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Synopses on Palaearctic Collembola

CAPBRYINAE & ENTOMOBRYINI

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With 813 figures

Contents

* With affection to Ken Christiansen and Wolfram Dunger.

1. Introduction

This volume of the 'Synopses on Palaearctic Collembola' is a review of the subfamily Capbryinae and the tribe Entomobryini belonging to the family Entomobryidae. We have studied up to 13.000 specimens belonging to 270 species out of 11 genera. They have been described and drawn, taking into account older sources as well as the recent literature. Geographically, arctic species are included as well as species from the Chinese-Japanese region, the Himalaya and North Africa.

The specimens examined come from many national museums, universities and scientific institutions around the world and from some private collections.

For the study and description of each species, we have tried to use the types. For about 40% of all cases this was not possible due to lack of response from the institutions where the types are stored, sometimes the types have been lost or they are in poor condition. In these situations, we have tried to obtain material from sites close to the type locality or recent descriptions of the same species. In some occasions we had to recuperate dried specimens with a methodology described below. The types of older material were often very difficult to examine; frequently it was necessary to remount them, but this was not always possible, although some museums have given the permission to do so.

For many species of the family Entomobryidae, frequently erroneous citations have been published over the years. This was because the species identification was based on the colour pattern, but there is a great range of variation in some widespread species, and many other species are known only from the type locality.

For these reasons the information given on distribution, biology and ecology must be taken with some reservation, except for those species that are well-known and widely distributed.

This book is not intended as a collection of papers or extensive descriptions about each of the species. I rather tried to provide an original work with the full description of the chaetotaxy of the species (if possible), extending the enormous work done by SZEPTYCKI (1979) on the chaetotaxy of some species to all species studied in this book. However, I attempted to simplify the character pattern he proposed, and have taken into account only some of the segments and areas on the tergites that Szeptycki had introduced.

During my study of the specimens, several new species were discovered. These have been described and published in scientific journals over the years. These papers were prepared in cooperation with different researchers. E. Baquero, disciple and friend, has always been one of the main authors. From papers published together I have taken some figures that I can use as one of the authors involved. Throughout the years in which this book has taken shape, E. Baquero has been a consultant required to comment or confirm my observations, however I am responsible and author of all the figures in this book if no other information is given.

The review ends with species published by the end of 2011.

Abbreviations of anatomical terms

A, B, C, D, E, F, G, H = corneolae of the ocular field (Fig. 2)

Abdominal mac (= macrochaetal) areas:

A1–A2 = dorsal mac areas on Abd II (Figs 1, 4)

A3–A5 = dorsal mac areas on Abd III (Figs 1, 4)

A6–A10 = dorsal mac areas on Abd IV (Figs 1, 5)

A6'–A10' = lateral mac areas on Abd IV (Fig. 1)

Abd I–VI = abdominal segments I–VI

Ant I–IV = segments I–IV of the antenna

as = dorsal microchaeta

asl = above sea level

Emp = Empodium

H = dorsal mac areas on head (Figs 1, 2):

H1 = mac area of chaetae An

H2 = mac area of chaetae A

H3 = mac area of chaeta S'_0

H4 = mac area of chaetae S_1, S_3, S_4

H4' =mac area of chaetae S_{4i}–S_{5i}

H5 = mac area of chaetae $P_{s1–5}$

Head chaetotaxy:

An = antennal row

A = anterior row

M = medio-ocellar row

S = sutural row

Ps = post-sutural row

Pa, Pm, Pp, Pe = posterior region rows

Labial chaetotaxy: M, m, R, r, E, e, L2, l1, L2, l2 (uppercase means ciliated mac and lowercase means smooth mac (Figs 206, 354B)

Man = manubrium

mac = macrochaeta/ae

mes = mesochaeta/ae

mic = microchaeta/ae

mm = millimetre

µm = micrometre

Omma = ommatidium/ia, ocellus, single eye

PAO = postantennal organ

psp = pseudopore/a

s = sensillum/a

T = dorsal mac areas on Th II:

T1 and T2: mac areas on Th II (Figs 1, 3)

T_1, T_2, T_4, T_5, T_6: Trichobothria on these locations

Tbt = tibiotarsus

Th II–III = thoracic segments II–III

VT = ventral tube

Signature of insertion points of chaetae:

● = primary chaetae

○ = possible additional chaetae

↰ = microchaetae

↰ = pseudopore/a

* = this notation in Figs of colour pattern indicates that the length of body segments shown here does not represent real life proportions.

Abbreviations of Institutes with Collembolan collections

AE = Arabic Emirates

CMV = Museu Balear de Ciències Naturals, Sóller (Mallorca), Spain

CNUJ = Chonbuk National University, Jeonju, South Korea

DEI = Senckenberg Deutsches Entomologisches Institut, Müncheberg, Germany

HKBL = Hamra-Kroua collection, Constantine, Algeria

HNHM = Hungarian Natural History Museum, Budapest, Hungary

INHS = Illinois Natural History Survey, Champaign, IL, USA

IRSNB (KBIN) Institut Royal des Sciences Naturelles de Belgique, Brussels, Belgium.

ISER = Racovitza Institute of Speleology, Bucharest, Romania

MCZ = Museum of Comparative Zoology, Harvard University, Cambridge, MA, USA

MNCN = Museo Nacional de Ciencias Naturales, Madrid, Spain

MNHN = Muséum national d'Histoire naturelle, Paris, France

MNHU = Museum of Natural History of the Ukrainian Academy of Sciences, Lviv, Ukraine

MPGU = Moscow State Pedagogical University, Russia

MZNA = Museum of Zoology University of Navarra, Pamplona, Spain

NHMG = Natural History Museum of Geneva, Switzerland

NHM = Natural History Museum London, U. K.

NJU = Nanjing University, China

PAN = Institute of Systematics and Evolution of Animals of the Polish Academy of Sciences, Krakow, Poland

SMNG = Senckenberg Museum für Naturkunde Görlitz, Germany

SZMN = Siberian Zoological Museum, Institute of Animal Systematics and Ecology, Novosibirsk, Russia

UUZN = Uppsala University Zoological Museum, Sweden

ZIRAS = Zoological Institute of Russian Academy of Sciences, St. Petersburg, Russia

ZSI = Zoological Survey of India, Kolkata, India

2. Methods

Specimen conservation

One of the problems with specimens of small animals with soft integuments, such as Collembola, is to conserve them in a way that avoids the evaporation of the preservative medium, usually 70% ethanol. There are two procedures:

1. To use a mixture of 70% ethanol with 5% glycerol, this means that in the case of ethanol evaporating the specimens are at least embedded in the remaining glycerol. During curation, the tubes are re-filled with 70% ethanol to the initial level (note that for successful extraction of DNA the use of high percentage ethanol [95–99%] is vital). This procedure has the drawback of making the specimens softer, but offers protection against loss through desiccation.
2. Using doubled glass containers. Specimens are stored in 70% ethanol (70% or 95–99% as needed) along with an identifying label inside. The vial is completely filled and closed with a stopper or cotton plug without leaving air bubbles. This vial is placed in a larger jar alone or together with other vials (usually of the same species, or from the same locality). This bottle is hermetically sealed airtight but not completely filled to avoid problems with changes of pressure. The advantage of this procedure is that the risk of antennae, legs, furcae etc. to break off is minimised, and that loss of ethanol can be seen before damage occurs to specimens.

Recovering dry material

In the case that the specimens received had dried out, we had to perform a slow rehydration process.

1. First we filled the vial with a mixture of water, ethanol, and glycerol (Seinhorst I solution, see below) and kept it at 40 ºC for one week. This step initiated the rehydration process, and the specimens regained their former shape, although they still stuck to the walls of the vial.
2. The second step was to insert the vial into an alcoholic chamber with 100% ethanol; this replaced the water with ethanol over time. Every day the resulting excess of fluid in the vial was removed. When the level of fluid no longer increased, the specimens were floating in a mixture of ethanol and glycerol. Then Seinhorst II solution was added (a mixture of ethanol and glycerol, see below), and the vial incubated in the alcoholic chamber for another 24 hours. This step usually increased the level of liquid, hence the vial subsequently was kept at 40 °C outside the chamber for 6-8 h until all the ethanol had evaporated. At this point the specimens were embedded only in the remaining glycerol, they had regained their former volume and were rehydrated. The next step was to refill the vial with 100% ethanol, getting a mixture of ethanol and glycerol, and to incubate it closed tight at 40 °C for 24 hours. Then as much of the liquid as possible was removed, 100% ethanol was added, and these two steps were repeated 5 times, to ascertain that the specimens now were embedded in pure ethanol. The ethanol then was replaced by 90% ethanol, kept for 24 hours, then replaced by 80% ethanol and, after another 24 hours, by 70% ethanol. At this point the material was in appropriate condition for storage or investigation.

Media

Seinhorst I solution (SEINHORST 1959):
20 ml of 95% ethanol
1 ml of glycerol
79 ml of water

Seinhorst II solution (SEINHORST 1959):
95 ml of 95% ethanol
5 ml of glycerol

Method of specimen mounting for chaetotaxy observation

Larger specimens are generally easier to work with, but some juvenile specimens often have to be included, e.g. when these are the only source of males. Prior to mounting, each specimen should be photographed laterally and dorsally in order to preserve their colour pattern, which is an important character for the determination of many species (Fig. 7). When there is large variation in colouration of the specimens, the entire series should be photographed and one of each colour pattern type should be mounted.

The specimens are manipulated under a stereomicroscope with a flat needle provided with a handle. Before mounting heavily pigmented specimens, Nesbitt's fluid is used for clearing. The specimen is soaked for several minutes in Nesbitt's fluid until it has become clear, then returned to 70% ethanol for one hour, to wash out the HCl from Nesbitt's fluid, which otherwise will continue to dissolve tissues after the specimen is mounted on a slide. Thereafter, a small drop of a gum-chloral mounting medium, e. g. that of Hoyer[1] (see below), is put on a slide and the specimen is positioned in a way that the head is oriented upwards and the body in a dorsolateral position (Fig. 6). This positioning is achieved with a fine needle and with some experience, it will be fixed finally during the lowering of the cover slip onto the specimen. Under optimal conditions, furca and legs then are in proper orientation for observation.

As the very aggressive fluid (Nesbitt) usually causes a certain loss of chaetae, it is advisable to mount another specimen in Hoyer's medium without Nesbitt treatment, which will better retain the chaetae. In any case it is necessary to orient the specimen in the correct position before placing the cover slip.

When dealing with very large specimens, it is recommended to dissect the head and to mount it on another slide, or on the same slide but under a different cover slip, while the remaining body is then oriented in a dorsoventral position for easier observation of chaetotaxy. Usually then one leg and the furca should be removed, too, and mounted separately for better visibility.

Media

Nesbitt's Fluid (KRANTZ 1978):

Chloral hydrate	40.0 g
Concentrated HCl_{aq}	2.5 ml
Distilled water	25.0 ml

[1] Note from the editors: additional recipes of gum-chloral mounting media as well as notes on the necessity to seal the slides are given in UPTON 1993. All mountants based on chloral hydrate bear a high risk eventually to degrade the specimen so should be avoided if indefinite storage is needed, as in a type specimen.

Preparation of Nesbitt's fluid:

Dissolve 40 g of chloral hydrate in 25 ml of distilled water, when completely dissolved 2.5 ml of HCl_{aq} are added.

Hoyer's medium (KRANTZ 1978):

Gum Arabic (not powdered!)	30.0 g
Glycerol	16.0 ml
Chloral hydrate	200.0 g
Distilled water	50.0 ml

Preparation of Hoyer's medium:

1 g of gum Arabic is added to 50 ml of hot distilled water; when completely dissolved, more gum Arabic is added successively and so on until finally 30 grams are dissolved completely. Then, slowly and under permanent stirring, 200 g of chloral hydrate are added, After all components have dissolved, the glycerol is added. Since chloral hydrate is a toxic agent, the whole preparation should be done under a fume hood.

Chaetotaxy

For the description of the Entomobryini in this volume, in addition to morphology and colour pattern, the chaetotaxy of certain segments of the body (head, thorax II, abdomen II–IV) proves to be extremely important (Fig. 1). Each of these body parts has areas with a characteristic chaetotaxy pattern, delineated by imaginary rectangles in Figs 1 to 5. The arrangement of macrochaetae (mac) is given for the dorsal parts of head, Thorax II and Abdomen II, III and IV, respectively. The overall number, presence or absence of mac can be described with a 'simplified formula' of chaetotaxy. Only primary mac (illustrated as full circles in the figures) will be included in this formula. In this simplified formula, the number of macrochaetae for each chaetotaxy area from head's H1 to abdominal A5 is given for one half of each tergite (see Figs 1–5).

Examples are given for the genera *Entomobrya*, *Homidia* and *Coecobrya*.

Entomobrya schoetti: (Figs 3, 4)

3-1-0-3-2/2-4/2-3/1-2-2/0-4(5-6)-3-2-2

3-1-0-3-2	/ 2-4	/ 2-3	/ 1-2-2	/ 0-4(5-6)-3-2-2
H1-H2-H3-H4-H5	/ T1-T2	/ A1-A2	/ A3-A4-A5	/ A6-A7-A8-A9-A10
Head	Th II	Abd II	Abd III	Abd IV dorsal

Homidia similis: (Figs 361, 362, 365)

3-1-0-3-2/4-5/2-4/0-1-1/0-8-0-4-5

3-1-0-3-2	/ 4-5	/ 2-4	/ 0-1-1	/ 0-8-0-4-5
H1-H2-H3-H4-H5	/ T1-T2	/ A1-A2	/ A3-A4-A5	/ A6-A7-A8-A9-A10
Head	Th II	Abd II	Abd III	Abd IV dorsal

Coecobrya akiyoshiana: (see Fig. 50 for dorsal and lateral view of Abd IV)

2-1-0-3-3-1b/2-2/0-1/0-0-1/0-2-0-1-1/0-1-2-0-2

2-1-0-3-3-1b	/ 2-2	/ 0-1	/ 0-0-1	/ 0-2-0-1-1	/ 0-1-2-0-2
H1-H2-H3-H4´-H5	/ T1-T2	/ A1-A2	/ A3-A4-A5	/ A6-A7-A8-A9-A10	/ A6´-A7´-A8´-A9´-A10´
Head	Th II	Abd II	Abd III	Abd IV dorsal	Abd IV lateral

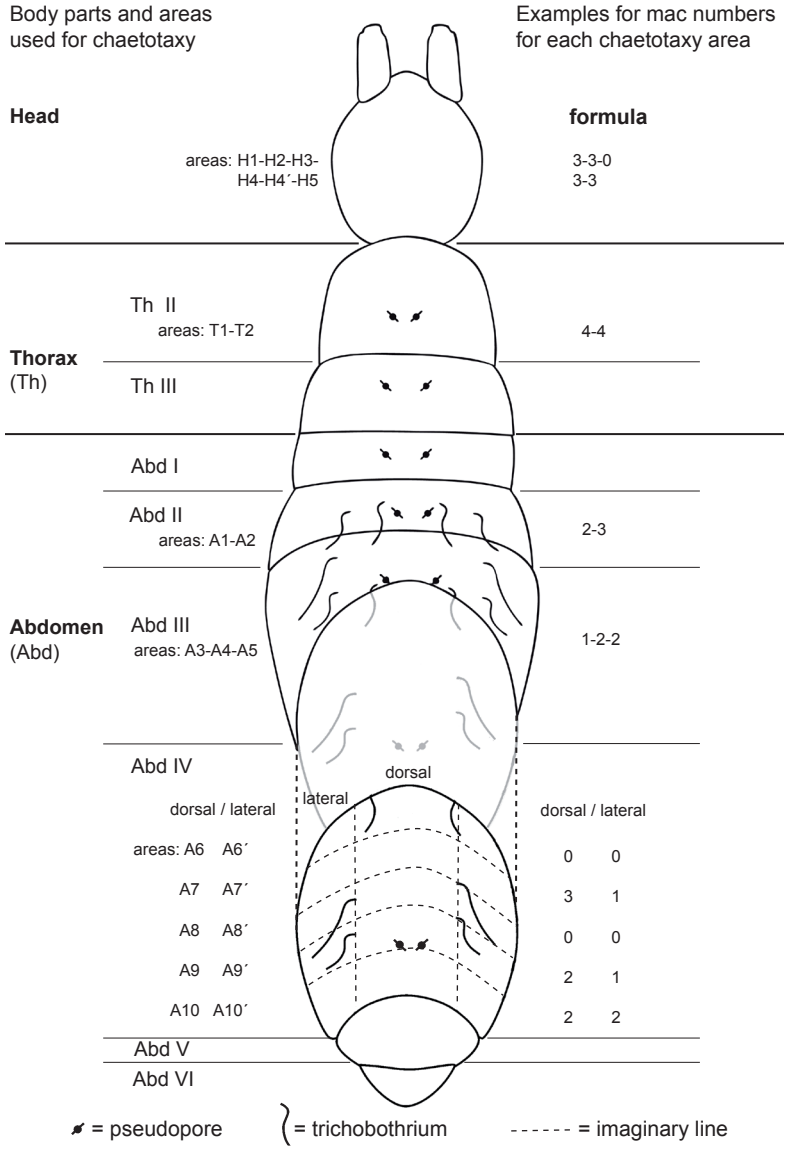


Fig. 1 Schematic dorsal view of a species of Entomobryini, showing the distribution of areas contributing to the simplified formula of chaetotaxy. Abd IV here is visually separated from the anterior part of the body. For details of the position of areas see the following Figs 2 (head), 3 (Th II), 4 (Abd II, III) and 5 (Abd IV). The areas of chaetotaxy used to determine the chaetotactic formula are demarcated by the position of pseudopores and trichobothria (except for the head).

