G. McLagl

Part III. of Volume II. will be published on
May 15, 1904.

The Fauna and Geography
of the
Maldive and Laccadive Archipelagoes

Being the Account of the Work carried on and of the Collections made by an Expedition during the years 1899 and 1900

Edited by

J. STANLEY GARDINER, M.A.

Fellow of Gonville and Caius College and late Balfour Student
of the University of Cambridge.

VOLUME II. PART II.

With Plates XXXV—XLVIII and Text-Illustrations 120—126.

CAMBRIDGE:
at the University Press.

LONDON: C. J. CLAY AND SONS,
Cambridge University Press Warehouse,
Ave Maria Lane.

Price Fifteen Shillings net.

The Fauna and Geography
of the
Maldive and Laccadive Archipelagoes

VOLUME II. PART II.

London: C. J. CLAY AND SONS,
CAMBRIDGE UNIVERSITY PRESS WAREHOUSE,
AVE MARIA LANE,
AND
H. K. LEWIS,
136, GOWER STREET, W.C.

Glasgow: 50, WELLINGTON STREET.
Leipzig: F. A. BROCKHAUS.
New York: THE MACMILLAN COMPANY.
Bombay and Calcutta: MACMILLAN AND CO., LTD.

The Fauna and Geography
of the
Maldive and Laccadive Archipelagoes

Being the Account of the Work carried on and of the Collections made by an Expedition during the years 1899 and 1900

Edited by
J. Stanley Gardiner, M.A.
Fellow of Gonville and Caius College and late Balfour Student
of the University of Cambridge.

VOLUME II. PART II.

With Plates XXXV—XLVIII and Text-Illustrations 120—126.

Cambridge:
at the University Press.
1903

CAMBRIDGE:
PRINTED BY J. AND C. F. CLAY,
AT THE UNIVERSITY PRESS.

CONTENTS OF VOL. II. PART II.

Reports.

MARINE MOLLUSCA.

By Edgar A. Smith, I.S.O.

(With Plates XXXV. and XXXVI.)

As the first collection of Marine Mollusca of any importance that has hitherto been obtained at the Maldive Islands, that about to be described is of considerable interest. It consists of about 380 different species and probably comprises a large proportion of the forms which occur in these islands. That many have escaped notice and will eventually be collected by others is quite certain, but it seems probable that most of the larger species are represented in this collection and that it is only among the smaller and obscurer forms that many additional species will hereafter be discovered.

There are, however, certain common and widely distributed species which one would have expected to have been found, notably belonging to the genera *Conus*, *Terebra*, *Sistrum*, *Purpura*, *Nassa*, *Oliva*, *Solarium*, *Trochus* and *Circe*. It is also worthy of remark that certain genera which have representatives in the surrounding seas do not appear to have been met with. Of these I may mention *Fasciolaria*, *Rissoa*, *Patella*, *Eulima*, *Hydatina*, *Aplysia*, *Umbraculum* and *Mytilus*.

As might be expected the fauna is similar to that of other islands in the Indian Ocean, many of the species occurring in Ceylon, Mauritius, Madagascar, the Amirantes, Seychelles, and a great many ranging as far north as the Red Sea and Persian Gulf. Rather more than a seventh of the forms have been recorded from the Andamans, and probably many others occur at these and the neighbouring Nicobar group. It is well known that great numbers of marine molluscs have a very wide range, and therefore it is not surprising that many, in fact about three-fourths, of the Maldive shells are known to occur in the seas surrounding the Philippine Islands and the Malay Archipelago, and still further north about one-fourth of the species have been recorded from the islands of Japan. In the Pacific, from the East coast of Australia to the Loyalty Islands and Polynesia, rather over three-sevenths of the Maldive species have been recorded, many of them ranging all over both the Indian Ocean and the Malay region also. About one-third of the species are known from Ceylon, but doubtless many more occur there, although they may not have been recorded. About 177 species have been found at the Mauritius, the fauna of which has been more extensively worked than that of the Seychelles. With regard to the general distribution of the species about to be recorded, it is curious to observe that a larger proportion of them have previously been noted from the China Sea eastward and in the Pacific, than in the Indian Ocean, including the Red Sea and Persian Gulf.

The following table shows at a glance the distribution of the species as far as the writer has been able to ascertain without a very exhaustive search. The column under Malaysia includes species which occur in the China Sea, the Philippine Islands, Malay Archipelago, N. Australia, New Guinea, and as far east as the Solomon Islands. Under Polynesia are indicated the species which are met with either in E. Australia or at the Loyalty Islands, or at the various groups of islands of Polynesia.

	Mauritius	Madagascar	Amirantes	Seychelles	Red Sea and Gulf of Aden	Persian Gulf	Ceylon	Andaman Is.	Malaysia	E. Australia to Polynesia
Solidula glabra	...	..	...	...	...	...	...	...	+	...
,, *nitidula*	...	...	+	+	...	...	...	...	+	+
,, *solidula*	+	...	+	+	...	...	+	...	+	+
,, *tessellata*	...	...	...	...	+	...	...	...	...	...
Bulla ampulla	+	+	...	+	+	+	+	...	+	+
Alys cylindrica	+	...	...	+	+	...	+	+	+	...
,, *naucum*	...	...	...	+	+	...	+	...	+	+
,, *succisa*	...	...	...	...	+	...	...	...	...	...
Volvatella cincta	...	...	...	...	...	...	+	..	...	...
Oxynoe delicatula	...	...	...	...	...	...	+	...	...	+
Cryptophthalmus minikoiensis, n. sp.	...	...	...	...	...	...	...	...	...	...
Conus arenatus	+	+	+	+	+	...	+	...	+	+
,, *betulinus*	+	+	+	+	+	+	+	...	+	...
,, *catus*	+	...	+	+	+	...	+	...	+	+
,, *ceylanensis*	+	...	...	...	+	...	+	+	+	+
,, *consors*	...	...	..	...	...	...	...	...	+	...
,, *distans*	+	...	...	...	...	...	...	...	+	...
,, *eburneus*	+	+	+	...	...	...	+	+	+	+
,, *ermineus*	...	...	...	...	...	...	+	...	+	...
,, *flavidus*	+	...	+	+	+	+	+	...	+	+
,, *generalis*	+	+	+	+	+	+	+	...	+	+
,, *glans*	+	...	...	...	...	...	+	+	+	+
,, *hebræus*	+	+	+	+	+	...	+	+	+	+
,, *lividus*	+	+	+	+	+	+	+	...	+	+
,, *miles*	+	+	+	+	...	...	+	+	+	+
,, *minimus*	...	...	...	...	+	+	+	+	+	+
,, *nussatella*	+	+	+	+	+	...	+	...	+	+
,, *pennaceus*	+	...	...	...	...	+	+	...	+	...
,, *quercinus*	...	+	...	...	+	+	+	...	+	+
,, *tendineus*	+	...	...	...	...	...	...	..	...	+
,, *tessellatus*	+	+	+	+	+	+	+	...	+	+
,, *textile*	+	+	+	+	+	+	+	+	+	+
,, *tulipa*	+	...	...	+	...	...	+	...	+	+
,, *zonatus*	...	...	...	...	...	...	+	...	...	...
Terebra maculata	+	...	+	+	+	+	+	...	+	+
,, *dimidiata*	+	+	+	+	...	...	+	+	+	+
,, *argus*	+	...	...	...	...	...	...	...	+	+
,, *oculata*	+	...	...	+	...	...	...	...	+	+
,, *subulata*	+	+	+	+	+	...	+	...	+	+
,, *crenulata*	+	+	...	+	+	...	...	...	+	+
,, *cingulifera*	+	...	...	...	...	...	...	...	+	+
,, *babylonia*	+	...	...	...	+	+	+	...	+	+
,, *monile*	...	...	...	+	...	...	..	...	+	+

	Mauritius	Madagascar	Amirantes	Seychelles	Red Sea and Gulf of Aden	Persian Gulf	Ceylon	Andaman Is.	Malaysia	E. Australia to Polynesia
Terebra undulata	...	...	...	...	...	...	...	...	+	+
,, *offinis*	+	...	...	+	+	...	...	+	+	+
,, *columellaris*	...	...	...	...	...	...	...	...	...	+
,, *brugnieri*	...	...	...	+	...	...	...	...	+	...
,, *amœna*	...	...	...	...	...	...	...	+	+	...
,, *violascens*	...	...	...	...	...	...	...	...	+	...
,, *lanceata*	+	...	+	+	...	...	...	...	...	+
,, *celidanota*	...	...	...	...	...	...	...	...	...	...
Pleurotoma armillata	...	...	...	...	...	...	...	...	+	...
,, *bijubata*	...	...	...	...	...	...	...	..	+	...
,, *tigrina*	+	+	...	+	...	+	+	+	+	+
Drillia exasperata	+	...	...	...	...	..	...	...	...	...
Clathurella robillardi	+	...	...	...	...	...	...	...	...	...
Daphnella saturata	...	...	...	...	...	...	...	...	+	...
Oliva erythrostoma	+	+	...	+	+	...	+	...	+	+
Harpa ventricosa	+	+	+	+	+	+	+	...	+	+
,, *minor*	+	...	+	+	+	...	+	...	+	...
Marginella picturata	+	...	...	...	...	...	...	...	...	...
Mitra episcopalis	+	+	+	+	...	...	+	...	+	+
,, *pontificalis*	...	...	+	+	...	...	...	...	+	+
,, *tessellata*	...	...	...	...	...	...	...	...	...	+
,, *adusta*	...	...	...	...	...	...	...	...	+	+
,, *digitalis*	+	...	...	...	...	...	...	...	+	...
,, *crenifera*	+	...	...	...	...	+	...	+	+	...
,, *scabriuscula*	+	...	...	...	.	+	+	...	+	+
,, *variegata*	+	...	...	...	...	...	...	..	+	...
,, *cucumerina*	+	...	+	+	...	...	+	...	+	+
,, *filaris*	+	...	...	...	...	...	...	...	+	+
,, *insculpta*	...	...	...	...	...	...	+	...	...	...
,, *interlirata*	+	...	...	...	...	...	...	...	+	+
,, *literata*	+	...	...	+	+	+	+	+	+	+
,, *acuminata*	+	...	...	...	...	...	...	...	+	+
,, *auriculoides*	+	...	...	...	...	...	...	...	...	...
,, *exasperata*	+	+	...	+	...	...	...	+	+	...
,, *sculptilis*	...	...	...	...	...	...	...	...	+	...
,, *acupicta*	+	...	...	...	...	+	...	+	...	...
,, *armigera*	..	...	...	...	...	...	...	...	...	...
,, *deshayesii*	+	...	...	...	...	...	...	+	...	+
,, *angustissima*, n. sp.	...	...	...	...	...	...	...	...	...	...
Cylindra sinensis	...	...	...	...	...	...	...	...	+	...
Latirus craticulatus	+	...	...	+	+	...	...	...	+	+
,, *fastigium*	...	...	...	...	...	...	+	+	...	...
Peristernia nassatula	+	+	...	+	+	...	...	+	+	+

	Mauritius	Madagascar	Amirantes	Seychelles	Red Sea and Gulf of Aden	Persian Gulf	Ceylon	Andaman Is.	Malaysia	E. Australia to Polynesia
Leucozonia smaragdula	+	+	+	+	...	...	...	...	+	+
Cynodonta cornigera	+	...	...	+	+	..	+	...	+	+
Engina mendicaria	+	+	+	...	+	+	...	...	+	+
,, *bonasia*	+	...	...	+	...	...	+	...	...	...
,, *rawsoni*	...	...	...	...	...	+	...	...	...	...
Phos roseatus	...	...	...	..	+	+	...	+	+	...
,, *textilis*	...	...	...	...	...	...	...	...	+	...
Nassa bifaria	...	...	...	...	...	...	...	+	+	+
,, *marratii*	..	...	...	...	...	...	...	+	+	...
,, *monile*	...	...	...	...	...	...	+	+	+	...
,, *stigmaria*	...	...	...	...	...	+	...	+	+	+
,, *echinata*	...	...	...	...	...	...	...	...	+	+
,, *glans*	...	..	...	...	...	...	+	...	+	+
,, *granifera*	...	...	...	...	...	...	...	...	+	...
,, *maldivensis*, n. sp.	...	...	...	...	...	...	...	...	...	...
,, *mulukuensis*, n. sp.	...	...	...	...	...	...	...	...	...	...
,, *cestilba*	...	...	...	...	...	...	...	...	...	+
,, *subtranslucida*, n. sp.	...	...	..	...	...	...	...	...	..	...
,, *disparilis*, n. sp.	...	...	...	...	...	...	...	...	...	...
Columbella conspersa	...	...	+	...	...	...	...	...	...	...
,, *flava*	...	...	...	...	...	...	+	+	...	...
,, *jaspidea*	...	...	...	...	...	...	...	...	+	...
,, *galaxias*	...	...	...	...	...	...	...	...	...	...
,, *turturina*	+	+	+	+	+	...	...	...	+	+
,, *varians*	...	...	...	...	+	...	...	...	+	+
Murex ternispina	...	...	...	...	+	+	+	..	+	...
,, *haustellum*	+	+	...	..	+	...	+	...	+	...
,, *tripterus*	+	...	...	...	...	...	...	...	+	...
,, *aculeatus*	...	...	...	...	...	...	...	...	+	...
,, *adustus*	+	+	...	...	...	...	+	+	+	+
,, *rubiginosus*	...	...	...	...	...	...	...	...	+	...
,, *ramosus*	+	+	+	+	...	...	+	...	+	+
,, *salmoneus*	...	...	...	...	...	...	...	...	...	...
,, *pleurotomoides*	...	...	...	...	...	...	...	...	...	...
,, *submissus*, n. sp.	...	..	...	...	...	...	...	...	...	...
Purpura armigera	+	...	+	+	...	...	...	...	+	+
,, *bituberculavis*	..	...	...	...	...	...	...	...	+	...
,, *hippocastanum*	+	...	+	+	+	+	+	...	+	+
,, *pica*	+	...	+	+	...	...	...	...	+	...
Iopas situla	...	...	...	...	...	...	...	...	...	+
,, *sertum*	+	...	...	+	+	...	+	+	+	+
Sistrum digitatum	+	+	...	+	...	...	...	...	+	...
,, *horridum*	+	+	+	+	+	...	+	...	+	+

	Mauritius	Madagascar	Amirantes	Seychelles	Red Sea and Gulf of Aden	Persian Gulf	Ceylon	Andaman Is.	Malaysia	E. Australia to Polynesia
Sistrum ricinus	+	+	+	+	+	...	+	+	+	+
,, *tuberculatum*	+	+	+	+	+	...	+	...	+	+
,, *undatum*	+	+	...	+	+	...	...	+	+	+
,, *elatum*	...	...	...	...	+	...	...	...	+	...
,, *spinosum*	...	...	...	...	...	...	...	...	+	...
,, *biconicum*	...	...	...	...	...	...	+	...	+	...
,, *cavernosum*	...	...	...	...	...	...	...	...	+	...
,, *iostoma*	...	...	...	...	...	...	...	..	+	...
,, *squamosum*	...	...	...	...	...	...	...	...	...	+
,, *concatenatum*	+	...	...	...	...	...	+	...	+	...
,, *decussatum*	...	...	...	...	...	...	...	. .	+	...
Coralliophila monodonta	+	...	...	...	+	...	...	...	...	+
,, *neritoidea*	+	+	+	+	...	...	+	...	+	+
,, *suturalis*	...	...	...	...	...	...	...	...	+	...
,, *squamosissima*	...	...	...	...	...	...	...	...	...	...
Leptoconchus ellipticus	+	...	...	...	...	...	...	...	...	...
,, *cumingii*	+	...	...	...	...	...	...	...	...	...
Lotorium chlorostoma	+	...	+	+	+	...	+	...	+	...
,, *gemmatum*	+	...	. .	...	...	...	+	...	+	+
,, *pyrum*	+	...	...	...	...	...	...	...	+	...
,, *tuberosum*	+	+	+	+	+	...	+	...	+	+
Colubraria ceylonensis	...	...	...	...	...	+	+	...	+	...
,, *obscura*	+	...	...	...	...	...	...	...	+	...
,, *bracteata*	...	...	...	...	+	...	...	...	+	+
,, *digitale*	...	...	...	...	...	...	...	...	+	+
Distortrix anus	+	+	...	+	+	...	+	...	+	...
Ranella bufonia	+	...	+	+	+	...	+	...	+	...
,, *granifera*	+	...	...	+	+	...	+	...	+	+
,, *lampas*	+	+	+	+	+	+	+	...	+	...
,, *tuberosissima*	+	...	...	...	...	...	...	...	+	...
,, *thomae*	+	...	...	...	...	...	...	...	...	...
Cassis cornuta	+	...	...	...	...	...	+	...	+	...
,, *rufa*	+	...	+	+	+	...	+	...	+	+
Malea pomum	+	+	...	...	+	...	...	...	+	+
Dolium costatum	+	...	...	...	...	...	...	...	+	...
,, *olearium*	+	+	...	...	+	+	+	...	+	+
Pirula ficoides	+	+	...	...	...	...	+	...	+	...
Cypræa annulus	+	...	+	+	+	+	+	+	+	+
,, *arabica*	+	+	+	+	+	...	+	+	+	+
,, *argus*	+	+	+	+	...	...	+	...	+	+
,, *asellus*	+	+	...	+	+	...	+	+	+	+
,, *caput-serpentis*	+	+	+	+	+	...	+	...	+	+
,, *carneola*	+	+	+	+	+	+	+	+	+	+

	Mauritius	Madagascar	Amirantes	Seychelles	Red Sea and Gulf of Aden	Persian Gulf	Ceylon	Andaman Is.	Malaysia	E. Australia to Polynesia
Cypræa caurica	+	+	+	+	+	+	+	+	+	+
,, *clandestina*	+	...	...	...	...	...	+	...	+	...
,, *cribraria*	+	...	...	...	...	...	+	...	+	+
,, *erosa*	+	+	+	+	+	+	+	+	+	+
,, *felina*	+	...	...	...	+	+	+	...	+	...
,, *gangrenosa*	...	...	...	...	...	...	+	+	+	...
,, *globulus*	+	...	...	...	...	...	+	...	+	+
,, *helvola*	+	+	+	+	+	...	+	+	+	+
,, *hirundo*	+	...	...	...	...	...	+	...	+	+
,, *isabella*	+	+	+	+	+	...	+	+	+	+
,, *lamarckii*	+	...	...	...	...	...	..	...	+	+
,, *lynx*	+	+	+	+	+	...	+	+	+	+
,, *mauritiana*	+	+	...	+	+	+	+	...	+	+
,, *minoridens*	+	...	...	+	...	...	...	...	...	+
,, *moneta*	+	...	+	+	+	+	+	...	+	+
,, *poraria*	+	...	...	...	...	...	+	...	+	+
,, *staphylæa*	+	..	...	+	+	...	+	+	+	+
,, *talpa*	+	+	+	+	+	...	+	...	+	+
,, *tigris*	+	+	+	+	+	...	+	...	+	+
,, *vitellus*	+	+	+	+	+	...	+	+	+	+
,, *walkeri*	...	...	...	...	...	...	...	...	+	+
,, *ziczac*	+	...	...	...	...	+	+	...	+	...
Trivia pellucidula	...	...	...	...	...	...	...	...	+	+
Strombus dentatus	+	...	...	...	+	...	...	...	...	...
,, *floridus*	+	+	...	+	+	...	...	...	+	+
,, *gibberulus*	+	+	+	+	+	+	+	+	+	+
,, *labiosus*	..	...	...	...	...	...	+	...	+	...
,, *lentiginosus*	+	...	...	+	...	...	+	...	+	+
,, *guttatus*	...	...	...	...	...	...	...	...	+	...
,, *lamarckii*	...	...	...	...	...	...	+	...	+	...
Pterocera lambis	+	+	...	...	+	+	+	...	+	+
,, *chiragra*	+	+	+	+	+	...	+	...	+	...
Terebellum terebellum	+	...	...	+	...	+	+	...	+	...
Triforis corrugatus	...	...	...	...	...	...	...	...	+	+
,, *elegans*	...	...	...	...	...	...	...	...	+	...
,, *sculptus*	...	...	...	...	...	...	...	+	+	...
,, *lilaceocinctus*, n. sp.	+	...	...	..	...	...	...	...	...	...
,, *excellens*, n. sp.	...	..	...	...	...	...	...	...	...	...
,, *gracilis*, n. sp.	...	...	...	...	...	...	...	...	...	...
,, *pura*, n. sp.	...	...	...	...	...	...	...	...	...	...
Vertagus articulatus	...	...	...	...	...	...	...	...	+	...
,, *fasciatus*	...	...	+	+	+	+	+	...	+	+
,, *kochi*	+	...	...	...	+	...	...	+	+	...

	Mauritius	Madagascar	Amirantes	Seychelles	Red Sea and Gulf of Aden	Persian Gulf	Ceylon	Andaman Is.	Malaysia	E. Australia to Polynesia
Vertagus obeliscus	+	...	+	+	+	...	+	+	+	+
Cerithium columna	+	...	...	...	+	...	...	...	+	+
,, *echinatum*	+	+	+	+	...	...	...	...	+	...
,, *lacteum*	+	...	...	...	...	...	...	...	+	+
,, *piperitum*	...	...	...	...	...	...	...	...	+	...
,, *salebrosum*	...	...	...	...	...	...	...	...	+	...
,, *tuberculatum*	...	...	...	...	+	...	...	...	+	+
,, *alborvaricosum*	...	...	...	...	...	...	...	...	...	+
Terebralia palustris	...	+	+	+	+	...	+	...	+	...
Modulus tectum	+	+	...	+	+	...	...	...	+	+
Planaxis ineptus	..	...	...	...	...	...	+	...	...	...
Littorina glabrata	+	+	+	+	+	...	...	...	+	...
,, *scabra*	+	+	+	+	...	...	+	+	+	+
,, *undulata*	...	...	...	...	...	...	+	+	+	+
Solarium modestum	...	...	...	...	...	...	...	...	+	+
Philippia cingulum	+	...	...	...	..	...	...	+	+	+
Mitrularia cicatricosa	...	...	...	...	+	...	...	...	+	...
,, *equestris*	+	...	...	...	...	+	...	+	+	...
Hipponyx danieli	...	...	...	...	...	...	...	...	...	+
,, *australis*	...	...	...	...	...	...	+	+	+	+
Thyca crystallina	...	...	...	...	...	...	...	+	...	+
Xenophora indica	...	...	...	...	...	...	...	+	+	...
Vanicoro cancellata	+	...	...	...	...	+	...	...	+	+
Natica robillardi	+	...	...	...	...	...	...	...	...	...
,, *euzona*	...	...	...	...	...	+	...	...	+	...
Polinices mamilla	+	+	+	+	+	+	+	+	+	+
,, *albumen*	...	...	...	...	...	...	+	...	+	...
,, *melanostoma*	+	+	+	+	+	+	+	...	+	+
,, *simiae*	+	...	...	...	+	...	+	+	+	...
Ianthina communis	+	+	+	+	+	...	+	...	+	+
Scala replicata	...	...	...	...	...	+	...	...	...	+
,, *consors*	...	...	...	...	...	...	...	...	...	+
,, *texto*, n. sp.	...	...	...	...	...	...	...	...	...	...
Pyramidella corrugata	+	...	...	...	...	...	...	...	...	...
,, *nodicincta*	...	...	...	...	...	...	...	...	+	...
Obeliscus dolabratus	+	...	...	+	+	...	+	+	+	+
,, *monilis*	...	...	...	...	...	...	...	...	+	...
,, *sulcatus*	+	...	...	+	+	+	...	+	+	+
Nerita albicilla	+	+	+	+	+	+	+	...	+	+
,, *histrio*	...	...	...	...	...	...	...	...	...	+
,, *plicata*	+	+	...	+	+	...	+	...	+	+
,, *polita*	+	+	+	+	+	+	+	...	+	+
Turbo argyrostoma	+	...	+	+	...	...	...	...	+	+

	Mauritius	Madagascar	Amirantes	Seychelles	Red Sea and Gulf of Aden	Persian Gulf	Ceylon	Andaman Is.	Malaysia	E. Australia to Polynesia
Liotia squamicostata, n. sp.	...	...	...	...	...	...	...	...	...	...
Trochus incrassatus	...	...	...	...	...	...	...	+	+	...
,, *maculatus*	...	+	...	...	+	...	...	...	+	+
,, *obesus*	...	...	...	..	...	...	...	...	...	...
,, *radiatus*	...	+	...	..	+	+	+	...	+	...
Thalotia maldivensis, n. sp.	...	...	...	...	...	...	...	...	...	...
Clanculus atropurpureus	...	...	...	...	...	...	...	...	+	+
Perrinia angulifera	...	...	...	...	...	...	...	...	+	...
Forskalia pulcherrima	...	...	...	...	...	...	...	+	+	...
Monilia calyculus	...	...	...	...	...	...	...	+	+	..
,, *simulans*	...	...	...	...	...	...	...	...	+	...
Ethalia rhodomphala, n. sp.	...	...	...	...	...	..	...	...	...	...
Gena auricula	...	...	...	...	...	...	...	...	+	...
Haliotis ovina	...	...	...	...	...	...	...	...	+	+
Glyphis bombayana	...	...	..	...	...	...	...	...	...	...
,, *singaporensis*	...	...	...	...	...	...	...	...	+	...
Emarginula incisura	...	...	...	...	...	...	...	...	...	...
,, *planulata*	...	...	...	...	...	...	...	...	+	...
Chiton miles	...	...	...	...	...	...	...	...	+	...
Schizochiton incisus	...	...	...	...	...	...	...	...	+	...
Callochiton platessa	...	...	...	...	...	...	...	...	...	+
Ischnochiton hululensis, n. sp.	...	...	...	...	...	...	...	...	...	...
,, *feliduensis*, n. sp.	...	...	...	...	...	...	...	...	...	...
,, *maldivensis*, n. sp.	...	...	...	...	...	...	...	...	...	...
Acanthochites laqueatus	...	...	...	...	...	...	+	...	+	...
Cryptoplax burrowi	...	...	...	...	...	...	...	...	...	+
Proncomenia australis	...	...	...	...	...	...	...	...	...	...
Spondylus imperialis	...	...	...	...	...	...	...	...	+	...
Lima fragilis	...	...	...	...	...	...	...	...	+	+
,, *inflata*	...	...	...	...	...	...	...	...	+	...
,, *squamosa*	...	...	...	...	+	...	+	...	+	+
Pecten senatorius	...	...	...	...	+	...	+	...	+	...
,, *lemniscatus*	...	...	...	...	...	...	...	...	...	...
,, *mirificus*	+	...	...	...	...	...	...	...	+	...
,, *noduliferus*	+	...	...	...	...	...	...	...	...	...
,, *irregularis*	+	...	...	...	...	...	...	...	+	...
,, *nux*	...	...	...	...	...	...	...	...	...	+
,, *cooperi*, n. sp.	...	..	...	...	...	...	...	...	...	...
,, *maldivensis*, n. sp.	...	...	...	...	...	...	...	...	...	...
Janira gardineri, n. sp.	...	...	...	...	...	...	...	...	...	...
Pallium plica	...	...	...	...	+	...	+	...	+	...
Amussium pauciliratum, n. sp.	...	...	...	...	...	...	...	...	...	...
Semipecten forbesianus	...	...	...	...	...	...	...	...	+	...

	Mauritius	Madagascar	Amirantes	Seychelles	Red Sea and Gulf of Aden	Persian Gulf	Ceylon	Andaman Is.	Malaysia	E. Australia to Polynesia
Malleus anatinus	...	...	...	...	...	...	...	...	+	...
Vulsella rugosa	...	...	...	...	...	...	...	...	...	...
Electroma ala-corvi	...	...	...	...	+	...	...	...	+	...
,, *zebra*	...	...	...	...	...	...	...	...	...	+
Melina perna	...	...	...	...	...	...	...	...	...	...
Pinna muricata	...	...	...	...	...	...	...	...	...	...
,, *nigra*	...	+	...	...	+	...	...	...	+	+
,, *saccata*	+	...	+	+	+	...	...	...	+	+
,, *serrata*	...	...	...	...	...	...	...	...	...	...
Modiola arborescens	...	...	...	...	...	...	...	...	+	...
,, *auriculata*	+	...	...	+	+	...	...	...	...	+
,, *flavida*	...	...	...	...	...	...	...	...	+	...
Lithodomus cinnamominus	+	...	...	+	+	...	+	...	+	...
,, *gracilis*	...	...	...	...	...	...	...	...	+	...
,, *malaccanus*	...	...	...	...	...	...	...	...	+	...
,, *nasutus*	...	...	...	...	...	...	...	...	...	...
,, *teres*	+	...	+	+	...	...	...	...	+	...
Modiolaria argentea	...	...	...	...	...	...	...	...	...	...
Septifer bilocularis	+	...	+	+	...	...	+	...	+	+
Arca maculata	...	...	...	...	...	...	...	...	+	+
,, *imbricata*	...	...	...	...	+	...	...	...	+	...
,, *clathrata*	...	...	...	...	+	...	...	...	+	...
,, *urypygmelana*	+	+	...	...	+	...	...	...	+	+
,, *antiquata*	...	...	...	...	+	...	...	...	...	+
,, *rhombea*	...	...	...	...	...	...	+	...	+	...
,, *symmetrica*	...	...	...	...	...	...	...	...	+	...
,, *domingensis*	...	...	...	...	+	...	...	...	+	...
,, *lacerata*	+	...	...	...	+	...	...	...	+	...
,, *lima*	...	...	...	...	+	...	...	...	+	...
,, *tenella*	...	...	...	...	...	...	...	...	+	...
Mytilicardia variegata	+	...	+	+	+	+	+	...	+	...
Galeomma formosa	...	..	...	...	...	...	...	...	...	+
Thyreopsis coralliophila	+	...	...	...	...	...	...	...	...	...
Tridacna cumingii	...	...	...	...	...	...	...	...	+	...
Cardium leucostoma	+	...	...	...	+	...	+	...	+	...
,, *nebulosum*	...	...	...	...	...	...	...	...	...	...
,, *maculosum*	...	...	...	...	+	...	+	...	+	...
,, *levisulcatum*, n. sp.	...	...	...	...	...	...	...	...	...	...
,, *sueziense*	...	...	...	...	+	...	...	...	...	...
,, *lobulatum*	...	...	...	...	...	...	...	...	+	...
,, *australe*	+	...	...	...	+	...	+	+	+	...
,, *biradiatum*	...	...	...	...	...	...	+	...	+	...
,, *victor*	+	...	...	...	...	...	...	...	+	...

	Mauritius	Madagascar	Amirantes	Seychelles	Red Sea and Gulf of Aden	Persian Gulf	Ceylon	Andaman Is.	Malaysia	E. Australia to Polynesia
Cardium fornicatum	...	...	...	...	+	...	...	...	+	...
Chama jukesi	...	...	...	...	+	...	...	...	+	...
,, *imbricata*	+	...	...	...	...	...	...	...	...	+
Meiocardia lamarckii	...	...	...	...	...	...	...	...	+	...
Trapezium oblongum	+	...	...	...	...	...	...	...	+	...
Venus reticulata	...	...	...	...	+	...	+	...	+	...
,, *marica*	+	...	...	...	...	...	...	...	+	...
,, *recognita*	...	..	...	...	...	...	...	...	+	...
,, *torcuma*	...	...	...	...	...	...	...	...	...	+
Circe scripta	...	...	...	+	+	...	+	...	+	...
Lioconcha picta	...	...	...	...	+	...	...	...	+	...
,, *sulcatina*	...	...	...	...	...	...	...	...	+	...
Petricola lapicida	+	...	...	...	+	...	...	...	+	...
Psammobia rugulosa	...	...	...	...	...	...	...	...	+	...
,, *pulcherrima*	...	...	...	...	...	...	...	...	+	+
Asaphis deflorata	+	+	...	+	+	...	...	...	+	+
Rocellaria gigantea	...	...	...	...	...	...	...	...	...	...
,, *mytiloides*	+	+	...	...	...	...	...	...	+	...
Paphia trigona	...	...	...	...	...	...	...	...	...	...
,, *glabrata*	...	...	+	+	+	...	...	...	+	...
Lucina divergens	...	...	...	...	+	...	...	...	+	...
,, *punctata*	+	...	+	+	...	...	...	...	+	+
,, *dalliana*	...	...	...	...	...	...	...	...	...	...
Cryptodon globosus	+	...	...	...	+	...	...	...	...	...
Tellina elegans	+	...	...	+	...	...	...	...	...	...
,, *crucigera*	...	...	...	...	+	...	...	...	+	...
,, *rastellum*	...	...	...	+	+	...	...	...	+	...
,, *rhomboides*	+	...	...	...	...	..	...	...	+	...
,, *dispar*	...	...	...	...	...	...	...	...	+	+
,, *robusta*	+	...	...	+	...	...	...	...	+	+
,, *rugosa*	+	...	...	...	+	...	+	...	+	+
,, *scobinata*	...	...	...	...	+	...	...	...	+	+
,, *carnicolor*	...	...	...	...	...	...	...	...	+	+
,, *verrucosa*	...	...	...	...	...	...	...	...	+	...
Semele jukesi	...	...	...	...	...	...	...	...	+	...
Cuspidaria elegans	...	...	...	...	...	...	...	...	+	...

It has been noticed in other groups of animals that the specimens collected at the Maldives have a tendency to be smaller than those found upon the shores of the mainland and Ceylon. This peculiarity also to a certain extent is noticeable among the Mollusca, or, at all events, the representatives of many species are small in comparison with the larger dimensions they often attain.

No attempt has been made to give full synonymy or many references to illustrations, but it has been thought advisable, in each case, to quote a figure or a description, so as to show what species was really referred to. This is necessary in some instances where an author's species has been differently interpreted by his successors, as, for example, in the case of *Strombus auris-dianae* of Linné, where Reeve's and Deshayes' view of this species is quite the reverse of that held by Sowerby.

In the account of the numerous species hereafter mentioned the localities where they were obtained are referred to under numbers only which are explained in the following list of stations.

I.	Addu Atoll,	5—40 fathoms
II.	Suvadiva Atoll,	5—44 ,,
III.	Haddumati Atoll,	3—40 ,,
IV.	Kolumadulu Atoll,	1—40 ,,
V.	S. Nilandu Atoll,	1—36 ,,
VI.	Mulaku Atoll,	1—40 ,,
VII.	Felidu Atoll,	1—35 ,,
VIII.	S. Male Atoll,	1—30 ,,
IX.	Hulule Island,	1—6 ,,
X.	N. Male Atoll,	1—35 ,,
XI.	Goidu Island,	On reef
XII.	Mahlos Atoll,	4—24 ,,
XIII.	Fadifolu Atoll,	2—23 ,,
XIV.	Miladumadulu Atoll,	3—28 ,,
XV.	Minikoi,	On reef and 5—7 fathoms.

[The editor regrets that the dimensions of the whole work on the Fauna of the Maldives and Laccadives have made it necessary to follow the method adopted by many publications in placing the list of literature at the end with reference numbers to the same in heavy black type, and more especially since Mr Smith had most carefully prepared his manuscript with the references in full under each species. He also deeply regrets that the special geographical distribution given, in the manuscript, with each form, and which entailed considerable research into conchological literature, has, for the same reason, had to be omitted. Roman numerals in italics refer to the volume of the work quoted. Ed.]

Family ACTAEONIDAE.

1. **Solidula glabra,** Reeve, var. **37,** *XV.* (*Solidula sulcata,* Pilsbry (nec *Voluta sulcata,* Gmelin), **34,** *XV.*) X, XV.

In my opinion this is not the *Voluta sulcata* of Gmelin, as stated by Martens and Pilsbry. The name *sulcata* practically proves this, and a reference to the grooved figures in the Conchylien-Cabinet upon which the species was founded also shows that it is quite distinct from Reeve's *Tornatella glabra.* Moreover Martini (*Conch. Cab.* vol. II. p. 124) described his shell as being "*tief gefurchet,*" a character not at all applicable to the present species but admirably suiting the well-known *Solidula solidula* (Linn.) with which, in my opinion, the *V. sulcata* is synonymous.

The specimens from the above stations are small and slender.

2. **Solidula nitidula,** Lamk. **34,** *XV.* IX, XV.

3. **Solidula solidula,** Linn., var. **34,** *XV.* VIII.

A single specimen, pure white, with only a few grey dots upon the ridges near the outer lip.

4. **Solidula tessellata,** Reeve, **34,** *XV.* IX.

Family BULLIDAE.

5. **Bulla ampulla,** Linn. **34,** *XV.* II, IX, XI.

Family AKERIDAE.

6. **Volvatella cincta,** Nevill, **34,** *XV.* XV.

Family SCAPHANDRIDAE.

7. **Atys cylindrica,** Helbling, **34,** *XV.* II.

8. **Atys naucum,** Linn., **34,** *XV.* II, III, V, IX.

9. **Atys succisa,** Ehrenberg, **40,** *a, XVII.,* **1,** *c.* XV.

It is uncertain whether the shells figured by Adams and Sowerby truly represent Ehrenberg's species, but it is equally certain that they do not belong to *A. cylindrica* as stated by Pilsbry. The latter has made a curious mistake in connection with *A. succisa* (*Man. Conch.* vol. xv. p. 267). He states, "There is the trace of a median gibbosity," whereas Ehrenberg distinctly says it is absent, "gibberis vestigium in zona media deest."

Family OXYNOEIDAE.

10. **Oxynoe delicatula,** Nevill, **34,** *XV.* XV.

Family PHILINIDAE.

11. **Cryptophthalmus minikoiensis,** n. sp. (Pl. XXXV. figs. 1, 2). XV.

Animal corpore oblongo, angusto; discus capitalis parte corporis reliqua brevior, bipartitus, parte anteriori scutiformi, antice bimarginata, truncata, postice angustata, bilobata, parte posteriori postice truncata, ad latera carinata et lamellata; pes infra orem leviter sinuatus, ad angulos rotundatus, extensionibus lateralibus semicircularibus, sed in exemplo singulo supra tergum reflexis; testa minima, ad extremitatem corporis posticam posita, cute tenuissima tecta, tenuis, semipellucida, supra convexa, semiconvoluta, postice acuminata, striis incrementi tenuibus sculpta; branchiae plumiformes, multilamellatae, sensim versus extremitatem attenuatae, infra testam sitae. Longit. tota 17 millim. Discus capitalis 7 longus, 4 latus. Diam. lobis pedis expansis 12 millim. Testa 4 longa, $2\frac{1}{3}$ lata.

Closely allied to *C. smaragdinus*, Leuckart, and differing only in the form of the shell. This is exactly the same as that erroneously figured by H. and A. Adams in the *Genera of Recent Mollusca*, vol. III. Pl. LVIII, figs. 3 *a*, 3 *b*, as *Chelidonura hirundinina* of Quoy and Gaimard. A comparison of these figures with those of Leuckart[1] and Ehrenberg[2] at once shows the considerable difference in form.

The shell of *Crypt. luteus*, Quoy and Gaimard, is more like that of the present species, but the short folds on each side of the head-shield do not appear to be present in that species, at all events they are not referred to by the authors. The most remarkable character in this species consists in the structure of the cephalic disc. It is, as it were, in two parts, the one superimposed upon the other. The anterior portion is shield-shaped, being broad, truncate, and double-edged in front, and narrowed behind. The converging sides are not, however, united posteriorly, but form very small lobes, attached to the hinder portion of the disc. The latter is squarely truncate behind, keeled at the sides, and exhibits beneath the carinate margins about fifteen short oblique lamellae. This is a very striking feature, and occurring in *C. smaragdinus*, makes one doubtful whether the present species, although the shell is very different, is really specifically distinct.

Family CONIDAE.

12. **Conus arenatus,** Hwass. **37,** *I.* VIII, IX, XI, XII, XIV, XV.

13. **Conus betulinus,** Linn. **37,** *I.* (*C. medusa*, Gmelin, **16**) IX, XI.

14. **Conus catus,** Hwass. **37,** *I.* (var. = *C. discrepans*? Sowerby, **40,** *a*, var. = *C. adansoni*, Reeve (now Lamk.), **37,** *I.*, var. = *C. nigropunctatus*, Sowerby, **40,** *b*, *III.*) IX, XV.

15. **Conus ceylonensis,** Hwass. **37,** *I.* (var. = *C. pusillus*, Chemnitz, **37,** *I.*, var. = *C. nanus*, Broderip, **37,** *I.*) IX.

16. **Conus distans,** Hwass. **37,** *I.* (*C. mennonitarum coronatus*, Chemnitz, **9**) IX.

17. **Conus eburneus,** Hwass. **37,** *I.* IX, XII, XV.

18. **Conus ermineus,** Born. **40,** *b*, *III.* (*C. lithoglyphus*, Meuschen, **37,** *I.* *C. orleanus*, Bolten, **30,** var. = *C. lacinulatus*, Kiener, **23,** var. = *C. carpenteri*, Crosse, **11,** *a*) IX.

19. **Conus flavidus,** Lamarck. **37,** *I.* (*C. maltzanianus*, Weinkauff, **43,** var. *granulata* = *C. frigidus*, Reeve, **37,** *I.*, var. = *C. neglectus*, Pease, **31,** *b*) XV.

20. **Conus generalis,** Linn. **37,** *I.* (var. = *C. maldivus*, Hwass. **37,** *I.*, var. = *C. monile*, Hwass. **37,** *I.*, var. = *C. bayani*, Jousseaume, **22,** jun. = *C. spirogloxus*, Deshayes, **40,** *b*, *XII.*) XIV.

21. **Conus glans,** Hwass. **37,** *I.* (var. = *C. tenuistriatus*, Sowerby, **40,** *b*, *III.*, var. = *C. fabula*, Sowerby, **37,** *I.*, var. = *C. scabriusculus*, Chemnitz, **9**) IX.

22. **Conus hebraeus,** Linn. **37,** *I.* (var. = *C. vermiculatus*, Lamarck; var. = *C. chaldaeus*, Bolten, **30**) IX.

---

[1] See Pilsbry, *Man. Conch.* vol. XVI. Pl. VI. figs. 33–34.

[2] See Pilsbry, *l.c.* fig. 32.

23. **Conus lividus,** Hwass. **37,** *I.* (var. = *C. citrinus*, Gmelin, **40,** *b*, *III.*, var. = *C. sanguinolentus*, Quoy and Gaimard, **35,** var. = *C. maurus*, Gray? **18,** *b*) IX, XI.

24. **Conus miles,** Linn. **37,** *I.* IX.

25. **Conus minimus,** Linn. **37,** *I.* (*Conus coronatus*, Dillwyn (non Gmelin), **43.** *C. barbadensis*, Hwass. **40,** *b*, *III.* *C. aristophanes* (Duclos?), **40,** *b*, *III.*) I, XV.

26. **Conus nussatella,** Linn. **37,** *I.* (*C. terebra*, Chemnitz (nec Born), **9**). IX.

27. **Conus pennaceus,** Born, **37,** *I.* IX, XI.

C. praelatus, Hwass, *C. rubiginosus*, Hwass, *C. episcopus*, Hwass, *C. omaria*, Hwass, *C. magnificus*, Reeve, *C. elisae*, Kiener, *C. racemosus*, Sowerby, and *C. madagascariensis*, Sowerby, may be regarded as varieties of this species.

28. **Conus quercinus,** Linn. **37,** *I.* (*C. buxeus*, Link, **30.** *C. ponderosus*, Beck, **6**). II.

29. **Conus consors,** var. **40,** *b*, *III.* (var. = *C. innexus*, A. Adams, **I.** *b*) I.

With this species, besides *C. innexus*, I also associate, as varieties, *C. anceps*, A. Adams and *C. daullei*, Crosse.

The single specimen from Addu atoll differs from the typical form of the variety *innexus* in being almost entirely white, and of a slightly more slender form. It is clothed with a thinnish greyish periostracum and the upper whorls of the spire are finely coronated and of a lilac tint.

30. **Conus tendineus,** Hwass. **40,** *I.* IX.

31. **Conus tessellatus,** Born. **37,** *I.* IV, V, IX, XIV.

32. **Conus textile,** Linn. **37,** *I.* IX.

The variation in this species is most remarkable, and although we can recognise typical examples of the many named forms, personally I have not been able to accept as distinct *species* the following:—*C. vicarius*, Lamarck, *C. verriculum*, Reeve, *C. textilina*, Kiener, *C. tigrinus*, Sowerby, *C. corbula*, Sowerby, *C. scriptus*, Sowerby, *C. panniculus*, Lamarck, *C. canonicus*, Hwass, *C. rubescens*, Bonnet, *C. legatus*, Lamarck, *C. paulucciae*, Sowerby, *C. archiepiscopus*, Hwass, and *C. abbas*, Hwass.

33. **Conus tulipa,** Linn. **37,** *I.* (var. = *C. obscurus*, Humphreys, **37,** *I*, jun. = *C. borbonicus*, Adams, **2, 42**). IX, XI, XV.

34. **Conus zonatus,** Hwass. **37,** *I.* IX.

Family TEREBRIDAE.

35. **Terebra maculata,** Linn. **37,** *XII.* IX, XI, XV.

36. **Terebra argus,** Hinds, **37,** *XII.* (*Terebra nebulosa*, Kiener, **23**). IX.

37. **Terebra dimidiata,** Linn. **37,** *XII.* IX.

38. **Terebra oculata,** Lamarck, **37,** *XII.* IX.

39. **Terebra subulata,** Linn. **37,** *XII.* XI.

40. **Terebra crenulata,** Linn. **37,** *XII.* XV.

Buccinum varicosum, Gmelin, *B. luteolum*, Martyn, are synonyms and *T. fimbriata*, Deshayes, and *T. interlineata*, Deshayes, I regard as varieties of this species.

