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LIV.—Ten-legged Pycnogonids, with Remarks on the Classification of the Pycnogonida

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NATAL: Verulam; PORTUGUESE E. AFRICA: Beira (*P. A. Sheppard*).

TYPE in the British Museum.

In addition to the characters mentioned in the key, this species may be distinguished from its only near ally, *C. immeritus*, Fähr., by the following points:—the shorter rostrum; the closer punctuation of the thorax, which is often longitudinally scrobiculate; the broader and more deeply punctured striæ on the elytra; and the narrower subcarinate intervals.

This species was found under the bark of rotten Euphorbia trees.

LIV.—*Ten-legged Pycnogonids, with Remarks on the Classification of the Pycnogonida*. By LEON J. COLE.

IN a recent paper published in this Journal by T. V. Hodgson (1904), Biologist to the National Antarctic Expedition, appears a description of a most interesting Pycnogonid taken during the stay of the 'Discovery' in winter-quarters in McMurdo Bay. It differs from the ordinary members of the group in possessing five pairs instead of the usual number of four pairs of walking or "ambulatory" legs. In other respects it is very close to the well-known genus *Nymphon*. Hodgson considers that this remarkable animal should be regarded as representing a new genus as well as a new species, and has proposed for it the name *Pentanympyon antarcticum*. That it is not a fortuitous or "freak" variation is pretty well shown by the fact that in all twenty-eight individuals were taken, both males and females. They were found inhabiting water from 12 to 125 fathoms in depth.

Hodgson believes that "the presence of a fifth pair of legs [is] a character which separates it from all Pycnogonids hitherto known"; but as early as 1837 Eights (1837) published a description of a Pycnogonid with a fifth pair of walking-legs from the South Shetland Islands, and gave to it the name *Decolopoda australis*—a fact which seems never to have come to the attention of workers on the group since that time. Eights gives a very good description and illustration of the species—much better than the average at that early date,—though the figures do not seem to agree in all details with the description. He states that the entire animal was of a bright scarlet colour, and so figures it; and

regarding their abundance says, "They are to be found in considerable numbers in connexion with the fuci, thrown up by the waves along the shores of the islands, after being detached by the motion of the large masses of ice, from the bottom of the sea." It appears that the specimens were collected by himself, and at least the one from which the description was made is recorded as in the "Cabinet of James Eights." About a year ago I attempted to secure information regarding Dr. James Eights and where he had lived, in the hope of locating these specimens, but was unsuccessful. Thinking they might have been deposited later in the collections of the Boston Society of Natural History, with the assistance of Mr. Johnston, the Curator, I made search there, but with like result.

An interesting question immediately arises as to the relationship of these unusual forms to the other Pycnogonida. It would be natural to expect that they would form a rather closely related and perhaps primitive group—possibly a distinct family—by themselves; but such does not appear to be the case. As has been stated, the only important feature in which *Pentanympyon* differs from *Nymphon* is in the possession of the extra pair of appendages. *Decolopoda*, on the other hand, resembles more closely in general appearance the genus *Chatonympyon* of G. O. Sars; but the possession of 10-jointed palpi throws it out of the family Nymphonidæ entirely if we accept the family as limited by Sars (1891, p. 54), though it might be included in the broader definitions given by Meinert (1899, p. 33) and Hoek (1881, p. 17). It still differs, however, from the other known forms in the family by the possession of so many (ten) palpal joints, and would seem to come intermediate between the Nymphonidæ and the Eurycydidæ (*Ascorhynchidæ*), leaving out of consideration for the present the extra pair of legs. There are two ways in which these forms might be related to the other Pycnogonids:—(1) The extra pair of appendages may indicate that they are more primitive and that this is an indication of their origin from a form which possessed a still larger number of segments, thus forming, perhaps, a connexion with the Crustacea; or (2) it may be a character which represents a later differentiation, though this latter does not to me seem at all probable. In this connexion the speculation of Eights in the paper mentioned above (1837, p. 205) is of interest. He says:—"I have placed this interesting animal in the class ARACHNIDES, in consequence of its close approximation to

