A FURTHER NOTE ON THE STYLE SACS OF GASTROPODS.

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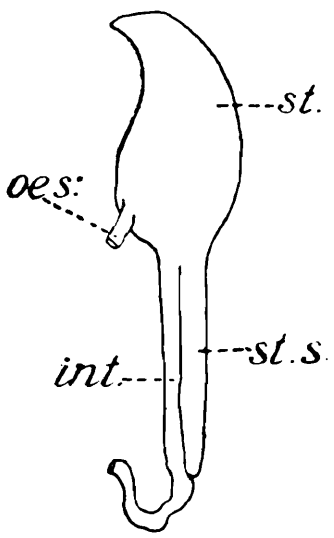
Yonge (9) recently compiled a list of forty one Gastropod genera, in which the style sac is known to occur. From this list *Ampullaria* has to be omitted, since Bouvier's record of a style sac in this genus has not been confirmed, particularly by the investigations of Prashad (5) who considers that the caecum in the Ampullariidae is not a style sac.

The present note records the presence of a style sac in five more genera, viz., (i) *Septaria* (ii) *Cyclotopsis* (iii) *Stomatodon* (iv) *Acrostoma* (v) *Tiara*. With the inclusion of these, the number of the Gastropod genera possessing a style sac comes to forty five, omitting *Ampullaria*.

In determining the presence of a style sac in the case of very limited preserved material one should look for two decisive features, the gastric shield and the epithelium of the style sac. In the case of the genera dealt with in this note, the material available for study was mostly limited and I have been guided by the above two features in arriving at my conclusions.

In the family Neritidae, a style sac was recorded by Lenssen in *Neritina*. Bourne (1) who described the anatomy of *Septaria* made no mention of a style sac in it. He found the stomach of *Septaria* to consist of a dilated oesophageal and a narrower pyloric moiety, but did not explain the relation of the latter to the intestine. He remarked however, about the presence of a thickened epithelial ridge, the " crete stomacale," in the stomach resembling the condition found in Gastropods with a crystalline style.

The shape of the stomach of *Septaria borbonica*, figured by Bourne (1) differs from that of *Septaria dravidica* [1] as will be seen from text-fig. 1. In *Septaria dravidica* the stomach is about 7 mm. of which the wider gastric portion is about 3 mm. and the narrower cylindrical part, about 4 mm. The gastric part is more than twice as broad as the pyloric portion. The latter consists of the style sac and intestine, which can be made out externally by the two longitudinal grooves separating them on the dorsal and ventral surfaces. In a transverse section, the style sac and the first part of the intestine are seen to be in " wide and open communication," being incompletely separated by the two typhlosoles. The style sac is twice as broad as the intestine. Its epithelium, which is thicker than that of the intestine, shows the usual features. The cells in the intestinal part are shorter and the cilia also are shorter. The minor typhlosole is a simple projection, whereas the major typhlosole is broad and shows

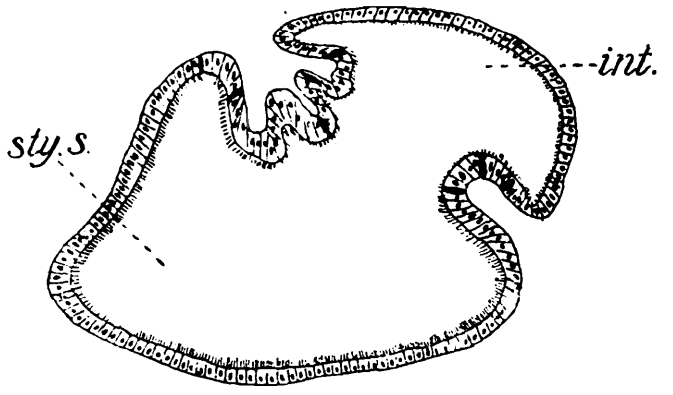


TEXT-FIG. 1.—The stomach of *Septaria dravidica*. *int.* intestine in communication with the style sac ; *oes.* oesophagus ; *st.* posterior or gastric part of the stomach ; *st. s.* style sac.

