In the *Stomatopoda* the eye is present in both *Squilla mantis* and *Squilla Desmarestii*. It is borne on an elongated stalk which extends anteriorly from the brain, at a point midway between the optic nerves to the inner surface of the shell. Bellonci[3] (1878) in his description of the brain of *Squilla mantis* entirely overlooked this structure though Claus[4] had mentioned its presence in the young adult of *Gonodactylus* in 1871.

Only two Schizopods have been examined, one a large and the other a small species of *Euphausia*. The eye present in both, and easily seen from the exterior, is located between the compound eyes and is directed dorsally.

In the Macrura I have found the eye in the Caridiidae in *Alpheus dentipes*, where it is very evident, in *Nika edulis* and in *Peneus membranaceus* and *Peneus caramote*. — In the Astacidae it occurs in *Homarus vulgaris*. — In the Palinuridae it occurs in *Palinurus vulgaris* and *Scyllarus arctus*. — In the Galatheidae it occurs in *Munida rugosa* and *Galathea squamifera*. — In the Thalassinidae in *Gebia littoralis* and *Callianassa subterranea* and in the Paguridae in *Eupagurus Prideauxii*.

I have not examined examples of the Sergestidae, Polychelidae and Hippidae, though the organ is probably present in these groups.

The only Brachyuran examined, a species of *Homola*, gave the same general result as the Macrurans, though the organ was somewhat less intensely pigmented.

In a later paper, dealing with the central nervous septum of the Crustacea, figures and a more detailed description of this organ will he given.

Stazione Zoologica, Naples. April 2, 1894.

3. Protandric Hermaphroditism in Myzostoma.

By William Morton Wheeler, Ph.D., Chicago University.

eingeg. 5. April 1894.

In the following preliminary note I would call attention to certain peculiarities in the sexual conditions of the Myzostomids. My results were obtained from a study of the four Mediterranean species: *Myzostoma glabrum* Leuck., *M. cirriferum* Leuck., *M. alatum* v. Graff and *M. pulvinar* v. Graff. The two former occur on the common *An-*

[3] G. Bellonci, Morfologia del Sistema Nervoso Centrale della *Squilla mantis*. Ann. del Mus. Civico di Storia Naturale di Genova. Vol. XII. p. 518.

[4] C. Claus, Die Metamorphose der Squilliden. Göttinger Abhandlungen, 1871. XVI. p. 4.

tedon rosacea Norm., the two latter on the rarer *A. phalangium* Müller[1].

All writers on the anatomy of Myzostomes — Lovén[2], Semper[3], v. Graff[4], Beard[5], Nansen[6], Prouho[7] — assume that the large branching organ containing ova in various stages of maturescence is the ovary. This organ is lined with peritoneal epithelium and opens on either side by means of a number of conduits into the median »uterus«. The uterus, a capacious receptacle in the mid dorsal line, opens posteriorly into the cloaca very near the anal orifice. Most writers believe that the ova develop in situ from peritoneal cells lining the coecal ramifications of the ovary; v. Graff, however, inclines to the more improbable view that the ova arise from connective tissue elements.

Nansen, while sharing with other investigators the interpretation of the ramified organ as an ovary, pointed out the existence of a pair of very small bodies (in some species two pairs) lying one on either side of the main stem of the gut near the middle of the body. He regarded these structures (»problematical organs«), which he described as consisting of minute deeply staining cells, as abortive ovaries, and supposed that they had lost the power of producing ova when this function was transferred to the general peritoneal epithelium lining the coeca of the ramified organ.

A closer study of these »problematical organs« enables me to state that they are in no sense abortive, but the only true ovaries of *Myzostoma*. Under a high magnification they are seen to be solid proliferations of the peritoneal epithelium over a very restricted area. In the string-like masses of minute cells numerous caryokinetic figures may be detected, especially in young Myzostomes. These divisions finally result in the formation of groups of three cells each. In each group

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[1] At Naples I have not been able to find *M. Bucchichii*, a species described by v. Wagner (Zool. Anz. No. 255. 1887. p. 363—364) from a single specimen found on *A. rosacea* near the Isle of Clemente.

[2] S. Lovén, *Myzostoma cirriferum* Leuck., ein parasitischer Wurm. Arch. f. Naturg. 8. Jhg. 1842. p. 306—314. Tab. VIII.

[3] C. Semper, Zur Anatomie und Entwicklungsgeschichte der Gattung *Myzostoma* Leuck. Zeitschr. f. wiss. Zool. IX. Bd. 1857. p. 48—64. Tab. III, IV.

[4] L. Graff, Das Genus *Myzostoma* (F. S. Leuckart). Leipzig 1877. p. 1—82. Tab. I—XI.

[5] J. Beard, On the Life History and Development of the Genus *Myzostoma* (F. S. Leuckart). Mitth. a. d. Zool. Stat. Neapel. V. Bd. 1884. p. 544—580, Tab. XXXI, XXXII.