41. **Terebra cingulifera,** Lamarck, **37,** *XII.* (*Buccinum succinctum*, Gmelin, **16.** *T. punctulata*, Sowerby, **40,** *c.* *T. punctatostriata*, Gray, **18,** *a.* *T. pallida*, Deshayes, **12,** *b.* *T. chinensis*, Deshayes, **12,** *d*). IX, X, XII.

42. **Terebra babylonia,** Lamarck, **37,** *XII.* XIV.

43. **Terebra monile,** Quoy and Gaimard, **37,** *XII.* II.

44. **Terebra (Myurella) undulata,** Gray, var. **37,** *XII.* (*T. approximata*, Deshayes, **12,** *d*). II, XIV.

45. **Terebra (Myurella) affinis,** Gray, **37,** *XII.* (*T. striata*, Quoy and Gaimard, **34**). IX, X, XII, XIII, XV.

46. **Terebra (Myurella) columellaris,** Hinds, **37,** *XII.* VIII, X, XII.

47. **Terebra (Myurella) bruguieri,** Deshayes, **37,** *XII.* (*T. hindsii*, Deshayes, **12,** *b*). II.

48. **Terebra (Myurella) amoena,** Deshayes, **37,** *XII.* (*T. andamanica*, Melvill and Sykes, **39**). VII.

A comparison of the types of the above-named species shows that they are merely different stages of growth of one and the same form.

49. **Terebra (Myurella) violascens,** Hinds, var. **20,** *b*, **37,** *XII.* II, IV, VI.

The specimens from the above stations are not typical and vary *inter se.* None are of a violet tint, but whitish or yellowish. The shell described by Reeve had the whorls undivided by a groove or punctured depression, whereas Hinds described the type with whorls "supernè lineâ impressâ obsoletè cinctis." The Maldive specimens agree with the type in this respect. *Terebra exigua*, Deshayes, and *T. polygyrata*, Deshayes, are probably only slight varieties.

50. **Terebra (Hastula) lanceata,** Linn. **37,** *XII.* (var. *penicillata*, Hinds, **37,** *XII*, var. *venosa*, Hinds, **37,** *XII.*). XV.

The specimen from Minikoi (station XV.) belongs to the variety *penicillata.*

51. **Terebra celidonota,** Melvill and Sykes, **29.** XIV.

Family PLEUROTOMIDAE.

52. **Pleurotoma armillata,** Reeve, **37,** *I.* VI.

53. **Pleurotoma bijubata,** Reeve, **37,** *I.* VIII.

54. **Pleurotoma tigrina,** Lamarck, **37,** *I.* VI, IX, XIV.

55. **Drillia (Clavus) exasperata,** Reeve (*Pleurotoma exasperata*, Reeve, **37,** *I.*). II.

56. **Clathurella robillardi,** Adams, **41,** *VI.* XIV.

57. **Daphnella saturata,** Reeve, **37,** *I.* II, VI.

Family OLIVIDAE.

58. **Oliva erythrostoma,** Lamarck (var. *ponderosa*, Reeve, **37,** *VI.*). IV, VI, IX, XI.

Apparently browsing on a black crinoid (Gardiner).

Family HARPIDAE.

59. **Harpa ventricosa,** Linn. **37,** *I.* IX.

60. **Harpa minor,** Lamarck, **37,** *I.* IX.

A specimen captured by Mr Gardiner at station I. has the hinder portion of the foot detached. Judging from the large size of the separated portion, the animal apparently divested itself of it, being unable to withdraw this bulky appendage within the shell. Or, may it not be cast off as a peace offering to any fish or other predatory creature who attacks the helpless Mollusc?

Family MARGINELLIDAE.

61. **Marginella picturata,** Nevill, var. Pl. XXXV. figs. 3, 4 (*M. picturata,* Weinkauff, **43**). X.

The two specimens which I believe to be a variety of this species differ from the type in having the outer lip strongly denticulate within, in one example the denticles numbering thirteen, in the other only nine. Both are of a fleshy tint, with two white narrow zones with reddish-brown spots upon the penultimate whorl, and three upon the last, one at the suture, one at the shoulder, and one towards the base, all terminating upon the thickened labrum in a red spot. Between the second and third zones there are three or four transverse lines of pinkish red colour and the extreme tip of the spire is also reddish. The brown spots upon the narrow white zones are small and might be described as cross lines rather than spots.

Family MITRIDAE.

62. **Mitra episcopalis,** Linn. **40,** *b, IV.* XI.

63. **Mitra pontificalis,** Lamarck, **40,** *b, IV.* IX.

64. **Mitra tessellata,** Martyn, **40,** *b, IV.* IX.

65. **Mitra adusta,** Lamarck, var. **40,** *b, IV.* IX.

One specimen of a uniform rich brown colour and without any crenulations beneath the sutures.

66. **Mitra digitalis** (Chemnitz), Dillwyn, **40,** *b, IV.* IX.

67. **Mitra (Scabricola) crenifera,** Lamarck, **40,** *b, IV.* IV.

68. **Mitra (Scabricola) scabriuscula,** Linn. **40,** *b, IV.* XI.

69. **Mitra (Scabricola) variegata,** Reeve, **40,** *b, IV.* II.

70. **Mitra (Chrysame) cucumerina,** Lamarck, **40,** *b, IV.* IX, XIII, XV.

71. **Mitra (Cancilla) filaris,** Linn. **41,** *IV.* (*M. filosa,* Born, **40,** *b, IV.*) XI.

72. **Mitra (Cancilla) insculpta,** A. Adams, var. **40,** *b, IV.* V, VI.

73. **Mitra (Cancilla) interlirata,** Reeve, **40,** *b, IV.* II.

74. **Mitra (Strigatella) literata,** Lamarck, **40,** *b, IV.* IX, XI, XV.

75. **Mitra (Strigatella) acuminata,** Swainson, **40,** *b, IV.* I, IX, XI.

76. **Mitra (Strigatella) auriculoides,** Reeve, var. **40,** *b, IV.* IX.

The two specimens obtained by Mr Gardiner differ considerably from all the figures given of this species. They are much more slender, and the upper part of the shell above the white zone is white, blotched with dark chestnut. The lower part of the body-whorl is minutely white-dotted. Intermediate forms connecting this with the type occur in the British Museum collection. Length, 17 mm., diam. 7 mm.

77. **Mitra** (**Costellaria**) **exasperata,** Gmelin, **40,** *b*, *IV.* (var. = *M. arenosa*, Lamarck, **40,** *b*, *IV.*) VII, VIII, IX, X, XII, XIV, XV.

The two specimens from station XIV. are variations of the form *arenosa*, differing from normal examples in being almost entirely white, with only one or two faint zones below the middle of the body-whorl.

78. **Mitra** (**Costellaria**) **sculptilis,** Reeve, **37,** *II.* II, V, X.

79. **Mitra** (**Costellaria**) **acupicta,** Reeve, **40,** *b*, *IV.* V.

80. **Mitra** (**Costellaria**) **armigera,** Reeve, var. **37,** *II.* IX.

A single specimen only of this species was obtained. It differs from the type in being whiter, with a thread-like brown line round the middle of the upper whorls and three on the last. The locality of the type is unknown. *M. turrigera*, Reeve, is closely allied, but more sculptured between the costae.

81. **Mitra** (**Costellaria**) **deshayesii,** Reeve, **40,** *b*, *IV.* X.

82. **Mitra** (**Costellaria**) **angustissima,** n. sp. (Pl. XXXV. fig. 5). V.

Testa gracillima, elongato-fusiformis, pallide fuscescens, ad partem anfractuum superiorem albida, fusco maculata, et circa medium anfr. ultimi maculis subquadratis notata; anfractus circiter 10, superiores subgradati, fere plani, caeteri leviter convexiusculi, costis numerosis (circiter 28) gracilibus instructi, et sulcis spiralibus inter costas punctatis (in anfr. penult. 7, in ultimo 12—13) sculpti, ultimus antice circa caudam sulcis obliquis fortioribus haud punctatis ornatus; apertura parva, angusta; longit. totius $\frac{1}{3}$ paulo superans; columella plicis quinque obliquis instructa, callo tenui induta; labrum tenue. Longit. $12\frac{1}{2}$ mm., diam. 4. Apertura 5 longa, $1\frac{1}{3}$ lata.

Remarkable for its very slender form and the punctate striae between the costellae. The folds on the columella correspond to the oblique ridges between the sulci on the cauda of the body-whorl. These ridges are spotted with pale brown.

83. **Cylindra sinensis,** Reeve, **40,** *b*, *IV.* VI.

Family FASCIOLARIIDAE.

84. **Latirus craticulatus,** Linn. (*Turbinella craticulata*, Reeve, **37,** *IV.*) IX.

85. **Latirus fastigium,** Reeve (*Turbinella fastigium*, Reeve, **37,** *IV.*) XII.

86. **Peristernia nassatula,** Lamarck (*Turbinella nassatula*, Reeve, **37,** *IV.*) IX.

87. **Leucozonia smaragdula,** Linn. (*Turbinella smaragdula*, Reeve, **37,** *IV.*) IX, XI, XIII.

Family TURBINELLIDAE.

88. **Cynodonta cornigera,** Lamarck (*Turbinella cornigera*, Reeve, **37,** *IV.*) Maldives.

Family BUCCINIDAE.

89. **Engina mendicaria,** Lamarck (*Ricinula mendicaria,* Reeve, **37,** *III.*) XI.

90. **Engina bonasia,** Martens (*Plicatella* (*Peristernia*) *bonasia,* Martens, **26**). IX.

91. **Engina rawsoni,** Melvill (*Sistrum rawsoni,* Melvill, **27,** *a*). V.

The columella is described as "simplice," but all the specimens examined, including the type, exhibit a thin circumscribed callosity, with a small transverse tubercle at the upper end, and a few anteriorly. All also have a pale peripheral zone, and some of the costae are whitish. In one of the Maldive specimens, white is the predominating tint; on the contrary, a second example is almost entirely of a rich brown colour, excepting the whitish zone round the middle of the body-whorl, which is rather more contracted and produced anteriorly than usual, the canal, in consequence, appearing a little longer.

92. **Phos roseatus,** Hinds, **40,** *b, III.* II, IV, V, VI, VII.

93. **Phos textilis,** A. Adams, **40,** *b, III.* V, XIII.

The specimens from the above localities are considerably smaller than the type from the Philippine Islands but do not offer any tangible differences in other respects. The protoconch is large and consists of three smooth glossy convex yellowish whorls. The normal volutions may vary from four-and-a-half to five-and-a-half.

Family NASSIDAE.

94. **Nassa bifaria,** Baird, var. **5, 39,** *f.* II, IV, V, VII, X.

The Maldive specimens belong to the same variety as those from the Andaman Islands which I recorded and figured at the above reference. Tryon in his absurd craze for "lumping" considered this species "a stumpy variety" of *N. hirta,* Kiener, a species with which it has in fact but slight resemblance, differing in size, colour and sculpture.

95. **Nassa marratii,** Smith, **39,** *e, f.* XI.

Two specimens were obtained agreeing with the type excepting in their larger size, being 19 mm. in length, like the Andaman examples figured in the *P. Z. S.*

96. **Nassa monile,** Kiener, **37,** *VIII.* XI.

97. **Nassa stigmaria,** A. Adams, **37,** *VIII.* V, XII, XV.

98. **Nassa echinata,** A. Adams, **37,** *VIII.* IX, X, XII, XV.

99. **Nassa glans,** Linn. **37,** *VIII.* III.

100. **Nassa granifera,** Kiener, **37,** *VIII.* IV, VIII, X, XIII, XV.

101. **Nassa maldivensis,** n. sp. (Pl. XXXV. figs. 6—8). VIII, IX, XII.

Testa *N. algidae*[1] similis, sed concolor, albida, anfractu ultimo majori; lirae aperturae circiter 12 et columellae rugae validae. Longit. 25 mm., diam. 15. Apertura cum labro 15 longa, 7 lata.

var. *a.* VII. Testa minor, anfractu ultimo costato. Longit. 20 mm., diam. 11.

Shell ovate, turreted, white; whorls $6\frac{1}{2}$ gradate, upper ones costate, the costae nodose at the upper end through being traversed by a depression or groove, gradually dying out so that the

---

[1] *Nassa algida,* Reeve, *Con. Icon.* vol. VIII. figs. 145 *a, b.*

body-whorl is quite smooth excepting towards the labrum where a few sulci parallel with it are sometimes visible and four or five rather coarse grooves encircle the base. The outer lip is sharp at the edge with four or five denticles anteriorly thickened and lirate within. Lirae twelve in number, produced within the aperture, thread-like, not reaching to the edge of the lip. Columella transversely lirate, furnished with a free-edged callosity. The operculum is yellowish, unguiform, with a terminal nucleus, and serrated on each side towards the apex.

102. **Nassa mulukuensis,** n. sp. (Pl. XXXV. figs. 9, 10). VI.

Testa *N. maldivensi* similis, sed gracilior, anfractibus superioribus spiraliter liratis, operculo diverso instructa.

Longit. 24 mm., diam. 12. Apertura 12½ longa, 6 lata.

Shell elongate-ovate, turreted, whitish, with a few dots and spots of a reddish colour on the upper edge of the whorls, especially on the dorsal margin of the body-whorl. Whorls 9, the three apical smooth, glassy, the four following obliquely costate and transversely sulcate, the grooves causing the costae to be somewhat nodulous. The last two whorls are smooth, excepting the subsutural row of nodules and a few sulci parallel with the labrum and around the lower part of the body-whorl. The labrum, lirae within and the columellar callosity are as in *N. maldivensis.*

The operculum, however, is quite different from that of the species referred to, being ovate, concentric, with a central nucleus, and having only a few serrations on one (the outer) side.

103. **Nassa subtranslucida,** n. sp. (Pl. XXXV. fig. 11). V.

Testa elongata, turrita, subpellucida, nitens, albida, maculis et lineis dilute fuscis irregulariter picta; anfractus 7, superiores tres laeves, convexiusculi, circa medium carinati, caeteri gradati, convexiusculi, longitudinaliter costati, costis laevibus, crassiusculis, quam interstitiis latioribus, in interstitiis trasversim striati, ultimus circa basim fortiter sulcatus et nodose liratus, cauda alba oblique sulcata instructus; apertura intus alba, longit. totius ½ haud aequans; labrum extra valde incrassatum, album, maculis duabus fuscis ornatum, intus tenuiter liratum; columella arcuata, callo tenui, antice denticulum formante, induta.

Longit. 8 mm., diam. 4.

This is a shining semipellucid species, rather strongly costate for its size. The last three or four ribs behind the labrum are obsolete inferiorly, and all are subnodose below the suture, through being crossed by a shallow groove. The colour-markings are irregularly disposed, but the principal spots are upon the upper extremities of some of the costae and at the middle and base of the body-whorl.

104. **Nassa disparilis,** n. sp. (Pl. XXXV. fig. 12). V.

Testa minima, ovata, alba, lineis rufis duabus circa anfract. ultimum cincta; anfractus 7—8, superiores tres convexiusculi, laeves, politi, circa medium carina filiformi instructi, caeteri longitudinaliter oblique costati (costis in anfr. penult. et antepenult. crassis, circiter 8, in ultimo gracilioribus, circiter 16, supra nodosis) inter costas spiraliter distincte sulcati; apertura parva, longit. totius ⅖ adaequans; labrum extra varice albo crasso transversim striato instructum, intus liris 9, haud ad marginem productis, munitum; columella callo circumscripto induta, arcuata, transversim tuberculata.

Longit. 7½ mm., diam. 4.

Only a single example is in the collection. It is remarkable for the stoutness and small number of the costae upon the penultimate and antepenultimate whorls in comparison with those upon the last. The upper extremities are cut across by a distinct groove, thus forming a row of nodules below the suture. Of the two reddish lines upon the last whorl, the upper one is around the middle, and the other at the base.

105. **Nassa ecstilba,** Melvill and Standen, **28,** *a.* XIV, XV.

Family COLUMBELLIDAE.

106. **Columbella conspersa,** Gaskoin, **37,** *XI.* II.

A single typical specimen.

107. **Columbella flava,** Bruguière, **37,** *XI.* I, X.

108. **Columbella jaspidea,** Sowerby, **37,** *XI.* **40,** *b, I.* IX.

Only a single specimen was obtained. Probably *C. plicaria*, Montrouzier (*Journ. Conch.* vol. x, p. 234, pl. IX, fig. 3, 1862) is a variety of this species. The specimen figured by Reeve is not mottled or spotted like the type, the latter agreeing in this respect with *C. plicaria.*

109. **Columbella galaxias,** Reeve, **37,** *XI.* XV.

110. **Columbella turturina,** Lamarck, **37,** *XI.* IX, XV.

111. **Columbella varians,** Sowerby, var. **40,** *b, I.* **37,** *XI.* IX.

A single whitish example with the transverse striae indistinct so that the surface is rather smooth.

Family MURICIDAE.

112. **Murex ternispina,** Lamarck, **37,** *III.* I, VI, X, XIII.

113. **Murex haustellum,** Linn. **37,** *III.* VI, X.

114. **Murex (Pteronotus) tripterus,** Born. **37,** *III.* V.

115. **Murex (Chicoreus) aculeatus,** Lamarck, **37,** *III.* V, XII.

116. **Murex (Chicoreus) adustus,** Lamarck, **37,** *III.* V, VII.

117. **Murex (Chicoreus) rubiginosus,** Reeve, **37,** *III.* IX.

118. **Murex (Chicoreus) ramosus,** Linn. **37,** *III.* IX.

119. **Murex (Ocinebra) salmoneus,** Melvill and Standen, **28,** *b.* (*Murex pumilus*, A. Adams, **1,** *b.* **40,** *b, IV.* **39,** *g.*) XII.

The name *pumilus*, A. Adams, was preoccupied by Broderip many years previously, hence the employment of the name *salmoneus.* I think there is little doubt that Messrs Melvill and Standen redescribed this species, for examination of the types of both forms shows that they are the same species. The single example from the Maldive Islands is dirty whitish, but, being a dead shell, and occupied by a *Pagurus*, it probably has lost the usual rose-colour.

120. **Murex (Ocinebra) pleurotomoides,** Reeve, **37,** *III.* II.

Three specimens rather smaller than the type, with the anterior canal stained with brown and a pale brown zone round the middle of the body-whorl. The lirae within the labrum are about six in number, and the tubercles on the columella, three or four. The posterior sinus, at the upper end of the outer lip, seems to be a constant feature.

121. **Murex (Ocinebra) submissus,** n. sp. (Pl. XXXV. fig. 13). XII.

Testa minima, ovata, rimata, supra acuminata, albida, lineis interruptis nigro-fuscis cincta; anfractus 6½, superiores tres laeves, convexi, caeteri supra concave declives, costis longitudinalibus octo et liris spiralibus supra costas elatis (in anfr. penult. 2, in ultimo 8—9) instructi, incrementi lineis tenuissimis striati, ultimus in medio convexiusculus, antice contractus; apertura intus flavescens; labrum extra incrassatum, intus liris brevibus sex haud ad marginem productis munitum; columella sinuosa, callo tenui reflexo flavescente induta, in medio prominens, tuberculis parvis 3—4 munita; canalis anterior obliquus, recurvus.

Longit. 8½ mm., diam. 5.

The dark brown transverse lines, about six or seven upon the last whorl, are interrupted between the costae, and falling upon the raised lirae, the ribs appear to be crossed by coloured tubercles.

The costae are a little oblique and continuous up the spire. The smooth protoconch is marked off from the first normal whorl by a slender varix or thickened lip of its last whorl. The three whorls of which it consists have a yellowish margination beneath the suture.

122. **Purpura armigera,** Lamarck, **37,** *III.* IX.

123. **Purpura bituberculāris,** Lamarck, **37,** *III.* IX.

124. **Purpura hippocastanum,** Lamarck, **37,** *III.* XI, XV.

125. **Purpura pica,** Blainville, **37,** *III.* IX.

126. **Iopas situla,** Reeve (*Buccinum situla,* Reeve, **37,** *III.*) IX.

127. **Iopas sertum,** Bruguière (*Buccinum sertum,* Reeve, **37,** *III.*) I.

128. **Sistrum digitatum,** Lamarck (var. *lobatum,* Blainville; *Ricinula digitata,* Reeve, **37,** *III.*) IX.

129. **Sistrum horridum,** Lamarck (*Ricinula horrida,* Reeve, **37,** *III.*) I, IX.

130. **Sistrum ricinus,** Linn. (*Ricinula arachnoides,* Reeve, **37,** *III.*) I, IX, XI, XV.

131. **Sistrum tuberculatum,** Blainville (*Ricinula tuberculata,* Reeve, **37,** *III.*) IX.

132. **Sistrum undatum,** Chemnitz (*Ricinula fiscellum,* Reeve, **37,** *III.* *Sistrum undatum,* partim, Tryon, **41,** *II.*) VIII, X, XV.

133. **Sistrum elatum,** Blainville (*Ricinula spectrum,* Reeve, **37,** *III.*) II, IX, XI.

In the two fresh specimens obtained, the labrum is white, but the interior of the aperture is yellowish.

134. **Sistrum spinosum,** A. Adams (*Ricinula chrysostoma,* partim, Reeve, **37,** *III.* *Ricinula biconica,* partim, Tryon, **41,** *II.*) XIII.

Messrs H. and A. Adams (*Genera Recent Mollusca,* vol. I. p. 130) recognised that Reeve had wrongly identified the *Ricinula chrysostoma* of Deshayes and imposed the name of *spinosus* upon the misunderstood species. The term *spinosus* is applicable to fig. 12 *b* rather than to 12 *a*, which represents the *Ricinula biconica* of Blainville. I think therefore the species *spinosus* should be restricted to the figure 12 *b*. Whether it is conspecific with *S. biconicum* has yet to be proved. Although united by Tryon, at present I am inclined to consider them sufficiently distinct.

135. **Sistrum biconicum,** Blainville (*Purpura biconica*, Kiener, **23.** *Sistrum biconicum*, Tryon, **41,** *II.* *Ricinula chrysostoma*, partim, Reeve, **37,** *III.*) XIII.

136. **Sistrum cavernosum,** Reeve (*Ricinula cavernosa*, Reeve, **37,** *III.*) IX, XV.

137. **Sistrum iostoma,** A. Adams (Pl. XXXV. fig. 14). (*Murex iostomus*, A. Adams, **1,** *a.*) VIII.

This species is allied to *S. spinosum*, but appears to be separable.

138. **Sistrum squamosum,** Pease, **31,** *a.* XI.

The Maldive specimen is quite typical.

139. **Sistrum concatenatum,** Lamarck (*Ricinula concatenata*, Reeve, **37,** *III.*, var. = *Purpura fragum*, Blainville, **23**). IX.

A very variable species in size, form, and colour. Only a single small specimen was obtained at the above station and it most resembles the variety *fragum* as the aperture and labrum are white and not orange red as in the type.

140. **Sistrum decussatum,** Reeve, var. (*Murex decussatus*, Reeve, **37,** *III.*) XIV.

A single very small specimen differing from the type in having a shorter anterior canal, and in the nodules at the upper angle of the whorls being uncoloured and acute. Although adult, only 13 mm. in length.

Family CORALLIOPHILIDAE.

141. **Coralliophila monodonta,** Quoy and Gaimard (*Purpura monodonta*, **23**). II, V, IX, XI, XIII.

142. **Coralliophila neritoidea,** Gmelin (*Purpura violacea*, Kiener, **37,** *III.*) VIII, IX.

143. **Coralliophila suturalis,** A. Adams, **1,** *b* (*C. galea* (partim), **41,** *II.* *Rhizocheilus exaratus*, Pease, **31,** *b*). IX, XV.

144. **Coralliophila squamosissima,** Smith, **41,** *II.* IX.

145. **Leptoconchus ellipticus,** Sowerby (*Magilus ellipticus*, Sowerby, **40,** *a, XVIII.*) XV.

The transverse ribbing usually extends over the greater part of the body-whorl, although, in the description, Mr Sowerby observes that the shell is "spirally slightly ribbed below the middle," as if this were a specific feature. A fine example in the British Museum from the Mauritius is 27 mm. long, and 22 in diameter.

146. **Leptoconchus cumingii,** Deshayes, **12,** *a*, **40,** *a, XVIII.* XV.

The shell figured by Sowerby (*l.c.* fig. 10) as *Magilus globulosus*, I regard as a form of the present species.

Family LOTORIIDAE.

147. **Lotorium chlorostoma,** Lamarck (*Triton chlorostoma*, Reeve, **37,** *II.*) IX, XV.

148. **Lotorium gemmatum,** Reeve (*Triton gemmatum*, Reeve, **37,** *II.*) IX.

149. **Lotorium pyrum,** Lamarck (*Triton pyrum*, Reeve, **37,** *II.*) IX.

150. **Lotorium tuberosum,** Lamarck (*Triton tuberosus*, Reeve, **37,** *II.*) I.

151. **Colubraria ceylonensis,** Sowerby (*Triton ceylonensis*, Reeve, **37,** *II.*) V, XIV.

152. **Colubraria obscura,** Reeve (*Triton obscurus,* Reeve, **37,** *II.*) XIV.

153. **Colubraria bracteata,** Hinds (*Triton bracteatus,* Reeve, **37,** *II.*) IX.

A small form only about 13 mm. in length.

154. **Colubraria digitale,** Reeve (*Triton digitale,* Reeve, **37,** *II.*) IX.

In fresh specimens three rows of pale brownish spots are visible upon the last whorl, one below the suture, one at the middle, and the third below it. These spots form interrupted colour bands, which, however, are only observable in well preserved shells.

155. **Distortrix anus,** Lamarck (*Triton anus,* Reeve, **37,** *II.*) IX.

156. **Ranella bufonia,** Lamarck, **37,** *II.* IX, XV.

157. **Ranella granifera,** Lamarck, **37,** *II.* IX, XI, XIV.

158. **Ranella tuberosissima,** Reeve, **37,** *II.* XIV.

159. **Ranella thomae,** d'Orbigny, **14** (*R. bergeri,* Canefri, **7**). XII.

The single Maldive specimen has the transverse ridges of a blackish brown colour but in other respects agrees very well with the examples cited from the above localities.

160. **Ranella (Lampas) lampas,** Lamarck (*Triton lampas,* Reeve, **37,** *II.*) IX.

Family CASSIDIDAE.

161. **Cassis cornuta,** Linn. **37,** *V.* IX.

162. **Cassis rufa,** Linn. **37,** *V.* IX.

Family DOLIIDAE.

163. **Malea pomum,** Linn. (*Dolium pomum,* Reeve, **37,** *V.*) IX.

164. **Dolium costatum,** Menke, **37,** *V.* IX.

165. **Dolium olearium,** Lamarck, **37,** *V.* XV.

166. **Pirula ficoides,** Lamk. jun.? **23** (*Ficula reticulata,* Reeve (non Lamarck), **37,** *III.*) V, VII.

Family CYPRAEIDAE.

167. **Cypraea arabica,** Linn. (*a.* var. *typica,* **40,** *b, IV.* IX. *b.* var. *eglantina,* Duclos, **40,** *b, IV.* IX. *c.* var. *histrio,* Meuschen, **40,** *b, IV.* IX, XI, XII, XIII. *d.* var. *intermedia,* Gray, **40,** *b, IV.* IX.).

168. **Cypraea argus,** Linn. **37,** *III.* IX.

169. **Cypraea asellus,** Linn. **37,** *III.* IX.

170. **Cypraea caput-serpentis,** Linn. **37,** *III.* IX, XI, XV.

171. **Cypraea carneola,** Linn. **37,** *III.* I, IX, XI.

172. **Cypraea caurica,** Linn. **37,** *III.* IX, XI, XIII.

173. **Cypraea clandestina,** Linn. **37,** *III.* IX.

174. **Cypraea cribraria,** Linn. **37,** *III.* XIV.

175. **Cypraea erosa,** Linn. **37,** *III.* IX, XI, XIII, XV.

176. **Cypraea felina,** Gmelin, var. **37,** *III.* IX, XV.

177. **Cypraea gangrenosa,** Solander, **40,** *b*, *IV.* X, XII.

178. **Cypraea (Epona) globulus,** Linn. **37,** *III.* XIII.

179. **Cypraea helvola,** Linn. **37,** *III.* VIII, IX.

180. **Cypraea hirundo,** Linn. **37,** *III.* IX, XIII.

181. **Cypraea isabella,** Linn. **37,** *III.* IX, XI.

182. **Cypraea lamarckii,** Gray, **37,** *III.* III, VIII.

183. **Cypraea lynx,** Linn. **37,** *III.* I, IX.

184. **Cypraea mauritiana,** Linn. **37,** *III.* XI.

185. **Cypraea minoridens,** Melvill, **27,** *b*, **39,** *d* (*Cypraea fimbriata,* partim, Sowerby, **40,** *b*, *IV.*) IX.

186. **Cypraea moneta,** Linn. **37,** *III.* IX, XI, XIII, XIV, XV.

187. **Cypraea poraria,** Linn. **37,** *III.* IX, XI.

188. **Cypraea annulus,** Linn. **37,** *III.* IX.

189. **Cypraea staphylaea,** Linn. **37,** *III.* VII.

190. **Cypraea talpa,** Linn. **37,** *III.* IX.

191. **Cypraea tigris,** Linn. **37,** *III.* IX.

192. **Cypraea vitellus,** Linn. **37,** *III.* IX.

193. **Cypraea walkeri,** Gray, **37,** *III.* II, III, V, VI, XIII.

194. **Cypraea ziczac,** Linn. **37,** *III.* XIII.

195. **Trivia pellucidula,** Gaskoin (*Cypraea pellucidula,* Sowerby, **40,** *b*, *IV.*) X.

Family STROMBIDAE.

196. **Strombus dentatus,** Linn. (var. *Rüppellii,* Reeve, **37,** *VI.*) I—VI.

197. **Strombus floridus,** Lamk. **37,** *VI.* I, IX, XI, XV.

198. **Strombus gibberulus,** Linn. **37,** *VI.* IX—XII, XIV, XV.

199. **Strombus labiosus,** Gray, **37,** *VI.* V, VI.

200. **Strombus lentiginosus,** Linn. **37,** *VI.* IX.

201. **Strombus guttatus** (Chemnitz), Kiener, **23, 37,** *VI.* V.

202. **Strombus lamarckii,** Gray, **40,** *b*, *I.* IX.

203. **Pterocera lambis,** Linn. **37,** *VI.* IX.

204. **Pterocera chiragra,** Linn. **37,** *VI.* IX.

205. **Terebellum terebellum,** Linn. (*Terebellum punctatum,* Reeve, **37,** *VI.*) II—VI, X.

Family CERITHIIDAE.

206. **Triforis corrugatus,** Hinds, **20,** *a*, **8.** X.

207. **Triforis elegans,** Hinds, **20,** *a* (*T. picturatus,* Sowerby, **40,** *e*). IX.

I have compared the type of *T. picturatus* with authentic specimens of the present species and have no hesitation in pronouncing them specifically the same. Although Mr Sowerby described his shell as having three keels on a whorl, there are in fact four, and they alternate, larger and smaller, as stated by Hinds. No mention is made by either author of the spotted carina below the periphery of the body-whorl. *Triforis* is a genus which wants monographing by a competent person, and ought to be illustrated with much enlarged photographed figures. At present it is practically impossible to identify most of the described species by means of the published figures and descriptions.

208. **Triforis sculptus,** Hinds, **20,** *a.* XIV.

This species varies much in size, and is sometimes considerably larger than the shell figured by Hinds or the dimensions given in his original description[1]. The largest specimen in the British Museum is 20 mm. in length, whereas another, equally adult, is only 15.

209. **Triforis lilaceocinctus,** n. sp. (Pl. XXXV. fig. 15). XIV.

Testa elongato-pupoidea, supra acuminata, granulis flavescentibus et albis, lirata, inter granula rufo punctata; anfractus circiter 15, superiores liris duabus granosis aequalibus instructi, pauci anteriores lira graciliore mediana, dilute lilacea, vix granulata ornata, sutura lineari sejuncti, microscopice spiraliter striati, ultimus circa basim lilaceus, liris aliis tribus nodulosis, rufo punctatis, instructus; apertura obliqua, piriformis; canalis parvus, dextrorsus, semiclausus.

Longit. 10½ mm., diam. 3½ mm.

A general glance at this pretty species gives the impression that the whorls have each two adjacent rows of large granules. Such however is not the case. It is the lower row in one whorl being adjacent to the upper one in another (the linear suture being between) that gives this appearance, the unspotted and more slender median lirae also lending to the effect. This lira gradually dies out as it ascends the spire, so that the upper whorls have only two rows of equal sized granules. This species also occurs at the Mauritius (Brit. Mus.).

210. **Triforis excellens,** n. sp. (Pl. XXXV. figs. 16, 17). V.

Testa magna, dilute fuscescens, hic illic saturatius maculata; anfractus numerosi (25—30), plani, cingulis tribus aequalibus acutis cincti, inter cingula laeves, ultimus ad peripheriam bicingulatus, infra vix convexus, liris 4—5 instructus; apertura irregulariter quadrata; labrum tenue; columella callo reflexo crassiusculo induta.

Longit. 29 mm., diam. 6 mm.

The spirals are equal in size, but the space separating the lowermost from the median one is a little broader than the groove between the upper two. The suture except at the upper part of the spire is marked with a spiral thread.

---

[1] *Ann. Mag. Nat. Hist.* 1843, vol. XI. p. 17.

211. **Triforis gracilior,** n. sp. (Pl. XXXV. figs. 18, 19). V.

Testa *T. excellenti* similis, sed gracilior, cingulis duobus inferioribus subundulatis, alba, hic illic fusco maculata.

Longit. 28 mm., diam. 5½ mm.

Like *T. excellens*, this species has three keels upon each whorl, but they are not so equal, the uppermost being a trifle more slender than the others. The latter also are slightly affected by faint longitudinal depressions giving them an obscurely beaded appearance. The body-whorl is bicarinate at the periphery and has three or four lirae beneath. As in the preceding species, the space between the second and third keel is a little broader than that which separates the first and second, and the suture is filo-lirate.

212. **Triforis pura,** n. sp. (Pl. XXXV. figs. 20, 21). XII.

Testa elongata, alba, clathrata, granulata; anfractus circiter 20, fere plani, costis spiralibus tribus granosis inaequalibus (costa mediana minima) cincti, inter costas longitudinaliter costati, ultimus costis senis (prope labrum duabus intercalatis) ornatus; canalis dextrorsus, clausus, laevis; apertura irregulariter ovata, obliqua; labrum antice prominens, postice recedens; columella callo crassiusculo reflexo induta.

Longit. 14 mm., diam. 3.

Of the three spirals the uppermost is a little stouter than the lowermost and the central one is rather finer than the latter. The granules form oblique rows of three, being connected by the longitudinal costae. The suture is thread-like.

213. **Vertagus fasciatus,** Bruguière, var. **40,** *a, XV.* VIII, IX.

214. **Vertagus kochi,** Philippi, **40,** *a, XV.* XI.

215. **Vertagus articulatus,** A. Adams and Reeve (*Cerithium articulatum*, Adams and Reeve, **3.** *V. articulatus*, Sowerby, **40,** *a, XV.*) VI, X.

216. **Vertagus obeliscus,** Bruguière, var. *cedo-nulli* (*V. cedo-nulli*, Sowerby, **40,** *a, XV.*) I, IX.

V. cedo-nulli is perhaps separable from *obeliscus*.

217. **Cerithium columna,** Sowerby, **40,** *a, XV.* IX, XI, XIII.

218. **Cerithium echinatum,** Lamarck, **40,** *a, XV.* XIII.

219. **Cerithium lacteum,** Kiener, **40,** *a, XV.* XI.

220. **Cerithium piperitum,** Sowerby, **40,** *a, XV.* IX.

221. **Cerithium salebrosum,** Sowerby, **40,** *a, XV.* II.

222. **Cerithium tuberculatum,** Linn. (var. = *C. variegatum*, Quoy and Gaimard, **40,** *a, XV.*) XI.

223. **Cerithium albovaricosum,** Smith, var. **39,** *g.* I.

Three specimens, a little larger (19 mm. long), paler, and with less of the brown dotting between the costae than in the type.

224. **Terebralia palustris,** Linn. (*Pyrazus palustris*, Sowerby, **40,** *a, XV.*) XI.

225. **Modulus tectum,** Gmelin, **41,** *IX.* IX.

Family PLANAXIDAE.

226. **Planaxis ineptus,** Gould, **17, 40,** *a, XX,* **41,** *IX.* X.

The Maldive specimens are a little larger than the dimensions given by Gould, being 5½ mm. in length. Most of them also exhibit a purplish stain on the columella which is not referred to in the original description. There are generally three principal colour lines upon the body-whorl —one above the periphery, one below it and the third still more anterior.

Family LITTORINIDAE.

227. **Littorina glabrata,** Philippi, **33,** *b,* **37,** *X.* XI, XV.

228. **Littorina scabra,** Linn. **37,** *X.* XV.

229. **Littorina undulata,** Gray, **37,** *X.* XI, XV.

Family SOLARIIDAE.

230. **Solarium modestum,** Philippi, **40,** *b, I.* V.

231. **Philippia cingulum,** Kiener, **40,** *b, III.* II, IX.

Family HIPPONYCIDAE.

232. **Mitrularia cicatricosa,** Reeve (*Calyptraea cicatricosa,* Reeve, **37,** *XI.*) IX.

233. **Mitrularia equestris,** Linn. (*Calyptraea equestris,* Reeve, **37,** *XI.*) IX.

234. **Hipponyx danieli,** Crosse (*Capulus danieli,* Crosse, **11,** *b*). III—V.

235. **Hipponyx australis,** Lamarck, **41,** *VIII.*

Family CAPULIDAE.

236. **Thyca crystallina,** Gould (*Hipponyx crystallinus,* Tryon, **41,** *VIII.*) VIII.

Family XENOPHORIDAE.

237. **Xenophora indica,** Gmelin, **41,** *VIII.* (*Phorus indica,* Reeve, **37,** *I.*) V.

Family VANICOROIDAE.

238. **Vanicoro cancellata,** Lamarck, **41,** *VIII.,* **40,** *b, V.* IX, XIII.

Family NATICIDAE.

239. **Natica robillardi,** Sowerby, **40,** *d.* XII, XV.

240. **Natica euzona,** Recluz (Pl. XXXV. fig. 22), **36** (*N. picta,* partim, Reeve, **37,** *IX. N. decora,* Philippi, **33,** *a*). VII.

The operculum of this species is shelly, white, concave externally, shining except in the middle where there is a dull opaque thickening. The outer curved side has a thickened edge, within which is a parallel furrow and then a raised ridge or rounded keel. The convex side is covered with a thin yellow pellicle and is marked with lines of growth.

241. **Polinices mamilla,** Lamarck (*Natica mamilla*, Reeve, **37,** *IX.*) III, IX, XII, XV.

242. **Polinices albumen,** Lamarck (*Natica albumen*, Reeve, **37,** *IX.*) III.

243. **Mamilla melanostoma,** Lamarck (*Natica melanostoma*, Reeve, **37,** *IX.*) VI, XV.

244. **Mamilla simiae,** Deshayes (*Natica simiae*, Reeve, **37,** *IX.*) IX.

Family IANTHINIDAE.

245. **Ianthina communis,** Lamarck? **37,** *XI.* IX.

The figures most resembling the specimens from the above station are Reeve's figures of *I. affinis* (figs. 2 *a*, *b*). That so-called species and several others described in the same monograph are probably mere varieties of one variable species. (See Tryon, *Man. Conch.* vol. IX. pp. 36, 37.)

Family SCALIDAE.

246. **Scala replicata,** Sowerby (*Scalaria replicata*, Sowerby, **40,** *b*, *I.*) IX.

247. **Scala consors,** Crosse and Fischer (*Scalaria consors*, Tryon, **41,** *IX.*) XI.

A single example considerably larger than the type, being 18 mm. long, and 7 mm. in width. The locality given by Crosse and Fischer is St Vincent's Gulf, S. Australia, but four specimens, supposed to include the type among them, were presented to the British Museum in 1870 by Mr G. F. Angas and were marked "Ceylon" by him. The Maldive example has a dark line at the suture.

248. **Scala (Cirsotrema) texta,** n. sp. (Pl. XXXV. fig. 23). X.

Testa elongata, subulata, imperforata, solidiuscula, albida, longitudinaliter plus minus plicata, varicibus paucis obliquis instructa, spiraliter sulcata et tenuiter punctato-striata, lineis incrementi tenuissimis obliquis sculpta; anfractus circiter 12, supra valde declives, vix concavi, in medio obtuse angulati, sutura obliqua irregulariter corrugata sejuncti, ultimus ad peripheriam angulatus, costis ad angulos subnodosis; apertura oblique ovata; peristoma continuum, expansum, margine externo varice crasso circumdato. Longit. 17 mm., diam. 5; apertura intus 3 longa, 2 lata.

This very distinct species is well-characterized by the fine cancellated sculpture, like a piece of linen, the interstices being minutely punctate. The whorls exhibit spiral shallow sulci and intervening raised ridges, both the latter and the grooves being covered with the spiral and longitudinal striae. Every second or third whorl exhibits an oblique varix, and the upper ends of the plicae form a very irregular puckered or dentate sutural line.

Allied to *S. bicarinata*, Sowerby, but much larger, of different form, differently plicate and spirally sulcate.

Family PYRAMIDELLIDAE.

249. **Pyramidella corrugata,** Lamarck, **23.** XV.

250. **Pyramidella nodicincta,** A. Adams, **40,** *b*, *II.* XIV.

251. **Obeliscus dolabratus,** Linn. (*O. dolabratus* and *O. terebellum*, **40,** *b*, *II.*) IX, XV.

252. **Obeliscus monilis,** A. Adams, **40,** *b, II.* IX, XIV.

253. **Obeliscus sulcatus,** A. Adams, **40,** *b, II.* XV.

Family NERITIDAE.

254. **Nerita albicilla,** Linn. **37,** *IX.* IX, XV.

255. **Nerita histrio,** Linn. **37,** *IX.* XI.

256. **Nerita plicata,** Linn. **37,** *IX.* IX, XI.

257. **Nerita polita,** Linn. **37,** *IX.* I, XII.

Family TURBINIDAE.

258. **Turbo (Senectus) argyrostoma,** Linn. **37,** *IV.* (var. = *T. margaritaceus,* Reeve, **37,** *IV.*) IX, XI, XV.

Family LIOTIIDAE.

259. **Liotia squamicostata,** n. sp. (Pl. XXXV. fig. 24). X.

Testa subglobosa, anguste umbilicata, alba; anfractus quatuor, ad suturam canaliculati, costis granosis spiralibus (in anfractu penultimo 4, in ultimo 8) cincti; granula ad peripheriam subsquamiformia; apertura circularis, margine externo crenulo, columellari incrassato, reflexo. Diam. maj. 5 mm., alt. 4.

The spiral ridges are rather strong, broader than the grooves between them, and the granules upon the second, third, fourth, and fifth upon the body-whorl, and the second and third upon the penultimate, are scale-like, and that which encircles the umbilicus is much thicker than the rest and transversely grooved. The terminations of the spirals upon the outer lip give it a crenulated aspect.

Family TROCHIDAE.

260. **Trochus (Lamprostoma) incrassatus,** Lamarck, **34,** *XI.* I, XV.

261. **Trochus (Lamprostoma) maculatus,** Linn. **34,** *XI.* IX, XI.

262. **Trochus (Lamprostoma) obesus,** Reeve, **37,** *XIII.* IX.

263. **Trochus (Lamprostoma) radiatus,** Gmelin, **34,** *XI.* XI.

264. **Thalotia maldivensis,** n. sp. (Pl. XXXV. figs. 25, 26). II, X.

Testa parva, elate conica, imperforata, ad peripheriam acute angulata, supra viridis, ad suturam albo et roseo maculata, apicem versus rubescens. supra anfractum ultimum strigis albis obliquis paucis ornata, infra roseo et albo tessellata; anfractus 8—9 plani, seriebus granulorum parvorum septenis (quarum series duae inferiores contiguae et albo et roseo maculatae) instructi, ultimus infra angulum seriebus 9—10 ornatus, subplanus; apertura obliqua, subquadrata, margaritacea, iridescens; labrum tenue; columella alba, incrassata, reflexa, leviter arcuata, antice truncata.

Diam. maj. 7½ mm., min. 7, alt. 10. Var. Testa rufescens, concolor.

A very pretty conical shell, generally more or less green with a white and pink spotted band above the suture and dotted with pink in the middle of the base. Some examples are uniformly pinkish reddish and with only tinges of green above or below.

265. **Clanculus atropurpureus**, Gould (*Trochus* (*Clanculus*) *atropurpureus*, **34**, *XI.*) IX, XIII.

266. **Perrinia angulifera**, A. Adams (Pl. XXXV. fig. 27); (*Turcica* (*Perrinia*) *angulifera*, **34**, *XI*). X.

267. **Forskalia pulcherrima**, A. Adams (*Gibbula pulcherrima*, Pilsbry, **34**, *XI.*) IV, VI.

268. **Monilea calyculus**, Wood, **34**, *XI.* II—IV.

269. **Monilia simulans**, Smith, var. **39**, *c.* V, VI, X.

These specimens differ from the type in having only very faint indications of the nodose plications at the upper angle of the whorls. They also differ in colour, being paler and less rosy. *Trochus* (*Monilea*) *warnefordi*, G. and H. Nevill, may be the same as this species.

270. **Ethalia rhodomphala**, n. sp. (Pl. XXXVI. figs. 1, 2). III, V, X.

Testa orbiculata, supra breviter conica, semiobtecte anguste umbilicata, ad peripheriam acute angulata, supra albida, maculis paucis remotis fuscis et lineis tenuissimis irregularibus undulatis radiatim picta, ad peripheriam maculis semipellucidis roseo pictis ornata, infra lineis albis opacis irregularibus subzigzagformibus variegata, circa umbilicum rosea; anfractus sex leves, nitidi, ultimus circa medium striis paucis sculptus, circa umbilicum radiatim plicatus; apertura oblique subquadrata, margaritacea, iridescens; columella crassa, in medio margaritacea, valde reflexa, alba vel rosea, callosa, umbilicum semiobtegens.

