anzunehmen, daß die 2 Vipern aus der Nähe von Riaz, nordöstlich von Bulle, welche Dr. Clerc der ärztlichen Gesellschaft in Bulle demonstrierte, der Species *Aspis* angehörten (Bullet. de la Soc. méd. de la Suisse romande, Sept. 1869).

Diese Notiz ist das einzige, was wir bis jetzt in Beziehung auf die Reptilienfauna dieses großen Kantons wissen. Vermutlich findet sich *Aspis*, vielleicht auch *Berus* noch an manchen Lokalitäten der Freiburger Berge, und es dürfte sich mit der Zeit eine Ergänzung des roten Strichs der Karte etwa von Vivis durch das Greyerzerland gegen das Simmental hin ergeben.«

Auf dieser Angabe, die um so nichtssagender ist, als man in hiesiger Gegend auch die Kreuzotter als vipère bezeichnet, beruht also jene irrige faunistische Angabe.

2. The Classification of the Styelidae.

By A. G. Huntsman, Biological Department, University of Toronto.

(With 13 Figures.)

eingeg. 7. Januar 1913.

Recently I have had occasion to consider rather carefully the basis of classification in the family of the Styelidae. This has led to the investigation of the limited amount of material belonging to this family that has been at my disposal. As there is slight prospect of my continuing this study, I have thought it best to publish the results obtained thus far. Of certain species I have been able to study a large number of specimens which had been well preserved. This has been of distinct advantage.

Styelid Characters.

There are a number of characters that are of use in distinguishing Styelids from members of the other Ptychobranchiate families.

They are distinguished from Caesirids (Molgulids) by their straight stigmata, by the absence of a renal organ and by the four-lobed (or slit-like) oral aperture; from Caesirids and Tethyids (Cynthiids) by the definite stomach, by the absence of a liver and by the simple tentacles (except in *Pyuropsis* Mchlsn. 1911). From the Botryllids they differ only in never forming (when colonial) systems of individuals with a common cloaca. The zooids are so remarkably similar in Styelids and Botryllids that it is doubtful whether the presence or absence of systems is of enough importance to warrant their separation into distinct families.

Of the characters so far considered, none are peculiar to Styelids. Pyloric Caecum. I think it quite probable that the peculiar out-

growth of the stomach, known as the pyloric caecum, that has been described for so many Styelids and Botryllids, will ultimately be found to be of general occurrence in these two groups. With one exception, I have found it in every species that I have been able to examine. In many cases, I was at first unable to find it, but it was revealed by further search. As yet I have not been able to find it in Heller's *Polycarpa elata*. The poor state of preservation of the single specimen at my disposal may be responsible for this.

The pyloric caecum appears to be particularly distinct in small individuals. Not only in species in which mature individuals are of small size (e. g. Botryllidae and Polyzoinae), but also in small, immature individuals of large species. In a specimen of *Styela gibbsii* (Stimps.) $^1/_2$ mm long the pyloric caecum is very distinct, being as long as the stomach itself. In the adult of this species it is scarcely distinguishable. It is probable that in species in which it is quite unrecognizable in the adult, it may be characteristic of the immature stages.

Atrial Tentacles. These structures are not found, as far as my knowledge goes, in any other family. They appear to be peculiar to Styelids. They occur in all the Styelids that I have examined. I have not been able to find them in *Botryllus*, although I have examined an individual of that genus in serial sections. The atrial tentacles are usually of small size and hence difficult to detect. Owing to their peculiar structure, which will be described subsequently, they are frequently removed with the test in dissection and of course cannot then be found on the wall of the atrial siphon. They were first noticed by Herdman and described in the results of the Challenger Expedition. Since that time they have been frequently mentioned in descriptions of species, particularly in the last few years. They have not yet been found in the majority of the species, but further search will doubtless show that they are present in all.

Their structure does not appear to have been the object of study. They show a very curious condition, differing much from that of the oral tentacles. In most Ascidians the junction of the test-bearing and testless epithelia of the walls of the siphons is not very prominent. The epithelial cells are usually somewhat higher at that point than elsewhere and may project slightly into the siphon forming a ridge which runs circularly around the siphon. This is the condition in *Corella*, *Chelyosoma* and *Ascidiopsis*. In the Ptychobranchiates this ridge becomes very prominent, projecting so far as to form a distinct shelf or velum. The velum is only slightly developed in *Botryllus*. In the Caesirids that I have examined, it is quite narrow. In many Styelids and Tethyids it is very broad and usually in these families it does not project into the

cavity of the siphon but is closely applied to the wall (see Fig. I). It is the outer or test-bearing surface of the velum that is applied to the wall. For the most part the conditions in the oral and atrial siphons are the same.

The test-bearing epithelium of the velum appears to be very active. It may, at the junction of the velum with the siphonal wall, grow down into the wall in a series of hollow processes, which of course will contain test. A secondary velum may be formed at the base of the siphon at the level of the sphincter muscle. The processes may pass into this secondary velum. I have in no case found them passing into the oral tentacles.

