one superior nematotheca (including *P. halecioides* Alder 1859, *P. bonneviae* Billard 1906, *P. inermis* Nutting 1900, and others) has been assigned by Bedot (1923) to *Kirchenpaueria*, by Stechow (1923b) to a new genus *Ventromma*, and by most other authors to *Plumularia*. To this category also belong *Plumularia irregularis* Millard 1958 and *P. triangulata* Totton. Most of these species have monothalamic superior nematothecae, and are thus intermediate between a typical *Plumularia* and a typical *Kirchenpaueria*. In *K. triangulata*, however, a poorly developed septum is often visible in the nematotheca, and in *K. irregularis* it is quite distinct, so that in these genera the nematothecae are strictly speaking bithalamic and verging on the *Plumularia* type.

The South African material of *K. triangulata* agrees closely with Totton's description and resembles it in the epizootic habit of growth. The material shows much evidence of regeneration after injury, and this probably accounts for the presence of the many intermediate internodes, which were not mentioned by Totton. In one case the end of a stem has regenerated as a hydrocladium.

The species is closely related to *K. irregularis* (Millard) 1958, differing from it in the longer distal part to the hydrocladial internode and in the arrangement of the cauline nematothecae.

It is the first record of the species from South Africa.

Oswaldella nova (Jarvis), 1922

(Fig. 6 A–D)

Plumularia nova Jarvis, 1922, p. 347, pl. 26 (fig. 20).
Kirchenpaueria adhaerens Millard, 1958, p. 203, fig. 13 F, G.

Records. South coast: MB 47Z. SCD 84T. TRA 92H.
West coast: WCD 7N.
(Additional from Natal: NAD 1P.)

Description. A number of samples of epizootic colonies growing on other hydroids (*Halopteris glutinosa* (Lamx.)), *H. valdiviae* (Stechow) and *Gattya humilis* Allman).

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A–D. *Oswaldella nova* Jarvis.

A. Part of colony on back of stem of *Halopteris glutinosa*, from TRA 92H (hydrocladia of host cut off short).

B–D. Portions of hydrocladia from different colonies to show variation in size and shape: B from TRA 92H, C from NAD 1P, and D from MB 47Z.

E–J. *Kirchenpaueria triangulata* (Totton), from SCD 175G.

E. A colony including a pinnate stem bearing gonothecae, and several simple stems, removed from host.

F. A portion of a pinnate stem showing arrangement of nematothecae.

G, H. Hydrocladial internodes from a simple stem and a pinnate stem respectively.

J. A single nematotheca with diaphragm.

Hydrocladia arising direct from adherent stem, usually unbranched, but in one sample (TRA 92H) often forked. The division occurs immediately above the origin of a hydrotheca; both limbs are of equal thickness, and their hydrothecae do not face one another, but lie in the same plane as those of the original hydrocladium. Unbranched hydrocladia bearing up to 14 hydrothecae.

Hydrotheca variable in size and shape, with diameter generally exceeding, but occasionally equal to, height; usually free from internode for a small proportion of its length, but occasionally completely adnate.

Gonothecae absent, but scars probably of old ones present below hydrothecae and slightly to one side.

Measurements (mm.)

	MB 47Z	NAD 1P	TRA 92H	*Type material*
Internode length (posterior surface)	0·29–0·31	0·35–0·41	0·42–0·57	0·39–0·48
diameter near distal end	0·06–0·07	0·065–0·08	0·08–0·11	0·04–0·05
Hydrotheca, length abcauline	0·05–0·08	0·075–0·10	0·08–0·12	0·06–0·075
length of free part	0·01–0·03	0·00–0·02	0·01–0·04	*0·01
free part/abcauline length	0·125–0·43	0·00–0·25	0·10–0·40	*0·125
diameter at mouth	0·105–0·135	0·10–0·11	0·11–0·13	0·07–0·08

Remarks. Examination of the type material of Jarvis's species *Plumularia nova* in the British Museum of Natural History (slide no. 23.2.15.283 from Zanzibar) has established the fact that this species is synonymous with *Kirchenpaueria adhaerens* Millard. The correct measurements are quoted above and replace the incorrectly calculated ones given in 1958. The type material is scanty and damaged, and no hydrocladia bear more than 2 hydrothecae. The median inferior nematothecae are missing, though their orifices remain. In the only hydrotheca lying in a suitable position there is a short free part to the adcauline wall. The remains of one very damaged gonotheca are present, but it is impossible to determine the shape.

The discovery of forked hydrocladia in the new material necessitates the transfer of the species from *Kirchenpaueria* to *Oswaldella*, to which genus all its structural details indicate a closer affinity. Further knowledge of the growth-habits may indicate that it is merely an epizootic form of *O. bifurca* (Hartlaub) or *O. antarctica* (Jäderholm).

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* One measurement only.

Subfamily **Plumulariinae**

Nemertesia ciliata Bale, 1914b

(Fig. 7 E–G)

Nemertesia ciliata Bale, 1914b, p. 170, pl. 36 (fig. 1). Bale, 1915, p. 298. Briggs, 1914, p. 307, pl. 10 (fig. 3). Jäderholm, 1919, p. 23.

Records. West coast: TRA 47N. AFR 729H.
South coast: TRA 92F. AFR 945L. SCD 5N, 175C. SAMH 329.

Description. Several colonies, the largest reaching a height of 24·5 cm. Stem and larger branches fascicled, smaller branches unfascicled, branching always in one plane. Hydrocladia given off in whorls of 2, 3, or 4, but irregular in lower parts of branches; consisting of alternate thecate and athecate internodes, of which the first is always thecate.

Appearance and structure as described by Bale and Briggs, with the following minor points of difference.

The branching is not so luxuriant as in the specimen figured by Briggs and the branches are more widely spaced, with intervals in the neighbourhood of 5–10 mm. between them. In branches with two hydrocladia to a whorl it sometimes happens that the alternate pairs are not set at right angles to each other but compressed in one plane, forming angles of 40–60/120–140° with each other, and giving a flattened appearance to the branch. The same tendency may be found in stems with 3 hydrocladia to a whorl, as in *N. japonica* (Stechow) 1909, but it is not constant within a colony. The hydrocladia are often longer than in the type material, reaching 5–7 mm., and the internodes are in general somewhat longer, but the measurements of the hydrothecae are very similar.

Gonothecae as described by Bale.

Measurements (mm.)

Hydrocladium, internode length, thecate		0·29–0·51
athecate		0·14–0·28
diameter at distal end of internode		0·04–0·095
Hydrotheca, height abcauline		0·02–0·07
diameter at margin		0·06–0·085
Nematotheca, lateral, height		0·05–0·10
Gonotheca, length	reaching	0·49
maximum diameter	reaching	0·24

Remarks. This is the first record of the species from South Africa. So far it is known only from Tasmania and Japan.

I have not separated a var. *cruciata* as was done by Bale (1915), although both this and the normal form are present, as the tendency to produce different numbers of hydrocladia to a whorl almost certainly depends on the growth and age of the colony as has been shown for other species of the genus.

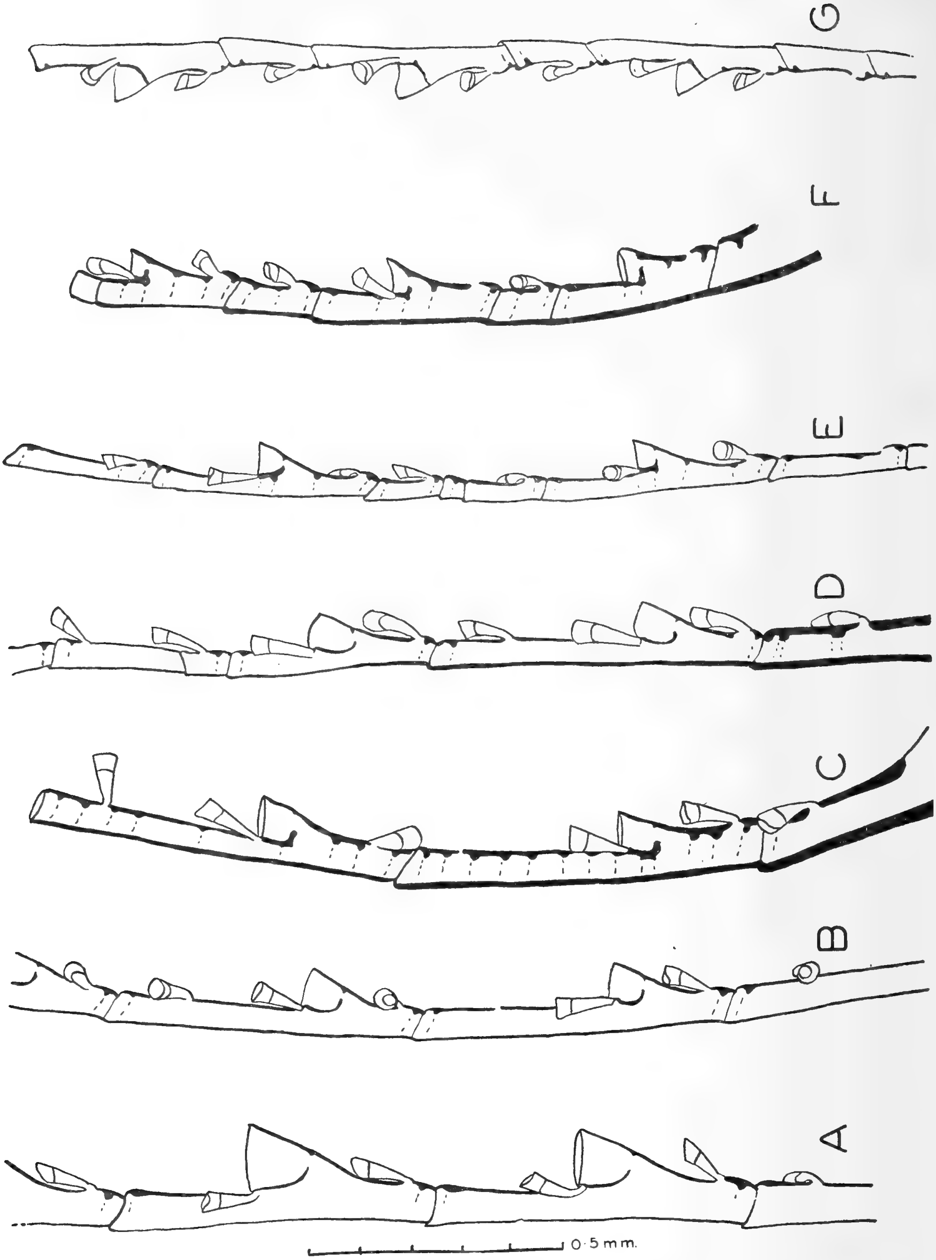

Fig. 7. *Nemertesia* spp., portions of hydrocladia showing variation.

A–D. *Nemertesia ramosa* Lamx.

- A. The typical appearance from TRA 125K. No superior medial nematotheca.
- B. An example with smaller hydrothecae, longer internodes, and superior medial nematothecae, from NAD 9K.
- C, D. Hydrocladial internodes from old and young regions respectively of the same colony, from TRA 134S. C with internodal septa and thickened perisarc.

E–G. *Nemertesia ciliata* Bale.

- E. The typical appearance, from TRA 47N.
- F, G. Hydrocladial internodes from old and young regions respectively of the same colony, from SAMH 329.

Nemertesia cymodocea (Busk), 1851

Nemertesia cymodocea. Billard, 1910, p. 39. Millard, 1957, p. 234. Millard, 1961, p. 207.

Records. West coast: SB 178B. TB 3, 4, 5, 18, 21A. TRA 156A.
South coast: MB 81N. AFR 865R. TRA 92K. SCD 26C, 36T, 52M, 153H, 175E, 219V. SAMH 148, 240, 347.

Description. The length of the hydrocladial internodes is variable, sometimes being almost double that quoted by Billard (1910, p. 40), though the size of the hydrotheca remains fairly constant.

Observations suggest that during the growth of a colony the stems first produce alternate hydrocladia, one to an internode, and that later the decussate arrangement develops at the tip of the stem, and still later the hexastichous arrangement. Thus young colonies bear only alternate hydrocladia and stems may reach a length of 10 cm. (and bear gonophores) before the decussate arrangement starts. The hexastichous arrangement is characteristic of the distal ends of old colonies, though by this time the proximal hydrocladia may be lost or buried by the peripheral tubes of the stem. In young colonies, too, the peripheral tubes bear a thick coating of nematothecae, which appear to fall off with age.

Nemertesia ramosa Lamouroux, 1816

(Fig. 7 A–D)

Antennularia ramosa, var. *plumularioides* Billard, 1906, p. 215.
Nemertesia ramosa. Millard, 1957, p. 235. Millard, 1961, p. 206.
Nemertesia ramosa, var. *plumularioides* (Billard), 1906. Vervoort, 1959, p. 293, figs. 46 b, 47.

Records. West coast: WCD 12D, 32H.
South Coast: TRA 92E. SAMH 333. SCD 5P, 96A, 153N, 175B.
(Natal: NAD 9K.)
(Additional from False Bay: TRA 134S.)

Description. A number of colonies of varying size, the largest reaching 28·2 cm. Considerable variation in appearance and structure occurs, much of which is probably due to growth and ageing of the colony.

The number of hydrocladia produced in a verticil appears to increase with age. In young colonies the hydrocladia have an alternate arrangement, 1 or 2 pairs to an internode. As growth proceeds the young shoots produce 2, 3, 4, or even 5 hydrocladia to a verticil, members of one verticil alternating with those of the next resulting in as many as 10 longitudinal rows. In old colonies only the verticillate arrangement is visible since the lower hydrocladia with alternate arrangement tend to fall off and their apophyses to be buried by the peripheral tubes of the stem.

The thickness of the perisarc also appears to increase with age and is possibly influenced by other factors as well. In young colonies the perisarc is thin, with the hydrocladia white and the stem a pale yellow or straw colour.

In old colonies the thickened perisarc gives to the stem and bases of the hydrocladia a dark brown colour. Associated with the thickening of the perisarc the nodes of the stem become indistinguishable and the hydrocladial apophyses very thick and long, athecate internodes become more numerous in the hydrocladia, and in the apophyses and basal parts of the hydrocladia appear internodal septa (up to 12 to an internode). The appearance of these regions is thus very different from that in the growing tips of the stems and the distal ends of the hydrocladia where the structure is similar to that usually described for the species.

Measurements (mm.)

Hydrocladium, internode length, thecate		0·34–0·86
diameter at distal end of internode		0·06–0·13
Hydrotheca, height abcauline		0·06–0·14
diameter at margin		0·07–0·14
Nematotheca, lateral, height		0·07–0·135
Gonotheca, length	reaching	0·94
maximum diameter	reaching	0·43

Remarks. Billard (1906) has created a var. *plumularioides* for forms of *N. ramosa* with alternate hydrocladia, but if, as seems practically certain, the arrangement of hydrocladia is a matter of age, the retention of this variety is unnecessary. Vervoort (1959) has described specimens with alternate hydrocladia reaching lengths of up to 25 cm. from tropical west Africa, but he himself mentions that the hydrocladia may be arranged in whorls of 3 in the upper parts of the larger colonies.

Plumularia filicaulis Kirchenpauer, 1876

Plumularia filicaulis. Millard, 1958, p. 209, fig. 13 D, E.

Records. West coast: WCD 34D, 81K.

Plumularia lagenifera Allman, 1886

Plumularia lagenifera. Millard, 1957, p. 230.

Records. West coast: TRA 156D. LAM 2J, 7L, 9V, 13H, 26Q, 46N, 59A, 62T. PP 1W. LB 511E (recorded by Day, 1959). A 382. WCD 34C, 81H. CP 650C.

South coast: KNY 30O (recorded by Day, Millard and Harrison (1952) as *P. setacea*).

Plumularia pulchella Bale, 1882

Plumularia pulchella. Millard, 1957, p. 232.

Records. South coast: SCD 37S. SAMH 290, 302. MB 8Q, 47Q, 52F, 55G, 60L. KNY 71B, 165B (recorded by Day, Millard and Harrison, 1952). LIZ 27C.

Description. Colonies reaching a maximum height of 1·1 cm. (KNY 71B), but usually between 0·3 and 0·7 cm.

Gonothecae ovate, truncated distally, with wide distal aperture, 5–5½ times height of hydrotheca.

Plumularia setacea (Ellis and Solander), 1755

Plumularia setacea. Millard, 1957, p. 232. Millard, 1958, p. 212. Millard, 1959b, p. 252.

Records. West coast: WCD 18R, 20F, 34E. TRA 156B. B 114D. LAM 21T, 27Z, 35C, 45X. SB 150A. LB 152, 367W (recorded by Day, 1959). TB 2, 21H. CP 640C.

South coast: SCD 5K, 52S, 169V. TRA 159A. SAMH 198, 224. CPR 1, 46H. MB 8T, 24X, 47R, 55F. E 170 (recorded by Stephenson, Stephenson and Bright, 1938). LIZ 17H, 27E. L 57, 145 (recorded by Eyre, Broekhuysen and Crichton, 1938).

Plumularia spinulosa Bale, 1882

Plumularia spinulosa. Bale, 1884, p. 139, pl. 12 (figs. 11–12). Bale, 1888, p. 783, pl. 19 (figs. 11–13). Warren, 1908, p. 320.
Monotheca spinulosa var. *obtusa* Stechow, 1923b, p. 224.
Plumularia spinulosa var. *obtusa.* Millard, 1957, p. 232.
Plumularia spinulosa var. *typica* Stechow, 1923b. Millard, 1958, p. 212.

Records. South coast: SCD 29G, 36W, 75G, 85A. SAMH 199, 291, 303. MB 47P, 58C. LIZ 13D, 27D. L 111 (reported by Eyre, Broekhuysen and Crichton, 1938).

Remarks. I have no longer attempted to distinguish var. *obtusa* from var. *typica* as I have found that the length of the terminal spine of the hydrocladium varies not only in different samples but also within the same colony. The origin of the hydrocladium, whether from the middle or distal end of a stem internode, is also a variable feature.

Plumularia wasini Jarvis, 1922

(Fig. 8)

Plumularia wasini Jarvis, 1922, p. 349, pl. 26 (fig. 23), fig. 1.

Records. South coast: CPR 46G.

Description. Stem reaching a height of 1·6 cm., unfascicled, unbranched, divided into internodes of irregular length by transverse nodes; basal part short and without hydrocladia; no hinge-joints; distal part giving rise to alternate hydrocladia, 1–3 per internode, the 2 rows in the same plane. Intervals between hydrocladia not regular, some being short and others long. Stem bearing 2 rows of cauline nematothecae (2–14 per internode), sometimes on the lateral sides but often shifted on to the anterior or even the posterior surface.

Hydrocladia borne on very short apophyses of stem, divided into alternate athecate and thecate internodes terminated by oblique and straight nodes respectively. Apophysis without nematothecae or mamelon.

Hydrotheca large, with even or slightly sinuated margin; free from internode for more than half height; with diameter always exceeding depth. Hydrothecae not strictly on upper surface of hydrocladium but shifted slightly onto anterior surface.

Nematothecae: 1 (or occasionally 2) on each athecate internode; 4 on each thecate internode, including 1 median inferior not quite reaching base of hydrotheca, 1 pair of laterals seated on processes next to hydrotheca and not quite reaching its margin, and 1 superior in angle behind adcauline thecal wall. All bithalamic and movable except superior which is monothalamic.

Gonothecae borne on thecate hydrocladial internodes, each on a short pedicel of 2 segments, and each bearing 2 or 3 large nematothecae on basal region. Two types present: the larger (probably female, but empty) on first thecate internode of hydrocladium only, pear-shaped, with large operculum at distal end; the smaller (male) usually on thecate internodes other than the first, more rounded and without operculum.

Measurements (mm.)

Stem internode, length		0·34–0·99
diameter		0·145–0·24
Hydrocladium, internode length (on posterior surface), thecate		0·16–0·21
athecate		0·17–0·25
Hydrotheca, height abcauline		0·12–0·185
height adcauline, free part		0·10–0·13
free part/abcauline height		0·65–1·00
diameter at margin		0·20–0·24
Nematotheca, lateral		0·06–0·085
inferior median		0·07–0·09
superior		0·03–0·045
cauline		0·09–0·11
Gonotheca, female?, length without pedicel	reaching	0·69
maximum diameter	reaching	0·61
male, length without pedicel,	reaching	0·35
maximum diameter	reaching	0·24

Remarks. This material was compared with a slide of Jarvis's type in the British Museum of Natural History. In the latter the athecate internodes normally bear 2 nematothecae, but the number is variable and some have only one. In the present material 1 is the normal condition and 2 occur only rarely. In the type material the superior median nematotheca is 1-chambered and not 2-chambered as figured by Jarvis (1922, pl. 26, fig. 23 A).

Certain minor variations sometimes occur. Thus in CPR 46G one hydrocladium bears a branch arising from its first thecate internode and bearing one hydrotheca.

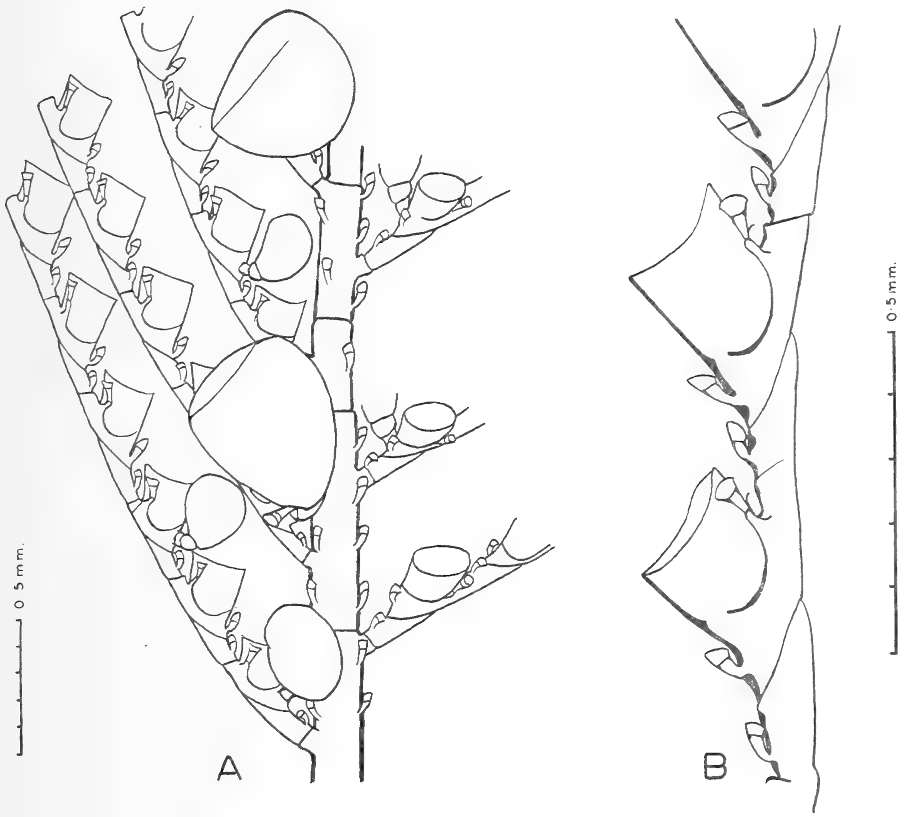

FIG. 8. *Plumularia wasini* Jarvis.

A. A portion of stem in anterior view showing male (small) and female (large) gonothecae and origins of hydrocladia. Gonothecae removed on right side.
B. A portion of a hydrocladium.
Both from CPR 46G.

This species is in some ways reminiscent of *Halopteris*, as instance the large hydrothecae which are not completely adnate, the shape and arrangement of the gonothecae, and the presence of nematothecae on them.

The species is so far only known from Wasin, East Africa. It is a new record from South Africa.

Subfamily **Aglaopheniinae**

Aglaophenia late-carinata Allman, 1877

Aglaophenia late-carinata. Millard, 1958, p. 213, fig. 14. Vervoort, 1959, p. 309, fig. 54.

Records. South coast: CPR 46F.

Aglaophenia pluma (Linn.) 1758, subsp. *dichotoma* (M. Sars), 1857

Aglaophenia pluma, var. *dichotoma*. Millard, 1957, p. 239, fig. 15 B, C. Vervoort, 1959, p. 308, fig. 52 b.

Records. West coast: LAM 16W, 35B, 51A. WCD 32G.

South coast: MB 5E, 34F, 37C, 42A, 79E, 81M, 84A. KNY 22F, 28C, 70B, 71D, 127A (recorded by Day, Millard and Harrison (1952) as *A. ?dichotoma*). TRA 35C, 36A, 38A, 42A, 56W, 99M. SAMH 149, 163, 195, 215, 322, 330, 344. SCD 20C, 26A, 29D, 69A, 94C, 103D, 104F, 108J, 126J, 133H, 152X, 153B, 191P, 195J, 199U, 239B.

Aglaophenia pluma (Linn.) 1758, subsp. *parvula* Bale, 1882

Aglaophenia pluma, var. *parvula*. Millard, 1957, p. 239, fig. 15 D–F. Millard, 1958, p. 215. Vervoort, 1959, p. 307, figs. 52 a, 53 b.

Records. West coast: SWA 5Y. N 116. LAM 45Z. B 114A. SB 141T, 194J. LB 511D. CP 17, 328, 335, 650G. TRA 156K. WCD 34F, 81A.

South coast: E 133. L 149. SAMH 201, 304.

Cladocarpus leloupi nov. nom.

Cladocarpus flexilis Leloup, 1939, p. 14, fig. 10.

Records. South coast: TRA 92J. SCD 96B, 122V, 141K, 145A, 153M, 188R.

Description. A number of colonies and fragments without root-stock, the longest stem reaching 22 cm. Stem fascicled but unbranched, bearing alternate hydrocladia. Stem internodes each bearing 3–6 median nematothecae, one in the axil of the hydrocladium and the rest below it. Cauline nematotheca with 1, 2 or 3 openings.

Hydrocladium and hydrotheca as described by Leloup, but intrathecal ridges tending to disappear towards the distal ends of the hydrocladia. Lateral nematotheca usually with 3 distal openings (but occasionally with 1, 2 or 4) and 1 lateral opening on mesial surface.

Gonophores absent.

Measurements (mm.)

Hydrocladial internode, length	0·70–0·87
diameter at distal end	0·08–0·13
Hydrotheca, depth to median tooth	0·45–0·62
diameter at margin	0·19–0·26

Remarks. In view of the fact that the name *Cladocarpus flexilis* is preoccupied by an American species, *C. flexilis* Verrill 1883, I assign to Leloup's species the new name *C. leloupi*.

Cladocarpus lignosus (Kirchenpauer), 1872

(Fig. 9)

Cladocarpus lignosus. Stechow, 1923b, p. 243, fig. J[1]. Stechow, 1925, p. 505. Millard, 1961, p. 206.

Records. South coast: TRA 38H, 56S, 151E. SAMH 167, 280, 284, 297, 306. SCD 36J, 52H, 84A, 153A, 201X.

(Natal: NAD 21F.)

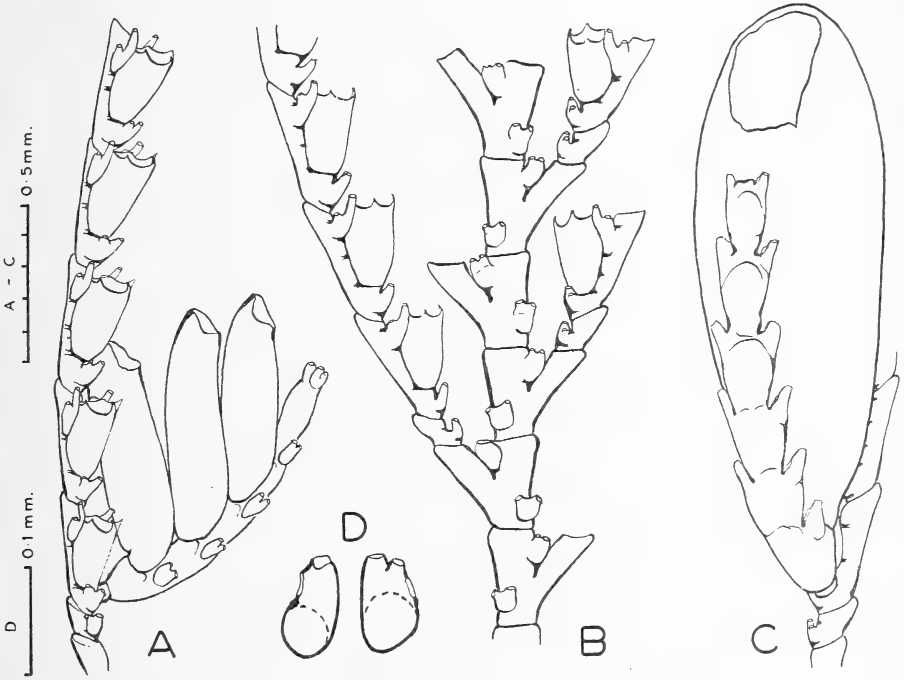

FIG. 9. *Cladocarpus lignosus* (Kirch.).

A, C. Phylactocarps bearing gonothecae, from NAD 21F and TRA 38H respectively.

B. The distal part of the hydrocladium-bearing tube of the stem to show segmentation and cauline nematothecae, from NAD 21F.

D. Two nematothecae from a phylactocarp, one with 2 apertures and the other with 3.

Description. Colonies large, reaching a maximum height of 34·5 cm., easily recognizable by the woody nature of the stem and the branching, which is always in one plane.

Stem dividing and subdividing in a very irregular fashion, some of the smaller branches showing a tendency towards an alternate arrangement, but frequently opposite or unilateral—the final result is a fan-shaped colony with well-dispersed branches.

Hydrocladia borne on the smaller and medium-sized branches, absent on the larger ones. Hydrocladia arising alternately from a single tube of the fascicled branch, this tube, where it is free from the peripheral tubes at the extremity, being regularly segmented, each internode giving rise to a long hydrocladium-bearing apophysis at about the middle of its length. Hydrocladium with first internode short and athecate, with 1 median nematotheca and 2 internodal septa; remaining internodes longer and thecate, each with a median and 2 lateral nematothecae, and 3 or 5 internodal septa. Three of the internodal septa situated as described by Stechow, but frequently an additional one at the extreme proximal and another at the extreme distal end.

Hydrotheca with depth about 1½ times width at mouth, slightly compressed laterally, with 1 anterior and 2 lateral marginal teeth, which may all be of equal size or with the anterior tooth slightly exceeding the laterals in length.

Median nematotheca arising from the basal swelling of the internode on which the hydrotheca is seated, very short, quite free from hydrotheca, with 2 distal, tubular apertures.

Lateral nematotheca with 3 apertures, one on the mesial surface, and 2 distal and tubular, of which the anterior one is long and reaches beyond thecal margin, and the other is shorter and reaches to the margin or just below it.

Two cauline nematothecae on one surface of each internode of the hydrocladia-bearing tube, 1 near base on opposite side to apophysis, and 1 in axil of apophysis, both with 2 distal apertures. Two rows of small, single nematothecae on each peripheral tube.

Phylactocarps present in the older parts of the colony, 1 or a pair, on each hydrocladium arising one on each side of the median nematotheca of the first thecate internode. Phylactocarp unbranched, curving towards hydrocladium, bearing up to 8 pairs of nematothecae. Nematothecae decreasing in size from base to tip, basal ones stout and with 3 apertures—2 terminal and 1 on mesial surface, distal ones more slender and generally with 2 apertures—1 terminal and 1 on mesial surface.

One to four gonothecae (not previously described) borne on each phylactocarp, 1 between the members of each pair of nematothecae on surface facing hydrocladium. Gonotheca elongated, with more or less rectangular aperture near distal end facing towards phylactocarp.

Measurements (mm.)

Hydrocladium, first internode, length on posterior surface	..	0·13–0·18
remaining internodes, length on posterior surface ..	..	0·33–0·42
Hydrotheca, depth to lateral tooth	..	0·23–0·29
width at mouth	..	0·15–0·19
Median nematotheca, length of free part	..	0·025–0·05
Lateral nematotheca, length	..	0·12–0·16
Gonotheca, length	reaching	1·78
width	reaching	0·68

Remarks. This endemic South African species occurs on the Agulhas Bank from 19°E. eastwards, extending round into Natal waters as far as 31°E. It occurs in depths ranging from 22 to 120 metres.

The plentiful material available makes possible the amplification of Stechow's description.

Halicornaria arcuata (Lamouroux), 1816

(Fig. 10 E)

Halicornaria arcuata. Millard, 1958, p. 218, fig. 15 D, E.

Records. South coast: MB 24U, 47G. KNY 30T, 71F. CPR 46A. SAMH 257, 300. SCD 20B, 84C, 117P, 169R.

Description. Rich colonies of unbranched stems reaching a maximum height of 12·8 cm.

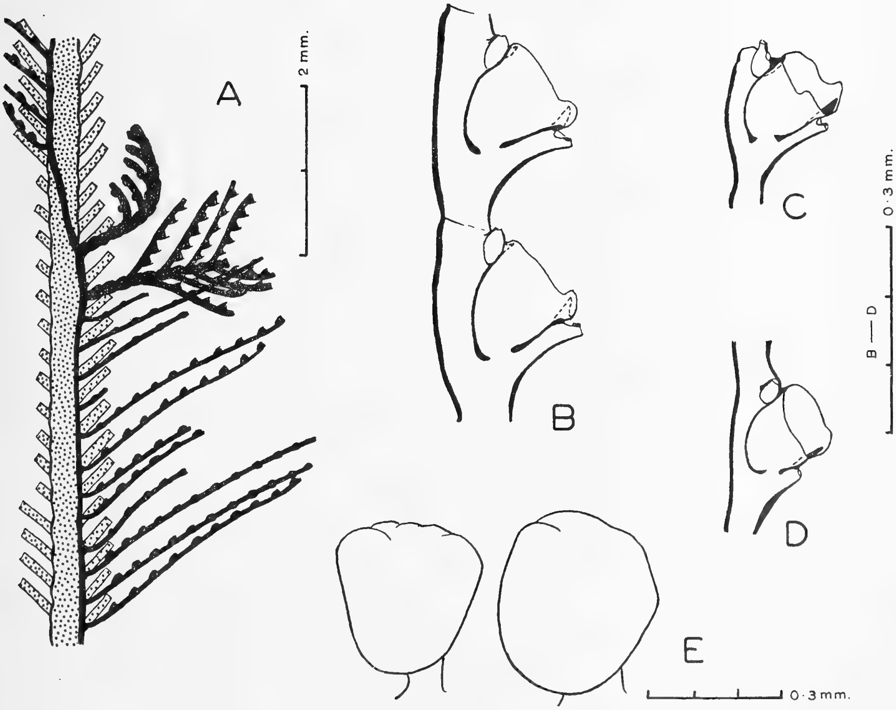

FIG. 10. *Halicornaria arcuata* (Lamx.).

A–D. Subsp. *epizootica* Millard.

A. Part of a colony from SCD 84D growing on the back of the stem of the normal subspecies. Hydrocladia of host cut off short.

B–D. Examples of reduced hydrothecae, B from SAMH 255, C and D from the upper and lower parts respectively of the same hydrocladium, from SAMH 355.

E. Subsp. *arcuata*, two gonothecae from MB 47G.

Hydrothecal margin with an anterior tooth, a posterior tooth and usually 3 pairs of lateral teeth. Of the latter the posterior pair is often poorly defined in the proximal region of the hydrocladium, and the middle pair in the distal region.

Median nematotheca usually closed at the tip, but often open in the proximal regions of the hydrocladia. Lateral nematothecae with 2 openings, of which 1 may be produced into a tube or into a long closed spine near the distal ends of the hydrocladia.

One stem bears several branching hydrocladia, possibly the result of injury. Each branch arises from the posterior surface of the hydrocladium and bears hydrothecae on the surface facing it.

Female gonothecae borne on the hydrocladial apophyses, 1 to each, and forming a double row on the anterior surface of the stem. Each is rounded below and truncated above, with the width slightly exceeding the height.

Remarks. Female gonophores are said to have been mentioned by Krauss (1837) as occurring in the axils of the hydrocladia, but this is the first description of these structures.

Halicornaria arcuata epizootica Millard, 1958
(Fig. 10 A–D)

Halicornaria arcuata var. *epizootica* Millard, 1958, p. 218, fig. 15 F.

Records. South coast: CPR 46C. SAMH 255. SCD 75B, 84D.
(Natal: SAMH 355.)

Description. Colonies epizootic on *Thecocarpus formosus* (Busk) and *Halicornaria arcuata* (nominate subspecies); consisting of solitary hydrocladia and upright pinnate stems.

Pinnate stems reaching 12·5 mm. in length and bearing hydrocladia with as many as 14 hydrothecae. Solitary hydrocladia bearing as many as 13 hydrothecae.

The hydrothecae and nematothecae are very variable in structure, those on the distal ends of the hydrocladia of pinnate stems resembling those of the nominate subspecies (see Millard, 1958, fig. 15 F), but those on the proximal ends of the same hydrocladia and those on solitary hydrocladia being successively reduced towards the base of the colony (fig. 10 B–D). This reduction affects: (*a*) the paired lateral and the posterior thecal teeth which become 'smoothed out' until the margin is merely sinuated; (*b*) the median inferior nematotheca, which becomes shorter and no longer reaches the level of the thecal margin; thus it may have no free portion and only one opening; and (*c*) the lateral nematothecae which become reduced, with the two apertures combined into one.

Gonophores absent.

Remarks. The same modifications were present in the holotype (Millard, 1958), but owing to the poor condition of the colony and the covering of silt it was not possible to determine whether the condition was normal or due to damage.

Halicornaria exserta nov. sp.

(Fig. 11 A–E)

Types and records. Holotype: SAMH 169 (South African Museum registered number). Additional records: SCD 36N, 153Y. All from the south coast.

Description (holotype). One upright stem 8·3 cm. in length and bearing gonophores. Hydrorhiza of same diameter as stem, with thick perisarc. Stem unfascicled and unbranched. Proximal region (about 1·5 cm.) unsegmented and without hydrocladia or nematothecae. Middel region (about 1 cm.) divided by transverse nodes into rather irregular internodes which tend to become progressively shorter, and which bear 1 or 2 median nematothecae each. Distal region divided into short hydrocladia-bearing internodes by slightly oblique nodes which slope in opposite directions so that the side of an internode bearing the hydrocladium is longer than the other.

Hydrocladia alternate, borne on short apophyses of the stem, one to an internode, reaching a maximum length of 1·75 cm. Each divided into thecate internodes by transverse nodes. No internodal septa.

Hydrotheca expanding to margin, with adcauline wall free from internode for a short region distally, and with abcauline wall bent strongly forwards. Margin with 1 prominent anterior tooth, 3 pairs of well-defined lateral teeth, and a low, rounded, posterior tooth. Hydropore with margin inturned.

Median inferior nematotheca short (about $\frac{1}{3}$ length of hydrotheca), adnate to hydrotheca for most of its length, with the terminal opening extending along all of the short free part, with no communication with thecal cavity. Lateral nematotheca ovoid, not reaching thecal margin or even beginning of free part, with 1 broad distal aperture. Cauline nematothecae similar to laterals: 1 inferior, 1 axillary anterior, and 1 axillary posterior.

Gonophores borne on hydrocladial apophyses and forming a double row down front of stem, bowl-shaped, with very short pedicels and broad, truncated, distal ends.

Measurements. See subspecies *epizootica.*

Remarks. This species is related to *H. sibogae* Billard 1918 and *H. expansa* Jäderholm 1903, but differs in the unbranched stem, shorter hydrothecae, the presence of a posterior marginal thecal tooth, and other minor details.

Halicornaria exserta epizootica nov. subsp.

(Fig. 11 F–H)

Holotype: SAMH 320 (South African Museum registered number). From south coast.

Description. Hydrorhiza epizootic on back of stem and hydrocladia of *Thecocarpus flexuosus* (Lamx.) *umbellatus*, giving off solitary hydrocladia and upright pinnate stems. Solitary hydrocladia arising alternately, reaching a maximum height of 0·5 cm. and bearing up to 10 hydrothecae, forming an angle of about 45° with hydrorhiza. The two rows of hydrocladia not in the same plane but shifted towards posterior surface of host. All hydrothecae facing same direction as those of host. Pinnate stems reaching a maximum height of 0·9 cm. and bearing alternate hydrocladia as in nominate subspecies.

Structural details similar to those of normal form except that the hydrocladial internodes tend to be longer and narrower and the hydrothecae are not so strongly bent forwards. Median and lateral nematothecae tending to be reduced in size towards the proximal region of solitary hydrocladia, so much so that the median nematotheca may not even reach the base of the hydrotheca.

Gonophores absent.

Measurements (mm.)

	Halicornaria exserta		subsp. *epizootica*
	SAMH 169	SCD 36N	SAMH 320
Hydrocladium, internode length	0·24–0·39	0·29–0·37	0·33–0·45
diameter at distal end	0·15–0·23	0·19–0·26	0·09–0·15
Hydrotheca, length adcauline	0·24–0·34	0·30–0·36	0·25–0·35
length adcauline, free part	0·03–0·06	0·03–0·06	0·04–0·08
length abcauline	0·28–0·34	0·34–0·36	0·22–0·33
diameter at margin	0·22–0·27	0·22–0·25	0·18–0·26
Median nematotheca, length	0·10–0·12	0·10–0·12	0·06–0·09
Lateral nematotheca, length	0·09–0·12	0·10–0·12	0·05–0·09
Gonotheca, length	0·26		
maximum diameter	0·42		

Remarks. This subspecies has a similar growth-form to that of *H. arcuata epizootica*, and shows the same tendency for reduction of nematothecae in solitary hydrocladia.

→

A–E. Subsp. *arcuata.*

A, B. The stem, and the gonotheca, from the holotype, SAMH 169.

C. Anterior view of stem showing the cauline nematothecae and scars for gonothecae (striped), from SCD 36N.

D, E. Anterior and lateral views respectively of part of a hydrocladium from the holotype.

F–H. Subsp. *epizootica*, from the holotype SAMH 320.

F. Part of a colony on the back of a stem of *Thecocarpus flexuosus umbellatus* showing solitary hydrocladia and 2 pinnate stems. Hydrocladia of host cut off short.

G, H. Anterior and lateral views respectively of part of a hydrocladium.

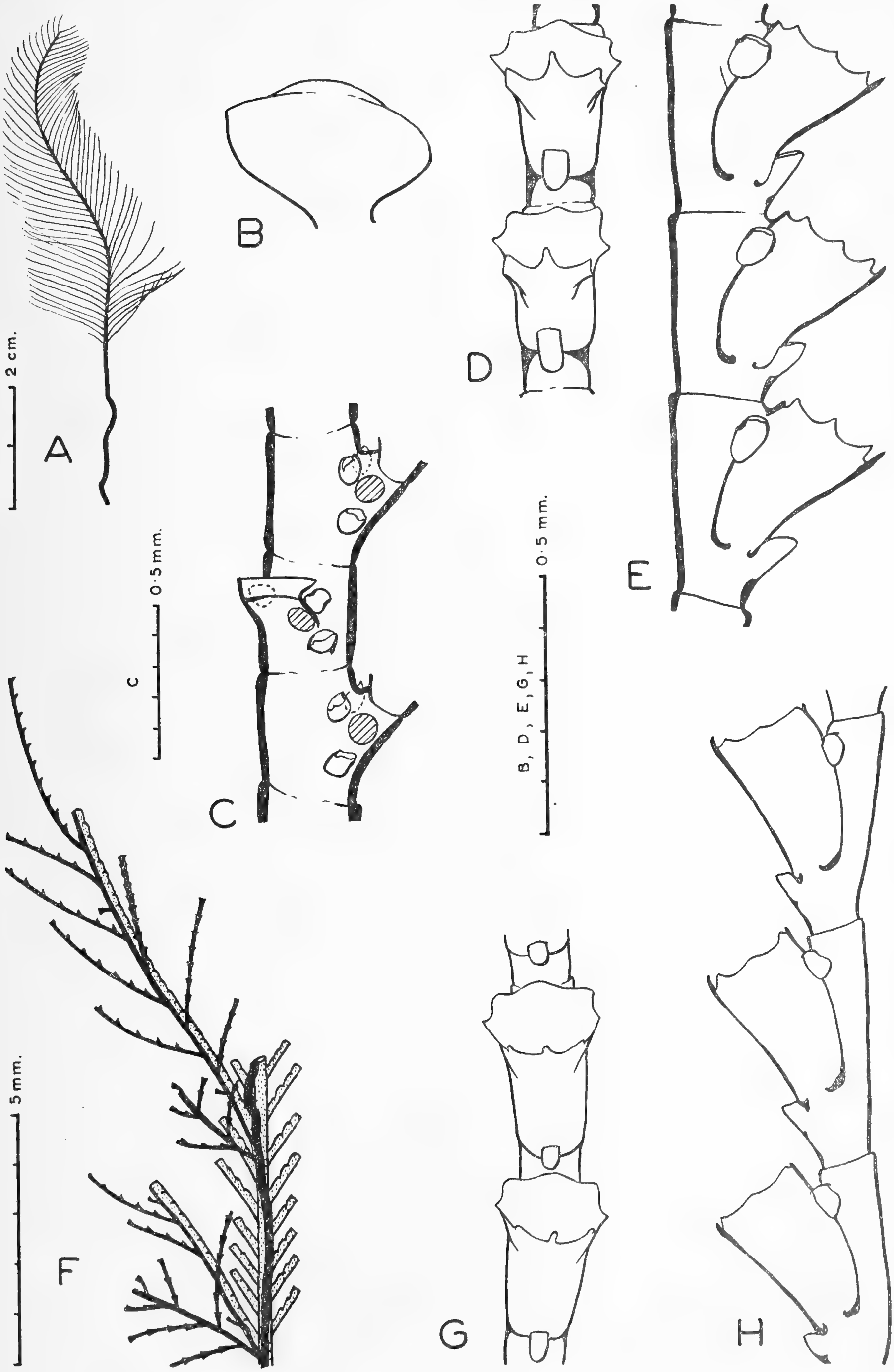

FIG. 11. *Halicornaria exserta* n. sp.

Halicornaria ferlusi Billard, 1901

Halicornaria Ferlusi. Billard, 1907, p. 370, pl. 25 (fig. 8), fig. 14.

Records. South coast: CPR 46B.
(Additional from Natal: NAD 1R.)

Description. Stem reaching a maximum height of 3 cm. Structural details exactly similar to those described by Billard.

Male gonothecae present (in NAD 1R only), similar to those described by Jarvis (1922) for var. *brevis*, except that there is no aperture, and no 'refractive discs' are visible. Each containing one gonophore.

Remarks. This species is known only from Madagascar, and var. *brevis* Jarvis from Wasin, East Africa. This is the first record from South Africa.

Lytocarpus filamentosus (Lamarck), 1816

Lytocarpus filamentosus. Millard, 1957, p. 241. Millard, 1958, p. 220.

Records. South coast: MB 15A, 24S, 26D, 39V, 47J, 52B, 55E, 58B, 70F, 72F, 83A. LIZ 7M, 13B, 27B. CPR 46E. TRA 42B. SAMH 150, 259. SCD 84F, 94E, 117Q, 169T.

Thecocarpus flexuosus (Lamx.), 1816

(Fig. 12)

Aglaophenia flexuosa Lamouroux, 1816, p. 167. Kirchenpauer, 1872, p. 25.
Aglaophenia plumifera Kirchenpauer, 1872, p. 31, pl. 1 (fig. 6), pl. 3 (fig. 6). Stechow, 1923b, p. 255, fig. K1.
Thecocarpus giardi Billard, 1907, p. 381, pl. 25 (figs. 9–10), pl. 26 (figs. 11–17), fig. 21. Vervoort, 1946, p. 335. Millard, 1957, p. 240. Millard, 1958, p. 221, fig. 16 A–C.
Thecocarpus flexuosus. Billard, 1909, p. 330.
? Aglaophenia(?) bifida Stechow, 1923a, p. 117. Stechow, 1925, p. 515, fig. 53.

Diagnosis. Stem thick, woody and fascicled, subdividing and giving rise to 'branches' formed from sympodially branching pinnae. Each pinna giving rise to a subsequent one from its anterior surface, the whole 'branch' twisted in a spiral manner and with a geniculate main axis formed from the proximal parts of successive pinnae. Each pinna consisting of a basal part bearing 1 large median nematotheca on each internode, and a distal part bearing 1 hydrocladium and 3 nematothecae on each internode. Hydrocladia alternately arranged, divided into internodes by slightly oblique nodes, each internode typically with 2 internodal septa. Hydrotheca adnate, deep, expanding to margin, with an intrathecal septum near base, and with 9 marginal teeth (1 median and 4 pairs lateral). Median nematotheca short, reaching approximately to level of intrathecal septum, with about $\frac{1}{4}$ length free. Lateral nematotheca reaching to thecal margin. Corbula replacing hydrocladium, with pedicel of 1–6 thecate internodes, elongated, closed. Each rib of corbula bearing a series of nematothecae along outer edge, a hydrotheca near the base, and a crested process of variable length below it. Base of corbula with a rounded projection facing towards pedicel.

Remarks. This species is endemic to southern Africa, where it appears to be widely distributed around the coast extending as far north as Madagascar on the east. It is extremely variable in its growth form and in its microscopic structure, necessitating the establishment of a number of subspecies. The characters of a subspecies are generally constant in a sample from a particular locality, though the occurrence of occasional intergrading specimens shows that all the material is conspecific. The species can always be recognized by the spiral arrangement of the pinnae, by the method of branching (described in detail by Billard (1907), and Millard (1958) under the name of *T. giardi*) and by the structure of the corbula.

It has already been shown (Millard, 1958) that the keel-like ridge along the abcauline wall of the hydrotheca (i.e. the outer point of the median tooth) may be hollow or solid. Material from the Agulhas Bank now shows that this ridge may be very poorly developed (so that the outer point of the median tooth may be shorter than the inner one), or absent altogether. Material with the latter arrangement has been placed in a separate subspecies, but amongst it rare hydrothecae occur showing the beginnings of a ridge, i.e. the first bifurcation of the median tooth. A series of hydrothecae can thus be arranged (fig. 12, C–M) showing the progressive development of this structure culminating in the large hollow spine of subsp. *flexuosus* and subsp. *umbellatus*.

The structure of the hydrotheca in the 'keelless' variety (fig. 12 C) closely resembles Stechow's diagram (1923b, fig. K^1) of Kirchenpauer's type material of *Aglaophenia plumifera*. The preserved material of the type of *A. plumifera* has unfortunately been lost, but Stechow states that the pinnae arise alternately and Kirchenpauer that they arise irregularly. Probably both are correct, for a series of alternate pinnae twisted in a spiral manner would give an irregular appearance. I have seen whole mounts of *A. plumifera* prepared by Stechow (loaned from the Munich Museum) including a complete pinna, and this shows absolute agreement with the 'keelless' variety including the presence of hinge-joints and the large median nematothecae on the internodes below them. The two are thus considered to be synonymous, and are given the status of a subspecies, under Kirchenpauer's name *plumiferus*.

Thecocarpus flexuosus plumiferus (Kirch.), 1872

(Fig. 12 C, D)

Aglaophenia plumifera Kirchenpauer, 1872, p. 31, pl. 1 (fig. 6), pl. 3 (fig. 6). Stechow, 1923b, p. 255, fig. K^1.

Diagnosis. Pinnae arranged in a loose to tight spiral around a 'main axis' which is seldom definitely geniculate. Intervals between pinnae regular and approximately equal. Basal and distal regions of pinnae separated by hinge-joints.

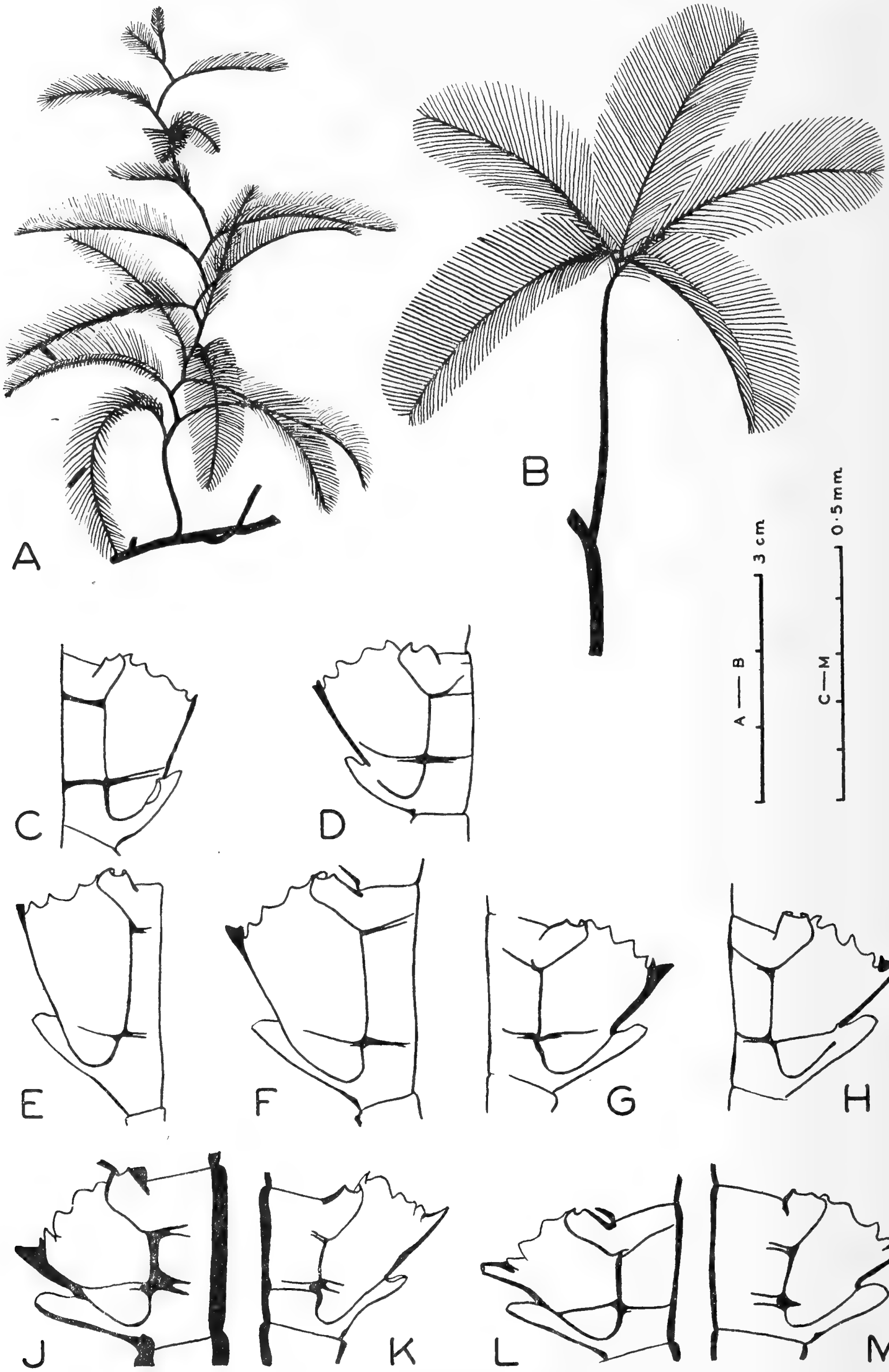

FIG. 12. *Thecocarpus flexuosus* (Lamx.).

Hydrocladia short, 3–6 mm. in length. Hydrotheca with no abcauline 'keel', but abcauline wall somewhat thickened near margin. First and second pairs of marginal thecal teeth not bifid.

Records. South coast: SCD 36L, 79H, 104G. SAMH 353.

Description. One of the colonies (SAMH 353) very large, reaching 46 cm., and with base of stem 12 mm. thick. The spiral twisting of the 'branches' is sometimes difficult to recognize in the lower, heavily fascicled regions of the colony, where also the geniculate appearance is lost. It is, however, quite distinct in the distal regions.

Unlike other subspecies a number of internodes below the hinge-joints may bear hydrocladia. Hinge-joints distal to origin of next pinna.

Corbulae sometimes very long, reaching a maximum length of 20 mm. and bearing up to 39 pairs of ribs.

See also p. 313.

Measurements. See under subsp. *umbellatus.*

Thecocarpus flexuosus flexuosus (Lamx.) 1816

(Fig. 12 A, J–L)

Thecocarpus giardi Billard, 1907, pp. 381–385, pl. 25 (fig. 9), pl. 26 (figs. 11–16), fig. 21. Vervoort, 1946, p. 335. Millard, 1957, p. 240. Millard, 1958, p. 221, fig. 16 A.
? Aglaophenia(?) bifida Stechow, 1923a, p. 117. Stechow, 1925, p. 515, fig. 53.

Diagnosis. Pinnae arranged in a loose to tight spiral, around a geniculate 'main axis'. Intervals between pinnae regular and approximately equal. No hinge-joints. Hydrocladia short, about 6 mm. in length. Hydrotheca with abcauline 'keel' extended beyond median tooth as a hollow spine. First and second pairs of marginal thecal teeth typically bifid.

Records. South coast: KNY 30R.

←

A. Subsp. *flexuosus.* Part of colony showing a spirally twisted 'branch' and its pinnae, from KNY 30R.
B. Subsp. *umbellatus* n. subsp. Part of colony showing one 'branch', from the holotype SCD 36M.
C–M. Selected hydrothecae showing variations, particularly of the anterior 'keel'.
  C, D. Subsp. *plumiferus* (Kirch.), a typical hydrotheca with no 'keel' from SCD 36L, and a rare hydrotheca with a slight indication of a 'keel', from SAMH 353.
  E–H. Subsp. *solidus* Millard, a rare terminal hydrotheca with the 'keel' barely distinct from the median tooth, from TRA 92C; a hydrotheca with well-developed 'keel' but restricted abcauline thickening, from TRA 92C; a typical hydrotheca with abcauline thickening reaching to base, from AFR 1028A (described by Millard 1958); and a rare hydrotheca with a hollow 'keel', from AFR 1028A (described by Millard, 1958).
  J–L. Subsp. *flexuosus,* a rare hydrotheca with a solid 'keel', from PF 396A (described by Millard, 1957); a typical hydrotheca with a hollow 'keel' and a bifid lateral tooth, from PF 12308B (described by Millard, 1958); and a hydrotheca with an extra long 'keel' pierced at distal end, from KNY 30R.
  M. Subsp. *umbellatus* n. subsp., a typical hydrotheca, very similar to K except that the lateral teeth are not bifid, from the holotype SCD 36M.

Thecocarpus flexuosus solidus Millard, 1958

(Fig. 12 E–H)

Thecocarpus giardi Billard, var. *solidus* Millard, 1958, p. 222, fig. 16 B, C.

Diagnosis. Pinnae arranged in a loose to tight spiral around a geniculate 'main axis'. Intervals between pinnae regular and approximately equal. Basal and distal regions of pinnae separated by hinge-joints. Hydrocladia short, about 6 mm. in length. Hydrotheca with abcauline 'keel' forming a solid spine. First and second pairs of marginal thecal teeth not bifid.

Records. South coast: TRA 92C. SCD 29F, 36K, 84E. SAMH 190.

Remarks. One of these samples (TRA 92C) shows characters tending towards subsp. *plumiferus* (fig. 12 E, F). The abcauline 'keel' of the hydrotheca is poorly developed and restricted to the margin, the typical chitinous thickening which usually extends down to the junction of the median nematotheca being absent.

In the same sample there is a number of branching hydrocladia. A hydrocladium may produce as many as 7 subsidiary hydrocladia, and in rare cases the subsidiary hydrocladia branch too. The hydrocladial internodes which give rise to branches are without hydrothecae and similar in every respect to those of the distal region of the pinna.

Thecocarpus flexuosus umbellatus nov. subsp.

(Fig. 12 B, M)

Diagnosis. Pinnae (usually 5) arranged in a very close spiral forming an umbel-like cluster at the end of a long 'stem' formed by the proximal region of the first pinna. Hinge-joints present on first pinna only. Hydrocladia long (reaching 15 mm.). Hydrotheca with abcauline 'keel' extending beyond median tooth as a hollow spine. First and second pairs of marginal thecal teeth not bifid.

Types and records. Holotype: SCD 36M (South African Museum registered number = SAMH 363).

Further records, south coast: SCD 33B, 117M, 153C. SAMH 168, 258, 286, 305, 319.

Description of holotype. Colony reaching a height of 12·3 cm. Stem fascicled and dividing near base to give the branching pinnae or 'branches'.

First pinna with basal part long (several cm.), usually lightly fascicled (though the peripheral tubes do not extend on to the distal part), divided into internodes each with 1 large median nematotheca with several (3–6) openings. This part terminated by 2 oblique hinge-joints, the internode between them bearing 2 large median nematothecae. Distal part bearing 2 hydrocladia on the first internode and 1 on each of the rest, and giving origin to the next pinna from the anterior surface of the first to fifth internode.

Second pinna facing towards the first, seated on a short apophysis, with no basal part and no hinge-joints, consisting only of hydrocladia-bearing internodes, and giving rise to the third pinna from its second internode.

Subsequent pinnae (usually 3) as second, and the 'main axis' (formed by the origins of consecutive pinnae) twisted in a spiral manner.

Hydrocladia alternate, long, reaching 15 mm. Hydrotheca similar in structure to subsp. *flexuosus* except that the first and second lateral teeth are not bifid. Hydrothecal depth and hydrocladial internode length varying from that found in subsp. *flexuosus* to that in subsp. *perarmatus* Billard 1907.

Corbula (not from holotype) with up to 20 ribs and reaching 12 mm. in length. In some cases there is an enormous development of the terminal parts of the ribs and the 'crests' arising from their bases, giving to the whole a spidery appearance similar to that sometimes encountered in *T. formosus*.

Measurements (mm.)

		subsp. *umbellatus*	subsp. *plumiferus*	*Aglaophenia plumifera**
Hydrocladium, internode length	..	0·19–0·32	0·28–0·37	0·28–0·30
Hydrotheca, height (to tip of inner point of median tooth)	.. .. ..	0·22–0·30	0·23–0·31	0·24–0·27
diameter at margin (inside)	..	0·16–0·21	0·14–0·205	0·13–0·18
Median nematotheca, length	.. ..	0·14–0·24	0·13–0·21	0·15–0·18
length of free part	.. .. ..	0·03–0·06	0·03–0·04	0·03–0·04
Corbula, length	.. .. reaching	8·50	20·00	
diameter	.. .. reaching	1·40	1·32	

Remarks. Although the arrangement described above is remarkably constant, variations do occur (e.g. longer intervals between origins of pinnae) which show that this form is not worthy of specific rank. The top part of the colony breaks easily at the hinge-joints and many specimens brought up by the dredge consist of crowns only. The pinnae often terminate in long tendrils.

Thecocarpus formosus (Busk), 1851

Thecocarpus formosus. Millard, 1958, p. 221. Millard, 1961, p. 206.

Records. South coast: MB 24Y, 47F. KNY 30S, 57K, 71A (recorded by Day, Millard and Harrison, 1952). LIZ 7N, 27A. BMR 12K. L 55. CPR 46D. SCD 20A, 29E, 36H, 50B, 75A, 84B, 94D, 117N, 169S. SAMH 200, 210, 254, 285, 299.

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* Measurements from Stechow's slides borrowed from the Munich Museum.

SUMMARY

A total of 35 species of plumularian hydroids is described from the south and west coasts of South Africa. Among these are 4 new species and 4 new records from South Africa.

A new subfamily, the Halopterinae, is created for genera with cauline hydrothecae and related forms, and possible evolutionary trends within it discussed.

The genus *Antennopsis* is sunk in the synonymy of *Nemertesia*, and a new genus, *Corhiza*, created. The genus *Paragattya* is sunk in the synonymy of *Gattya*.

Various problems of nomenclature are dealt with, including that of *Thecocarpus flexuosus*, and the subspecies of the latter are revised.

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SYNONYMY. Arrangement according to Schenk, E. T. & McMaster, J. H.: *Procedure in taxonomy.* 2nd ed. Stanford, Stanford university press, 1948. Bibliographic references modified.

'I. *Synonymy arranged according to chronology of names.*—All published scientific names by which a species has been previously designated (subsequent to 1758) are listed in chronological order, with bibliographical references to all descriptions or descriptive citations following in chronological order after each name. . . .

B. *Form of bibliographic references to synonymic names.*—The first reference following any name in the synonymy should be to the earliest citation of that name. This should be followed by references to all subsequent citations of the same name, arranged in chronological order. . . .'

Bibliographical references modified to consist of author's name, date of citation, pagination and illustrations (plates and figures).

Example:—

Eulalia (*Steggoa*) *capensis* Schmarda

Eulalia capensis Schmarda 1861, p. 86, pl. 29, fig. 231. Willey 1904, p. 259.
Eulalia viridis var. *capensis* McIntosh 1903, p. 34. Day 1953, p. 30.
Eulalia viridis (*non* Muller) Ehlers 1913, p. 455. Day 1934, p. 30.

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ANNALS

OF THE

SOUTH AFRICAN MUSEUM

VOLUME XLVI

PART XII

SOUTH AFRICAN DEEP-SEA PYCNOGONIDA, WITH DESCRIPTIONS OF FIVE NEW SPECIES

By

J. H. Stock

Zoölogisch Museum, Amsterdam, Holland

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[CONTINUED ON INSIDE BACK COVER

SOUTH AFRICAN DEEP-SEA PYCNOGONIDA, WITH DESCRIPTIONS OF FIVE NEW SPECIES

By

J. H. Stock

Zoölogisch Museum, Amsterdam, Holland

[Accepted April 1960]

(With 10 figures in the text)

Contents

Introduction

The interesting collection of deep-sea Pycnogonida on which the present paper has been based was entrusted to me by Dr. F. H. Talbot of the South African Museum. Taking into consideration the considerable depths in which the animals were caught (ranging from 1,470 to 1,785 fathoms), and the relative rarity of Pycnogonida in general, the present collection is pretty rich both in species and in individuals.

The material collected belongs to 5 genera only: *Nymphon* (1 species), *Ascorhynchus* (1 species), *Colossendeis* (6 species), *Anoplodactylus* (1 species), and *Pantopipetta* (3 species). Although all of these were known to be restricted to, or to have representatives in, the deep sea, the occurrence of not less than 3 species of *Pantopipetta*, a very rare genus, is most surprising.

The strong armature of body and legs with long spurs and long, stiff setae in several of these abyssal species is a curious morphological phenomenon, and is at least for the genus *Nymphon* quite unusual.

Pycnogonid material was taken in the following deep trawlings (gear: 15′ beam trawl); Station A 193 especially was very rich in species and specimens.

Station A 192. 33° 45′ S., 16° 23½′ E. 1,480 fms. Aug. 27, 1959.
Station A 193. 33° 49′ S., 16° 30′ E. 1,500–1,580 fms. Aug. 27, 1959.
Station A 315. 34° 37′ S., 17° 03′ E. 1,580–1,620 fms. Dec. 8, 1959.
Station A 316. 34° 42′ S., 16° 54′ E. 1,725–1,780 fms. Dec. 8, 1959.
Station A 319. 34° 05′ S., 16° 58′ E. 1,470–1,490 fms. Dec. 9, 1959.
Station A 322. 34° 36′ S., 17° 00′ E. 1,500 fms. Dec. 10, 1959.

The holotypes of the new species are in the South African Museum, Cape Town; duplicates are in the Zoological Museum, Amsterdam.

Ann. S. Afr. Mus. **46** (12), 1963, 321–340, 10 figs.

DESCRIPTIONS OF SPECIES

Nymphon laterospinum n.sp.

(Fig. 1)

Material. 1 ♂ ovig. Station A 193.

Description. Trunk fairly slender, completely segmented. Lateral processes separated by nearly 1½ times their own diameter; armed distally with spurs,

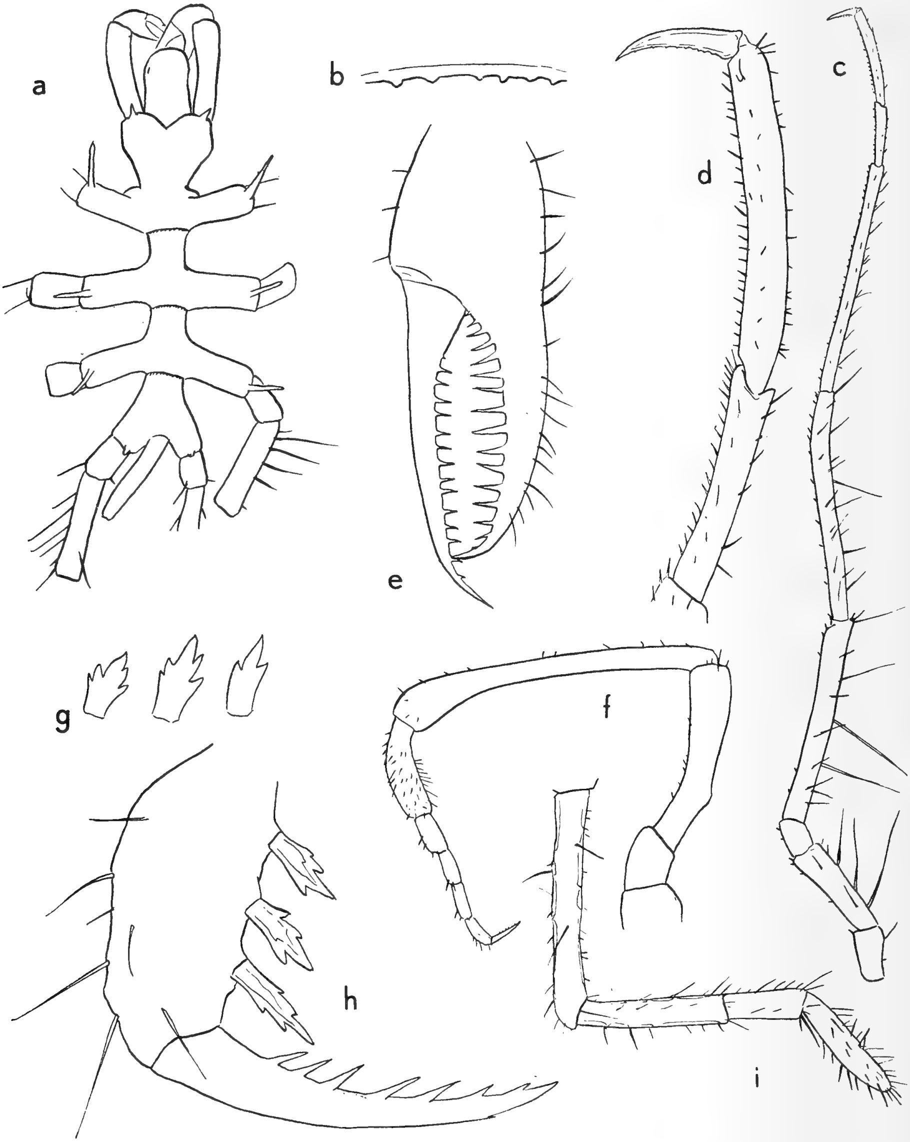

FIG. 1. *Nymphon laterospinum* n.sp., ♂ (holotype). *a*, dorsal view of the trunk; *b*, inner margin of the claw of a leg; *c*, first leg; *d*, distal segments of the first leg; *e*, chela; *f*, oviger; *g*, some special oviger spines; *h*, terminal part of the oviger; *i*, palp.

which are very tall and spiniform on lateral processes 1, 2 and 3, much shorter on lateral process 4. A protuberance of about the same size as that of the 4th lateral process is present on the neck, at the base of the chelifore. No eye tubercle, nor middorsal spurs. No eyes. Oviger implantation in contact with the first lateral process. Neck short, fairly broad. Abdomen long, reaching to at least a third of coxa 2 of leg 4. Proboscis about as long as the neck.

Fingers of chela nearly twice as long as the hand, curved; movable finger with about 16 short, spiniform teeth; immovable finger with the same number of stronger teeth.

Palp hairy; segment 1 short, segment 2 the longest (subequal to segments 3 and 4 combined), segment 5 slightly longer than segment 4.

Oviger segment 4 with a swelling at about a third of its length; segment 5 long, curved, distinctly clubbed distally; segment 6 very hairy; segments 7 to 10 with a small number of compound spines of a relatively simple structure, bearing only 1 to 3 serrations, according to the formula $5 + 3 + 3 + 3 = 14$. Terminal claw slender, slightly curved, longer than the 10th oviger segment, bearing 7 teeth at the inner margin. Eggs few (only two on each oviger in the only male available); they are collapsed now, but originally were probably large and rich in yolk.

Legs slender, setose; particularly coxa 2, femur and tibia 1, with very long, stiff setae; tibia 1 and 2 subequal; tarsus about $\frac{2}{3}$ of the propodus; propodus nearly straight; propodal sole with 20 to 25 small spinules of a size; claw about $\frac{2}{5}$ of the propodus, slightly curved, its inner margin armed with about 8 irregular denticulations.

Remarks. The only other slender, uniunguiculate, blind *Nymphon* that has the oviger implantation in contact with the first lateral process is *N. hedgpethi* Stock, 1953. Instead of spurs on the neck and the lateral processes, *N. hedgpethi* possesses long hairs on these spots. The new species is, by the presence of these spurs, and by its crenulated claw of the legs, particularly well characterized against the 120 other named taxa in this genus.

Measurements of the holotype (♂) *in mm.*

Length (frontal margin neck to base of abdomen)	3·3
Length of proboscis (in dorsal view)	0·89
Length of abdomen	0·7
Width across 2nd lateral processes	1·8

First leg—1st coxa, 0·52; 2nd coxa, 1·13; 3rd coxa, 0·33; femur, 2·20; 1st tibia, 2·44; 2nd tibia, 2·35; tarsus, 0·56; propodus, 0·89; claw, 0·34

Ascorhynchus inflatum n.sp.

(Figs. 2, 3)

Material. 4 specimens (2 of which adult females). Station A 193.

Description. Body completely segmented. Lateral processes separated by more than $1\frac{1}{2}$ times their own diameter. Neck rather slender, bearing two small

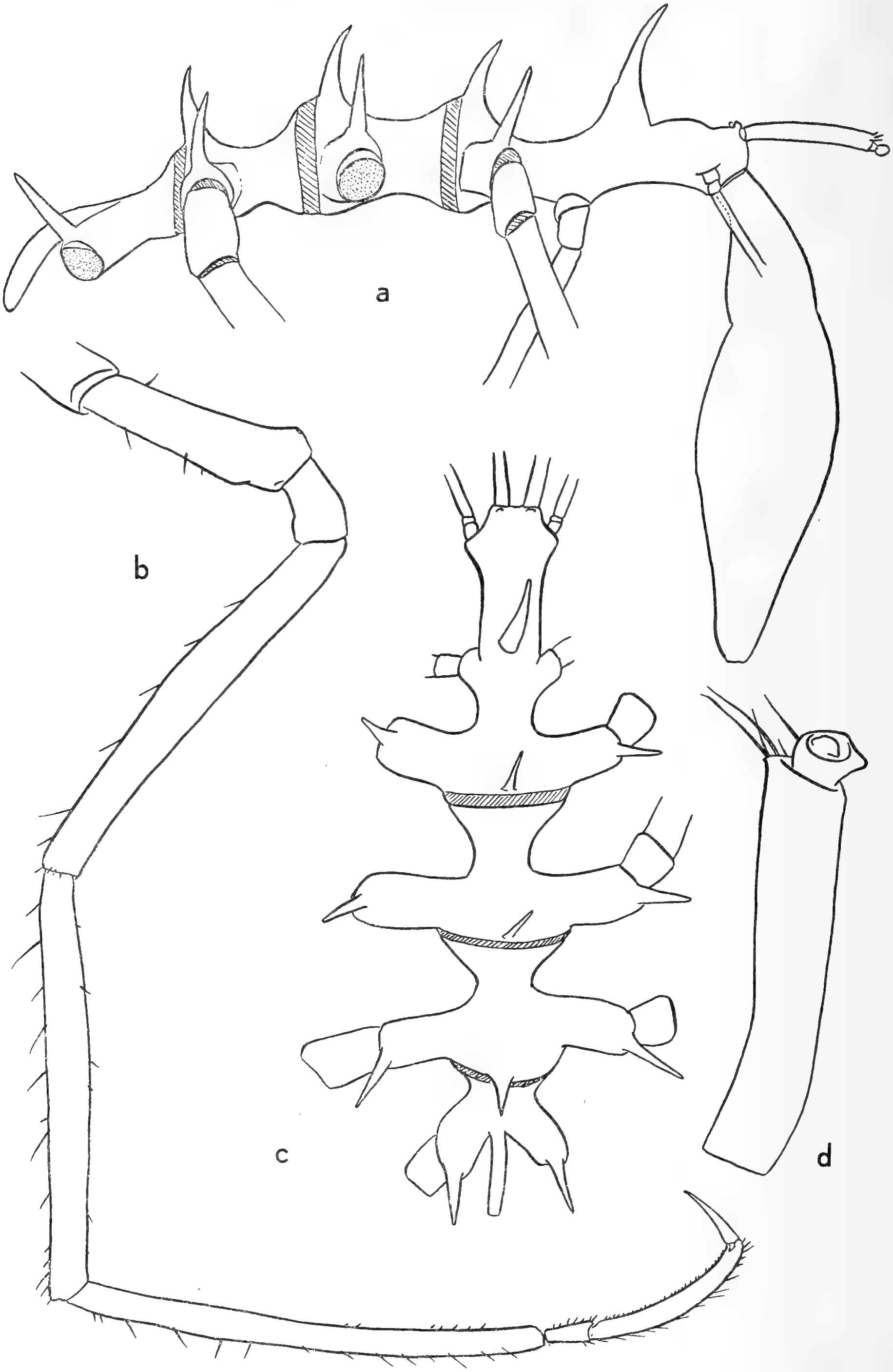

Fig. 2. *Ascorhynchus inflatum* n.sp., ♀ (holotype). *a*, lateral view of the trunk; *b*, fourth leg; *c*, dorsal view of the trunk; *d*, chelifore.

tubercles near the implantation of the chelifores. Basal protuberances for palps and ovigers distinct. Eye tubercle arising slightly in front of the oviger implantations, very tall, pointed, spine-like; eyes absent. Body segments 1, 2 and 3 with a tall, sharp medio-dorsal tubercle. Tubercles of about the same size and shape arise from the dorso-distal margin of the lateral processes. Abdomen curved, slender, much longer than the 4th lateral process. The posterior part of trunk segments 1, 2 and 3 and the anterior part of segments 2, 3 and 4 are strongly inflated. The articulation line runs just over this inflated part of the trunk segments. The proposed specific name refers to the curious gonflated aspect of the trunk segments.

