

in the upper jaw being 30 millim. instead of 72 as in the adult. They evidently represent the narrow apical portion of the permanent teeth, which as growth proceeds wears off, and they are not in any case milk-teeth. As the first of the series, or premolar, is as fully developed as the one which follows it (or first true molar) it must either have no predecessor, or one which has disappeared at an early stage of intra-uterine life.

2. Studies in the Holothuroidea.—III. On *Amphicyclus*, a new Genus of Dendrochirotus Holothurians, and its bearing on the Classification of the Family. By Professor F. JEFFREY BELL, M.A., Sec.R.M.S.

[Received March 28, 1884.]

Among the valuable collections made during 1876 by Captain H. C. St. John, H.M.S. 'Sylvia,' in the Japanese seas were a few Holothurians; these were not reported on along with the rest of the Echinodermata, which some years ago formed the subject of interesting communications from Prof. Martin Duncan, F.R.S., and Mr. Sladen¹.

Now that I am engaged in working through the collections of Echinoderms in the British Museum, the Trustees of which owe the specimens now under consideration to the generosity of Dr. Gwyn Jeffreys, F.R.S., I think it proper to direct the attention of the Society to two very remarkable specimens among these Holothurians which cannot be placed in any genus at present instituted. The lessons to be learned from these specimens, and the knowledge that has been acquired of forms unknown to Professor Semper, thanks chiefly to the labours of Ludwig and v. Marenzeller, lead, I think, to a reconsideration of the classificatory system and phylogenetic table which in 1868 was put out by Semper, to whom the student of Holothurians will always be under the deepest obligations. It is with diffidence that I propose to rearrange a family that has been studied by this distinguished naturalist.

Description of the Specimens.—Body elongated, tapering at its hinder end. Oral tentacles in two cycles; in the outer fourteen, of fair size, and more or less subequal; in the inner ten, very small, arranged regularly by pairs, radial in position. Suckers confined to the ambulacra, arranged in quite regular rows; in the bivial ambulacra they are set in pairs, but are a little more irregular and more crowded in the trivial ambulacra. Owing to the attenuation of the body in the hinder region, the rows of suckers approach one another. The interradii are altogether free of suckers. There are no signs of any calcareous pharyngeal plates.

¹ Journ. Linn. Soc. (Zool.), vol. xiv. pp. 424, 445.



There are no calcareous plates or spicules developed in the walls of the body or of the tube-feet, the only calcareous deposits being the terminal plates of the tube-feet, and the delicate and elegant bars which are found in the tentacles¹.

The integument is very thin anteriorly, but increases considerably in thickness in the hinder part of the body, where it is quite stout. When its walls were cut through, the anterior portion of the body-cavity was found to be filled with a large number of stout, rather short genital tubes, which branched only once or twice, but were so numerous as to obscure considerably the underlying parts. The retractors of the pharynx are inserted behind the middle point of the body; two of them are remarkable for approaching and uniting with one another; under the band thus formed, on one side the intestine passes twice. The intestine is very delicate. No Polian vesicle was detected, and it is probably of comparatively small size; the so-called water-lungs extend forwards to the anterior end of the body.

The characters presented by this form are sufficiently remarkable to justify the establishment of a new genus for its reception. It stands nearest to the two genera instituted by Ludwig—*Echinocucumis* and *Actinocucumis*; but it differs from them both in the important character of the regularly paired disposition of the radially placed smaller tentacles. With them, it differs from all other *polychirote* (or *Dendrochirotae* with more than ten tentacles), and agrees with the more simple of the *decachirote* *Dendrochirotae* in having the sucker-feet confined to the ambulacra.

In consequence of the definite disposition of the tentacles in two cycles, I propose to speak of it as *Amphicyclus*, this form of the name being sufficiently different from *Amphicyclia*².

The *Generic Characters* appear to be:—Stichopod arrangement of the suckers associated with the possession of more than ten oral tentacles; the tentacles in two circles: those of the inner are arranged in pairs, are ten in number, radial in position, smaller than those of the outer circle, in which there are fourteen subequal tentacles. There are no calcareous pharyngeal plates, and two of the retractors of the pharynx are united with one another.