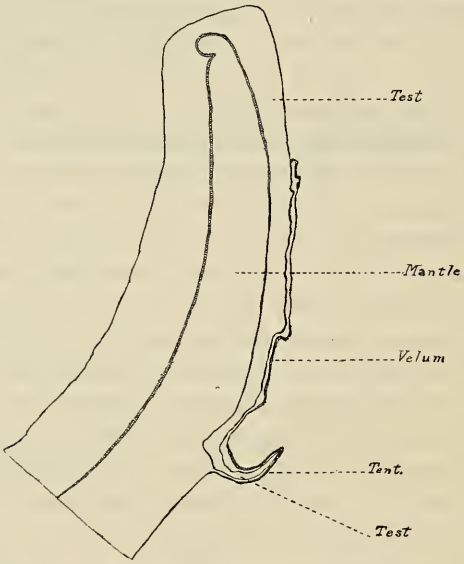

Fig. I. Longitudinal section of wall of atrial siphon in *Cnemidocarpa joannae.*

In the atrial siphons of Styelids these processes of the outer epithelium of the velum are particularly well developed and they are responsible for the formation of the atrial tentacles. They grow inwards to the inner epithelium of the velum and pushing this epithelium ahead of them, they project into the cavity of the siphon. As a result of this origin, each atrial tentacle consists of a central core of test and around this two epithelial layers united by a thin layer of connective tissue (see Fig. I). The tentacles are always simple (unbranched)[1].

[1] Ritter figures some of them branched in *Dendrodoa tuberculata* but I have not found them so in that species.

Characters of use in dividing the Styelidae.

One section of this family, namely the subfamily of the Polyzoinae, was revised by Michaelsen in 1904. He based his divisions on the characters exhibited by the gonads and pharynx. His revision has, I think, proved to be an eminently satisfactory one. The remaining subfamily, that of the Styelinae is in great need of revision. This has been voiced in particular by Dr. Hartmeyer.

I am not able to attempt this revision but I trust that the conclusions that I have reached from the study of a small number of species will be found of use when the revision is made. Certain characters that appear to be of major importance have been neglected in the descriptions of species and I desire to call attention to them.

As in many other groups, so in the Styelidae, we have nearly every possible combination of characters. This greatly augments the difficulties of classification. Dr. Hartmeyer has expressed this difficulty in his account of the family in Bronn's Tierreich in the following words; »Anderseits scheint mir bei den Tethyiden (= Styelidae) eine ziemlich weitgehende Konvergenz bei den verschiedensten Organen vorzuherrschen, die man nicht aus dem Auge verlieren darf, und die demnach bei einem Versuch die natürlichen Verwandtschaftsverhältnisse aufzuklären, eine wichtige Rolle spielt«. (Bd. III. Suppl. p. 1353.)

All classifications are admittedly artificial. But some have a greater degree of naturalness than others. What rules are there to guide one to the most natural arrangement of any group of organisms? There are none that can be fully relied upon and at best they can be used only in the most general way. The following appear to be important:

Constant characters are usually of major importance and inconstant or variable characters of minor importance.

Fundamental (and hence primitive) characters tend to appear early in ontogeny.

Change is usually from the simple to the complex.

An organ which is generally variable in a group is more useful than one which is only slightly variable.

The divisions that have been made in the Styelinae have been based upon the characters presented by the gonads and pharynx, just as in the Polyzoinae. Another feature might be added with advantage. This is the condition of the atrial tentacles. They show considerable variation among the Styelinae and yet the condition in each species is quite constant.

Pharynx. In some forms some or all of the pharyngeal folds fail to develop, e. g. in *Dendrodoa* and *Pelonaia*.

Gonads. The features that have been used are (1) size, (2) number, (3) whether found on one or on both sides of the body, and (4) whether mono-sexual or bi-sexual.

Sluiter has well shown that size and number are practically useless. As there is every possible gradation in size, this feature is not readily applicable. The number of gonads is of some value. There is great constancy in those species possessing only one gonad on each side. Where two on each side is the rule, there is little variation. The

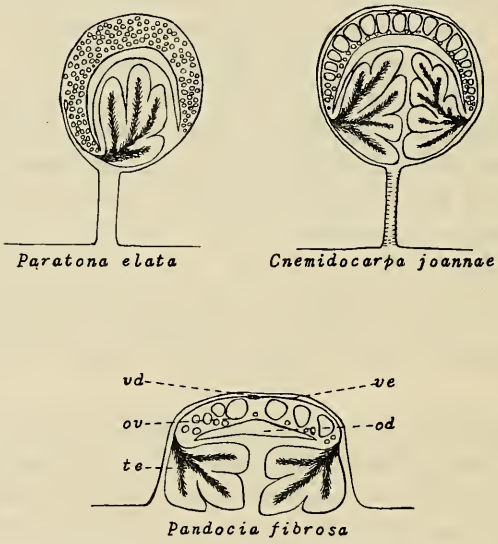

Fig. II. Diagrammatic transverse sections of gonads. *vd*, vas deferens; *ve*, vas efferens; *ov*, ovary; *od*, oviduct; *te*, testis.

cases in which only one or three occur on a side are rare. They are of sufficient rarity to be considered abnormal. Curiously enough they may be the first specimens examined. The first individual of *Styela montereyensis* that I examined had only one gonad on the left side and three on the right; the first of *Katatropa uclueletensis* had only one on the right side and two on the left, of which one was imperfectly developed. With more than two gonads on each side there is greater variation. In 5 specimens of *Cnemidocarpa joannae* there were from 5 to 12 gonads on the left side and from 7 to 12 on the right.