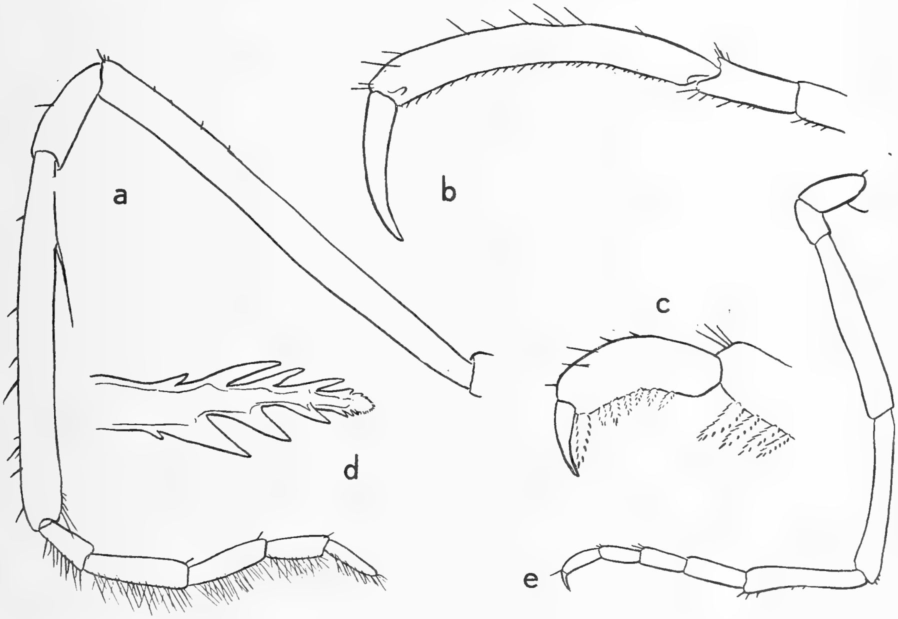

FIG. 3. *Ascorhynchus inflatum* n.sp., ♀ (holotype). *a*, palp; *b*, distal segments of fourth leg; *c*, terminal part of the oviger; *d*, compound oviger spine; *e*, oviger.

Basal third of proboscis distinctly separated from the distal two-thirds Chelifore scape 1-segmented, rather long; chelae reduced.

Palps 10-segmented; basal two segments small; segment 3 the longest 4 distal segments gradually diminishing in length.

Oviger 10-segmented. Terminal claw slender, smooth. Compound spines, bearing 3 to 5 strong basal denticulations and numerous fine crenulations at the tip, are present on segments 7 to 10, according to the formula $7 + 7 + 7 + 7 = 28$.

Legs slender, rather setose, especially the tibiae, but without tubercles or protuberances. Tarsus less than $\frac{1}{3}$ of the propodus; it is about twice as long as wide. Propodus slightly curved, the sole armed over its entire length with numerous small spinules of equal length. Claw short, distinctly less than half the propodus, feebly curved. No auxiliary claws. Genital pores (♀) on a very slight swelling of the ventro-distal surface of the 2nd coxa of all legs.

Remarks. This species is not unlike *A. abyssi* G. O. Sars, 1877, a blind northern Atlantic deep-sea species, but it differs notably from it in the much taller dorsal spurs, the taller eye tubercle, and the different mutual position of eye tubercle and oviger implantation.

Measurements of ♀ (holotype) in mm.

Length of trunk somite 1	2·7
Length of trunk somite 2	1·5
Length of trunk somite 3	1·5
Length of trunk somite 4	0·66
Length of proboscis	5·5
Length of abdomen	1·1
Width across 2nd lateral processes	2·2
Length of scape	1·3

Fourth leg—1st coxa, 0·66; 2nd coxa, 2·2; 3rd coxa, 0·70; femur, 5·2; 1st tibia, 5·2; 2nd tibia, 5·7; tarsus, 0·44; propodus, 1·54; claw, 0·66

Genus COLOSSENDEIS Jarz.

Brevitarsal group

Colossendeis macerrima Wilson

C. macerrima Wilson, Stock, 1953, pp. 308–311, fig. 17 *e–h* (lit., syn.). Barnard, 1954, p. 85.
C. japonica (*non* Hoek), Hedgpeth, 1949, pp. 299–300, fig. 46 *a–d*. Fage, 1956, p. 176 (new synonymy).

Material. 7 specimens. Station A 193.

Remarks. Barnard, 1954, and Flynn, 1928, have already recorded this species from South African waters. Concerning the proposed new synonymy, compare the remarks under *C. minuta*.

Colossendeis minuta Hoek

(Fig. 4)

C. minuta Hoek, 1881, pp. 73–74, pl. 10 figs. 12–14. Schimkewitsch, 1893, pp. 34–35 (tabulated only). Gordon, 1944, p. 13, fig. 2 *f–g* (remarks on holotype). Hedgpeth, 1948, p. 272, fig. 50 *c*.
C. japonica Hoek, 1898, pp. 295–296, figs. 11–13 (new synonymy).
[*Non*] '*C. japonica* Hoek', Hedgpeth, 1949, and Fage, 1956 (= *C. macerrima*).

Material. 3 specimens. Station A 193.

Remarks. Three specimens, quite striking as they have preserved their crimson colour, even in alcohol, agree in all particulars with the description of Hoek (1881) and the notes given by Gordon (1944) on Hoek's holotype. Their size is somewhat larger than in Hoek's immature material, though not yet quite as large ('about 25 cm. in extent') as the specimens recorded by Hedgpeth (1948).

Characteristic of the species are the blunt eye tubercles, without eyes but with distinct lateral sense organs; the ear-like lobes at the antero-lateral angles of the cephalic segment; the (more or less distinct) groove immediately in front of the first pair of lateral processes; the very short terminal claw of the legs; the shape of the proboscis, that is about as long as the trunk; the relative length of the palp segments (3 as long as 5; 7 very long; 8, 9 and 10 subequal).

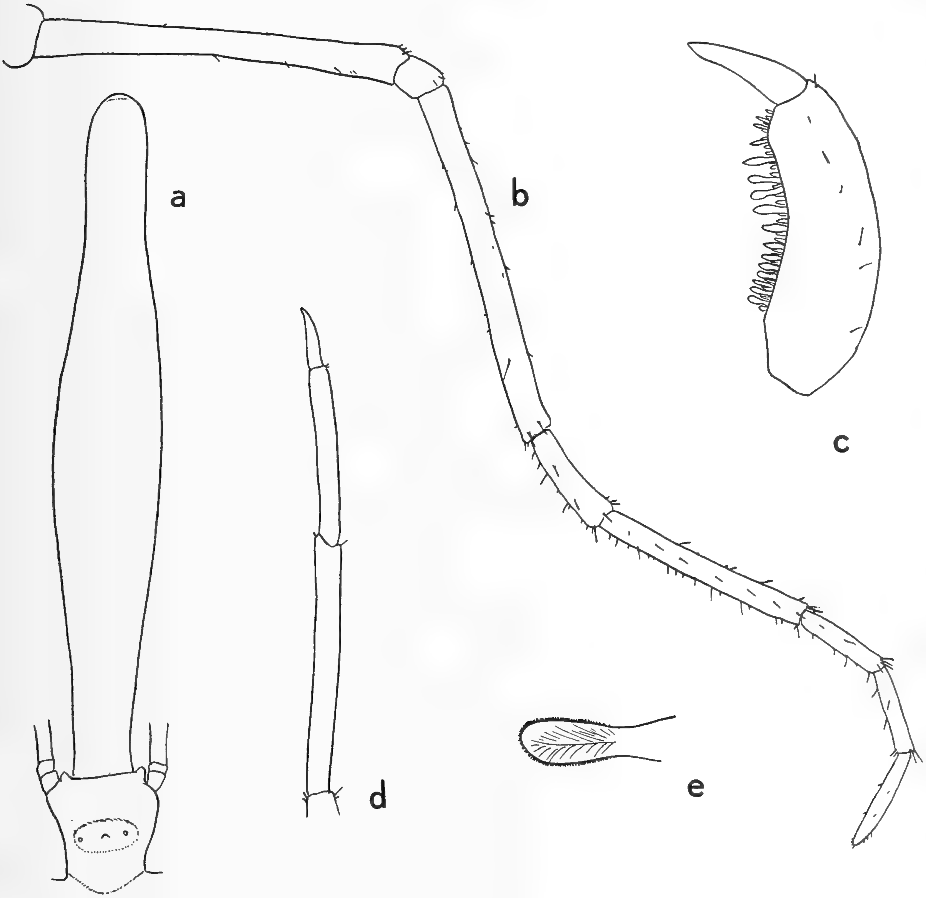

FIG. 4. *Colossendeis minuta* Hoek. *a*, neck and proboscis, in dorsal view; *b*, palp; *c*, terminal part of the oviger; *d*, distal segments of the fourth leg; *e*, compound spine from oviger segment 10.

I consider Hoek's *C. japonica* identical with *minuta*. Hoek stressed the great similarity between the two forms, but kept them apart, chiefly because of the different number of oviger spines and the relative length of the distal segments of the legs. The number of oviger spines in *Colossendeis* is considered nowadays of less value than in Hoek's time, and as to the relative length of the distal segments of the legs, the differences are too slight to be considered of specific value.

The ratios of tarsus, propodus, and claw of the 4th leg are:

in the holotype of *C. minuta* (cf. Gordon, 1944, p. 13, footnote)	1·5	1	0·46
in *C. japonica* (cf. Hoek, 1898)	1·5	1	0·44
in *C. minuta* (present material)	1·4	1	0·34
	1·45	1	0·34

The form recorded by Hedgpeth, 1949, and by Fage, 1956, under the name of *C. japonica* is quite distinct from Hoek's species. It has, as distinct from the real *japonica*, (1) a 5th palp segment that is at least $1\frac{1}{2}$ times as long as the 3rd; (2) a proboscis that is much longer than the trunk ($1\frac{1}{2}$–$1\frac{3}{4}$ times as long); (3) a very long terminal oviger claw; (4) the 6th and 7th palp segments subequal. All these features, and also the general aspect of the animal (Hedgpeth, 1949, fig. 46 *a*), indicate clearly that the animals in question belong to the *macerrima* complex, instead of to the *minuta* group.

Measurements in mm.

Proboscis: specimen 1, 9·5; specimen 2, 10·0.

Trunk, including abdomen: specimen 1, 12·5; specimen 2, 9·5.

Length of legs: 75.

Fourth leg: femur, 23·0; 1st tibia, 23·5; 2nd tibia, 18·0; tarsus, 3·5; propodus, 2·42; claw, 0·83.

Colossendeis oculifera n.sp.

(Fig. 5)

Material. 21 specimens, including 1 juvenile. Station A 193.

Description. The trunk is unsegmented. The lateral processes are separated by their own diameter. The conical eye tubercle varies somewhat in height (fig. 5 *c*, *d*); it is usually a very narrow cone with the slender apex directed forwards; in some specimens it is shorter (due to damage?). The 2 anterior eyes are much larger than the 2 posterior ones; all are well pigmented (brown in alcohol). Lateral sense organs, between the bases of the eyes, distinct. Cephalic segment without ear-like projections on the anterior margin. Proboscis narrowly cylindrical, straight, somewhat dilated in the middle, shorter than the rest of the body. Ratios proboscis : trunk + abdomen of 5 specimens (in cm.): 0·60 : 1·00; 0·77 : 0·90; 0·72 : 0·83; 0·80 : 0·98; 0·63 : 0·70. The abdomen is arched and somewhat clavate; it reaches to the middle of coxa 2 of leg 4.

Palp segment 3 slightly longer than 5; segment 7 twice as long as 6; segments 8, 9 and 10 subequal. Palp segments not very setose.

Ovigers slender; the 6th segment is a trifle longer than the 4th; the terminal claw is rather robust. The oviger spines on segments 7, 8 and 9 are longer than those on segment 10; they are tongue-shaped, and bear minute denticulations on the margin of their distal part.

Legs not very slender. In a specimen in which the trunk + proboscis measure 1·4 cm., the 3rd leg is 6·3 cm. In another specimen the femur is 1·95 cm., the 1st tibia 1·80 cm. and the 2nd tibia 1·73 cm.; the tarsus is 0·33 cm., the propodus 0·18 cm. and the claw 0·08 cm. The tarsus is always 1½ to 1¾ times as long as the propodus. The ventral side of the tarsus bears some robust spines; the sole of the propodus bears 4 or 5 spines, one or two of which are very robust, in its distal fourth. The claw is much less than half as long as the propodus. Female sexual pores are distinct on a slight swelling of the ventral surface of the 2nd coxa of all legs. The juvenile in the present collection, though still having an incompletely developed oviger, already possesses all the characteristic features of the species: in the length of the proboscis, ocular tubercle, relative length of palp and of leg segments, and propodal armature.

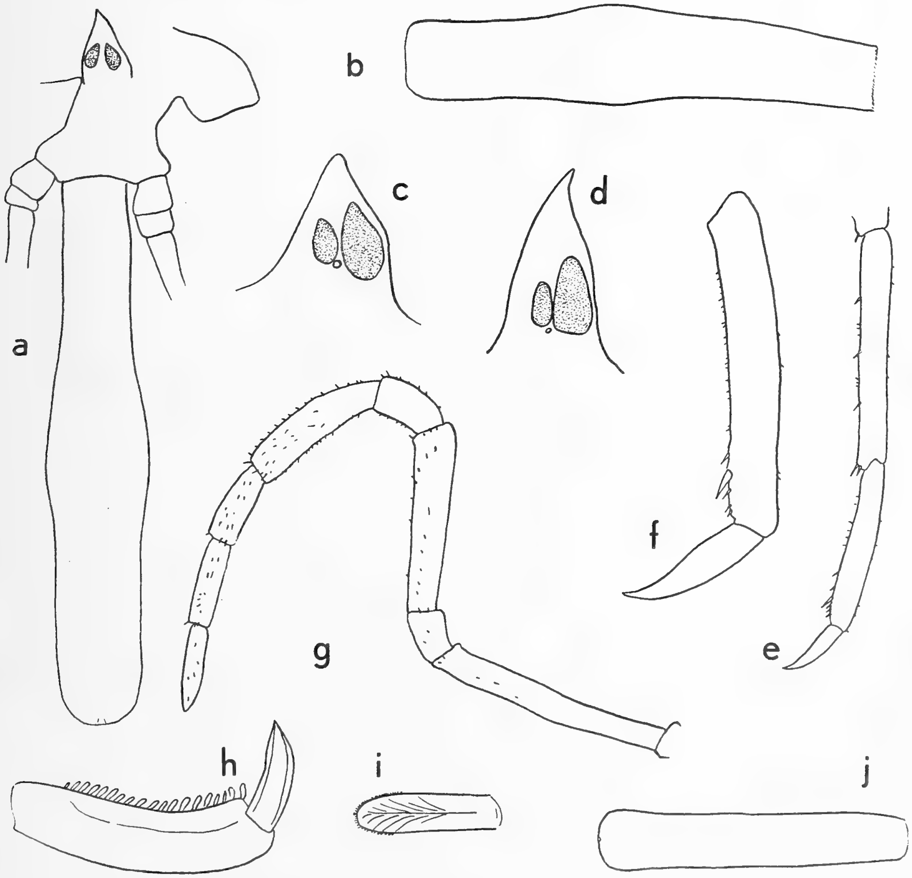

FIG. 5. *Colossendeis oculifera* n.sp. *a*, head and proboscis, in dorsal view; *b*, proboscis, from the left; *c*, *d*, ocular tubercle, from the right, of two different specimens; *e*, distal segments of a leg; *f*, propodus and claw; *g*, palp; *h*, distal part of the oviger; *i*, compound spine from oviger segment 7; *j*, abdomen in dorsal view.

Remarks. The only species of the brevitarsal group that shares the presence of a well-developed eye tubercle with a long 7th palp segment is *C. hoeki* Gordon, 1944. The latter has, however, the proboscis longer than the trunk, and the claw of the legs $\frac{3}{4}$–$\frac{4}{5}$ as long as the propodus. Moreover, the eyes of *C. hoeki*, though present, are unpigmented. We know nothing about the armature of the propodus of *C. hoeki*, but since Gordon compared this species with *C. gracilis*, *C. media*, *C. brevipes*, and *C. minuta*, all of which have practically unarmed propodal soles, we may safely assume that the sole of *C. hoeki* does not show such a curious armature as in the new species.

Longitarsal group

Colossendeis gracilis Hoek
(Fig. 6 *a*)

C. gracilis Hoek, 1881, pp. 69–70, pl. 9 figs. 6–8, pl. 10 figs. 6–7.

Material. 3 specimens, Station A 193; 6 specimens, Station A 315; 2 specimens, Station A 316; 1 specimen, Station A 319; 1 specimen, Station A 322.

Remarks. I am aware that most pycnogonid specialists have synonymized Hoek's *gracilis* with *C. angusta* Sars, but the present material (which I have compared with North Atlantic *angusta*) does not support this view. Calman, 1938, who was an advocate of the identity of *gracilis* and *angusta*, curiously enough stressed plainly their differences.

The South African material, consisting of adults and juveniles, agrees with *C. gracilis* (and consequently disagrees from *C. angusta*) in the presence of a highly conical, pointed ocular tubercle (fig. 6 *a*), in the 3 short distal palp segments (which are, combined, shorter than palp segment 7), in the small size (length trunk + abdomen 5–10 mm. in *gracilis*, 15–20 mm. in *angusta*), and in the relatively slender legs (6 to 7 times as long as the trunk + abdomen).

All specimens of *C. gracilis* in the present collection have neotenic chelifores, a phenomenon also met with, though much less frequently, in *C. angusta*.

Of the published records, only the North Atlantic (and possibly the North Pacific) ones belong to *C. angusta*. This species sometimes occurs in very shallow waters. The deep-sea records from the tropics and from the Southern hemisphere seem to belong to *C. gracilis*, but a revision of the material would certainly be necessary to make this statement more reliable.

Colossendeis curtirostris n.sp.
(Fig. 6 *b–h*)

Material. 1 ♀ (holotype), Station A 192. 1 specimen, Station A 315. 2 specimens, Station A 316.

Description of the holotype. Trunk elongated. Width across the 2nd lateral processes only slightly more than half the length of the trunk. Lateral processes separated by more than their own diameter. Intersegmental suture lines vaguely indicated (in other specimens absent), certainly no functional articulations present.

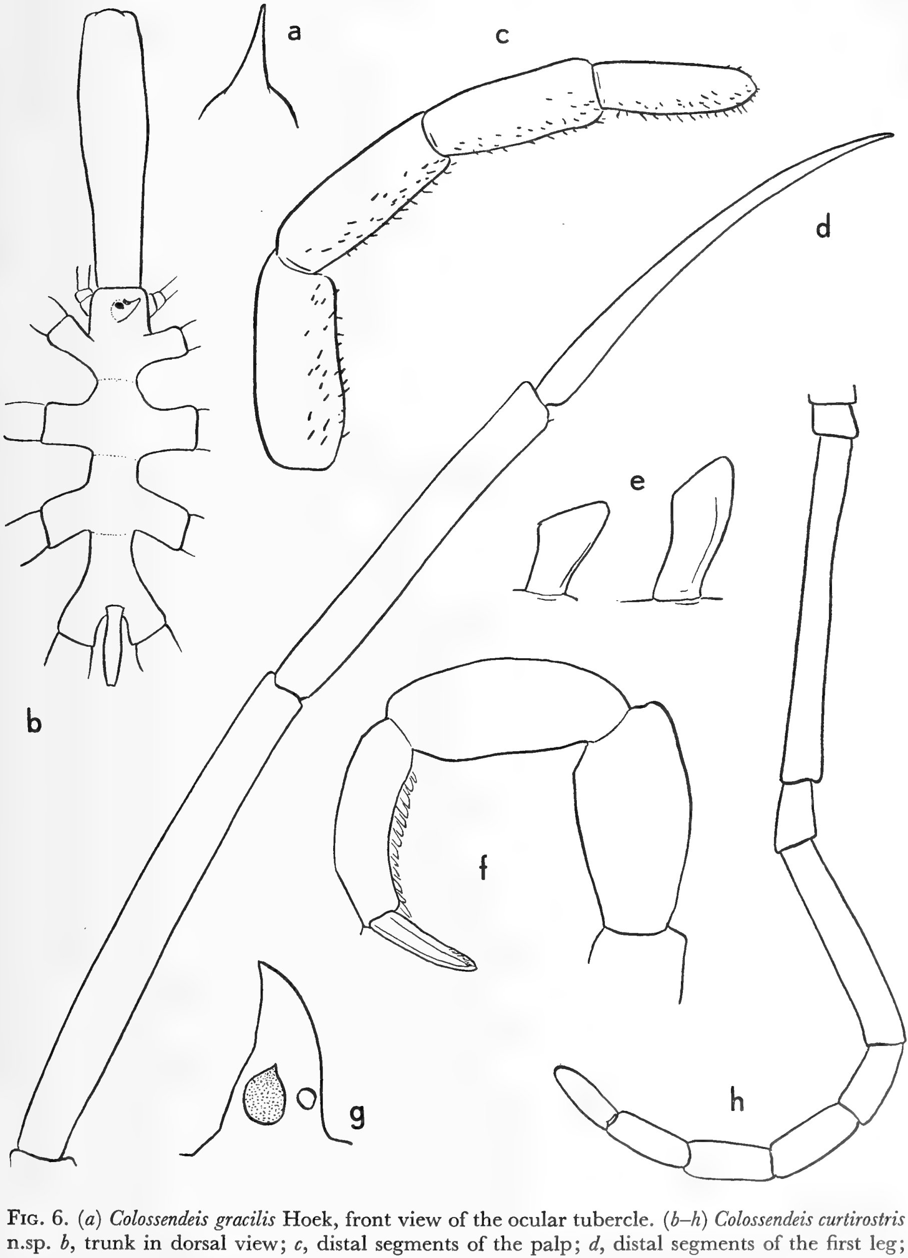

FIG. 6. (*a*) *Colossendeis gracilis* Hoek, front view of the ocular tubercle. (*b–h*) *Colossendeis curtirostris* n.sp. *b*, trunk in dorsal view; *c*, distal segments of the palp; *d*, distal segments of the first leg; *e*, two special oviger spines; *f*, distal part of the oviger; *g*, ocular tubercle from the left; *h*, palp.

Ocular tubercle highly conical, apical part bent forwards; anterior pair of eyes large, well pigmented, posterior pair very small, unpigmented (in some other specimens also the anterior eyes are not well pigmented). No anterior tubercles on the cephalic segment. Proboscis straight, only $\frac{3}{4}$ of the length of trunk and abdomen combined, somewhat club-shaped. Abdomen reaching nearly to the distal end of coxa 1 of leg 4.

No trace of chelifores. Palp segment 3 about $1\frac{1}{2}$ times as long as segment 5; of the 5 distal segments, segment 6 is the shortest, segment 7 the longest; the latter is slightly less than $2\frac{1}{2}$ times as long as wide; segments 8, 9 and 10 diminish gradually in length. Oviger segment 4 shorter than segment 6. Distal 4 segments with very densely placed, smooth-edged spines, mostly of a very peculiar, truncated appearance. Terminal oviger claw over half as long as the 10th segment.

Legs smooth, slender; 4th leg about 5 times as long as trunk and abdomen combined. Femur the longer segment. Tarsus at least $\frac{1}{3}$ longer than the propodus. Claw at least equal to the propodus. Propodal sole practically unarmed. The 2nd leg is the longest.

Remarks. The new species is apparently close to *C. drakei* Calman and *C. gracilipes* Bouvier (the latter being possibly synonymous with *C. glacialis* Hodgson). It has the smooth legs, the slender, non-globular distal palp segments and the long claw of *drakei*, and may represent a northern subspecies of this Antarctic and antiboreal shallow-water form.

C. curtirostris differs from *C. drakei* in the following respects: the much shorter proboscis, the longer abdomen, the more widely spaced lateral processes, the longer 2nd palp segment, the distal 4 palp segments that decrease successively in length, the simple oviger spines, and the longer tarsus.

Another South Atlantic species, *C. geoffroyi* Mañe-Garzón, is considered by its author to be close to *C. drakei*. This species differs from *curtirostris* in the more slender 7th palp segment, in the very short 8th palp segment, and in the lateral processes which are separated by less than their own diameter.

Measurements of the holotype (♀) *in mm.*

Length of proboscis .. .. 7·3
Length of trunk + abdomen .. .. 10·2
Palp—3rd segment, 4·05; 4th segment, 0·51; 5th segment, 2·67; 6th segment, 0·68; 7th segment, 0·91; 8th segment, 0·86; 9th segment, 0·82; 10th segment, 0·75
Diameter of 7th palp segment 0·38
Fourth leg—femur, 14·0; 1st tibia, 13·0; 2nd tibia, 11·5; tarsus, 5·5; propodus, 4·0; claw, 4·3

One of the specimens of Station A 316, a ♀, has the following measurements: proboscis, 8 mm.; trunk + abdomen, 11·5 mm.; width across the 2nd lateral processes, 6 mm.; total length 4th leg, 82 mm. This specimen has much longer legs (about 7 times as long as trunk and abdomen combined) than the holotype.

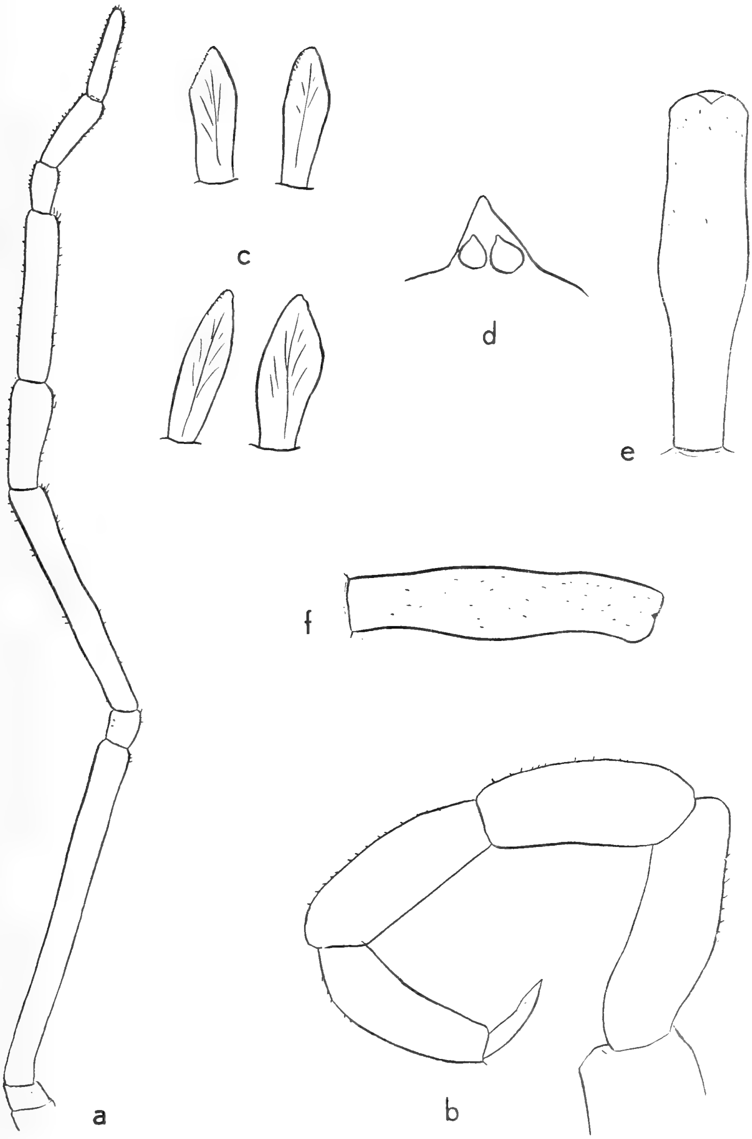

FIG. 7. *Colossendeis orcadensis* Hodgson, ♂ (Station A 322). *a*, palp; *b*, distal segments of the oviger; *c*, compound oviger spines; *d*, ocular tubercle, from the right; *e*, proboscis in dorsal view; *f*, proboscis from the right.

Colossendeis orcadensis Hodgson
(Fig. 7)

Colossendeis orcadense Hodgson, 1908, pp. 161, 184–186, pl. 2 fig. 3.

Material. 1 flabby specimen, Station A 192; 4 small specimens, Station A 193; 1 large ♂, Station A 315; 1 small specimen, Station A 316; 1 large ♂, Station A 322.

Remarks. Since the original description in 1908, this species has not been found again. The holotype and only specimen known was taken at the South Orkneys. The depth is not given, but in the introduction of Hodgson's account we find the following indication: 'it [= *C. orcadensis*] is quite blind—not an unusual character of the genus, but the more surprising as it is a shallow-water species.'

The present material, taken in the deep sea, is, as far as we can judge from the poor illustration of the holotype, identical with *C. orcadensis.*

The following measurements are derived from a big male specimen (Station A 315): Length of proboscis, 19 mm.; length trunk + abdomen, 15 mm.; length 2nd leg, 119 mm.; femur, 34 mm.; 1st tibia, 27 mm.; 2nd tibia, 22 mm.; tarsus, 12 mm.; propodus, 8·7 mm.; claw, 6·2 mm.

Another large male (from Station A 322) has distinct, although unpigmented, eyes. In all other specimens eyes are lacking. The specimen with eyes comes close to *C. megalonyx* Hoek; as a matter of fact, I believe that, when more material becomes available, we shall have to synonymize *orcadensis* and *megalonyx.*

Genus PANTOPIPETTA nom. nov.

It is a regrettable circumstance that the generic name *Pipetta* Loman, 1904, used universally in our pycnogonid literature, is preoccupied by Haeckel, 1887, for a genus of Protozoa. Reluctantly, I propose the new name *Pantopipetta* for the pycnogonid genus.

This curious deep-sea genus is represented in the present collection by not less than 3 species: *P. capensis* (Barnard), which was hitherto known from a single specimen only, *P. brevicauda* n.sp., and *P.* spec. (? *longituberculata* Turpaeva). All are present in fair numbers of both sexes. It is remarkable that, although several females are quite mature (bearing fully developed eggs in their trunks and legs), no ovigerous males are known. This, together with the structure of the oviger, in which segments 2, 4 and 6 are elongated, is a strong indication for attributing the genus to the family Colossendeidae.

I insert here (fig. 8 *f–h*) some new illustrations of the genotype, *P. weberi* (Loman), drawn from the holotype and only specimen known. This species is chiefly characterized by its low ocular tubercle (which may, however, be the result of a previous injury), but also by the very slender 2nd coxa and the long 5th palp segment.

The species of the genus are very similar to one another; they are known from some widely scattered localities in the deep sea: northern Pacific (Kurile-Kamchatka trench), East Indies, Antarctic, and off South Africa.

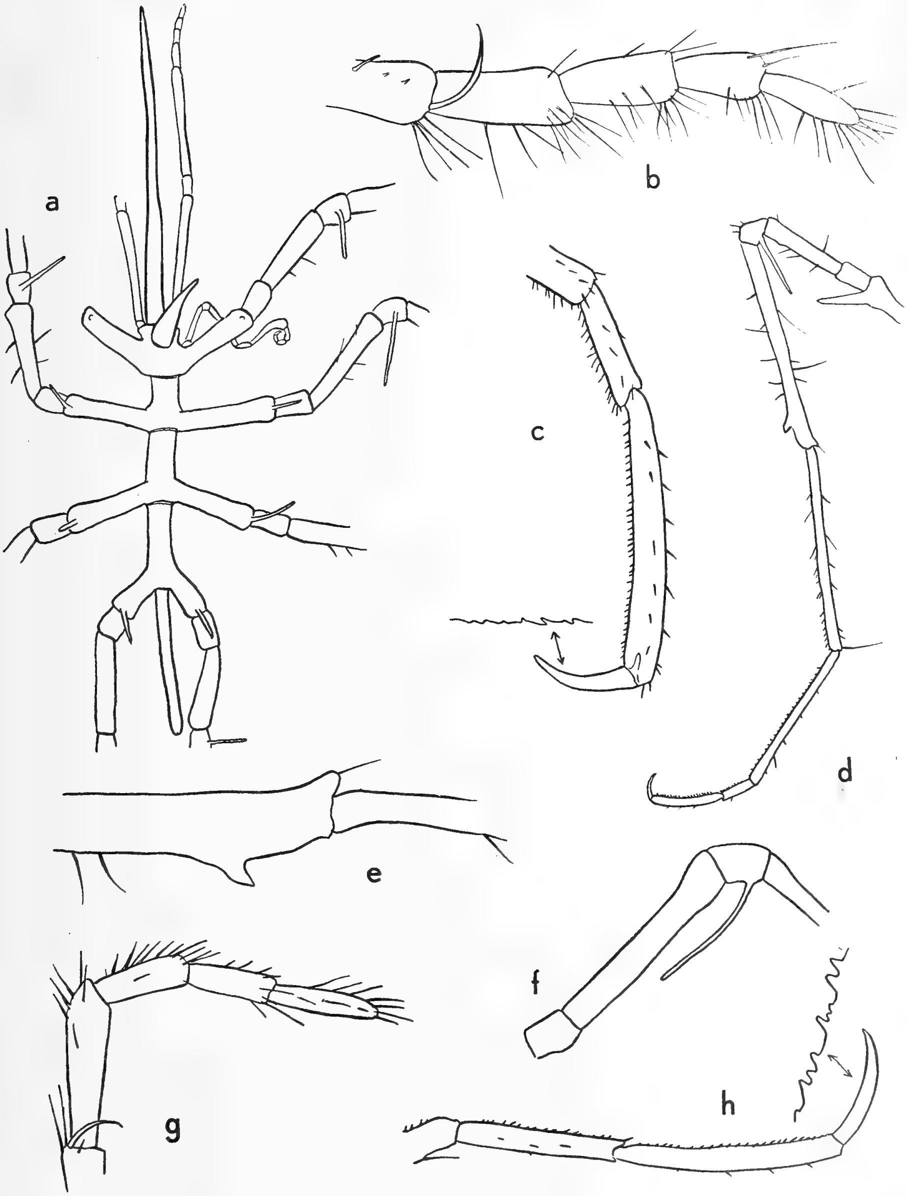

FIG. 8. (*a–e*) *Pantopipetta capensis* (Barnard). *a*, trunk in dorsal view (♀); *b*, distal segments of the palp (♂); *c*, distal segments of the third leg (♀); *d*, third leg (♂); *e*, terminal part of the femur, with the cement gland cone (♂). (*f–h*) *Pantopipetta weberi* (Loman), ♀ (holotype). *f*, coxae; *g*, distal part of the palp; *h*, distal segments of the leg.

Key to the known species:

1 (*a*) Lateral processes smooth, 2.
  (*b*) Lateral processes 2, 3 and 4 with a long dorsal spur; lateral process 1 with a dorsal tubercle. *P. capensis* (Barnard, 1946).
2 (*a*) Propodus 5 to 6 times as long as the tarsus. *P. australis* (Hodgson, 1914).
  (*b*) Propodus less than 4 times as long as the tarsus, 3.
3 (*a*) Abdomen reaching to the distal end of coxa 1 of leg 4. *P. brevicauda* n.sp.
  (*b*) Abdomen reaching nearly or entirely to the distal end of coxa 2 of leg 4, 4.
4 (*a*) Ocular tubercle high conical. Coxa 2 about 4 times as long as its distal diameter. *P. longituberculata* (Turpaeva, 1955).
  (*b*) Ocular tubercle low. Coxa 2 at least 6 times as long as its distal diameter. *P. weberi* (Loman, 1904).

Pantopipetta capensis (Barnard)
(Fig. 8 *a–e*)

Pipetta capensis Barnard, 1946, p. 60. Barnard, 1954, pp. 86–88, fig. 1.

Material. 8 ♀, 6 ♂ and 1 juvenile. Station A 193.

Remarks. Only 1 specimen, judging from Barnard's figure a female, of this interesting species was known. It was taken off Cape Point, N. 81° E. 32 miles, in 460 fathoms.

The present material, from the same general region, but taken in a much greater depth (1,500–1,580 fathoms) agrees perfectly with the description of the type.

The sexual differences are feebly developed; no such differences are found in the palps, ovigers and legs, with the exception of the presence in the male of a cement gland cone on the femur. This 'cone' or projection is situated at a slight distance from the distal end of the femur, somewhat variable in shape in different individuals, but roughly triangular in outline. Nothing about this cone was known in literature, although I suppose that the projection figured very vaguely and described superficially by Hodgson (1927) on the femur of *P. australis* is in fact the cement gland cone.

One of the specimens shows a curious anomaly: the first left leg, its corresponding lateral process and the left oviger have disappeared, probably as a result of a previous injury. Since no scar is visible, the animal in question offers a peculiar unbalanced aspect.

Pantopipetta brevicauda n.sp.
(Figs. 9, 10 *a*)

Material. 3 ♂, 3 ♀, 1 juvenile. Station A 193.

Description. Very slender. Body and appendages appreciably more delicate than in *capensis*. Trunk completely segmented. Lateral processes smooth, separated by intervals that are 2 to 3 times as large as their own diameter (slightly narrower between the lateral processes of segments 1 and 2). Eye tubercle a very tall cone; no eyes. Abdomen separated from the trunk by a

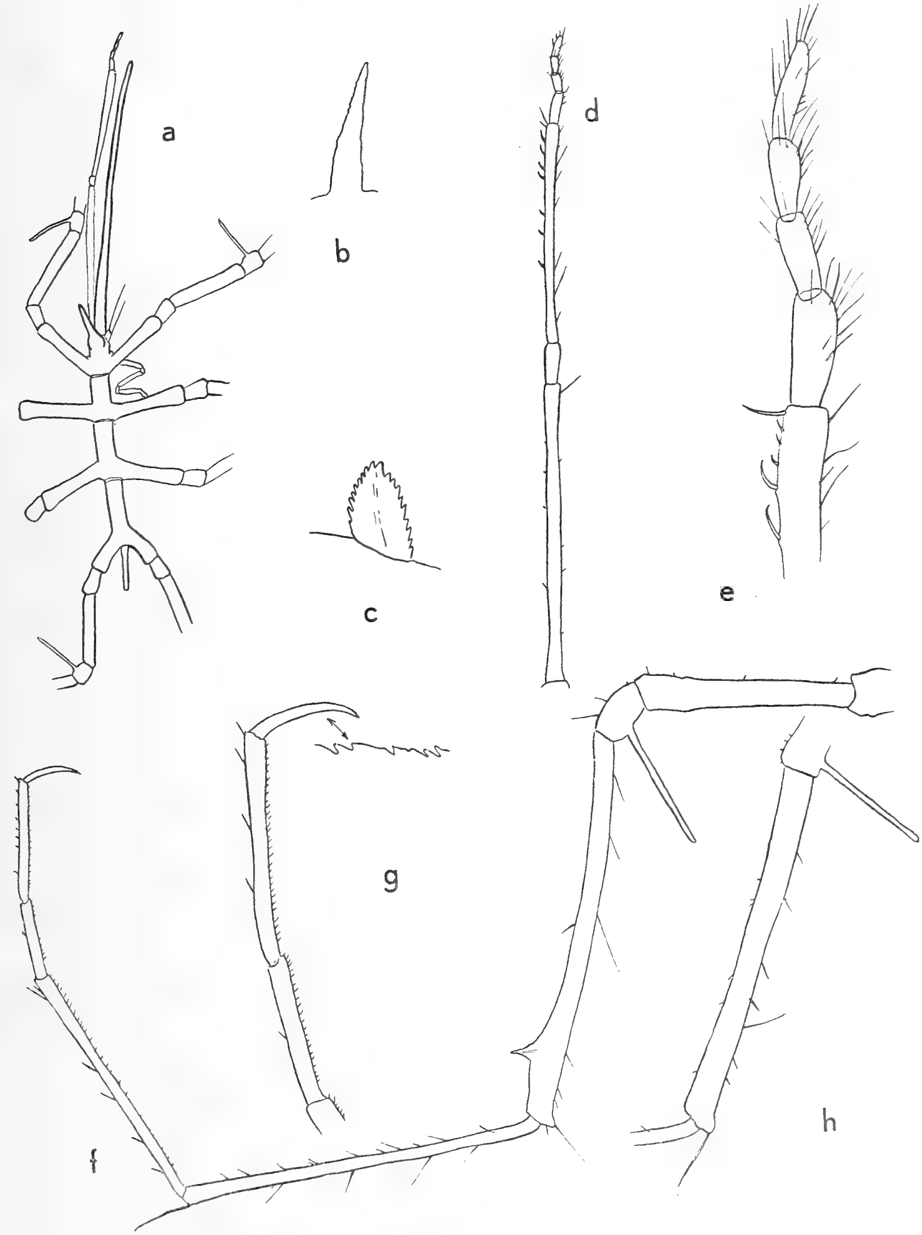

Fig. 9. *Pantopipetta brevicauda* n.sp. *a*, dorsal view of the trunk (♂); *b*, ocular tubercle in front view (♂); *c*, special spine from oviger segment 8; *d*, palp (♂); *e*, distal segments of palp (♂); *f*, third leg (♂); *g*, distal segments of the third leg (♂); *h*, femur (♀).

kind of suture, short, just reaching to the end of coxa 1 of leg 4. Proboscis tubiform, longer than the trunk and the abdomen combined.

Palps practically as in *capensis*, the 5th segment being less than 3 times as long as wide.

Ovigers also very similar to those of *capensis* (and of *weberi*). The formula of the compound spines on the distal segments is in a dissected ♀ 3 : 2 : 2 : 3 :: 0, in a dissected ♂ 3 : 1 : 2 : 3 :: 0. The shape of the compound spines is as in *capensis*.

Legs very slender, except for the sexual pores and the cement gland very similar in both sexes. Coxa 2 about 5 times as long as wide; coxa 3 with a long, twig-shaped, flexible dorsal projection. Femur with an inconspicuous distal spur; on the ventral surface of the femur of the ♂, not far from the distal end, a conical projection indicates the place where the cement gland discharges. Tibia 1 subequal to the femur; tibia 2 much shorter. Tarsus about $\frac{2}{3}$ of the propodus. Claw half as long, or slightly less than half as long, as the propodus. Inner margin of the claw armed, as in *P. capensis* and *P. weberi*, with irregular denticulations. Ventral margin of propodus, tarsus and distal part of tibia 2 armed with a row of minute spinules.

Remarks. Though occurring at the same station as *P. capensis*, the new species differs clearly from it, even at first sight, by its much more delicate appearance. The absence of projections on the lateral processes, the shorter abdomen and the different proportions of the distal segments of the legs form useful additional distinctions.

The only species which has about the same relative length of tarsus, propodus and claw is *P. weberi*. However, this East Indian species has the 5th palp segment much slenderer (about 4 times as long as wide), a much longer abdomen (reaching the end of coxa 2 of leg 4), and a short eye tubercle.

Measurements in mm.

	♀	♂
Length of proboscis	3·07	3·16
Length (frontal margin of neck to base of abdomen)	2·19	2·19
Length of abdomen	0·53	0·65
Width across 2nd lateral processes	1·74	1·67
Third leg—coxa 1	0·28	0·28
coxa 2	0·98	1·02
coxa 3	0·23	0·19
femur	1·91	1·91
tibia 1	1·86	1·86
tibia 2	1·35	1·33
tarsus	0·40	0·37
propodus	0·60	0·56
claw	0·28	0·28

Pantopipetta sp.
(Fig. 10 *b–c*)

Material. 1 ♂, 1 ♀. Station A 316.

Remarks. The two available specimens can be distinguished from both *capensis* and *brevicauda* by their much more robust appearance and less spaced lateral processes. They come close to *P. longituberculata* (Turpaeva), a deep-sea species from the Kurile-Kamchatka trench, except for the relatively longer propodus in the South African material, without attaining the enormous elongation found in *P. australis*. In *longituberculata* the propodus is less than 3 times as long

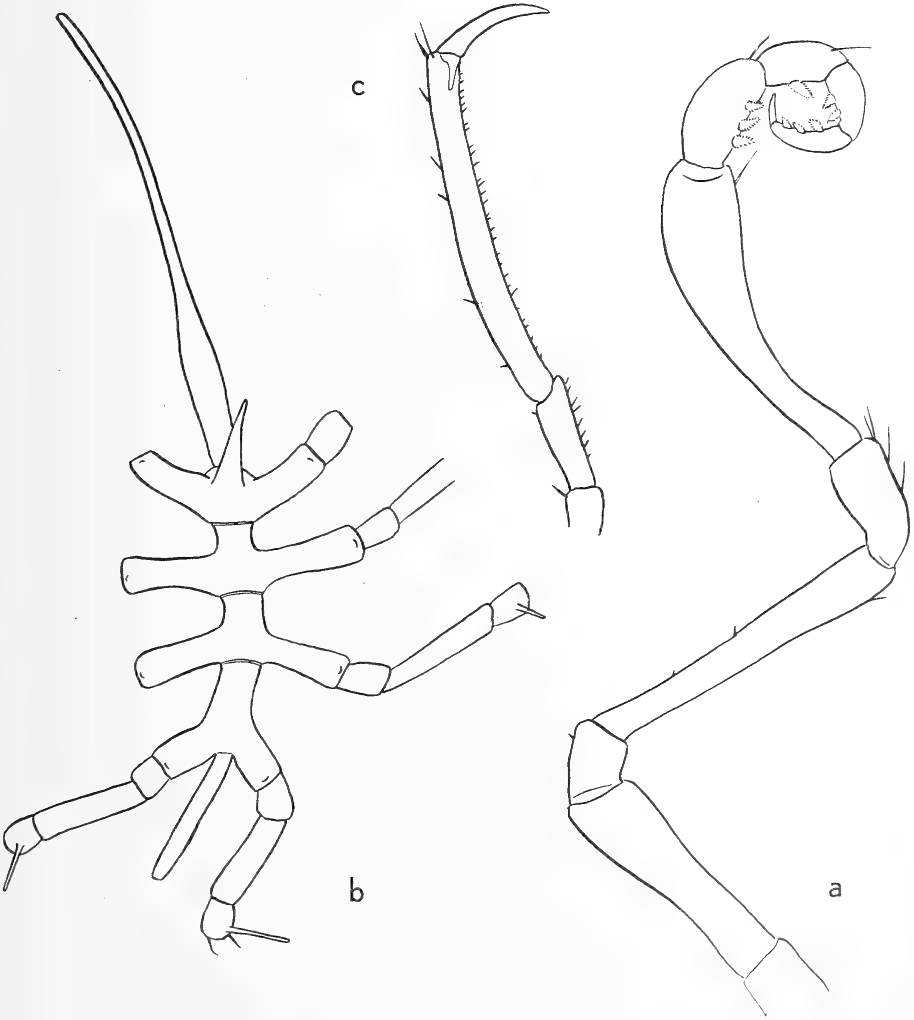

Fig. 10. (*a*) *Pantopipetta brevicauda* n.sp., oviger (♂). (*b–c*) *Pantopipetta* spec., ♀. *b*, dorsal view of the trunk; *c*, distal segments of the fourth leg.

as the tarsus, in the present specimens more than 3 times as long, while in *australis* it is 5 to 6 times as long. The lateral processes bear a low elevation on their dorsal surface. The ♀ has a proboscis of 4·6 mm.; the trunk is 3·6 mm. and the abdomen 1·3 mm. in length. The male is too much damaged to give exact measurements.

Anoplodactylus pelagicus Flynn

Anoplodactylus pelagicus Flynn, 1928, p. 25, fig. 14. Barnard, 1954, p. 128, fig. 19.

Material. 1 ♂ (damaged), Station A 316. 1 ♂ (damaged), off Cape Natal (Durban), 24 miles, 440 fathoms (don. Dr. K. H. Barnard). Z.M.A. Pa. 1327.

Remarks. The specimen from Station A 316 differs from Barnard's material (described in his 1954 paper) in having a highly conical ocular tubercle. Eyes, however, are, as in the previously recorded material, absent. Otherwise very similar to the published descriptions.

The species has up to now not been recorded below 300 fathoms.

Summary

A systematic account is given of a collection of Pycnogonida from the abyssal zone of the sea south-west of Cape Town. The collection included 12 species, 5 of which are new.

Acknowledgements

The Trustees of the South African Museum wish to acknowledge a grant from the Council for Scientific and Industrial Research towards the purchase of the deep trawling equipment with which the specimens reported on were collected, and a grant for the publication of this paper. Grateful acknowledgement is also due to the Director, Division of Fisheries, Department of Commerce and Industries, for making the collecting possible.

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SYNONYMY. Arrangement according to Schenk, E. T. & McMaster, J. H.: *Procedure in taxonomy.* 2nd ed. Stanford, Stanford university press, 1948. Bibliographic references modified.

'I. *Synonymy arranged according to chronology of names.*—All published scientific names by which a species has been previously designated (subsequent to 1758) are listed in chronological order, with bibliographical references to all descriptions or descriptive citations following in chronological order after each name. . . .

B. *Form of bibliographic references to synonymic names.*—The first reference following any name in the synonymy should be to the earliest citation of that name. This should be followed by references to all subsequent citations of the same name, arranged in chronological order. . . .'

Bibliographical references modified to consist of author's name, date of citation, pagination and illustrations (plates and figures).

Example:—

Eulalia (*Steggoa*) *capensis* Schmarda

Eulalis capensis Schmarda 1861, p. 86, pl. 29, fig. 231. Willey 1904, p. 259.
Eulalia viridis var. *capensis* McIntosh 1903, p. 34. Day 1953, p. 30.
Eulalia viridis (*non* Muller) Ehlers 1913, p. 455. Day 1934, p. 30.

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PART XIII

THE SOUTH AFRICAN SUBSPECIES OF THE BUFFY PIPIT, *ANTHUS VAALENSIS* SHELLEY

By

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Percy FitzPatrick Institute of African Ornithology
and
South African Museum, Cape Town

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[Accepted July 1962]

(With 1 figure in the text)

Contents

Introduction

The Buffy Pipit *Anthus vaalensis* was originally described from Newcastle, Natal, by Shelley in 1900. For some time it was regarded as a race of the Plain-backed Pipit *A. leucophrys* and is so treated by Sclater (1930). Roberts, however, pointed out that the two forms overlapped widely and must be regarded as distinct species; and the problem was discussed in greater detail by White (1948).

Three races of *vaalensis* have been described from within the limits of geographical South Africa, for Roberts separated off a bird from Griqualand West as *daviesi* in 1914 and others from the Chobe River as *chobiensis* in 1932. All three subspecies were accepted by Vincent (1952); and Benson and White (1957) and Smithers, Irwin and Paterson (1957) have recognized *chobiensis* as distinct. Vaurie, White, Mayr and Greenway (1960) and White (1961), however, synonymize *daviesi* with *vaalensis*, and *chobiensis*, together with *marungensis* Chapin and *muhingae* White, with *neumanni* Meinertzhagen, originally described (as *Anthus leucophrys angolensis* Neumann) from Ambaca, Angola. Hall (1959), in her discussion of the Angola forms of *A. leucophrys* and *A. vaalensis*, also considers it is impracticable to separate *marungensis* and *muhingae* from *neumanni*, but does not discuss *chobiensis*.

Ann. S. Afr. Mus. **46** (13), 1963, 341–352, 1 fig.

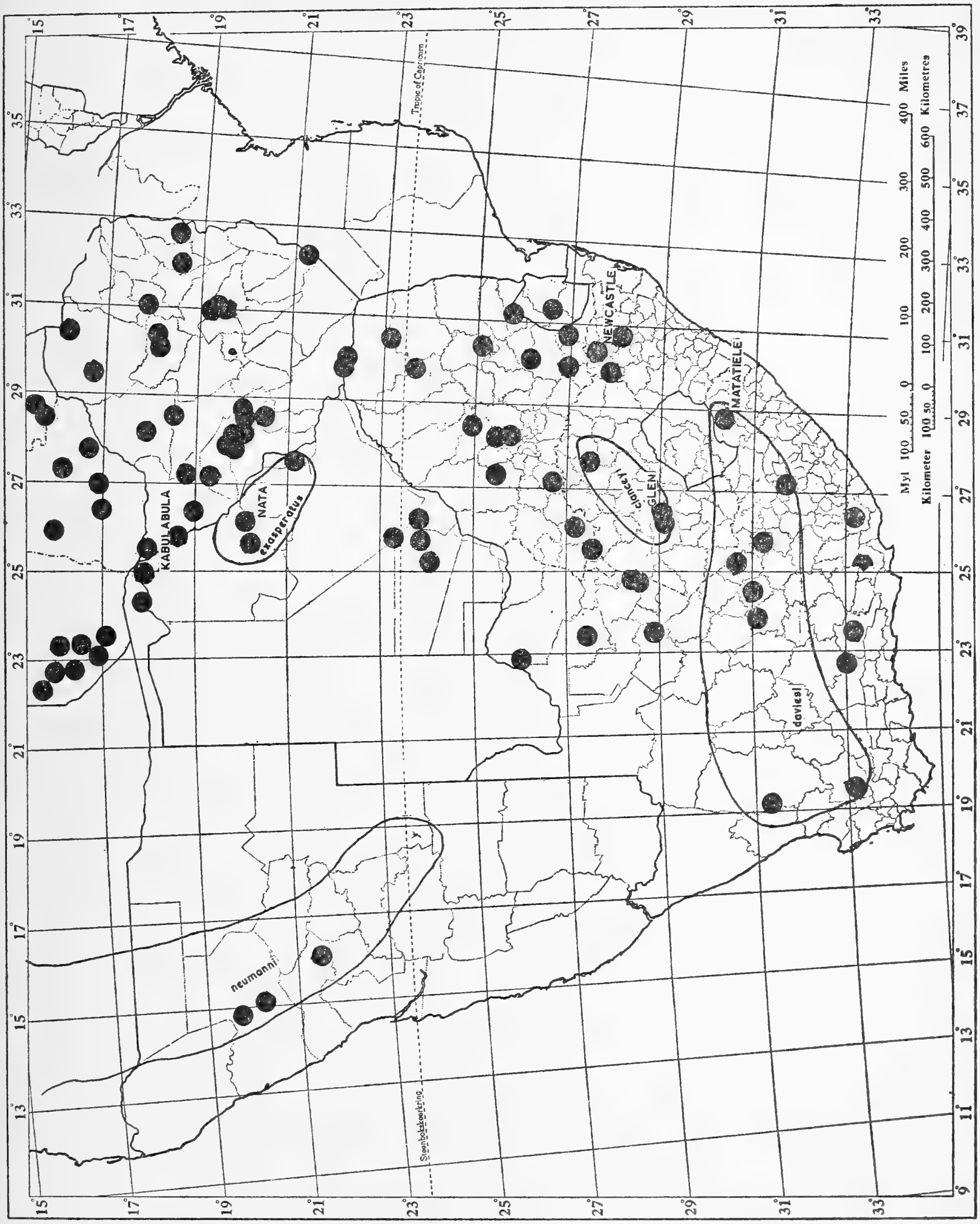
Discussion

For the present study I was able to utilize a series of 241 skins; and I am most grateful to the following for the loan of material: the Director, Mr. J. D. Macdonald and Mrs. B. P. Hall of the British Museum (Natural History); the Director (Mr. P. A. Clancey) of the Durban Museum and Art Gallery; the Director (Miss M. Courtenay-Latimer) of the East London Museum; the Director and Mr. O. P. M. Prozesky of the Transvaal Museum, Pretoria; the Director and Mr. M. P. S. Irwin of the National Museum of Southern Rhodesia, Bulawayo; and the Director (Dr. T. H. Barry) of the Albany Museum, Grahamstown.

Current literature (Vincent, 1952; Vaurie *et al.*, 1960) often includes the whole of South Africa within the range given for *Anthus vaalensis* and its subspecies; but this is misleading. The range is correctly given by McLachlan and Liversidge (1957). There appear to be no authentic records of the occurrence of this Pipit in the coastal strip of South Africa from Walvis Bay round to Portuguese East Africa (records from Black Rock, east of East London, and from the Bathurst District are due to confusion with *A. leucophrys*). On the Karoo, the records are sparse and scattered in the west and south, more frequent in the east. The sole record from the Transkei is the type of *daviesi*, from Matatiele; from Natal the species is known only from Newcastle, Utrecht and Blood River; and from the Orange Free State only from the neighbourhoods of Bloemfontein and Vredefort Road. It becomes commoner in the Transvaal and is widely distributed in Southern and Northern Rhodesia (Smithers, Irwin and Paterson, 1957; Benson and White, 1957). In South West Africa (Hoesch and Niethammer, 1940; Macdonald, 1957) it has only been recorded from the north (Omaruru, Klein Otavi, Kaukurus, Franzfontein, Kamanjab). It is not mentioned by Smithers (1959) or Smithers and Paterson (1959) from Bechuanaland, but on the evidence of specimens is widely distributed there. In Nyasaland (Benson, 1953) it is recorded from a few localities west of the Shiré, but not from the east.

The three races described from south of the Zambezi were differentiated solely on size. Roberts (1940) considered *daviesi* to be the southern race and larger than *vaalensis* (w., ♂, 109–112 mm., as against 100–108 mm.), and that Ngamiland and Southern Rhodesian birds represented the smaller *chobiensis* (w., ♂, 98–99 mm.). Smithers, Irwin and Paterson (1957), however, conclude that most Southern Rhodesian birds cannot be differentiated from typical *vaalensis*, and this point is further discussed below. McLachlan and Liversidge (1957) restrict the range of *chobiensis* to Ngamiland.

The present series shows that the average wing-lengths of males of various populations vary with no very clear geographical divisions between 101·1 mm. and 105·3 mm., with two marked, and one less striking, exceptions. Birds from north-eastern Bechuanaland Protectorate average markedly smaller (95·0 mm.) and those from the near-by Caprivi Strip also run smaller (100·0 mm.)



Range of *Anthus vaalensis* and its Subspecies in Southern Africa

Each dot represents a locality from which at least one specimen has been examined. Type localities of named subspecies, whether valid or not, are named. The approximate ranges of four subspecies are indicated; the rest of the area is the range of *Anthus vaalensis vaalensis* and *A. v. chobiensis* (N. of about 23°S.).

than the general population; and at the other extreme, birds from the Karoo average larger (112·0 mm.), though near the coast (Klaarstroom, Uniondale, Grahamstown, Zuurberg) they are smaller again (103·0 mm.). If we leave these aberrant populations out of account, then there are two minor population size-groups, that in Natal, the northern Cape, the Transvaal and southern Bechuanaland Protectorate comprising bigger birds (w., ♂, av. *c.* 104–105 mm.) and those in Southern and Northern Rhodesia and South West Africa smaller (*c.* 101–103 mm.). This broad grouping follows Bergmann's rule, but the rule does not apply within the groups (e.g. the average of 17 ♂s from Selukwe, 101·1 mm., is less than that of 17 ♂s from Northern Rhodesia, 102·3 mm.). Nevertheless, the broad difference is highly significant statistically.

In females, the average wing-lengths fall into three groups: Karoo (105 mm.); the rest of the Cape, Natal, southern Bechuanaland, Orange Free State and the Transvaal (99–101 mm.); and the rest (94–98 mm.), in which the smallest birds are in northern Bechuanaland. Here again, Bergmann's rule is broadly conformed to, but not within each group (e.g. of the middle group, the birds from the southern Cape are the smallest; Barotseland birds are bigger than any Southern Rhodesian population; and Angola birds are bigger than those from South West Africa). The two sexes agree in that Karoo birds are the biggest; that birds from south of the Limpopo are larger than those from the north; and that the smallest are those from northern Bechuanaland. These differences, too, are statistically significant.

Commenting on size-differences, White (1948) says: 'The birds of the high ground in the interior of the Cape Province seem to form a definable large race. . . . Those from northern Bechuanaland are smallest on the Chobe River, but not worth separating on size alone.'

We may note that males with wings of 108 mm. or more (108 mm. being the minimum given by White for male *daviesi*) occur sporadically as far north as Ngoma (15° 54′ S.) in Northern Rhodesia; and that the shortest-winged population in northern Bechuanaland occurs not on the Chobe but in the Makarikari Pan area.

Turning now to colour, no recent worker has suggested any variation in populations in geographical South Africa. Hall (1959), discussing the Angola population, distinguishes two variants—a sandier form and a greyer form—the former predominating in the west, the latter in the east, so that, if considered in isolation, Angola birds might be classified in two subspecies; but she points out that 'some from as far east as Mzimba, Nyasaland, are indistinguishable from the co-types of *neumanni*' (a sandy bird). She therefore considers it is impracticable to recognize more than one subspecies; but she believes 'that *A. v. neumanni* can be distinguished from *A. v. vaalensis* by smaller size and less sandy colour'.

In the present series, two populations stood out from the others on colour grounds. One was from the neighbourhood of Bloemfontein, where the birds are distinctly greyer above than surrounding populations, as well as being bigger than any except that to the south (*daviesi*), though the latter difference is not statistically significant. A small series from Vredefort Road, 150 miles farther north in the Orange Free State, probably belongs here too, but the skins are old, faded and mostly very badly prepared, so that it is difficult to be sure.

The second distinctive population is that from South West Africa, whence the birds are decidedly redder above and below than the general series. It should be noted, however, that a May bird from Darwendale, Southern Rhodesia, fits perfectly into this series, and a number of other skins from the Rhodesias approach the less extreme South West African examples fairly closely. I have not seen any Angola specimens but I have been unable to detect any general colour variation between series of birds from the Transvaal, Natal, southern Bechuanaland, northern Cape, Southern Rhodesia and Northern Rhodesia.

Summarizing the variation in this species, I consider that there are four well-marked but very localized variations:

(i) A large-sized population in the higher ground of the Cape from Matatiele to the west coast escarpment. For this the name *daviesi* Roberts is available.

(ii) A grey population in the Orange Free State. This is named, below, *clanceyi*.

(iii) A small-sized population in north-east Bechuanaland. Unfortunately the name *chobiensis* (Roberts) cannot be used for this population. Roberts does not give the wing-measurement of the type of *chobiensis* separately; he only says 'males, 98–99 mm.'; but I have measured the type twice myself and asked Dr. G. J. Broekhuysen to measure it independently and all three measurements were just over 101 mm. Of the three Chobe birds available to me, two, including the type of *chobiensis*, are too big to be placed in this small race, which I have accordingly named, below, *exasperatus*.

(iv) A reddish population in South West Africa. In view of the evidence cited above, I believe this to be indistinguishable from the birds named *neumanni* Meinertzhagen, and propose to use this name for them, which is the name used also by Hoesch and Niethammer (1940), though Macdonald (1957) calls his birds from this area *chobiensis*, and White (1948) synonymizes *neumanni* with *vaalensis* but keeps *chobiensis* and *marungensis* separate.

The rest of the population consists of birds intermediate in various degrees between these four subspecies but divisible at the Limpopo into two populations, on average size. If we divide the males into those with wings of 105 mm. and over and those with wings of 104 mm. or less, than 20 out of 29 (69%) of the birds from south of the Limpopo fall into the former class and 78 out of 101 (77%) of those from north of that river into the latter. Treating the females similarly but drawing the line between 98 and 99 mm., then 23 out of 27 (85%) from south of the Limpopo fall into the large group and 55 out of 70 (78%) from north of that river into the small one. The combined total separable in size alone is 176 out of 227 (78%). If it is considered that this is sufficient to warrant nomenclatorial recognition, then the birds north of the Limpopo must be called *A. v. chobiensis* (Roberts). Considerable differences exist as to the exact meaning of the 'seventy-five per cent' rule (Amadon, 1949), but in view of the comments of Mr. A. N. Rowan in the Appendix, I propose to revive *chobiensis* for the birds north of the Limpopo.

Two possible explanations of the curious distribution pattern exhibited by the races of this species may be advanced: (i) A uniform population is in the process of differentiating into geographical subspecies; (ii) the species is in the course of extending, or has recently extended, its range, bringing into contact discrete populations previously isolated. The latter seems to fit the facts better, and also seems inherently the more probable. White (1948) points out that, although *A. vaalensis* and *A. leucophrys* frequently occur on the same ground, yet on the whole *vaalensis* prefers drier and *leucophrys* damper conditions. During the last pluvial (or hypothermal) period, the areas suitable for *vaalensis* would have been markedly more restricted than they are today; and I suggest that the four subspecies, *daviesi*, *clanceyi*, *exasperatus* and *neumanni*, were differentiated at that time. With the increasing desiccation since then, the species has expanded its range and a 'hybrid swarm' has come to occupy most of the area, including, probably, some of the original ranges of the four distinct subspecies, and has begun to 'swamp' their distinctiveness. The '*neumanni*' specimen from Darwendale has already been mentioned; and a January female from 3 m. south of Nata, with a wing of 102 mm., 6 mm. longer than the wing of any other female and 4 mm. longer than that of any male from within the range of *exasperatus*, is another example: though in view of the nomadic habits of *Anthus* spp. in the off-season, the possibility that these are stragglers cannot be excluded, even if the date renders it unlikely in the second case.

Taxonomic List

Taxonomically, six subspecies may be recognized.

1. *Anthus vaalensis vaalensis* Shelley

Anthus vaalensis Shelley, 1900, 311—Newcastle, Natal.

Plumage, size and degree of sexual dimorphism intermediate between the other races. Greyish brown above, unstreaked; buff below, usually with some dark flecking on the breast, but never very much.

Range: South Africa from the Little Karoo and inland eastern Cape to the Transvaal and southern Bechuanaland, except those areas occupied by the next two races.

Measurements: 29 ♂s; wing 97–110 mm., av. 104·9 mm.; tail 69–80 mm., av. 74·4 mm.; culmen 17–21 mm., av. 19·5 mm.; tarsus 24–30 mm., av. 26·9 mm.; hind-claw 8–12 mm., av. 9·5 mm.

22 ♀s; wing 94–105 mm., av. 100·1 mm.; tail 64–76 mm., av. 70·8 mm.; culmen 17–20 mm., av. 18·7 mm.; tarsus 25–28 mm., av. 26·7 mm.; hind-claw 8–11 mm., av. 9·3 mm.

Material examined

Cape Province: South African Museum 3 (Klaarstroom, Kimberley, Molopo R.); Durban Museum 6 (Uniondale, Riverton, Griquatown-Niekerkshoop); Albany Museum 4 (Grahamstown, Zuurberg, Kimberley); National Museum, Bulawayo 3 (Riverton, Langley, Kuruman); British Museum 1 ('Cape of Good Hope'); total, 17.

Natal: British Museum 1 (Ingangani R.): Durban Museum 2 (Blood R., Utrecht); total, 3.

Transvaal: British Museum 3 (Rustenburg, Lydenburg, Potchefstroom); Durban Museum 8 (Piet Retief, 10 m. E. of Wakkerstroom); Transvaal Museum 15 (Hammanskraal, Pretoria, Groot Spelonken, Bloemhof, Wolmaransstad, Barberton, Carolina, Warmbaths); Albany Museum 1 (Pietersburg); South African Museum 1 ('Transvaal'); total, 29.

Swaziland: Transvaal Museum 1 (Ndhlovudwalili); total, 1.

Bechuanaland: National Museum, Bulawayo 7 (23 and 25 m. S. of Letlaking, Lephepe-Dabeete, 41 m. N.W. of Molepole, Lotlelekane Wells); total, 7.

2. *Anthus vaalensis daviesi* Roberts

Anthus daviesi Roberts, 1914, 172—Matatiele.

Larger than *vaalensis* and with less sexual dimorphism of size.

Range: The higher parts of the Cape Province, from Matatiele to Nieuwoudtville and the Cold Bokkeveld, north to Philipstown and Colesberg. Occasional birds from as far north as Ngoma, in Northern Rhodesia, are inseparable.

Measurements: 6 ♂s; wing 108–113 mm., av. 112·0 mm.; tail 70–83 mm., av. 75·3 mm.; culmen 18–20 mm., av. 19·5 mm.; tarsus 23–30 mm., av. 27·6 mm.; hind-claw 9–10 mm., av. 9·6 mm.

1 ♀; wing 105 mm.; tail 71 mm.; culmen 20 mm.; tarsus 26 mm.; hind-claw 11 mm.

Material examined: South African Museum 4 (Nieuwoudtville, Cold Bokkeveld, Hanover, Glen Grey); British Museum 1 (Deelfontein); Transvaal Museum 1 (Matatiele (type, *daviesi*)); Albany Museum 1 (Colesberg); Durban Museum 1 (Steynsburg); total, 8.

3. *Anthus vaalensis clanceyi* subsp. nov.

Decidedly greyer than *vaalensis* or *daviesi*; intermediate in size; virtually no sexual dimorphism of size.

Type: Ad ♂, in Durban Museum: 'Glen Lyon', Glen, Modder River, Bloemfontein; collected by Durban Museum personnel, 8 June, 1960.

I name this subspecies after Mr. P. A. Clancey, who first drew my attention to it.

Range: The Central Orange Free State, from Bloemfontein to (?) Vredefort Road.*

Measurements: 8 ♂s; wing 103–109 mm., av. 105·7 mm.; tail 72–79 mm., av. 74·7 mm.; culmen 18–19 mm., av. 18·5 mm.; tarsus 25–30 mm., av. 27·2 mm.; hind-claw 8–10 mm., av. 9·4 mm.

5 ♀s; wing 102–111 mm., av. 106·8 mm.; tail 70–83 mm., av. 74·4 mm.; culmen 18–19 mm., av. 18·4 mm.; tarsus 25–28 mm., av. 26·4 mm.; hind-claw 9–10 mm., av. 9·4 mm.

Material examined: Durban Museum 6 (Glen (type, *clanceyi*)); British Museum 3 (Vredefort Road); Albany Museum 2 (Vredefort Road, Bloemfontein); East London Museum 2 (Glen); total, 13.

4. *Anthus vaalensis exasperatus* subsp. nov.

Smaller than *vaalensis* or any other race (w. normally less than 100 mm.); little sexual dimorphism in size (w. ♀, 99% of ♂).

Type: Ad ♂, in National Museum of Southern Rhodesia, Bulawayo, No. 29147, 3 m. S. of Nata, Bechuanaland Protectorate; collected 28 January, 1957, collector's number M.118.

Range: North-eastern Bechuanaland, from the Nata River to Francistown. Occasional males from Matabeleland and Northern Rhodesia are inseparable; and females are only distinguishable in series.

Measurements: 4 ♂s; wing 91–98 mm., av. 95·0 mm.; tail 64–69 mm., av. 67·0 mm.; culmen 18 mm., av. 18·0 mm.; tarsus 25–29 mm., av. 26·7 mm.; hind-claw 10 mm., av. 10·0 mm.

7 ♀s; wing 91–102 mm., av. 94·4 mm.; tail 60–71 mm., av. 67·9 mm.; culmen 17–19 mm., av. 18·1 mm.; tarsus 24–28 mm., av. 26·7 mm.; hind-claw 8–11 mm., av. 9·2 mm.

Note that females of this race are less obviously smaller than those of neighbouring populations (S.W.A., w. av. 94·7 mm.; Caprivi Strip, w. av. 95 mm.) than are the males, in correlation with the lesser sexual dimorphism of size shown by this race.

Material examined: National Museum, Bulawayo 12 (Mache, Nata (type, *exasperatus*), 4 m. S. of Francistown, Makarikari); total, 12.

5. *Anthus vaalensis chobiensis* (Roberts)

Meganthus vaalensis chobiensis Roberts, 1932, 29—Kabulabula.
Anthus leucophrys marungensis Chapin, 1937, 342—Kaschi, Marungu, Belgian Congo.
Anthus vaalensis muhingae White, 1944, 6—Muhinga plain, Kasendoge, Katanga.

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* Since the above was written, Mr. Clancey has found specimens of this race in Griqualand West.

Similar to *A. v. vaalensis* but smaller; larger than *A. v. exasperatus*, especially in the males.

Range: From the Limpopo to western Nyasaland, Northern Province of Northern Rhodesia, Katanga and eastern Angola, except the north-eastern corner of Bechuanaland.

Measurements: 99 ♂s; wing 90–109 mm., av. 101·9 mm.; tail 60–79 mm., av. 72·0 mm.; culmen 15–22 mm., av. 18·9 mm.; tarsus 21–29 mm., av. 24·2 mm.; hind-claw 7–12 mm., av. 9·1 mm.

78 ♀s; wing 90–105 mm., av. 96·4 mm.; tail 60–78 mm., av. 69·4 mm.; culmen 16–21 mm., av. 18·4 mm.; tarsus 21–30 mm., av. 25·7 mm.; hind-claw 7–11 mm., av. 9·1 mm.

Material examined

Southern Rhodesia: Durban Museum 1 (Tjolotjo); National Museum, Bulawayo 104 (Gazuma Pan, Wankie Game Reserve, Kana R., Dorset Siding, Hopefountain, Nyamandhlovu, Copleston, Tjolotjo, Lupane, Bulawayo, Shangani R., Matopos, Bembezi, Inseze, Limpopo R., Khami, Sebungwe, Umvuma, Darwendale, Headlands, Salisbury, Rusape, Inyanga, Sabi-Lundi confluence, Hunyani R., Selukwe); Albany Museum 2 (Matopos); total, 107.

Northern Rhodesia: South African Museum 2 (Balovale, Lusaka); National Museum, Bulawayo 33 (Ngoma, Mazabuka, Choma, Lochinvar, Chuunga, Chilanga, Lusaka, Lukanga Swamp, Luanshya, Ntemwa-Lufupa confluence, Moshi-Lufupa confluence, Mweru Marsh, Mpika, Mwinilunga, Kasanga, Mporokoso, Kasusu, 8 m. N. of Nangweshi, Matabele Plain, Chiolola, Chunga Pools, Luete, Senenga); total, 35.

Caprivi Strip: Transvaal Museum 3 (Kabulabula (type, *chobiensis*), Kabuta); total, 3.

6. *Anthus vaalensis neumanni* Meinertzhagen

Anthus leucophrys neumanni Meinertzhagen, 1920, 23—Ambaca, Angola.

Decidedly redder than any other race.

Range: South West Africa and western Angola. Some specimens from eastern Angola, the Rhodesias and Nyasaland are indistinguishable from this form.

Measurements (S.W.A. birds only); 3 ♂s; wing 101–103 mm., av. 102·0 mm.; tail 73–76 mm., av. 74·7 mm.; culmen 17–18 mm., av. 17·7 mm.; tarsus 24–26 mm., av. 25·0 mm.; hind-claw 9–12 mm., av. 10·3 mm. (Hall, 1959, gives w. 93–105 for Angola birds, and White, 1948, 95–106 mm. for S.W.A. birds.)

3 ♀s; wing 92–98 mm., av. 94·7 mm.; tail 63–73 mm., av. 67·7 mm.; culmen 17–18 mm., av. 17·7 mm.; tarsus 27–28 mm., av. 27·7 mm.; hind-claw 9–12 mm., av. 10·3 mm. (Hall gives w. 89–102 mm. for Angola birds and White 94–99 mm. for S.W.A. birds.)

Material examined: Durban Museum 4 (Omaruru); British Museum 2 (Kamanjab, Franzfontein); total, 6.

Summary

The forms of *Anthus vaalensis* are discussed, and six subspecies: *vaalensis* Shelley, *daviesi* Roberts, *clanceyi* subsp. nov., *exasperatus* subsp. nov., *chobiensis* Roberts, and *neumanni* Meinertzhagen, are recognized. A statistical analysis is made of the measurements of the specimens.

Acknowledgements

I am deeply indebted to Mr. A. N. Rowan for statistical analysis of the measurements; to Mr. P. A. Clancey for drawing my attention to the peculiar series from the Orange Free State; and to Miss A. Schweitzer for the map.

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Appendix

STATISTICAL ANALYSIS OF THE NUMERICAL DATA

By

A. N. Rowan

In his study of *Anthus vaalensis*, Winterbottom measured the lengths of wing, tail, culmen, tarsus and hind claw in 258 museum specimens, of which 150 were males. These data, arranged geographically, were submitted for statistical analysis. As a first step, male wing lengths were tested for homogeneity using the F test, and were found to be very significantly heterogeneous, thus indicating that there were statistically valid differences between various populations.

A preliminary study of the figures suggested that male wing lengths tended to decrease with decreasing latitude, and the possible existence of a cline was examined by plotting these two measurements against each other. However, the correlation coefficient was not significantly different from zero, showing that a cline did not exist.

From a further inspection of the data it appeared (1) that males from northern Bechuanaland had smaller wings and tails than other groups; and (2) that the entire series could be separated into two groups, one with larger dimensions south of the Limpopo River, and the other comprising smaller birds north of that river. Accordingly, the 't' test was employed to test for significant differences between the postulated northern and southern groups and between them and the birds of northern Bechuanaland. Tables A and B give the results for wing, tail, tarsus and culmen lengths. The dimensions of the hind claw were omitted from this analysis since they showed no clear relation to other measurements and the over-all differences in length were too small in relation to the units of measurement employed.

From Table A it is clear that southern males are very significantly larger than their northern counterparts in all measurements and that southern females are significantly larger in all measurements except culmen length.

Table A: Comparisons between Northern and Southern Birds

		Averages				
Character	Sex	Southern group mm.	C.D.	Northern group mm.	t	Probability
Wing length	Male	105·80	0·60	101·76	2·58	0·01–0·02
	Female	101·33	0·70	96·53	>6	Far less than 0·001
Tail length	Male	74·50	0·45	71·64	3·40	Less than 0·01%
	Female	71·60	0·25	69·78	2·24	0·02–0·05
Length of tarsus	Male	27·17	0·33	26·06	3·26	Less than 0·01
	Female	26·63	0·34	25·59	2·53	0·01–0·02
Length of culmen	Male	19·23	0·27	18·72	2·47	0·01–0·02
	Female	18·63	0·12	18·39	1·11	Not significant

These results were further examined using the Coefficient of Difference, as recommended by Mayr *et al.* (*Methods and Principles of Systematic Zoology*, New York, 1953: 146). Table A shows the C.D. for various combinations. The conventional level of subspecific difference is 1·28. None of the coefficients of difference approaches this figure. Thus, using this criterion, it would appear that no single character is sufficient to indicate subspecific difference, but if all of them are considered together a good case might be made for subspecific difference between the populations north and south of the Limpopo.