Note that the trichobothria on both sides are differing in their position (left for *Entomobrya*-like species, right for *Coecobrya* and *Sinella*). The areas H4' on the head and A6' to A10' are taken into account only for *Coecobrya* and *Sinella*). The lateral formula (Abd IV right) belongs to *Sinella shobuensis* YOSII, 1956; CHEN & CHRISTIANSEN, 1993.

An ‘m’ following this number indicates that mesochaetae are present (e.g. Fig. 599). The digit 1_0 indicates a chaeta in midline position on the Abd IV being present (for example A_{04} in Fig. 5).

Additionally, the lateral areas H4’ and A1’ to A10’ (Fig. 1) are considered, but used only in the genera *Sinella* and *Coecobrya*.

The investigation is based on more than 13,000 specimens from 400 species. The nomenclature of mac follows SZEPTYCKI (1979) and JORDANA & BAQUERO (2005). In this nomenclature ‘a’ means anterior, ‘m’ medial and ‘p’ posterior position on the tergite. The subscript numbers indicate the chaeta position in ascending order from the midline towards the lateral edges, the subscript characters i = inner and e = exterior, a = anterior, p = posterior, pp = postposterior.

Juveniles have a different chaetotaxy compared to adults, and, frequently, have many mes, which are very difficult to differentiate from macrochaetae. Their body segments are shorter than in adults, especially on Abd IV. As a consequence, juveniles cannot be identified to the species level. For shape of genital apertures see Figs 200 and 201.

Dorsal chaetotaxy of the head (Fig. 2). On the head 5 chaetotaxy areas (H1–5) with mac in transversal rows have been considered (Fig. 2A left side, after JORDANA & BAQUERO 2005). As reference points the ocelli can be used. This nomenclature was derived from the systems proposed by SOTO-ADAMES (pers. comm.) and MARI-MUTT (1979), which are depicted on the right side of Fig 2A, also with five rows of chaetae (An, A, M, S and Ps).

H1 includes usually 3 mac (An_2 to An_3, Fig. 2) but can have up to 6 mac (Fig. 62). Figs 56–63 schematise eight different distribution patterns. The number of mac in area H1 is the first digit of the simplified formula of the head, in the example pictured in Fig. 2 it would read 3. Only the total number of mac is relevant regardless of their position in the area.

H2 usually has 1 mac, but it may have up to 3 mac (A_5 to A_7) as shown in Fig. 2. Three other possible patterns of distribution are schematised in Figs 64–66. The number of mac in area H2 is the second digit of the simplified formula of the head. Sometimes mac A6 and A7 are present as mesochaetae (mes) and then are added to the formula as (+1) or (+2), e. g. in Fig. 634.

H3 indicates the presence or absence of the unpaired mac S'_0, hence 1 or 0 is the third digit of the simplified formula.

In **H4** usually 3 mac are present (S_1, S_3 and S_4) as shown in Fig. 2. Three further distribution patterns are schematised in Figs 67–69. The number of mac is the fourth digit of the head simplified formula.

In **H4’** usually 3 mac are present (S_{4i}, S_5 and S_{5i}) as shown in Figs 2. Three other possible distribution patterns are schematised in Figs 53–55. The number of mac in H4’ corresponds to the fifth digit of the head’s simplified formula of the genera *Coecobrya* and *Sinella*. This also means that these two genera comprise 6 digits instead of 5 in the simplified formula of the head. In the other genera of this book H4’ is not taken into account in the simplified formula.

H5 includes 3 mac (Ps_2, Ps_3 and Ps_5) as in Fig. 2. In Figs 70–73 four different distribution patterns are schematised. The number of mac in this area (H5) is the fifth digit of the simplified formula of the head in the genus *Entomobrya*, or the sixth digit in *Coecobrya* and *Sinella*. An additional ‘a’ behind the mac number (1a) indicates that Ps_5 is the only mac present (Fig. 70), while 1b means that Ps_2 is the only mac present (Fig. 71) (e.g. Figs 589, 604).

Dorsal chaetotaxy of the thorax (Figs 3 and 4). On Th II (Fig. 3), two areas are distinguished (central T1 and lateral T2). The **pseudopore** (psp) and three transversal rows of mac (a anterior, m medial and p posterior) are used as reference points for areas T1 and T2 and chaetae position. These characters are constant for the majority of the species, but some appear to show within-species variation (a state known as plurichaetosis).

As the pseudopores are used as reference points for chaetae position and delineation of areas, their unambiguous identification is crucial. They can be distinguished from similar structures, such as sockets of lost setae, by the following characters: The macrochaetae sockets are more or less triangular or circular in shape, with thick edges; the sockets of trichobothria are smaller, completely circular and often show a double contour: the pit or bothridium. The pseudopores have a circular shape and are at the same level as the cuticle surface: As the psp do not show any embossed structure, they are difficult to detect at a magnification lower than 100x (Fig. 5C).

The area **T1** covers the central group of mac that is located above the psp on both sides of the midline. Here, mac m_1, m_2, m_{2i} and m_{2i2} can be present. In some cases, more mac (up to 8) can be present in T1 (open circles). Figs 74–97 show other possible distribution patterns of these mac on T1. Their number corresponds to the first digit of the thoracic simplified formula (after first slash).

The area **T2** covers the lateral area of the Th II including mac a_5, the m_4 group (m_4, m_{4i}, m_{4p} and m_{4pi}) and m_5. In some cases more mac are located in T2 they are taken into consideration (as Fig. 114). Figs 98–122 show different possible distribution patterns of the mac on T2, which may vary from 0 to 9. Their number corresponds to the second digit of the thoracic simplified formula (after first slash)

Dorsal chaetotaxy of the abdomen. Only some mac on Abd II, III and IV segments are considered (mac contained in the delimited areas A1 to A10 in Figs 4 and 5).

On Abd II (Fig. 4) the chaetotaxy of 2 areas, A1 and A2, is taken into account; both situated between the two trichobothria m_2 and a_5 present on this tergite.

Area **A1** covers the mac a_2 and a_3 nearest to trichobothrium m_2. The mac number can vary from 0 to 2 mac (Figs 123–125). Their number corresponds to the first digit of the simplified formula of Abd II (after second slash).

Area **A2** covers the m_3 mac complex with m_3, m_{3ep}, m_{3e} m_{3ea}, (full circles indicate the most frequent mac), m_{3eai}, m_{3eai2} and m_{3ei} as possible secondary chaetae (open circles) are taken too into consideration for formula compilation. These mac form an arc that begins below the mic as and reaches to the trichobothrium a_5. Usually area A2 has 2 or 3 mac, but their number can vary from 0 to 7. Different patterns of distribution are shown in Figs 123 and 126–135.

On Abd III (Fig. 4) three taxonomic relevant areas A3 to A5 have been defined. They are located between the midline of the segment and the lateral trichobothria a_5 and m_5. Different pattern distributions are shown in Figs 136–153.

Area **A3** contains the mac a_1, located between the midline of Abd III and the psp. This mac can be present or absent, so that the simplified formula number here is 1 or 0.

Area **A4** contains the mac (a_2, a_3 and a_{2a}), located above trichobothrium m_2. Their number varies from 0 to 3, so that the simplified formula number is 0 to 3.

Area **A5** covers the m_3 mac complex (m_3 and $m_{3e,}$ or m_{3a} as in Fig. 194). Usually the number of mac varies between 0 and 3 mac. The number corresponds to the third digit of the simplified formula of Abd III (after third slash). In some species, m_3 can be in m_{3a} location (Fig. 4).

On Abd IV (Figs 1, 5) the species of Entomobryini have always 2+2 trichobothria present on Abd IV (Fig. 1), but in different positions depending on species. This variability in position

– the absence or presence of the trichobothria in the four possible positions (T_1, T_2, T_4 (T_5) or T_6) – provides useful characters for area characterisation (Fig. 277). Additionally, the position of the pseudopore is of eminent importance.

On Abd IV we consider the dorsal areas A6, A7, A8, A9 and A10. These areas are bordered by the midline of the segment and an imaginary line from trichobothrium T_2 to T_4, elongated to the (not always present) trichobothria T_1 and T_7, respectively (Fig. 5A). As a fixed point the pseudopore (psp) has to be located: it is situated below the A5 mac, which is almost always present, and at the level of T_4-T_5 trichobothria. In Fig 5C a microphotograph (100x) is reproduced, in normal phase contrast, showing this area with both A_5 mac and both psp.

Because of the position of psp in the posterior part of Abd IV the characterisation of the areas must start from A9 or A10 resp., going upwards to A6:

In *Entomobrya*-like species, the area **A10** starts below the pseudopore and extends to the end of Abd tergite IV (Figs 1 and 5A). This area encloses usually two mac (A_6, B_6), and the possibly absent mac A_{i2}, A_{e7} and A_{e8} supplementary to mac A_6 and B_6.

Area **A9** is located above the psp and reaches somewhat deeper than an imaginary horizontal line spanning between both trichobothria T_2. This area encloses the mac complex B_5 and A_5 with the secondary mac A_{e5}, A_{e5p}, A_{e5pp} and A_{i1} and may have an unpaired mac (A_{05}) present. Usually 2 or 3 mac can be present there, but the number of mac can vary from 1 to 6. Their number corresponds to the fourth digit in the simplified formula of Abd IV (after the fourth slash). When an unpaired mac is present on Abd IV areas, a 1_0 is added before the corresponding digit (for example see simplified formula of *E. primorica*).

The border between the areas A9 and **A8** is located in the middle between the trichobothria T_4 and T_2. The number of mac in this area can vary from 0 to 5 (C_{2a}, B_4, A_4, A_{4a}, A_{e4}). This number is the third digit in the simplified formula of Abd IV after the fourth slash. When an unpaired mac is present, a 1_0 is added before that digit.

The border between A8 and **A7** can be drawn approximately in the middle between T_1 (if present) and T_2. The area is characterised by a line of chaetae extending towards the middle from T_1, E_1, C_1 and B_3 (if present) to A_3 and A_{2p} (if present). The number of mac in this area varies from 0 to 9 (except in *Homidia*, see there) and corresponds to the second digit in the simplified formula of Abd IV after the fourth slash. When an unpaired mac is present, a 1_0 is added before that digit.

The group of mac in area **A6** (if present) is located in the anterior part of Abd IV between mac A_2 and the anterior intersegmental membrane. Usually this area lacks any chaetae, but in few species 1 to 6 mac or mes are present.

Within the Entomobryini the chaetotaxy pattern of *Homidia*, *Coecobrya* and *Sinella* deviates from that of the other genera. The most important difference is the inclusion of lateral mac areas on Abd IV in the compilation of the simplified formula (see Fig. 1). Also the chaetotaxy of dorsal areas of Abd IV (e.g. Figs 361–365) of these three genera shows some divergence from the generalised schema of the Entomobryini.

Due to a shifting of the position of trichobothria in these genera, their areas 7 and 8 are situated further back. In *Coecobrya* (Figs 49, 50) and *Sinella* (e.g. Figs 483, 484), area A7 reaches up to the level of trichobothria T_2. In *Homidia* area A7 shows a characteristic transversal row of numerous (up to 20) mac (Figs 363–365), and area A8 reaches upwards, beginning at the level of trichobothrium T_4 (Fig. 365). There is usually no (only sometimes 1) mac located in front of trichobothrium T_4.

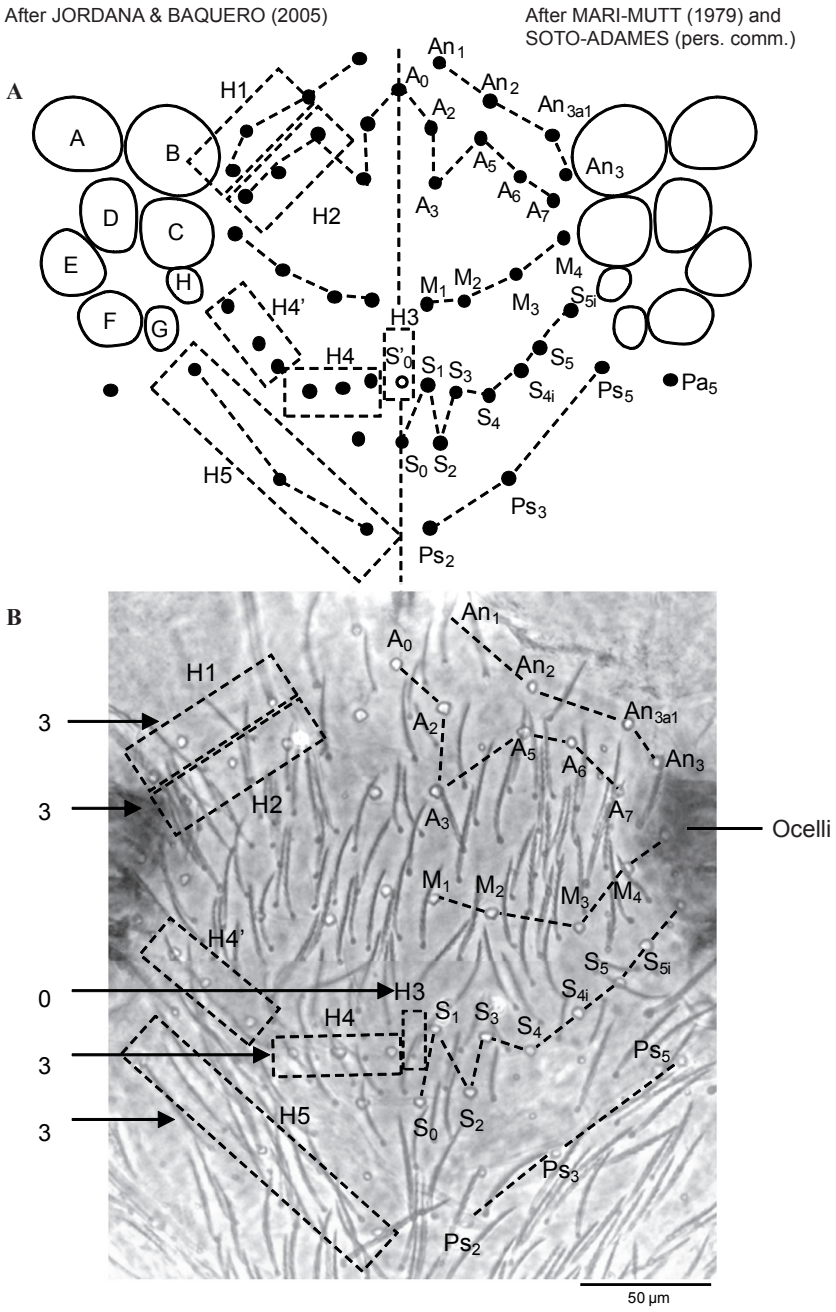


Fig. 2 **A**: Generalised chaetotaxy of the head of *Entomobrya*. **B**: Real view under phase contrast photomicrograph (note that S'_0 on H3 here is absent).
Explanation of abbreviations and signatures are given in the introduction.