Characters (3) and (4) above are undoubtedly of great value.

Another important feature that has not been emphasized sufficiently is the relation of the testes to the ovary in the gonad.

The typical gonad of the Styelidae consists of a central somewhat

elongated ovary and arranged along either side of it a series of testicular masses. The ducts of the latter unite on the inner free surface of the ovary to form a common vas deferens. The vas deferens and the oviduct open near each other at one end of the gonad (see Fig. V, 3). It will be most suitable to speak of each of the testicular masses as a testis, of their ducts as vasa efferentia and of the common duct as the vas deferens. The primitive position of the testes appears to have been in the angle (as seen in a transverse section of the gonad) between the ovary and the body wall. In *Pelonaia corrugata* (see Fig. III for a

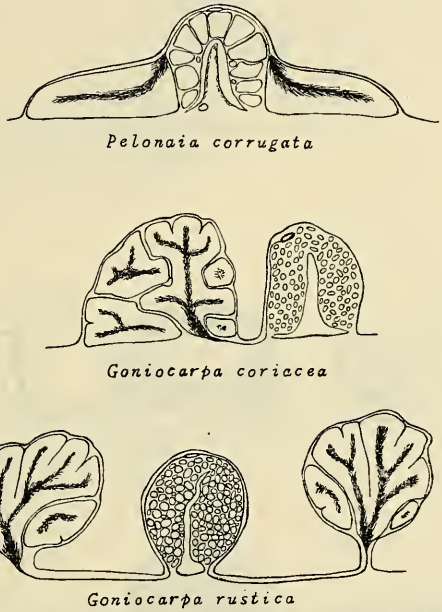

Fig. III. Diagrammatic transverse sections of gonads.

transverse section) there has been only a slight departure from this primitive condition.

There are apparently no species in which this original condition has been retained (?). There have been two directions of change from this condition.

In the first case, exemplified by *Dendrodoa*, *Pandocia* and *Cnemidocarpa*, the testes have extended in between the ovary and the body wall, as is shown in Fig. II. They have at the same time become more or less lobed. The gonad varies in its relation to the body wall and this affects its shape. These differences appear to be of slight value only. In perhaps the majority of cases the gonad is closely applied to the wall as in *Pandocia fibrosa* (see Fig. II). This is the condition in *Dendrodoa* and also in *Cnemidocarpa mollis*. In these the transverse

section is approximately square. In *Paratona elata* (Fig. II and Fig. V, 1) the gonad has moved inwards from the wall, remaining attached to it by a web of tissue running the length of the gonad. In *Cnemidocarpa joannae* (Fig. II) the gonad has moved inwards from the wall, but the connection with the wall is by a series of tubular processes or 'vessels', one of which is represented in the figure. In the last two cases the testes have been somewhat enveloped by the broad oviduct and the gonad in section is approximately circular.

Katatropa yakutatensis

Styela partita

Botryorchis atlanticus

Fig. IV. Diagrammatic transverse sections of gonads.

Another character of more importance than the relation of the gonad to the wall is the restriction of the testes to one side only of the ovary, as occurs in *Paratona elata* (Fig. II and V, 1). This (together with differences in the atrial tentacles) is of sufficient importance to warrant the formation of a new genus for this species, as distinct from *Pandocia*. The gonads in this species are numerous and small. On each side of the body they are oriented in such fashion that in each the end having the openings of the ducts is directed posteriorly toward the atrial siphon. It seemed probable that the testes might be found on a definite side of each ovary, e. g. always on the dorsal side or always on

the ventral side. Investigation showed that this did not occur. The testes are sometimes dorsal and sometimes ventral. To a certain extent neighboring gonads have them reversed, e. g. in one dorsal and in the next ventral.

The second direction of extension of the testes is away from the ovary, as exemplified by *Styela*, *Pelonaia* and *Goniocarpa*. Dr. Van Name in his recent account of the simple Ascidians of the New England coast (P. Bost. Soc. N. Hist., vol. 34, No. 13) has indicated the differences between this group and the previous one in his key to the species of the genus *Tethyum* (= *Styela*). He has however placed those forms with the testes close beside the ovary in one group with those in

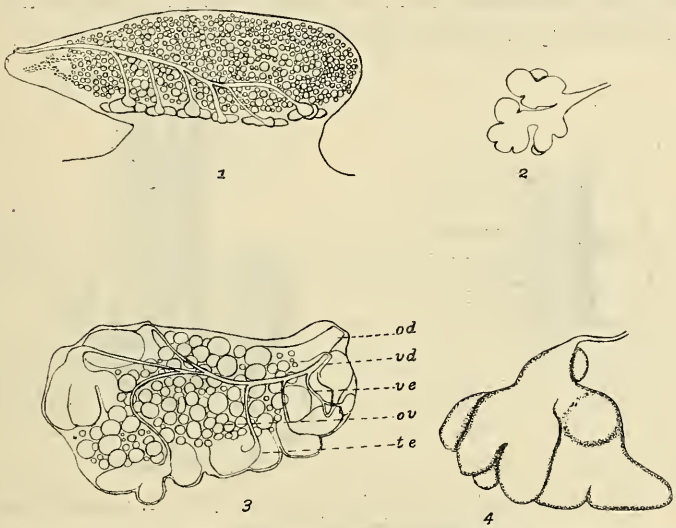

Fig. V. *Paratona elata*; 1, a gonad viewed from the side; 2, a testis. *Pandocia fibrosa*; 3, a gonad viewed obliquely; 4, a testis. (1, 2 and 4, × 27; 3, × 21.) *od*, oviduct; *vd*, vas deferens; *ve*, vas efferens; *ov*, ovary; *te*, testis.