Table B gives similar figures for northern Bechuanaland birds and those of the northern groups. It can be seen that while the northern males are larger than the northern Bechuanaland birds in wing, tail and culmen length the difference is highly significant only in wing length and moderately significant in tail length. The females of the two groups are not significantly different. In no case does the coefficient of difference reach the conventional level for subspecific difference. In view of the few specimens of northern Bechuanaland birds examined and because only male wing length is very significantly larger, it is considered very doubtful whether they should be separated on the mensural data alone.

TABLE B: COMPARISONS BETWEEN NORTHERN BIRDS AND NORTHERN BECHUANALAND BIRDS

Character	Sex	Averages Northern birds mm.	 Northern Bechuanaland birds mm.	t	Probability
Wing length	Male	101·76	95·00	3·51	Less than 0·01
	Female	96·53	94·23	1·76	Not significant
Tail length	Male	71·64	67·00	2·58	0·01–0·02
	Female	69·78	67·86	1·50	Not significant
Length of tarsus	Male	26·06	26·75	0·82	Not significant
	Female	25·59	26·71	1·41	Not significant
Length of culmen	Male	18·72	18·00	1·24	Not significant
	Female	18·39	18·14	0·65	Not significant

[CONTINUED FROM INSIDE FRONT COVER

References thus appear as follows:

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SYNONYMY. Arrangement according to Schenk, E. T. & McMaster, J. H.: *Procedure in taxonomy.* 2nd ed. Stanford, Stanford university press, 1948. Bibliographic references modified.

'I. *Synonymy arranged according to chronology of names.*—All published scientific names by which a species has been previously designated (subsequent to 1758) are listed in chronological order, with bibliographical references to all descriptions or descriptive citations following in chronological order after each name. . . .

B. *Form of bibliographic references to synonymic names.*—The first reference following any name in the synonymy should be to the earliest citation of that name. This should be followed by references to all subsequent citations of the same name, arranged in chronological order. . . .'

Bibliographical references modified to consist of author's name, date of citation, pagination and illustrations (plates and figures).

Example:—

Eulalia (*Steggoa*) *capensis* Schmarda

Eulalis capensis Schmarda 1861, p. 86, pl. 29, fig. 231. Willey 1904, p. 259.
Eulalia viridis var. *capensis* McIntosh 1903, p. 34. Day 1953, p. 30.
Eulalia viridis (*non* Muller) Ehlers 1913, p. 455. Day 1934, p. 30.

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PART XIV

POLYCHAETE FAUNA OF SOUTH AFRICA: PART 7 SPECIES FROM DEPTHS BETWEEN 1,000 AND 3,330 METRES WEST OF CAPE TOWN

By

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Zoology Department, University of Cape Town

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POLYCHAETE FAUNA OF SOUTH AFRICA: PART 7
SPECIES FROM DEPTHS BETWEEN 1,000 AND 3,330 METRES WEST OF CAPE TOWN

By
J. H. Day

[Accepted July 1962]

Zoology Department, University of Cape Town

(With 3 figures in the text)

Contents

Introduction

At the request of Dr. F. H. Talbot of the South African Museum, the Director of the Division of Fisheries kindly allowed R.V. *Africana II* to make a series of deep-water trawls on the continental slope west of Cape Town during August 1959, and a further series during December. The 15-foot Agassiz trawl brought up rich hauls of fish and invertebrates, and I am grateful to Dr. Talbot for allowing me to examine the Polychaeta. I have taken the opportunity of describing in this paper not only Dr. Talbot's collection, but also material from the same area and depth range obtained by means of a 0·1m.^{2} van Veen grab operated from the University of Cape Town's research vessel, the *John D. Gilchrist*. As might be expected, the grab sample contained several small species which were absent from the trawl samples.

Details of the stations which contained Polychaeta are as follows:

Vessel	*Station*	*Date*	*Position*	*Depth* (m.)	*Bottom*
Africana II					
	A.189	25/8/59	33°50′S./17°21′E.	1098	Globigerina ooze
	A.190	25/8/59	33°26′S./16°33′E.	2269	,, ,,
	A.191	26/8/59	33°36′S./16°15′E.	2745	,, ,,
	A.193	27/8/59	33°49′S./16°30′E.	2745	,, ,,
	A.315	8/12/59	34°37′S./17°05′E.	2930	,, ,,
	A.316	8/12/59	34°42′S./16°54′E.	3203	,, ,,
	A.317	9/12/59	33°50′S./16°30′E.	2850	,, ,,
	A.318	9/12/59	33°52′S./16°51′E.	2520–2780	,, ,,
	A.319	9/12/59	34°05′S./16°58′E.	2700	,, ,,
	A.321	10/12/59	34°33′S./16°42′E.	3330	,, ,,
	A.322	10/12/59	34°36′S./17°00′E.	2745	,, ,,
J. D. Gilchrist					
	WCD 73–75	8/10/60	34°25′S./17°36′E.	1240	gn. S.M.

Ann. S. Afr. Mus. **46** (14), 1963, 353–371, 3 figs.

These are not the first deep-water collections made in this area. In November 1921 the late Professor Gilchrist occupied several abyssal stations off Cape Town. The Polychaeta from these stations were described by McIntosh (1925). The total list of species recorded from depths exceeding 1,000 metres in this area is shown below.

Species	*McIntosh* 1925	*Present records*
Aphrodita alta Kbg.		×
Hermonia hystrix (Sav.)	×	
Laetmonice benthaliana McI.		×
= *L. filicornis* (McI. non Kbg.)	×	
Eunoe assimilis McI.	×	×
Eunoe macrophthalma McI.	×	
Harmothoe profunda n. sp.		×
Harmothoe sp.		×
Euphione elizabethae McI.	×	
Macellicephala mirabilis McI.	×	
Leanira hystricis Ehl.	×	×
Leanira tetragona (Oersted)		×
Nereis (Neanthes) papillosa n. sp.		×
Nephthys (Aglaophamus) macroura Schm.		×
Nephthys hystricis McI.		×
Nephthys paradoxa Malmgren		?
Hyalinoecia sp.		×
Lumbrineris brevicirra (Schm.)		×
Lumbrineris magalhaensis Kbg.		×
Paraonis gracilis oculata Hartman		×
Aricidea suecica simplex nov.		×
Prionospio steenstrupi Malmgren		×
Spiophanes soderstromi Hartman		×
Poecilochaetus serpens Allen		×
Notomastus latericeus Sars	×	
Maldanella fibrillata Chamberlin		×
Lumbriclymene minor Arwidsson		×
Phalacrostemma elegans Fauvel		×
Neosabellides elongatus (Ehl.)		?
Amphitrite cirrata Müller		×
Streblosoma abranchiata n. sp.		×
Streblosoma chilensis (McI.)		×
Terebellides stroemi Sars		×
Pista cristata (Müller)		×

The list includes 31 identified species of which 4 are new. A further 9 species are new records for South Africa; in fact only 4 of the 31 species listed are known to occur at depths less than 100 metres in South African seas. Many of the others such as *Laetmonice benthaliana*, *Euphione elizabethae*, *Macellicephala mirabilis*, *Maldanella fibrillata* and *Phalacrostemma elegans* are abyssal species from such widely separated regions as the sub-Antarctic, the North Pacific, New Zealand, the Gulf of Panama and Madeira. This does not indicate any affinity between the faunas of these areas, merely that abyssal species are very widely distributed and poorly known. It also emphasizes the importance of indicating the depth when listing distribution records.

The study of this collection was facilitated by side-by-side comparisons with the rich collections housed in the British Museum. I wish to thank my many friends at the British Museum for their help while I worked there and the Oppenheimer Memorial Trust which financed my research.

The material described in this report has been deposited in the South African Museum, Cape Town, and the registration number of each species is given in the text.

SYSTEMATIC SECTION

Family **Aphroditidae**
Sub-family **Hermoninae**

Genus Laetmonice Kinberg 1855

Both *L. filicornis* Kbg. and *L. producta* var. *benthaliana* McI. have been recorded from South Africa but the published descriptions do not indicate clearly the differences between them. Before the new material was identified specimens of *Laetmonice* in the British Museum were examined. The results are set out below.

Laetmonice filicornis Kinberg 1855 (type locality Sweden)

Material examined: British Museum specimen 1865 : 9 : 23 : 13 from Bohuslan, Sweden, and 1921 : 5 : 1 : 94–100 from the Shetland Islands.

The two samples are conspecific and the following description is based on the Bohuslan specimen. Length 30 mm. for 32 segments. Ommatophores not pigmented. Tentacular segment without purse-shaped lobes at the sides of the prostomium. 15 pairs of elytra. A felt present. Harpoon-setae numerous and much larger than the notopodial spines of cirrigerous feet. Ventrum covered with rounded papillae. Ventral cirri well developed, their tips reaching the bases of the inferior neurosetae.

Laetmonice producta Grube 1877 (type locality Kerguelen)

Material examined: British Museum specimens 1941 : 3 : 3 : 439–50 from Kerguelen.

Length 40–100 mm. for 42–46 setigers. Each ommatophore with a small eye-spot. Tentacular segment with a pair of purse-shaped lobes at the sides of the prostomium. 18 pairs of elytra. No felt. Harpoon-setae rare and the notopodial spines of cirrigerous feet as strong as those of elytrigerous feet. Ventrum covered with rounded papillae. Ventral cirri are well developed and reach the bases of the inferior neurosetae.

Laetmonice producta var. *wyvillei* McIntosh 1885

Material examined: British Museum type 1885 : 12 : 1 : 34 dredged off Prince Edward Island, and type 1885 : 12 : 1 : 35 from Challenger station 157 in the Antarctic.

The first is a specimen of *L. producta* differing from Kerguelen specimens only in the possession of smaller lobes on either side of the prostomium and indistinct eyes. All other characters agree. The second, chosen as the lectotype of *L. producta* var. *wyvillei*, may be described as follows:

Length 40 mm. for 42 segments. Ommatophores not pigmented. Tentacular segment without lobes at the sides of the prostomium. 18 pairs of elytra. Felt poorly developed. Harpoon-setae well developed and stronger than the notopodial spines of cirrigerous feet. Ventrum with a few papillae. Ventral cirri are small and do not reach the bases of the inferior neurosetae.

Laetmonice benthaliana McIntosh 1885

Material examined: Types of *L. producta* var. *benthaliana* in the British Museum numbered 1885 : 12 : 1 : 1 from Challenger station 147 off Prince Edward Island (lectotype). 1885 : 12 : 1 : 36 from Challenger station 244 in the Pacific. 1885 : 12 : 1 : 37 from Challenger station 241 in the North Pacific. Types of *L. producta* var. *willemoesi* in the British Museum numbered 1885 : 12 : 1 : 31 from Challenger station 169 off New Zealand. 1885 : 12 : 1 : 32 from Challenger station 146 off Prince Edward Island.

The lectotype measures 35 mm. for 32 segments. Ommatophores not pigmented. Tentacular segment without lobes at the sides of the prostomium. 15 pairs of elytra. Felt present but scanty (? lost). Harpoon-setae common and markedly larger than the notopodial spines of cirrigerous feet. Ventrum smooth. Ventral cirri are very small and do not reach the bases of the inferior neurosetae.

KEY TO *Laetmonice producta*, *producta wyvillei*, *filicornis* AND *benthaliana*

1. Body with 42 or more segments; 18 pairs of elytra 2
   Body with about 32 segments; 15 pairs of elytra 3
2. Purse-shaped lobes at the sides of the prostomium. No felt. Notopodial spines of cirrigerous feet as strong as those of elytrigerous feet .. .. *L. producta*
   No purse-shaped lobes. A scanty felt. Notopodial spines of cirrigerous feet weaker than those of elytrigerous feet .. .. *L. producta wyvillei*
3. Ventrum covered with rounded papillae. Tips of ventral cirri reach bases of inferior neurosetae .. .. *L. filicornis*
   Ventrum smooth or with a few papillae at the bases of the parapodia. Ventral cirri small and not reaching the base of the neurosetae .. .. *L. benthaliana*

RECORDS OF *Laetmonice* FROM SOUTH AFRICA

Laetmonice benthaliana McIntosh 1885

Laetmonice producta var. *benthaliana* McIntosh 1885, p. 45, pl. 8 figs. 4–5, pl. 4 fig. 12.

? *Laetmonice filicornis* McIntosh 1925, p. 20.

Records: Station A.191 (2) and A.193 (9)—S.A. Museum Register No. A.19778.

Station A.316 (15), A.317 (2), A.318 (2), A.319 (4) and A.322 (1)—Register No. A.19959.

Notes: This species seems to be one of the commonest polychaetes at abyssal depths west of Cape Town, and these South African specimens agree closely with the type described above. McIntosh (1925) recorded *L. filicornis* from five stations in this area and from 4–10 fathoms in Saldanha Bay. The only two specimens from this collection, which are now in the British Museum (numbers 1924 : 7 : 21 : 21–22) are *Hermonia hystrix*; possibly the missing specimens were *L. benthaliana*. At any rate the record of *L. filicornis* must be eliminated.

Laetmonice producta wyvillei McIntosh 1885

Laetmonice producta var. *wyvillei* McIntosh 1885, p. 44.
Laetmonice producta (*non* Grube) Day 1934, p. 18.

Notes: The two specimens recorded by me (Day, 1934) from deep dredgings off Portuguese East Africa have been re-examined. They are *L. producta wyvillei* with 18 pairs of elytra, a smooth ventral surface and very small ventral cirri.

Aphrodita alta Kinberg 1855

Aphrodita alta Kinberg 1857, p. 2, pl. 1 fig. 1 *a–g*. Day, 1960, p. 274.

Records: Station A.319 (1 juvenile)—S.A. Museum Register No. A.19964.

Sub-family **Polynoinae**

Harmothoe profunda n. sp.

(Fig. 1 *a–e*)

Records: Station A.193 (2)—S.A. Museum Register No. A.19780. Stations A.316 (2) and A.318 (1)—Register No. A.19960.

Description: The holotype from station A.193 is the only complete specimen. It is 16 mm. long for 33 segments. The dorsum is black or possibly purple when fresh but the elytra and parapodia are pale. The prostomium (fig. 1*a*) is bilobed with obvious frontal peaks and the anterior pair of eyes is large and half-way back on the sides of the head. The median antenna is missing and the laterals are small, about half as long as the prostomium, markedly tapered and obviously ventral in origin. The dorsal cirri are about as long as the neurosetae and like the antennae they are sparsely beset with long papillae.

The whole length of the body is covered with 15 pairs of elytra. Individual elytra (fig. 1*b*, *b'*) vary from rounded to broadly oval and each is densely covered with chitinous tubercles which increase gradually in size from the anterior to the posterior margin. The small anterior ones are bluntly conical, those near the centre are larger and stouter, and a few near the posterior margin are almost spherical. Some are smooth, others rugose and some even have small blunt projections. A few small soft papillae are to be found near the external margin and it might be said that the elytra are minutely fringed.

The notopodium is well developed (fig. 1*c*) and bears numerous sabre-shaped notosetae much stouter than the neurosetae. Each notoseta (fig. 1*d*, *d′*) bears numerous rows of strong serrations and has a short, flanged and bluntly pointed tip. The neuropodium is rather short with a triangular presetal lobe and rounded postsetal lip. The neurosetae (fig. 1*e*, e^1) have rather long blades with 15–20 rows of well-marked spinules. The tips are of normal length and bidentate, but the relative size of the two teeth varies. In superior setae the secondary tooth is not much smaller than the terminal one, but in the middle of the series the secondary tooth decreases and inferior setae have a strong terminal tooth and a weak secondary one, only half the length of the terminal.

There are many resemblances between this species and *H. exanthema* var. *bergstromi* Monro 1936 from the Magellan area. An examination of the type in the British Museum proved that the main difference is in the character of the tubercles on the elytra. In Monro's species there is a scattering of uniformly small, slightly curved conical tubercles and a few very large, soft, pedunculate vesicles but no intermediate forms. Moreover the antennae and cirri are more densely papillose, the notosetae have finer serrations and the neurosetae have longer naked tips and a smaller secondary tooth.

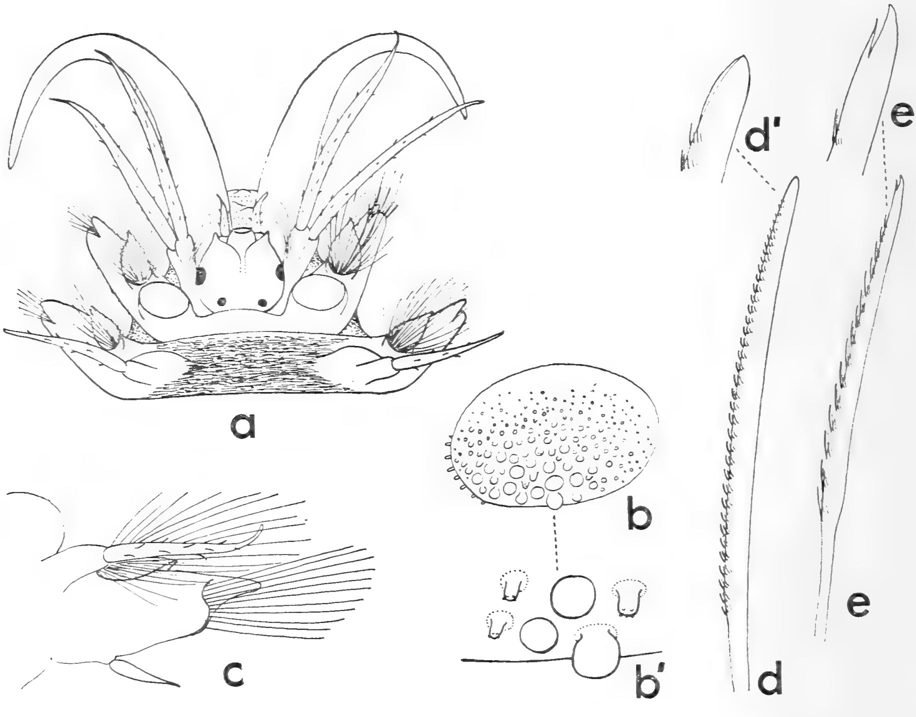

Fig. 1. *Harmothoe profunda.*

(*a*) Head. (*b*, *b′*) Elytron and details of marginal tubercles. (*c*) Parapodium. (*d*, *d′*) Notoseta and details of tip. (*e*, *e′*) Neuroseta and details of tip.

Harmothoe sp.

Records: Station A.190 (1)—S.A. Museum Register No. A.19771.

Notes: Although the specimen is too poorly preserved to give it a specific name it is obviously different from any other recorded from South Africa. The characters may be briefly summarized as follows. Antennae and cirri smooth. Elytra with minute conical tubercles anteriorly and 4–5 large cylindro-conical soft papillae on the external margin. Notosetae with small, close-set serrations and strongly flanged tips. Neurosetae with long, weakly spinulose blades and minutely bidentate or unidentate tips.

Eunoe assimilis McIntosh 1925

Eunoe assimilis McIntosh 1925, p. 21, pl. 2 figs. 1–2, pl. 3 fig. 3.

Records: Station A.193 (2)—S.A. Museum Register No. A.19782. Station A.316 (1)—Register No. A.19961. Station A.318 (1)—(doubtful identification) Register No. A.19962.

Description: McIntosh's original description is incomplete and a re-examination of the type in the British Museum and the discovery of a complete specimen with elytra allow me to give a summary of the diagnostic characters.

Body 20–30 mm. long with 36–37 segments, rather broad but tapered posteriorly. Body completely covered with 15 pairs of elytra. Colour generally pale, but the ventral cirri and outer margins of the elytra are tinged with purple.

Prostomium with small frontal peaks but without eyes. Median antenna three times the prostomial length; laterals ventral in origin and about 1·5 times the prostomial length. Antennae and cirri appear smooth but are really clad with short papillae. Dorsal cirri are tapered and reach the ends of the neurosetae. Elytra large and delicate with smooth margins; the surface is glabrous apart from a small patch of tiny rounded tubercles near the anterior margin.

Notosetae fairly numerous, each stout with close-set rows of weak serrations and a long, narrowly flanged and bluntly pointed tip. Neurosetae few and unidentate, the swollen blades having about 20 rows of short spinules and a long hooked and sharply pointed tip. There is no trace of a secondary tooth.

E. assimilis is close to *E. abyssorum* McIntosh 1885 dredged in 2,600 fathoms south of Australia. The type was examined in the British Museum. Like *E. assimilis* it lacks eyes and has papillose antennae and dorsal cirri. The elytra are missing. The setae are not markedly different, but the notosetae are more strongly serrated and the tips are quite smooth, not flanged. On the other hand each neuroseta does have a flange preceding the strong terminal tooth. *E. assimilis* may prove to be a synonym of *E. abyssorum*, but until the elytra of *E. abyssorum* are known the two should be kept separate.

Sub-family **Sigalioninae**

Leanira tetragona (Oersted, 1845)

Leanira tetragona (Oersted), Fauvel 1923, p. 117, fig. 43 *a–g*.

Records: Station A.189 (2)—S.A. Museum Register No. A.19768.

Notes: This is a new record for South Africa but although the specimens are in poor condition and lack elytra their other characters agree with specimens from northern Europe (the type locality is Norway). In particular the prostomium lacks eyes, the median antenna is long and unjointed with a pair of flaps at its base, there is a dorsal cirrus on setiger 3 and there are several slender stylodes on the parapodia; the notopodium has 5–7 and the neuropodium a series of 10–12. Cirriform branchiae appear on setiger 5 or 6, and 3 ciliated swellings or 'cupuliform branchiae' are present between the notopodium and the elytrophore. There are no simple setae in the neuropodia—all are compound with smooth or weakly serrated shaft-heads and laddered blades. It may be added that European specimens have a few delicate papillae on the external margins of the elytra, a character which distinguishes this species from *L. hystricis* and *L. incisa* which have both been recorded from southern Africa. Both of them also lack a dorsal cirrus on setiger 3.

Fauvel (1923) was doubtful of the presence of a dorsal cirrus on setiger 3 of any species of *Leanira*, but an examination of the types of *L. magellanica* McIntosh 1885, *L. areolata* McIntosh 1885 and *L. japonica* McIntosh 1885 shows that all three have a dorsal cirrus on setiger 3. A revision of the genus is necessary.

Leanira hystricis Ehlers 1874

Leanira hystricis Ehlers, Fauvel 1923, p. 118, fig. 43 *h–m*.
L. hystrix McIntosh 1925, p. 38.

Records: Stations A.315 (1), A.317 (4) and A.319 (1)—S.A. Museum Register No. A.19963. WCD 73 (1).

Notes: McIntosh's specimen in the British Museum agrees with the present material. There are no eyes, the median antenna lacks ctenidial flaps, there is no dorsal cirrus on setiger 3, and cirriform gills appear between the 24th and 30th foot. The stylodes are all sausage-shaped; there is one on the notopodium and 2–5 on the neuropodium. There are no simple neuropodial setae.

Family **Nereidae**

Nereis (*Neanthes*) *papillosa* n. sp.

(Fig. 2 *a–g*)

Records: Station A.191 (1)—S.A. Museum Register No. A.19779.

Description: The holotype is a complete specimen 25 mm. long with 58 segments. It is pale in alcohol without any colour pattern. It is an incipient heteronereid female with enlarged eyes and swimming setae developing in setigers 16–35.

The prostomium (fig. 2*a*) is broadly oval with short broad palps but the antennae and tentacular cirri do not present any features of special interest. The anterior pair of eyes is greatly enlarged but the posterior pair is normal. The proboscis (fig. 2*b* and *c*) when dissected proved to have very pale, poorly chitinized paragnaths difficult to see; in particular some doubt must remain as to the presence of paragnaths on groups VI, VII and VIII. Group I = 1, II = 3–4, III = 4, IV = 5–6 in a wedge, V = 0, VI = 2 or 3 (very faint), VII + VIII = a single row of about 4 very pale points.

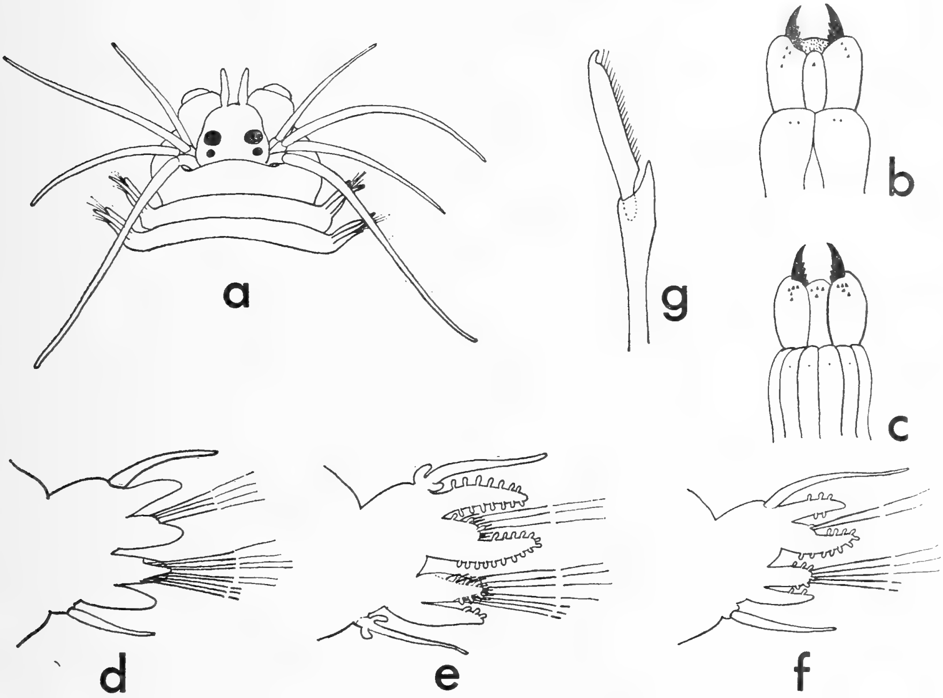

FIG. 2. *Nereis* (*Neanthes*) *papillosa*.
(*a*) Head. (*b*, *c*) Dorsal and ventral views of proboscis. (*d*) 10th foot. (*e*) 25th foot. (*f*) 45th foot. (*g*) Posterior neuropodial falciger.

Anterior feet (fig. 2*d*) have conical lobes and a rather short dorsal cirrus. There are only two notopodial lobes but the notosetae arise from a dorsal bulge on the inferior lobe so that the notopodium might be said to have 2½ lobes. The neuropodium is normal. In the middle of the body (fig. 2*e*) there is a marked gap between the notopodium and the neuropodium, and all the lobes bear numerous club-shaped papillae. It is unlikely that these papillae are modifications due to the heteronereid phase for this does not occur in other species and in any case the papillae continue on the posterior feet where swimming setae are not developed. The posterior feet (fig. 2*f*) have long dorsal cirri without any basal flaps, the parapodial lobes are slender and the papillae are less numerous.

The notosetae are homogomph spinigers throughout, there being no notopodial falcigers. The neurosetae include the usual homogomph and heterogomph spinigers and heterogomph falcigers (fig. 2*g*). These have rather long straight blades. In middle segments the tips of the developing swimming setae project from both setigerous lobes.

There is a general similarity between *N. kerguelensis*, *N. unifasciata* and *N. papillosa*. All have two notopodial lobes in anterior feet and a single row of paragnaths on groups VII + VIII. *N. papillosa* is unique in having papillae on the parapodial lobes.

Family **Nephthydidae**

Nephthys (*Aglaophamus*) *macroura* Schmarda 1861

Aglaophamus macroura (Schmarda), Hartman 1950, p. 118.
Nephthys (*Aglaophamus*) *macroura* Schmarda, Day 1960, p. 327.

Records: WCD 73 (1).

Notes: The single specimen is a juvenile 25 mm. long and its identification is therefore doubtful. The ventral cirrus on setiger 1 is large but the dorsal cirrus is rudimentary. Cylindrical, involute branchiae appear on setiger 3. An average parapodium from the middle of the body has conical setigerous lobes but lacks presetal lamellae on both rami. The postsetal lamella of the notopodium is divided into a large rounded superior part and a small inferior part. The notopodial cirrus is well developed, tapered and rounded in section, not flattened and blade-like. The postsetal lamella of the neuropodium is auricular and just exceeds the setigerous lobe. Anterior setae are normal laddered capillaries and posterior setae are long, fine and minutely denticulate on one side.

The absence of a dorsal cirrus on setiger 1 and the early appearance of the branchiae suggest *N. macroura*, but the structure of the feet, particularly the notopodial cirrus, is closer to *N. malmgreni*, which is also a deep-water species. Possibly the early appearance of the branchiae is a juvenile character.

Nephthys hystricis McIntosh 1900

Nephthys hystricis McIntosh, Fauvel 1923, p. 373, fig. 146 *a–e*.

Records: WCD 73 (1).

Notes: The single specimen is a juvenile and is referred to *N. hystricis* with hesitation.

Nephthys (*Nephthys*) ? *paradoxa* Malmgren 1874

Nephthys (*Nephthys*) ? *paradoxa* Malmgren, Day 1960, p. 327.

Records: Station A.315 (1)—S.A. Museum Register No. A.19965.

Notes: The specimen is broken and badly preserved. While it is similar to the one reported by Day, 1960, the identification must remain uncertain. A large parasitic nematode lies in the body cavity.

Family **Eunicidae**

Sub-family **Onuphidinae**

Hyalinoecia sp.

Records: WCD 73—15 specimens and 3 juveniles.

Notes: These specimens approach *H. bilineata* var. *rigida* as described by Fauvel, 1923, p. 424, but differ in several respects. They are encased in fragile tubes covered with detritus quite unlike the tough quill tubes of *H. tubicola*, the only species of the genus previously recorded from South Africa. The two frontal antennae are rather broad and the five occipital antennae are mounted on 4-ringed ceratophores, each ring having a projecting lateral lobe. There are no eyes and no tentacular cirri. Conical ventral cirri are present on the first 3 setigers. Gills start on setiger 9 and continue for about 12 segments. Each gill is a small inconspicuous filament no larger than the dorsal cirrus. The hooded hooks of setigers 1 and 2 are unidentate and very faintly pseudo-compound.

I know of no species of *Hyalinoecia* with branched ceratophores to the occipital antennae, but similar structures do occur in the genus *Epidiopatra* and it is just possible that all these specimens may develop spiral gills at a later stage. For this reason they have not been named as a new species.

Sub-family **Lumbrinerinae**

Lumbrineris magalhaensis Kinberg 1864

Lumbrineris magalhaensis Kinberg, Day 1960, p. 362, fig. 12 *h–j*.

Records: Station A.189 (1)—S.A. Museum Register No. A.19769.

Lumbrineris brevicirra (Schmarda 1861)

Lumbrineris brevicirra (Schmarda), Day 1961, p. 361, fig. 12 *e–g*.

Records: Station A.193 (1)—S.A. Museum Register No. A.19781.

Family **Paraonidae**

Paraonis gracilis oculata Hartman 1957

Paraonis gracilis oculata Hartman 1957, p. 331, pl. 44, figs. 1–3.

Records: WCD 74 (3 juveniles).

Notes: All three specimens are broken but probably measured less than 8 mm. when complete. The prostomium bears a pair of subdermal eyes and there are only 3 pairs of gills on setigers 6, 7 and 8. Posterior neurosetae include 1–2 capillaries and 2–3 short stout acicular hooks with curved, sigmoid shafts and blunt unidentate tips. There is no trace of an arista. Ehlers (1913) recorded *Aonides gracilis* (now recognized as a synonym of *Paraonis gracilis*) from False Bay but did not mention whether his specimen had eyes or not.

Aricidea suecica simplex var. nov.

(Fig. 3 *a–b*)

Records: WCD 73 (3).

Description: All three specimens are broken and only one is sufficiently long to identify the posterior neurosetae. It has been chosen as the holotype. It is 8 mm. long with 65 segments and probably represents about half of the original worm.

The prostomium (fig. 3*a*) is short and broad with well-marked nuchal slits, a very short median antenna, but no eyes. The anterior region is flattened dorsally and the posterior region rounded. Branchiae start on setiger 4 and continue to setiger 15 so that there are 12 pairs in all. Each gill is stout with a pointed tip and just meets its fellow in the mid-dorsal line. All gills are subequal except for the last 2–3 which are small. The postsetal notopodial lobe of setiger 1 is a small papilla but later ones soon increase in size and in the branchial region they are 2/3 the length of the gills. The neuropodia are merely low

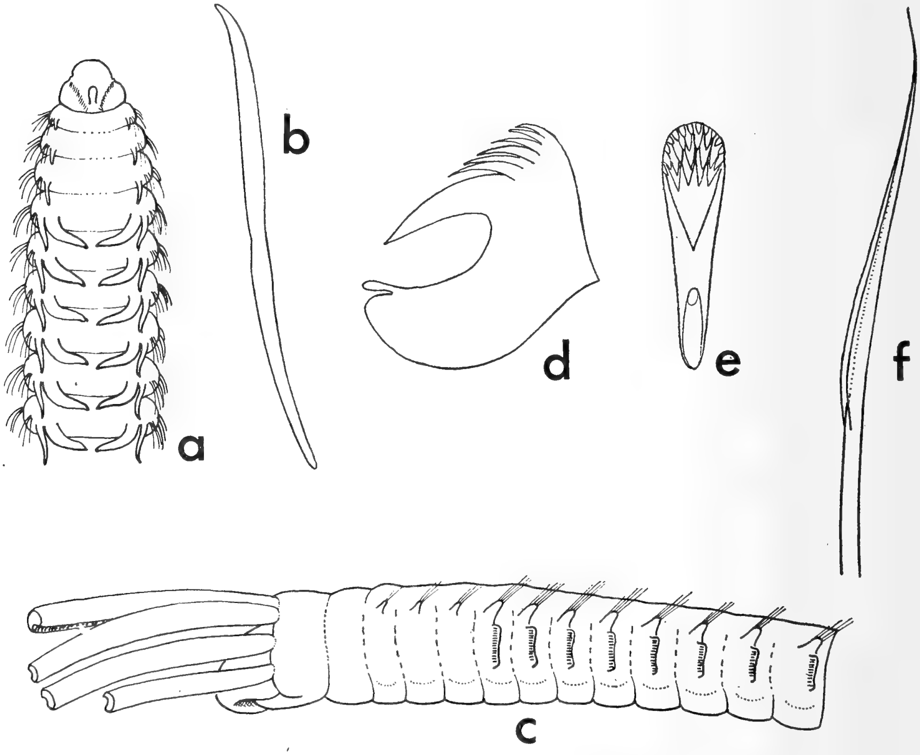

FIG. 3. *Aricidea suecica* var. *simplex*.
(*a*) Head and anterior segments. (*b*) Posterior neuropodial hook. *Streblosoma abranchiata:* (*c*) Lateral view of head and anterior segments. (*d, e*) Lateral and edge-on views of thoracic uncinus. (*f*) Thoracic notoseta.

lateral ridges. Anterior notosetae and neurosetae are similar. Each is a curved capillary with a slender blade.

The posterior region as defined by the appearance of the neuropodial hooks starts on setiger 24. The segments are rounded in section, each with a slender postsetal notopodial lobe. The posterior notosetae are 2–3 fine capillaries but the neurosetae are more numerous. Each neuropodium bears about 5 long slender capillaries and an increasing number of hooks; at first there are only 1–2 but later as many as 10. The hooks (fig. 3*b*) are all similar from segment 24 onwards. Each is sigmoid in shape with a shaft which is constricted where it leaves the surface and a curved unidentate tip which never has any prolongation or sign of an arista.

The stem form *A. suecica* Eliason 1920 from northern Europe is described as having an arista or slender blade projecting beyond the apex of the neuropodial hook in the middle of the body, but this is lost later and posterior neuropodial hooks are sigmoid and unidentate. There is also a pair of eyes. This is a new record for South Africa.

Family **Spionidae**

Prionospio steenstrupi Malmgren 1867

Prionospio steenstrupi Fauvel 1927, p. 60, fig. 21 *f–i*.
Prionospio malmgreni var. *dubia* Day 1961, p. 489, fig. 3 *j–n*.

Records: WCD 73 (1).

Spiophanes soderstromi Hartman 1953

Spiophanes soderstromi Hartman 1953, p. 41, fig. 14 *a–c*. Day 1961, p. 484.

Records: WCD 74 (1 juvenile).

Family **Disomidae**

Poecilochaetus serpens Allen 1904

Poecilochaetus serpens Allen, Fauvel 1927, p. 67, fig. 23 *a–m*. Day 1961, p. 497.

Records: WCD 73 (1 juvenile).

Family **Maldanidae**

Maldanella fibrillata Chamberlin 1919

Maldanella fibrillata Chamberlin 1919, p. 413, pl. 72 figs. 1–6, pl. 73 figs. 1–2.

Records: Station A.190 (5)—S.A. Museum Register No. A.19773.

Description: The 5 specimens were encased in fragile tubes covered with grey silt. Their bodies were broken and the number of segments is unknown. Head with an oval cephalic plate inclined at 45° to the axis of the body and surrounded by a high, smooth rim which is continuous apart from a small anterior gap occupied by the prostomium. No eye spots. Nuchal grooves straight and half the length of the cephalic plate but their anterior ends are continuous with a streak which curves sharply back around the inside of the rim. Anterior segments short, hardly longer than broad, and without collars but with glandular rings on the first 7. Middle segments long but the posterior ones shorter and sausage-shaped. 3 achaetous preanals which decrease in length. The last is not very distinct and is situated at the base of the pygidial funnel which is rimmed with 30 equal anal cirri. Anus on a pleated cone without a marked ventral valve.

Setiger 1 with notosetae only. Setiger 2 with notosetae and 15–20 neuropodial hooks. Later segments similar but with more hooks. The notosetae are all narrow-winged capillaries, some long and some short. The hooks on setiger 2 have a vertical series of 2–3 teeth above the main fang while those of later segments have 3–4 teeth.

These characters agree with Chamberlin's description and it may be added that his original specimen was complete and measured 70 mm. by 5·5 mm. and had 19 setigerous segments.

M. fibrillata is a rare abyssal species from the Pacific off the coast of Panama. The only species of *Maldanella* known from South Africa is *M. capensis* Day which has 4 achaetous preanals (not 3) and only 2–3 neuropodial hooks on setiger 2 (not 12 or more).

Lumbriclymene minor Arwidsson 1906

Lumbriclymene minor Arwidsson: Fauvel 1927, p. 196, fig. 68 *k–q*.

Records: Station A.315 (1)—S.A. Museum Register No. A.19966.

Notes: The tube is free and encrusted with foraminiferan shells. The body is 20 mm. long with 19 setigers and 3 indistinct preanals in front of the pygidium. The anterior end is bluntly rounded without a well-defined prostomium, cepalic plate or crest. Even the curved nuchal grooves are poorly marked. The 19 setigers do not differ greatly in length, each being about three times as long as broad. The anterior margins of anterior setigers are slightly glandular but the intersegmental constrictions are not deep and there is no sign of collars. The three achaetous preanal segments are short and poorly marked with indistinct lateral tori. The pygidium is blunt and slightly swollen with a dorsal anus. The ventral valve is very large and is continuous with the bluntly conical posterior end. The ventral surface of the pygidium is somewhat flattened and slopes upwards. There are no anal cirri. The notosetae are all winged capillaries, some smooth-edged and some striated towards the distal end. Each of the first 4 setigers bears a single stout, smoothly pointed, acicular seta. Subsequent neurosetae are rows of about 6 hooks, each with a vertical series of 4 teeth above the rostrum and a few lateral denticles. Below the rostrum is a short 'neck' and then a marked swelling in the shaft.

This is a new record for South Africa. Its pygidium differs from *L. cylindricauda* Sars which has recently been found in shallow water in this area (unpublished record). In *L. cylindricauda* as the name implies the posterior end is cylindrical with a terminal anus; in *L. minor* the anus is dorsal and the ventral surface of the pygidium is flattened and slanting.

Family **Sabellariidae**

Phalacrostemma elegans Fauvel 1911

Phalacrostemma elegans Fauvel 1914, p. 270, pl. 24, figs. 1–16.

Records: Station A.315 (1)—S.A. Museum Register No. A.19967.

Notes: The single specimen is poorly preserved and lacks a tube, but the available characters, in particular the setae, agree completely with Fauvel's description.

The opercular lobes are separate and each bears a single ring of long, tapered and spirally serrated 'paleae' with about 3 stout acicular setae at the base. At the junction of the opercular lobes there is one pair of hooks dorsally and a single median tentacle ventrally. The buccal tentacles and palps have disintegrated. There are 4 parathoracic segments with oar-shaped setae. There are at least 12 abdominal segments bearing uncini and capillaries, but the gills have been lost and the posterior end has disintegrated so that the exact number of segments and details of the caudal region are unknown.

This is a new record for South Africa. Fauvel's original specimen came from 1,968 metres off Madeira.

Family **Ampharetidae**

Neosabellides cf. elongatus (Ehlers) 1913

[?] *Sabellides elongatus* Ehlers 1913, p. 551, pl. 42, figs. 1–6.
[?] *Neosabellides elongatus* (Ehlers), Hessle 1917, p. 104. Monro 1936, p. 175.

Records: Station A.319 (3)—S.A. Museum Register No. A.19968.

Description: The 3 specimens are encased in characteristically slender and closely ringed brownish mud tubes. The body is slender, slightly swollen anteriorly, about 30 mm. long and 1·2 mm. wide at the broadest part of the thorax.

The prostomium is bluntly spade-shaped without lateral grooves but has a single pair of eyes. The tentacles are largely retracted and lateral pinnules are poorly marked. Segment II is narrow but unusually distinct. Segment III lacks paleae and is fused to segment IV which bears a small bundle of notopodial capillaries. Segments V and VI also bear notopodial capillaries but no uncini. Segment VII and the next 10 segments bear both notopodial capillaries and neuropodial uncini so that there is a total of 14 segments with notosetae of which the first three lack uncini. Segment III bears two groups of 3 smooth, tapered gills which project well beyond the prostomium. The two groups of gills are well separated in the dorsal median line and each group is arranged in a transverse row, but there is no obvious branchial ridge nor is there any sign of nephridial papillae between the two groups of gills. The first

5 thoracic segments are short, each being about three times as broad as long, but subsequent segments become much longer until in the middle of the thorax each segment is three times as long as broad. The length of the segments affects the glandular ventral pads which are recognizable on all except the last thoracic segment. Anterior ones are well marked and contiguous, but posterior pads are poorly developed and well separated from one another. The abdomen consists of 32 segments. Each uncigerous pinnule is a small, roughly square lateral lobe with a small papilla above the row of uncini. The pygidium bears a circle of 6–8 tapered anal cirri and a larger pair of ventral lobes.

The notosetae are smooth-winged capillaries. Thoracic uncini bear 8 teeth in two vertical rows of 4.

These South African specimens agree with Ehlers's original description of *Sabellides elongatus* from Antarctica in regard to most characters, but the first three setigers lack uncini whereas Ehlers states that only two anterior setigers lack uncini. Moreover Ehlers found only 19 abdominal segments or less, whereas these South African specimens have over 30. It may be that Ehlers (1913), Hessle (1917) and Monro (1936), who all describe material from the Antarctic or sub-Antarctic, missed the first bundle of notosetae, which is small and very close to the second, but for the present the identity of the South African specimens must remain doubtful.

Family **Terebellidae**

Amphitrite cirrata Müller 1771

Amphitrite cirrata Müller, Fauvel 1927, p. 251, fig. 86 *i–o*.

Records: Station A.319 (6)—S.A. Museum Register No. A.19971.

Notes: The present material agrees perfectly with Fauvel's description. There is a general resemblance to a species of *Thelepus* since the three pairs of gills are filamentous, with the right and left tufts well separated. Each tuft arises from a basal stump. There are 17 thoracic segments starting on segment 4 (3rd branchiferous), each bearing a bundle of notopodial capillaries with minutely denticulate tips. There are small lateral lobes on segments 2, 3 and 4, and 12 ventral pads. Uncini start on segment 5 (setiger 2) and are arranged in double rows after the first few. Each uncinus is avicular with a close-set cap of denticles above the main fang. The denticles are irregularly arranged but approximate to the formula: MF : 4–5 : 5–6 : 8–10 : 10–15.

The abdomen is broken in every specimen but has at least 20 segments with square uncigerous pinnules.

This species is well known from high latitudes in the North Atlantic. Fauvel (1914) recorded *Amphitrite cirrata profunda* from abyssal depths off the Azores, but as he says himself it is very doubtfully distinct from the stem form.

This is the first record of the genus *Amphitrite* from South Africa.

Pista cristata (Müller 1776)

Pista cristata (Müller), Fauvel 1927, p. 266, fig. 93 *a–g*.

Records: Station A.317 (1), A.319 (6)—S.A. Museum Register No. A.19970.

Notes: These specimens agree well with Fauvel's description. There are 2 pairs of gills, each with a long stem and a terminal pompon of spirally arranged filaments. There are 3 pairs of lateral lobes; the pair on segment 2 is small and continuous across the ventrum, the pair on segment 3 is large and lateral in position, and the pair on segment 4 is small. 17 thoracic segments bear bundles of smooth-winged notopodial capillaries. The first four rows of uncini have a close-set crest of denticles, short 'necks' below the main fang, rounded bases and well-developed shafts; later uncini have no shafts.

P. cristata var. *capensis*, reported by McIntosh (1925) from Portuguese East Africa, was said to have a single tooth above the main fang. The type has been lost. *P. brevibranchia* Caullery, reported by me (Day, 1951 and 1957) from Portuguese East Africa, may be distinguished from *P. cristata* by the shortness of the branchial trunks and the uncini. Only the first row of uncini has well-developed shafts, the neck of the uncinus is longer and the base larger and more triangular.

Terebellid— ? gen. et sp.

Records: Station A.316 (12)—S.A. Museum Register No. A.19972.

Notes: The specimens are very soft and poorly preserved, and some of the characters are doubtful. They are obviously different from the other species recorded here but cannot be identified with certainty.

An average specimen is about 50 mm. long and 4 mm. wide across the anterior thorax. The collar-shaped tentacular lobe bears numerous orange tentacles. No gills were found; it is possible that they have been lost, but there was no clear sign of scars. No lateral lobes were visible. There are 17 bundles of notosetae starting on segment 3 or possibly 4. The notosetae are of two lengths, both with smooth, broad wings and *very* long attenuated tips which appear to be quite smooth. Uncini start on setiger 2 (i.e. segment 4 or 5), and on the posterior thorax they are arranged in double rows. The thoracic uncini are all similar, each being avicular with a crest of numerous irregularly arranged denticles above the main fang. There are at least 12 ventral pads. The abdomen consists of 40 or more segments bearing short uncigerous pinnules.

These specimens belong to the sub-family *Amphitritinae* as shown by the arrangement and structure of the uncini. I know of no species which has smooth-bladed notosetae and lacks gills. However, a better preserved specimen is necessary to confirm that gills are really absent.

Streblosoma abranchiata n. sp.

(Fig. 3 *c–f*)

Records: Station A.190 (numerous tubes and specimens)—S.A. Museum Register No. A.19770.

Stations A.315 (2), A.319 (Common) and A.321 (1)—Register No. A.19969.

Description: The type material is No. A.19770 from Station A.190. The tubes are long, fragile and heavily encrusted with foraminiferan shells. The worms themselves are poorly preserved, but judged by the size of the larger fragments the body was cylindrical, rather slender and about 30 mm. long by 1·5 mm. wide with over 60 segments.

The tentacular lobe (fig. 3*c*) is short and collar-like, with about a dozen long, grooved tentacles. There are no eye-spots. An oral hood overhangs the ventral mouth but the lower lip is small. There are no lateral lobes on anterior segments and no sign of gills although all specimens were carefully examined. The first bundle of notosetae is on segment 2 and there are at least 19 segments with notosetae. The longest anterior fragment had disintegrated at this point but posterior fragments of 20 or more uncigerous segments are without notosetae. The notosetae (fig. 3*f*) are smooth-winged capillaries. Uncini appear on setiger 4 (segment 5). They are arranged in single rows throughout and borne on poorly marked uncigerous ridges even in abdominal segments. Each uncinus (fig. 3*d* and *e*) has a close-set cap of denticles above the main fang. These are irregularly arranged but approximate to the formula MF: 4–5 : *ca.* 8 : *ca.* 12. The base of the uncinus has the characteristic clog-shape of the sub-family *Thelepinae* with a forwardly produced rounded prow and a well-marked dorsal button.

All other species of *Streblosoma* have at least 2 pairs of filamentous gills, and the present species was assigned to the genus with some hesitation; but it obviously belongs to the *Thelepinae*, and the segmental arrangement of the setae and the lack of lateral lobes on anterior segments agree with *Streblosoma*.

Streblosoma chilensis (McIntosh 1885)

Euthelepus chilensis McIntosh 1885, p. 467, pl. 51 figs. 4–5, pl. 28A figs. 14–15.

Records: WCD 73 (1 juvenile).

Notes: The genus *Euthelepus* was erected by McIntosh 1885 for two species, *E. setabulensis* and *E. chilensis*. The types of both have been re-examined in the British Museum. *E. setabulensis*, which has page priority, has been accepted as the type species by both Fauvel (1927) and Hartman (1959). It has 3 pairs of filamentous gills on segments 2–4 and notosetae from segment 3 (not segment 2 as suggested by McIntosh). Uncini start on segment 5 (setiger 3). Lateral lobes are present on segments 2–4. *E. chilensis* has 2 pairs of simple filamentous gills on segments 2 and 3. Notosetae start on segment 2 (the first branchiferous) and uncini on segment 5 (setiger 4). There are no lateral lobes on anterior segments. It thus differs from *E. setabulensis* in the possession of notosetae on segment 2 and in the absence of lateral lobes. It should thus be transferred to the genus *Streblosoma*.

The single South African specimen is a juvenile but agrees in all essential respects with McIntosh's type from abyssal depths off Chile.

Terebellides stroemi Sars 1835

Terebellides stroemi Sars, Fauvel 1927, p. 291, fig. 100 *i–q*.

Records: WCD 73—2 juveniles.

Summary

Twenty-eight species of Polychaeta are described from abyssal dredgings west of Cape Town. The collection includes 4 new species and 11 new records for this area. Only 4 of these species are known from depths less than 100 metres; the rest are widespread at abyssal depths. There is no obvious Antarctic component.

Acknowledgements

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SYNONYMY. Arrangement according to Schenk, E. T. & McMaster, J. H.: *Procedure in taxonomy.* 2nd ed. Stanford, Stanford university press, 1948. Bibliographic references modified.

'I. *Synonymy arranged according to chronology of names.*—All published scientific names by which a species has been previously designated (subsequent to 1758) are listed in chronological order, with bibliographical references to all descriptions or descriptive citations following in chronological order after each name. . . .

B. *Form of bibliographic references to synonymic names.*—The first reference following any name in the synonymy should be to the earliest citation of that name. This should be followed by references to all subsequent citations of the same name, arranged in chronological order. . . .'

Bibliographical references modified to consist of author's name, date of citation, pagination and illustrations (plates and figures).

Example:—

Eulalia (*Steggoa*) *capensis* Schmarda

Eulalis capensis Schmarda 1861, p. 86, pl. 29, fig. 231. Willey 1904, p. 259.
Eulalia viridis var. *capensis* McIntosh 1903, p. 34. Day 1953, p. 30.
Eulalia viridis (*non* Muller) Ehlers 1913, p. 455. Day 1934, p. 30.

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VOLUME XLVI

PART XV

THE PSEUDODIAPTOMIDAE (COPEPODA; CALANOIDA) OF SOUTHERN AFRICAN WATERS, INCLUDING A NEW SPECIES, PSEUDODIAPTOMUS CHARTERI

By
John R. Grindley
South African Museum, Cape Town

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[CONTINUED ON INSIDE BACK COVER

THE PSEUDODIAPTOMIDAE (COPEPODA; CALANOIDA) OF SOUTHERN AFRICAN WATERS, INCLUDING A NEW SPECIES, PSEUDODIAPTOMUS CHARTERI

By

John R. Grindley
South African Museum, Cape Town

[Accepted July, 1962]

(With 5 figures in the text)

Contents

Introduction

The Pseudodiaptomidae are a very interesting group of calanoid copepods which occur in marine, brackish and fresh water in many parts of the world. They are frequently the dominant organisms within their particular habitat, while their interesting distribution makes them of zoogeographical importance. While working on the plankton of South African estuaries it became clear to me that a revision of the South African species of Pseudodiaptomidae was required. The only Pseudodiaptomid previously recorded from southern African waters was *Pseudodiaptomus serricaudatus* (Cleve, 1904; Marques, 1958; etc.). I was, however, doubtful whether our specimens should be referred to this species for they differed slightly from the form originally described by T. Scott (1894). Tanaka (1960) confirmed my opinion by describing specimens of the South African form, obtained from the Agulhas bank by the Japanese Antarctic Research Expedition, as a new species, *Pseudodiaptomus nudus*. This species occurs chiefly in neritic waters. Two species of *Pseudodiaptomus* are the dominant planktonic animals in South African estuaries and lagoons. One species from the west and south coasts was found to be *Pseudodiaptomus hessei* which was recorded (in a preliminary report only) from the mouth of the Congo (Mrázek, 1894). After this it does not appear to have been reported again, and it was never fully described. The species found on the Natal coast was apparently previously unknown and is described here. A complete description

Ann. S. Afr. Mus. **46** (15), 1963, 373–391, 5 figs.

is given of *P. hessei* and the other species are described largely by comparison with it. The terminology I have used to describe the regions of the copepod body follows the recommendations of Gooding (1957).

Family **Pseudodiaptomidae**

Genus PSEUDODIAPTOMUS

Pseudodiaptomus Herrick 1884, 180.
Schmackeria (*non* Poppe & Richard 1890) Mrázek 1894, 1.
Heterocalanus T. Scott 1894, 39.
Weismanella Dahl 1894, 10.

Head smoothly rounded, separated from or fused with first pedigerous prosome segment. Fourth and fifth pedigerous segments usually fused, with rounded or pointed posterior angles, frequently bearing spines or hairs, particularly in the female. Genital segment of the female usually swollen, bearing setae and spines arranged asymmetrically. Caudal rami at least twice as long as wide, caudal setae often jointed or thickened. First four pairs of legs biramous, rami 3-segmented. Female fifth legs uniramous and 4-segmented. Male fifth legs 4-segmented, uniramous or bearing 1-segmented endopods on either or both legs. The right endopod, when present, is usually rudimentary. Three species represented in southern African waters. *Pseudodiaptomus pelagicus* Herrick (1884), which is the type of the genus, has not been seen since that time and the original description is brief and the figures unfortunately poor.

Pseudodiaptomus hessei (Mrázek)

(Figs. 1 *a–k*; 2 *a–f*; 3 *a–f*)

Schmackeria hessei Mrázek 1894, 1, figs. 1, 2, 3.
Pseudodiaptomus hessei (Mrázek) Giesbrecht & Schmeil 1898, 65. Marsh 1933, 36, pl. 19, figs. 1, 2.

Occurrence

Abundant in estuaries and lagoons on the west and south coasts of South Africa as far east as the Kleinmond estuary (Bathurst division). Material from the latter locality was collected for me by Professor J. Omer-Cooper. Specimens have been found in water with salinity ranging from about $10^0/_{00}$ to over $40^0/_{00}$.

Known distribution

Banana Creek (brackish water) at the mouth of the Congo River (Mrázek, 1894).

Description

Female: Length 1·55–1·80 mm. (1·20 mm., Mrázek). Prosome slender' viewed dorsally approximately two and a half times as long as wide, rounded anteriorly (fig. 1 *a*, *b*). Fourth and fifth pedigerous segments fused. Posterior angles of metasome bearing a sharp spine on each side on the postero-dorsal margin. Rostrum well developed with two strong filaments which reach the middle of the proximal segment of the first antennae.

Urosome 4-segmented and about two-thirds as long as prosome. Genital segment (fig. 1 *f*, *h*) asymmetrical, with irregular swellings laterally and a prominent genital boss ventrally. A number of setae are present mainly on the lateral swellings, and there is a patch of fine hairs in the middle of the dorsal surface. The genital boss is of characteristic form. It bears a row of spinules anteriorly and the genital flaps each have a distal seta. The first three urosome segments are furnished with rows of coarse teeth on their postero-dorsal margins. The caudal rami (fig. 1 *g*) are divergent, more than three times as long as wide and furnished with fine hairs on their inner margins. The third or middle caudal seta (not counting the sensory bristle between the fourth and fifth setae) is broad and flattened in a characteristic blade-like form. It is about three times as wide as the other setae and is easily visible under low magnification so that it is a useful feature for distinguishing the females of this species. Similar broad setae occur in a number of species of the *Schmackeria* group from Asia.

Antenna 1 (fig. 1 *c*) of 21 segments, reaching the second urosome segment when extended. Segments 1 + 2, 3 + 4, 8 + 9 and 24 + 25 apparently fused. Proportional lengths and setation of segments as shown in figure 1 *c*. Giesbrecht and Schmeil (1898) and Marsh (1933) reported 22 segments, but Mrázek (1894) does not mention the number of segments.

There is one aesthetask on each segment up to and including no. 16, one on no. 19 and one on the terminal segment. (Aesthetasks are not shown in figure 1 *c*.) A specialized comb-like seta (fig. 1 *i*) is present on the third last segment. It lies parallel to the antenna so that it is not readily noticed. Its distal end is curved and slightly expanded and bears about three distinct recurved hooks and a number of much smaller ones which grade into a series of minute comb-like teeth (3μ long and 1μ apart) along the shaft of the seta. There is a bulbous swelling near the base of this seta. There is also an unspecialized plumose seta on this segment. The comb-like seta is an interesting feature, for modified setae (apparently of varying form) have been described on this segment of the first antenna of the female and the unmodified antenna of the male from a number of widely scattered species within the genus. Some form of comb-like seta has been noted in *Pseudodiaptomus stuhlmanni*, *P. serricaudatus* and *P. hessei* (Poppe and Mrázek, 1895); *P. richardi* (Mrázek, 1901); *P. hickmani*, *P. masoni* and *P. salinus* (Seymour Sewell, 1932); *P. ardjuna* (Ummerkutty, 1961), and *P. charteri* and *P. nudus* in this present work. This feature thus occurs in species from America to the orient and is not confined to any particular sub-group of this genus.

Antenna 2 (fig. 2 *a*) with basipod partially divided by an incomplete suture, bearing 1 lateral and 2 terminal setae. Exopod 3-segmented, third segment only partially separated, bearing 2 setae on the first segment, 7 setae on the second, and 6 terminal setae and a lateral fringe of fine hairs on the distal segment. Endopod apparently 4-segmented, third segment small and indistinct, bearing 1 seta on segment 1, 2 lateral and 3 distal on segment 2, 1 on segment 3 and 2 lateral and 3 terminal on segment 4.

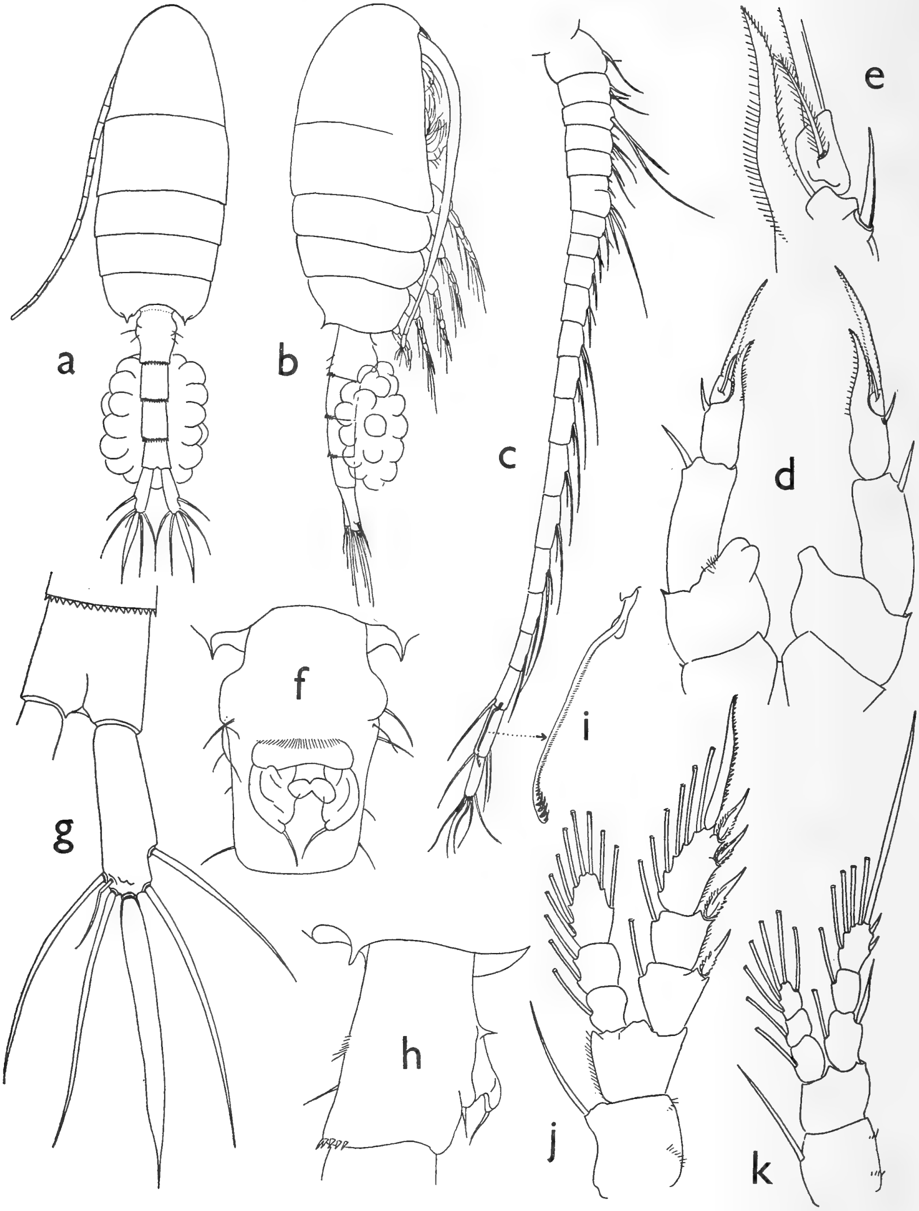

FIG. 1. *Pseudodiaptomus hessei* (Mrázek). *a*, ♀ dorsal; *b*, ♀ lateral; *c*, antenna 1 ♀; *d*, fifth legs ♀; *e*, distal part of latter enlarged; *f*, ♀ genital segment ventral; *g*, caudal ramus ♀; *h*, ♀ genital segment lateral; *i*, comb-like seta enlarged; *j*, fourth swimming leg; *k*, first swimming leg.

Mandible (fig. 2 *c*) with gnathal lobe heavily chitinized and bearing about 10 fine teeth and a plumose spinule. Basipod of palp with 4 inner marginal setae. Exopod indistinctly 3-segmented, bearing 1 lateral and 5 terminal setae. Endopod 2-segmented, bearing 4 setae on segment 1 (1 separate) and 8 setae distally on segment 2 (1 jointed and crooked). This last segment is narrowly triangular and bears a row of tiny bristles.

Maxilla 1 (fig. 2 *d*) with first inner lobe or gnathobase bearing about 10 strong spines, small second inner lobe bearing ?3 setae and third inner lobe bearing 3 terminal setae. Outer lobe or coxal epipod bearing 8 long setae. Exopod with 9 marginal setae. Endopod 3-segmented bearing 4 setae medially on the basal portion (second basal segment) and groups of 4 setae medially on segments 1 and 2 and approximately 7 terminal setae on segment 3.

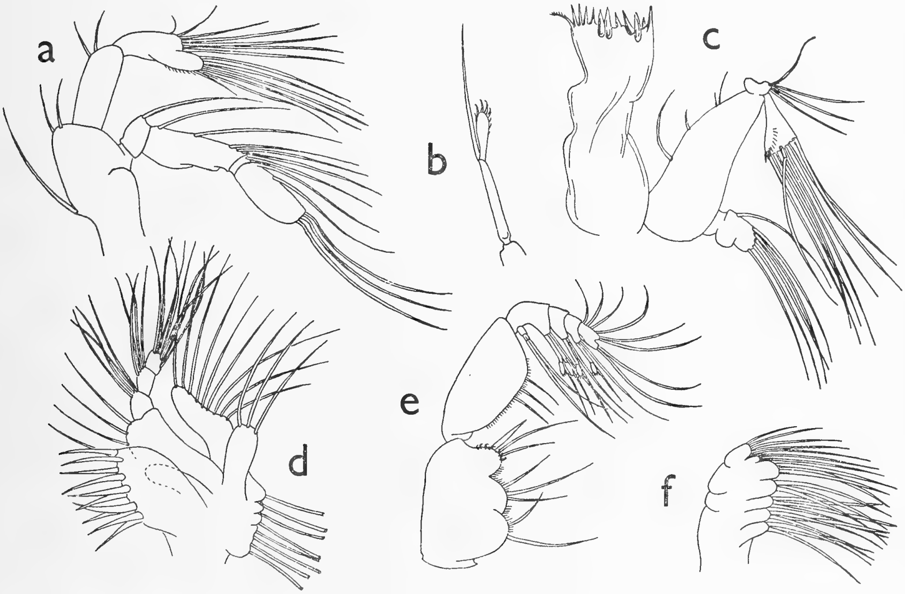

FIG. 2. *Pseudodiaptomus hessei* (Mrázek). *a*, antenna 2; *b*, divided seta from maxilliped; *c*, mandible; *d*, maxilla 1; *e*, maxilliped; *f*, maxilla 2.

Maxilla 2 (fig. 2 *f*) with 5 large medial lobes or endites and 2 smaller terminal lobes each bearing 3 or 4 setae. Distal portion indistinctly segmented.

Maxilliped (fig. 2 *e*) 6-segmented, 2 basal segments large, 4 distal segments small and decreasing in size distally. First segment with 3 medial lobes bearing 2 setae, 3 setae and 2 setae and a spine respectively. There are short fine hairs medially and tiny hooked spinules on the third lobe. Second segment expanded medially with 3 setae and a fringe of short fine hairs on the medial margin. Third segment bearing 2 + 3 setae, fourth segment 2 setae, fifth segment 2 setae, sixth segment 2 setae medially and 6 on an outer lobe. Among the setae on segments 3, 4 and 5 are four with a peculiar branched structure. These branched setae (fig. 2 *b*) were noticed by Mrázek (1894) on what he called the 'hinteren Maxillipeden'. He said: 'Bei unserer Form sind es gewöhnliche Borsten die aber von der Mitte ihrer Länge an gespalten sind.' It is clear that Mrázek must have examined this species very carefully although he never described it fully. These branched setae have a thickened basal portion and divide near their middle, one branch continuing as a thinner seta forming the extension of the proximal part while the other is short, broad and spatulate, fringed with short curved spinules. (. . . löffelförmig erweitert ist und einige feine steife Härchen trägt.—Mrázek, 1894.)

Similar branched setae were noted in *Pseudodiaptomus stuhlmanni* by Poppe and Mrázek (1895). They were described as being on the second maxilla, but Seymour Sewell (1932, 243) has shown that it is clear from their figure that the appendage on which these modified setae were present is that which is now termed the maxilliped. Branched setae have also been described on the maxilliped of *P. dauglishi* (Seymour Sewell, 1932) and *P. euryhalinus* (Johnson, 1939) and they are here recorded in *P. charteri* and *P. nudus*.

Swimming legs 1–4 biramous, with 2-segmented basipodite and 3-segmented exopodite and endopodite. They are similar in both sexes.

The first pair (fig. 1 *k*) are somewhat different to the following three pairs. The outer marginal spines of the exopod are not serrate and blade-like. The first segment of the exopod has one outer edge spine. the second no spine, and the terminal segment has two short lateral spines and a long, slender terminal spine. On the endopodite the numbers of setae on the successive segments are 1 on the first, 1 on the second and 5 on the third. On the exopodite the setation is 1 on the first, 1 on the second and 4 on the third segment.

The remaining swimming legs (2–4) (fig. 1 *j*) bear serrated blade-like spines on the outer distal corners of each exopod segment, an extra spine on the distal part of the outer margin of the terminal segment and a long blade-like terminal spine serrate only on its outer margin. On the exopodite the setation of the segments is: 1 on the first, 1 on the second and 5 on the third. Endopodite: 1 on the first, 2 on the second and 8 on the third. All the setae on the swimming legs are jointed and slightly thicker proximal to the joint. The first basal segment of all the legs has 2 groups of short stiff hairs on the outer margin and a long seta on the inner distal margin. The second basal segment is completely naked in the first leg and bears only a medial fringe of fine hairs in the remainder. Fine short hairs occur on the outer margins of exopod segments 2 and 3.

The ornamentation of the swimming legs may be represented by the table on the next page.

The fifth pair of legs in the female (fig. 1 *d*, *e*) is uniramous, 4-segmented and asymmetrical, particularly as regards the hyaline projections of the inner margin of the second basal segment. There seems to be some individual variation in the forms of these projections. Marsh (1933) suggests that these might be regarded as rudimentary indications of an endopod. Such rudiments are present also in *P. stuhlmanni* and *P. charteri*, but otherwise endopods of the female

Leg	Protopod				Endopod							Exopod						
	1		2		1		2		3			1		2		3		
	Si	Se	Si	Se	Si	Se	Si	Se	Si	St	Se	Si	Se	Si	Se	Si	St	Se
P_1	1	0	0	0	1	0	1	0	2	2	1	1	**I**	1	0	4	**I**	**II**
P_2	1	0	0	0	1	0	2	0	4	2	2	1	**I**	1	**I**	5	**I**	**II**
P_3	1	0	0	0	1	0	2	0	4	2	2	1	**I**	1	**I**	5	**I**	**II**
P_4	1	0	0	0	1	0	2	0	4	2	2	1	**I**	1	**I**	5	**I**	**II**

Si, Se, St represent internal, external and terminal spines or setae respectively. The number of setae is shown in arabic numerals and spines in roman numerals.

fifth legs are completely lacking in the Pseudodiaptomidae. The outer distal angles of the first and second basal segments are produced into very small spines. The first segment of the ramus bears a spine near the distal end of the outer margin. The second segment bears a spine on the outer distal angle and is produced distally on the medial side into a large curved spiniform process bearing short bristles on the anterior and posterior margins and reaching about the midpoint of the terminal spine. The terminal spine has a small distinct basal portion bearing a slender plumose seta on its posterior face, while the long terminal blade-like portion is furnished with minute bristles on its anterior and posterior margins. Terminal spine, including the basal portion, slightly longer than the third segment. Marsh (1933, 28) points out that the distinct basal portion of the terminal spine found in some species is not a real segment but a modification of the terminal spine or 'hook'.

The egg sac is single, containing about 25 eggs arranged in a single layer curved to fit the urosome.

Male: Length 1·35–1·45 mm. (1·05 mm., Mrázek). Habitus as in the female (fig. 3 *a*, *b*). Posterior angles of the metasome without spines. Urosome 5-segmented, uniformly slender, first and last segments shorter than the remainder. Posterior margins of the second, third and fourth segments fringed partially (2nd segment) or completely (3rd and 4th segments) with rows of coarse teeth. The caudal setae (fig. 3 *e*) are distinctly different from those of the female, for the middle seta is not expanded and all the setae are jointed about one-third of their length from the proximal end.

Left antenna 1 as in female, including setation and arrangement of aesthetasks. Right antenna 1 geniculate (fig. 3 *c*), with 21 segments, reaching the second urosome segment when extended. The last four long segments are apparently each formed by the fusion of two segments. Porportional lengths and setation as shown in figure 3 *c*. There is a hooked spine on segment 10. There is one aesthetask on segments 2, 5, 7, 9–16, and the second last and last segments.

Male fifth legs (fig. 3 *d*) biramous and 4-segmented. In the right leg the first basal segment is naked except for some rugosity on the medial surface,

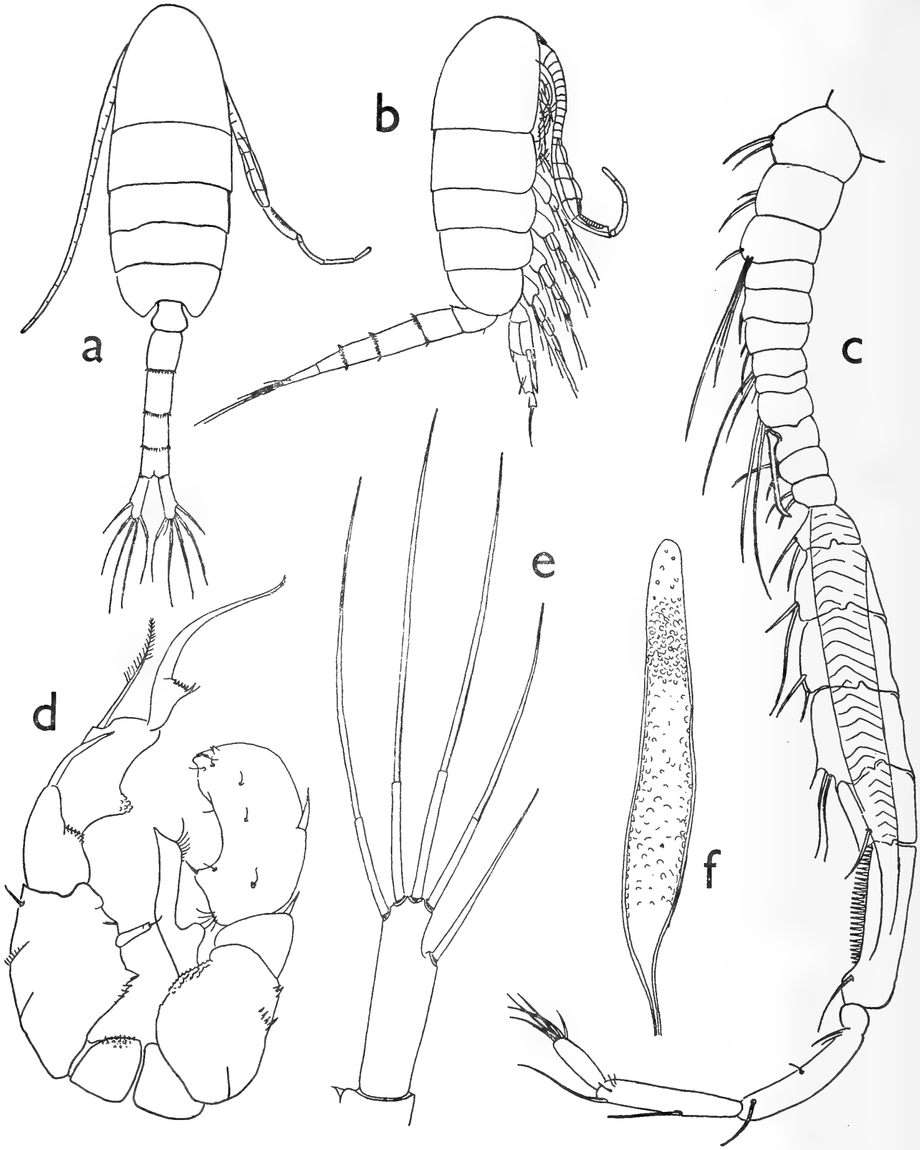

Fig. 3. *Pseudodiaptomus hessei* (Mrázek). *a*, ♂ dorsal; *b*, ♂ lateral; *c*, right antenna 1 ♂; *d*, fifth legs ♂; *e*, caudal ramus ♂; *f*, spermatophore.

The second basal segment is larger with some small spinose processes on the inner margin, and bears a small rod-like endopodite with a short terminal seta. On the outer margin there are a row of minute spinules and a fine seta near the distal angle. The exopodite is 2-segmented, the first segment produced into a curved spine at its outer distal angle, which just reaches the base of the spine on the following segment, and bears some spinules near the inner distal angle. The second segment bears a long, partly plumose spine on the distal part of the outer margin and a rugose swelling on the proximal part of the inner margin. The terminal hook has a triangular basal portion, broadest distally where it bears a row of small spinules and is produced at the outer corner into a slightly curved hook as long as the two exopod segments. The tip is recurved and minutely serrate. In the left leg the first basal segment is naked and the second basal segment bears a few spinules near the outer margin, some rugosity on the inner margin and a long hyaline endopodite. This has an expansion basally, is apically acute, and bears a fringe of about 8 fine hairs near the apex. The exopodite is 2-segmented, the first segment short, bearing a short spine at its outer distal angle. The second segment is expanded and flattened, somewhat convex posteriorly and emarginate medially. The outer distal margin is strongly convex and the inner distal margin nearly straight. There is a spine near the middle of the outer margin, and a number of small setae and spinules on the posterior surface and margins and around the apex. The left leg reaches the base of the terminal hook of the right leg.

The spermatophore (fig. 3 *f*) is fusiform, stalked, and 250–400μ long.

COLOUR: Unpigmented except for some orange coloration around the mouth-parts.

Types

Hypotypes, S.A.M. A10958, in the South African Museum.

Remarks

This species was named after P. Hesse who first collected it. It was originally described as a *Schmackeria* but was correctly transferred to the genus *Pseudodiaptomus* by Giesbrecht and Schmeil (1898). The species is easily distinguished by the broad middle caudal seta in the female and by the characteristic fifth legs in the male. Our specimens are considerably larger than those originally described.

Pseudodiaptomus charteri sp. n.

(Figs. 4 *a–j*)

Occurrence

Abundant in the estuaries of St. Lucia and Richards Bay on the Natal coast. Specimens have been found in water with salinity ranging from about $10^0/_{00}$ to about $38^0/_{00}$.