Diam. maj. 8 mm., min. 7, alt. $3\frac{2}{3}$.

Viewed with the naked eye, the upper surface of this shell looks whitish with a few brown radiating blotches. A closer inspection with a lens, however, reveals the presence of very fine lineation, more or less broken up, undulating or dotted. The puckering around the umbilicus is pinkish, the rest of the base being covered with opaque white irregular markings upon a subtranslucent ground. The last whorl is angled at the periphery and above the angle is marked with a few distinct spiral striae.

Family STOMATELLIDAE.

271. **Gena auricula**, Lamarck, **34**, *XII.* IX, XIII.

Family HALIOTIDAE.

272. **Haliotis ovina**, Chemnitz, **34**, *XII.* IX, XII.

The number of open perforations may vary from two to six.

Family FISSURELLIDAE.

273. **Glyphis bombayana**, Sowerby, **34**, *XII.* IX.

274. **Glyphis singaporensis**, Reeve, **34**, *XII.* XIII.

275. **Emarginula incisura**, A. Adams, **34**, *XII.* XIII.

The locality of this species has not previously been recorded. The single specimen obtained is of a greenish yellow tint externally and the central portion of the interior is of a somewhat similar colour. The anterior slit is very peculiar, being clean-cut, and extending from the margin almost to the apex.

276. **Emarginula planulata**, A. Adams, **34**, *XII.* VIII.

A single specimen apparently inseparable from this species.

Family CHITONIDAE.

277. **Chiton (Sclerochiton) miles**, Carpenter, **34**, *XIV.* I.

Torres Straits is the only locality previously known for this *Chiton.*

278. **Schizochiton incisus**, Sowerby, **34**, *XIV.* I.

This I believe is the first record of the occurrence of this remarkable species in the Indian Ocean.

Family ISCHNOCHITONIDAE.

279. **Callochiton platessa**, Gould, **34**, *XIV.* V.

280. **Ischnochiton hululensis**, n. sp. (Pl. XXXVI. figs. 3—6). IX.

Testa ovata, mediocriter elata, roseo-albida, punctis roseo-griseis numerosis ornata, cingulo minute squamulato, albido viridi-griseo maculato, circumdata; valvae undique minute decussatae, antica transversim corrugata, lamina inserta brevi, fissuris novem instructa, medianae areis lateralibus bene circumscriptis, elatis, transversim corrugatis, postica mucrone centrali instructa, dimidio posteriori convexo, anteriore concavo et corrugato, lamina inserta fissuris undecim parata; squamae cinguli minutae, acute ovales, transversim striatae.

Longit. 13 mm., diam. 19.

The single specimen obtained is of a pale pinkish colour down the sides of the valves and whitish flecked and spotted with greenish grey down the middle. The hinder almost straight edge of the valves is pale with a few greenish grey spots and a dash of the same colour occurs along the sides in front of the lateral areas. The girdle is covered with alternate patches of greyish green and white scales. The insertion-plates of median valves have a single slit, that of the front valve has nine slits and that of the tail-valve eleven.

281. **Ischnochiton feliduensis**, n. sp. (Pl. XXXVI. figs. 11—14). VII.

Testa ovata, mediocriter elata, in medio carinata, pallida, sordide alba; valvae tenuissimae, antica et areae laterales valvarum centralium minute granulatae; areae centrales longitudinaliter grano-liratae; valva anterior semicircularis, postice in medio sinuata; mucro valvae posterioris antemedianus, parum prominens; cingulum album, squamis minutis striatis ornatum. Longit. 6 mm., diam. 4 mm.

Remarkable for the thinness of the valves, the flatness of the lateral areas, and its style of sculpture. The posterior valve has twelve slits in the insertion plate, the anterior has nine and the intermediate valves one.

282. **Ischnochiton maldivensis**, n. sp. (Pl. XXXVI. figs. 7—10). VII.

Testa elongato-ovata, elata, convexa, in medio subcarinata, pallida, plus minus rufescens, albo minute punctata, cingulo minute squamulato griseo maculato circumdata; valva antica et areae laterales laeves, areae centrales sulcis paucis longitudinalibus utrinque sculptis, valva posterior in medio mucronata; squamae cinguli minutae, adamantiformes, indistincte striatae.

Longit. 8 mm., diam. 4.

The salient features of this species are the smoothness of the head-valve and the lateral areas, and the distinct incised lines upon the sides of the central areas, a space down the middle of the shell being smooth. The insertion plates are thick and striated across the edge. The anterior valve exhibits eight slits, the posterior ten and the median valves none.

Family ACANTHOCHITIDAE.

283. **Acanthochites (Loboplax) laqueatus**, Sowerby, **34**, *XIV.* (*Angasia tetrica*, **34**, *XIV.*) V, XII, XIV.

Testa parva, elongata, subdepressa, purpureo-rosea, albo variegata, valvis antica et postica pallidis, cingulo puniceo vel viridi, hic illic albo maculato, circumdata; valvae rugose squamatae; antica costis radiantibus quinque vix elatis instructa, undique squamata, medianae angustae, in medio postice rostratae, area dorsali sublaevi, postica undique squamata, breviter mucronata.

Longit. 16 mm., diam. 12 mm.

This species is remarkable for its brilliant variable colour, the narrowness of the central valves and their coarse squamulation.

The anterior valve in the Maldive specimens is greenish grey with five paler rays and the posterior margins are also whitish with one or two black spots. Central valves purplish rose with some whitish streaks or wrinkles on each side the dorsal area. Mantle purple red with a white spot on each side the first, seventh and eighth valves surrounding the lateral pores there situated, also some black spots set in white rings all round the edge, about 17 or 18 altogether, and with a fringe at the extreme margin of short white spicules.

Another specimen has the valves similarly coloured, only the seventh is decidedly green excepting the rosy-purplish dorsal area. The mantle, however, is of a vivid green, with a white stripe on each side the anterior valve and four or five stripes or spots in front, the outer margin with a similar fringe of spicules.

Valves. First valve semicircular, the posterior margins being slightly divergent, exhibiting five not much raised rays which, like the rest of the surface, are covered with coarse elongate scales which are finer towards the middle of the hinder edge. Insertion plate finely striated externally, acute at the edge, with five shallow slits.

Central valves narrow, curved in front and rather acutely beaked behind; dorsal area narrow, smooth, with cross marks of growth; squamae arranged in rows, some parallel with the posterior margin, others obliquely across the valves, three or four rows on each side the dorsal area being white; insertion plates with a single posterior slit.

Posterior valve semicircular, shortly mucronate, squamate everywhere, except upon the short mucro which of course is like the dorsal area of the preceding valve; insertion plate thickish, with nine slits.

The colour of the interior of the valves of the only specimens disarticulated is a pinkish flesh tint, the head and tail valves being paler than the rest.

It does not seem to me advisable to place this species in the genus *Angasia* as distinct from *Acanthochites.* I might also point out that the name *Angasia* was preoccupied in Crustacea. (See *P. Z. S.* 1863.)

Family CRYPTOPLACIDAE.

284. **Cryptoplax burrowi**, Smith, **34**, *XV.* IX.

Family NEOMENIIDAE.

285. **Proneomenia australis**, Thiele, **34**, *XVII.* V.

Only a single specimen, apparently belonging to this species, was obtained.

Family SPONDYLIDAE.

286. **Spondylus imperialis**, Chenu, **37**, *IX.* IV.

Family LIMIDAE.

287. **Lima (Mantellum) fragilis**, Chemnitz, **40**, *b*, *I.* I, IX, XI, XV.

288. **Lima (Mantellum) inflata**, Chemnitz, **40**, *b*, *I.* (*Lima fasciata*, **40**, *b*, *I.*) XIII.

289. **Lima squamosa**, Lamarck, **40**, *b*, *I.* II.

290. **Lima (Ptenoides) tenera**, Chemnitz jun.? **40**, *b*, *I.* V.

Family PECTINIDAE.

291. **Pecten senatorius**, Gmelin, **40**, *b*, *I.*, **37**, *VIII.* II—VI.

Only young specimens obtained. *P. layardi*, Reeve, *P. cristularis*, Adams and Reeve, *P. rugosus*, Sowerby and some other so-called species, I regard as half-grown or young specimens of the present form.

292. **Pecten lemniscatus**, Reeve, var. **37**, *VIII.* II.

293. **Pecten mirificus**, Reeve, **37**, *VIII.* V.

294. **Pecten noduliferus**, Sowerby, **40**, *b*, *I.* V, XII.

295. **Pecten irregularis**, Sowerby, **40** *b*, *I.*, **15.** V, X, XII.

Remarkable for the very numerous fine costae which are closely prickly scaled in fresh young specimens.

296. **Pecten nux**, Reeve, **37**, *VIII.* II, V, VI.

297. **Pecten cooperi**, n. sp. (Pl. XXXVI. figs. 15—18). VII.

Testa parva, compressa, albida, rufo maculata, aequivalvis; valva sinistra costis principalibus novem et aliis gracilioribus intercalatis instructa, supra costas pulcherrime concentrice lamellata; auriculae valde inaequales, postica minima, antica costis 2—3 magnis aliisque paucis tenuibus ornata, transversim tenuiter lamellata, lamellis supra costas incrassatis, conspicuis; valva dextra costis circiter 12, tri- vel quadripartitis, instructa, concentrice tenuiter lamellata; auricula antica costis tenuibus radiantibus circiter 10 squamulatis ornata, costa suprema marginali maxima.

Longit. 12½ mm., alt. 14½, diam. 4.

A single example only was obtained. The species has very remarkable sculpture and very unequal auricles. The concentric lamellae are similar on both valves but the costae are different. On the left valve there are about nine principal ones with a secondary one between them and often with still finer ones on each side of the secondaries. The right valve has about twelve costae each made up of three to five small ones, or in other words it is ornamented with numerous slender riblets arranged in groups of three to five. Named after Mr Forster Cooper who was associated with Mr Stanley Gardiner in the exploration of these islands.

298. **Pecten maldivensis**, n. sp. (Pl. XXXVI. figs. 19, 20). II, IV, VI.

Testa compressissima, albida, plus minus roseo radiata et maculata, et maculis albis opacis interdum variegata, tenuissime radiatim striata, lineisque incrementi tenuibus sculpta; valvae subaequales, dextra vix convexiore; auriculae inaequales, posticis paulo majoribus, levibus, anticis costis tenuissimis paucis radiantibus ornatis.

Longit. 17 mm., alt. 19, diam. 3½.

Very compressed and usually very finely radiately striated, but sometimes smoother, with less distinct striae. The colour is variable, some specimens are entirely white with only a few colour-spots on the dorsal slopes. Others are dirty whitish, with about seven rather obscure reddish rays and one example has the right valve rayed with red and the left blotched with opaque white and red. All exhibit the red-spotting at the sides of the dorsal slopes.

299. **Janira gardineri**, n. sp. (Pl. XXXVI. figs. 21, 22). V, VII.

Testa mediocriter compressa, suborbicularis, costis 19 planatis, quadratis, latioribus quam sulci, instructa, undique confertim tenuissime concentrice lamellata; valva sinistra plana, albida, rufo lineata et punctata, dextra alba, umbones versus rufo tincta; umbones laeves, acuti, contigui, haud radiatim striati, nitidi, albidi, lateribus convergentibus rectis; auriculae inaequales, posticis paulo majoribus, costis paucis radiantibus tenuibus parum conspicuis instructae, transversim tenuissime lamellatae, et linea cardinis valvae dextra squamicristata; pagina interna alba.

Longit. 25 mm., alt. 23, diam. 6.

A very beautiful species well characterized by the flat-topped and square-cut costae which are rather broader than the intervening grooves. The concentric fine lamellae seem liable to disappear from the grooves in the flat valve, but they are very conspicuous on the costae and towards the umbo are thickened, so that they are more like granules than lamellae. The red markings occur both on and between the ribs. In the convex valve the lamellae are as conspicuous in the sulci as upon the costae. The lamellae upon the auricles are much more delicate and closer than those upon the rest of the shell. This species probably attains larger dimensions than those given above.

300. **Pallium plica**, Linn. (*Pecten plica*: Reeve, **37,** *VIII*). II—VI.

301. **Amussium paucilirata**, n. sp. (Pl. XXXVI. figs. 23, 24). V.

Testa parva, compressa, tenuis, pellucida, laevis, polita, aequivalvis, valva sinistra alba, dextra pellucida albo et rufo radiata et variegata, radio conspicuo albo supra latus anticum ornata; auriculae inaequales, postica valvae sinistrae infra leviter sinuata, posteriori valvae dextrae majori; umbones acuti; pagina interna radiatim substriata, lira brevi unica utrinque instructa.

Longit. 7½ mm., alt. 7½, diam. 2.

An interesting little species, having one valve pure white and the other mottled and rayed with white and red. The presence of only two internal lirae is also remarkable. In addition to these a short lira runs from the ligament-pit along the base of each auricle. Although the surface of both valves looks smooth and glossy, under a lens fine striae of growth are visible. The umbones are acute, that in the coloured or right valve being a little more prominent than that of the left. The opaque white ray down the anterior side appears to be a specific feature, for it is present in all the specimens examined.

302. **Semipecten forbesianus**, Adams and Reeve, **37,** *VI*.

Family PTERIIDAE.

303. **Malleus anatinus**, Gmelin, **37**, *XI*. IV.

304. **Vulsella rugosa**, Lamarck, **13.** XII.

305. **Electroma ala-corvi**, Chemnitz (*Avicula ala-corvi*, Reeve, **37**, *X*.) XV.

306. **Electroma zebra**, Reeve (*Avicula zebra*, Reeve, **37**, *X*.) X.

307. **Melina perna**, Linn. (*Ostrea perna*, Hanley, **19**, *b*. *Perna* (*Isognomon*) *samoensis*, Baird, **5**.) XI.

308. **Pinna muricata** (Linn.), Reeve, **37**, *XI*. XV.

309. **Pinna nigra** (Chemnitz), Dillwyn, **37**, *XI*. IX.

310. **Pinna saccata**, Linn. **37**, *XI*. I.

311. **Pinna serrata**, Solander (jun.?), **37**, *XI*. VII.

Family MYTILIDAE.

312. **Modiola arborescens**, Chemnitz, **37**, *X*. IX, X, XIII, XIV.

313. **Modiola auriculata**, Krauss, **25**, **10.** IX.

314. **Modiola flavida**, Dunker, **37**, *X*. X.

315. **Lithodomus cinnamominus**, Chemnitz, **37**, *X*. II.

316. **Lithodomus gracilis**, Philippi, **37**, *X*. XII.

317. **Lithodomus malaccanus**, Reeve (Young?), **37**, *X*. IX.

318. **Lithodomus nasutus**, Philippi var.? **37**, *X*. XIV.

319. **Lithodomus teres**, Philippi? **37**, *X*. VII, XV.

320. **Modiolaria argentea**, Reeve (*Lithodomus argenteus*, Reeve, **37**, *X*.) II.

321. **Septifer bilocularis**, Linn. (*Mytilus nicobaricus*, Reeve, **37**, *X*.) XII.

Family ARCIDAE.

322. **Arca maculata**, Sowerby, **37**, *II*. I, IX, XI, XV.

323. **Arca imbricata**, Bruguière, **37**, *II*. IX, XV.

324. **Arca** (**Anadara**) **clathrata**, Reeve, **37**, *II*. VII.

325. **Arca** (**Anadara**) **urypygmelana**, Bory, **37**, *II*. VII, IX.

326. **Arca** (**Anadara**) **antiquata**, Linn. **37**, *II*. Maldives.

327. **Arca** (**Scapharca**) **rhombea**, Born, **37**, *II*. IX.

328. **Arca** (**Acar**) **symmetrica**, Reeve, **37**, *II*. VII, VIII.

329. **Arca** (**Acar**) **domingensis**, Lamarck, **24.** II, VII, IX, XIII, XIV.

330. **Arca (Barbatia) lacerata**, Linn. **37**, *II.* II.

331. **Arca (Barbatia) lima**, Reeve, **37**, *II.* II, V, IX, XIV, XV.

332. **Arca (Barbatia) tenella**, Reeve, **37**, *II.* I, IX, XV.

Family CARDITIDAE.

333. **Mytilicardia variegata**, Bruguière (*Cardita variegata*, Reeve, **37**, *I.*) I, IX, XI, XV.

Family GALEOMMIDAE.

334. **Galeomma formosa**, Deshayes, **40**, *b*, *III.* XIV.

335. **Thyreopsis coralliophila**, H. Adams, **2.** II.

In this remarkable genus the mantle is united ventrally, with a small anterior slit for the passage of a small pointed foot, and a very minute anal opening behind, near to which the surface is somewhat scabrous or minutely papillose. There is a narrow free fold of the mantle bordering the margin of the valves which are thickened within and gives rise to a delicate riblet which extends across the inner surface of each valve from a point near the middle about half way towards the umbo[1]. Only faint traces of adductor scars are visible and probably the free edge of the mantle above referred to is the principal means of attachment to the shell. It does not appear as if it would be reflected upon the exterior of the shell when living. In a form where the valves are permanently more or less spread out almost horizontally, the animal being too large for them to close, adductor muscles would be of little service, and therefore we might expect to find them but feebly developed. The shell is of a purplish tint within and without, except towards one end, which is white. The exterior is excessively finely concentrically striate and microscopically radiately striate and the inner surface of the valves appears to be minutely pitted. The dorsal margins are thickened within and the ligament is attached in a depression of this thickening immediately beneath the minute, glossy, convex, boss-like umbones.

Family TRIDACNIDAE.

336. **Tridacna cumingii**, Reeve, **37**, *XIV.* IX.

Family CARDIIDAE.

337. **Cardium leucostoma**, Born, **37**, *II.* IX.

338. **Cardium nebulosum**, Reeve, **37**, *II.* II.

339. **Cardium maculosum**, Wood, **37**, *II.* III.

340. **Cardium levisulcatum**, n. sp. (Pl. XXXVI. figs. 25, 26). IX.

Testa irregulariter quadrata, inaequilateralis, alba, mediocriter convexa, latere antico brevi, rotundato, postico oblique curvatim truncato, multo majori, margine ventrali late arcuato; valvae radiatim anguste sulcatae quam costis multo angustiores; costae planiusculae, circiter 25, quarum

---

[1] This riblet is only feebly indicated in Adams's type in the British Museum by a slight sinuation of the margin at that point.

anteriores squamis transversis subgranuliformibus subconfertis instructae, posteriores haud granulatae sed transversim tenuissime striatae.

Longit. 15 mm., alt. 12, diam. 8½.

Remarkable for its somewhat compressed and quadrate form, the slender radiating sulci and the slightly raised ribs, of which only the anterior half bear transverse granules, those on the hinder half of the shell being only very finely transversely striated. The colour is entirely white excepting the dorsal margin just in front of the umbones, which is stained with pink.

341. **Cardium sueziense**, Issel, **21**, **39**, *a*. II, X, XV.

342. **Cardium (Laevicardium) lobulatum**, Deshayes, **12**, *c*. II, III, V, VII.

343. **Cardium (Laevicardium) australe**, Sowerby, **37**, *II.* IX, XII, XIII, XV.

344. **Cardium (Laevicardium) biradiatum**, Bruguière, **37**, *II.* V, VII, IX, XII.

345. **Cardium (Ctenocardia) victor**, Angas, **4**. VIII.

The ribs on the greater part of this beautiful shell are alternately larger and smaller, the former being spinosely squamate and the latter only very delicately scaled. On the posterior end the costae are about equal in stoutness and ornamented with short scale-like spines.

346. **Cardium (Ctenocardia) fornicatum**, Sowerby, **37**, *II.* V, X.

Family CHAMIDAE.

347. **Chama jukesi**, Reeve, **37**, *IV.* I.

348. **Chama imbricata**, Broderip, **37**, *IV.* IX.

Family CYPRINIDAE.

349. **Meiocardia lamarckii**, Reeve, **37**, *II.* V.

350. **Trapezium oblongum**, Linn. **37**, *I.* V.

Family VENERIDAE.

351. **Venus reticulata**, Linn. **37**, *XIV.* I, IX.

352. **Venus marica**, Linn. **37**, *XIV.* IX, XV.

353. **Venus recognita**, Smith, **39**, *a*. II.

354. **Venus toreuma**, Gould. **37**, *XIII.* IX.

355. **Circe scripta**, Linn. **37**, *XIV.* VI.

356. **Lioconcha picta**, Lamarck (*Circe picta*, Reeve, **37**, *XIV*, **38**.) III—V, VII, IX, X, XII, XV.

357. **Lioconcha sulcatina**, Lamarck, **38**. VIII, var. IX.

The variety differs from the type in being smooth anteriorly, without the fine yet conspicuous concentric striae which usually occur at that end of the shell. In form and colour-pattern they exhibit scarcely any difference. One example however is entirely white.

Family PETRICOLIDAE.

358. **Petricola lapicida**, Chemnitz. **40**, *a*, *XIX*. II, VIII, XV.

Family PSAMMOBIIDAE.

359. **Psammobia rugulosa**, Adams and Reeve, **37**, *X*. X.

360. **Psammobia pulcherrima**, Deshayes, **37**, *X*, **39**, *a*. X.

The Maldive specimen is considerably larger than the type described by Deshayes, being 31 millim. long, and 16 broad. It is whitish with several irregular somewhat broken purple red rays which are also visible upon the inner surface of the valves. The scales upon the posterior costae become obsolete as the shell increases.

361. **Asaphis deflorata**, Linn. (*Capsa deflorata*, Reeve, **37**, *X*). IX.

Family ROCELLARIIDAE.

362. **Rocellaria gigantea**, Deshayes (*Gastrochaena gigantea*, Sowerby, **190**, *a*, *XX*). IX.

363. **Rocellaria mytiloides**, Lamarck (*Gastrochaena mytiloides*, Sowerby, **37**, *XX*). XII.

Family MESODESMATIDAE.

364. **Paphia trigona**, Deshayes (*Mesodesma trigona*, Reeve, **37**, *VIII*). IX.

365. **Paphia glabrata**, Gmelin (*Mesodesma glabrata*, Reeve, **37**, *VIII*). IX.

Family LUCINIDAE.

366. **Lucina (Codakia) divergens**, Philippi, **33**, *b*. (*Lucina fibula*, Reeve, **37**, *VI*). IX.

367. **Lucina (Codakia) punctata**, Linn. **37**, *VI*. IX.

368. **Lucina (Divaricella) dalliana**, Vanatta var. **42**. IX.

Three valves from the Maldives are a trifle more globose than S. African specimens, the divaricating lines are rather less numerous, and the smooth band, where they meet, is not quite so evident. In typical and especially in young examples the posterior straight dorsal margin forms a rounded angle where it meets the posterior curved outline. This angle is less apparent in the Hulule specimens.

The very fine crenulation within the margin of the valves is similar in both forms.

This species has been erroneously quoted by Mr Sowerby as *L. quadrisulcata*, d'Orbigny, (*Marine Shells S. Africa*, Appendix, p. 26). Of this I speak with certainty as the shells so-named by him are now in the British Museum.

369. **Cryptodon globosus**, Forskäl (*Lucina globosa*, Pfeiffer, **32**). IX.

Family TELLINIDAE.

370. **Tellina elegans**, Gray, **40**, *a*, *XVII*. IX.

371. **Tellina crucigera**, Lamarck, var. *amoena*, Deshayes, **37**, *XVII*. IX.

372. **Tellina rastellum**, Hanley, **19.** XV.

373. **Tellina dispar**, Conrad, **40,** *b*, *I.* IX.

Two specimens, one white suffused with pale yellow, the other exhibiting a broad rosy ray posteriorly and a fainter one in front.

374. **Tellina rhomboides**, Quoy and Gaimard, **19,** *a.* XV.

375. **Tellina robusta**, Hanley, **19,** *a.* X, XIV, XV.

376. **Tellina rugosa**, Born, **40,** *a*, *XVII.* IX.

377. **Tellina scobinata**, Linn. **40,** *a*, *XVII.* IX.

378. **Tellina carnicolor**, Hanley, **40,** *b*, *I* (*Tellina corbis*, Sowerby, **40,** *b*, *I.* *Tellina strangei*, Deshayes, **12,** *c.*) III, X.

The types of *T. corbis* and *T. strangei* being in the British Museum collection I have carefully compared them with Hanley's species and I fail to discern even varietal differences. The "more equilateral" form in *T. corbis* spoken of by Sowerby is so very slight as to be scarcely appreciable and may be regarded merely as an individual variation. *Tellina tessellata*, Deshayes from Moreton Bay (= *T. tenuistriata*, Sowerby, *Con. Icon.* fig. 128) is also closely allied but is somewhat differently sculptured. *T. tenuistriata* is described as "orange" in colour, but the figure is purplish brown in the copy of the work at hand. In reality it is of a pale fleshy tint and orange along the dorsal margins, with some opaque white markings radiating from the umbones.

379. **Tellina verrucosa**, Hanley, **40,** *a*, *XVII.* IV.

Family SCROBICULARIIDAE.

380. **Semele jukesi**, A. Adams (*Amphidesma jukesii*, Reeve, **37,** *VIII*). VIII.

Family CUSPIDARIIDAE.

381. **Cuspidaria elegans**, Hinds (*Neaera elegans*, Smith, **39,** *a*; *Neaera moluccana*, Adams and Reeve, **3**). X.

LITERATURE.

1. Adams, A. (*a*) *Proc. Zool. Soc.*, 1851, pp. 267 *et seq.*; (*b*) *Proc. Zool. Soc.*, 1853, pp. 69—74, 94—99, 116—119; (*c*) *Thes. Conch.*, Vol. II.

2. Adams, H. *Proc. Zool. Soc.*, 1868, pp. 12—17, 288—294.

3. Adams and Reeve. *Voyage "Samarang."*

4. Angas. *Proc. Zool. Soc.*, 1872, pp. 610 *et seq.*

5. Baird. *Brenchley's Cruise of H.M.S. "Curaçoa."*

6. Beck. *MSS.*

7. Canefri. *Ann. Soc. Mal. Belgique*, Vol. XV. p. 50.

8. Chenu. *Man. Conch.*

9. Chemnitz. *Conch. Cab.*, Vol. x.

10. Clessin. *Conch. Cab.*, Ed. 2.

11. Crosse. (*a*) *Journ. de Conch.*, Vol. xiii.; (*b*) *Rev. et Mag. Zool.*, Vol. x. 1858.

12. Deshayes. (*a*) *Maillard's L'Ile de la Réunion*, Vol. ii.; (*b*) *Journ. de Conch.*, Vol. vi.; (*c*) *Proc. Zool. Soc.*, 1854, pp. 317 *et seq.*; (*d*) *Proc. Zool. Soc.*, 1859, pp. 270 *et seq.*

13. Delessert. *Recueil de Coquilles.*

14. D'Orbigny. *Moll. Cuba*, Vol. ii.

15. Dunker. *Index Moll. maris Japon.*

16. Gmelin. *Syst. Nat.*

17. Gould. *Otia Conchologica.*

18. Gray. (*a*) *Proc. Zool. Soc.*, 1834, pp. 57 *et seq.*; (*b*) (? Gray) *Appendix*, King's *Australia*, Vol. ii.

19. Hanley. (*a*) *Thes. Conch.*, Vol. i.; (*b*) *Ipsa Linn. Conch.*

20. Hinds. (*a*) *Voyage "Sulphur" Mollusca*; (*b*) *Thes. Conch.*, Vol. i.

21. Issel. *Malacol. mar Rosso.*

22. Jousseaume. *Rev. et Mag. de Zool.*, Vol. xxiii.

23. Kiener. *Coq. viv.*

24. Kobelt. *Conch. Cab.*, Ed. 2.

25. Krauss. *Sudafr. Moll.*

26. Martens. *Mobius' Meeresfauna Mauritius, Mollusken.*

27. Melvill. (*a*) *Mem. Manchester Soc.*, Vol. xli.; (*b*) *Journ. Conch.*, Vol. x.

28. Melvill and Standen. (*a*) *Journ. Conch.*, Vol. viii.; (*b*) *Journ. Linn. Soc.*, Vol. xxvii. p. 150 *et seq.*

29. Melvill and Sykes. *Proc. Malac. Soc.*, Vol. iii.

30. Mörch. *Cat. Conch. Yoldi.*

31. Pease. (*a*) *Amer. Jour. Conch.*, Vol. iii.; (*b*) *Proc. Zool. Soc.*, 1860, p. 397 *et seq.*

32. Pfeiffer. *Conch. Cab.*, Ed. 2.

33. Philippi. (*a*) *Conch. Cab.*, Ed. 2; (*b*) *Abbild.*, Vol. iii.

34. Pilsbry. *Man. Conch.*, Vols. xi. xii. xiv. xv. xvii.

35. Quoy et Gaimard. *Voyage "Astrolabe."*

36. Récluz. *Journ. de Conch.*, 1850.

37. Reeve. *Conch. Icon.*, Vols. i. ii. iii. iv. v. vi. viii. ix. x. xi. xii. xiii. xiv. xv. xvii. xx.

38. RÖMER. *Novitat. Conch., Monogr. Venus*, Vol. I.

39. SMITH. (*a*) "*Challenger*" *Lamellibranchiata*; (*b*) *Proc. Malac. Soc.*, Vol. I.; (*c*) *Proc. Malac. Soc.*, Vol. III.; (*d*) *Proc. Malac. Soc.*, Vol. V.; (*e*) *Journ. Linn. Soc.*, Vol. XII.; (*f*) *Proc. Zool. Soc.*, 1878, pp. 804 *et seq.*; (*g*) "*Alert*" *Report.*

40. SOWERBY. (*a*) *Conch. Icon.*, Vols. XV. XVII. XVIII. XIX. XX.; (*b*) *Thes. Conch.*, Vols. I. II. III. IV. V.; (*c*) "*Tankerville*" *Cat., Appendix*; (*d*) *Proc. Malac. Soc.*, Vol. I.; (*e*) *Proc. Malac. Soc.*, Vol. IV.

41. TRYON. *Man. Conch.*, Vols. II. IV. VI. VIII. IX.

42. VANATTA. *Proc. Acad. Nat. Sci. Philad.*, Vol. LIII.

43. WEINKAUFF. *Küster's Conch. Cab.*, Ed. 2.

EXPLANATION OF PLATES.

PLATE XXXV.

Fig. 1. *Cryptophthalmus minikoiensis*, dorsal view.
Fig. 2. ,, ,, shell.
Figs. 3, 4. *Marginella picturata*, var.
Fig. 5. *Mitra* (*Costellaria*) *angustissima*, n. sp.
Fig. 6. *Nassa maldivensis*, n. sp.
Fig. 7. ,, ,, operculum.
Fig. 8. ,, ,, var.
Fig. 9. ,, *mulukuensis*, n. sp.
Fig. 10. ,, ,, operculum.
Fig. 11. ,, *subtranslucida*, n. sp.
Fig. 12. ,, *disparilis*, n. sp.
Fig. 13. *Murex* (*Ocinebra*) *submissus*, n. sp.
Fig. 14. *Sistrum iostoma*, A. Adams.
Fig. 15. *Triforis lilaceocinctus*, n. sp.
Fig. 16. ,, *excellens*, n. sp.
Fig. 17. ,, ,, sculpture magnified.
Fig. 18. ,, *gracilior*, n. sp.
Fig. 19. ,, ,, sculpture magnified.
Fig. 20. ,, *pura*, n. sp.
Fig. 21. ,, ,, sculpture magnified.

Fig. 22. *Natica euzona*, operculum.

Fig. 23. *Scalaria (Cirsotrema) texta*, n. sp.

Fig. 24. *Liotia squamicostata*, n. sp.

Figs. 25, 26. *Thalotia maldivensis*, n. sp.

Fig. 27. *Perrinia angulifera*, A. Adams.

PLATE XXXVI.

Figs. 1, 2. *Ethalia rhodomphala*, n. sp.

Fig. 3. *Ischnochiton hululensis*, n. sp.

Fig. 4. ,, ,, anterior valve.

Fig. 5. ,, ,, median ,,

Fig. 6. ,, ,, posterior ,,

Fig. 7. ,, *maldivensis*, n. sp.

Fig. 8. ,, ,, anterior valve.

Fig. 9. ,, ,, median ,,

Fig. 10. ,, ,, posterior ,,

Fig. 11. ,, *feliduensis*, n. sp.

Fig. 12. ,, ,, anterior valve.

Fig. 13. ,, ,, median ,,

Fig. 14. ,, ,, posterior ,,

Fig. 15. *Pecten cooperi*, n. sp. left valve.

Fig. 16. ,, ,, sculpture magnified.

Fig. 17. ,, ,, right valve.

Fig. 18. ,, ,, sculpture magnified.

Fig. 19. ,, *maldivensis*, n. sp. left valve.

Fig. 20. ,, ,, right valve.

Fig. 21. *Janira gardineri*, n. sp. left valve.

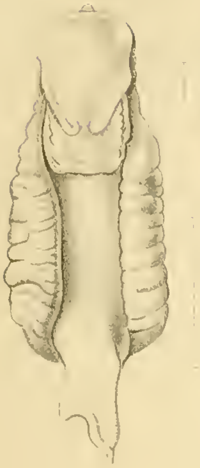
Fig. 22. ,, ,, right valve.

Fig. 23. *Amussium pauciliratum*, n. sp. exterior.

Fig. 24. ,, ,, interior.

Fig. 25. *Cardium levisulcatum*, n. sp. right valve.

Fig. 26. ,, ,, dorsal view.



1

2.

3

4

5

5

6

7

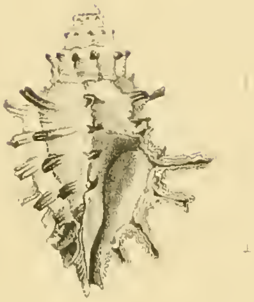
9

10

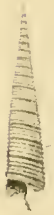
11

12

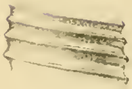
13



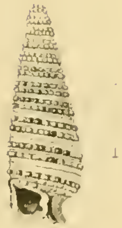
14



16



17.



15

18

19.

20

21

22

23

24

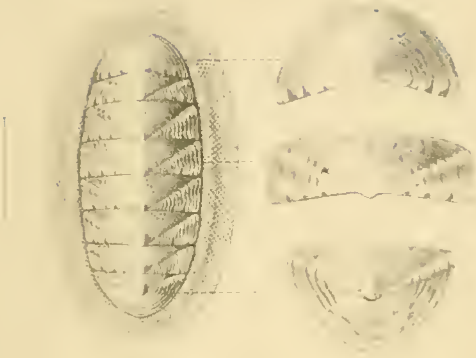
25

26

27

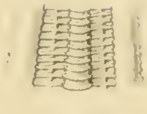
E Wilson, Cambridge.

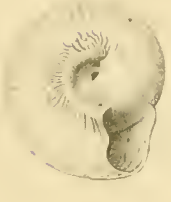
Edgar Smith - Mollusca


3
4
5
6

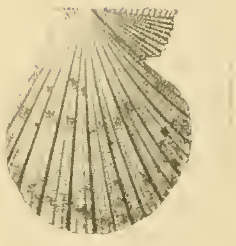

1

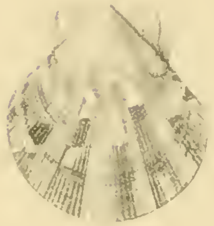

15

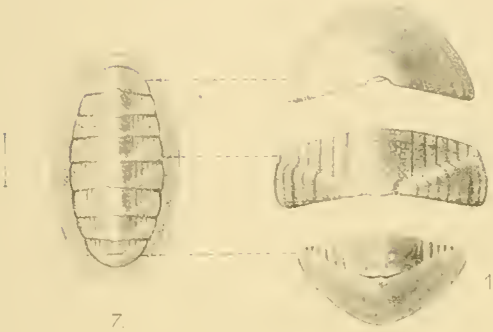

16


2

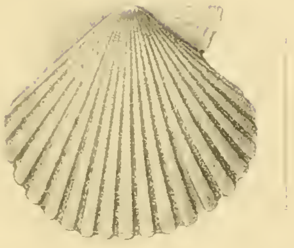

18

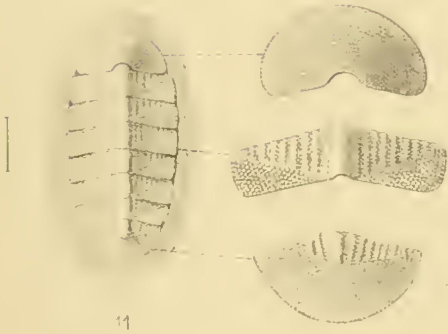

17.

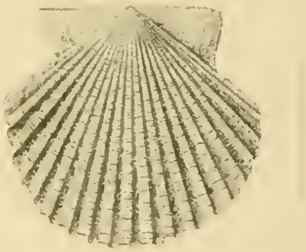

19


7.
8
9
10


20.

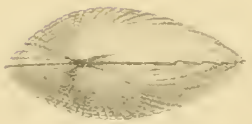

21

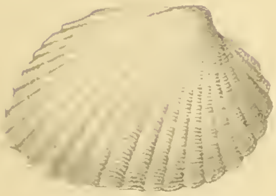

11
12
13
14.


22


23


24


25


26

E. Wilson Cambridge

Edgar Smith - Mollusca

THE ENTEROPNEUSTA.

By R. C. Punnett, M.A., *Fellow of Gonville and Caius College, and Demonstrator of Comparative Anatomy in the University of Cambridge.*

(With Plates XXXVII.—XLVI. and Text-figs. 120, 121.)

CONTENTS.

INTRODUCTION.

The collection of Enteropneusta brought together by Mr Stanley Gardiner is the most extensive hitherto made in any single locality, not only in the variety of forms, but also in point of numbers. To Mr Gardiner's recognition of the importance of collecting considerable numbers and to his perseverance and zeal I owe this opportunity of making some observations on the variation shewn by the genus *Ptychodera*, a field hitherto unexplored. The material is on the whole excellently preserved, and I would here express my thanks to Mr Gardiner for entrusting to me so interesting a collection. I am also greatly indebted to Mr Forster Cooper for the coloured sketches from life which form the first plate to this paper. With the account of the Laccadive and Maldive forms I have incorporated a description of an interesting new form kindly placed in my hands by Mr Crossland, who collected it in Zanzibar. Many regenerating specimens occurred in Mr Gardiner's collection. These I hope to make the subject of a subsequent paper.

SYSTEMATIC ACCOUNT.[1]

Fam. 1. **Harrimaniidae.**

(Not represented.)

Fam. 2. **Glandicipitidae.**

PAGE

Spengelia porosa, Willey, 1898 633

Sp. maldivensis, n. sp.

Collar relatively very short with cornua of nuchal skeleton extending to extreme hind end. Dorsal septum throughout collar. Medium proboscis septum very short. Dermal pits very small. No median gonads in post-branchial region. 635

---

[1] The classification adopted is that recently revised by Spengel.

PAGE

Willeyia bisulcata, nov. gen., n. sp.

Collar and proboscis both very long. Branchial part of œsophagus small compared with ventral portion. No dermal pits, synapticula or median gonads . 637

Fam. 3. **Ptychoderidae.**

Balanoglossus carnosus, Willey, 1899 640

B. parvulus, n. sp.

Small form with very short branchial region. Genital pleurae small and widely separate at collar. Gill pouches without ventral caecum. No accessory gonads. Collar cord with continuous lumen 640

Ptychodera flava, Eschscholtz, 1825.

Var. *parva*, nov. var.

Small form. Proboscis cavity large and with longitudinal muscles gathered into distinct separate bundles. Both proboscis pores functional. Number of dorsal roots 2—3. Branchial region short, *i.e.* less than 2 × collar length. Collar cord with continuous lumen. Nuchal cornua well developed . . . 644

Var. *laccadivensis*, nov. var.

Large form. Proboscis cavity large and with longitudinal muscles gathered into distinct separate bundles. Number of dorsal roots 3—6. Branchial region on the average more than 2 × collar length. Collar cord with continuous lumen. Nuchal cornua well developed 646

Var. *maldivensis*, nov. var.

Moderately large form. Proboscis cavity fairly large with longitudinal muscles gathered into distinct separate bundles. Dorsal roots only 1—2. Branchial region averages less than 2 × collar length. Collar cord with continuous lumen. Nuchal cornua short 648

Var. *saxicola*, nov. var.

Medium sized form. Proboscis cavity fairly large with longitudinal muscles gathered into distinct separate bundles. Dorsal roots 2—4. Branchial region very short, averaging only slightly more than collar length. Lumen of collar cord with tendency to obliteration. Nuchal cornua short 650

Var. *gracilis*, nov. var.

Small and rather slender form. Proboscis cavity fairly large with longitudinal muscles gathered into distinct separate radial bundles. Dorsal roots 2—3. Branchial region short, averaging about half as long again as collar length. Collar cord with continuous lumen. Nuchal cornua rather short 651

Var. *muscula*, nov. var.

Small, rather stoutly built form. Proboscis cavity much reduced and longitudinal muscles not gathered into distinct separate radial bundles. Branchial region fairly long, averaging more than 2 × collar length. Lumen of collar cord with marked tendency to obliteration. Nuchal cornua rather short . . . 653

PAGE

Var. *cooperi*, nov. var.

Very small form with short proboscis and collar. Proboscis cavity small and longitudinal muscles not gathered into distinct separate radial bundles. Branchial region rather more than 2 × collar length. Lumen of collar cord with tendency to obliteration. Nuchal cornua very long, overlapping branchial region 655

Pt. viridis, n. sp.

Medium sized form. Proboscis markedly longer than collar. Prevailing colour in life green. Proboscis cavity very small and longitudinal muscles not gathered into distinct separate bundles. Branchial region very short. Lumen of collar cord completely obliterated 656

Pt. asymmetrica, n. sp.

Rather small form. Proboscis cavity small and longitudinal muscles not gathered into distinct separate radial bundles. Lumen of collar cord almost obliterated. Gonads asymmetrical, on left side only 657

Spengelia porosa, Willey, 1898 (Pl. XXXVIII. fig. 13; Pl. XLI. figs. 5, 7; Pl. XLII. fig. 11).

Locality, etc. This species was found in three localities, viz.:

(*a*) Goifurfehendu Atoll, Goidu, where it was obtained from the sandy shore close to the east of the island in the sand below the weed and under some square slabs of beach sandstone in company with *Pt. flava*, var. *muscula*. (All this material was much macerated.)

(*b*) S. Mahlos Atoll, Mamaduwari, where it was very common under the beach sandstone masses to the north of the island.

(*c*) Male Atoll, Hulule. A single specimen was obtained from a hole in a coral mass dredged from 7 fathoms in the lagoon of Hulule Atoll. (Anterior end only.)

External features. In Willey's specimen the proboscis was of a rich yellow colour, the collar bright orange and the body generally of a dull yellow colour. No observations on the colour of the Maldive specimens have reached me except of the single one from Hulule. Mr Stanley Gardiner noted that the colour here was uniformly pale lemon. Much stress however cannot be laid on the difference in colour from Willey's specimen as this Hulule individual was represented only by the pre-genital part of the animal and was a rather small specimen.

The general appearance of the Maldive forms agrees closely with the figure given by Willey (**'99**, Pl. XXVII. fig. 8). The size also is about the same though the length of the proboscis as compared with the collar is on the whole slightly greater than in Willey's specimen. The relative length of the branchial region to the collar is on the average about 6, as in Willey's animal. In the single entire specimen in the collection the total length was 215 mm. The branchial region is fairly constant in its length relative to the collar in individuals of different sizes. The number of gill slits increases markedly with the size of the animal. These facts are brought out in the following table of measurements:—

	No. of Specimen.							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Length of collar	3	3	3	2·5	2·5	2·5	1·5	—
„ „ proboscis	5·5	6	5	5	4·5	4·5	4	—
„ „ branchial region ...	20	17	16	17	17·5	17	10·5	9
Total length.......................	—	215	—	—	—	—	—	—
$\frac{\text{Branchial length}}{\text{Collar length}}$	6·6	5·6	5·3	6·8	7	6·8	7	—
No. of gill slits	116	—	110	104	102	88	74	58

The specimens are given in order of size, (1) being the largest, (8) the smallest.

In his account Willey states that external liver saccules are not present in the allied species *S. alba* (**'99,** p. 277), "although, when fresh, the annular ridges were found to be turgid and to present the appearance of rudimentary saccules, an appearance which was almost entirely lost after preservation." He was unable to state anything with regard to this region in *Sp. porosa* as his only well-preserved specimen lacked the post-genital portion of the body. External liver saccules are nevertheless present in *Sp. porosa,* though they are not very prominent (Pl. XXXIX. fig. 13). That they project somewhat from the dorsal surface may be more readily seen in transverse sections (see Pl. XLI. fig. 5). They are also characterized by their green colour.

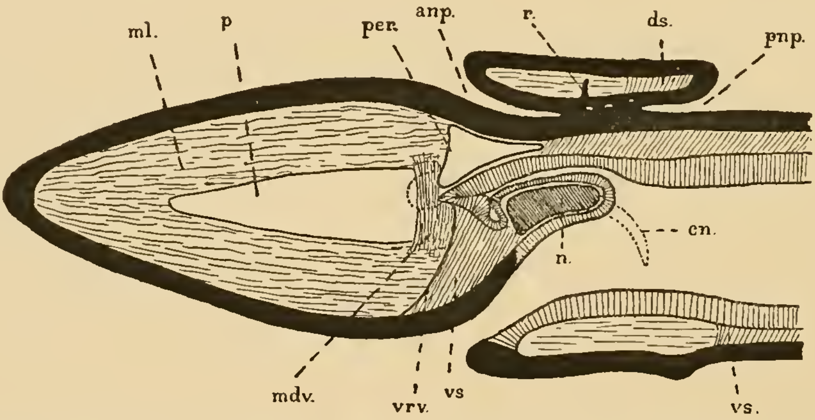


Fig. 120. Schematic reconstruction of anterior end of *Sp. porosa,* × 10. The dotted line in front of the stomochord indicates the forward extension of the pericardial auricles. For lettering see p. 676.

