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THE GENERIC COMPOSITION OF THE CYLINDROIULINI WITH REFERENCE TO BRITISH SPECIES

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INTRODUCTION

The tribe Cylindroiulini, according to Hoffman (1979:110), consists of 8 genera, 6 of which contain only one (or possibly two) species (5 of these are not found in Britain). One genus Allajulus contains a large number of species (over 100) which have been divided into 15 subgenera. Several of the subgenera have been used as generic names, one in particular, Cylindroiulus is used extensively and has several representatives in Britain. According to Hoffman (1979) Allajulus should be used in place of Cylindroiulus which is the junior name (for example in punctatus and latestriatus etc.).

The genus Allajulus can be split into two clear groups. One of the more obvious features separating the two groups is the presence or absence of metazonite setae (i.e., hairs on the body). The species having metazonite setae show some similarities with the genus Enantiulus which is also in the Cylindroiulini and contains nine species at present, including armatus found in Britain.

The revision undertaken was to examine the genera in the Cylindroiulini and try to clarify the relationships between them. The results given here relate principally to the genera Allajulus and Enantiulus as they have representatives in Britain. The results concerning the remaining genera, Styrioiulus, Solaenoiulus, Micromastigoiulus, Dendroiulus and Olisteroiulus can be found in the original publication (Read 1990). The final genus of Hoffman's Cylindroiulini, Tachypodoiulus, will be dealt with here in a later paragraph.

Analysis of the groups was undertaken using cladistic principles. In order to do this, each species of millipede was observed and scored for many different characters. It is necessary, as far as possible, to determine for each character used which is the primitive state and which is the derived or advanced state.

Characters used in the Analysis

Some characters were based on external observation, and others after dissection of the male gonopods and female vulvae. A scanning electron microscope was used in addition to a binocular light microscope.

External Features

The Cylindroiulini appear very similar externally, thus it is difficult to find useful characters. Some of those used are given below:

Metazonite setae - As already mentioned, the presence or absence of setae on the body is important. It is generally thought that primitive millipedes are setose whereas those with less setae are more advanced.

Pre-anal Ring - The shape of the pre-anal ring of the telson is a reliable and widely used character for separating the British julid species. The shape is extremely variable however and there does not seem to be much pattern to the variation so it is not easy to use phylogenetically.

Sub-anal Scale - Most species have a fairly small sub-anal scale, in a few e.g., E.armatus it is strongly projecting. Like the pre-anal ring, this character is difficult to interpret.

Number of Ocelli - The theoretical total complement of ocelli is the result of additions of complete rows at each moult. In many cases, fewer than a complete row are added. On occasions this can lead to a very strong reduction in the number of ocelli (as in C.salicivorus, found recently from Edinburgh) or complete lack of numbers (e.g., C.vulnerarius); this is probably a derived situation. Degree of reduction in number of ocelli (i.e., reduction from maximum number) was recorded.

Cheek Plate - The males of some julids have an expanded cheek plate when mature (see Blower 1985, Fig. 12b). Others have a normal shaped cheek like the females. A normal cheek plate is probably the primitive situation.

General Similarity - General size and colouring can link some species together. Although somewhat subjective this can help as a supportive character in some instances.

Gonopod Characters

A generalised Cylindroiulini gonopod is shown in Figure 1. The gonopod consists of 3 main parts.

1. Promerite which seems to vary relatively little.
2. Mesomerite, which forms a pair of pincers with the promerite used to grasp the female vulvae in mating (Haacker & Fuchs 1970), and which may be single or forked.
3. Opisthomerite which contains the solenomerite. Sperm are passed into the female vulvae from a canal in the solenomerite. The opisthomerite may bear numerous flanges and hooks e.g., a brachite - which projects anteriorly and is usually a hook shaped structure with or without small spines; a phylacum - a thin plate extending posteriorly from the opisthomerite; a membrane - found at the base of the opisthomerite (see figure of C.nitidus in Blower 1985, Fig. 46c) seen most clearly with scanning electron microscope.

Some species have a long flagellum stemming from the promerite which helps in sperm transfer, others have a shortened flagellum or lack it completely.

Posterior to the opisthomerite there is sometimes another structure which is the paracoxal projection; this may continue laterally to a ridge running parallel to the gonopod but separated from the main bulk by a 'valley'; this is known as the paracoxal rim and is only found in a few tribes of julids.

THE TWO PRINCIPAL GENERA AS THEY STAND AT THE MOMENT

Allajulus

Enghoff (1982) defined Cylindroiulus (=Allajulus) as Julidae lacking frontal setae (2 setae on the head missing in all Cylindroiulini), with gonopods bearing a flagellum and with a deep incision between the opisthomerite and a free mesomerite (i.e., opisthomerite and mesomerite not joined as seen in Unciger Blower 1985, Fig. 59d). Other characters may vary within the genus e.g., metazonite setae may be present or absent, the mesomerite may be single or forked.

Enantiulus

This genus is characterised by the presence of metozonite setae and the absence of a flagellum in the gonopods. The genus has been divided into two groups according to whether the mesomerite was forked or single (Verhoeff 1908). Subsequently one of the single mesomerite species (pelindnus) was removed to a separate genus (Styrioiulus).

