RECORDS

ZOOLOGICAL SURVEY

OF

PAKISTAN

HALF-YEARLY

Vol. II **Number 2**

Edited and Published
By
THE DIRECTOR
ZOOLOGICAL SURVEY OF PAKISTAN
Pak. Sectt., Blocks 13 & 14, Shahrah-e-Liaquat
KARACHI—I

SEPTEMBER 1970

PRINTED BY THE MANAGER PRINTING CORPORATION OF PAKISTAN PRESS, KARACHI
1971

Zoological Survey of Pakistan

This file has been converted into PDF format in response to the growing demand of online readers. This initiative was made possible through the dedicated efforts of the Director, Mr. Altaf Hussain Khuhro, Zoological Survey of Pakistan (ZSP), Ministry of Climate Change & Environmental Coordination, Government of Pakistan, Islamabad.

Special appreciation is extended to Mr. Altaf Hussain Narejo, Zoologist, for his keen interest, commitment, and active support in the development and promotion of the Online Directory of the Zoological Survey of Pakistan.

We are also grateful to Mr. Muhammad Moazzam for his valuable contribution in providing some missing Records and reference material, which significantly supported the compilation and accuracy of this work.

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RECORDS
ZOOLOGICAL SURVEY OF PAKISTAN
VOLUME II, *Number 2, Karachi, 1971*

CONTENTS

NOTES ON SOME BATS OF THE ORIENTAL REGION

BY

M. S. U. SIDDIQUI

Zoological Survey of Pakistan.

While preparing a checklist of the mammals of Pakistan with particular reference to the mammalian collection in the British Museum (Natural History) along with the identification of some bats collected by Zoological Survey of Pakistan, some observations were made on the taxonomy of certain forms as follows :

I. Family EMBALLONURIDAE

A revised Key to the species of genus Taphozous *of the Oriental Region* :

Dobson (1878) reported the presence of a semicircular fold of skin between the angles of the lower jaws in the males of *T. kachhensis*, but he did not regard this structure as a true gular sac. Thomas (1915) described it as a shallow sac with depth 1-2 mm. in males and in females as a mere patch of bare skin. Dobson (1878) also noted that the abdomen was devoid of fur in both sexes of *kachhensis* and it appears that Wroughton (1918) formulated his key to the species of Taphozous on the basis of Dobson's descriptions.

While working on the *Taphozous* bats of Pakistan, some discrepancies were observed not only in the presence of the gular sac and nakedness of the abdomen in *kachhensis*, but also in the size of fore-arm and fur colour among the representatives of other species. It was, therefore, considered desirable to study the entire collection in the British Museum (Natural History) of *Taphozous* species of the Oriental Region and to prepare a revised key for their identification.

Revised key to the species of Taphozous (*After Wroughton* 1918),

1. Radiometacarpal pouch distinct, lower lip feebly grooved.
   - (*a*) No gular sac in either sexes.
   - (*b*) Body fur extending upon part of wing and interfemoral membranes.
   - (*c*) Black beard in most males especially during breeding season.
   - (*d*) Tail thickened and laterally compressed.
   - (*e*) Fore-arm : 60.3-66.5 (64.3), condylobasal length: 18.0-19.9 (19.0), Zygomatic width : 11.5-12.8 (12.2), c-m^3 : 5.7-6.0 (5.8). ..... *melanopogon melanopogon* Temm.

   (*a*') Entire throat dark in both the sexes.

(d^1) Extremity of tail not thickened.

(e^1) Fore-ark : 71.1-72.4 (72.1), condylobasal length : 20.8-21.3 (21.1), zygomatic width : 13.2-13.5 (13.3) : c-m^3 : 6.4-6.6 (6.5).

.....*theobaldi theobaldi* Dobson.

(b^1) Body fur narrow across the loins and not extending upon wing or interfemoral membrane but ending in a pattern.

(c^{ii}) Region across the throat darker.

(e^{ii}) Fore-arm : 70.0-71.6 (70.8), condylobasal length : 21.5-21.8 (21.6), Zygomatic width : 13.4-13.6 (13.5) : c-m^3 : 6.8.....

.....*theobaldi secatus* Thomas.

(a^i) Gular sac in males, rudimentary or absent in females.

(b^{ii}) Body fur extending upon part of wing and interfemoral membranes.

(e^{iii}) Fore-arm : 59.3-64.9 (61.9) : condylobasal length : 17.7-18.7 (18.4) : zygomatic width : 11.5-11.8 (11.7) : c-m^3 : 8.1-8.6 (8.4).

(f) Gular sac absent in females.

(g) Abdomen much lighter in colour than back.

.....*perforatus perforatus E.* Geoffroy

(e^{iv}) Fore-arm : 56.3-64-8 (59.1), condylobasal length : 18.5-19.3(18.9), zygomatic width : 12.4-13.0 (12.6), c-m_3 : 8.4-9.1 (8.7).

(f^i) Gular sac rudimentary in females.

(g^i) Abdomen not lighter in colour than back.

.....*longimanus longimanus* Hardwickei.

(b^{iii}) Body fur not extending upon part of wing or interfemoral membrane

(e^v) Fore-arm : 68.7-77.1 (72.7), condylobasal length : 21.3-23.0 (22.5), zygomatic width : 15.0-16.0 (15.6), c-m^3 : 10.1-11.2 (10.8).

(h) Fur normal and close.....*kachhensis kachhensis* Dobson.

(e^{vi}) Fore-arm : 71.0-75.7 (73.8), condylobasal length : 23.9, zygomatic width : 17.0; c-m^3 : 7.2.....*kachhensis nudaster* Thomas.

2. Radiometacarpal pouch absent; lower lip with a deep narrow groove in the centre.

(a^{ii}) Gular sac well developed in males but smaller in females.

(b^{iv}) Wing and interfemoral membranes naked except at the base of the tail.

(e^{vii}) Fore-arm, 65.4-66.9 (66.3), condylobasal length ; 20.4-23.1 (21.6), zygomatic width : 15.4-15.6 (15.5), c-m^3 : 6.5-7.5 (7.0) .....*saccolaimus crassus* Blyth.

Supplementary notes on **T. k. kachhensis** Dobson :

Eight Male specimens in spirit from Tori (Jacobabad distt.), Sind, collected by Zoological Survey of Pakistan were examined. The gular sac in these specimens is very distinct with a depth 2-5 mm. from its posterior wall. The body fur of the abdomen extends up to the loins and does not spread beyond onto the wing or the interfemoral membrane. Size of fore-arm is 70.0-73.8 mm. in these specimens.

II. Family RHINOPOMATIDAE

Notes on the status of **Rhinopoma kinneari** Wroughton.

Dobson (1878) included all the large Rat-tailed bats of the genus *Rhinopoma* in one species, *microphyllum* Brunnich, ranging from Africa (Sudan and Egypt) through Arabia, Iraq, Persia, the Indo-Pakistan subcontinent to Burma. Blanford (1891) accepted Dobson's views. Gray (1831) named the lesser Rat-tailed bats from the Indo-Pakistan subcontinent as *Rhinopoma hardwickei*. Wroughton (1912) described a new species, *Rhinopoma kinneari* from the Cutch Collection of the Mammalian Survey of the B.N.H. Society, with fore-arm longer than *microphyllum* as he understood it. He later (1918) added other localities in India and restricted *microphyllum* to Egypt. The difference between these two was based on *kinneari* being larger and separated geographically.

Ellerman and Morrison-Scott. (1951) retained three species in the entire range of *Rhinopoma*, namely the two larger forms, *microphyllum* (range from Egypt to Persia) and *kinneari* (the Indo-Pakistan subcontinent and Burma) and the third smaller *hardwickei* (range from Egypt to Siam).

All specimens of the three species in the British Museum (Natural History) collection were examined and it was observed that the two larger forms, namely *microphyllum* and *kinneari* have the same fur colour and their Principal measurements fall within the same range.

TABLE I.—*Showing Principal measurements (in mm.) of the specimens of* Rhinopoma *species examined* :

Brit. Mus., No. Sex and locality	Fore-arm	Condylo-basal length	Zygomatic width	c-m3
R. microphyllum				
2.10.01.6, Female, Tetespid, Persia	70.3	18.8	12.0	7.3
3.2.7.11, Male, Sudan, North Africa	65.9	18.0	11.7	7.2
3.2.7.12, Male, Sudan, North Africa	65.4	17.6	11.8	6.8
19.11.8.1, Female, Las Bela, Baluchistan, West Pakistan	67.8	18.2	11.7	7.2
64.8.17.48 (?) : Palestine	67.6	18.5	11.8	7.4
94.7.22.2 (?), Gizeh, Egypt	68.6	..	..	7.3
Average	67.6	18.2	11.8	7.2
R. kinneari				
11.12.11.1, Male, Bhuj, Cutch, India-*Type* ..	70.0	19.4	12.8	7.8
15.11.1.42, Male, Sukkur, Sind, West Pakistan	70.5	18.8	12.3	7.5
15.11.1.43, Female, Sukkur, Sind, West Pakistan	65.5	18.5	11.9	7.3
15.11.1.44, Female, Gambat, Sind, West Pakistan	63.0	17.6	..	7.1
15.11.1.45, Female, Gambat, Sind, West Pakistan	67.1	17.3	11.7	6.9
15.11.1.46, Female, Gambat, Sind, West Pakistan	65.5	17.2	11.4	6.9
15.11.1.47, Female, Gambat, Sind, West Pakistan	64.6	17.5	11.4	7.0
25.11.3.19, Male, Amb, Salt Range, West Pakistan	72.2	..	..	..
23.11.3.20, Female, Amb, Salt Range, West Pakistan	67.3	..	..	7.0
23.11.3.21, Female, Amb, Salt Range, West Pakistan	69.8	17.8	11.6	7.0
23.11.3.22, Female, Rohtas, Salt Range, West Pakistan	69.3	17.9	..	7.1
23.11.3.23, Female, Rohtas, Salt Range, West Pakistan	68.8	17.9	..	7.0
23.11.3.24, Female, Rohtas, Salt Range, West Pakistan	66.8	17.8	..	7.0
26.9.2.6, Male, Ara, Salt Range, West Pakistan	70.7	18.3	12.1	7.2
26.9.2.7, Male, Ara, Salt Range, West Pakistan	68.5	18.5	12.1	7.4
26.9.2.8, Female, Ara, Salt Range, West Pakistan	66.4	17.7	11.9	7.2
Average	67.9	18.0	11.9	7.2

Brit. Mus., No. Sex and locality	Fore-arm	Condylo-basal length	Zygomatic width	c-m3
R. hardwickei				
1e, Male, India—Type	60.6	16.5	11.1	6.2
15.11.1.48, Male, Landhi, Karachi, W. Pakistan	63.1	16.9	..	6.2
15.11.1.49, Female, Landhi, Karachi, W. Pakistan	58.8	15.7	..	6.1
25.11.3.7, Male, Amb, Salt Range, W. Pakistan	61.8	16.2	10.9	6.3
23.11.3.8, Male, Amb, Salt Range, W. Pakistan	58.1	16.3	10.3	6.2
23.11.3.9, Female, Amb, Salt Range, W. Pakistan	59.6	16.1	10.6	6.1
23.11.3.10, Female, Amb, Salt Range, W. Pakistan	60.3	15.4	10.0	6.0
23.11.3.11, Female, Rohtas, Salt Range, W. Pakistan	61.3	16.3	..	6.2
23.11.3.12, Female, Rohtas, Salt Range, W. Pakistan	60.9	16.0	..	6.0
29.9.2.4, Male, Ara, Salt Range, W. Pakistan ..	60.7	..	..	..
29.9.2.5, Male, Ara, Salt Range, W. Pakistan ..	60.7	16.2	10.6	6.2
Average	60.5	16.2	10.5	6.2

There are no geographical barriers for these flying mammals, from Persia to the Indo-Pakistan subcontinent and therefore, Wroughton's decision to create a new species, *kinneari* appears to have no justification.

Hence it is concluded that there are two species of the genus *Rhinopoma* occurring together from Africa (Sudan) through Iraq, Persia, Indo-Pakistan to Burma and Siam, the larger *Rhinopoma microphyllum* Brunnich (Synon. *R. kinneari* Wroughton) and the smaller *Rhinopoma hardwickei* Gray.

III. Family VESPERTILIONIDAE :

Notes on the status of Pipistrellus lepidus *Blyth.*

Blyth (1845) described a new species, *Pipistrellus lepidus* from Kandahar (Afghanistan) with fur colour " light-yellowish clay, paler sandy and isabella-brown, underneath paler ". Dobson (1872) also described a new species, *Pipistrellus leucotis* (Synon. *Pipistrellus kuhli*—1819) from Rajanpur, Punjab, Frontier and Kachh, with fur colour " on the upper surface black at the base of the hairs for about half their length, remaining portion light yellowish brown, beneath some what similar ". Wroughton (1916) identified Praters' collection (B.N.H.S. —Mammalian Survey) of the Pipistrelle bats from Kashmor, Mirpur and Sukkur —all in Sind—as *Pipistrellus lepidus* Blyth, and from Gambat (Khairpur), Sind as *Pipistrellus kuhli* Kuhl, and expressed the view that " there seem to be very little difference between these two forms, but as the specimens from Kashmor (Sind) seem some what larger than those from Gambat (Sind), I have retained Blyth's subspecies ". Wroughton (1918) also differentiated these two by their fur colour (darker is *kuhli* and paler in *lepidus*).

Tate (1942) suggested the need for the revision of this species. Ellerman & Morrison-Scott (1951) maintained these two subspecies and indicated the range of *P. kuhli* from Europe, North Africa, Persia and Sind (West Pakistan), and that of *P. lepidus* from Afghanistan to Kashmir and Upper Sind Frontier (West Pakistan). Observations on the collections in the British Museum (Natural History) of *kuhli* from Egypt, Persia, Iraq and West Pakistan and of *lepidus* from Persia, Baluchistan and West Pakistan are given in Table II below :

TABLE II.—*Principal measurements (in mm.) of the specimens of* Pipistrellus *species examined :*

Brit. Mus. No. Sex and locality	Fore-arm	Condylo-basal length	Zygomatic width	c-m3
P. kuhli kuhli				
5.10.4.11, Male, Ahwaz, Karun River, Persia ..	34.7	..	..	..
5.10.4.12, Female, Ahwaz, Karun River, Persia	34.0	11.6	..	4.4
7.7.14.3, Male, Tehran, Persia	34.0	..	..	..
10.1.18.8, Male, Multan, Punjab, West Pakistan	36.2	..	..	..
10.1.18.9, Male, Multan, Punjab, West Pakistan	35.8	..	..	4.7
10.1.18.10, Male, Multan, Punjab, West Pakistan	35.0	11.9	..	4.8
10.1.18.11, Male, Multan, Punjab, West Pakistan	36.0	12.5	7.8	4.9
10.1.18.12, Female, Multan, Punjab, West Pakistan	36.8	..	..	..
15.11.1.1, Female, Khairpur, Sind, West Pakistan	35.5	12.2	..	4.8
15.11.1.2, Female, Khairpur, Sind, West Pakistan	35.1	12.2	7.9	4.8
15.11.1.3, Female, Khairpur, Sind, West Pakistan	36.8	12.1	..	4.8
15.11.1.4, Female, Khairpur, Sind, West Pakistan	35.6	11.8	7.7	4.7
15.11.1.5, Female, Khairpur, Sind, West Pakistan	33.9	11.8	..	4.7
15.11.1.6, Female, Khairpur, Sind, West Pakistan	35.7	12.1	7.8	4.9
18.7.4.13, (?), Amara, Iraq	33.0	..	..	..
21.5.6.1, (?), Giza, Egypt	33.3	11.6	..	4.8
24.2.19.15, Female, Salhia, Sharkia Prov., L. Egypt	32.5	12.1	7.8	4.7
36.4.14.16, (?), Baghdad, Iraq	33.8	11.9	..	4.8
36.4.14.18, Female, Fao, Persian Gulf ..	32.8	11.9	..	4.7
Average	34.7	11.9	7.8	4.8

Brit. Mus. No. Sex and locality	Fore-arm	Condylo-basal length	Zygomatic width	c-m3
P. kuhli lepidus				
15.11.1.7, Male, Kashmor, Sind, W. Pakistan ..	33.8	..	..	..
15.11.1.8, Male, Kashmor, Sind, W. Pakistan ..	34.6	12.3	7.9	4.8
15.11.1.9, Female, Kashmor, Sind, W. Pakistan	34.8	11.8	..	4.6
15.11.1.10, Female, Kashmor, Sind, W. Pakistan	33.5	..	..	..
15.11.1.11, Female, Chak Sukkur, Sind, W. Pakistan	35.6	..	..	..
15.11.1.12, Male, Mirpur Sukkur, Sind, W. Pakistan	33.2	11.9	..	4.7
15.11.1.13, Male, Sukkur, Sind, W. Pakistan ..	35.0	12.7	7.8	4.9
19.11.7.11, Male, Panjgur, Baluchistan, West Pakistan	34.9	11.8	..	4.5
19.11.7.12, Male, Mag, Baluchistan, W. Pakistan	34.0	11.9	..	4.7
20.2.9.6, Female, Shiraz, Persia	34.2	11.7	..	4.7
25.10.4.1, Female, Zarghun, Persia	36.5	11.9	7.7	4.7
25.10.4.2, Female, Zarghun, Persia	33.7	11.6	..	4.6
25.10.4.3, Female, Shiraz, Persia	32.8	11.0	..	4.3
52.14.67, Female, Iranshahr, Persian Baluchistan	33.8	..	..	..
Average	34.3	11.9	7.8	4.7

It is clear that there is no difference between the two forms with regard to size. The fur colour in both the series is very variable. Hence only one form should be recognised namely *Pipistrellus kuhli kuhli* Kuhl, 1918 (Synon. *Pipistrellus kuhli lepidus* Blyth, 1845) ranging from Europe through North Africa, Persia and Afghanistan to West Pakistan.

ACKNOWLEDGEMENTS

This is a part of the work carried out in the British Museum (Natural History) while in receipt of a fellowship from the Colombo Plan from January, 1959 to August, 1960 for which I am thankful to the authorities concerned. I should like to thank Dr. W. P. Crowcroft and Mr. R. W. Hayman for their valuable advice and criticism in my work and also Dr. A. R. Ranjha, Officer-in-Charge, Zoological Survey of Pakistan for this opportunity of working in the British Museum (Natural History) and for sending specimens.

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It is clear that there is no difference between the two forms with regard to size. The fur colour in both the series is very variable. Hence only one form should be recognized in [illegible] (Syn. [illegible] [illegible] Blyth, 1859) ranging from Europe through North Africa, Persia and Afghanistan to West Pakistan.

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"PAGURIDS" IN THE COLLECTION OF ZOOLOGICAL SURVEY DEPARTMENT

BY

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The pagurids which are shelter dwellers and inhabit mostly the empty gastropod shells as a portable habitation though abounds in number along the coastal region of Pakistan, but are poorly represented in their forms. They are only represented by two families namely, Paguridae and Coenobitidae comprising three genera and ten species. An earlier account of Hermit crabs was given by Henderson (1893, 1896) and Alcock (1905) from the East Coast of India and Bay of Bengal. Their forms included both littoral and benthic species. The forms which are represented in this paper are exclusively the littoral forms inhabiting rocky, muddy and sandy biota. Because of their least economic importance this group had not received the attention of zoologists in the past and hence the coastal region of Pakistan remains unexplored as regards to the distribution and the various forms which are indigenous to this coast.

Some forms like *Clibanarius arethusa* and *Diogenes violaceus* had been earlier recorded only from Bay of Bengal, but the present investigation on their taxonomic studies have shown that their range of distribution also extend in the Arabian Sea and are found in lesser number along the Karachi Coast. This paper therefore, gives an account of the various forms found along our coast, which the authors think will prove to be of value and will contribute to our knowledge of Decapod Crustacea of Pakistan.

Family : PAGURIDAE

Sub-Family : PAGURINAE

1. **Clibanarius inferaspinatus**, Hilgendorf.

This species is readily distinguished from others in attaining a very large size. The variable length of carapace is from 15 to 38 mm. The eye-stalk is longer than the anterior border of carapace. The ophthalmic scales are more or less triangular, pointed at the apices, spinose and with setae at their free edges. The rostrum is very small like a tuberculum and hardly reaching the base of the ophthalmic scales. The antennal acicle is serrated along its inner edge and beset with long bristles. The chelipeds are alike and equal. The merus on its upper and inner edge bears a very strong tooth. The carpus bears three spines on its upper and inner border. The fingers of chelipeds and 2nd and 3rd pair of legs have blackened tipped ends. The wrist and hand of chelipeds are beset with rounded tubercles. The dactyli of 2nd and 3rd pair of legs are longer than the propodites.

A very common species along the coastal region of East and West Pakistan over muddy and sandy beaches.

Locality.—Cox's Bazar (East Pakistan)
Nativejetty, Sonmiani, Baba Island (West Pakistan).

2. **Clibanarius padavensis**, de Man.

This species is of a smaller size, attaining a variable length of carapace from 12 to 22 mm. The eye-stalk is more than half the anterior border of carapace and equals antenular peduncles. The ophthalmic scales are spinose and beset with only few bristles at their free edges. The rostrum is small and reaching the base of ophthalmic scales. The antennal acicle is setose and never reaching beyond the base of the terminal joint of peduncle. The cheliped are similar, equal and stouter than legs. The merus is without tooth at its inner edge. The surface of wrist and hand is granulose. The 2nd and 3rd pair of legs are longer than cheliped by their dactyli. The dactyli are longer than propodites. The eye-stalk and all pair of legs have red longitudinal lines throughout their length.

This is also a very common species along the coast inhabiting the same area as above.

Locality.—West Wharf Karachi (West Pakistan).
Cox's Bazar (East Pakistan).

3. **Clibanarius aequabilis**, Dana.

This species is also of smaller size and has a variable length of carapace from 15 to 20 mm. The eye-stalk is as long as the antennular peduncle. Ophthalmic scales are setose and serrated at their free edges. The antennal acicle is setose and terminates at the base of last peduncular joint. The rostrum is wanting. The chelipeds are equal and comparatively much stouter. The merus is without spine or tooth. The wrist and hand have conical tubercles on their upper surfaces. The 2nd and 3rd pair of legs are longer than chelipeds and are smooth with long setae. The finger tips of dactyli are black.

This is not a very common species and is generally a habitant of muddy and sandy shores.

Locality.—Bhit Island, Karachi (West Pakistan).

4. **Clibanarius arethusa**, de Man.

This species is generaly of medium size, having a variable length of carapace from 18 to 30 mm. This has much resemblance in morphological characters to *C. aequabilis*. The eye-stalk is much longer than the anterior border of carapace and is slightly shorter than the antennular peduncle. The ophthalmic scales are spinose at their free edges with lesser number of bristles. The rostrum

is small, reaching the base of ophthalmic scales. The basal joint of antennal peduncle is thick and stout with numerous setae. The antennal acicle reaches the base of the terminal joint of peduncle. The chelipeds are equal. The wrist and hand have few conical tubercles on their surfaces and have scanty growth of bristles. The dactyli of 3rd pair of legs are as long as the propodites. The finger tips and claws of dactyli are black.

This species is characterised in having a yellowish white carapace with deep orange red chelipeds and legs.

This species was recorded earlier from Bay of Bengal (Mergui & Arakan) but we have been able to collect a specimen from Manora, Karachi. This shows a greater range of distribution. It is an inhabitant of rocky shores.

Locality.— St. Martin Island, (East Pakistan).
Manora Island, Karachi, (West Pakistan).

5. **Diogenes diogenes**, Herbest, Henderson.

A large size species, having a carapace length from 20 to 34 mm. and characterised by the very presence of a serrated anterior and anterolateral border of the carapace. The ophthalmic process (a term used by Barnard for rostrum), is serrated and longer than the ophthalmic scales. It is less than half the length of eye-stalk. The antennular peduncle is thick, stout and fringed with setae all along its border. The antennal acicle is bifurcate. The outer large fork reaching the base of terminal joint of peduncle. Antennal flagellum is setose. Chelipeds are unequal. The chelipeds and legs are thickly spinose and some-what pinkish in colouration. The spines on the outer surface of the palm are claw shaped. The dactyli and propodites of 2nd and 3rd pair of legs have their spines arranged in raised longitudinal rows. The finger of smaller cheliped and dactyli of 2nd and 3rd pair of legs are thickly setose. Dactyli are longer than propodites.

