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Morpho-systematic studies on *Collembola*.
II. Postembryonic development of the chaetotaxy
in *Entomobryoides myrmecophila* (REUTER, 1886)
(*Entomobryidae*)

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Badania morfologiczno-systematyczne nad *Collembola*
II. Postembrionalny rozwój chetotaksji u *Entomobryoides myrmecophila*
(REUTER, 1886) (*Entomobryidae*)

Морфолого-систематические исследования над *Collembola*
II. Постэмбриональное развитие хетотаксии
у *Entomobryoides myrmecophila* (REUTER, 1886)
(*Entomobryidae*)

Abstract. The postembryonic development of the chaetotaxy of the body and head as well as of the labial base in *Entomobryoides myrmecophila* (REUTER) is described.

INTRODUCTION

In the modern taxonomy of the *Collembola* the chaetotaxy of the body has been playing an increasingly important part. It has been examined in detail in the *Poduromorpha* s.l., for which the exact homology and uniform denomination of setae have already been established. This is not the case, however, in so far as the *Entomobryomorpha* are concerned. In the family *Iso-tomidae* chaetotaxy is of minor taxonomic significance as yet and has hitherto excited only little attention of investigators. Contrariwise, chaetotaxy is a character generally used in the taxonomy of the *Entomobryidae* s.l., but the di-

versity of chaetoms in particular genera and even species does not allow the reduction of these arrangements of setae to a common pattern. Some attempts in this line have only recently been made using closely related genera, *Pseudosinella* SCHÄFFER, 1897 and *Lepidocyrtus* BOURLET, 1839 (GISIN, 1966, 1967; SNIDER, 1967).

The establishment of the pattern of chaetotaxy is important not only for the sake of the uniform denomination of setae, which would simplify taxonomic descriptions exceedingly, but also for the knowledge of the phylogenesis of the group and its natural systematics. Researches carried out for many years on the ontogenesis of chaetotaxy gave excellent results in acarology (cf. KNÜLLE, 1957 and numerous papers by GRANDJEAN quoted there), whereas YOSHI (1961) tried to adopt comparative studies on chaetotaxy in phylogentic considerations concerning springtails.

In order to establish this common pattern of chaetotaxy it seems necessary to investigate its postembryonic development at least in the members of the chosen genera, for it is the only way in which the primary microchaetae, probably homologous with those in other genera and species, can be singled out from the uniform mass of microchaetae covering the whole body of adult specimens. However, both the older studies on the postembryonic development of the *Collembola* (bibliography given by AGRELL, 1948) and a large number of the newer ones (AGRELL, 1948; LINDEMANN, 1950; UCHIDA and CHIBA, 1958, 1959; UCHIDA and HONGO, 1962) deal with some biological aspects of development, e. g., the number of moults, the duration of particular instars, etc., and with some biometrical problems and those of the development of the chosen morphological characters, e. g., the shape of the claw, empodial appendage and postantennal organ, but leave out the development of chaetotaxy. Some data concerning the chaetotaxy of young instars of several members of the *Onychiuridae* and *Isotomidae* can be found in the paper by YOSHI (1961) and that by HALLE (1965); in this last case the data refer merely to a few taxonomically important fragments of the dorsum in the genus *Onychiurus* GERVAIS, 1841. Only the study by THIBAUD (1967) contains a detailed description of the postembryonic development of chaetotaxy in some members of the *Hypogastruridae*.

The present paper is concerned with the ontogenesis of the chaetotaxy of the dorsum, head, and labial base in *Entomobryoides myrmecophila* (REUTER). I wish to express my hearty thanks to Dr J. WIŚNIEWSKI of the Department of Forestry, Academy of Agriculture in Poznań, for the donation of material for the present study.

MATERIAL AND DEVELOPMENTAL STAGES

The material used this for work was collected during the studies on the fauna of anthills of *Formica polyctena* FÖRSTER, 1850 at Zielonka, Poznań District.

As my investigation did not include laboratory breeding, I failed to establish

the number of moults preceding the imago. Nevertheless, I distinguished 8 developmental stages of chaetotaxy (Figs. 1—2), marked with the Roman numerals, I—VIII, from the youngest to the oldest. It may well be that these stages do not coincide with the number of moults exactly. Great variation in size within some of the stages suggests that there may occur several successive moults without a change in chaetotaxy. The last stage (VIII) appears not only in completely ripe specimens but also in those somewhat younger in which the development of the genital area and the chaetotaxy of the labial base has not yet been completed thoroughly; the final form of the dorsal chaetotaxy is therefore attained before the attainment of sexual maturity.