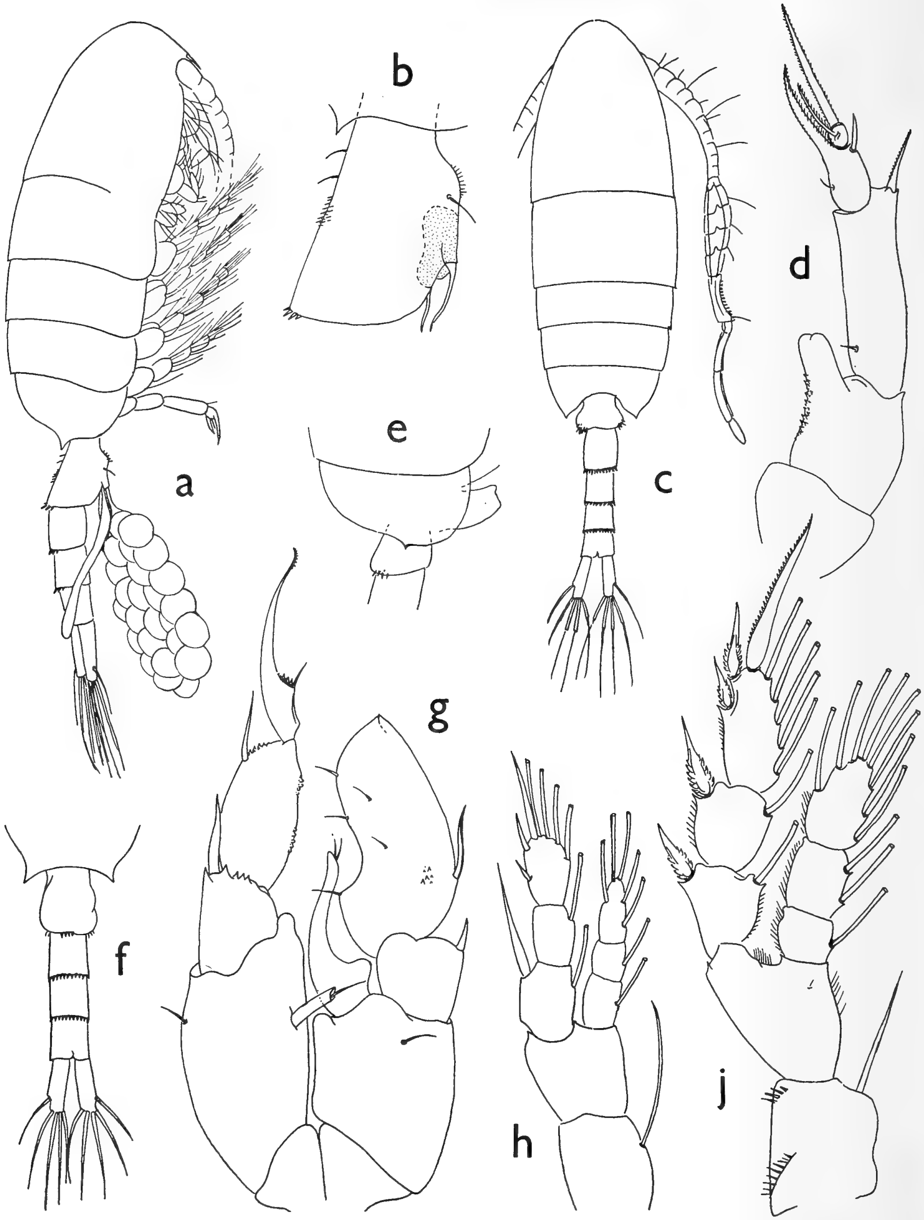

Fig. 4. *Pseudodiaptomus charteri* sp. n. *a*, ♀ lateral; *b*, ♀ genital segment lateral; *c*, ♂ dorsal; *d*, fifth leg ♀; *e*, posterior angle of ♂ metasome lateral; *f*, ♀ urosome dorsal; *g*, ♂ fifth legs; *h*, first swimming leg; *j*, fourth swimming leg.

Description

Female: Length 1·40–1·55 mm. Prosome slender, viewed dorsally more than two and a half times as long as wide. Head rounded anteriorly. Fourth and fifth pedigerous segments fused. Posterior angles of metasome bearing a sharp spine on each side near the middle of the posterior margin. Rostrum well developed with two strong filaments which reach the middle of the proximal segment of the first antenna.

Urosome (fig. 1 *f*) 4-segmented and less than two-thirds as long as the prosome. Genital segment (fig. 4 *b*) asymmetrical with irregular lateral swellings in the posterior part and a prominent genital boss ventrally. A few coarse teeth are present on the postero-dorsal margin, some setae dorsally and laterally and a patch of fine hairs on the mid-dorsal surface. The genital boss is similar to that of *P. hessei* with genital flaps, setae and an anterior fringe of spinules. The second and third urosome segments are furnished with rows of coarse teeth on their postero-dorsal margins. The caudal rami are divergent, more than 3 times as long as wide and furnished with fine hairs on their inner margins. The caudal setae are all similar, unjointed but tapering sharply to the thinner distal part.

Antenna 1 of 21 segments, reaching the second urosome segment when extended. Proportional lengths, setation and arrangement of aesthetasks as in *P. hessei.*

Antenna 2, mandible, maxilla 1 and 2 and maxillipeds all apparently identical with those of *P. hessei.* The same peculiar branched setae are present on the maxillipeds.

Swimming legs 1–4 as in *P. hessei* except in the following respects. In the first leg (fig. 4 *h*) the terminal exopod spine is shorter and there are apparently no spinules on the first basal segment. In legs 2–4 (fig. 1 *j*) the second basal segment is longer and narrow proximally and there are fine short hairs on the outer margin of the exopod and between it and the endopod on the second basal segment. The setal formula is identical with that of *P. hessei.*

The fifth pair of legs in the female (fig. 4 *d*) is similar to those of *P. hessei.* The inner processes of the second basal segment are furnished with minute spinules medially. The first outer spine is minutely serrate. A single hair is present on the medial margin of segments 3 and 4. The spiniform process of the fourth segment reaches beyond the midpoint of the terminal spine. Terminal spine, including the basal portion, slightly shorter than the third segment.

Egg sac as in *P. hessei.*

Male: Length 1·25–1·30 mm. Habitus similar to the female (fig. 4 *c*). Posterior angles of the metasome bearing very small spines on the posterior margin (fig. 4 *e*). Urosome 5-segmented, as in *P. hessei* except for some postero-lateral spinules on the first segment and a mid-ventral patch of hairs on the second segment. Caudal setae jointed about one-third of their length from the proximal end as in the male of *P. hessei.* Left antenna 1 as in female. Right antenna

1 geniculate with 21 segments, reaching the second urosome segment when extended. Proportions and setation as in *P. hessei.*

The male fifth legs (fig. 4 *g*) are similar to those of *P. hessei* in general form but show the following differences. In the right leg the first basal segment is naked and smooth, second basal segment without inner spinose processes or outer row of spinules. Outer spine of first exopod segment straight and not reaching the base of the second outer spine. The latter non-plumose and not reaching beyond the thickened basal portion of the terminal hook. There are some rugose patches on the medial and distal margins of the second segment but no inner swelling. Terminal hook not as long as the two exopod segments. In the left leg the second basal segment is without medial or outer spinules. The endopodite is apically rounded and bears only 2 fine hairs near the apex. The second exopodite segment is a different shape to that of *P. hessei,* with the outer distal margin only slightly convex and the inner distal margin strongly convex. The outer marginal spine is longer and more proximal.

The spermatophore is similar to that of *P. hessei,* 400–600μ long. Frequently more than one are attached to a female.

COLOUR: Unpigmented except for some orange coloration in the anterior part of the metasome.

Types

Types are in the South African Museum, Cape Town. Holotype, male, S.A.M. A10959; allotype, female, S.A.M. A10960; paratypes, S.A.M. A10961; from St. Lucia Lagoon, Natal, plankton sample STL–G2, collected by R. S. Crass on 21/9/54.

Remarks

This species is named after Mr. R. R. Charter in recognition of his extensive unpublished work on the Copepoda of South Africa. *P. charteri* differs from *P. hessei* in a large number of characters which are mentioned in the above description. It may be distinguished most easily in the female by the caudal setae which are all similar and in the male by the fifth legs, particularly the shorter marginal spines on the right leg.

Pseudodiaptomus nudus Tanaka

(Figs. 5 *a–j*)

Pseudodiaptomus serricaudatus (*non* T. Scott 1894). Cleve 1904, 196.
Pseudodiaptomus nudus Tanaka 1960, 47, pl. 21, figs. 1–9.

Occurrence

Present in neritic waters off the Cape and abundant over the Agulhas bank. Found mostly in sea water with salinity near $35^0/_{00}$ but does penetrate into water of reduced salinity.

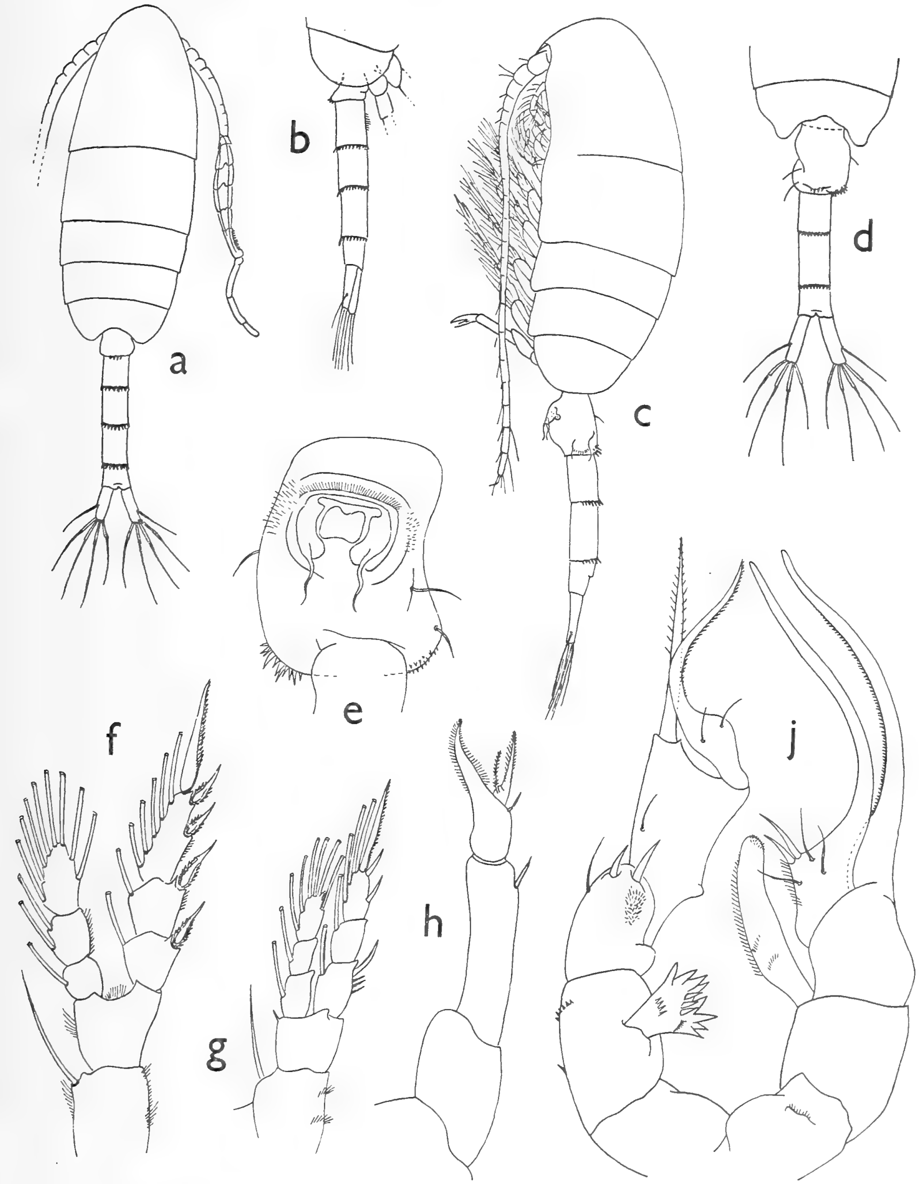

FIG. 5. *Pseudodiaptomus nudus* Tanaka. *a*, ♂ dorsal; *b*, ♂ urosome lateral; *c*, ♀ lateral; *d*, ♀ urosome dorsal; *e*, ♀ genital segment ventral; *f*, fourth swimming leg; *g*, first swimming leg; *h*, fifth leg ♀; *j*, fifth legs ♂.

Known distribution

Station 8 of the Japanese Antarctic Research Expedition off Cape Agulhas (Tanaka, 1960).

Description

Female: Length 1·30–1·40 mm. Prosome slender, viewed dorsally approximately two and a half times as long as wide (fig. 5 *c*). Head rounded anteriorly. Posterior angles of the metasome rounded and naked. Rostrum well developed with 2 strong filaments which reach the proximal segment of the first antenna.

Urosome (fig. 5 *d*) 4-segmented, slightly over half as long as metasome. Genital segment (fig. 5 *e*) asymmetrical, the right side inflated and the left side depressed, and a prominent genital boss ventrally. The right distal angle is furnished with a group of small spines. The left lateral swelling bears 2 setae distally and some minute spinules. The genital boss is similar to that of *P. hessei* but also bears spinules on the periphery. There are rows of coarse teeth on the postero-dorsal margins of the second and third urosome segments and a few on the genital segment. Proportional lengths of urosome segments are given by Tanaka (1960). The caudal rami are divergent, approximately 3 times as long as wide, and the setae are jointed and not expanded.

Antenna 1 of 21 segments, reaching the posterior margin of the second urosome segment when extended. Proportional lengths of segments are given by Tanaka (1960). Setation and arrangement of aesthetasks as in *P. hessei.*

Antenna 2, mandible, maxilla 1 and 2 and maxillipeds all apparently identical with those of *P. hessei.* The same peculiar branched setae are present on the maxillipeds.

Swimming legs 1–4 resemble those of *P. hessei* except in the following respects. In the first leg (fig. 5 *g*) the terminal exopod spine is serrate and about as long as the last 2 exopod segments. On the first exopod segment there are 3 small spinules proximal to the outer marginal spine which is shorter than in *P. hessei.* The second basipod segment bears a small inner distal spinule. The distal endopod segment bears 6 setae. In swimming legs 2–4 (fig. 5 *f*) the distribution of fine short hairs is similar to that in *P. charteri* but even more extensive.

The ornamentation of the swimming legs may be represented as follows:

Leg	Protopod				Endopod							Exopod						
	1		2		1		2		3			1		2		3		
	Si	Se	Si	Se	Si	Se	Si	Se	Si	St	Se	Si	Se	Si	Se	Si	St	Se
P_1	1	0	1	0	1	0	1	0	3	2	1	1	**IV**	1	**0**	3	**I**	**II**
P_2	1	0	0	0	1	0	2	0	4	2	2	1	**I**	1	**I**	5	**I**	**II**
P_3	1	0	0	0	1	0	2	0	4	2	2	1	**I**	1	**I**	5	**I**	**II**
P_4	1	0	0	0	1	0	2	0	4	2	2	1	**I**	1	**I**	5	**I**	**II**

The female fifth legs (fig. 5 *h*) are uniramous and 4-segmented, lack medial processes on the second basal segment, and are nearly but not quite symmetrical. The terminal spine is shorter than the spiniform process of the fourth segment, and bears a slender plumose seta in place of the short, stout, serrate spine of *P. serricaudatus*.

The egg sac is single and similar to that of *P. hessei*.

MALE: Length 1·15–1·20 mm. Habitus similar to the female (fig. 5 *a*). Urosome (fig. 5 *b*) 5-segmented and similar to that of *P. hessei*. Proportional lengths of the segments are given by Tanaka (1960). The second urosome segment bears a mid-ventral patch of hairs. Caudal setae as in the female. Antenna 1, 21-segmented, right geniculate, as in *P. hessei*. Proportional lengths of the segments are given by Tanaka (1960). The male fifth legs (fig. 5 *j*) are in the main identical with those of *P. serricaudatus* (T. Scott) (1896), but in the right leg the second marginal spine reaches as far as the terminal hook does. The endopod is more complex than in *serricaudatus*. There are also minor differences in setation and proportions. The spermatophore is similar to that of *P. hessei*.

COLOUR: Scattered orange pigment is present throughout the metasome and the female genital segment. The urosome is colourless apart from a distinctive red patch in the anal segment.

Types

3 ♀♀, 8 ♂♂ and 1 juv. deposited in the National Science Museum of Japan. There are many hypotypes and topotypes in the South African Museum (S.A.M. A10962).

Remarks

Pseudodiaptomus nudus Tanaka differs from *P. serricaudatus* (T. Scott) (1896), to which it is closely allied, in the following characters. In both sexes the posterior thoracic margin is spineless, from which (presumably) the name *nudus* is derived. This species is somewhat larger. In the female the genital segment is asymmetrical and the terminal spine and seta of the fifth legs are different. In the male fifth legs the right endopod is more complex and the terminal spine of the right leg is longer. *P. nudus* is easily distinguished from the other South African species by the naked posterior angles of the metasome in the female and the characteristic fifth legs of the male. The above account of this species includes some small additions and corrections to Tanaka's (1960) description. I am somewhat doubtful as to whether this species is really distinct from *serricaudatus* but a re-examination of T. Scott's types will be necessary to determine this, for his original description is inadequate. I have examined Cleve's (1904) specimens of *serricaudatus* in the South African Museum (S.A.M. A2067, A2068) from off Cape Infanta, and they are of the *nudus* form.

Both *nudus* and *serricaudatus* should be maintained in the genus *Pseudodiaptomus* rather than being placed in the genus *Schmackeria* as suggested by Marsh (1933). They do not possess the characteristic long, curved projection on the inner border of the second segment of the left fifth leg of the male, but have a normal endopod similar to that of the African and American species.

Discussion

It is perhaps appropriate now to discuss the relationships of this group of species, for the description of these three species clarifies the picture of the distribution of this group round the coast of Africa. It is now clear that the African species have a number of important features in common and tend to constitute a distinct morphological and zoogeographical unit. Early authors tended to overlook this. Mrázek (1894), for example, in his note on *P. hessei* compares it to *gracilis* Dahl (1890) from South America and *forbesi* Poppe & Richard (1890) from China. It is now apparent that both of these are really extremely divergent forms and the only resemblances are those common to the genus or family. Brehm (1951), when discussing the relationships of *P. pauliani* from Madagascar, persists in comparing African and American species, on the basis of such characters as the possession of a left endopod. He also says that all attempts to arrange the Pseudodiaptomidae into groups that are morphologically and also geographically common are in vain, but it would seem that this is now possible. All the species found round the coast of Africa are characterized by the possession of both left and right endopods in the fifth legs of the male. Certain oriental species also possess both endopods but they may be separated on the basis of other features such as the possession of a 'Y'-shaped right endopod in the fifth leg of the male.

A series of species related to *P. hessei* and *P. charteri* are found on the east coast of Africa. *P. stuhlmanni* (Poppe & Mrázek) (1895) was described from the estuary of the Quilimane river on the coast of Mozambique north of Beira. The male fifth legs of this species are almost identical with those of *P. charteri* except for the strikingly different right endopod which is spatulate, furnished with bristles terminally and with a large stout claw at its base. *P. salinus* (Giesbrecht) (1896) is a marine species known from the north-west Indian Ocean and Red Sea (Sewell, 1947). The male fifth legs of this species although still basically similar in structure to the South African species show further differences in details and proportions. The two species described from Madagascar, *P. pauliani* Brehm (1951) and *P. batillipes* Brehm (1954), are also related but reveal some distinctive modifications such as the inner projection on the second basal segment of the left male fifth leg. *P. ardjuna* Brehm (1953) from Salsette Island near Bombay on the west coast of India falls into the African group also, on the basis of the structure of the male fifth legs as described by Brehm (1953).

Ummerkutty (1961), however, has shown that specimens of this species from off Mandapam in the Gulf of Mannar region of south-east India have a 'Y'-shaped spinous right endopod in the fifth leg of the male such as is found in the oriental '*hickmani* group'. It would be interesting to re-examine material of this species from Bombay to see whether this difference really exists.

On the west coast of Africa *P. hessei* has been recorded from the mouth of the Congo, while a related species is figured by Marques (1951) from Portuguese Guinea.

The status of the remaining South African species, *P. nudus* Tanaka 1960, is somewhat doubtful. It is obviously very closely allied to *P. serricaudatus* (T. Scott) (1894) described from the Gulf of Guinea, but differs slightly from the original description and figures. Marques (1947), however, gives figures of specimens of *P. serricaudatus* from Portuguese Guinea that resemble the *nudus* form. *P. serricaudatus* has also been recorded from Sierra Leone (Bainbridge, 1959) and Angola (Marques, 1958) and various other localities on the West African coast. In the Indian Ocean *P. serricaudatus* has been recorded from the east and west coasts of India, Ceylon, the Arabian Sea, south Arabian coast, Gulf of Aden and Red Sea (Sewell, 1947). Sewell suggested that it appeared to be an Indian Ocean form that had managed to get round the Cape of Good Hope into the Gulf of Guinea, where it was originally taken. If the *nudus* form from the Cape is really distinct it is likely that the Indian Ocean form will also prove to be different from the originally described West African form, which is completely geographically isolated.

The left exopod of the fifth leg of *P. serricaudatus* and *P. nudus* with two long curved spines is quite different from that of any other pseudodiaptomid, but the presence and nature of the left and right endopods indicates that their affinities are with the other African species.

P. nudus, like *P. serricaudatus*, appears to be essentially a neritic marine species not found far from land except over the wide, shallow Agulhas bank. It penetrates into the mouths of estuaries, however, and can live in water of reduced salinity. *P. hessei* and *P. charteri*, like *P. stuhlmanni*, are essentially estuarine species found in water of reduced salinity and in hypersaline lagoons, and occur only rarely together with *P. nudus*. There is thus an ecological separation between these species despite the geographical overlap.

Specimens of all three species occurring in South Africa are considerably larger than the same or related species from elsewhere on the African coast.

The question of the grouping of the species of *Pseudodiaptomus*, *sensu-lato* and the relationships and zoogeographical significance of these groups is being considered further in a forthcoming paper.

KEY TO THE SOUTHERN AFRICAN SPECIES OF PSEUDODIAPTOMUS

Key to the females (*urosome 4-segmented*)

1.	Posterior corners of metasome without spines	*nudus*
2.	Posterior corners of metasome bearing spines	3
3.	Middle caudal seta broad and blade-like	*hessei*
4.	Middle caudal seta identical to other setae	*charteri*

Key to the males (*urosome 5-segmented*)

In the right fifth leg:

1.	Second marginal spine reaching as far as tip of terminal hook	*nudus*
2.	Second marginal spine much shorter than terminal hook	3
3.	Second marginal spine not reaching beyond thickened basal part of terminal hook	*charteri*
4.	Second marginal spine reaching well beyond thickened basal part of terminal hook	*hessei*

Summary

Descriptions and figures of the three species of Pseudodiaptomidae occurring in southern African waters are given. A full description is given of *P. hessei* (Mrázek, 1894), which was never fully described. A new species, *P. charteri*, is described. A further description of *P. nudus* (Tanaka, 1960) is given. The affinities of these species with other members of this interesting genus are discussed. The existence of a distinct African group of pseudodiaptomids characterized primarily by the possession of both left and right endopods in the fifth legs of the male is noted. It is considered that *nudus* and *serricaudatus* should be maintained in the genus *Pseudodiaptomus* and not placed in the genus *Schmackeria* as had been suggested. It is further noted that the affinities of the latter two species lie with the African group of species.

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SYNONYMY. Arrangement according to Schenk, E. T. & McMaster, J. H.: *Procedure in taxonomy.* 2nd ed. Stanford, Stanford university press, 1948. Bibliographic references modified.

'I. *Synonymy arranged according to chronology of names.*—All published scientific names by which a species has been previously designated (subsequent to 1758) are listed in chronological order, with bibliographical references to all descriptions or descriptive citations following in chronological order after each name. . . .

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Example:—

Eulalia (*Steggoa*) *capensis* Schmarda

Eulalis capensis Schmarda 1861, p. 86, pl. 29, fig. 231. Willey 1904, p. 259.
Eulalia viridis var. *capensis* McIntosh 1903, p. 34. Day 1953, p. 30.
Eulalia viridis (*non* Muller) Ehlers 1913, p. 455. Day 1934, p. 30.

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SUPPLEMENTARY CONTRIBUTIONS TO THE REVISION OF THE BOMBYLIIDAE (DIPTERA) OF SOUTHERN AFRICA: THE GENUS SYSTROPUS

By
A. J. Hesse
South African Museum, Cape Town

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REFERENCES. Harvard system—authors' names and dates of publication given in the body of the text; references arranged at the end of the paper in alphabetical order of authors' names.

Bibliographical arrangement of references at the end of the paper must give:

1. Name of author, followed by his initials. Names of joint authors connected by ampersand (&), and not 'and'.
2. Year of publication. If several papers by the same author in one year are cited, suffixes a, b, etc., are used.
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4. Title of the journal, abbreviated according to the *World list of scientific periodicals*, and underlined to indicate italics.
5. Series number, if any, in parenthesis, e.g. (3), (n.s.), (N.F.), (B).
6. Volume number in arabic numerals (without prefix 'vol.'), with wavy underlining to indicate black type.
7. Part number, only if the separate parts of one volume are independently numbered.
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Name of author of paper; his initials; date of publication; title of paper; 'In' italicized; name of author of book; his initials; title of book, in italics; edition, if any; volume number, if any, in black type arabic numerals; pagination of paper; place of publication; name of publisher.

[CONTINUED ON INSIDE BACK COVER

SUPPLEMENTARY CONTRIBUTIONS TO THE REVISION OF THE BOMBYLIIDAE (DIPTERA) OF SOUTHERN AFRICA: THE GENUS SYSTROPUS

By

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Contents

Descriptions of New Species

Subfamily **Systropinae**

Genus SYSTROPUS Wied.

Systropus Wiedemann 1820, p. 18. Wiedemann 1828, p. 359. Hesse 1938, p. 991.

Since my revision of the South African representatives of this genus in 1938 the South African Museum has acquired some new species from the Cape Province, Southern Rhodesia and Portuguese East Africa. Descriptions of these are given below.

Systropus bicoloripennis n. sp.

This peculiar smallish species which differs from all the other known South African forms in certain respects is characterized as follows:
Body mainly black; frons, sides of face and genae yellowish in ♂, dark or black in ♀; buccal rim black in both sexes; antennae entirely black in ♀, but segment 1 ivory yellowish and silvery-haired above in ♂; propleural callosity or a spot on it ivory yellowish in both sexes; base of sternite 2 and sometimes to a smaller and lesser extent apex of sternite 2 and base and apices of 3 and even 4 very pale yellowish; a large transverse humeral spot passing into a narrow notopleural streak on each side, broadened on false tegulae in front of wing-bases, continued in a curve above wings to include postalar calli and narrowly across hind margin of thorax, pteropleuron or greater part of it, down middle of pleurae (posterior part of sternopleuron or middle epimeral part), more or less anterior half of hypopleural (or posterior episternal) part, the broad anterior

border (much broadened above) of metasternal part, postnotal process and area around it, a large basal spot on each side of tergite 1, narrowly continuous with its fellow along anterior margin, broadish sides (narrowed in middle) and to an obscure extent narrowish dorsal hind margins of tergites 2–5, hind margins of rest of tergites in ♂ and of 6 and 7 in ♀, anterior faces of front coxae, sides in basal halves and hinder part of middle coxae, a ring-like fascia round posterior coxae (broader on front face), femora, tibiae and basal segments of tarsi, excepting only the dark callus-area on front femora and dark apical parts of hind femora and tibiae, yellowish red, reddish or ferruginous red; scutellar callosities also ferruginous reddish or brownish. *Vestiture* with the hairs on antennae black, excepting silvery white ones on segment 1 above in ♂; those on face also black; pruinescence on head in front silvery; scaling on thorax, pleurae and especially hypopleural and metasternal parts and on sides of tergite 1 glittering iridescent and silvery, definitely scale-like, the individual scales broad, leaf-shaped or ovate, not fine and hair-like as in all the other known South African forms, excepting *namaquensis* Hesse; fine scaling on abdomen dark or black in a broad dorsal streak, in a broadish streak on each side of venter and on club, the dorsal band being broadened at about middle of tergites 2–5, suggesting a node-like or spindle-shaped structure; scales on pale coloured sides of tergites 2–5 gleaming sericeous yellowish, becoming silvery white in apical patches, especially on 2–4, and those across hind margins of these segments also silvery; fine hair-like scaling on legs greyish or whitish on coxae, mainly dark on femora and tibiae, but yellowish on inner faces of hind femora and to a much lesser extent on the others and outer faces of front and middle tibiae. *Head* with the eyes above in ♂ separated by only a narrow line, about or a little more than 3 times length of ocellar tubercle, in ♀ by a narrow space about as wide as front ocellus and a little shorter than ocellar tubercle; antennal segment 1 in ♂ longer than in ♀ and also more distinctly longer than segments 1 and 2 combined; segment 2 markedly short, markedly broadened apically, more so in ♂; segment 3 flattened, narrowed and pointed apically, apparently slightly longer in ♀, a little more than 2, to nearly 3, times as long as 2 in ♂ and about 2 to 3 times as long as 2 in ♀; proboscis about 2·5–3 mm. *Thorax*, excluding scutellum, subquadrate, only a little broader than long, both it and scutellum above fairly coarsely rugulosely punctured; scutellum transverse, markedly broader, or much broader, than long; hypopleural and metasternal parts rugosely punctured, the latter transversely grooved behind; postnotum on each side at base of tergite 1 produced into a distinct or prominent, somewhat triangular, dentate process or spine which in most other species is blunt or only rounded. *Wings* with a very characteristic pattern of infuscation, the basal part up to level of end of axillary lobe and the anterior costal half to discoidal cell and cubital fork brown to dark brown in both sexes, but evidently slightly darker anteriorly, with the spot-like infuscations at base of first submarginal cell, on apical cross veins of second basal cell, on middle cross vein and at base of upper cubital branch darker, conspicuous; entire discoidal cell, almost entire first posterior cell (excepting its extreme base only), second submarginal cell and more or less apical half of third posterior cell uninfuscated and clear, sharply demarcated and contrasting with especially the anterior infuscated half; only two submarginal cells present; alula entirely wanting; vein between submarginal cells less sinuous than in most other species; first posterior cell markedly narrowed and acuminate apically, often closed and subtending on hind margin or even shortly stalked; middle cross vein much beyond middle of discoidal cell; knobs of halteres brownish to dark brown above. *Abdomen* rather thick and stout, its petiole composed of 3 segments; last sternite of ♀ elongate, shining, spout-like, sharply pointed and slightly produced apically where it is also laterally compressed, and apex slightly bent downwards; last tergite of ♂ produced apically below on each side into an inwardly directed and upwardly curving process, the apices of which are slightly dilated and rounded; beaked apical joints of fused basal parts (taking up the position of a last sternite) with their sharp spine-like or hook-like apices curved inwards and slightly downwards; exposed and projecting part of medial aedeagal process stoutish, rod-like, rounded and slightly dilated apically; accessory processes on each side sharply pointed (similar to those depicted for *macilentus* Wied., cf. Hesse 1938, p. 1004, text-fig. 310); fused apical part of lateral rami (cf. text-fig. 310, R.) tongue-shaped, curved down towards aedeagal process and rounded apically; callus-area on terminal plates in last tergite roughly bean-shaped. *Legs* with the hind femora unarmed and rather abruptly clavate apically.

From 17 ♂♂ and 9 ♀♀ (types in the South African Museum).
Length of body: about 9·25–13 mm.
Length of wing: about 5–8 mm.

Localities. Western Cape: Leipoldtville–Elands Bay (Mus. Exp., Oct. 1947) (types, 14 ♂ and 6 ♀ paratypes); Ysterfontein (S.A.M., Sept. 1960) (1 ♀ paratype). Namaqualand: Bowesdorp (S.A. Mus. Exp., Sept. 1941) (2 ♂ and 1 ♀ paratypes).

The smallish size, striking bicolorous wings, much narrowed or even stalked first posterior cell, flattened iridescent and silvery scales on thorax and metasternum, transverse scutellum, the dentate postnotal processes and very short second antennal segments as well as the distribution of the red on body, distinguish this species from all other known South African forms. It is apparently restricted to the west coastal belt of the Cape. In general appearance and method of flight it simulates species of the Conopid genera *Conops* and *Physocephala*.

Systropus namaquensis Hesse

Systropus namaquensis Hesse 1938, p. 1006.

Since the publication of the specific description of a damaged ♂ specimen of this species which I compared with *macilentus* Wied. at the time, the Museum has acquired numerous other ♂♂ and also quite a number of ♀ specimens. To include the as yet undescribed ♀ the original description may therefore be supplemented as follows:

Body mainly black; frons, face and genal parts mainly dark, with silvery pruinescence, except on middle part of face; buccal rim ivory yellowish; antennae entirely black and black-haired; following parts yellowish red to red: a humeral spot on each side continued as a narrow notopleural line to the broad false tegulae and to include the postalar calli, propleural callosity and sclerite above it, middle sutural (or posterior sternopleural and anterior hypopleural) part, lower part of posterior episternal (or hypopleural) part, metapleural part to a certain extent, sides of tergites 2–5, greater part of hind femora (excepting their black apical parts), at least or more than basal halves of hind tibiae, at least outer faces of front and middle tibiae, and sometimes to a much lesser and variable extent outer faces of anterior and middle femora; tergite 1 sometimes obscurely dark reddish at its basal corners like the exposed postnotal parts below; scutellar callosities flattened, ivory yellowish. *Vestiture* peculiar in that, as in *bicoloripennis* n. sp., the fine silvery whitish hair-like scales or hairs of most other species are in this case replaced by distinct, narrow, flattened scales (or scale-like hairs) on thorax, especially posteriorly, on scutellum, hypopleural and metasternal parts and on sides of tergite 1. *Head* with the eyes above contiguous in ♂ for a distance a little more than 3 to about 4 times length of ocellar tubercle, narrowly separated for a short distance in ♀, narrowest part being subequal in length to that of tubercle and about as wide as front ocellus; frons in ♀ thus much longer; antennal segment 1 in ♂ longer than in ♀; segment 2 relatively short, equally long in both sexes; segment 3 flattened, more sharply pointed apically, slightly shorter in ♂, about 3 or a little more (3½ or nearly 4) times length of 2 in ♂ and from 4½ to nearly 5 times length of 2 in ♀, subequal or more usually shorter than segment 1 in ♂, but longer than 1 in ♀. *Wings* with only 2 submarginal cells, smoky greyish to dusky in ♂, darker in costal part and marginal cell, distinctly darker and very much more infuscated in ♀, smoky brown, more so basally and in anterior half; first posterior cell only slightly narrowed apically; knobs of halteres very dark brown to almost black above. *Abdomen* rather thick and long; petiole composed of 4 segments; last sternite in ♀ elongate, scoop-like; last tergite in ♂ like that of *macilentus* Wied., with inwardly and upwardly curved, apically thickened apical prongs, which are however distinctly more U-curved; exposed part of hypopygium in ♂ with the beaked apical joints similar to those of *macilentus*, but their inwardly tumid beaks apparently blunter, the aedeagal process more broadened and bifid apically and the accessory processes similar, but the other on each side dorsally which I labelled as 'ramus' in *macilentus* (cf. text fig. 310, p. 1004, 1938) is fused apically with its companion and is produced into a flattened pointed process.

From 19 ♂♂ (including the original holotype) and 12 ♀♀ in the South African Museum.

Length of body: about 13–18·5 mm.
Length of wing: about 8–10 mm.

Localities. Namaqualand: Giftsberg (van Rhynsdorp) (Sept. 1911) (original holotype ♂); Wallekraal (Mus. Exp., Oct. 1950) (1 ♂); Graafwater (Mus. Exp., Oct. 1947) (♀ allotype, 4 ♀ paratypes and 4 ♂♂). Koup Karoo: Lammerskraal in Prince Albert Dist. (Mus. Exp., Sept. 1947) (2 ♀ paratypes and 8 ♂♂); Koup Siding–Laingsburg (Mus. Exp., Oct. 1952) (1 ♀ paratype). Moordenaars Karoo: Lammerfontein (Mus. Exp., Oct. 1952) (1 ♀ paratype and 1 ♂). North Western Karoo: Augusfontein near Calvinia (Mus. Exp., Sept. 1947) (3 ♀ paratypes and 4 ♂♂).

Systropus sheppardi n. sp.

A large species which superficially resembles the wasp *Belonogaster junceus* (*Vespidae*) and which is characterized as follows:

Body mainly black; frons, face, genal parts, interior of buccal cavity, first antennal segments, palps, and base of proboscis yellowish or pale yellowish reddish; following parts ferruginous reddish: a broad humeral quadrate patch on each side anteriorly on thorax, continued as broad sides of thorax, including the false tegulae, to postalar calli, sides basally of scutellum, metanotal part, area around wing-bases, posterior part of pteropleuron, middle episternal and epimeral (or sternopleural) parts, metapleural part, anterior margin and lower lappet of posterior episternal (or hypopleural) part, the extreme upper margin of metasternal part, the area in upper half dividing the metasternal parts, the narrowish area surrounding the base of postnotal process on each side, the coxae and legs; a variable spot on propleural callosity, and scutellar callosities yellow; sides of tergites 2–4, sides of base of 5 and entire club of abdomen black; exposed parts of hypopygial structures also ferruginous. *Vestiture* with the hairs on antennae and on face black; those on declivous anterior part of thorax in humeral region and a characteristic brush of dense hairs in groove on thorax above wing-base on each side also black; frons, face and genae with silvery pruinescence; fine hairs or hair-like scaling on thorax above composed of greyish and dark ones, mostly in broadish streaks, those posteriorly and on scutellum longer, more silvery; hair-like scaling on pleurae relatively sparse, denser posteriorly and on metasternal part, silvery white, but relatively shorter than in most species; fine scaling on abdomen dark or black on dark parts, yellowish on pale parts, but those on last two or three segments of club greyish white or silvery; scaling on legs mainly dark, even on middle and hind femora below, pale basally below on front ones; fine hairs or hair-like scaling on callosities on front femora (in certain lights), on outer faces of front and middle tibiae silvery whitish, the dark ones on front or inner faces gleaming golden in certain lights, especially in ♀. *Head* with the eyes in both sexes in contact above for a little more than 3 times length of ocellar tubercle; frons more depressed centrally in ♀; antennal segment 1 slender, elongate, very slightly longer in ♂ than in ♀, about or almost as long as last four tarsal segments together, a little more than 3, or nearly 4 times length of segment 2 (segment 3 missing in specimens); palps quite or nearly half length of antennal segment 1; proboscis long, slender, about 6·52–6·72 mm. *Thorax* dull above, leathery in appearance, more finely punctured in hinder half, slightly more coarsely on scutellum; metasternal part transversely grooved. *Wings* dusky, tinged smoky brownish, very much darker in ♀, darker in costal part in both sexes, but more so in ♀; veins dark brown; two submarginal cells present; first posterior cell narrowed apically; alula and outer squamal lobe wanting; knobs of halteres very dark or black above. *Abdomen* long, with a petiole composed of three segments; last sternite in ♀ elongate, produced apically into two sharp, spine-like processes; last tergite in ♂ only deeply emarginate apically, not armed with a spine or process on each side; exposed hypopygium of ♂ with the fused basal parts (ventral in position) broad, scoop-like, truncate apically, armed apically on its inner side on each side with an inwardly directed, curved, somewhat flattened, spine-like apical segment (clasper) which is also curved downwards apically; exposed accessory structures or aedeagal processes in form of a medial, dorsally directed, broadish, hook-like structure, flanked on each side by a broad, flattened, apically rounded, lobe-like structure. *Legs* without spines on hind femora below, the latter not clavate apically; hind legs relatively long and with rather well-developed spicules on hind tibiae.

From a ♂ and 2 ♀♀ (♂ holotype and ♀ allotype in the South African Museum and 1 ♀ paratype in Transvaal Museum).

Length of body: about 25–25·5 mm.

Length of wing: about 14–14·5 mm.

Localities. Southern Rhodesia: Vumba in Umtali Dist. (P. A. Sheppard, March 1931) (♂ holotype); Umtali Dist. (P. A. Sheppard, April 1931) (♀ allotype and ♀ paratype).

Distinguished from the other large *Belonogaster*-like Rhodesian species *marshalli* Bezz. by its different colour-pattern in which the base of the thorax, scutellum, propleural callosities and base of tergite 1 are not reddish, and the wings are not yellowish, but dusky or smoky brownish. From *snowi* Adams, a slightly smaller species from Rhodesia with a similar colour-pattern, it may, apart from the larger size, be at once distinguished by the much smaller propleural yellow spot, the non-pallid outer faces of front and middle tibiae, less red on lower part of hypopleuron, presence of black hairs on face, anterior humeral part and densely in groove above wing-bases, and the much darker wings.

Systropus gracilis n. sp.

A slender-bodied species superficially resembling *leptogaster* Lw., but agreeing and differing from the latter as follows:

Body mainly black; frons, face, genal parts, humeral angle and a fascia from it down on each side to include propleural callosity (but not transversely on thorax above as in *leptogaster*), front coxae, apical halves of front femora, part of underside of middle femora and outer faces of front and middle tibiae and their basal tarsal segments, and scutellar callosities ivory yellowish; hind femora below even more extensively pallid or yellowish and white-scaled than in *leptogaster*; thorax above on false tegulae without any oblique yellow fascia or spot; pleurae entirely black, the middle sutural part between sterno- and hypopleural parts dull velvety black, not reddish; tergites 2–5, especially 4 and 5, laterally also ochreous yellowish, but even bases of 6 laterally also yellowish; apical halves of front and middle tarsi black; apices of hind tibiae and tarsi also black or dark. *Vestiture* with the fine tomentum on frons, face and genae silvery; fine hairs on antennae black; fine and sparse hairs on disc of thorax appearing greyish yellowish to brownish in certain lights; hairs or hair-like scales on pleurae, metasternum, scutellum, and sides of tergite 1 silvery white, those on metasternum longer, but sparser than in *leptogaster*; fine hair-like scaling on disc of tergite 1 blackish brown; that on dorsum of rest of tergites and also on sides ventrally below black like most of those on abdominal club; that on sides of tergites 2–5, but less so on sides of 2, yellowish; fine hair-fringes across hind margins of same tergites more silvery white, more conspicuous than yellowish or dark ones of *leptogaster*; fine scaling on upper sides of femora and tibiae dark, contrasting with pale ones on lower surfaces and with the silvery white fine hairs and scales on outer sides of front and middle tibiae and basal segments of their tarsi. *Head* with the eyes above in ♂ in contact for a very much shorter distance, only a very little more than 3 times length of ocellar tubercle, not actually about 5 times as in *leptogaster*; antennal segment 3 longer, elongate, a little longer than segment 1, more or less spindle-shaped and bluntly pointed and about or nearly 3 times length of segment 2 in ♂ (proportions of segments 7 : 2·6 : 8) whereas in ♂ of *leptogaster* segment 3 is about or only a little more than twice length of segment 2; proboscis about 3·6 mm. long. *Thorax* relatively much shorter (excluding scutellum), distinctly much shorter than width of head, its upper surface shining, more coarsely rugosely punctured (dull and more finely rugulose in *leptogaster*); scutellum shorter, more rounded and not subemarginate posteriorly; metasternal part distinctly much narrower, more finely transversely rugose, without the normal transverse groove-like sculpture of most other species, in profile sloping more sharply forwards, the hind coxae appearing shifted far forwards to below level of neck (in *leptogaster* to about below middle of thorax). *Wings* tinted only a little less smoky greyish than in ♂ of *leptogaster*, the costal cell also darker and similarly yellowish brownish, veins brownish; spot-like infuscations on middle cross vein and base of discoidal cell, apart from one at common base of second and third veins, slightly less conspicuous than in *leptogaster*; a delicate, shiny, hyaline, lobe-like outer squama (or part of alula) present which in *leptogaster* is entirely wanting as in other known South African species;

three submarginal cells present, but base of normal second submarginal cell distinctly very much shorter; middle cross vein apparently nearer middle of discoidal cell; first posterior cell less narrowed apically; knobs of halteres paler, more yellowish brown above. *Abdomen* more slender, but also with a three-segmented petiole, though segment 4 is relatively less broadened (side view) and may almost be considered as a fourth segment of the petiole. *Legs* as in *leptogaster*; hind femora not clavate apically, only gradually thickened. *Hypopygium* of ♂ with the callus-area on terminal plates in last tergite very much broader and more oval than in *leptogaster*; aedeagal process flattened, ending into two slightly diverging flattened lobes, not cowl-like or hood-like as in latter.

From a ♂ in the South African Museum.
Length of body: about 11·5 mm.
Length of wing: about 6·5 mm.

Locality. Portuguese East Africa: Nyaka (R. Lawrence, Feb. 1924).

Superficially this species also resembles the species *ichneumoniformis* which I described from the Congo (1958, p. 64), and which also has similar hyaline, lobe-like, outer squamae at base of wings, dusky wings, shiny thorax, elongated third antennal segments, etc. From the latter, *gracilis* differs, however, in its ivory yellowish face, genal parts, ivory yellowish fascia from humeral angle to coxae, ivory yellowish front coxae, more yellowish legs, shorter, more convex and more coarsely sculptured thorax, much longer line of contact between eyes above, etc.

Key to the Southern African Species of Systropus

A revised and descriptive key to all the known southern African species.

1(*a*) Wings with only two submarginal cells. 2
(*b*) Wings with three submarginal cells. 11

2(*a*) Antennal segment 2 distinctly much shorter, much less than half length of segment 3, or shorter than, subequal in length to, or only a little longer than anterior tarsal segment 3; club of abdomen without or with scarcely any, or with only poorly developed, silvery hairs in apical part, these hairs if pale usually not silvery white; pteropleuron without or with only very short silvery hairs or hair-like scales posteriorly, and sides of tergite 1 and metasternal part with sparser and usually shorter silvery elements; outer faces of front and middle tibiae usually without conspicuous, resplendent, silvery hairs or pubescence, and if yellowish, with feebler and less conspicuous silvery hairs, and if resplendently silvery, antennal segment 2 short; hind femora more abruptly and markedly clavate apically. 3
(*b*) Antennal segment 2 distinctly much longer, nearly or almost half length of 3, or much or very much longer than anterior tarsal segment 3; club of abdomen usually with conspicuous or dense silvery hairs or with conspicuous silvery-gleaming pubescence in apical part; pteropleuron with more conspicuous and distinctly longer (or with a tuft of distinctly longer) silvery hairs posteriorly, and sides of tergite 1 and metasternal part usually also with longer and much denser silvery elements; outer faces of front and middle tibiae, even if not yellowish, usually with conspicuous, resplendent, silvery hairs; hind femora not or scarcely abruptly clavate apically. 6

3(*a*) Wings markedly short, anterior half and basal part up to end of axillary lobe darkly infuscated, the cross veins more darkly so, but rest or lower apical half clear; first posterior cell very much narrowed apically, acute, closed or sessile on hind margin; antennae relatively short, segment 2 markedly broadened apically and 1 whitened and white-haired above in ♂; postnotum on each side at base of tergite 1 produced spine-like or dentately prominent; abdomen relatively thick or stoutish, with 3-segmented petiole, the apical parts of which have a large quadrate patch of fine silvery hair-like scaling on each side; base of sternite 2 conspicuously bone yellowish; mesopleural, posterior episternal and epimeral (metasternal) parts and sides of tergite 1 with small broadish iridescent or pearly scales; hind femora without spines; smallish form, not more than 13 mm. . . . . . . ♂ ♀ *bicoloripennis* n. sp. (W. Cape, Namaqualand)

(*b*) Wings relatively longer, not so bicolorously infuscated, either tinged uniformly throughout or with only costal part darker and with the spots on cross veins less conspicuous; first posterior cell either not or only slightly narrowed apically, usually broadly open apically; antennae distinctly much longer, segment 2 not or less broadened apically, and 1 not whitened above, dark-haired in both sexes; postnotal angle on each side at base of tergite 1 less sharply prominent, bluntly angular or rounded; abdomen distinctly more slender, with 4-segmented petiole, the apical parts of which with more yellowish or pallid fine scales or hairs or with darker hairs; base of sternite 2, if pale, more normally yellowish; pleural, metasternal parts and sides of tergite 1 with silvery hair-like scales or with longer, less broadish silvery ones; hind femora usually with some spines below at about middle; larger forms, usually more than 13 mm. 4

4(*a*) Wings distinctly more darkly infuscated, either in both sexes, or in ♀♀ more darkly than in ♂♂; propleural tubercle, front coxae and outer surfaces of front and middle tibiae castaneous brownish, reddish brown or yellowish brown, both pairs without even faint silvery hairs; apices of hind femora and tibiae conspicuously dark or blackened, greater part of hind legs being pale reddish or yellowish brown; hyposternal and metasternal parts or at least hind part of metasternum black 5

(*b*) Wings less dark, more cinereous or smoky greyish, darker only at base and costal part, especially in ♀; propleural tubercle, front coxae, a subapical spot on front femora below and outer faces of front and middle tibiae ivory yellowish or whitish, both pairs with faint, but distinct, silvery whitish hairs on ivory faces; legs dark or black, hind ones entirely so; pteropleuron, middle epimeral, metapleural, posterior episternal and epimetal (or metasternal) parts entirely pale reddish or yellowish brownish. . . . ♂ ♀ *barnardi* Hesse (1938, p. 1006) (S.W. Cape)

5(*a*) Wings in both sexes more uniformly reddish brownish, only very slightly darker in ♀; halteres slightly paler, the knobs more yellowish brownish to castaneous brown above; entire or greater part of antennae, face, sides of thorax broadly, base of thorax, apical spot on or hind margin of scutellum, pteropleuron, middle epimeral, metapleural, posterior episternal parts and front part of posterior epimeral (or metasternal) part, base of tergite 1, tergites 2–5 above and medially below, and legs including basal segments of tarsi pale reddish brown, yellowish brown to ochreous brownish; silvery vestiture on thorax, pleurae, metasternum and sides of tergite 1 in form of finer hair-like scales or hairs. . . . ♂ ♀ *macilentus* Wied. (1938, p. 1001) (W. Cape, Karoo)

(*b*) Wings in ♀ very dark smoky brownish, darker in anterior half and basally, less infuscated in ♂, more cinereous or smoky greyish, darker only in costal part and base; halteres darker, more dark castaneous to blackish brown, the knobs dark to almost black above; antennae, face or middle part of face, upper half or even greater part of genae, greater part of thorax above, entire scutellum, greater part or entire pteropleuron, hypopleuron or posterior episternal part (excepting only its reddish lower part), entire posterior epimeral part, entire tergite 1, dorsum and sides below of tergites 2–5 and abdominal club black; coxae, front and middle femora, more or less apical parts of their reddish brown tibiae, apical parts of hind femora, almost apical halves of hind tibiae, and all the tarsi very dark to black; silvery vestiture on thorax, pleurae, metasternum and sides of tergite 1 tending to be more in form of scale-like hairs or even scales in part. . . . ♂ ♀ *namaquensis* Hesse (W. Karoo, Namaqualand)

6(*a*) Wings entirely glassy hyaline in ♂ at least; antennal segment 1 entirely dark or black, apical part of 3 more distinctly and more sharply produced outwards; humeral angle and across anterior spiracle, including propleural tubercle, a large rounded spot on each side of thorax above wings, postalar calli, front coxae and to a certain extent outer face of front tibiae ivory whitish; vestiture on posterior episternal (hypopleural) and epimeral (or metasternal) parts slightly longer, denser, that towards apex of abdomen not conspicuously silvery; black callus-area on terminal plates of last sternite (tergite) of ♂ very narrow, linear. . . . . . ♂ *munroi* Hesse (1938, p. 1010) (Transvaal)

(*b*) Wings even in ♂♂ not entirely glassy hyaline, either tinged smoky brownish or with at least costal and basal parts brownish; antennal segment 1 not entirely dark, either basal part, basal half or entire segment brownish, reddish brown or reddish, and apical part of 3 even if acute not distinctly produced or prolonged; humeral angle, anterior spiracular part, spot or macula above wing-base and postalar calli not ivory whitish, usually reddish or ferruginous red; vestiture on hypopleural and metasternal parts on the whole shorter, less dense and shaggy (if dense and longish other characters do not differ), that towards apex of abdomen usually more conspicuously silvery; callus-area on terminal plates of last sternite (tergite) of ♂♂ distinctly broader. 7

7(*a*) Wings glassy hyaline, but base, costal cell and marginal cell to a variable extent in ♂, and in ♀ also greater part of first basal cell, to a variable extent base of second basal cell and also basal half of first submarginal cell dark brown or reddish brownish; knobs of halteres pale above; frons, entire antennal segment 1 at least above, face, genae and base of tergite 1 in addition to other red on thorax pale reddish or pale reddish brown; propleural tubercle ivory yellowish only in upper part and sclerite above it, black; outer faces of front and middle tibiae and tarsi, though silvery-haired, only slightly yellowish; scutellar callosities very dark, blackish brown or black; eyes above contiguous for only a short distance in both sexes; thorax above distinctly more coarsely rugulose-punctate; vestiture on body, especially on thorax above, distinctly and markedly denser, longer, that on antennal segment 1 above and to a certain extent also on 2 denser, longer, entirely silvery white, especially in ♂.
♂ ♀ *crudelis* Westwd. (1938, p. 1012) (N.W. Cape, Bechuanaland, Transvaal, Natal)

(*b*) Wings not glassy hyaline, distinctly tinged more greyish or cinereous, smoky or even dark smoky or reddish brownish, the darker basal and costal parts not contrastingly demarcated from less dark parts; knobs of halteres dark or black to a variable extent; first antennal segments darkened in apical part or half or entirely dark or black, but apical part of frons, face or sides of face, and genae yellow; tergite 1 entirely dark; propleural tubercle and sclerite above it usually entirely ivory yellowish and if darker other characters do not differ; outer faces of front and middle tibiae and tarsi usually much paler or yellowish, contrasting with inner faces; scutellar callosities very pale yellowish, almost white; eyes above in actual contact for a much longer distance; thorax above only very finely rugulose; vestiture on body above distinctly very much sparser, shorter and finer, and that on antennal segment 1 finer, less shaggy, entirely dark or with fewer intermixed pale ones. 8

8(*a*) Wings distinctly less darkly infuscated in both sexes, only tinted greyish, cinereous or faintly smoky or yellowish brownish, the basal and costal parts slightly darker, more so in ♀♀ than in ♂♂; sides of thorax above continuously pale reddish from broad humeral spot; legs on the whole very much paler, pale reddish or yellowish reddish, the femora not or scarcely darkened above, their fine dark scaling present only sparingly; vestiture on thorax above entirely or predominantly whitish. 9

(*b*) Wings distinctly more dusky or darkly infuscated smoky brownish, even in ♂♂, but much more so in ♀♀, the basal and costal parts being darker still; sides of thorax above darker red or more ferruginous reddish or the red is interrupted just behind humeral spot; legs darker, darker brownish or reddish brown, the femora also distinctly more darkened above, to a large extent due to denser or more extensive fine black scaling; vestiture on thorax above not entirely silvery or pale, but with at least some fine dark or black hair-like scales or hairs either in streaks or on anterior declivous part or above wing-bases. 10

9(*a*) Pleurae predominantly black, the greater part or at least upper half of hypopleuron (or posterior episternal part), entire metasternal part and metanotal part also black; front coxae dark or black in front or on sides; tergites 2–5 darker, more blackish above and

5 with dorsum and apical half of sides also very dark or black; vestiture on antennal segment 1 sometimes entirely black, even in ♂.
. . . ♂ ♀ *snowi* Adams (1938, p. 1015) (Rhodesia)

(*b*) Pleurae with greater part of pteropleuron, entire hypopleural (or posterior episternal) part and metanotal part as well as middle part of metasternum behind red; front coxae paler, tending to be largely pallid or ivory yellowish in front; tergites 2–5 less dark above, more brownish, and 5 entirely or predominantly pale reddish yellowish or ochreous; vestiture on antennal segment 1 with more intermixed pale or yellowish hairs or even pale-haired in basal half in ♂ at least.
. . . ♂ *zuluensis* Hesse (1938, p. 1018) (Zululand)

10(*a*) Smaller form, about 14·5 mm.; first posterior cell in wings markedly narrowed apically; frons, face, entire propleural tubercle and sclerite above it, anterior faces of front coxae and outer faces of front and middle tibiae and apical half of halteral knobs ivory whitish; red on thorax above not continuous on sides, the humeral spot being isolated; sternopleural part mainly black and at least lower half of hypopleuron (or posterior episternum) reddish; hairs in groove above wing-bases sparse and pale, and those on anterior declivity in front of humerus and on face also pale; fine hairs on hind coxae and hair-like scaling on femora below pale, sericeous or silvery.
. . . ♂ *fumosus* Hesse (1938, p. 1019) (Portuguese East Africa)

(*b*) Much larger form, about 25–25·5 mm.; first posterior cell only slightly narrowed; frons and face reddish or reddish brownish, only a smallish spot on propleural tubercle ivory yellowish or whitish, the front coxae reddish and outer faces of front and middle tibiae more pale yellowish reddish, not ivory whitish; knobs of halteres entirely very dark blackish brown or black above; ferruginous red on sides of thorax continuous and confluent with humeral spot; sternopleural part mainly ferruginous and only extreme sternal part of hypopleural part ferruginous; hairs in grooves above wing-bases dense, conspicuous and black like those on anterior declivous part of humerus and on face; fine hairs on hind coxae and hair-like scaling on entire femora black.
. . . ♂ ♀ *sheppardi* n. sp. (S. Rhodesia)

11(*a*) Wings dusky, darkly tinged smoky brownish or reddish brownish, darker in basal and costal parts, more so in ♀♀; veins darker, brownish or blackish brown; eyes in actual contact in both sexes for a long distance; antennae darker, segment 1 dark reddish brown to almost black, segment 2 black and usually longer; scutellum entirely or predominantly black, and scutellar callosities yellow; hind legs with the tibiae darkened or blackened apically and hind tarsi entirely very dark or black; callus on front femora larger, nearly half length of femora; knobs of halteres very dark or blackish above; club of abdomen shorter; smaller forms, usually less than 20 mm. 12

(*b*) Wings tinged predominantly yellowish, the costal and basal parts broadly yellowish, the posterior clearer part more greyish, being slightly more mauvish at apex; veins mainly yellowish; eyes subcontiguous or very nearly separated in both sexes; antennal segments 1 and 2 very pale yellowish red and 2 much shorter; scutellum predominantly reddish and its callosities dark velvety brown; hind legs mainly yellowish red, even basal half of tarsi reddish, only bases of femora and apical parts of tarsi dark; callus on front femora much shorter, narrower, less than half length of femora; knobs of halteres paler, more yellowish brown above; club of abdomen more elongate; larger form, about 20–22 mm. . . . . . . ♂ ♀ *marshalli* Bezz. (1938, p. 1026) (Rhodesia)

12(*a*) Wings more uniformly dusky or tinged smoky brownish, only a narrow costal part slightly darker in both sexes; apical or third submarginal cell normally broadened apically, vein separating it from second submarginal not markedly curved hindwards; antennal segment 2 much longer, usually more than a third length of segment 3, sometimes at least half in ♂♂; sides of thorax not reddened all round, but humeral angle or sometimes a transverse fascia continuous with it, a continuous fascia from humerus including propleural tubercle and sometimes a transverse stripe in front of wing-bases ivory yellow; greater part of pleurae, excepting sometimes only the reddish sutural part between sterno- and hypopleuron, black; tergite 1 entirely black and rest also more darkened or even black above; femora more darkened or dark-scaled above, and front coxae and outer faces of front and middle tibiae and tarsi ivory yellowish, silver-haired; hind femora without spines below; thorax and scutellum above and mesopleuron usually with finer sculpture; hairs on face pale and with the two longitudinal bands of darkish hairs on thorax scarcely discernible. 13

(*b*) Wings with a more delimited, darker, more dark brownish, infuscation in anterior half up to level of upper vein of discoidal cell, including basal part of second basal cell, more so in ♀; apical or third submarginal cell characteristically narrowed apically, its lower vein characteristically curved hindwards at about middle; antennal segment 2 much shorter, only about a third or less length of 3; sides of thorax and across base, propleural tubercle, pteropleuron, middle parts of pleurae and entire hypopleural part and even upper and lower parts of metasternum reddish; base of tergite 1 also broadly reddish and rest of tergites scarcely or not darkened above; legs on the whole paler reddish, front coxae dark, and outer sides of front and middle tibiae not ivory yellowish, nor strikingly silver-haired; hind femora with some spines below at about middle; thorax, scutellum and mesopleuron more coarsely sculptured; hairs on face black and with more distinct dark ones on thorax above.
. . . . ♂ ♀ *sanguineus* Bezz. (1938, p. 1021) (S.W. Cape)

13(*a*) A lobe-like outer squama (part of alula) absent; knobs of halteres much darker above or even blackish; thorax (excl. scutellum) longer, subequal to width of head, duller above, with very much finer rugulose sculpture; metasternal part normally broader, more coarsely sculptured and grooved, not sloping or markedly shifted forwards, hind coxae not below level of neck; transverse ivory yellowish fascia on humeral part and propleural part on each side extending transversely across front part of thorax for some distance towards middle; a variable oblique transverse ivory yellowish fascia or mark present in front of wing-bases or at least a yellowish spot on false tegulae; middle pleural part between sterno- and hypopleural parts as well as extreme lower part of hypopleuron reddish; silvery vestiture on metasternal part distinctly denser, though shorter, and fine pale hairs across hind margins of tergites 2–5 not in form of conspicuous silvery rings; larger form, about 15·5–18 mm.
. . ♂ ♀ *leptogaster* Lw. (1938, p. 1024) (Natal, E. Transvaal, Portuguese E. Africa)

(*b*) A distinct delicate, transparent, lobe-like outer squama (part of alula) present; knobs of halteres much paler, more yellowish brownish above; thorax (excl. scutellum) much shorter, distinctly much shorter than width of head, more shiny above, distinctly more coarsely rugulosely sculptured; metasternal part relatively much narrower, much finer transversely rugose, distinctly more sloping or more markedly shifted forwards, the hind coxae being at level of neck; transverse ivory yellowish fascia on humeral angle and propleural part not continued dorsally for some distance across anterior part of thorax; no spot on fascia present above wing-bases; pleurae black and middle pleural part velvety black; silvery vestiture on metasternal part, though less dense, distinctly longer, and fine hairs across hind margins of tergites 2–5 in more conspicuous silvery rings; smaller and more slender form, about 11·5 mm. . . . ♂ *gracilis* n. sp. (Portuguese E. Africa)

SUMMARY

Descriptions are given of three new species of *Systropus* (*Systropinae*): *S. bicoloripennis*, *S. sheppardi* and *S. gracilis*. A further description of *S. namaquensis* is given, including the previously undescribed female. A revised and descriptive key to all the known southern African species of *Systropus* is included.

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SYNONYMY. Arrangement according to Schenk, E. T. & McMaster, J. H.: *Procedure in taxonomy.* 2nd ed. Stanford, Stanford university press, 1948. Bibliographic references modified.

'I. *Synonymy arranged according to chronology of names.*—All published scientific names by which a species has been previously designated (subsequent to 1758) are listed in chronological order, with bibliographical references to all descriptions or descriptive citations following in chronological order after each name. . . .

B. *Form of bibliographic references to synonymic names.*—The first reference following any name in the synonymy should be to the earliest citation of that name. This should be followed by references to all subsequent citations of the same name, arranged in chronological order. . . .'

Bibliographical references modified to consist of author's name, date of citation, pagination and illustrations (plates and figures).

Example:—

Eulalia (*Steggoa*) *capensis* Schmarda

Eulalis capensis Schmarda 1861, p. 86, pl. 29, fig. 231. Willey 1904, p. 259.
Eulalia viridis var. *capensis* McIntosh 1903, p. 34. Day 1953, p. 30.
Eulalia viridis (*non* Muller) Ehlers 1913, p. 455. Day 1934, p. 30.

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PART XVII

DEEP SEA MOLLUSCA FROM WEST OF CAPE POINT, SOUTH AFRICA

By

K. H. Barnard
South African Museum, Cape Town

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DEEP SEA MOLLUSCA FROM WEST OF CAPE POINT, SOUTH AFRICA

By

K. H. Barnard
South African Museum, Cape Town

[Accepted July 1962]

(With 11 figures in the text)

Contents

Introduction

The material described here was obtained by Dr. F. H. Talbot of the South African Museum, on board the R.S. *Africana II* of the Division of Sea Fisheries in August and December 1959, at twelve stations off Cape Point and west of the Cape Peninsula. It comprises approximately 590 specimens, of which more than half are Prosobranch Gastropods. The number of species in the groups is as follows: Gastropods 43; Heteropods 2; Pteropods 5; Tectibranchs 2; Nudibranch 1; Solenogastres 2–3; Scaphopods 6; Cephalopods 3–4; Lamellibranchs 11; Brachipod 1. Total: about 78.

One Cephalopod is here recorded. Two or three species of Octopods were also obtained, but these have not yet been identified.

An attempt has been made to identify the Solenogastres, but owing to technical difficulties in section-cutting, the attempt has been temporarily postponed. There appear to be two, possibly three, species.

The material contains several species obtained many years ago by the Cape Government trawler s.s. *Pieter Faure*, under the direction of the late Dr. J. D. F. Gilchrist. The *Africana II*, however, has sampled depths greater than those worked by the *Pieter Faure*. Therefore, as might have been expected, several new records and new species have been obtained.

Most of the new forms belong to the family *Turritidae* (Gastropoda); the *Pieter Faure* also collected more representatives of this family than of any other; and similar results have been obtained in other regions by other expeditions.

Ann. S. Afr. Mus. **46** (17), 1963: 407–452, 11 figs.

The most interesting discovery has been the Volute *Guivillea alabastrina* (Watson), originally taken by the *Challenger* between Marion Island and the Crozets; and later by the *Scotia* near the South Orkneys.

Some of the species have already been recorded in Part III of the author's 'Contributions to . . . fauna of South African Marine Mollusca', and in the *Journal of Conchology* (see list of titles).

The whole collection made by Dr. Talbot and submitted to me for report is now deposited in the South African Museum and is catalogued with South African Museum registration numbers.

The Lamont Geological Observatory research vessel *Vema* obtained abyssal molluscs from stations off the west coast of South Africa and south-west of Cape Town (St. 14, 16, 18, 51, 52, 53), which have been reported on by Clarke (1961). This author seems to have been misinformed as to the true position of the Agulhas Basin, and has erroneously localized Stations 51 and 52 (1,000 and 800 miles respectively *south-west* of Cape Town) in the 'Agulhas' Basin. The naming of two new species from Station 51 as '*agulhasae*' is also very misleading.

List of Species

GASTROPODS

	Station No.	
Terebra sp.	A322	1 dead; more material wanted
Surcula scalaria Brnrd. 1958	A189	3 dead
Clavatula lobatopsis n. sp.	A190	2 dead
	A191	2 living
	A192	1 living
	A193	1 living, 1 dead (fresh)
	A315	2 living
	A316	1 living
	A317	11 living
	A318	2 living
	A319	1 dead
	A322	6 living, 3 dead
Moniliopsis psilarosis n. sp.	A316	1 living, 1 dead
	A322	3 dead
Typhlomangelia(?) *polythele* n. sp.	A317	2 living
Cythara(?) *glaucocreas* n. sp.	A193	2 living
	A315	1 dead (ex anemone)
	A318	1 living, 2 dead (ex anemone)
Cythara(?) *dagama* n. sp.	A191	5 living
	A192	3 dead
	A315	1 dead
	A317	5 dead
	A322	1 living, 1 juv. dead

Typhlosyrinx pyrropelex n. sp.	A191 1 living, 1 dead A317 6 dead A318 2 dead A319 1 dead A322 3 living
Typhlosyrinx chrysopelex n. sp.	A322 1 living
Typhlosyrinx subrosea n. sp.	A318 1 living, 1 dead
Philbertia cala (Watson)	A316 3 living
Mangilia sp.	A189 1 dead A315 1 dead A317 2 dead
Daphnella(?) *verecunda* n. sp.	A189 2 living, 1 dead
Daphnella(?) *bitrudis* n. sp.	A193 2 dead
Gymnobela sp.	A189 1 dead; more material wanted A317 1 dead
? Gen. (*Turritidae*)	A317 1 dead; more material wanted A319 2 dead
Cancellaria euthymei Brnrd. 1960	A322 1 living
Admete decapensis Brnrd. 1960	A315 1 living
Guivillea alabastrina (Watson)	A315 1 dead (apex only) A316 1 protoconch A317 1 fragment (columella) A319 1 dead (half grown) A322 1 dead (half grown) and fragments
? Gen. (?*Fasciolariidae*)	A315 2 dead (ex anemone); more material wanted
Charitodoron pasithea Tomlin	A189 2 living, 1 dead A322 1 dead
Charitodoron thalia Tomlin	A190 1 living A191 1 living A192 2 living A193 2 living, 1 dead A318 1 living A322 5 dead
Nux alabaster Brnrd. 1960	A190 1 living A318 2 living
Neptunea bonae-spei n. sp.	A193 1 living A318 2 living, 2 dead A322 1 living
Prosipho torquatus n. sp.	A315 1 living A317 1 dead A322 1 dead

Pyrene cf. *profundi* Dall	A193 1 dead A322 8 living, 10 dead
Trophon acceptans Brnrd. 1959	A189 4 living, 7 dead A191 9 living, 2 dead A192 2 living A193 8 living, 1 dead A315 4 living, 1 dead A316 2 living, 2 dead A317 10 living A319 2 living A322 3 dead
Trophon cf. *droueti* Dautzenberg	A322 3 dead
Columbarium rotundum Brnrd. 1959	A189 6 living, 16 dead
Columbarium angulare Brnrd. 1959	A318 2 living, 4 dead
Thallassocyon bonus Brnrd. 1960	A190 1 living A193 1 living A315 1 dead A317 1 living
Oöcorys watsoni Locard	A190 2 dead A192 2 living, 1 dead A193 1 and 2 juv. living A316 1 dead (large) A317 2 dead A318 1 living, 2 dead A319 1 living, 18 dead A322 2 living, 3 dead
Polynices cleistopsila Brnrd. 1963	A189 1 living A190 1 dead A191 3 living A192 2 dead A317 1 living, 2 dead A319 6 dead A322 3 dead
Falsilunatia pseudopsila Brnrd. 1963	A315 1 living
Turbonilla sp. (cf. *kraussi*)	A189 1 dead; more material wanted
Cerithiella taylori Brnrd. 1963	A190 1 dead
Lamellaria capensis Bergh	A316 2 living
Scala bonae-spei Brnrd. 1963	A193 2 living A316 1 living
Abyssochrysos melanioides Tomlin	A190 1 dead A319 2 living, 5 dead
Calliotropis metallica (W.–M. & A.)	A190 1 living, 1 dead A322 1 living

Calliotropis pompe n. sp.	A316 1 dead A317 1 living, 1 dead
Basilissa gelida n. sp.	A190 1 living
Calliostoma glaucophaos n. sp.	A318 2 living
? *Solariella*	A190 1 dead; more material wanted

HETEROPODS

Atlanta sp.	A193 1 dead
Cardiapoda richardi Vayss	A190 1 living

PTEROPODS

Cavolinia tridentata (Forskal)	A189 2 dead A190 18 dead A193 14 dead A315 4 dead A317 1 dead A318 11 dead A319 24 dead A322 3 dead
Cavolinia limbata D'Orb...	A190 1 dead
Cavolinia ? *globulosa*	A315 2 dead
Diacria trispinosa (Lesueur)	A190 1 dead A322 3 dead
Herse (*Cuvieria*) *columnella* (Rang)	A322 2 dead

TECTIBRANCHS

Scaphander puncto-striatis Mighels	A192 1 juv. living A315 3 living A317 1 living A318 1 living A319 3 dead A322 1 juv. living
Gastropteron sp.	A318 1 living A319 1 living

NUDIBRANCHS

Doridoxa benthalis n. sp.	A316 1

SOLENOGASTRES

In course of study	A191 A193 A316 (large) A316 (small)

SCAPHOPODS

Dentalium capense Tomlin	A189 1 living, 2 dead

Dentalium eualdes n. sp.	A190 1 living
	A191 8 living
	A192 1 and 1 juv. living
	A193 14 living, 3 dead
	A315 1 adult living, 1 juv. dead
	A317 18 living, 2 dead
	A318 1 living, 1 dead
	A319 12 living, 1 dead
	A322 4 living, 1 juv. dead
Dentalium lardum n. sp.	A193 5 dead
	A318 2 dead
	A322 1 living, 1 juv. dead
Dentalium sp. (9 ribs)	A190 2 dead; more material wanted
	A315 1 dead
	A322 2 dead
Dentalium sp. (18–22 ribs)	A189 17 dead; more material wanted
Cadulus promontorii Brnrd. MS.	A189 3 living

CEPHALOPODS

Eggs	A190
	A318
Octopus sp. ♂	A189 1
Octopus sp. juv.	A192 1
Octopus sp.	A318 1
Octopus sp. large	A319 1
Octopus sp. small	A319 1
Leachia cyclura Lesueur	A192 1

LAMELLIBRANCHS

Nucula (*Pronucula*) *benguelana* Clarke	A322 1 living
Malletia estheriopsis n. sp.	A317 2 living
	A319 3 living
	A321 1 living
	A322 2 living
Leda parsimonia n. sp.	A317 1 living
Leda macella n. sp.	A190 1 living
	A192 1 living
	A317 1 living
	A319 a lot living
? *Sarepta* sp.	A322 1 valve

Limopsis cf. *straminea* Smith	A190 3 living A191 17 living A192 12 living A193 10 living A315 3 living A317 6 living, 5 valves A319 34 living, 4 valves A322 2 living, 1 valve
Thyasira investigatoris (Smith)	A189 1 valve
Abra longicallus (Scacchi)	A189 1 living, 2 dead A322 1 living
Halicardia flexuosa (V. & S.)	A189 1 living
Cuspidaria sp. (cf. *meridionalis*)	A189 1 living
Cuspidaria sp. (cf. *maxima*)	A315 1 valve, 1 broken valve A322 1 broken valve

BRACHIOPODS

Terebratula sp.	A316 2 living

Species Found at Each Station

33° 50′ S., 17° 21′ E., 600 fathoms. (Station number A189)*

Surcula scalaria Brnrd. 1958	
Mangilia sp.	new to fauna-list
Daphnella verecunda	n. sp.; Type
Gymnobela sp.	new to fauna-list
Charitodoron pasithea Tomlin	
Trophon acceptans Brnrd. 1959	
Columbarium rotundum Brnrd. 1959	
Polynices cleistopsila Brnrd. 1963	n. sp.
Turbonilla sp.	more material wanted
Cavolinia tridentata (Forskal)	
Dentalium capense Tomlin	
Dentalium sp. (18–22 ribs)	new to fauna-list
Cadulus promontorii Brnrd. MS.	n. sp.; Types
Octopus sp. ♂	
Halicardia flexuosa (V. & S.)	
Cryptodon investigatoris Smith	
Abra longicallus (Scacchi)	new to fauna-list
Cuspidaria sp. (cf. *meridionalis*)	new to fauna-list

33° 26′ S., 16° 33′ E., 1,240–1,300 fathoms (A190)

Clavatula lobatopsis	n.sp.
Charitodoron thalia Tomlin	

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*Not to be confused with South African Museum registration numbers which have the prefix A.... and *four* numerals. For this reason, in the descriptions and notes only the localities are given, not the station number.

Nux alabaster Brnrd. 1960	n. g., n. sp.; Type
Thalassocyon bonus Brnrd. 1960	n. g., n. sp.
Oöcorys watsoni Locard	
Polynices cleistopsila Brnrd. 1963	n. sp.
Cerithiella taylori Brnrd. 1963	n. sp.; Type
Abyssochrysos melanioides Tomlin	
Calliotropis metallica (W–M. & A.)	
Basilissa gelida	n. sp.; Type
? *Solariella*	more material wanted
Cavolinia tridentata (Forskal)	
Cavolinia limbata D'Orb.	
Diacria trispinosa (Lesueur)	
Cardiapoda richardi Vayss.	new to fauna-list
Dentalium eualdes	n. sp.
Dentalium sp. (9 ribs)	new to fauna-list
Cephalopod eggs	
Limopsis sp. cf. *straminea* Smith	new to fauna-list
Leda macella	n. sp.
33° 36′ S., 16° 15′ E., 1,520–1,570 fathoms (A191)	
Clavatula lobatopsis	n. sp.; Types
Cythara(?) *dagama*	n. sp.; Types
Typhlosyrinx pyrropelex	n. sp.; Types (of juvenile)
Charitodoron thalia Tomlin	
Trophon acceptans Brnrd. 1959	
Polynices cleistopsila Brnrd. 1963	n. sp.
Dentalium eualdes	n. sp.; Types
Solenogastres	new to fauna-list
Limopsis sp. cf. *straminea* Smith	new to fauna-list
33° 45½′ S., 16° 23½′ E., 1,480 fathoms (A192)	
Clavatula lobatopsis	n. sp.
Cythara(?) *dagama*	n. sp.
Charitodoron thalia Tomlin	
Trophon acceptans Brnrd. 1959	
Oöcorys watsoni Locard	
Polynices cleistopsila Brnrd. 1963	n. sp.
Scaphander puncto-striatus Mighels	
Dentalium eualdes	n. sp.
Octopus sp. juv.	
Leachia cyclura Lesueur	new to fauna-list
Limopsis sp. cf. *straminea* Smith	new to fauna-list
Leda macella	n. sp.
33° 49′ S., 16° 30′ E., 1,500 fathoms (A193)	
Clavatula lobatopsis	n. sp.
Cythara(?) *glaucocreas*	n. sp.