This species mostly inhabit the shells of *Babylonia* & *Tibia* sp. along muddy shores.

Locality.—Korangi Creek, Karachi, (West Pakistan).

6. **Diogenes custos,** Fabr., Henderson.

This species is closely allied to *D. diogenes*, but is of smaller size. The ophthalmic process is half the length of eye-stalk and the ophthalmic scales extend nearly 3/4th of ophthalmic process. Carapace is serrated at its anterior and anterolateral borders. The antennal and antennular peduncles are of equal length. The outer fork of antennal acicle exceeds well beyond the base of terminal joint of peduncle. Antennal flagellum is comparatively more setose. The palm of chelipeds and legs surfaces are granulose. Dactylus of left cheliped has only ne row of spines along its upper border.

A very common species along muddy and sandy shores.

Locality.—Nativejetty, Bhit Island, Karachi (West Pakistan).

7. **Diogenes violaceus**, Henderson.

This species is nearly allied to *D. custos*, but Alcock has described it a variety of *D. custos*, Henderson, 1893. It has very many characteristics of *D. custos* but differs in the following particulars.

The carapace is without any serration at its borders. The antennal peduncle is longer than the antennular peduncle. The antennal acicle is obscurely bifurcate. The inner fork is very slightly produced. The outer fork scarcely reaches the base of terminal joint of peduncle. The antennal flagellum is short with comparatively few long hairs. The palm of cheliped is longer than broad. The hand is oblong instead of being oval.

A species earlier reported by Alcock from Bay of Bengal is uncommon at Karachi Coast. Inhabits sandy and muddy shores.

Locality.—Manora Island, Karachi (West Pakistan.)

8. **Diogenes, costatus**, Henderson.

The carapace measures 11 mm. in length. The anterior and anterolateral borders of carapace are without serration. The eye-stalk is nearly 3½ times longer than the ophthalmic process. The ophthalmic process is small and in the form of a spine without serration and not reaching the apics of ophthalmic scales. The ophthalmic scales are quite large with a very prominent terminal spine at the inner end of the anterior border. The antennal acicle is straight with its inner border spinose, scarcely reaching the terminal joint of peduncle. The antennal and antennular peduncles are of equal length. The left cheliped is enormously large with the fixed finger deflexed. The outer surface of palm is almost smooth, but has a ridge beginning at the lower proximal angle, which runs up parallel to carpal articulation and then turning towards the finger cleft. Dactyli are longer than propodites and are setose.

This is a rare species along our coast and was reported earlier by Alcock (1905) from the East Coast of India.

Locality.—Shamspir, Karachi, (West Pakistan).

Family: COENOBITIDAE

9. **Coenobita rugosus**, Edwards.

This species is quite of a large size having a much more calcified carapace with a variable length of 21 to 36 mm. The eye-stalk is laterally compressed and reaches beyond the middle of the terminal joint of peduncle. The ophthalmic scales are narrow, more or less triangular and smooth. The antennal peduncle

reaches almost to the middle of 2nd joint of the antennular peduncle. The antennal acicle is fused with the 2nd joint of peduncle. The chelipeds are unequal. A series of oblique laminar tubercles on the upper part of the exposed surface of hand of left cheliped serves as a lever for stridulating mechanism. A thick triangular brush of hairs is present on the upper part of the inner surface of the palm, below which on the left palm there is a strong longitudinal ridge. The outer surfaces of dactyli of 3rd pair of legs are flattened. The coxae of 5th pair of legs are produced, more so in male than in female and more so in right coxa of male than in the left.

This is common species along Mekran Coast inhabiting rocky and sandy shores.

Locality.—Astola Island, Mekran (West Pakistan).

10. **Coenobita perlatus**, Edwards.

This species is closely allied to *C. rugosus*, but can be distinguished as follows.

The antennal peduncle does not reach the middle of the 2nd joint of the antennular peduncle. The exposed surfaces of legs and chelipeds are covered with small tubercles having dark corneous tips. These tubercles turn into spines on the dactyli and inner edges of propodites,. The coxa of fifth right leg in male is produced into a long curved and compressed tube.

This is also a common species along Mekran Coast inhabiting same area as above.

Locality.—Astola Island, Mekran (West Pakistan).

ACKNOWLEDGEMENTS

The authors would like to express their thanks to the Director, Mr. M.S.U. Siddiqi for providing all sorts of facilities and encouragement during the preparation of this paper. Thanks are also due to Mr. Nooruddin, Zoologist for his valuable suggestions.

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EXPLANATION OF FIGURES

1. *Clibanarius inferaspinatus* ... outer view of propodus and dactylus of 3rd left leg X 2.

1a. *Clibanarius inferaspinatus,* ... inner view of left cheliped showing a tooth at inner border of merus X 2.

2. *Clibanarius padavensis,* ... front of carapace from above X 3.

2a. *Clibanarius padavensis,* ... left cheliped X 3.

3. *Clibanarius aequabilis,* ... front of carapace from above X 3.

3a. *Clibanarius aequabilis,* ... left cheliped X 6.

4. *Clibanarius arethusa,* ... front of carapace from above X 6.

4a. *Clibanarius arethusa,* ... left cheliped X 6.

5. *Diogenes diogenes,* ... ... front of carapace from above X 3.

5a. *Diogenes diogenes,* ... ... left cheliped X 3.

6. *Diogenes custos,* ... ... front of carapace from above X 8,

6a. *Diogenes custos,* ... ... left cheliped X 4.

7. *Diogenes violaceus,* ... ... front of carapace from above X 8.

7a. *Diogenes violaceus,* ... ... left cheliped X 6.

8. *Diogenes custos,* ... ... front of carapace from above X 8.

8a. *Diogenes custos,* ... ... left cheliped X 6.

9. *Coenobita rugosus,* ... ... front of carapace from above X 3.

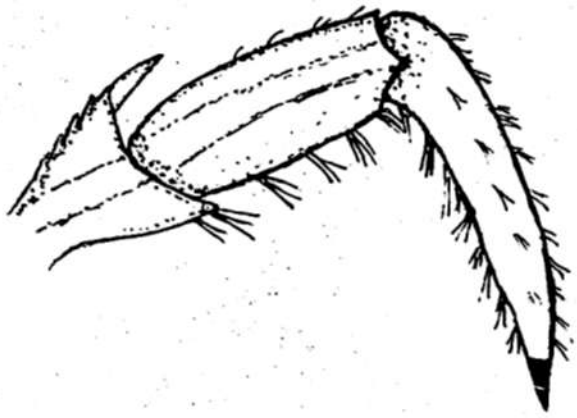
9a. *Coenobita rugosus,* ... ... left cheliped X 2.

9b. *Coenobita rugosus,* ... ... Coxae of 5th leg X 2.

10. *Coenobita perlatus,* ... ... front of carapace from above X 3.

10a. *Coenobita perlatus,* ... ... left cheliped X 2.

10b. *Coenobita perlatus,* ... ... Coxae of 5th leg X 2.



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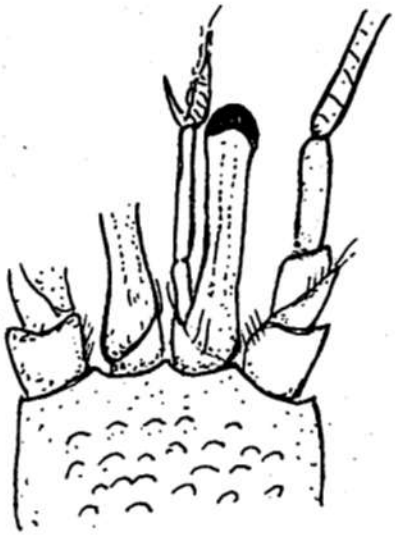

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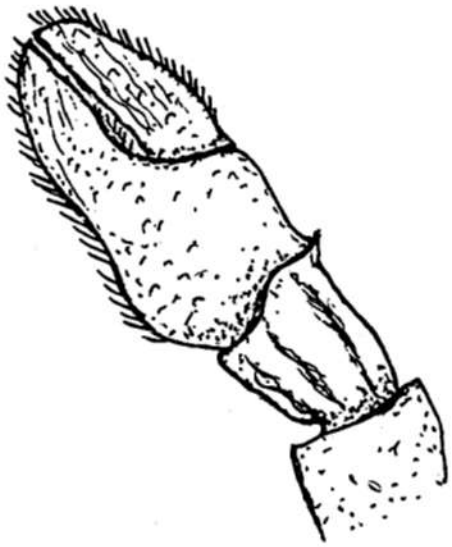

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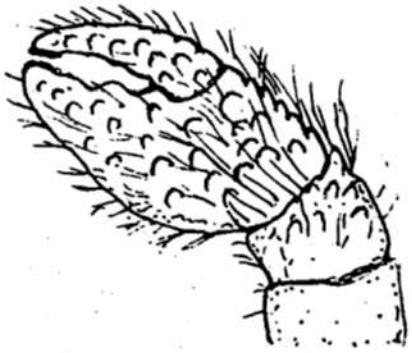

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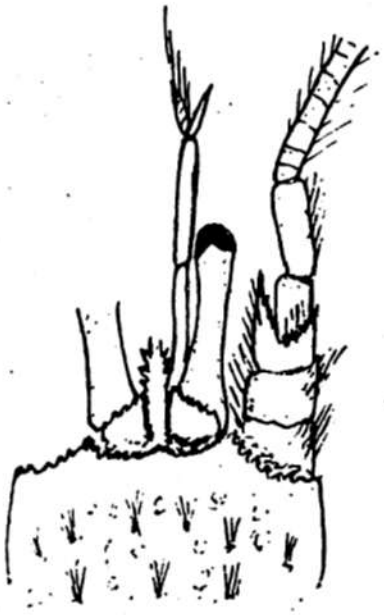

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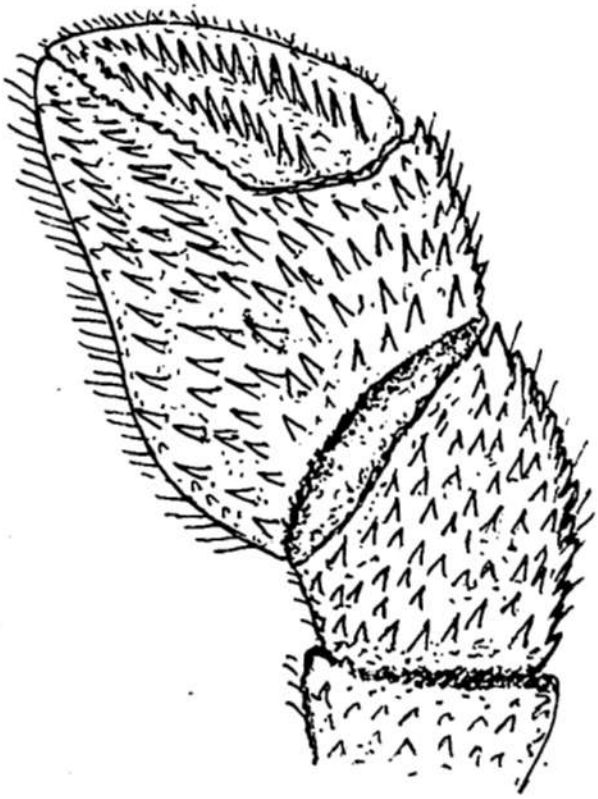

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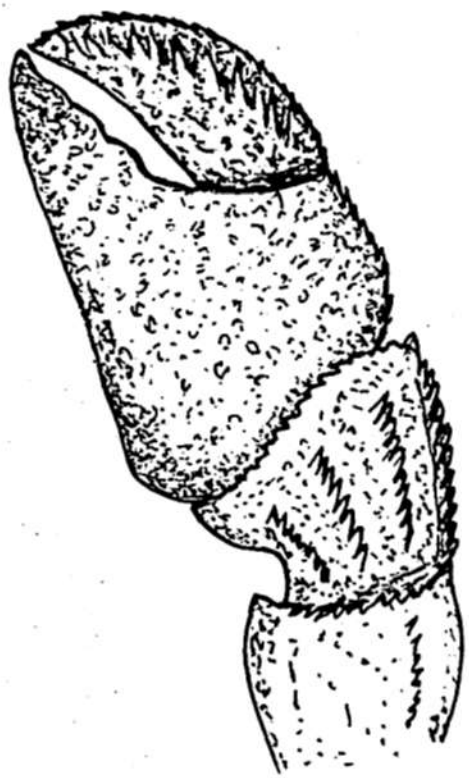

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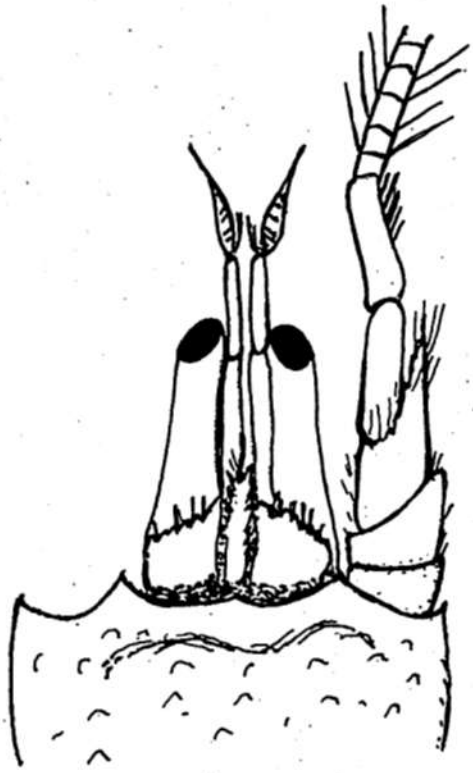

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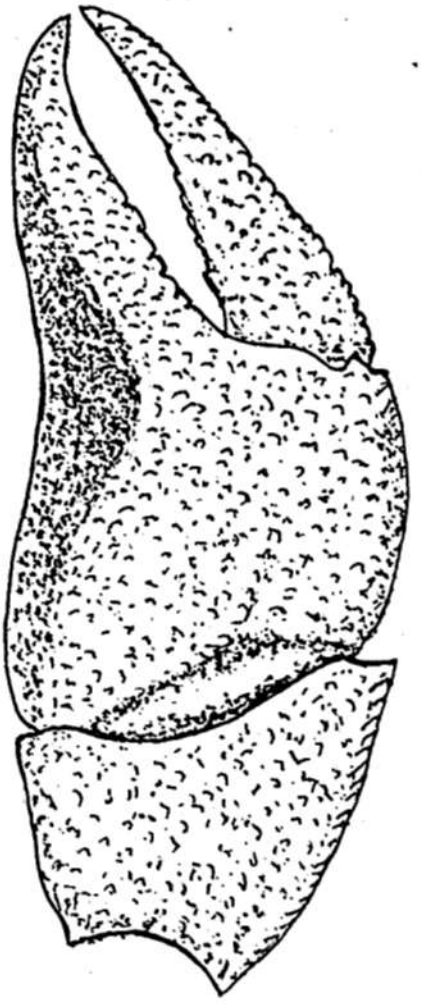

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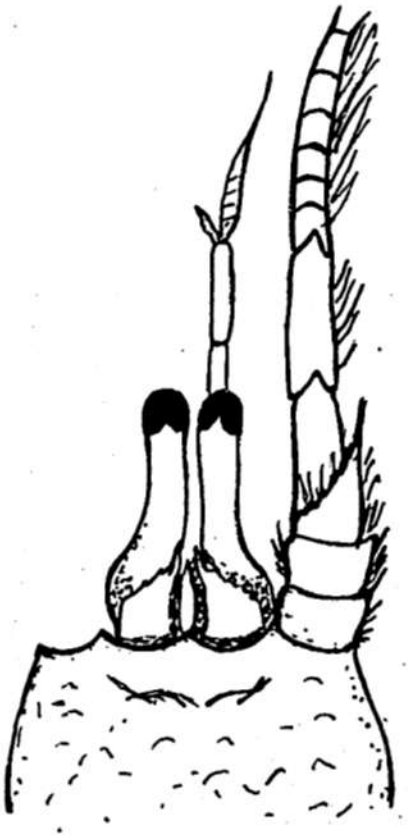

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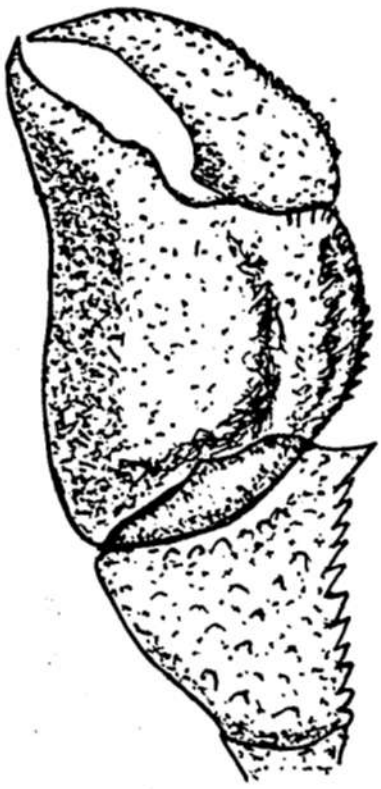

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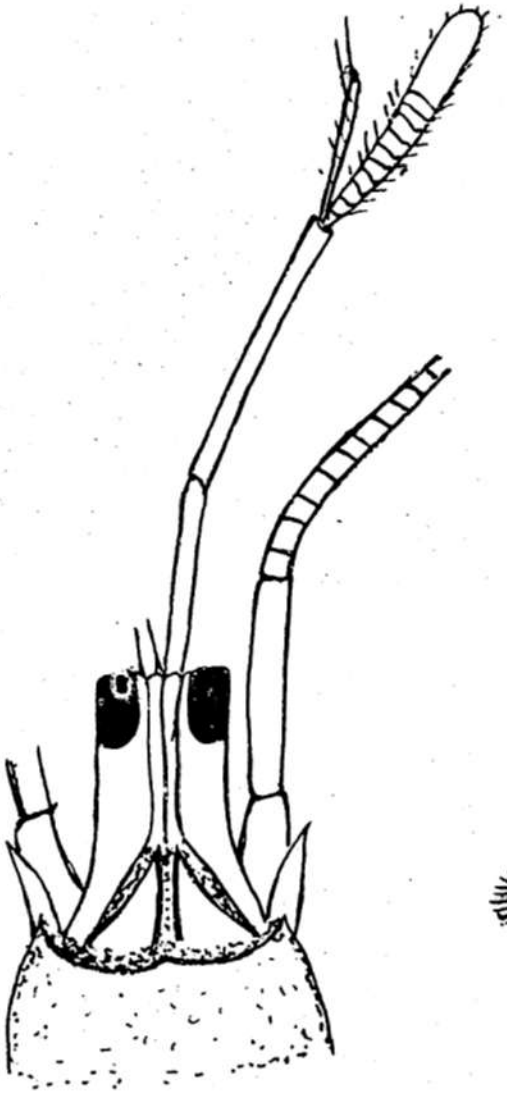

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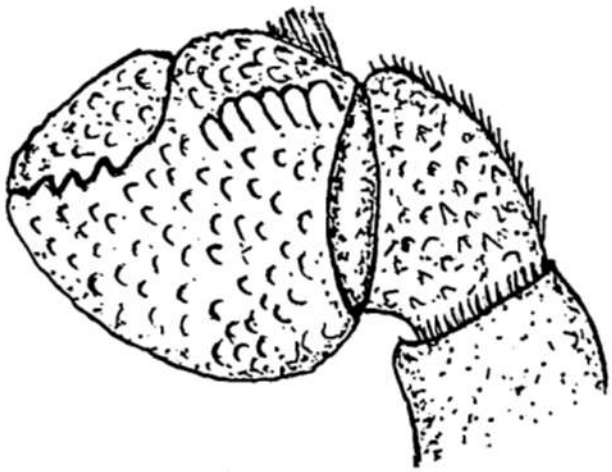

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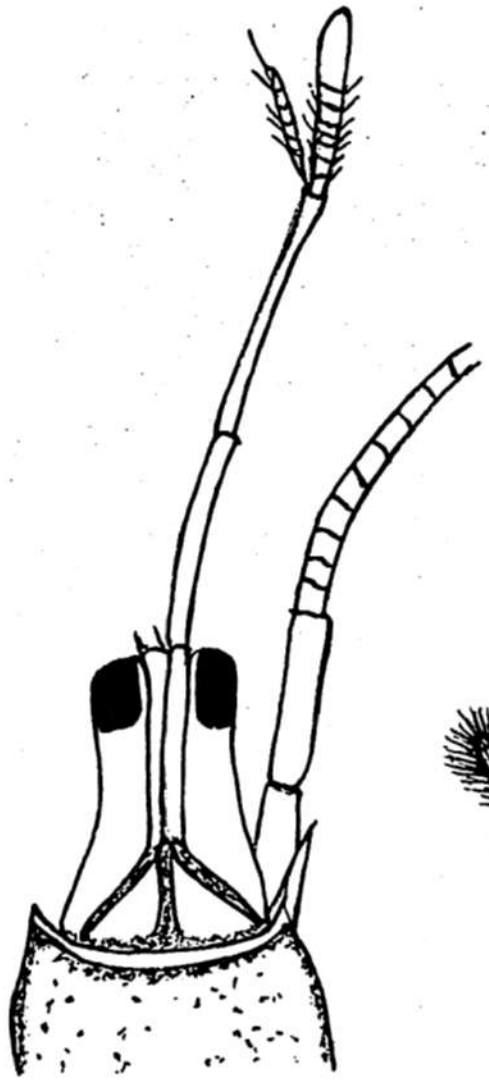

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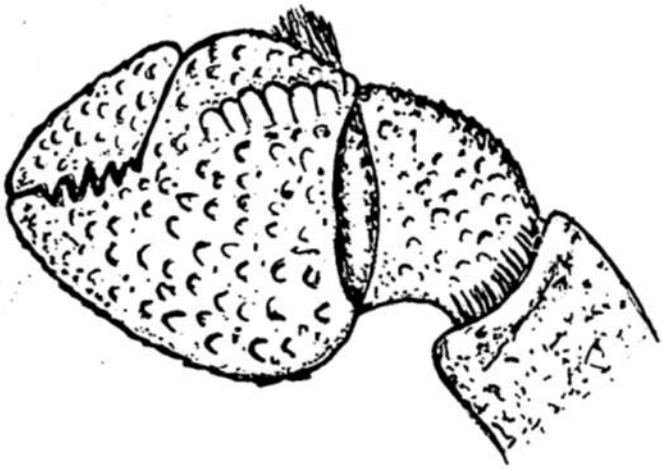

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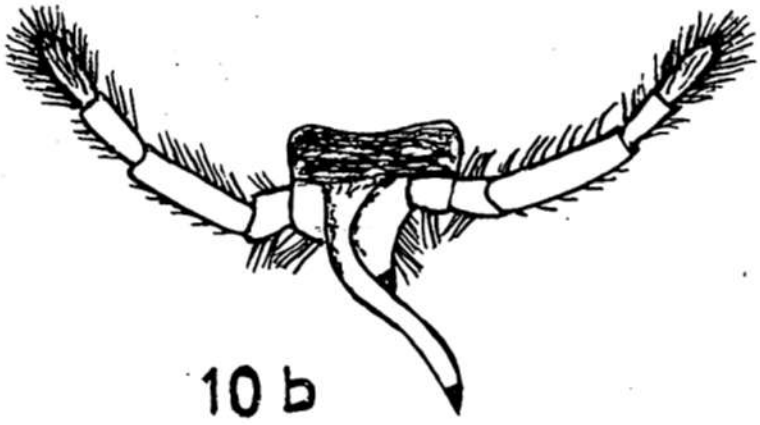

10 b

BRYOZOA OF THE GENUS BUGULA OF KARACHI COAST

By

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Introduction :

Bryozoa (or Polyzoa), are a small group of colonial animals and are chiefly represented by the genus Bugula and its various species along the Karachi coast. They are mostly marine forms with exception of a few which are fresh water and are found attaching themselves to rocks, various animal forms, alive or dead, or seaweeds and other hard substratum which are found suitable for their survival. Nearly seven species and four varieties have been recorded from waters of Indo-Pak subcontinent, specially from south Indian coast and from Bay of Bengal ; Annandale (1916), Robertson (1921), Thornely (1907, 1912, 1916), Thurston (1895) and Waters (1909, 1915).