As there is only one species known, the discrimination of the specific characters is, of course, unsafe; but these appear to be:—(1) Complete absence of rods or spicules from the walls of the body or tube-feet; (2) attenuation of the hinder end; (3) thinness of integument of anterior end; (4) large number of genital tubes.

As the locality is known (lat. 41° 12' N., long. 140° 45' E.; 43 fms., sand and mud), I propose the specific name of *japonicus*.

The useful classification proposed by Professor Semper in his magnificent work has been universally adopted by systematists since the year 1868; in it the *Dendrochirotae* *Pneumonophora* were

¹ In *Cucumaria frondosa*, where calcareous deposits are reduced to a minimum, there are well-developed plates in the tentacles; and *Thyone okeni* (see Brit. Mus. Cat. 'Alert' coll.) has rods in the tentacles only.

² Haeckel, *Jenaische Zeitschr.* vol. xv.

grouped under the three subfamilies of Stichopoda, Gastropoda, and Sporadipoda, according as the ambulacral suckers were set in definite rows, and the interradii were altogether or almost completely devoid of suckers (e. g. *Cucumaria*), were confined to the trivium ("ventral surface") (e. g. *Psolus*), or were scattered more or less regularly over the whole body, as in *Thyone*.

Among the Sporadipoda, *Thyone* and *Stereoderma* alone had ten tentacles only; and, till the time of Ludwig's institution of *Pseudocucumis* and *Actinocucumis*, all Stichopods were thought to have ten tentacles or to be "decachirote."

The recent researches of Von Marenzeller have resulted in an emendation of the generic characters of *Colochirus*¹, and have in principle removed it from the Stichopoda to the Sporadipoda, so that in place of saying with Semper "Die Füßchen der Bauchseite stehen in 3 deutlich von einander getreunten Reihen," we now say, with Marenzeller, "Die Ambulacralfüßchen der Bauchseite stehen entweder in drei deutlichen Reihen oder nahezu regellos." While Von Marenzeller has demonstrated the inconstancy of the Stichopod arrangement in one of the Stichopoda, it has been my fortune to show² that the Sporadipod disposition of the ambulacral feet in *Stereoderma* is, in *S. murrayi*, carried further than it is in *S. unisemita*, the only species of the genus that was known in 1868.

We are then led to the conclusion that the disposition of the ambulacral suckers offers a less certain basis for arrangement than was supposed some years since. It might, indeed, well have been thought that as the Holothurian got further and further away from the parent stock which remained under the domination of the pentamerous disposition of parts, it would, as it began to develop more than five pairs of tentacles, have its sucker-feet developed in the interradii as well as the radial parts of the body. Such a theoretical consideration would find support in the fact that some forms as they grow older lose a stichopodous and acquire a sporadipodous arrangement of the sucker-feet; while a not unimportant consideration for the systematist is the variability of this character.

With regard to the former, however, opposing evidence is offered by the case of *Amphicyclus*, where, with in all 24 tentacles, we have the stichopod arrangement completely retained; and by the genus *Actinocucumis*, made known to us by H. Ludwig, where there is a stichopod arrangement, and from 18 to 20 tentacles.

As to the latter consideration, I should like to speak with diffidence till I have a better acquaintance than I have now with the species of the genus *Cucumaria*. As a matter of fact, however, systematists do, at this moment, unite under that head (α) stichopods with ten equal tentacles, (β) stichopods with ten tentacles of which two are smaller than the rest, and (γ) forms with eight large and two smaller tentacles, and some sucker-feet scattered in the interambulacra. Semper has hinted at the advantage of separating the last from the rest and forming for them a new generic group; but he

¹ Verh. zool.-bot. Ges. Wien, 1881, p. 129.

² P. Z. S. 1883, p. 61.

has not done more than give a hint, which has not till yet been acted upon.

Any statement as to the phylogeny of the Holothurians must be made with the greatest caution, for this reason, if for no other, that our knowledge of the palæontological history of the class is almost nil¹. If, therefore, in what follows there appears to be anything like dogmatic statements, the student will remember that such a mode of presentation is often convenient on the score of brevity.

In distinguishing the two families of pedate Pneumonophorous Holothurians, the form of the tentacle is an important factor; in distinguishing the genera of one of these suborders is it not probable that the number and mode of disposition of the tentacles may be well taken into consideration?