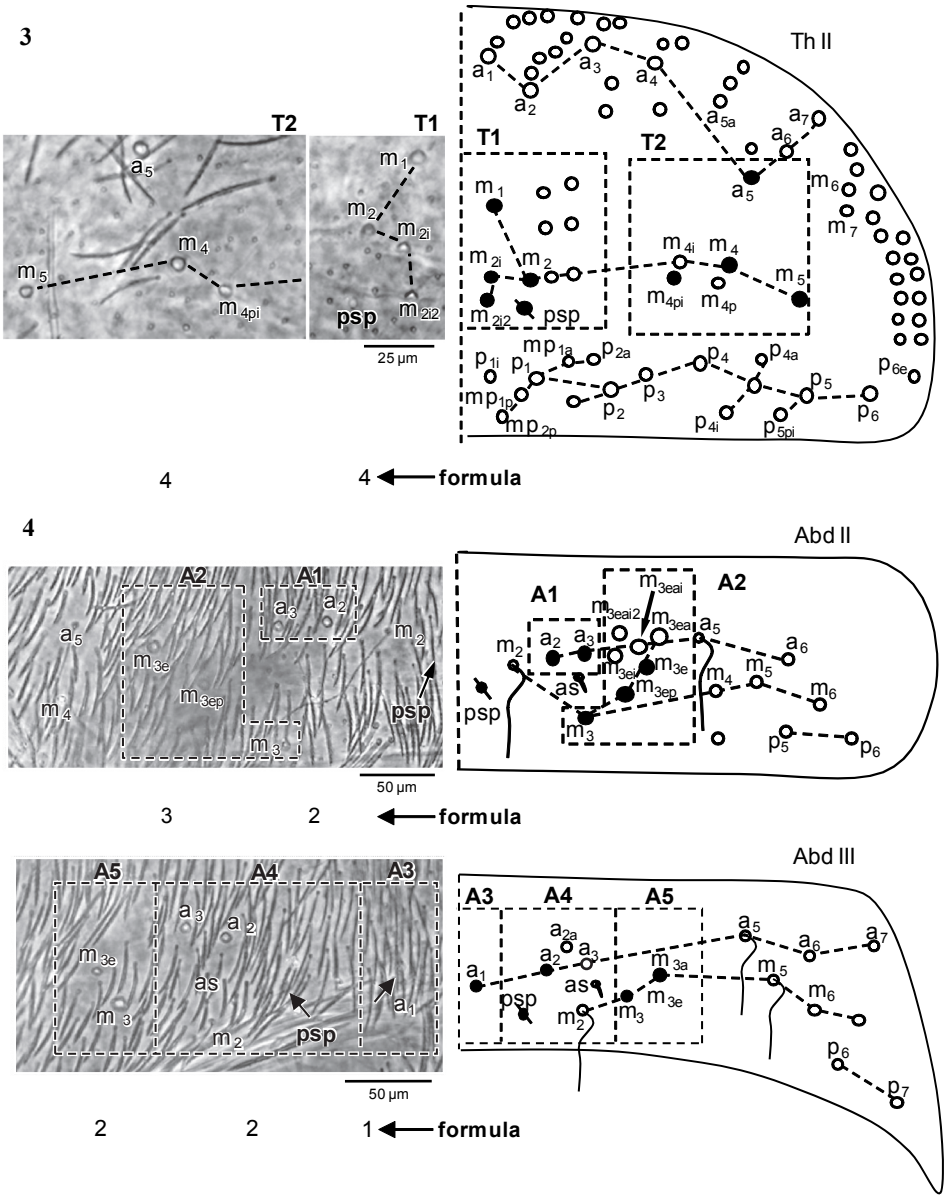


Fig. 3 Left: Chaetal pattern as visible in a phase contrast photomicrograph (40x) of *Entomobrya schoetti*. Right: generalised chaetotaxy of Th II of *Entomobrya*.

Fig. 4 Left: Chaetal pattern as visible in a phase contrast photomicrograph (40x) of *Entomobrya schoetti*. Right: generalised chaetotaxy of Abd II–III of *Entomobrya*.

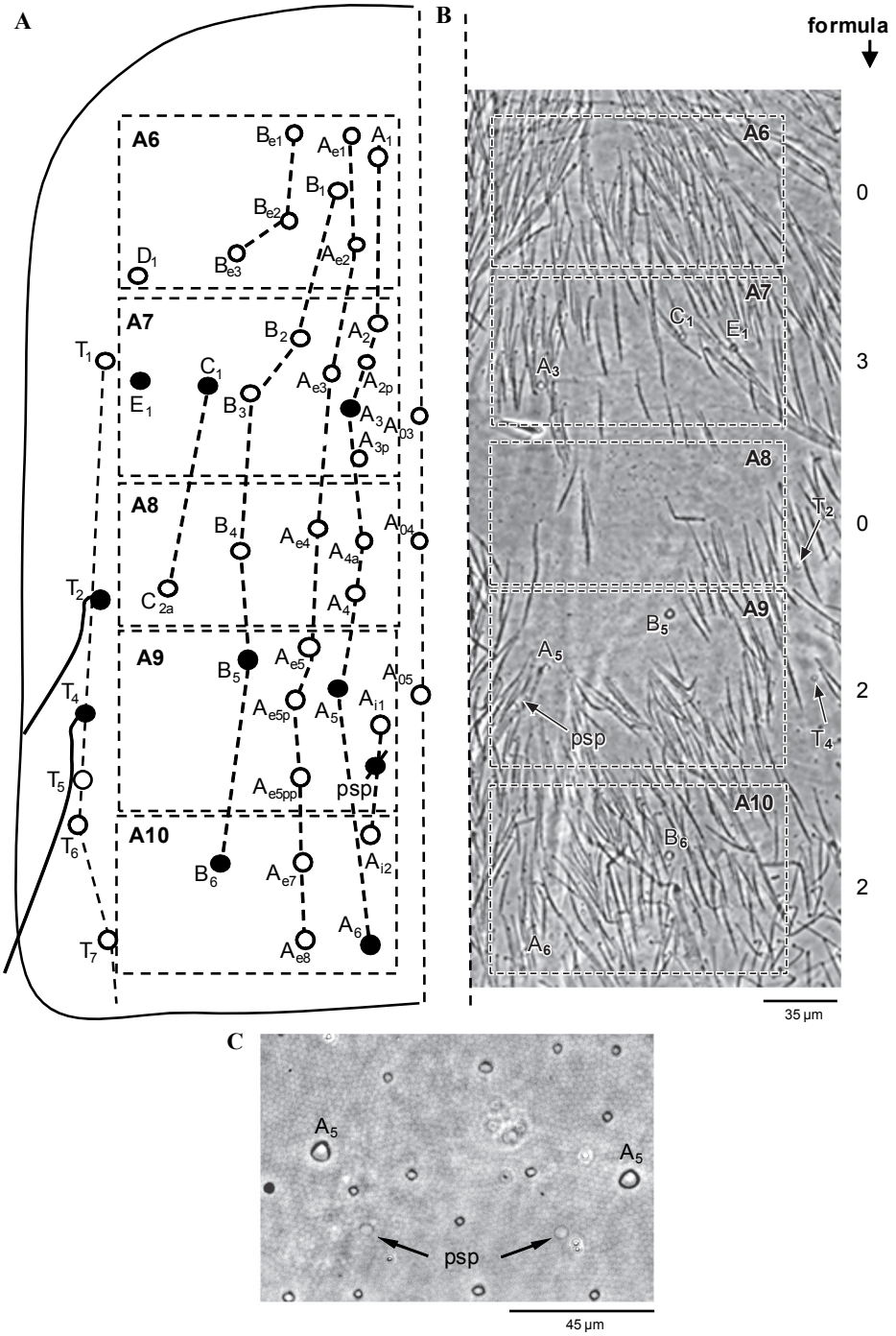


Fig. 5 **A**: Generalised chaetotaxy of Abd IV of a species of Entomobryini. **B**: real view of chaetotaxy on Abd IV of *Entomobrya nivalis* in phase contrast photomicrograph (40x). **C**: A_5 mac and psp on area A9 in phase contrast photomicrograph (100x).

6

7

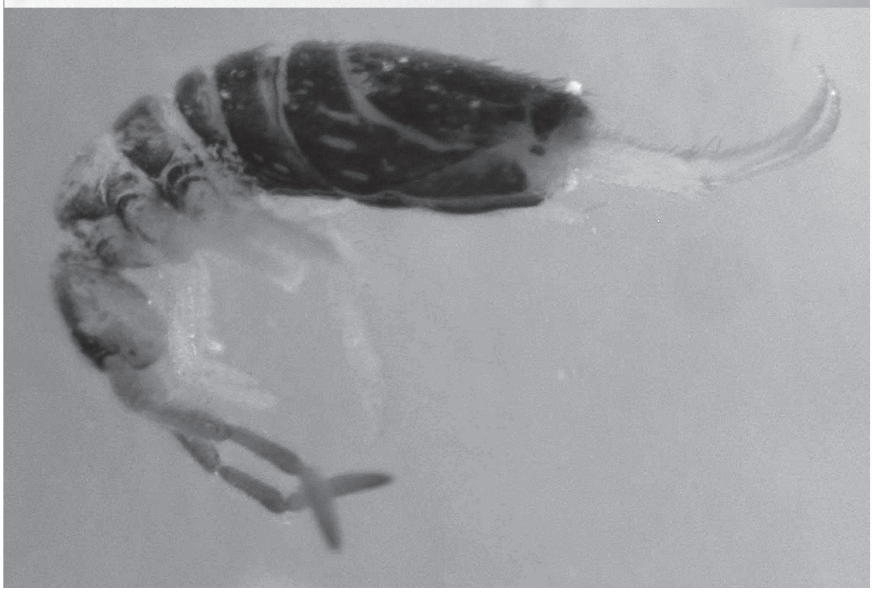


Fig. 6 Microphotograph of *Entomobrya schoetti* cleared with Nesbitt's fluid and mounted in Hoyer's medium to see the chaetotaxy.

Fig. 7 Microphotograph of *Entomobrya schoetti* before clearing.

3. Order Entomobryomorpha Börner, 1913, sensu Soto-Adames et al., 2008

Assuming the conclusions of the paper of SOTO-ADAMES et al. (2008) and accepting BRETFELD's view (1999) (for Symphypleona), the Entomobryomorpha is one of three orders of Collembola: Poduromorpha Börner, 1913, sensu D'Haese, 2002, Entomobryomorpha Börner, 1913, sensu Soto-Adames et al., 2008 and Symphypleona Börner, 1901, sensu Bretfeld, 1999.

General description

The member of the order Entomobryomorpha are characterised by the reduction of the first thoracic segment, i. e the pleurites, sternite and legs remain, but tergite I is reduced and hidden under the tergite of Th II; in contrast to the Poduromorpha, which have Th I well developed. The Entomobryomorpha have in common with Poduromorpha a long linear six-segmented abdomen; however some species of Entomobryomorpha have fewer than six segments due to a fusion of Abd IV–VI or Abd V–VI. This long linear abdomen differentiates them from the Symphypleona with their thoracic and abdominal segments more or less fused together to one or two morphological segments.

The body of Entomobryomorpha is covered with chaetae and, sometimes, scales of different forms. Sensilla are present on the body and antennae.

It is not my intention to discuss the affinities among suprageneric levels in this order. Some recent literature about this subject could be useful to understand its complexity (D'HAESE 2004, COOK et al. 2005, LUAN et al. 2005, XIONG et al. 2008, and SOTO-ADAMES et al. 2008). We must wait for more detailed insights to understand the probable segregation of Tomoceroidea and their affinities to Oncopoduridae. In this systematic description, we will follow SOTO-ADAMES et al. (2008), which classifies the Entomobryomorpha as follows:

Entomobryomorpha

Superfamily	**Family**	**Subfamily**	**Tribe**
Isotomoidea			
	Isotomidae		
	Actaletidae		
Coenaletoidea			
	Coenaletidae		
Tomoceroidea			
	Tomoceridae		
		Tomocerinae	
		Lepidophorellinae	
	Oncopoduridae		
Entomobryoidea			
	Paronellidae		
		Paronellinae	
			Bromachanthini
			Cremastocephalini
			Callyntrurini

Superfamily	Family	Subfamily	Tribe
			Paronellini
			Troglopedetini
		Cyphoderinae	
	Entomobryidae		
		Capbryinae	
		Entomobryinae	
			Entomobryini
			Lepidocyrtini
			Seirini
			Willowsiini
		Orchesellinae	
			Bessionellini
			Corynothricini
			Heteromurini
			Mastigocerini
			Nothobryini
			Orchesellini
	Microfalculidae		
Oncobryoidea			
Praeentomobryoidea			

Key to the superfamilies of Entomobryomorpha

1 Body chaeta usually smooth, unilaterally or multilaterally ciliated (Fig. 8). Mac always acuminate, scales absent **2**

– Most head and body chaetae ciliated, mac sometimes multilaterally ciliated and cylindrical, usually truncate or broadened at the tip (Fig. 9), body with or without scales **4**

2 Abd III–IV fused, body as in Fig. 10 **Coenaletoidea**

– Abd III–IV not fused. Ratio Abd IV/Abd III less than 1.5 or Abd IV–VI fused (Figs 11–12) **Isotomoidea 3**

3 Abd IV–VI distinct (Fig. 11), if fused, then shorter than length of Th II to Abd III (Fig. 12); tibiotarsi with tenent hairs variously shaped but never scale-like **Isotomidae**

– Abd IV–VI fused and longer than Th II to Abd III (Fig. 13), tibiotarsi with tenent hairs scale-like (Fig. 14) **Actaletidae**

4 Abd II/III with 2/3 trichobothria (Fig. 15), with post–ocular trichobothria **Entomobryoidea**

– Abd II/III with 0-1 or 1-2, but never with 2/3 trichobothria, without post-ocular trichobothria **Tomoceroidea**