Latreille's second family *Pycnogonides**, of his order TRACH-
EARÆ; it possesses all of the characters, besides which it
has a segment supporting two additional legs, making in all
five perfect pairs; this latter circumstance would doubtless
bring it in the preceding class CRUSTACEA, being a cha-
racter which strikingly distinguishes the animals that compose
it; at all events, I think it will certainly form a connecting-
link in the great chain of the animal kingdom, between these
two classes, passing from the CRUSTACEA into the
ARACHNIDES by the genera NYMPHON, PHOXICHLI,
PYCNOGONUM, &c."

That the Pycnogonids form a remarkably homogeneous
group has often been mentioned, and with the discovery of
new forms the existing gaps are rapidly being filled. It is
the existence of gaps in our series that enables us to designate
species, genera, families, and other taxonomic groups, and as
these gaps become gradually filled the demarcation of the
groups becomes increasingly difficult. It leads at first either
to putting narrower limits upon our various terms and
splitting one genus into a number of genera, one species into
a number of species, &c., or the formation of new subgroups
as new subgenera, subspecies, &c. Both of these processes
have been going on extensively in nearly all branches of the
animal kingdom; but as the series becomes more and more
complete it becomes more and more difficult to draw lines of
distinction—in other words, to find gaps; and as any gap
becomes filled our subspecies, species, or genus, or whatever
it is, must expand to include all those forms to the next
existing break in the series, or else an arbitrary artificial
demarcation must be made. In the Pycnogonida the series
of characters upon which the present classification depends
is so nearly complete—the differences are so small—that the
limitations, especially of the larger groups, such as the
families, are admittedly arbitrary, and it is a matter upon
which hardly two authors agree. But whereas this profusion
of "connecting-links" is a source of much confusion to the
taxonomist, it should enable us to trace very definitely the
phylogenetic development. Whether this can be done on
the basis of the characters at present in use we cannot
say until a more careful examination has been made of
the anatomical details of other organs, and probably not
until the early embryonic and larval development of more
of the species is better known, though I believe a thorough

* • Cuvier, Règne Animal."

PXCNOGONIDA.	Chelifori	Palpi	Oviger.	Denticulato spines	Trunk-segmentation	Genital openings.	
						♂.	♀.
Order ПУСНОГОНОРИА, ПУСОК [ACHILATA, Sars]. Pycnogonidae. Ploxiellidae.	— —	— —	♂ only. ♂ only.	— —	well marked. well marked.	4 2, 3, 4	4 1, 2, 3, 4
[ПЕЧЕНКАТА, Sars]. Ploxiellidae. <i>Hannonia</i> . Pallemitia. Nymphonidae.	well developed. well developed. well developed. well developed.	— — — or rudimentary. well developed; ♂ joints.	♂ only. ♂ and ♀. ♂ and ♀. ♂ and ♀.	— — present. present.	well marked. well marked. well marked. well marked.	1, 2, 3, 4 3, 4 (1, 2), 3, 4 2, 3, 4	1, 2, 3, 4 1, 2, 3, 4 1, 2, 3, 4 1, 2, 3, 4
Order СОЛОСЕНУКОГОРИА, ПОГ. [СЫРТОСМЕЛАТА, Sars]. Pasilothidae (including <i>Colossendeis</i>). Amuothidae.	— usually present, but not chelate, in adult.	well developed; 10 joints. well developed; 4-5 joints. well developed; 10 joints.	♂ and ♀. ♂ and ♀. ♂ and ♀.	— present. present.	— — or well marked. well marked.	3, 4 3, 4 3, 4	3, 4 1, 2, 3, 4 1, 2, 3, 4
<i>Discoplepoda</i> .	well developed.	well developed; 10 joints.	♂ and ♀ (?).	present.	well marked.	?	?

* Loman (1904, p. 33f).

knowledge of the embryology is going to be of more importance in elucidating the question of the relationship of the Pycnogonida to the other Arthropoda.