Internal structure. To the full and careful account given by Willey I have little to add, and that chiefly in regard to the post-genital region which, as has already been mentioned, was absent in his specimen.

Proboscis. In Willey's specimen the ventral recurrent vessel was independent of the ventral septum. In the three specimens which I have examined it runs up to the central complex in the anterior free edge of the ventral septum (Text-fig. 120, *vrv.*).

Willey states that the median muscular system extends over about $\frac{1}{3}$ of the length of the proboscis. It is not quite so long in the Maldive forms and may be exceedingly short (Text-fig. 120, *mdv.*), not extending quite so far forwards as the pericardial auricles.

The vermiform process is usually well-marked and coextensive with the dorso-ventral muscles. In the instance where these muscles were reduced the vermiform process had altogether disappeared.

Collar. Willey states that "there is no dorsal septum in the collar, except the fold of basement-membrane associated with the first vestigial root, which is probably to be regarded as a vestige of the dorsal septum. On the other hand the ventral septum has an unusual forward extension, commencing a short distance behind the region of bifurcation of the nuchal skeleton." In the Maldive forms the dorsal septum is present though only at the hind end of the collar (Text-fig. 120, *ds.*), whilst no ventral septum is to be found.

A vestigial root was found in one of the three specimens examined. It was, however, very small and did not reach to the epidermis (Text-fig. 120, *r.*). Both anterior and posterior neuropores are very deep, so that only about $\frac{1}{3}$ of the collar cord is devoid of a continuous lumen. This portion contained traces of a cavity.

In his specimen Willey found that the cornua of the nuchal skeleton extended to the extreme posterior end of the collar. This may be the condition in the Maldive specimens, whilst on the other hand the hindermost quarter of the collar may be without cornua.

The collar canals open into the first branchial pouch and I have been unable to find the truncal canals described by Willey.

Trunk. The branchial and genital regions agree closely with Willey's account.

In the hepatic region there is no internal circular musculature. The longitudinal muscles are gathered into three bands on either side, viz. a dorsal, a ventral, and a lateral one (Pl. XLI. fig. 5). Consequently there are in this region two longitudinal areas where no muscle fibres intervene between the intestinal wall and the epidermis.

In the intestinal region there is a longitudinal dorsal groove on either side which shews slight depressions at intervals (Pl. XLI. fig. 7). The circular muscles form a complete ring round the body here but the longitudinal muscles are wanting beneath the grooves. The intestine itself is small and laterally compressed, the body cavity being occupied by strands of connective tissue.

Although there are several small points of difference between the Maldivan forms and Willey's specimen I have thought it best, in view of the considerable variations shewn on these very points, not to separate these forms from Willey's. It is possible that when more material is forthcoming the differences may be found to be sufficient to separate them as distinct varieties.

Spengelia maldivensis, n. sp. (Pl. XLI. figs. 6, 8; Pl. XLII. fig. 20).

Locality, etc. Hulule. From beach sand-rock. A single specimen only was obtained and this lacked the posterior part of the body, which was broken away in the genital region.

External features. A small form and the colour after preservation is quite white. The total length of the fragment obtained was 21 mm. Of this the proboscis measured 4 mm., the collar 1·8 mm. (with a width of 3 mm.), whilst the length of the branchial region was 6 mm. Characteristic is the shortness of the collar, the length of which is not much more than half its width. The width of the genital region did not exceed 3 mm.

INTERNAL STRUCTURE.

Proboscis. The outer circular muscle layer is very delicate. The proboscis contains a central cavity which is not divided into right and left portions in front of the central complex. The long verniform process of the stomochord runs forwards dorsal to the cavity (Pl. XLI. fig. 8, *v.*). It is somewhat fragmented in places. Where it joins the stomochord proper appears the ventral septum separating the ventral coelom into two portions, which do not subsequently join with one another. A dorsal septum also occurs in front of the junction of the pericardium with the basement membrane below the epidermis. The lumen of the stomochord is well marked in some places though obliterated in others. The lumen of the lateral diverticula is only patent at the extremity of each. The chondroid tissue is well developed. The nuchal skeleton possesses a well-marked keel.

The left proboscis pore alone is present. The right perihaemal cavity reaches forwards considerably further than that of the left side (Pl. XLI. fig. 6, *ph.*).

The pericardial auricles are very short.

Collar. The outer longitudinal muscles are poorly developed and there is no circular layer. The collar is without a cavity. The dorsal septum extends through the length of the collar, whilst the ventral one is only found complete at the posterior end.

The nerve cord is practically solid throughout, only very faint traces of a lumen being discoverable here and there. There is no sign of any dorsal root.

The cornua of the nuchal skeleton are long and reach backwards to the extreme hind end of the collar (Pl. XLI. fig. 8, *cn.*) and to some extent overlap the branchial region.

The collar pores open into the first gill pouch, which possesses a small diverticulum reaching forwards for a short distance ventral to the collar canal (Pl. XL. fig. 8, *p.* 1). This is doubtless the structure referred to by Willey (**'99**, p. 280) as the truncal canal. In the present species it possesses no trace of an opening into the perihaemal space, and the diverticulum differs in nowise histologically from the rest of the gill pouch, thus lending no support to the morphological importance with which Willey is inclined to regard them.

Trunk. The circular musculature is, as usual in this genus, found inside the longitudinal layer. In the branchial region the ventral portion of the œsophagus is almost as large as the branchial division, the proportions being similar to those in *Sp. porosa* as figured by Willey (**'99,** Pl. XXXI. fig. 45). About nine synapticula are present on each gill bar. A distinct but small post-branchial groove is present (Pl. XLII. fig. 20). The grooves into which the gill pouches open are produced backwards past the branchial region. They do not however exhibit the peculiar depressions found in *Sp. porosa* and *Sp. alba* which Willey has termed dermal pits. Too much stress must not be laid on their absence, however, as the gonads are somewhat immature and it is possible that with their increase in size small dermal pits might arise. There is little doubt that they would never reach the same development as in the above-named forms, a circumstance probably correlated with the smaller size of the species under consideration.

In the branchial region both median and lateral gonads are present. In the genital region however the lateral gonads alone are present. The median gonads are always very small and are not nearly so numerous as the lateral ones.

Though the above species has been created on the strength of a single imperfect specimen yet in its short collar, its undivided proboscis cavity, the reduction or absence of its dermal pits and median gonads, it exhibits structural differences sufficient to separate it at once from *Sp. porosa* and *Sp. alba*, the only two species of this genus hitherto described.

Willeyia bisulcata, nov. gen., n. sp. (Pl. XXXVIII. figs. 14, 23; Pl. XXXIX. fig. 29; Pl. XLI. figs. 9, 10; Pl. XLII. figs. 12—16).

LOCALITY, ETC. This species was fairly abundant at Zanzibar, whence portions of two specimens were brought back by Mr Crossland. They were obtained by digging in mud on which *Zostera* was growing at low-water mark.

EXTERNAL FEATURES. To judge from the fragments the length of this species must in the entire state be considerable. The proboscis is about double the length of the collar and is marked both dorsally and ventrally by a deep median groove (Pl. XXXVIII. fig. 14). Its width is somewhat greater than its dorso-ventral depth. The collar is long and is somewhat broader behind than in front. Near its posterior end there is a well-marked circular groove. In one of the two specimens available, which was somewhat larger than the other, the length of the proboscis was 14 mm., that of the collar 7 mm. The average breadth of both was about 4 mm. The branchial region and trunk have each a breadth somewhat less. In the specimen above alluded to some 32 mm. of the branchial region were still attached to the collar. No external liver saccules were visible on any of the fragments. Probably they are not present. No portion of the caudal region was preserved. With the exception of the proboscis, which is somewhat dorso-ventrally flattened, the whole body of the worm is more or less cylindrical. When living the animal was of a uniform cream colour.

Proboscis. The epithelium is high though almost destitute of glands. It shews a very distinct layer of elongated nuclei about its middle and numerous small rounded nuclei in its deeper portion. The layer of nerve fibrils is very distinct and well developed throughout this region and rests on a fine but clearly marked basement-membrane. The circular muscle layer is strong, being nearly half as thick again as the nervous layer. The longitudinal muscles are well-developed, filling the greater portion of the proboscis (Pl. XLII. fig. 12). The nervous layer is thickened in the grooves.

The proboscis coelom consists of a right and a left cavity which are entirely separate throughout. They are lined by a well-marked epithelium which is considerably thickened near the middle line (Pl. XLII. fig. 12 and Pl. XXXIX. fig. 29). The two divisions of the coelom are surrounded by a common layer of circular muscles (Pl. XLII. fig. 12). The left division of the proboscis coelom communicates with the exterior by a large pore (Pl. XLI. fig. 9). The right division ends blindly. No dorsal septum is present but there is a well-marked ventral septum, at the upper edge of which runs the ventral recurrent vessel of the proboscis (Pl. XLII. figs. 11 and 12, and Pl. XXXIX. fig. 29, *vrv.*). This septum springs from almost the tip of the proboscis and does not become complete until shortly behind where the pericardium arises. Here the ventral vessel becomes connected with the vessels of the glomerulus. On either side of the middle line are found dorso-ventral muscles, the dorsal ones being more marked than the ventral. Both converge towards the vermiform process of the stomochord where this structure is found (Pl. XXXIX. fig. 29).

The stomochord exhibits a well-marked lumen throughout, both in its central portion and in the lateral diverticula. Anteriorly it is produced forwards as a vermiform process which is about $\frac{2}{3}$ of the length of the rest of the stomochord (Pl. XLII. fig. 10).

The nuchal skeleton is strongly developed, occupying a large portion of a transverse section in the region of the proboscis stalk (Pl. XLI. fig. 9). The keel is strongly developed but much blunted, its side to side diameter being greater than the dorso-ventral one.

The pericardium is provided with two small "auricles" reaching forward about $\frac{1}{10}$ mm. from the main structure on either side.

Collar. The epithelium of this region is high and fairly well provided with gland-cells. The posterior part of the collar on either side of the circular furrow is characterized by a more highly glandular zone. In the preserved specimens this region is somewhat paler in colour than the rest of the collar. The nerve fibre layer is distinct, whilst, as in the proboscis, the basement-membrane is thin. There is no layer of circular muscles outside the longitudinal musculature.

The collar coelom is entirely filled by longitudinal muscle fibres and connective tissue, with the exception of a small space round the opening of each of the collar funnels. The dorsal septum is complete throughout the entire length of the collar. The ventral septum is lacking only at the extreme anterior end (Pl. XLI. fig. 10).

The median nuchal skeleton is long whilst its cornua are exceedingly short (Pl. XLI. fig. 10), a feature in which this genus differs markedly from the remaining members of the family. The cornua embrace nearly $\frac{2}{3}$ of the total circumference of the œsophagus.

The collar cord exhibits a well-marked anterior and a smaller posterior neuropore. The anterior neuropore especially reaches some way down into the collar (Pl. XLI. fig. 10). Towards its hinder limit it becomes somewhat separated off from the nerve cord on the dorsal surface of the latter. It is lined with a definite epithelium somewhat glandular and richly provided with cilia. The nerve cord itself is quite solid and is almost entirely surrounded by a layer of nerve fibres (Pl. XXXVIII. fig. 23). In its hinder portion it shews a well-marked ridge projecting up towards the dorsal septum. This ridge is filled with cells containing a yellowish-brown pigment. These cells reach a little way into the nerve cord and similar cells are also to be found in the perihaemal spaces (Pl. XXXVIII. fig. 23). Pigment has previously been described by Spengel (**'93,** p. 134 and Taf. 7, figs. 2, 12, 14) in the collar cord of *Balanoglossus apertus*. Without going so far as Willey (**'99,** p. 316) in claiming that the dorsal roots are homologues of the vertebrate pineal eyes it is yet conceivable that these aggregations of pigment may serve for the perception of light rays. Besides this small dorsal ridge there occurs no representative of dorsal roots in *W. bisulcata*.

From the anterior part of the collar cord passes off on either side a well-marked nerve to the layer of nerve fibrils beneath the œsophageal epithelium. These I have termed the œsophageal nerves (Pl. XLII. fig. 16, *on.*).

With regard to the histology of the collar cord it may be stated that giant cells, such as Spengel (**'93,** p. 609) has described for several species of Enteropneusts, are absent. Certain of the ganglion cells near the dorsal surface attain a somewhat larger size, but this does not exceed 20—25 μ. Faint vestiges of the remains of cavities in the cord are visible here and there under a high power. The pigment referred to above is found along the whole length of the cord.

The perihaemal spaces are well developed and ventrally contain transverse muscle fibres. They do not come into contact with one another until just in front of the point where the cornua of the nuchal skeleton diverge. Anterior to this they are widely separated by the stomochord.

The right and left peripharyngeal spaces are separate except at the hind end of the collar, where they meet ventrally. As they reach forwards their ventral borders slope obliquely and gradually upwards until the two borders merge at a spot dorsal to the œsophagus, where the circular muscles which the spaces contain are inserted into the nuchal skeleton. Where the peripharyngeal spaces are deficient ventrally the œsophagus is still provided with a layer of circular muscles probably derived from the longitudinal musculature.

Branchial region. One of the chief characteristics of the present species as compared with the other members of its family lies in the fact that the branchial portion of the œsophagus is of considerably less extent than the remainder (Pl. XLII. fig. 13). This results in the septal and tongue bars being relatively short. The musculature is in this region well-developed. Beneath the powerful longitudinal layer is a sheath of circular fibres extending up to the lower ends of the gill pouches. Noteworthy is the position of the ventral nerve cord which projects so far inwards that it almost abuts against the circular muscles. Of the posterior branchial region it is not possible to give any account, since I have been unable to identify it among the fragments which have come to me. Synapticula are absent. The first three gill pouches are dorsally confluent, forming a chamber with a single external pore into which opens the collar pore. No trace of truncal pores is to be found resembling those described by Willey (**'99**, pp. 273, 280) for *Spengelia*. The branchial region is probably devoid of gonads, or if these occur here it is only in its most posterior portion that they are to be found. In the specimen with the greater attached length of branchial region, this was about 4½ times the length of the collar. No gonads were present even at the extreme end of this fragment.

Schizocardium	*Glandiceps*	*Spengelia*	*Willeyia*
Pericardial auricles very large.	Pericardial auricles very small.	Pericardial auricles small.	Pericardial auricles small.
No dermal genital pits.	No dermal genital pits.	Dermal genital pits.	No dermal genital pits.
Œsophageal part of branchial sac very small.	Œsophageal part of branchial sac reduced to a broad tract.	Œsophageal part of branchial sac a deep groove.	Œsophageal part of branchial sac much larger than branchial part.
Peripharyngeal cavities.	No peripharyngeal cavities.	Peripharyngeal cavities.	Peripharyngeal cavities.
Cornua of nuchal skeleton to posterior collar region.	Cornua of nuchal skeleton to posterior collar region.	Cornua of nuchal skeleton to posterior collar region.	Cornua of nuchal skeleton not found in posterior half of collar.
No median gonads.	Median gonads present or absent.	Median gonads present or absent.	No median gonads.
Synapticula.	No synapticula.	Synapticula.	No synapticula.
External liver saccules.	No external liver saccules.	External liver saccules present or absent.	(?)
Ventral proboscis septum long and reaching vermiform process.	Ventral proboscis septum short and not to vermiform process.	Ventral proboscis septum short and not to vermiform process.	Ventral proboscis septum very long but not to verminform process.

Genital region. The longitudinal muscles are still strongly developed (Pl. XLII. fig. 14) but the circular layer has now disappeared. The ventral nerve cord still shews the peculiar deeply sunk position which it exhibited in the branchial region. Subgenital pits such as Willey found in *Spengelia* (**'99**, p. 274) are absent. The gonads form a single row on either side of the body. Ripe spermatozoa occurred in the specimen from which the sketch of the genital region was taken.

As belonging to the family Glandicipitidae there have already been described three genera, viz. *Schizocardium*, *Glandiceps*, and *Spengelia*. It cannot be said with any confidence that *Willeyia* bears a closer resemblance to any one of these genera than to another. Features which separate it from all these three are the shortness of the nuchal cornua, the comparatively small extent of the branchial portion of the œsophagus as compared with the digestive, and possibly also the absence of gonads in the branchial region. With respect to other features of generic importance *Willeyia* resembles now one genus and now another. To which of the above genera it bears most resemblance with respect to the more salient features of its anatomy may be gathered from the appended table, p. 639.

Balanoglossus carnosus, Willey, 1899 (Pl. XXXVII. fig. 3).

Locality, etc. The greater portion of a very large specimen was obtained at Minikoi, at the base of a cylindrical casting in the sand flat lagoon. Fragments of the same species were also found at Hulule in sand under a large Porites mass close to the boulder zone.

A coloured sketch was made of the Minikoi specimen by Mr Forster Cooper before preservation. This is reproduced on Pl. XXXVII. fig. 3, and shews the natural colours of the animal. A bright yellow line occurred mid-ventrally which was probably the nerve cord.

The dimensions of this large specimen were taken by Mr Gardiner while it was yet alive. I have also taken them on the preserved specimen and the results of both are as follows:—

	Living	Preserved
Length of proboscis beyond collar...	9 mm.	3 mm.
Breadth ,, ...	5 ,,	—
Length of collar.........................	22 ,,	13 ,,
,, ,, branchial region	—	60 ,,
,, ,, genital pleurae...............	—	204 ,,
,, ,, animal obtained	440 ,,	355 ,,

When alive and undamaged the animal probably exceeded 60 cm. in length, and possessed an average diameter of 10—12 mm. The above measurements agree fairly well with those given by Willey (**'99**, p. 248). There appears to be considerable variation in the relative length of the branchial region which may be somewhat less than double the collar length, or may be as much as four times as much. The present specimen agrees with the largest of Willey's specimens, which it rivals in size, in having a relatively long branchial region.

In addition to the above fairly complete specimen a number of jelly tubes were found at the surface in castings similar to that which marked the position of the large worm. These tubes were much distended with sand, and of a transparent straw colour with bright yellow mid-dorsal and mid-ventral lines. The edge of the free (= anal ?) end was marked by brown-black pigment. Doubtless these tubes are the broken off caudal ends of this species. Like *Pt. flava* (see p. 646) it may have developed the habit of autotomy.

Balanoglossus parvulus, n. sp. (Pl. XXXVIII. figs. 15, 18, 22; Pl. XXXIX. fig. 24; Pl. XLI. figs. 1—4).

Locality, etc. Represented only by a fragment comprising the anterior end and including the proboscis, collar, branchial region, and a portion of the genital region. From Mahlos Atoll.

External features. An exceedingly small form. The proboscis is nearly 1·5 mm. in length and is somewhat longer than the collar (Pl. XXXVIII. fig. 18). The branchial region is about half as long again as the collar. Width of collar and proboscis about 1·5 mm. The width of the branchial region is not quite so great, whilst the genital region is less than 1 mm. wide. The anterior border of the collar is rather wider than the rest of this part of the animal and is somewhat crinkled. Posteriorly the collar shews a well-marked circular furrow (Pl. XXXVIII. fig. 18, *t.f.*). The genital pleurae are small and are widely separated from each other where they join the collar. The mature and swollen gonads in this specimen cause the edges of the pleurae to assume a somewhat beaded appearance.

Proboscis. The proboscidial coelom is almost entirely filled by connective tissue and muscle fibres. A delicate layer of longitudinal muscle fibres is found beneath the basement membrane, but circular fibres are absent. Traces of a dorsal septum are to be found slightly in front of the pericardial sac. The ventral septum is complete at a level shortly before that at which the glomerulus ends; it carries the ventral glomerulus vessels. The ventral proboscis coelom is packed with muscle fibres and connective tissue except at its extreme posterior end where the ventral septum is lacking (Pl. XXXVIII. fig. 22, *v.c.*). A racemose organ is not present.

A single median proboscis pore is present, placing the left division of the dorsal proboscis coelom in communication with the exterior (Pl. XXXVIII. fig. 22, *p.p.*). The right moiety of the dorsal proboscis coelom ends blindly. Throughout its whole extent the stomochord shews a well-marked lumen. The lateral diverticula of the stomochord are small (Pl. XXXVIII. fig. 22, *s.c.*). The nuchal skeleton is provided with a deep narrow keel (Pl. XLI. fig. 3, *sk.* 1). The chondroid tissue in this region is exceedingly scanty.

Collar. The collar epithelium is very thick (Pl. XXXIX. fig. 24, *ep.*). The glandular zone commences at the level where the cornua of the nuchal skeleton terminate and reaches to the commencement of the collar funnels. The outer longitudinal muscle layer is well-marked, particularly in the anterior and middle regions of the collar (Pl. XXXIX. fig. 24, *el.*). The inner longitudinal layer is also strongly developed. No circular muscle fibres are present.

The collar coelom is entirely filled with muscle fibres and connective tissue except for a very small space on either side of the dorsal septum. This last-named structure is first found immediately behind the first dorsal root in the middle of the collar region. Traces of a ventral septum exist but in no place is it complete. The collar funnels are of the usual form and open into the first gill pouch.

The cornua of the nuchal skeleton extend half-way round the œsophagus. In length they are short, being only about $\frac{1}{7}$ of the total collar length.

The collar cord is tubular containing a single axial canal (Pl. XXXVIII. fig. 15) surrounding which are the ganglion cells. The layer of dorsal ganglion cells (Pl. XXXVIII. fig. 15, *gcd.*) is thin, being best marked in the region where the first and second dorsal roots are given off. Above it is a much attenuated layer of nerve fibrils. The ventral ganglion cells (*gcv.*) are much more numerous and in transverse section are seen as a V-shaped mass shewing a bifurcation at the point of the V. The layer of nerve fibrils surrounding them is well-developed. Separating the dorsal and ventral ganglion cells on either side is a layer of large oval vacuolated cells—probably gland cells from which the secretion has been ejected or dissolved out. Some deeply staining mucoid substance is to be found in the medullary canal. Here and there occur ganglion cells rather larger than the rest, but no giant cells are present such as have been figured by Spengel for *B. apertus* (**'93**, Taf. 7, fig. 18). Except at its anterior end the collar cord is sunk in the perihaemal spaces which embrace it on either side and which may posteriorly reach nearer to the dorsal surface than the cord itself. The medullary canal communicates with the exterior by the anterior and posterior neuropores.

The first two dorsal roots are large, close together, and contain nerve fibrils but are devoid of a lumen. They spring from a common crest and reach the epidermis where their nerve fibrils fuse with the nervous layer of the skin. Behind these are two or three small incomplete roots with traces of a lumen but without nerve fibrils.

A well-marked peripharyngeal space surrounds the œsophagus (Pl. XXXIX. fig. 24, *pph.*) reaching dorsally to where the cornua of the nuchal skeleton diverge, and ventrally somewhat anterior to this point.

Branchial region. This region is characterized by the small genital pleurae which are widely separate at their junction with the collar. At the base of the pleurae open the gill pouches (Pl. XLI. fig. 1, *bp.*) which are not provided with ventral caeca. The branchial and digestive portions of the œsophagus are approximately of equal size. Gonads are not found in the anterior fourth of the branchial region. Not more than six synapticula are present on either side of the tongue bars. The post branchial canal is large and the posterior incipient gill slits open into its ventral portion (Pl. XLI. fig. 2, *).

Genital region. The great bulk of this region is occupied by the gonads in the much swollen pleurae (Pl. XLI. fig. 4). Accessory gonads are not present, but each gonad is roughly two-branched, one division lying on either side of the lateral septum. The genital pores are found on the edges of the pleurae at the spot where the lateral septum joins the epidermis. The single specimen was an adult female.

Affinities. The genital pleurae of *B. parvulus* are relatively smaller than in any other member of the genus and in this respect it approximates to the genus *Glossobalanus*. Of the members of its own genus it bears most resemblance to *B. apertus* (Spengel, **'93**). In both the genital pleurae are widely separate where they join the collar, and this character serves to distinguish these two species from all the other members of the genus except *B. misakiensis* (Kuwano, **'02**). Both *B. parvulus* and *B. apertus* are small forms without accessory gonads, with a tubular collar cord, and with gill pouches unprovided with a ventral caecum. The present species however differs from *B. apertus* in the following features.

B. parvulus	*B. apertus*
Branchial region but little longer than the collar.	Branchial region several times as long as collar.
Gonads open at edges of genital pleurae.	Gonads open on inner surface of genital pleurae.
No circular muscles to body-wall.	Feeble circular musculature.
Tongue bars with not more than 6 synapticula.	Tongue bars with about 10 synapticula.
Medullary tube open at either end.	Medullary tube closed at either end.
Giant ganglion cells not found in collar cord.	Giant ganglion cells present in collar cord.

In *B. parvulus* also the keel of the nuchal skeleton is more marked, whilst the ventral proboscis coelom has undergone greater reduction. An idea of the relations of these two species with the other members of the genus may be gathered from the appended table.

	Size	Relative lengths of proboscis and collar	Relative lengths of branchial region and collar (approximately)	Genital pleurae	Gill pouches	Gonads	Proboscis pores	Collar cord	Roots
parvulus	Very small	Proboscis rather longer	Branch. = 1—2 × collar	Small and not in contact at collar	Without ventral caecum	No accessory. Primary branched	Median pore. Rt. coelomic sac ends blindly	Tubular	—
apertus	Small	(?)	Branch. = at least 4 times collar length	Small and not in contact at collar	Without ventral caecum	No accessory	As *parvulus*	Tubular	5 (from fig.)
australiensis ...	Large	About equal	Branch. = 3—4 × collar	Large	Without ventral caecum	No accessory. Primary much branched	Two median and confluent or single median or left only	Solid	1—5, usually 4
aurantiacus ...	Not large	Proboscis not so long as collar	Branch. = more than 5 × collar	Large	Without ventral caecum	Accessory present	As *parvulus*	Traces of cavity	1 only
clavigerus	Large	About equal	Branch. = 2—3 × collar	Large	With ventral caecum	No accessory	As *parvulus*	Traces of cavity	2—3
gigas	Giant	Proboscis about $\frac{1}{2}$ length of collar	Branch. = 5 × collar (?)	Large	With ventral caecum	No accessory (?)	As *parvulus*	(?)	(?)
carnosus	Giant	Proboscis usually less than $\frac{1}{2}$ collar length	Branch. = 2—4 × collar	Large	With ventral caecum	No accessory (except in very old ones)	As *parvulus*	Traces of cavity	2—3
biminiensis ...	Large	Proboscis less than $\frac{1}{2}$ length of collar	Branch. = 4 × collar	Large	With ventral caecum	Accessory present	Two pores, median, confluent. Rt. coelomic sac ends blindly	Solid	1 only
jamaicensis ...	Giant	Proboscis much less than collar length	(?)	Large	With ventral caecum	Accessory present	Two pores. Separate	Solid	1 only
misakiensis ...	Large	Proboscis nearly as long as collar	Branch. = 4 × collar	Large but not in contact at collar	Without ventral caecum	Accessory present	Nearly median pore. Rt. coelomic sac ends blindly	(?)	(?)

Ptychodera flava, var. **parva** (Pl. XXXVIII. figs. 16, 20, 21; Pl. XXXIX. fig. 26; Pl. XLIII. figs. 21—28; Pl. XLIV. figs. 30—32; Pl. XLVI. fig. 48).

LOCALITY, ETC. From Turadu, S. Mahlos Atoll. About a dozen specimens procured, all more or less of the same size. They were dredged from 20 fathoms on a bottom of coarse sand.

EXTERNAL FEATURES. A small, somewhat short and slender form. The proboscis is of about the same length as the collar, which measures 2·5—3 mm. long, and is of approximately the same width. Behind the branchial region the body is not more than about 2 mm. wide. The liver saccules are not large and are slightly lobulated in the larger specimens. There is no apparent differentiation in colour among them as is usual in this species. The average length of the branchial region is about 1½ times the length of the collar, it being thus comparatively short (*vide* p. 673). In the single entire specimen the total length was only 30 mm.

INTERNAL STRUCTURE.

Proboscis. A delicate layer of circular fibrils surrounds the longitudinal muscles which are gathered together into radial bundles. A few longitudinal fibres are more closely gathered round the central lumen of the proboscis and give it a definite outline (Pl. XLIII. figs. 21, 22). Dorso-ventral muscles are always found dorsal to the central complex anterior to the pericardium. The ventral proboscis septum is well-marked and reaches forwards almost or quite to the tip of the stomochord. Both dorsal divisions of the dorsal proboscis coelom are in communication with the exterior by the paired and equal proboscis pores (Pl. XLIII. fig. 26). In one case the proboscis pores opened together almost in the mid-dorsal line (Pl. XLIII. fig. 23), a condition of great rarity in this genus and recalling those obtaining in *Balanoglossus apertus* (Spengel, **'94**) and *B. jamaicensis* (Willey, **'99**, p. 293).

The racemose organ is usually well-marked but is never lobulated. The lumen of the stomochord anterior to the lateral diverticula may be fairly distinct or almost obliterated. The lumen of each lateral diverticulum is large and open at the end but the portion by which it would communicate with the central lumen is usually almost or quite obliterated.

Collar. Beneath the basement-membrane is found a fine but definite layer of longitudinal muscle fibres. In the anterior part of the collar they are rather better developed and here directly enclose a delicate layer of circular muscles. No outer circular layer is found over the greater part of the collar. The anterior free cavity of the collar coelom is very spacious (Pl. XLIII. fig. 27, *c.*) extending as usual completely round the œsophagus in this region. Inside it are found the inner longitudinal muscles of the collar and within these again the peripharyngeal spaces with their enclosed circular muscle fibres. The dorsal collar septum is as usual complete immediately behind the first root. In one case it was complete just anterior to this structure. The ventral septum may be absent or present in the extreme hind portion of the collar.

The nerve cord exhibits a complete lumen throughout, though sometimes with a faint tendency to obliteration. When this occurs the height of the cord as seen in transverse section is rather greater than usual and the gland cells are more numerous (cf. Pl. XXXVIII. figs. 20 and 21). The number of the dorsal roots is either two or three. The majority reach to the ectoderm.

The cornua of the nuchal skeleton extend over nearly a quarter of the length of the collar. Their length is apparently very fairly constant for this variety (cf. Table 1, p. 645).

TABLE 1.

Ptychodera flava, var. *parva*.

No. of specimen	(1)	(2)	(3)	(4)	(5)
Proboscis coelom	Spacious. Cavity with distinct outline	as (1)	as (1)	as (1)	as (1)
Collar coelom	Very spacious	as (1)	as (1)	as (1)	as (1)
Ventral proboscis septum	To tip of stomochord	as (1)	as (1)	as (1)	Almost to tip of stomochord
Dorso-ventral proboscis muscles	Present	as (1)	as (1)	as (1)	as (1)
Dorsal collar septum	Complete after 1st root	as (1)	as (1)	Complete just before 1st root	as (1)
Ventral collar septum	Absent	as (1)	Complete at hind end of collar	as (3)	as (1)
Racemose organ	Small and unlobulated	Well marked but unlobulated	as (2)	as (2)	as (2)
Dorsal proboscis muscle decussation	Small. No ventral circular musc. fibres	as (1)	as (1)	as (1)	as (1)
Dorsal roots	*Rrr	RRr	RR	Rr	RR
Proboscis pores	*LR	LR	LR	LR	LR (opening together)
Nerve cord	Lumen complete throughout	Lumen with faint tendency to occlusion	Lumen with very faint tendency to occlusion	as (1)	as (1)
$\frac{\text{Length of post-branchial groove}}{\text{Length of branchial region}}$	—	·19	—	·15	·16
$\frac{\text{Length of cornua} \times 100}{\text{Length of collar}}$	21·2	26·5	22·8	21·7	21·0
$\frac{\text{Circumference of branchial œs.}}{\text{Circumference of œsoph. œs.}}$	1·11	1·05	1·06	1·04	1·07
Synapticula	Not more than 8	Not more than 7	as (1)	as (1)	as (1)

* R denotes a dorsal root reaching to the epidermis, r an incomplete root which does not extend to the epidermis. Of the proboscis pores L represents the left and R the right one. When the pore is functional and places the proboscis coelom in communication with the exterior a capital letter is used. When the pore is not thus functional it is denoted by a small letter.

Trunk. The branchial region, as has already been seen, is in this variety relatively short. The post-branchial groove is moderately well developed and is about $\frac{1}{6}$ of the length of the branchial region. The genital folds in the region of the branchiae are large

(Pl. XLVI. fig. 48), springing from low down. The branchial division of the œsophagus is somewhat more capacious than the ventral division of the œsophagus. The number of synapticula on the longest gill bars is either 7 or 8.

Ptychodera flava, var. **laccadivensis** (Pl. XXXIX. fig. 25; Pl. XL. figs. 36, 38—40; Pl. XLV. fig. 43; Pl. XLVI. figs. 49, 51, 57).

LOCALITY, ETC. Minikoi; from lagoon close to edge of lagoon flat. It occurred in 4 feet of water at low spring tides and was very abundant. The following notes were made by Mr Gardiner.

"A few points about them are of interest, viz. (*a*) The tail part of the body, *i.e.* posterior $\frac{1}{3}$, is merely a bag of sand and is often broken off if the animal be held still by the head end. Under these circumstances the sand appears to be driven back by peristaltic movements of the whole body-wall more rapidly than it can escape, and as a result the posterior end simply breaks off. This I have verified by repeated observations under water and I believe that it occurs in life. (*b*) In distribution they are limited to the weed and to an area close to the edge of the flat. (*c*) Their natural position when alive is within 4 inches of the surface of the sand. The head is close to the surface whilst the body and tail are horizontal. (*d*) When thrown on to a sandy bottom the motion is very feeble or *nil* if the body be full of sand. The posterior part is at once dehisced. A wriggling motion of the branchial and genital regions ensues, accompanied by powerful contractions of the collar and extensions of the proboscis. The proboscis and collar[1] are very slowly forced into the sand and then the body follows with comparative rapidity."

EXTERNAL FEATURES. This variety shews a great resemblance to *Pt. flava*, var. *caledoniensis* (Willey, **'99,** p. 228) in general appearance. The largest complete specimens which reached me are about 150 mm. in length, but fragments of larger specimens point to its attaining a somewhat greater size. The proboscis is of about the same length as the collar or slightly longer. The anterior liver saccules are dark, the posterior lighter in colour. The larger liver saccules are lobulated along one edge, such lobulation being most marked in the larger specimens. The length of the branchial and post-branchial genital regions are dealt with later (p. 663) in connection with variation in the group. The colour of the animal in life was bright yellow or pale lemon, thus differing somewhat from *Pt. caledoniensis*, which is of a duller hue inclining to brownish.

INTERNAL STRUCTURE.

Proboscis. Just beneath the basement-membrane occur a few delicate circular fibres surrounding the longitudinal muscles which are gathered up into radial bundles. These bundles project into the proboscis coelom, which has no well-defined boundary (Pl. XXXIX. fig. 25). Dorso-ventral muscles are usually to be found in the region of the central complex. The ventral proboscis septum extends forwards as far as the tip of the stomochord. The decussation of muscle fibres on the dorsal side of the anterior portion of the proboscis is well-marked as a rule, and a few circular fibres may be continued from it round the inner edge of the longitudinal muscles on the ventral surface of the proboscis cavity. The proboscis coelom of both sides may be placed in communication with the exterior by the two proboscis pores. It as often happens however that the communication between the proboscis coelom

---

[1] In *Dolichoglossus pusillus*, whose movements form the subject of a paper by Ritter (**'02**), the proboscis appears to play a relatively more important part.

and the end vesicle opening by the proboscis pore is lacking. Sometimes this occurs on one side and sometimes on the other.

TABLE 2.

Pt. flava, var. *laccadivensis*.

No. of specimen	(1)	(2) (Regenerated)	(3)	(4)	(5)	(6)
Proboscis coelom	Fairly large	as (1)	Large	Spacious	as (1)	as (1)
Collar coelom	Spacious	Small but well defined	as (1)	as (1)	as (1)	as (1)
Ventral proboscis septum	To tip of stomochord	—	as (1)	as (1)	as (1)	as (1)
Dorso-ventral proboscis muscles	Absent	—	Traces	Present	as (4)	as (4)
Dorsal collar septum	Complete after 1st root	(Regenerating)	as (1)	as (1)	After 1st root. Incomplete in places	as (1)
Ventral collar septum	Absent	Complete at hind end of collar	as (1)	as (2)	as (1)	as (2)
Racemose organ	Large and lobulated	Small and unlobulated	Well marked and slightly lobulated	Well marked. Unlobulated	as (1)	as (4)
Dorsal proboscis muscle decussation	Strong with ventral circular muscles	Feeble. No ventral circular muscles	Distinct. A few ventral circular muscles	Distinct but no ventral circular muscles	Strong with a few ventral circular fibres	Well marked. No ventral circular muscles
Dorsal roots	*RRRRRR	Collar cord in contact with epidermis throughout	RRRr	Rrrr	RRr	RRR
Proboscis pores	*lR	LR	LR	LR	Lr	lR
Nerve cord	Lumen continuous	Middle of cord solid	Lumen continuous	Lumen continuous	Lumen with strong tendency to obliteration	Lumen continuous
$\frac{\text{Length of post-branchial groove}}{\text{Length of branchial region}}$	—	—	·20	·16	—	·24
$\frac{\text{Length of cornua} \times 100}{\text{Length of collar}}$	28·7	21·1	28·9	21·1	22·5	16·2
$\frac{\text{Circumference of branchial œs.}}{\text{Circumference of œsoph. œs.}}$	—	·48	·88	·90	—	·55
Synapticula	—	—	—	—	—	—

* See foot-note on p. 645.

The racemose organ is always well-marked and in the larger specimens is usually somewhat lobulated.

Collar. The cavity in the anterior part of the collar is usually spacious though not quite to the same extent as in *Pt. parva.* The dorsal septum is usually complete after the first root. The ventral septum may be entirely absent or, equally as often, it may be found in the hinder part of the collar. The number of proboscis roots varies from three up to as many as six. The collar nerve cord usually has a distinct and continuous lumen which may rarely shew a tendency to become obliterated. The length of the cornua of the nuchal skeleton is subject to a good deal of variation. It averages a trifle less than a quarter of the collar length.

Trunk. In the branchial region the number of synapticula varies with the size of the animal. The branchial region averages rather more than double the length of the collar (p. 665, Table 8). The post-branchial groove is well-developed, its length being about one-fifth of that of the branchial region. At its anterior level the genital folds are still of considerable size (Pl. XLVI. fig. 49). At the end of the post-branchial groove the folds have become much reduced (Pl. XLVI. fig. 51). The branchial portion of the œsophagus is somewhat smaller in section than the œsophageal portion (Pl. XLVI. fig. 57). A pygochord is present in the caudal region.

Ptychodera flava, var. **maldivensis** (Pl. XXXIX. fig. 27).

Locality, etc. From Maradu, Addu Atoll, where it was taken from sandy holes of the reef-flat. Fairly abundant. Two specimens also obtained from Hulule, on the east reef underneath the stones of the boulder zone in sand.

External features. In general shape and appearance this variety is indistinguishable from *laccadivensis* to which it is very closely allied. Moreover the coloration in life was similar, this variety, like *laccadivensis*, shewing differentiation of the hepatic caeca into an anterior dark group and a posterior larger and lighter group.

Internal structure. Exceedingly similar to that of *laccadivensis* from which variety however the present one would seem to differ on the following points. The proboscis cavity has a definite outline as in *parva* (cf. Pl. XLIII. fig. 21) and does not reach up among the radial muscle bundles as in *laccadivensis* (cf. Pl. XXXIX. fig. 25).

The racemose organ is on the whole somewhat smaller.

The dorsal roots are less numerous, a feature in which this variety resembles *cooperi.*

The cornua of the nuchal skeleton are relatively shorter than in *laccadivensis.*

The branchial portion of the œsophagus is as large or larger than the ventral portion, whilst in *laccadivensis* it is always smaller.

The branchial region is relatively shorter than in *laccadivensis*, averaging only 1·63 times the collar length as against 2·26 times in the latter variety, a difference which is the more striking when one takes into account the comparatively large number of specimens examined (see below, p. 665, Table 8).

The post-branchial groove of *maldivensis* is also somewhat shorter than that of *laccadivensis.*

In point of size the present variety is considerably smaller than *laccadivensis*, preserved specimens of which may be as much as 150 mm. in length, whilst the largest specimen of

TABLE 3.

	Pt. flava, var. *saxicola*.				var. *maldivensis*.	
No. of specimen	(1)	(2)	(3)	(4)	(1)	(2)
Proboscis coelom	Spacious	Not large	Fairly large	as (3)	Fairly well developed and with definite outline	as (1)
Collar coelom	Spacious	Somewhat occluded by connective tissue	Spacious	Spacious	Very spacious	as (1)
Ventral proboscis septum	Nearly to tip of stomochord	as (1)	as (1)	as (1)	Nearly to tip of stomochord	Not nearly to tip of stomochord
Dorso-ventral proboscis muscles	Present	Traces	as (2)	Absent	Present	as (1)
Dorsal collar septum	Commences just anterior to 1st root	Commences ·5 mm. behind 1st root	Complete after 1st root	as (3)	Complete after 2nd root	Complete after 1st root
Ventral collar septum	Complete in hinder part of collar	as (1)	Present in hinder part of collar but not complete	as (1)	Absent	as (1)
Racemose organ	Well marked but small and unlobulated	Well marked and lobulated	Well marked and slightly lobulated	Distinct but not lobulated	Small and unlobulated	as (1)
Dorsal proboscis muscle decussation	Distinct	Strong. Also a few ventral circular fibres	Well marked. A few ventral circular fibres	Strong but no ventral circular fibres	Feeble. No ventral circular fibres	as (1)
Dorsal roots	*RRrr	Rr	RR	RRR	Rr	R
Proboscis pores	*Lr	LR	lR	LR	Lr	lR
Nerve cord	Lumen with tendency to obliteration in middle part	Lumen with marked tendency to obliteration	Lumen continuous	Lumen with slight tendency to obliteration	Lumen continuous. Slight tendency to obliteration posteriorly	Lumen continuous
$\frac{\text{Length of post-branchial groove}}{\text{Length of branchial region}}$	·43	—	·22	·25	·16	·16
$\frac{\text{Length of cornua} \times 100}{\text{Length of collar}}$	17·1	10·1	19·4	7·0	15·0	8·4
$\frac{\text{Circumference of branchial œs.}}{\text{Circumference of œsoph. œs.}}$	·33	·5	·5	·38	1·01	1·20
Synapticula	Not more than 5	Not more than 6	Up to 9	Not more than 3	—	—
$\frac{\text{Length of branchial region}}{\text{Length of collar}}$	·95	1·25	1·16	·92	1·34	1·70

---

* See foot-note on p. 645.

maldivensis procured was only 80 mm. long. *Maldivensis* is also a more stunted form, its total length averaging about 18 times the collar length as against 23 times in *laccadivensis*.

All of which considerations point to the fact that we are here dealing with two distinct though closely related forms.

Ptychodera flava, var. **saxicola** (Pl. XXXVIII. fig. 17; Pl. XXXIX. figs. 28, 30, 31; Pl. XLIV. figs. 33—41).

LOCALITY, ETC. Hulule, Maldive Is. Four specimens were obtained by breaking up a dead coral mass on the sand-flat.

EXTERNAL FEATURES. This is a relatively short stunted form. The length of the smallest specimen when preserved was 32 mm., that of the largest 65 mm. The animal is thick in comparison with its length (Pl. XXXVIII. fig. 17). The total length relative to the collar as unity in the four specimens is 16·2, 12·8, 16·5, 16·3, giving an average of rather less than 16, which is low in comparison with such forms as *laccadivensis* (see p. 664). The genital pleurae are large but the liver saccules are small and not lobulated. Neither is there any differentiation into an anterior darker and a posterior lighter group.

INTERNAL STRUCTURE.

Proboscis. The radial arrangement of the longitudinal muscles is almost as well-marked as in *laccadivensis*. The proboscis cavity is fairly spacious. Dorso-ventral muscles in front of the pericardium may or may not be present. The ventral proboscis septum reaches nearly to the tip of the stomochord. The dorsal muscular decussation in the anterior part of the proboscis is well-marked and a few ventral fibres may pass from it round the cavity of the proboscis. Paired proboscis pores are present of which one or both may be in functional communication with the dorsal coelom. The racemose organ is well-marked but differs considerably in size among the different specimens. It may shew a certain amount of lobulation.

Collar. The cavity of the anterior part of the collar is spacious. The dorsal collar septum in two cases shewed the usual condition, *i.e.* was complete after the 1st root. In one case, however, it commenced about ·5 mm. behind the 1st root, and in another a little in front of it. The ventral collar septum is more marked than usual, being in three of the four specimens complete in the hinder part of the collar.

The nerve cord may shew a lumen continuous throughout or there may be a greater or less amount of occlusion. The number of dorsal roots varies from 2—4. In one specimen a somewhat remarkable dorsal root occurred. It was of considerably larger size than usual (Pl. XXXIX. fig. 28) and was obviously formed by two distinct portions, viz. an outgrowth from the collar cord with a cap of yellowish brown pigment, and an epidermal ingrowth at the end of which was a large mass of mucus. The two portions of the root fused more or less with one another. It is possible to regard such a structure as possessing some sensory significance, and to suggest that the mucous portion of the epidermal ingrowth may act as a crude lens in focussing rays of light on the pigmented portion of dorsal outgrowth from the collar cord.

The cornua of the nuchal skeleton vary greatly in length but are on the whole unusually short.