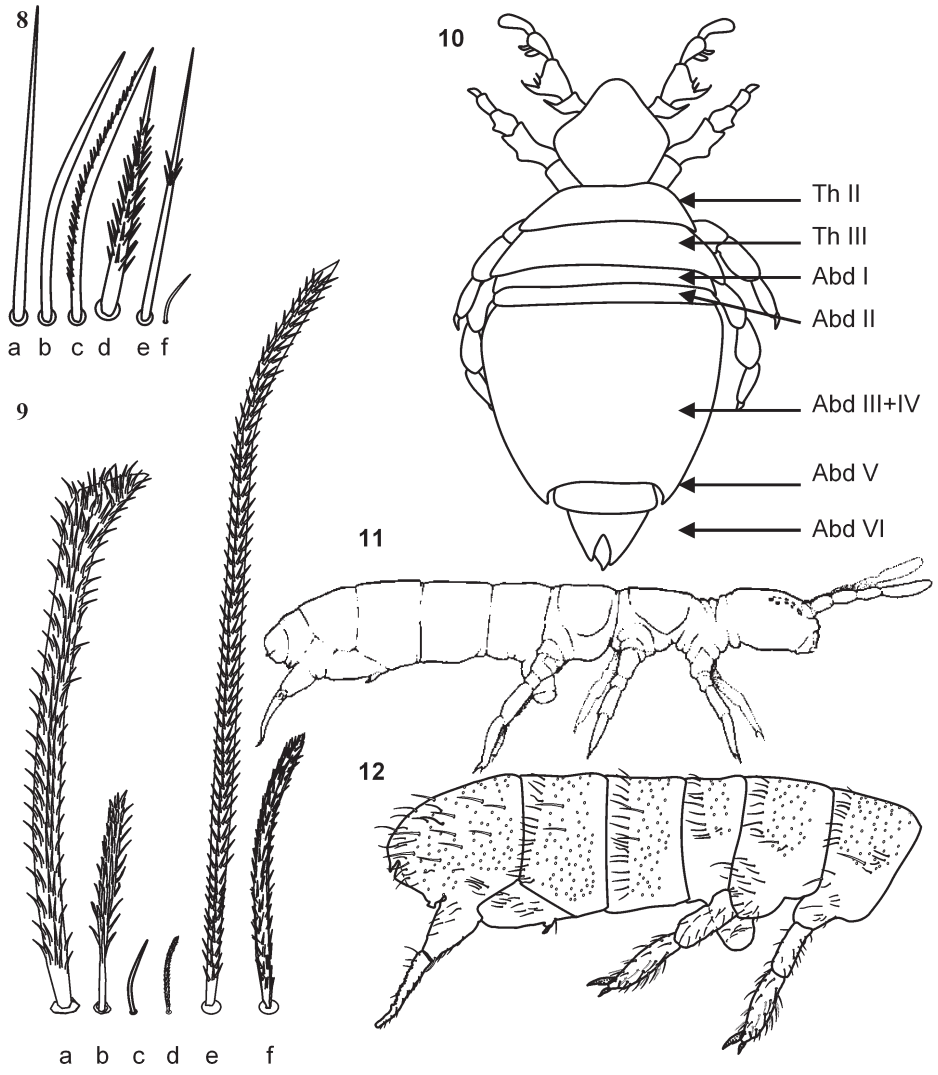


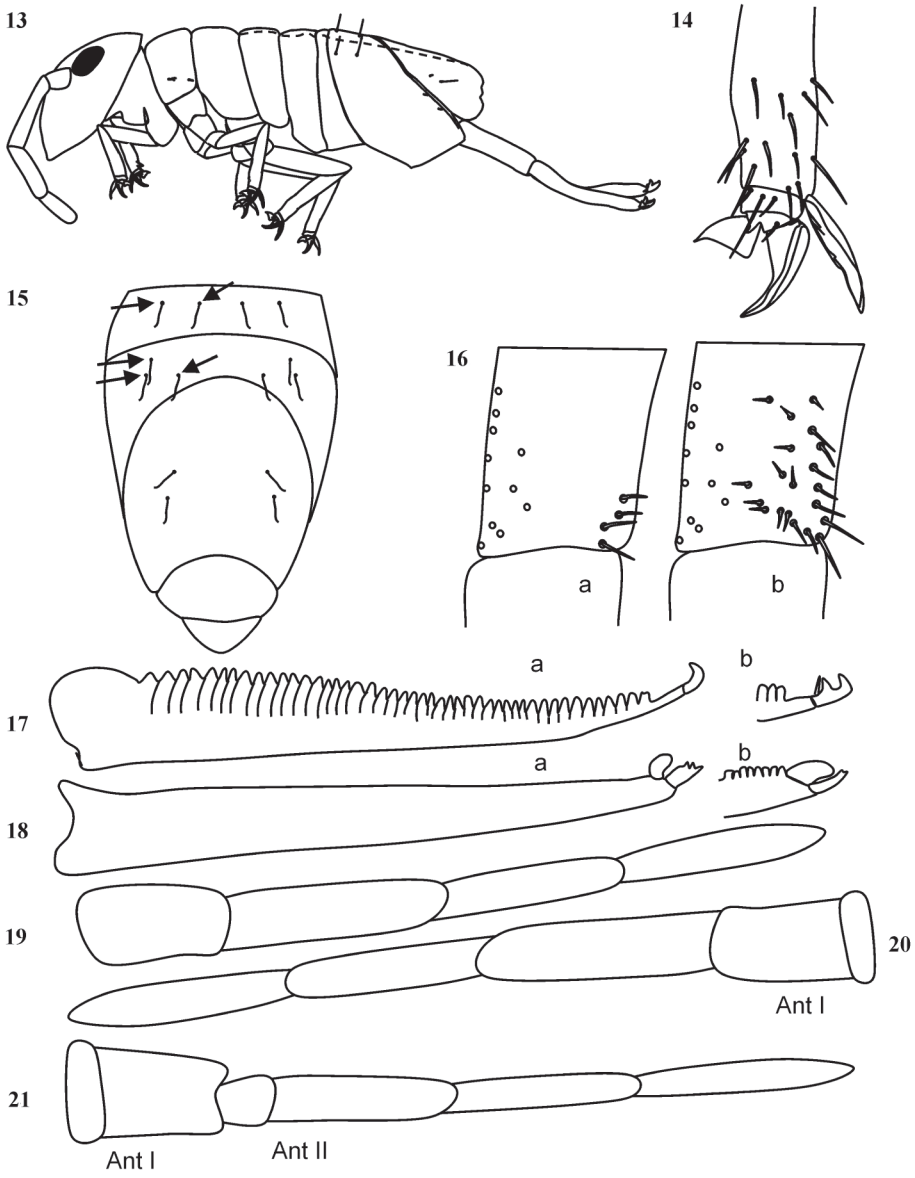
Fig. 8 Some different chaetae on Entomobryomorpha (not Entomobryoidea or Tomoceroidea): a: stiff chaeta or smooth mac, b: normal smooth mac, c, d: ciliated mac, e: foil chaeta, f: sensillum.

Fig. 9 Some different chaetae on Entomobryoidea or Tomoceroidea, a: body chaeta type 1, b: broadened microchaeta, c: smooth sensillum, d: ciliated sensillum, e: body chaeta type 2, f: body chaeta type 5.

Fig. 10 Habitus of Coenaletoidea.

Fig. 11 Habitus of Isotomidae: *Vertagopus cinereus* (after POTAPOV 2001).

Fig. 12 Habitus of Isotomidae: *Folsomia fimetaria* Abd IV–VI fused.



Figs 13–14 *Actaletes neptuni*: habitus (**13**), tibiotarsus (**14**).

Figs 15–21 characters of Entomobryoidea: Trichobothria on Abd II–III (**15)**; Two different types of trochanteral organs (**16)**; Dens crenulated and tapering, mucro falciform (**17a**), mucro with two teeth (**17b**); Dens smooth and cylindrical (**18a**), dens crenulated with a bladder-like appendage (**18b**); Ant with 4 segments (**19**); Ant with 5 segments (Ant I divided) (**20**); Ant with 6 segments (Ant I and II divided) (**21**).

4. Superfamily Entomobryoidea Womersley, 1934, sensu Soto-Adames et al., 2008

Genera of this superfamily have a trochanteral organ composed of 3 or more chaetae (Fig. 16 a–b), a post-ocular trichobothrium always present and Abd IV distinctly longer than Abd III [more than 1.7 times (with the exception of some Orchesellinae)]. This feature is shared with Actaletidae (Fig. 13, placed into Isotomoidea) and some Oncopoduridae. Another feature of Entomobryoidea is the absence of cylindrical or swollen, moderately long, blunt chaetae on the Ant IV.

Key to the families of Entomobryoidea

1	Dens crenulated and tapering (Fig. 17)	2
–	Dens smooth and cylindrical (Fig. 18a), if crenulated, then with a bladder-like appendage (Fig. 18b)	**Paronellidae**
2	Mucro present	**Entomobryidae**
–	Mucro absent	**Microfalculidae**

Microfalculidae is a monospecific family characterised by absence of the mucro; it does not occur in the Palaearctic. Paronellidae are characterised by their nearly cylindrical dens and varied mucro. Entomobryidae have a crenulated and tapered dens and a mucro with 2 teeth or falcate (Fig. 17).

5. Family Entomobryidae Tömösvary, 1882

The family Entomobryidae is characterised by its mucro: with 2 teeth or falcate, with or without basal spine. Antennae with 4 to 6 segments. They are the only family within Entomobryomorpha with these characters. Body with or without scales. With a constant presence of 2, 3, 2 trichobothria on Abd II–IV (on each hemi-segment) (Fig. 15).

Key to the subfamilies of Entomobryidae:

1	Trochanteral organ (in adults) with 3–4 chaetae (Fig. 16a) and 4 antennal segments (Fig. 19)	**Capbryinae**
–	Trochanteral organ with more than 3–4 chaetae (Fig. 16b); if only with 3–4 chaetae, then antennae with 5–6 segments (Figs 20, 21)	**2**
2	Ratio Abd III/IV at midline ≥ 2	**Entomobryinae**
–	Ratio Abd III/IV at midline ≤ 1.7	**Orchesellinae**

6. Subfamily Capbryinae Soto-Adames, Barra, Christiansen & Jordana, 2008

This subfamily has a group of characteristics that separates it from other subfamilies: Abd IV/Abd III ratio from 1.7 to 2.0 separates this subfamily from Entomobryinae (> 2) and Orchesellinae (1.2–1.5), except of the Nothobryini (1.3–1.8). Nothobryini has, in addition, crochet-like labral papillae, as other Orchesellinae (BAQUERO et al. 2004). In the subfamily

Capbryinae, there are two genera: *Capbrya* Barra, 1999 and *Hispanobrya* Jordana & Baquero, 2004. The latter is present in the Palaearctic. Differences among these genera are in the claw structure, with 3 ridges on the claw in *Hispanobrya*.

Genus *Hispanobrya* Jordana & Baquero, 2004

Type species: *Hispanobrya barrancoi* Jordana & Baquero, 2004

Diagnosis of the genus

Capbryinae without scales. Abd IV 1.72 times as long as Abd III. Ant I undivided, Ant IV with apical vesicle. 7+7 Omma (Fig. 24) with reticulated cornea, and a poorly developed 8th Omma (G) (not visible in light microscope). PAO present, forming a protruding vesicle with a perforated cavity on top (Fig. 24). No distinct tenent hairs on legs. A reduced trochanteral organ is present on leg III.

Only a single species is described.

Occurrence: South of the Iberian Peninsula (Spain).

Diagnosis of the species

Hispanobrya barrancoi Jordana & Baquero, 2004

Body length up to 1 mm excluding antennae (Fig. 25). Body colour pattern: grey bands on each segment. Head: Antennal length 400 µm, 2–3 times the length of the head, Ant IV with a simple apical vesicle. Relative length of Ant I–IV 1/1.6/1.6/2. Without labral papillae (Fig. 28). 8 Omma, H smaller than E, F; G not visible in light microscopy, Omma with reticulated corneolae. PAO present as a projected vesicle with a perforated cavity on top (Fig. 24).

Claw with 4 internal teeth: first pair at 71% distance from base of the claw, and 2 unpaired teeth, first one at 75% distance from base and the most distal one minute. Dorsally three longitudinal ridges present reaching beyond the level of the internal paired teeth, central ridge longer than the lateral ones. Emp spike-like, with smooth external edge on leg III. Trochanteral organ with 5–6 spines. Length ratio of Abd IV/Abd III < 2. Length of furca 400 µm. Man plate with 3 chaetae and 2 pseudopores. Mucro falcate and without basal spine (Fig. 27). Distally 1/3 of dens without crenulation (Fig. 26).

Chaetotaxy: Simplified formula = 3-1-0-2-2/10-6/0-0/0-0-0/0-0-1-0-0. Head chaetotaxy as in Fig. 24, without S'_0. Ventral chaetotaxy as in Fig. 29. Thorax: Area T1 on Th II with 10 mac (Fig. 22). Area T2 on Th II with 6 mac (Fig. 22). Th II–III chaetotaxy as in Fig. 30. Abdomen: Areas A1 and A2 on Abd II without mac, Abd III without mac, Abd IV with 2 mac on area A8 (Fig. 31).

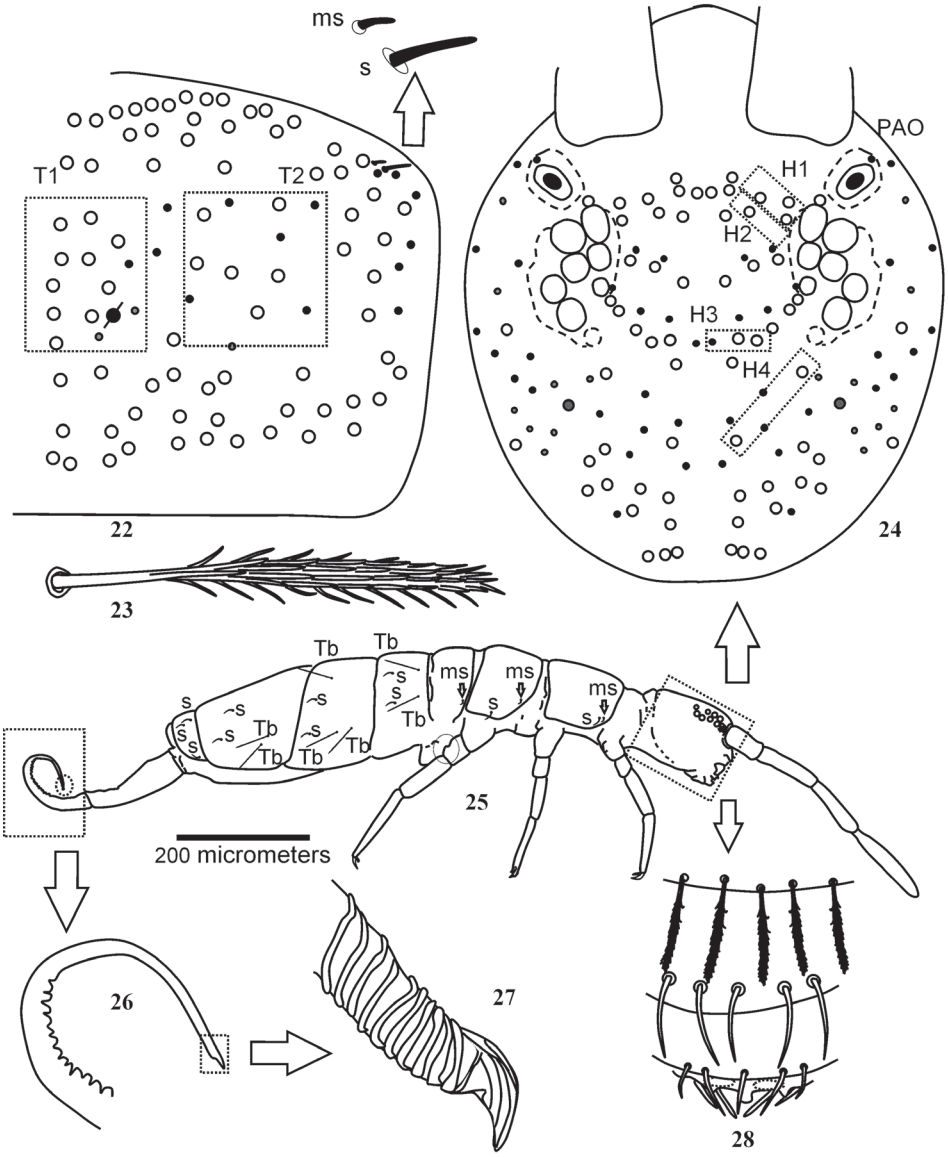
Type locality and material: Spain, 'Paraje Natural Karst en Yesos de Sorbas' Almería, 300 m asl (UTM coordinates 30SWG8308), Mediterranean maquis, 28.VI.2002, leg. RUIZ-PORTERO.

Deposition of type material: MZNA. Type studied.

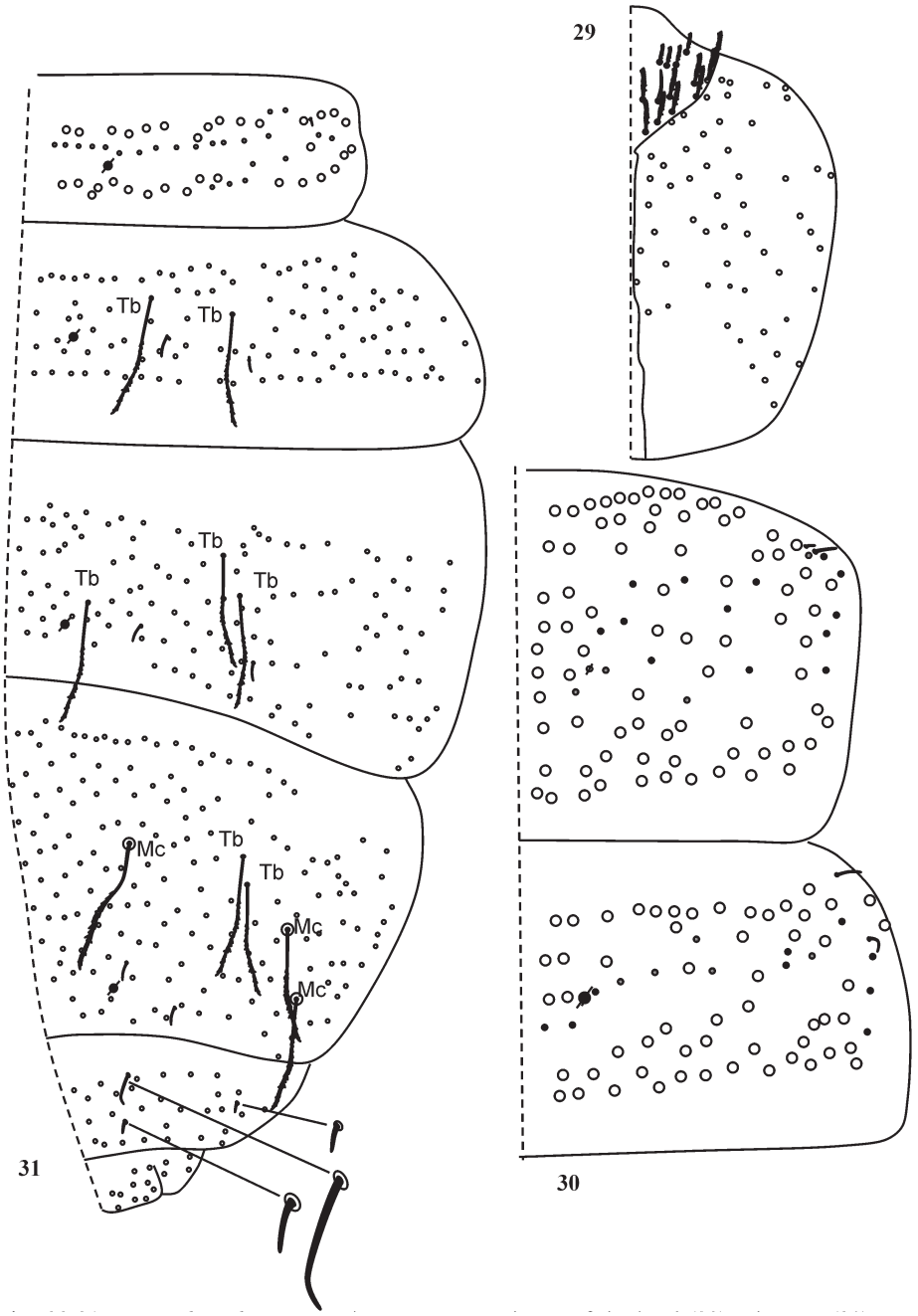
Occurrence: Only known from type locality.

Biology: In Mediterranean maquis.

Remarks: This species has, in the lateral part of Th II–Abd I, 1 sensillum and 1 microsensillum, 2 dorsolateral sensilla on Abd II–IV and 3 on Abd V (Fig. 25).