Daphnella(?) *bitrudis*	n. sp.; Types
Charitodoron thalia Tomlin	
Neptunea bonae-spei	n. sp.
Pyrene cf. *profundi* Dall	new to fauna-list
Trophon acceptans Brnrd. 1959	n. sp.
Thalassocyon bonus Brnrd. 1960	
Oöcorys watsoni Locard	
Scala bonae-spei	n. sp.; Types
Atlanta sp.	
Cavolinia tridentata (Forskal)	
Solenogastres	new to fauna-list
Dentalium eualdes	n. sp.
Dentalium lardum	n. sp.; Types
Limopsis sp. cf. *straminea* Smith	new to fauna-list
34° 37′ S., 17° 03′ E., 1,580–1,620 fathoms (A315)	
Clavatula lobatopsis	n. sp.
Cythara(?) *glaucocreas*	n. sp.
Cythara(?) *dagama*	n.sp.
Mangilia sp.	new to fauna-list
? *Fasciolariidae* ? gen.	new to fauna-list
Admete decapensis Brnrd. 1960	n. sp.; Type
Guivillea alabastrina (Watson)	new to fauna-list
Prosipho torquatus	n. sp.; Type
Trophon acceptans Brnrd. 1959	
Thalassocyon bonus Brnrd. 1960	n. sp.
Falsilunatia pseudopsila	n. sp.; Type
Cavolinia tridentata (Forskal)	
Cavolinia ? *globulosa*	
Scaphander puncto-striatus Mighels	
Dentalium eualdes	n. sp.
Dentalium sp. (9 ribs)	new to fauna-list
Limopsis sp. cf. *straminea* Smith	new to fauna-list
Cuspidaria sp. cf. *maxima*	new to fauna-list
[Fragment of *Argonauta*]	
34° 42′ S., 16° 54′ E., 1,725–1,780 fathoms (A316)	
Clavatula lobatopsis	n. sp.
Moniliopsis psilarosis	n. sp.; Types
Philbertia cala (Watson)	new to fauna-list
Guivillea alabastrina (Watson)	new to fauna-list
Trophon acceptans Brnrd. 1959	
Oöcorys watsoni Locard	
Lamellaria capensis Bergh	
Scala bonae-spei	n. sp.
Calliotropis pompe	n. sp.

Doridoxa benthalis	n. sp.; Type
Solenogastres	new to fauna-list
Brachiopod	
33° 50′ S., 16° 30′ E., 1,480–1,660 fathoms (A317)	
Clavatula lobatopsis	n. sp.
Typhlomangelia polythele	n. sp.; Types
Cythara(?) *dagama*	n. sp.
Typhlosyrinx pyrropelex	n. sp.
Mangilia sp.	new to fauna-list
Gymnobela sp.	new to fauna-list
Turritid. Gen. ?	new to fauna-list
Guivillea alabastrina (Watson)	
Prosipho torquatus	n. sp.
Trophon acceptans Brnrd. 1959	
Thalassocyon bonus Brnrd. 1960	n. sp.
Oöcorys watsoni Locard	
Polynices cleistopsila Brnrd. 1963	n. sp.
Calliotropis pompe	n. sp.; Types
Cavolinia tridentata (Forskal)	
Scaphander puncto-striatus Mighels	
Dentalium eualdes	n. sp.
Limopsis sp. cf. *straminea* Smith	new to fauna-list
Leda macella	n. sp.
Leda parsimonia	n. sp.; Type
Malletia estheriopsis	n. sp.; Types
[Fragment of *Janthina*]	
33° 52′ S., 16° 51′ E., 1,380–1,520 fathoms (A318)	
Clavatula lobatopsis	n. sp.
Cythara(?) *glaucocreas*	n. sp.; Type
Typhlosyrinx pyrropelex	n. sp.
Typhlosyrinx subrosea	n. sp.; Types
Charitodoron thalia Tomlin	
Nux alabaster Brnrd. 1960	n. sp.
Neptunea bonae-spei	n. sp.; Types
Columbarium angulare Brnrd. 1959	
Oöcorys watsoni Locard	
Calliostoma glaucophaos	n. sp.; Types
Cavolinia tridentata (Forskal)	
Scaphander puncto-striatus Mighels	
Gastropteron sp.	new to fauna-list
Dentalium eualdes	n. sp.
Dentalium lardum	n. sp.
Cephalopod eggs	
Octopus sp.	

34° 05′ S., 16° 58′ E., 1,470–1,490 fathoms (A319)
Clavatula lobatopsis .. .. n. sp.
Typhlosyrinx pyrropelex .. .. n. sp.
Turritid. Gen. ? .. .. new to fauna-list
Guivillea alabastrina (Watson)
Trophon acceptans Brnrd. 1959
Oöcorys watsoni Locard
Polynices cleistopsila Brnrd. 1963 .. .. .. n. sp.
Abyssochrysos melanioides Tomlin
Cavolinia tridentata (Forskal)
Scaphander puncto-striatus Mighels
Gastropteron sp. .. .. new to fauna-list
Dentalium eualdes
Octopus sp. (large)
Octopus sp. (small)
Limopsis sp. cf. *straminea* Smith .. .. .. new to fauna-list
Leda macella .. .. n. sp.; Types
Malletia estheriopsis .. .. n. sp.

34° 33′ S., 16° 42′ E., 1,770–1,880 fathoms (A321)
Malletia estheriopsis .. .. n. sp.

34° 36′ S., 17° 00′ E., 1,500–1,760 fathoms (A322)
Terebra sp. .. .. new to fauna-list
Clavatula lobatopsis .. .. n. sp.
Moniliopsis psilarosis .. .. n. sp.
Cythara(?) *dagama* .. .. n. sp.
Typhlosyrinx pyrropelex .. .. n. sp.
Typhlosyrinx chrysopelex .. .. n. sp.; Type
Cancellaria euthymei Brnrd. 1960 .. .. .. n. sp.; Type
Guivillea alabastrina (Watson) .. .. .. new to fauna-list
Charitodoron pasithea Tomlin
Charitodoron thalia Tomlin
Neptunea bonae-spei .. .. n. sp.
Prosipho torquatus .. .. n. sp.
Pyrene cf. *profundi* Dall .. .. new to fauna-list
Trophon acceptans Brnrd. 1959
Trophon cf. *droueti* Dautzenberg .. .. .. new to fauna-list
Oöcorys watsoni Locard
Calliotropis metallica (W.–M. & A.)
Cavolinia tridentata (Forskal)
Diacria trispinosa (Lesueur)
Herse (*Cuvieria*) *columnella* (Rang)
Scaphander puncto-striatus Mighels
Dentalium eualdes .. .. n. sp.
Dentalium lardum .. .. n. sp.

Dentalium sp. (9 ribs)	new to fauna-list
Abra longicallus (Scacchi)	new to fauna-list
Limopsis sp. cf. *straminea* Smith	new to fauna-list
Cuspidaria sp. cf. *maxima*	new to fauna-list
Nucula (*Pronucula*) *benguelana* Clarke	new to fauna-list
? *Sarepta* sp.	new to fauna-list
Malletia estheriopsis	n. sp.

Descriptions and Notes

GASTROPODA

Terebridae

Terebra sp.

(Fig. 1 *a*)

Protoconch 2 ($2\frac{1}{2}$) whorls, last whorl bulbous, smooth. Postnatal whorls 7. Axial plicae 14–15 on 2nd whorl, increasing to 18 on last whorl, straight, slightly protractive; intervening grooves shallow. Slight indication of a subsutural spiral groove, and 4–5 very faint spiral lirae in the axial grooves. Base with growthlines and very faint spiral striae. 6·5 × 2 mm. Very pale corneous, protoconch opaque white.

34° 36′ S., 17° 00′ E., 1,500–1,760 fathoms, 1 dead (S. Afr. Mus. A9854, F. H. Talbot coll.).

Remarks. As further and better specimens may be obtained later, no specific name is attached to this specimen.

Turritidae

Subfam. **Turrinae**

[Turris lobata]

In 1958 I united *Pieter Faure* specimens from Cape Point with specimens from Cape Natal (Durban)-East London under the specific name *lobata* Sow., and transferred it to the genus *Turris*. The new material raises doubts as to the conspecificity of the shells, and the generic position.

Comparison of the 7 additional specimens with the previous material shows that the Cape Point shells can be separated on conchological characters from those of the Cape Natal-East London area, though the differences are subtle (slightly exaggerated in the figures herewith).

From the *Pieter Faure* material two radulae were obtained, one from an East London shell and one from a Cape Point shell, both of them extracted from poorly preserved animals. They seemed to show a slight difference in the shape of the lateral plate. On re-examination, and comparison with 4 radulae from the new material, the difference appears to be due merely to the slightly different position in which the plates are lying in the mounted preparation.

A more important point, however, is that the 4 additional radulae show distinctly the presence of a central plate and of an accessory wing-like appendage, albeit both are very delicate.

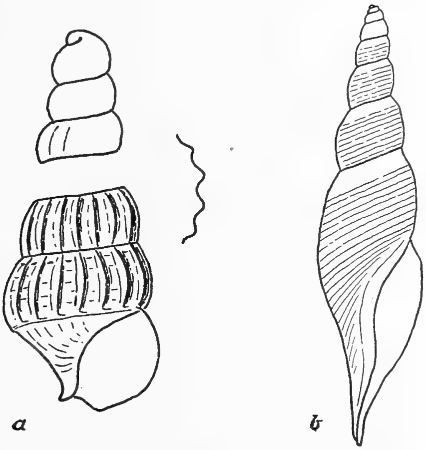

Fig. 1. *a*, *Terebra* sp. Apex and base, with cross-section of whorl. *b*, *Daphnella* (?) *bitrudis* n. sp.

These Cape Point shells must therefore be placed in *Clavatula*. Possibly when more material is obtained from the Natal-East London area, it will show that *lobata* has been incorrectly transferred to *Turris*; but for the present I retain it in *Turris*.

Turris lobata (Sow.)

(Fig. 2 *b*)

Turris lobata (Sow.), [*partim*] Barnard, 1958, p. 107, figs. 3 *i*, 6 profile.

To the description should be added: upper margin of whorl straight, suture visible; the sharp keel continuous, without any trace of nodules; the mid-whorl nodules always rounded, though they may be divided by a slight sulcus.

In my description the number of midwhorl tubercles was not given. Sowerby's original description gave 13 on the penultimate whorl, and his figure seems to confirm this. There is, however, a possibility that '13' was a misprint for 18, because a lobate specimen, labelled by Sowerby, has 13 on the 3rd whorl, 18 on the 9th and 22 on the 10th; other specimens agree, none having less than 16 tubercles on the 8th whorl.

Natal and East London area, 440 and 310 fathoms (S. Afr. Mus. A1673, A1674, P.F. coll.).

The remarks in the above reference on the formation of the lobe on the outer lip apply to *lobata* (Sow.).

There is one dead shell from the Cape Point area, 380–475 fathoms (S. Afr. Mus. A1675, P.F. coll.), however, which seems referable to *lobata*. Although damaged several times and repaired by the animal, and corroded, nevertheless it shows the diagnostic features of *lobata*, not those of the other Cape Point shells from much greater depths.

Clavatula lobatopsis n. sp.

(Fig. 2 *a*)

Turris lobata (Sow.), [*partim*] Barnard, 1958, p. 107, fig. 3 *j*.

Extremely like *Turris lobata* but upper margin of whorl undulate, and slightly raised so that the actual suture is scarcely or only partly visible in lateral view; instead of the sharp keel in *lobata* there is a blunt lira with small nodules, corresponding in number with those in the mid-whorl series, often divided by a slight sulcus; between this lira and the mid-whorl nodules there may be 2–3 feeble lirae, or none at all; the mid-whorl nodules are sharper than in *lobata*, more tubercular than nodular, and they may be divided by a faint sulcus; on the last whorl (or last half thereof) in the larger shells the tubercles

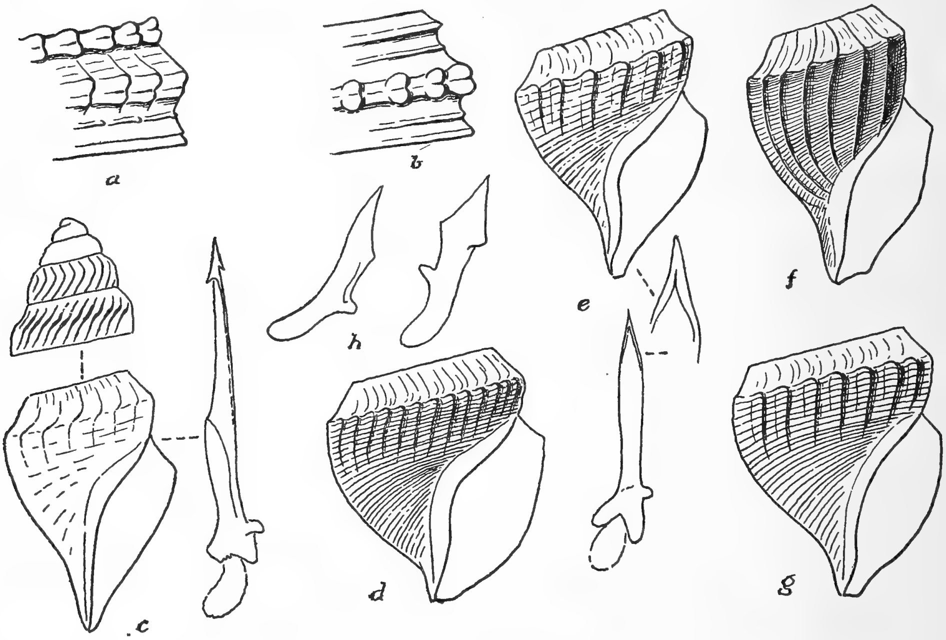

Fig. 2. *a*, *Clavatula lobatopsis* n. sp. Sculpture for comparison with *b*. *b*, *Turris lobata* (Sow.). Sculpture. *c*, *Typhlosyrinx pyrropelex* n. sp. Protoconch and base; radula tooth. *d*, *Cythara* (?) *glaucocreas* n. sp. *e*, *Daphnella* (?) *verecunda* n. sp. With radula tooth. Apex of latter further enlarged. *f*, *Mangilia* (?) sp. *g*, *Cythara* (?) *dagama* n. sp. *h*, two radula teeth.

tend to disappear, leaving only a continuous well-marked lira (or costa) at the lip sinus.

Lirae below the mid-whorl girdle as in *lobata*, but with no tendency to become costate and form a lobe on the outer lip; the lira next below the mid-whorl girdle may have small nodules.

Number of midwhorl tubercles 13–14 on 3rd whorl, increasing to 21–24 on 9th whorl. Towards the end of the last whorl the tubercles often tend to be feeble and irregular.

Among the specimens from Station A317 (S. Afr. Mus. A9800) was one with 12 midwhorl tubercles on the 3rd whorl, increasing to 14 on the last (8th) whorl. This can be regarded only as a casual variation.

Up to 40 × 14 mm. and 39 × 16 mm. (apices corroded).

Operculum oval, nucleus apical.

Animal pale. Eyes absent, or sometimes indicated by a minute brown or black speck. Radula with *c.* 70 rows, central plate narrow, acicular, extremely delicate, lateral plate with accessory appendage.

Cape Point NE. × E.$\frac{1}{4}$E. 46 miles, 900 fathoms, 1 living; N. 70° E. 40 miles, 800 fathoms, 2 dead; NE. × E.$\frac{1}{4}$E. 40 miles, 800–900 fathoms, 1 living, 3 dead (S. Afr. Mus. A1676–A1681, P.F. coll.).

33° 26′ S., 16° 33′ E., 1,300 fathoms, 2 dead; 33° 36′ S., 16° 15′ E., 1,520–1,570 fathoms, 3 living (Types; 33° 45$\frac{1}{2}$′ S., 16° 23$\frac{1}{2}$′ E., 1,480 fathoms, 1 dead; 33° 49′ S., 16° 30′ E., 1,500 fathoms, 1 living, 1 dead (fresh); 34° 37′ S., 17° 03′ E., 1,580–1,620 fathoms, 2 living; 33° 50′ S., 16° 30′ E., 1,480–1,660 fathoms, 11 living; 33° 52′ S., 16° 51′ E., 1,380–1,520 fathoms; 2 living; 34° 05′ S., 16° 58′ E., 1,470–1,490 fathoms, 1 dead; 34° 26′ S., 17° 00′ E., 1,500 fathoms, 6 living, 3 dead (S. Afr. Mus. A9712, A9730 (Types), A9740, A9752, A9771, A9800, A9820, A9838, A9855; F. H. Talbot coll.).

Surcula scalaria Brnrd.

Surcula scalaria, Barnard, 1958, p. 146, fig. 22 *d*.

Like the *Pieter Faure* specimens, the present shells are dead; the generic position therefore remains uncertain.

33° 50′ S., 17° 21′ E., 600 fathoms, 3 dead (S. Afr. Mus. A9695, F. H. Talbot coll.).

Subfam. **Brachytominae**

Moniliopsis psilarosis n. sp.

(Fig. 4 *a*)

Protoconch and ? 2 whorls missing. Remaining postnatal whorls 6. First 3 whorls (probably the 3rd–5th) distinctly but not strongly shouldered, profile of following whorls evenly convex. Oblique, protractive axial riblets 17–18 on first 2 whorls, 18–19 on 3rd whorl, forming small knobs at the shoulder, petering out below and scarcely reaching suture; becoming evanescent and obsolete on following whorls; crossed by impressed spiral striae 4 on first 2 whorls, 4–5 on 3rd, increasing to 8–9 on 4th, and *c.* 13 on last 2 whorls; sometimes 2–3 fine striae above the shoulder on the sulcus. Base with *c.* 24 (main and interpolated) spiral striae. Sulcus feebly concave, lip sinus moderately deep. Canal rather short and narrow. 47 × 16 mm. Operculum narrow oval, 13 × 5 mm. Drab or brownish, columella and interior of aperture dull pinkish; operculum amber.

Animal pale; eyes at base of short tentacles. Radula with 15 pairs of rather elongate, unbarbed teeth.

34° 42′ S., 16° 54′ E., 1,725–1,780 fathoms, 1 living, 1 dead (fresh); 34° 36′ S., 17° 00′ E., 1,500–1,760 fathoms, 3 dead (worn and corroded) (S. Afr. Mus. A9789 (Types) and A9856; F. H. Talbot coll.).

Remarks. Seems to fit best into the genus *Moniliopsis.* The sculpture on the later whorls resembles a bare ploughed field.

The smallest worn specimen has lost the protoconch, but retains the first 2 postnatal whorls (corroded); the full complement of postnatal whorls would appear to be 8. The two largest specimens, corroded and comprising 4th–8th whorls, measure 51·5 × 19 mm. I have seen a larger one, comprising 3th–8th whorls, measuring 56 × 20 mm. (in coll. Fisheries Survey).

Typhlomangelia (?) *polythele* n. sp.

(Fig. 3 *e*, *f*)

Protoconch and ? 2 whorls corroded. Postnatal whorls 4½; profile angularly shouldered a little above middle of whorl. Small peripheral knobs on the shoulder, *c.* 20 on 2nd whorl, *c.* 23 on 3rd, *c.* 26 on last whorl, evanescent towards outer lip, not continued below shoulder (or only very slightly); low flat spiral lirae 3–4 on 1st whorl, 4–5 on 2nd, 5–6 on 3rd, 7–8 on last whorl; 8–9 additional lirae on base, plus about the same number of finer lirae on rostrum. Sulcus scarcely concave, with a keel forming a distinct cingulum below the suture. Growth-lines distinct, especially on sulcus where they are subpliculose. Lip sinus deep, semicircular. 13 × 5·5 mm. Operculum oval, nucleus apical. White, operculum amber.

Animal pale. No eyes. Radula with 22 pairs of dagger-like, unbarbed teeth.

33° 50′ S., 16° 30′ E., 1,480–1,660 fathoms, 2 living (S. Afr. Mus. A9802, F. H. Talbot coll.).

Remarks. Placed provisionally in *Typhlomangelia* although the radula teeth are not elongate as in *nivalis* (see Sars, 1878, pl. ix, fig. 10).

Subfam. **Cytharinae**

Cythara (?) *glaucocreas* n. sp.

(Fig. 2 *d*)

Protoconch corroded. Postnatal whorls 6, apical whorls more or less corroded; profile of whorls moderately convex, shoulder distinct, base rather ventricose. Oblique axial ribs on penultimate and ultimate whorls 26–30, from shoulder to suture below, more or less traceable on base; spiral lirae 7–8 or 9 on sulcus; ribs crossed by 8–10 spiral lirae below shoulder, *c.* 20–24 on base (main and intermediaries). Growth-lines distinct across sulcus, often forming pliculae, nearly straight on upper half, curved when nearing the shoulder. Columella curved, canal wide, very short. 25·5 × 11·5 mm. and 21 × 11 mm. No operculum. White.

Animal greenish, no eyes, Radula with 21 pairs of short dagger-like, unbarbed teeth (similar to those of *D. verecunda*, see fig. 2*e*).

33° 49′ S., 16° 30′ E., 1,500 fathoms, 2 living; 34° 37′ S., 17° 03′ E., 1,580–1,620 fathoms, 1 dead (extracted from an anemone); 33° 52′ S., 16° 51′ E., 1,380–1,520 fathoms, 1 living (Type) and 2 dead (S. Afr. Mus. A9753, A9773, A9821 (Type), A9824; F. H. Talbot coll.).

Remarks. Belongs to one of the Cytharine genera and is provisionally placed in *Cythara.*

Cythara (?) *dagama* n. sp.

(Fig. 2 *g*, *h*)

Protoconch corroded. Profile of whorls convex, shoulder not prominent owing to corrosion, except in the smallest (6-whorled) shell. Postnatal whorls 8. Oblique axial ribs 14 on 3rd whorl, 16 on 4th, 16–17 on 5th, 19 on 6th, 20–22 on 7th, but becoming obscure towards end of whorl, ribs on 8th whorl (only one shell) uncountable owing to corrosion, from shoulder to suture below, evanescent on base; 5–7 spiral lirae on sulcus (chiefly on lower part), obscure on later whorls; ribs crossed by 6–7 lirae between shoulder and suture on 4th and 5th whorls, 7–8 on 6th, 8–9 (10) on 7th whorl (? 10–11 on 8th whorl, corroded), 12–15 on base, lirae regular, without intermediaries except one or two on base. Growth-lines forming a nearly even curve on the sulcus, slightly pliculose on earlier whorls. Columella curved, canal short, moderately wide. 38 × 16·5 mm.; 34 × 15 mm.; 30 × 13 mm.; 23 × 11 mm. White. No operculum.

Animal pale. Tentacles short, no eyes. Radula with 20 pairs of dagger-like teeth, proximally not divided, a short process on inner margin slightly nearer to base than to apex, distally expanded with short lateral tangs, but not barbed.

33° 36′ S., 16° 15′ E., 1,520–1,570 fathoms, 5 living (Types); 33° 45½′ S., 16° 23½′ E., 1,480 fathoms, 3 dead; 34° 37′ S., 17° 03′ E., 1,580–1,620 fathoms, 1 dead; 33° 50′ S., 16° 30′ E., 1,480–1,660 fathoms, 5 dead, corroded; 34° 36′ S., 17° 00′ E., 1,500–1,760 fathoms, 1 living, 1 juv. dead (S. Afr. Mus. A9731 (Types), A9741, A9772, A9806, A9860; F. H. Talbot coll.).

Typhlosyrinx pyrropelex n. sp.

(Fig. 2 *c*)

Pleurotoma (*Surcula*) *dissimilis* (*non* Watson). Barnard, 1958, p. 147, fig. 23 *a* (protoconch).

Shell smooth, polished. Protoconch 3½–4 whorls, last 2 or 3 whorls with regular oblique (protractive) pliculae, becoming slightly sigmoid near junction with 1st postnatal whorl. Postnatal whorls 6½ (7); profile convex, with slight shoulder. Growth-lines strongly sigmoid, irregularly pliculose near the suture, becoming strongly protractive (nearly horizontal) on the shoulder, and forming in some specimens obscure rounded axial ribs below shoulder on 3rd and 4th whorls, *c.* 14 on 4th whorl, best seen as marginal undulations in apical view. Fine indistinct spiral striae below shoulder, *c.* 5–6 on 2nd whorl, 7–8 on 3rd, 8–9 on 4th, increasing to *c.* 25 on 7th whorl, on base 25–30 on 4th whorl, 50–66 on 7th. Juveniles: up to 22·5 × 9 mm. (4 whorls). Creamy-white, glossy, protoconch fulvous brown. No operculum.

Animal pale; eyes represented by a minute pigment speck or absent. Radula (juveniles) with 25–30 pairs of slender doubly-barbed teeth, with a projecting knob proximally.

Cape Point N. 77° E. 650–700 fathoms, 2 dead; NE. × E.½E. 43 miles, 900 fathoms, 2 dead; NE. × E.¾E. 38 miles, 750–800 fathoms, 1 dead (S. Afr. Mus. (Types) A1643, A1644, A1645; P.F. coll.).

33° 36′ S., 16° 15′ E., 1,520–1,570 fathoms, 1 living, 1 dead; 33° 50′ S., 16° 30′ E., 1,480–1,660 fathoms, 6 dead; 33° 52′ S., 16° 51′ E., 1,380–1,520 fathoms, 2 dead; 34° 05′ S., 16° 58′ E., 1,470–1,490 fathoms, 1 dead; 34° 36′ S., 17° 00′ E., 1,500–1,760 fathoms, 3 living (S. Afr. Mus. A9732, A9805, A9823, A9839, A9858; F. H. Talbot coll.).

Remarks. The radula corresponds with that of *T. vepallida* von Martens (see: Thiele, 1903, pl. 9, fig. 74; and 1929, fig. 450) and the species may be provisionally included in *Typhlosyrinx.*

The shells obtained by Dr. Talbot are evidently juveniles of the same species as was obtained farther to the south-east by the *Pieter Faure.* In 1958 I was in two minds whether to refer the Cape shells to the Philippine *dissimilis* or the Cape Verde *alberti.* I now consider that slight differences in shape are unimportant, but that, on the other hand, the strong protractive bend in the growth-lines is sufficient to distinguish the Cape shells from both the other

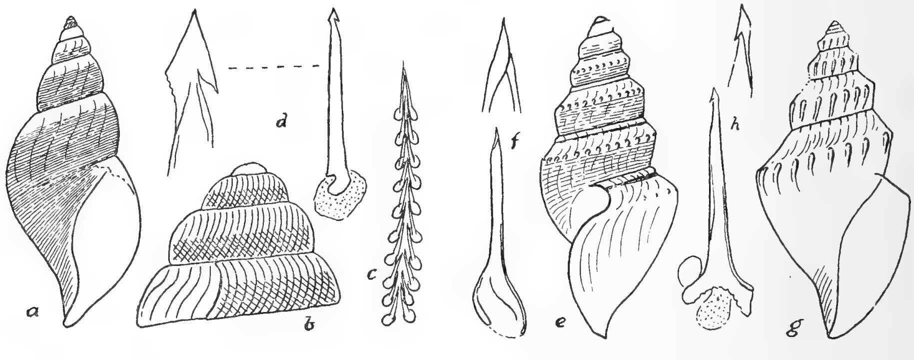

Fig. 3. *a*, *Typhlosyrinx subrosea* n. sp. *b*, protoconch. *c*, radula as arranged in radula sac. *d*, radula tooth, with apex further enlarged. *e*, *Typhlomangelia polythele* n. sp. *f*, radula tooth, with apex further enlarged. *g*, *Typhlosyrinx chrysopelex* n. sp. *h*, radula tooth, with apex further enlarged.

species. The protoconch was missing in *dissimilis*, and though present in the living example of *alberti*, was not stated to be coloured.

Several species with coloured (brown or yellow) protoconchs on a white shell have been described (see: Dautzenberg, 1927), mostly assigned to 'Pleurotoma'.

The *Pieter Faure* shells are regarded as Types of the adult. One of the shells of S. Afr. Mus. A1643 was sent to Tomlin, and presumably remains in his collection. The specimens S. Afr. Mus. A9858, from the largest of which the radula was extracted, may be regarded as Types of the juvenile and radula.

In the 1958 description (p. 147), for protoconch 'lip', read 'tip'.

Typhlosyrinx chrysopelex n. sp.

(Fig. 3 *g*)

Protoconch 3 whorls, somewhat worn, whorls pliculose, cancellate on lower half. Postnatal whorls 4½, profile shouldered slightly above middle of whorl. Slightly oblique axial ribs from shoulder to suture, petering out on base, 13 on 1st whorl, 15 on 2nd, 16 on 3rd, and 19 on last whorl. No spiral sculpturing, except 12–15 feeble lirae on rostrum. Sulcus slightly concave, lip sinus shallow. Growth-lines distinct on sulcus, some of them pliculose below the suture. 19 × 9 mm. No operculum. White, glossy, protoconch yellowish-brown (faded).

Animal pale, eyes present. Radula with 25 pairs of dagger-like, barbed and flanged teeth, base broad and concave.

34° 36′ S., 17° 00′ E., 1,500–1,760 fathoms, 1 living (S. Afr. Mus. A9857, F. H. Talbot coll.).

Remarks. Also placed provisionally in *Typhlosyrinx.*

Typhlosyrinx subrosea n. sp.

(Fig. 3 *a–d*)

Thin-shelled. Protoconch 3½–4 whorls, with (except 1st) oblique (protractive) pliculae, crossed below the periphery by retractive pliculae, producing a micro-clathrate sculpture. Postnatal whorls 4½, profile evenly convex, the sulcus not concave, scarcely distinguishable from rest of profile. No axial sculpture except the growth-lines, which are sigmoid but not very concave across the sulcus. Impressed spiral striae scarcely indicated on 1st and 2nd whorls, but becoming distinct near end of 2nd whorl, *c.* 16 on 2nd–3rd, *c.* 20 on 3rd–4th, *c.* 24 on 4th whorl, with 2–4 additional finer ones on the sulcus above the 'shoulder'. On base at least 36 striae, extending to end of rostrum. Columella curved, canal rather short and narrow. In the larger living shell no columellar callus concealing the spiral striae; in the smaller dead shell a weak callus partly concealing the striae, especially on the rostrum. 36 × 16 mm. No operculum. Very pale translucent pink, protoconch golden-brown.

Animal pale, no eyes. Radula with 10 pairs of rather short, dagger-like teeth, apically barbed and flanged.

33° 52′ S., 16° 51′ E., 1,380–1,520 fathoms, 1 living, 1 dead (S. Afr. Mus. A9822, F. H. Talbot coll.).

Remarks. Somewhat similar to the shells described as *pyrropelex*, but the sulcus not so distinct and the columella more curved.

Philbertia cala (Watson)

(Fig. 4 *b–e*)

Clathurella cala Watson, 1886, p. 361, pl. 26, fig. 11.

Protoconch 3½ whorls, last 2½ with fine oblique protractive pliculae, and on the lower half of the whorl oblique retractive pliculae between the protractive ones, giving a faint cancellate or granulate sculpture. Postnatal whorls 5½, profile strongly convex, shoulder well marked but rounded (Watson: 'hunchy'). Oblique protractive axial riblets 12 on 1st whorl, increasing to 18 on last, on the early whorls traceable across the sulcus, but not on the last 2 (or 3) whorls, continued across base; crossed by fine spiral lirae 4 on 1st whorl, 5 on 2nd, 5–6 on 3rd, 8 on 4th and 10 on last whorl (6–7 main lirae plus intermediaries). On base 6–7 main lirae plus intermediaries, but on rostrum lirae subequal. Sulcus concave, lip sinus rather deep. 19 × 10 mm. No operculum. White, protoconch chestnut-brown.

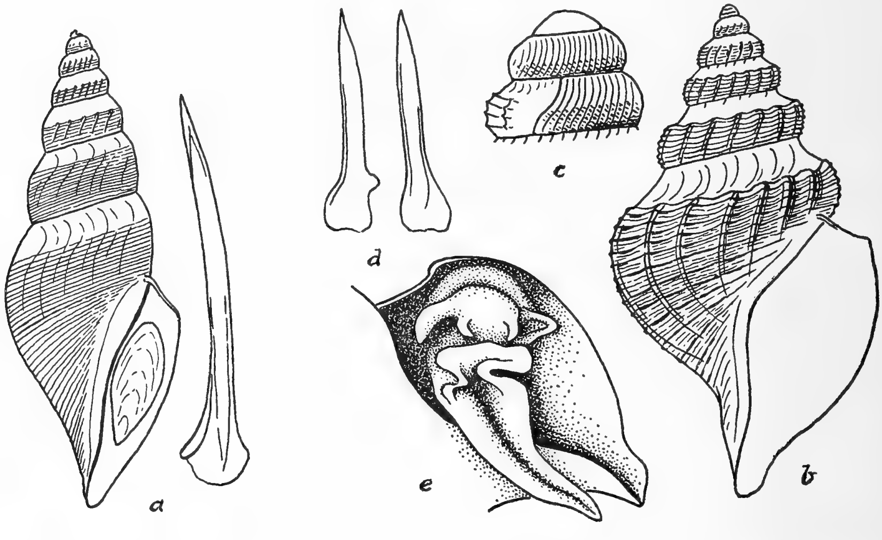

Fig. 4. *a*, *Moniliopsis psilaropsis* n. sp. with radula tooth. *b*, *Philbertia cala* (Watson). *c*, protoconch. *d*, two views of radula tooth. *e*, aperture with animal, as preserved, showing grooved foot.

Animal pale, no eyes. Radula with 20–25 pairs of short, dagger-like, unbarbed teeth.

34° 42′ S., 16° 54′ E., 1,725–1,780 fathoms, 3 living (S. Afr. Mus. A9790, F. H. Talbot coll.).

Distribution. South Atlantic: 32° 24′ S., 13° 5′ W., 1,425 fathoms (Watson).

Remarks. These specimens agree so well with Watson's description that the identification seems certain. There are only two points to note: the largest of the present specimens is 19 mm. long with 5½ whorls, the *Challenger* shell only 0·55 inches with the same number of whorls; and the Cape shells have 2–3 ribs more than the *Challenger* shell. These differences seem insignificant as against the essential similarities.

One of the present specimens with 4 postnatal whorls has all the lirae on the 3rd and 4th whorls subequal, not divided into main and intermediaries.

In all three specimens the elongate grooved tongue-like foot has not been withdrawn within the aperture. This reaction to the preservative seems to be peculiar to this species, because it has not occurred in any of the other Turritid specimens in the present collection, all of which were preserved in the same manner. In the latter the foot is contracted into a compact mass and withdrawn within the aperture.

Comparable (conchologically) species in deep water off the New England coast seem to be *Pleurotomella saffordi* V. & S. and *benedicti* V. & S., 1884.

Mangilia (?) sp.

(Fig. 2 *f*)

Protoconch corroded. Profile of whorls convex, with a slight shoulder. Postnatal whorls 5. Oblique axial ribs 14 on 3rd whorl, increasing to 16 on 5th whorl, crossing the sulcus, and also base; *c.* 15 spiral lirae between shoulder and suture on 3rd whorl, crossing the ribs, increasing to at least 20 on 5th whorl; on base at least 30 lirae. Growth-lines forming an even curve on sulcus, those which are continued as axial ribs stronger than the others. Lip sinus moderately deep. Columella slightly curved, canal short, rather wide. 15 × 6·5 mm. White.

33° 50′ S., 17° 21′ E., 600 fathoms, 1 dead (S. Afr. Mus. A9696, F. H. Talbot coll.).

Three specimens resemble the above described shell, but have 20 axial ribs on the last whorl.

34° 37′ S., 17° 03′ E., 1,580–1,620 fathoms, 1 dead; 33° 50′ S., 16° 30′ E., 1,480–1,660 fathoms, 2 dead (S. Afr. Mus. A9775, A9803; F. H. Talbot coll.).

Daphnella (?) *verecunda* n. sp.

(Fig. 2 *e*)

Protoconch corroded. Profile of whorls angular. Postnatal whorls 7. Oblique axial ribs 12–13 on 4th and 5th whorls, 14–15 on 6th and 7th, from shoulder to suture, evanescent on base; crossed by 6–7 spiral lirae on 4th and 5th whorls, 7–8 on 6th and 7th, *c.* 15 on base, including on the latter some intermediaries; no spiral lirae on sulcus, or only extremely faint ones visible in places. Growth-lines forming a nearly even curve on sulcus, without pliculae. Columella curved, canal short, moderately wide. 22 × 10·5 mm. White, middle portion of columella with faint salmon flush. No operculum.

Animal pale. Tentacles short, no eyes. Radula with *c.* 25 pairs of dagger-like teeth, proximally bifid, enclosing the poison gland, a short process on inner side proximally, apex sharply pointed, not barbed.

33° 50′ S., 17° 21′ E., 600 fathoms, 2 living, 1 dead (S. Afr. Mus. A9697, F. H. Talbot coll.).

Remarks. Differs from *Surcula sulcicancellata* Brnrd. 1958 in having fewer ribs and no sculpturing on the sulcus.

The radula teeth have some similarity with those figured by Thiele (1929, fig. 456) for a species of *Daphnella.*

Daphnella (?) *bitrudis* n. sp.

(Fig. 1 *b*)

Very narrow fusiform. Point of protoconch broken, and apical whorls corroded; 7 postnatal whorls remaining. Profile of whorls evenly convex, no shoulder. Growth-lines for the most part distinct, somewhat variable but not forming axial ribs, strongly protractive on sulcus before passing over on to whorl. Fine spiral lirae 4 on 4th whorl, 6 on 5th, 8–9 on 6th and 10 on 7th, on base *c.* 15 additional lirae but not well defined on rostrum. Columella sinuous, canal long, narrow. 15 × 3·5 mm. White, glossy except where corroded.

33° 49′ S., 16° 30′ E., 1,500 fathoms, 2 dead, but fresh (S. Afr. Mus. A9754, F. H. Talbot coll.).

Remarks. May be compared with *Mangilia scipio* Dall (1889, p. 117, pl. 10, fig. 12) from the West Indies, 124 and 982 fathoms; and *Clathurella* (*Daphnella*) *monoceros* Watson (1886, p. 365, pl. 20, fig. 1) from off Sierra Leone, 2,500 fathoms.

The genus is quite provisional; perhaps the species might fit into *Spergo*, but the suggestion is made without much confidence.

One of the most slender of the Turritids, being slightly more slender than *Pleurotoma torta* Dautzenberg (1912, p. 11, pl. 1. figs. 3, 4).

Gymnobela sp.

Two dead specimens, 9·5 × 6·5 mm. and 13 × 8 mm., closely resemble the figures of *G. blakeana* Dall 1889 and *G. rhomboidea* Thiele 1925, but the axial ribs are obsolete while the growth-line pliculae across the sulcus are distinct.

Although in fair condition, it is preferable to wait for more material, with the animal, before describing these shells.

33° 50′ S., 17° 21′ E., 600 fathoms, 1 dead; 33° 50′ S., 16° 30′ E., 1,480–1,660 fathoms, 1 dead (S. Afr. Mus. A9698 and A9804, F. H. Talbot coll.).

Gen. ?

Somewhat resembling *Pleurotomella lottae* Verrill 1885, from the New England coast, 1,525 fathoms, but narrower and less ventricose. Five to six whorls, profile convex. Sulcus ?, not clearly marked. No axial sculpture. Spiral lirae over greater part of whorl, *c.* 10, finer above and encroaching on the 'sulcus'. Growth-lines sigmoid, more or less pliculose below suture, especially on early whorls. 11·5 × 7, 13 × 7·5 and 14 × 8 mm. White.

33° 50′ S., 16° 30′ E., 1,480–1,660 fathoms, 1 dead; 34° 05′ S., 16° 58′ E., 1,470–1,490 fathoms, 2 dead (S. Afr. Mus. A9807, A9840, F. H. Talbot coll.).

Cancellariidae

Cancellaria euthymei Brnrd.

Cancellaria euthymei Barnard, 1960c, p. 438, fig. 1 *b.*

34° 36′ S., 17° 00′ E., 1,500–1,760 fathoms, 1 living (S. Afr. Mus. A9888, F. H. Talbot coll.).

Admete decapensis Brnrd.

Admete decapensis Barnard, 1960c, p. 439, fig. 1 *a.*

34° 37′ S., 17° 03′ E., 1,580–1,620 fathoms, 1 living (S. Afr. Mus. A9777, F. H. Talbot coll.).

Since the above description was published, a second specimen has been found among the Fisheries Survey collections. Presumably it is from the same locality as the Type. It is of the same size as the Type. The columellar pleats are slightly more prominent; and posterior to the upper one is a pair of small narrow pleats close together.

Type and second specimen in the South African Museum.

Volutidae

Guivillea alabastrina (Watson)

(Fig. 5)

Wyvillea alabastrina Watson, 1882, p. 332.

Guivillea alabastrina (Watson), Watson, 1886, p. 262, pl. 15, fig. 2. Pelseneer, 1888, p. 3, pl. 1, figs. 1, 2 (animal). Melvill & Standen, 1907, p. 140. Barnard, 1960a, p. 398. South African Museum Report, 1961, pl. 4, fig. C.

Four worn and broken specimens were obtained. An apex consisting of protoconch plus 2 whorls; a portion of a very worn columella, identifiable by comparison with the following specimen; a protoconch plus 2½ whorls, length 77 mm.; and a protoconch plus 2¾ whorls, length 90 mm., together with fragments.

The protoconch agrees with Watson's description. Its extent is uncertain owing to corrosion of the surface, but 1½ (possibly 2) whorls would seem a reasonable estimate.

The columella (pillar), however. has no kink as has the *Challenger* shell, and it has a very slight groove, visible on the 77 and 90 mm. apices, but disappearing on the basal part of the columella as seen in the fragments.

The canal is not so markedly truncate as the figure of the *Challenger* shell would seem to suggest, even when seen in approximately the same position. Perhaps the edge of the canal was broken, but drawn by the artist as if unbroken.

The fragments from the same haul as the 90 mm. apex include: a portion of the outer wall of the shell with sutural inflexion, which does not fit on to the apex as far as the latter is preserved; the canal with adjacent columella (pillar) to the upper end of which another fragment of columella appears to join (the opposed surfaces are not large enough to form an undeniable 'fit').

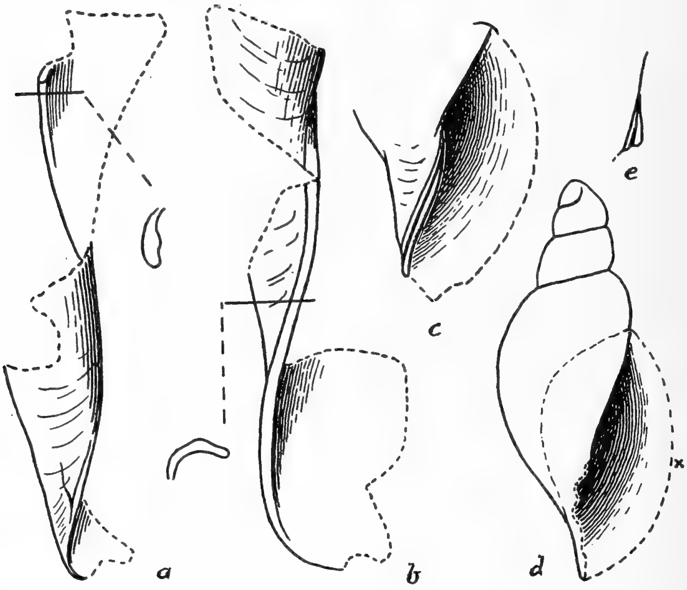

Fig. 5. *Guivillea alabastrina* (Watson). *a*, *b*, two views of columella, with (slightly enlarged) sections. *c*, aperture of last whorl of specimen (protoconch + 2¾ whorls), showing grooved columella. *d*, specimen A9841 with, *e*, view of broken end of columella at a point opposite x, at right angles to frontal view. (All figures about $\frac{6}{7}$ natural size.)

There is some doubt whether the 90 mm. apex and the columella fragments belong to one or two shells.

Dr. Talbot tells me that the contents of the dredge when it came aboard formed such a compact mass of globigerina ooze that the extraction of the animals was difficult. Nevertheless he thinks that if a second shell (apex) had been present it would not have been overlooked.

If the apex and the columella are placed end to end in their correct relative position, and without allowance for the probable loss of small intervening pieces, the shell would be at least 7½ inches long; the *Challenger* shell was 6½ inches long, and the species may well grow an inch larger.

34° 37′ S., 17° 03′ E., 1,580–1,620 fathoms, 1 protoconch plus 2 whorls; 33° 50′ S., 16° 30′ E., 1,480–1,660 fathoms, 1 columella (worn); 34° 05′ S., 16° 58′ E., 1,470–1,490 fathoms, 1 protoconch plus 2½ whorls; 34° 36′ S., 17° 00′ E., 1,500–1,760 fathoms, 1 protoconch plus 2¾ whorls, and fragments (S. Afr. Mus. A9776, A9809, A9841, and A9870; F. H. Talbot coll.).

Distribution. Between Marion Island and the Crozets, 46° 16′ S., 48° 27′ E., 1,600 fathoms (Watson: *Challenger*); South Orkneys (Melvill & Standen: *Scotia*).

Remarks. This is the most interesting of the results of Dr. Talbot's deep-sea dredging.

Watson gave only a general description of the external appearance of the *Challenger* animal. In 1882 he said that Prof. Huxley had undertaken the detailed description of the anatomy, and in 1886 he said the description would appear elsewhere (i.e. not in his *Challenger* Report). I have not been able to trace any description by Huxley.

The animal, however, was submitted to Pelseneer, and a brief account appeared in a later volume of the *Challenger* Reports (Pelseneer, 1888, p. 3, pl. 1, figs. 1, 2). Pelseneer figured the foot and cephalic region from the right side, but undertook no dissection or anatomical investigation except to remove and section one of the rudimentary unpigmented eyes (Thiele, 1929, repeated Watson's statement that eyes were absent).

Possibly, therefore, the radula is still within the remains of the animal. Mr. Dance (in litt. 2 Febr. 1960) told me that the animal was intact in the British Museum. Can no one be found to extract the radula and confirm, or otherwise, the animal's position in the *Volutidae*?

Fasciolariidae?

Gen. ?

Two broken and corroded shells, one 30 mm. long, the other 23 × 10 mm., extracted from anemones. Whorls preserved: 5 and 4 respectively. Aperture (incl. canal) about 1½ times the spire. Profile evenly convex, but possibly with a slight midwhorl shoulder. No sulcus. Columella slightly curved, no pleats; canal well marked. No axial sculpture; spiral lirae on last whorl (4th) of smaller shell 12–13, regular, subequal; on 5th whorl of larger shell 12 on upper half, 6 on lower half of whorl. Although the numbers of lirae on the two shells differ in number and strength, they cover the whorl completely between upper and lower sutures. On base (of smaller shell) 12 lirae plus *c.* 8 on rostrum.

34° 37′ S., 17° 03′ E., 1,580–1,620 fathoms, 2 dead (S. Afr. Mus. A9774, F. H. Talbot coll.).

Mitridae

Gen. Charitodoron Tomlin

Barnard, 1960b, p. 402.

Examination of the living material brought up by Dr. Talbot's dredging has resulted in transferring this genus from the *Buccinidae* to the *Mitridae.*

Fam. ?

Nux alabaster Brnrd.

Nux alabaster Barnard, 1960c, p. 440, fig. 2.

The radula of this curious species indicates one of the Rhachiglossate families, but its exact systematic position remains doubtful.

Mr. A. E. Salisbury (in litt. 20 June 1961) has drawn my attention to the previous use of the generic name *Nux*, viz.: Humphrey, *Mus. Callonianum,* 1797, p. 59. This work was arbitrarily rejected by the International Committee (Opinion 51). But a future International Committee may, also arbitrarily, reverse this opinion. The name is in Sherborn's *Index Animalium* 1758–1800, but not in Neave's *Nomenclator.* For the time being I maintain the name.

Buccinidae

Neptunea bonae-spei n. sp.

(Fig. 6 *a*, *b*)

Protoconch $2\frac{1}{2}$ whorls, smooth, but corroded and junction with 1st postnatal whorl indistinct. Postnatal whorls 6; profile of whorls evenly convex. Axial ribs *c.* 15 on 1st whorl (but slightly corroded), 16 on 2nd, 18 on 3rd, 20 on 4th, 22 on 5th, and 26 on 6th whorl, straight or slightly retractive, from suture to suture, obsolete on base; crossed by spiral lirae 5 or 6 on 1st, 7–8 on 2nd, 8 on 3rd and 4th, 10 plus intermediaries on last two whorls, *c.* 24 on base. Canal short, rather wide. 55 × 26 mm. and 51 × 27 mm. Operculum ovate, nucleus apical, 14 × 9 mm. Creamy-white with pale buff, thin, somewhat scabrous periostracum; operculum amber-brown.

Animal pale. Eyes well developed. Radula with 80–85 rows, central plate quadrangular, with median cusp, sometimes a minute denticle on one side or on both sides; lateral plate much stronger than central plate, unequally bicuspid, with 2–5 tiny denticles between the two cusps, the denticles not always symmetrical.

33° 49′ S., 16° 30′ E., 1,500 fathoms, 1 living; 33° 52′ S., 16° 51′ E., 1,380–1,520 fathoms, 2 living (Types), 2 dead; 34° 36′ S., 17° 00′ E., 1,500–1,760 fathoms, 1 living (S. Afr. Mus. A9757, A9826 (Types), and A9887, F. H. Talbot coll.).

Remarks. The assignation of this Cape species to the old boreal genus *Neptunea* may seem strange; it is admittedly somewhat unsatisfactory, but it is an alternative to instituting a new genus.

The shell is an ordinary-looking Buccinid, but the radula has unusual features.

The central plate resembles that of *Mohnia* (see Thiele, 1929, fig. 342), *Chauvetia* (*Lachesis*) (see Thiele, 1929, fig. 357), some species of *Sipho* (e.g. *islandicus, gracilis, glaber*) (see Sars, 1878, pl. x, figs. 19, 20, 21), and *Lachesis australis* von Martens (= *albozonata* Watson) (see Thiele, 1903, pl. 9, fig. 55; also Powell, 1951, fig. K 59).*

On the other hand the lateral plate agrees with that of none of these genera, but closely resembles that of *Chrysodomus turtoni* (see Sars, 1878, pl. x, fig. 16). Thiele (1929) puts *Chrysodomus* as a synonym of *Neptunea*, but does not mention a particular species as its representative. The length of the outer cusp and shortness of the inner cusp give the lateral plate of *C. turtoni* and *Neptunea bonae-spei* a distinctive shape. (The central plate of *C. turtoni* has no cusp.)

The specimen from 34° 36′ S., 17° E. (A9887), is more slender than the other specimens; the axial ribs are evanescent on the last whorl, and obsolete on the back of the outer lip.

I have been shown a 7-whorled specimen (in coll. Fisheries Survey) 62 × 30 mm. On the 7th whorl the axial ribs are obsolete.

Prosipho torquatus n. sp.

(Fig. 6 *c*, *d*, *e*)

Protoconch $1\frac{1}{2}$ whorls, alt. and diam. 1 mm. Postnatal whorls 4; profile of whorls angularly shouldered, but not sharply, a little above middle of whorl. Axial ribs on 1st whorl (partly corroded) 16, on each of the following whorls 17–18, from shoulder to suture, and extending across base; crossed by spiral lirae 3–4 on 2nd whorl, 5–7 on 3rd, 8–9 on 4th whorl; small granules on the intersections, those on the shoulder slightly larger than the others; 15 additional lirae on base. Below the suture a circlet of granules, about twice as many as the axial ribs. 15·5 × 7 mm. Operculum 4 × 2 mm., ovate, nucleus apical. Dirty white, operculum pale amber.

Radula with 75 rows, central plate excised in front, with 3 cusps, lateral plate strong, twice as long as the central plate, with 2 apical cusps.

34° 37′ S., 17° 03′ E., 1,580–1,620 fathoms, 1 living (Type); 33° 50′ S., 16° 30′ E., 1,480–1,660 fathoms, 1 dead; 34° 36′ S., 17° 00′ E., 1,500–1,760 fathoms, 1 dead (S. Afr. Mus. A9884, A9801 and A9886 respectively; F. H. Talbot coll.).

Remarks. *P. astrolabiensis* (Strebel) seems to be the only other species with a bicuspid lateral radula plate, the others having more than two (3–6). The shape

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*For the last-mentioned species, from Kerguelen, Powell (1951) proposed the generic name *Falsimohnia*.

of the lateral plate, however, in the present species is different from that of *astrolabiensis* as figured by Powell (1951, fig. K 56). When mounting the radula some of the lateral plates were purposely displaced into various positions, but none of them assumed the shape shown in Powell's figure.

The shell of *astrolabiensis* is quite different from the present shell.

This record forms a noteworthy extension of the known distribution of this Antarctic and sub-Antarctic genus.

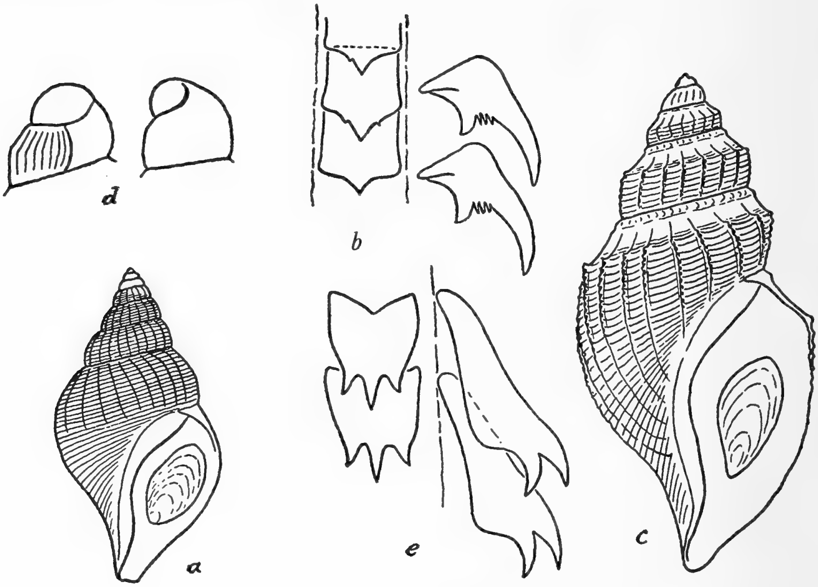

FIG. 6. *a*, *Neptunea bonae-spei* n. sp. *b*, central and lateral plates of radula. *c*, *Prosipho torquatus* n. sp. *d*, two views of protoconch. *e*, central and lateral plates of radula.

Pyrenidae

Pyrene cf. *profundi* (Dall)

Astyris profundi Dall, 1889, p. 192, pl. 35, fig. 3.
Columella (*Astyris*) *profundi* Dautzenberg, 1927, p. 89.

Protoconch nucleus diam. 0·25 mm., plus 7 whorls. Profile of whorls slightly convex. Spire longer than aperture. Surface smooth, without any sculpture, the growth-lines for the most part very indistinct; but a few spiral lirae on rostrum. Outer lip sometimes with feeble varicoid thickening; no plicae on inner surface. No periostracum. 11 × 5 mm. Operculum subtriangularly ovoid, thickened on inner surface in basal half (i.e. from nucleus onwards), the thickening extending along both lateral margins and also forming a midrib, leaving a semi-oval thinner area between the latter and the margins; midrib not (or scarcely) visible on external surface. White, operculum amber.

Radula normal, proximal cusp on lateral plate well separated from the bifalcate apex.

34° 36′ S., 17° 00′ E., 1,500–1,760 fathoms, 8 living, 9 dead; 33° 49′ S., 16° 30′ E., 1,500 fathoms, 1 dead (S. Afr. Mus. A9864 and A9758 respectively; F. H. Talbot coll.).

Remarks. A perfectly plain, smooth and slightly glossy species, comparable with both *Astyris diaphana* Verrill from off east coast of North America and with *A. profundi* Dall from the same region and also the Azores and Cape Verde; but intermediate between the two in proportions.

The appearance of a trident on the internal surface of the operculum is not distinctive, because it occurs in *P. filmerae* and in *Columbella fulgurans.*

Muricidae

Trophon acceptans Brnrd.

(Fig. 7 *a*)

Trophon acceptans [*partim*] Barnard, 1959, p. 202, figs. 40 *d* (radula), 43 *b* (only the fig. of adult) (only the adults A3449, A3473 and A3480).

33° 50′ S., 17° 21′ E., 600 fathoms, 4 living, 7 dead; 33° 36′ S., 16° 15′ E., 1,520–1,570 fathoms, 9 living, 2 dead; 33° 45½′ S., 16° 23½′ E., 1,480 fathoms, 2 living; 33° 49′ S., 16° 30′ E., 1,500 fathoms, 8 living, 1 dead; 34° 37′ S., 17° 03′ E., 1,580–1,620 fathoms, 4 living, 1 dead; 34° 42′ S., 16° 54′ E., 1,725–1,780 fathoms, 2 living, 2 dead; 33° 50′ S., 16° 30′ E., 1,480–1,660 fathoms, 10 living; 34° 05′ S., 16° 58′ E., 1,470–1,490 fathoms, 2 living; 34° 36′ S., 17° 00′ E., 1,500–1,760 fathoms, 3 dead (S. Afr. Mus. A9701, A9734, A9743, A9759, A9778, A9791, A9811, A9842, A9865; F. H. Talbot coll.).

The new material comprises 56 specimens ranging from 10 to 46 mm. in length, most of them living.

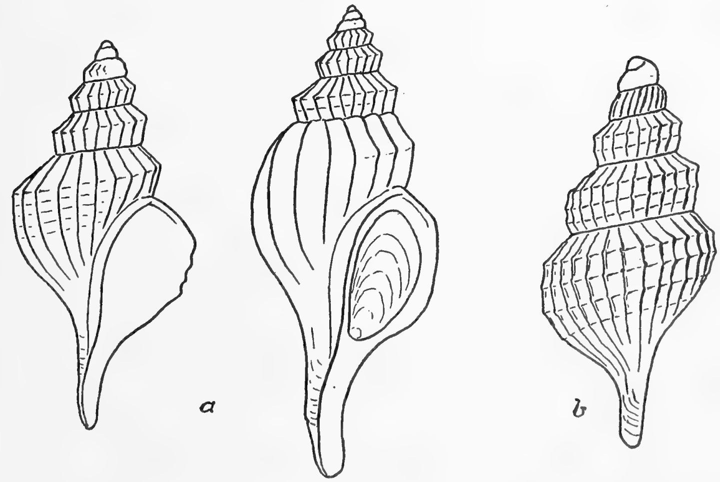

Fig. 7. *a*, *Trophon acceptans* Brnrd., multicostate variations. *b*, *Trophon* cf. *droueti* Dautzenberg.

In the original description were included some juveniles, 3·5 to 8 mm., which appeared to be conspecific with the adults, the smallest of the latter being 18 mm. in length. I am now inclined to think this was an error, and that not enough importance was attached to the position of the shoulder. There is, in fact, in these juveniles no *angular* shoulder, and the highest part of the profile of the ribs is at, or nearly at, a level with the suture (see figs. of juv.). The recently obtained 10 mm. specimen shows, although the apex is corroded, that there is a definite angular shoulder from at least the 2nd (postnatal) whorl onwards. Therefore the juveniles from the Agulhas Bank, Algoa Bay and East London are now excluded from *acceptans*, and considered as belonging to a separate species. This is best left without a name pending the discovery of further and better material.

The original description, omitting those characters which apply to the juveniles, may be emended and added to as follows: Postnatal whorls 7 (1st whorl corroded in all specimens); 2nd and following whorls angularly shouldered; axial ribs on 2nd and 3rd whorls 11–12, on 4th and 5th 12–13, on 6th and 7th 13–14, sharply keeled and slightly squamosely lamellate at the shoulder (when not worn or corroded); on the later whorls the intervals between the ribs become U-shaped, and when the ribs are far apart the intervals are very open and flat. The rostrum and canal may be slightly curved in the largest shells. A thin, pale brown periostracum, which usually comes away when the investing Epizoanthus is removed. Radula of large specimens with 125–135 rows.

Remarks. All the material collected by the *Pieter Faure* and Dr. Talbot came from the same area (see original description and the localities given above). The bathymetrical distribution is as follows:

At 630–800 fathoms 7 specimens 18–21 mm., somewhat corroded but clean, 1 of them living (*Pieter Faure*).

At 600 fathoms 11 specimens 10–22 mm., somewhat corroded but clean, 4 of them living.

At 1,480 fathoms 2 living specimens 31 and 35 mm., somewhat corroded, part of each shell covered with the beginning of a colony of purple *Epizoanthus* (Coelenterate), with one or two polyps.

At 1,470–1,490 fathoms 2 living, 22 and 25 mm., clean.

At 1,480–1,660 fathoms 10 living, with Epizoanthus colonies.

At 1,500 fathoms 9 specimens, 8 of them living, 21–45 mm., somewhat corroded, covered with Epizoanthus colonies, that on the largest shell with 7 polyps.

At 1,500–1,760 fathoms 2 dead.

At 1,520–1,570 fathoms 11 specimens, 9 of them living, 30–46 mm., somewhat corroded, covered with Epizoanthus colonies, with up to 10 polyps on a shell.

At 1,580–1,620 fathoms 5 specimens, 4 of them living, with Epizoanthus colonies, and 1 dead extracted from an anemone (Actinian).

At 1,725–1,780 fathoms 4 specimens, 2 of them living, 30 and 32 mm., clean.

No examples have been found in less than 600 fathoms, and all those obtained at this depth, and down to 800 fathoms, were not more than half-grown. The largest shells, and also half-grown (23 mm.) and three-quarter-grown shells were obtained at 1,480 fathoms and greater depths. The animals from lesser depths, though smaller, may nevertheless be sexually mature and represent a dwarf form. There is as yet no evidence on this point.

The purple Epizoanthus is found only at the greater depths, 1,480 fathoms onwards. It settles on half- or three-quarter-grown shells, and completely envelops the largest shells, including the whole ventral surface, though of course the polyps arise only dorsally and laterally. When the mollusc is withdrawn into its shell there is nothing to indicate that the object is other than a clump of polyps, distasteful to fishes (as many Coelenterates are known to be) and possibly also to predaceous molluscs or Echinoderms.

The original figure of the 'adult' will serve also for the larger shells, and represents the typical form; two figures are here given showing multicostate variations.

In the original description the one living specimen (S. Afr. Mus. A3473) was designated the Type. The new material contains specimens which, because they show the size to which it grows, are really *more typical* of the species (? hypertypes).

A resemblance to *tenuirostratus* Smith 1899 and 1901 was noted in the original description; but there is a considerably stronger resemblance to *obtuseliratus* Schepman 1911. These are resemblances between specimens from the Cape and from localities in the Indian Ocean and the East Indies.

A more serious question is the possible identity of the Cape shells with *guineensis* Thiele (1925, p. 169, pl. 30(18), fig. 11) from 2,278 metres in the Gulf of Guinea. Comparison of Thiele's figure and mine leaves little choice, and I fully expect that *acceptans* will *not* be accepted when further material is obtained from the Atlantic trough along the west coast of Africa. For the present the Cape shells are retained as a separate species.

Variation. The following examples I consider as no more than individual multicostate variations.

One (30 mm.) of the two examples from 1,480 fathoms has 16 ribs on the 5th, and 18 on the 6th whorl.

One (32 mm.) of the specimens from 1,500 fathoms has 15 ribs on the 3rd whorl, and 16 on the 4th, 5th and 6th whorls.

One (27 mm.) of the specimens from 1,500 fathoms has 16 ribs on the 3rd whorl, 18 on the 4th and 5th whorls, and 14 on the first three-quarters of the 6th whorl followed by 2 ribs widely separated.

One (46 mm.) of the specimens from 1,520–1,570 fathoms has 15 ribs on the 4th whorl, 17 on the 5th and 6th whorls, and 15 on the 7th whorl.

In the last-mentioned shell (46 mm.) the shoulder disappears on the last

(7th) whorl, and consequently the shell approximates in shape to the figure of *declinans* Watson, though the latter has no shoulder on any of the whorls.

Faint indications of 2 spiral lirae below the shoulder on the 6th whorl were noted in the original description. In these multicostate variations there are indications of 3 or even 4 such lirae.

Trophon cf. *droueti* Dautzbg.

(Fig. 7 *b*)

Trophon droueti Dautzenberg, 1889, p. 37, pl. 2, figs. 1 *a, b, c* (hand-drawn).

1927, p. 92, pl. 7, figs. 26–28 (photo).

Protoconch 1½ whorls, alt. and diam. *c.* 1 mm. (slightly corroded). Postnatal whorls 3½–4, profile angularly shouldered, but shoulder becoming rounded on last whorl. Axial ribs 16–17 on 1st whorl, increasing to 24 on last, retractive from suture to shoulder, straight below, sharp, becoming distinctly lamellate on back of outer lip. On 2nd and 3rd whorls a feeble lira at the shoulder and another below it produce small nodules on the ribs; on last whorl 2 more lirae below the subperipheral one. 10–11·5 × 5 mm. White.

34° 36′ S., 17° 00′ E., 1,500–1,760 fathoms, 3 dead (S. Afr. Mus. A9866, F. H. Talbot coll.).

Distribution. Azores, 1,287 metres.

Remarks. These shells are remarkably like *droueti*, and I deem it advisable not to institute a separate species for them, at least not until further material is available. They are slightly more slender (*droueti*: 8 × 4 mm.), thus possibly representing var. *elongata* Locard, 1897. The spiral lirae are very feeble, but sufficiently in relief to cast slight shadows, comparable with the grey bands in Dautzenberg's hand-drawn figures (1889).

Dautzenberg estimated from fragments that the species reached a size of 16 mm. The present specimens have a protoconch as large as that of *acceptans*, and the species may possibly reach a greater size than 16 mm. in the Cape area.

In Dautzenberg's fig. 1 *b* the number of riblets seems to be greater than would be expected.

Columbariidae

Columbarium rotundum Brnrd. and *angulare* Brnrd.

The localities from which specimens of these two species were obtained confirm the results obtained by the *Pieter Faure* (Barnard, 1959, pp. 235, 236). *C. rotundum* occurs in depths of 250–760 fathoms; but *angulare*, which the *Pieter Faure* obtained in depths of 720–900 fathoms, has now been shown to extend down to 1,520 fathoms.

Cymatiidae

Thalassocyon bonus Brnrd.

Thalassocyon bonus Barnard, 1960c, p. 440, fig. 3.

Excepting *Guivillea*, this is the most interesting Mollusc obtained by Dr. Talbot. The shell resembles in shape a *Semifusus*, but the animal was found to have a taenioglossate radula similar to that of *Cymatium*.

Oöcorythidae

Oöcorys watsoni Locard

Oöcorys sulcata (*non* Fischer) Watson, 1886, p. 412, pl. 17, fig. 11.
Oöcorys watsoni Locard, 1897, p. 288. Tomlin, 1927, p. 80. Barnard, 1963, p. 9.

Largest specimen 44 × 31 mm. Dead specimens were previously taken by the *Pieter Faure* off Cape Point in 720–1,000 fathoms.

Naticidae

Polynices cleistopsila Brnrd.

Polynices cleistopsila Barnard, 1963, p. 64.

Falsilunatia pseudopsila Brnrd.

Falsilunatia pseudopsila Barnard, 1963, p. 64.

Pyramidellidae

Turbonilla cf. *kraussi* Clessin

Turbonilla cf. *kraussi* Clessin, Barnard, 1963, p. 85.

Although closely similar to the littoral and shallow-water *kraussi*, the single dead specimen will probably prove to be a distinct species when more material is obtained.

Cerithiopsidae

Cerithiella taylori Brnrd.

Cerithiella taylori Barnard, 1963, p. 126.

Lamellariidae

Lamellaria capensis (Bergh)

Lamellaria capensis Bergh, Barnard, 1963, p. 58.

Scalidae

Scala bonae-spei Brnrd.

Scala bonae-spei Barnard, 1963, p. 104.

Abyssochrysidae

Abyssochrysos melanioides Tomlin

Abyssochrysos melanioides Tomlin, 1927, p. 78, figs. 1–3. Barnard, 1963, p. 141.

Previously taken by the *Pieter Faure* off Cape Point in 800–1,000 fathoms; now shown to occur down to 1,490 fathoms.

Trochidae

Calliotropis metallica (W.–M. & A.)

(Fig. 8 *a*)

Solariella metallica Wood–Mason & Alcock, 1891, p. 444, fig. 12 *a*, *b*.

Previously taken by the *Pieter Faure* off Cape Point. A notable extension of the hitherto known distribution: Gulf of Manaar, East Indies, East Africa. An account of the species will be given in Part IV of Barnard, Contributions . . . South African Marine Mollusca.

Calliotropis pompe n. sp.

(Fig. 8 *b*)

Shell thin-walled. Protoconch nucleus plus 7 whorls. First to 3rd whorls with *c*. 23–24 slightly retractive axial pliculae; on 3rd and following whorls crossed by a peripheral spiral lira at lower third of whorl, and at end of 3rd whorl and on 4th and following whorls by a second lira at upper third; the upper lira forms conical tubercles at the intersections with the pliculae, *c*. 18–20 increasing to *c*. 25 on 6th whorl, but becoming feeble and eventually evanescent on 7th whorl; on 5th-7th whorls the pliculae are distinct from suture to upper lira,

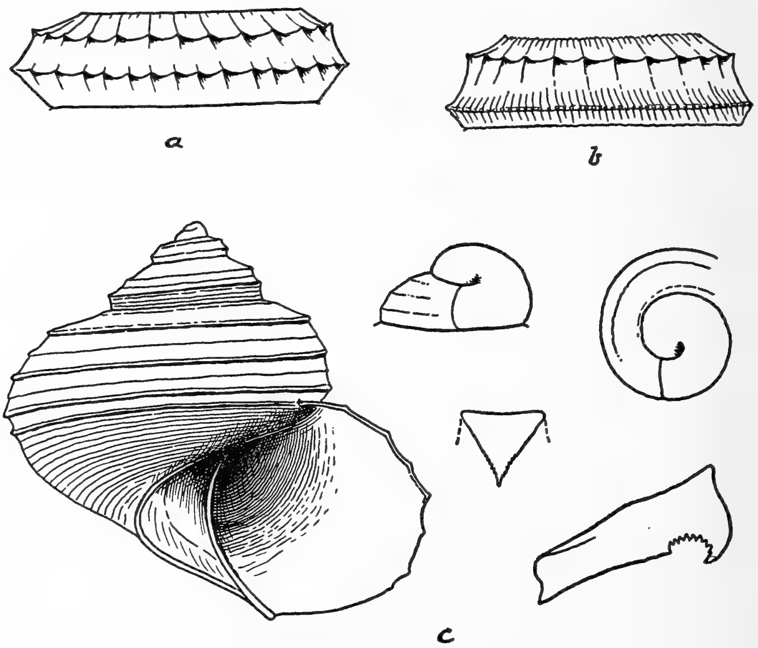

Fig. 8. *a*, *b*, sculpture of penultimate whorl of *Calliotropis metallica* (W.–M. & A.) and *C. pompe* n. sp. *c*, *Calliostoma glaucophaos* n. sp., with two views of protoconch, central and 1st marginal plates of radula.

extending less distinctly to the lower lira; from end of 5th whorl onwards accessory pliculae develop at the suture, 2–3 between each pair of main pliculae; similar accessory pliculae develop on the lower lira, so that the latter becomes finely granulate; on 7th whorl all the pliculae become less distinct and more or less indistinguishable from the growth-lines; the lower lira becomes almost smooth. On base growth-lines and pliculae continued, the latter becoming stronger towards the umbilicus; 5 spiral lirae, the outer 3 nearly smooth, the next one granulate, and the one bordering the umbilicus strongly granulate; umbilicus plicate within. 19 × 17 mm. (6 whorls); 22 × 20 mm. (7 whorls).

White, with a faint greenish tinge due to the nacreous interior. Operculum pale corneous.

Jaws and radula as in *granolirata*.

Off Cape Point: 34° 42′ S., 16° 54′ E., 1,725–1,780 fathoms, 1 dead; 33° 50′ S., 16° 30′ E., 1,480–1,660 fathoms, 1 living, 1 dead (Types) (S. Afr. Mus. A9795 and A9883 (Types); F. H. Talbot coll.).

Remarks. The procession (*pompe*) of close-set axial pliculae, and the granulate, instead of tuberculate (as in *metallica* and other species), lower spiral lira, seem distinctive.

Gen. BASILISSA Watson

Watson, 1879, p. 593; 1886, p. 96. Schepman, 1908, p. 61. Thiele, 1925, pp. 43, 44; 1929, p. 48.

Dall (1881) instituted the genus *Fluxina*, and considered that it should probably be placed in the *Solariidae*, occupying in this family an analogous position to that of *Basilissa* among the *Trochidae*.

Fluxina discula Dall (1889, p. 273, pl. 23, figs. 5, 6), *F. marginata* Schepm. 1908, *F. trochiformis* Schepm. 1908 and the present species are very much alike in shape, differing from *Basilissa* by being strongly depressed. Admittedly the difference is one of degree only, because *brunnea* Dall 1881 (genotype of *Fluxina*), *lampra* Watson 1879 (genotype of *Basilissa*) and *alta* Watson var. *delicatula* Dall (see 1889, pl. 22, fig. 2) form a series transitional to the higher species *simplex* Watson 1879 and *superba* Watson 1879.

The radulae of only a few species are known, e.g. *lampra* (see Schepman, 1908), *sibogae* Schepman 1908, and *trochiformis* (see Thiele, 1925). Thiele gave no figure of the latter. The present species has a radula somewhat resembling that of *sibogae*, but not at all like that of *lampra*.

Provisionally this n. sp. is included in *Basilissa*.

Basilissa gelida n. sp.

(Fig. 9)

Protoconch nucleus plus 5 whorls. Smooth, polished, periphery very sharply keeled. No spiral sculpture; fine close growth-lines, sigmoid both above the keel and on base. Umbilical wall smooth, vertical; umbilical margin rectangular, not keeled, no impressed line outside the margin. 8, alt. 3·5 mm.

White, transparent, slightly iridescent when wet.

Operculum not observed.

Jaws present, reticulate. Radula with *c.* 45 rows, central plate quadrangular, with slightly overturned cutting-edge, with feeble median cusp (? other serrations), lateral plate wide, with slightly overturned serrulate cutting-edge, 1st marginal plate, hastate, distally obscurely serrulate, and 3 slender hamate marginals.

33° 26′ S., 16° 33′ E., 1,240–1,300 fathoms 1 living (S. Afr. Mus. A9720, F. H. Talbot coll.).

Fig. 9. *Basilissa gelida* n. sp., with radula plates.

Remarks. Differs from *Fluxina discula* Dall 1889 from the West Indies, 982 fathoms, only in having a non-carinate umbilical margin, without impressed line; and in being slightly nacreous.

There are 3, possibly 4, slender outer marginal plates in the radula, in addition to the stouter 1st marginal plate.

Calliostoma glaucophaos n. sp.

(Fig. 8 *c*)

Shell like *Solariella* in shape, slightly wider than high. Protoconch nucleus plus 3½ whorls. Protoconch alt. 0·8, diam. 1 mm., smooth. Profile of whorls rounded, but with tabulate shoulder at upper third. One spiral lira forming the shoulder and one at middle of whorl, both beginning on 1st whorl; a third, peripheral lira concealed in the suture until the last half-whorl. On the tabulate shoulder 1 lira near the suture followed by 1 (2nd whorl), 3–4 (3rd whorl), 5 (last half-whorl) very fine lirae, also between inner lira and suture 2–3 very fine lirae visible on last half-whorl. Beginning on 2nd whorl 1 lira between the shoulder and mid-whorl lirae, and 1 between the latter and the peripheral lirae. Base with 1 lira almost as strong as the peripheral lira, starting at junction of outer lip and body-whorl, followed by *c.* 18 feeble lirae; umbilicus bordered by a strong lira; 1 feebler lira within the umbilicus, which is pervious but narrows rapidly. Growth-lines mostly faint, not pliculose. Aperture subcircular, slightly angular where outer lip meets the narrow lira-like columella. 11 (long) × 12·5 (diam.) mm.

White, iridescent, umbilical and columellar lirae opaque white. Operculum amber.

Jaws with intercalated platelets. Radula with *c.* 50 rows, resembling that of *perfragile*, but the central plate is broader, with a broadly triangular cusp, minutely serrulate distally; 5 lateral plates, 1st marginal plate strong, hooked and serrate distally. The lateral plates and especially the central plate are so very delicate that the shape of their bases could not be determined.

33° 52′ S., 16° 51′ E., 1,380–1,520 fathoms, 2 living (S. Afr. Mus. A9830, F. H. Talbot coll.).

Remarks. The specimen with the strong outer basal lira is figured. In the other shell this lira is much weaker, but both it and the next one are more distinct than the other basal lirae. The columella appears to have been injured and repaired, and consequently is broader and somewhat concavely angular.

Although clearly distinct, these shells are not unlike *Trochus* (*Margarita*) *charopus* Watson 1879 and 1886 from Kerguelen, 105 fathoms, and, though less so, *T*(*M*) *brychius* Watson 1879 and 1886, also from Kerguelen, 1,260 fathoms.

There is a general resemblance to a *Solariella*; and unless the animal had been present these shells might perhaps have been assigned to *Solariella*.

NUDIBRANCHIATA

Doridoxidae

Doridoxa benthalis n. sp.

(Fig. 10)

Length of animal as preserved *c.* 32 mm. Dull brown, the retracted rhinophores orange.

Frontal veil with lateral processes, on the underside of each process a wrinkled fold of skin connecting with the wrinkled margin of the mouth.

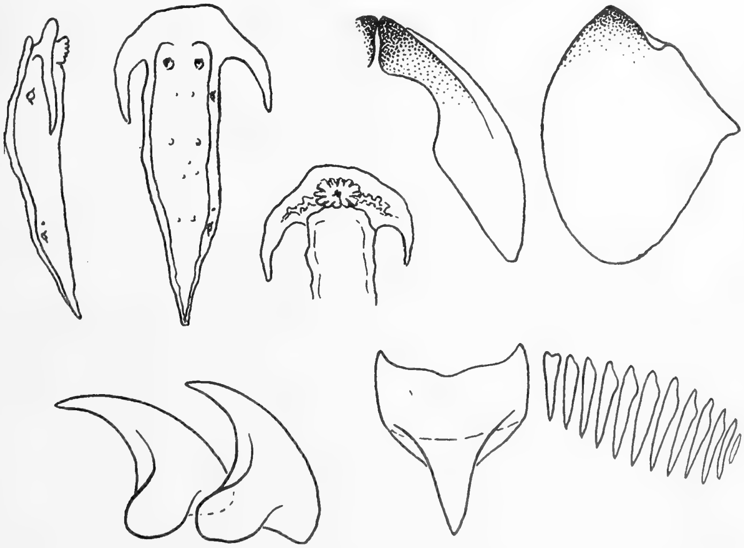

FIG. 10. *Doridoxa benthalis* n. sp. Lateral and dorsal views of animal; ventral view of anterior end; front and inner views of left mandible; two central plates of radula in side view; central and lateral plates of radula.