The three species recorded from Karachi coast are namely *B. neritina, B. avicularia* & *B. stolonifera.* Of these *B. neritina* and *B. avicularia* are the commonest, while *B. stolonifera* is seldom met with. The present paper accounts to study of the above species to which an ecological note on their occurrence, appearance is surmised alongwith their taxonomical study.

In determining the species of the genus Bugula the specific characters have been adapted after Harmer (1923, 26) copied by J. S. Ryland (1960).

Material :

The Bryozoa were collected from different localities of Karachi coast. They were found either embedded in the seaweed or under the rocks of the tidal zone.

Methods :

Following solutions were used for narcotisation of the animals :—

(1) Alcohol 100%

(2) $CuSO_4$-Solution 7%

Several branches were taken from a single colony. They were stained with Borax carmine and permanent slides were made for the record.

SPECIES WORKED OUT

1. **Bugula neritina** Linne/(Fig. 1 and fig. 2).

DIAGNOSIS.—This is strictly a biserial species having its bifurcation a little above its distal end and is of type 4 of Harmer (1923, 26) and J.S. Ryland (1960). The avicularia are altogether absent. The spines are absent but are denoted by small projections and the ovicells are attached to the inner distal angles.

REMARKS.—A species generally of brown colour and mostly inhabiting attached to rocks in pool and also to the floating algae near the shore. This is the most abundant species of all generally met with throughout the year. Their population increases during the month of March and April along the Karachi coast. A difference in their population density was also noted in different habitats. A situation comprising the muddy area along with rocks was the most favourable.

Habitat:—Attached to algae and tidal rocks.

Locality.—Keamari, Bhit and Manora Island (Karachi Coast).

2. **Bugula neritina var. minima**, Waters (fig. 3, fig. 4a & 4b.).

DIAGNOSIS.—This is a variety of *Bugula neritina* having the peculiar feature of possessing avicularia, the beak of which are parrot shaped. The projections instead of spines of *B. neritina* are also absent. It is much delicate than *B. neritina* and all the other characters are same.

Habitat :—Same as above.
Locality :—Same as above.

3. **Bugula anicularia**, Linne/(fig. 5, fig. 6a & 6b).

DIAGNOSIS.—This is almost a white species with a shadow of greyish tinge and commonly found growing on rocks, ascidians, etc. The branches are dichotomously divided and the zooecia are biserial. There is an addition in the number of spines making the total to three, of which 2 spines are on the outer margin and one on the inner. The avicularia are of larger size and extend even beyond the width of the zooecia.

REMARKS.—In *Bugula avicularia* the nature of attachment of avicularia was found to be a little bit different in almost all the slides made and examined. It is situated just below the spines instead of occupying the position to the 2nd or 3rd quarter of the total length. The growth rate of this species increases to a great extent from the beginning of the year reaching to the peak during the month of February and March.

Habitat.—Same as described above.
Locality.—Fish Harbour, Native Jetty (Karachi coast).

4. **Bugula stolonifera**, Ryland. (fig. 7, 8, 9, fig. 10a & 10b.)

DIAGNOSIS.—*Bugula stolonifera* is a greyish buff species and have a bushy colony with 3 long slender spines, two on one side and one on the inner. To every polype is attached an avicularia just a little below the spines.

REMARKS.—Represented very poorly along the Karachi coast this species is very similar to *B. avicularia* differing only in their very delicate appearence, very long and slender spines and smaller avicularia in contrast to the *B. avicularia* where the colony is coarser, spines are shorter and bigger avicularia.

Habitat.—Same as above.

Locality.—Bhit Island (Karachi Coast).

A chart showing locality, mean length and a comparison between avicularia and zooecia of the various species of Bugula of Karachi coast.

Each entry is based at least on the measurement of 20 avicularia, zooecia and colony as well, except that of *B. avicularia* and *B. stolonifera* where 15 and 5 entries have been made respectively in the case of colony.

Since avicularia are absent in *B. Neritina* no entries could be made in this case.

Sl. No.	Name of the species	Locality	Mean length of species	Mean length of avicularia	Mean breadth of zooecia	Ratio of avicularia and zooecia	Remarks
1	2	3	4	5	6	7	8
1.	**B. neritina**	Karachicoast. (Keamari, Bhit)	7.5×10mm.	..	..	..	..
2.	**B. neritina var. minima** ..	Karachi coast. (Bhit).	1.5×10mm.	1.46	1.47	1.46/1.57	Avicularia is smaller than the zooecia.
3.	**B. avicularia**	Karachi coast. (Native Jetty Fish Barbour)	2.4×10mm.	2.07	1.65	2.07/1.65	Avicularia is much biggerthan the zooecia.
4.	**B. stolonifera**	Karachi coast (Bhit, Native Jetty).	1.84×10mm.	1.67	1:8	1.67/1.8	Avicularia is very slightly smaller than the zooecia.

ACKNOWLEDGEMENT

I am grateful to Mr. M. S. U. Siddiqi, Director, Marine Biological Research Laboratory, Zoological Survey Department, Karachi, for kindly providing me the facilities to carry out the present research work.

I am thankful to Mr. S. M. Syed for suggesting me the problem, guidance and help in making this paper.

I am indebted to Mr. Nooruddin, Secretary Publication, for kindly going through the script and giving me valuable suggestions.

Further, I would like to put on record the assistance, co-operation, criticism and suggestion of Mr. Mohd. Sadiq Niazi a colleague of mine.

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ILLUSTRATIONS

FIG. 1. A branch of *B. neritina* colony.

FIG. 2. A branch of same showing the type of bifurcation.

FIG. 3. A branch of *B. neritina var. minima* colony.

FIG. 4a. An avicularium of *Bugula neritina var. minima* taken from marginal zooecia.

FIG. 4b. The same, taken from a different zooecia.

FIG. 5. A branch of *B. avicularia* colony.

FIG. 6a. An avicularium of *B. avicularia* taken from a marginal zooecia.

FIG. 6b. The same taken from an inner zooecia.

FIG. 7. A portion of the Zoarium of *B. stolonifera.*

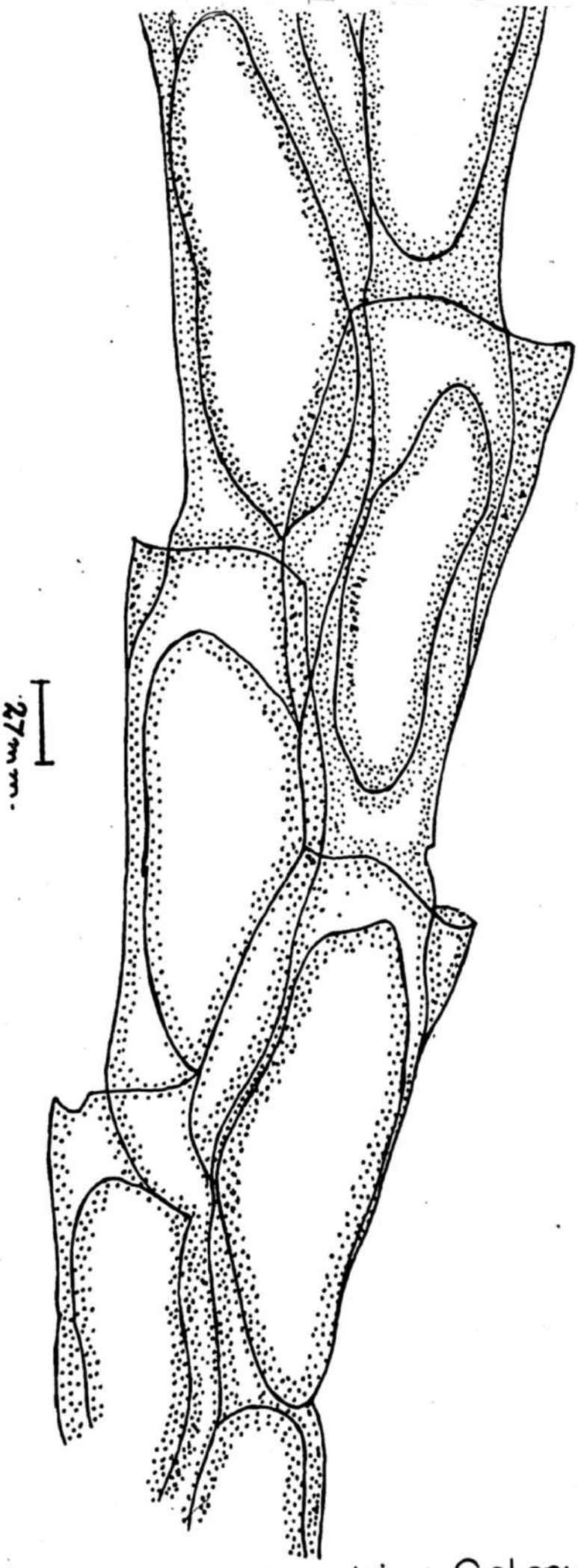
FIG. 8. A portion of the same being more magnified.

FIG. 9. A branch of the same showing the nature of bifurcation.

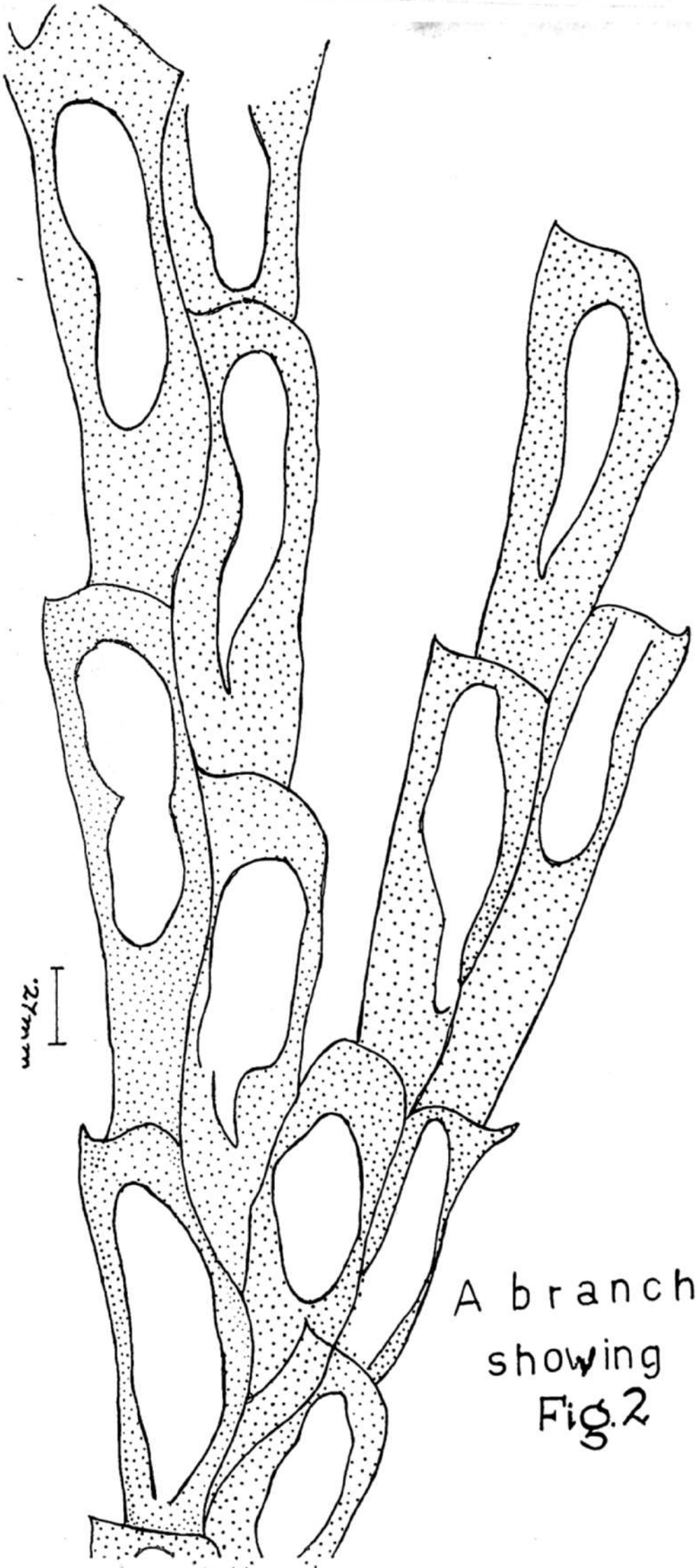
FIG. 10a. An avicularium of *B. stolonifera,* taken from a marginal zooecia.

FIG. 10b. An avicularium, taken from another marginal zooecia.