DEVELOPMENT OF ELEMENTS OF CHAETOTAXY

The four main elements that can be distinguished in the chaetotaxy of the body of *E. myrmecophila* (REUTER) are the basic chaetotaxy, the macrochaetae, the trichobotria (= lasiotrichia) and the smooth microchaetae.

The basic chaetotaxy is composed of numerous small microchaetae which cover the body more or less uniformly. They are all nearly the same length, somewhat longer in the posterior and lateral parts of the tergites (Fig. 4).

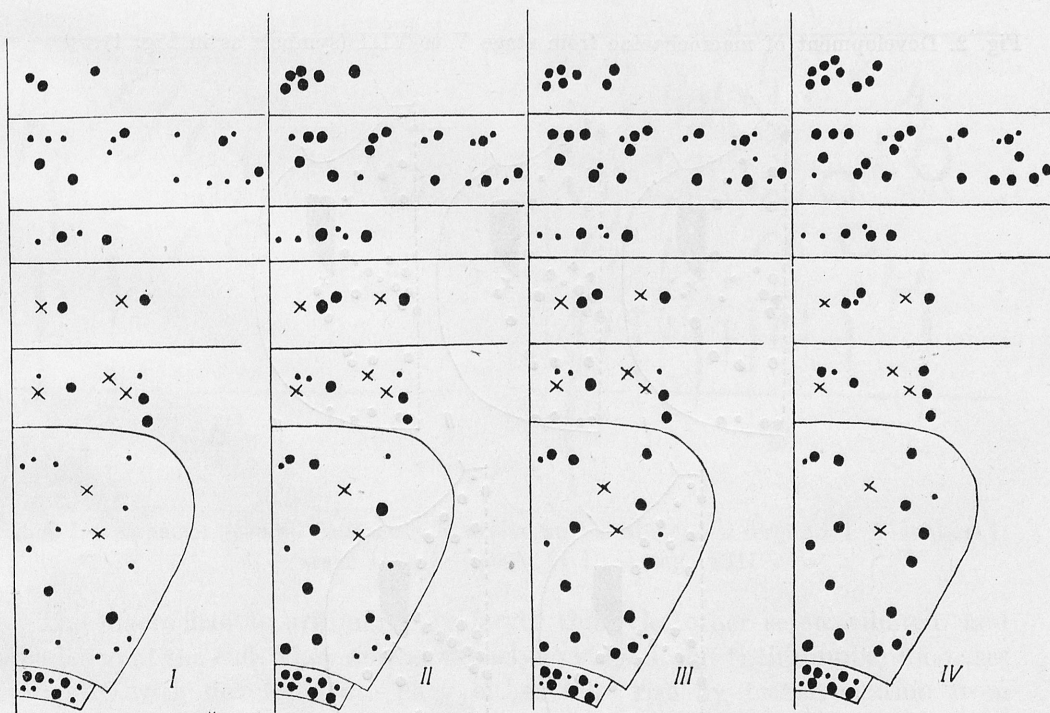


Fig. 1. Development of macrochaetae from stage I to IV (large dots — macrochaetae, small dots — microchaetae, x — trichobotria)