Foot tapering posteriorly. Dorsal surface smooth, but with faint indications of 4 pairs of small warts. No gills. Genital opening, nephroproct, and anus on right side, the nephroproct a short distance in front of anus.

Jaws large, 4·5 mm. long, cutting-edge entire. Radula with 30 rows, central plate very strong, lateral plates 11–12, dagger-like, graduated, the middle ones slightly larger than the others.

Internal organs not well enough preserved to determine the presence of a blood-gland, or whether there were 2 sphermathecae. There were, however, no liver diverticula.

34° 42′ S., 16° 54′ E., 1,725–1,780 fathoms, 1 (S. Afr. Mus. A9796, F. H. Talbot coll.).

Remarks. In spite of uncertainty about the internal anatomy, this specimen seems certainly to be a species of *Doridoxa* Bergh 1900, which was instituted for *ingolfiana* Bergh taken in the North Atlantic. There seem to be no later records.

I have not seen the original description, but Bergh (1906, pl. 31, figs. 7–12) gave 6 figures (presumably reproduced from his Ingolf Report, 1900), and Thiele (1929, fig. 521, after Bergh) figured the radula. The resemblance is close, but the present specimen appears to have no tentacles, larger lateral processes, and small differences in the radula plates. A n. sp. seems warranted and desirable.

SCAPHOPODA

Dentaliidae

Dentalium eualdes n. sp.

Thick-walled, moderately curved, ribs very numerous. Ribs 16–18 on the smallest shells (30 mm), increasing to 65–85 in the largest shells; ribs subequal to the grooves in larger specimens, but in juveniles usually narrower; the interpolation of intermediaries tends to narrow the grooves, and in large shells the ribs may be at least as wide as the grooves.

Ribs extending to aperture, but in the two largest shells there is an unribbed (or with only faint traces of ribs) 'collar' 3–4 mm. long around the aperture.

Apical slit usually present, may be 5–7 mm. long; juveniles may show 2–4 elongate perforations.

86, diam. aperture 13, apex 3 mm.; 90 × 12·5 × 2·75; 98 × 14·5 × 2·3; 99 × 13 × 1·75 mm.

Dull grey, the unribbed collar, when present, white.

Radula as in *salpinx*.

33° 36′ S., 16° 15′ E., 1,520–1,570 fathoms, 8 living (Types); 33° 45½′ S., 16° 23½′ E., 1,480 fathoms, 1 living and 1 juv.; 33° 49′ S., 16° 30′ E., 1,500 fathoms, 11 living and 3 juv.; 33° 26′ S., 16° 33′ E., 1,300 fathoms, 1 living; 34° 37′ S., 17° 03′ E., 1,580–1,620 fathoms, 1 adult living, 1 juv. dead; 33° 50′ S., 16° 30′ E., 1,480–1,660 fathoms, 18 living, 2 dead; 33° 52′ S., 16° 51′ E., 1,380–1,520 fathoms, 1 living, 1 dead; 34° 05′ S., 16° 58′ E., 1,470–1,490 fathoms, 12 living, 1 dead; 34° 36′ S., 17° 00′ E., 1,500–1,760 fathoms, 1 juv.

dead (S. Afr. Mus. A9736 (Types), A9747, A9765, A9767, A9784, A9815, A9834, A9849, A9875; F. H. Talbot coll.).

Remarks. Grows to a larger size than *salpinx* Tomlin, and has many more ribs.

It is not *capillosum*: it is more strongly curved during early growth, and the diameter increases more rapidly. On one of the smaller examples (52 mm.) the diameter increases from 1·3 to 5·5 mm. in a length of 30 mm., whereas in a specimen of *capillosum* (identified by Tomlin) the diameter reaches only 3 mm. in the same length. These two differential characters can also be observed by superimposing the 52 mm. shell on Watson's figure of the *Challenger* example of *capillosum* (1886 pl. 1, fig. 1 *a*).

The present species is stouter than the figure of *magnificum* Smith 1898 pl. 7, figs. 5, 5*a* (= *vernedei* Hanley).

Dentalium lardum n. sp.

Moderately curved. Smooth, glossy, with fine growth-lines. Apical portion ribbed, the ribs usually extending farther on the concave side, *c.* 20, increasing to 27–30 (but somewhat obscure), obsolete on later growth. No slit or perforations. Details of the specimens as follows.

40, diam. aperture 5·5, apex 0·75 mm. Glossy white; ribbed for the apical 23 mm., faintly indicated for another 7–8 mm. on concave side, thereafter only growth-lines; ribs 20, increasing to 27.

49 × 7 × 1·3 mm. Glossy, first two-thirds grey, thereafter white; ribs faintly visible only in the apical 10 mm.

50 × 7 × 1·5 mm. Glossy, ivory-white; partly corroded apically, but no trace of ribs.

65 × 8·5 × 2 mm. Glossy, grey or yellowish-grey; ribs faintly visible in apical 15–18 mm., more so on concave side than on convex, ribs *c.* 30 (but not easy to trace).

33° 49′ S., 16° 30′ E., 1,500 fathoms, 5 dead (Types); 33° 52′ S., 16° 51′ E., 1,380–1,520 fathoms, 2 dead; 34° 36′ S., 17° 00′ E., 1,500–1,760 fathoms, 1 juv. dead (S. Afr. Mus. A9768 (Types), A9835, A9876; F. H. Talbot coll.).

The specific name from the smooth, somewhat greasy appearance.

Dentalium sp.

One shell 7·5, one 8, one 11, one 13, and one 17 mm. long. Slightly curved. Ribs 9 on all specimens from apex onwards; at 13 mm. one intermediary begins between each pair of main ribs, and on the last 4 mm. of the 17 mm. shell there are 18 ribs, the intermediaries almost as strong as the main ribs. Apical diam. 0·4–0·5, basal diam. of 13 mm. shell 1·3, of 17 mm. shell 1·5 mm. Growth-lines but no other sculpture between the ribs.

33° 26′ S., 16° 33′ E., 1,240–1,300 fathoms, the 2 largest; 34° 37′ S., 17° 03′ E., 1,580–1,620 fathoms, 1; 34° 36′ S., 17° 00′ E., 1,500–1,760 fathoms, 1; all dead (S. Afr. Mus. A9885, A9877, A9785 resp.; F. H. Talbot coll.).

Remarks. Further material is desirable before a name is given to these specimens. But attention is drawn to the rather sudden doubling of the number of ribs; a larger specimen with the apical 13 or 14 mm. broken off would be regarded as an 18-ribbed species.

Dentalium sp.

33° 50′ S., 17° 21′ E., 600 fathoms, 17 dead (S. Afr. Mus. A9769, F. H. Talbot coll.).

A species with 18–22 ribs, comparable with but distinct from *plurifissuratum*. Up to 35 mm.

In this case also, more and better material seems desirable before attaching a specific name to these specimens.

Dentalium capense Tomlin

Dentalium capense Tomlin, 1931, p. 340.

33° 50′ S., 17° 21′ E., 600 fathoms, 1 living, 2 dead (S. Afr. Mus. A9770, F. H. Talbot coll.).

Previously taken by the *Pieter Faure* off Cape Point in 900 fathoms; and also off Durban in 440 fathoms.

Cadulidae

Cadulus promontorii n. sp.

Previously taken by the *Pieter Faure* off Cape Point in 700 fathoms.

For description and figure see: Barnard, Contributions . . . South African Marine Mollusca, Part IV [in press].

CEPHALOPODA

Cranchiidae

Leachia cyclura Lesueur

Leachia eschscholtzii Rathke, Chun, 1910, p. 347, pl. 52, figs. 4–7.

33° 45′ S., 16° 23′ E., 1,480 fathoms, 1 specimen (S. Afr. Mus. A9749, F. H. Talbot coll.).

LAMELLIBRANCHIATA

Nuculidae

Nucula (Pronucula) benguelana Clarke

(Fig. 11 *a*)

Pronucula benguelana Clarke, 1961, p. 368, pl. 3, figs. 9, 11.

Shell thin, subtriangular, not very oblique, length only slightly greater than altitude. Young shell, alt. 1 mm., large, prominent and sharply demarcated from rest of shell. Whole surface with numerous fine radiating striae, except in the positions of the lunule and escutcheon, which are otherwise undefined. Teeth anterior 7–8, posterior 6–7; ligament pit vertical to hinge-line; margin internally crenulate. Length 3·75, alt. 3·5 mm. Corneous, young shell paler.

34° 26′ S., 17° 00′ E., 1,500–1,760 fathoms, 1 living (S. Afr. Mus. A9882, F. H. Talbot coll.).

30° 14′ S., 13° 3′ E., 1,703 fathoms (approx. 400 miles north-west of Cape Town) (Clarke).

Remarks. Somewhat similar in shape to the North Pacific *profundorum* Smith (1885, p. 229, pl. 18, fig. 13), and the striae are, in Smith's words: 'hair-like whitish lines'.

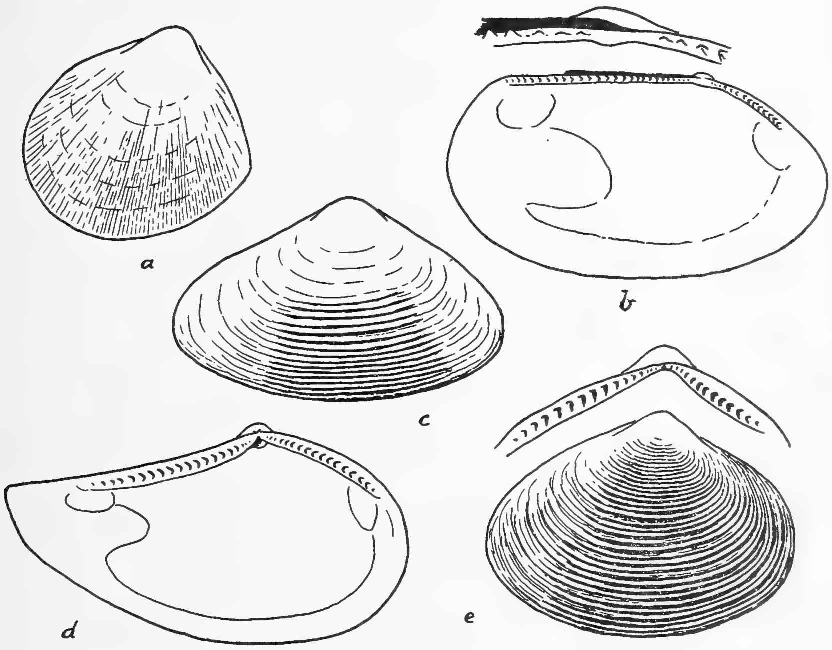

Fig. 11. *a*, *Nucula* (*Pronucula*) *benguelana* Clarke. *b*, *Malletia estheriopsis* n. sp. *c*, *Leda parsimonia* n. sp. *d*, *Leda macella* n. sp. *e*, *Sarepta* sp.

Malletiidae

Malletia estheriopsis n. sp.

(Fig. 11 *b*)

Thin, oblong-oval, rounded at both ends, the anterior end a little less broadly rounded, posterior dorsal margin straight; umbones at anterior third, not prominent. Concentric growth-lines only. Teeth anterior 12–13, posterior 28–30, 2–3 inconspicuous teeth on each side of the interruption below the umbo; ligament entirely external, conspicuous, about $\frac{2}{3}$ length of straight dorsal margin. Pallial sinus deep. Periostracum thin, pale yellowish. Length 15, alt. 8 mm. Siphons completely fused.

Cape Point N. 70° E. 40 miles, 800 fathoms, 1 (S. Afr. Mus. P.F. coll.).

33° 50′ S., 16° 30′ E., 1,480–1,660 fathoms, 2 living (Types); 34° 36′ S., 17° 00′ E., 1,500–1,760 fathoms, 2 living; 34° 33′ S., 16° 43′ E., 1,770–1,880 fathoms, 1 living; 34° 05′ S., 16° 58′ E., 1,470–1,490 fathoms, 3 living (S. Afr. Mus. A9817 (Types), A9880, A9890, and A9891 respectively; F. H. Talbot coll.).

Remarks. These specimens seem to differ from other species in their bean-like shape, rounded at both ends. Jeffreys (1879, p. 573) said his *Silicula fragilis* was like an Estheria (Crustacea, Conchostraca), but these specimens qualify even better for the epithet.

Conchologically they closely resemble the Arctic *obtusa* Sars (1878, p. 41, pl. 19, figs. 3*a–c*) but are not so obtuse and truncate posteriorly. Geographically, the nearest species is *pallida* Smith 1885 (p. 246, pl. 20, figs. 8, 8 *a*) from 2,250 fathoms between Tristan da Cunha and the Cape.

Ledidae

Leda parsimonia n. sp.

(Fig. 11 *c*)

Triangular, almost equilateral, umbones only slightly nearer to the anterior end; rounded at both ends. Middle of later part of shell with concentric pliculae, closer together near the margin, rest of shell with growth-lines only. Teeth 12 anterior, 15 posterior, with a few minute ones on each side of ligament pit. Pallial sinus very shallow. Length 13·25, alt. 8·25 mm. Yellowish-brown, glossy. Animal decomposed; siphons?

33° 50′ S., 16° 30′ E., 1,480–1,660 fathoms, 1 living (S. Afr. Mus. A9818, F. H. Talbot coll.).

Remarks. Resembles *Yoldia semisculpta* Thiele in being only partially plicate, but differs in shape, and does not gape.

Leda macella n. sp.

(Fig. 11 *d*)

Rostrate, anterior end broadly rounded, dorsal posterior margin straight (or very slightly concave), rostrum angular above, obliquely truncate, umbones at anterior $\frac{2}{5}$ of length. Border of lunule from umbo to upper corner of rostrum curved. Concentric growth-lines only, some on the later part of shell coarser than the others. Teeth at shell length 12 mm. 12–13 anterior, 14 posterior, increasing to 15–16 and 16–17 respectively, with a few minute ones on each side of the ligament pit. Pallial sinus moderately deep. No ridge on inner side of rostrum below, and parallel to the posterior series of teeth. Periostracum thin, yellowish or olivaceous brown. Length 20, alt. 10·5, thickness (valves together) 8 mm.

33° 26′ S., 16° 33′ E., 1,240–1,300 fathoms, 1 living; 33° 45½′ S., 16° 23½′ E., 1,480 fathoms, 1 living; 33° 50′ S., 16° 30′ E., 1,480–1,660 fathoms, 1 living; 34° 05′ S., 16° 58′ E., 1,470–1,490 fathoms, a lot living (Types) (S. Afr. Mus. A9729, A9751, A9819, and A9851 (Types); F. H. Talbot coll.).

Remarks. Similar in shape to *prostrata* Thiele 1931 and *silicula* Thiele 1931, but not so strongly nor so narrowly rostrate, and the rostrum is obliquely truncate; no longitudinal ridge on inside of rostrum; and the number of posterior teeth is less, in conformity with the shorter rostrum.

L. prostrata came from 981 metres in the middle of the South Atlantic (25° 25′ S., 6° 12′ E.), and *silicula* from 400–463 metres off the East African coast.

Sarepta sp.

(Fig. 11 *e*)

Interior not nacreous (but only one dead valve present). Oval, not very oblique, length greater than altitude; posterior margin convex. Concentric ridges over whole surface. No lunule. Teeth anterior 12, posterior 10. Ligament pit minute. Margin internally smooth. Length 5, alt. 4 mm.

34° 26′ S., 17° 00′ E., 1,500–1,760 fathoms, 1 valve (S. Afr. Mus. A9881, F. H. Talbot coll.).

Limopsidae

Limopsis cf. *straminea* Smith

Limopsis straminea Smith 1885, p. 255, pl. 18, figs. 5, 5 *a*.

Shell oblique, length greater than altitude; anterior margin convex, posterior margin nearly straight in upper half. Umbo slightly nearer to anterior end of hinge-line. Concentric lirae, and fine radial striae marking the insertion of the bristles. Internally smooth, no radial ridges, and no marginal crenulations; no thickened pad at posterior adductor scar. Lower margin of hinge slightly concave, very narrowly separated from ligament pit. Teeth interrupted, in juv. up to 10 mm. 4–5, later 5–7 on each side (occasionally 8 on posterior side), the posterior ones slightly more oblique than the anterior ones.

Length 27–28, alt. 24–25, width (valves together) 10–11 mm.

Foot with posterior process; byssus rudimentary.

33° 26′ S., 16° 33′ E., 1,240–1,300 fathoms, 3 living; 33° 26′ S., 16° 15′ E., 1,520–1,570 fathoms, 17 living; 33° 45½′ S., 16° 23½′ E., 1,480 fathoms 12 living; 33° 49′ S., 16° 30′ E., 1,500 fathoms, 10 living; 34° 37′ S., 17° 03′ E., 1,580–1,620 fathoms, 3 living; 33° 50′ S., 16° 30′ E., 1,480–1,660 fathoms, 6 living, 5 valves; 34° 05′ S., 16° 58′ E., 1,470–1,490 fathoms, 34 living, 4 valves; 34° 36′ S., 17° 00′ E., 1,500–1,760 fathoms, 2 living, one valve (S. Afr. Mus. A9727, A9739, A9750, A9766, A9786, A9816, A9850, A9879; F. H. Talbot coll.).

Remarks. In juveniles up to about 10 mm. long the obliquity of the shell is not so noticeable as in larger shells; and the lower margin of the hinge is not so narrowly separated from the ligament pit.

Assigning a specific name to these shells is difficult. A valve superimposed on Smith's figure of *straminea* agrees exactly in shape. The number of teeth is 'about 12'. Smith did not mention whether the margin was internally crenulate, but presumably it was not (he was dubious about this as a specific character: p. 257): he gave no internal view of the shell.

L. straminea was taken between Kerguelen and Heard Islands at only 150 fathoms; nevertheless the present shells may be conspecific.

Ungulinidae

Thyasira investigatoris (Smith)

Cryptodon investigatoris Smith, 1895, p. 13, pl. 2, figs. 6, 6 *a*; 1897, Moll. pl. 3, figs. 2–2 *b*.
Thyasira investigatoris (Smith) Thiele & Jaeckel, 1931, p. 218.

33° 50′ S., 17° 21′ E., 600 fathoms, 1 right valve (S. Afr. Mus. A9708, F. H. Talbot coll.).

Previously taken (one specimen) by the *Pieter Faure* off Cape Point in 720–800 fathoms.

Semelidae

Abra longicallus (Scacchi)

Abra longicallis [*sic*] Sars, 1878, p. 74, pl. 6, figs. 3 *a–c*; pl. 20, fig. 4.
Syndesmya longicallus Scacchi, Dautzenberg, 1927, p. 333.

Agreeing with Sars's description and figures. Length 13, alt. 9 mm. Up to 25 mm. (Sars).

33° 50′ S., 17° 21′ E., 600 fathoms, 1 living, 2 dead; 34° 26′ S., 17° 00′ E., 1,500–1,760 fathoms, 1 living (S. Afr. Mus. A9709, A9889; coll. F. H. Talbot, Aug. and Dec. 1959).

Distribution. Arctic and North Atlantic, Mediterranean, Canaries, Azores; Gulf of Mexico; 20–2,435 fathoms (Jeffreys).

Verticordiidae

Halicardia flexuosa (Verrill & Smith)

Halicordia [*sic*] *flexuosa* (Verrill & Smith), Tomlin, 1937, p. 23, fig. 1 (references).

33° 50′ S., 17° 21′ E., 600 fathoms, 1 living (S. Afr. Mus. A9707, F. H. Talbot coll.).

The *Pieter Faure* took 2 dead specimens off Cape Point in 460–650 fathoms.

Cuspidariidae

Cuspidaria spp.

Until better material is obtained it is not advisable to attach definite names to these specimens.

33° 50′ S., 17° 21′ E., 600 fathoms, 1 living (S. Afr. Mus. A9710, F. H. Talbot coll.).

13 × 7·5 × 6 mm. Similar in shape to the Atlantic *claviculata* Dall and *congenita* Smith, but has no 'clavicle'; and to the South Australian *meridionalis* Smith.

34° 37′ S., 17° 03′ E., 1,580–1,620 fathoms, 2 right valves (one of them broken); 34° 36′ S., 17° 00′ E., 1,500–1,760 fathoms, one broken left valve (S. Afr. Mus. A9787 and A9878, F. H. Talbot coll.).

The complete right valve is 40 × 25 mm., the broken left valve is at least 30 mm. alt. Compare: *maxima* Dautzenberg & Fischer from the Azores, 1,850 metres. Surface smooth, growth-lines only. Posterior lateral tooth in right valve forms a thickened, sausage-like ridge; the ligament pit is scarcely visible as it lies in a plane almost perpendicular to the sagittal plane of the valve.

Summary

A collection of deep-sea mollusca from west of Cape Point, South Africa, in depths between 600 and 1,880 fathoms is described. The collection comprises approximately 590 specimens of approximately 78 species including 25 new species.

Acknowledgments

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SYNONYMY. Arrangement according to Schenk, E. T. & McMaster, J. H.: *Procedure in taxonomy.* 2nd ed. Stanford, Stanford university press, 1948. Bibliographic references modified.

'I. *Synonymy arranged according to chronology of names.*—All published scientific names by which a species has been previously designated (subsequent to 1758) are listed in chronological order, with bibliographical references to all descriptions or descriptive citations following in chronological order after each name. . . .

B. *Form of bibliographic references to synonymic names.*—The first reference following any name in the synonymy should be to the earliest citation of that name. This should be followed by references to all subsequent citations of the same name, arranged in chronological order. . . .'

Bibliographical references modified to consist of author's name, date of citation, pagination and illustrations (plates and figures).

Example:—

Eulalia (*Steggoa*) *capensis* Schmarda

Eulalis capensis Schmarda 1861, p. 86, pl. 29, fig. 231. Willey 1904, p. 259.
Eulalia viridis var. *capensis* McIntosh 1903, p. 34. Day 1953, p. 30.
Eulalia viridis (*non* Muller) Ehlers 1913, p. 455. Day 1934, p. 30.

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PART XVIII

SOME ECNOMINAE FROM THE TRANSVAAL AND SOUTH WEST AFRICA (TRICHOPTERA: PSYCHOMYIDAE)

By
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National Institute for Water Research
South African Council for Scientific and Industrial Research

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[CONTINUED ON INSIDE BACK COVER

SOME ECNOMINAE FROM THE TRANSVAAL AND SOUTH WEST AFRICA
(TRICHOPTERA: PSYCHOMYIDAE)

By

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National Institute for Water Research
South African Council for Scientific and Industrial Research

[Accepted November 1962]

(With 5 plates and 1 map)

Contents

Introduction

During the past few years extensive collections of aquatic insects have been made in the Transvaal during river surveys carried out by Dr. A. D. Harrison* *et al.* (1960 and in press), Dr. B. R. Allanson† (1961), Mr. F. M. Chutter (in press), Mr. J. D. Agnew and other members of the staff of the National Institute for Water Research. The parts of the rivers concerned are situated in the Highveld region of the Transvaal. A small collection was also made in the Transvaal Lowveld by Dr. G. H. Frank of the Bilharzia Research Unit of the C.S.I.R. The caddis collected during these surveys were sent to the author for identification, and the present paper is the first of a series based on this material.

Grateful thanks are due to Dr. A. D. Harrison, Dr. B. R. Allanson, Dr. G. H. Frank and Messrs. F. M. Chutter and J. D. Agnew for permission to study and describe their collections of caddis, and for the trouble they have taken in the provision of extra material, maps and information; also to the South African Museum for the loan of type material, to Mr. D. E. Kimmins of the British Museum (Natural History) for his very kind assistance, and to Professor J. H. Day of the Zoology Department of the University of Cape Town in whose Department the work was carried out.

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*Then with the National Institute for Water Research, now Senior Research Fellow at the University College of Rhodesia and Nyasaland.

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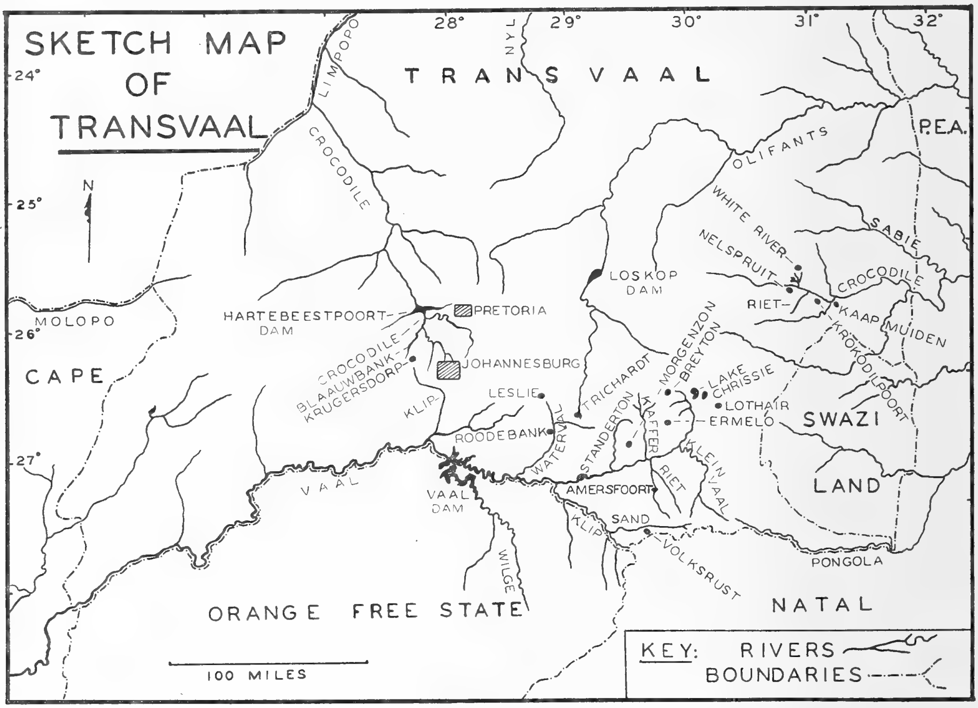
Ann. S. Afr. Mus. **46** (18), 1963, 453–468, 5 pls., 1 map.

In the present paper an account is given of the *Ecnomus* species found in the Transvaal collections. These include one new species, *E. kimminsi* sp. n., fresh material of a little-known species, *E. oppidanus* Barnard, and records of several other species. Some of the species have been correlated with their larvae, descriptions of which are given. Descriptions of females are also given where possible, because the female genitalia show well-marked differences which render identification from drawings and descriptions feasible. A map is given, on which the localities mentioned in this paper can be approximately located.



South African *Ecnomus* larvae fall into two groups, one plain yellow, the other patterned with brown, and it is difficult to distinguish the species from others in the same group as they are very similar. The species considered in this paper all fall into the patterned group, in which the head pattern (clypeus and genae particularly) has been found most useful for identification purposes, since patterns on the thoracic nota vary considerably in intensity with age and other factors, being darker in later instars than in earlier, and also darker and clearer in entire larvae than in larval sclerites taken from pupal cases. The mandibles are also helpful in identification; they are usually much alike in shape but show differences in the development of internal spines. Two types of yellow larva also occur in the area considered, but have not been described as they have not yet been correlated; this also applies to two of the patterned species.

DESCRIPTIONS OF SPECIES

Ecnomus oppidanus Barnard

(Plate XVI, A–H; plate XVII, A–G)

One of the new species described by Dr. K. H. Barnard in 1934 was *Ecnomus oppidanus.* The material then available consisted of two very old and mildewed specimens in the South African Museum collection, labelled Cape Town 1885, and Dr. Barnard suggested that their place of origin be accepted with caution until more specimens were discovered. None appears to have been found, however, until the collections of caddis from the Transvaal were studied, when, among those from the Vaal River area and the Lowveld, many specimens were found which apparently belonged to Dr. Barnard's species.

Through the kindness of Dr. A. J. Hesse of the South African Museum, the author was able to compare these new imagos with Barnard's type material, and found that these males from the Transvaal do correspond very closely to Barnard's specimens. They show, however, a range of variation from the type in minor details, as indicated in the drawings and descriptions. *Ecnomus oppidanus* Barnard may therefore be regarded either as a somewhat variable species, or as a species embracing a number of subspecies or varieties, and whose habitat includes the Transvaal. As the original description was not very full, a new description and drawings of the type material are given here for comparison with those of the Transvaal specimens.

Imagos: Barnard 1934, p. 378, fig. 45, *a–d.*
Locality 'Cape T. 1-1-85'. 2 ♂♂.

Neither of the two specimens in the South African Museum was designated as type by Dr. Barnard, so the better one has been selected by the author and labelled holotype ♂. Both are pinned specimens, old, fragile and in poor condition; the paratype lacks a head and its anterior portion is enveloped in cobweb. In both cases balsam preparations have been made of the genitalia after clearing and drawing them, and in the case of the paratype one forewing has also been mounted; both specimens lack hind wings.

Tibial spurs 3, 4, 4; length of forewing 5·0 mm.; general colouring yellowish, forewings yellowish chequered with slightly darker markings. Wings as figured by Barnard (1934, fig. 45 *a*).

Genitalia of holotype ♂ (pl. XVI, A–F): Lobes of tenth segment stout, shorter than the claspers, bluntly rounded, slightly upturned and dorsally keeled; internal apical teeth large, numerous, yellowish, some projecting apically. Between the lobes the median part of the tenth segment is membranous and difficult to distinguish, apparently forming a raised area, posterior to which are paired transparent projections with a depressed emargination between them (according to Nielsen—1957—these are the bilobed lips which lie just below the anus). Beneath these projections lie the paired internal processes of the tenth segment ('spiniform processes'; 'paraprocts' of Nielsen), oval in lateral view and armed with stout spines which curve upwards and outwards round them; the inner and lower parts of the processes are pubescent, and each ends posteriorly in a short apical projection tipped with three bristles. The spines on the processes show slight differences in number and position between holotype and paratype and between left and right sides (pl. XVI, B, C, G). Ninth tergite strongly rounded dorso-laterally; side-pieces deeply incised; sternite long, slightly wider than tergite. Claspers almost oblong in lateral view, bluntly triangular and turned slightly outwards in dorsal or ventral view, the dorso-lateral margins inturned and bearing long, recurved setae. Aedeagus (phallus of Nielsen) with narrow apodeme, then widely expanded, narrowing again to form a trough filled by membranous folds; above this lies a median sclerotized process, bifid for much of its length and ending apically in a pair of heavily sclerotized tips. The aedeagus then tapers to a long, slender, downcurved point.

This bifid sclerotized process presumably represents a pair of spines or titillators, as is indicated by its origin from the dorsal side of the aedeagus. This must be remembered when using Mr. Kimmins's key to the genus *Ecnomus* (Kimmins, 1957), as it may be mistaken for an upper part of the aedeagus, as was suggested in Barnard's original description, which reads 'penis divided into an upper portion which is apically bifid, and a lower portion which ends in a fine point; no curved titillators' (Barnard, 1934, p. 378). The bifid process corresponds to the 'upper beak' of Nielsen (1957, p. 60), which in *E. tenellus* is undivided.

New material (in spirit):

Transvaal (*Highveld*) *males* (numbers cited throughout the paper are catalogue numbers from the collections of the National Institute for Water Research): Olifantsvlei outlet, 1 ♂ (OLF 73 B, A.D.H., 17/1/55); Sandspruit near Volksrust, 1 ♂ (VAL 456 G, F.M.C., 20/11/58); headwater stream of Vaal River between Breyton and Lake Chrissie, 1 ♂ (VAL 516 C, F.M.C., 15/1/59); Vaal River where crossed by Ermelo-Lothair road, 1 ♂ (VAL 851 B, F.M.C., 8/11/59); Lake Chrissie, 4 ♂♂ (VAL 906 X (1–4), F.M.C., 21/1/60); Waterval River (tributary of the Vaal), below confluence of streams from Leslie and Trichardt, 1 ♂ (VAL 1253 A, F.M.C., 6/12/60).

Other Highveld material: 1 ♀ (VAL 988 P) was taken at Roodebank on the Waterval River, and larvae from the same place and also from Lake Chrissie and Olifantsvlei.

These males closely resemble the type material described above and appear to be the same species (see pl. XVI, J–M, of the male from Sandspruit). The flies have prettily mottled brownish-yellow forewings (length 5·0 mm.); palps clearly annulate, antennae faintly so. The Lake Chrissie specimens have very widely expanded genitalia which show some of the structures more clearly, so drawings of one of them have been included (pl. XVII, A, B). These Lake Chrissie males have slightly differently proportioned genitalia and the claspers are turned inwards instead of outwards. It is possible to distinguish the median part of X more clearly; it consists of a raised, transverse portion fused to IX, below which is a pair of thin, diagonally placed plates, projecting visibly in both dorsal and lateral view. These plates appear to have hinge-like sclerotized thickenings on their outer corners, partly dividing each into two portions and enabling them to be tucked downwards. Beneath them lie the internal processes, which in expanded specimens are definitely upcurved; this may also cause difficulty in the use of Kimmins's key to *Ecnomus* males (Kimmins, 1957). The difficulties can be resolved by amending couplets 12 and 13 of the key as follows:

12. Internal processes of tenth segment plain, upcurved, tipped with about 3 setae; titillators expanded apically, toothed, and with a basal branch.
E. aequatorialis Marlier

— Internal processes with teeth or spines; titillators without basal branch. 13

13. Internal processes slender, terminating in 3 teeth; titillators in form of sharp spines arising dorso-laterally from the aedeagus.
E. ulmeri Mosely

— Internal processes oval, spiny, basally pubescent, apex truncate and tipped with about three long setae; titillators broad with bluntly pointed tips, arising from a wide common base dorsal to the aedeagus.
E. oppidanus Barnard

The paired median processes of X are reminiscent of those figured for *E. tridens* (Marlier, 1958, fig. 5). *E. tridens* appears to be related to the *natalensis* group of *Ecnomus* with spurs, 2, 4, 4, however, and could not be confused with *E. oppidanus*. In any case, as the processes represent flaps beneath the anus (Nielsen, 1957), it is probable that they occur in many species of *Ecnomus*. *Transvaal (Lowveld) males* (pl. XVII, C, D): A number of specimens collected by Dr. G. H. Frank in the environs of Nelspruit also appear to belong to Barnard's species. The data concerning them can be summarized as follows:

Nelspruit district, taken from January to March 1957, 35 ♂♂ and 48 ♀♀. All but one of the collections made were small, and in them *E. oppidanus* was the only species of *Ecnomus* collected. The large batch (LOW 179 B) included, however, 14 ♂♂ and 5 ♀♀ of *E, natalensis* Ulmer in addition to 22 ♂♂ and 33 ♀♀ of *E. oppidanus*; also 1 ♀ of a new species of *Ecnomus* from Komatipoort (which will be described when more material is available). The *E. natalensis* ♀♀ were recognizable from the drawings given by Barnard (1934, fig. 45, *h*, *i*), and are the same as two ♀ paratypes of *E. natalensis* in the British Museum (Natural History); personal communication from Mr. Kimmins, who very kindly compared them with Ulmer's paratypes there. Besides the differences in the genitalia, the *oppidanus* ♀♀ can be distinguished from the other two species by the tibial spurs (3, 4, 4 in *oppidanus* and 2, 4, 4 in *natalensis* and the Komatipoort species).

The above-mentioned specimens were all collected from a small ground dam (Friedenheim Farm dam) on the Nelspruit-White River road, about 6 miles from Nelspruit. The dam is fed by a tributary of the Crocodile River, and most of the specimens were collected either in a floating trap designed by Dr. Frank or in a Brundin Cone trap, set either over the shallow fringe of the dam or over deeper water (about 3 feet in depth); bottom flocculent mud. A few imagos were also taken during random sampling with a hand-net. Recently Dr. Frank collected some *Ecnomus* larvae from a shady pool feeding the dam; conditions had changed in the dam itself which was silting up. Some of the adult *oppidanus* (LOW 159 A) were taken at the same shady pool in 1957.

In addition to the above specimens, a male and three female *E. oppidanus* were taken from the upper Krokodilpoort dam in the Kaapmuiden district (LOW 30 D, 25/10/55), and many *Ecnomus* larvae were collected from the Rietspruit, a small stream with grassy banks, clear, slow flow and muddy bottom, situated on the Krokodilpoort range about 10 miles south of Nelspruit. Both dam and stream connect with tributaries of the Crocodile River. All the larvae except one are similar to those collected in the shady pool, the exception being a larva of the new species described in this paper (*E. kimminsi* sp. n.). It cannot be definitely stated that the larvae collected are those of *E. oppidanus*, as the larvae of *natalensis* and the Komatipoort species are also unknown, and no mature ♂ pupae were found. Identification is, however, reasonably certain as similar larvae were also collected in Olifantsvlei, an acid vlei where the pH range was from 4·2 to 5·4 at the stations and seasons when the *Ecnomus* larvae were collected (Harrison *et al.*, 1960); Olifantsvlei lies on the Klip River some 14 miles SW. of Johannesburg. Very few caddis were able to tolerate the acid conditions, and *oppidanus* ♂♂ were the only adult *Ecnomus* found there. Similar larvae were also found in Lake Chrissie, a shallow eutrophic lake, where *oppidanus* was again the only species of *Ecnomus* found. A description of the larva is therefore given below.

The Lowveld males are on the whole slightly smaller than the rest (w. 4·5 mm.), and have genitalia very similar to the Lake Chrissie specimens, with short, rather humped, upper lobes. The small inner lobes are clear and easily visible; the spiniform processes are somewhat sinuous, with fewer teeth, and are hairier and more granular in appearance underneath (pl. XVII, D); the narrowed tips of the titillators are longer than in the type, and the lobes of X are frequently tucked inwards, with the central processes of X turned down, and sometimes with the ends of the spiniform processes showing (pl. XVII, C).

The yellow teeth arming the upper lobes of X vary in number from about 18 in the Lowveld and Olifantsvlei specimens, to about 28 in many Highveld specimens. The general appearance of the genitalia is however always much the same, and, while it might be possible to separate the material into two varieties or subspecies, it does not seem necessary, at least until the species is better known and more specimens have been collected.

E. oppidanus ♀♀ (pl. XVII, E, F, G):

Seventh segment normal; eighth and ninth segments with tergites normal, the ninth thickened posteriorly and fringed with setae. The eighth sternite forms a subgenital plate almost completely divided into two large leaf-like lobes connected proximally by a bridge; the lobes are setose with about three long marginal bristles and are thickened along their inner margins. Dorsal to the subgenital plate lie thinner flaps, possibly representing IX; proximal to these, and connecting with the subgenital plate, is a sclerotized bridge, seen as triangular in ventral view, in which the genital opening lies. The thin flaps are much folded posteriorly, curling round and connecting apically by way of a thickened collar with a pair of rounded, seta-studded projections, each tipped with three soft, finger-like papillae. The central papilla on each side stands on a small boss and has a narrowed tip. These projections and papillae possibly represent the tenth sternite; between them on the dorsal side the tenth tergite appears to be represented by a pair of small, rounded humps fringed with strong setae.

Females with their genitalia much expanded present a somewhat different appearance, so a figure of one has been included for comparison (pl. XVII, F).

The wide separation of the subgenital lobes is reminiscent of the female designated *E. kunenensis* by Barnard (1934, p. 380 and fig. 45, *r*; see also pl. XIX, K, of this paper). In *E. natalensis* Ulmer the subgenital plate is deeply cleft, with divergent lobes separated by a V-shaped incision (Barnard, 1934, p. 379 and figs. 45, *h*, *i*); a drawing of one is given here for comparison (pl. XX, D, *d*).

Probable larva of *E. oppidanus* (pl. XIX, B–D): larvae collected from the Nelspruit district (2/8/55, 7/3/62, G.H.F.); from Olifantsvlei (23/6/54, 21/7/54, 18/8/54, 6/10/55, A.D.H.); from Lake Chrissie (16/9/58, F.M.C.). (*Ecnomus* larvae have also been collected from many other localities all over South Africa, but many are too small to identify further, and many have not yet been identified to species as the differences between them are only now being recognized.)

Larva of the usual *Ecnomus* type described by Ulmer (1957); campodeiform, 8–10 mm. in length, all three thoracic tergites sclerotized. Head yellowish, patterned with brown (pl. XIX, B); the patterning on the clypeus consists of lateral strips on the anterior part only, the rest being plain yellow; the patterning on the genae, while darkest along the posterior part of the clypeus, continues back to the occipital foramen; there is also a small brown mark alongside the clypeus above each eye. Anteclypeus divided into four parts; gular sclerite short, widely triangular, with curved sides. Antennae minute, close to anterior margin of head. Eyes large, black, placed well forward in white areas beneath lens-like thickenings of the cuticle. Labrum (pl. XIX, C) rounded, yellowish, with median indentation flanked by a pair of slender bristles; six pairs of dorsal setae. Mandibles (pl. XIX, D) strong, dark, unequal, the right mandible with several blunt teeth and a number of short, stout, internal spines, the left mandible larger, with about five blunt teeth and a number of long, slender, internal spines. Maxillae and labium whitish, prominent; maxillary palp well developed, longer than lobe; labium broad basally, narrowing to a slender shaft, labial palps present, long, two-jointed.

Thoracic tergites (pl. XIX, B) sclerotized, with posterior margins dark; pronotum yellowish, unpatterned, with long posterolateral points which curl round ventrally; meso- and metanota yellowish with more or less clear brownish pattern and diagonal brown stripes in the anterolateral corners; lateral margins of mesonotum also darkened.

Legs strong, subequal; claws long, each with basal bristle. Anal appendages long, slender; anal claws large, strongly curved to form a right angle, a comb of small teeth along the central third of the inner edge, no dorsal hooks.

Abdomen somewhat flattened, no lateral gills, no lateral line, a few hairs along each side (there is a broad lateral tract of fuzzy hairs there in young larvae); five anal gills present.

Ecnomus kimminsi sp. n.

(Plate XVIII, A–M; plate XIX, A)

Imagos (in spirit): Vaal River shortly above confluence with Klein Vaal, holotype ♂ (VAL 860 F (2), 9/11/59, F.M.C.); Zwartkoppies on the Blaauwbank River, an unpolluted tributary of the Crocodile River, near Krugersdorp, 2 ♂ paratypes (ALL 13 G (1) and (2), 7/4/57, B.R.A.) (this is not the Lowveld Crocodile, but flows northwards through the Hartebeestpoort Dam to join the Limpopo). Klein Vaal near confluence with Vaal River, 1 ♂ pupa with pupal case containing larval sclerites (VAL 1022 L, 9/2/60, F.M.C.); Klein Vaal near confluence with Vaal River, 2 larvae (VAL 1022 M, 9/2/60, F.M.C.). Larvae were also found at several stations on the Vaal River, and higher up the Klein Vaal.

The above specimens all belong to the same species (larvae correlated via larval sclerites in pupal case together with mature ♂ pupa), which does not appear to be any of the species hitherto described from Africa. It belongs to the *natalensis* group of *Ecnomus*, and is nearest to *E. ugandanus* Kimmins. None of the females found could definitely be assigned to this species.

Tibial spurs 2, 4, 4; general colouring of head and thorax chestnut brown; antennae and legs yellowish, anterior face of forelegs browner, fore-tarsi and palps obscurely annulate. Forewings plain golden-brown, traces of irrorations present but wings largely denuded, membrane brownish, a white line along the anastomosis and the anterior edge of the median and thyridial cells. Wing length 5·0 mm., wings of the usual *Ecnomus* type (pl. XIX, A). Abdominal tergites purplish brown.

♂ *genitalia* (pl. XVIII, A–F): lobes of tenth segment long, narrowly oval in dorsal view, broadly so in lateral view, a little shorter than the claspers; internal apical teeth long, slender, dark, forming a band along the apical margin; proximal to them the inner surface of the lobe is set with long setae arising from tall papillae (as is the case in a number of *Ecnomus* species). The median part of the tenth segment forms a raised, semicircular membranous area, partly bounded anteriorly by narrow sclerotized strips. The paired internal processes of the tenth segment are almost as long as the lobes, stout, slightly sinuous and rodlike, set with small spines and tipped with about three bristles; the processes slope downwards for three-quarters of their length, then turn upwards near the apices. The ninth tergite has a T-shaped median suture-like sclerotization, the ninth sternite is long, with a median point. Claspers of the same type as in the *natalensis* group of species, with a curved apical finger which in dorsal view has an inturned beak-like point; the incision beneath it is rounded and bounded ventrally by a blunt incurved process; base of clasper about four-fifths of the depth of the part to which it is attached. In the Zwartkoppies specimens the apex of the clasper is more rounded than in the type. In lateral view the aedeagus has a triangular apodeme; posterior to this it is constricted, then expanded again to form a bulb which has a ventral membranous portion and is apically bifid to form upcurved, flattened plates with rounded apices, slightly toothed on the dorsal edge. The paired titillators are longer than the aedeagus, stout, spinelike, somewhat sinuous and terminally upcurved.

Holotype ♂ (VAL 860 F (2)) in spirit (genitalia cleared), in the South African Museum; one paratype (ALL 13 G (1)) in the British Museum (Natural History); rest of material in the National Institute for Water Research collection. I have much pleasure in naming the species after Mr. D. E. Kimmins.

Mr. Kimmins has informed me (personal communication) that the internal processes of X in *E. ugandanus* Kimmins are not entirely glabrous as they appear in the figures, but that under a $\frac{1}{4}''$ objective they show a sparse clothing of minute spines and a variable number of apical setae; the titillators are stouter and a little shorter than in *kimminsi*, and curved but not sinuous. *E. kimminsi* therefore differs from *E. ugandanus* in the more spiny internal processes, the longer, sinuous titillators, and the shape of the apex of the aedeagus and of the claspers. It runs down to the first part of couplet 6 on Kimmins's key (1957, p. 262), and can be keyed out from that point as 6A as follows:

6A. Internal processes set with small spines; titillators slightly longer than aedeagus, sinuous; apex of aedeagus in side view rounded, slightly toothed dorsally.
E. kimminsi sp. n.

— Internal processes glabrous or sparsely set with minute spinules; titillators slightly shorter than aedeagus, upcurved but not sinuous; apex of aedeagus in side view triangularly pointed. 7

7. Apical finger of clasper elongate, the excision beneath it in side view narrow. Apex of aedeagus in side view forming an acute spine (fig. 2, N); internal processes glabrous. *E. natalensis* Ulmer

— Apical finger shorter, slightly more downcurved, the excision beneath it widely rounded. Apex of aedeagus in side view forming a broad, acute triangle (fig. 2 U); internal processes sparsely set with minute spinules. .. .. *E. ugandanus* Kimmins

Larva of *E. kimminsi* sp. n. (VAL 1022 M, pl. XVIII, G–M):

Larva very similar to that of *E. oppidanus*. Length 9–11 mm. Head yellowish, patterned with brown (pl. XVIII, G); the lateral brown patches on the clypeus join or almost join centrally, and there is a patterned brown band crossing the middle of the head, interrupted by the plain yellow posterior part of the clypeus; back of head plain yellow. Anteclypeus, gular sclerite (pl. XVIII, M), eyes and antennae as in *oppidanus*. Mandibles strong, dark, each with about 5 blunt teeth and 2 dorsal bristles, the right mandible smaller than the left, with some very short inner spines; the left without inner spines. Labrum brownish, maxillae and labium whitish, very prominent, all very like those of *oppidanus* (pl. XVIII, J, M).

Thoracic tergites all sclerotized (pl. XVIII, G), yellow with brown pattern, posterior borders dark. Pronotum with a large triangular brown mark, meso- and metanota with well-marked pattern and dark diagonal stripes.

Legs, abdomen and claws (pl. XVIII, H) as in *oppidanus*.

Ecnomus thomasseti Mosely

(Plate XIX, E–K)

Ecnomus thomasseti Mosely 1932.

Imagos and larvae (in spirit): Standerton, 1 ♂, 1 ♀ (VAL 985, E 23/3/60), caught on wing; Vaal River near Standerton, 1 ♂ (VAL 1251 E, 6/12/60); Kafferspruit, tributary of Vaal River, near Ermelo, larvae (VAL 1107 L, 12/8/60), some of these larvae being bred out in the laboratory as follows: 2 ♂♂, 1 ♀ (VAL 1159 E, 12/10/60), 1 ♂ (VAL 1159 F, 12/10/60), 1 ♂ (VAL 1160 G, 12/10/60). Crocodile River, shortly before entry into the Hartebeestpoort Dam, 3 ♂♂ (ALL 1 A–C, 5/4/51), 3 ♂♂, 1 ♀ (ALL 5, 10/3/57). The VAL specimens were all collected by Mr. F. M. Chutter, the ALL specimens by Dr. B. R. Allanson. The larvae collected from the Kafferspruit and reared in the laboratory by Mr. Chutter made possible the correlation of the larva with both male and female imagos. The males are all typical *E. thomasseti*; the female and larva are described below. Larvae were also collected at several stations on the Vaal and Waterval rivers.

The ♀, as will be seen from the drawing (pl. XIX, K), greatly resembles Barnard's '*E. kunenensis*' ♀ from South West Africa. Owing to Kimmins's description of part of Barnard's S.W.A. material as *E. barnardi* (Kimmins, 1957), it was of course possible that the '*kunenensis*' ♀ might in reality be the ♀ of *E. barnardi*, or even of *E. thomasseti*, since Barnard did suggest (1934, p. 380) that one of his ♂ *Ecnomus* might be *E. thomasseti*. The latter possibility was supported by the resemblance of Barnard's ♀ to the *E. thomasseti* ♀♀ from the Transvaal.

Dr. Hesse kindly made Barnard's type material from S.W.A. available for comparison; it consisted of 9 pinned specimens, whose genitalia had in most cases been cleared and then mounted in gum arabic on card. The genitalia were removed from the cards and studied in clove oil before mounting in balsam. The specimens proved to be as follows (all localities given as Otjimbumbe, Kunene River, except in the case of No. 6, where the locality was Erikson's Drift, Kunene River; date in each case March 1923):

(1) *E. kunenensis* Barnard, 1 ♂. W. 4·0 mm. Specimen rather broken up, but parts present. This has been labelled *holotype* because it is the only ♂ of this species in the collection. A figure of it is given (pl. XX, A), to show the narrowing of the internal processes of X. Otherwise it agrees with Kimmins's drawings and description (Kimmins, 1957, p. 265 and fig. 2, K).

(2) *E. thomasseti* Mosely, 1 ♂. W. 3·5 mm. Also damaged, but genitalia typical.

(3) *E. barnardi* Kimmins, 1 ♂. W. 4·0 mm. Much damaged, only forewings and head remaining apart from genitalia, which however agree exactly with Kimmins's drawings and description (1957, p. 265, and fig. 2 B).

(4) *E. barnardi* Kimmins, 1 ♂. As (3); the hind-legs and 2 wings which were loose have also been mounted in balsam.

(5) *E. 'kunenensis'* Barnard, 1 ♀. W. 4·0 mm.

(6) *E. 'kunenensis'* Barnard, 1 ♀. W. 4·0 mm. Genitalia of both (5) and (6) as illustrated in plate XIX, K (which is actually an *E. thomasseti* ♀).

(7) *Ecnomus* sp. A, 1 ♀. W. 4·5 mm. (pl. XX, B). Head and right forewing which were loose have been mounted in balsam together with the abdomen.

(8) *Ecnomus* sp. A, 1 ♀. W. 4·5 mm. (as no. 7). A brief description of this species is given elsewhere in this paper.

(9) *Ecnomus* sp. Specimen with wings spread, rather broken, genitalia missing.

The new material of *E. thomasseti* from the Transvaal has provided correlation of the '*kunenensis*' ♀ with its larva and thence also with the ♂ of *thomasseti*, besides which the other Transvaal ♀♀ of this type were in each case caught with ♂♂ of *E. thomasseti* only. Thus, since *E. thomasseti* was also present in Barnard's S.W.A. collection, these ♀♀ may be regarded as almost undoubtedly being the ♀♀ of *E. thomasseti* Mosely. There is as yet no final proof of this, however, as none appears to have been taken *in copula*.

Description of ♀ genitalia (pl. XIX, K):

Seventh segment, and eighth and ninth tergites, normal. Eighth sternite forms a subgenital plate divided to form a pair of leaf-like lobes, each of which is laterally rounded, apically bilobed, tipped with three long bristles and studded with small setae; the lobes are widely separated by a squarish indentation with a triangular median point, which is actually the bridge bearing the genital opening, seen end-on. Dorsal to the subgenital plate are the flaps formed by the ninth sternite; these have rugose bands near the midline in their proximal portions, the rugose bands vary somewhat in extent in different specimens and appear to connect basally with a pair of oblong 'pockets', visible through the subgenital plate in a cleared specimen. The genitalia end apically in a pair of soft, rounded projections, each bearing three papillae.

In general appearance the ♀♀ are reminiscent of the ♀♀ of *oppidanus*, but the subgenital plate has definitely bifid lobes, and the space between them is squarer and less deep than in that species; the ninth sternite is less folded distally, and the 'pockets' visible through the plates are quite different from the small triangular slits of *oppidanus*. The two species are in fact distinguishable without clearing, even without considering the tibial spur count (3, 4, 4 in *oppidanus*, 2, 4, 4 in *thomasseti*).

Larva (pl. XIX, E, H):

Larva of the usual *Ecnomus* type, length 7–8 mm. Head yellowish, with brown patterning as indicated in the figure (pl. XIX, E); note that the patterning is less extensive than in *kimminsi* or *oppidanus*, the lateral bands on the clypeus being separated by a wide yellow area, and the patterned patches on the genae small, not extending as far as the sides of the head as seen in dorsal view. Anteclypeus, eyes, labrum and gular sclerite as in *kimminsi*, mandibles very similar to those of *oppidanus* in shape, the right smaller than the left; the inner spines on the right mandible are well marked, and two or three long spines arise from the deeply indented inner face of the left mandible. Condyles small, as is usual in *Ecnomus* larvae. Maxillae and labium of the same type as in other species. Patterning of the thoracic nota is much fainter, the pronotum being scarcely darkened, and the meso- and metanota having faint brownish marks and pale brownish diagonal stripes; all have a dark posterior band. Legs and anal appendages as in the other species. Abdomen rather strongly segmentally constricted, lateral tracts of fuzzy hairs well developed.

Pupal case (pl. XIX, J):

The pupal case of *E. thomasseti* has been figured as being typical of these *Ecnomus* species; it is composed of comparatively large sand grains with a few minute ones filling interstices, and is lined with thick, soft, semitransparent felt-like material. There are sieve plates at each end, allowing the passage of water currents, and the larval sclerites are found within the case, caught up in the soft lining. Length of case about 8 mm. One case, where the substratum had been of very fine sand, was composed entirely of minute sand grains, so the larva can evidently make use of whatever size is available, preferring however, to use larger sand grains when possible.

Ecnomus sp. A ♀

(Plate XX, B)

Ecnomus kunenensis Barnard, 1934: 380 (*partim*, ♀ paratypes in the South African Museum).

Otjimbumbe, Kunene River, South West Africa, March 1923, 2 ♀♀ (K. H. Barnard and R. F. Lawrence).

A brief description of the second species of ♀ associated with Barnard's S.W.A. material is given here; it is easily distinguished from the other species described in this paper by the genitalia.

Specimens old and fragile, body colour reddish brown with pale gold setae; eyes black; antennae slightly ringed; legs yellowish, tibial spurs 2, 4, 4. Wings pale gold, showing traces of a few darker flecks (the lack of patterning may be due to fading), length of forewings 4·5 and 5·0 mm.

Genitalia (pl. XX, B):

The subgenital plate is completely divided into a pair of subtriangular lobes, contiguous or slightly overlapping in the mid-ventral line; each bears 3–4 long, strong bristles and sparsely scattered small setae. Dorsal to the lobes are the flaps of the ninth sternite, each bearing a crescent-shaped tract which at first sight appears to be hairy; the 'hairs', however, seem actually to be small sclerotized ridges. These tracts are concealed by the subgenital plate but are visible by transparency in cleared genitalia. The papillae etc. of the tenth segment are much crushed and distorted in both specimens.

Ecnomus natalensis Ulmer

(Plate XX, D, *d*)

Ecnomus natalensis Ulmer 1931.

Friedenheim Farm dam, on tributary of Crocodile River, 6 miles from Nelspruit (LOW 179 B (2), LOW 179 B (4), 25/3/57, G.H.F.), 14 ♂♂, 5 ♀♀.

♂ specimens typical of *E. natalensis*. The ♀ of this species has been briefly described already (Barnard, 1934, p. 378 and fig. 45, *h*). A figure of it is, however, given here (pl. XX, D) for comparison with those of the other species described. The genitalia differ considerably in appearance from those of the ♀♀ of *oppidanus* and *kunenensis*, showing more affinity with the ♀♀ of species A and C described in this paper. The lobes of the subgenital plate are separated by a deep V-shaped incision, almost the full depth of the plate. Each lobe is traversed by a longitudinal dent or furrow, and bears a number of long setae and three strong marginal bristles. Between the lobes the fold bearing the genital opening can be seen, and dorsal to it the thin flaps of IX. Behind the lobes of the subgenital plate, and only visible in a cleared specimen, these flaps are thrown into raised, sclerotized folds which lie in the angles made by the dents on the subgenital plate. It is difficult to make out the structure of these folds; each appears to have strong, ridged walls enclosing a pocket or space (pl. XX, *d*). The vaginal apparatus is lightly sclerotized, and there is a sclerotized collar round each of the projections that bear the usual three papillae.

Ecnomus ugandanus Kimmins var.

Ecnomus ugandanus Kimmins 1957.

Volksrust (VAL 541 G (2), 11/2/59, F.M.C.), 1 ♂. Mr. Kimmins kindly identified this specimen as being a variety of his species.

Ecnomus sp., near *E. complex* Mosely

Ecnomus complex Mosely 1932.

Vaal River (VAL 899 D, 20/1/60, F.M.C.). Two ♂ pupae were found in the Vaal River between Morgenzon and Amersfoort. The pupae have well-developed ♂ genitalia with straight, out-turned upper lobes like *E. similis* Mosely (1932), but have the inner branches characteristic of *E. complex*. The pupal cases contain larval sclerites with almost plain clypeus, genae with a broad band of patterning, and thoracic nota faintly patterned, without dark diagonal bars. Definite identification must await further material.

Ecnomus sp. B ♀

(Plate XX, E–H)

Two ♀♀ spurs 3, 4, 4 were bred out from larvae taken from the upper part of the Klein Vaal River (VAL 1158 AK, larvae; VAL 1158 AL, ♀; VAL 1158 AM, ♀; all 20/7/60, F.M.C.). These ♀♀ appear to have lateral slits on abdominal segment V, rather like those of some Hydropsychidae though smaller and less obvious.

Genitalia (pl. XX, E):

The subgenital plate is reminiscent of *E. natalensis*, but the V-shaped indentation between the lobes is short, and the lobes are broader and turned farther outwards apically, with four long marginal bristles, and the ninth sternite is soft, there being no heavily sclerotized folds as in *natalensis*. There is a median point visible between the lobes, which appears to pertain to the vaginal apparatus and to lie dorsal to the subgenital plate. The usual apical papillae are present.

Larva (pl. XX, F–H):

Length 9–10 mm. Head capsule strongly patterned, particularly on the genae; 'muscle spots' very strongly marked; pattern on clypeus paler than that on the epicranial sclerites, consisting of pale greyish-brown lateral strips which extend back onto the triangular posterior part of the clypeus. The strong patterning on the epicranial sclerites is reminiscent of that in the larva of *oppidanus*, but is even darker except on the clypeus, which is much paler and differently shaped. The mandibles greatly resemble those of *thomasseti* and *oppidanus*, but are particularly large and strong (pl. XX, G, H); the spines in the right mandible are well developed, but the left mandible appears to lack spines entirely. Pronotum with faint brownish pattern, meso- and metanota with definite brown and yellow pattern, but lacking darker diagonal bars (pl. XX, F).

Similar larvae were also collected below the creamery and sewage outflows at Standerton on the Vaal River; also higher up the Vaal, and in a southern tributary, the Wilge River.

Ecnomus sp. C ♀

(Plate XX, c)

Three ♀♀, spurs 2, 4, 4, were bred out from larvae collected from the Waterval River at Roodebank, between Standerton and Leslie (VAL 1161 A, ♀; VAL 1161 B, ♀; VAL 1161 C, ♀; July 1960, F.M.C.). Four ♀♀ of the same species were collected in Amersfoort at light (VAL 977 C (2), 22/3/60, F.M.C.).

Genitalia (pl. XX, c):

Subgenital plate bluntly triangular, nearest to that of *natalensis* in shape, but with the apical points blunt and slightly bifid, each with four long bristles. The indentation between the lobes is also deeper and is basally squared; through it the small, rounded apex of the vaginal apparatus is visible. Dorsal to the subgenital plate a pair of sinuous, rugose tracts is visible by transparency in cleared specimens; these appear hairy at first sight, somewhat resembling those of *Ecnomus* sp. A. The subgenital plates of the two species are, however, quite different in shape. The rugose tracts appear to be connected with the ninth sternite and the vaginal apparatus, as in sp. A and *natalensis* ♀♀; these species all belong to the *natalensis* group of *Ecnomus* with spurs 2, 4, 4. The ♀♀ of *thomasseti*, belonging to the same group, also have rugose tracts, though somewhat different in appearance.

Only larval sclerites are available in this species, so a description of the larva will be postponed until entire specimens have been found. The sclerites resemble those of *thomasseti*, but are rather more strongly patterned.

The *Ecnomus* larvae described in this paper show resemblances to the larva of *E. relictus* Vaillant (1953), and to one of the larvae described by Corbet (1958, fig. 4, c). Several other patterned species of *Ecnomus* have been discovered in South Africa (two of them in the Transvaal); they will be described as they are correlated.

SUMMARY

An account is given of the *Ecnomus* species found in the Transvaal collections of the National Institute for Water Research. These include *E. kimminsi* sp. n. and new material of *E. oppidanus* Barnard. Females and larvae of several of the species are also described, and an account given of Barnard's *Ecnomus* material from South West Africa, now in the South African Museum.

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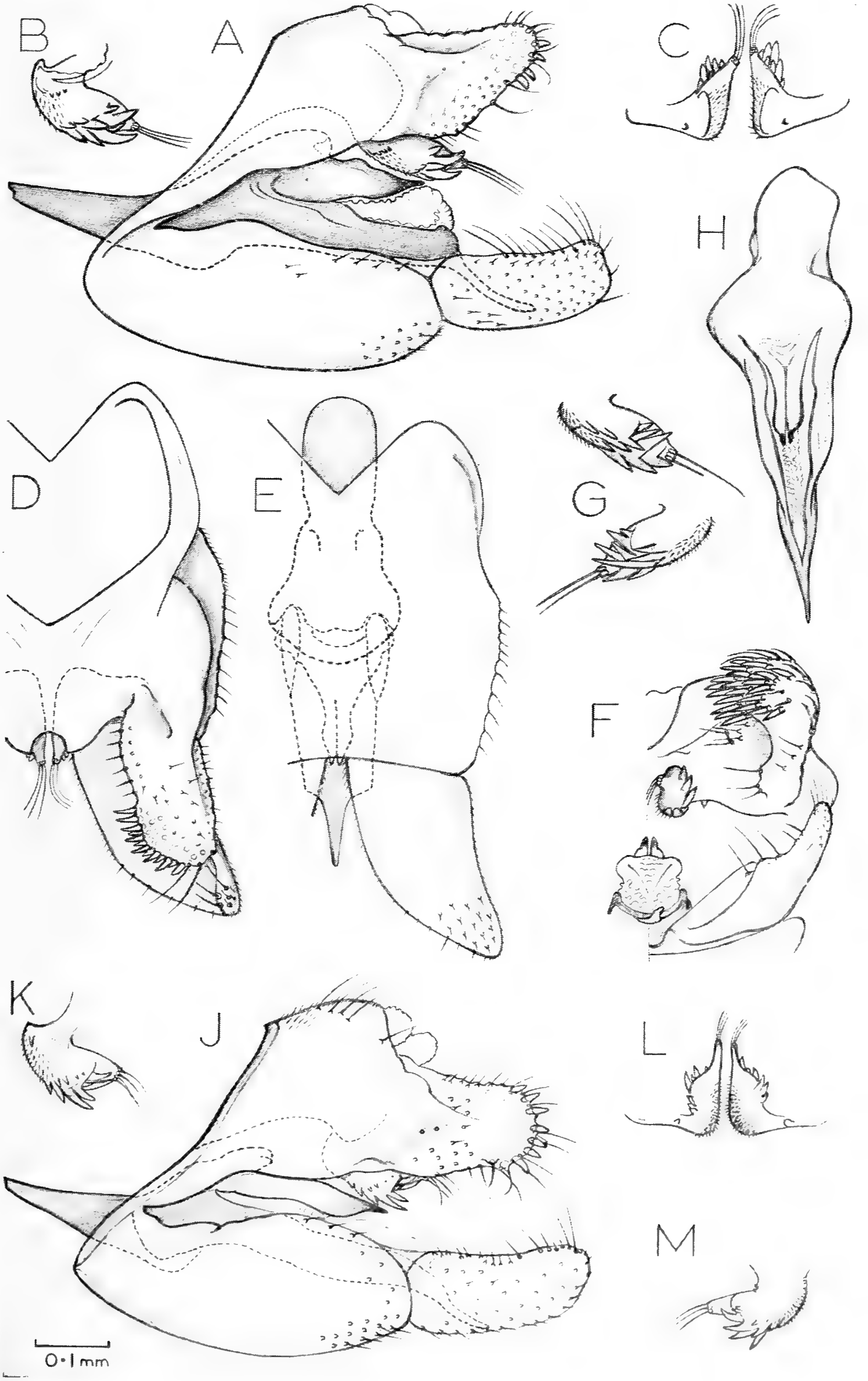
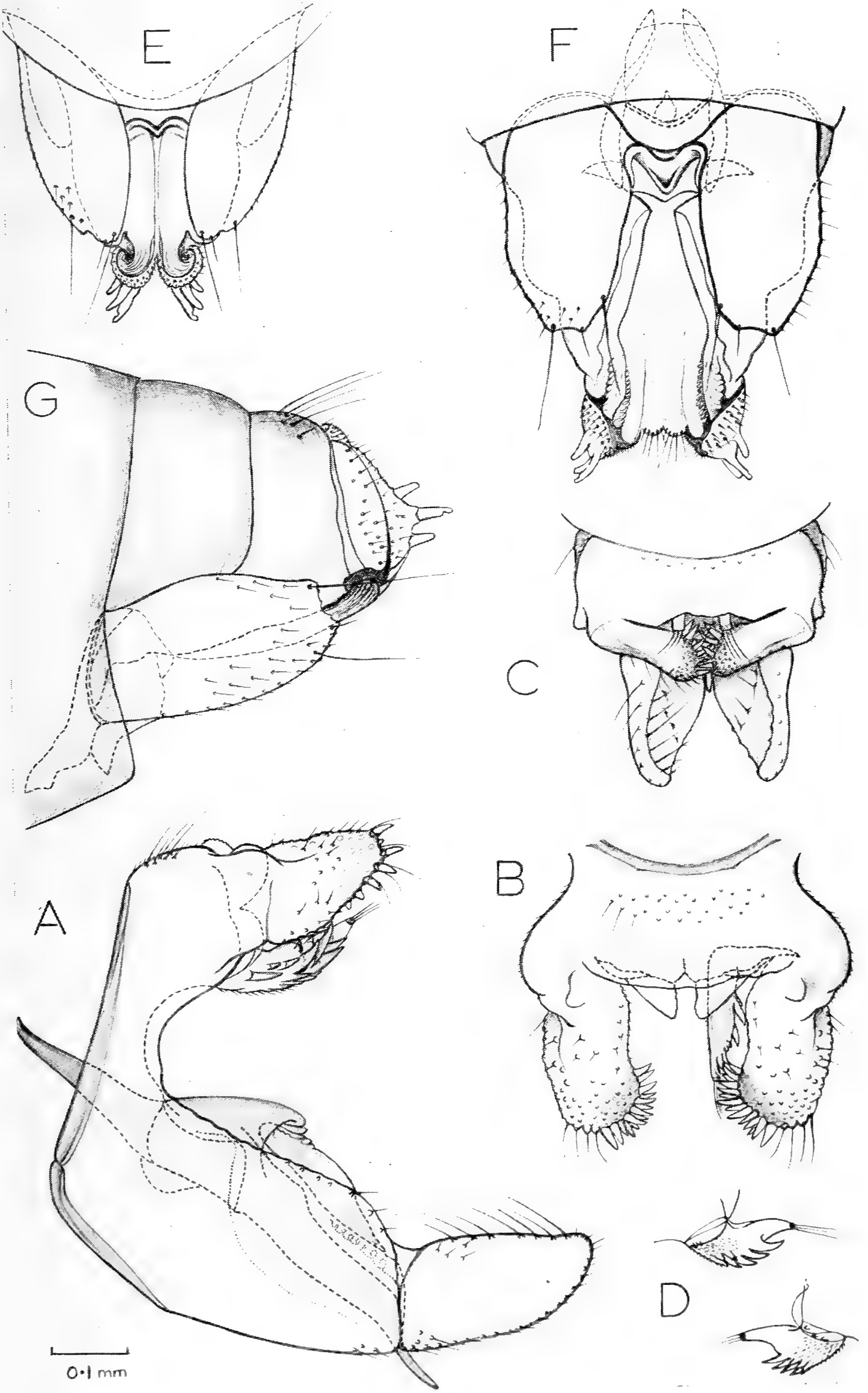
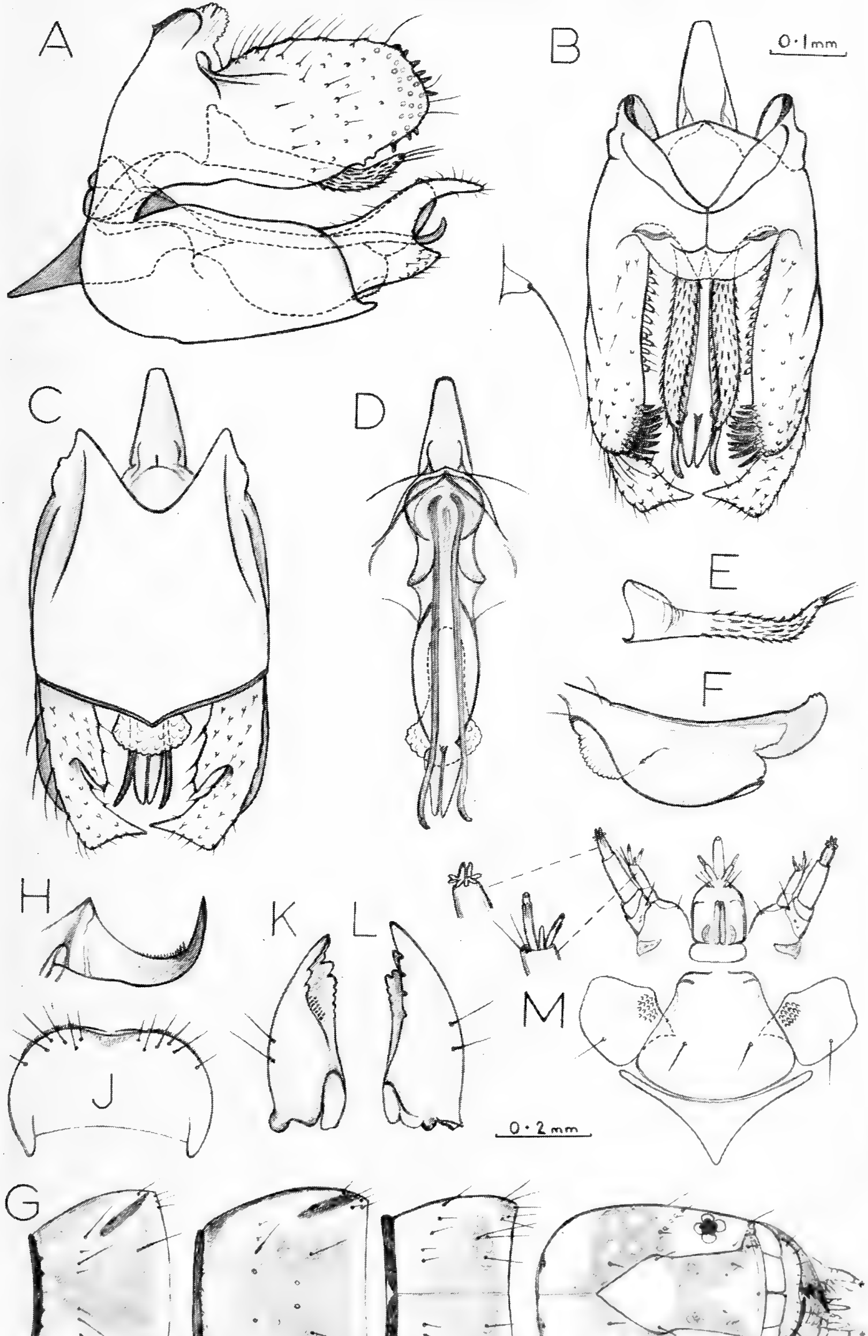


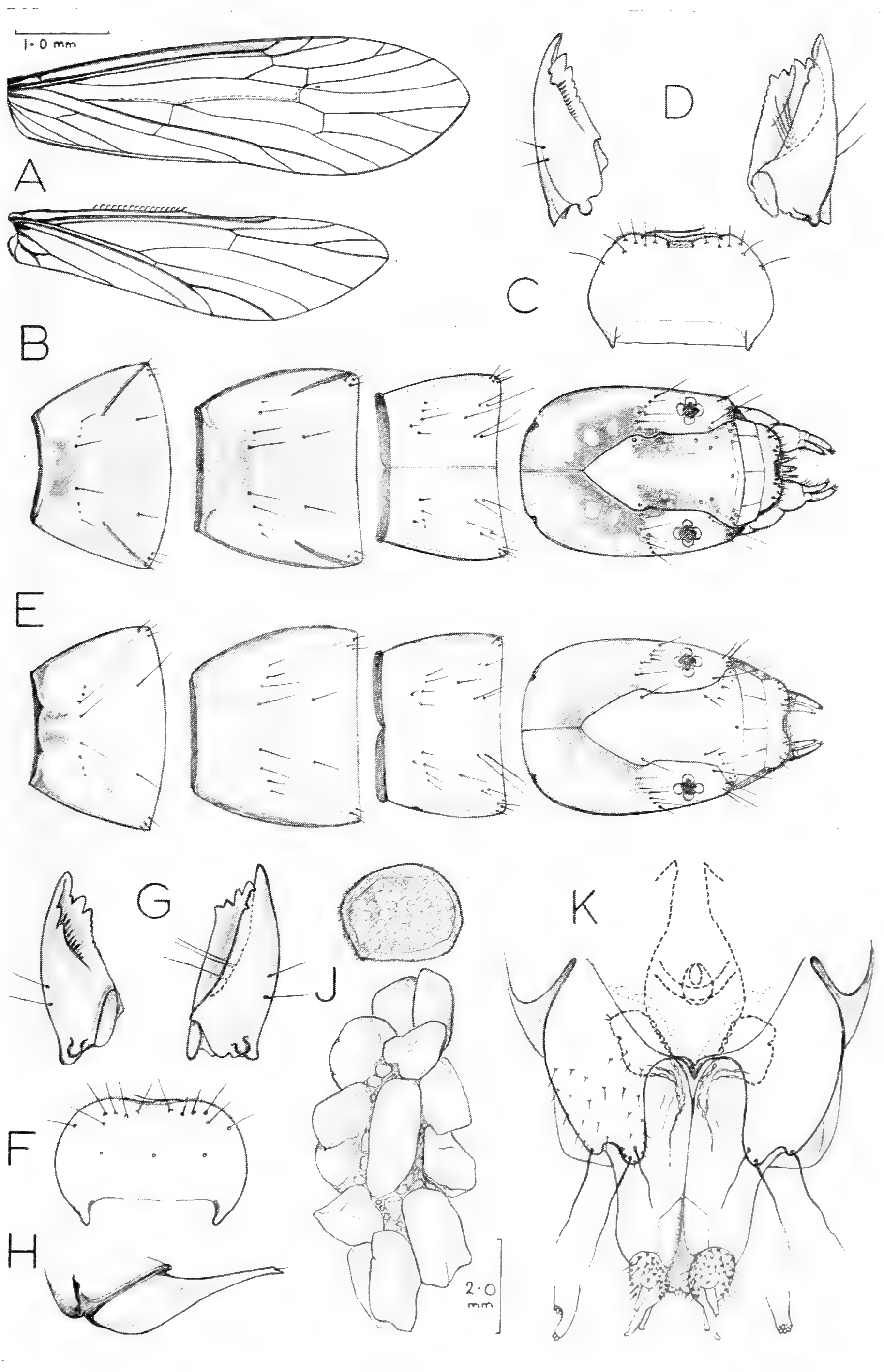
Ecnomus oppidanus Barnard. Holotype ♂: A, lateral view of genitalia; B, internal process of X (lateral); C, internal processes of X (dorsal); D, dorsal view of genitalia; E, ventral view of genitalia; F, posterior view of genitalia. Paratype ♂: G, internal processes of X; H, dorsal view of aedeagus and attached spines. ♂ from Sandspruit, Transvaal: J, genitalia, lateral view (VAL 456 G); K, internal process of X, lateral view, left side; L, internal processes of X, dorsal view; M, internal process of X, right side.