Among the Dendrochirotae, some species of *Cucumaria* and *Psolus* alone retain the primitive arrangement of five pairs of equal tentacles: *Psolus* early left the common stock and is, really, a form which is only essentially modified in the gastropod or trivial disposition of its tube-feet. Some of the *Cucumariæ* acquired the differentiation of a pair of tentacles smaller than the rest; thence branched off *Ocnus* and *Colochirus*, in which the suckers tended to be confined to the trivium, and in which a large deposit of calcareous bodies was still retained in the integument; of *Colochirus*, *Stereoderma* is a more specialized form.

Thyone, with four pairs of longer and one of smaller tentacles, has a sporadipod arrangement of the ambulacral feet; in *Thyonidium* five pairs of smaller tentacles are developed in addition; in *Orcula* and *Phyllophorus* a sporadipod arrangement of suckers is associated with an irregular disposition of the feet; while in *Pseudocucumis* ten pairs of tentacles, in *Amphicyclus* twelve pairs regularly arranged, lead to *Actinocucumis* with its irregularly disposed tentacles but its stichopod feet.

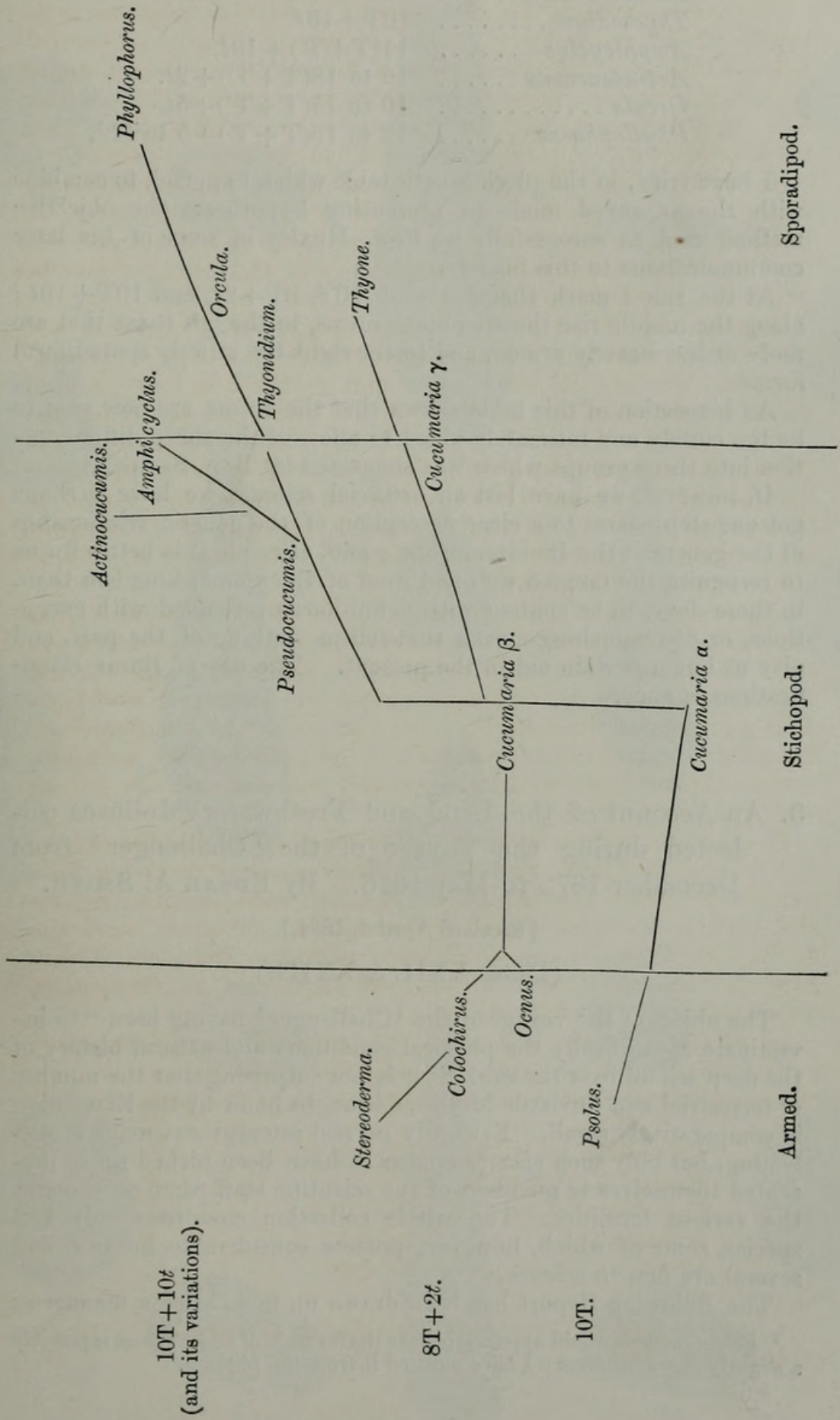
If, therefore, we retain the Semperian method of classification, we widely separate *Psolus*, with its primitively arranged tentacles, from *Cucumaria*; widely separate *Orcula* and *Phyllophorus*, with irregular and variable tentacles, from *Actinocucumis*; and place with the Stichopoda *Colochirus*, in which a sporadipod arrangement is perhaps not less rare than is a stichopod disposition in *Thyonidium*, which belongs to the Sporadipoda.