ILLUSTRATIONS

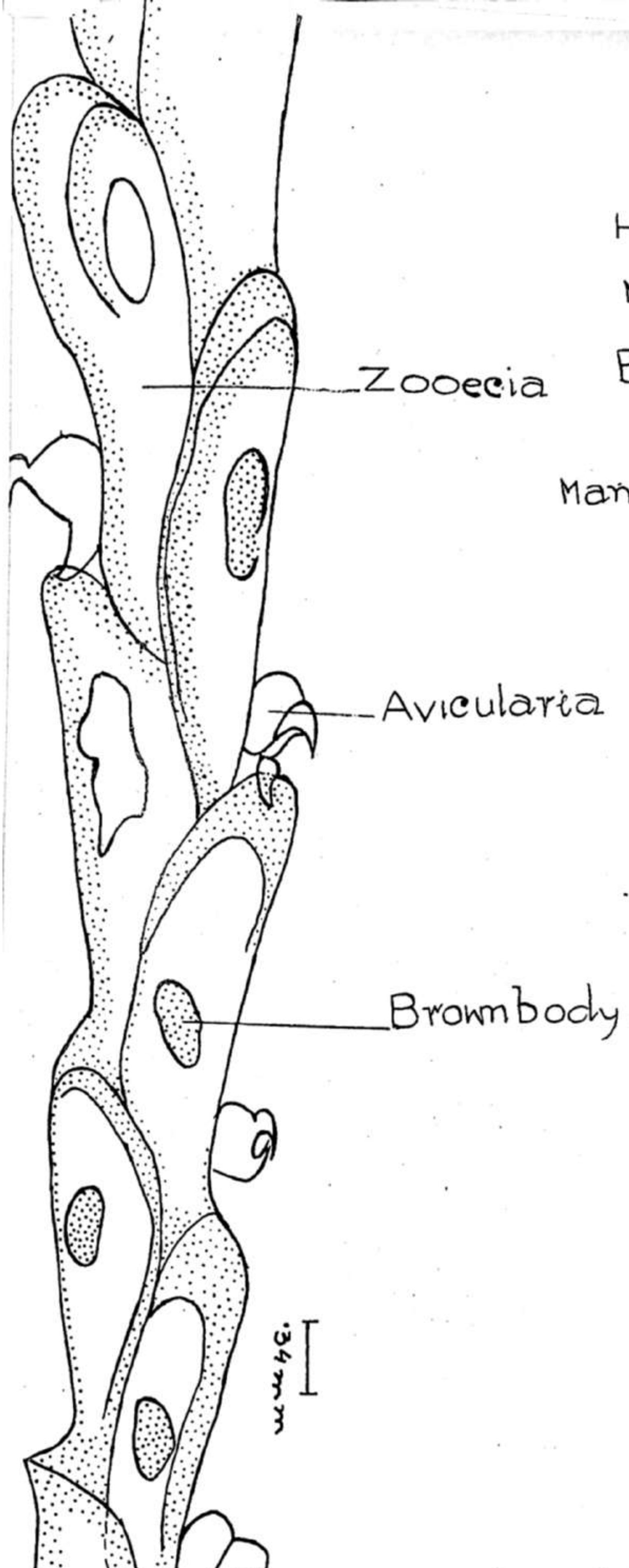


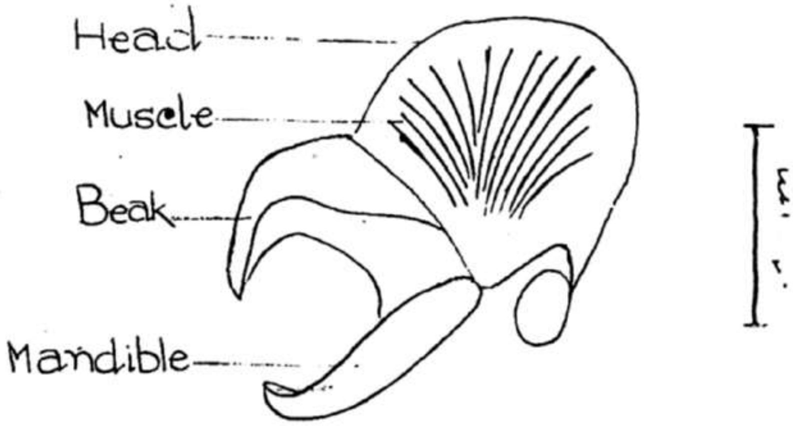
A branch of B. neritina Colony
Fig.1



A branch of the same showing bifurcation

Fig. 2



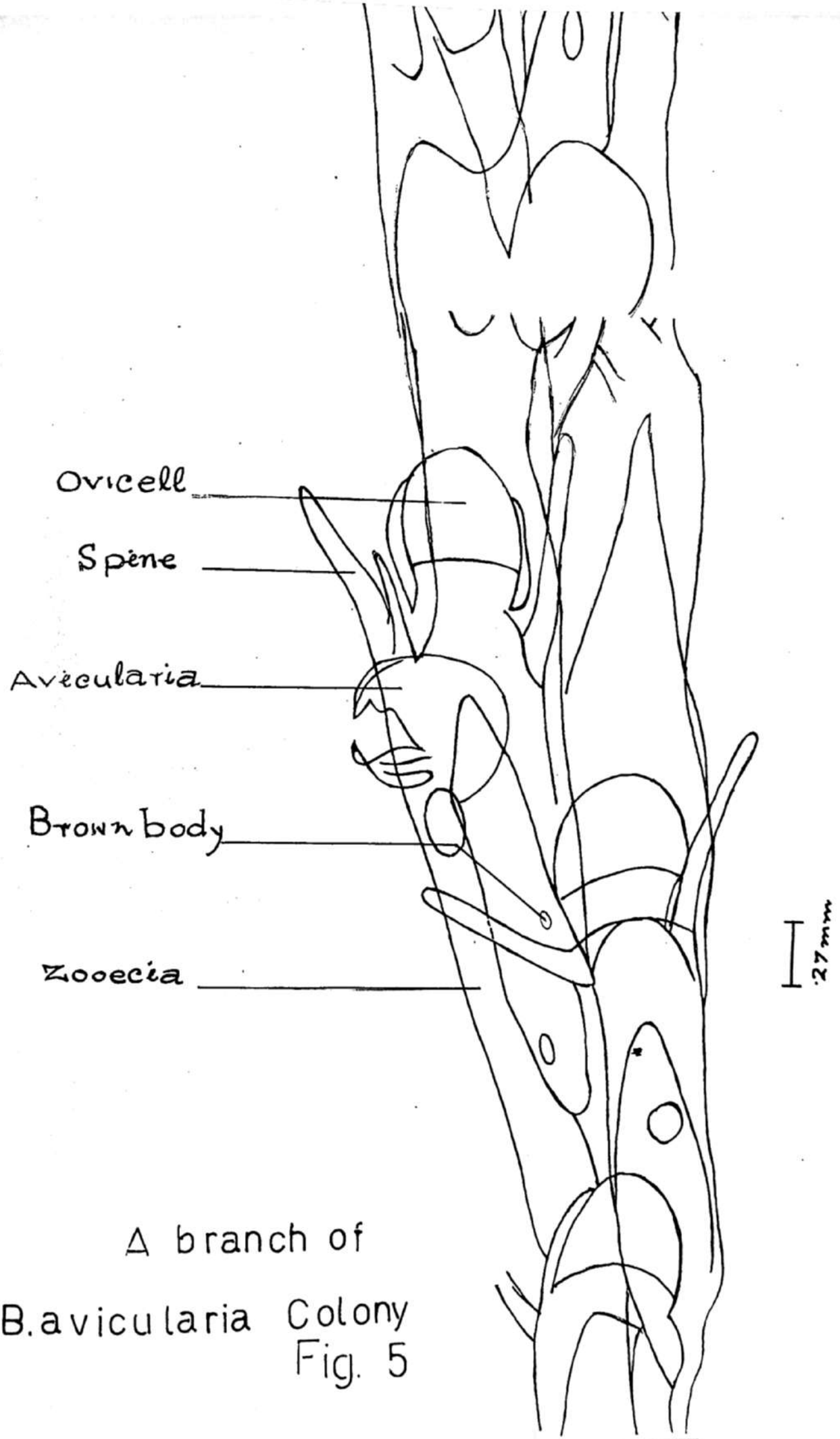


An Avicularia
Fig 4a

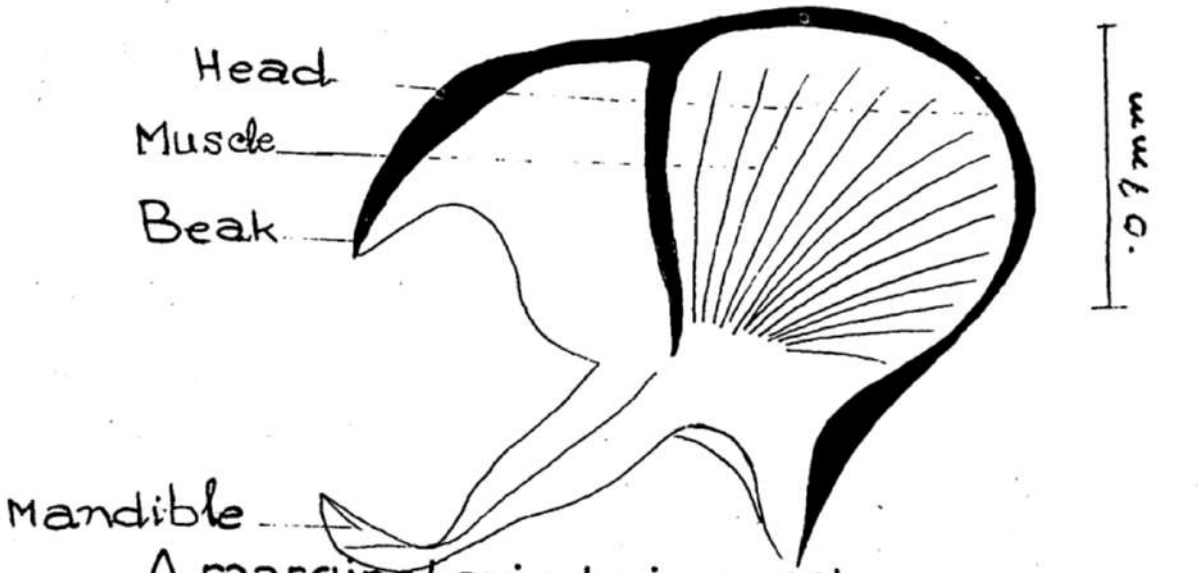
An Avicularea
Fig.4b

A branch of B.neritina var. minima

Fig.3

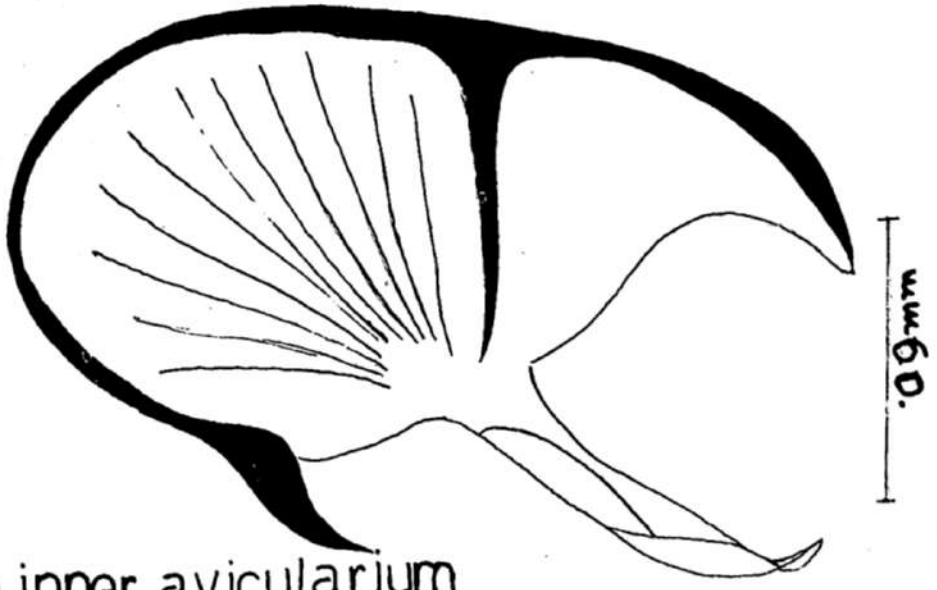


A branch of
B. avicularia Colony
Fig. 5



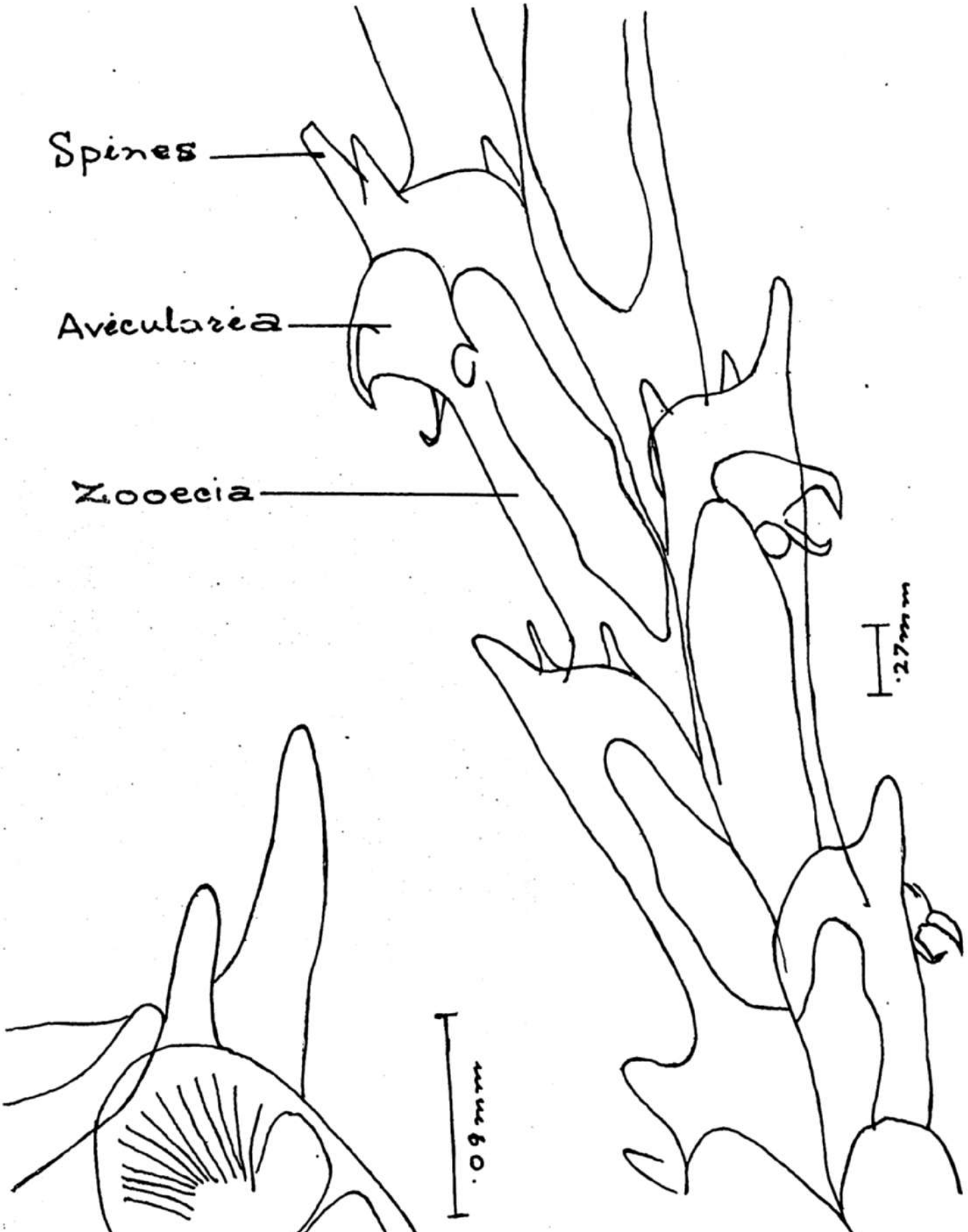
A marginal avicularium of the same

Fig. 6a



An inner avicularium

Fig. 6.b



A branch of B. stolonifera Colony

Fig. 7

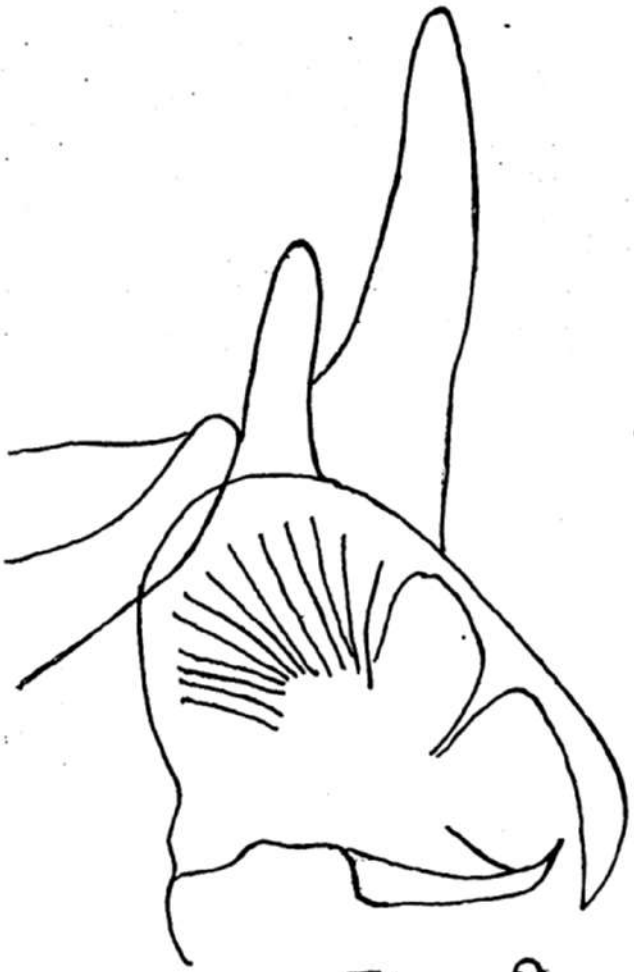


Fig. 8.

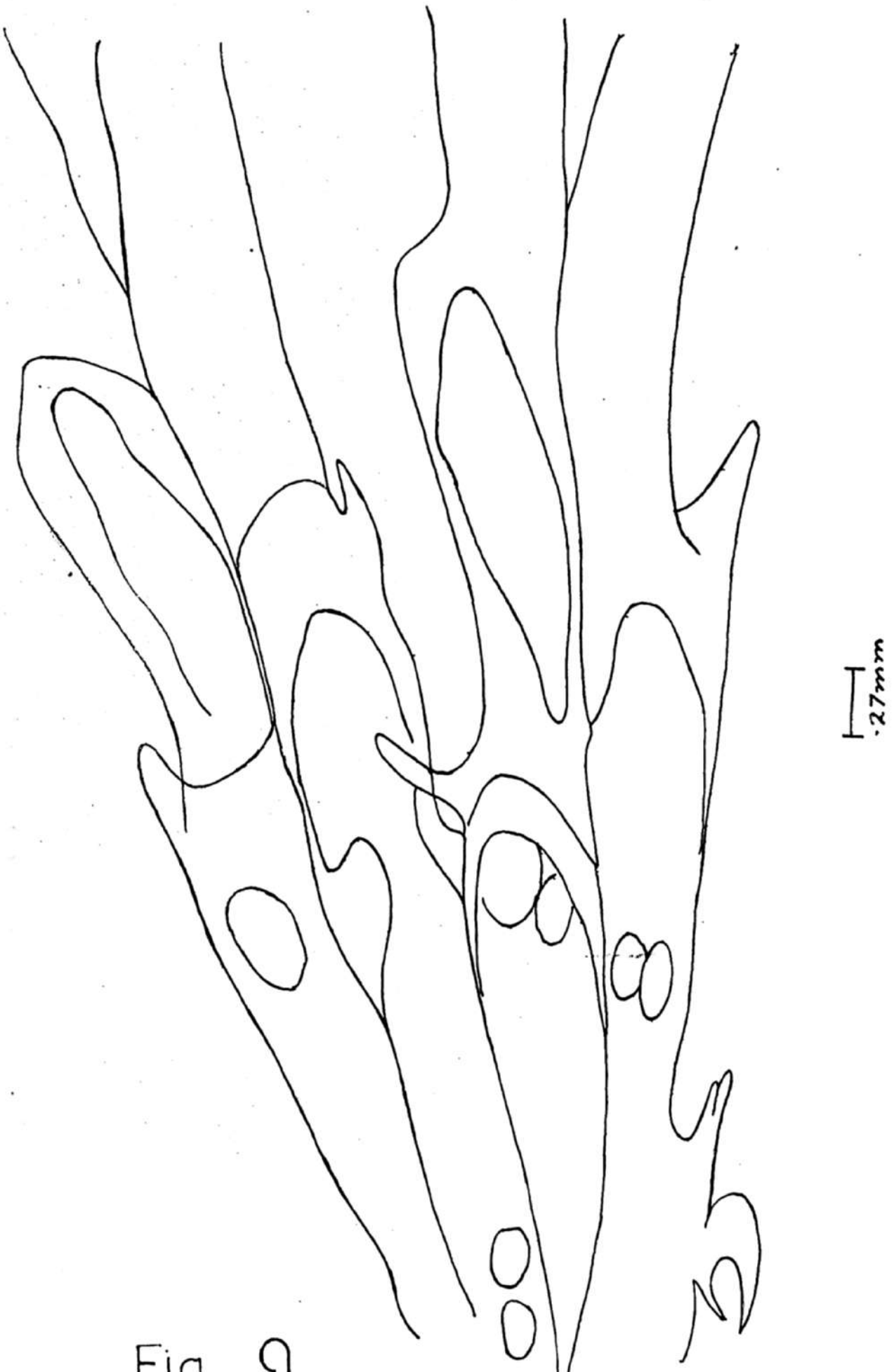
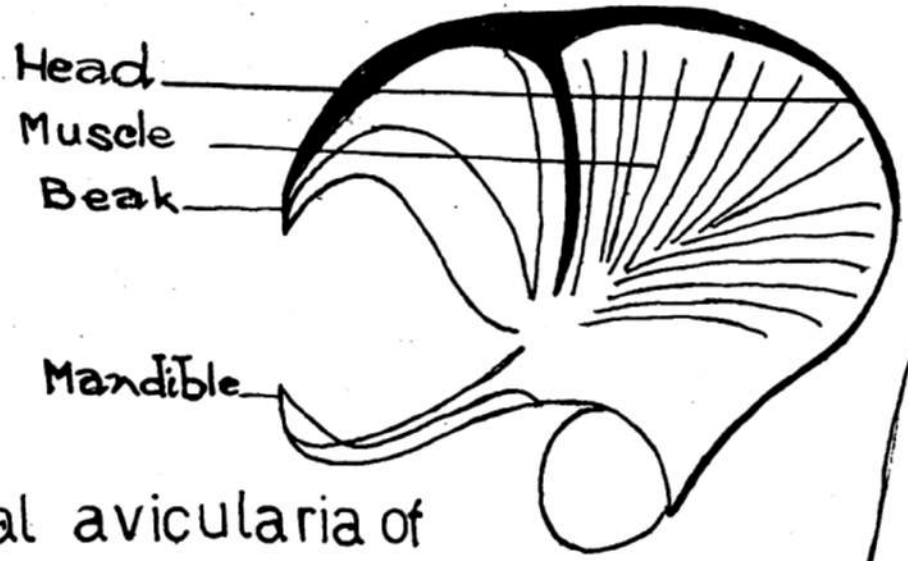
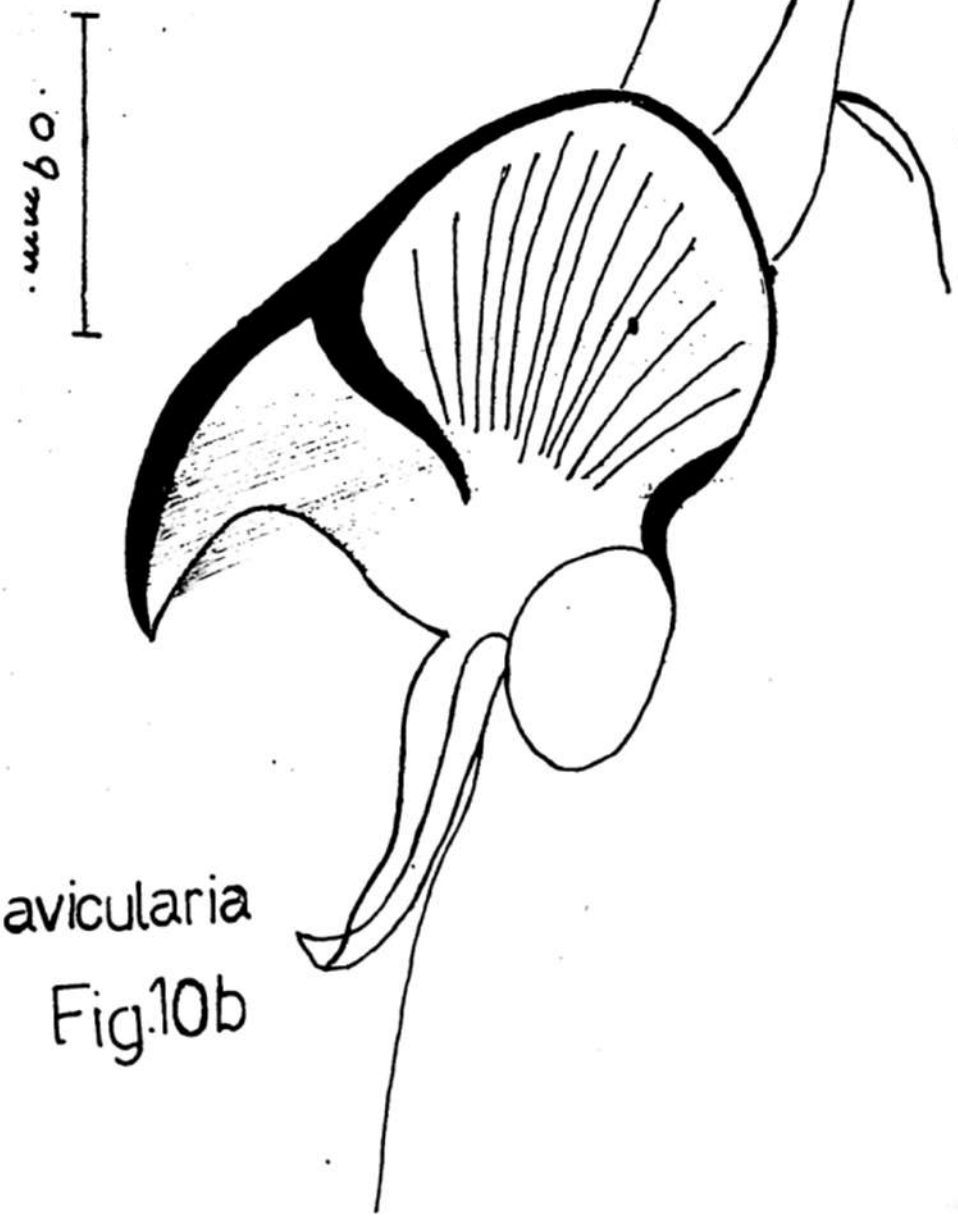


Fig. 9 A branch of the same showing bifurcation



A marginal avicularia of the same

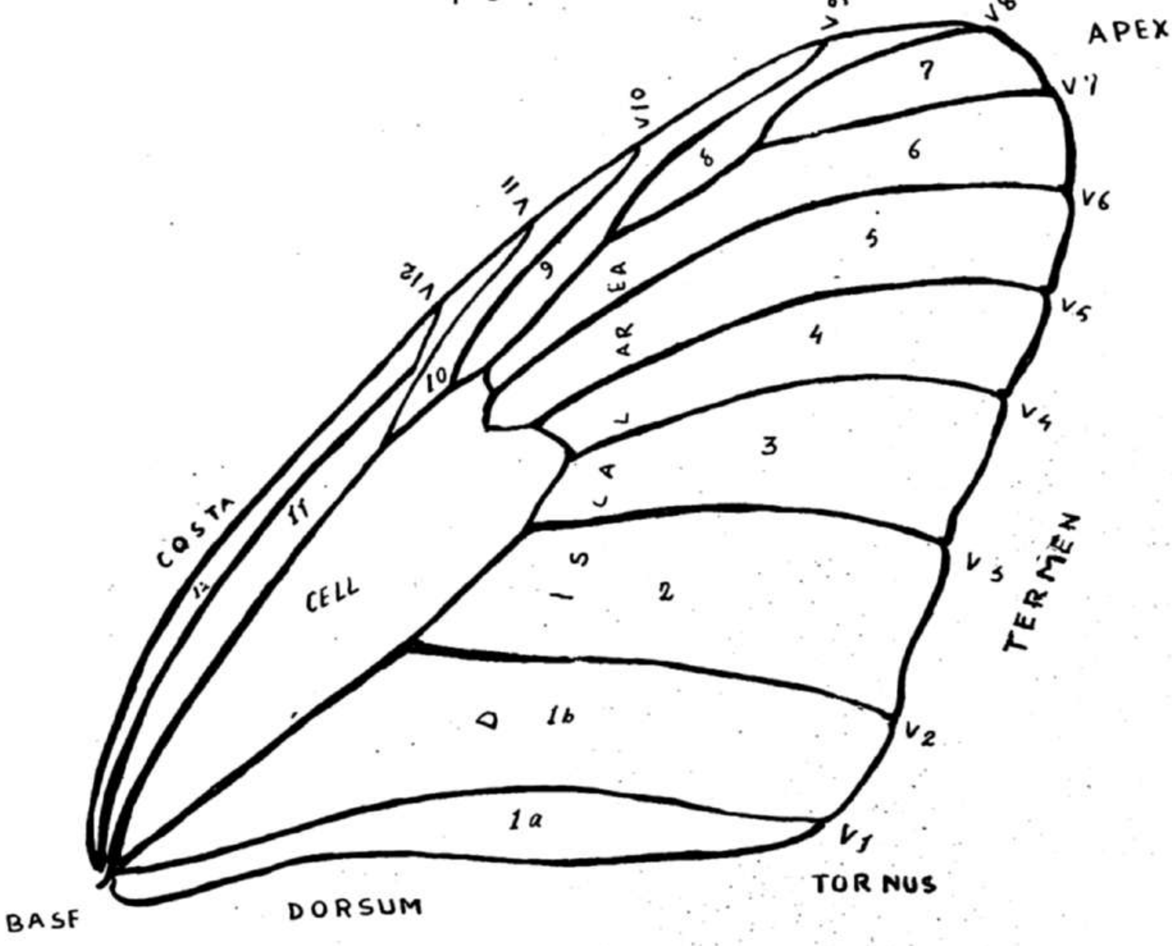
Fig.10 a



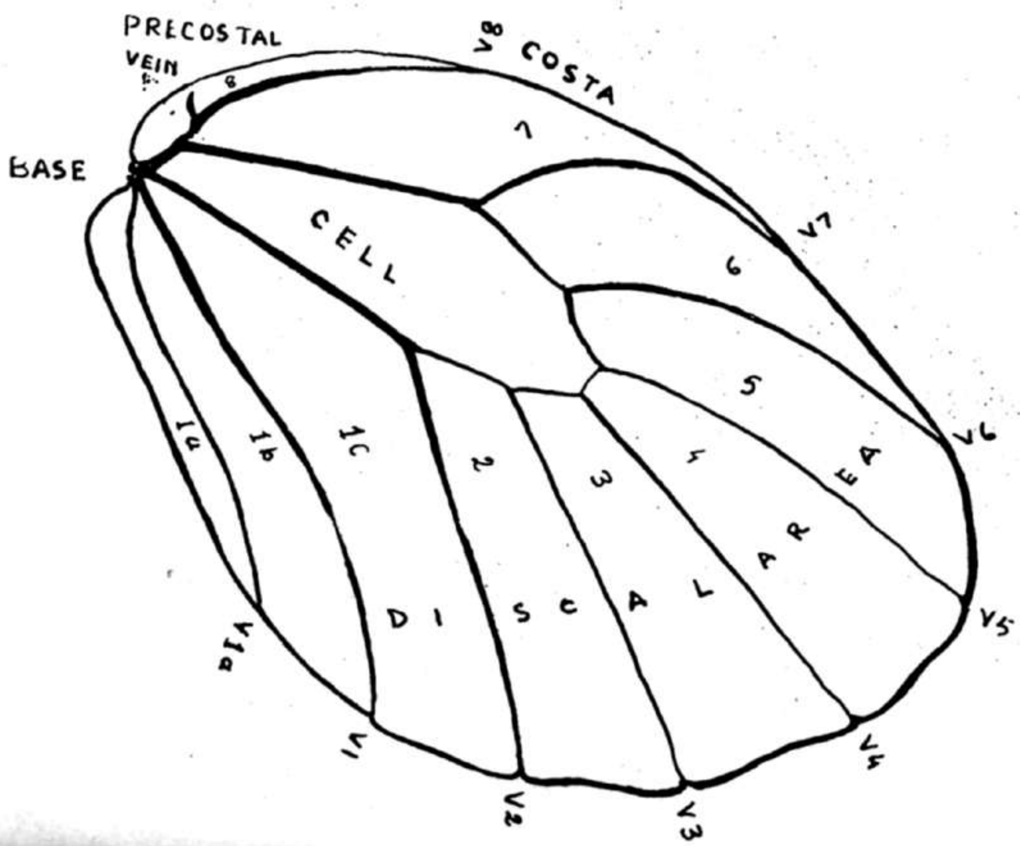
Another marginal avicularia

Fig.10b

FORE WING



HIND WING



NOTES ON THE BUTTERFLIES OF PAKISTAN IN THE COLLECTION OF ZOOLOGICAL SURVEY DEPARTMENT, KARACHI

By

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Zoological Survey of Pakistan

PART I

This work is an attempt towards a study of "The Butterfly Fauna of Pakistan". There are nearly 3,400 butterflies of the families *Danaidae* ; *Satyridae* ; *Amathusiidae* ; *Nymphalidae* ; *Acraeidae*, *Erycinidae* ; *Papilionidae* and *Pieridae* in the collection of Zoological Survey Museum ; Karachi. These butterflies were collected from arid, semiarid zones of West Pakistan and hilly tracts and humid zones of East Pakistan. These specimens collected from either wing of the country show a great many variation in the comprising fauna of the two wings.

A composite study of such a nature is lacking and the earlier works are of Fraser, (1911) ; Janjua, & Haque (1955) ; Menesse, (1950) ; Rhe-Philipe, George (1917) ; Swinhoe (1887).

The present paper enumerates to a study of 43 genera and 102 species. Efforts have also been made to include the locality; food plants ; number of specimens and the number of sex with available English Name and a short description. In the location only those places have been mentioned from where the butterflies were collected. The food plants of the larvae have been noted from the field notes and also after Wynter-Blyth (1957).

TYPICAL WING OF A BUTTERFLY

In the fore wing the 12 veins are shown as V1—V12.

The interspaces are indicated as 1a, 1—12.

In the hind wing the 8 veins are shown as V1a, V1—V8.

The interspaces are indicated as 1a, 1b, 1c—8.

Family—DANAIDAE

Danais limniace Cramer

The Blue Tiger is black on the upper side with semi-hyaline white bluish spots and streaks. In ten specimens, the two joined streaks in the interspace 1b in the fore wing enclose a ground colour space and extends a little beyond, which is sometimes absent. In the cell of the hind wing, the streak is thin which is forked in 18 specimens and unforked in 12 specimens and found absent in one specimen. On the under side, the basal two third and the apex of the fore wing and the whole

hind wing is olive brown. Secondary sex mark in male is a small fold on the under side of the hind wing. One male and female specimens in the collection are dwarf.

Foodplants : *Dregea volubilis* ; *Calotropis* ; *Hoya* ; *Marsdenia tenacissima* (*Asclepiadaceae*).

31 Specimens : 17 males, 14 females.

Location : East Pakistan : —Dacca, Mymensingh, Jharia.

Sind :—Karachi.

2. **Danais plexippus** (Linnaeus)

The Common Tiger is tawny on the upper side with broad black veins. The apical half, costa and the inner margin of the fore wing are black, speckled with white spots and bars. On the terminal margin of the hind wing there is a double row of white prominent spots. The male has a pouch on the under side of the hind wing, near vein 2.