Figs 22–28 *Hispanobrya barrancoi*: Th II (T1 and T2) (**22**), mac (**23**), head (**24**), habitus (**25**), end of dens (**26**), mucro (**27**), labrum (**28**).



Figs 29–31 *Hispanobrya barrancoi*: chaetotaxy: ventral part of the head (**29**), Th II–III (**30**), Abd I–VI chaetotaxy (**31**).

7. Subfamily Entomobryinae Schäffer, 1896

The subfamily Entomobryinae is characterised by a four–segmented antenna (Fig. 19) and by Abd IV being in the midline at least twice as long as Abd III. All members have a complex of microchaetae around some abdominal trichobothria. In some genera, the labial chaetotaxy is used as diagnostic character. A maximum of 7 basal mac is present on the labium as shown in Fig. 206: M_1, M_2, R_1, R_2, E, L_1 and L_2, but usually the most frequent formula is $M_1M_2REL_1L_2$ or -mrel$_1$l$_2$. These chaetae can be ciliated or smooth; the R chaeta is usually shorter than M, and either vestigial (i. e. only the socket is present) or absent.

General morphology of a member of the Entomobryini is given in Fig. 35.

Key to the tribes of Entomobryinae

1	Ventral surface of dens with scales	**2**
–	Ventral surface of dens without scales	**3**
2	Scales with coarse ribs, some pointed (Fig. 32)	**Seirini**
–	Scales without ribs, finely denticulate, apically rounded (Fig. 33)	**Lepidocyrtini**
3	Body without scales, in some genera with scale-like chaetae, but these narrower than scales	**Entomobryini**
–	Body with scales (Fig. 34)	**Willowsiini**

8. Tribe Entomobryini Börner, 1913

Entomobryinae characterised by a scale-less body and a mucro falcate or with 2 teeth, with or without basal spine.

Key to the genera of Entomobryini

1	Head with 6+6 or fewer Omma	**2**
–	Head with 8+8 Omma, frequently G–H < EF	**3**
2	Mucro with 2 teeth (Fig. 37)	***Sinella*** Brook, 1882
–	Mucro falcate (Fig. 38)	***Coecobrya*** Yosii, 1956
3	Mucro with 2 teeth, with or without basal spine (Figs 39, 40)	**4**
–	Mucro falcate, with or without basal spine (Figs 41, 42)	**9**
4	Intersegmental membranes with many microchaetae (Fig. 43)	***Marginobrya*** Yoshii, 1992
–	Intersegmental membranes without microchaetae	**5**
5	Dental spines present at less at basis of dens (Fig. 44)	***Homidia*** Börner, 1906
–	Dental spines absent	**6**

6	Body with scale–like flattened chaetae (Fig. 45)	***Himalanura*** Baijal, 1958
–	Chaetae on body not flattened	**7**
7	Ant without apical bulb; inner side of tibiotarsi with some chaetae apparently much more finely ciliated than normal 'smooth' chaetae (Fig. 46–47)	***Entomobryoides*** Maynard, 1951
–	Ant usually with apical bulb; all inner tibiotarsal chaetae similar in shape	**8**
8	Mucronal basal spine present (Fig. 39)	***Entomobrya*** Rondani, 1861
–	Mucronal basal spine absent (Fig. 40)	***Mesentotoma*** Salmon, 1942
9	Large mac absent on anterior margin of Th II	***Prodrepanura*** Stach, 1963
–	Large mac present on anterior margin of Th II	**10**
10	Mucro with basal spine (Fig. 41)	***Drepanura*** Schött**,** 1891
–	Mucro without basal spine (Fig. 42)	**11**
11	Claw with 4 inner teeth	***Calx*** Christiansen**,** 1958 (not Palaearctic)
–	Claw with 1 or 2 inner teeth	***Isotobrya*** Womersley, 1934 (not Palaearctic)

9. Genus *Coecobrya* Yosii, 1956 sensu Deharveng, 1990

Type species: *Sinella (Coecobrya) akiyoshiana* Yosii, 1956

Diagnosis of the genus

ZHANG et al (2009) redefined the genus Coecobrya as a genus with a falcate mucro present, a character that separates it from *Sinella* sensu DEHARVENG (1990). *Coecobrya* was erected by YOSII in 1956 as a subgenus of *Sinella*, but with an imprecise definition of *Sinella* and *Coecobrya*; also the description of YOSII (1964) was not entirely clear, because smooth manubrial chaetae could not be a defining generic character. The genus was split into two groups: *tenebricosa* (eyeless) and *boneti* (with Omma) (ZHANG et al. 2011).

For description of the chaetotaxy of this genus see the 'Methods' section.

This genus is distributed in soils around the world; half of the described species are cave dwellers.

Key to the Palaearctic species of *Coecobrya*

1	Claw with two teeth	**2**
–	Claw with more than two teeth	**3**
2	Claw long and slender, two times the length of Emp (Fig. 167)	*ishikawai* (Yosii, 1955)
–	Claw short (Fig. 171)	*maritima* Park, 2004
3	Claw with 4 teeth (Figs 172, 177)	**4**
–	Claw with 3 teeth	**5**

4 Tenent hair acuminate (Fig. 172) *montana* (Imms, 1912)
– Tenent hair spatulate (Fig. 177) *submontana* (Stach, 1960)

5 Th II with 1 mac on area T1 (m_1 present) (Fig. 78) **6**
– Th II with more than 1 mac on T1 **9**

6 Area A2 on Abd II with 5-7 mac (Figs 133–135) *tibetensis* Chen & Christiansen, 1997
– Area A2 on Abd II with 3 mac (Fig. 129) **7**

7 Areas A3-A5 of Abd III with 1 mac on areas A4 and A5 (Fig. 140)
liui Wang, Chen & Christiansen, 2002
– Areas A3-A5 of Abd III with 1 mac on area A5 (m_3 present) (Fig. 138) **8**

8 Area A9 on Abd IV with 3 mac (Abd IV dorsal with 8 mac), mucronal spine does not reach the tip of the mucro (Fig. 163) *hoefti* (Schäffer, 1896)

– Area A9 on Abd IV with 2 mac (Abd IV dorsal with 7 mac), mucronal spine reaching the tip of the mucro (Fig. 159) *communis* Chen & Christiansen, 1997

9 Th II with 2 mac on area T1 **10**
– Th II with 3 mac on area T1 **14**

10 Th II with 4 mac in area T2 (Fig. 107) *lanna* Zhang, Deharveng & Chen, 2009
– Th II with 2 mac in area T2 **11**

11 Area A2 on Abd II with 1 mac (Fig. 126) **18**
– Area A2 on Abd II with 2 or 3 mac **12**

12 Area A2 on Abd II with 2 mac (Fig. 128) *arcuata* (Yosii, 1955)
– Area A2 on Abd II with 3 mac **13**

13 4 dorsal mac on Abd IV (Fig. 161) *dubiosa* (Yosii, 1956)
– On Abd IV 3 dorsal mac (Fig. 175) *spinidentata* (Yosii, 1942)

14 Area A1 on Abd II with 1 mac (Fig. 124) **15**
– Area A1 on Abd II without mac (Fig. 123) **16**

15 Area A2 on Abd II with 3 mac (Fig. 129), Abd IV with 5 dorsal mac
huangi Chen & Christiansen, 1997
– Area A2 on Abd II with 2 mac (Fig. 128), Abd IV with 3 dorsal mac
mulun Zhang, Qu & Deharveng, 2010

16 Areas A3, A4 and A5 on Abd III with 1 mac (Fig. 149)
magyari Chen, Wang & Christiansen, 2002
– Only with 1 mac on area A5 (Fig. 138) (without mac on areas A3 and A4 on Abd III) **17**

17	5 lateral mac on Abd IV (Fig. 174)	*oligoseta* Chen & Christiansen, 1997
–	3 lateral mac on Abd IV (Fig. 179)	*tenebricosa* (Folsom, 1902)
18	3 lateral mac on Abd IV (Fig. 181)	*tibiotarsalis* Yosii, 1964
–	5 lateral mac on Abd IV (Fig. 50)	*akiyoshiana* (Yosii, 1956)

Key to the world species of *Coecobrya*

(This key has been made using the key of ZHANG et al. 2009, adding new species not cited therein)

1	Omma 3+3	*mulun* Zhang, Qu & Deharveng, 2010, China
–	Omma less than 3+3	**2**
2	Omma 2+2	*tetrophthalma* (Denis, 1948), Vietnam
–	Omma at most 1+1	**3**
3	Omma 1+1	**4**
–	Omma absent	**6**
4	Abd IV with 7+7 central mac. Abd I with 6+6 central mac	*indonesiensis* Chen & Deharveng, 1997, Indonesia*
–	Abd IV with 6+6 central mac	**5**
5	Abd I with 4+4 central mac	*tukmeas* Zhang, Deharveng & Chen, 2009 Cambodia*
–	Abd I with 6+6 central mac	*boneti* (Denis, 1948), Vietnam
6	Mucronal basal spine very short, not reaching the apex of apical tooth	**7**
–	Mucronal basal spine long, reaching at least near apex of apical tooth	**8**
7	Tenent hair spatulate	*caeca* (Schött, 1896), USA
–	Tenent hair pointed	*hoefti* (Schäffer, 1896), Germany*
8	Claw with 2 unpaired inner distal teeth	**9**
–	Claw with at most 1 unpaired inner distal teeth	**10**
9	Tenent hairs pointed	*montana* (Imms, 1912), India
–	Tenent hairs spatulate	*submontana* (Stach, 1960), Afghanistan
10	Man with dorsal smooth chaetae	**11**
–	Man without dorsal smooth chaetae	**31**
11	Claw without unpaired inner distal tooth	**12**
–	Claw with unpaired inner distal tooth	**13**

12 Dental smooth part about 0.7 times as long as mucro *ishikawai* (Yosii, 1955), Japan*

– Dental smooth part about 1.5 times as long as mucro *maritima* Park, 2004, Korea

13 Outer tooth on Emp twice as broad as Emp itself *papuana* Yosii, 1971, New Guinea*

– Outer tooth on Emp at most slightly broader than Emp itself **14**

14 Ant more than five times as long as the cephalic diagonal . *nupa* Christiansen & Bellinger, 1992, Hawaii*

– Ant less than four times as long as the cephalic diagonal **15**

15 Tibiotarsus with rows of 'smooth' inner differentiated chaetae (i.e. with cilia closely adpressed to axis) **16**

– Tibiotarsus without rows of 'smooth' inner differentiated chaetae **20**

16 Abd IV with 4+4 central mac **17**

– Abd IV with more than 4+4 central mac **18**

17 Abd III with 3+3 lateral mac *tibiotarsalis* Yosii, 1964, Japan

– Abd III with 2+2 lateral mac *tenebricosa* (Folsom, 1902), worldwide*

18 Abd III with 1+1 central mac *hoefti* (Schäffer, 1896), Germany

– Abd III with 2+2 central mac **19**

19 Th II with 3 medio-central and 2 medio-lateral mac . *magyari* Chen, Wang & Christiansen, 2002, Hungary

– Th II with 2 medio-central and 3 medio-lateral mac *lanna* Zhang, Deharveng & Chen, 2009, Thailand

20 Claw elongate, with unpaired inner distal tooth basal, at less than 20% from the base of the claw *akiyoshiana* (Yosii, 1955), Japan*

– Claw with unpaired inner distal tooth at more than 25% from the base of the claw **21**

21 Abd II with 4+4 central mac *kukae* Christiansen & Bellinger, 1992, Hawaii*

– Abd II with at most 3+3 central mac **22**

22 Abd II with 2+2 central mac **23**

– Abd II with 3+3 central mac **25**

23 Th II with 3+3 central mac on areas T1 and T2 *similis* Deharveng, 1990, Thailand

– Th II with 2+2 central mac on areas T1 and T2 **24**

24 Abd IV with 3+3 dorsal mac (0-1-0-1-1 on areas A6, A7, A8, A9 and A10) and 3+3 lateral mac (0-1-0-1-1) *arcuata* (Yosii, 1955), Japan

– Abd IV with 4+4 dorsal mac (0-2-0-1-1 on areas A6, A7, A8, A9 and A10) and 6+6 lateral mac (0-1-2-1-2) *kennethi* Jordana & Baquero, 2008, Rapa Nui, Easter Island*

25	Abd I with 4+4 central mac	**26**
–	Abd I with 5+5 central mac	**27**
26	Abd IV with less than 4+4 central mac	*lua* Christiansen & Bellinger, 1992, Hawaii*
–	Abd IV with 6(7)+6(7) central mac	*aokii* (Yoshii, 1995), Vanuatu
27	Claw with paired teeth at less than 25% from the base of the claw	*spinidentata* (Yosii, 1942), Japan*
–	Claw with paired teeth at more than 35% from the base of the claw	**28**
28	Abd IV with 5+5 central mac	*dubiosa* (Yosii, 1956), Japan and Korea*
–	Abd IV with at most 4+4 central mac	**29**
29	Abd IV with 3+3 central mac	*oligoseta* Chen & Christiansen, 1997, China
–	Abd IV with 4+4 central mac	**30**
30	Th II with p4 mic and p_{4i} absent	*guanophila* Deharveng, 1990, Thailand*
–	Th II with p4 and p_{4i} mac	*borerae* Christiansen & Bellinger, 1992, Hawaii
31	Abd III with 1+1 central mac	**32**
–	Abd III with 2+2 central mac	**34**
32	Abd IV with 7+7 central mac	*communis* Chen & Christiansen, 1997, China
–	Abd IV with less than 6+6 central mac	**33**
33	Abd IV with 5+5 central mac	*tropicalis* Qu, Chen & Greenslade, 2007, Australia
–	Abd IV with 3+3 central mac	*edenticulata* (Handschin, 1926), Java*
34	Abd IV with 5+5 central mac	*huangi* Chen & Christiansen, 1997, Tibet
–	Abd IV with at least 7+7 central mac	**35**
35	Abd IV with 7+7 central mac	*liui* Wang, Chen & Christiansen, 2002, China
–	Abd IV with at least 8+8 central mac	*tibetensis* Chen & Christiansen, 1997, Tibet

* species found in caves.

Diagnoses to the Palaearctic species of *Coecobrya*

Coecobrya akiyoshiana (Yosii, 1956)

Bas: *Sinella (Coecobrya) akiyoshiana* Yosii, 1956

Body length up to 2 mm excluding antennae, according to original description (studied type 1.58 mm). Body colour slightly yellowish-brown. For simplified formula of chaetotaxy see Fig. 521. Head: Antennal length 770 µm, less than two times the length of the head (Ratio Ant/head = 1.9), Ant IV without apical vesicle. Relative length of antennal segments Ant I/II/III/IV = 1/1.3/1.6/3.8. Labral papillae absent. Omma absent.

Claw very slender with 3 basal internal teeth: first pair at 14% distance from base of claw, and 1 unpaired tooth at 20% distance from base. Dorsal tooth absent (Fig. 154). Emp smooth on external edge on leg III, with an external tooth. Length ratio of Abd IV/III > 4. Length of Man+Dens = 640 µm. Mucro with basal spine, subapical teeth absent, mucro falciform; mucronal spine present.

Chaetotaxy: Simplified formula = 3-1-0-3-3-1b/2-2/0-1/0-0-1/0-2-0-1-1/0-1-2-0-2. Head: Head chaetotaxy H1, H2, H4 and H4' as in Fig. 51, H5 as in Fig. 71, without S'_0. Thorax: Area T1 on Th II with 2 mac (m_1 and m_2 present) (Fig. 89). Area T2 on Th II with 2 mac present (a_5 and m_4) (Fig. 100). Abdomen: Area A1 on Abd II without mac as in Fig. 127 and area A2 on Abd II with 1 mac as in Fig. 126. Abd III with 1 mac on A5 as in Fig. 138. Abd IV with 4+4 dorsal mac and 5+5 lateral mac as in Fig. 50.

Measurements in µm (from type specimen):

Ant I	Ant II	Ant III	Ant IV	Ant	Head	Th II	Th III	Abd I
100	130	160	380	770	400	180	110	100
Abd II	Abd III	Abd IV	Abd V	Abd VI	Body	Man	Dens	Furca
100	100	450	80	60	1580	300	340	640

Type locality and material: Japan, Taishô–Dô, Akiyoshi, Yamaguchi Prefecture (30 specimens, 14–15.VIII.1952, leg. UÉNO) (possibly the indication of days 14–15 means a pitfall trap placed in the cave).

Deposition of type material: NHMG. Type studied.

Occurrence: karst caves at Akiyoshi, Hakugyo-Dô (2 specimens), Odaishi no Iwaya (1 specimen), Terayama no Ana (9 specimens), Hime-yama no Iwaana (3 specimens), Kagekiyo Dô (9 specimens), Akiyoshi-Dô (3 specimens), Kanekiyo Ana (2 specimens), Dobin Iwa no Shin Ana (4 specimens), Nakao Dô (20 specimens), Hanazi no Oh Ana (4 specimens), Komori Ana (17 specimens).