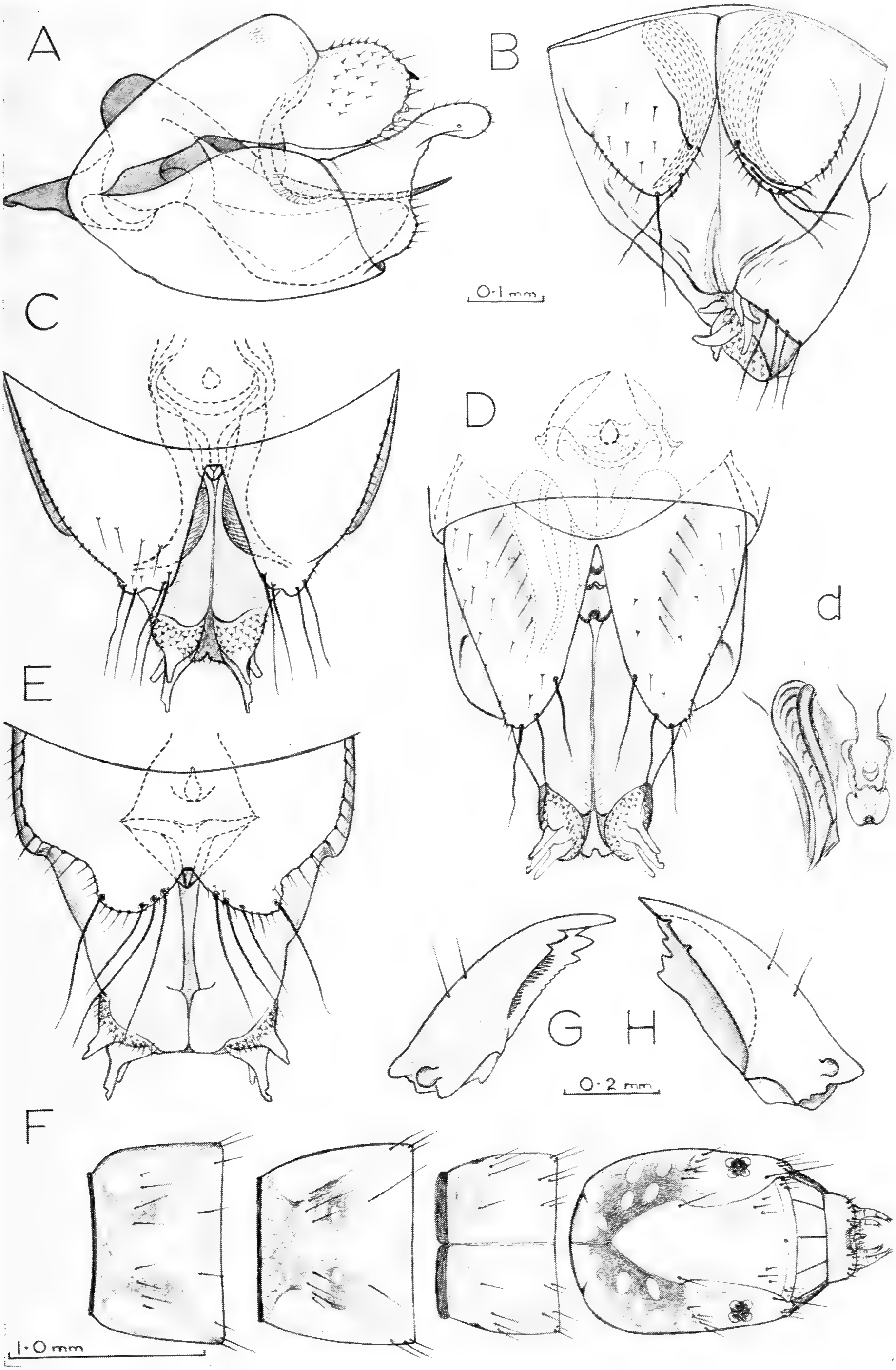
Ecnomus oppidanus Barnard. ♂ from Lake Chrissie (VAL 906 X (1)): A, lateral view of genitalia; B, dorsal view of genitalia (left internal process omitted). ♂ from Friedenheim Farm dam (LOW 157 A): C, dorsal view of genitalia, outer lobes of X tucked in. ♂ from Friedenheim Farm dam (LOW 168 A): D, internal processes of X, lateral view. Probable ♀♀ of *E. oppidanus* Barnard: ♀♀ from Lake Chrissie (LOW 179 B (3)): E, ventral view of contracted genitalia; F, ventral view of expanded genitalia; G, lateral view of expanded genitalia.



Ecnomus kimminsi sp. n. Holotype ♂ from Vaal River (VAL 860 F (2)): A, lateral view of genitalia; B, dorsal view of genitalia (with setate papilla from within lobe of X further enlarged); C, ventral view of genitalia; D, dorsal view of aedeagus; E, lateral view of internal process of X; F, lateral view of aedeagus. Larva from Klein Vaal (VAL 1022 M): G, dorsal view of thoracic tergites and head; H, anal claw (twice magnification of G); J, dorsal view of labrum; K, L, ventral view of right and left mandibles; M, ventral view of maxillae and labium (tips of maxillary palp and maxilla further enlarged), with gular sclerite etc.



Ecnomus kimminsi sp. n.: A, fore- and hind-wings of holotype ♂. *E. oppidanus* Barnard, probable larva: B, head and thoracic nota, dorsal view; C, labrum; D, right and left mandibles, ventral view. *E. thomasseti* Mosely, larva: E, head and thoracic nota, dorsal view; F, labrum; G, right and left mandibles, ventral view; H, process of trochantin; J, pupal case, with sieve plate further enlarged; K, ventral view of ♀ genitalia, with tips of papillae further enlarged. (Note: Scale of wings and pupal case indicated, otherwise scales used same as in the other plates.)



Ecnomus kunenensis Barnard: A, holotype ♂, lateral view. *Ecnomus* sp. A, ♀: B, ventral view of genitalia. *Ecnomus* sp. C, ♀: C, ventral view of genitalia. *Ecnomus natalensis* Ulmer, ♀: D, ventral view of genitalia; *d*, sclerotized part of inner plate. *Ecnomus* sp. B, ♀: E, ventral view of genitalia; F, dorsal view of head and thoracic nota of larva; G, H, ventral view of right and left mandibles of larva.

[CONTINUED FROM INSIDE FRONT COVER

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SYNONYMY. Arrangement according to Schenk, E. T. & McMaster, J. H.: *Procedure in taxonomy*. 2nd ed. Stanford, Stanford university press, 1948. Bibliographic references modified.

'I. *Synonymy arranged according to chronology of names.*—All published scientific names by which a species has been previously designated (subsequent to 1758) are listed in chronological order, with bibliographical references to all descriptions or descriptive citations following in chronological order after each name. . . .

B. *Form of bibliographic references to synonymic names.*—The first reference following any name in the synonymy should be to the earliest citation of that name. This should be followed by references to all subsequent citations of the same name, arranged in chronological order. . . .'

Bibliographical references modified to consist of author's name, date of citation, pagination and illustrations (plates and figures).

Example:—

Eulalia (*Steggoa*) *capensis* Schmarda

Eulalis capensis Schmarda 1861, p. 86, pl. 29, fig. 231. Willey 1904, p. 259.
Eulalia viridis var. *capensis* McIntosh 1903, p. 34. Day 1953, p. 30.
Eulalia viridis (*non* Muller) Ehlers 1913, p. 455. Day 1934, p. 30.

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ANNALS

OF THE

SOUTH AFRICAN MUSEUM

VOLUME XLVI

PART XIX

SOME NEW CADDIS FLIES (TRICHOPTERA) FROM THE WESTERN CAPE PROVINCE

IV: SOME HYDROPTILIDAE

By

K. M. F. Scott

National Institute for Water Research
South African Council for Scientific and Industrial Research

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[Accepted November 1962]

(With 3 plates)

Contents

Introduction

This is the fourth paper in the present series; in it a new species of *Orthotrichia* from the Great Berg River is described, together with its larva and larval and pupal cases. The other Hydroptilidae collected along the same river are commented upon, and the larva of *Oxyethira velocipes* (Barnard) described.

Methods of work have been the same as described in earlier papers (Scott, 1955, 1958, 1961). Many of the Hydroptilidae referred to were collected during the survey of the Great Berg River (Harrison and Elsworth, 1958; Harrison, 1958); further specimens have since been taken in the same area. The new species, *Orthotrichia barnardi* sp. n., was first correlated by Dr. A. D. Harrison, from larvae inhabiting the small cases resembling caraway seeds illustrated by Dr. Barnard in his work on South African caddis flies (Barnard, 1934, p. 391). Since then further specimens have been bred out, from similar cases taken from various parts of the Berg River; the resulting imagos all appear to belong to the same species. The caraway seed case is typical of genus rather than species, as is usually the case in the Hydroptilidae; a different species has been bred out from very similar cases elsewhere in South Africa, this will be described in a later paper. The immature stages of the two species, though superficially alike, do show recognizable differences. The new species is named in honour of Dr. K. H. Barnard, who first discovered the pupal cases.

Sincere thanks are again due to Dr. A. D. Harrison (now at the University College of Rhodesia and Nyasaland) for much of the material, to Mr. D. E.

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Kimmins of the British Museum (Natural History) for his very kind advice, and to Professor J. H. Day of the Zoology Department of the University of Cape Town in whose department this work was carried out.

DESCRIPTIONS OF SPECIES

Genus ORTHOTRICHIA Eaton

Eaton, 1873, 141.
McLachlan, 1880, 518.

Orthotrichia barnardi sp. n.

(Plate XXI, A–G; plate XXII, A–M)

A minute, dark, hairy insect with a median longitudinal pale streak down head, thorax and wings when at rest. Spurs 0, 3, 4. No ocelli. The larvae and pupae inhabit small, dark, seed-like cases.

Imago (♂, described when alive, ♀ similar) (pl. XXI, A–G; XXII, A–C): *Head* (pl. XXI, G): Eyes large, black; dense tuft of peach-coloured setae on face between eyes, extending back between bases of antennae; main part of vertex bare, but apical part with some setae, and the whole entirely obscured by these and the facial setae and by two dense, bushy tufts of setae which arise from a pair of large, raised warts on the back of the head. These tufts are mainly pinkish, with a few black lateral setae. Antennae with 28–30 segments (24–25 in ♀), about half wing length, pinkish fawn with grey annulations (setae thickened and shaded); two white bands near apex, each of two segments. Maxillary palps five-jointed, pinkish with some grey setae anteriorly, first and second joints small, the second with long stiff bristles; labial palps three-jointed, pinkish. *Thorax* (pl. XXI, G); prothorax reduced, with a small pair of median warts and a larger pair of lateral warts; mesonotum with scutum covered with recumbent setae, postnotum and scutellum with a dense fur of erect setae; metanotum with a median band of recumbent setae flanked by lateral tracts of erect hairs; all thoracic setae pinkish except for tufts of black hairs on tegulae and on antero-lateral corners of pronotum. *Legs*: very hairy, pinkish, with some grey setae anteriorly (pinkish when seen from below, grey from above). Mid- and hind legs with tibiae expanded and bearded. Spurs 0, 3, 4, hairy, normal, the inner preapical spurs on the hind legs very long. *Wings*: forewings very densely hairy, almost entirely covered with erect, somewhat thickened, blunt-tipped setae; mainly black, with a broad streak of pale peach-coloured setae along the hind margin, producing a conspicuous pinkish longitudinal stripe down the middle of the back when the insect is at rest. This stripe starts from the tufts on the head and narrows gradually, merging posteriorly with the thick peach-coloured fringe at the tips of the forewings; it is partially interrupted by two blackish patches near the middle. There are also several peach-coloured streaks on the wings, particularly towards and along the anterior margin. Fringe pink and black, brindled in appearance in some parts, very long and dense (wider than wing in widest part). Hind wings greyish with extremely long, silky, pinkish-grey fringe (three to four times width of wing). *Abdomen* pale green, genitalia brown. In specimens which have dried out for some time, the colouring fades to a brownish black marked with buff, with a pinkish tinge in places; abdomen grey-green; setae on legs and thorax pale gold. In spirit specimens the general appearance is brown and yellowish-gold.

Wings (pl. XXII, A): ♂ forewing 3·0 mm., ♀ same. ♂ forewing without lobe, with forks 1, 2, 3: R_1 with long cross-vein to Rs which makes it appear basally double; R_3 does not arise from stem of R_{4+5} as in *O. sanya* Mosely, *O. spinicauda* Kimmins and *O. straeleni* Jacquemart, but in the normal way. There is a line of long, stiff hairs on the ventral side of the wing, along the basal half of Cu_2; no black scales along subcosta. ♂ hind wing with fork 2 only. ♀ forewing with venation very similar to that of ♂, but somewhat obscured by thickened, pitted bands to which upright setae were evidently attached; similar, narrower bands also occur between several of the apical veins. Sc shorter than in ♂; R_3 incomplete basally. ♀ hind wing also very similar to that of ♂, but R_1 incomplete basally, and cross-vein joins Rs and M_{1+2} instead of Rs and M; pitted bands also present between some of the veins, particularly in the apical forks.

♂ *genitalia* (pl. XXI, A–F): ♂ genitalia of the usual complex asymmetrical type. Sixth sternite with a tuft of hair covering a spatula-shaped process in the mid-ventral line; seventh sternite with a pointed process. Ninth segment largely withdrawn within the eighth. Ninth tergite strongly sclerotized, wider posteriorly than anteriorly, from the side cut away anteriorly, side-pieces being present in the posterior half only; these sweep round to join the claspers, the two sides being united ventrally by a membranous area which is bounded laterally by longitudinal ventral sutures, as Nielsen describes for *O. tetensii* (Nielsen, 1957) (see pl. XXI, F). From these side-pieces a pair of asymmetrical lateral processes arise, each tipped with a long seta, the process on the right being the longer. The claspers are short, narrow, leaf-like, with an irregular margin, the left one being larger than the right; each has a curved, finger-like projection forming the inner tip, and a stout seta on the outer edge. In dorsal view the ninth tergite is fused onto the tenth, which forms a narrower, lightly sclerotized hood, widening basally to form a sheath for the aedeagus; the hood bears a sharp, laterally directed spine near the right side of the apex. This spine is connected to a long, curved, blunt-ended process beneath the hood. Another strong, sinuously curved, backwardly-directed spine arises near the junction of IX and X in the mid-dorsal line; this is conspicuous in lateral views. The apical spine appears to correspond to the right-hand, laterally bent spine in *O. tetensii*, but there is no corresponding one on the left, unless indeed the curved dorsal spine should represent it, or even possibly the blunt-ended process beneath the hood. The aedeagus is long and slender, widening anteriorly, with a spiral titillator coiled loosely round it (pl. XXI, E); when fully extended the aedeagus may be as long as the entire abdomen, about 1·5 mm.; according to Nielsen (1957) it is incapable of retraction when once extended. Within the dorsal hood, above the aedeagus, there are two spine-like parameres; the one on the left side is long and slender, running the full length of IX and X and projecting slightly beyond the apex of the hood; the one on the right is less than half as long, arising near the junction of IX and X and projecting from the right side close to the curved process of the basal plate. Both appear to be connected with an internal sclerite or sclerites, shown by dotted lines in plate XXI, D. Below the aedeagus there is an elongated structure apparently connected to a narrow basal apodeme; it widens and divides posteriorly into two branches, each tipped with a stout seta. This forked structure can be clearly seen in a cleared specimen in ventral view (pl. XXI, F), and the two apices are visible projecting beyond the ends of the claspers. According to Nielsen (1957) the forked structure may possibly represent the dorsal branches of the coxopodites of the claspers.

♀ *genitalia* (pl. XXII, B, C): The ♀ genitalia show clear relationship to those of *O. spinicauda* Kimmins (1958). The sixth sternite has a small, sharply pointed, median process; seventh sternite normal. Eighth segment, as in *spinicauda*, forms a complete ring, the dorsal and lateral parts with an irregular margin fringed with stout setae, the sternite forming an asymmetrical subgenital plate, partly membranous, which appears to enclose a duct; apex of plate strongly sclerotized and apparently connected to the membranous part of IX dorsal to it. Tergite of IX forming a lightly sclerotized hood, partly withdrawn into the eighth segment; sternite membranous, bearing a pair of subtriangular sclerotized plates which are usually pressed against the dorsal hood; they may, however, stand away from it, being attached along the proximal margin; proximal and lateral parts of these plates are more heavily sclerotized than the rest, apical margin irregular, pale, with a few small setae. The dorsal hood narrows just beyond the plates, and the terminal portion, rounded and with a small pair of rod-like cerci and a few setae, appears to represent the tenth segment.

This species resembles most other African species so far described in possessing a bifid structure beneath the aedeagus, a spiral titillator accompanying the aedeagus, and partly fused claspers; like *O. aequatoriana* Kimmins and *O. alboguttata* Jacquemart it lacks the row of black scales between costa and subcosta in the ♂ forewing. It shows most resemblance to *O. spinicauda* Kimmins, but can easily be distinguished from that species by its much larger size, wing differences, and, in the ♂ genitalia, by the strongly curved dorsal spine and the slender, upcurved, lateral processes. The ♀ also resembles *spinicauda*, but is easily recognizable in ventral view by the brown scale-like sclerotized plates.

Distribution

Case-bearing larvae of this species have been found in the upper part of the Great Berg River from late winter to early autumn, mainly on stones in current and on the trailing *Scirpus digitatus* on such stones, also in slower-flowing reaches in pools with stony bottoms, and sometimes on marginal vegetation. Pupae and imagos appeared in the Mountain Torrent Zone (Station 1) in early autumn (March), and in the foot-hills (Stations 3 and 5) in spring and summer

(September to December). Larvae were also found much lower down the river in the stony run at Piketberg (Station 18) in the late summer. No larvae were found during the winter floods. Early instars are not at present identifiable, and many even of the smaller case-bearing larvae passed right through the nets used. Further details of the habitat will be found in Harrison and Elsworth (1958) and Harrison (1958).

Specimens (imagos)

All except GBG 770 H were collected from the Great Berg River as larvae or pupae, either from stones in current or *Scirpus* in current, and bred out in the laboratory. GBG 770 H was caught in the field, on the fish-ladder in Tulbagh Kloof, Klein Berg River (a tributary of the Berg).

GBG 542 A–F, 4 ♂♂, 2 ♀♀ (Stn. 1, March 1952, A.D.H.).
GBG 770 H, 1 ♂ (Tulbagh Kloof, 23/10/53, A.D.H.).
MISC 70, 2 ♂♂ (Stn. 3, December 1954, K.M.F.S.).
MISC 71, 2 ♀♀ (Stn. 3, December 1954, K.M.F.S.; one pinned).
MISC 85, 1 ♂ (Stn. 3, December 1954, K.M.F.S.).
MISC 122, 1 ♂, 2 ♀♀ (Stn. 3, October 1956, K.M.F.S.).
MISC 123, 1 ♂, 1 ♀ (Stn. 3, October 1956, K.M.F.S.).
MISC 134, 1 ♂ (Stn. 3, October 1959, K.M.F.S.).

(Catalogue numbers all refer to the collections of the National Institute for Water Research.)

The *holotype* ♂ (GBG 542 A) and paratypes (GBG 542 B, ♂, and MISC 71, ♀) will be placed in the South African Museum, and paratypes (MISC 70, 2 ♂♂, and MISC 123 A, 1 ♀) in the British Museum (Natural History). The rest of the material, together with larval and pupal specimens, is in the collections of the National Institute for Water Research.

Immature stages

Larval cases found vary in length from 1·5 to 2·5 mm.; none was found smaller than this. Case-bearing larvae are in their 5th instar according to Nielsen (1948), and increase considerably in size in this instar, adding to their cases as they grow. Similar-looking free-living Hydroptilid larvae have been seen, probably earlier instars of this species.

Larval case (pl. XXII, E)

The mature larvae live in small, brown, bivalve cases made of silky secretion. These resemble caraway seeds, and each has one pair of dorso-lateral ridges. The cases show striae, evidently resulting from the mode of formation from threads of secretion; the line of junction of the two halves of the case is mid-ventral, where the two 'valves' overlap slightly.

Mature larva (pl. XXII, D–L)

Length of larva slightly less than that of case, up to about 2·3 mm. Head brown, with paler areas round the fairly large eyes; lens-like areas present in cuticle above eyes (pl. XXII, F). Clypeus wide, posteriorly triangular, one pair of slight lateral indentations. Labrum with an asymmetrical median point; mandibles large, blunt, with a single apical tooth below which is an indentation bounded proximally by a tooth or point, the broader left mandible with an inner brush of slender spines. Gular sclerite Y-shaped, a small triangular anal gular sclerite also present (pl. XXII, L). Pro-, meso- and metanota (pl. XXII, F) each with a pair of brown sclerotized plates, posterior margins darkened; narrow dark brown sternites also present (posterior or anal sclerites only). Pronotum longest, mesonotum shorter, metanotum shortest, each with a fringe of short, stiff setae interspersed with longer setae along the anterior border. Legs small, brown, much like those described by Nielsen for *O. tetensii*; forelegs shorter and stouter than mid- and hind legs, which are sub-equal, the hind legs being the longer (pl. XXII, G, H, J). Abdomen large, thick, white, more dorso-ventrally than laterally compressed, with clear segmentation; segment 1 small, with a few dorsal setae, largely covered by segment 2, segment 5 largest. Abdomen fits so closely into the case that the latter must be split open to extract the larva. No gills, no lateral line. Ninth segment with strongly sclerotized semicircular brown anal sclerite, bearing eight long marginal setae and two shorter, stout, curved bristles. Anal appendages small, each with a large basal sclerite and a minute hooked anal claw (pl. XXII, D, K).

The larva shows clear resemblances to that of *O. tetensii* Kolbe as figured by Nielsen (1948) and Ulmer (1957); there are, however, various minor differences, and the cases of *O. tetensii* have paired lateral ridges, in the fully grown specimens at any rate. There are also resemblances to the larva of *Orthotrichiella ranauana* Ulmer (1957). Ulmer distinguishes the larvae of *Orthotrichia* and *Orthotrichiella* on a basis of claw length as related to length of tarsus, and of antenna length as related to length of left mandible (1957, p. 182). The larva of *Orthotrichia barnardi*, however, has not quite the proportions of either, though nearer to the latter; the foreclaw is slightly shorter than the tarsus, and the claws of mid- and hind legs only half, or less than half, the length of the tarsi; length of antenna about a third of the length of the left mandible. The adults, however, definitely appear to fall into the genus *Orthotrichia*.

The larva is easily distinguishable from the species figured by Corbet (1958, fig. 4, *e–f*), as it lacks the dark, patterned metanotum and the dark mark on the clypeus, and the case has one, not two, pairs of dorso-lateral ridges. In comparison with the figures of the larva of *O. straeleni* (Jacquemart, 1957, figs. 135–154), the thoracic nota of *O. barnardi* lack the broad, darkened bands, and the sclerite on IX is much more strongly sclerotized; the larva of *O. straeleni* appears to make a plain case without lateral ridges.

Pupal case (pl. XXII, M)

The pupal cases have terminal holdfasts which anchor them firmly to *Scirpus* plants or to stones. The larval cases are utilized in their formation, with additional material closing them at both ends; they are opened by a V-shaped dorsal slit when the mature pupa emerges. The larval sclerites are retained in the end of the pupal case opposite to this opening.

Ross (1944, p. 117) states that the pupae of the Hydroptilidae are very uniform in structure and no characters have been found to key them to genus; no description of the pupa is therefore given; it is of the usual Hydroptilid type.

Hydroptila capensis Barnard

Hydroptila capensis Barnard 1934, 391, fig. 51, *a–i*. Harrison and Elsworth, 1958, Tables 19, 21, 24. Harrison 1958, p. 263.

In the Great Berg River, the larvae and pupae of this species occurred mainly in the foot-hills, often in quiet tributary streams (Stations 1, 9, 10, 13 and 19 on main river, also Station 4 on the Franschhoek stream at La Motte, in the Dwars River at Groot Drakenstein, in the Klein Berg at the Tulbagh Barrage, and in the Kuils River near Piketberg), and principally at times of the year when the rivers were low and running slowly and patches of *Spirogyra* had been able to develop. Thus most were found during the summer and autumn months, when the winter floods were over and the flow had slowed down. Numbers encountered were not generally large, excepting in early autumn one year (March 1953) at Wellington (Station 12), where slight organic pollution had resulted in a blanketing growth of *Spirogyra* among the stones in the stickles. The river was low and flow sluggish at the time. It seems that the limiting factor is current and its effect on algal growth rather than temperature, because numbers of larvae and pupae were also found in June (early winter), in this case, however, in a very small tributary brook that runs down behind the Forest Station at La Motte, where they were living on alga-covered stones in a small pool sheltered from flooding by banks of sedges.

This species is one of the few that may appear in temporary water in this country; the Kuils River does not run during the dry season (larvae and pupae were found there in spring—October), and the author has also found this species in temporary mountain streams and a recently filled farm dam in the same area.

H. capensis is typically found in association with *Spirogyra*, with filaments of which the larval and pupal cases are covered, but such larvae cannot be identified as *H. capensis* on case alone without correlation, at least with mature ♂ pupae, since specimens bred out in the Transvaal have shown that *H. cruciata* Ulmer also covers its cases with *Spirogyra* (material supplied by Mr. F. M. Chutter; this will be described in a later paper).

Hydroptila sp.

Hydroptila sp. Barnard 1934, 393, fig. 51, *j*.
'*Hydroptila* sp. A' Harrison 1958, p. 263.

Small numbers of larvae were also found with cases similar to those described by Barnard (1934); the bivalve cases are made of secretion covered with minute sand grains. Similar larvae collected in the Transvaal have been bred out by Mr. F. M. Chutter, the imagos proving to be a new species of *Hydroptila*, but it cannot be assumed that the Berg River specimens belong to the same species without correlation, a difficult matter as the larvae are very small and far from common. A few were found in backwaters at Station 3, Berg River, in spring and summer, and among stones in the stickles in autumn.

Oxyethira velocipes (Barnard)

(Plate XXIII, A–K)

Argyrobothrus velocipes Barnard, 1934, 393, figs. 52, *a–j*.
Argyrobothrus velocipes Barnard, Harrison and Elsworth 1958. Harrison 1958.
Oxyethira velocipes (Barnard), Kimmins 1962.

Distribution

Larvae belonging to this species construct flat, transparent, flask-like cases, and were found from Station 1 in the Mountain Torrent Zone of the Berg River right down to the last station before the estuary. They appeared among the marginal vegetation in spring, summer and autumn, when the river was slowing down, and sometimes became locally common, showing a sporadic distribution which evidently depended on amount of shelter and extent of algal growth among other factors. This might be expected from the feeding habits, beautifully described by Nielsen (1948). The larvae were identified by correlation in the laboratory, imagos all proving to be *O. velocipes* (Barnard). As Barnard did not describe the larva of his species, but only figured the pupal case, a description of the larva and case is given below.

Larval cases (pl. XXIII, A, B)

The cases of the younger fifth instar larvae have plain, smooth edges; as the larva adds to the case, however, it does so in such a manner that each new section added is evidently commenced some little distance within the old posterior opening. As a result of this, the cases of older larvae show a series of strong lateral serrations along each side of the case. In this they differ from the cases of *O. costalis* described by Nielsen (1948), except for one aberrant specimen (Nielsen, 1948, fig. 54, K). In *O. costalis* the smooth, plain shape is retained, and the same case used for pupation. Larval cases of *O. velocipes* show the remnants of material used for the ring-shaped fixing belt, just as in *O. costalis*. The larvae are orientated in the cases with head to the narrow end with the small, circular opening; the wide, flat end usually remains closed owing to the shape of the case, it can however be pushed open.

Larval cases vary in length from 1·3 to 4·5 mm.; the fifth instar larvae inhabiting them range from 1·3 to 2·2 mm. in length; as they increase in size the abdomen becomes proportionately larger in comparison with the rest of the body, always, however, retaining its laterally compressed shape, with the posterior end curled round ventrally.

Fifth instar larvae (pl. XXIII, A–K)

Plate XXIII, A, illustrates a mature larva in its case; as, however, in such specimens the thorax and 1st abdominal segment are largely obscured by the 2nd abdominal segment, a slightly younger 5th instar larva has been chosen to illustrate details of structure (pl. XXIII, C–K).

Head pale yellowish; eyes fairly large, under lens-like areas of cuticle (pl. XXIII, D); clypeus with one pair of lateral indentations, pointed antero-lateral corners, and triangular posterior area, three pairs of the bristles on the clypeus are thick, dark brown, and expanded towards the base. Labrum with a pair of pointed antero-lateral spines, an apparently soft central projection, and two larger and eight smaller setae, all of which are decumbent. There are tufts of setae on the ventral side. Both clypeus and labrum show strong resemblances to those of *O. costalis*. Antennae fairly long, with rounded base, slender sensilla, and long lateral seta. There is one pair of extremely long, slender setae, situated just above the eyes; the other setae on the head are much shorter and also slender (except for the thickened ones on the clypeus). The mouthparts usually seem to be carried tucked inwards. Mandibles (pl. XXIII, H): the right mandible is simple, with 3 small apical teeth; the left mandible has one apical tooth, below which are two broad, projecting, cutting edges, each with about 4 low, blunt teeth. There appears to be a deep cavity between these, from which arises a row of stout spines; the dorsal cutting edge is shorter than the ventral, its base being scooped out to show a penicillus of slender hair-like spines. These two lots of spines presumably correspond to the two brushes of setae in the left mandible of *O. costalis*, described by Nielsen. Gular sclerite (pl. XXIII, J), a scooped-out triangle with transverse thickenings; a small triangular anal gular sclerite also present. *Thorax*: Pro-, meso- and metanota lightly sclerotized, pale yellowish, the two latter narrower than the former, with pointed, darkened, lateral corners and few setae; pronotum wider, with rounded anterior corners and more setae. *Legs*: forelegs short, mid- and hind legs long and slender, subequal, not, however, increasing in size as the abdomen grows during the fifth instar; arrangement of setae as illustrated (pl. XXIII, E, F, G); legs pale yellowish to brownish in colour, the mid- and hind legs with a brownish band across the femora. *Abdomen* whitish, strongly laterally compressed, segmentation obvious; in the mature larva segment 2 hides most of segment 1 and the meso- and metanota. Ninth segment with a pale yellowish sclerite and a few strong setae. Anal prolegs fused to form 10th segment; small anal claws present; each claw appears to consist of one large hook and four smaller ones, but the smallest are difficult to distinguish clearly. No gills, no lateral line.

Pupal case (pl. XXIII, L)

The pupae are also found in flat, transparent cases; these have, however, smooth, plain edges like those of the youngest fifth instar larvae, and appear to be freshly made, not altered larval cases. The cases are anchored to a leaf by four discs made of secretion, two at each end, and the rounded opening is closed by a fluffy plug of secretion as in *O. costalis*, not by a domed cap as in *O. incana* (Ulmer, 1957, fig. 277). The other (wide) end is also closed off, by a narrow strip of the same material, making an oval space in which the pupa lies. The pupae are orientated the opposite way round to the larvae, with the head at the wide end of the case. The larval sclerites are found within the case, at the narrow end.

Summary

A new species of *Orthotrichia*, *O. barnardi* sp. n. (Trichoptera: Hydroptilidae), is described from South Africa, together with its larval stages. The larva of *Oxyethira velocipes* (Barnard) is also described, and an account given of Hydroptilid material collected from the Great Berg River, Western Cape Province.

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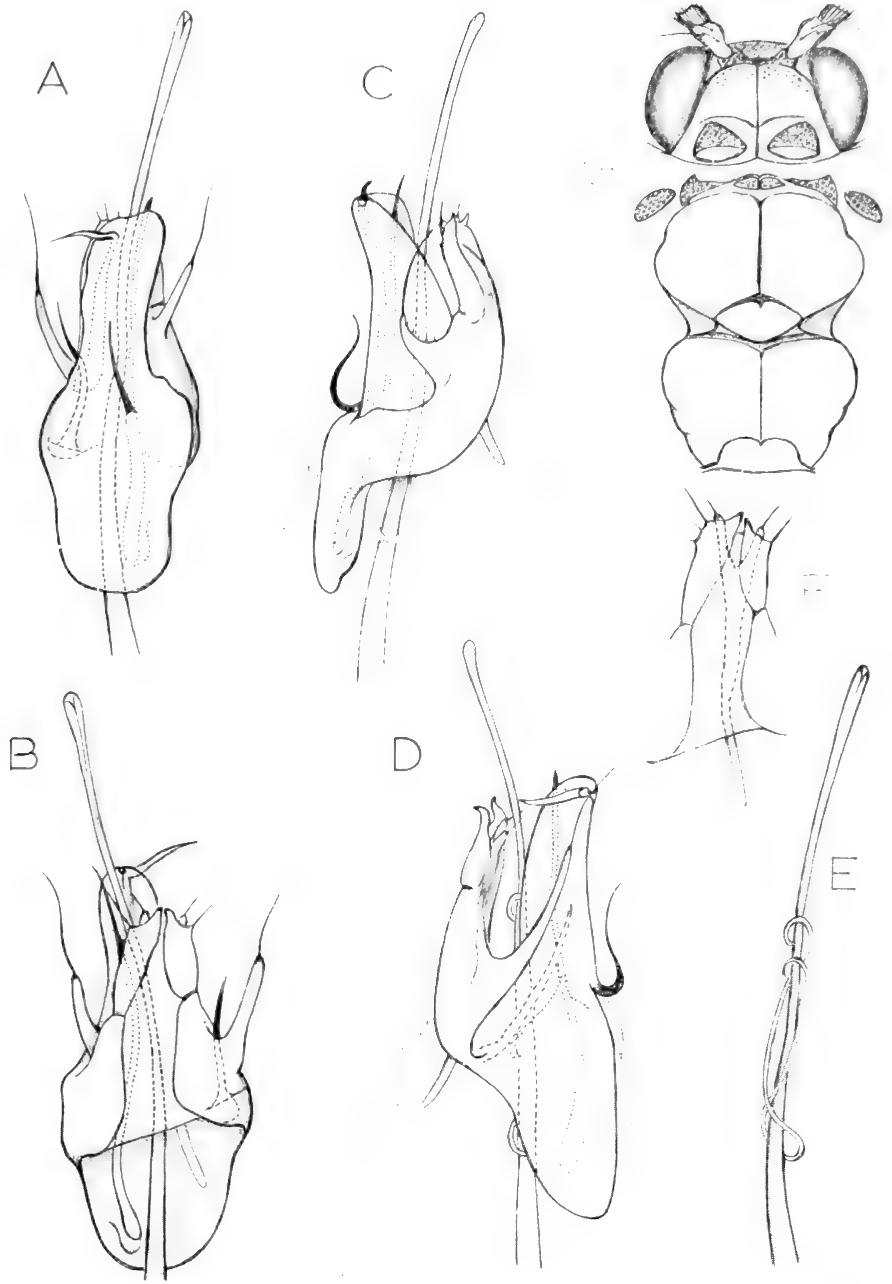
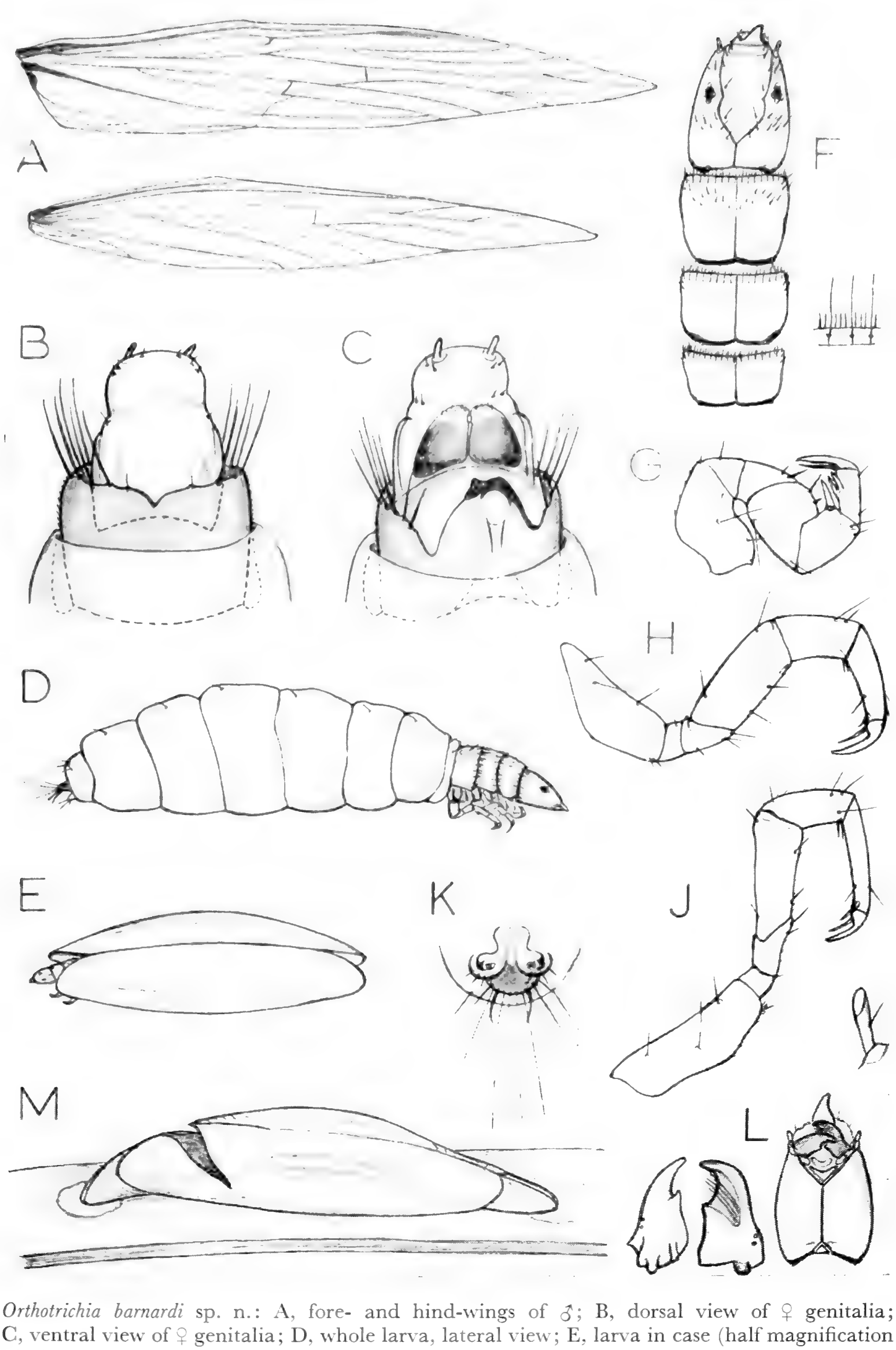
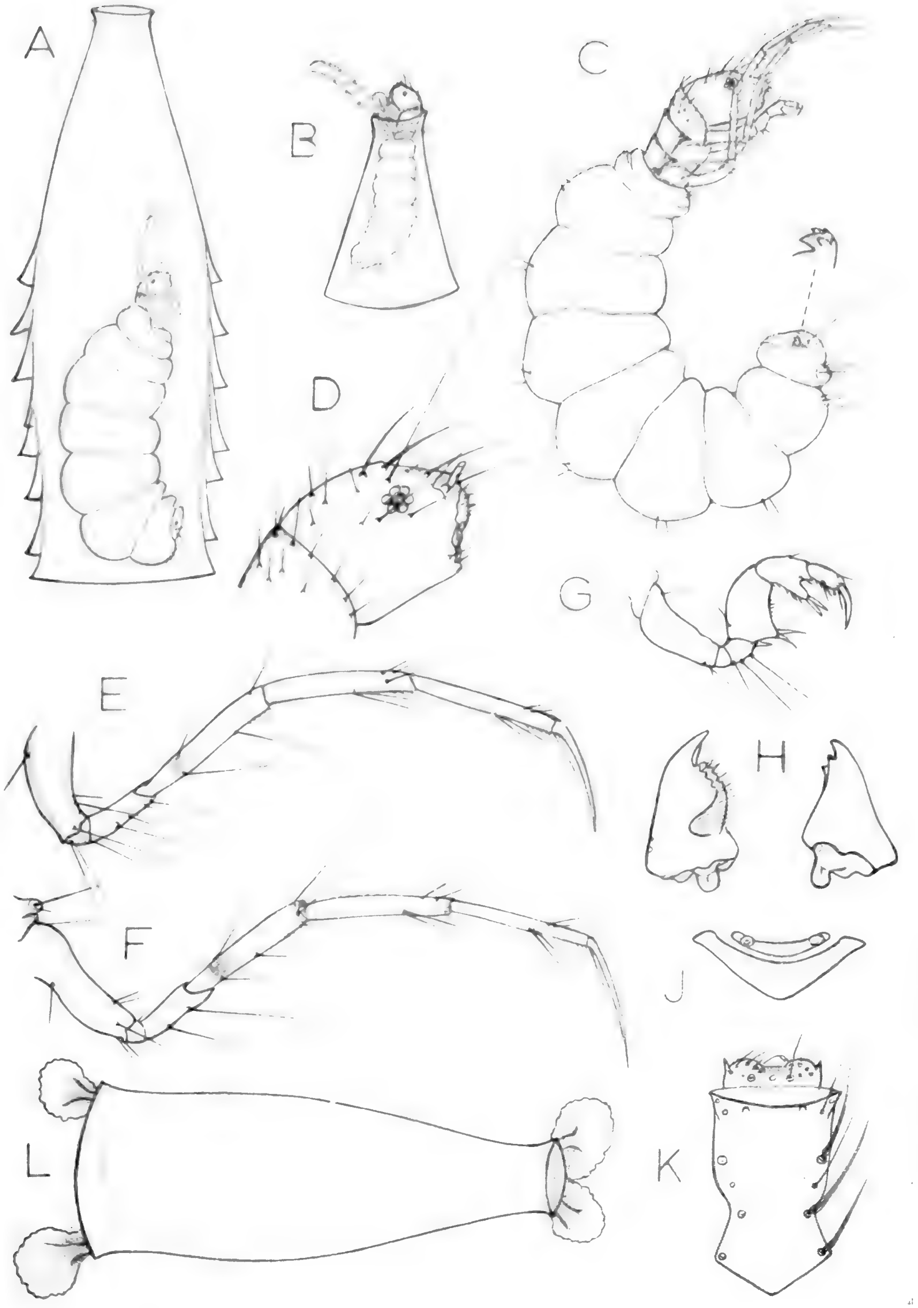


Orthotrichia barnardi sp. n., ♂ genitalia: A, dorsal view; B, ventral view; C, left latera view; D, right lateral view; E, aedeagus in dorsal view showing spiral titillator; F, claspers in ventral view to show position of furcate structure; G, dorsal view of head and thoracic nota. (In all cases except E and F the spiral titillator and furcate structure have been omitted where seen by transparency. In C and D the position of the eighth and part of the seventh segments are shown in outline.)



Orthotrichia barnardi sp. n.: A, fore- and hind-wings of ♂; B, dorsal view of ♀ genitalia; C, ventral view of ♀ genitalia; D, whole larva, lateral view; E, larva in case (half magnification of D); F, dorsal view of head and thoracic nota of larva, with small part of margin of pronotum further enlarged; G, H, J, fore-, mid- and hind-legs of larva; K, ventral view of terminal segments of abdomen of larva; L, ventral view of head of larva, with antenna and right and left mandibles further enlarged (labium and palps omitted for clarity); M, empty pupal case, attached to *Scirpus* leaf.



Oxyethira velocipes (Barnard): A, mature 5th instar larva in case; B, young 5th instar larva in case; C, lateral view of large but not quite mature 5th instar larva, extracted from case, anal claw further enlarged; D–K, parts of same larva, further enlarged (D, head; E, F, G, mid-, hind and forelegs; H, left and right mandibles in dorsal view; J, gular sclerite and submental sclerite; K, clypeus and labrum); L, pupal case.

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SYNONYMY. Arrangement according to Schenk, E. T. & McMaster, J. H.: *Procedure in taxonomy.* 2nd ed. Stanford, Stanford university press, 1948. Bibliographic references modified.

'I. *Synonymy arranged according to chronology of names.*—All published scientific names by which a species has been previously designated (subsequent to 1758) are listed in chronological order, with bibliographical references to all descriptions or descriptive citations following in chronological order after each name. . . .

B. *Form of bibliographic references to synonymic names.*—The first reference following any name in the synonymy should be to the earliest citation of that name. This should be followed by references to all subsequent citations of the same name, arranged in chronological order. . . .'

Bibliographical references modified to consist of author's name, date of citation, pagination and illustrations (plates and figures).

Example:—

Eulalia (*Steggoa*) *capensis* Schmarda

Eulalis capensis Schmarda 1861, p. 86, pl. 29, fig. 231. Willey 1904, p. 259.
Eulalia viridis var. *capensis* McIntosh 1903, p. 34. Day 1953, p. 30.
Eulalia viridis (*non* Muller) Ehlers 1913, p. 455. Day 1934, p. 30.

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PART XX

TOOTH REPLACEMENT IN THE CYNODONT *THRINAXODON LIORHINUS* SEELEY

By
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TOOTH REPLACEMENT IN THE CYNODONT *THRINAXODON LIORHINUS* SEELEY

By

A. W. Crompton

South African Museum, Cape Town

(With 17 figures in the text)

Contents

Introduction

The very mammalian appearance of the dentition of such theriodont reptiles as the cynodonts invited the assumption that these reptiles replaced their teeth as mammals do and that they had milk and permanent dentitions (Broom, 1913) rather than the indefinite series of replacing teeth occurring in typical reptiles. But Parrington (1936) has shown that in the cynodont *Thrinaxodon* alternately numbered postcanines were replaced at different times. In the eight skulls at his disposal Parrington could show that each of the postcanines was replaced at least once. He divided the material into a younger group in which postcanines nos. 1, 3 and 5 had been replaced shortly before death or were actually undergoing replacement, and an older group in which postcanines 2, 4 and 6 had been replaced shortly before death, and he assumed that the tooth position of the 1st postcanine in the younger group was homologous with the tooth position of the 1st postcanine in the older group. Parrington noted that some of the specimens have six upper postcanines whereas others have seven, but he gave no explanation for this. He claimed that the 7th post-

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canines were unlikely to have had predecessors and were erupting for the first time. Also Parrington described the mandibular postcanines in one specimen in which he noted that the 7th and 8th postcanines had five cusps and the 5th four cusps, instead of the customary three.

Subsequently Brink (1955*b*) has described a very young specimen of *Thrinaxodon*, found in close association with a large specimen which has seven teeth. He formed the opinion that the postcanines were replaced several times during life because the teeth of the young specimen were so much smaller than those of the large specimen. I have (Crompton, 1955) discussed tooth replacement in *Cynognathus* zone and Middle Triassic cynodonts, notably *Scalenodon*. In *Scalenodon* postcanine teeth were found to have been added at the back of the postcanine row during life and a few were lost in front. Fourie (1963) has obtained similar results in *Diademodon*. Recently I (Crompton, 1962) showed that in the bauriamorph *Ericiolacerta* the replacing teeth developed in pits in the alveolar bone lingually to the roots of the functional postcanines and that alternately numbered teeth were replaced at different times.

MATERIAL

Four specimens of *Thrinaxodon* have recently been beautifully prepared with the aid of acetic acid by the staff of the British Museum (Natural History). These are B.M.N.H. R3731, R5480, R511a and R511. The first three were studied by Parrington (his specimens E, G and I respectively). I studied three of the British Museum specimens, viz. R3731, R511a and R511. Several specimens in the collections of the South African Museum have also been prepared with the aid of acetic acid. Consequently much additional information on the structure of the tooth crowns and tooth replacement has come to light.

For the purpose of this paper a small skull of *Thrinaxodon* housed in the Universitäts Institut für Paläntologie u. historische Geologie in Munich and the very young specimen of *Thrinaxodon* housed in the Bernard Price Institute for Palaeontological Research in Johannesburg were studied. For convenience the specimens studied have been lettered A to I, as follows:

A = Bernard Price Institute for Palaeontological Research Catalogue No. 274.
B = Universitäts Institut für Paläontologie u. historische Geologie, Munich.
C = B.M.N.H. R3731 = Parrington's Specimen E.
D = S.A.M. K 377.
E = S.A.M. K 380.
F = B.M.N.H. R511.
G = S.A.M. K 378.
H = B.M.N.H. R511a = Parrington's Specimen I.
I = S.A.M. K 379.

The structure of the postcanine teeth indicates that this sample may contain more than one species of *Thrinaxodon*. This is discussed on pp. 511.

Replacement of Individual Teeth

Postcanines: A shallow longitudinal groove (long.g., fig. 2 A and 6 A and D) is present in the maxilla and mandible lingual to the alveolar borders of the postcanines and the canine. This groove presumably housed the dental lamina. Replacement teeth commenced their development in shallow pits (p) in the floor of this groove in the dentary and in the roof of this groove in the maxilla. Initially these pits were separated by a layer of bone from the alveoli of the

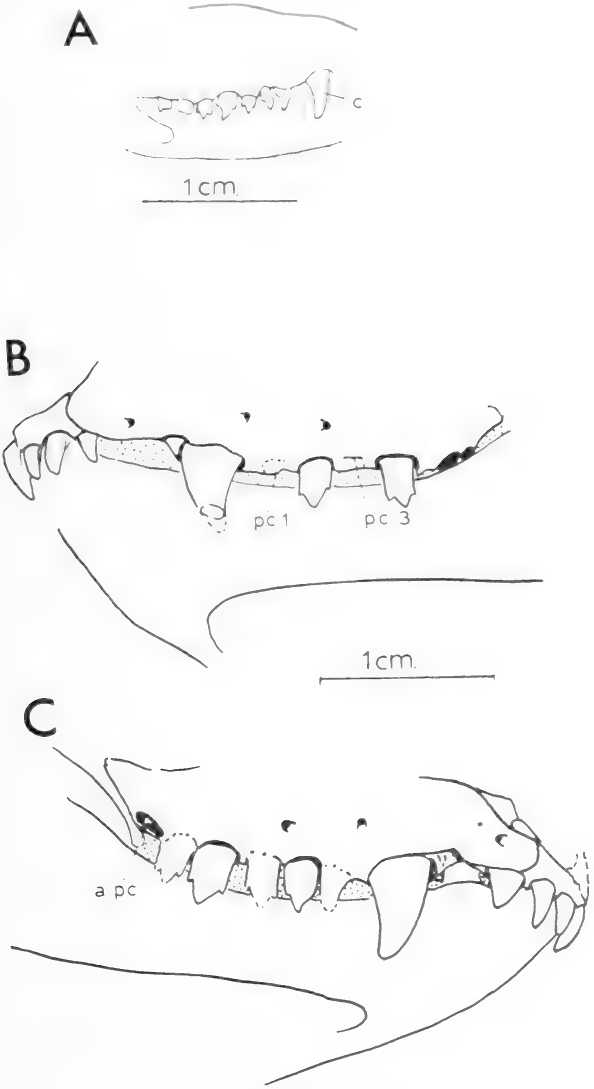


Fig. 1. *Thrinaxodon liorhinus.*
A, right maxillary dentition of Specimen A.
B and C upper dentition of Specimen B.
Key to lettering p. 521.

functional postcanines which lie labial to them. These pits are well preserved in the acid-prepared specimens and in many cases replacing teeth are preserved in the pits (rep.t., fig. 2 B). The functional teeth are usually firmly held in place by a ring of attachment bone around the neck of the tooth. The attachment bone (a.b.) is well preserved around the neck of several postcanines studied and is especially well preserved around the 2nd and 4th upper postcanines of specimen E (fig. 5 A). A ring of small foramina indicates the line of fusion between the attachment bone and the tooth itself. The various stages of the growth of a replacing tooth between its initial development in a pit and its eventual eruption are well shown in the acid-prepared specimens. As the replacing tooth increased in size the pit containing it also increased in size and opened into the alveolus of the functional tooth. The replacing tooth migrated labially and the root of the functional tooth was resorbed to make space for it. Consequently, shortly before the replacing tooth erupted little remained of the root of the functional tooth. At this stage the remaining part of the functional tooth was secured solely by the ring of attachment bone around its neck at the alveolar border. In many specimens the functional tooth was lost at this stage by absorption of the neck of the tooth in a horizontal plane in line with the outer surface of the ring of attachment bone so that nothing visible remains externally to indicate the previous presence of a functional tooth except a ring of foramina in the attachment bone around the remnant of the tooth root. (See fig. 1 B.) This phenomenon accounts for the gaps in the tooth row in the right maxillae of Parrington's specimens A and F. Before the replacing tooth erupted the alveolus was considerably enlarged by the resorption of the attachment bone and the new tooth erupted into an alveolus far larger than the neck of the replacing tooth. Consequently the younger teeth that erupted shortly before death were loosely held in their respective alveoli, e.g. 1st, 3rd, and 5th in the maxilla of specimen C and 3rd, 5th and 7th in the mandible of specimen C (fig. 2). The older teeth, e.g. 2nd and 4th in the maxilla of specimen C (fig. 2 A and B), were firmly held in place by attachment bone.

A replacement cycle identical to that of *Thrinaxodon* appears to have been present in the bauriamorph *Ericiolacerta* (Crompton, 1962) and was also present in *Cistecephalus* zone cynodonts that have been studied by the author.

The material studied for this paper supports Parrington's (1936) conclusion that the odd- and even-numbered postcanines erupted at different times. This is clearly seen in most specimens, e.g. in the maxilla of specimen C (fig. 2 A) the 1st, 3rd and 5th erupted shortly before death and were loosely held in large alveoli whereas the 2nd and 4th were tightly held and have pits for replacing teeth in the maxilla lingual to them. However, it appears that all the odd-numbered (or even-numbered) teeth did not erupt simultaneously; but that the posterior replacing teeth erupted before the anterior teeth of the same set. This is well shown in the right mandible of specimen H (fig. 10 D). The 3rd, 5th and 7th teeth are loosely held in the alveoli and erupted shortly before death. The 7th tooth was fully erupted, the 5th partially erupted and the 3rd was still completely contained in its alveolus. In terms of alternate replacement a replacing tooth would be expected to be present in the first alveolus. However, the old functional tooth is still present in this position, but a deep pit for a well-developed replacing tooth is present adjacent to the old 1st functional postcanine. In the left mandible (fig. 10 C) the condition is similar to that in the right, except that the old functional 1st postcanine has been lost and a partially displaced replacing tooth is present in the first alveolus. This evidence suggests that the odd-numbered replacing postcanines erupted in the following order: 7th, 5th, 3rd, 1st. In the maxilla of specimen F (fig. 6 A) the replacing tooth for the 6th postcanine (r.pc.6.) is larger than that for the 2nd (r.pc.2.) and that of the 4th is intermediate in size between the 2nd and the 6th. The younger postcanines, i.e. 1st, 3rd and 5th of this maxilla, that are loosely held in their alveoli appear to have erupted in the following order: 5th, 3rd, 1st. A similar phenomenon can be observed in most of the specimens studied with the exception of the lower postcanines of specimen G (fig. 9) where the rule of alternate replacement seems to break down over a short distance.

In most reptiles that actively replace their teeth a wave of replacement passes along each alternately numbered tooth series either from back to front or front to back (Edmund, 1960, 1962). In *Thrinaxodon* the wave passes from back to front.

Canines: Replacing canines are present in both the upper and lower jaws of most specimens of *Thrinaxodon* studied. The replacing canines commenced their replacement in distinct pits in the maxilla and dentary. In the specimens studied the pits in the maxilla (specimen E, fig. 5 A) are always found antero-lingual of the functional canine whereas the pits in the dentary (specimen E, fig. 5 B) are always found postero-lingual of the functional tooth. As the replacing canine enlarged, the pit containing it fused with the main alveolus (specimen D, fig. 3 A and B) and the replacing canine migrated to lie in front of the functional canine in the upper jaw and behind the functional canine in the lower jaw (specimen F, fig. 6 B and D). Fourie, however (1963), has described a specimen of *Thrinaxodon* in which the upper replacing canine lies behind the functional canine.

Incisors: The incisor region is not well preserved in most of the specimens studied. The replacing incisors appear to have developed in pits behind the functional ones. These pits, where preserved, are confluent with the alveoli of the functional teeth. In the premaxilla of specimen F (fig. 6 A and B) replacing teeth are present behind all four incisors. It is not possible to determine the order of replacement of the functional incisors.

Structure of the Crowns of the Postcanines

In a few instances Parrington (1936) was able to describe additional cusps on the lingual side of the crowns of upper postcanines. In the acid-prepared specimens the whole structure of the crowns of the teeth can be studied, and it

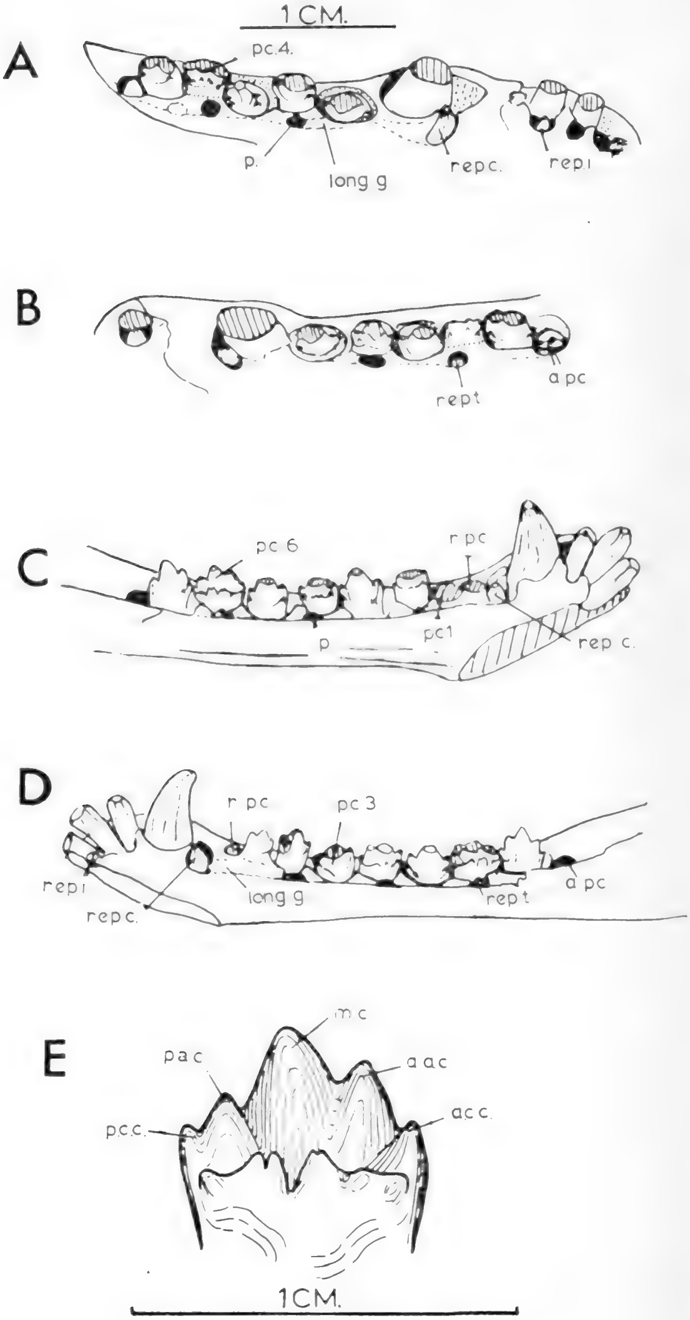


Fig. 2. *Thrinaxodon liorhinus*, Specimen C.
A and B upper dentition, C and D, lower dentition and E, lingual view of the lower 6th postcanine.
Key to lettering p. 521.

has been found that in many cases quite complex patterns are present which differ considerably from the simple crown pattern usually associated with *Thrinaxodon.*

On the basis of the pattern of the crowns of the lower posterior postcanines, it is possible to divide the specimens studied into three ill-defined groups. Specimens A, B or I, however, cannot be assigned to any of these groups as the structure of their lower postcanines is not known. The members of the three groups form a consecutive series of increasing size (see table I, page 500).

Group I consists only of specimen C.

Group II consists of specimens D, E, F and G.

Group III consists of specimen H.

GROUP I

Lower Postcanines. Specimen C (fig. 2 C, D and E)

Seven lower functional postcanines are present. A remnant of a tooth (r.pc.) is present anterior to the 1st functional postcanine and an unerupted postcanine (a.pc.) which does not appear to have had a predecessor is present behind the last functional postcanine.

The crown structure of the more recently erupted 3rd, 5th and 7th postcanines is different from that of the older 2nd, 4th and 6th. In each series, i.e. the odd-numbered, 3rd, 5th, 7th and the even-numbered 2nd, 4th and 6th, the crown pattern becomes increasingly complex in a posterior direction. Of great interest and importance is the fact that each of the more recently erupted teeth has crowns with a simpler pattern than the older teeth anterior or posterior to it. The tooth with the most complex crown is the 6th postcanine (fig. 2 E). It consists of three cusps aligned antero-posteriorly; a main cusp (m.c.), an anterior accessory cusp (a.a.c.) and a posterior accessory cusp (p.a.c.). Because the anterior accessory cusp is larger than the posterior accessory cusp the anterior margin of the main cusp is shorter than its posterior margin. Anterior to the anterior accessory cusp and posterior to the posterior accessory cusp two smaller cusps are present. These have for convenience been designated as anterior and posterior cingular cusps (a.c.c., p.c.c.) respectively. It is, however, extremely difficult to determine whether the anterior and posterior cingular cusps do in fact develop upon a definite cingulum. In some cases this appears to be the case, but in other cases these cusps appear to be quite distinct from the cingulum. A well-developed cingulum is present on the lingual surface of the crown. It supports a series of small cusps. The largest are twin cusps that lie either side of the midline. A deep valley separates the anterior and posterior twin cusps. Two small cuspules are present anterior to the twin cusps and one is present posterior to them.

The crown pattern of the 4th and 2nd postcanines is similar to that of the 6th except that accessory and the anterior and posterior cingular cusps and the cusps on the lingual cingulum are not so well developed. The crowns of the younger 7th, 5th and 3rd postcanines in the odd-numbered series also consist of three cusps (anterior accessory, main and posterior accessory) aligned antero-posteriorly. The anterior and posterior cingular cusps are situated low down on the lingual surface of the anterior and posterior accessory cusps and they do not lie anterior or posterior to the latter as they do in the 6th postcanine. In the odd-numbered teeth no cusps appear to be present on the lingual side between the anterior and posterior cingular cusps.

Upper postcanines (fig. 2 A and B)

As in the lower postcanines there is a great difference between the older and younger postcanines, but this is not as marked as in the lower jaw. The crowns are in many cases damaged.

Six functional postcanines are present. The even-numbered erupted later than the odd-numbered. The 6th postcanine has apparently been shed and an unerupted postcanine is visible above it. The crown of the 4th postcanine, which is a member of the older series of teeth, consists of three antero-posteriorly aligned cusps, anterior and posterior cingular cusps and a series of cusps upon a lingual cingulum. The cingulum of the crown of the second postcanine is very poorly developed and supports only an anterior cingular cusp. In the younger 5th and 3rd postcanines anterior and posterior cingular cusps are present but no cusps are present on the lingual cingulum.

Group II

Lower postcanines. Specimen D (fig. 3 B and C and 4B)

Seven functional postcanines are present. A remnant of a tooth root (r.p.c.) is present anterior to the 1st. A small, apparently non-functional tooth is present behind the 7th postcanine (pc.8.). This tooth is completely covered laterally by the anterior border of the coronoid process. As in specimen C, the crowns of the older teeth are different from those of the younger teeth.

The sixth postcanine (fig. 4 B), belonging to the older series, has three cusps (anterior accessory, main and posterior accessory) aligned antero-posteriorly. The main cusp and the anterior accessory cusp are about the same size and the posterior accessory is slightly smaller. The posterior cingular cusp lies directly behind the posterior accessory cusp whereas the anterior cingular cusp lies slightly antero-lingually of the anterior accessory cusp. As a result the crown, when viewed from above, has a wide, blunt anterior region and a tapering posterior region. A large and prominent cingular cusp (c.c.) is present on the lingual surface below the junction of the main and anterior accessory cusps. A small poorly defined cuspule is present posterior to this cusp. A poorly developed cingulum (cing.) is present between the two lingual cingular cusps (c.c.) and the posterior cingular cusp. In the fourth postcanine the main cusp is considerably larger than the accessory cusps. The anterior cingular cusp is fairly well developed, but the posterior cingular cusp is small and the cingulum and cusps upon the cingulum are very poorly developed. When viewed from above, the crown has a wide anterior region and a tapering posterior region, as in the 6th postcanine. The 4th postcanine is shorter but wider than the 6th.

In the second postcanine the crown is dominated by the main cusp and the anterior and posterior accessory cusps and the anterior and posterior cingular cusps are very small. The lingual cingulum is absent. In crown view the tooth is more circular than the 4th postcanine. Within the even-numbered postcanines there is, therefore, in a posterior direction a progressive increase in the size of the accessory and cingular cusps and a progressive decrease in the size of the main cusp relative to the size of the accessory cusps. In addition posteriorly the teeth become progressively more longitudinally ovate.

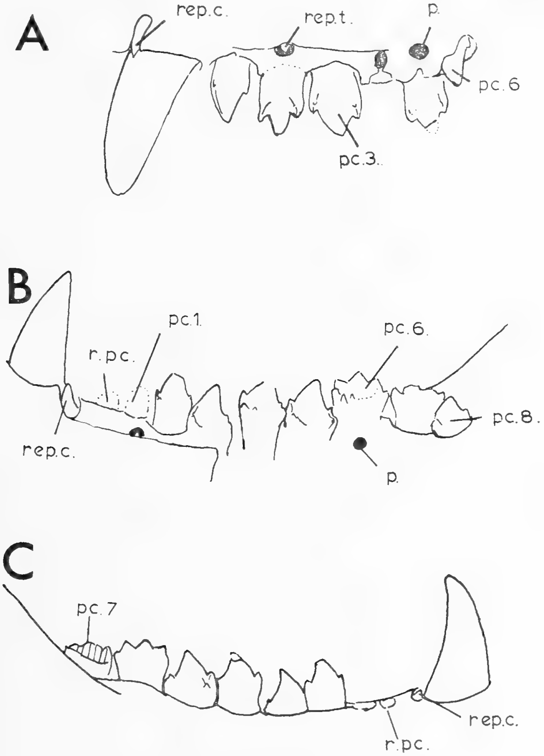
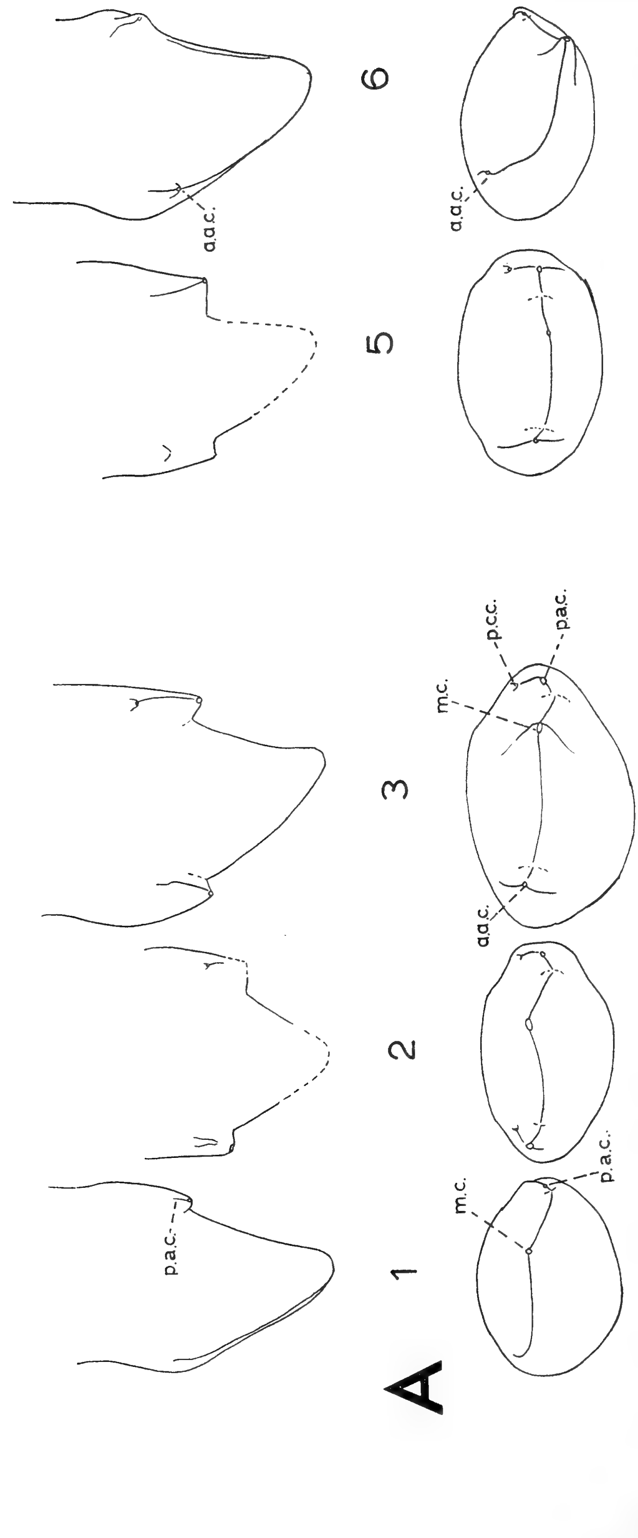


FIG. 3. *Thrinaxodon liorhinus*, Specimen D.
A, lingual view of the upper postcanines,
B, lingual and C, labial view of the lower postcanines.
Key to lettering p. 521.

Similar tendencies can be observed in the odd-numbered teeth of the same specimen, but the structure of the crown is slightly different. Unfortunately the crown of the 7th postcanine is partially destroyed. The remaining portion is similar to the 5th except that the cingulum and cingular cusps are absent and it is more longitudinally ovate.


A
1
2
3
5
6
p.a.c.
m.c.
a.a.c.
p.c.c.
1MM.

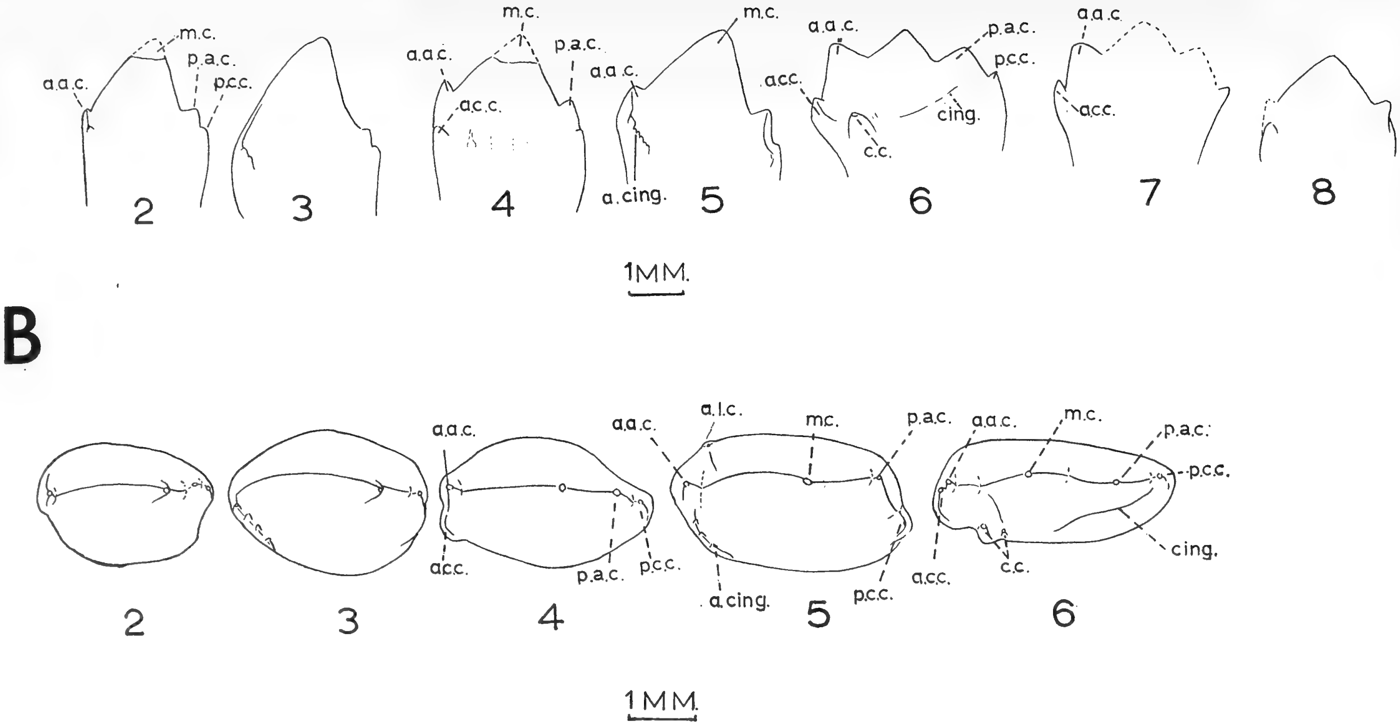


Fig. 4. *Thrinaxodon liorhinus*, Specimen D.

A, lingual and crown views of the upper postcanines and B, lingual and crown views of the upper postcanines.

Key to lettering p. 521.

In the 5th postcanine the crown is dominated by the main cusp and the accessory cusps are small. In contrast to the even-numbered teeth the posterior cingular cusp does not lie directly behind the posterior accessory cusp, but postero-lingually to it. A well-defined anterior cingular cusp is absent; in its place is a series of small cuspules arranged to form a short ridge (a.cing.) running downwards in a posterior direction. Because the posterior cingular cusp is well developed and the anterior cingular cusp poorly developed, the crown has a wide (transverse) posterior region and a slightly tapered anterior region, i.e. opposite to the conditions in the even-numbered teeth. A small cuspule (a.l.c.) called the anterior labial cusp is present on the labial surface of the tooth below the junction of the main and anterior accessory cusps. The 3rd postcanine is similar to the 5th except that the main cusp is relatively larger and the remaining cusps relatively smaller. The cuspule on the labial surface is absent.

It is clear from the above description that the crowns of the odd-numbered series (3, 5 and 7) have the same basic structure and that this is quite distinct from the structure of the crowns of the even-numbered series (2, 4 and 6). In each series, however, the teeth become more complex in a posterior direction. Thus not only do the odd- and even-numbered teeth replace at different times in specimen C, but in addition the crown patterns of the two series are distinct from one another.

The 8th postcanine is an enigma. It is smaller than any of the other lower postcanines with the exception of the first. The main cusp dominates the crown. The only part of the cingulum developed is the anterior cingular cusp. It is discussed on p. 509. The last upper postcanine of this specimen is also of a simpler construction than the penultimate tooth. This is the only specimen in the series in which this phenomenon was observed.

Specimen E (fig. 5 B, C, D)

This specimen is larger than D, but the individual teeth are smaller than those of D.

Seven functional lower postcanines are present. The remnant (r.pc.) of a tooth is present anterior to the 1st postcanine. Partially erupted 8th postcanines were present on both sides, but have been lost from the specimen. These teeth appeared to have had no functional predecessor as there are no indications of a root remnant in their alveoli. Unfortunately only the 6th and 7th postcanines are well preserved. The crowns (fig. 5 C and D) of these two teeth are characterized by a mixture of the features present on the crowns of the 6th and 7th postcanines of specimen D. In both, the accessory cusps are nearly as large as the main cusps. In the 6th postcanine the anterior cingular cusp lies almost directly in front of the anterior accessory cusp, but the posterior cingular cusp lies slightly postero-lingually to the posterior accessory cusp. Two well-developed cingular cusps (c.c.) are present on the lingual surface at the base of the anterior accessory cusp. These are followed posteriorly by three

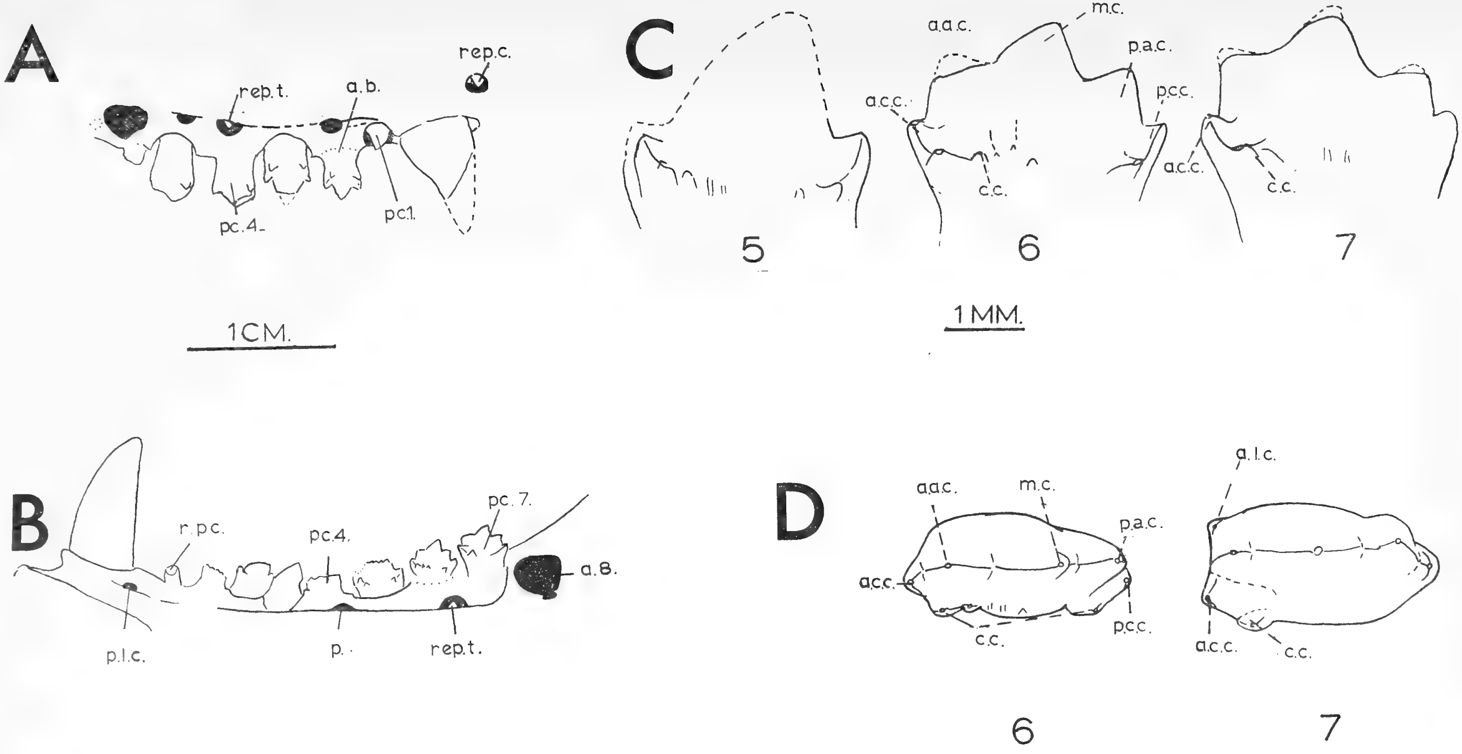


Fig. 5. *Thrinaxodon* sp., Specimen E.