In the following discussion I have used the families as adopted by Sars (1891), not because I consider them necessarily more true to a correct system than those given by some other authors, but because they are better adapted to my present purpose. I shall use them simply as milestones to mark certain points, or, perhaps better, stretches along the road of phylogenetic development, without intending to imply that these stretches might not consistently be fewer or greater in number, and with their limits at different points.

The systems given by most recent authors differ from that which I have temporarily adopted here for the most part only in the employment of different names, derived from other genera, or in being more or less inclusive. The number of families given by Sars (1891, p. 144) is larger than is generally recognized, and consequently his classification is more useful to me in showing the gradual stages of differentiation; and where, in one or two instances, this series has not been complete enough for my purpose, I have introduced generic names for greater completeness. In most cases the names of the families are derived from well-known genera; where another genus in the family is perhaps better known I have indicated the fact. I have retained the order of sequence as given by Sars, except for the transposition of the Pasithoidæ to a position next the Ammothoidæ instead of the Eurycydidæ, as they appear to be more nearly related to the former.

The character on which the families are chiefly based is the presence or absence or the state of development attained by the first three pairs of appendages—cheliferi, palpi, and ovigera. In general those forms which possess these appendages well developed are to be considered the more primitive, a fact shown by the ontogenetic development of those which do not possess them in the fully adult stage. The condition of these appendages (together with the presence or absence of denticulate spines on the ovigera, the degree of trunk-segmentation, and the number and position of the genital openings) is given for the various families in the table on p. 408.

It will be noticed from the table that there are two diverging series, each starting from a primitive condition, fairly well represented, seemingly, by *Decolopoda*. *Decolopoda* might well be the basis for a distinct family, the Decolopodidæ, if it were not for difficulties encountered in

disposing of *Pentanympyon*, which will be taken up again. These relationships are expressed more graphically in the following diagram:—

PYCNOGONOMORPHA.

Pycnogonidæ.

Phoxichilidæ.

Phoxichilidiidæ.

Hannonia.

Pallenidæ.

Nymphonidæ.

Pentanympyon.**COLOSSENDEOMORPHA.**

Pasithoidæ.

Ammotheidæ.

Eurycydidæ.

Decapoda.

In the table I have indicated the division of the families into orders as arranged by Sars. Lankester (1904) makes practically the same grouping, but employs different names. I can see no valid reason for a division into Achelata and Euchelata (or into Pycnogonomorpha and Nymphonomorpha, as given by Lankester), a distinction based on the absence of a single pair of organs (the chelifori) in the former group, since the palpi are absent or rudimentary in the Pallenidæ, and in the Phoxichilidiidæ the ovigera are present only in the male. A reference to the table will show that there is no place in this series where a line can be drawn based on a number of characters—in fact, not more than a single one of the characters given changes at any given point in the series. It therefore seems best to make but two orders, representing the two divergent series. These can well be designated by

names derived from their most specialized forms; for one I have therefore used the name *Pycnogonomorpha*, Pocock, given by Lankester (1924, p. 225), while for the sake of consistency I have proposed the term *Colossendecomorpha* for the other order.

In *Decolopoda*, of all known Pycnogonids, we have the most primitive conditions. Here the chelifori are well developed and strongly chelate, the palpi are present and made up of ten joints, the ovigera are present in both sexes* and are provided with denticulate spines, and the trunk-segmentation is distinct. In the *Pycnogonomorpha* we find that there is a gradual tendency to a reduction of the anterior appendages: the chelifori are lost in the *Phoxichilidæ*; in the palpi the joints are reduced one half in number at the beginning, and are lost entirely in some of the *Pallenidæ*; the females no longer bear ovigera in the *Phoxichilidiidæ*, and in *Hannonia* the denticulate spines are lacking from these appendages; the segmentation remains distinct and well marked throughout. In the *Colossendecomorpha* the chelifori have rather rudimentary chelæ in the *Eurycydidæ*, are present (usually) but not chelate in adult *Ammotheidæ*, and are lost entirely in the *Pasithoidæ*; the palpi remain well developed throughout, but are reduced as to the number of joints composing them in the *Ammotheidæ*, in which character they make a slight break in the gradation of the series †; the ovigera are retained in both sexes throughout, though the denticulate spines are lost in the *Pasithoidæ*; the trunk-segmentation shows a direct gradation from a well-marked condition in the *Eurycydidæ* to a complete coalition in the *Pasithoidæ*, both conditions being found in the intermediate family.