Biology: in caves (YOSII 1955).

Coecobrya arcuata (Yosii, 1955)

Bas: *Sinella arcuata* Yosii, 1955

Body length up to 1.5 mm excluding antennae. Body colour white. For simplified formula of chaetotaxy see Fig. 522. Head: Antennal length 593 µm, less than two times the length of the head (Ratio Ant/head = 1.9), Ant IV without apical vesicle. Relative length of antennal segments Ant I/II/III/IV = 0.8/1.7/1.2/2.3. Labral papillae absent. Omma absent.

Claw with 3 internal teeth: first pair at 29% distance from base of claw, and 1 unpaired tooth at 37% distance from base. Dorsal tooth absent (Fig. 155). Emp smooth on external edge on leg III, with an external tooth. Length ratio of Abd IV/III < 4. Length of Man+dens = 600 µm. Man dorsally with some long, straight, smooth chaetae on each side. Manubrial plate with 3 chaetae and 2 psp. Mucro with basal spine, subapical teeth absent, mucro falciform.

Chaetotaxy: Simplified formula = 3-1-0-2-2-1b/2-2/0-2/0-0-1/0-1-0-1-1/0-1-0-1-1. Head: Areas H1 and H2 as in Fig. 51, H4 and H4' as in Fig. 53, H5 as in Fig. 71, without S'_0. Thorax: Area T1 on Th II with 2 mac (m_1 and m_2 present) (Fig. 89). On area T2 on Th II with 2 mac present (a_5 and m_4) (Fig. 100). Abdomen: Area A1 on Abd II without mac as in Fig. 123

and area A2 on Abd II with 2 mac as in Fig. 128. Abd III with 1 mac on A5 as in Fig. 138. Abd IV with 3+3 dorsal mac and 3+3 lateral mac as in Fig. 156.

Measurements in µm (from type specimen):

Ant I	Ant II	Ant III	Ant IV	Ant	Head	Th II	Th III	Abd I
72	171	117	233	593	311	160	100	80
Abd II	Abd III	Abd IV	Abd V	Abd VI	Body	Man	Dens	Furca
120	120	400	100	60	1451	280	320	600

Type locality and material: Types, 25 specimens from Japan, Asibikigô Cave, Takara-zima (25.V.1953).

Deposition of type material: NHMG. Types studied.

Occurrence: Only known from type locality.

Biology: in caves.

Coecobrya communis Chen & Christiansen, 1997

Body length up to 2 mm excluding antennae. Body colour white–yellowish, for simplified formula of chaetotaxy see Fig. 523. Head: Antennae 2–3 times the length of the head (Ant/head = 1.8–3), Ant IV without apical vesicle. Labral papillae absent. Chaetotaxy at base of labium usually with one smooth mac M (sometimes a smooth M_1 mic may be present), mic R smooth or ciliated, E, L_1 and L_2 as smooth mac (Fig. 158). Omma absent. Tibiotarsus with inner differentiated chaetae finely ciliated (apparently smooth) (Fig. 47), with cilia moderately adpressed to axis of chaetae.

Claw with 3 internal teeth: first pair at 39% distance from base of claw, and 1 unpaired tooth at 65% distance from base. Dorsal tooth approximately at half distance between claw basis and internal pair of teeth (Fig. 157). Emp smooth on external edge on leg III, with an external tooth. Length ratio of Abd IV/III unknown. Manubrial plate with 3 chaetae and 3 psp. Mucro with basal spine, subapical teeth absent, mucro falciform as in Fig. 159.

Chaetotaxy: Simplified formula = 3-1-0-3-3-1b/1-3(4)/0(1)-3/0-0-1/0-2-1-2-2/0-1-1-2-2. Head: Areas H1, H2, H4, H4' and H5 on the head as in Fig. 51, without S'_0. Thorax: Area T1 on Th II with 1 mac (m_1 present) (Fig. 78). Area T2 on Th II with 3(4) mac present (Fig. 107). Abdomen: Area A1 on Abd II with 1 mac or without mac, area A2 on Abd II with 3 mac as in Fig. 129. Abd III with 1 mac on A5 (Fig. 138), Abd IV with 7+7 dorsal mac and 6+6 lateral mac as in Fig. 160.

Type locality and material: Holotype female China, Anhui, Chuxian County, Langya Mountain, 8.IV.1990. Paratypes: 2 females, 2 males; same data as holotype.

Deposition of type material: NJU. Types not studied.

Occurrence: China: Anhui (Yellow Mountain, 3.VI.1990); Jiangsu (Nanjing) Xuanwu Park, 4.VII.1990; Nanjing (Baguazhou, 19.VI.1990); Jiangning County, 8.VI.1990; Jurong County (Baohua Mountain, 28.V.1990–22.VII.1990); Shangdong: Qufu 9.IV.1990; Shaanxi (Xi'an, city park, 23.IV.1990); Sichuan (Chengdu, 27.IV.1976) Huang Fu Sheng 1.V.1975; Guanxian County, park 5.V.1975.

Biology: Deciduous also mixed woods and shrubs, lives under stones or in litter.

Remarks: This is the most common species of *Coecobrya* found in China (CHEN & CHRISTIANSEN 1997).

Coecobrya dubiosa (Yosii, 1956)

Bas: *Sinella dubiosa* Yosii, 1956

Body length up to 1.5 mm excluding antennae, according to original description (studied type specimen 1.84 mm). Body colour white, for simplified formula of chaetotaxy see Fig. 524. Head: Antennal length 820 µm, less than two times the length of the head (Ant/head = 1.9), Ant IV without apical vesicle. Relative length of antennal segments Ant I/II/III/IV = 1/2/1.9/3. Without labral papillae. Omma absent.

Claw with 3 internal teeth: first pair at 26% distance from base of claw, and 1 unpaired tooth at 49% distance from base. Dorsal tooth absent. Emp with a tooth on external edge of leg III. Length ratio of Abd IV/III < 4. Length of Man+dens = 760 µm. Dorsum of Man dorsally with some long, straight, smooth chaetae on each side. Manubrial plate with 2 chaetae and 2 psp. Mucro with basal spine, subapical tooth absent, mucro falciform.

Chaetotaxy: Simplified formula = 2-1-0-3-2-1b/2-2/0-3/0-0-1/0-2-0-1-1/0-1-1-1-1. Head: Areas H1 and H2 as in Fig. 52 (An_2 mes), H4–H5' as in Fig. 54 , without S'_0. Thorax: Area T1 on Th II with 2 mac (m_2 and m_{2e} present) (Fig. 77). Area T2 on Th II with 2 mac (Fig. 111). Abdomen: Area A1 on Abd II without mac as in Fig. 123 and area A2 on Abd II with 3 mac as in Fig. 129. Abd III with 1 mac on A5 as in Fig. 138. Abd IV with 4+4 dorsal mac and 4+4 lateral mac as in Fig. 161.

Measurements in µm (from type specimen):

Ant I	Ant II	Ant III	Ant IV	Ant	Head	Th II	Th III	Abd I
101	211	195	312	819	429	203	125	100
Abd II	Abd III	Abd IV	Abd V	Abd VI	Body	Man	Dens	Furca
140	180	500	100	60	1837	320	440	760

Type locality and material: Japan, Ana no Gozen, Ehime, 9 specimens, 10.XI.1953, leg. UÉNO.

Deposition of type material: NHMG. Type studied.

Occurrence: Japan and Korea (LEE & PARK 1984, PARK & LEE 1995, ZHANG et al. 2009)

Biology: in caves.

Species description: YOSII 1956, 1964, 1966.

Coecobrya hoefti (Schäffer, 1896) sensu Szeptycki, 1979

Bas: *Sinella hoefti* (Schäffer, 1896)

Body length up to 1.2 mm excluding antennae. Body colour white. For simplified formula of chaetotaxy see Fig. 525. Omma absent.

Claw with 3 internal teeth: first pair at 44% distance from base of claw, and 1 unpaired tooth at 57% of distance from base; lateral teeth present, dorsal tooth absent. Emp with an external tooth. Mucro falcate with basal spine not reaching to tip of the mucro (Fig. 163) (redrawn after original description).

Chaetotaxy. Simplified formula = -----/1-3/1-3/0-0-1/0-2-1-3-2/0-1-1-2-2 (from SZEPTYCKI 1979). Thorax: Area T1 on Th II with 1 mac (m_1 a present) (Fig. 78). Area T2 on Th II with 3 mac present (Fig. 104). Abdomen: Area A1 on Abd II with 1 mac as in Fig. 124 and area A2 on Abd II with 3 mac as in Fig. 129. Abd III with 1 mac on A5 (Fig. 138). Abd IV with 8+8 dorsal mac and 6+6 lateral mac as in Fig. 162 (some mes could be present).

Type locality: Germany.

Deposition of type material: Unknown.

Occurrence: Europe, recorded from around the world, but some findings must be confirmed. Many authors think that this species needs a revision. I have not found specimens from Germany, many records in literature are from caves and litter.

Biology: Found in a flowerpot with *Templetonia nitida* (now *Heteromurus nitidus*) at Hamburg.

Species description: SCHÄFFER 1896; SZEPTYCKI 1979.

Remarks: the original description from SCHÄFFER (1896) is as follows (personal translation): 'White, without markings. Omma absent. Upper claw on the inner side with 2 adjacent teeth, a very large and one smaller (Fig. 103 and 104). Lower claw on the outside with very big tooth (Fig. 103). Mucro with strong basal spine and curved apical tooth (Fig. 105), length 1.2 mm. The hairs are like *S. curviseta* Brook. It should be noted that even on the first two antennal segments are scattered sensorial hairs. The species is found so far only in the Hamburg apartment of its discoverer Mr HOEFT. Under a flower pot (with *Templetonia nitida*), but with many individuals.'

This species was synonymised with *C. caeca* (Schött, 1896) and hence recorded under this name by many authors. It seems that it lives in Europe only and, perhaps, some citations around the world are erroneous. SZEPTYCKI (1979) took it as a model to establish the chaetotaxy of the group. DENIS (1932) described a variety 'ciliata' based on a single specimen that is kept at MNHN, now synonymised by ZHANG et al. (2009) with *C. tenebricosa*. YOSII (1942) described the species based on specimens from a cave in Japan as variety 'spinidentata', which is now regarded as a true species. I believe SZEPTYCKI could have seen the true species of *S. hoefti*, and his description of its chaetotaxy is accepted and used here.

Coecobrya huangi Chen & Christiansen, 1997

Body length up to 1.74 mm excluding antennae. Body colour pale yellow. For simplified formula of chaetotaxy see Fig. 526. Head: Antennal length less than two times the length of the head (Ant/head = 1.3–1.8), Ant IV without apical vesicle. Labral papillae absent. Labial chaetotaxy: M_1 smooth mac, R smooth mic, E, L_1 and L_2 smooth mac. Omma absent.

Tibiotarsus with inner differentiated chaetae finely ciliated (apparently smooth) (Fig. 47) with cilia moderately adpressed to axis of chaetae. Claw with 3 internal teeth: first pair at 42% distance from base of claw, and 1 unpaired tooth at 68% distance from base. Dorsal tooth near of the claw basis (Fig. 164). Emp smooth with an external tooth on leg III. Length ratio of Abd IV/III unknown. Manubrial plate with 3(2) chaetae and 2 psp. Mucro falciform with basal spine as in Fig. 159.

Chaetotaxy: Simplified formula = 3-1-0-3-3-1b/3-4/1(0, 2)-3/0-1-1/0-2-1-1-1/0-1-1-1-1. Head: chaetotaxy H1, H2, H4, H4' and H5 as in Fig. 51, without S'_0. Thorax: Area T1 on Th II with 3 mac (m_1, m_2 and m_{2i} present) (Fig. 84). Area T2 on Th II with 4 mac present (Fig. 107). Abdomen: Area A1 on Abd II with 0–2 mac and area A2 on Abd II with 3 mac as in Fig. 129. Abd III with 1 mac on areas A4 and A5 as in Fig. 140. Abd IV with 5+5 dorsal mac and 4+4 lateral mac as in Fig. 165.

Type locality and material: Holotype, China, Tibet, Zadaqusongbigong, 4350 m asl, 23.VI.1976, leg. HUANG FU-SHENG.

Deposition of type material: NJU, 5 paratypes.

Occurrence: Tibet. Additional records: Tibet: 1 female, Pulanbaxishen Mountain, 4900 m asl, Zadadiyalongwanglanan, 28.VI.1976, 23.VII.1976; 4 specimens, males and females, leg. HUANG FU-SHENG.

Biology: Unknown.

Remarks: This species has on Abd II the mac a_2 often present and a_3 rarely present. Key: ZHANG et al 2009.

Coecobrya ishikawai (Yosii, 1956)

Bas: *Sinella (Coecobrya) ishikawai* Yosii, 1956

Body length up to 1.7 mm excluding antennae, according to original description (studied type specimen: 1.8 mm). Body colour white, for simplified formula of chaetotaxy see Fig. 527. Head: Antennal length 721 µm (after studied type specimen), 2–3 times the length of the head (Ratio Ant/head = 2.6), Ant IV without apical vesicle. Relative length of antennal segments Ant I/II/III/IV = 0,5/2.1/1.9/2.6. Without labral papillae. Omma absent.

Tibiotarsus with inner differentiated chaetae finely ciliated (apparently smooth) (Fig. 47) with cilia moderately adpressed to axis of chaetae. Claw with 2 internal teeth at 22% distance from base of claw, without unpaired teeth; dorsal tooth absent (Fig. 167). Emp with an external tooth on leg III. Length ratio of Abd IV/III < 4. Length of Man+dens = 740 µm. Man dorsally with with some long, straight, smooth chaetae on each side. Manubrial plate with 2 chaetae and 2 psp. Mucro falciform with basal spine.

Chaetotaxy: Simplified formula = 3-1-0-3-3-1b/2-2/0-3/0-0-1/0-2-1-1-1/0-1-2-1-2.
Head: Area H1, H2, H4, H4' and H5 as in Fig. 51, without S'_0. Thorax: Area T1 on Th II with 2 mac (m_1 and m_2 present) (Fig. 82). Area T2 on Th II with 2 mac present (Fig. 111). Abdomen: Area A1 on Abd II without mac as in Fig. 123 and area A2 on Abd II with 3 mac as in Fig. 129. Abd III with 1 mac on A5 as in Fig. 138. Abd IV with 5+5 dorsal mac and 6(5)+6(5) lateral mac as in Fig. 166.

Measurements in µm (from type specimen):

Ant I	Ant II	Ant III	Ant IV	Ant	Head	Th II	Th III	Abd I
51	218	187	265	721	281	234	195	94
Abd II	Abd III	Abd IV	Abd V	Abd VI	Body	Man	Dens	Furca
140	156	514	109	78	1801	351	390	741

Type locality and material: Japan. Saruta Do, Kusaka Mura, Kôti, 23 specimens, 17.III.1973 [sic], YOSII et al. leg.

Deposition of type material: NHMG. Type studied.

Occurrence. Aka Ana, Iwaizumi, Iwaté (1 specimen, 4.VII.1954, UÉNO leg.) - Irimizu Dô, Fukushima (5 specimens, 28.VIII.1954, YOSII leg.) - Izuru cave, Tochigi (7 specimens 29–30.VIII.1954, YOSII leg.) – Fuji Ana, Gumma (5 specimens, 1.IX.1954, YOSII leg.) – Okutama Cave, Tokyo (33 specimens, 17.X.1954, YOSII leg.) – Fukugakuchi, Niigata (17 specimens, 22.VIII.1954, YOSII et al. leg.) – Kasiwagi, cave, Kr. Nara (38 specimens, 29–30.IV.1952, YOSII & UÉNO leg.) – Dorogawa cave, Nara (5 specimens, 13.X.1953, UÉNO & IMADATÉ leg.) – Ryomen Iwaya, Kr. Gifu (25 specimens, 20.VIII.1954, YOSII et al. leg.) – Agi Shônyûdô, Gifu (9 specimens, 2.VII.1953, UÉNO leg.) – Shikoku cave, Kyûshû Bay, Tokushima, Kôchi, Ehime, Ohita, Miyazaki und Kumamoto (114 specimens, several sampling dates, YOSII et al. leg.). Key: ZHANG et al. 2009.

Biology: in caves .

Species description: YOSII 1955, 1956.

Coecobrya lanna Zhang, Deharveng & Chen, 2009

Body length up to 2 mm excluding antennae. Body colour pale yellow, for colour and simplified formula of chaetotaxy see Fig. 528. Head: Antennal length 2–3 times the length of the head (Ant/head = 1.88–2.41), Ant IV apical vesicle absent. Relative length of antennal segments Ant I/II/III/IV = 1 / 1.5–2.0 / 1.0–1.5 / 2.4–3.5. Without labral papillae. Labium chaetotaxy with M, R, E, L_1 and L_2 smooth mac present. Omma absent.