This is a common butterfly. The specimens of the dry months have paler hind wing. Two females in the collection are dwarf.

Foodplants : *Cynanchum dalhousieae* ; *Ceropegia intermedia*; *Stephanotis* ; *Raphistemma pulchellum* (*Asclepiadaceae*).

38 specimens : 25 males, 13 females.

Location : East Pakistan :—Dacca ; Rajshahi ; Comilla ; Mymensingh ; Jharia Bhairab Bazar ; Rangpur.

Sind :—Karachi ; Tando Adam.

Baluchistan :—Astolla Island.

3. **Danais chrysippus** (Linnaeus)

The upper side of the Plain Tiger is tawny, paler than *Danais plexippus*, with no broad black veins. The tawny colour is darker in the cell of the fore wing. The hind wing is paler in colour, with three disco-cellular black marks, and a narrow black margin with incomplete spots.

This is the most common butterfly present in all habitats. The dwarf males and females are also present in the collection. It was also collected on light at Dinajpur (East Pakistan).

Foodplants : *Calotropis gigantea* ; *C. procera* ; *Asclepias curassavica* (*Asclepiadaceae*).

786 specimens : 494 males, 268 females. Dwarf males 17, Dwarf females 7.

Location : East Pakistan:—Dacca ; Mymensingh ; Shampur ; Barkal ; Cox's Bazar ; Harbang ; Rangpur ; Dinajpur ; Comilla and Natore.

Sind:—Karachi ; Sukkur ; Thatta, Dadu ; Tando Jam ; Tando Alayar, Bangote ; Larkana ; Saidabad ; Jacobabad, Sakrand.

Punjab:—Pindi, Campbellpur ; Lahore ; Hasan Abdal ; Haripur.

N. W. F. P.:—Peshawar.

Baluchistan:—Astolla Island ; Harnai ; Quetta ; Sibi ; Babar Kachh.

4. **Danais dorippus** Klug

This is a dimorph of *Danais chrysippus* and can be distinguished in having no black apical margin and white band.

8 specimens: 5 males, 3 females.

Location : Sind :—Karachi.

5. **Danais dorippus** Klug, **Var—albinus** Lanz

This is the variety of *Danais dorippus*. The hind wing is washed with shining white.

1 specimen : female.

Location : Sind:—Karachi.

6. **Euploea core** (Cramer)

The male and female Common Indian Crow, is dark brown on the upper side. There is a series of terminal and subterminal white spots, along the terminal margin, on the broad ground paler colour.

It is fairly common in East Pakistan. It apparently does not occur in Sind (Menesse—1950), but there are 8 specimens in the museum collected from Karachi.

Foodplants : *Streblus asper* ; *Ficus bengalensis* (Banyan) ; *F. glomerata* ; *F. indica* ; *F. religiosa* (Peepul) (*Urticaceae*) *Holarrhena antidysenterica* ; *Nerium odorum* ; *N.oleander* (Oleander) ; *Ichnocarpus frutescens* (*Apocynaceae*) ; *Hamidesmus indicus* ; *Cryptolepis elegans* (*pauciflora*) (*Asclepiadaceae*).

23 specimens ; 6 males ; 17 females.

Location : East Pakistan:—Mymensingh ; Dacca ; Madhupur ; Bijatpur ; Rajshahi ; Barkal ; Jharia ; Rangpur ; Dohazari.

Sind : Karachi.

7. **Euploea mulciber** (Cramer)

The upper side of the Striped Blue Crow is brown. The disc of the fore wing is glossed with blue and have white spots. The terminal series of spots on the hind wing are prominent and whiter than the fore wing. On the hind wing there are narrow white streaks in and around the cell.

1 specimen : female.

Location : East Pakistan:—Shamganj (Mymensingh).

8. **Euploea deione** Westwood

On the upper side of the Long-Branded Blue Crow the dark brown fore wing is suffused with a brilliant irridescent blue except a very narrow brown apical margin. The hind wing is paler and uniform brown in colour. The substerminal spots in the fore wing is large and complete, where as in the hind wing it is elongated and faint. The spots are more distinct on the under side of both the wings.

1 specimen : male.

Location : East Pakistan:—Teknaf.

9. **Euploea diocletiana** (Fabricuius)

The fore wing of the Magpie Crow on the upper side is black with a brilliant blue gloss throughout, having white spots and bars. The terminal half of the hind wing is black glossed with blue and the rest is light brown with white streaks and blue spots.

1 specimen : male.

Location : East Pakistan:—Dohazari (Chittagong).

Family—SATYRIDAE

10. **Mycalesis perseus** (Fabricius).

The Comm on Bushbrown is vandyke brown on the upper side. There is a white centred fulvous ringed black ocellus on the upper side of the fore wing. On

the under side of the hind wing the three posterior ocelli are in a straight line and the remaining are outwardly curved.

Foodplants : *Grasses.*

1 specimen : male.

Location : East Pakistan:—Chittagong.

11. **Lathe christophi** Leech

The upper side is brown. Below the centre of the hind wing there is a large scent spot which appears as glossy oil stain. The only marking on the upper side is the submarginal row of black spots on the hind wing. The under side is shining. The edges of the wings are brownish. There are two dark lines on the disc which are partly straight and partly somewhat curved. There is a submarginal row of small ocelli on the under side of the hind wing. The first ocellus which is double and the 6th ocellus are distinct. Rest are obslescent.

1 specimen : male.

Location : N. W. F. P.:—Chitral.

12. **Lethe europa** Fabricius

The inner third of the hind wing of the Bamboo Tree Brown is covered with long brown hairs. The upper side of the male is dark brown. The discal fascial on the under side is faintly visible on the upper side. The under side is dark blackish brown with no discal band on the under side. The series of ocelli on the under side is curved outward and inward in the fore and hind wing respectively. The female can be distinguished having an oblique broad white discal band on the upper side of the fore wing.

Foodplants : *Bamboo, Grasses.*

2 specimens : 1 male, 1 female.

Location : East Pakistan:—Mymensingh.

N.W.F.P. :—Peshawar.

13. **Parage schakra** (Kollar)

The Common Wall is pale vandyke brown. On the fore wing a black white pupilled ocellus is present on the fourth, the largest of the orange spots. There are three black white pupilled orange ringed ocelli on the upper side of the hind wing. The under side is pale greyish white with dark and orange brown lines. There is a curved row of six ocelli on the under side of the hind wing. The upper side of the fore wing in female has a broad pale short line on to the inward side of the orange spot.

11 specimens : 3 males, 8 females.

Location : Punjab:—Nathiagali.

Baluchistan:—Peshin, Harnai.

14. **Maniola pulchella** (Felder)

The fore wing of the Tawny Meadowbrown is ochracious yellow on the upper side with broad greyish costa, termen and dorsum and a preapical round black spot. This black spot is white centred on the under side. The hind wing is smooth shining greyish brown on the upper side and marked with dark brown specks on the under side.

3 specimens : males.

Location : Punjab:—Hassan Abdal.

15. **Eumenis parisatis** (Kollar)

The White Edged Rock Brown is valvet blackish brown on the upper side with bluish white border. There is a pupilled ocellus in interspace 5 unpupilled ocellus in interspace 2 on the fore wing and pupilled ocellus in the interspace 2 on hind wing. The under side is pale sepia brown with dark brown streaks. The female has broad bluish white border.

2 specimens : 1 male, 1 female.

Location : Punjab :—Hasan Abdal.

16. **Eumenis thelephassa** (Hubner)

The female Baluchi Rock Brown, is pale brown on the upper side. The wings are crossed by a post discal, broad ochracious band on the upper side, with two white centred black ocelli, and two intermediate white spots within the band. On the upper hind wing there is a ocellus, and white speck. The under side is pale greyish white, freckled with black and dark striae.

1 specimen : female.

Location : Baluchistan:—Peshin.

17. **Aulocera swaha** (Kollar)

The ground colour of the Common Satyr is with a bronzy sheen. The broad discal band is tinged with creamy yellow which does not reach the dorsal margin of the hind wing. The lower basal area on the under side of th hind wing is tinged with green.

Foodplants : *Grasses.*

1 specimen : female.

Location : N. W. F. P. :—Kaghan.

18. **Erebia scanda** (Kollar)

The Pallied Argus is dark velvety brown with a bipupilled preapical ocellus. On the under side of the hind wing there are two small sub-basal, fulvous ringed, white pupilled black ocelli with four minute white dots above them.

Foodplants : *Grasses.*

35 specimens.

Location : East Pakistan :—Rangpur; Bhairab Bazar.

Punjab :—Hasan Abdal; Murree; Nathiagali.

19. **Erebia annada** (Moore)

The Ringed Argus has marginal and discal bands, with two small tornal unpupilled ocelli and some white frosting on the under side of the hind wing.

Foodplants : *Grasses.*

1 specimen.

Location : Punjab:—Murree.

20. **Erebia daksha** (Moore)

The upper side is dark brown. The apex of the fore wing and the terminal margin are paler. The fore wing is with a bipupilled preapical ocellus and hind wing with a pupilled tornal ocellus. There is a series of white spots above the ocellus on the under side of the hind wing.

Foodplants : *Grasses.*

5 specimens.

Location : Punjab :—Nathiagali.

21. **Ypthima hubneri** Kirby

On the upper side the Common Fouring has two, pupilled ocelli on the hind wing and one, bipupilled ocellus on the fore wing. On the under side of the hind wing there are four, pupilled ocelli.

Foodplants : *Grasses.*

2 Specimen : Female (Wet- Season form).

Location : East Pakistan:—Dacca ; Rangpur.

22. **Ypthima baldus** Fabricius

The Common Fivering has three pupilled ocelli and two tornal ocelli on the hind wing. On the under side of the hind wing there are four prominent ocelli.

Foodplants: Grasses.

1 specimen : male (Wet-season form).

Location : East Pakistan :—Jharia (Mymensingh).

23. **Ypthima sakara** Moore.

The Himalaya Fivering is umber brown on the upper side and ochracious brown on the under side. The two subapical ocelli on the under side of the hind wing are large, geminate and encircled in a common ring. The tornal ocellus is bipupilled.

Foodplants : Grasses.

6 specimens : females.

Location : East Pakistan :—Bhairab Bazar.

Punjab :—Nathiagali.

24. **Orsotrioena medus** (Fabricius)

There is only one disorted Nigger in the collection. The upper side in uniform vandyke brown with terminal pale line on both the wings. The white discal band which crosses both the wings on the under side is faintly visible on the upper side. The ocelli are obsolescent.

Foodplants : Grasses.

1 specimen (Dry season form).

Location : Punjab :—Murree.

25. **Melanitis leda** (Drury)

The wet season form of the Common Evening Brown, is dull dark brown on the upper side. The fore wing on the upper side has two black spots with white pupils. The under side is grey and clearly striated with dark brown lines. The ocelli are present. In dry season form there is a short dark yellow bar above and at the inner edge of the black spots. The under side is richly spotted with blacks. The ocelli are absent. The specimens were collected on light.

Foodplants : Grasses.

12 specimens : Dry season form : 4; Wet-season form : 8.

Location : East Pakistan :—Dohazari, Mohanganj ; Ramganj, Barisal and Comilla.

26. **Elymnias hypermnestra** Linnaeus

Race :—*undularis Drury*.—The male Common Palm Fly is blackish brown on the upper side and pale brown on the under side. There is a terminal series of blue spots forming almost and oblique bar upto the costa. The margin of the hind wing on the upper side is chestnut brown. On the under side of the fore wing there is a triangular pale purplish white preapical mark.

Foodplants : Palm.

4 specimens : males.

Location : East Pakistan :—

Mymensingh ; Jharia.

FAMILY AMATHUSIIDAE

27. **Discophora tullia** (Cramer)

There is only the right half of a female mutilated Common Duffer, in the collection. The upper side is purplish brown with three rows of small bluish spots on the fore wing and three rows of yellow spots on the hind wing.

Foodplants : Bamboo.

1 specimen : famale.

Location : East Pakistan :—

Cox's Bazar.

FAMILY NYMPHALIDAE

28. **Euthalia garuda** (Moore)

The colour on the upper side of the female Baron is olivaceous brown. There is a curved series of five white discal spots on the upper side of the fore wing. The dark brown, elongate, outwardly acute spots on the upper side of the fore wing are well separated.

Foodplants : *Mangifera indica* (Mango) ; *Anacardium accidentale* (Cashew) (*Anacardiaceae*) *Streblus asper* (*Urticaceae*).

1 specimen : female.

Location : East Pakistan:—

Dacca.

29. **Euthalia lusentina** (Cramer)

The male Gaudy Brown is greenish brown on the upper side and with a band of white dots conforming to Y shape in the fore wing. The hind wing has red

black spots. The under side is purplish brown with large and clear markings than the upper side.

Foodplants : *Loranthus scurrula* ; *L. longiflorus* (*Loranthaceae*).

1 specimen : male.

Location : East Pakistan :—

15 miles north-east of Dacca.

30. **Limenitis trivena** Moore

The Indian White Admiral is dull black on the upper side with broad white discal band and is crossed by veins in the hind wing and consisting of separate spots in the fore wing. The fore wing has transverse band in the cell and a white spot in the interspace 1b. Yallowish white narrow spots are present on the marginal line of both the wings.

Foodplants : *Lonicera tatarica* (*Caprifoliaceae*) *vide* de Niceville.

1 specimen:

Location : Punjab :—Nathiagali.

31. **Neptis hylas** Moore.

The Common Sailer is black on the upper side and golden ochracious beneath. The costal streak on the upper side of the fore wing is short. The triangular spot is outwardly sharp. The white markings on the under side is broad and defined in black.

Foodplants :—*Cylista* ; *Flemingia* ; *Mucuna* ; *Xylia* ; *Canavalia ensiformis* (*gladiata*) ; *Vigna catjang* (*Leguminosae*) ; *Grewia* ; *Triumfetta* ; *Corchorus* (Til) ; *Bombax* (*Malvaceae*) ; *Holicteres* (*Sterculiaceae*) ; *Mappia foetida* (*Icacinaceae*).

1 specimen :

Location : East Pakistan :—

Cos'x Bazar.

32. **Nepits astola** Moore

The upper side is black with white markings. The spots in the post discal series on the upper side of the hind wing are quadrate. The under side is pale ochracious yellow with indistinct black edges to white band.

2 specimens : Wet-season form.

Location : East Pakistan :—Co'x Bazar.

33. **Hypolimnas bolina** (Linnaeus)

The male of the Great Egg Fly is velvety black on the upper side with a shining irridescent blue patch broadly centred with white on each wing. The female is a mimic of *Euploea core*. The upper side of the female is dark brown. The outer discal row of pale yellow spots are present on both the wings. A blue, short discal band of spots visible on the fore wing of the dry season form in the collection.

Foodplants : *Fleurya interrupta* ; *Elatostemma cuneatum* (*Urticaceae*) *Portulaca oleracea* (*Portulacaceae*).

2 specimens : 1 male, 1 female (Dry-season form).

Location : Sind :—Karachi.

34. **Hypolimnas misippus** (Linnaeus)

The male of the Danaid Egg Fly is rich velvety dark brownish black on the upper side with a white discal spot surrounded by dark irridescent blue ground in both the wings. The female is a mimic of *Danais chrysippus*, but it can be easily distinguished having the margin more waved and on the upper side of the hind wing there is a prominent black costal spot.

Foodplants : *Portulaca oleraceae* (*Portulacaceae*); *Abutillon hibiscous* (*Malvaceae*).

54 specimens ; 40 males, 14 females.

Location : East Pakistan :—

Dacca, Mymensingh.

Punjab : Rawalpindi.

Sind : Karachi.

35. Female form : **inaria** Cramer

It is the mimic of *Danais chrysippus*. The white banded balck spex is absent.

2 specimens.

Location : Sind :—Karachi.

36. **Precis hierta** (Fabricius)

The male Yellow Pansy is bright yellow on the upper side. The costa and termen of the fore wing is narrowly black and the black apex bears yellow markings. The black dorsum is broadly black at the tornus. The hind wing is with black costa and a large brilliant blue central spot along the anterior black area. The female is duller in colour with two ocelli in the interspace 2 and 5 on the upper side of the fore wing.

Foodplants : *Asteracantha longifolia* ; *Barleria* (*Acanthaceae*).

42 Specimens : 28 males, 14 females.

Location : Sind :—Karachi ; Tando Adam.

37. **Precis orithyia** (Linnaeus)

The basal two-third of the fore wing of the Blue Pansy on the upper side is velvety black, and the pale brown apex has white bands and two ocelli. The upper side of the hind wing is shining blue shaded with black toward the inner base. The female is smaller in size with more prominent ocelli. The whole basal area on the upper side is black.

Foodplants : *Justicia procumbens* ; *Justicia micrantha Lepidagathis prostrata* (*Acanthaceae*).

74specimens : 53 males, 21 females.

Location : East Pakistan :—

Dacca, Bhairab Bazar, Jharia.

Sind :—Karachi ; Dadu.

Punjab :—Campbellpur; Abbottabad.

N. W. F. P. :—Peshawar.

Baluchistan :—Astolla Island; Quetta; Harnai.

38. **Precis lemonias** (Linnaeus)

The Lemon Pansy is olive brown on the upper side having numerous lemon yellow spots on the fore wing. There is a prominent ocelli in the interspace 2 on the fore wing and other in the interspace 5 on the hind wing.

Foodplants : *Nelsonia campestris* ; *Asteracantha longifolia* (*Acanthaceae*) ; and also on Jute and *Sida rhombifolia* (*Malvaceae*).

72 specimens.

Location : East Pakistan :—

Harbang ; Dohazari ; Comilla ; Mymensingh ; Cox's Bazar.

Sind :—Karachi.

Baluchistan :—Mastung Road.

39. **Precis almana** (Linnaeus)

The Peacock Pansy is bright yellow on the upper side having ocelli in the interspace 2 & 5 in both the wings. In hind wing the ocelli in the interspace 5 is the largest one and on the fore wing there are dark costal bar in and beyond the

cell. The fore wing in the dry season form is fulcate and produced. The hind wing is tailed at tornus and ocellus at 2 is absent. The under side is leaf like.

Foodplants : *Asteracantha longifolia* ; *Hygrophila* ; *Barleria* (*Acanthaceae*) ; *Osbeckia* (*Melastomaceae*).

104 specimens, D.S.F. : 37, W.S.F. : 67.

Location : East Pakistan :—

Dacca, Jharia, Dohazari, Munshiganj, Mymensingh, Mohanganj, St. Martin's Island.

Sind : Karachi.

N.W.F.P. : Peshawar.

40. **Precis atlites** (Johanssen)

The Gray Pansy is pale levender brown on the upper side having brown lines. There is a row of outer discal ocelli on both the wings. The under side has delicate and lilacine white markings.

Foodplants : *Asteracantha longifolia* ; *Barleria* (*Acanthaceae*).

23 specimens : 15 males, 8 females.

Location : East Pakistan :—

Dacca, Jharia, Dohazari, Munshiganj, Mohanganj.

41. **Precis iphita** (Cramer)

The upper side of the Chocolate Pansy is brown having dark brown bands. There is a row of small ocelli on the upper side of the hind wing. The apex of the fore wing and the tornus of the hind wing are slightly produced. The under side is leaf like, and have white markings.

Foodplants : *Strobilanthes callosus* ; *Justicia micrantha* ; *Asteracantha longifolia* (*Acanthaceae*).

1 specimen.

Lcation :—East Pakistan :—

Cox's Bazar.

42. *Form* : **siccata** Frushtarfer

This is the dry season form of *Precis iphita*. This is smaller and have no white marking on the under side.

1 specimen.

Location : East Pakistan :—Cox's Bazar.

43. **Vanessa cardui** (Linnaeus)

The Painted Lady is pinkish red on the upper side. The apical half of the fore wing and the termen are dusky black having white spots. The discal and median golden area have black markings. The hind wing is densely brown and the orange discal area and the termen have black spots.

Foodplants :—*Zornia diphylla* (*Leguminoceae*) ; *Artemisia* ; *Blumea* (*Compositae*) *Debregeasia bicolor* (*Urticaceae*).

Location : Sind : Karachi.

Punjab : Campbellpur.

Baluchistan : Harnai.

44. **Vanessa indica** (Herbst)

The Indian Red Admiral is dark brown on the upper side with white spots at the apex of the fore wing along with a central red band with a large black spot. The termen of the hind wing is red with black spots.

Foodplants : *Utrica* (Nettles) ; *Girardinia heterophylla* (Giant Nettle) (*Urticaceae*).

1 specimen.

Location :—Baluchistan : Peshin.

45. **Vanessa rizana** Moore

The basal half and the costa of the fore wing on the upper side is pale brown having orange area with black spots. The basal area of the hind wing is dusky brown with a right yellow band and blue spots on the termen.

1 specimen.

Location : Baluchistan : Peshin.

46. **Vanessa canace** (Johanssen)

The Blue Admiral on the upper side is deep indigo blue black with a paler blue band on both the wings. On the hind wing this band is traversed along its outer margin by a series of small black dots. The under side is brownish black with a white spot at the apex of the cell in the hind wing.

Foodplants : *Smilex* (*Liliaceae*) ; Wild Yams(*Dioscoraceae*).

1 specimen.

Location : Punjab : Nathiagali.

47. **Vanessa xanthomelas** (Denis & Schieffermuller)

The Large Tortoise Shell is rich orange yellow. On the upper side there is a large irregular black spot at the mid costa on the hind wing and few black spots on the fore wing. The margin is dark with a narrow irregular blue band on the hind wing only. The mid and the hind legs are brown.

Foodplants : *Pistacia integerrima* (*Anacardiaceae*) ; *Celtis australis* (*Urticaceae*).

1 specimen.

Location : Baluchistan : Peshin.

48. **Argynnis hyperbius** (Johanssen)

The Indian Fritillary is orange yellow on the upper side with black spots and markings. The under side of the hind wing is greenish brown variegated with ochraceous, brown, and silver markings. The apical half of the fore wing in female is black having four white spots and a white band.

Foodplants : Viola (*Violacae*).

2 specimens : 1 male ; 1 female.

Location : Punjab :—Campbellpur.

49. **Argynnis jarnadeva** Moore

The upper side is rich tawny yellow with black markings. The subterminal spots are rounded on both the wings. On the under side there is a transverse series of silvery centred dark ferruginous spots bordering the discal row of silvery spots on the hind wing.

Foodplants : Viola.

2 specimens : males.

Location :—N.W.F.P. :—Chitral.

50. **Argynnis kamala** Moore

The Common Sliverstripe is golden yellow with black markings on the upper side of the wings. There is an inverted N shaped mark beyond the cell in the fore wing. The base of the hind wing is clothed with long yellow hairs. The under side of the hind wing is dark green with 5 silver bands. The discal line is bent out in the middle.

Foodplants : Viola.

1 specimen : male.

Location : N.W.F.P. ; Chitral.

51. **Argynnis clara** Blanchard

The upper side is ochracious yellow with black markings. The base of the fore wing and most of the hind wing is suffused with green. On the under side the fore wing is paler and the hind wing is shining green with bluish white markings.

Foodplants : Viola.

1 specimen : female.

Location : N.W.F.P. : Chitral.

52. **Argynnis lathonia** (Linnaeus)

The upper side of the Queen of Spain Fritillary is pale fulvous with larg black spots. The base of wings are suffused with olivaceous brown. The fore wing is produced along the anterior apical margin. The under side of the hind wing is yellowish brown with very large silver spots.

Foodplants : Vioia.

4 specimens : males.

Location :—Punjab : Nathiagali.

53. **Atella phalantha** Drury

The Common Leopard is bright ochracious with black spots and markings. The cell of the fore wing has three transverse irregular black lines including a line along the discocellular. The under side is paler ochracious with faint markings. The outer half of the hind wing on the under side is suffused with purple.

Foodplants :—*Flacourtia ramontchi* ; *F. montana* ; *Aberia gardner* (*Bixaceae*) ; *Smilex* (*Liliaceae*) ; *Salix* (*Salicaceae*).

21 specimens.

Location :—East Pakistan :—

Dacca, Natore.

Sind : Karachi.

Punjab : Abbottabad.

Baluchistan : Harnai.

N.W.F.P. : Peshawar.

54. Ergolis ariaden (Johanssen)

The Angled Castor is ochraceous rufous on the upper side with regular solitary lines. The fore wing is deeply concave between veins 2, 3 & 5. The termen of the hind wing is deeply scalloped.