[1] *Septaria dravidica* Prashad, from Porto Novo, South India.

two grooves. Gland cells are especially abundant in the major typhlosole.

The style sac communicates by its entire length with the intestine. A gastric shield is present in the posterior chamber of the stomach and



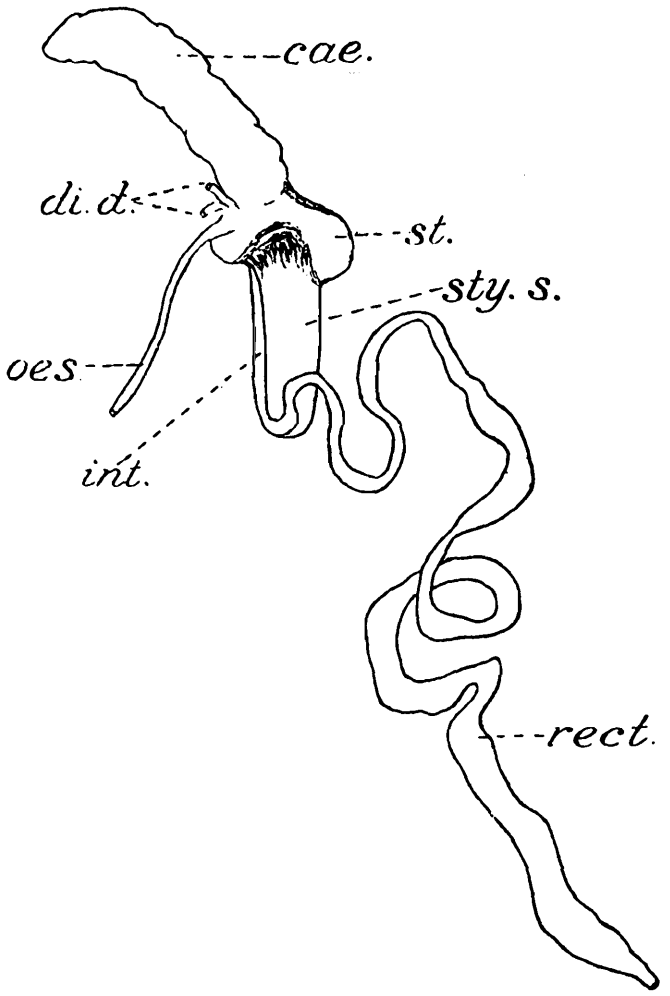
TEXT-FIG. 2.—Transverse section through the anterior part of the stomach (style sac and intestine) of *Septaria dravidica*. A few gland-cells are represented. Lettering as in fig. 1.

has the appearance of the "crete stomacale" described by Bourne (1) in *Septaria borbonica*.

The only terrestrical genus in which the style sac has been recorded till now is *Pomatias* (=*Cyclostoma*). Garnault's (2) observation recording the presence of a style sac in it was confirmed by Yonge (9). I find that *Cyclotopsis* also possesses a style and style sac. The stomach of *Cyclotopsis* differs to some extent in shape from that of *Pomatias*. It may be considered to comprise of three portions, a posterior caecum corresponding to the "cul-de-sac" of the stomach in *Pomatias*, a middle gastric portion and an anterior cylindrical part. The latter is what Garnault (2) termed the "intestine conoide" in *Pomatias*. He considered it as a part of the intestine. In *Cyclotopsis* it is composed of the first part of the intestine and the style sac, and may, therefore, be considered as the pyloric extension of the stomach, as in the case of the other genera possessing a style sac. The two parts, the intestinal and the stylar, can be made out externally. The intestinal part is whitish, narrow, and runs alongside of the wider greyish style sac. The pyloric part of the intestine is continued into the 'cylindrical part.' The presence of the intestinal and stylar portions was not described by Garnault (2) in the case of the "intestine conoide" of *Pomatias*.