Tibiotarsus with inner differentiated chaetae finely ciliated (apparently smooth) (Fig. 47) with cilia moderately adpressed to axis of chaetae. Claw with 3 internal teeth: first pair at 45% distance from base of claw, and 1 unpaired tooth at 59% distance from base. Dorsal tooth absent (Fig. 168). Emp smooth on external edge on leg III, with an external tooth. Length ratio of Abd IV/III > 4. Man dorsally with some long, straight, smooth chaetae on each side. Manubrial plate with 3 chaetae and 2 psp. Mucro falciform with basal spine reaching near the tip of the mucro.

Chaetotaxy: Simplified formula = 3-1-0-3-3-1b/2-4/0-3/0-1-1/0-3-1-1-2/0-1-1-2-2. Head: Areas H1, H2, H4, H4' and H5 as in Fig. 51, without S'_0. Thorax: Area T1 on Th II with 2 mac (m_1 and m_2 present) (Fig. 82). Area T2 on Th II with 4 mac present (Fig. 107). Abdomen: Area A1 on Abd II without mac as in Fig. 123 and area A2 on Abd II with 3 mac as in Fig. 129. Abd III with 1 mac on A4 and A5 as in Fig. 140. Abd IV with 7+7 dorsal mac and 6+6 lateral mac as in Fig. 169.

Type locality and material: Holotype male, 7 female paratypes. Thailand, Changwat Chiang Mai: Amphoe Chiang Dao, Doi Chiang Dao, in forest litter, 1720 m asl, 11.VII.1985, Berlese-Tullgren extraction.

Deposition of type material**:** Holotype and 4 paratypes on slide in MNHN, 3 paratypes on slide in NJU. Types not studied.

Occurrence: North Thailand.

Biology: Broadleaf forest litter.

Remarks: The species is included in this key due to its type locality in North Thailand, close to the southern border of the Palaearctic.

Coecobrya liui Wang, Chen & Christiansen, 2002

Body length up to 1.8 mm excluding antennae. Body colour pale yellow. For simplified formula of chaetotaxy see Fig. 529. Head: Antennal length less than two times the length of the head (Ant/head = 1.2–1.9), Ant IV without apical vesicle. Labral papillae absent. Labial chaetotaxy: M, R, E, L_1 and L_2 smooth mac. Omma absent.

Tibiotarsus with inner differentiated chaetae finely ciliated (apparently smooth) (Fig. 47) with cilia moderately adpressed to axis of chaetae. Claw with 3 internal teeth: First pair at 45% distance from base of claw and 1 unpaired at 74% distance from base. Dorsal tooth absent. Emp smooth on external edge on leg III, with an external tooth. Manubrial plate with 3 chaetae and 2 psp. Mucro falciform with basal spine.

Chaetotaxy. Simplified formula = 3-1-0-3-3-1b/1-4/0-3/0-1-1/0-2-1-2-2/0-1-1-2-2. Head: Areas H1, H2, H4, H4' and H5 as in Fig. 51, without S'_0. Thorax: Area T1 on Th II with 1 mac (m_1 present) (Fig. 78). Area T2 on Th II with 4 mac present (Fig. 107). Abdomen: Area A1 on Abd II without mac as in Fig. 123 and area A2 on Abd II with 3 mac as in Fig. 129. Abd III with 1 mac on A4 and A5 as in Fig. 140. Abd IV with 7+7 dorsal mac and 6+6 lateral mac as in Fig. 160.

Type locality and material: Holotype female, China: Qinghai, foot of Laoye Mountain, 6.VI.1997.

Deposition of type material: Collection number 8655, NJU. Types not studied.

Occurrence: China.

Biology: Found in litter, under stones and rotten wood or in cavities with ants, in coniferous woods, deciduous woods or shrubland.

Remarks: Tenent hair on Tbt thin, approximately equal to or slightly longer than Emp, with tip acuminate or truncate on first pair and (slightly) clavate on last two pairs. Key: ZHANG et al. 2009.

Coecobrya magyari Chen, Wang & Christiansen, 2002

Body length up to 2.07 mm excluding antennae. Body colour white to pale yellow. For simplified formula of chaetotaxy see Fig. 530. Head: Antennal length less than two times the length of the head (Ant/head = 1.6–1.9), Ant IV without apical vesicle. Labral papillae absent. Labium chaetotaxy with Labial chaetotaxy: M, R, E, L_1 and L_2 smooth mac. Omma absent.

Tibiotarsus with inner differentiated chaetae finely ciliated (apparently smooth) (Fig. 47) with cilia moderately adpressed to axis of chaetae. Claw with 3 internal teeth: First pair at 38% distance from base of claw and 1 unpaired teeth at 59% distance from base. Dorsal tooth basal. Emp smooth on external edge on leg III, with an external tooth. Man dorsally with some long, straight, smooth chaetae on each side. Manubrial plate with 2 chaetae and 2 psp. Mucro falciform with basal spine.

Chaetotaxy: Simplified formula = 3-1-0-3-3-1b/3-3/0-3(4)/1-1-1/0-2(3)-0-2-3/0-0-1-1-2. Head: Areas H1, H2, H4, H4' and H5 as in Fig. 51, without S'_0. Thorax: Area T1 on Th II with 3 mac (m_1, m_2 and m_{2i} present) (Fig. 84). Area T2 on Th II with 3 mac present (Fig. 104).

Abdomen: Area A1 on Abd II without mac as in Fig. 123 and area A2 on Abd II with 3-4 mac as in Fig. 129 or 130. Abd III with 1 mac on areas A3 and A4, m_3 mac on A5 as in Fig. 149. Abd IV with 7(8)+7(8) dorsal mac and 4+4 lateral mac as in Fig. 170.

Type locality and material: Holotype female and paratypes 16 females, 2 males, Hungary: Pater K.: Gödöllö, 1996 and 2000.

Deposition of type material: Collection numbers 7934 and 9090, coll. István Kiss, NJU. Types not studied.

Occurrence. Hungary, cited by DÁNYI & TRASER 2008.

Biology: Collected from soil of indoor plants, then cultured in the laboratory.

Remarks: Abd III has 3+3 medial mac. Key and some characters added by ZHANG et al. (2009).

Coecobrya maritima Park, 2004

Body length up to 1.1 mm excluding antennae. Body colour white. For simplified formula of chaetotaxy see Fig. 531. Head: Antennal length less than two times the length of the head (Ant/head = 1.5), Ant IV without apical vesicle. Relative length of antennal segments Ant I/II/III/IV = 1/1.6/1.6/2.9. Labral papillae absent. Chaetotaxy of labium unknown. Omma absent.

Tibiotarsus with inner differentiated chaetae finely ciliated (apparently smooth) (Fig.171) with cilia moderately adpressed to axis of chaetae. Claw with 2 internal teeth: first pair at 20% distance from base of claw, without unpaired teeth; dorsal tooth absent. Emp smooth on external edge on leg III, with an external tooth. Man dorsally with some long, straight, smooth chaetae on each side. Mucro falciform with basal spine.

Chaetotaxy: Simplified formula = 2-1-0-3-2-1b/2-2/0-3/0-0-1/0-2-0-1-1/0-1-1-1-1.

Chaetotaxy as in *C. dubiosa* according to author's original description, Abd IV as in Fig. 161.

Type locality and material: Holotype female, Gyeongsangbuk do Province, Pohang si, Gooryongpo eup, Gooryongpo beach, Korea.

Deposition of type material: 16. V 2003, collection no. 203-13-2. Paratypes: 2 male and 3 female specimens, same data as holotype, CNUJ. Type not studied.

Occurrence: Korea.

Biology: Collected from a heap of seaweeds hauled up on coarse sand particles of intertidal zone. Halophilic.

Remarks: This species must be studied to see the chaetotaxy. Key: ZHANG et al. 2009.

Coecobrya montana (Imms, 1912)

Syn: *Aposinella montana* Paclt, 1971

Body length up to 2 mm excluding antennae. Body white. No chaetotaxy is given. Head: Omma and PAO absent. Antennal length 900 µm. Relative length of antennal segments Ant I/II/III/IV = 8/13/13/26; Ant IV tapering somewhat distally, IMMS (1912) does not mention the presence of an apical vesicle.

Claw with 4 internal teeth: first pair at 44% distance from base of claw and 2 unpaired teeth, first one at 69% distance from base. Dorsal tooth at basal position on the claw. Emp smooth with an external tooth on leg III (Fig. 172). Tibiotarsus with inner differentiated chaetae finely ciliated (apparently smooth). Length ratio of Abd IV/ III < 4 (2.9). Mucro falciform with basal spine reaching to tip of mucro.

Type locality and material: mountainside near Badrinath, Garhwal Himalaya, circa 3140 m asl, 27.V.1910, leg. IMMS.

Deposition of type material: Number 8606/16 Indian Museum collection.

Occurrence: Palaearctic, Himalaya, type locality. It was sampled, apparently, in Southwestern Indian Nilgiris Mountains (Kateri Valley and Coonoor), and these specimens have been described by HANDSCHIN (1929), but this record is far from the original locality and all the more in a tropical environment at 1600 m asl, quite different from the Himalaya.

Biology: Found in an ant nest at the type locality.

Remarks: Only twice recorded from India in two quite distant localities. YOSII (1971) synonymises this species with *C. hoefti*, but there are several differences between them: 3 internal teeth on the claw in

C. hoefti and 4 in *C. montana*, the first unpaired tooth is at 57% and 69% respectively and tenent hairs are clavate and acuminate respectively in each species. *C. montana* has a basal dorsal tooth on the claw. With these differences, I recommend that it should be regarded as a valid species until some new specimens could be sampled or the type material could be re-examined. I do not know if the material from India belongs to the same species. All the cited literature about this species is based only on these two records.

Coecobrya mulun Zhang, Qu & Deharveng, 2010

Body length up to 1.4 mm excluding antennae. Body colour violet–bluish, for colour pattern and simplified formula of chaetotaxy see Fig. 532. Head: Antennal length 500 µm, less than two times the length of the head (Ant/head = 1.6–1,9), Ant IV without apical vesicle. Relative length of antennal segments Ant I/II/III/IV = 1.0/ 1.5-1.8/1.3-1.5/2.3-2.5. Labral papillae absent. Prelabral and labral chaetae 4/5, 5, 4, all smooth. Labium chaetotaxy: -MREL$_1$L$_2$ all chaetae smooth, R smaller than M. 3 Omma present (2 anterior and 1 posterior).

Claw with 3 internal teeth: first pair at 50% distance from base of claw, and 1 unpaired tooth at 65% distance from base. Dorsal tooth absent. Emp smooth on external edge on leg III, without an external tooth. Length ratio of Abd IV/III = 3-3.6. Man dorsally without smooth chaetae on each side, manubrial plate 3 chaetae and 2 psp. Mucro falciform; mucronal spine present.

Chaetotaxy: Simplified formula = 2-1-0-3-3-0/3-4/1-2/0-0-1/0-0-1-1-1/0-1-2-2-1. Head: Areas H1, H2 as in Fig. 52, areas H4, H4' and H5 as in Fig. 55 , without S'$_0$. Thorax: Area T1 on Th II with 3 mac (m$_1$, m$_2$ and m$_{2i}$ present) (Fig. 84). Area T2 on Th II with 4 mac present (a$_5$, m$_4$, m$_{4p}$ and m$_{4i}$, without m$_5$) (Fig. 107). Abdomen: Area A1 on Abd II with a$_2$ mac present as in Fig. 124 and area A2 on Abd II, with 2 mac as in Fig. 128. Abd III with 1 mac on area A3 as in Fig. 138. Abd IV with 3+3 dorsal mac and 5+5 lateral mac as in Fig. 173.

Measurements in micrometres

Ant I	Ant II	Ant III	Ant IV	Ant	Head	Th II	Th III	Abd I
85	108	111	211	515	298	179	138	70
Abd II	Abd III	Abd IV	Abd V	Abd VI	Body	Man	Dens	Furca
76	116	336	101	58	1372	281	297	578

Type locality and material: China, Guangxi, Huanjiang, Mulun National Reserve, Min Li Forest.

Deposition of type material: sample number CHIgx05-102, 14.III.2005, DEHARVENG & BEDOS leg., Holotype female on slide. Paratypes: same data as holotype, 1 female on slide (NJU); 1 female on slide (MNHN). Type studied.

Occurrence: China.

Biology: In leaf litter of broadleaf forest.

Coecobrya oligoseta Chen & Christiansen, 1997

Body length up to 2 mm excluding antennae. Body colour white. For simplified formula of chaetotaxy see Fig. 533. Head: Antennal length of 900 µm, Ant IV without apical vesicle. Labral papillae absent. Labium chaetotaxy with M, R, E, L$_1$ and L$_2$ smooth mac. Omma absent.

Claw with 3 internal teeth: first pair at 46% distance from base of claw, and 1 unpaired tooth at 69% distance from base. Dorsal tooth approximately at half distance between claw basis

and internal pair of teeth. Emp with an external tooth on leg III. Man dorsally with some long, straight, smooth chaetae on each side. Manubrial plate with 3(2) chaetae and 2 psp. Mucro falciform with basal spine reaching to the tip of mucro.

Chaetotaxy: Simplified formula = 3-1-0-2-2-1b/3-4/0-3/0-0-1/0-2-0-1-1/0-1-1-1-2. Head: H1 and H2 as in Fig. 52, H4, H4' and H5 as in Fig. 53, without S'_0. Thorax: Area T1 on Th II with 3 mac (m_1, m_2 and m_{2i} present) (Fig.84). Area T2 on Th II with 4 mac (Fig. 107). Abdomen: Area A1 on Abd II without mac as in Fig. 123 and area A2 on Abd II with 3 mac as in Fig. 129. Abd III with 1 mac on A5 as in Fig. 138. Abd IV with 4+4 dorsal mac and 5+5 lateral mac as in Fig. 174.

Type locality and material: Holotype male, China: Jiangsu, Nanjing, Xuanwu Park, 4.VII.1990; paratypes 6 females, same data as holotype.

Deposition of type material: NJU. Types not studied.

Occurrence: China.

Biology: On grass.

Species description: CHEN & CHRISTIANSEN 1997, JORDANA & BAQUERO 2008.

Remarks: Key by ZHANG et al. 2009.

Coecobrya spinidentata (Yosii, 1942)

Bas: *Sinella höfti* var. spinidentata Yosii, 1942

Body length up to 1.6 mm excluding antennae, according to original description (studied type specimen: 1.94 mm). Body colour white, for simplified formula of chaetotaxy see Fig. 534.

Head: Antennal length 840 µm, less than two times the length of the head (Ratio Ant/head = 1.8), Ant IV without apical vesicle. Relative length of antennal segments Ant I/II/III/IV = 1.0/2.0/1.8/3.0. Labral papillae absent. Omma absent.

Claw with 3 internal teeth: first pair at 19% distance from base of claw, and 1 unpaired tooth at 28% distance from base. Dorsal tooth absent (Fig. 176). Emp with an external tooth on leg III. Length ratio of Abd IV/III = 2.7. Man dorsally with some long, straight, smooth chaetae on each side. Mucro falciform; mucronal spine present.

Chaetotaxy: Simplified formula = 3-1-0-3-3-1b/2-2/0-3/1-0-1/0-1-0-1-1/0-1-1-1-1. Head: Areas H1, H2, H4, H4' and H5 as in Fig. 51, without S'_0. Thorax: Area T1 on Th II with 2 mac (m_2 and m_{2e} present) (Fig. 77). Area T2 on Th II with 2 mac present (Fig. 100). Abdomen: Area A1 on Abd II without mac as in Fig. 123 and area A2 on Abd II with 3 mac as in Fig. 129. Abd III with 1 mac on area A3 and 1 on area A5 as in Fig. 147. Abd IV with 3+3 dorsal mac and 4+4 lateral mac as in Fig. 175.

Measurements in µm (from type specimen):

Ant I	Ant II	Ant III	Ant IV	Ant	Head	Th II	Th III	Abd I
130	200	190	320	840	400	200	160	100
Abd II	Abd III	Abd IV	Abd V	Abd VI	Body	Man	Dens	Furca
200	180	500	120	80	1940	–	–	–

Type locality and material: Lectotype: Japan, Kyoto, Sizusi Cave, 20.X.1939.

Deposition of type material: Type studied.

Occurrence: Kaza Ana. Suzuka, Siga (1 specimen, 24.V.1952, UÉNO leg.), Koti Kaza Ana, Seritani Mura, Siga (3 specimens, 25.V.1952, UÉNO leg.), Suse no Dja Ana, Ishimaki Mura, Aiti (5 specimens, 15.VI.1952, YOSII et al. leg.), ibid. (3 specimens, 5.VI.1954, UÉNO leg.), Kugo Do, Taniai Mura, Gifu (15 specimens, 14.V.1952, YOSII et al. leg.), ibid. (8 specimens, 7.VI.1954, UÉNO leg.).