Trunk. One of the most conspicuous features of this variety is the small size of the branchial region. Not only is the branchial portion of the œsophagus very small compared with the ventral portion (Pl. XLIV. fig. 38), but the length of the branchial region compared with that of the collar is exceedingly short. In none of the specimens is it more than a quarter as long again as the collar, whilst in two cases it is even shorter than the latter structure.

The post-branchial groove however is well-developed, being on the average about one-third of the length of the branchial region.

The number of synapticula is very variable. As many as nine or as few as three may be present.

The genital folds are large (Pl. XLIV. figs. 38, 39) in the branchial region and also in the region of the post-branchial groove (Pl. XLIV. fig. 41). Just behind this region they rapidly diminish in size (Pl. XLIV. fig. 40). In all four specimens the gonads are quite immature. Points of interest in connection with them are dealt with later (p. 661).

An account of the pygochord is given on p. 659.

Ptychodera flava, var. **gracilis** (Pl. XXXVII. fig. 5; Pl. XXXVIII. figs. 10, 19; Pl. XLV. figs. 42, 44; Pl. XLVI. figs. 50, 53—55).

LOCALITY, ETC. Hulule, Maldive Is. From boulder zone under stones in sand. Also from sand at Minikoi in company with *Pt. flava*, var. *laccadivensis*.

With reference to the specimens from Hulule Mr Stanley Gardiner has made the following note:—"They are found sparingly under the stones of the boulder zone in the sand. A couple of specimens or more can almost invariably be obtained wherever a large grey Actinian lives, the latter seeming to protect the Enteropneusts. Polychaets, Sipunculids, and Holothurians are not generally found in the same patch of sand."

EXTERNAL FEATURES. This is a small variety, the longest specimen of which measured 68 mm. after preservation, the shortest 32 mm. (see Table 12, p. 673). It is somewhat slenderly built though the total length in comparison with that of the collar averages 19·6. The posterior portion of the animal's body is usually very slender (cf. Pl. XXXVII. fig. 5) though this is not so much the case in larger specimens. The liver saccules shew an anterior dark group and a more extensive posterior lighter group. The saccules are not large (Pl. XXXIX. fig. 19) and are as a rule not at all or but slightly lobulated except in the case of large specimens (Pl. XXXIX. fig. 10, *). In the specimen from which the coloured sketch (Pl. XXXVII. fig. 5) was made all the liver saccules appear dark. It is possible that it is only after preservation that the darker anterior group can be separated from the rest.

INTERNAL STRUCTURE.

Proboscis. The musculature is rather feebly developed, the longitudinal fibres being gathered into widely separated radial bundles as in *laccadivensis* (cf. Pl. XXXIX. fig. 25). The dorsal muscular decussation may be feebly developed or fairly strong. Dorso-ventral proboscis muscles are present anterior to the pericardium. The ventral proboscis septum is well-developed, reaching almost to the tip of the stomochord. Of the paired proboscis pores only one is functional, placing the dorsal coelom in communication with the exterior. This may be either on the right or left side. The other pore is generally smaller and in one case had disappeared altogether. The racemose organ is well-marked though unlobulated or only faintly so.

Collar. The musculature of the collar, like that of the proboscis, is somewhat feebly developed. The cavity in the anterior part of the collar is very spacious. The intra-collar lumen of the œsophagus is unusually large (Pl. XLV. fig. 42). The dorsal collar septum is present as usual behind the first root. The ventral septum may be found at the hind end of the collar or it may be absent.

TABLE 4.

Pt. flava, var. *gracilis*.

No. of specimen	(1)	(2)	(3)	(4)	(5)
Proboscis coelom....................	Fairly large	Not large	as (2)	Spacious	as (1)
Collar coelom	Spacious	as (1)	as (1)	as (1)	as (1)
Ventral proboscis septum	Nearly to tip of stomochord	as (1)	as (1)	as (1)	as (1)
Dorso-ventral proboscis muscles	Present	as (1)	as (1)	—	—
Dorsal collar septum	Complete after 1st root	as (1)	as (1)	as (1)	as (1)
Ventral collar septum	Traces only	as (1)	Absent	as (3)	Complete at hind end of collar
Racemose organ	Well marked but small and unlobulated	Well marked. Unlobulated	Well marked. Slightly lobulated	as (1)	as (1)
Dorsal proboscis muscle decussation	Fairly well marked. No ventral circular muscles	Not very marked. No ventral circular muscles	Well marked. No ventral circular muscles	Very feeble. No ventral circular muscles	as (1)
Dorsal roots..........................	*RR	RRr	RRR	RRr	RRr
Proboscis pores	*lR	Lr	lR	lR	L only
Nerve cord	Lumen continuous	as (1)	as (1)	as (1)	as (1)
$\frac{\text{Length of post-branchial groove}}{\text{Length of branchial region}}$	·11	·11	·10	·16	·15
$\frac{\text{Length of cornua} \times 100}{\text{Length of collar}}$	17·4	19·0	11·3	15·5	14·1
$\frac{\text{Circumference of branchial œs.}}{\text{Circumference of œsoph. œs.}}$	1·26	1·14	1·00	·60	·85
Synapticula	Not more than 9	Not more than 7	Not more than 7	—	Not more than 7

The collar cord exhibits a continuous lumen throughout. Three roots are usually to be found. The cornua of the nuchal skeleton are rather shorter than usual, extending over about $\frac{1}{6}$—$\frac{1}{7}$ of the collar length.

---

* See foot-note on p. 645.

Trunk. The branchial region in this variety is very short, averaging only a quarter as much again as the collar length (see Table 12, p. 673). In the Maldive specimens the branchial part of the œsophagus is at least as large and generally somewhat larger than the ventral portion. In the Minikoi specimens on the other hand it is somewhat smaller, a feature in which they approximate to *laccadivensis*. The post-branchial groove is very short in the specimens from Hulule, not being more than about $\frac{1}{10}$ of the length of the short branchial region. In the Minikoi specimens it is rather longer. The genital pleurae are large in the branchial region (Pl. XLVI. figs. 50, 54). They diminish in size considerably in the region of the post-branchial groove (Pl. XLVI. figs. 53, 55), after which they are very small.

The proportions of the various regions of the body in the above account have been determined from an examination of 28 specimens from Hulule (*vide* Table 12, p. 673). Five specimens only were procured from Minikoi and, as will be seen in Table 4, Nos. 4 and 5, these differ somewhat from the Hulule forms. It is possible that examination of a larger amount of material may shew that these Minikoi specimens belong to a distinct variety. The difference in their mode of occurrence (p. 651) would seem to point the same way, but in any case they are very closely related to the Hulule form.

Ptychodera flava, var. **muscula** (Pl. XLII. fig. 18).

LOCALITY, ETC. A Maldive form from Goifurfehendu Atoll, Goidu. It was obtained from the sandy shore to the east of the island in the sand below the weed and under some square slabs of beach sandstone. In company with it was found *Spengelia porosa*. About a dozen specimens procured in all.

EXTERNAL FEATURES. Colour in life pale yellow with very black hepatic region. A small form with a total length after preservation of 31—48 mm. Average length compared with collar as unity = 15·6. A somewhat short and stoutly built form, generally speaking. The anterior hepatic caeca are, after preservation, darker than the rest.

INTERNAL STRUCTURE.

Proboscis. The internal longitudinal musculature is very strongly developed and closely surrounds the central complex, almost obliterating the proboscis cavity. No dorso-ventral muscles anterior to the pericardium. The ventral proboscis septum is short and does not reach nearly to the tip of the stomochord. Of the paired proboscis pores one may not be functional. The racemose organ may be small or fairly well marked and slightly lobulated. The nuchal skeleton has a well-developed keel which gives off a flattened expansion over the racemose organ. Such an expansion occurs generally in the genus but is not usually so well-marked as in the present variety (Pl. XLII. fig. 18). A strong dorsal muscular decussation occurs in the anterior portion of the proboscis, and from it pass some circular fibres ventrally.

Collar. The musculature of this region also is well developed. The cavity in the anterior part of the proboscis is comparatively large. The dorsal septum is found as usual after the first root though it may not immediately be complete. The ventral septum is absent or traces of it only are to be found.

The lumen of the nerve cord shews a marked tendency to become occluded. Three or four dorsal roots may be present.

TABLE 5.

	Pt. flava, var. *muscula*.		*Pt. flava*, var. *cooperi*.		*Pt. viridis*.	
No. of specimen	(1)	(2)	(1)	(2)	(1)	(2)
Proboscis coelom	Very small	Small	Spacious	Small	Very small	Small
Collar coelom	Spacious	Fairly large	Very spacious	as (1)	Small	Very small
Ventral proboscis septum	Not nearly to tip of stomochord	as (1)	Not nearly to tip of stomochord	as (1)	Not nearly to tip of stomochord	Not quite to tip of stomochord
Dorso-ventral proboscis muscles	Absent	as (1)	Absent	as (1)	Absent	as (1)
Dorsal collar septum	After 1st root. Not complete	After 1st root complete	Complete after 1st root	as (1)	Complete after 1st root	After 1st root but not at once complete
Ventral collar septum	Traces	Absent	Absent	Traces in extreme hind end of collar	Complete at extreme hind end of collar	Traces
Racemose organ	Very small	Well marked. Slightly lobulated	Well marked. Unlobulated	as (1)	Large. Unlobulated	Large and slightly lobulated
Dorsal proboscis muscle decussation	Strong with ventral circular fibres	as (1)	Feeble. No ventral circular muscles	Moderately developed. No ventral circular muscles	?	Strong with a few ventral fibres
Dorsal roots	*RRR	RRrr	R	Rr	RRr	?
Proboscis pores	*Lr	LR	lR	R	?	LR
Nerve cord	Lumen with tendency to obliteration	as (1)	Lumen with tendency to obliteration	as (1)	Lumen completely obliterated	as (1)
$\frac{\text{Length of post-branchial groove}}{\text{Length of branchial region}}$	—	14·5	·12	·15	Very short and insignificant	as (1)
$\frac{\text{Length of cornua} \times 100}{\text{Length of collar}}$	14·0	15·8	45·5	53·7	16·1	27·8
$\frac{\text{Circumference of branchial œs.}}{\text{Circumference of œsoph. œs.}}$	·78	·81	1·19	1·13	1·02	·95
Synapticula	—	—	Not more than 8	Not more than 7	—	—
$\frac{\text{Length of branchial region}}{\text{Length of collar}}$	—	1·30	2·23	2·06	·85	1·44

---

* See foot-note on p. 645.

The cornua of the nuchal skeleton are short, extending over less than $\frac{1}{6}$ of the collar length.

Trunk. The branchial region is fairly long, averaging more than double the length of the collar in 10 specimens (see Table 12, p. 673). In one small specimen only was it less than double the length of the collar. On the whole it is remarkably constant in length. The branchial division of the œsophagus is considerably less than the ventral portion. The post-branchial canal was found to be short in the specimen examined, being less than $\frac{1}{6}$ of the length of the branchial region. The post-branchial pre-hepatic genital tract is comparatively short. The genital pleurae are well-developed.

Ptychodera flava, var. **cooperi** (Pl. XXXVIII. fig. 12; Pl. XLV. figs. 45—47).

Locality, etc. Two specimens, both somewhat imperfect, from N. Male Atoll. Dredged in 5 fathoms on a sandy bottom within the velu of Jaro near Helengeli.

External features. A small form with a maximum breadth in the collar and branchial region of less than 3 mm. Behind the hepatic region the diameter of the animal is only a trifle over 1 mm. In the preserved specimens the collar and proboscis are both very short, their width being greater than their length (Pl. XXXVIII. fig. 12). The genital pleurae are large in the branchial region, which is rather more than double the length of the collar. The genital region between the termination of the branchial and the commencement of the hepatic caeca is relatively long. The hepatic caeca are short but well-developed, and on their inner sides are lobulated. There is no distinction into lighter and darker ones.

Internal structure.

Proboscis. The cavity of the proboscis is well-developed in one specimen, whilst in the other it is small. The radial arrangement of the muscles is not so conspicuous as in most members of the genus. Dorso-ventral muscles anterior to the pericardium are not present, and the ventral proboscis septum is very short. The right proboscis pore in each case places the dorsal coelom in communication with the exterior. The left pore is present in one specimen but absent in the other. The racemose organ is well-marked but unlobulated. The keel of the nuchal skeleton is somewhat larger than usually obtains in the species (Pl. XLV. fig. 45). The skeleton is altogether massive (Pl. XLV. fig. 46).

Collar. The cavity in the anterior part of the collar is very spacious. Posterior to it the collar musculature is unusually strongly developed, a fact which may in some measure account for the extreme shortening of this region on preservation. The dorsal septum is as usual complete after the first root. A ventral septum was completely absent in one specimen though traces of it occurred at the extreme hind end of the collar in the other. In one case a single dorsal root reaching to the epidermis was found. In the second specimen this was supplemented by a rudimentary one. The lumen of the collar cord shews a tendency to occlusion behind the level where the roots come off.

A noteworthy feature of this variety is the condition of the nuchal cornua which extend back to the hind end of the collar, the tip of them being found in sections which also pass through the first branchial bars. Such a condition is most unusual amongst the Ptychoderidae, recalling that recently described by Ritter (**'00,** p. 113) for *Harrimania maculosa.*

Trunk. The branchial portion of the œsophagus is rather larger than the ventral portion. Seven to eight synapticula are present. The post-branchial groove is large (Pl. XLV. fig. 47), whilst the œsophagus at this level is very small. The genital pleurae are still large in this region but become much reduced shortly after it.

Ptychodera viridis, n. sp. (Pl. XXXVII. figs. 2, 6, 7; Pl. XXXIX. fig. 32; Pl. XLII. figs. 17 and 19).

LOCALITY, ETC. From Hulule, Maldive Is. Three specimens only, two being complete, were dug from sand towards the east of the island.

EXTERNAL FEATURES. Coloured sketches from life of this worm were fortunately made by Mr Forster Cooper. From the reproductions of these on Plate XXXVII. it will be seen that green is the prevailing tint on the body of the animal, though the proboscis is pale yellow, and the collar pale yellow with a certain amount of orange. To the predominant body tint the animal owes its specific name. From the sketches it appears that the proboscis is considerably longer than the collar, a proportion which still exists in the preserved creature. The length is not great. Of the two complete specimens one measured 36 mm. and the second only 21 mm. in length after preservation (ratio of total length to collar length being respectively 18 : 1 and 14 : 1). Compared therefore with such forms as *Pt. flava*, var. *laccadivensis*, this species is a small, short, and somewhat stunted form. The genital pleurae are well-developed. The external liver saccules are relatively feebly developed and are of a uniform colour.

INTERNAL STRUCTURE. The musculature of the proboscis is strong and compact, the radial bundles into which the longitudinal muscles are gathered being closely connected by connective tissue. The powerful development of the longitudinal muscles leads to the practical obliteration of the proboscis cavity (Pl. XXXIX. fig. 32). A well-marked dorsal muscular decussation occurs in the anterior part of the proboscis (Pl. XXXIX. fig. 32, *dmd*) and fibres from it pass ventral to the central complex. Dorso-ventral muscles anterior to the pericardium are not present. The ventral proboscis septum reaches forwards almost to the tip of the stomochord. The racemose organ is small and unlobulated. Both proboscis pores are present though only one is in functional communication with the dorsal proboscis coelom. This may be either the right or the left one.

Collar. The musculature and the connective tissue are here strongly developed and the cavity of the collar is very much reduced. The dorsal septum occurs after the first root as usual and is generally complete. Traces of the ventral septum may occur. The lumen of the collar cord is almost entirely obliterated throughout and the cord in section has as great a dorso-ventral diameter as a lateral one (Pl. XLII. fig. 19). In one of the specimens sectioned three roots were present of which the last was rudimentary.

The cornua of the nuchal skeleton apparently vary much in length. In one specimen they extended over about $\frac{1}{6}$ of the collar, whilst in another they were rather more than a quarter as long as this structure.

Trunk. The branchial region is short. Compared to the collar length as unity it measured in the three available specimens ·85, 1·00, and 1·44, giving an average of 1·10. The branchial portion of the œsophagus is approximately of the same size as the ventral portion. The post-branchial groove is very short and insignificant. The genital folds are large in the branchial region and also in the region of the post-branchial groove (Pl. XLII. fig. 17).

Ptychodera asymmetrica, n. sp. (Pl. XXXVII. figs. 1 and 9; Pl. XLVI. figs. 52, 56, 58).

LOCALITY, ETC. From Hulule. According to Mr Stanley Gardiner, "Near the south islet is a pool with loose rocks well within the boulder zone. This form was found here in accumulations of sand under stones. They are remarkable in life for the enormous quantity of mucus they secrete, so much indeed that it is almost impossible to obtain them clean for preservation." About 10 specimens were procured, mostly somewhat fragmentary.

EXTERNAL FEATURES. A small form measuring on the average about 40 mm. in length (Pl. XXXVII. fig. 1). One larger specimen, a sketch of which was made by Mr Forster Cooper and is reproduced on Pl. XXXVII. fig. 9, measured after preservation 60 mm. in length with a collar 3 mm. long. This specimen however was unusually large. Two points about its external appearance merit attention. In the first place the liver saccules are somewhat small and uniformly dark in colour. There is no sharp line of demarcation between an anterior set of very dark caeca and a posterior set of lighter ones as in *Pt. flava*, var. *laccadivensis*. In the second place careful examination shews that the left genital pleura is always somewhat larger and more swollen than the right one. In all the eight specimens examined by me the gonads shew asymmetry by being developed only on the left side. This was the case both in a very young specimen with quite immature gonads, and also in the large specimen above alluded to in which the gonads were full of ripe spermatozoa. In his account of *Pt. flava* Willey (**'99**, p. 240) mentions a case in which the gonads were only developed in the right genital pleura, those in the left being apparently in a state of arrested development. Evidently with the case of *Asymmetron* in his mind Willey writes, "Such a differential behaviour of the two sides of the body is of interest as indicating a tendency to unilaterality in the matter of the gonads." Spengel (**'03**, p. 305) criticises this remark of Willey's, regarding such a condition as produced by the presence of a parasitic copepod, *Ive sp.* In the two cases examined by Spengel where the gonads of one side were undeveloped the parasite occurred in the genital pleura of that side, and there seems little doubt that Spengel's explanation is here correct, and that the condition is a pathological one. But there can be no doubt that this explanation will not hold for *Pt. asymmetrica*. The fact that in eight cases, in different stages of growth, gonads were always absent from the right pleura, coupled with the fact that no parasite was to be found, seems to shew beyond all question that unilaterality of the gonads is a feature which is characteristic of this species.

INTERNAL STRUCTURE.

Proboscis. The longitudinal muscles do not exhibit a markedly radial arrangement of bundles. They are strongly developed and almost entirely fill the cavity of the proboscis so that there is no space, or only a very small one, between them and the central complex. There are no dorso-ventral muscles in front of the pericardium. The ventral proboscis septum does not reach to the tip of the stomochord and is often much shorter.

The racemose organ is subject to considerable variation. It may be small and unlobulated, large and lobulated or not.

There is usually a well-marked dorsal muscular decussation in the anterior part of the proboscis though no circular fibres pass from it ventrally.

Collar. The cavity of the collar varies considerably. It is on the whole not large and may be almost absent. The collar musculature is well-developed. The dorsal septum is always complete after the first root. The ventral septum is a more conspicuous structure in this species than in most others of the genus. It is always found in the posterior part of the collar and may reach forwards over $\frac{1}{3}$ of the collar length.

TABLE 6.

Pt. asymmetrica.

No. of specimen	(1)	(2)	(3)	(4)	(5)
Proboscis coelom	Very small	as (1)	Well marked but small	as (1)	Obliterated by muscles
Collar coelom	Much reduced	Almost obliterated	Fairly spacious	Very small	Well marked
Ventral proboscis septum	Short. Not nearly to tip of stomochord	Not to tip of stomochord	Not quite to tip of stomochord	as (3)	as (1)
Dorso-ventral proboscis muscles	Absent	as (1)	as (1)	as (1)	as (1)
Dorsal collar septum	Complete after 1st root	as (1)	as (1)	as (1)	as (1)
Ventral collar septum	Complete in hind end of collar	as (1)	as (1)	as (1)	Complete in posterior $\frac{1}{3}$ of collar
Racemose organ	Large but unlobulated	Large and lobulated	as (1)	Small and unlobulated	Very large and lobulated
Dorsal proboscis muscle decussation	Well marked. No ventral circular muscles	as (1)	as (1)	Not well marked. No ventral circular muscles	as (1)
Dorsal roots	*RRR	RRrr	RR	R	RR
Proboscis pores	*LR	Lr	lR	lR	lR
Nerve cord	Lumen almost obliterated	Lumen distinct in places	Lumen distinct in places. Strong tendency to obliteration	as (1)	as (1)
$\frac{\text{Length of post-branchial groove}}{\text{Length of branchial region}}$	·23	—	·18	·24	—
$\frac{\text{Length of cornua} \times 100}{\text{Length of collar}}$	24·5	20·9	47·3	40·5	25·7
$\frac{\text{Circumference of branchial œs.}}{\text{Circumference of œsoph. œs.}}$	·98	1·08	1·04	—	1·06
Synapticula	—	—	Not more than 5	—	—

The lumen of the collar cord is never continuous throughout. It may be present as a number of small cavities much broken up, or it may be practically absent, the cord shewing

---

* See foot-note on p. 645.

only the merest traces of a lumen. As is often the case with the collar cord, when the lumen shews a marked tendency to occlusion, the dorso-ventral diameter as seen in transverse section tends to become relatively great as compared with the transverse diameter (Pl. XLIV. fig. 29). The number of the dorsal roots is very variable. There may be as few as one, though four seems to be the maximum.

The cornua of the nuchal skeleton are on the whole long for members of this genus, but shew a considerable amount of variation. They may extend over only $\frac{1}{5}$ of the collar length, or their length may be equal nearly to $\frac{1}{2}$ that of the collar.

Trunk. The branchial portion of the œsophagus is of about the same size as the ventral part. The relative length of the branchial region as compared with the collar length is short, it being seldom more than half as long again as the latter and sometimes even less. In the large specimen figured on Pl. XXXVII. fig. 9, however, it was rather more than three times the collar length.

The post-branchial groove on the other hand is longer than usual, averaging between $\frac{1}{5}$ and $\frac{1}{4}$ the length of the branchial region.

The genital folds are somewhat small (Pl. XLVI. figs. 52 and 56) and become mere ridges in the region of the post-branchial groove (Pl. XLVI. fig. 58).

SOME ANATOMICAL POINTS.

As Spengel in his latest publication (**'03**) differs on one or two points from Willey it may be worth devoting a few lines to them. In two of these cases, the pygochord and the lateral septa, I find myself in agreement with Spengel rather than Willey.

The **pygochord** is a structure on which Willey has laid some stress, describing it as "a longitudinal, solid, supporting band" (**'99,** p. 243), and evidently seeing in it a skeletal structure for the support of the caudal region. On the ground of its minute proportions Spengel (**'03,** p. 317) dissents from Willey's interpretation, and one cannot help agreeing with Spengel in refusing to regard such a small and rudimentary structure as of any importance from this point of view. As Spengel remarks we have absolutely no knowledge of the function of this apparently vestigial structure, and it is with some diffidence that I venture to suggest that it may be the remains of a ventral siphon which was at one time of functional importance but now vestigial. The occurrence of such a siphon, whatever may be its exact function, is common among sand-feeding animals. Similar structures occur in the Echinoidea, in the Capitellidae, and in certain Chaetopoda such as *Thallasema* and *Echiurus* —all creatures which derive their nutriment from among the large quantities of sand continually passing through the alimentary canal. The condition of the pygochord found in a specimen of *Pt. saxicola* is interesting in this connection. The structure in question was here connected at either end with the intestine whilst for the middle part of its course it was entirely free (cf. Pl. XLIV. figs. 35—37), a condition strongly suggestive of a collateral intestine.

The **lateral septum** is described by Willey as passing to the epidermis at the base of the genital pleurae in the post-branchial region (**'99,** Pl. XXIX. fig. 14). Spengel, however, finds that this is not so, but that it ends at the lateral blood vessel (**'03,** p. 297). It is sufficient to remark that on this point I find myself in agreement with Spengel.

Lastly there is a point in connection with the **branchiae** which calls for short notice. It has been assumed that the main function subserved by these structures is that of respiration, and in the figures given by most authors the blood vessels form a prominent feature. Nevertheless the course of the branchial circulation is a point which has never been satisfactorily cleared up (cf. Delage and Herouard, **'98,** p. 41), and in looking through numerous series of sections through the branchial region I have been struck by the infrequency with which one finds any blood in these structures. On the other hand the sub-epidermal vascular plexus is exceedingly well-developed everywhere and it is difficult to avoid the conclusion that respiration is mainly, if not entirely, carried out by the large skin area, whilst the main function of the gills is to act as a sieve for straining off the water from the mixture of sand and water continually swallowed by the animal.

THE FORMATION OF THE GONADS.

The origin of the gonads is a subject on which widely diverse views have been upheld by different observers. Bateson (**'86**) attributed to them an ectodermal origin, Spengel (**'95**) regards them as being developed in a blood space, whilst Morgan (**'94,** p. 60) holds that they are formed from the mesodermal elements of the coelom. The question is one of considerable difficulty and none of the above observers has made out a very strong case in support of his view. Bateson bases his belief on the early connection apparent between the gonad and the ectoderm (**'86,** Pl. XXXII. fig. 110). Spengel considers this connection to be due to the precocious formation of a duct and claims to have found sex cells at a very early stage of development inside the blood vessels (**'95,** Pl. II. figs. 27 and 28). He finds additional support for his view in the fact that in a small specimen[1] of *Pt. flava*, var. *laysanica*, the "Anlage" of the gonad first appears between the two lamellae of the lateral septum (**'03,** p. 302). The case which he has made out is far from convincing since it is by no means certain that the small cells which he regards as primitive sexual cells are of that nature, whilst on the other hand there are good grounds for looking upon the lateral septum as composed of four rather than of two lamellae (see below, p. 661). Lastly Morgan's contention as to the mesodermal origin of the gonads is not borne out by his figures. In the earliest stage figured by him (**'94,** Pl. VI. fig. 79) the gonad is obviously in continuity with the ectoderm, a connection which, to judge by his figures, is very soon lost, though doubtless re-established later on the formation of the genital ducts. The question of the ectodermal origin of the gonads turns largely upon the interpretation of the ectodermal connection found at different stages of their development. In other words, has the gonad an ectodermal connection at two different stages of its growth, the earlier representing the ingrowth of ectoderm to form the gonad, whilst the latter represents the functional duct? From the following observations on *Pt. flava* I am inclined to believe that such is the case. As the gonads appear to develop earlier in some varieties than in others I have considered them apart with the following results.

(1) Var. *laccadivensis.* The youngest stages of the gonads were met with in a very small specimen about 15 mm. long. The young gonads are in many places in connection with the ectoderm (Pl. XL. fig. 36). In the region of the genital pleurae this connection

---

[1] Judging from the regenerated material at my disposal in the case of *Pt. flava*, var. *laccadivensis*, I have very little doubt in considering this small specimen of Spengel's to be a regenerated one.

is almost invariably found where the lateral septum joins the basement-membrane at the tip of the pleura. Occasionally an ingrowth from the ectoderm of the inner surface of the pleura is to be seen, but this is rare. The irregular occurrence of the ectodermal connections and their somewhat attenuated condition seems to indicate that they are in process of disappearance. And this supposition is borne out by the fact that in somewhat older specimens the gonads are devoid of any ectodermal connection.

(2) Var. *saxicola*. Though all the specimens of this variety were of fair size the gonads in all are in a very backward state of development. The gonads are in all cases young and in all cases possess a more or less well-marked ectodermal connection. This connection is relatively wider in the younger gonads (cf. Pl. XL. figs. 41 and 42). A still younger stage of an ectodermal ingrowth at the tip of a genital pleura is shewn on Pl. XXXIX. fig. 31. There can be little question but that this is of the nature of an ingrowth, and indeed rounded cells may be seen in it, which are not to be found in other parts of the ectoderm, and which are probably to be regarded as primitive genital cells. The main ingrowth is that at the tip of the pleura as in var. *laccadivensis*, but the accessory ingrowths on the inner surface of the pleurae are much more numerous in *saxicola*, a fact probably correlated with the larger size attained by the animal for a similar stage of gonidial development. Unfortunately none of the four specimens of this variety possessed older gonads.

(3) Var. *muscula*. In a specimen with immature and somewhat small gonads an ectodermal connection is generally wanting. It may be present here and there. In an older specimen in which spermatocytes could be recognized in the gonads (Pl. XL. fig. 37) the ectodermal connections are present on almost all the gonads.

(4) Var. *maldivensis*. This variety is characterized by often having long slender genital ducts. They are found connected with fairly well-developed gonads and in some cases I have been able to make out their double origin, in part from an ectodermal ingrowth and in part from an outgrowth from the gonad. In one or two instances the two portions had not effected a junction, a condition supporting the view that the true genital ducts are late in making their appearance. It has already been noticed that the ectodermal ingrowths near the tip of the pleurae always occur directly over the point where the lateral septum joins the basement-membrane and pass down between its lamellae. On the other hand the ducts in connection with the gonads nearest the tip of the pleurae may be entirely independent of the lateral septum (Pl. XXXIX. fig. 27).

All the above observations are in harmony with the view that the gonads are (in *Pt. flava* at any rate) derived from ectodermal ingrowths, that they subsequently lose their connection with the ectoderm, but regain it later when the genital ducts are established. Further, on this view we can explain the lateral septum of the Ptychoderidae, regarding it as having in the first place been brought about by the basement-membrane being carried in by the primitive ectodermal ingrowths at the tip of the pleurae (at that time probably very much smaller). On this view the lateral septum should be four-layered since the basement-membrane consists already of two layers enclosing blood spaces. That four potential layers are present is shewn by the fact that the apparently single layer round the gonad is in reality a double one since blood spaces frequently occur in it (Pl. XL. fig. 41). The cavity of the gonad is therefore quite distinct from the blood spaces, which militates against Spengel's view of the nature of the gonad.

The gonads of *Ptychodera flava* are characterized by the presence of peculiar bodies apparently devoid both of structure and of nucleus. The origin of these bodies, the "fettartig Kügelchen" of Spengel and the "eosinophil globules" of Willey, is somewhat obscure. Willey holds that they are the products of nuclear degeneration accompanied by hypertrophy of the nucleolus. Spengel (**'03**, p. 306) refuses to believe that they are the outcome of degenerative changes. In the young specimen of *Pt. laccadivensis* referred to above I have been able to follow what seems to be the history of these bodies. Certain of the spindle-shaped mesodermal cells become first oval and then more or less spherical in shape (Pl. XL. fig. 38, *a*—*b*), at the same time increasing slightly in bulk. A few granules make their appearance in the hitherto clear cytoplasm. A little later these cells appear to collect together in clusters of about 6—10 (fig. 38, *c*), which subsequently fuse together to form giant cells packed with granules and with the nuclei degenerating (fig. 38, *d* and *e*). Later the nuclei disappear and the giant cells apply themselves close to the gonad. Where this occurs the wall of the gonad seems to break down and by some method which is not clear the nutriment stored in the giant cells is transferred to the interior of the gonad where it loses its granular appearance (cf. Pl. XL. fig. 37). At later stages small round corpuscles of an eosinophil nature also make their appearance in the mesoderm and subsequently apply themselves to the gonads in a similar manner (Pl. XL. fig. 41). The chief interest of the process seems to lie in the fact that although the sexual cells themselves are derived from the ectoderm[1], it is the mesoderm which provides them with nourishment and which contributes the yolk to the eggs.

The above account is of interest when it is considered with reference to our conception of the nature and properties of the coelom. According to present ideas one of the chief functions of the coelom is to give rise to the generative cells from the epithelium which lines it. Further it is usually held that the most primitive method of formation of the coelom is that of archenteric diverticula. In animals like the Enteropneusta, where this method of the formation is found, we should naturally look for genital cells arising from its lining. That this is not so may cause us to regard with some reservation the statement that the coelom was originally a gonocoel[2], and to consider it rather as an organ specialized, among other things, for the reception and maturation of the genital cells.

VARIATION IN *PTYCHODERA FLAVA*.

The different varieties of *Pt. flava* are by no means easy to distinguish from one another after preservation. An adequate examination of the characters which are of systematic value involves the preparation of a large number of serial sections. If a trustworthy criterion based upon external features alone could be found much labour might be spared the Enteropneustic systematist. The large amount of material collected by Mr Stanley Gardiner has enabled me to attempt this.

The characters upon which such a criterion might be based must satisfy two conditions; (1) they must be capable of easy measurement, and (2) they must be independent of the

---

[1] In this connection it is interesting to notice that so long ago as 1885 Hubrecht described the ectodermal origin of the gonads in the Nemertean *Lineus gesserensis*. He was able here to distinguish with certainty the primary ectodermal connection from the later formed duct (Hubrecht, **'85**, Pl. v. figs. 88 and 89).

[2] For the most recent general account of the coelom the reader may be referred to Lankester's *Treatise on Zoology*, 1900, Pt. II. chap. II.

growth of the animal. This latter condition precludes the direct use of absolute measurements. It is obvious that a ratio must be made use of—a simple ratio whose two factors are equally affected by growth changes. Though several distinct regions may be distinguished in the body of a *Ptychodera*, with the exception of the collar and branchial region, their limits are not very clearly defined. Accordingly most attention has been paid to the ratio of branchial to collar length. And this more especially since any collection of Enteropneusts will be largely made up of damaged specimens, and though few specimens may attain to anything like completeness, yet in the great majority both collar and branchial regions will be perfect. Great accuracy in the measurement of such animals as the Enteropneusta is out of the question since in a soft-bodied creature relative differences in the state of contraction of the various body regions may easily occur, whilst the personal equation must enter largely into the result. In the present instance however all the material had been treated in the same way, *i.e.* had been narcotised in chloral hydrate for several hours before preservation, thus ensuring an equable contraction, whilst the personal equation was as far as possible eliminated by my making all the measurements within the space of a week or so.

By far the most frequent of the varieties described in this paper is *laccadivensis*, and it is here that the measurements are most complete. In addition to the length of the collar and of the branchial region the total length and the length of the genito-hepatic regions was measured wherever the specimen was sufficiently perfect. The width of the collar was also registered. The results for 123 specimens (fewer in the case of the genito-hepatic and total lengths) are given in Table 11, pp. 671—2, and in the diagram on p. 666. Before however any value can be attached to these figures it must be shewn how, if at all, growth affects these ratios.

The method employed for estimating growth changes was to divide the animals into several groups according to size, and to calculate the above three ratios for each group separately. As the collar width was sometimes less, sometimes greater, than the length it was thought advisable to take this factor also into account, and in the case of *laccadivensis* the following groups were made.

	Numbers in Group		
	Branchial	Genito-hepatic	Total
Group 1. Collar length × breadth not > 16	47	38	19
,, 2. ,, ,, × ,, > 16, but not > 25	45	33	17
,, 3. ,, ,, × ,, > 25, ,, ,, > 36	27	15	13
,, 4. ,, ,, × ,, > 36	4	—	—
	123	86	49

The mean of each ratio was then calculated for each of the above groups with the following result:—

		No. of Specimens
$\frac{\text{Branchial length}}{\text{Collar length}}$.	Mean for Group 1 = 2·08	47
	,, ,, ,, 2 = 2·18	45
	,, ,, ,, 3 = 2·36	27
	,, ,, ,, 4 = 2·77	4
	Average 2·20	

		No. of Specimens
$\frac{\text{Genito-hepatic length}}{\text{Collar length}}$.	Mean for Group 1 = 4·94	38
	,, ,, ,, 2 = 4·90	33
	,, ,, ,, 3 = 4·84	15
	Average 4·90	
$\frac{\text{Total length}}{\text{Collar length}}$.	Mean for Group 1 = 23·1	19
	,, ,, ,, 2 = 22·4	17
	,, ,, ,, 3 = 23·4	13
	Average 22·9	

An examination of the above table brings out clearly the important fact that two of the three ratios, *i.e.* those of the genito-hepatic and total lengths, are quite unaffected by growth changes, whilst that of the branchial region is not greatly affected. Neglecting group 4 in which there are so few specimens there is a gradual rise in the ratio with increase in size from 2·08 in group 1 to 2·18 in group 2, and 2·36 in group 3. There is therefore an increase of about 12 $^\circ/_\circ$ in group 3 as compared with group 1, an increase sufficiently well-marked though not very great when we take into account the unavoidable roughness of the measurements. A possible source of error must be noticed here. A considerable number of specimens (some 8—10 $^\circ/_\circ$) were regenerating. Where this process was obviously at work the specimens were not included in the above measurements. In the latest stages, however, regenerated individuals are impossible to distinguish from ordinary ones with a somewhat shorter branchial region than usual. As regeneration is far more common in the smaller specimens it seems almost certain that the values of the ratio for groups 1 and 2 are somewhat too low in comparison with those of group 3. On the whole it would appear from these measurements on *laccadivensis* that the proportions of the body of this Enteropneust are very little, if at all, liable to alteration during the later stages of growth.

This conclusion is borne out by a similar series of measurements made on *Pt. flava*, var. *maldivensis*. The 52 specimens of this variety were divided into three groups of which the last contained only the five largest specimens (see Table 13, p. 674). On taking the mean for the three ratios in each group the following figures were obtained.

TABLE 7.

		No. of Specimens
$\frac{\text{Branchial length}}{\text{Collar length}}$.	Mean for Group 1 = 1·65	19
	,, ,, ,, 2 = 1·62	28
	,, ,, ,, 3 = 2·00	5
	Average 1·67	
$\frac{\text{Genito-hepatic length}}{\text{Collar length}}$.	Mean for Group 1 = 4·58	19
	,, ,, ,, 2 = 4·14	28
	,, ,, ,, 3 = 5·23	5
	Average 4·41	
$\frac{\text{Total length}}{\text{Collar length}}$.	Mean for Group 1 = 16·5	6
	,, ,, ,, 2 = 18·7	9
	,, ,, ,, 3 = 17·6	2
	Average 17·7	

There is more irregularity here in the figures for the genito-hepatic length and total length, which perhaps is only to be expected in view of the smaller number of specimens. There is however no uniformity indicating a growth change. The value for group 3 in the branchial series is far larger than for groups 1 and 2. This however is due to the large branchial region of a single specimen (Table 13, No. 49) and its effect on the few individuals of group 3. The closeness of the figures for groups 1 and 2 (1·65 to 1·62), where there are more specimens available, points to the ratio of branchial length to collar not being affected by growth changes. Assuming then, and the assumption seems a fair one, that growth has little or no effect on the relative proportions of the body in *Ptychodera* we have before us an easily applied criterion for distinguishing different positions of organic stability in this genus. We have but to determine one of these ratios (and in practice the branchial one will be found the most convenient) on a number of specimens of each supposed variety, and to apply to the series so obtained the ordinary biometric methods for measuring the variability. Marked differences occurring in two groups of specimens would at once cast a doubt on the identity of two such groups.

This method has been adopted here for such of the varieties as possessed nine or more specimens. The branchial ratio alone was used owing to the fragmentary condition of most of the individuals in each variety. On working out the mean and standard deviation in each case the following results were obtained:—

TABLE 8.[1]

	Pt. laccadivensis (Minikoi)	*Pt. maldivensis* (Maldives)	*Pt. muscula* (Goidu)	*Pt. gracilis* (Hulule)	*Pt. parva* (Turadu)
M.	2·263	1·630	2·225	1·259	1·514
P. E. M.	± ·1405	± ·1724	± ·2484	± ·1995	·1753
σ	± 2·3098	± 1·8431	± 1·1647	± 1·5656	·7798
P. E. σ	± ·0993	± ·1219	± ·1757	± ·1411	·1240
C. V.	102·07	113·08	52·35	124·35	51·50
N.	123	52	10	28	9

These results shew clearly that in certain cases we are without doubt dealing with different races[2] of *Pt. flava*. Thus the two forms *laccadivensis* and *maldivensis* are exceedingly alike both in external appearance and in internal structure. The branchial ratio is however very different, the mean for *maldivensis* (1·63) being very much lower than that (2·26) for *laccadivensis*. And the difference between the two is almost four times the probable error of either, from which it may be calculated that the odds are many thousands to one against its being due to errors of random sampling alone.

---

[1] For the actual measurements on which these figures are based see Tables 11—13, pp. 671—4. Of the letters in the above Table (*i.e.* Table 8), M.=mean; P.E.M.=probable error of the mean; σ=standard deviation; P.E.σ.=probable error of standard deviation; C.V.=coefficient of variation; whilst N.=number of specimens in each case.

[2] I am not here concerned with the question of the statistical method as a criterion of species and variety (cf. Davenport, C., *Statistical Methods*, 1899, p. 38). My point is that in the group of animals collectively designated *Pt. flava* there are to be found different positions of organic stability, and in giving to these "a local habitation and a name" there is no thought of distinguishing by statistical methods between the terms, *race*, *variety*, and *species*. For the value attached to such distinctions must for the present be largely a matter of individual taste.

Fig. 121. This figure illustrates graphically the variations in the ratio $\frac{\text{Branchial length}}{\text{Collar length}}$ which occur in the different varieties of *Pt. flava*. Each dot signifies a single specimen. Thus in the material of *Pt. flava*, var. *maldivensis*, there are two specimens in which the branchial length is 2·25—2·49 times the length of the collar in those specimens. The unit of variation selected is $\frac{1}{4}$ × collar length in each case. The dots below the dotted line in the figure for *laccadivensis* are all specimens belonging to Group 1 (see p. 663), and the distribution of these in the diagram illustrates graphically the fact that this ratio is independent of growth at these stages.

In fact from these figures one may affirm with some confidence that *laccadivensis* and *muscula* (though they cannot be separated from one another by this criterion) are quite separate from *maldivensis*, *gracilis*, and *parva*, whilst of the last three *gracilis* is very probably distinct from the other two. By this criterion alone it is not possible to separate *maldivensis* from *parva* any more than *laccadivensis* from *muscula*. No doubt this could be done in the case of these forms if the material were sufficient to treat another ratio (*e.g.* the length ratio) in the same way.

The total length ratio was worked out for *laccadivensis* and *maldivensis*, in which forms alone the amount of material rendered the attempt feasible. As there are no definite segments by which to reckon, the absolute value obtained for σ will depend upon the number of groups into which the material is broken up. In this case the mean in the two varieties is 23·1 and 17·9 respectively. The series have been broken up into groups separated by an interval of two units, which is approximately 10 °/₀ of the mean in each case. The treatment has been uniform in each case and the results are as follows:—

TABLE 9.

	var. *laccadivensis*	var. *maldivensis*
M. =	23·1	17·9
P. E. M. =	± ·129	± ·260
σ =	±1·798	±1·589
P. E. σ =	± ·091	± ·184
N. =	49	17

Hence the mean is widely separate in the two forms—separated by so many times the probable error as to render it absolutely certain that no random selection of 17 specimens from a large quantity of *laccadivensis* could ever have a mean length ratio with the remotest approximation to the above 17 specimens of *maldivensis*.

Leaving now the question of variation as a criterion of species and variety we may pass on to consider one other point in connection with it. A great feature in the group of the segmented Chordata is the process of cephalization which becomes more and more pronounced as we pass upwards from *Amphioxus* to Mammals. Accompanying this process, and doubtless intimately bound up with it, is the phenomenon of unequal variability in the different regions of the animal's body from the meristic point of view. With increased cephalization we find associated a decreased variability at the cephalic as compared with the caudal end. The nearer we approach to the caudal extremity the greater appears to become the meristic variability[1]. From this point of view the relative variability of the different regions of the Enteropneust's body becomes of interest, especially as most writers see in the collar cord the commencement of the cephalization process. From the data given in Table 11, p. 671,

---

[1] For the present this statement is based upon a number of unpublished data from different Vertebrata, chiefly fishes, collected by the writer. The phenomenon is perhaps most familiar in the case of the Mammals where, speaking generally, the cervical region exhibits no meristic variation, the dorso-lumbar and sacral regions a small amount, whilst the caudal region exhibits most of all. Probably some such phenomenon is to be found also among Invertebrates, but absence of data permits only of conjecture.

I have therefore estimated the variability of three separate regions of the body in *Pt. laccadivensis*, viz. the branchial region, the genito-hepatic region, reaching from the hind end of the branchial region to the point of junction of light and dark hepatic caeca, and the hepatic-caudal, extending from this point of junction to the anus. In the following table this is expressed quantitatively when the unit of variation[1] selected was the same in all three cases, *i.e.* collar length × 1.

TABLE 10.

	σ	C.V. $= \frac{\sigma \times 100}{M.}$
Branchial region	± ·6712	29·66
Genito-hepatic region ...	± 1·015	20·72
Hepatic-caudal region ...	± 2·711	11·79

From this table it appears that the variability as measured by the standard deviation gradually rises as we recede from the collar. But these three regions are of very different length and the unit of measurement (collar length) bears towards the branchial region a relation as regards length very different to that which it bears towards the hepatic-caudal region. To avoid this difficulty we must consider the coefficient of variation (C.V.) in each case, and when this is worked out (Table 10) it is at once evident that the relative variability of the branchial region as regards length is far greater than that of the genito-hepatic, and this again than that of the hepatic-caudal. In a word, as we proceed caudalwards from the collar the relative variability of the body as regards length becomes less. In *Amphioxus* and the Vertebrata on the other hand the relative variability of the body as measured by the number of segments becomes greater as we proceed caudalwards. One of three alternatives would seem to follow:—either (1) we must regard the processes of differential growth as widely different in the two cases, or (2) we must look upon the number of a meristic series as altogether independent of its length, or (3) we must consider that there exists in *Ptychodera* a somewhat vague segmentation—that the animal is composed of morphologically equivalent though ill-defined segments of which the length differs considerably in different regions of the body. The amount of favour with which we can regard the first of these suggestions depends upon our conception of the relations of the Enteropneusts to the Chordata. Those who are inclined to uphold the chordate affinities of this group would naturally turn to either of the other two alternatives. The former of these I regard as untenable, since such data as I have been able to collect on the subject all tend to shew that there is a fairly high correlation between the relative total length of a vertebrate axial meristic series and the number of units of which it is composed. There remains to be considered the last of these hypotheses. Are there grounds for attributing any form of segmentation[2] to the Enteropneustic body, and further, if this is the case, for considering that such segments may differ in size in the different regions of the animal? To the first part of the question the answer must be in the affirmative. In the branchiae, in the hepatic caeca, and in the epidermal annulations, we have series of repeated parts of which the latter two

---

[1] The choice of the unit is often a matter of convenience. Thus in Text-fig. 121, p. 666, the unit of variation selected is collar length × ½.