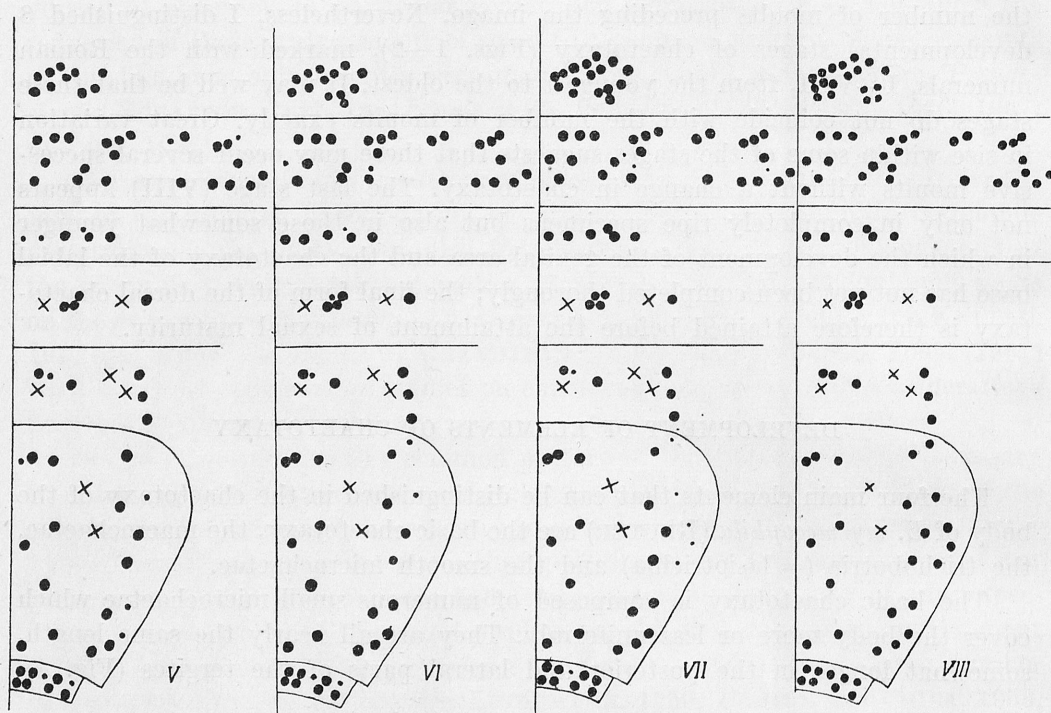


Fig. 2. Development of macrochaetae from stage V to VIII (symbols as in Fig. 1)

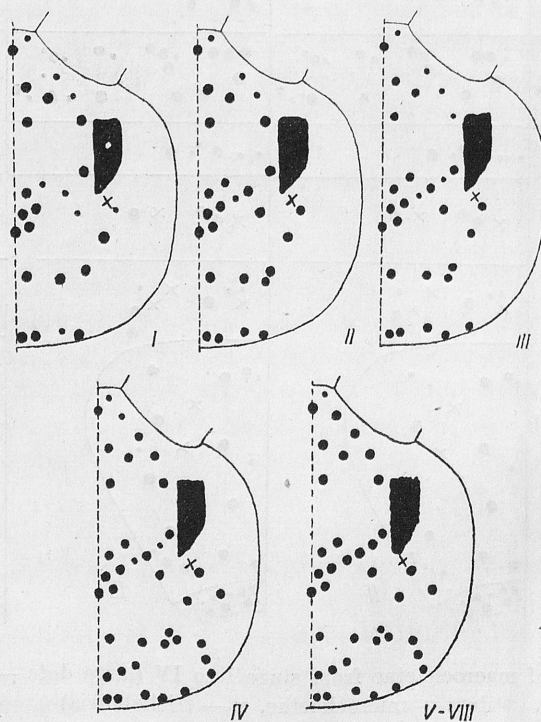


Fig. 3. Development of macrochaetae on the head (symbols as in Fig. 1)

Ontogenetically, the basic chaetotaxy is a young structure. At the first (youngest) stage only a small number of its microchaetae are visible (Fig. 4A); this number increases by degrees in the next stages till the body becomes completely covered in the imago (Fig. 4D).