THE RESULT OF THE CLADISTIC ANALYSIS

The genus Allajulus in the sense of Hoffman (1979) has been split into three parts. The name Allajulus being retained for species with metazonite setae and with a forked mesomerite. The name Cylindroiulus is now applied to the rest which have no metazonite setae and a single mesomerite. One species (occultus) does not fit into either group and has very different gonopods so a new genus (Kryphioiulus) has been erected for it. The genus Enantiulus remains for most of the species originally in that genus. A few other smaller changes are made.

THE CLADOGRAM (numbers refer to those in Figure 2)

Figure 2 shows a much simplified version of the final analysis. The cladogram should represent the best possible outcome i.e., the lowest number of branches and the fewest reversals of character states (these being when characters revert to a more primitive state). Each split is ideally a bifurcation and each branch should be marked by a character which applies to all those taxa above it but not to those below it. This character should be apomorphic i.e., one which is a derived or advanced situation.

Two characters unite this group of millipedes, that of a free mesomerite (1) and the absence of frontal setae (2). The Schizophyllini are considered a separate tribe from the rest, as the genera have rather more complex gonopods, ozopores opening posterior to the suture and an enlarged leaf like accessory claw on the legs of young stadia (3). The three remaining lineages represent the Cylindroiulini.

The two genera Cylindroiulus and Styrioiulus are characterised by the loss of metazonite setae (4) (Cylindroiulus here refers to the non setose species of Hoffman's (1979) Allajulus).

Styrioiulus is distinguished by the loss of the flagellum in the gonopods (5). The species in the last major branch of the tetrachotomy are united by the development of a forked mesomerite (6). Subsequent loss of flagellum (5) and presence of a spinose brachite (7) designate the genus Enantiulus. The genus Allajulus is distinguished by the development of a membrane on the opisthomerite (8) and by a smooth brachite. The final lineage is for occultus

which does not show apomorphies for either of the other lines and is here designated a separate genus.

Figure 2 is not a perfect cladogram; some of the problems are indicated below.

First, the base of the phylogeny is a tetrachotomy which it is not possible to resolve at present. Secondly, the genus Cylindroiulus has no apomorphy i.e., no character by which it is separated from the ancestor of both the genera Styrioiulus and Cylindroiulus. In fact it is possible that these two genera should be combined, the only difference being the loss of flagellum in Styrioiulus. Many Cylindroiulus species show distinct shortening of the flagellum. (Recent studies of the Cylindroiulus from the USSR have revealed an individual of a new species in which the flagellum is very short and double on one gonopod and lacking on the other). Thirdly, there are some reversals of character states. One species of Enantiulus and one species of Allajulus have only single mesomerites where the others are forked, but these species in all other respects conform to their respective species. Fourthly, one species of Enantiulus (armatus) has a membrane on the gonopods like the species of Allajulus. armatus clearly belongs to Enantiulus and the membrane is not the only feature characterising Allajulus.

Despite these shortcomings the final analysis is a great improvement on the previous classification and links Enantiulus and Allajulus as being more closely related to each other than to Cylindroiulus. The genera are now defined as such:

Allajulus C.L. Koch, 1847

Fairly small, often unpigmented species. Ocelli muddled and often reduced in number. Metazonite setae present. Pre-anal projection present, either horizontal or upturned. Mesomerite forked (except for spinus (Ribaut, 1904)). Opisthomerite with a large membrane and usually a smooth brachite. Gonopods with flagellum. Male cheek sometimes expanded. British species; nitidus (Verhoeff, 1891).

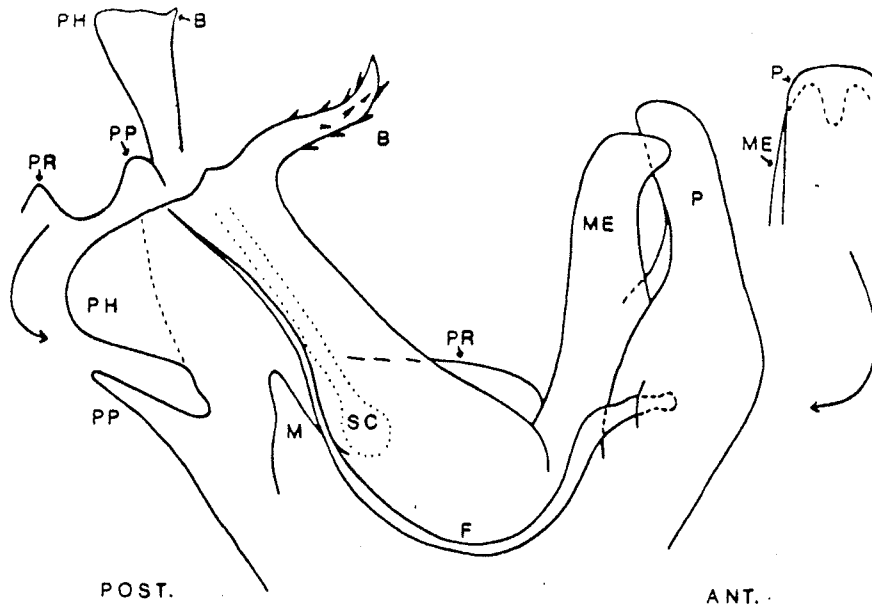
Enantiulus Attems, 1894 (= Leptophyllum Verhoeff, 1895)

Pale species often with reduced and jumbled eyes. Metazonites with setae. Gonopods without flagellum, with forked mesomerite (except for transsilvanicum Verhoeff, 1899) and brachite with spines. Projection on telson pointing downwards. British species; armatus (Ribaut, 1909).