[2] Apart of course from the primitive segmentation into the three regions, proboscis, collar, and trunk.

usually correspond fairly closely (cf. Willey, **'99,** Pl. XXVI. fig. 1, and Spengel, **'03,** Pl. XXIV. fig. 8). With regard to the second part of the question it may be easily demonstrated that in a given stretch of body length the branchiae are more numerous than are the epidermal annulations or the hepatic caeca in a stretch of the same length in the post-branchial region. The number of tongue bars averages about 5·6 per mm. of length (see Table 14, p. 675). On the other hand the number of epidermal annulations in the post-hepatic region is about 1·6 per mm. Therefore if we look upon these repeated parts as evidences of a rudimentary segmentation[1], we must regard the post-branchial segments (or at least those of the hepatic caudal region) as being on the average 3·5 times as long as the branchial segments. In other words the branchial segments are three times as numerous as the hepatic-caudal ones per unit of length. Consequently if we calculate the coefficients of variation on the basis of "segments" instead of collar length units we must multiply the coefficient of variation for hepatic-caudal region by 3·5 in order to compare it directly with that for the branchial region. This brings it up to the value 41·26 as compared with 29·66 for the branchial region. If therefore we regard the Enteropneusts as exhibiting a rudimentary form of segmentation the variability in the different body regions falls into line with that of the Holochorda[2]. Much phylogenetic stress however must not be laid upon this point since it is not improbable that the phenomenon of cephalization may be shewn to be widespread among the Invertebrates also. What is of more importance is the influence, small though it be, which the occurrence in the Enteropneusta of a form of segmentation, similar in kind though less marked, may exert upon our conception of the manner in which the merism of the Vertebrata may have arisen. And here a few remarks of a more speculative nature may not be irrelevant in connection with

METAMERISM IN THE ENTEROPNEUSTA.

Willey (**'99,** p. 303) has recently made a brilliant suggestion with regard to the origin of gill clefts. The discovery of the peculiar dermal pits of *Spengelia* has led him to regard gill-slits as having originally arisen as perforations in the interannular grooves formed for the aeration of the gonads, a function which they eventually gave up for that of respiration on the establishment of an elaborate vascular system. In this way Willey establishes a connection between the segmentation of the gills and of the epidermal annulations, the connecting link being the gonads. It has seemed to me possible to extend this conception of Willey's and to see in the gonads and their arrangement the prime factor in the segmentation of the chordata. We may take as our starting-point a small Triploblastic (and perhaps also Tricoelomate) creature with three more or less definite body regions, of not widely unequal length, and of which the hindermost contains the gonads. The reproductive elements would be small and fertilization external in the sea. Under these conditions it is obvious that, other things being equal, those with the largest gonads would have the best chance of leaving offspring to perpetuate and amplify this feature. Increased size of

---

[1] Spengel (**'03,** p. 276 seq.) disagrees with Willey's view of the significance of the epidermal annulations and sees in them only the effects of muscular contraction on the disposition of the epidermal glands. He points out that there exists a certain amount of irregularity. Such irregularity however seems to me in no way to militate against the view of the significance of these structures taken by Willey.

[2] It is interesting to notice that in *Ptychodera* the difference between variability in the different regions of the body is not nearly so marked as in *Amphioxus* where we may regard the cephalization process as having extended further. I have found the following values for C.V. in different regions of the latter genus. Preatrioporal segments, C.V. = 1·792; postatrioporal preanal, C.V. = 2·655; postanal, C.V. = 6·185.

gonad spells increased bulk and in the absence of a specialized vascular system this increase of bulk must be almost entirely dependent on increased length. For respiration would depend on transepidermal diffusion, a process which would more readily occur in a long slender animal than in a short thick one. This great elongation of the gonad would necessitate the establishment of accessory ducts by which its products could readily and rapidly escape. From this it is but a short step to the stage of a series of independent gonads each with its own duct extending throughout the elongated trunk region—a condition physiologically comparable to that now found among the Nemerteans. Increase of bulk will still mean increased fertility and such individuals will be favoured by Genetic Selection[1], provided always that the means for ensuring due aeration are adequate, whence we come to the establishment of dermal pits for the aeration of the gonads. Later the pits become perforated and no doubt these perforations supplied a physiological need and filtered off the excess of water from the sand passing through the animal's alimentary canal. Probably it was somewhere near this phylogenetic epoch that the ancestral Enteropneusts took to an arenicolous life. The problem of extraction of nutriment from a relatively enormous mass of innutritious substance resulted in the specialization of the middle and hinder part of the digestive tract, and the establishment of the hepatic caeca led to the disappearance of the gonads in this region. They have left traces of their former presence in the epidermal annulations which shew some tendency to irregularity now that their determining cause has disappeared; they are still found in a rudimentary state in the hepatic region of some forms, but increased physiological specialization has on the whole led to their confinement to the more anterior portions of the trunk.

BIBLIOGRAPHY.

'86. BATESON, W. "Development of *Balanoglossus Kovalevskii*," *Quart. Journ. Mic. Sc.* Vol. XXVI.

'98. DELAGE AND HEROUARD. *Traité de Zoologie Concrète*, Vol. VIII. *Les Procordés.*

'94. HILL, J. P. "On a new species of Enteropneusta from the coast of New South Wales," *Proc. Linn. Soc. N.S.W.* Vol. X.

'98. HILL, J. P. "The Enteropneusta of Funafuti," *Memoirs Aust. Mus.* III.

'85. HUBRECHT, A. A. W. *Proeve eener ontwikkelingsgeschiedenis van Lineus obscurus.* Utrecht.

'02. KUWANO, H. "On a new Enteropneust from Misaki, *Balanoglossus misakiensis*, n. sp." *Annot. Zool. Jap.* Vol. IV.

'94. MORGAN, T. H. "The Development of *Balanoglossus*," *Journ. Morph.*

'00. RITTER, W. E. "*Harrimania maculosa*," *Proc. Wash. Acad. Sc.* Vol. II.

'02. RITTER, W. E. "The movements of the Enteropneusta," *Biol. Bull.* Vol. III.

'93. SPENGEL, J. W. "Die Enteropneusten," *Naples Monograph.*

'01. SPENGEL, J. W. "Die Benennung der Enteropneusten-Gattungen," *Zool. Jahr.* Vol. XV. Syst. Abt.

'03. SPENGEL, J. W. "Neue Beiträge zur Kenntniss der Enteropneusten," *Zool. Jahr.* Vol. XVIII. Anat. Abt.

'99. WILLEY, A. "Enteropneusta from the South Pacific, etc.," *Willey's Zoological Results*, Pt. 3.

---

[1] Cf. Pearson, K., *The Grammar of Science*, 1900, p. 437, and also *The Chances of Death, etc.*, 1897, Vol. I. p. 63 (Essay on Reproductive Selection).

TABLE 11.

Pt. flava, var. *laccadivensis.*

No. of Specimen	Absolute measurements (in millimetres)			Relative measurements (collar length = 1)			No. of Specimen	Absolute measurements (in millimetres)			Relative measurements (collar length = 1)		
	Collar length	Collar breadth	Total length	Branchial	Genito-hepatic	Total		Collar length	Collar breadth	Total length	Branchial	Genito-hepatic	Total
1	4	4	—	1·50	—	—	32	3·5	3	—	2·28	4·85	—
2	4	4	80	2·12	4·13	20·0	33	3·5	3·5	—	1·28	2·07	—
3	4	4	—	2·00	6·75	—	34	3	3·5	74	2·50	3·83	24·6
4	3·5	3·5	82	1·71	5·14	23·5	35	4	4	114	2·00	7·75	28·5
5	3·5	3·5	75	2·14	5·00	21·4	36	3	3·5	78	1·33	4·50	26·0
6	4	4	78	1·75	4·75	19·5	37	4	4	—	2·25	4·75	—
7	3·5	3·5	—	2·00	6·00	—	38	4	4	76	1·37	4·37	19·0
8	3	3	—	3·00	—	—	39	3·5	4	73	1·14	5·28	20·8
9	4	4	—	1·25	5·50	—	40	3	3·5	76	3·00	4·66	25·3
10	3	2·5	60	1·83	4·17	20·0	41	3·5	3·5	83	2·14	4·71	23·7
11	3·5	3·5	90	2·71	6·43	25·7	42	4	4	—	2·12	5·62	—
12	4	3·5	—	1·75	—	—	43	3·5	4	—	2·00	5·85	—
13	4	4	—	3·00	—	—	44	4	4	—	2·37	5·37	—
14	3·5	3·5	105	1·75	4·43	30·0	45	3·5	4	—	2·85	5·14	—
15	4	4	—	2·75	5·50	—	46	3	3·5	—	1·63	4·16	—
16	4	4	—	3·00	—	—	47	3	3	—	1·63	4·16	—
17	4	4	—	1·50	—	—	48	5	5	120	2·80	—	24·0
18	3	3	—	3·00	4·66	—	49	5	5	110	2·30	—	22·0
19	3	3	—	2·33	6·33	—	50	5	5	—	2·80	—	—
20	2·5	2·5	60	1·80	4·20	24·0	51	5	5	—	2·00	—	—
21	3	3	—	2·00	6·00	—	52	5	5	93	2·60	4·20	18·6
22	3	3	—	2·00	—	—	53	5	5	—	2·00	—	—
23	3·5	3·5	74	1·85	5·27	21·1	54	5	5	—	2·20	—	—
24	3·5	3·5	—	2·43	—	—	55	5	5	140	2·70	3·50	28·0
25	4	4	—	3·00	—	—	56	5	5	125	2·50	5·10	25·0
26	3	3	—	2·66	4·67	—	57	5	5	125	2·20	5·40	25·0
27	3	3	—	2·00	4·66	—	58	5	5	—	1·50	6·50	—
28	4	4	85	1·37	4·37	21·2	59	4·5	4·5	—	3·33	—	—
29	3·5	3·5	74	2·28	4·85	21·1	60	5	5	—	2·10	4·30	—
30	4	4	93	2·25	3·50	23·2	61	5	5	111	1·90	6·10	22·2
31	4	3·5	—	1·75	4·37	—	62	5	5	105	2·20	3·80	21·0

Nos. 1—47 (inclusive) = Group 1.
„ 48—92 „ = Group 2.

Nos. 93—119 (inclusive) = Group 3.
„ 120—123 „ = Group 4.

In Group 1 Collar length × breadth is not greater than 16.
„ „ 2 „ „ × „ is greater than 16, but not greater than 25.
„ „ 3 „ „ × „ is „ „ 25, „ „ „ 36.
„ „ 4 „ „ × „ is „ „ 36.

TABLE 11 (*continued*).

No. of Specimen	Absolute measurements (in millimetres)			Relative measurements (collar length = 1)		
	Collar length	Collar breadth	Total length	Branchial	Genito-hepatic	Total
63	4·5	4·5	96	2·11	4·77	21·3
64	5	5	100	1·80	4·80	20·0
65	5	5	—	3·00	2·22	—
66	5	5	—	2·20	4·40	—
67	4·5	4·5	—	2·44	—	—
68	4·5	5	110	1·66	5·89	24·4
69	5	5	115	2·60	7·00	23·0
70	5	5	—	3·00	4·60	—
71	5	4·5	—	1·50	6·90	—
72	5	5	—	2·00	—	—
73	5	4·5	108	2·00	4·60	21·6
74	5	5	105	2·00	5·60	21·0
75	5	5	—	2·00	3·00	—
76	4·5	4·5	—	1·77	6·00	—
77	5	5	—	1·80	4·60	—
78	5	5	—	2·40	—	—
79	4·5	4	—	1·25	5·75	—
80	4·5	4·5	—	1·44	—	—
81	5	4	—	1·80	—	—
82	5	4·5	—	2·75	5·20	—
83	5	5	—	2·90	3·40	—
84	4	5·5	76	1·37	5·12	19·0
85	5	4·5	—	1·50	4·10	—
86	5	4·5	—	1·40	4·20	—
87	5	4	102	1·80	4·40	20·4
88	4	4·5	98	2·25	4·75	24·5
89	5	5	—	3·80	6·40	—
90	5	5	—	2·00	5·80	—
91	5	5	—	2·10	5·50	—
92	5	5	—	2·40	3·80	—
93	6	6	—	4·00	—	—
94	6	6	150	3·50	—	25·0
95	5	6	112	2·60	—	22·4
96	6	5	—	2·08	—	—
97	6	6	—	2·16	—	—
98	5	6	—	2·20	—	—
99	6	6	—	3·00	—	—
100	6	6	—	2·00	4·33	—
101	5	6	—	3·40	—	—
102	6	5	—	2·00	—	—
103	6	5	—	2·83	—	—
104	5·5	5·5	—	2·55	—	—
105	6	6	—	2·00	5·33	—
106	6	5	—	1·66	—	—
107	5	6	85	1·60	2·60	17·0
108	5	6	100	2·20	5·40	20·0
109	5	5·5	130	2·40	6·00	26·0
110	5	6	109	2·40	4·40	21·8
111	5	6	—	1·70	4·30	—
112	5	5·5	136	2·80	4·80	27·2
113	6	6	140	1·91	4·75	23·3
114	5	5·5	116	1·70	5·50	23·2
115	5	5·5	123	2·50	4·70	24·6
116	6	5·5	138	1·50	5·33	23·0
117	6	5·5	—	1·75	4·25	—
118	5	5·5	116	2·50	4·90	23·3
119	5	5·5	—	3·00	6·00	—
120	7	7·5	140	2·28	3·71	20·0
121	6·5	7	—	3·39	—	—
122	6	7	145	3·16	—	24·1
123	7	7	—	2·28	—	—

Table 12.

Pt. flava, var. *muscula*.

No. of Specimen	Absolute measurements (in millimetres)			Relative measurements (collar length = 1)		
	Collar length	Collar breadth	Total length	Branchial	Genito-hepatic	Total
1	2·5	3	31	2·20	1·20	12·4
2	3	4	48	2·33	3·66	16·0
3	2	2·5	37	2·50	2·75	18·5
4	2·5	3	35	2·20	3·40	14·0
5	2·5	3	43	2·80	1·60	17·2
6	3	3·5	—	2·00	2·00	—
7	3	3·5	—	2·00	3·33	—
8	3	3	—	2·50	1·83	—
9	2·5	3·5	—	2·40	3·80	—
10	2·5	3	—	2·00	1·80	—

Pt. flava, var. *gracilis*.

No. of Specimen	Absolute measurements (in millimetres)			Relative measurements (collar length = 1)		
	Collar length	Collar breadth	Total length	Branchial	Genito-hepatic	Total
1	3	3	65	1·66	—	21·6
2	2	2·5	68	2·00	—	34·0
3	2	2	36	1·25	—	18·0
4	2	2·5	56	2·00	—	28·0
5	3	3	—	1·83	—	—
6	2·5	2·5	—	1·40	—	—
7	3	3	—	1·33	—	—
8	2	2	—	1·50	—	—
9	2	2	—	1·25	—	—
10	1·5	1·5	41	1·33	—	27·3
11	2·5	3	—	1·40	—	—
12	2·5	2·5	49	1·20	—	19·6
13	2	2·5	—	1·50	—	—
14	2·5	2·5	40	1·20	—	16·0
15	2	2	36	1·00	—	18·0
16	2	2·5	44	1·50	—	22·0
17	2·5	3	44	1·20	—	17·6
18	2·5	3	—	1·40	—	—
19	2·5	3	—	1·20	—	—
20	2·5	2·5	42	1·00	—	16·8
21	2·5	2·5	36	1·20	—	14·4
22	2·5	2·5	42	1·00	—	16·8
23	3	2·5	44	1·00	—	14·6
24	2	2·5	—	1·25	—	—
25	2·5	2·5	40	1·00	—	16·0
26	2	2	32	1·00	—	16·0
27	2	2	34	1·00	—	17·0
28	2	2	—	1·00	—	—

Pt. flava, var. *parva*.

Relative length of branchial region (collar length = 1) in 9 Specimens =
1·20, 1·33, 1·33, 1·40, 1·60, 1·60, 1·60, 1·66, 2·00.

Collar length in each case was 2·5—3 mm.

In one complete Specimen total length = 30 mm. and relative length (collar length = 1) was 12·0.

TABLE 13.

Pt. flava, var. *maldivensis.*

No. of Specimen	Absolute measurements (in millimetres)			Relative measurements (collar length = 1)			No. of Specimen	Absolute measurements (in millimetres)			Relative measurements (collar length = 1)		
	Collar length	Collar breadth	Total length	Branchial	Genito-hepatic	Total		Collar length	Collar breadth	Total length	Branchial	Genito-hepatic	Total
1	2·5	3	—	1·40	3·60	—	27	4	4	—	1·75	3·75	—
2	2·5	3	—	2·00	5·00	—	28	3	3	—	1·50	3·83	—
3	2·5	3	—	2·20	5·20	—	29	3	3	—	1·50	4·50	—
4	3	2·5	48	1·00	4·66	16·0	30	3	3	65	1·83	7·16	21·6
5	2·5	3	—	1·40	3·40	—	31	3·5	3	68	1·57	3·42	19·4
6	2·5	3	—	1·60	6·20	—	32	3	3·5	50	1·50	3·50	16·6
7	2·5	3	48	1·40	4·60	19·2	33	3·5	3·5	62	1·42	6·28	19·0
8	2·5	2·5	43	2·00	3·80	17·2	34	3	3·5	64	2·50	4·33	21·3
9	2·5	3	—	1·80	6·80	—	35	3·5	3	—	1·14	3·85	—
10	2·5	3	—	2·40	5·40	—	36	3	3	—	1·00	4·33	—
11	2·5	3	—	1·80	4·40	—	37	3	3	—	1·00	3·33	—
12	2·5	3	—	1·40	4·25	—	38	3	3	—	1·66	3·00	—
13	2·5	3	—	2·00	4·60	—	39	3	3	—	1·66	3·00	—
14	2·5	2·5	41	1·80	4·60	16·4	40	3	3	38	1·16	3·33	12·6
15	2·5	3	39	1·40	3·80	15·6	41	3·5	4	—	1·71	5·85	—
16	3	2·5	—	1·33	3·66	—	42	3	3	—	1·50	4·16	—
17	2	2·5	29	1·00	2·75	14·5	43	3	3	—	1·33	4·00	—
18	2·5	3	—	1·60	5·00	—	44	3	3	41	1·16	3·83	13·6
19	2·5	3	—	1·80	5·40	—	45	3	3	—	2·00	6·50	—
20	3·5	3·5	—	1·57	3·00	—	46	3	3	—	1·50	4·83	—
21	3	3·5	72	3·00	5·00	24·0	47	3	3	—	1·83	4·16	—
22	4	4	—	1·37	3·12	—	48	4·5	4	—	1·55	4·55	—
23	3	3	—	1·33	2·33	—	49	4	4·5	—	3·50	6·25	—
24	4	4	80	1·87	4·12	20·0	50	4	4·5	68	1·37	4·50	16·5
25	3	3	—	2·16	4·16	—	51	4	4·5	75	1·37	5·50	18·7
26	3	3	—	2·00	3·33	—	52	4	4·5	—	2·25	5·37	—

Nos. 1—19 (inclusive) = Group 1. Nos. 20—47 (inclusive) = Group 2. Nos. 48—52 (inclusive) = Group 3.

In Group 1 Collar length × breadth is less than 9.
„ „ 2 „ „ × „ is not less than 9, or greater than 16.
„ „ 3 „ „ × „ is greater than 16.

TABLE 14.

Pt. flava, var. *laccadivensis.*

	No. of tongue bars	Length in mm.	Tongue bars per mm.	No. of tongue bars	Length in mm.	Tongue bars per mm.
	104	19	5·4	55	9·5	5·8
	98	18	5·4	52	10	5·2
	83	14	5·9	50	9·5	5·3
	79	14	5·6	50	9·5	5·3
	74	15	4·9	49	8	6·1
	71	13·5	5·3	48	9	5·3
	70	14·5	4·8	48	7·5	6·4
	66	13	5·1	47	8	5·9
	64	10	6·4	40	7	5·7
	62	12	5·2	40	7	5·7
	62	11	5·6	38	6	6·3
	59	10	5·9	34	5·5	6·2
	57	10	5·7	32	5·5	5·8
	56	10	5·6	30	4·5	6·6
Average	71·8	13·1	5·5	43·8	7·6	5·8

EXPLANATION OF PLATES.

adv. = advehent vessel of proboscis.
anp. = anterior neuropore.
bm. = basement membrane.
bp. = branchial pouch.
bv. = blood vessel.
c. = collar coelom.
cc. = collar canal.
ch. = chondroid tissue.
cl. = central lumen of stomochord.
cn. = cornua of nuchal skeleton.
cnu. = nuchal collar coelom (containing muscles).
ct. = connective tissue.
cvr. = vascular ring of collar.
dn. = dorsal nerve.
dpc. = dorsal proboscis coelom.
ds. = dorsal septum.
dv. = dorsal vessel.
el. = external longitudinal muscles of collar.
ev. = efferent proboscis vessel.
g. = gonad.
gc. = ganglion cells.
gcd. = dorsal ganglion cells of collar cord.
gcv. = ventral ganglion cells of collar cord.
gl. = gland cells.
glo. = glomerulus.
gp. 1. = 1st gill pouch diverticulum.
il. = internal longitudinal muscles of collar.
int. = intestine.
ldc. = left diverticulum of dorsal proboscis coelom.
ll. = lateral lumen of stomochord.
lm. = longitudinal muscles.
ls. = lateral septum.
lu. = lumen of collar cord.
mc. = circular muscles.
mdv. = dorso-ventral muscles.
ml. = longitudinal muscles.
mlc. = longitudinal muscles of collar.
mld. = longitudinal dorsal muscles.
mll. = longitudinal lateral muscles.
mlv. = longitudinal ventral muscles.
n. = nuchal skeleton.
ngl. = gland cells of collar cord.

nk. = keel of nuchal skeleton.
nl. = layer of nerve fibrils (Punkt-substanz).
o. = oesophagus.
oep. = oesophageal epithelium.
ou. = oesophageal nerve.
p. = proboscis coelomic cavity.
pb. = parabranchial ridge.
pbg. = post-branchial groove.
per. = pericardium.
ph. = perihaemal space.
pg. = pygochord.
pig. = pigment.
pnp. = posterior neuropore.
pp. = proboscis pore.
pph. = peripharyngeal space.
pvl. = left proboscis end vesicle.
pvr. = right proboscis end vesicle.
r. = either (1) racemose organ or (2) dorsal root.
rdc. = right diverticulum of dorsal proboscis coelom.
s. = stomochord.
sc. }
sld. } = cavity of lateral diverticulum of stomochord.
*sk.*1. = nuchal skeleton.
skg. = branchial skeleton.
tb. = tongue bar.
v. = vermiform process of stomochord.
vn. = ventral nerve.
vpc. = ventral proboscis coelom.
vrv. = ventral recurrent vessel of proboscis.
vs. = ventral septum.
vv. = ventral vessel.

PLATE XXXVII.

FIG. 1. *Ptychodera asymmetrica.* × 3.

FIG. 2. *Pt. viridis,* ventral view. Slightly enlarged.

FIG. 3. *Balanoglossus carnosus.* Slightly reduced.

FIG. 4. *Pt. flava,* var. *gracilis.* × 2.

FIG. 5. *Pt. flava* (var. *maldivensis*?). Regenerating. × 1.

FIG. 6. *Pt. viridis,* dorsal view. Slightly enlarged.

FIG. 7. *Pt. viridis,* lateral view. Slightly enlarged.

FIG. 8. *Pt. flava* (var. *maldivensis*?). Regenerating. × 1.

FIG. 9. *Pt. asymmetrica.* A large specimen. Slightly enlarged.

PLATE XXXVIII.

FIG. 10. *Ptychodera flava,* var. *gracilis.* Preserved specimen from Hulule. × $\frac{5}{2}$.

FIG. 11. *Pt. flava,* var. *parva.* From preserved specimen. × 3.

FIG. 12. *Pt. flava,* var. *cooperi.* From preserved specimen. A small portion of the caudal end probably missing. × 5.

FIG. 13. *Spengelia porosa.* A small portion of the hepatic region. × 4.

FIG. 14. *Willeyia bisulcata.* Anterior end seen from dorsal surface. × 3.

FIG. 15. *Balanoglossus parvulus.* Section through the collar cord. A small clot of mucous substance is seen in the lumen. × 85.

FIG. 16. *Pt. flava,* var. *parva.* Section through anterior collar region with the 1st dorsal root coming off the collar cord. × 20.

FIG. 17. *Pt. flava*, var. *saxicola*. Dorsal view, slightly enlarged.

FIG. 18. *Balanoglossus parvulus*. Anterior end from dorsal surface. × 6.

FIG. 19. *Pt. flava*, var. *gracilis*. Preserved specimen from Minikoi. × 3.

FIG. 20. *Pt. flava*, var. *parva*. Section through collar cord. The dorsal and ventral walls of the central lumen shew a tendency to stick together. × 85.

FIG. 21. *Pt. flava*, var. *parva*. Section similar to above but from another specimen. The central lumen shews a marked tendency to occlusion and the lateral gland cells (*gl.*) are strongly developed. × 85.

FIG. 22. *Balanoglossus parvulus*. Section through proboscis pore. × 45.

FIG. 23. *Willeyia bisulcata*. Section through collar cord. × 85.

PLATE XXXIX.

FIG. 24. *Balanoglossus parvulus*. Section through collar. × 45.

FIG. 25. *Pt. flava*, var. *laccadivensis*. Section through proboscis. × 45.

FIG. 26. *Pt. flava*, var. *parva*. Section through anterior collar region. × 20.

FIG. 27. *Pt. flava*, var. *maldivensis*. Section through edge of left genital pleura. × 85.

FIG. 28. *Pt. flava*, var. *saxicola*. Unusual dorsal root formed by pigmented outgrowth from collar cord and glandular ingrowth from epidermis. These two portions fuse a few sections further back. × 85.

FIG. 29. *Willeyia bisulcata*. Section through proboscis towards its hinder end. The dorso-ventral muscles (*mdv.*) are seen converging to the minute vermiform process of the stomochord. × 45.

FIG. 30. *Pt. flava*, var. *saxicola*. Small portion of inner surface of genital pleura shewing ingrowth from epidermis forming gonad. × 110.

FIG. 31. *Pt. flava*, var. *saxicola*. Section through tip of a genital pleura shewing epidermal ingrowth forming gonad. × 180.

FIG. 32. *Pt. viridis*. Section through proboscis. × 20.

PLATE XL.

FIG. 33. *Pt. flava*, var. *parva*. An immature gonad shewing ectodermal connection, and quantity of mucus inside. × 180.

FIG. 34. *Spengelia maldivensis*. Section through collar canal just anterior to its opening into the first gill pouch. Ventral to it is the blind diverticulum of the first gill pouch of which the internal opening is marked by an asterisk *. × 85.

FIG. 35. *Pt. flava*, var. *parva*. An immature gonad in which the ectodermal connection is occluded by a mucous plug. × 180.

FIG. 36. *Pt. flava*, var. *laccadivensis*. From young specimen (anterior hepatic region) shewing very young gonad connected with the ectoderm. × 410.

FIG. 37. *Pt. flava*, var. *muscula*. A nearly ripe ♂ gonad breaking through to the ectoderm. × 180. (*sp* = spermatocytes.) From an iron haematoxylin preparation.

FIG. 38. *Pt. flava*, var. *laccadivensis*. From young specimen. *a*—*e* represent stages in the formation of the giant nutritive cells. All × 520.

FIG. 39. *Pt. flava*, var. *laccadivensis*. Young gonad, shewing cavity formed inside, and outer coat of nutritive cells forming a kind of follicle. The membrane surrounding the gonad derived from the lateral septum is still intact. × 410.

FIG. 40. *Pt. flava*, var. *laccadivensis*. Young gonad, slightly older than in preceding figure. The membrane surrounding the gonad tends to break down in places. × 410.

FIG. 41. *Pt. flava*, var. *saxicola*. Section through young gonad with ectodermal connection. At the base of the gonad the membrane is deficient permitting the invasion of nutritive cells. × 180.

FIG. 42. *Pt. flava*, var. *saxicola*. Gonads somewhat older than in preceding figure. × 110.

PLATE XLI.

FIG. 1. *Balanoglossus parvulus*. Section through branchial region. × 45.

FIG. 2. *B. parvulus*. Through region of post-branchial groove. × 45.

FIG. 3. *B. parvulus*. Through nuchal skeleton in anterior region of collar. × 45.

FIG. 4. *B. parvulus*. Through post-branchial genital region. × 45.

FIG. 5. *Spengelia porosa*. Through hepatic region. On the right the section has gone through the middle of a hepatic caecum. × 12.

FIG. 6. *Sp. maldivensis*. Section through nuchal skeleton in the region of the keel (*nk.*). The perihaemal cavity (*ph.*) of the right side is seen at this level. That of the left side does not reach so far forwards. × 45.

FIG. 7. *Sp. porosa*. Section through the intestinal region behind the hepatic caeca. × 12.

FIG. 8. *Sp. maldivensis*. Schematic longitudinal sagittal section reconstructed from transverse sections. × 10.

FIG. 9. *Willeyia bisulcata*. Section through proboscis pore. × 45.

FIG. 10. *W. bisulcata*. Schematic reconstruction as in fig. 8. × 10.

PLATE XLII.

FIG. 11. *Spengelia porosa*. Section through posterior part of proboscis. × 12.

FIG. 12. *Willeyia bisulcata*. Section through anterior part of proboscis. × 30.

FIG. 13. *W. bisulcata*. Section through branchial region. × 22.

FIG. 14. *W. bisulcata*. Section through genital region. × 22.

FIG. 15. *W. bisulcata*. Section through hinder part of anterior neuropore. × 45.

FIG. 16. *W. bisulcata*. Through anterior part of anterior neuropore, shewing the œsophageal nerve coming off on the left side of the figure. × 45.

FIG. 17. *Ptychodera viridis.* Section through post-branchial groove. × 12.

FIG. 18. *Pt. flava*, var. *muscula.* Section just anterior to the proboscis pores, shewing the expansion of the nuchal skeleton over the racemose organ (*r*). × 45.

FIG. 19. *Pt. viridis.* Section through anterior collar region. × 20.

FIG. 20. *Sp. maldivensis.* Section through post-branchial groove. × 45.

PLATE XLIII.

All figures on this plate are from *Pt. flava*, var. *parva.*

FIG. 21. Through anterior part of proboscis. × 30.

FIG. 22. Through anterior portion of central proboscis complex. × 30.

FIG. 23. Through specimen in which the two proboscis pores have a common opening near the mid-dorsal line. × 54.

FIG. 24. Through hinder part of proboscis shortly before the lateral diverticula of the stomochord appear. × 54.

FIG. 25. Through region of the lateral diverticula of the stomochord. × 54.

FIG. 26. Through the proboscis pores behind the lateral diverticula of the stomochord. × 54.

FIG. 27. Through anterior cavity containing region of collar. × 30.

FIG. 28. Through region of racemose organ, behind the proboscis pores. × 54.

PLATE XLIV.

FIG. 29. *Pt. flava*, var. *asymmetrica.* Section through collar cord. × 45.

FIG. 30. *Pt. flava*, var. *parva.* Section through same level as Pl. XLIII. fig. 25, but through another specimen in which the lumen of the stomochord is obliterated instead of being patent. × 45.

FIG. 31. *Pt. flava*, var. *parva.* Section through middle of collar region shewing longitudinal muscles arranged in bundles. × 20.

FIG. 32. *Pt. flava*, var. *parva.* Section through proboscis pores. In this specimen the perihaemal spaces reach forwards to this level. More usually they commence shortly behind the pores (cf. Pl. XLIII. figs. 23, 26). × 45.

FIG. 33. *Pt. flava*, var. *saxicola.* Section just anterior to the proboscis pores shewing great width of keel of nuchal skeleton. × 45.

FIG. 34. *Pt. flava*, var. *saxicola.* Section through stomochord in region of lateral diverticula. × 85.

FIGS. 35, 36, 37. *Pt. flava*, var. *saxicola.* Sections through the pygochord. The three sections are from the same specimen; fig. 35 is nearest to the anus, fig. 37 is furthest from it. × 85.

FIG. 38. *Pt. flava*, var. *saxicola.* Through anterior branchial region. × 12.

FIG. 39. *Pt. flava*, var. *saxicola.* Through posterior branchial region of same specimen as in fig. 38. × 12.

FIG. 40. *Pt. flava*, var. *saxicola.* Through level immediately behind the post-branchial groove. Also from same specimen as fig. 38. × 12.

FIG. 41. *Pt. flava*, var. *saxicola.* Through region of post-branchial groove. The genital pleurae are still almost as large as in the branchial region. × 12.

PLATE XLV.

FIG. 42. *Pt. flava,* var. *gracilis.* Section through hinder part of collar region. × 45.

FIG. 43. *Pt. flava,* var. *laccadivensis.* Sections through stomochord. All × 85.

a. Near anterior extremity.
b. At anterior level of lateral diverticula.
c. Through lateral diverticula at their maximum breadth.
d. In region of nuchal skeleton.

FIG. 44. *Pt. flava,* var. *gracilis.* Through stomochord, shewing completely obliterated lumen. × 85.

FIG. 45. *Pt. flava,* var. *cooperi.* Through keel of nuchal skeleton. × 85.

FIG. 46. *Pt. flava,* var. *cooperi.* Through proboscis stalk close to opening of proboscis pores. × 85.

FIG. 47. *Pt. flava,* var. *cooperi.* Through post-branchial groove. The groove is large and the genital pleurae well marked. × 45.

PLATE XLVI.

Sections through the region of the branchial and post-branchial groove in several species and varieties of *Ptychodera.* All × 27.

FIG. 48. *Pt. flava,* var. *parva.* Through middle of branchial region.

FIG. 49. *Pt. flava,* var. *laccadivensis.* Through post-branchial groove.

FIG. 50. *Pt. flava,* var. *gracilis* (Hulule). Through middle of branchial region.

FIG. 51. *Pt. flava,* var. *laccadivensis.* Through hind end of post-branchial groove.

FIG. 52. *Pt. asymmetrica.* Through middle of branchial region.

FIG. 53. *Pt. flava,* var. *gracilis* (Hulule). Through hind end of post-branchial groove.

FIG. 54. *Pt. flava,* var. *gracilis* (Minikoi). Through branchial region.

FIG. 55. *Pt. flava,* var. *gracilis* (Minikoi). Through hind end of post-branchial groove.

FIG. 56. *Pt. asymmetrica.* Through posterior branchial region.

FIG. 57. *Pt. flava,* var. *laccadivensis.* Through middle of branchial region.

FIG. 58. *Pt. asymmetrica.* Through hind end of post-branchial groove.

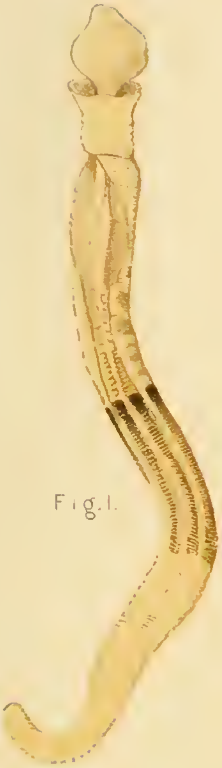


Fig. 1.

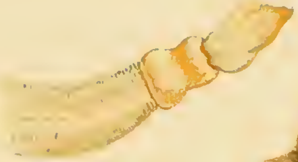


Fig. 2.

Fig. 3.

Fig. 6.

Fig. 4.

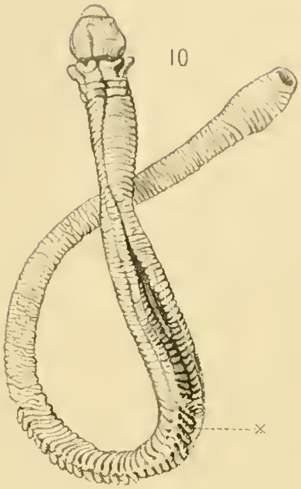
Fig. 5.

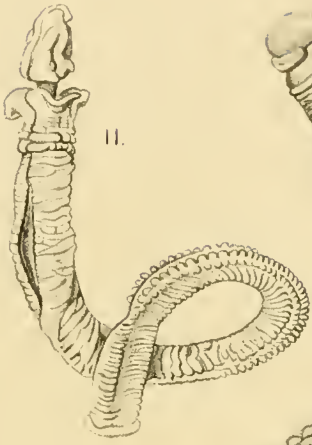
Fig. 9.

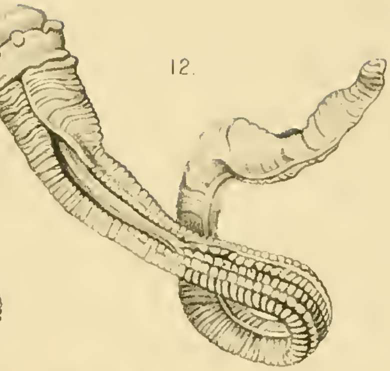
Fig. 7.

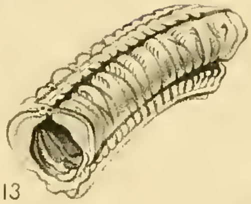
Fig. 8.

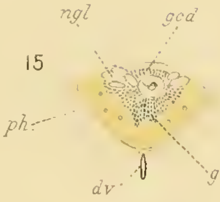
C.F.C. del

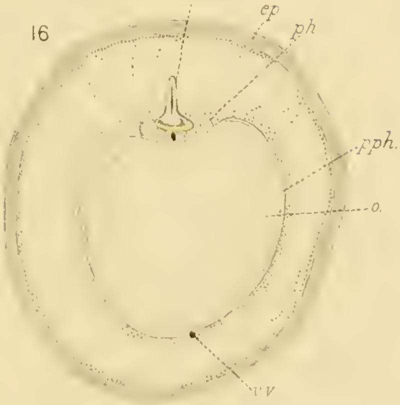


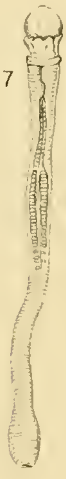


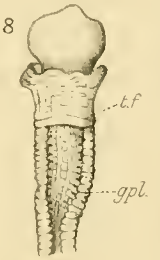


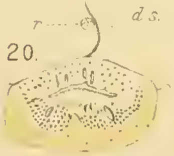


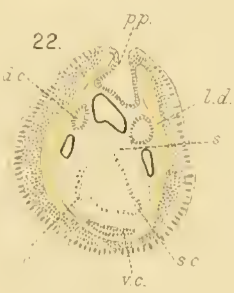


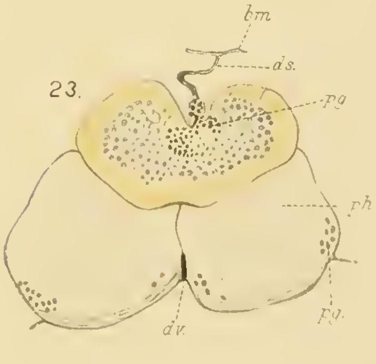












Figs. 10-14 and 19 E.W. cetera R.C.P. del.

[illegible] Cambridge

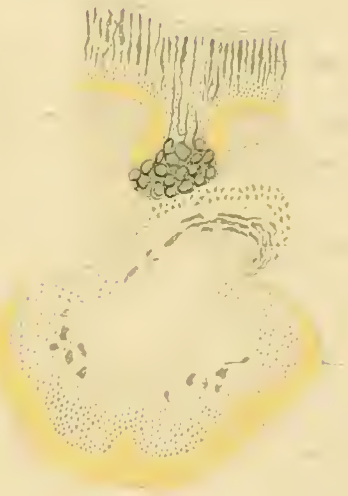
Punnett - Enteropneusta

24

25

26

27



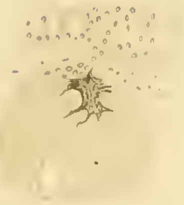
28

29

30

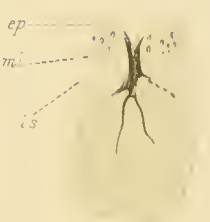
3

33.

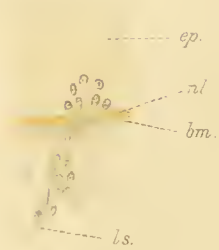


34.

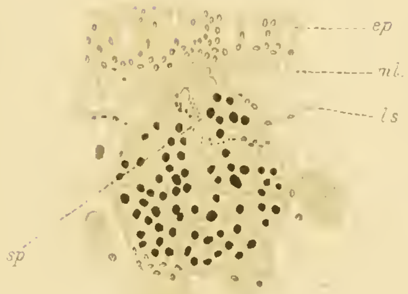
35



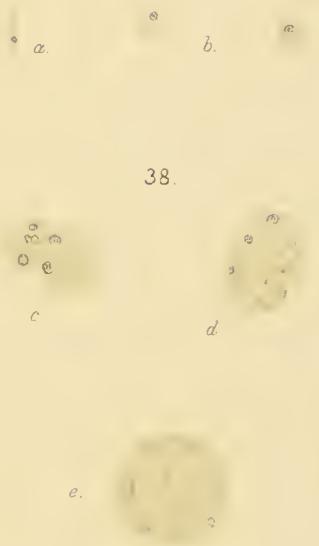
36.



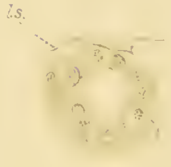
37.



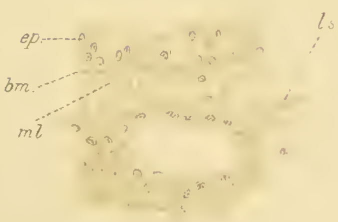
38.



39.

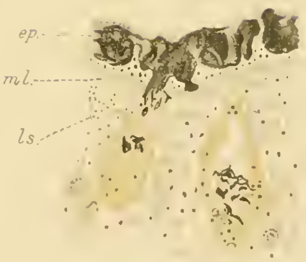


40.



41.

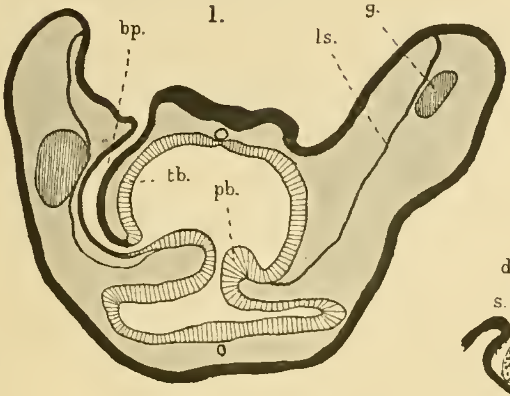
42



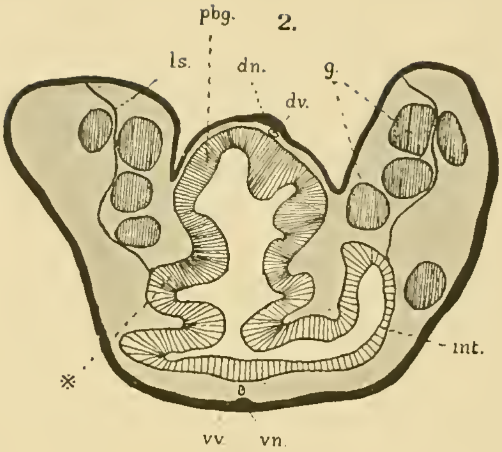
R.C.P. del.
E. Wilson, Cambridge.

Punnett - Enteropneusta.

1.

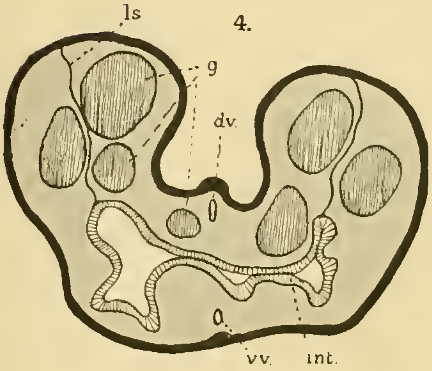


2.

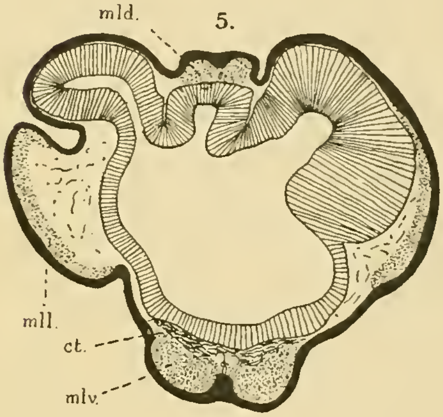


3.

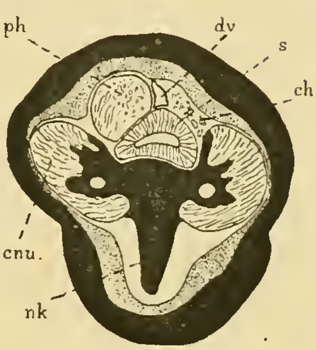
4.