which the ovary overlies the testes and includes in this group the *Ascidia plicata* of Lesueur. My study of specimens of this latter species from Naples shows that the testes are as distinctly separate from the ovary as in *Styela partita*. All the species that I have examined show no intergrading between those forms with the testes growing under the ovary (Fig. II) and those with the testes growing away from the ovary (Fig. III and IV). In immature individuals of the genera *Styela*, *Pelonaia* and *Goniocarpa* there is a definite interval between the testes and the ovary. Dr. Van Name has figured this for a young *Pelonaia*. Later the ovaries and testes may enlarge so much that they come together or the testes may even grow over the ovary as occasionally occurs in *Goniocarpa*. This is quite secondary.

As a result of this growth of the testes away from the ovary, the testes are attached to the body wall more or less separately from the ovary. This condition has frequently been described as 'testes separated from the ovaries'. This expression would lead to the idea that the two were independent. The position of the vas deferens on the ovary shows that they are not independent but that they belong to the one gonad. Hancock in 1867 and Lacaze-Duthiers and Delage in 1892 maintained that in *Styela variabilis* the numerous testes opened separately into the atrial cavity and were independent of the ovary. This was doubtless an error. The vasa efferentia and vas deferens are seen only with great difficulty unless filled with spermatozoa. I have not been able to examine *Styela variabilis*, but in the nearly related *S. partita* the ducts have the customary relation to the ovary.

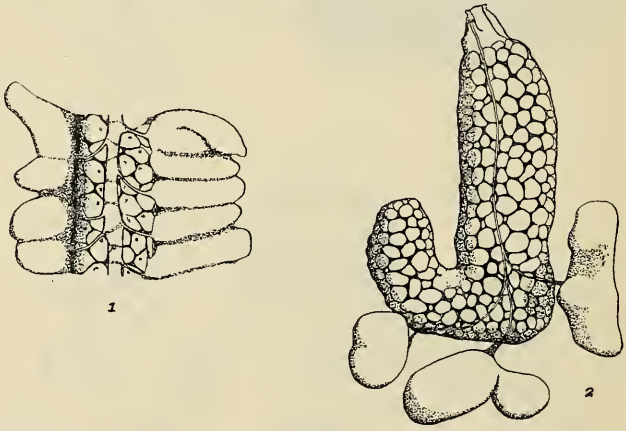

Fig. VI. 1. Part of a gonad of *Pelonaia corrugata* (× 16); 2. a gonad of *Katatropa vancouverensis* (× 12).

This group contains species which are in many respects the most highly organized of Styelids. The peculiar stalked forms of the North Pacific (one has recently been described from the Cape of Good Hope by Dr. Hartmeyer and I understand that Dr. Michaelsen has received one from the coast of West-Africa) all belong to this group. The peculiar spinules of the siphons reach their highest development in this group.

The testes in this group show considerable variation in their method of growth. The species may be divided into two distinct groups on a basis of the way in which the testes react to the body wall. Loeb has given the name stereotropism to that condition in which an organism tends to place itself close against the substratum. Organisms growing against the substratum are positively stereotropic and those growing away from the substratum are negatively stereotropic. In one group

the testes grow against the bodywall and are hence positively stereotropic and in the other group they grow away from the wall and are hence negatively stereotropic. This difference is shown in figures III and IV. The testes of *Pelonaia*, *Goniocarpa* and *Botryorchis* are positively and those of *Styela* and *Katatropa* negatively stereotropic. In

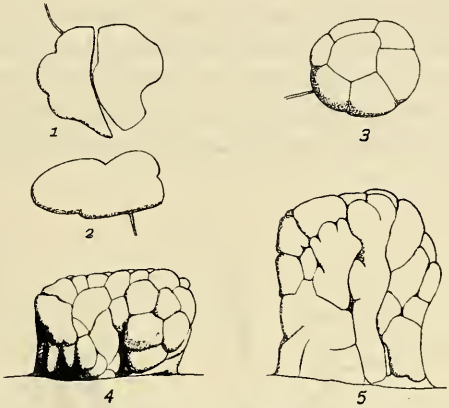

Fig. VII. Stages in the formation of the testes in *Goniocarpa coriacea*. 1, 2 and 3, viewed from above (perpendicularly to body-wall); 4 and 5, viewed from the side. (1 and 2, × 40; 3, × 20; 4 and 5, × 10.)

the former case the testes begin growth by elongating and sending out lobes in the plane of the body wall (see Fig. VII, 1 and 2). In *Pelonaia* they develop no farther. In the other two genera they continue to grow and send out lobes. These grow over each other as they do over the body wall and they may even grow over the ovary. They always keep

Fig. VIII. Testes of *Styela montereyensis* viewed from the side (× 12).

close to the bodywall, to each other, or to the ovary. Neighboring testes may grow together into a large mass which may rise some distance up from the body wall (Fig. VII, 4 and 5). In *Goniocarpa coriacea* these masses remain attached to the wall by a broad base (Fig. III). In *G. rustica* they usually move away from the wall,

remaining connected with it by a narrow stalk traversed by the vasa efferentia (Fig. III). This process appears to be quite distinct from the stereotropic reaction. In these genera the lobes of the testes (not the masses) do not project into the atrial cavity but are closely bound together.