By writing T for the large primary tentacles, T' for the secondary (more than 10) large tentacles, and *t* for the small tentacles, we can at a glance see the relations of the genera in this particular.

<i>Cucumaria</i> . .	10 T or 8T + 2 <i>t</i> .
<i>Psolus</i>	10 T.
<i>Colochirus</i>	8T + 2 <i>t</i> .
<i>Stereoderma</i>	8T + 2 <i>t</i> .
<i>Ocnus</i>	8T + 2 <i>t</i> .

¹ Consult the single page (pp. 559-60) devoted to Holothurians in Zittel's valuable 'Handbuch.'

TABLE OF THE GENERA OF DENDROCHIROTÆ.



<i>Thyone</i>	$8T + 2t$.
<i>Pseudocucumis</i>	$10T + 10t$.
<i>Thyonidium</i>	$10T + 10t$.
<i>Amphicyclus</i>	$14(T + T') + 10t$.
<i>Actinocucumis</i>	$16 \text{ to } 18(T + T') + 2t$.
<i>Orcula</i>	$10 \text{ to } 15(T + T') + 5t$.
<i>Phyllophorus</i>	$12 \text{ to } 16(T + T') + 5 \text{ to } 6t^1$.

I have tried, in the phylogenetic table which I append, to combine with the approved mode of presenting hypotheses the objective method used so successfully by Prof. Huxley in some of his later communications to this Society.

At the side I mark the stages of $10T$, $8T + 2t$, and $10T + 10t$; along the middle rise the stichopod forms, to the left those that are more or less heavily armed, and to the right the strictly sporadiform forms.

An inspection of this table shows that the forms are now seen to be too closely and intimately allied to allow of the sharp differentiation into three groups which was suggested by Prof. Semper.

If, however, we have lost an artificial scheme, we have perhaps got one step nearer to a clear perception of the genetic relationship of the genera of the Dendrochirotae; and, after all, it is better for us to recognize the tangled web and woof of the animal kingdom than, in these days, to be content with definitions overloaded with exceptions, or distinguishing marks that tell us nothing of the past, and give us but uncertain aid in the present. The day of linear classifications is gone.

3. An Account of the Land and Freshwater Mollusca collected during the Voyage of the 'Challenger' from December 1872 to May 1876. By EDGAR A. SMITH.

[Received April 4, 1884.]

(Plates XXII. & XXIII.)

The object of the voyage of the 'Challenger' having been "to investigate scientifically the physical conditions and natural history of the deep sea all over the world," it is not surprising that the number of terrestrial and fluviatile Mollusca brought home by the Expedition is comparatively small. Evidently no real attempt was made at collecting, but only such species appear to have been picked up as presented themselves to members of the scientific staff when on shore at the various localities. The whole collection comprises only 152 species, some of which, however, possess considerable interest, and several are new to science.

The following Report has been drawn up in as brief a manner as

¹ *Echinocucumis* would apparently have the formula of $8t + 2T$, and is possibly a slightly degraded form; I have omitted it from the phylum.



Bell, F. J. 1884. "Studies in the Holothuroidea. -- III. On Amphicyclus, a new genus of dendrochirotoous holothurians, and its bearing on the classification of the family." *Proceedings of the Zoological Society of London* 1884, 253–258.

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