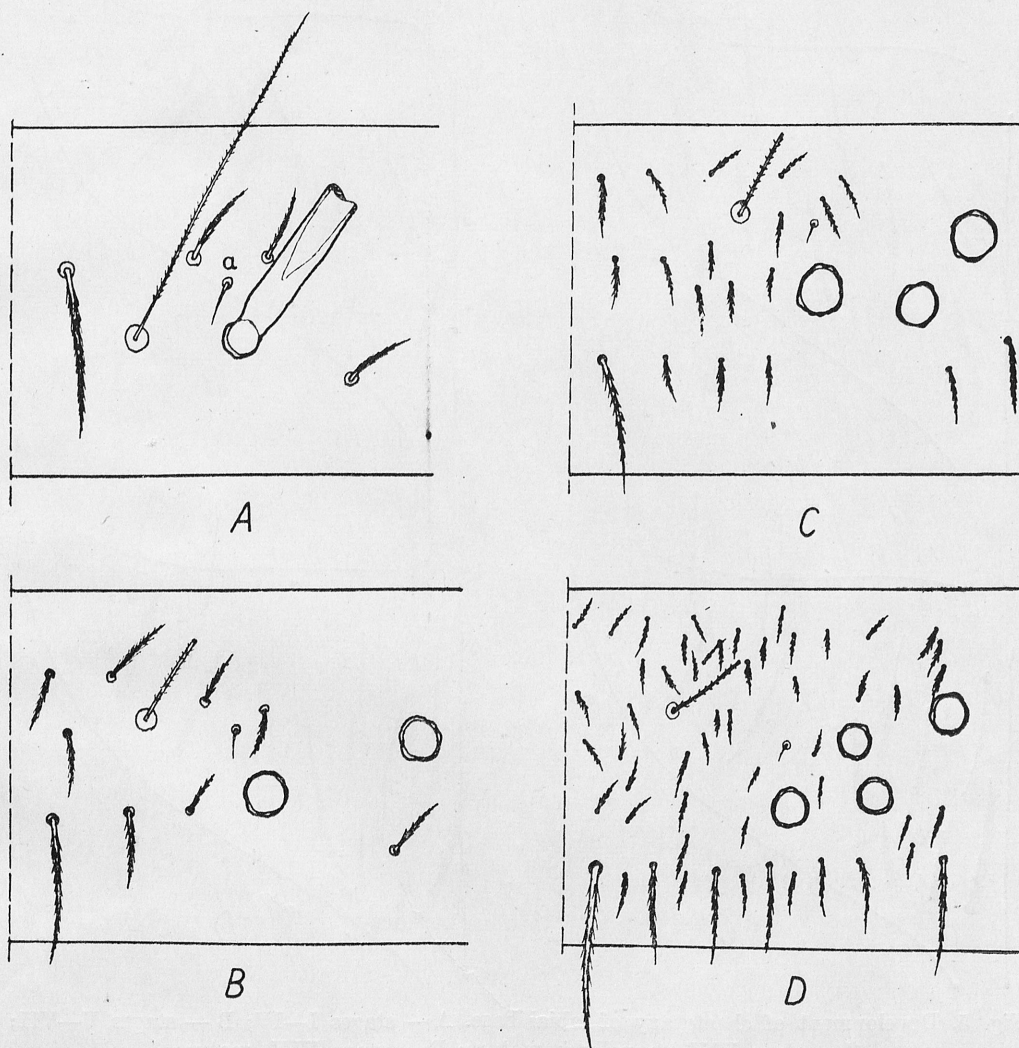


Fig. 4. Development of basic chaetotaxy in medial part of abdominal tergite III. A — stage I; B — stage III; C — stage V; D — stage VIII

The macrochaetae are markedly larger than the other setae, ciliated, and broadened at the end. They appear as early as stage I, but their number increases gradually with development. They either take rise by transformation from the microchaetae existing at stage I or coming to be at one of the succeeding stages, or develop as entirely new structures. This last type of formation of macrochaetae can be observed, above all, in the posterior part of the haed

and on the mesothorax. Figures 1—3 show the chronology of appearance of the macrochaetae. The drawings present only the microchaetae which are just transforming into macrochaetae, otherwise they are left out.