A, lingual view of the upper postcanines;
B, lingual view of the lower postcanines;
C, lingual view of the 5th, 6th and 7th postcanines;
crown view of the 6th and 7th postcanines.

Key to lettering p. 521.

minute cuspules. A well-developed cusp is present on the lingual surface of the base of the posterior cingular cusp. This tooth is almost identical with the 6th postcanine of specimen D. In the 7th postcanine the anterior cingular cusp is presumably represented by a well-developed cusp antero-lingual to the anterior accessory cusp. A single large cingular cusp (c.c.) is present below the junction of the anterior cingular cusp and anterior accessory cusp. No further cusps are

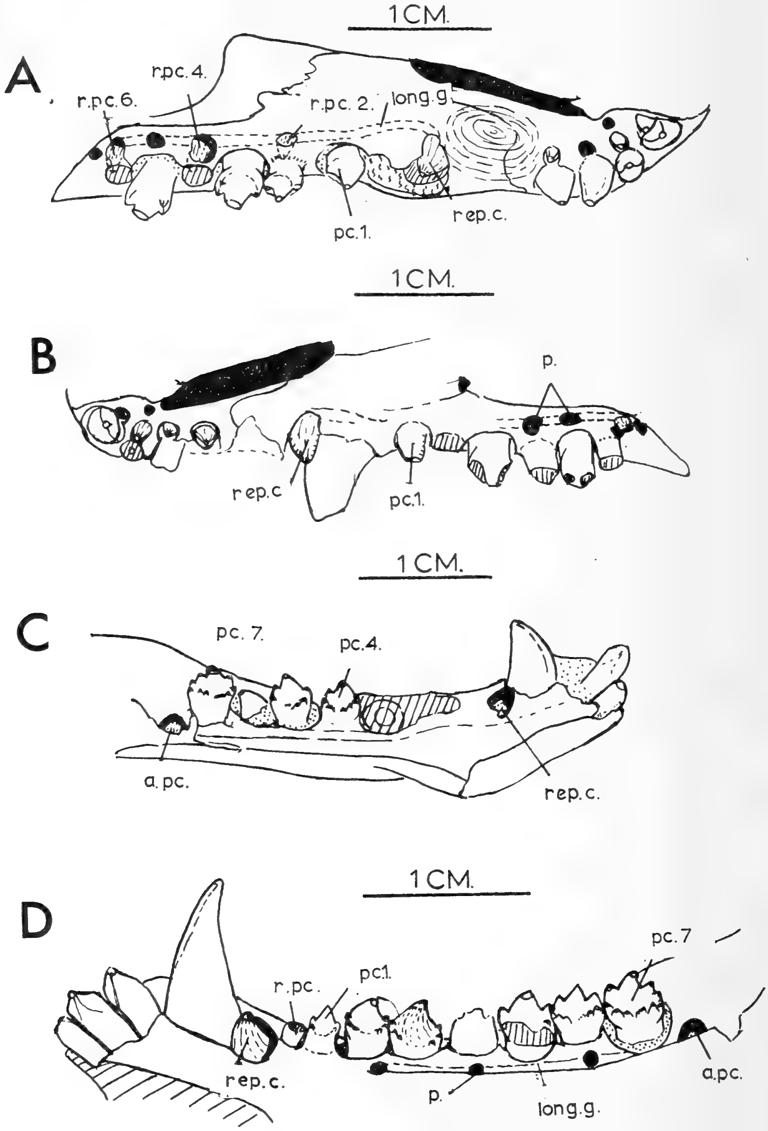


Fig. 6. *Thrinaxodon* sp., Specimen F.
A and B, upper dentition; C and D, lower dentition.
Key to lettering p. 521.

present behind this cusp between it and the posterior cingular cusp. A well-developed cusp is present on the labial surface (a.l.c.) antero-labial to the apex of the anterior accessory cusp when seen in crown view. The 5th postcanine apparently had a high dominant main cusp. The anterior cingular cusps are arranged to form a ridge not unlike a similar structure of the 3rd and 5th postcanine of specimen D.

Specimen F (Fig. 6 C and D and fig. 7)

The lower postcanines of specimens F and G are more similar to one another than they are to those of specimens D and E, but because of numerous similarities all four specimens have been placed in Group II.

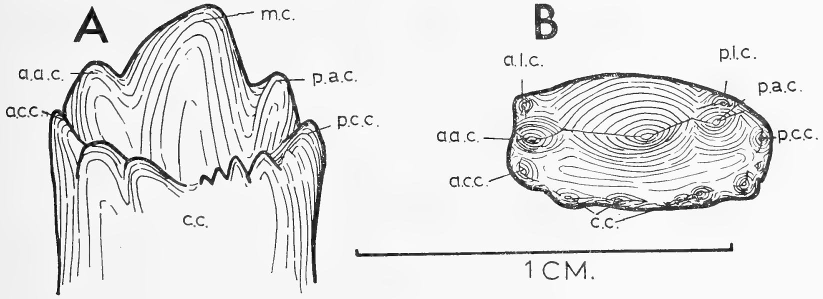


FIG. 7. *Thrinaxodon* sp., Specimen F.
A and B, lingual and crown views of the 7th lower postcanine.
Key to lettering p. 521.

Seven functional postcanines are present in the right mandible (fig. 6 D). They are preceded by the remnant of a tooth (r.p.c.) and an unerupted and partially formed tooth (a.p.c.) is present in a crypt behind the last postcanine. The crowns of the individual postcanines are not sufficiently well preserved to permit a detailed comparison of the crown structures of odd and even postcanines, but the differences do not appear to be as marked as in specimens C and D. As in other specimens there is a progressive complication of the crowns in a posterior direction. The crowns are characterized by well-developed cingular cusps. These are particularly well preserved in the 7th functional postcanine (fig. 7). In this tooth the accessory cusps are large (a.a.c., p.a.c.), but not as large as the main cusp. An anterior cingular cusp is present antero-lingual to the anterior accessory cusp. It is followed by two large cingular cusps (c.c.). The posterior portion of the cingulum consists of a series of six cuspules which, with the exception of one, increase progressively in size in a posterior direction. Well-developed cuspules are present on the labial surface of the crown at the base of the anterior and posterior accessory cusps (a.l.c., p.l.c.). With the exception of the cusps on the posterior portion of the cingulum this tooth is almost identical to the 7th postcanine of specimen E (fig. 5 C and D).

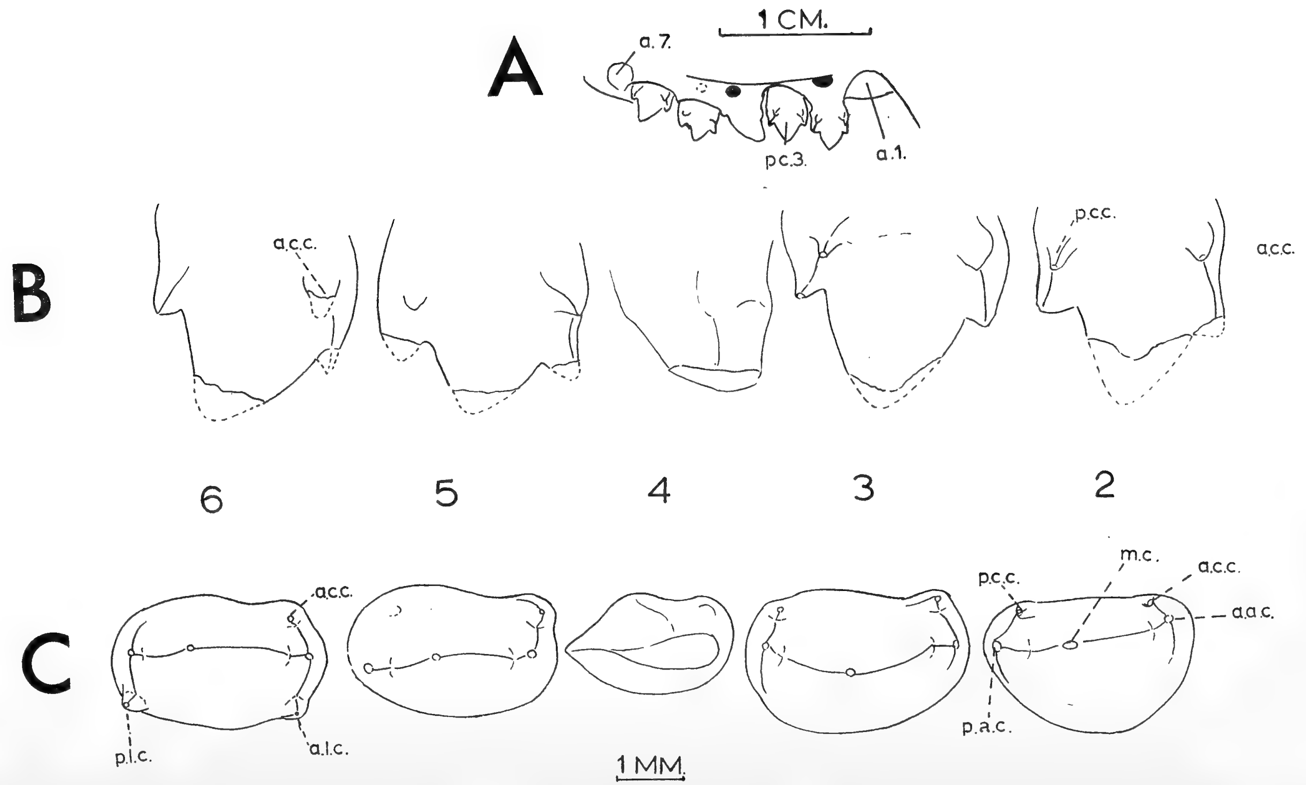


FIG. 8. *Thrinaxodon* sp., Specimen G.

A, lingual view of the upper postcanines;
B, lingual and C, crown views of the upper postcanines.

Key to lettering p. 521.

Specimen G (fig. 9)

The jaw contains eight functional postcanines. The 8th, 5th and 3rd appear to have erupted shortly before death. The 6th tooth is missing. The remaining teeth are all badly worn. This is the only specimen in which postcanines show advanced signs of wear and in which replacement does not appear to be strictly alternate.

The crown of the 5th postcanine (fig. 9 B and C) is almost identical to the 7th functional postcanine of specimen F (fig. 7) except that the posterior cingular cusp (p.c.c.) lies lingual to and not posterior to the posterior accessory cusp. The 8th postcanine of specimen G is identical to the 5th except that it lacks the posterior labial cusp and is more longitudinally ovate. The anterior part of the cingulum of the 3rd postcanine does not support the three large cusps that are present in this position in the 5th and 8th postcanine, but consists of a series of six small cusps arranged to form a ridge which terminates anteriorly at the base of the anterior accessory cusp. The posterior cingulum supports a single well-developed cusp (p.c.c.) postero-lingual to the posterior accessory cusp. This tooth is similar to the 5th functional postcanine of specimen D (fig. 4 B). In postcanines nos. 8, 5 and 3 the main cusp becomes progressively larger in an anterior direction and the accessory cusp progressively smaller. The 2nd and 4th postcanines although badly worn are characterized by large anterior cingular cusps and poorly developed posterior cingular cusps. In this respect they are not unlike the 6th postcanines of specimen D (fig. 4 B) and Specimen E.

Upper postcanines, *Specimen D* (figs. 3 A and 4 A)

Without exception the upper postcanines have crown patterns less complex than those of the corresponding lower teeth. Six functional postcanines are present in specimen D. The 6th is preserved partially erupted. The 1st and 3rd appear to have erupted shortly before death. The 5th already has a large pit for a replacing tooth at its base. The 1st postcanine (fig. 4 A) consists of a large main cusp, which is slightly recurved; the anterior accessory cusp is missing, but a small posterior accessory cusp (p.a.c.) is present. A cingulum and cingular cusps are absent. The 3rd postcanine has a large main cusp which is flanked by smaller anterior and posterior accessory cusps. A small posterior cingular cusp is present on the lingual surface at the base of the anterior accessory cusp. No other cingular cusps are present. The 5th postcanine is similar. The 6th postcanine is almost identical to the 1st postcanine except that it possesses a very small anterior accessory cusp. The 2nd postcanine appears to have both anterior and posterior cingular cusps.

Specimen E (fig. 5 A)

Six functional postcanines are present. The 1st, 3rd and 5th are only partly erupted indicating that they erupted shortly before death. The structure of the crowns of the postcanine teeth are identical to those of specimen D.

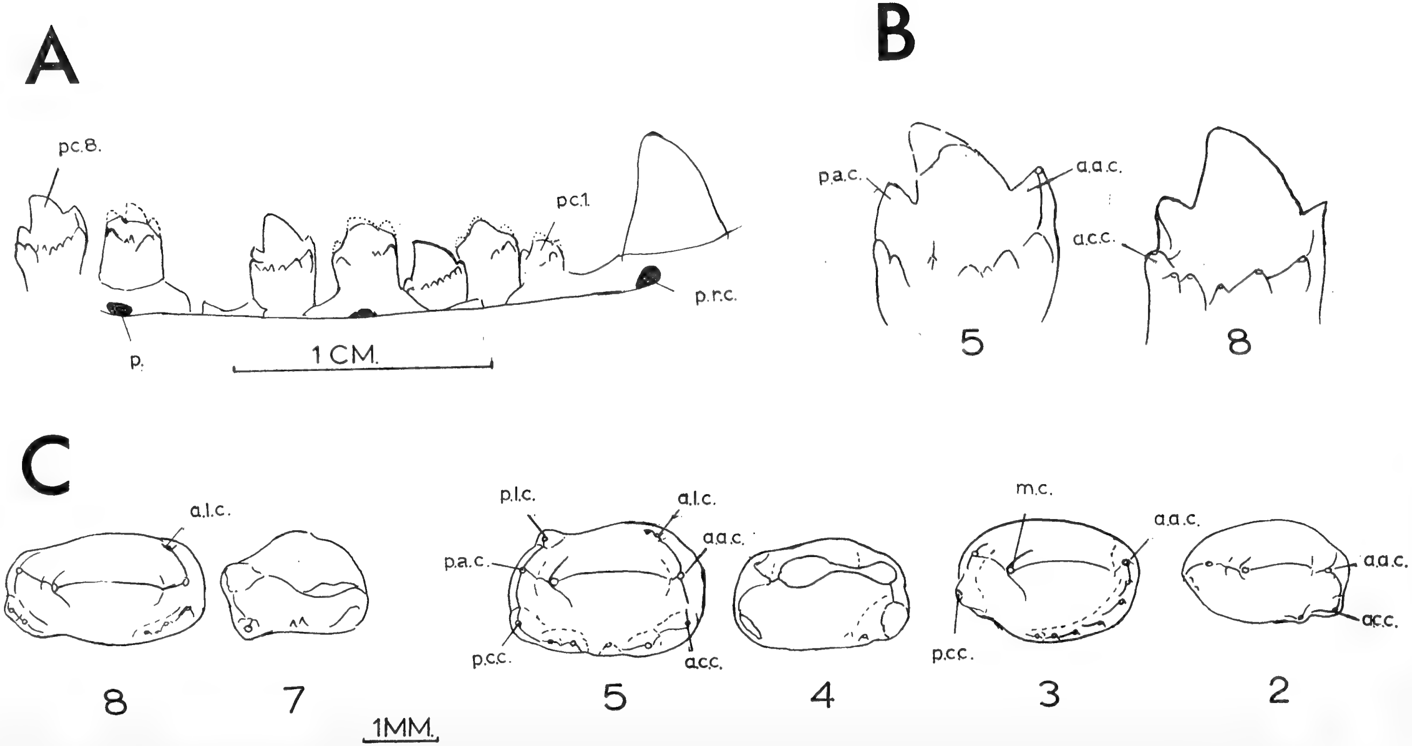


FIG. 9. *Thrinaxodon* sp., Specimen G.

A, lingual view of the lower postcanines;
B, lingual view of the 5th and 8th postcanines;
C, crown views of the 2nd to 8th postcanines.

Key to lettering p. 521.

Specimen F (fig. 6 A and B)

Six functional postcanines are present in specimen F. The 1st, 3rd and 5th erupted shortly before death and well-developed replacing teeth are present in pits at the bases of the older 2nd, 4th and 6th postcanines. The crypt for an additional tooth is present behind the 6th postcanine. The structure of the crowns of the upper postcanines is identical to those of specimens D and E.

Specimen G (fig. 8)

Six functional teeth are present. In the even-numbered series the 2nd and 4th have well-developed pits for replacing teeth above them, but the replacing tooth for the 6th had already erupted before death. The 2nd and 3rd teeth are almost identical in structure and possess well-developed anterior and posterior cingular cusps. The 4th is badly worn. The 5th and 6th lack well-developed posterior cingular cusps. The 6th has two well-developed cusps on the labial side of the tooth (p.l.c., a.l.c.) one above the anterior and one above the posterior accessory cusp.

Group III

Lower postcanines. Specimen H (fig. 10 C and D)

The lower postcanines of this specimen are characterized by poor development of the cingulum and cingular cusps. In this respect they are quite different from the lower postcanines of Groups I and II. The lower postcanines of specimen H closely resemble the upper postcanines of this and other specimens. Seven functional postcanines are present. The crown of the 7th consists of the characteristic main cusp, anterior and posterior accessory cusps, and anterior and posterior cingular cusps. In the 5th and 3rd the crown structure is similar except that the main cusp becomes progressively more dominant in an anterior direction.

Upper postcanines. Specimen H (fig. 10 A and B)

Six functional postcanines are present in the right maxilla. The cingular cusps are very poorly developed and appear to be entirely absent on most of the postcanines.

Discussion

Extension of Growth series of 'Thrinaxodon'

The present study has confirmed Parrington's (1936) conclusion that alternate replacement took place in the postcanine teeth of *Thrinaxodon*. Parrington showed that it was possible to divide the specimens of *Thrinaxodon* that he studied into two groups; a younger group in which the 1st, 3rd and 5th maxillary postcanines were younger than the remaining ones and an older group in which the 2nd, 4th and 6th maxillary postcanines were younger than the others.

The skull lengths of Parrington's younger group vary between 61 mm. and 79 mm. (see table I). One of Parrington's specimens, viz. his E (C in the present investigation), was prepared in acid and it has been confirmed that the 1st, 3rd and 5th maxillary postcanines were the younger. Four additional skulls falling within this size range were studied. These are specimens D, E, F and G. In all of them the 1st, 3rd and 5th postcanines were the younger. The skull lengths of these specimens are given in table I. Parrington concluded that the 1st, 3rd and 5th teeth were replaced at least once and that the 2nd,

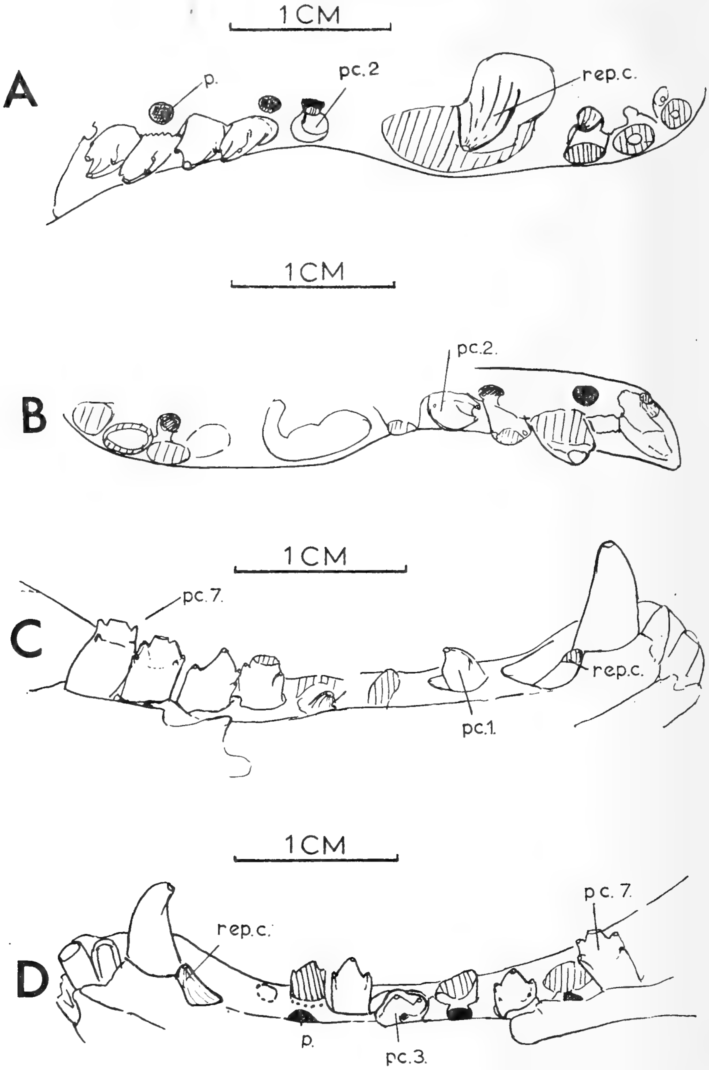


Fig. 10. *Thrinaxodon* sp., Specimen H.
A and B, upper and C and D, lower dentitions.
Key to lettering p. 521.

4th and 6th were also replaced at least once. Parrington's two stages are diagrammatically shown in figure 11 A. In this figure they are labelled II and III. Fully erupted teeth are drawn in black below the alveolar border and unerupted replacing teeth in dotted lines above the alveolar border. Only the portion below the alveolar border of partially erupted teeth is shown in black.

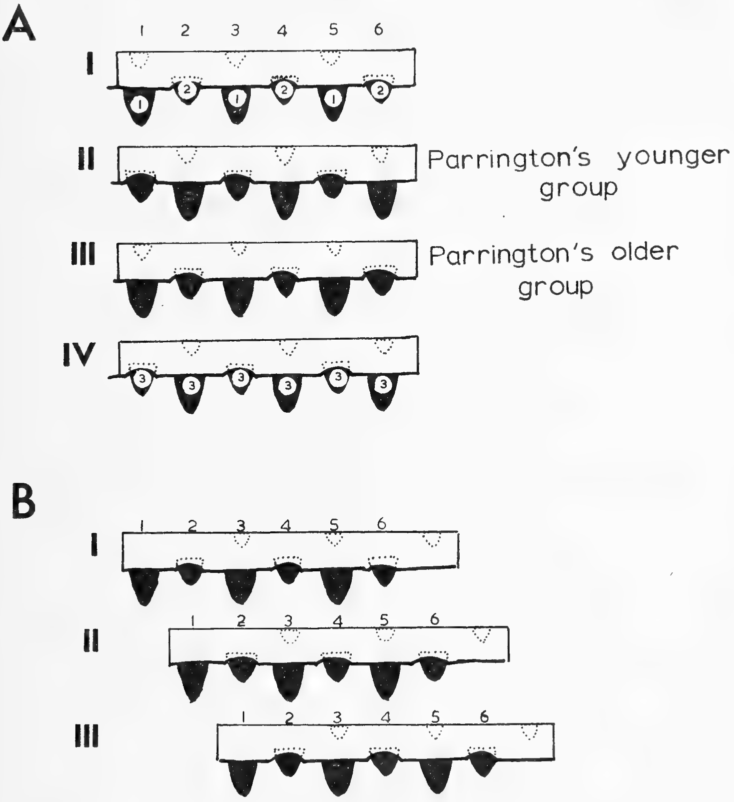


FIG. 11. Tooth replacement in *Thrinaxodon*.

A, diagram to illustrate simple alternate replacement concluded by Parrington to have been present in *Thrinaxodon*. Additional growth stages I and IV have been added.

B, diagram to illustrate a possible way in which posterior migration of the post-canine row could have been achieved.

In figure 11 A, stage II, the 1st, 3rd and 5th are partially erupted and in figure 11 A, stage III, the 2nd, 4th and 6th of stage II have been replaced and partially erupted teeth are present in these alveoli. Specimens both larger and smaller than those available to Parrington were available for the present study. See table I.

TABLE I

Designation of specimens in present paper	*Designation of specimens in Parrington's* (1936) *paper*	*Length of skull* (*tip of snout to posterior end of sagittal crest*)	*Youngest teeth*						
			1	2	3	4	5	6	7
A		36 mm.		×		×		×	
B		58 mm.		×		×		×	
	B	61 mm.	×		×		×		
	C	63 mm.	×		×		×		
C	E	68 mm.	×		×		×		
	F	70 mm.	×		×		×		
D		73 mm.	×		×		×		
E		78 mm.	×		×		×		
	G	78 mm.	×		×		×		
F		78 mm.	×		×		×		
G		80 mm.	×		×		×		
	H	82 mm.		×		×		×	
H	I	85 mm.		×		×		×	
I		86 mm.	×		×		×		

In specimen A (fig. 1 A) the 2nd, 4th and 6th postcanines were younger than the 1st, 3rd and 5th. This skull is incomplete, but as reconstructed by Brink (1955*b*) it could not have had a skull length of much more than 36 mm. It is the youngest specimen available and in comparison with older specimens the teeth are minute. It has seven functional postcanines. This fact is discussed on p. 502.

In specimen B (fig. 1 A and B) (skull length 58 mm.) the 2nd, 4th and 6th postcanines were also the youngest. The difference in the size of the corresponding teeth in A and B suggests that several growth stages intervened between specimens A and B. In specimens with skull lengths between 61 mm. and 80 mm. the 1st, 3rd and 5th teeth were the younger. From 80 mm. to 85 mm. the 2nd, 4th and 6th were the younger. In a damaged *Thrinaxodon* skull (referred to as specimen I) in the collection of the South African Museum with a skull length of approximately 86 mm., the 1st, 3rd and 5th teeth appear to have been the younger.

The additional material shows that the series available to Parrington covered only part of the growth series and that the individual postcanines were replaced several times. The additional growth stages are shown in figure 11 A, stages I and IV. Stage I represents specimens A and B in which the 2nd, 4th and 6th are the youngest. The older teeth in stage I have been numbered 1 and the younger teeth 2. By the time stage IV is reached the teeth numbered 1 have been replaced twice and, therefore, the teeth in the corresponding positions have been numbered 3. The teeth numbered 2 in stage I are replaced once and the teeth in the corresponding position in stage IV are, therefore, numbered 3. It is, however, apparent from an analysis of the postcanine teeth of the specimens available that in *Thrinaxodon* the replacement pattern is more complex than the simple alternation shown in figure 11 A. Further detailed consideration of the specimens is therefore necessary.

Posterior migration of the postcanine row

The number of postcanines in the jaws studied varies slightly. In many cases remnants of postcanines are present in front of the functional postcanines and in some cases unerupted or partially erupted teeth are present behind the functional row. In some cases these teeth do not appear to have had predecessors. This information is summarized in table II. The number of functional teeth appears to be fairly constant. All the maxillae, with the exception of specimen A, have six functional teeth and all the mandibles with the exception of specimens D and G have seven functional postcanines.

TABLE II

	UPPER POSTCANINES				LOWER POSTCANINES			
	Anterior tooth remnants	*No. functional p.c.*	*Unerupted posterior p.c.*	*Total*	*Anterior tooth remnants*	*No. functional p.c.*	*Unerupted posterior p.c.*	*Total*
A		7		7				
B		6		6				
C		6		6	(1)	7	(1)	9
D		6		6	(1)	8		9
E		6	(1)?	7	(1)	7	(1)	9
F		6	(1)	7	(1)	7	(1)	9
G		6	(1)	7		8		8
H		6	(1)	7		7		7

The constant number of functional postcanines in most specimens, the frequent occurrence of a tooth remnant anterior to the functional row and the presence behind the postcanine row of an unerupted postcanine which does not appear to have had a predecessor, suggest that during growth the anterior postcanines were lost and that new postcanines were added posteriorly. In mandibles of specimens C, E, F and G (figs. 2, 5, 6 and 9) it would be expected in terms of alternate tooth replacement that the 1st functional tooth would be a younger tooth erupted shortly before death or at least that it would have a well-developed replacing tooth in a pit at its base. This is not the case. In all four specimens the first functional tooth is firmly held by attachment bone and there is no indication of a replacing tooth at its base. The fact that the first functional tooth was not about to have been replaced in these four specimens suggests that in a more advanced growth stage the first functional tooth became the tooth remnant anterior to the postcanine row which is preserved in some specimens. This fact supports the conclusion that postcanines were lost anteriorly and added posteriorly during growth. In other words, the functional row of postcanines migrated backwards during growth. This appears to be so arranged that the number of functional postcanines remained roughly constant during growth. An explanation of this nature could account for the varying postcanine count attributed to *Thrinaxodon* in the literature. For example, if in the lower jaw the new tooth behind had erupted sufficiently to be considered part of the functional row the number would be given as eight, if not as seven. In figure 11 B, a series of growth stages are shown in which teeth are progressively lost in front and added behind. This has been superimposed upon the simple alternate replacement shown in figure 11 A. Although this model appears to be theoretically sound it only agrees with the state of eruption of the postcanines in some of the specimens, to wit those in which the 2nd, 4th and 6th postcanines are replacing. If teeth were added and lost in the manner suggested in figure 11 B, the state of the postcanine row at each growth stage would appear to be identical, i.e. it would always appear that the 2nd, 4th and 6th teeth were replacing because teeth are added and lost at the same rate. This is clearly not the case as specimens are also available in which the 1st, 3rd and 5th teeth are replacing.

Posterior migration of the postcanine row appears to be a characteristic of many of the advanced cynodonts, e.g. *Scalenodon* (Crompton, 1955); South American gomphodont cynodonts (Patterson and Olson, 1961) and *Diademodon* (Fourie, 1963).

There is ample evidence that the canines replaced several times. As the replacing canines were larger than their predecessors the new teeth invaded the region occupied by the anterior postcanine. It appears that in order to compensate for the loss of anterior postcanines further teeth were added at the back of the tooth row.

Replacement cycle

In figure 12 an attempt has been made to fit the postcanine rows of the specimens studied into an orderly sequence. This series indicates how posterior migration of the postcanine row was achieved in such a way that in some specimens the odd-numbered teeth are replacing and in others the even-numbered teeth are replacing. The upper postcanines are shown in figure 12 A and the lower postcanines in figure 12 B. In this figure teeth drawn in dotted lines above the alveolar border in the upper jaw and below it in the lower jaw had not yet erupted.

The first growth stage (I) in the series in figure 12 A is a diagrammatic representation of the upper postcanine row in specimen H (fig. 10). The 2nd, 4th and 6th teeth are in the process of erupting, but the 6th is further erupted than the 2nd or 4th (replacement wave). Replacement teeth are present above the 3rd and 5th postcanines, but not above the 1st. An unerupted tooth is present behind the 6th in position 7. There was no functional predecessor for this tooth. It is larger than the replacing tooth at position 5.

In specimen A (stage I A on the right of fig. 12 A) seven teeth are present, of which the 2nd, 4th and 6th are the youngest. It is possible that the state of the postcanine row in specimen A is similar to that of H except that the unerupted postcanine in position 7 has erupted and is functional.

In a later growth stage (fig. 12 A, II) the 1st functional postcanine which had no replacement tooth in stage I has been shed. The partially erupted 2nd, 4th and 6th postcanines of stage I are now fully erupted. Because one postcanine has been lost the 2nd, 4th and 6th of stage I become the 1st, 3rd and 5th of stage II. Consequently the replacing teeth that were developing in stage I above the 3rd and 5th replace the previous teeth and erupt in stage II as the 2nd and 4th. The unerupted additional tooth (position 7) of stage I erupts as the 6th in stage II. Consequently although in both stages I and II the 2nd, 4th and 6th teeth are the youngest, the teeth referred to are not the same in both stages.

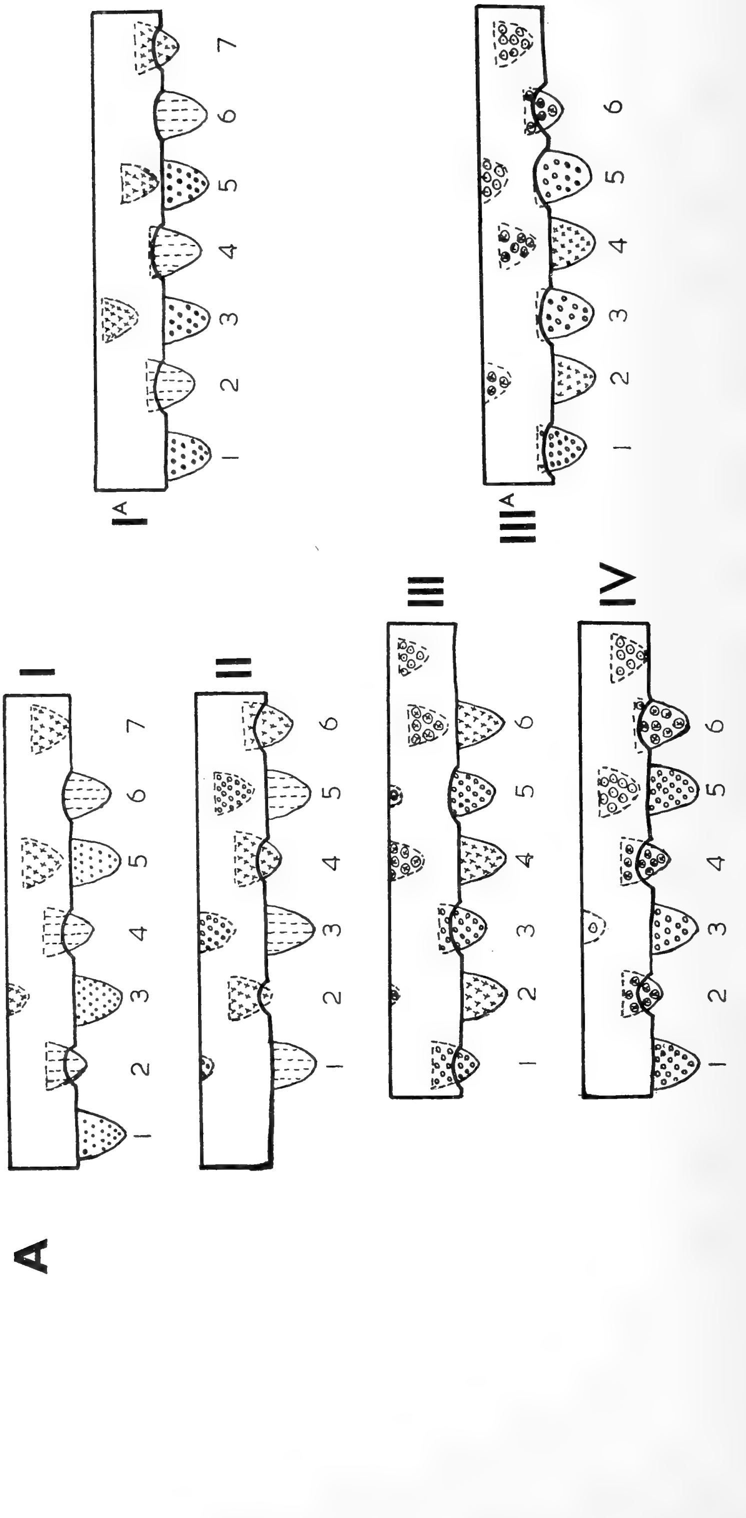
Replacing teeth are developing above the 1st, 3rd and 5th teeth in stage II. Stage II appears to correspond with specimen B. In this specimen there is no indication of an unerupted tooth behind the functional postcanine row. As the functional 1st, 3rd and 5th in specimen B are considerably larger than the corresponding teeth in specimen A, several growth stages probably separated these two specimens. This point will be considered again later.

In stage III the replacing teeth developing above the 1st, 3rd and 5th postcanines in stage II have erupted. In stage II replacing teeth are erupting in the 2nd, 4th and 6th alveoli. In stage III these are fully erupted. An additional tooth is developing behind the functional row and the development of a replacing tooth for the 5th has commenced. The state of eruption and replacement of the postcanines in this stage corresponds exactly to that present in specimens E and F (figs. 5 and 6). Specimens C, D and G appear to be slightly in advance of stage III because the replacing tooth for the 6th postcanine has erupted and replaced the old functional tooth in this position. This is illustrated in stage III A on the right of figure 12 A. Stage III is followed by a stage IV. Apart from the fact that the first functional tooth is now one position further back, this stage is identical to I, thereby completing the cycle.

The replacement cycle (fig. 12 B) in the lower jaw is basically the same as that concluded to have been present in the upper jaw. The only real difference is that the number of functional teeth is seven instead of six.

In growth stage I (fig. 12 B) the 1st, 3rd, 5th and 7th teeth are in the process of erupting. Replacing teeth are developing below the 2nd, 4th and 6th postcanines. This stage corresponds with the postcanine row of specimen H. In the right mandible of this specimen the old functional first tooth had not been shed, but it was shed on the left. This tooth has been indicated by a dotted outline in stage I. In specimen H there is no indication of an unerupted postcanine behind the last functional tooth. Specimen D (fig. 3 B) corresponds with stage I in regard to the state of eruption of the first seven postcanines, but a small 8th tooth is present behind the postcanine row. The state of eruption of the postcanines in specimen D is shown diagrammatically in stage I A (on the right-hand side of fig. 12 B). This specimen is discussed in more detail below.

In stage II the replacing teeth which were developing below the 2nd, 4th and 6th in stage I are erupting and replacing teeth are developing for the 3rd, 5th and 7th postcanines, but not for the first postcanine. An unerupted tooth is developing behind the 7th postcanine. The 1st, 3rd, 5th and 7th teeth that


A
I
1
2
3
4
5
6
7
II
1
2
3
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6
III
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IV
1
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I^A
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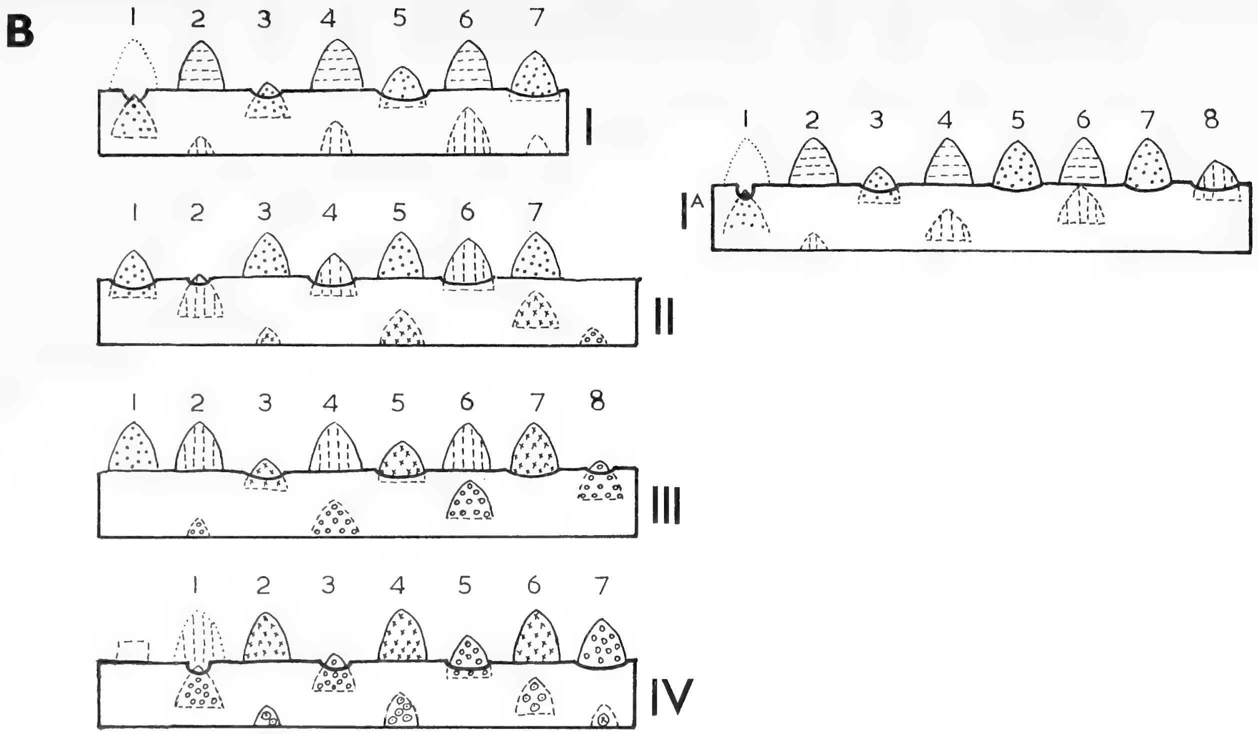

FIG. 12. *Thrinaxodon* sp. Replacement cycle of all the postcanines. A, upper and B, lower.

were partially erupted in stage I have in stage II erupted further. The 7th is fully erupted, but the 1st is only partially erupted. This stage is not represented in the material studied. In stage III the partially erupted 1st postcanine of stage II is fully erupted and retained. The other odd-numbered, functional teeth (3rd, 5th, 7th) of stage II have, however, been lost in stage III and their replacing teeth which were developing in stage II are now erupting. The retention of the 1st postcanine in stage III is presumably correlated with this tooth having no successor and being younger than the other functional odd-numbered teeth in stage II. Replacing teeth are developing below the 2nd, 4th and 6th postcanines and a partially erupted tooth is present behind the functional row. This stage corresponds with the postcanine row in specimens C, E and F (figs. 2, 5 and 6). In these specimens the remnant of a tooth is visible anterior to the functional postcanine row. This is discussed below. Specimen G (fig. 9 A) is similar to stage III in the state of eruption of the first five postcanines, but the partially erupted 8th postcanine shown in stage III is fully erupted.

The next stage, IV, is identical to I, except that the first functional tooth is one position further back. The 1st postcanine of stage III which has no replacing tooth, is retained as a tooth remnant. This remnant would presumably have been retained in the next three stages of the replacement cycle.

Edmund (1960, 1962) has made a thorough study of tooth replacement in reptiles. He has shown that the spacing between hypothetical impulses which initiate the development of teeth and which travel along the free margin of the dental lamina can account for the fact that in some reptiles the replacement pattern is strictly alternate, whereas in others waves of replacement pass from back to front or front to back along alternately numbered tooth series. Back to front waves are present in all the specimens of *Thrinaxodon* studied. Edmund has shown that the basic units in the dentition of all reptiles are *Zahnreihen*. He has suggested that Bolk's term 'Odontostichi' be dropped. *Zahnreihen* consist of a series of teeth that are either the 1st, or the 2nd, or the 3rd, etc., teeth developed from successive tooth positions, e.g. all the first teeth to develop at each successive tooth position form the 1st *Zahnreihe*, all the second teeth, the 2nd *Zahnreihe*, and so on. Development of teeth at each tooth position is iniated by an impulse travelling backwards along the free margin of the dental lamina. The spacing between successive impulses determines the spacing between successive *Zahnreihen*. Edmund has shown that the functional dentition in reptiles is the product of several *Zahnreihen*. In order to obtain a complete dentition many members of each *Zahnreihen* must be discarded or resorbed, for example, as Edmund has shown in a dentition consisting of 21 positions, '. . . 15 members of the first *Zahnreihe* are discarded before the first anlage of position twenty-one is laid down, and many members of the first seven *Zahnreihen* must be discarded before the first mature tooth is produced at position twenty'.

The type of replacement which took place in *Thrinaxodon* is basically the same as that which takes place in living reptiles. Therefore, the postcanine row of *Thrinaxodon* also probably consisted of the products of several *Zahnreihen*. It should, therefore, be possible to account for cycle of replacement concluded to have taken place in the postcanine row of *Thrinaxodon* in terms of Edmund's theory of the development of the functional dentitions of reptiles.

In figure 13 an attempt has been made to reconstruct the ontogenetic stages which led up to the development of the functional lower postcanine row. These are illustrated in figure 13 A to G. Subsequent changes in the postcanine row which were concluded in the section above to have taken place are shown in figure 13 H to L. The embryonic stages were deduced by working back from figure 13 H in terms of Edmund's theory.

In a hypothetical early stage, figure 13 A, the first impulse to travel along the free margin of the dental lamina is shown at position no. 1. It has initiated the development of the first tooth at this position. The first impulse is indicated as an arrow followed by the number 1. In a later stage (fig. 13 B) the impulse has moved to tooth position 2 and initiated the development of a tooth at this position. The tooth at position 1 is larger. In figure 13 C the first impulse has passed position 3 where it initiated the development of a tooth. A second impulse, 2·5 tooth positions behind* the first impulse, has initiated a second tooth at position 1. In a later stage, figure 13 E, this second impulse is 2·5 tooth positions in front of tooth position 1 and a third impulse commences in position 1. In figure 13 G the third impulse has initiated the development of the 3rd tooth at tooth position 3. Three teeth have, therefore, been formed at teeth positions 1, 2 and 3. The second impulse is 2·5 tooth positions in advance of the third impulse and two teeth have been formed in positions 4 and 5. The first impulse has initiated a tooth at tooth position 8 and one tooth has, therefore, been formed at tooth positions 6, 7 and 8.

In figure 13 H, the 4th impulse has initiated the development of a tooth at position 2, 2·5 tooth positions behind the 3rd impulse. The 4th impulse did not initiate the development of a tooth at position 1. The 1st impulse has faded out and no further teeth are initiated at this stage behind tooth position 8. In figure 13 H the alveolar border is indicated. The parts of the functional teeth above the alveolar border have been drawn in black. Unerupted teeth have been drawn in dotted outline. The teeth drawn in outline only above the functional teeth are the teeth that were resorbed or shed during development. Figure 13 H corresponds to stage III of the replacement cycle shown in figure 12 B, i.e. similar to the arrangement of the postcanines in specimens C, E, and F. In figure 13 H the functional postcanine row is built up of the teeth belonging to the first three *Zahnreihen* (Z1, Z2 and Z3). Five teeth have been lost from the first *Zahnreihe* and three from the 2nd *Zahnreihe*. Development of the 4th *Zahnreihe* (Z4) has commenced. The 1st, 2nd and 3rd functional teeth are the third teeth to have developed in these positions and are part of the 3rd *Zahnreihe*. The 4th, and 5th are the second teeth to have developed in this

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*The word 'behind' is used with reference to the direction of migration of the hypothetical impulse. Since the latter is moving from back to front, 'behind' means 'anterior to'.

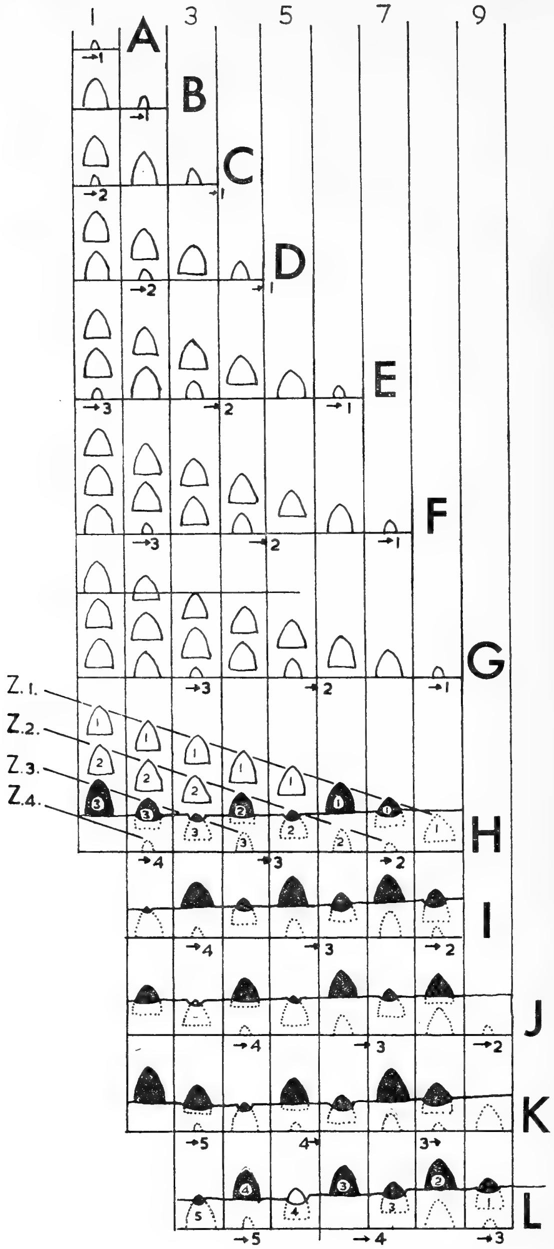

FIG. 13. *Thrinaxodon* sp.

Diagram to illustrate hypothetical development stages (A–G) leading up to a functional lower postcanine row (H) and the subsequent replacement cycle (I–L). Based upon Edmund's theory.

position and form part of the second *Zahnreihe*. The 6th and 7th teeth are the first to have developed in these positions and form part of the first *Zahnreihe*.

In a later growth, figure 13 I, the 1st functional tooth of figure 13 H is lost and no new tooth is present in this position. Therefore, the tooth in position 2 in figure 13 I is the first functional tooth. Figure 13 I is the same as stage IV or I in figure 12 B. In this stage the condition of the postcanine row is as in specimen H. In figure 13 I, the 4th impulse has initiated a tooth in position 3 (i.e. beneath the 2nd functional tooth). The 3rd impulse has initiated a tooth in position 5 and the 2nd impulse has initiated a tooth in position 8. Figure 13 J is equivalent to stage II in figure 12 B. Figure 13 K corresponds to stage III in figure 12 B and the 2nd, 3rd and 4th impulses have moved one tooth position backwards. Figure 13 K is a repetition of figure 13 H. In the former the 2nd impulse has faded away and the 5th impulse has initiated a tooth at tooth position 3 (functional 2). Figure 13 L is a repetition of figure 13 I. In figure 13 L the partially erupted tooth in position 3 is the first functional tooth. Thus Edmund's theory of successive impulses which initiate teeth and travel along the free margin of the dental lamina can account for the replacement cycle for the postcanine series concluded to have taken place in the lower jaw of *Thrinaxodon*.

We must now return to consider specimen D, which is peculiar in possessing eight functional lower postcanines. Furthermore the extra tooth, instead of being large, is small and simple. On the basis of a scheme of the type shown in figure 13, it is possible to account for these peculiarities. It can be assumed that in the development of specimen D, when a stage similar to figure 13 H was reached, the first impulse did not fade away but initiated a tooth at position 9. A tooth initiated in this stage would become functional in a later stage similar to figure 13 I. With the exception of the additional tooth, the state of eruption of the individual postcanines in specimen D is similar to that shown in figure 13 I. It is possible to account for the simple crown pattern of this tooth if it is assumed that its crown was formed behind the point where the morphogenetic gradient for 'molarization' was at its maximum (see p. 513).

If Edmund's scheme is followed it is also possible to account for the replacement cycle concluded to have taken place in the upper postcanines. These are shown in figure 14. The first stage shown (fig. 14 A) corresponds exactly with figure 13 G. It is unnecessary to repeat the stages leading up to figure 14 A as these correspond to those shown in figure 13. For convenience the teeth in figure 14 are orientated pointing downwards, to indicate that they are upper teeth. The postcanine row in figure 14 A consists of six functional teeth and an unerupted tooth behind. This row consists of the products of three *Zahnreihen* (Z^1 to Z^3). The 2nd impulse has initiated a tooth at position 5 and the 3rd impulse a tooth at position 3. The stage represented in figure 14 A is the same as stage I in figure 12 A. In a later stage, figure 14 B, which corresponds to stage II in figure 12 A the 1st functional tooth has been shed and no new tooth has been initiated in this position. The 1st tooth initiated by the 4th impulse is present at tooth position 2. In figure 14 C, which corresponds with stage III in figure 12 A, the 2nd impulse has initiated a new tooth in position 8, and the 3rd a tooth in position 5 and the 4th a tooth in position 3. Figure 14 D is identical to figure 14 A, except that the tooth row has moved one tooth position backwards. After the stage shown in figure 14 C the 2nd impulse appears to fade away. In figure 14 E to I the replacement cycle is continued. In figure 14 E the 5th impulse has initiated a tooth in position 3. In figure 14 H the 6th impulse has initiated a tooth in position 4.

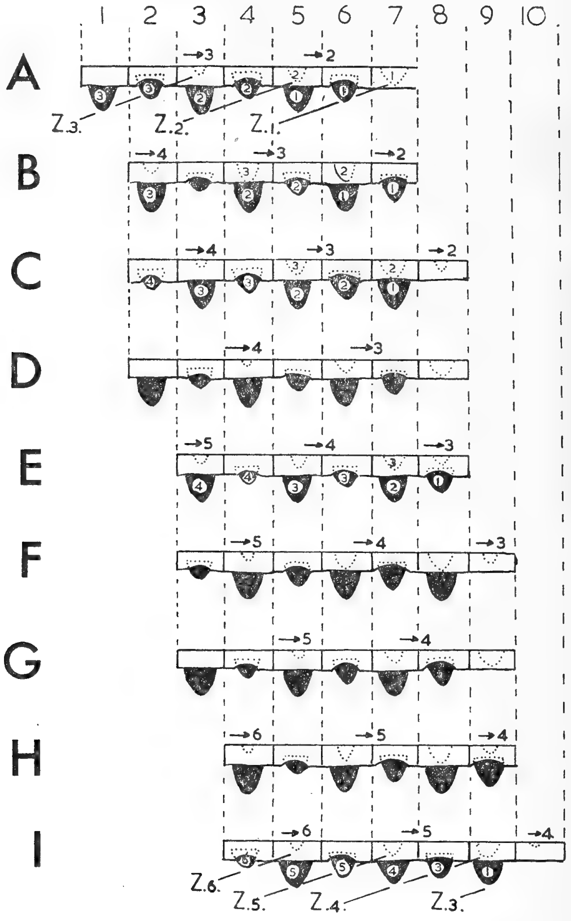

FIG. 14. *Thrinaxodon* sp.
Diagram to illustrate the application of Edmund's theory of tooth replacement to the replacement cycle for the upper postcanines.

It is thus possible to account for the state of eruption and replacement of individual postcanines and the posterior migration of the postcanine row in several specimens of *Thrinaxodon* if it is assumed that:

(1) regular impulses, 2·5 tooth spaces apart, travel caudad along the free margin of the dental lamina;

(2) each new impulse commences one tooth position behind the tooth position where the previous impulse commenced.

The sequence of a replacement in successive growth stages shown in figure 12 was based upon the state of eruption of the individual postcanines in a number of actual specimens. It is important that this sequence agrees with the sequence based upon Edmund's theory and shown in figures 13 and 14.

Once the replacement cycle is determined it is possible to estimate the minimum number of times each postcanine was replaced. The youngest specimen known (specimen A) appears to correspond with the stage shown in figure 14 A. The 1st and 2nd teeth of this stage are apparently the third teeth to have developed in these positions, the 3rd and 4th are the second, the 5th and 6th, the first at their respective positions. The state of eruption of the postcanines of specimen B corresponds with the stages shown in figure 14 B, E and H. As there is a considerable difference in the size of the individual postcanines of specimens A and B (see fig. 1) it is not possible for specimen B to have been the immediate successor of a specimen similar in size to that of specimen A. Therefore, several growth stages probably separate specimens A and B. If specimen A is equated with figure 14 A it is reasonable to equate specimen B with figure 14 E. Figure 14 F corresponds with specimens C, D, E, F and G and Parrington's specimens E, F, G (see table I). Specimen H and Parrington's I corresponds with figure 14 G. A specimen corresponding with figure 14 H is not known. Specimen I corresponds with figure 14 I. In figure 14 I the 1st functional tooth corresponds with tooth position 4. The postcanine row in figure 14 I is made up of the members of the 3rd, 4th, 5th and 6th *Zahnreihen* (Z^3–Z^6). The 1st functional postcanine (i.e. the tooth at tooth position 4) is the 6th tooth to develop in this position, the 2nd and 3rd functional are the 5th to develop in these positions, the 4th functional is the 4th tooth to develop in this position, the 5th functional tooth is the 3rd tooth to develop in this position and the 6th functional the 1st to develop in this position.

This means that the 1st functional tooth of an old specimen has been replaced at least five times, the 2nd and 3rd, four times, the 4th, three times, the 5th, twice, and the 6th not replaced. The fall off in the number of replacements in a posterior direction is correlated with the posterior migration of the postcanine row.

Differentiation of the postcanine row

A characteristic of *Thrinaxodon* is the increase in the complexity of the crown pattern in a posterior direction. The anterior postcanines are 'caniniform' in appearance and the crown is dominated by the main cusp whereas the posterior teeth have a complex 'molariform' pattern not unlike that of some early mammals. It has already been shown (Crompton, 1963) that *Thrinaxodon* was one of the earliest of the mammal-like reptiles which was capable of a sustained bite across the postcanines. The power of this bite was greatest across the posterior region of the postcanine row and it is possible to correlate the complex postcanines in this region with this fact. The simple pattern of anterior postcanine teeth was possibly correlated with their position close to the canine. If the anterior teeth had complex crowns they would have interfered with the stabbing action of the canines to a greater extent than simple 'caniniform' postcanines.

In most of the specimens studied the postcanines do not all form a graded series in which each postcanine is slightly more molariform than the tooth immediately in front of it. Usually it is possible on the structure of the crowns divide the postcanine row into two series, one consisting of partially erupted postcanines and one consisting of the fully erupted postcanines. The series are alternately numbered, i.e. the teeth numbered 3, 5 and 7 form one series and the teeth numbered 2, 4, 6 form the other series. In each of these series there is a progressive complication of the crown structure in a posterior direction. One of the major differences between the crown structure of the two series is that the partially erupted teeth have simpler crown patterns (or were more caniniform) than the fully erupted teeth immediately anterior or posterior to them. During growth postcanines are lost from the front of the row and others are added behind. Consequently if differentiation of the postcanine row into simple postcanines anteriorly, and complex postcanines posteriorly, is to be maintained during growth each tooth must be replaced by a tooth with a simpler crown pattern. This is illustrated in figure 15. The stage of the replacement cycle shown in figure 15 A corresponds to figure 13 H and that shown in figure 15 B corresponds to that shown in figure 13 I. The tooth developing below the second functional in figure 15 A would become the 1st functional tooth in the later stage, figure 15 B. It must therefore be more caniniform than the tooth it replaces. This explanation could account for minor differences between adjacent teeth, but in fact the differences are far greater than could be accounted for in this way. It has been noted above that it is possible to divide the row up into

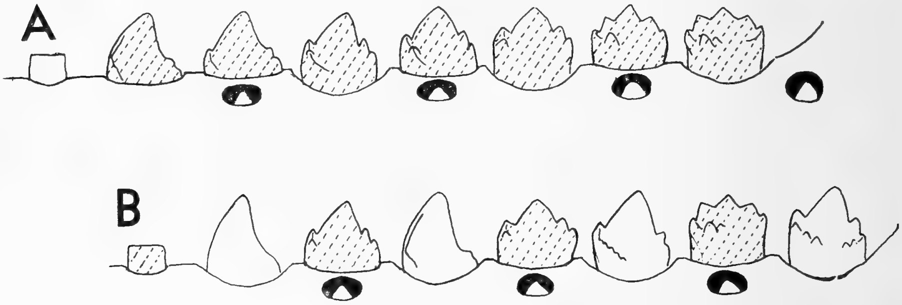

Fig. 15. *Thrinaxodon* sp.
Posterior migration and differentiation of the lower postcanines.

two series. Teeth belonging to one series have different crown patterns from teeth belonging to the other series. The differences between the two series in specimen D are described in detail on p. 486.

The complication of the teeth in a posterior direction suggests that they develop under the influence of a morphogenetic gradient, in the manner which has been suggested by Butler (1939) for mammalian dentitions. Butler postulates a short steeply graded field of 'caninization' determining the form of the canine tooth, succeeded by and slightly overlapping a longer, more gently graded molarization field, affecting the entire postcanine row. The teeth immediately behind the canine will therefore show little molarization since they develop under the influence of the low anterior end of the molarization gradient and are also slightly affected by the caninization field. Further back the canine field vanishes and the molarization field becomes increasingly strong, so that the

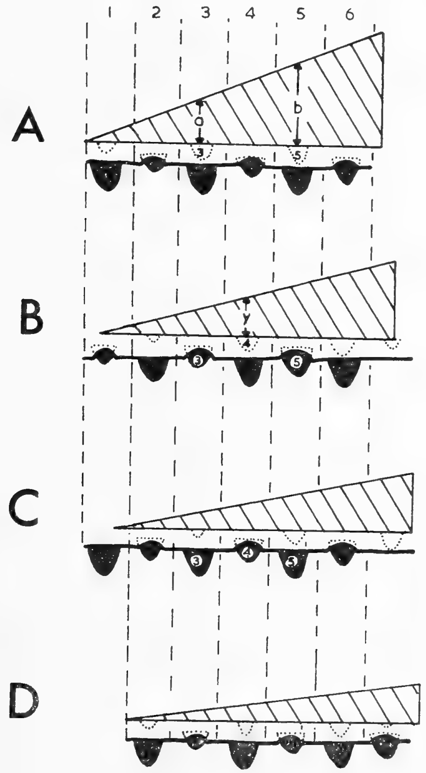

Fig. 16. *Thrinaxodon* sp.
Diagram to illustrate posterior migration and changes in the morphogenetic gradient responsible for the structure of the lower postcanines.

teeth become progressively more molarized from front to back of the postcanine row. In figure 16 the morphogenetic gradient of the molarization field in a series of growth stages has been shown diagrammatically. For simplicity sake the caninization field is not shown. It can be imagined as lying directly in front of the 1st postcanine and fading out rapidly, so that its influence does not extend beyond the 1st postcanine. During growth the gradient migrates in a posterior direction. In figure 16 A the gradient commenced at tooth position 1. In figure 16 D the gradient had shifted to tooth position 2. In the intervening stages a gradual shift of the gradient in a posterior direction presumably took place.

In specimens C, D, E and F the most molariform teeth in the lower jaw have well-developed cingular cusps and the main cusps are about the same size as the accessory cusps. In the larger specimen G the most molariform tooth is less molariform than those in specimens C, D, E and F. In this tooth the cingular cusps are well developed, but the main cusp is relatively larger. In the larger specimen H, the most molariform tooth is less molariform than that of specimen G. The main cusp is large and the cingular cusps are poorly developed. This suggests that the morphogenetic gradient is very steep in early stages, but levels off in later growth stages. In the four growth stages shown in figure 16, this feature is shown diagrammatically. The replacing teeth for 1st, 3rd and 5th teeth in stage A develop when the gradient is steep and commences at tooth position 1, whereas the replacing teeth for the 2nd, 4th and 6th teeth develop at a later stage, B, when the gradient is further posterior and is less steep. The replacing teeth developing in stages A and B form the functional postcanines in stage C. The structure of the crowns of 1st, 3rd and 5th in stage C increases in complexity in a posterior direction, but despite this their crown patterns are distinct from those of the 2nd, 4th and 6th. It may be possible to correlate this with the fact that the two series developed under different gradients occupying different positions. Take, for example, the 3rd, 4th and 5th functional postcanines in stage C. The 4th tooth is formed in stage B. The strength of the gradient at this point in stage B has been indicated and labelled Y. The 3rd and 5th functional teeth of stage C are formed in stage A. The strength of the gradient affecting these teeth is indicated and labelled *a* and *b*. As *a* and *b* are both larger than *y* the 3rd and 5th teeth will be more molariform than the fourth.

This conclusion is highly speculative and well-prepared additional material is required to confirm these results. If it is correct it would explain why a recently erupted tooth has a simpler and different crown pattern than the postcanines anterior and posterior to it. It is of some interest that the changes in the ontogeny of *Thrinaxodon* are of essentially the same type as Butler (1939) suggests have been operative during mammalian phylogeny.

In the descriptive section the specimens were divided into three groups. This division was based on the structure of the postcanine teeth in the mandible. The different crown patterns are correlated with skull length, and it is therefore possible that these differences are related to changes which the morphogenetic gradient undergoes during growth. Consequently these differences probably have no taxonomic importance. Until this is confirmed or denied no attempt should be made to place the different groups in different species.

Notes on the postcanine row of Gomphodont cynodonts

Diademodon is characterized by a differentiated postcanine row (Brink, 1955*a*, 1957; Crompton, 1955). Three distinct regions can be recognized in both upper and lower jaws—an anterior, central and posterior. The three to four postcanines of the anterior region have simple conical crowns with a slight development of a cingulum on the lingual edge. These teeth are small in comparison with the remaining postcanines. The central region consists of about seven postcanines with transversely ovate gomphodont crowns. In this region wear of the crown surfaces decreases progressively in a posterior direction. The size of the crowns increases progressively in a posterior direction. The posterior region consists of about four teeth. In this region the crowns become progressively more longitudinally ovate in a posterior direction. Fourie (1963) has referred to the crown patterns of these four teeth as 'intermediate gomphodont', 'intermediate sectorial', 'large sectorial' and 'small sectorial'.

Diademodon specimens covering a wide size range are known. In all specimens the postcanine row is differentiated in the same way and in all the specimens the postcanines of the central region are characterized by a progressive decrease, in a posterior direction, of the wear of the crown surfaces and a progressive increase, also in a posterior direction, of size. Brink (1957) has noted '. . . that replacement would tend to cause an irregular series of differently sized teeth'. An irregular series of postcanines in the central region has never, to the author's knowledge, been observed in *Diademodon*.

The teeth of the central region are considerably larger in older specimens of *Diademodon* than in younger specimens. Tooth replacement must therefore have occurred in this region. Replacement must have taken place in such a way that the postcanines of both the central and posterior regions always formed a graded series. How was this achieved? In order to answer this question it is necessary to review the evidence of replacement of the postcanines in *Diademodon*.

Fourie (1963) has found evidence for the loss of anterior postcanines during growth. He has also found unerupted postcanines which had no predecessor behind the functional postcanines. He has concluded that during life the postcanine row migrated posteriorly. The number of functional teeth remained constant as teeth were lost and added at roughly the same rate. Broom (1913) has reported replacement of some of the anterior conical postcanines by new conical postcanines. Fourie will also describe several specimens showing replacement in this region.

In a specimen of *Diademodon* housed in the Geologish-Paläontologisches Institut und Museum in East Berlin the right maxilla contains two conical anterior postcanines. These are followed by a small, greatly worn transversely ovate postcanine. This tooth is the first of the central region consisting of postcanines with transversely ovate crowns. In the left maxilla three and not two anterior postcanines with sharply pointed conical crowns are present. The posterior of the three appears to have erupted shortly before death and shows no sign of wear. There is no doubt that numerically this tooth corresponds with the greatly worn transversely ovate postcanine in the right maxilla. This suggests that replacement in the left maxilla was in advance of that in the right and also that a simple conical postcanine replaced a transversely ovate postcanine. The author (1955) has reported the replacement of the 6th postcanine (second postcanine of the central region) in *Diademodon*. The replacing tooth appears to be more conical than transversely ovate.

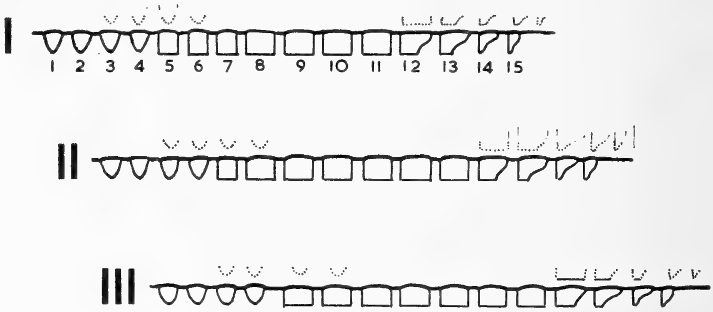

FIG. 17. *Diademodon* sp.
Diagram to illustrate replacement and posterior migration of the postcanine row.

The author (1955) has also claimed that in two specimens of *Diademodon* one of the upper longitudinally ovate sectorial postcanines in the posterior region was replaced by a tooth with a gomphodont crown pattern. This claim was based upon the fact that a longitudinally ovate foramen which follows immediately after an alveolus for a gomphodont tooth is present in these specimens below the unerupted gomphodont postcanine. This foramen was interpreted as an alveolus for a sectorial postcanine. Brink (1957) has challenged this view and has offered an alternative interpretation for the longitudinally ovate foramina behind the functional postcanine row. He has claimed that '. . . these openings could equally well be interpreted as ordinary gubernacular canals'. I find this interpretation difficult to accept for two reasons: (1) in most specimens of *Diademodon* the postcanine row is terminated by sectorial postcanines; (2) replacement of sectorial teeth by gomphodont teeth at the back of the postcanine row has also been reported in *Cricodon* (Crompton, 1955) and in *Trirachodon* (Parrington, 1960). Fourie (1963) has confirmed the replacement of sectorial teeth by gomphodont teeth at the back of the row in *Diademodon*. He has shown that the 'intermediate gomphodont postcanines' are replaced by 'gomphodont'; the 'intermediate sectorial' by 'intermediate gomphodont' and, 'large sectorial' by 'intermediate sectorial', a 'small sectorial' by 'large sectorial'.

In figure 17 the information listed above has been applied to a growth series of *Diademodon.* In the first growth stage I the postcanine row consists of fifteen teeth. The 1st to the 4th are conical, the 5th to the 11th are gomphodont. In a posterior direction the latter increase progressively in size and wear decreases progressively. The 12th is intermediate gomphodont, the 13th intermediate sectorial, the 14th large sectorial and the 15th small sectorial. There is evidence that the 1st and 2nd postcanines were lost, that the 3rd–6th and 12th–15th postcanines were replaced and that teeth were added posteriorly. If teeth are lost anteriorly and added posteriorly then it follows that if the differentiation of the postcanine row is to be maintained that:

(1) the 3rd and 4th postcanines must have been replaced by conical teeth;

(2) the 5th and 6th postcanines must have been replaced by conical teeth;

(3) the 12th postcanine must have been replaced by a gomphodont tooth; the 13th by an intermediate gomphodont; the 14th by intermediate sectorial and the 15th by a large sectorial;

(4) the new tooth at the back of the row must be a small sectorial type.

All this is in agreement with the available evidence. If replacement of this nature is repeated differentiation of the postcanine row will be maintained throughout the period of growth. The crowns of the central region will always form a graded series because as greatly worn anterior teeth of the series are replaced by conical teeth new unworn gomphodont teeth are added behind.

The description above accounts for the maintenance of a fully differentiated postcanine row, and it is interesting to speculate on the growth stages that led up to the formation of a fully differentiated postcanine row. The youngest *Diademodon* specimen that has been described (Fourie, 1963) already has a fully differentiated row. In this specimen, however, there is no evidence that teeth had been lost anteriorly. The progressive increase of the wear of the crowns of the central region suggests that during growth these teeth were added one after the other after the animal had started to use its teeth. This implies that *Diademodon* commenced active life with only a few teeth. This also suggests that the posterior region of the row was only added after a full complement of gomphodont teeth had erupted. As mentioned above the youngest available specimen does not appear to have lost anterior teeth. This may suggest that replacement only commenced after a complete postcanine dentition had erupted.

The above discussion of the growth of the postcanine row is highly speculative, but the available evidence on the growth of the postcanine row of Middle Triassic cynodonts tends to confirm at least some of the conclusions reached above. A good growth series of the jaws of *Scalenodon* has been described (Crompton, 1955).

The youngest available specimen of *Scalenodon* has five postcanines. These are all transversely ovate and wear decreased in a posterior direction. Conical anterior postcanines are not present. During growth postcanines were added progressively behind to increase the length of the postcanine row. The largest specimen has eleven postcanines. Sectorial teeth were only added at an advanced growth stage. These were replaced by transversely ovate teeth. Teeth were lost in front during growth. This process appears to have commenced at an early stage, but appears to have been slower than addition behind.

Olson and Patterson (1961) have stated that in undescribed South American cynodonts teeth were also lost anteriorly and added behind. Kühne (1956) has made a similar observation in the tritylodontid *Oligokyphus*.

In no gomphodont cynodonts is there any indication of alternate replacement in the postcanine row. It appears rather that postcanines are added progressively from front to back and that some of these teeth are progressively replaced. In *Diademodon* some of the anterior and posterior postcanines are replaced, in *Scalenodon* only posterior postcanines are apparently replaced and in *Oligokyphus* none of the cheek teeth were replaced.

In most placental mammals teeth are laid down progressively from front to back. Edmund (1960) has pointed out that as the deciduous dentition and the molars are the first teeth to be formed in the positions they occupy, they constitute a single *Zahnreihe*. The permanent incisors, canines and premolars constitute a second *Zahnreihe*. In *Thrinaxodon* and other early cynodonts the products of several *Zahnreihen* function simultaneously and alternate replacement is present. The absence of alternate replacement in gomphodont cynodonts and the progressive addition of teeth suggest that gomphodont cynodonts paralleled to some extent later development in mammals. Large sections of the functional postcanine row of *Diademodon* appear to form part of a single *Zahnreihe* since teeth were added progressively without anterior replacement. Teeth numbered 1 to 15 in figure 17 (I) may constitute a single *Zahnreihe*. The teeth that replaced them may constitute a second *Zahreihe* of which the central members had been suppressed.

SUMMARY

1. Tooth replacement is described in eight specimens of the cynodont *Thrinaxodon liorhinus* Seeley. It is shown that replacing teeth developed in pits lingually to the functional teeth. During growth the replacing teeth migrated labially to lie below the crowns of the functional teeth. It is concluded that the replacement cycle of individual teeth is identical to that reported for *Ericiolacerta* (Crompton, 1962).

The replacement cycles of the entire postcanine row (both upper and lower) are deduced from the state of eruption of the individual postcanines of the specimens studied.

2. Parrington's (1936) observation that the teeth replaced alternately is confirmed. It is shown that a wave of replacement passed from back to front along both the odd and even numbered postcanines.

3. The loss of anterior postcanines and the addition of further teeth at the back of the row resulted in a posterior migration of the functional postcanine row. This was probably correlated with the increase in size of each successive replacing canine.

The stages at which teeth were lost anteriorly and added posteriorly is illustrated.

It is shown that Parrington's (1936) series of *Thrinaxodon* only covered part of the growth period. Older and younger specimens are described.

4. It is shown that it is possible to interpret the replacement cycle in *Thrinaxodon* in terms of Edmund's (1960) interpretation of reptilian tooth replacement. It is shown that in *Thrinaxodon* erupting postcanines usually had simpler (less molariform) teeth than the fully erupted postcanines immediately anterior or posterior to them. It is suggested that the posterior migration of the postcanine row can only partially explain this phenomenon.

It is suggested that the postcanines of *Thrinaxodon* developed under the influence of a morphogenetic gradient (Butler, 1939). Teeth developed under the influence of the anterior portion of the gradient were 'caniniform' and those developed under the posterior portion of the gradient 'molariform'. It is suggested that in the early stages the gradient was steep, but that in older specimens the gradient levelled off and moved progressively caudad. It is concluded that the younger teeth in each specimen (i.e. partially erupted) developed under the influence of a different gradient than the older teeth in the same specimen. It is concluded that this could account for the difference in crown structure between old and new postcanines. It could also account for the fact that teeth developed at the same time would have had the same basic crown structure.

5. Tooth replacement in gomphodont cynodonts is discussed. It is shown that in *Diademodon* the postcanine row is divided into three regions. The postcanines of the central region always form a structurally graded series. It is shown that during growth teeth were lost anteriorly and added posteriorly; it is shown that the postcanine row continued to be differentiated in the same way despite the posterior migration of the postcanine row during growth. It is concluded that replacement was limited to the anterior and posterior regions and to the anterior and posterior members of the central region. No replacement took place along the remainder of the central region.

It is concluded that during growth teeth were added progressively in *Diademodon* and that large sections of the postcanine row of Diademodon constituted a single *Zahnreihe*. It appears that in this aspect *Diademodon* paralleled later mammals.

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Key to Lettering

a.a.c.	anterior accessory cusp
a.b.	attachment bone
a.c.c.	anterior cingular cusp
a.cing.	anterior portion of lingual cingulum
a.l.c.	anterior labial cusp
a.pc.	additional postcanine
a.l.	alveolus for first postcanine
a.8.	alveolus for 8th postcanine
c.c.	cingular cusp
cing.	cingulum
long.g.	longitudinal groove for the dental lamina
m.c.	main cusp
p.	pit for replacing tooth
p.a.c.	posterior accessory cusp
p.c.c.	posterior cingular cusp
p.c.1.	1st postcanine
p.c.8.	8th postcanine
p.l.c.	posterior labial cusp
p.r.c.	pit containing developing crown of a replacing canine
rep.c.	replacing canine
rep.xi.	replacing incisor
r.pc.	redundant or suppressed postcanine
r.pc.6.	crown of the 6th replacing postcanine

[CONTINUED FROM INSIDE FRONT COVER

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'I. *Synonymy arranged according to chronology of names.*—All published scientific names by which a species has been previously designated (subsequent to 1758) are listed in chronological order, with bibliographical references to all descriptions or descriptive citations following in chronological order after each name. . . .

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Eulalia (*Steggoa*) *capensis* Schmarda

Eulalis capensis Schmarda 1861, p. 86, pl. 29, fig. 231. Willey 1904, p. 259.
Eulalia viridis var. *capensis* McIntosh 1903, p. 34. Day 1953, p. 30.
Eulalia viridis (*non* Muller) Ehlers 1913, p. 455. Day 1934, p. 30.

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