Foodplants : *Tragia involucrata* ; *T. cannabina* ; *Ricinus communis* (Castor Oil Plant) (*Euphorbiaceae*).

9 specimens : 3 males, 6 females.

Location :—East Pakistan :—

Dacca ; Bhairab Bazar ; Rangpur ; Jaidabpur and Mymensingh.

55. Ergolis merione (Cramer)

The Common Castor is brownish ochracious on the upper side with highly waved black lines. In fore wing the termen is much rounded. On the under side the transverse bands are diffused.

Foodplants : *Tragia involucrata* ; *T. nnabina* (Probably) ; *Ricinus communis* (Euphorbiaceae).

7 specimens : males (Wet Season Form).

Location :—East Pakistan :—

Dacca ; Bhairab Bazar ; Jaidabpur.

Family—ACRAEIDAE

56. Telchinia violae (Fabricius)

The Tawny Coster is brick-red on the upper side with black spots in the cel and disc of both the wings. The termen of the fore wing on the upper side is narrowly dark and the hind wing has white spots on the black termen.

Foodplants : *Modecca palmata* ; Cultivated Passion Flowers ; *Passiflora foetida* (*Passifloraceae*) ; *Cucurbitaceae* (Cucumbers etc.) ; *Hibiscus cannabinus* (*Malvaceae*).

16 specimens : 12 males, 4 females.

Location :—East Pakistan :—

Dacca ; Rajshahi.

Punjab : Abbottabad.

Family—ERYCINIDAE

57. **Libythea lepita** Moore

The Common Beak is darker brown on the upper side with an orange yellow streak. The spot beyond the end of cell is separate from the cell streak or slightly joined. The orange patch on the upper side of the hind wing is narrower.

Foodplants : *Celtis australis* (*Urticaceae*).

3 specimens.

Location :—Punjab : Nathiagali ; Hasan Abdal.

58. **Zemeros flegvas** Cramer

The Punchinello is purple brown on the upper side with many small white spots. Each spot is bordered inwardly by a black spot. The hind wing is angulated at vein 4.

1 specimen : male.

Location : East Pakistan :—Jharia.

59. **Dodona durga** Kollar

The Common Durga is dark brown on the upper side with prominent yellow spots on both the wings. There is a yellow bar at the end of the cell on the fore wing and prominent black spots in the interspace 1b, 5, and 6 and on the base of the tornus on the hind wing. It is tail-less. The ground colour on the under side is ochracious brown and the veins on the basal halves of the wings are pale ochracious white.

Foodplants : Grasses.

1 specimen : male.

Location :—Punjab : Hasan Abdal.

Family—PAPILIONIDAE

60. **Polydorus hector** (Linnaeus)

The Crimson Rose is tailed and black. The fore wing on the upper side have prominent interrupted irregular apical and discal white bands. The hind wing has discal and marginal rows of bright crimson spots.

Foodplants : *Aristolochia indica* (Aristolochiaceae).

1 specimen.

Location :—East Pakistan : Teknaf.

61. **Plydorus aristolochiae** (Fabricius)

The Common Rose is black and tailed. The hind wing is with five (four in two specimens in the collection) elongated white spots which are remote from the cell. In some specimens the spot in the interspace 1 is red. There is a marginal series of dirty red crescents.

Foodplants : *Aristilochia indica.*

43 specimens.

Location :—East Pakistan :—Dacca ; Mymensingh ; Comilla.

Sind : Karachi.

62. Form : **diphilus** Esper

The discal spots on the hind wing are placed close to the cell.

24 specimens.

Location : Sind : Karachi, Tando Adam.

63. **Polydorus aristolochia goniopeltis** (Rothschild)

The discal spots on the hind wing is closed to the cell. The spot in the interspace 1 is pointed and long. On the under side this spot is entirely red.

6 specimens.

Location :—Sind : Karachi.

64. **Chilasa clytia** (Linnaeus)

Form : **dissimilis** Linnacus :—The Common Mime is the mimic of *Danais limniace.* On the upper side it is black with creamy stripes. On the hind wing there is a tornal yellow spot on the upper side and large yellow terminal spot on the under side.

Foodpiants : *Alseodaphine semicarpifolia* ; *Cinnamomum zeylanicum* (Cinnamon) ; *Tetranthera apetala* ; *Litasea sebifera* (*Lauraceae*).

3 specimens : males.

Location :—East Pakistan : Mymensingh ; Rajshahi.

65. **Papilio polyctor** Boisduval

The Common Peacck is dull black thickly irrorated with golden scales. There is a golden green band on the fore wing and a bright blue patch on the hind wing which does not enter the cell. There are three claret-red marginal crescents on the hind wing.

Foodplants : *Zanthoxylum alatum* ; *Limonia acidissima* (*Rutaceae*).

6 specimens : 2 male ; 4 females.

Location :—N.W.F.P. : Peshawar.

66. **Papilio helenus** (Linnaeus)

The Red Helen is black and tailed. On the hind wing there are large creamy white discal patches in the interspace 5, 6 and 7 and also a marginal series of claret red crescents on the under side of the hind wing which form a complete row.

Foodplants :—Cultivated Citrus ; *Zanthoxylum rhetsa* ; *Glycosmis pentaphylla* (*Rutaceae*).

1 specimen.

Location :—East Pakistan : Teknaf.

67. **Papilio polytes** (Linnaeus)

The male Common Marmon is black and tailed. The terminal series of yellowish white spots on the fore wing is decreasing in size towards the apex. On the hind wing the discal band of elongate spots is white. On the under side of the hind wing the incomplete series of lunes are white.

Foodplants : Cultivated Citrus ; *Glycosmis pentaphylla* ; *Citrus medica* ; *Zanthoxylum rhetsa* ; *Aegle marmelos* ; *Murraya koenigii* (*Rutaceae*).

12 specimens.

Location :—East Pakistan : Jharia, Mymensingh, Dacca, Comilla.

Sind : Karachi.

Female form: **cyrus** Fabricius.—This female form of *Papilio polytes* is distinguished having ochracious submarginal series on the under side of the hind wing.

6 specimens.

Location : East Pakistan :—Rajshahi.

Sind : Karachi.

68. Female form : **romulus** Cramer:—The mimic of *Polydorus hector* is black and tailed with broad interrupted irregular white band from cell to tornus and the other below the apex. On the upper side of the hind wing the apex of the cell and the disc have elongate red spots. The margin bears red crescents and the termen have red spots.

5 specimens.

Location : Sind :—Karachi.

69. Female form : **stichius** Hubner:—This female form is the mimic of *Polydorus aristolochiae.* On the upper side of the fore wing there are pale streaks between the veins. On the hind wing there are four white elongate spots adjacent to the cell. The spot at the apex of the cell in the hind wing is absent in one specimen in the collection. The marginal series of lunes are red and a paler series of narrow red spots present. The body has no red markings.

4 specimens.

Location : East Pakistan :—Mymensingh, Jharia.

Sind : Karachi.

70. **Papilio polytes nickobarus** Feldr

The male is larger than the *Papilio romulus* and the band on the upper side of the hind wing is narrower.

3 specimens : male.

Location : Sind : Karachi.

71. **Papilio demoleus** Linnaeus

The Lime Butterfly is black and tail-less. There are broad irregular yellow discal band on the upper side of the hind wing which is broken into irregular spots and patches on the fore wing. On both the wings there are marginal and terminal rows of yellow spots. On the hind wing there are tornal red spot and apical black and blue spot. There are dwarf specimens in the collection.

Foodplants : Cultivated Citrus ; *Glycosmis pentaphylla* ; *Ruta graveoleus* ; *Aegle marmelos* ; *Murraya koenigii* ; *Chloroxylon swietenia* (*Rutaceae*).

180 specimens : Dwarf : 10.

Location : East Pakistan :—Dacca, Comilla, Bhairab Bazar, Sylhet.

Sind : Karachi, Sakrand.

Baluchistan : Harnai.

Family—PIERIDAE

72. **Delias aglaia** (Linnaeus)

The male and female Red-base Jezebel is quite different in appearance. The male is black on both the sides. The upper side of both the wings have marginal greyish white hastate spots and white cell spot. The cell in the fore wing is some greyish scaling and the inner area of the hind wing is yellow. On the under side of the fore wing there is a broad greyish white discal band. On the under side of the hind wing there are yellow stripes and spots and the inner yellow area is bright.

The female is brownish black on the upper side with prominent greyish white marginal and lower discal stripes. On the under side the hind wing is yellow with brownish black veins and margin.

In both the sexes there is a red basal band which extends from costa to dorsum.

3 specimens : 1 male ; 2 females.

Location : East Pakistan : Jharia (Mymensingh).

73. **Delias descombesi** (Boisduval)

The male Red-spot Jezebel is white on the upper side and the fore wing has narrow black costa and small apical and terminal black area. The under side of the fore wing is black with white spots and stripes. The veins are thinly streaked with white. The hind wing on the under side is bright yellow with yellow marginal spots and the area below the cell has dark scales.

The fore wing of the female on the upper side is brownish black. There occurs a white spot at the end of the cell and a row of pale marginal spots with pale veins. The hind wing is white with pale spotted dark border. On the under side the hind wing is yellow with black border bearing yellow spots.

There is a long basal red patch above the cell in the interspace 7 on the under side of the hind wing in both the sexes.

2 specimens : 1 male, 1 female.

Location : East Pakistan : Jharia (Mymensingh).

74. **Delias eucharis** (Drury)

The male Common Jezebel is black on the upper side with broad veins on the fore wing and a black outer discal veins on both the wings. The hind wing on the under side is yellow with black veins containing large red spots on the black border. The red spots are pointed at the margin and black edged inwardly. The female on the upper side is white tinged with yellow.

Foodplants : *Loranthus elasticus* ; *L. longiflorus* ; *L. scurrula* (*Loranthaceae*).

5 specimens : 2 males , 3 females.

Location : East Pakistan : Dacca, Mymensingh, Rajshahi.

75. **Huphina nerissa** (Fabricius)

The wet season form of the Common Gull is white on the upper side with few black veins. The fore wing has black terminal border and broad black apex with white spots. On the under side the hind wing is yellow with greenish veins. In female the margin of the cell is darkened and broad. The fore wing has a black spot in the interspace 1b and yellow or white spots at the apex. The black outer border of the hind wing has yellowish white spots. In dry season forms the black markings are much reduced. In male the hind wing on the under side is pale yellow with no markings.

Foodplants : *Capparis aphylla* ; *C. sepiaria* ; *C. heyneana* ; *C. horrida* (*Capparidaceae*).

W.S.F. : 19 specimens : 16 males ; 3 females.

D.S.F. : 11 specimens : 4 males ; 7 females.

Location : East Pakistan : Dacca ; Mymensingh ; Rajshahi ; Gopalpur, Natore.

76. **Anaphaeis aurota** (Fabricius)

Race : **mesentina** Cramer:—The male Pioneer on the upper side is white. The fore wing is with broad streaked black apex and a black bar at the end of the cell. The underside of the hind wing is white to yellowish. The female is white with black costa from base to cell bar which is joined to the costa.

Foodplants: *Capparis aphylla* ; *C. sepiara* ; *C. heyneana* ; *C. spinosa* (vide Munshi, G.M.) ; *Cadaba indica* ; *Maerua arenaria* (*Capparidaceae*).

86 specimens : 58 males ; 28 females.

Location : East Pakistan : Dacca, Barkal.

Sind : Karachi.

Baluchistan : Sibi, Baber Kachh, Harnai.

77. **Appias libythea** (Fabricius)

Race : **Zelmira** Cramer:—The male Striped Albatross on the upper side is white. The apex of the fore wing is black with white stripes and black termen. The hind wing in the wet season form is with a terminal series of triangular spot at the apices of the veins. The humeral angle on the under side is tinged with yellow. In female of dry season form the hind wing is completely white.

Foodplants ; *Crataeva religiosa* ; *Capparis sepiaria* ; *C. roxburghii* ; *C. horrida* (*Capparidaceae*).

W.S.F. : 11 specimens : 8 males, 3 females.

D.S.F. : 3 specimens : females.

Location : East Pakistan:—Rajshahi, Dinajpur.

78. *Form* : **Olferna** Swinhoe :—

The upper side of the fore wing in the female of wet season forms have yellow spots on the apex and termen. The under side of the hind wing has broad yellow discal stripe.

2 specimens : females.

Location : East Pakistan :—Dacca.

79. **Appias lyncida** (Cramer)

The female Chocolate Albatross is black with four discal streaks on the upper side of the fore wing. The discal area of of the hind wing is white with a yellow patch on the humeral angle and the terminal area is broadly dusky.

Foodplants : *Crataeva religiosa* ; *Capparis roxburghii* (*Capparidaceae*)
3 specimens : females.

Location : East Pakistan : Dacca.

80. **Pieris canidia** (*Sparrman*)

The apex of the fore wing of the Indian Cabbage White is black which is dentate inwardly. The discal spot is present. The hind wing on the upper side has apical and terminal dots. The female has an additional discal spot on the upper side of the fore wing.

Foodplants : *Cruciferae.*

21 specimens : 9 males ; 12 females.

Location : Punjab : Campbellpur ; Abbottabad.

N.W.F.P. : Peshawar.

81 **Pieris brassicae** (Linnaeus)

The apex of the fore wing on the upper side is black in the Large Cabbage White and there is an apical spot on the hind wing. In female there are two discal spots and a black patch on the upper side of the fore wing.

Foodplants : *Cruciferae.*

18 specimens : 11 males ; 7 females.

Location : West Pakistan :

Punjab : Pindi, Hasan Abdal, Abbottabad.

N.W.F.P. : Peshawar.

82 **Pieris rapae** (Linnaeus)

The Small Cabbage White has a very small black apical area on the upper side of the fore wing. There is a discal and faint apical spot on the fore and hind wing respectively. On the upper side of the fore wing the female has an additional discal spot.

Foodplants : *Cruciferae.*

10 specimens : 4 male ; 6 females.

Location : Punjab : Murree. Baluchistan, Quetta.

83 **Pontia daplidice** (Linnaeus)

The female Bath White has black apical margin on the upper side of the fore wing with white spots and lines. There is a black spot at the end of the cell which is joined to the costa and a discal spot in the interspace lb. The hind wing on the upper side has terminal and marginal row of spots and the under side is blotched with green.

Foodplants : *Cruciferae.*

3 specimens : females.

Location : West Pakistan : Punjab, Hasan Abdal.,

N.W.F.P. : Peshawar.

84 **Pontia glauconome** (Klug)

The Desert Bath White differs from the *Pontia daplidice* in having yellow veins on the under side of the hind wing.

Foodplants : *Cruciferae.*

8 Specimens : 6 males, 2 females.

Location : Punjab : Pindi, Nathiagali ; Hasan Abdal,

N.W.F.P. ; Peshawar.

85 **Ixias marrianne** (Cramer)

In the female White Orange Tip the apical half of the fore wing on the upper side is black enclosing an orange patch which contains four black spots and there is a black bar at the end of the cell. The cell and the bases of the wings are dusted with black.

Foodplants : *Capparis sepiaria* ; *C. divaricata* ; *C. aphylla, C. grandis* (Capparidaceae).

1 specimen : female.

Location : Sind : Karachi.

86 **Colotis calais** (Cramer)

The small Salmon Arab is salmon pink on the upper side. The fore wings have a spot at the end of the cell which is joined to the dark costal border. The apex and terminal border are black with ground colour spots. In female the ground colour is paler.

Foodplants : *Salvadora persica* ; *S. oleoides*; *Azima tetracantha* (*Salvadoraceae*)

203 Specimens : 156 males ; 47 females.

Location : Sind : Karachi, Tando Adam, Daro.

87 **Colotis phisadia** (Godart)

The Blue Spotted Arab is rich salmon pink. On the upper side the costa and the termen of the fore wing is broadly black. The apex of the fore wing has bluish grey spots and bluish grey scaling on the costa and at base. The cell spot is joined to the black border of the costa. The hind wing on the upper side has broad black border and bluish grey scaling from the base along the dorsum. In female the cell spot is larger.

Foodplants : *Capparidaceae*.

2 Specimens : 1 male ; 1 female.

Location : Sind : Karachi.

88 **Colotis vestalis** (Butler)

The White Arab is with broad black terminal border which is brownish in the female. On the hind wing there is a prominent spot in the interspace 3 and on the apex there are three white spots in male and one white spot in female.

Form: **Peelus.** Swinhoe—The ground colour on the upper side is pale creamy yellow.

Foodplants : *Salvadora persica* (*Salvadoraceae*).

125 specimens : 55 males ; 70 females.

Location : Sind : Karachi , Larkana, Mirpur.
Punjab : Abbottabad, Sahiwal.
N.W.F.P. Peshawar.
Baluchistan : Sibi.

89 **Colotis fausta** (Oliver)

Form : **faustina** (*C&R Felder*):—The Large Salmon Arab is salmon colour with a black cell spot on the upper side of the fore wing. The apex and the termen

of the fore wing is black bearing ground colour spots. The hind wing on the upper side has marginal black spots. The femeale has broad markings.

Foodplants : *Maerua arenaria* (*Capparidaceae*)

2 specimens : 1 male ; 1 female.

Location : Sind : Karachi.

90 **Colotis etrida** (Boisduval)

The Little Orange Tip is white. The apex of the fore wing on the upper side has an apical orange patch, bordered by black, and the cell spot is very small. On the upper side of the hind wing there are terminal black spots. The female can be distinguished having additional spots on the fore wing. On the hind wing the terminal spots are slightly larger.

Foodplants : *Cadaba indica* (*Capparidaceae*)

58 Specimens : —30 males : 28 females.

Location : Sind : Karachi, Thatta, Tando Adam.

Baluchistan:—Sibi, Harnai.

91 **Colotis danae** (Fabricius)

The Crimson Tip is White on the upper side with black scales at the base of the wings. The apex of the fore wing is carmine, bordered by brown colour. There are terminal brown spots on the under side of the hind wing. In female the carmine area is crossed by a line of black spots.

Foodplants : *Cadaba indica* ; *Maerua arenaria* ; *Capparis sepiaria* ; *C. divaricata* (*Capparidaceae*)

48 Specimens : 29 males ; 19 females.

Location : Sind. Karachi, Tando Adam.

92 **Parenonia ceylanica** (C & R Felder)

The male Dark Wander is bluish green on the upper side with dark veins. The black border of the fore wing has small bluish green spots. In female, on the upper side of the fore wing the marginal streak and the discal spot in the interspace 3 is shifted inwards. The hind wing has small marginal ground colour spots.

Foodplants : *Capparis heyneana* (*Capparidaceae*)

4 specimens : 2 males ; 2 females.

Location : East Pakistan :—

Mymensingh.

93 **Catopsilia crocale** (Cramer)

The Common Emigrant is pale yellow to white on the upper side. The male is sulphur yellow basally and the fore wing is with narrow black termen and apex. In female the costa, apex and the termen of the fore wing are broadly black and the cell spot is joined to the costa. On the upper side the hind wing has a black terminal border.

Foodplants : *Cassia fistuala* ; *C. siamea* ; *C. tora* ; *Butea frondosa Bauhinia racemosa* (*Leguminosae*)

35 Specimens : 28 males ; 7 females.

Location : East Pakistan :—

Dacca, Rajshahi, Mymensingh.

Sind : Karachi.

94 Female form : **Catopsilia jugartha** : (Cramer) :—The female is sulphur yellow. The fore wing has a black bar at the end of the cell which joined to the broad black costa. The apex and the termen of the fore wing and the termen of the hind wing on the upper side have black border.

10 Specimens.

Location : East Pakistan :—

Comilla.

Sind ; Karachi Baluchistan : Harnai Baber Kachh

95 **Catopsilia pomana** (Fabricius)

The female Lemon Emigrant is sulphur yellow on the upper side. The costa is black only near the apex of the fore wing which has a cell spot. On the under side of the hind wing there are black spots at the apices of the veins.

Foodplants : *Cassia fistula* (Indian Laburnam) ; *C. siamea* ; *C. tora* ; *Butea frondosa* (Flame of the Forest) ; *Bauhinia racemosa* (*Leguminosae*)

4 Specimens : females.

Location : East Pakistan:—

Dacca.

96 **Catopsilia pyranthe** (Linnaeus)

The Moulted Emigrant is chalky white. On the upper side of the fore wing the apical and terminal black border is continuous and narrowing towards the tornus. In female the cell spot is larger.

Foodplants : *Cassia tora* ; *C, auriculata* ; *C. accidentalis* (*Leguminosae*)

135 Specimens : 80 males ; 55 females.

Location. East Pakistan :—

Dacca ; Rajshahi ; Mymensingh ; Bhairab Bazar.

Sind : Karachi.

97 **Catopsilia florella** (Fabricius)

The male African Emigrant is white on the upper side with brown markings. The apex of the fore wing is very narrow black. In female the brown markings and the cell spots are prominent.

Foodplants : *Cassia tora* ; *C. auriculata* ; *C. accidentalis* (*Leguminosae*)

65 Specimens : 50 males ; 15 females.

Location : East Pakistan :—

Dacca ; Rangpur ; Bhairab Bazar.

Sind : Karachi.

98 **Gonepteryx rhamni** (Linnaeus)

The male Common Brimstone is sulphur yellow aad the female is white. The costa in the fore wing is rounded before the apex which is produced and the termen below the apex is fulcate. The termen of the hind wing is toothed at vein 3. There is a drk orange spot at the end of the cell of each wing.

Foodplants : *Rhamnus dahuricus* (*virgatus*) (*Rhamnaceae*) ; *Vaccinium* (*Vacciniaceae*).

10 specimens : 7 males ; 3 females.

Location : Punjab ; Abbottabad, Nathiagali, Kaghan.

99 **Eurema hecabe** (Linnaeus)

The wet season forms of the Common Grass Yellow is bright yellow on the upper side. The termen of the fore wing on the upper side is broadly black and excavated between vein 2 & 4. The hind wing on the upper side has narrow black terminal border. On the under side there are irregular ring spots, at the end of cell. In the Dry season forms there are rusty markings on the under side. The black border on the upper side of the fore wing is less excavated.

Foodplants : *Cassia tora* ; *C. fistula* (*Indian Laburnum*) ; *Wagatea spicata* ; *Pithecolobium dulce* ; *Sesbania aculeata* ; *Caesalpinia spp.* ; *Albizzia spp.* (*Leguminosae*).

WSF : 269 specimens ; 194 males, 75 females.

DSF : 174 specimens : 102 males, 72 females.

Location : East Pakistan :—

Rangpur, Dacca, Shampur ; Cox's ;Bazar ; Mymensingh.

Sind : Karachi, Tando Adam.

N.W.F.P. : Peshawar.

100. **Colias erate** (Esper)

The Pale Clouded Yellow is lemon yellow on the upper side and the fore wing have black outer and a prominent cell spot. The hind wing on the upper side have black terminal spot.

101 Female form : **pallida** *Staudinger* :—It is white and have ground colour spots on the black outer border of the fore wing.

Foodplants : *Parochetus communis.*

2 specimens : 1 male; I female. Female form *pallida* - 1.

Location : Balushistan : Mastung Road.

Punjab : Hassan Abdal.

102 **Calias electo** (Linnaeus)

The Dark Clouded Yellow, is deep orange yellow with broad unspotted black border. The fore wing has a prominent black cell spot. In female the border has ground colour spot and the hind wing on the upper side is heavily dusted with black scaling.

Foodplants : *Indigofora dosua.*

21 Specimens : 16 males, 5 females.

Location : Punjab : Lahore, Abbottabad.

Sind : Karachi.

N.W.F.P. : Peshawar.

(*Continued*).

Sind : Ka

VARIATIONS IN THE PALLETS OF *TEREDO (KUPHUS) MANNII* WRIGHT COLLECTED FROM KARACHI COAST

By

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INTRODUCTION

Teredines or shipworms are wood borers of the family Teredinidae exhibiting a great many variations in their forms. The shape and dimensions of pallets alone are the key characters helpful in their taxonomic studies. The wide range of variations to which they are mostly subjected creat great confusion. Paul Bartsch (1921) has described *Teredo beachi* as an independant species whereas, R. C. Miller (1922 and 1923) considered this as a variable form of *Teredo navalis* Linn. Similarly F. Roch (1935) pointed out that *Teredo navalis* var *maxima* is not a distinct variety, but it fits into the variability of *Teredo navalis* Linn. Visualizing such intricacies, this paper deals with the variations found in the pallets of *Teredo* (*Kuphus*) *mannii Wright.*

MATERIAL AND METHOD

Very often collections were made from Bhit Island, opposite Karachi Boat Club, Native Jetty, behind Intelligence School Goni, Phitti, Patt, Char, and Dharkan. Besides, specimens were also collected from drifting woods along Keamari coast and Korangi Creek. Some specimens from reserve collection of Marine Biological Reseearch Laboratory were also examined and studied. The varying individuals were sorted out, their pallets removed, for ascertaining their variability. The pallets then examined under binocular and sketched with the help of Camera lucida. In this way 34 specimens were studied and variations in the pallets were traced.