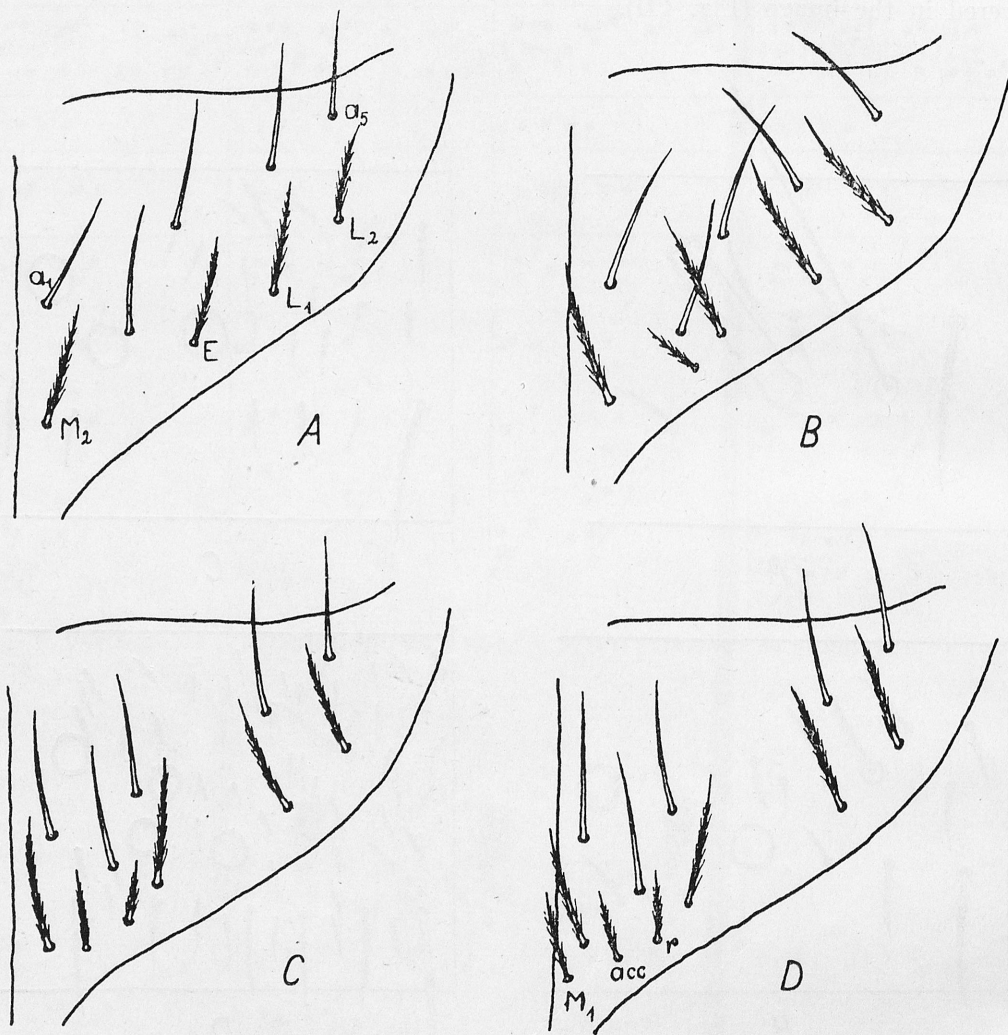


Fig. 5. Development of chaetotaxy of labial base. A — stages I—IV; B — stages V—VII; C — stage VIII, sexually immature; D — stage VIII, mature

The trichobotria of the species under discussion resemble those in many other members of the *Entomobryidae*. They are present on the head and on abdominal tergites II—IV. On either side of the head there is 1 trichobotrium, situated behind the eye (postocellar trichobotrium), on abdominal tergite II one trichobotrium is situated submedially and one sublaterally, on abdominal tergite III one submedially and two sublaterally, and on abdominal tergite IV 2 trichobotria are positioned sublaterally. This pattern is subject to no changes during the ontogenesis. As it recurs (with the exception of the postocellar tri-

chobotria) in many other members of the *Entomobryidae*, this characteristic seems to be phylogenetically old. The postocellar trichobotria occur in the *Entomobryidae* very rarely; so far they have been found only in *Pseudosinella gamae* GISIN, 1967 by GISIN (1967).

The smooth microchaetae (Fig. 4) are markedly smaller than the setae which make up the basic chaetotaxy. They are smooth, have fairly broad bases, and occur in small numbers on the tergites from thoracic segment III to abdominal segment III (Fig. 6A). Their number and arrangement do not change during ontogenesis. They may correspond with the setae described as „p“ and „q“ on abdominal segment II in *Pseudosinella* SCHÄFFER and *Lepidocyrtus* BOURLET (GISIN, 1966, 1967). The small number and regular distribution of the smooth microchaetae suggest that they play a peculiar part; perhaps they are sensillae.

DEVELOPMENT OF CHAETOTAXY OF LABIAL BASE

The chaetotaxy of the labial base consists of a small number of setae disposed in two rows. They are very likely homologous with the setae observed by GISIN (1965) in the genus *Lepidocyrtus* BOURLET. Nine setae (Fig. 5A) occur here in the initial stages (I—IV), namely, those designated a_1 — a_5 of the anterior row and the setae M_2 , E , L_1 and L_2 of the posterior row. The first row undergoes hardly any changes during ontogenesis, in the posterior row a small seta appears next to the a_2 at stage V (Fig. 5B); it is probably homologous with the seta r . Another small seta, designated as accessory (*acc.* — Fig. 5C), arises between the M_2 and r in sexually immature specimens whose chaetotaxy of body is however completely developed. It cannot be homologized with any seta occurring in the species of the genus *Lepidocyrtus* BOURLET. Finally, a third smaller seta, situated medially to M_2 and homologous with M_1 (Fig. 5D), appears additionally in sexually mature specimens.