In the negatively stereotropic forms (*Styela* and *Katatropa*) we have the reverse condition. In the early stages, before any lobes are formed, the testes elongate perpendicularly to the body wall (Fig. IV, *K. yakutatensis*). In *K. greeleyi* (Fig. IX, 4) little or no lobing occurs and the testes of the adult are long cylindrical structures projecting freely into

Fig. IX.

Fig. X.

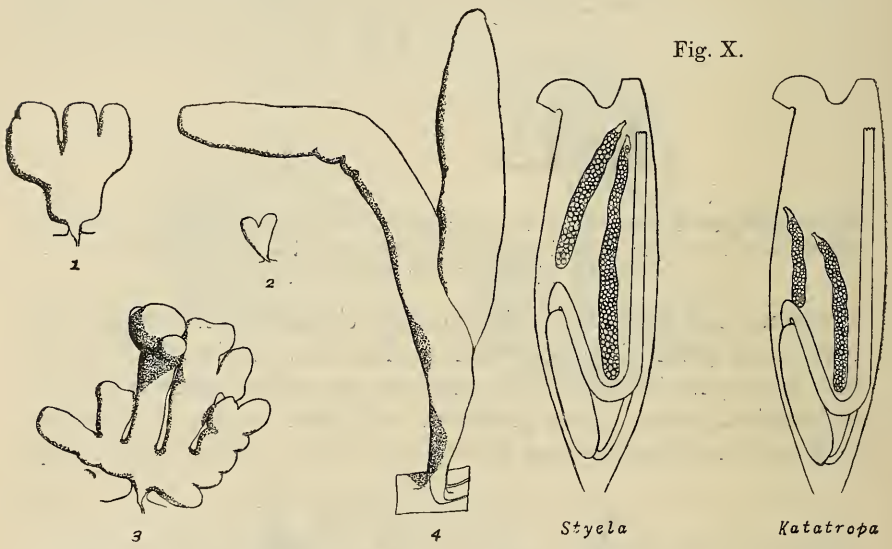

Fig. IX. Testes of *Styela* and *Katatropa* viewed from the side. (× 10.) 1, *K. vancouverensis*; 2, *S. costatum*; 3, *S. partita*; 4, *K. greeleyi.*

Fig. X. Diagrams to show the relative positions of the gonads in *Styela* and *Katatropa*. The form of body shown is that of the stalked species. The testes are not indicated.

the atrial cavity. In most species the testes become lobed and the lobes diverge from each other and project freely into the cavity (Figs. VIII and IX). The greatest extreme in branching is shown by *S. partita* (Fig. IV and Fig. IX, 3). When the testes are very closely placed, the branches may not be able to diverge and may be forced to grow together more or less (Fig. VIII on the right side). Masses so formed may superficially resemble the masses formed by the positively stereotropic testes but close inspection will at once show the difference.

The ovary shows certain differences throughout the series of forms

that have been investigated but I have been unable to seize upon any characters of definite value in classification.

The orientation of the gonad plays a very small part in the divergence of the species. When the gonads are numerous and small, as in *Pandocia* and *Paratona*, they are for the most part oriented with their apertures toward the atrial siphon. When they are large and elongated, their apertures open usually near the base of the atrial siphon. This is of advantage for the ready escape of the eggs and spermatozoa. A strong current of water will usually be passing over the apertures. In some forms, however, the gonads open some distance from the atrial siphon. In *Dendrodoa carnea* the single gonad opens posteriorly and ventrally. This results in the retention of the eggs, a broad cavity being formed behind the pharynx. In *Katatropa* the gonads (two on each side) open anteriorly and ventrally (Fig. X). As in the other genus, the eggs are retained, although there is no definite brood cavity. In the related genus, *Styela*, the eggs are not retained. The difference shown in Fig. X is as exhibited by the stalked species. In the shorter species the difference is more marked.

Atrial Tentacles. Up to the present the atrial tentacles have not been used in classification. The atrial velum shows constant differences in the species, but as these differences are quantitative (narrower or wider) they cannot readily be used. The forms with the testes growing away from the ovary have a very narrow velum. In the others it varies in width. The tentacles are sometimes restricted to the attached margin of the velum (Fig. XI) and sometimes scattered over the whole inner surface (Fig. XII). In *Dendrodoa, Pandocia* and *Cnemidocarpa* the velum is variable in width and the atrial tentacles are in a single row. In *Paratona elata* the velum is extremely broad and the tentacles sparsely scattered over its whole surface. In *Styela*, *Katatropa*, *Pelonaia*, *Goniocarpa* and *Botryorchis* the velum is quite narrow and the tentacles more or less thickly scattered over its whole surface (Fig. XII, 1).

Anus. Dr. Hartmeyer has suggested that the characters presented by the margin of the anus (whether lobed or smooth) is of some value in classifying the Styelids. I have not found it so with my material. The lobing of the anus varies from very distinct to indistinct. I have found it even in *Dendrodoa* (*D. carnea*), in which genus Dr. Hartmeyer states that the margin of the anus is smooth. Being a question of degree only, it will not be readily applicable but will still be of assistance in checking over a classification based upon other characters.