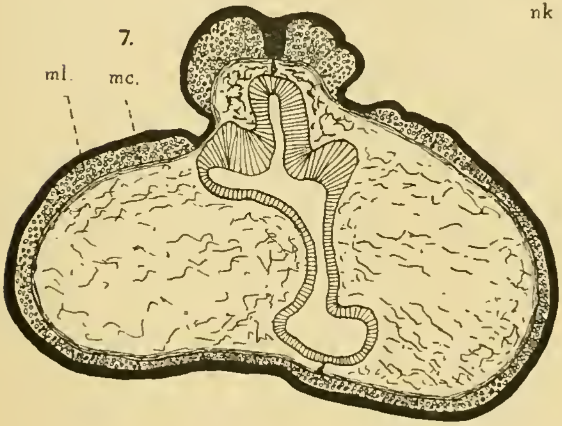
5.



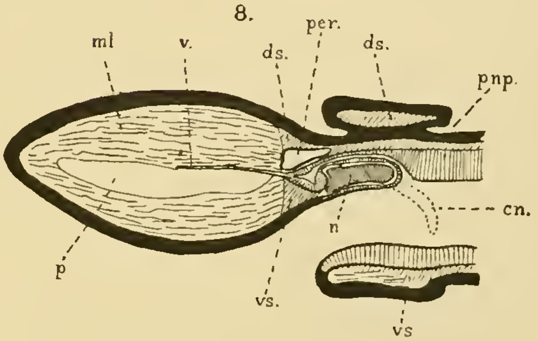
6.



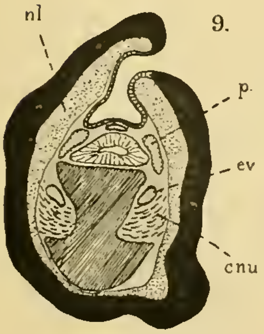
7.



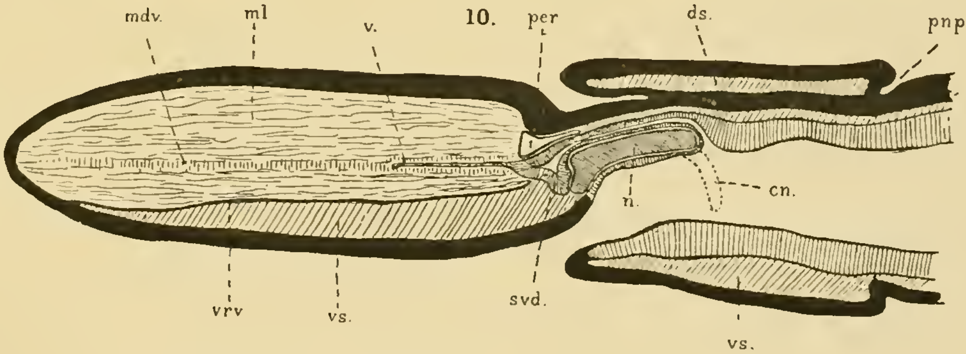
8.



9.



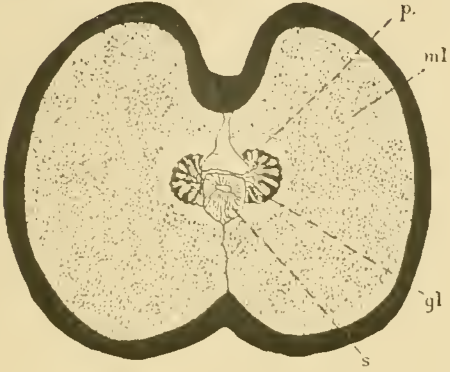
10.



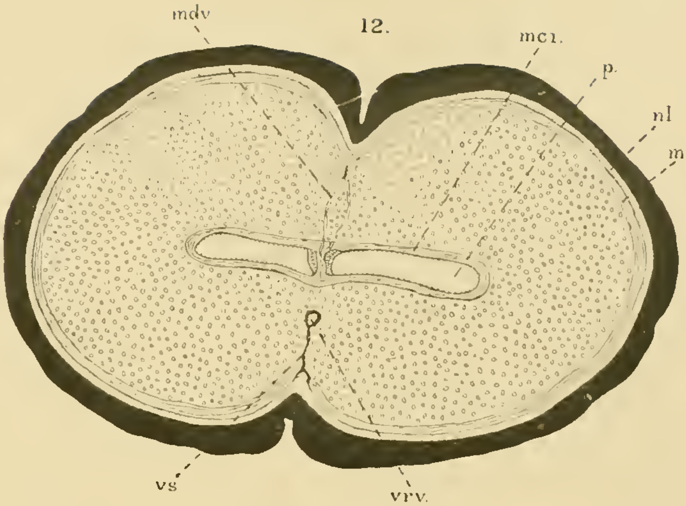
R. C. P. del.

PUNNETT——ENTEROPNEUSTA.

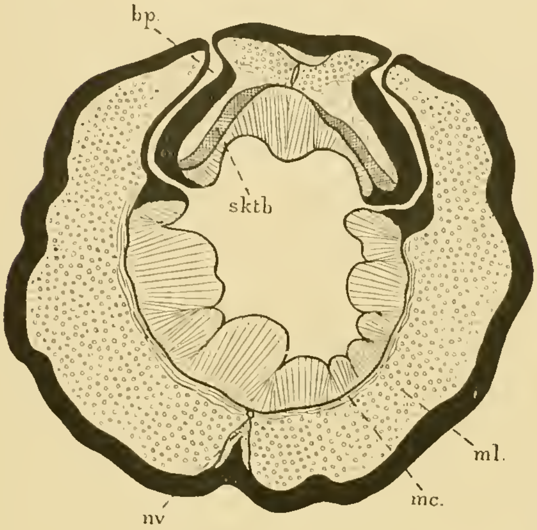
11



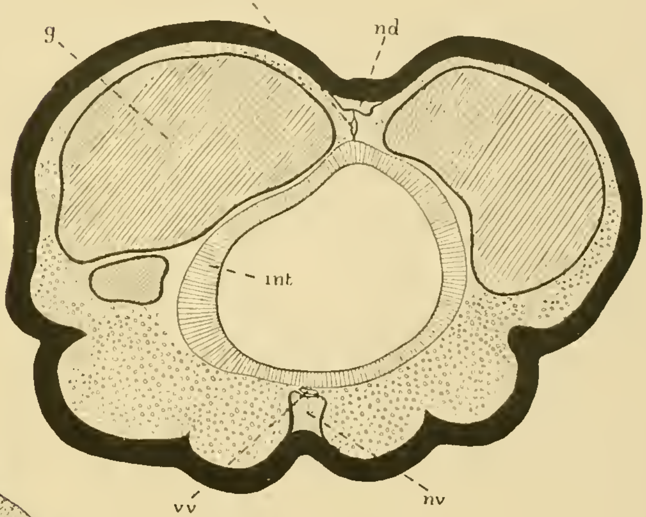
12.



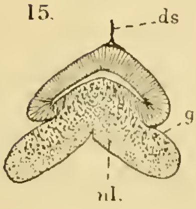
13.



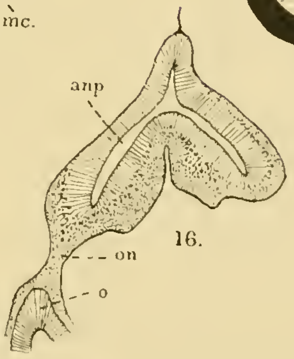
14.



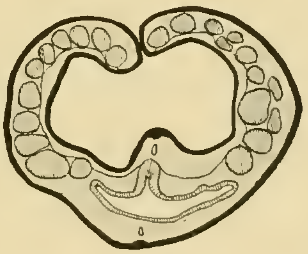
15.



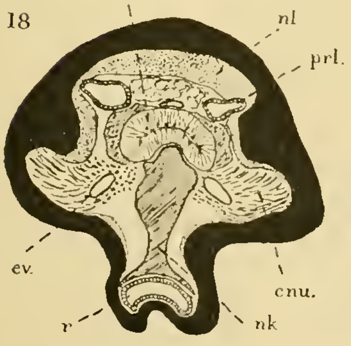
16.



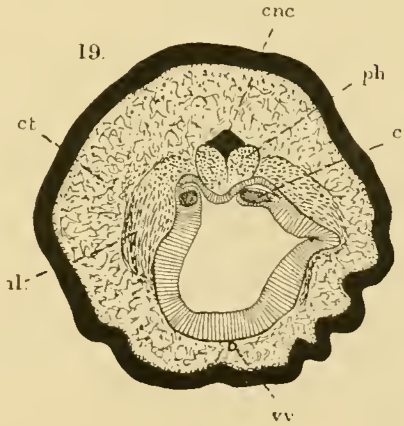
17.



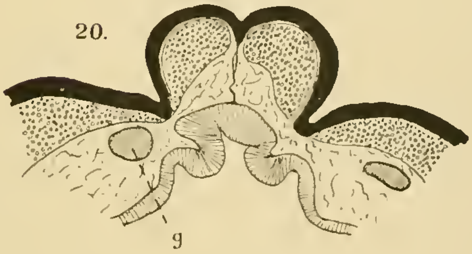
18



19.



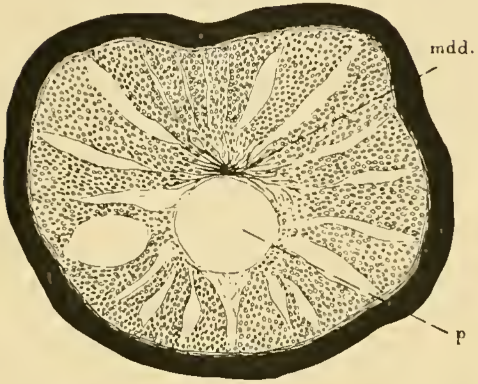
20.



R. C. P. del.

PUNNETT——ENTEROPNEUSTA.

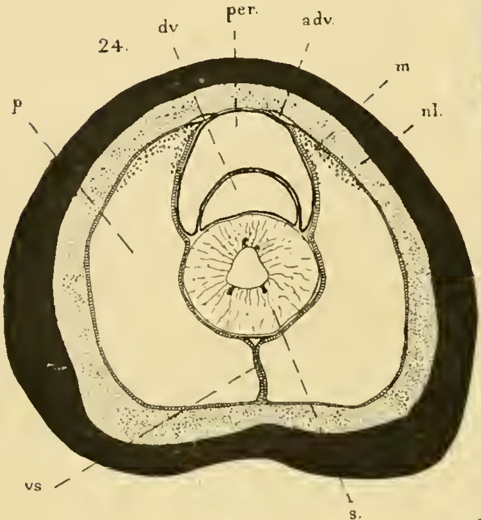
21



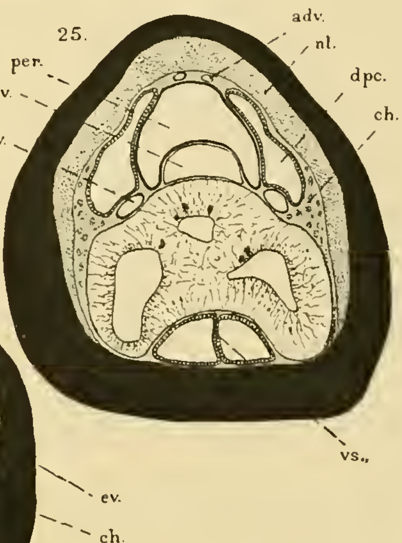
22

23.

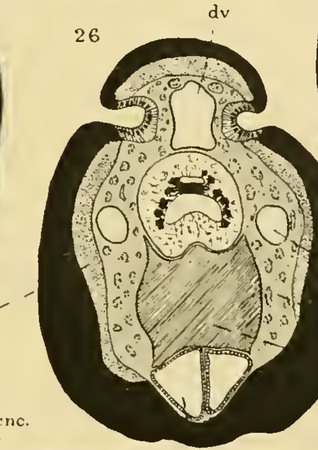
24.



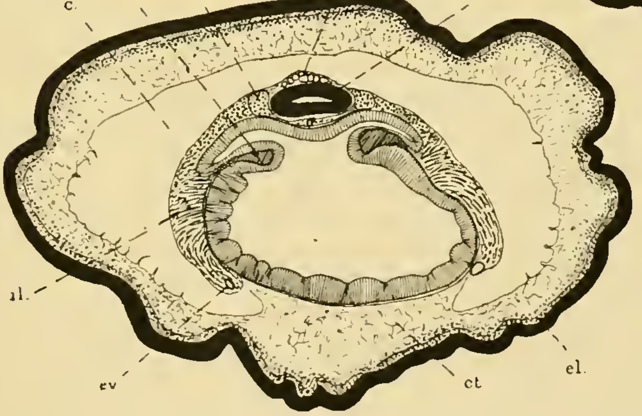
25.



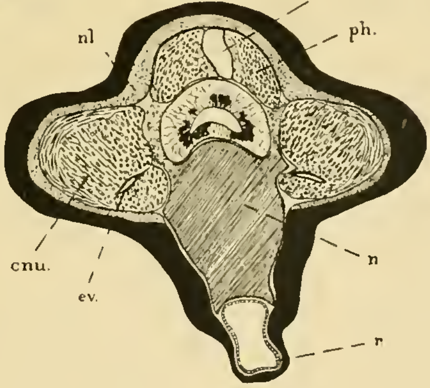
26



27.



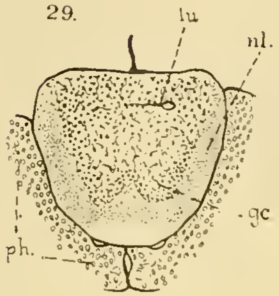
28.



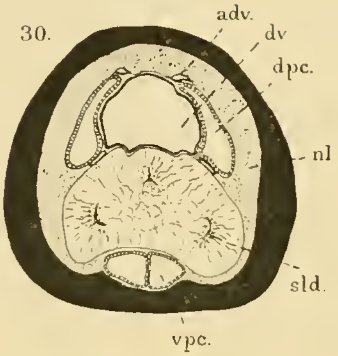
R. C. P. del.

PUNNETT——ENTEROPNEUSTA.

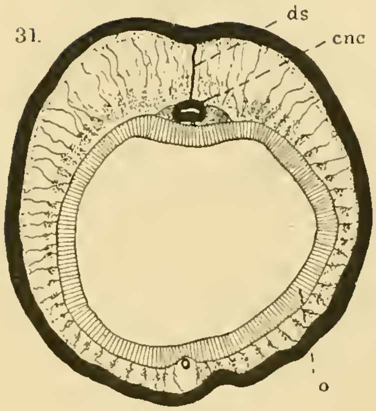
29.



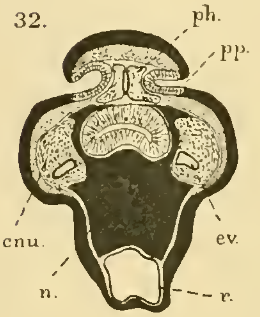
30.



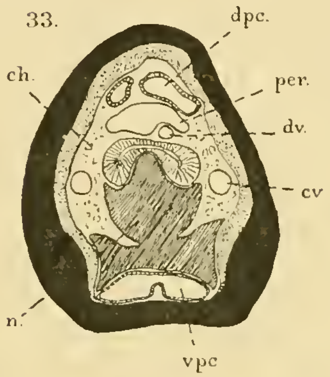
31.



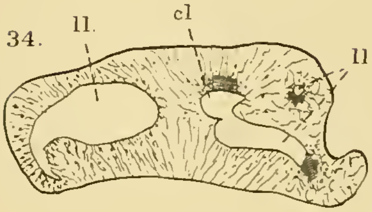
32.



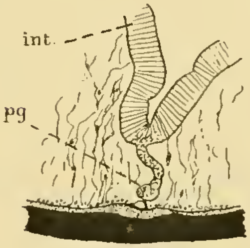
33.



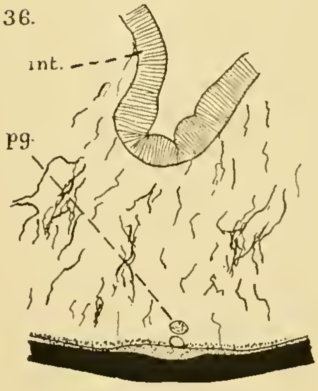
34.



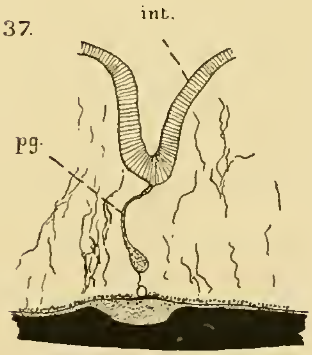
35.



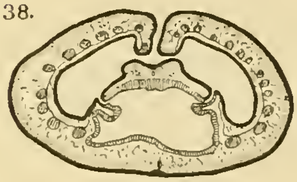
36.



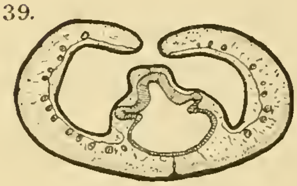
37.



38.

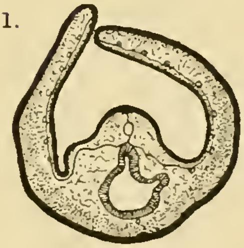


39.



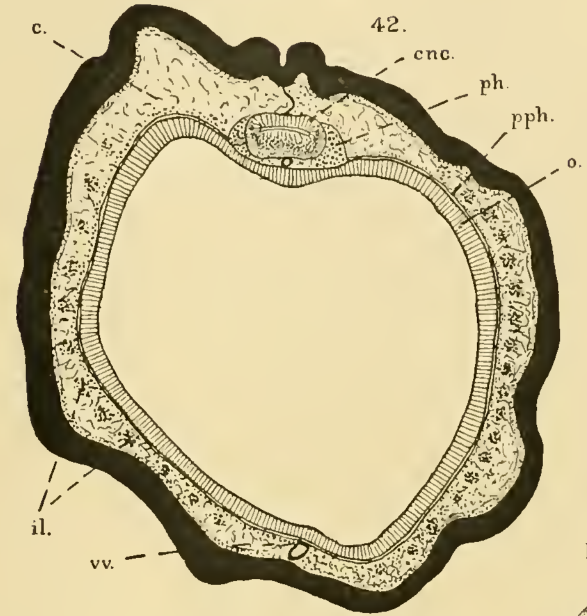
40.

41.

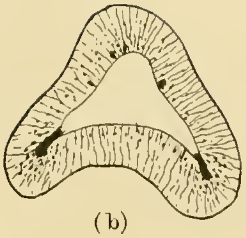


R. C. P. del.

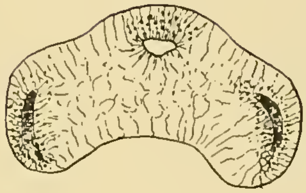
PUNNETT——ENTEROPNEUSTA.


42.

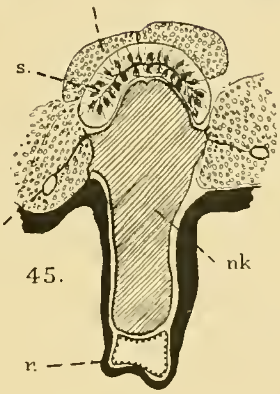

(a)

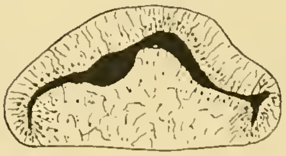

(b)

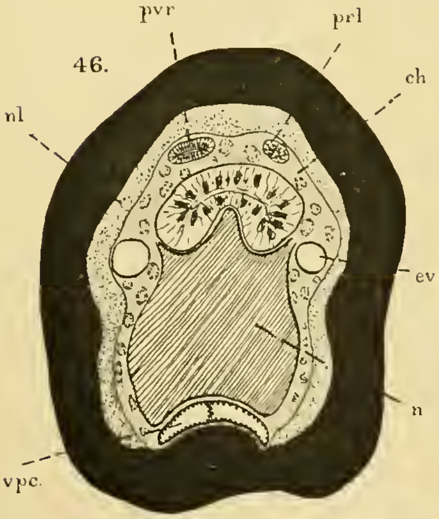
43.

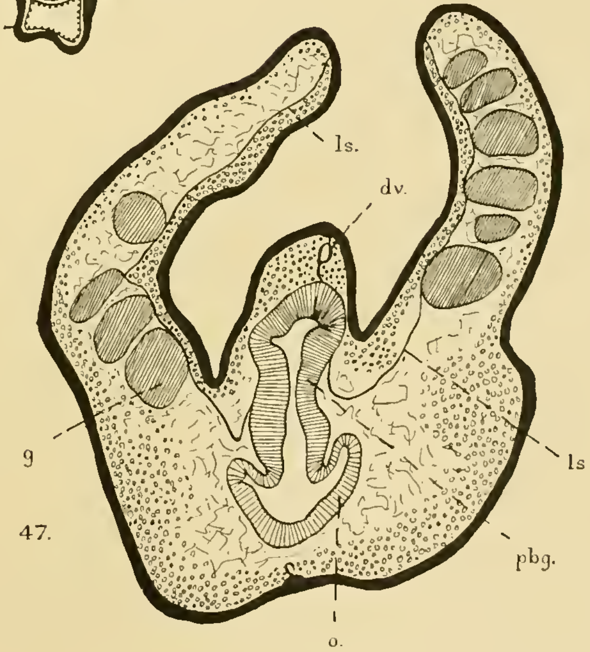

(c)


(d)


45.

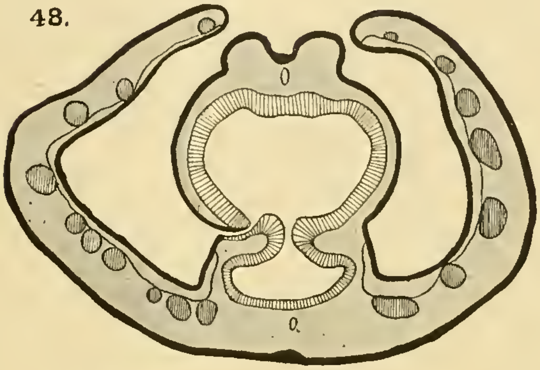

44.

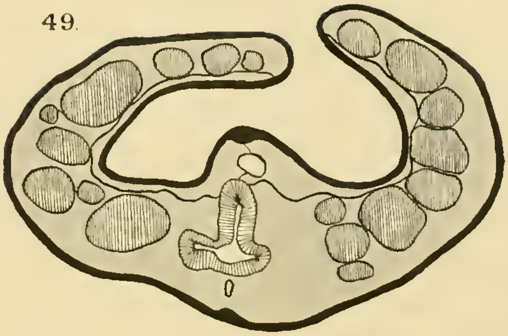

46.


47.

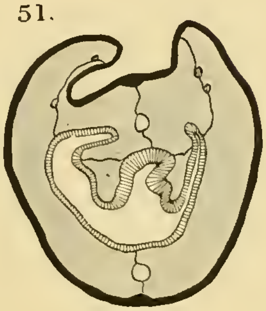
R. C. P. del.

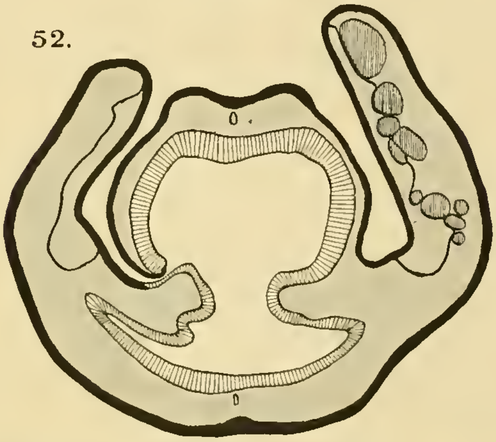
PUNNETT——ENTEROPNEUSTA.

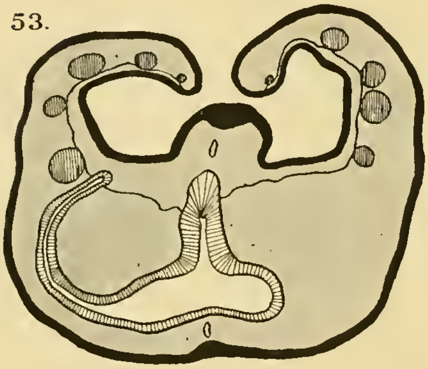

48.

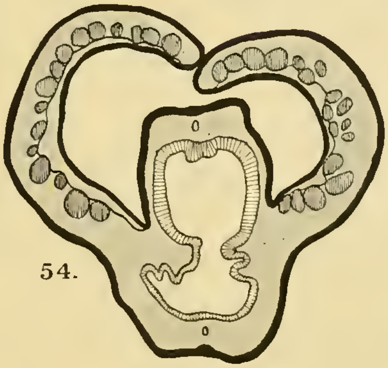

49.

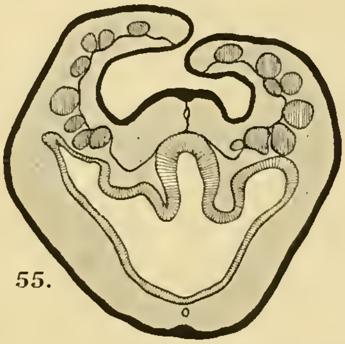

50.

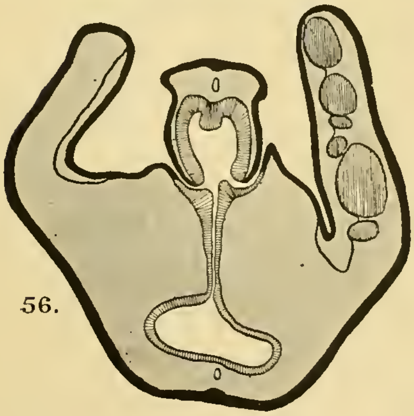

51.

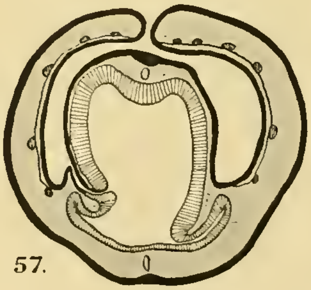

52.

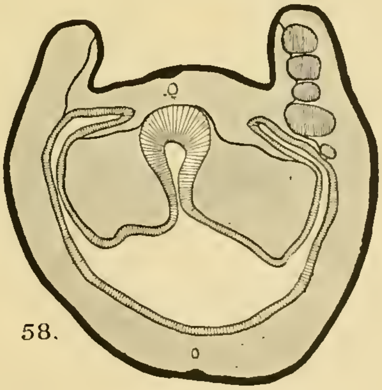

53.


54.


55.


56.


57.


58.

R. C. P. del.

PUNNETT—ENTEROPNEUSTA.

MARINE CRUSTACEANS.

PARTS X. AND XI.

By L. A. Borradaile, M.A., *Lecturer in Natural Sciences at Selwyn College, Cambridge.*

(With Plates XLVII. and XLVIII. and Text-figures 122—6.)

X. THE SPIDER-CRABS (OXYRHYNCHA).

The Oxyrhyncha are a fairly well characterized group. Sharply separated, on the one hand from the Dromiacea by the coxal opening of the oviduct, the loss of the first abdominal limb in the female, and the normal shape and position of the last pair of legs (except in two or three cases as *Ocinopus* (Fig. 123), *Grypachaeus* and *Zebrida*), and on the other hand from the Oxystomata by the square mouth and the normal maxillipeds (Pl. XLVII. fig. 5 *b*), they differ from the Brachyrhyncha in the shape of the body, which is narrowed in the fore part, so that in most cases it is triangular, and has a well-marked rostrum (Pl. XLVII., and Text-figs. 122 and 123), and usually in the imperfection of the orbits. Slender legs and weak chelae are another common feature, but not a diagnostic one. Their prevailing habitat may be summed up by saying that they are the crabs of the weed and weed-like animals, but this statement needs some explanation and qualification.

The loss of their tail-fin has left the crabs, as a whole, a distinctly slower-moving group than most of the tailed Reptantia. To this there are, indeed, exceptions—as, for instance, the Ocypodes on land and the swimming crabs in the water—but for the bulk of the Brachyura it holds good, and each of the sections of the tribe has had to meet the difficulty in its own way. In the Brachyrhyncha the cuticle has generally become thickened into a stout armour, while the crab keeps fairly active in its habits, at all events after dusk, and usually defends itself vigorously with its strong chelae when it is attacked. In this legion protective coloration and shape are comparatively rare, and the habit of covering the body with foreign objects decidedly so (*Caphyra*), though the custom of hiding under stones is common. The remaining groups have, so to say, accepted the situation. Driven by the loss of their tail-fin to lead a sluggish life, they have found safety in exaggerating this inertness and combining it with various devices for escaping observation. The Dromiacea hold foreign bodies over their backs with their hind legs, the Oxystomes bury themselves in sand or shingle, and in each of these groups the most characteristic features, to which they owe their distinctness, are due to the method of concealment[1]. The

---

[1] See above, p. 434.

typical members of the Oxyrhyncha—the Maiidae[1]—have adopted another plan. They hide themselves by covering their bodies with bits of seaweeds, zoophytes, or sponges, which are held on by hooked or jagged hairs of special shape found on the body and limbs of the true spider-crabs and not elsewhere (Pl. XLVII. figs. 3 *c* and 4 *d*). They are gathered and placed in position by the crab itself, which uses for this purpose its chelipeds. These limbs are specially shaped so as to have a mobility not found in other crabs, and are thus able to reach distant parts of the body and legs. In order that they may adhere better, the fragments of weed, etc. are treated with a secretion given out by glands on the first maxilliped[2]: and they not only remain in a living state, but often continue to grow, so that in some genera it is not uncommon to find the whole crab as completely hidden by a single sponge as any *Dromia*. Besides seaweeds, the organisms used include sponges, hydroids, polyzoa, and ascidians, and in some cases barnacles and tubicolous worms add themselves as self-invited guests. Several different kinds of organisms may sometimes be found on the back of one crab, but in most cases, very possibly in all, the species planted by it are those amongst which it is living and are changed if it be placed in other surroundings where they would be conspicuous. This implies considerable care in the choice of the clothing, and indeed such may easily be seen to be bestowed if a captive individual, say a *Maia squinado*, be watched while it is disguising itself. I have even seen this species cover its back with shingle when no weed was available. The number of hairs naturally varies, as does also the extent to which the crab is hidden, but it rarely happens (*Epialtus*) that they are quite wanting.

---

[1] *Key to the families of the Oxyrhyncha.*

I. Carapace thin and flat. First leg (cheliped) not long or specially mobile or with fingers bent at an angle with the hand. Male opening sternal. [No orbits. Second joint of antennal stalk slender, fused with epistome but not with front. No hooked hairs.] *Hymenosomidae.*

II. Carapace not thin *and* flat (except *Ocinopus*). First leg either mobile or powerful with bent fingers. Male opening coxal.

  A. Chelipeds specially mobile, rarely much larger than the other legs or with fingers bent at an angle on the hand. Second joint of antenna well developed, generally fused with epistome and often with front. Orbits generally more or less incomplete. Hooked hairs almost always present. *Maiidae.*

  B. Chelipeds not specially mobile, usually much longer and heavier than the other legs and with fingers bent on the hand at an angle towards the side on which the fixed finger is set. Second joint of antenna small, short, and not fused with epistome or front. Orbits well made. Hooked hairs almost always wanting. *Parthenopidae.*

Key to the subfamilies of the Maiidae.

I. Second joint of antenna very slender throughout its length. [No orbits. Eyestalks generally long.] *Inachinae.*

II. Second joint of antenna not very slender.

  A. No true orbits (eyestalks hidden under a supraocular spine or sunken in the sides of a great rostrum). Second joint of antenna truncate-triangular. Eyestalks very short. *Acanthonychinae.*

  B. True orbits, containing both supra- and postocular elements sheltering the eyes, are more or less completely formed, except in a few genera where the eyestalks are long and slender. Second antenna-joint broad, usually not truncate-triangular. Eyestalks long or short.

    1. A large, cupped, usually blunt postocular process present. Eyestalks short. Cornea of eyes not completely hidden when they are folded back. *Pisinae.*

    2. Postocular process, if present, usually sharp and not cupped, but if not so then cornea hidden (as also in most other cases). Eyestalks usually long. *Maiinae.*

Key to the subfamilies of the Parthenopidae.

I. Carapace usually triangular, sometimes suboval or subpentagonal. Rostrum simple. Chelipeds much bigger than the other legs. Branchial regions of the body deeply separated from cardiac. *Parthenopinae.*

II. Carapace usually sharply pentagonal. Rostrum cleft into two. Chelipeds of moderate size. Branchial regions of the body not deeply separated from cardiac. *Eumedoninae.*

[2] For an account of those structures in the Spider-Crabs which are specially adapted to their habit of clothing themselves, see Aurivillius, *Kong. Svenska Vet.-Ak. Hand. Bt.* XXIII. no. 4 (1889).

Such habits as these need a corresponding habitat, and the Spider-Crabs are essentially haunters of weeds, and weed-like animals. The larger kinds cling to the rocks and stones on which grow the organisms they clothe themselves with. The walking-legs of such species usually end in strong, sharp, curved claws by which they can hold fast to the ground. Smaller kinds often live on the weed itself, and these frequently bear hooked or even sub-chelate claws on the hinder legs with which to cling to the branches, while one or both of the second and third pairs are long—probably because they are used in climbing (Pl. XLVII. figs. 1, 3 and 4). The first pair (chelipeds) are also sometimes used, monkey-wise, in clambering. Research will no doubt show that some of the peculiar features of particular species and genera are adaptations to special kinds of sessile organisms. At present I can only recall the flat, leaf-like body of *Huenia*, which resembles the *Halimeda*-weed among which it is generally found (see below, p. 686), and it is certainly the case that very many species show no preference whatever in this respect.

The habit of living on or among sessile organisms is probably kept up by some of the members of the other two families of the Oxyrhyncha, although it is the Maiidae alone which clothe themselves in the way described above. Further information, however, is much needed on this point. The Hymenosomidae (Fig. 122) seem clearly adapted by their structure—their delicate bodies and slender legs with hooked end-joints—for living on plants or zoophytes. They may certainly sometimes be found in such situations, but are also reported to have been taken under stones[1], a position for which their flat backs are not unsuitable. Among the Parthenopidae, the Eumedoninae are probably guests of other organisms. *Zebrida* has, indeed, been taken among the spines of a sea-urchin whose colouring it assumes. But the Parthenopinae (Pl. XLVII. fig. 5) have an entirely different habitat. The members of this subfamily have left the weed (that they originally had the same habits as the Maiidae seems likely from the occurrence of hooked hairs, slight and few in number, in certain members of the genus *Lambrus*) and have taken up the same habitat as the Oxystomata—that is to say beds of sand and shingle. The result is a series of modifications strikingly like some of those which are found in the latter group[2]. The overlapping wings of the carapace which hide the legs of *Calappa* and *Tlos* reappear in such forms as *Cryptopodia*, *Heterocrypta* and *Oethra* and less strongly marked in *Lambrus*, especially *L. calappoides*. The long chelipeds of some Leucosiids are repeated in an altered shape in various species of *Lambrus* and *Parthenope*. The bent fingers of *Ranina* and some species of *Calappa* are found throughout the group. In *Lambrus calappoides* we find again the flat hands of *Calappa* held against the breast. But the most striking of these likenesses is the arrangement of the inward channel for the breathing-stream in *Aulacolambrus*, which, while it is wholly new, yet strongly recalls that of the Leucosiidae. In this subgenus, the underside of the carapace (pterygostome) is traversed, on each side, just outside the third maxilliped, by a deep groove which is covered in, not like the analogous channel in the Leucosiidae by the maxillipeds, but by thick fringes of hairs borne by the maxillipeds and by the carapace, becoming thus a closed tube leading from the front of the body to the opening of the gill-chamber at the base of the chelipeds (Pl. XLVII. fig. 6). A similar

---

[1] Adams and White, *Crustacea of the Samarang*. The authors make the same statement about *Trapezia*, which is certainly a coral crab. Perhaps these genera take shelter under stones when they are by some accident removed from the neighbourhood of their natural habitat, growing organisms. Or, again, it may be that the hollows under the stones from which the *Elamena* was taken were lined, as such hollows often are, with a scrubby growth of weed.

[2] See above, pp. 434, 435.

arrangement is found in the other subgenera of *Lambrus*[1]. In this case, however, there are two shallow grooves, an outer one running outward and an inner one running forward from the gill-opening, and both uncovered (Pl. XLVII. fig. 5 *b*). The rough, knobbed back of the Parthenopinae is like that of *Calappa*, but a similar texture is so common among crabs that little can be argued from it. Probably it is less conspicuous on a sandy bottom with coral pebbles than a quite smooth object would be.

We have already stated that the Oxyrhyncha are among the sluggish groups of crabs. When they are seized they do not attempt to defend themselves with their chelae, but move their legs feebly and aimlessly. Indeed the Parthenopinae—like the Calappidae in this respect also—often seem to be hypnotised by being moved, drawing up their legs under them and remaining still. In general the intelligence of the group is of a low order, with the single exception of their cleverness in disguise, which, after all, is probably no more than a fairly simple reflex.

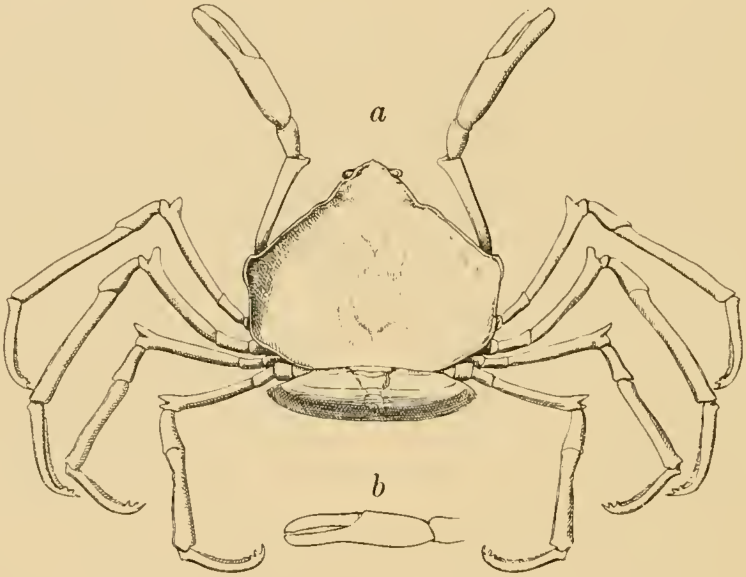


FIG. 122. *Elamena gracilis*; *a*. whole animal, *b*. outside of hand.

Of the 29 species in the collection made by the expedition, three are new. The rest are all recorded from the Indian region by Major Alcock[2], with the exception of two which were described as new by Miss Rathbun in her account of Prof. Agassiz's Maldive Crabs[3]. The following systematic list sets forth these species in order.

Family **Hymenosomidae.**

Genus *Elamena* H. M.-Edw., 1837.

1. *Elamena gracilis*, n. sp. (Fig. 122)

Diagnosis: "An *Elamena* in which the sides of the hinder part of the body are straight from the 4th to the 1st pair of legs, and then turn inwards almost at right angles to

---

[1] Owing to lack of material I am unable to say whether this groove is found throughout Parthenopinae.

[2] In his series of papers on the Indian Crabs in the *Journ. As. Soc. Bengal.*

[3] *Bull. Mus. Harvard*, XXXIX. 5 (1902).

join the fore part, which is triangular, with very slightly irregular sides; the front also triangular but with indications of two teeth at its sides; the eyes showing a small part of the cornea at the sides of the front when seen from above; the chelipeds short, slender, with narrow, spooned fingers about as long as the palms; and the walking-legs slender, with a spine at the end of the meropodite, and the last joint strongly hooked, with a group of little thorns underneath at the tip and a fringe of hair all along."

Length of longest specimen: 6 mm. Breadth: 7 mm. Colour: in spirit, pale yellow; when alive, legs black-brown, rest of body transparent.

A female was taken at Minikoi, and a male and female at Hulule, Male Atoll, all on the reef.

Family **Maiidae.**

Subfamily **Inachinae.** Genus *Achaeus* Leach, 1815.

2. ? *Achaeus spinosus* Miers, 1879. Alcock, I. p. 171[1].

My specimen agrees with Alcock's and Miers' descriptions, but the last *two* pairs of legs have strongly curved end-joints. Miers and Alcock only mention the last pair.

Dredged in Mahlos Atoll in 24 fathoms.

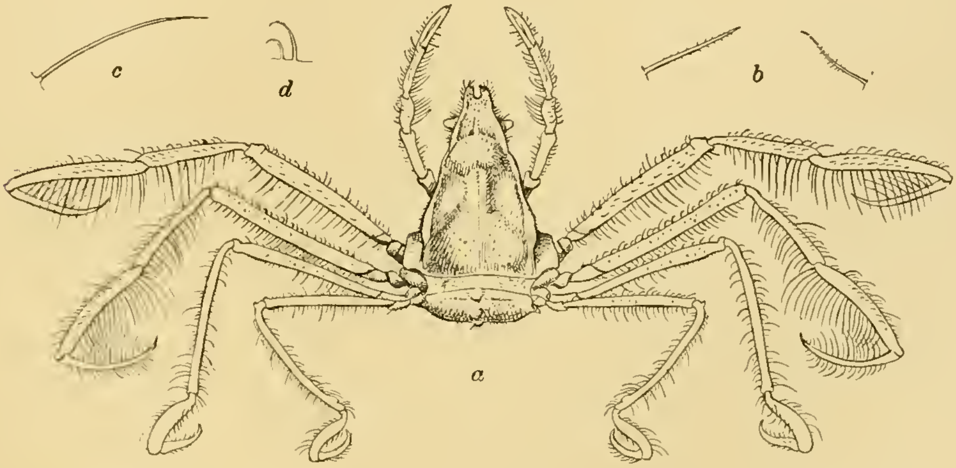


FIG. 123. *Ocinopus aranea*; *a.* whole animal, *b.* two of the hairs on the hinder pair of legs, *c.* one of the long hairs on the legs of the second and third pairs, *d.* hooked hairs.

Genus *Ocinopus* de Haan, 1837.

3. *Ocinopus aranea* de Haan, 1837. Alcock, I. p. 183 (Fig. 123).

The shape of the lobes at the tip of the rostrum in this species varies somewhat.

A very common crab, taken practically throughout the group in 19—45 fathoms.

---

[1] For a statement of the principles on which references are given in this series of papers see above, p. 192. Major Alcock's paper on the Indian Oxyrhyncha appeared in *Journ. As. Soc. Bengal*, LXIV. ii. 2, p. 157 (1895).

Subfamily **Acanthonychinae**. Genus *Xenocarcinus* White, 1847.

4. *Xenocarcinus tuberculatus* White, 1847. Alcock, I. p. 192.

Dredged outside Fadifolu Atoll, in 70 fathoms.

Genus *Menaethius* H. M.-Edw., 1834.

5. *Menaethius monoceros* (Latr.), 1825. Alcock, I. p. 197.

A common species, taken in Male, Fadifolu, Minikoi, and Goifurfehendu Atolls down to 6 fathoms.

Genus *Huenia* de Haan, 1837.

6. *Huenia proteus* de Haan, 1837. Alcock, I. p. 195 (Pl. XLVII. figs. 1, 2).

In the extraordinarily variable shape of its body, this crab is fully worthy of its name. The simplest form is found in most of the males, which are flat and triangular, much like *Menaethius*, with a long, sharp rostrum (Pl. XLVII. fig. 1). What may be the habitat of these males is yet to be settled: the specimen figured carried a large flat piece of a green weed, held on its rostrum by means of the hooked hairs always found there in this species. On the other hand, most of the females and some of the males—true males, not "unsexed females" with parasites—have the body widened into a leaf-like shape by outgrowths of the hepatic and branchial regions (Pl. XLVII. fig. 2). These individuals, at least in most cases, live on the flat *Halimeda*-weed, which they closely resemble both in shape and colour. Figure 124 is given to show this likeness. Some of the females, however, come near the three-cornered shape of the ordinary male. This, and the fact that intermediates are found in both sexes, prevents us from calling the phenomenon "dimorphism." Another interesting feature is shown by the walking legs. The last joint in these limbs is strongly toothed, and can be shut back at a sharp angle on the one before it. In the broad individuals the legs are short and stout and keeled to look like the edges of *Halimeda* "leaves," and here the whole under-edge of the last joint but one is hairy; but in the triangular form, where the legs are long and slender, there is a special tuft of hairs to meet the end-joint, and this tuft is often raised on a knob. The whole structure thus formed is all but subchelate and seems clearly adapted for holding on by.

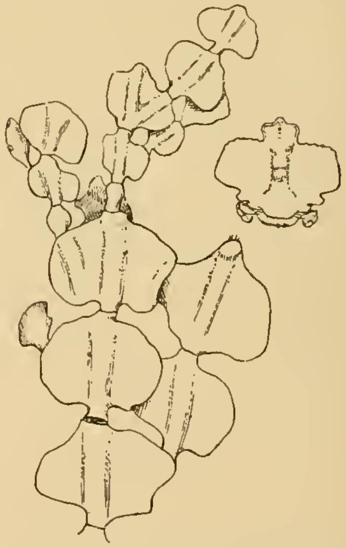


Fig. 124. A sprig of *Halimeda*-weed with a specimen of *Huenia proteus*, showing the likeness of the latter to a "leaf" of the weed.

The surface of the body of these crabs may be seen under a high magnification to have the curious graving shown in fig. 1 *a*, on Plate XLVII.

The species was taken in Male Atoll on the reef, and dredged from 22 fathoms in Kolumadulu Atoll.

Subfamily **Pisinae.** Genus *Naxioides* A. M.-Edw., 1865.