The most remarkable features in these two series are the directness of the two lines of differentiation and the similar tendency in both to a reduction of the parts. Each of the families is intermediate, in the characters commonly used for their distinction, between the one that precedes and the one that follows (with the minor exception in the case of the *Ammotheidæ*, as noted). This approaches the kind of "chain" that was looked for by some of the early evolu-

* "Of the many specimens that I obtained I saw none but such as were furnished with what are termed the egg-bearing organs, consequently if those are the females that are thus distinguished, they prove much more numerous than the males."—EIGHTS (1837, p. 205). It is probable that he had both sexes.

† This is indicated in the diagram by representing the *Ammotheidæ* as having branched off slightly from the direct line.

tionists, and I know of no other group where it is so direct and complete. The genera within the families will undoubtedly show much secondary branching from this direct line of descent.

While it is difficult to understand why so many characters should vary in common if such were the case, still it is possible that the utilization of these characters does not give us a true classification. This is suggested by the positions of the genital openings, as shown in the above table, as well as by the structure of the ovaries and possibly some of the other organs. The condition of the ovary in *Nymphon* has led Hock (1881, p. 131) to remark:—"I perfectly believe, however, that the occurrence of a part of the ovary in the body of a Pycnogonid is rather rare, because, as a rule, only the lateral excrescences remain. No doubt this must be considered as a secondary condition; and seeing that, so far as I could ascertain, it is the rule in all the species of *Nymphon*, my original opinion, that the genus *Nymphon*, of all the genera of Pycnogonida, resembled most the hypothetical ancestors of our group, was severely shaken."

The system here brought out differs in many respects from that of Hock (1881, p. 195), but it is interesting to note how closely the form *Decolopoda* agrees with his hypothetical genus *Archipycnogonum*, which he postulates as follows (*l. c.* p. 491):—"Archipycnogonum (genre hypothétique).—Pycnogonides de grandes dimensions, aux mandibules fortes de trois articles et armées d'une pince terminale, aux palpes longues de dix articles, aux pattes ovifères, également de dix articles, dont les quatre derniers sont pourvus de plusieurs rangées d'épines en forme de feuilles. Les pattes thoracique ont huit articles et se terminent par une griffe accompagnée de deux griffes accessoires." Light's description of *Decolopoda* agrees in all particulars with this except that he does not mention the "accessory claws," which, however, it is fair to assume were present. Hodgson mentions and figures them in *Pentanymphon*. Had Hock but been aware of it there was no need for him to construct a hypothetical genus as the starting-point of the Pycnogonids—it had already been described just as he wanted it (except that it had one more pair of legs than he supposed) more than forty years earlier.

Pentanymphon I have placed between *Decolopoda* and the Nymphonidae; but *Boreonymphon* and *Chaetonymphon*, with their compact bodies and closely approximated lateral processes, would much more nearly resemble *Decolopoda* in general appearance if they had but the fifth pair of legs. It would be expected that such a character as the possession

of an extra segment bearing a pair of legs would be more than sufficient for the establishment of a separate family in a group where family distinctions are based upon such minor characters as the extent of development or suppression of certain appendages, with no question of the loss of a segment; but *Pentanympyon* apparently resembles *Nymphon* so closely in all its minor details, even to the presence of a claw, denticulate on one border, terminating the oviger, that it is incomprehensible that these characters could have been developed independently. Except for the extra legs *Pentanympyon* is in all respects a true *Nymphon*, and this, did we not know of another ten legged form, would lead us to suppose that it represented the primitive stem of the Pycnogonida. Must we, then, conclude that the group has had two points of origin?