Cylindroiulus Verhoeff, 1894

Variable in size and colour, often larger than Allajulus and with some pigmentation. Variable number of ocelli often in clear rows (may be absent). Pre-anal projection variable, not always present. Metazonites without setae, gonopods with flagellum (which may be reduced). Mesomerite simple. Male cheek plate expanded. British species; londinensis (Leach, 1815), caeruleocinctus (Wood, 1864), vulnerarius (Berlese, 1888), punctatus (Leach, 1815), latertriatus (Curtis, 1945), britannicus (Verhoeff, 1891), parisiorum (Brolemann & Verhoeff, 1896), truncorum (Silvestri, 1896) and salicivorus (Verheoff, 1907).

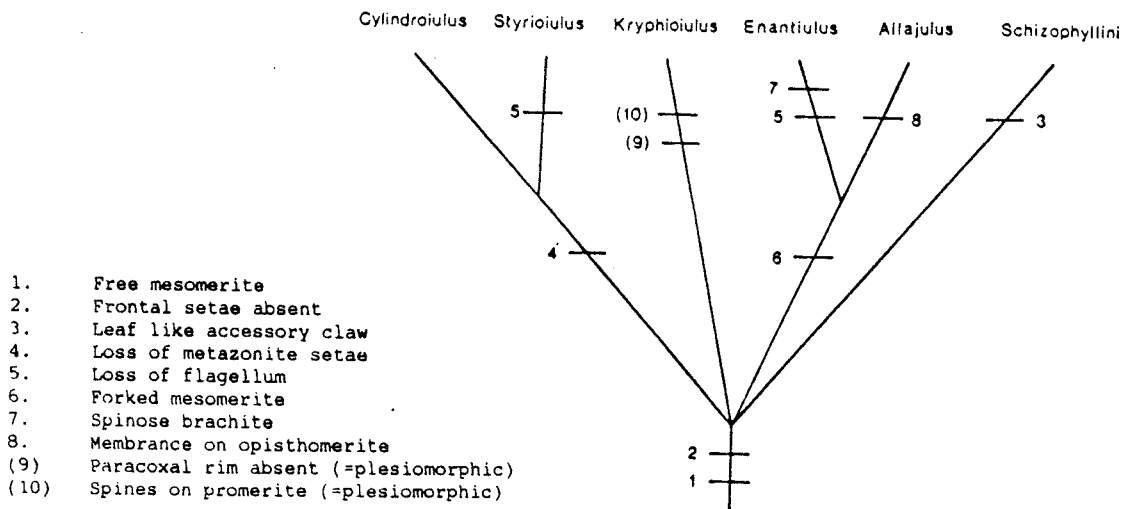
This genus is a large and variable one (containing over 100 species), further studies may indicate that further splitting is necessary.



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|-------|--------------|----|---------------------|
| Ant. | - anterior | M | - membrane |
| Post. | - posterior | PH | - phylacum |
| P | - promerite | B | - brachite |
| ME | - mesomerite | PP | - paracoxal process |
| F | - flagellum | PR | - paracoxal rim |

FIGURE 1

A generalised Cylindroiulini gonopod seen in mesal view and in anterior and posterior views. The gonopod is one of a pair, the other is joined to this one in the foreground of the figure, thus is the 'inside' view.



1. Free mesomerite
2. Frontal setae absent
3. Leaf like accessory claw
4. Loss of metazonite setae
5. Loss of flagellum
6. Forked mesomerite
7. Spinose brachite
8. Membrane on opisthomerite
- (9) Paracoxal rim absent (=plesiomorphic)
- (10) Spines on promerite (=plesiomorphic)

FIGURE 2

Cladogram showing the positions of the taxa. Numbers refer to apomorphic characters.

FINAL POINTS

The classification of Hoffman (1979) places Tachypodoiulus (with one species, niger) as a genus of the Cylindroiulini. It is now replaced in the Schizophyllini (where it was situated prior to 1979), together with Ommatoiulus and Rossiulus, as it shows the characters mentioned above, including the enlarged accessory claw.

Various other changes are given in the original paper which do not concern the British species. A discussion is also given of the position of the cylindroiulini within the Julidae.

As in Britain it has become customary to refer to the genus Allajulus as Cylindroiulus, the only major nomenclature change for British workers to note is that the species Cylindroiulus nitidus now becomes Allajulus nitidus.

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