The synonymy of this genus is discussed by Rathbun, *Proc. Biol. Soc. Washington*, XI. p. 157 (1897).

7. *Naxioides hirta* A. M.-Edw., 1865.

Naxia hirta, Alcock, *loc. cit.* p. 218.

Taken in Kolumadulu, Suvadiva, Haddumati, and South Nilandu Atolls in 30—40 fathoms.

8. *Naxioides spinigera*, n. sp. (Pl. XLVII. fig. 3).

Diagnosis: "A *Naxioides* with the horns more than half the length of the body, bearing the accessory thorn a third of their length from the end; the body hairy, with many knobs and thorns, of which the largest are three in a row on the gastric region, two on the cardiac, one on the intestinal, three in a triangle on the branchial, with one in front of them, and one on each eye-hood, these latter being quite upright, but bent slightly forwards at the tip, no thorn at the angle of the mouth, two knobs on the pterygostome, two thorns on the outside of the basal joint of the antenna; the chelipeds slender, little longer than the body, the fingers half the length of the palm, finely toothed and meeting along nearly their whole length, a spine at the end of the arm; and the walking legs slender, the first pair very long, a long spine at the end of the meropodite of this limb, a short one on the next, and none on the hinder two."

Length: 11 mm. Breadth: 8 mm. Colour in spirit: white.

Allied to *N. cerastes* (Ortm.), 1894.

Three males dredged in 30 fathoms in North Male Atoll.

Genus *Halimus* Latr., 1829.

For the synonymy of this genus, which is identical with *Hyastenus* White, 1847, and not *Naxia* Leach, 1828, see Rathbun, *Proc. Biol. Soc. Washington*, XI. p. 157 (1897).

9. *Halimus tenuicornis* (Pocock), 1890. Alcock, I. p. 215.

The colour of this species as preserved in formalin is white with bright pink markings. It was dredged in South Nilandu, Male, Mulaku, Felidu and North Male Atolls in 25—30 fathoms.

10. *Halimus gracilirostris* (Miers), 1879. Alcock, I. p. 215.

Dredged throughout the group in 20—70 fathoms.

11. *Halimus diacanthus* (de Haan), 1837. Alcock, I. p. 210.

Found on a black crinoid dredged in 30 fathoms in South Nilandu Atoll.

12. *Halimus calvarius* (Alc.), 1895. Alcock, I. p. 213.

Dredged in South Nilandu, Mulaku, Suvadiva, Haddumati, and North Male Atolls in 19—40 fathoms.

13. *Halimus convexus* (Miers), 1884. Alcock, I. p. 216.

The one specimen in the collection is a female, and differs from Miers' (a male) in that: (i) the horns are less strongly divergent, (ii) the palm is slenderer and the fingers much less gaping. The species is allied to *H. calvarius* but differs in that: (i) the horns are more slender and diverge more strongly, curving, as well as slanting, outwards, (ii) there is no trace of a knob on the gastric mound, which is also more prominent, (iii) there is no epibranchial spinule or intestinal spine, (iv) the carapace is narrower, and (v) the palm is rather more swollen. It was dredged in 30 fathoms in Suvadiva Atoll.

14. *Halimus espinosus*, n. sp. (Pl. XLVII. fig. 4).

The group of forms akin to *H. diacanthus* (including var. *elongata* Ortm., 1893, *H. subinermis* Zehnter, 1894, *H. convexus* Miers, 1884, and *H. calvarius* Alc., 1895) are in all likelihood no more than varieties of one variable species. The collection contains a specimen of another such form, which I describe here. The following characters, taken together, separate it from its allies mentioned above: (i) carapace narrow (10 : 6); (ii) gastric region swollen, with traces of the knob; (iii) horns rather less than half the length of the carapace, straight, not very divergent; (iv) a spinule on each branchial region and a low knob in place of the intestinal spine; (v) the outer angle of the basal antennal joint not strongly marked. The specimens, which are both males, were dredged in Haddumati Atoll in 35 and 39 fathoms.

15. *Halimus agassizi* Rathb., 1902.

Halimus agassizii, Rathbun, *Bull. Mus. Harvard*, XXXIX. 5, p. 133, fig. 6.

The females of this species have very slender chelipeds with long narrow palms and short fingers, which gape very slightly. Miss Rathbun's only specimen was taken in the same locality as ours, Nilandu Atoll, and in practically the same depth, 24 fathoms.

Genus *Phalangipus* Latr., 1825.

Miss Rathbun (*Proc. Biol. Soc. Washington*, XI. p. 159, 1897) has shown that this name must be substituted for *Egeria* Leach, 1815, which is preoccupied.

16. *Phalangipus arachnoides* Latr., 1825. Alcock, I. p. 223.

Dredged in Mulaku, South Nilandu, and Felidu Atolls, in 25—36 fathoms.

Genus *Tylocarcinus* Miers, 1879.

17. *Tylocarcinus styx* (Hbst.), 1803. Alcock, I. p. 235.

Taken on the reef in Male, Fadifolu, and Goifurfehendu Atolls.

Subfamily **Maiinae.** Genus *Schizophrys* White, 1848.

18. *Schizophrys aspera* (A. M.-Edw.), 1834. Alcock, I. p. 243.

Taken on the reef in Male and Fadifolu Atolls, and dredged in 34 fathoms in Felidu and 20 fathoms in Suvadiva Atoll.

Genus *Cyclax* Dana, 1852.

19. *Cyclax* (*Cyclomaia*) *suborbicularis* (Stimps.), 1857. Alcock, I. p. 245.

Taken on the reef at Hulule, Male Atoll.

Genus *Micippa* Leach, 1816.

20. *Micippa philyra* (Hbst.), 1803. Alcock, I. p. 249.

Taken on the reef at Hulule, Male Atoll, and dredged in Kolumadulu, South Nilandu, Fadifolu, Suvadiva and North Male Atolls in 20—35 fathoms.

21. *Micippa margaritifera* (Hend.), 1893. Alcock, I. p. 253.

Dredged in Suvadiva Atoll in 43 fathoms.

22. *Micippa parca* Alc., 1895. Alcock, I. p. 253.

I think that this form should have specific rank, rather than that of a variety of *M. margaritifera*, given to it by Alcock.

Dredged in 20 and 25 fathoms in Mahlos and South Nilandu Atolls respectively.

Genus *Macrocoeloma* Miers, 1879.

23. *Macrocoeloma nummifer* Alc., 1895. Alcock, I. p. 255.

Almost all the spines on my specimens end in a round knob. Alcock does not mention this, but such knobs were present on several of the spines in the individual he figures. In my specimen thickenings of a like kind are set on the tips of the front. Alcock's figure, however, shows none. The knobs cannot be rubbed off and do not seem to be due to foreign growths of any kind.

The species was dredged in 30 fathoms in South Nilandu, and in 23 fathoms in Mahlos Atoll.

Family **Parthenopidae.**

Subfamily **Parthenopinae.** Genus *Lambrus* Leach, 1815.

24. *Lambrus* (*Rhinolambrus*) *bispinosus* Rathb., 1902.

Lambrus (*Rhinolambrus*) *bispinosus*, Rathbun, *Bull. Mus. Harvard*, XXXIX. 5, p. 134, figs. 1, 2.

In her description of this species, Miss Rathbun says that the upper side of the hand bears *two* lobes. Later she says that the species is separated from *L. confragosus* (among other differences) by the presence of only *one* lobe in this position. Her figure and my specimens bear out the latter statement.

Dredged in South Nilandu Atoll in 25 fathoms.

25. *Lambrus* (*Rhinolambrus*) *pelagicus* Rüpp., 1830. Alcock, I. p. 267.

The granules on the back are quite well marked in my specimens, as in Milne-Edwards' figure (*Nouv. Arch. Mus.* VIII. Pl. XIV. fig. 4). It would seem that Alcock had found in the Andamans local races both of this species and of *L. gracilis*, in which the granules were reduced in size and distinctness.

Dredged in Mulaku, Suvadiva, and Addu Atolls, in 28—43 fathoms.

26. *Lambrus* (*Rhinolambrus*) *gracilis* Dana, 1852. Alcock, I. p. 269.

The specimens which I assign to this species agree with Alcock's description fully, except that the surface of the carapace is not absolutely smooth, there being several granules round the cardiac spine and along the branchial ridges.

Dredged in Felidu, Fadifolu and Suvadiva Atolls, in 22—43 fathoms.

27. *Lambrus* (*Rhinolambrus*) *turriger* Ad. and Wh., 1847. Alcock, I. p. 269 (Pl. XLVII. fig. 5).

Dredged in South Nilandu, Felidu, Mulaku, Haddumati, Suvadiva, Kolumadulu and North Male Atolls, in 25—42 fathoms.

28. *Lambrus* (*Aulacolambrus*) *sculptus* A. M.-Edw., 1872. Alcock, I. p. 272 (Pl. XLVII. fig. 6).

Dredged in South Nilandu, Felidu, Mulaku, and Suvadiva Atolls, in 20—43 fathoms.

29. *Lambrus* (*Parthenolambrus*) *calappoides* Ad. and Wh., 1847. Alcock, I. p. 275.

Dredged in South Nilandu and Suvadiva in 36 and 35 fathoms respectively.

XI. ON THE CLASSIFICATION AND GENEALOGY OF THE REPTANT DECAPODS.

Besides the brachyurous Crabs, Boas' Reptantia[1] comprised sundry groups which are not brachyurous, that is have a pair of biramous limbs on the sixth segment of the abdomen, which bears traces of adaptation to other purposes than reproduction, such as swimming or holding on a shell, and have also no fusion between the rostrum or front and the epistome and no angle on the endopodite of the first maxilliped. The following are the names of these groups: Eryonidea, Scyllaridea (= Loricata), Nephropsidea (= Homaridea and Astacidea), Thalassinidea, Paguridea, Galatheidea, and Hippidea, the last three being together known as Anomala by Boas and most other writers.

Our present object is to arrange these divisions according to their relationships, and to do this we must first of all form an idea of the ancestor from which they may be supposed to be descended. More space would be needed than can be spared here to set forth in detail the process of comparison of the various types with one another and with the prawns of the Stenopidea and Penaeidea, by which this result may be reached, and indeed this might after all be hardly worth while, for the following statement will, I think, commend itself to those who have studied the subject as on the whole probable.

The forebears of the reptant Decapods, if they could be examined, would probably show the following characters:

(1) The *rostrum* of a good size, flat but keeled, and narrowly triangular.

(2) The *carapace* subcylindrical, free from the epistome both at the sides and in the middle, overlapped behind by a process of the first abdominal segment on each side, and marked by the following grooves: on the back two running transversely (the first, line *e* of Boas, is Bouvier's

---

[1] See above, Art. IV. vol. I. p. 424.

cervical groove, and the second, line *c* of Boas, is Bouvier's branchial groove, ordinarily known as the cervical groove; it would be well if these were known as the first and second cervical grooves); at the sides three transverse grooves slanting forwards, the first two being prolongations of the two cervical grooves and the third being line *a* of Boas; and two irregular longitudinal grooves, the upper, line *d* of Boas, connecting the first cervical groove with the fore edge below the antenna, and the second, line *b*, b^1 of Boas, starting from the lower end of *a* and joining the lower ends of the two cervical grooves with the fore edge some way below the line *d*[1] (see Fig. 125).

(3) The *abdomen* long, straight, tapering somewhat from the second segment backwards, moderately broad, not greatly compressed but with pleura bent downwards and terga well arched. Both terga and pleura stout and overlapping. The telson pointed.

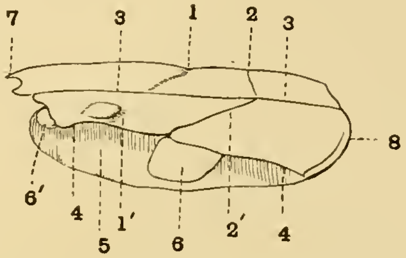


FIG. 125. Cephalothoracic carapace of *Callianassa novaebritanniae* from the left side, 1. first cervical groove—the line *e* of Boas and "cervical groove" of Bouvier, 2. second cervical groove—the line *c* of Boas and Bouvier's "branchial groove," ordinarily known as the "cervical groove," 1′ and 2′. continuations of 1 and 2 at the sides of the carapace, 3. upper longitudinal line—the *linea thalassinica* and perhaps also the *linea homolica*—the front part of which is the line *d* of Boas, 4. lower longitudinal line—the *linea anomurica* and perhaps also the *linea dromiidica*—the front part of which is the line *b* of Boas, 5. a soft area at the side of the carapace, 6, 6′. hard plates in this area, 7. *rostrum*, 8. thickened hinder edge of the carapace. The second cervical groove is here represented only by a line or crack in the carapace. It is, however, in the same place as the cervical groove of other Callianassas, and there is a good deal of evidence that a groove may be represented by a crack. The *linea thalassinica*, for instance, is sometimes a groove in part of its length.

(4) The *eyes* well developed and pigmented. The eye-stalks of moderate length, made up of two cylindrical joints, of which the second is longer than the first.

(5) The *first antenna* with a straight stalk of three short, subequal subcylindrical joints, and two subequal flagella, which are longer than the stalk, but shorter than the flagellum of the second antenna.

(6) The *second antenna* with the basal joint free, a scale which is broad but not leaf-like and ends in a sharp point that represents the tooth on the outer angle in the prawns, and a flagellum which is slender and about as long as the body.

(7) The *mandible* with a broad cutting edge, a small stump to represent the molar process, and a stout, curved, three-jointed palp.

(8) The *first maxilla* with the plate which represents the basipodite broader than that which represents the coxopodite, and the endopodite of a good size, and divided into two joints, the second of which is directed outwards.

(9) The *second maxilla* with the coxopoditic and basipoditic plates both cleft, so that four lobes result, these lobes all narrow, and the scaphognathite ending behind in an angle, which is rather less than a right angle.

(10) The *first maxilliped* with a many-jointed flagellum on the exopodite, a two-jointed endopodite which is not very broad and an epipodite. The basipoditic plate deep, but not broad.

(11) The *second maxilliped* with the exopodite longer than the endopodite, carrying a jointed flagellum, and the endopodite slender, with the last joint at the end.

---

[1] A backward prolongation of the upper of these lines (*d*), known as the *linea thalassinica*, is found in many Thalassinidea, and a similar prolongation of the lower (*b*), known as the *linea anomurica*, in the Anomala. The *linea homolica* and *linea dromiidica* correspond in position with the first and second of these respectively, but as they are not continuous with *d* and *b* it is doubtful how far they can be looked upon as homologous. In any case the term *linea anomurica* loosely applied to the longitudinal suture of the Homolidae (as on p. 575 above) is wrong.

(12) The *third maxilliped* with the exopodite shorter than the endopodite, carrying a straight, jointed flagellum directed forwards, and the endopodite narrow, with separate ischiopodite and meropodite.

(13) All the *legs* seven-jointed. The first three pairs chelate with normal chelae, the first the greatest, equal, the fourth pair simple, the fifth pair simple (?) and having its last two joints slightly twisted so that, when the basal joints are pressed against the sides of the body, while the last joint of the fourth pair points downwards and backwards, that of the fifth pair points forwards and inwards[1].

(14) The *gills* many, including mastigobranchs and podobranchs on all the thoracic limbs but the last, arthrobranchs on all but the first and last, and pleurobranchs on the last four.

(15) The *thoracic segments* which bear the legs with distinct sterna, which are not very broad, but grow broader from before backwards, and are all fused except the last[2].

(16) The first pair of *abdominal limbs* unbranched. Those of the second to fifth segments with two fairly broad branches, the inner of which bears an *appendix interna* (Fig. 126 *c*). The last pair about as long as the telson, with broadly oval branches, across the outer of which is a suture.

The internal anatomy of the various groups is not yet well enough known to allow of general statements being made about it.

The animal was hatched in the Zoea stage, with a segmented abdomen but no limbs behind the third maxilliped, and passed through a *Mysis* stage with exopodites on all the legs.

The descendants of the crustacean which we have thus reconstructed fall into two sets, one comprising the Eryonidea, Scyllaridea, and Nephropsidea, in which the abdomen is strong and well-armoured, stretched out unprotected, and used as a swimming organ by means of its tail-fin, and the other containing the rest of the groups, in which it has for some reason become a burden and a source of danger to be protected and kept from exposure, even though it be still shaped and used for swimming. The first of these sets is on a lower and more primitive grade of organisation than the second. This is shown (1) by the abdomen, with its stout armour, overlapping terga and pleura, strong processes to clip the carapace on the first segment, broad tail-fin, and, in the Eryonidea and Scyllaridea, *appendices internae*. To this form of abdomen, which is always carried at length, I shall restrict the term "macrurous." (2) by the legs, which in the Eryonidea and Nephropsidea are chelate in the first three pairs and have seven joints (except for the first pair of the Nephropsidea) whereas in all other Reptantia they have only six, owing to the fusion of the basipodite and ischiopodite, (3) by the large number of the gills, (4) by the slender third maxillipeds with their long flagella directed forwards, (5) by the broad antennal scale of the Eryonidea and Nephropsidea. Of course some of the foregoing characters are found in primitive members of other groups, but they stamp this set of groups as a whole. Of the three macrurous groups, the Eryonidea and Scyllaridea are more nearly allied together than either of them is to the Nephropsidea. They have both lost, or much reduced, their rostrum (except *Palinurellus*), reduced the inner lobes of the second maxilla, and fused their carapace at the sides with the epistome, but they have kept the *appendices internae*. Their body

---

[1] This character, though it is most prominent in the Anomala and Thalassinidea and the lower Crabs, is seen to some extent even in the more primitive groups, as the Palinuridae and Potamobiidae.

[2] A primitive feature, found not only in Boas' Anomala but also in the Thalassinidea, Potamobiidae and Parastacidae and in the prawn *Stenopus*. In *Penaeus* the anterior sterna are free, but the last two are joined by secondary thickenings in the membrane between them.

shows a tendency to be flattened. The Nephropsidea differ from them in all these respects. Between the Eryonidea and the Scyllaridea the most striking difference lies in the fact that in the former all the legs are chelate and in the latter none are so. The Eryonidea are the more primitive in keeping the antennal scale, the joint between the ischiopodite and meropodite, and the chelae on the first three legs.

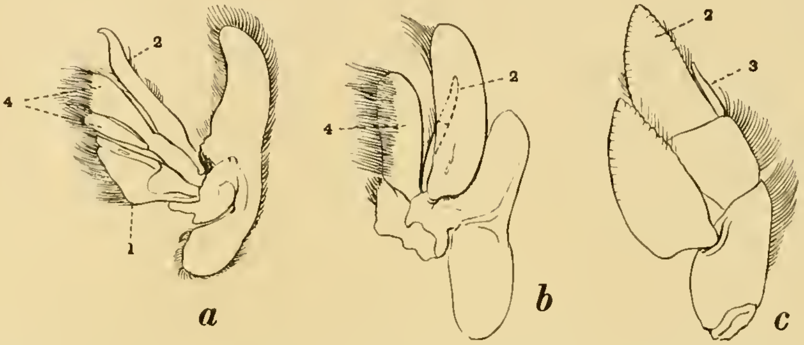


Fig. 126. Limbs of *Axius acanthus*; *a.* second maxilla, *b.* first maxilliped, *c.* abdominal limb of the third pair. 1. gnathobase or first lobe of coxopodite, 2. endopodite, 3. *appendix interna*, 4. lobes of basipodite.

In considering the second set of groups, we have first to settle whether to look upon them as of common descent and treat them as a whole, or whether we must find a separate point of origin for each of them from among the Macrura. Now it may be allowed at the outset that there is but one character that every member of them shares with the rest. In the macrurous groups the first three pairs of legs are all alike, adapted either to seizing or to crawling—chelate, that is, or simple. But in the modified groups we are now dealing with the third pair is never adapted to the same end as the first. In the overwhelming majority the first pair are chelate or subchelate[1] and the third used for walking, and in the Hippidae, where the first are simple and straight, the third are hooked and flattened for burrowing or swimming. Nor is this point an unimportant one, for the likeness of the first three legs is a heritage from the penaeid prawns, and as such is of considerable value. Moreover it is possible to find a number of characters which, while they are not seen in every member of the non-macrurous groups, are yet common in each of them, and do not occur elsewhere. These are: (1) a large gnathobase, or inner coxopoditic lobe, on the second maxilla (Fig. 126 *a*), (2) the shape of the first maxilliped, which has a broad but shallow basipoditic lobe, whose inner margin is in the same line with that of the coxopodite[2], and a broad basal half to the exopodite (Fig. 126 *b*), (3) the flagella of the maxillipeds turned inwards and curved forwards at their ends, (4) reduction in various ways of the abdomen, (5) the presence of backward prolongations of the longitudinal lines of the carapace[3]. Since, however, numbers (3) to (5) are less strongly marked in the more primitive forms of some of the groups, it is doubtful whether much stress can be laid upon them.

Taking it for granted, then, that the non-macrurous Decapods had a common, if remote, ancestor, it remains to be seen where that ancestor must be placed with regard to the

---

[1] *Gebicula* seems at first sight to be an exception to this, but there is on the propodite a strong tooth near the end which seems almost certain to be used in the same way as the "thumb" of the allied *Upogebia*.

[2] Found also in at least one species of *Nephropsis*.

[3] See above, footnote to p. 691.

macrurous groups. For this purpose we must add to the list above certain other characters which, either from their own primitive character or because they are found in many of the primitive members of the groups we are trying to place, may be attributed to the forebears of these groups: (6) a large gill-formula, including all the gills of the ancestral reptant[1], (7) a small thorn-like antennal scale[2], (8) the last pair of legs not only on a free sternum[3] as in the Potamobiidae and Parastacidae, and slightly twisted at the end as in most macrurous Reptantia, but distinctly smaller than the fourth pair, removed from them, and carried more dorsally, (9) a rather short and broad *rostrum*, (10) *appendices internae* on abdominal limbs[3], (11) a transverse suture on the telson[4].

Numbers (6) to (9) of these remove the crustaceans in which they are found from the neighbourhood of the Eryonidea and Scyllaridea, since they are primitive features that the latter have lost. Numbers (6) and (10) remove them for the same reason from the Nephropsidea, to which, nevertheless, they are more akin than to the other macrurous groups. The jaws and the last thoracic sternum, but not the structure of the gills or the grooves on the carapace, are more like those of the Potamobiidae than those of the Nephropsidae.

Assuming, as above, a common descent for the Crabs, Anomala and Thalassinidea, we must at the same time admit that they very early divided into two widely separated branches, one containing the Crabs and the other the remaining groups. The characters by which this separation is shown are the following: (1) The great reduction of the abdomen in the Crabs. This is entirely independent of similar developments in the higher Anomala, for the more primitive of the Paguridea and Thalassinidea, though they share the tendency, common to the whole assemblage of families under discussion, to shelter and protect their abdomen, have as yet been hardly more affected by it than, say, the burrowing genera of Nephropsidea, which are quite macrurous, while the primitive Galatheidea are little better in this respect. Moreover, in the Crabs, the reduction has gone so far that the abdomen, having lost its sixth pair of limbs (except for doubtful, unbranched vestiges in some Dromiidea), is now fitted for, and shows traces of no other function than those connected with reproduction, while in the Anomala and Thalassinidea, though some of its macrurous features are always reduced, it has kept the sixth pair of limbs and nearly always uses them either for swimming or for holding on a shell. The Lithodinea alone form an exception to this statement, but in them the asymmetry of the abdomen clearly recalls its former use, as in the Hermit crabs, to hold on a shell. These two types of abdomen—of which one does, while the other does not, show traces of adaptation to some other function than that of reproduction —I propose to call the "brachyurous" and "anomurous" respectively. (2) The carapace, which in the Anomala and Thalassinidea remains free, is in the Crabs fused with the epistome both at the sides and (except in *Homolodromia*) in the middle, under the front. (3) The antennal scale, which in many Anomala and Thalassinidea remains and is moveable, is never found in that condition in the Crabs. (4) The endopodite of the first maxilliped is broad and has nearly always an outer angle in the Crabs (see above, p. 425, fig. 110), but has not this shape in the Anomala and Thalassinidea, though some Hippidea approach it. (5) There are never *appendices internae* on the abdominal limbs of the Crabs, whereas these structures are present in most Thalassinidea and some Anomala. (6) The third pair of maxillipeds of the Crabs are

---

[1] See above, p. 692. This is shown by *Jaxea*, *Homolodromia*, etc.

[2] Among the Crabs found only in *Homolodromia*, where it is fused to the stalk.

[3] Not found in the Crabs.

[4] Found in certain Galatheidea and Paguridea.

usually broad, forming a cover to the mouth, whereas those of the Thalassinidea and Anomala are only exceptionally so. These characters, however, are in themselves hardly enough to negative the supposition that the Crabs have originated from one of the other non-macrurous groups. What does make it impossible to derive them from the Anomala is the presence in the primitive crab *Homolodromia* of podobranchs on some of the legs, while an origin from the Thalassinidea is equally untenable on account of the less primitive condition of the grooves of the carapace and the reduction of the endopodite and flagellum of the first maxilliped in the latter group.

We are now left with the Thalassinidea and the three divisions of the Anomala still unaccounted for. Among these there can be no question that the Thalassinidea are, as a whole, the most primitive. Their straight symmetrical abdomen, with well-developed biramous limbs on all the segments except the first, and the sixth pair broad and flat in all but *Thalassina*, the presence in most of *appendices internae*, and in some of good pleura, the simple legs of the fourth pair and sometimes also of the fifth, the *rostrum* usually well-developed, the moveable antennal scale seldom wholly lost, and the large gill-formulae of many genera, extending from the second maxilliped to the fourth leg, with mastigobranchs, podobranchs, arthrobranchs and sometimes pleurobranchs—all these point to the same conclusion. Nor can there be any doubt that the Paguridea and the Thalassinidea are closely akin and have branched off from the same not very remote ancestor. The only differences between the Axiidae and the primitive Pagurids with symmetrical abdomen such as *Pylocheles* are the presence of a pleurobranch on the last leg, a suture across the telson in some species (which is never found in Thalassinidea), better developed eyes[1], the loss of epipodites on the legs, a reduced rostrum, subchelate legs of the fourth pair, and the branches of the last pair of abdominal limbs narrow and not adapted for swimming. The first three of these features, being primitive, show that the Paguridea are not to be derived from any of the existing Thalassinidea and the remainder make it equally impossible to derive the latter group from the former. The two meet at a point below our present horizon.

The Galatheidea join the stem from which the last two groups arise before its bifurcation, that is, they are less closely akin to either of these than the latter are to one another. The fact that they may have epipodites on some of the legs, and the more primitive shape of the rostrum and sixth pair of abdominal appendages make it impossible to place their ancestor within the present limits of the Paguridea. The suture on the telson and the pleurobranch on the last leg remove it also from the Thalassinidea. And the general shape of the body, depressed, with broad flat abdomen carrying long pleura and bent under the thorax, is so different from the compressed body, with straight abdomen, of the primitive Paguridea and Thalassinidea that there can be little doubt that the ancestral Galatheid left the non-macrurous stock, after the Crabs indeed, but before it gave rise to the Thalassinids or Hermit-crabs. As for the *linea anomurica*, this is found not only in the Galatheidea and Paguridea but also very distinctly in *Callianassa novaebritanniae*, and it is curious to notice that it is wanting in the primitive Pagurids such as *Pylocheles*, and most Thalassinids as in *Axius*, and that in the Galatheid *Aeglea*, which is also primitive in many respects, the hinder part is again wanting. Thus it would seem as though this line appeared only in the higher and more typical forms of each group. The Hippidea present a very difficult problem. On

---

[1] Such species as *Axiopsis clypeatus*, however, have the eyes well developed, though not so large as those of the Paguridea.

the whole, however, their general shape of body, with a bent abdomen carrying good pleura, subcylindrical or depressed cephalothorax, and fourth pair of legs like the third rather than the fifth, shows a nearer kinship to the Galatheidea than to any of the other groups, and in the absence of any evidence to the contrary this judgment must stand. As for their likeness to the Raninidae among the Crabs, an admission that this indicated relationship would lead to great difficulties, as for instance that the Raninidae must either be removed from the closely related Oxystomes or the latter be supposed to be derived by modification from the highly specialised Hippidea—in itself a very unlikely speculation.

Each of the above groups has its peculiar habits and habitat. The Galatheidea hide under stones or dwell in weed. The Thalassinidea generally make burrows, but the more primitive genera among them show a tendency to shelter in weed or sponges. The Paguridea (except Lithodinea) place their abdomen in the hollow of some foreign body, which is usually a gastropod shell, but in the primitive genera may be a stone or a sponge. The Hippidea bury themselves in the sand. Of these habits, that of the Galatheidea is the least specialised and could easily have given rise to the others.

We are now in a position to sum up in the form of a tree the results reached in this and former articles (Pl. XLVIII.). When this is done two facts of importance appear. First that the proper place of the Thalassinidea is in the midst of the anomurous groups, and that they must no longer be classed with the Macrura, and secondly that, when this change is made, the Anomura, like the Brachyura, become a true, monophyletic group. Thus the reptant decapods fall into three divisions, Brachyura, Anomura[1] and Macrura. To the subject of the taxonomic value of these groups and their relation to the natant families I hope to return later on. For the present they may be called suborders[2].

The following keys give more precisely the classification of the groups discussed above:

Key to the reptant suborders of the Decapoda.

I. 3rd pair of legs like the first, either chelate or simple and subcylindrical. Abdomen macrurous (straight, symmetrical, well armoured, with good pleura and strong, broad tail-fin, a lobe on the first segment clipping the carapace). Gnathobase of 2nd maxilla narrow. Basipoditic lobe of 1st maxilliped usually deep. Exopodites of maxillipeds with lash directed forwards. Gills numerous. [Last thoracic segment with legs not differing greatly from the rest and sternum rarely free.] *Macrura.*

II. 3rd pair of legs unlike the first[3], never chelate. Abdomen rarely macrurous. Gnathobase of 2nd maxilla typically broad. Basipoditic lobe of 1st maxilliped broad but shallow, its inner edge in a line with that of the coxopodite. Exopodites of maxillipeds with lash, when present, nearly always bent inwards. Gills usually few. Last thoracic segment with limbs often differing greatly from the rest and sternum free or not.

1. Carapace not fused with epistome. Last thoracic sternum free, its legs differing always clearly in size and position and nearly always in shape from the third pair. Abdomen anomurous (reduced in some of its features but showing clear traces of some other function than that of reproduction and almost always carrying biramous limbs on the 6th segment) or, rarely,

---

[1] Unlike Boas' term "Anomala," the name "Anomura" has had very different meanings in the pages of different writers. This fact allows it to be used here with a denotation which it has not had before.

[2] The Brachyura is ranked lower on p. 427.

[3] See footnote to p. 693.

macrurous. A moveable antennal scale often present. Third pair of maxillipeds usually narrow. *Anomura*.

2. Carapace fused with epistome at the sides and nearly always in the middle. Last thoracic sternum fused with the rest, its legs often like the others. Abdomen brachyurous (small, straight, symmetrical, bent under the thorax, showing no traces of any other function than that of reproduction, and without biramous limbs on the 6th segment). Never a moveable antennal scale. 3rd pair of maxillipeds usually narrow. *Brachyura*[1].

Key to the tribes of the reptant Macrura.

I. Carapace fused at the sides to the epistome. Rostrum small or wanting (except *Palinurellus*). Inner lobes of 2nd maxillae and 1st maxillipeds reduced. An *appendix interna* on some of the abdominal limbs, at least in the female, but the exopodite of the last pair without sharp suture. Body often depressed.

1. Carapace gripped by first abdominal segment alone. First joint of antenna not fused with epistome; a scale present on this limb. All the legs, except sometimes the last pair, chelate; the first longer than the rest. Unbranched limbs on the first abdominal segment. Tail-fin not softer behind than before, without sutures. Telson pointed. *Eryonidea*.

2. Carapace gripped between a lobe on the 1st abdominal segment and a knob on the side of the last thoracic segment. First joint of antenna fused with epistome; no scale on this limb. None of the legs much longer than the rest or, except sometimes the first pair, chelate. No limbs on the 1st abdominal segment. Tail-fin divided by indistinct sutures into a soft hinder half and a harder front half. Telson roughly squared behind. *Scyllaridea*[2].

II. Carapace free from the epistome. Rostrum of good size. Inner lobes of 2nd maxillae and 1st maxillipeds not reduced. No *appendix interna*, but the exopodite of the last abdominal limb divided by a suture. Body subcylindrical. [Carapace gripped by first abdominal segment only. 1st joint of antenna free. A scale present. First three legs chelate, first pair the longest. Telson firm, squared, often sutured.] *Nephropsidea*.

Key to the tribes of the Anomura.

I. End-joints in 2nd to 4th legs curved and flattened. First pair styliform or subchelate. [Tail-fin not adapted for swimming. Abdomen bent under thorax. Rostrum small or wanting. 3rd pair of maxillipeds carry no mastigobranchs.] *Hippidea*[2].

II. End-joints in 2nd to 4th legs not curved and flattened. First pair not styliform, rarely subchelate.

1. 6th abdominal limb adapted for swimming (except in *Thalassina* where it is styliform. Pleura usually well developed. Abdomen symmetrical.

   a. Body depressed. A pleurobranch to the last leg. Often a transverse suture on the telson. Abdomen more or less bent under the thorax. *Galatheidea*.

   b. Body compressed. No pleurobranch to the last leg. No transverse suture on the telson. Abdomen straight. *Thalassinidea*[3].

---

[1] For a classification of the Crabs, with keys, see above, vol. I. pp. 426 ff.

[2] Keys to the families of these groups will be given in the articles which deal with them.

[3] For a classification of this group, with keys, see *Ann. Mag. N. H.* (7), XII.

2. 6th abdominal limb, when present, has the branches neither broad nor styliform but adapted for holding the body into hollow objects. Pleura very rare. Abdomen nearly always asymmetrical and either soft and twisted, or bent under the thorax. *Paguridea.*

Key to the subtribes of the Paguridea.

I. Abdomen straight or twisted. Carapace firm and more or less compressed in the fore part, soft in the hinder part. Fourth pair of legs unlike the third. Rostrum almost or quite wanting. *Pagurinea.*

II. Abdomen bent under the thorax. Body crab-like. Carapace firm all over. Fourth pair of legs like the third. Rostrum spiniform. *Lithodinea.*

EXPLANATION OF PLATE XLVII.

Fig. 1. *Huenia proteus*, male of triangular shape; *a.* whole animal, *b.* part of the fine graving of the back, greatly magnified.

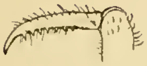
Fig. 2. *Huenia proteus*, female.

Fig. 3. *Naxioides spinigera*, male; *a.* whole animal, *b.* outside of hand, *c.* hooked hairs of two different shapes.

Fig. 4. *Halimus espinosus*, male; *a.* whole animal, *b.* outside of hand, *c.* end-joint of a walking leg, *d.* hooked hairs.

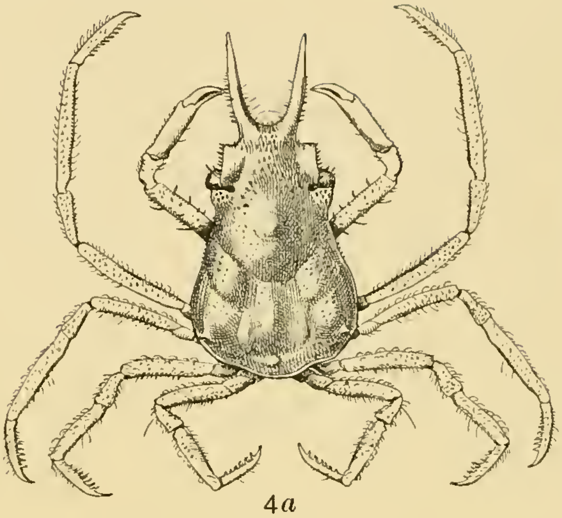
Fig. 5. *Lambrus* (*Rhinolambrus*) *turriger*; *a.* whole animal, *b.* part of under side to show grooves for breathing stream. 1. endopodite of 3rd maxilliped, 2. exopodite of the same, 3. base of epipodite of the same, covering opening to gill-chamber, 4. ridge on under side of body (not outer edge), 5. outer end of inner groove, 6. outer end of outer groove, 7. inner groove, 8. fore edge of mouth.

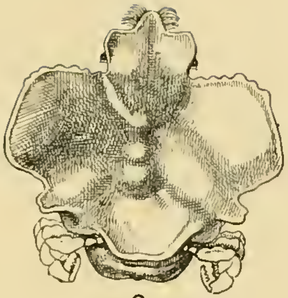
Fig. 6. *Lambrus* (*Aulacolambrus*) *sculptus*; part of inner groove corresponding to (7) in fig. 5, showing the covering of hairs.

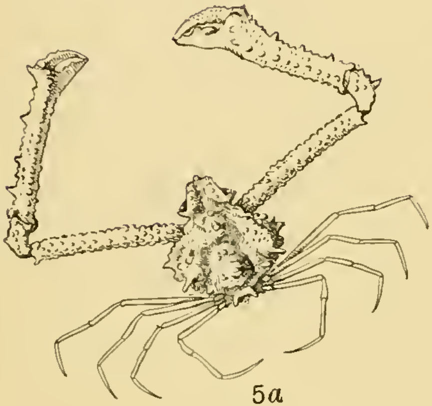

4*c*


4*d*

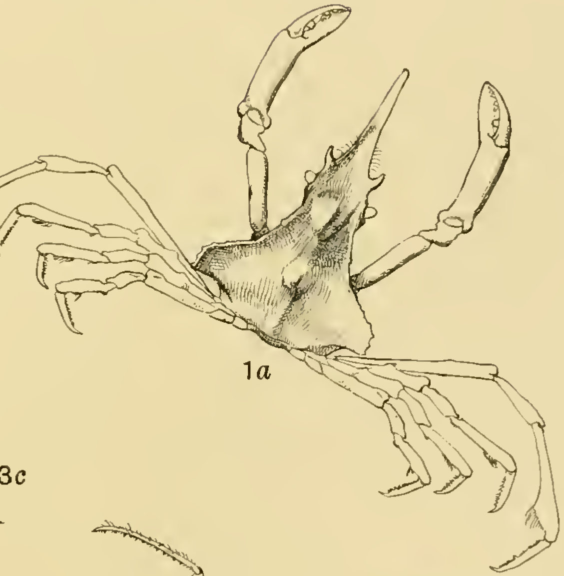

4*b*


4*a*


2


5*a*

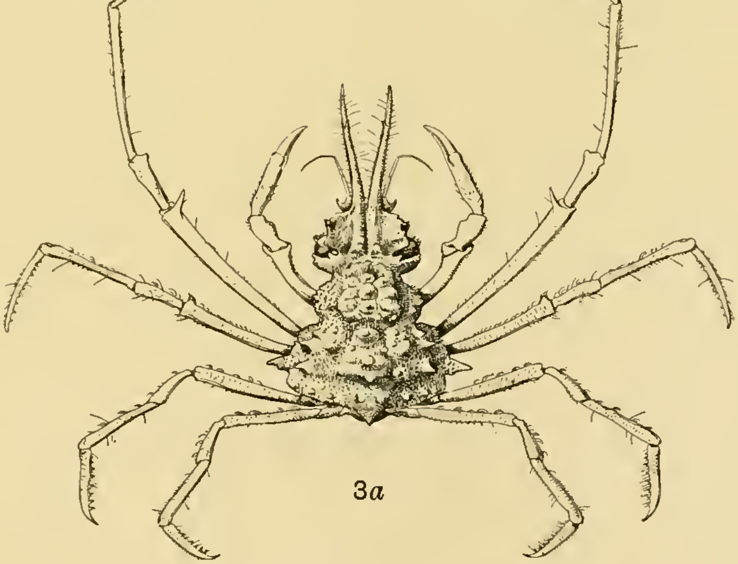

1*b*

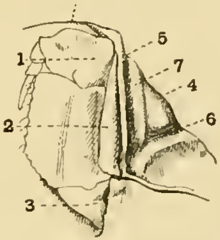

1*a*


3*c*


6


3*b*

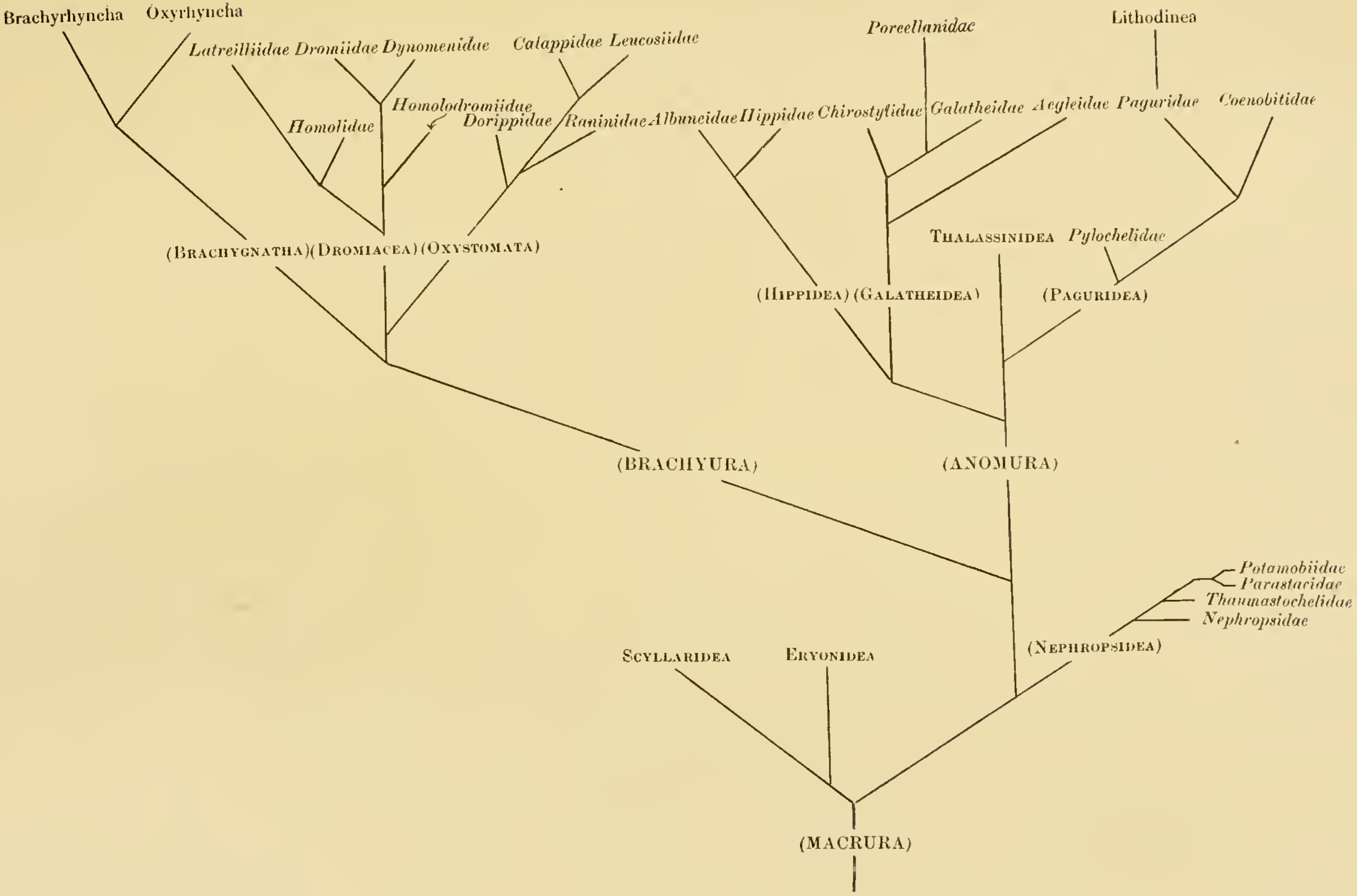

3*a*



5*b*

E. W. del.

BORRADAILE——OXYRHYNCHA.



GENEALOGICAL TREE OF THE REPTANT DECAPODA.

The groups in the first row have all reached the same grade of organisation as the Crabs. Those in the second row are in the Anomalous grade, the third row in the Thalassinid grade, and all below in the Macrurous grade. (The Brachyrhyncha and Oxyrhyncha should be in the first row with the Latreilliidae, etc.)

Now ready, Parts I—IV forming Volume I.

The Fauna and Geography
of the
Maldive and Laccadive Archipelagoes

Being the Account of the Work carried on and
of the Collections made by an Expedition
during the years 1899 and 1900

Edited by

J. STANLEY GARDINER, M.A.

Fellow of Gonville and Caius College and late Balfour Student
of the University of Cambridge.

VOLUME I.

With Plates I—XXV and Text-Illustrations 1—119

CAMBRIDGE:
at the University Press.

LONDON: C. J. CLAY AND SONS,
Cambridge University Press Warehouse,
Ave Maria Lane.
GLASGOW: 50, Wellington Street.

1903

Volume I. of the above work is now complete and contains the following Reports:—

It was supposed that the whole work would be completed in eight parts, forming two volumes, but it is now anticipated that one or more supplementary parts may have to be issued; each part will contain about 120 pages of text, demy quarto, and will be fully illustrated by lithographic plates and text illustrations prepared by Mr EDWIN WILSON of Cambridge.

The edition is limited to 475 copies and the subscription for the whole work including any supplementary parts that may be issued is *for the present* £4 4*s*. net. The separate parts are published at 15*s*. net.

FORM OF SUBSCRIPTION.

Messrs C. J. CLAY & SONS,
Cambridge University Press Warehouse,
Ave Maria Lane, London.

Please send me .... cop...... of

The Fauna and Geography of the Maldive and Laccadive Archipelagoes

price £4 4*s*. per copy (*including any supplementary parts*). *The work to be forwarded in separate parts on publication.*

Name..

Address..

Date..

To M..

....

....