Siphonal Spinules. These small spines are developed to a much greater extent in the Tethyidae (Cynthiidae) than in this family. They

occur on the inner surface of the siphons (where the test is not covered by the velum), on the margins of the apertures and to some extent on the outer surface of the siphons and on the body generally. They seem to be usually restricted to the siphons.

Each spinule appears to be derived from a single test-cell of a kind differing from the ordinary cells of the test. They are of somewhat larger size and in some cases at least stain more deeply with eosin. They pass to the free surface of the test and the exposed part of the cell wall becomes converted into the spinule. They orient themselves with reference to the long axis of the siphon, the spine pointing toward the outer opening of the siphon.

Fig. XI.

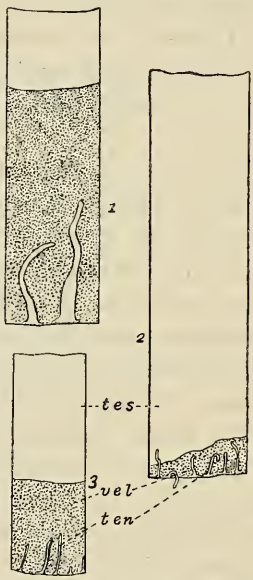

Fig. XII.

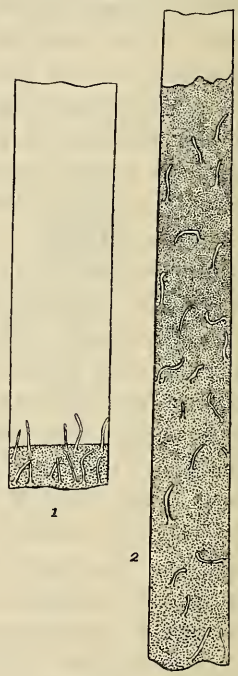

Fig. XI. Atrial walls of various Styelids. (× 13.) 1, *Cnemidocarpa joannae*; 2, *Pandocia fibrosa*; 3, *Dendrodoa carnea*. *tes*, test; *vel*, velum, *ten*, tentacle.
Fig. XII. Atrial walls of (1) *Katotropa vancouverensis* and (2) *Paratona elata*. (× 13.)

These spinules do not occur in all Styelids, though doubtless the peculiar test-cells are to be found in all. The spinules show a considerable variety in form in the various species, but the general plan is the same in all. The principal differences are due to the spinules of some species developing farther than those of others. In the simplest form there is a transverse thickening of the wall of the cell. This thickening

has a very definite margin anteriorly (Fig. XIII, 1). In surface view it shows delicate striations at right angles to this margin. As the margin frequently shows distinct teeth the striations are doubtless due to a corrugation of the surface. As the spinule is very minute, (usually from 10 to 30 μ long) it is difficult to properly interpret what is seen. The next stage is shown in Fig. XIII, 2. The anterior margin projects forming a lip, inside which is a groove. When the lip becomes more prominent a definite pocket is formed inside it (Fig. XIII, 3, 4 and 5). The margin of the lip may be truncate (2 and 4) or pointed (3 and 5). It may be smooth (2 and 3) or dentate (4 and 5). In only one species that I have examined is a definite spine formed (6). It is very evidently an elongation of the median point of the lip.

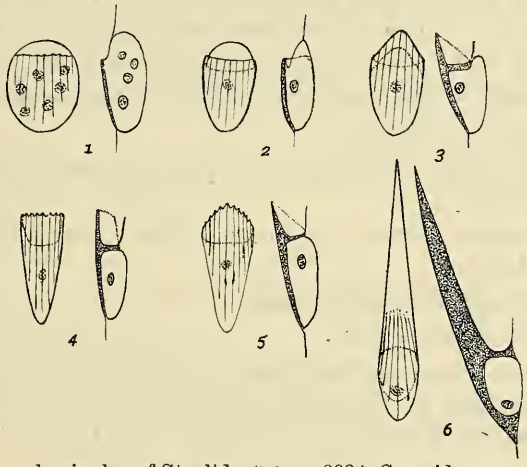

Fig. XIII. Siphonal spinules of Stylelids. ($\times$ ca. 660.) *Cnemidocarpa joannae*; 2, *Pelonaia corrugata*; 3, *Goniocarpa coriacea*; 4, *Katatropa yakutatensis*; 5, *Styela plicata*; 6, *Katatropa greeleyi*. In each case, the figure on the left is a surface view and that on the right is an optical median section.

The spinules are found in all the forms having the testes growing away from the ovary. Of these *Pelonaia* shows the simplest condition. Of the other forms (having the testes growing under the ovary) I have been able to find definite spinules only in *Cnemidocarpa joannae*. Also they were less perfectly developed than in any of those of the other group. In this species the cell has originally only one nucleus but during the formation of the spinule the nucleus divides and a multinucleate condition is attained. This does not occur in the other group.

Beyond corroborating the classification based upon other characters, the spinules cannot be readily used for defining the genera.

The shape of the body and the character of the surface of the

test appear to be of secondary importance in the classification. Frequently they sustain conclusions reached from a consideration of other characters.

Classification.