FORM-A TYPICA

The blade or expended portion of the pallet of this species is roughly triangular in shape. The outer surface is convex whereas the inner is almost flat. The outer convex surface is excavated and the inner is flat except at the median portion which is raised and incised to form a median notch. From this a convexity is directed backwardly. It is curved and appears like a cupid's bow. Along the margin of the outer excavated area is a border of dark brown horny substance which is continued alongwith distal margin of the inner surface. The remainder of the surface of blade is chalky white. Stalk is wavy and longer than the blade. Moreover it is over-lapped by the blade.

VARIATIONS :

Variations noted during study can be classified as under :—

(1) Physical or Adventitious Variation.

(2) Individual Variation.

(3) Environmental Variation.

1. *PHYSICAL OR ADVENTITIOUS VARIATIONS* :

This group comprises the following variations :—

(*a*) *Variations in blade and stalk ratio* : Blade and stalk ratio is variable *i.e.*, blade is either equal to stalk or longer than stalk.

(*b*) *Variation in length and bredth ratio of blade* : In many pallets their blades are longer than broad or vice versa.

(*c*) *Variation in appearance of stalk* : Stalk is roughly straight in young borers whereas wavy in older ones. When age advances much, the stalk becomes zigzag.

(*d*) Variation in position of notch and raised *rib or furrow* :—Notch and excavated rib is washed off in some extreme cases of erosion. If present these are irregularly curved.

(*e*) *Variation in symmetry* :—In curved pallets the stalk is inserted at one side of the median line. Such pallets are asymmetrical.

2. *INDIVIDUAL VARIATIONS* :

In this type of variation two pallets of the same individual are different.

ENVIRONMENTAL VARIATION.—

It is the variation of a pallets in different environments.

DISCUSSION

Variation is a common phenomenon in shipworm and is the result of (*i*) age and (*ii*) environment. The first factor when aided by erosion is more effective than the second. The maximal effect of age and erosion may even wash the blade completely. The young borer possesses straight or slightly wavy stalk usually longer than the blade maintaining a non eroded surface and a clear notch. With the growing age the stalk becomes wavy and absolutely zigzag (Fig. 7—9). The blade as a result of continuous erosion loses its notch, leaving a plain surface alone (Fig. 3a, 6b.). The general surface of blade which is smooth in younger borer becomes rough as the age advances and contains longitudinal ridges in the proximal area. A raised excavated rib on the plain surface of young blade shows an irregularity. In pallets of older borers it is generally washed off as a result of erosion leaving a small raised portion which ends in a notch (Fig. 5b). In rar

cases both notch and the rib are washed off. The triangular shape of the blade has irregular outlines on the lateral surfaces, ranging from convex to concave, either in different pallets or even in the same. A straight pallet has generally its lateral surfaces of blade either concave or convex on the contrary in curved pallet, the surfaces will be convex and concave antagonising each other. The greater number of dwarf pallets, studied, contain convex surfaces, whereas the long pallets possess concave surface (Fig. 2a, pallet with both surface concave, Fig. 3c, 4a, pallet with both the surfaces convex; and Fig. ia, b, Fig. 5a, curved pallets with both the convex and concave surfaces). The pallets may be called either concave or convex according to the type of lateral surfaces.

A symmetry in pallets met with is also an obvious variation. It is in fact a secondary modification brought about by the relative nature of burrow. If a young borer, during its early life, faces a node or a burrow in its way, it instantly changes its direction. This results in a curve or bend. As growth proceeds, this portion becomes the curved siphonal end which eventually possesses curved pallets. In such asymmetrical pallets the stalk is inserted at one side of the median line (Fig. 1a, b, Fig. 4b, Fig. 5a). If the burrow is straight near the end (siphonal end), obviously pallets fitted in it will be smooth and straight (Fig. 2a).

The breadth and length ratio of blade is also a secondary modification. The broader pallets are found in borers of soft wood where it expands readily without the least resistance due to its softening nature. In hard wood where the burrow is narrow which possesses longer pallets.

Individual variation causes dissimilarity in the two pallets of a pair (Fig. 10a, b). Difference in individual pallets is sometimes so striking that one gets confusion and suspects them to belong to other borer. "Variation of this sort cannot of course be attributed to factors in the environment which would be expected to operate alike on the two members of each pair ; rather do they represent some unknown factor of the biochemical or other aspect of the organization of the animal which tends to asymmetry" (Miller 1923).

The peculiar variation to a specific locality has not been noticed. A notable change of colour variation in the horny substances is to be seen along the border of excavated surface. When inhabiting the part of wood in mud it is dark brown or black, brownish near the m dline, and bright brown away from the midline. Pallets of two specimens collected from a piece of wood of broken boat near the Marine Biological Research Laboratory at Korangi Creek were bright yellowish brown. Colour variations cannot be studied in preserved specimens.

ACKNOWLEDGEMENT

I am grateful to Mr. M. S. U. Siddiqui, Director, Marine Biological Research Laboratory, Zoological Survey Department, Government of Pakistan, who suggested me this topic and provided me all possible facilities in this connection. My humble thanks are also to Mr. S. M. Syed, Marine Zoologist, Incharge

Marine Biological Research Laboratory, who took keen interest in this work and encouraged me for compiling this paper. I am also thankful to Mr. Nooruddin, Zoologist, Zoological Survey Department, who gave some valuable suggestions. Mr. Khairuzaman, Field Man, was most helpful in assisting me in the field as well as in the Laboratory.

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EXPLANATION OF FIGURES

FIGURE 1. Pallets of *Teredo* (*Kuphus*) *mannii* Wright, from Dharkan Showing asymmetry.

FIGURE 2. Pallets of same species from Dharkan showing a straight pallet (a) and curved median for furrow (b).

FIGURE 3. Pallets of *Teredo* (*Kuphus*) *mannii* Wright, from Native Jetty.

FIGURE 4. Pallets of the same species from opposite Karachi Boat Club.

FIGURE 5. Pallets showing difference between an old and a comparatively young individual, a=3.5 mm. long pallet of shipworm from Native Jetty, b=14 mm. long from opposite Karachi Boat Club.

FIGURE 6. More pallets from opposite Karachi Boat Club.

FIGURE 7. Variable stalks of pallets from Char (a & c) and from opposite Karachi Boat Club (c).

FIGURE 8. Variable stalks of pallets from Native Jettay (a), opposite Karachi Boat Club (b) and Goni (c).

FIGURE 9. Variable stalks of pallets from opposite Karachi Boat Club (a). and Native Jetty (b, c, d).

FIGURE 10. Pallets showing individual variation, a=left pallet and b=right pallet of the same shipworm.

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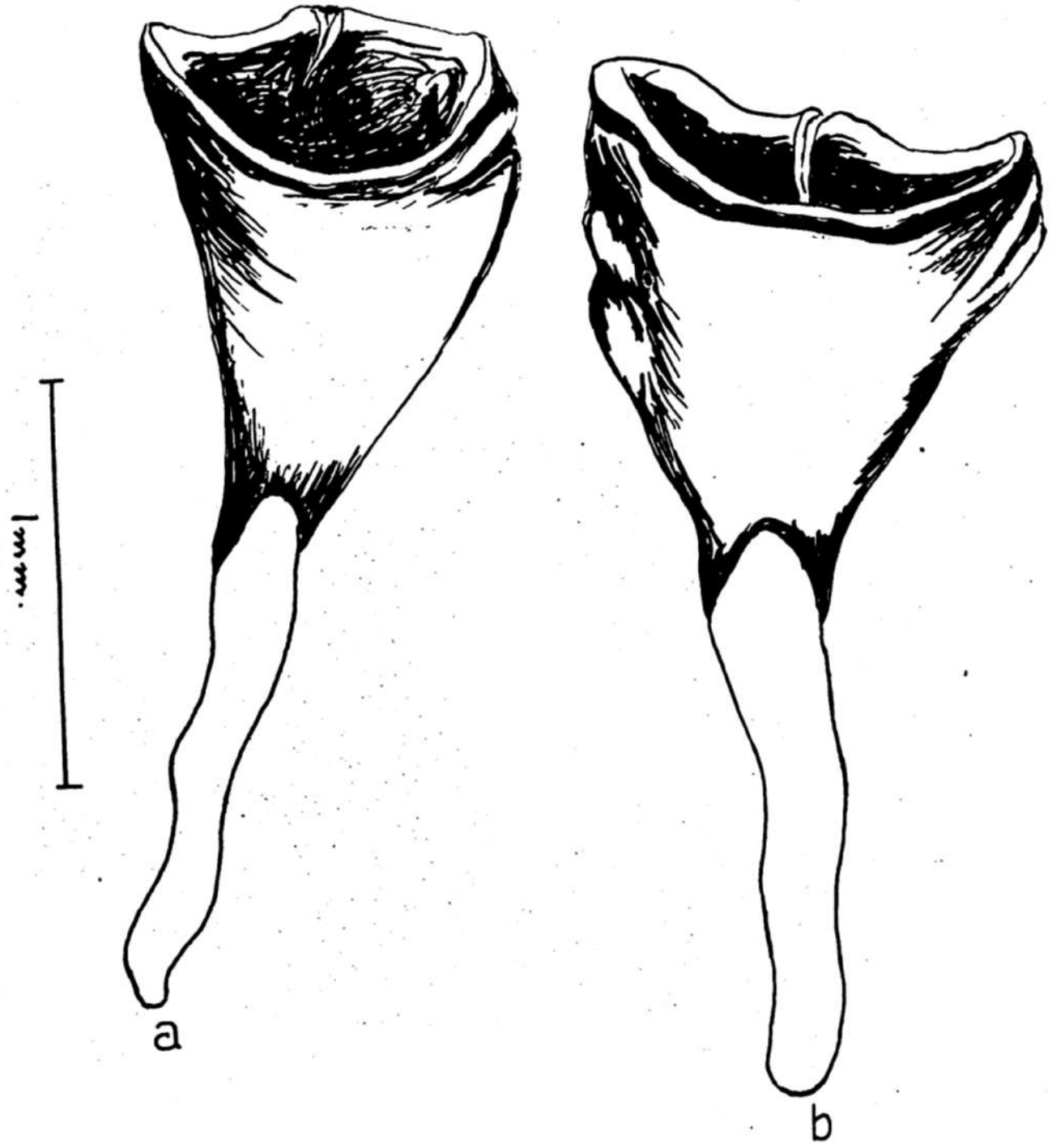
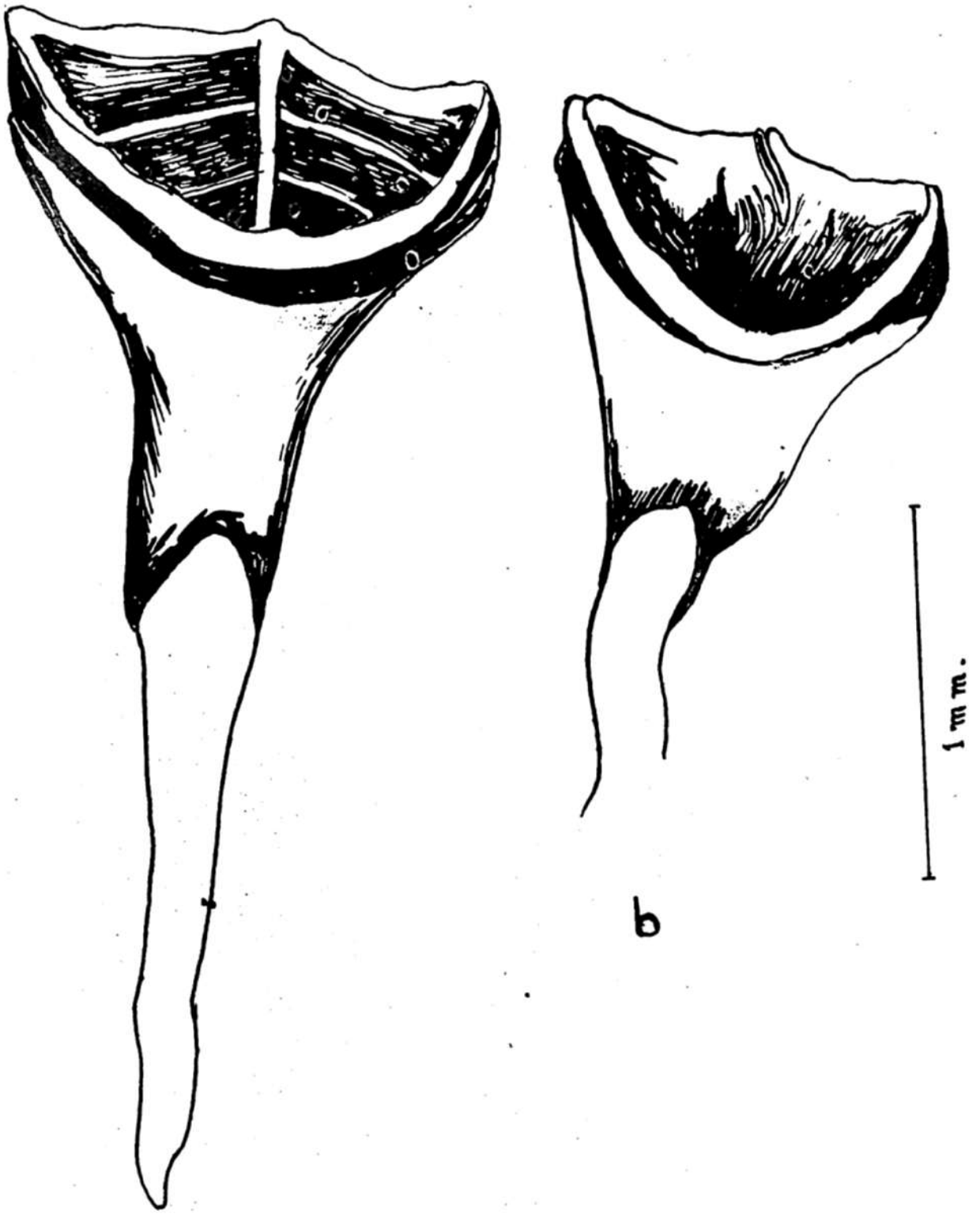


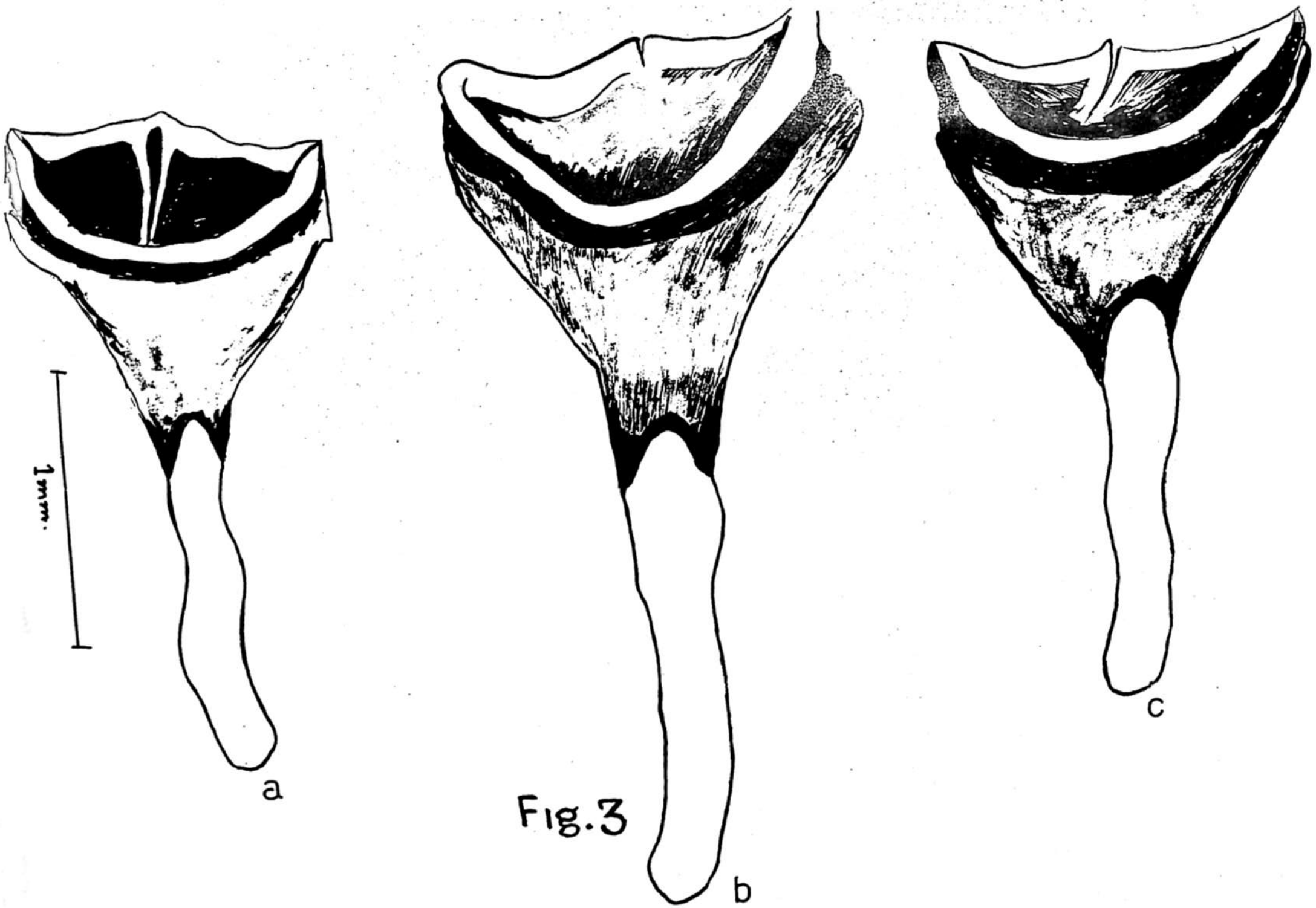
Fig. 1



a

b

Fig. 2.



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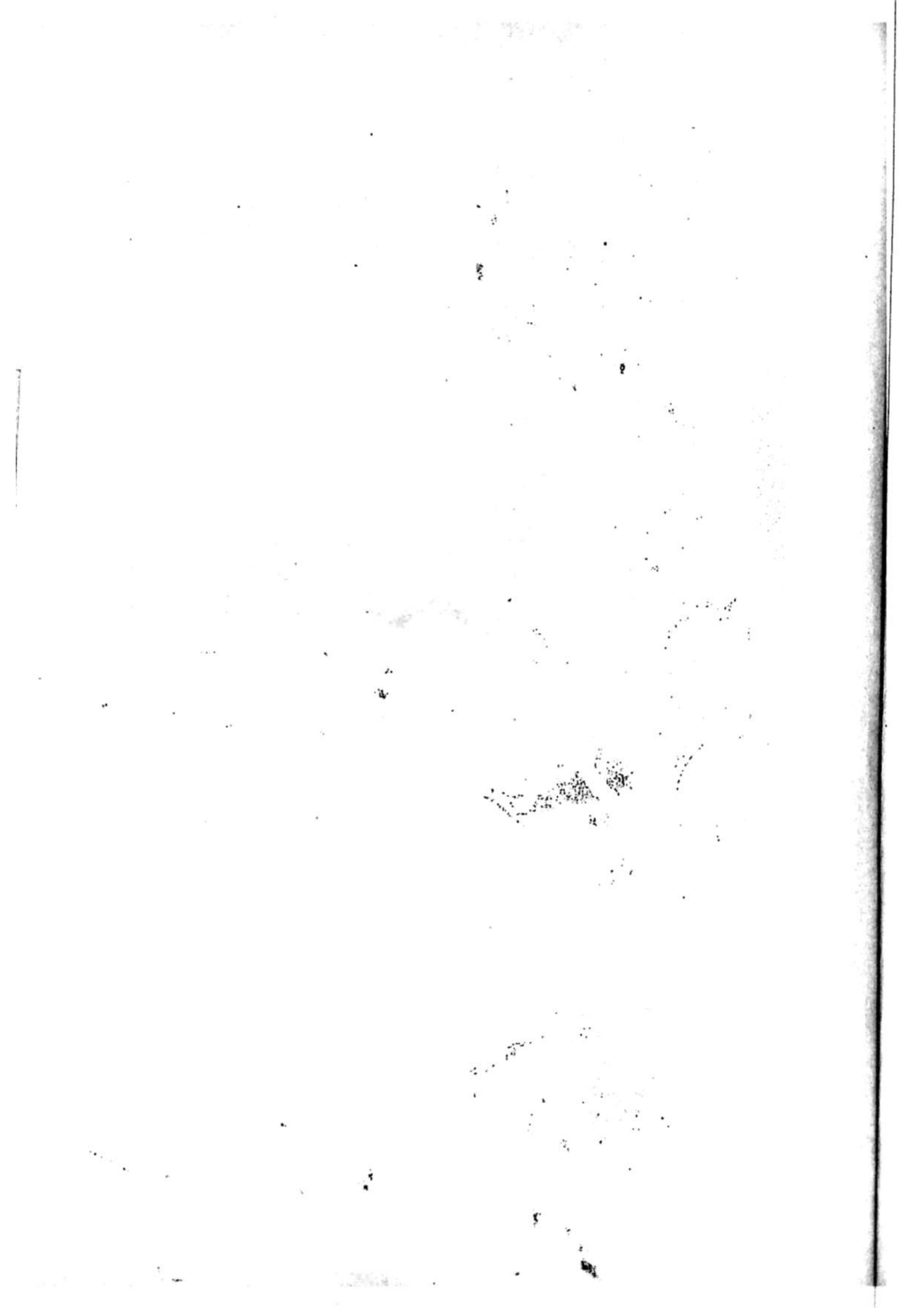