[6] F. Nansen, Bidrag til Myzostomernes Anatomi og Histologi. (English Resumé.) Bergen 1885. p. 1—80, Tab. I—IX.

[7] H. Prouho, Sur deux Myzostomes parasites de l'*Antedon phalangium* (Müller). Compt. Rend. 1892. p. 846—849.

one of the cells is larger and more transparent; the two others are very small and closely applied one to either side of the large cell. At the outer edge of the organ, where it projects into the »uterus«, the three-celled clusters may be seen breaking away and migrating out into the conduits leading to the smaller coecal ramifications of the »ovary«. They ultimately attach themselves to the epithelial walls of the coeca and begin to grow. Soon the two accessory cells fuse with the middle cell, the nucleus of which becomes the germinal vesicle of the ovum. The nuclei of the accessory cells retain their identity for a considerable time, gradually enlarging but never attaining to the size of the germinal vesicle. In quite large eggs their faint boundaries may still be traced, one at either pole of the irregularly ellipsoidal ovum. Finally they fade away and become indistinguishable from the general egg-cytoplasm which is just beginning to acquire yolk-granules. The curious and constant arrangement of the cells in groups of three enables one to trace their development step by step from their origin in Nansen's organ to their attachment and growth in the coeca of the so called »ovary«. The resemblance of this course of development to the conditions in Chaetopods where the young ova fall into and mature in the body cavity, is at once apparent and constitutes an additional indication that the Myzostomida are degenerate Annelids. It also follows that we are to interpret the so called »ovary« as the true body-cavity which is really well developed in Myzostomes and not a mere rudiment as most authors have assumed.

The discovery of the true ovaries leads to still further interesting conclusions. Nansen found the »problematical organs« in all the »complemental males« of the species that he studied. I have also seen them in the »complemental males« of *M. glabrum* and *M. alatum*, so that these small individuals are not really males but hermaphrodites. In *M. glabrum* I have studied sections of specimens of different sizes wich the following results:

1) The youngest *M. glabrum* were those found attached to the anterior dorsal edge of the medium-sized and large individuals. They have only the male organs in a high degree of development, the spermatozoa being found in all stages of formation and fully mature. In the true ovaries the cells are not found proliferating, nor do the young ova migrate as yet through the body cavity, which exists only in the form of a small uterus without ramifications. It was these very young Myzostomes which Beard called »complemental males« and to which he emphatically denied any traces of female reproductive organs.

2) The youngest specimens found attached to the disc of the *Antedon* are but slightly larger than those attached to the backs of the

larger Myzostomes. The testes fill out much of the body, but caryokinetic figures have appeared in the ovaries and the triplet cells are found in the uterus and its incipient branches. A very few of these cells are also found attached to the dorsal walls of these branches.

3) Still older and larger individuals (about one-third or to two-thirds grown) have ovaries and testes about equally well developed. Both mature spermatozoa and ova capable of normal development can be readily pressed from the body. These individuals are, therefore, functional hermaphrodites.

4) The largest and oldest individuals are full of ripe and developing ova but the testes are much reduced and in some cases appear to be absent, although a few ripe spermatozoa of uncertain origin are found scattered through the body cavity or massed together in a narrow space in the mid-dorsal line over the uterus.

Thus *M. glabrum* is throughout its life hermaphrodite but functionally male in its early youth and functionally female in its old age. Beard overlooked the ovary of *M. glabrum* and, apparently too much absorbed in drawing a parallel between Myzostomes and Cirripedia, failed to examine a sufficient series of individuals of different ages. v. Graff was right in regarding the socalled »complemental males« as young specimens which had attached themselves to the backs of the first settlers on the disc of the *Antedon*. The main purpose of this attachment is not to fertilize the eggs of the succumbent hermaphrodites — although this very probably occurs — but to be near the food-current passing into the mouth of the Crinoid. Only after the death and dissolution of the old Myzostomes do the young ones appear to be able to attach themselves directly to the lips of their host.

Only a few specimens of *M. alatum* were examined, but the conditions appear to be the same as in *M. glabrum*. In both species there is only a single pair of ovaries. Prouho has shown that *M. alatum* is protandric, but like other investigators he has failed to detect the true ovaries which are also present in the »complemental males« of this species.

In *M. cirriferum*, which is an actively moving species occurring in considerable numbers on the arms and disc of *Antedon rosacea*, the conditions are very similar. There are, however, two pairs of ovaries in this form. In the youngest specimens which I have sectioned only the testes contained mature reproductive cells. As the Myzostome grows the ova make their appearance in the body cavity and ultimately the individuals contain great masses of mature ova and spermatozoa side by side. I am not sure that *M. cirriferum* ultimately reaches the condition in which the testes are greatly reduced in number or wanting;

the largest specimens examined during February and March may not have attained their full growth.

It is more than probable that *M. brevicirrum* also agrees with the three species which I have studied. According to v. Graff[8] this species when only 24 mm in diameter »has the seminal vesicles filled with spermatozoa whereas the eggs are but little developed« and adds that »it may be concluded that the male apparatus is earlier developed than the female«.