Biology: in caves.

Species description: YOSII 1942, JORDANA & BAQUERO 2008.

Coecobrya submontana (Stach, 1960)

Body length up to 3 mm excluding antennae. Body colour white.

Head: Antennal length 2–3 times the length of the head (Ant/head = 2.4), Ant IV without apical vesicle. Relative length of antennal segments Ant I/II/III/IV = 2/4/4/5.2. Labral papillae absent. Omma absent.

Tibiotarsus with inner differentiated chaetae finely ciliated (apparently smooth) (Fig. 47) with cilia moderately adpressed to axis of chaetae. Claw with 4 internal teeth: first pair at 50% distance from base of claw, and 2 unpaired teeth, first one at 72% distance from base and the most distal one minute. Dorsal tooth approximately at half distance between claw basis and internal pair of teeth. Emp with an external tooth on leg III, tenent hair expanded (Fig. 177). Mucro falciform, mucronal spine present, not reaching to the tip of mucro.

The description of STACH is quite short. *C. submontana* is one of the two species of the genus with 4 teeth on claw; *C. submontana* is separated from other species by the presence of tenent hairs.

Type locality and material: Afghanistan, Tchehel Tan Cave, Kabul, 4.X.1957.

Deposition of type material: 8 specimens (lost).

Occurrence: Type locality and Kouh-Mostoufi Cave, near Robat (Ghazni), 12.V.1958, 1 specimen; Darreh-Chakh (Beltchiragh), under a stone in a walnut wood, 29.X.1957, 1 specimen; Kouh-Nayak (near pole–Ranga, Ghourband Valley), 2100 m asl, under a stone near the stream, 12.V.1959, 1 specimen.

Biology: In caves and in soil.

Key: ZHANG et al. 2009.

Remarks: The type specimens are not in STACH's collection and are probably lost.

Coecobrya tenebricosa (Folsom, 1902)

Syn: *Sinella caeca* Christiansen & Bellinger 1980, 1992 ad partem
Sinella caeca Christiansen & Redell, 1986; nec *S. caeca* Schött 1896
Sinella ciliata Denis, 1932; synonymised by ZHANG et al 2009

Body length up to 2 mm excluding antennae. Body colour white, for simplified formula of chaetotaxy see Fig. 535. Head: Antennal length less than 2 times the length of the head (Ratio Ant/head = 1.4–2.3), Ant IV without apical vesicle. Relative length of antennal segments Ant I/II/III/IV = 1.5/2.1/2/4. Labral papillae absent. Labium chaetotaxy with M, R, E, L_1 and L_2 as smooth mac. Omma absent.

Tibiotarsus with inner differentiated chaetae finely ciliated (apparently smooth) (Fig. 47) with cilia moderately adpressed to axis of chaetae. Claw with 3 internal teeth: first pair

at 33% distance from base of claw, and 1 unpaired tooth at 60% distance from base. Dorsal tooth absent. Emp with an external tooth on leg III. Length ratio of Abd IV/ III < 4 (3.04). Man dorsally with some long, straight, smooth chaetae on each side. Manubrial plate with 2 chaetae and 2 psp. Mucro falciform with basal spine reaching to the tip of mucro (Fig. 178).

Chaetotaxy: Simplified formula = 3-1-0-2-2-1b/3-3(4)/0-3/0-0-1/0-2-0-1-1/0-0-1-1-1. Head: Areas H1 and H2 as in Fig. 51, H4 and H4' as in Fig. 53, H5 as in Fig. 51, without S'_0. Thorax: Area T1 on Th II with 3 mac (m_1, m_2 and m_{2i} present) (Fig.84). Area T2 on Th II with 3 or 4 mac present (Fig. 104, 107). Abdomen: Area A1 on Abd II without mac as in Fig. 123 and area A2 on Abd II with 3 mac as in Fig. 129. Abd III with 1 mac on A5 as in Fig. 138. Abd IV with 4+4 dorsal mac and 3+3 lateral mac as in Fig. 179.

Type locality and material: Originally 24 specimens have been described from sample, but only 10 are currently available: 4 females, 1 male, 5 ?, USA, District of Columbia, graves, 1896, M.G. MOTTER leg.

Deposition of type material: NMNH type number 6146.

Material studied: Cova des Pas de Vallgonera (Sala dês Gorg): 1 specimen, 17.II.2007, M. VADELL leg., (MZNA); (Sala de les Arrels): 9 specimens, 17.II.2007, M. VADELL leg., (7 specimens at MZNA and 2 specimens at CMV, reg. no 170207–1).

Occurrence: Cosmopolitan.

Biology: In caves and in soil.

Species descriptions: CHRISTIANSEN & BELLINGER 1980, CHRISTIANSEN & REDDELL 1986, VADELL et al. 2007, ZHANG et al. 2009.

Remarks: This species has been erroneously identified as *C. caeca*. The drawing comes from a specimen from a cave in Mallorca (Spain).

Coecobrya tibetensis Chen & Christiansen, 1997

Body length up to 2 mm excluding antennae. Body colour white. For simplified formula of chaetotaxy see Fig. 536. Head: Antennal length less than 2 times the length of the head (Ratio Ant/head = 1.7–2.1), Ant IV without apical vesicle. Labral papillae absent. Labium chaetotaxy with M; R, E, L_1 and L_2 as smooth mac. Omma absent.

Tibiotarsus with inner differentiated chaetae finely ciliated (apparently smooth) (Fig. 47) with cilia moderately adpressed to axis of chaetae. Claw with 3 internal teeth: first pair at 37% distance from base of claw, and 1 unpaired tooth at 67% distance from base. Dorsal tooth approximately at half distance between claw basis and internal pair of teeth. Emp with an external tooth on leg III. Manubrial plate with 4 mac and 2 psp. Mucro falciform; mucronal spine present reaching to the tip of mucro.

Chaetotaxy: Simplified formula = 3-1-0-3-3-1b/1-4/0-7(5)/0-1-1/0-3(4)-1-2-2/0-1-2-1-2. Head: H1, H2, H4, H4' and H5 as in Fig. 51, without S'_0. Thorax: Area T1 on Th II with 1 mac (m_1 present) (Fig. 78). Area T2 on Th II with 4 mac present (Fig. 107). Abdomen: Area A1 on Abd II without mac as in Fig. 123 and area A2 on Abd II with 7 mac as in Figs 133–135 (could be 5–7). Abd III with 1 mac on areas A4 and A5 as in Fig. 140. Abd IV with 8(10)+8(10) dorsal mac and 6+6 lateral mac as in Fig. 180.

Type locality and material: Holotype: China, Tibet, Jilongtuodang, 3300 m asl, 4.VIII.1975, HUANG FU–SHENG leg.; paratypes: 3 males, 4 females, same data as holotype.

Deposition of type material: NJU. Types not studied.

Occurrence: China, Tibet.

Biology: Unknown.

Key: ZHANG et al. 2009, including a comparison with *C. lanna* and *C. magyari*.

Remarks: This species is easily distinguishable from all other species of the genus by its dorsal chaetotaxy on abdomen II–IV. More mac are present on abdomen II and IV than in any other examined member of this genus.

Coecobrya tibiotarsalis Yosii, 1964

Body length up to 2 mm excluding antennae. For body colour pattern and simplified formula of chaetotaxy see Fig. 537. Head: Antennal length 606 µm, less than 2 times the length of the head (Ratio Ant/head = 1.5), Ant IV without apical vesicle. Relative length of antennal segments Ant I/II/III/IV = 1.2/1.6/0,8/2.4. Without labral papillae. Omma absent.

Tibiotarsus with inner differentiated chaetae finely ciliated (apparently smooth) (Fig. 47), with cilia moderately adpressed to axis of chaetae. Claw with 3 internal teeth: first pair at 43% distance from base of claw, and 1 unpaired tooth at 57% distance from base. Dorsal tooth absent. Emp smooth on external edge on leg III, with an external tooth. Length ratio of Abd IV/III < 4. Length of Man+dens = 700 µm. Man dorsally with some long, straight, smooth chaetae on each side. Manubrial plate with 3 chaetae and 2 psp. Mucro falciform, with basal spine.

Chaetotaxy: Simplified formula = 3-1-0-3-2-1b/2-2/0-1/0-0-1/0-1-0-1-1/0-0-1-1-1. Head: H1, H2 and H4 as in Fig. 51, H4' as in Fig. 54, H5 as in Fig. 51, without S'_0. Thorax: Area T1 on Th II with 2 mac (m_1 and m_2 present) (Fig. 82). Area T2 on Th II with 2 mac present (Fig. 111). Abdomen: Area A1 on Abd II without mac as in Fig. 123 and area A2 on Abd II with 1 mac as in Fig. 126. Abd III with 1 mac on area A5 as in Fig. 138. Abd IV with 3+3 dorsal mac and 3+3 lateral mac as in Fig. 181.

Measurements in µm (from type specimen):

Ant I	Ant II	Ant III	Ant IV	Ant	Head	Th II	Th III	Abd I
120	166	80	240	606	429	200	170	120
Abd II	Abd III	Abd IV	Abd V	Abd VI	Body	Man	Dens	Furca
150	220	460	160	80	1989	300	400	700

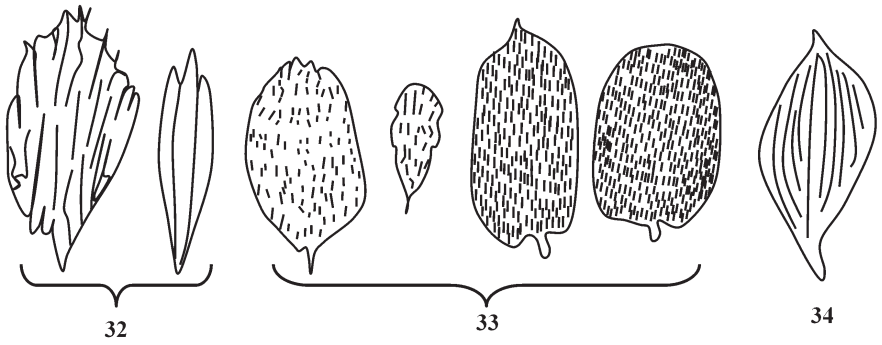
Type locality and material: Japan, 28 specimens Ohtani Mine, Kiura, Pref. Oita, 27.III.1955, YOSII leg.

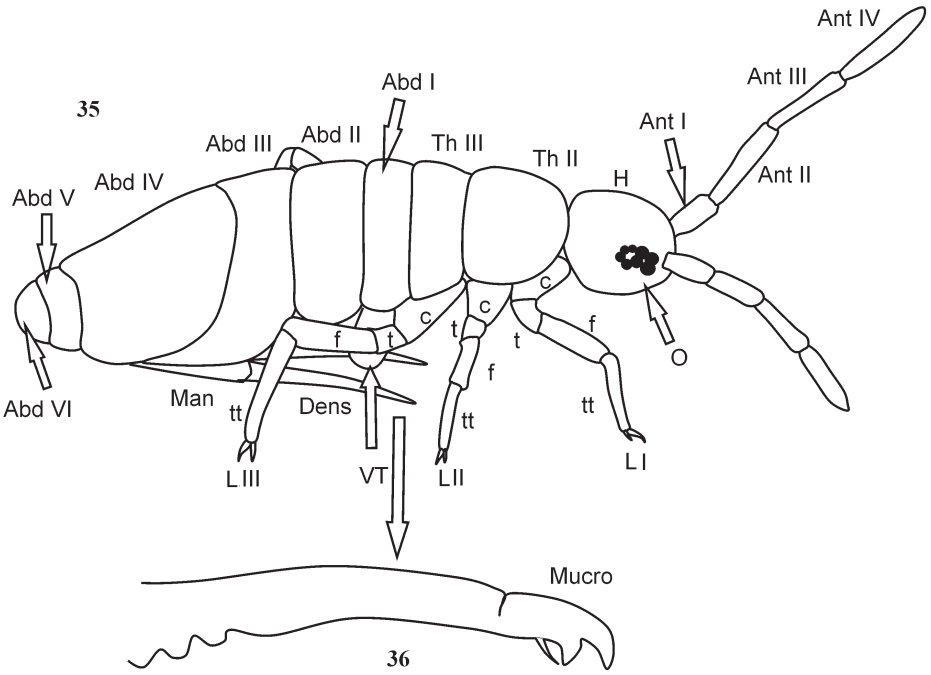
Deposition of type material: NHMG. Type studied.

Occurrence: This species is widely distributed in the southern part of Japan.

Biology: in caves.

Species descriptions: YOSII 1964, JORDANA & BAQUERO 2008, Key: ZHANG et al. 2009.





Figs 32–34 Types of scales of Seirini (**32**), Lepidocyrtini (**33**), Willowsiini (**34**) (after SOTO-ADAMES et al. 2008).

Fig. 35 Habitus of an *Entomobrya* sp., without colour (Ant, antennal segments I, II, III and IV, head (H), Omma (O), thoracic segments II and III (Th), abdominal segments I–VI (Abd), legs 1, 2 and 3 (L), coxa (c), trochanter (t), femur (f), tibiotarsus (tt), manubrium (Man), ventral tube (VT).

Fig. 36 Distal part of dens and mucro.

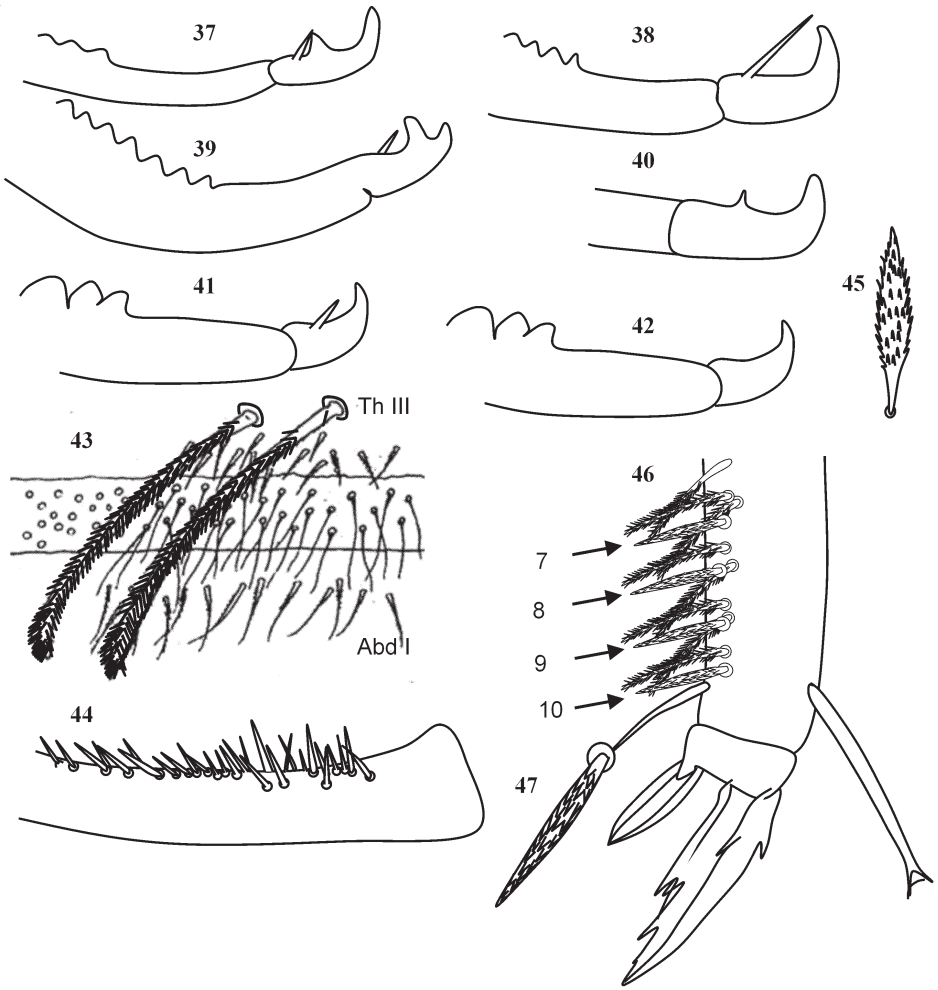


Fig. 37 Mucro of *Sinella*.
Fig. 38 Mucro of *Coecobrya*.
Fig. 39 Mucro of *Entomobrya*.
Fig. 40 Mucro of *Mesentotoma*.
Fig. 41 Mucro of *Drepanura*.
Fig. 42 Mucro of *Calx*.
Fig. 43 Intersegmental membrane with microtricha of *Marginobrya marginifera* (modified after YOSHII 1992).
Fig. 44 Dental spines of *Homidia*.
Fig. 45 Scale-like seta of *Himalanura*.
Figs 46–47 'Smooth setae' of *Entomobryoides*.