DISCUSSION

As I have already mentioned at the beginning, there are no data on the ontogenesis of chaetotaxy in the *Entomobryomorpha* in literature, and for this reason I must limit myself to only very general remarks for the present.

In the course of ontogenesis the chaetotaxy of *E. myrmecophila* (REUTER) undergoes extensive changes, which consist in the progressive development of the basic chaetotaxy, the transformation of microchaetae into macrochaetae, and the appearance of new macrochaetae. No regressive changes are observed during ontogenesis. In the *Hypogastruridae*, described by THIBAUD (1967), the changes during ontogenesis are slight and confined only to a small increase

in the number of setae, there being no differentiation of the setae themselves. This confirms the generally admitted opinion on the primitive nature of chaetotaxy in the *Hypogastruridae*.

So far, little can be said about the phylogenetically primitive characters at the early stages of chaetotaxy in the species under study. Some traces of the arrangement of setae in two transverse rows on the tergites from thoracic segment III to abdominal segment III at stage I, particularly distinct in the lateral parts of the tergites (Fig. 6A), could be counted among these characters

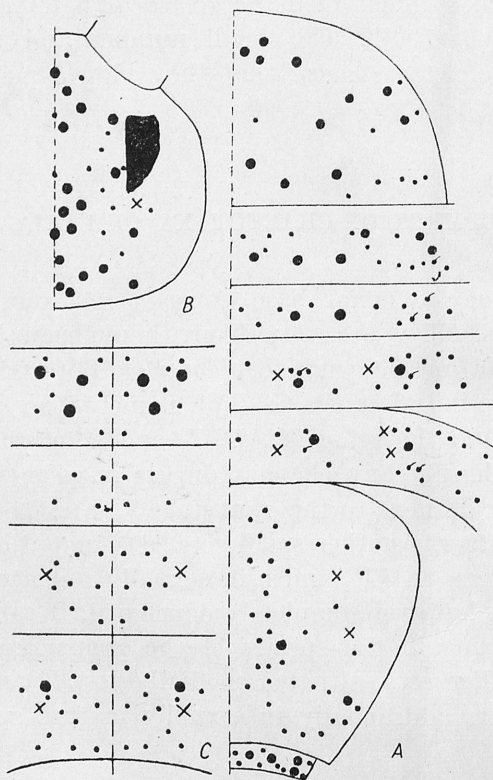


Fig. 6. Details of chaetotaxy at early stages. A — chaetotaxy of body, stage I; B — chaetotaxy of head, stage I; C — chaetotaxy of medial portion of tergites from thoracic segment III to abdominal segment III, stage III (symbols as in Fig. 1., small dots with coma — smooth microchaetae).

and they resemble the patterns of this type met with in most of the members of the *Poduromorpha*. These species also seem to have some characters common with the *Poduromorpha* in so far as the chaetotaxy of the thorax and head is concerned (Fig. 6B). However, there are as many as 4 medial setae on the head in them, whereas the *Poduromorpha* have at most two such setae. In stages II—IV a set of 3 microchaetae is situated in the medial parts of the tergites from thoracic segment III to abdominal segment III, parallel to the long axis

of body (Fig. 6C) and resembling such patterns in the *Onychiuridae* and some members of the *Isotomidae* (YOSII, 1961, figs. 14—16).

For lack of comparative data it is impossible to draw any conclusions on the phylogenesis of chaetotaxy in the *Entomobryidae*. None-the-less I hope that further researches on the development of this character in other genera will allow a more detailed analysis in the future.

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Autor opisuje rozwój postembrionalny chetotaksji grzbietu, głowy i podstawy labium u *Entomobryoides myrmecophila* (REUTER, 1886) oraz podkreśla konieczność badań tego typu dla studiów nad filogenezą *Collembola*.

РЕЗЮМЕ

Автор описывает постэмбриональное развитие хетотаксии спины, головы и основания нижней губы у *Entomobryoides myrmecophila* (REUTER, 1886) а также подчёркивает необходимость этого рода исследований для изучения филогенеза *Collembola*.

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