In a transverse section of the anterior chamber or "intestine conoide", the style sac is seen as a wide circular chamber communicating with the small intestinal portion on one side. The communication between the style sac and intestine, which is wide in the upper part of the style sac, but narrower in the lower part, is bounded by the two typhlosoles. The typhlosoles present the features recorded in the other genera possessing a style sac. Gland cells are conspicuous on them, as also in the intestinal part of the anterior chamber. The style sac communicates by its entire length with the intestine. The epithelium of the style sac shows the usual characteristic features. The style, as made out in transverse

sections, consists of co-axial layers with a central core showing food particles consisting of vegetable matter. The animal is herbivorous, and in the laboratory was fed on bananas and moistened filter paper.



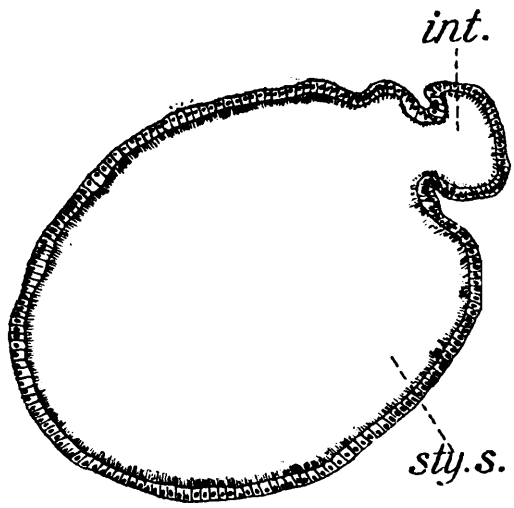
TEXT-FIG. 3.—A partial dissection of the alimentary canal of *Cyclotopsis subdiscoidea*. *cae.* caecum of the stomach; *di. d.* ducts of the digestive gland; *int.* intestine in communication with the style sac; *oes.* oesophagus; *rect.* rectum; *st.* stomach; *sty. s.* style sac.

Sections through the middle chamber of the stomach showed the thickened cuticle in the form of a gastric shield. The cavity is usually filled with a large quantity of hard vegetable matter, and for sectioning, the chamber had to be slit open and cleaned of its food contents before clearing and embedding.

The style sacs of *Acrostoma*, *Tiara*, *Stomatodon* are of the type found in the other Melaniidae.

In this connection it may be pointed out that the structure of the style sac within the limits of a family is strikingly uniform. The only exception appears to be *Lithoglyphus* in which a style sac separate from the intestine was recorded by Von Ihering in 1885. I think it needs reinvestigation, as in other known members of the Hydrobiidae the style sac has a restricted communication with the intestine. As was pointed out by Yonge (9), the style sac cannot be of any taxonomic significance, but is correlated with the nutritional demands of the animal. As to the uniformity of structure within a family, it may be said that

the species of a family having a common structural potentiality can develop in response to their nutritional needs a common type of style sac.



TEXT-FIG. 4.—Transverse section through the anterior part of the stomach (style sac and intestine) of *Cyclotopsis subdiscoidea*. Lettering as in fig. 3.

Another point that may be referred to in this connection is the classification of the style sacs. More emphasis seems to have been laid by some authors on the width of the communication between the style sac and intestine, rather than on the length, as seen from the use of the expression "wide and open communication." The style sac, as in *Turritella*, may have a wide communication with the intestine and at the same time the communication may be *restricted*, extending only to a part of the length of the style sac. It seems better, therefore, to avoid the expression "wide and open communication" in the classification of the style sacs and use only the terms "free communication, restricted communication, and separate style sac" as Yonge (9) has done. The classification of the style sacs of Gastropods, as given by Mackintosh (4), may be re-stated as follows :—

Stage I.—(*a*) Style lying in the intestine or
(*b*) Style sac communicating by its entire length with the intestine.

Stage II.—Style sac communicating by part of its length. The communication may be wide as in *Turritella* or narrow as in *Mysorella*.

Stage III.—Style sac communicating by a small fraction of its length or quite separate.

In conclusion I have pleasure in expressing my best thanks to Dr. Baini Prashad for sending me some of the references and the specimens of Melaniidae referred to in this note, and for the identification of *Septaria dravidica*.

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