It is perhaps desirable that the classification adopted (although having to do with so few species) should be put in tabular form. No apology need be offered for the proposal of new names. Advance in classification can be made only by the formation of new divisions and references to new divisions are greatly simplified when the divisions bear names. Old names have been retained wherever possible, the diagnosis being altered. Names have not been given to all the divisions but only to those which seem to deserve the rank of genera or subgenera. For the most part this synopsis has been restricted to species that I have examined myself. Some species have been included which I have not examined but which it has been possible to place with some degree of certainly. Each of these has been marked with an asterisk (*).

A_1. Gonads few and large.
Testes attached to the body wall separately from the ovary (Fig. VI, also III and IV).
Atrial velum narrow, its inner surface covered with tentacles (Fig. XII, 1).
Siphonal spinules well developed.
Anus with distinct lobes.

B_1. Testes negatively stereotropic, elongated in a direction perpendicular to the plane of the body wall, their lobes diverging (Figs. VIII and IX, also upper two of IV).

C_1. Ducts of gonads opening near anus and atrial siphon (Fig. X, left side).
Genus *Styela* Fleming. Type, — *S. canopus* (Sav.).
Four pharyngeal folds on each side.
Aperture of dorsal tubercle curved. Open interval directed forwards or to left.
Two or more gonads on each side.
Spinules truncate or pointed (Fig. XIII, 5).

Section I.

Normally two gonads on each side. Surface of body smooth or rough, sometimes longitudinally furrowed.
In this section there are 5 short species, — **S. canopus* (Sav.), **S. variabilis* (A. and H.), **S. canopoides* Heller, *S. partita* (Stimps.) and **S. pupa* Heller; one elongated

species, — *S. gibbsii* (Stimps.); and two stalked species, — *S. montereyensis* (Dall) and *S. costatum* (Hrtmyr.).

Section II.

More than two gonads, at least on the right side. Surface of body fairly smooth and with large irregular folds. Short species. *S. plicata* (Les.), **S. pinguis* Hrdmn., **S. stolonifera* Hrdmn.

C_2. Ducts of gonads turned ventrally and opening near endostyle (Fig. X, right side).

Genus *Katatropa* Huntsman. Type, — *K. vancouverensis* Hntsmn.

Four pharyngeal folds on each side.

Open interval of dorsal tubercle directed toward left.

Two gonads on each side.

Spinules truncate or acicular. (Fig. XIII, 4 and 6).

The species of this genus are not as robust as those of *Styela*. The oral tentacles are fewer and the testes show less branching. (κατά, down and τροπή, a turning, referring to the gonads.)

Section I.

Testes short and usually somewhat lobed (Figs. IV upper, VI, 2 and IX, 2).

Spinules truncate (Fig. XIII, 4).

In this section there are two short species, — *K. vancouverensis* Hntsmn. and *K. uclueletensis* Hntsmn.; and one stalked species, — *K. yakutatensis* (Ritter).

Section II.

Testes very long and without lobes (Fig. IX, 4.)

Siphonal spinules acicular (Fig. XIII, 6).

The single species, *K. greeleyi* (Ritter), is a stalked form. Dr. Hartmeyer considers this species to be identical with the *Ascidia clavata* of Pallas, relying upon the very close external similarity. As there is a series of stalked forms, which are often indistinguishable externally and yet have very marked internal differences, I prefer to leave the question open until the distribution of the North Pacific stalked species has been studied more thoroughly. I am in entire accord with Prof. Ritter who has recognized three stalked species on the American side of the Pacific. The three species are quite distinct.

B_2. Testes positively stereotropic, elongated (when simple and not massed) in the plane of the body wall; when lobed, the lobes are closely bound together (Figs. III and VII).

D_1. Pharynx without folds.

Genus *Pelonaia* Forbes and Goodsir. Type and single species, — *P. corrugata* F. and G.

One U-shaped gonad on each side.

Testes only slightly lobed (Fig. VI, 1).

Siphonal spinules poorly developed (Fig. XIII, 2).

This genus has been placed in a separate family or subfamily. It is however closely related to *Goniocarpa*. A reduction in the pharyngeal folds occurs in other Styelids. The position of the intestinal loop to a great extent behind the pharynx is due to the poor development of the pharynx. The loop is distinctly on the left side of the pharynx as in all Ptychobranchiates.

D_2. Four pharyngeal folds on each side.

E_1. One gonad on each side.

Genus *Goniocarpa* Huntsman. Type, — *G. coriacea* (A. and H.) (*Styela loveni* Hrtmr., 1903).

Gonad usually bent forming an angle.

Spinules well developed.

(*γωνία*, angle, and *καρπός* fruit, referring to the bent gonad.)

Section I.

Testes much lobed.

Test leathery. Short species.

Species, — *G. coriacea* (A. and H.) [with which the following are probably synonymous, **granulata* (Alder), **northumbrica* (A. and H.), **armata* (Lac.-Duth. and Delage), *placenta* (Packard), **loveni* (Sars) and *coccodes* Hntsmn.], **G. braueri* (Mchlsn.), and *G. rustica* (L.).

Section II.

Testes with few or no lobes.

Test gelatinous. Stalked form.

Single species, — *G. gelatinosa* (Traustedt).

E_2. Two or more gonads on each side.

Genus *Botryorchis* nov. Type, — *B. atlanticus*

(Van Name) (= *Tethyum atlanticum* Van Name 1912).