Hodgson (1904, p. 462) states that he understands Mr. W. S. Bruce, of the Scottish Antarctic Expedition, has taken several specimens of a ten-legged Pycnogonid from the Weddell Sea which may prove to be identical with *Pentanympyon antarcticum*. But since the Weddell Sea is on the opposite side of the Antarctic continent to McMurdo Bay, and not far from the South Shetland Islands, it would not be surprising if Mr. Bruce's specimens turned out to be identical with *Decalopoda australis* *. Should they prove to be *Decalopoda* rediscovered, a careful study of them may add much of importance to our knowledge of the Pycnogonida. It is noteworthy that the two species of ten-legged Pycnogonids so far described both come from the Antarctic, though from opposite sides of the Polar area †.

The bearing of this extra appendiculate segment on the ancestry of the Pycnogonida and their relationship to the other Arthropods I shall not discuss at this time, except to call attention to the fact that it adds further difficulties to

* [Mr. C. V. Hodgson has kindly sent us the following note on this point:—Mr. W. S. Bruce's collection of Pycnogonida from the South Orkneys includes a single specimen of *Pentanympyon antarcticum* and several specimens of Eight's *Decalopoda australis*. This latter has been fully described in a paper communicated to the Royal Physical Society of Edinburgh on Jan. 23, 1905. With regard to the genital apertures, they exist in both sexes of *Decalopoda australis* on the second coxa of all the legs. In *Pentanympyon antarcticum* they are very difficult to observe, and at present I can only vouch for the female. They occur on all the segments also.—Eds.]

† South Shetland Islands, about lat. 63° S., long. 60° W.; McMurdo Bay, approximately lat. 78° S., long. 163° E. (From map showing work of National Antarctic Expedition, 'Geographical Journal,' vol. xxiv. no. 2, August 1904.)

the acceptance of the homologies of the metameres and appendages of the Pycnogonida as suggested by Lankester (1904), who believes that the whole portion of these animals anterior to the so-called abdomen corresponds to the prosoma of the Arachnids. The segment which bears the fourth pair of walking-legs he thinks represents the pregenital somite, and it is true that wherever else the genital openings may be wanting, they appear always to be present on this pair of legs. Neither Eights nor Hodgson mentions the genital openings in the ten-legged forms, and a knowledge of conditions there will be of considerable theoretical interest. It may be mentioned here that Lankester appears to have overlooked the two pairs of appendages present in the embryos of all Pycnogonids (possibly absent in *Pallene* and related species: Meinert, 1899), which are not represented in the appendages of any adult species. Lankester considers the Pycnogonida a subclass of the Arachnida, and Meinert, chiefly from his studies of the embryology, also relates them to that group, but differs entirely from Lankester in his conception of the homologies of the various appendages. Carpenter (1903) likewise classes them with the Arachnida and agrees more nearly with Lankester as to the homologies of the metameres; he believes, however, that the palps of the Pycnogonids are not represented by appendages in living Arachnids, and concludes that the present type of Arachnid head "was preceded by a head with four pairs" of appendages. More recently Meisenheimer (1902) has made a careful study of the early embryonic stages of *Ammonothea echinata*, and has reached conclusions exactly opposed to those of Meinert. In a short paper giving his main results Meisenheimer (1902A), after presenting his evidence, concludes (p. 64):—"Und somit hat uns die Larvenentwicklung der Pantopoden mit grosser Bestimmtheit auf eine nahe Verwandtschaft dieser Gruppe mit den Crustaceen hingeführt." It is thus obvious that naturalists are no nearer to agreeing to-day upon the systematic position of the Pycnogonida than they have been at any time in the past.

Cambridge, Mass., U.S.A.,
12th January, 1905.

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 LV.—*Descriptions of new Species of Sphlegidæ and Ceropalidæ from the Khasia Hills, Assam.* By P. CAMERON.

[Continued from p. 229.]

Ceropalidæ.

Ceropales pruinosa, sp. n.

Black, the scape of the antennæ broadly below, palpi, a narrow interrupted line on the pronotum, the apical half of