Fig. 4

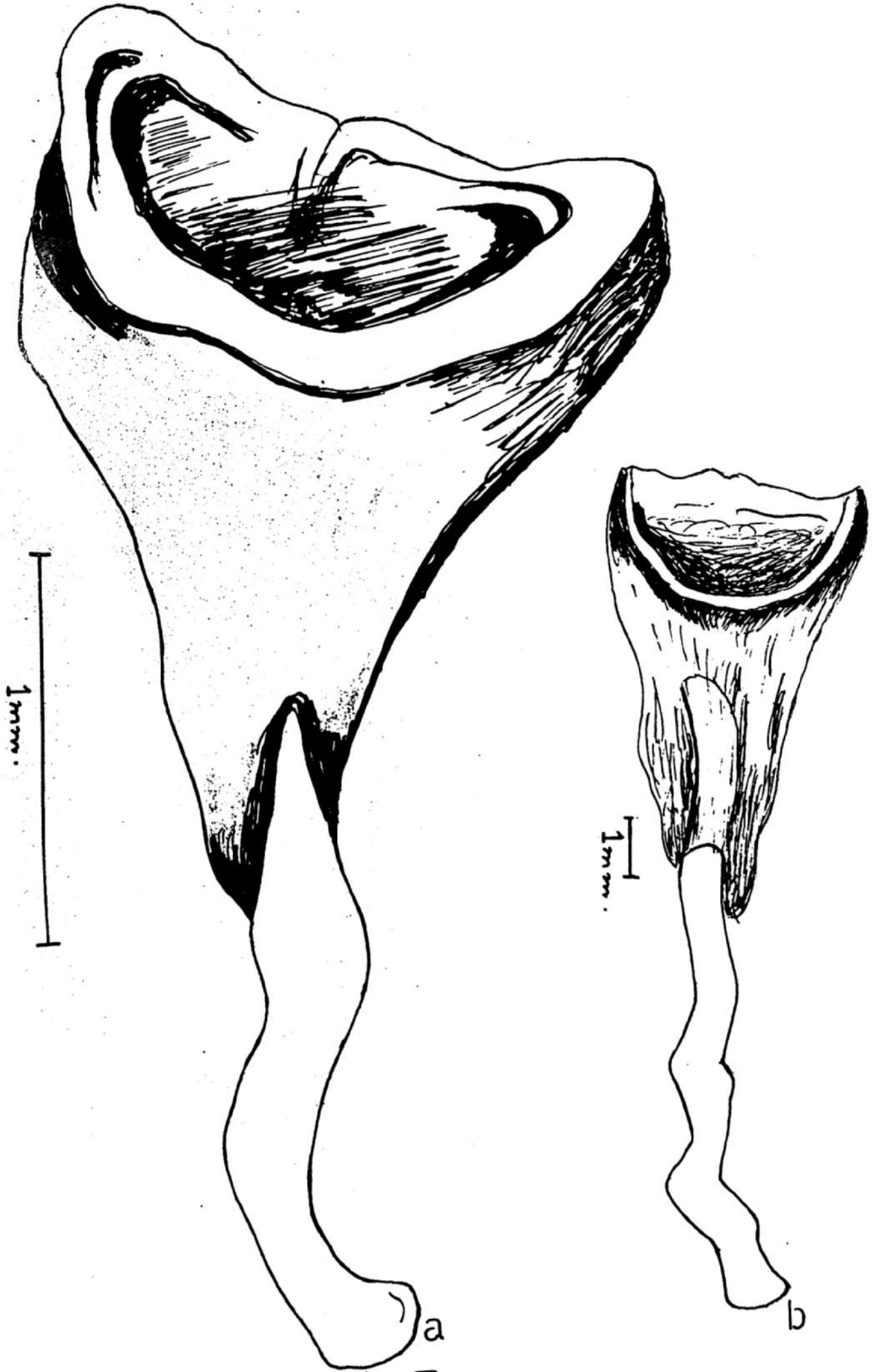
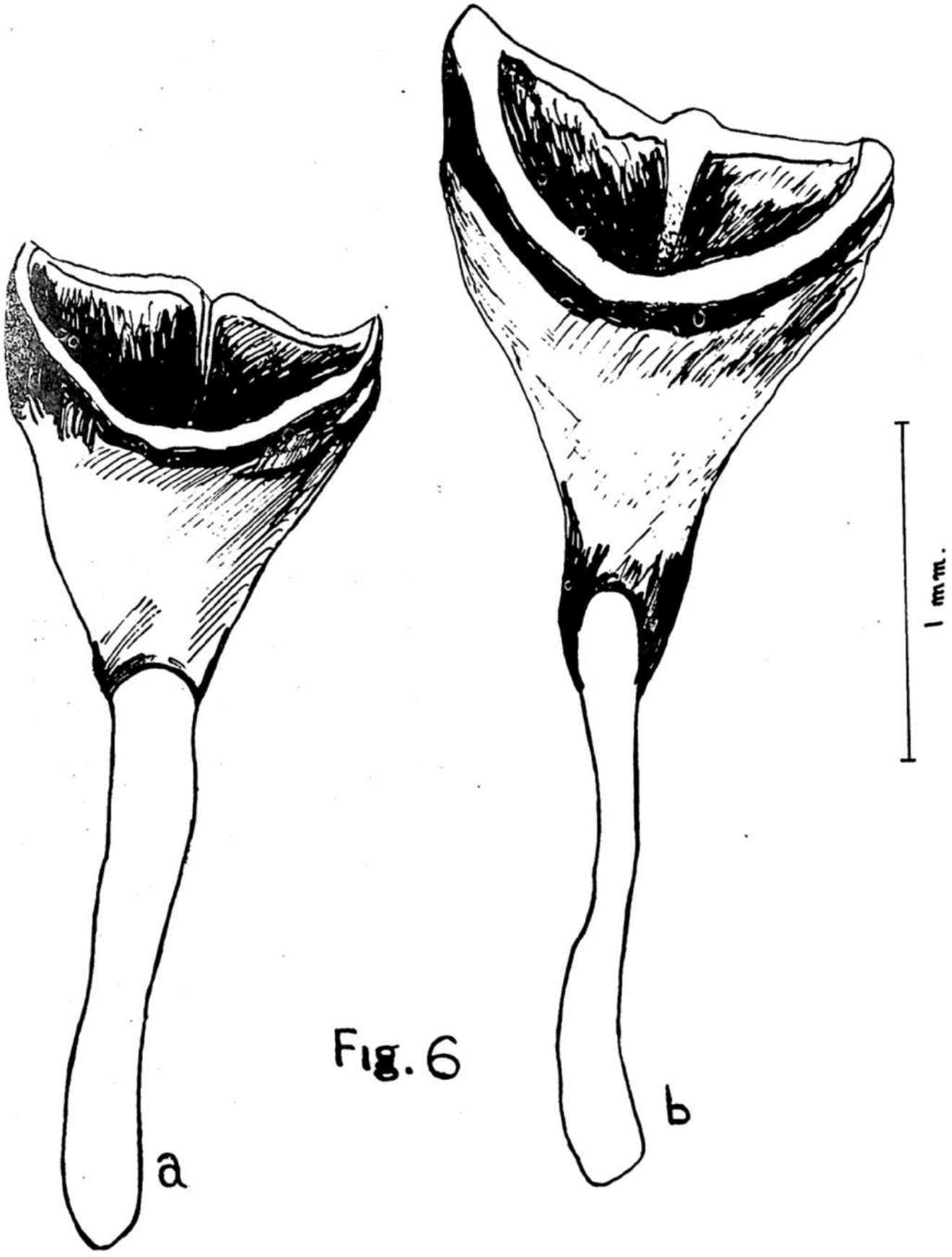


Fig 5



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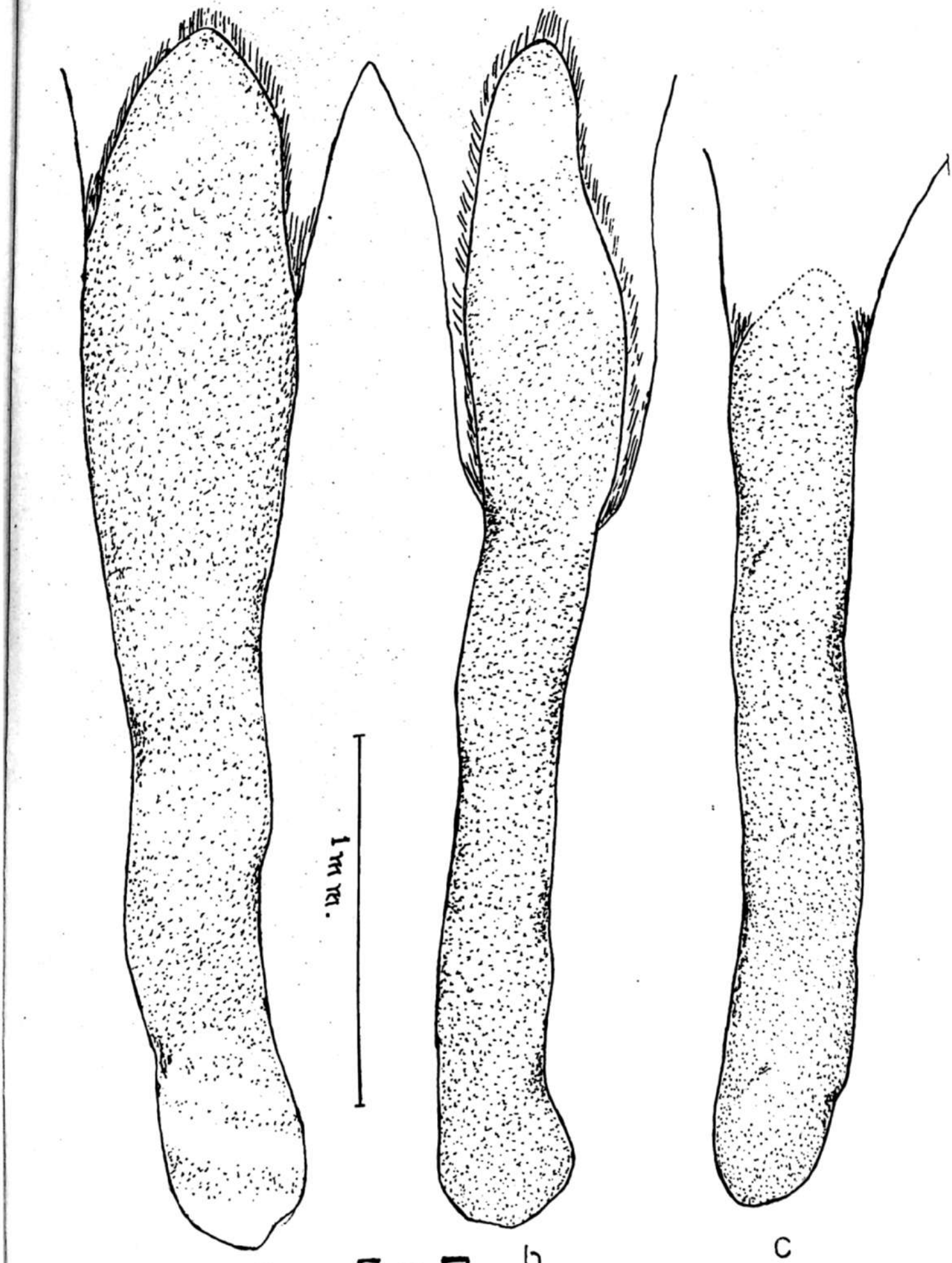

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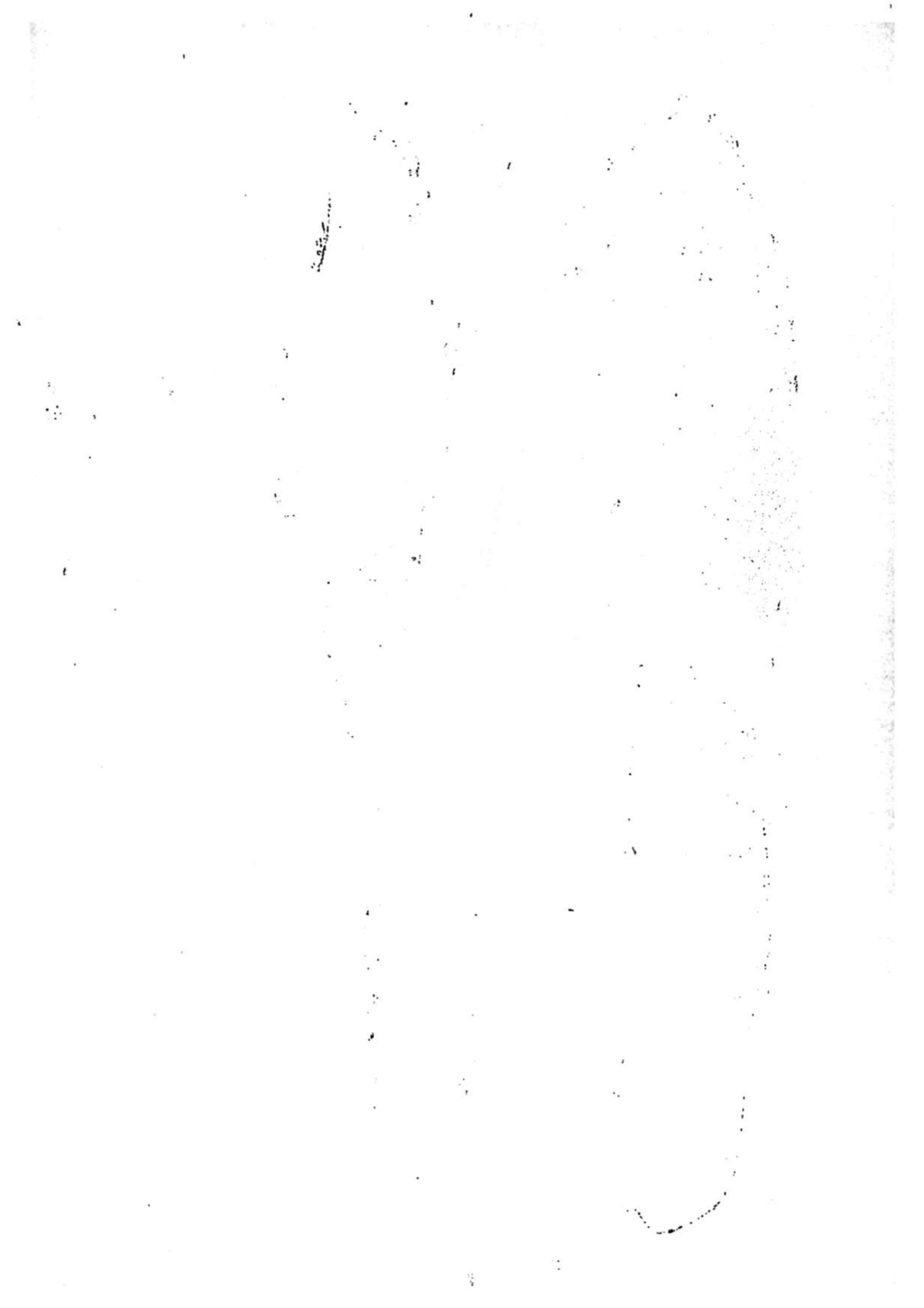

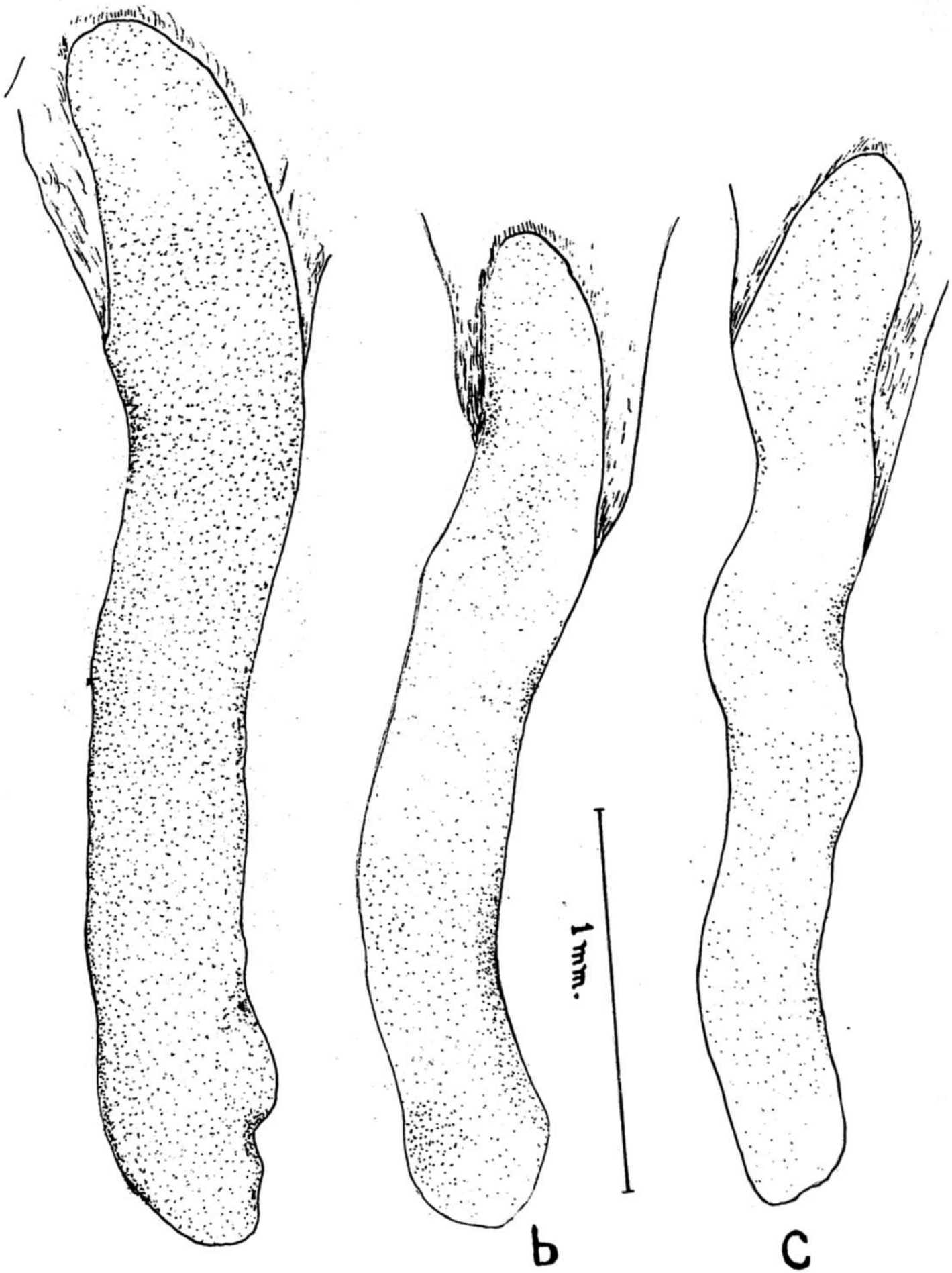

Fig. 8

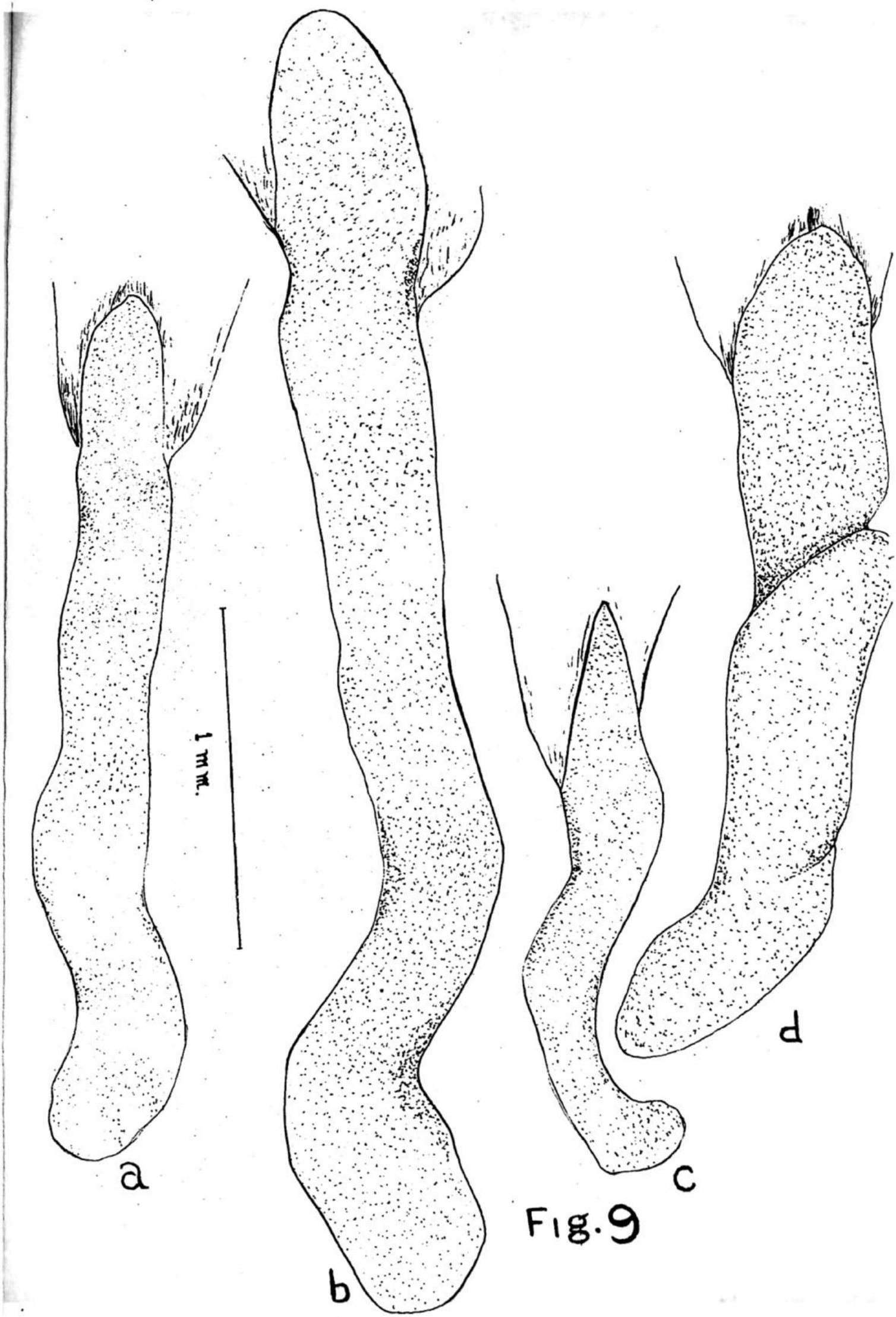

Fig. 9

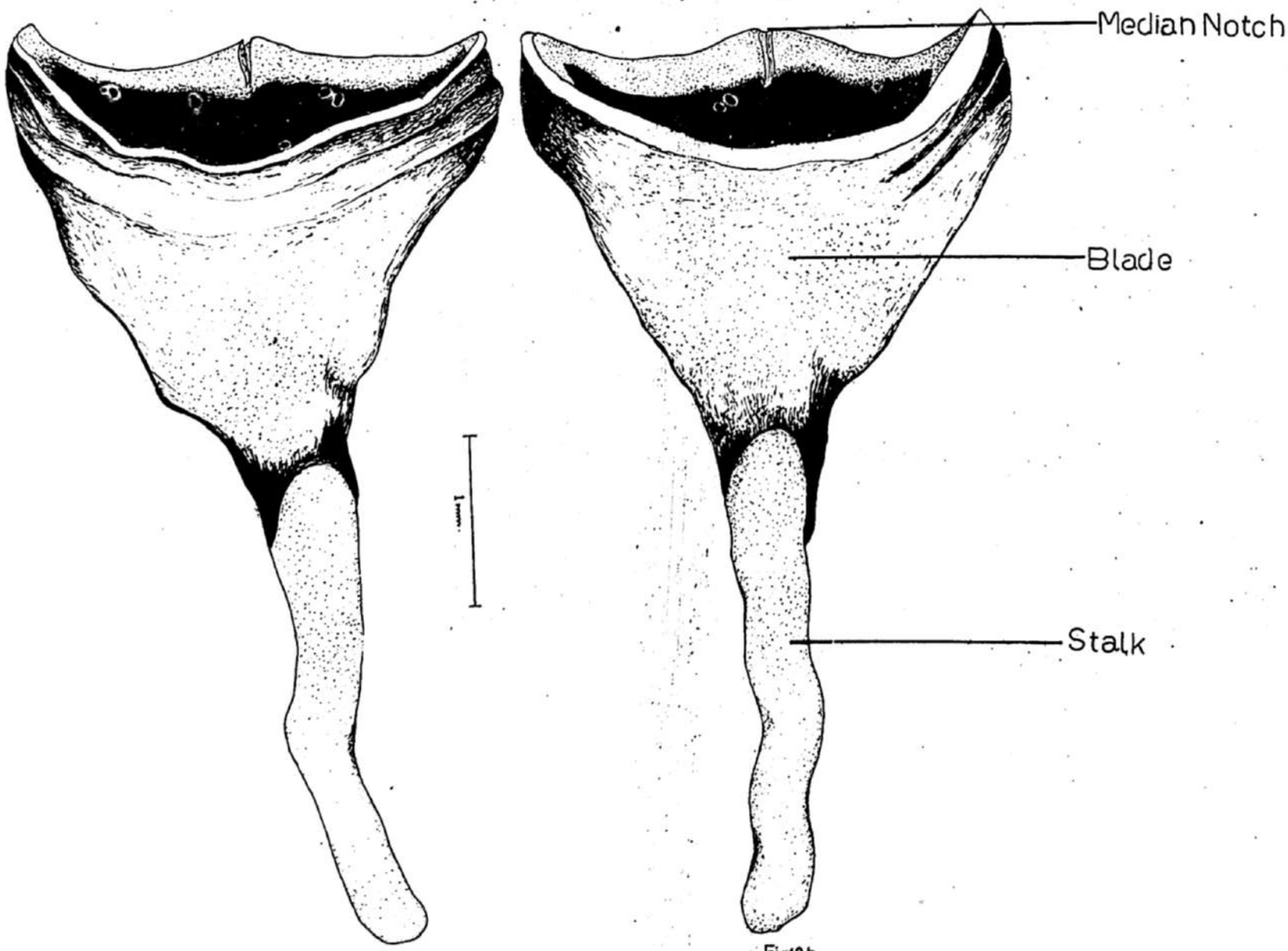

Fig10a

Fig10b