All the free-living species of the genus *Myzostoma* will probably be found to agree with the forms which have just been considered. We may, perhaps, go even further and include the cysticolous species under the same law. Of the ten swelling- or cyst-producing species described by v. Graff the sexual condition of the specimens is mentioned in seven. Two of these (*M. pentacrini* and *M. deformator*) are hermaphrodites and appear to agree with the free-living species except in the unilateral development of the testes. In five species each cyst contains a large female and a small male individual. In one of these (*M. cysticola*) the large female has rudiments of testes. This fact together with his above-quoted observation on *M. brevicirrum*, led v. Graff to conclude that the young of the cysticolous species associate in pairs and bore their way into the arm-joints of the Crinoids together. He supposed that in both individuals the testes developed first but that in one (the female) the male reproductive organs degenerated or entirely disappeared when the ovaries made their appearance. This hypothesis is in perfect accord with my own observations on the free-living species.

Unfortunately I have been unable to secure specimens of the cysticolous species, but in *M. pulvinar*, which occurs in the alimentary tract of *Antedon phalangium* the sexual conditions appear to be identical with those of the extreme cysticolous forms like *M. inflator*, Graff, *M. Murrayi*, Graff, etc. As Prouho has shown, *M. pulvinar* occurs in pairs, each consisting of a large female and a very small male. Although I have sectioned a number of specimens I am unable to maintain that the males are really young individuals which will ultimately develop into females after passing through an hermaphrodite stage. Still I have seen nothing to render such a supposition improbable. The diminutive males have traces of the uterus and in one case I found what I took to be a proliferation of peritoneal epithelium like that of the ovaries in the young *M. glabrum*. This very imperfect development of the ovaries may be attributed to the fact that all the

[8] L. v. Graff, Report on the *Myzostomida* collected during the voyage of H. M. S. Challenger during the years 1873—1876. Zool. Chall. Exped. Part. XXVII. 1884. p. 1—52 and Suppl. p. 1—16. Pl. I—XVI.

males examined during January were still immature, there being no ripe spermatozoa in the testes or vasa deferentia. A study of this species in different stages of growth will very probably reveal sexual conditions essentially like those which obtain in the free-living forms.

Without wishing to attack Beard's general proposition that »hermaphroditism, probably all hermaphroditism had its origin in a unisexual condition« — a proposition supported by the weighty authority of Fritz Müller[9] — I must, nevertheless, dissent from the English author's view that the Myzostomes present sexual conditions of the same nature as the *Cirripedia*. The mutual resemblance extends only to the hermaphroditism which has probably been acquired in both groups in consequence of a sedentary or sluggish life. A much closer resemblance exists between the Myzostomes and the protandric Isopods (*Anilocra*, *Nerocila*, *Cymothoa*) described by Bullar[10] and Paul Mayer[11], or between the Myzostomes and *Myxine* as described by Cunningham[12] and Nansen[13].

In conclusion I wish to thank Prof. Dohrn for the facilities which I have enjoyed while working at his Zoological Station, and Professors Eisig and Paul Mayer for many a kind suggestion.

Stazione Zoologica, Naples, April 1st 1894.

4. Eine neue Brookesia (Chamaeleontidae) aus Nossibé.

Von Prof. Dr. O. Boettger, Frankfurt am Main.

eingeg. 9. April 1894.

Brookesia Stumpffi n. sp.

= *Chamaeleo* (*Brookesia*) *superciliaris* Boettger, non *Ch. superciliaris* Kuhl. in: Abhandlg. Senckenbg. Nat. Ges. 11. Bd. 1879, p. 484, Taf.-Fig. 2 und 12. Bd. 1881, p. 481, Taf. 3 Fig. 11*a—b*.

Char. Körper schlank, walzenförmig, von den Seiten wenig zusammengedrückt, Rücken flach. Helm hinten stumpfwinklig ausgerandet, die Orbitalbogen in kurze, nach vorn und oben gerichtete,

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[9] Fritz Müller, Die Zwitterbildung im Thierreiche. Kosmos, 2. Bd. 1885.

[10] J. F. Bullar, The Generative Organs of the parasitic Isopoda. Journ. Anat. and Phys. Vol. XI. 1876. p. 118—128. Tab. IV.

[11] Paul Mayer, Carcinologische Mittheilungen. VI. Über den Hermaphroditismus bei einigen Isopoden. Mitth. a. d. Zool. Stat. Neapel, 1. Bd. 2. Heft. p. 165—179. Taf. V. 1879.

[12] J. T. Cunningham, On the Structure and Development of the Reproductive Elements in *Myxine glutinosa*, L. Quart. Journ. Micr. Sci. Vol. XXVII. n. ser. p. 49—76. Tab. VI and VII. 1887.

[13] J. Nansen, A Protandric Hermaphrodite (*Myxine glutinosa*, L.) amongst the Vertebrates. Bergens Museums Aarsberetning for 1887. p. 5—35. Tab. I and II. 1888.