Spinules well developed.

In this genus there are two short species, — *B. atlanticus* (Van Name) and **B. longitubis* (Traust. and Weltn.); and one stalked species, — *B. clava* (Hrdmn.). The first two species have only two gonads on each side. The last species has been reported as having sometimes two and sometimes more than two. Possibly distinct species have been reported under the one name. The matter requires investigation. (βότρυς, a bunch of grapes and ὄρχις, a testis.)

A_2. Gonads few and large or numerous and small.

Testes placed between the ovary and the body wall (Figs. II and V, 3).

Ducts of testes pass from both sides of ovary to form the vas deferens.

Atrial velum variable, narrow or broad.

Atrial tentacles in a single row at base of velum.

Spinules imperfectly developed or absent.

F_1. Only one gonad, which is situated on the right side.

Genus *Dendrodoa* McLeay. Type, — *D. aggregata* (Rathke).

Pharyngeal folds more or less rudimentary (usually).

Surface smooth or rough.

Of ten species referable to this genus, I have examined only two, — *D. carnea* (Agassiz) and *D. tuberculata* Ritter. As has been indicated by Hartmeyer and Van Name, the genus is readily divided into two groups, one consisting of the species **grossularia*, *carnea* and **uniplicata*, having an unbranched gonad and very much reduced pharyngeal folds (this might be considered a subgenus and Traustedt's name *Styelopsis* retained for it), and the other consisting of the remaining species, having a branched gonad and the pharyngeal folds less reduced.

F_2. Gonads on both sides of body.

G_1. Gonads few to many, elongated, placed in a single row on each side. Ducts opening near atrial siphon.

Genus *Cnemidocarpa* Huntsman. Type, — *C. joannae* (Hrdmn.).

Four pharyngeal folds on each side.

There are a large number of species, that have been placed in the genus *Styela* or *Tethyum*, and that doubtless belong here but the descriptions in most cases are insufficient. There are a number of more or less distinct groups, some of which have been pointed out by Dr. Hartmeyer. In one group of species, containing the type, the surface of the body is smooth and the gonads are rather numerous (5 to 12). In another group, containing *C. mollis* (Stmps.), the surface of the body is coated with sand, etc., and the gonads are less numerous (4 to 7). In *Tethyum mortenseni* Hartmeyer, which evidently belongs here, there are two gonads on the right side and only one on the left.

(κγήμις, spoke of a wheel and καρπος, fruit.)

G_2. Gonads numerous, short (Fig. V, 3), scattered (not in a single row). The ducts open toward the atrial aperture.

Genus *Pandocia* Fleming. Type, — **P. conchilega* Fleming (probably = *Cynthia comatha* Alder, according to Hartmeyer, 1908).

Four pharyngeal folds on each side.

This genus, as defined above, doubtless includes a large number of species that have been placed in the genus *Polycarpa* or *Pandocia*, but the descriptions are in most cases insufficient. *P. fibrosa* (Stimps.) is the only one that I have examined. It is the type (by designa-

tion by Heller) of Stimpson's genus *Glandula*, which is therefore synonymous with *Pandocia*.

A_3. Gonads numerous and small (always?).
Testes placed between ovary and body wall.
Vasa efferentia on one side only of ovary (Fig. V, 1).
Atrial velum very broad, its inner surface with sparsely scattered, filiform tentacles (Fig. XII, 2).
Spinules absent.
Genus *Paratona* nov. Type, — *P. elata* (Heller), (= *Polycarpa elata* Heller).
Four pharyngeal folds on each side.
It is not possible to state whether any species, other than the type, belong in this genus.
(παρά τονος, hanging down by the side, alluding to the gonad).

It is not thought that the groups as defined above will prove to be absolutely distinct. Intermediates will doubtless be found and are to be expected. It is maintained however that the groups represent the relationships of the species. It is an entirely arbitrary matter as to what ranks the groups should have.

I wish to express my thanks to Prof. W. E. Ritter for the loan of a large quantity of material of the stalked Styelids of the Pacific Coast of America and to Dr. R. Hartmeyer and Dr. W. G. Van Name for sending me specimens of certain of their species.

3. Beiträge zur Entwicklung von Halicryptus spinulosus (von Siebold).

Von Olof Hammarsten.
(Aus dem Zootomischen Institut der Universität zu Stockholm.)
(Mit 3 Figuren.)

eingeg. 2. Januar 1913.

Mit Dredschungen in den Schären Stockholms beschäftigt, hatte ich kürzlich Gelegenheit, einige interessante Beobachtungen über die Entwicklung von *Halicryptus spinulosus* zu machen. Die Dredschungen wurden in der Nähe von Blidö, etwa 5 Meilen nördlich von Stockholm, auf lehmigem Boden und in einer Tiefe von 30—15 m ausgeführt. *Halicryptus* kommt hier das ganze Jahr hindurch in reichlicher Menge vor. Man findet Tiere aller Größen, von voll ausgewachsenen Individuen bis zu Würmern, die nicht mehr als einige Millimeter messen. Versuche, noch kleinere Exemplare zu erhalten, waren jedoch lange erfolglos. Erst vergangenes Jahr gelang es mir, einige Larven, die in voll ausgedehntem Zustande nicht mehr als 1,7 mm lang waren, zu erhalten. Da diese Larven