

One new genus and two new species of Helotrephidae (Insecta: Heteroptera) from India, with notes on the phylogeny of the family

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Abstract

One genus and two species of Helotrephidae are described as new from Kerala, South India. *Fischerotrephes indicus* sp.n. is the first record of the genus for the Indian Region; *Fischerotrephes* ZETTEL, 1994, has previously been recorded from Peninsular Malaysia and Borneo. *Indotrephes bufula* gen.n. et sp.n. is provisionally placed in the subfamily Idiocorinae, which so far has been known only from Africa. The phylogenetic relations between the taxa Idiocorinae, Helotrephinae, Helotrephini, and Limnotrephini are discussed. The monophyly of Limnotrephini and Helotrephinae in the present sense is doubtful, because Idiocorinae may be a derived group of Limnotrephini.

Key words: Helotrephidae, Fischerotrephinae, Idiocorinae, Helotrephinae, Helotrephini, Limnotrephini, *Fischerotrephes*, *Indotrephes*, new genus, new species, morphology, phylogeny, India, Kerala.

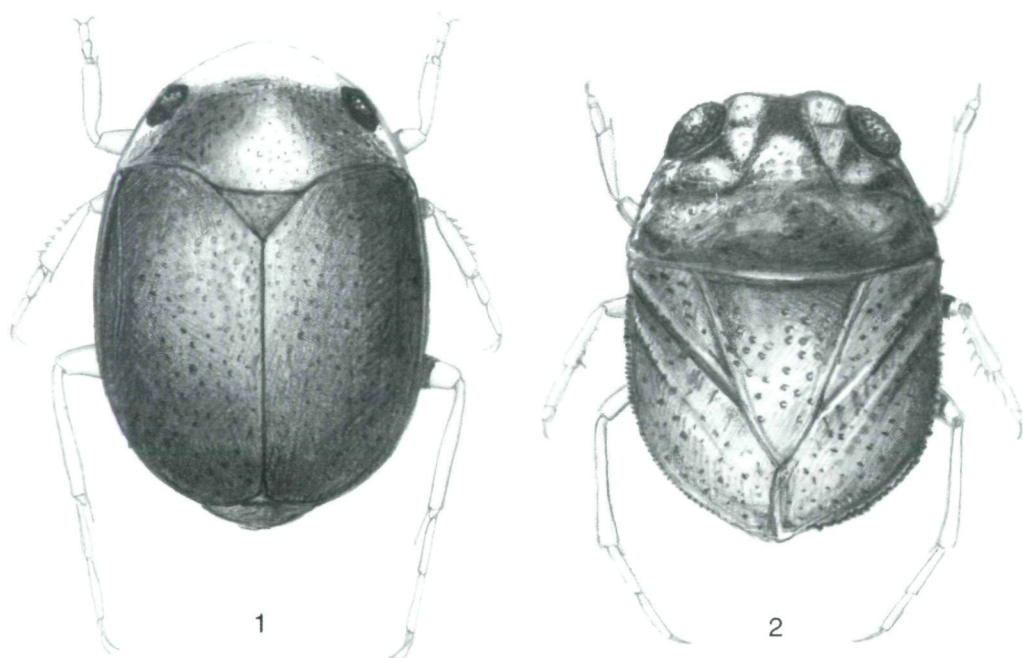
Zusammenfassung

Eine Gattung und zwei Arten der Familie Helotrephidae werden aus Kerala (Südindien) neu beschrieben. *Fischerotrephes indicus* sp.n. ist der Erstnachweis der Gattung für die indische Subregion; *Fischerotrephes* ZETTEL, 1994, ist bisher nur aus Westmalaysia und Borneo gemeldet. *Indotrephes bufula* gen.n. et sp.n. wird vorläufig der Unterfamilie Idiocorinae zugeordnet, die bisher nur aus Afrika bekannt gewesen ist. Die phylogenetischen Beziehungen zwischen den Taxa Idiocorinae, Helotrephinae, Helotrephini und Limnotrephini werden diskutiert. Die Monophylie der Limnotrephini und Helotrephinae im derzeitigen Sinne wird in Frage gestellt, da die Idiocorinae möglicherweise eine abgeleitete Gruppe der Limnotrephini sind.

Introduction

Helotrephidae are small aquatic Heteroptera which probably evolved from pleid-like ancestors. They mainly occur in tropical areas, highest species diversity is found in the Oriental Realm, but a few species are also described from Africa, Madagascar, South America, and two species even from the southern Palaearctic Realm (see catalogue in POLHEMUS 1990). In contrast to the richness of Southeast Asia, especially Indochina and the Malayan Archipelago, only four species are known from the Indian Region: *Hydrotrepes kirkaldyi* (ESAKI & CHINA, 1928) (Sri Lanka), *Limnotrepes campbelli* ESAKI & CHINA, 1928 (North India, ? Sri Lanka), *L. kumaonis* POLHEMUS, 1990 (North India, Nepal), and *Tiphotrephes indicus* (DISTANT, 1910) (India, Myanmar, Thailand, Malaysia) (distributional data from POLHEMUS 1990 and ZETTEL 1995); all these species belong to the subfamily Helotrephinae sensu auctt.

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Figs. 1 - 2: Habitus of (1) *Fischerotrephes indicus* sp.n. and (2) *Indotrephes bufula* gen.n. et sp.n.

ZETTEL (1994) has described the new genus *Fischerotrephes* and the subfamily Fischerotrephinae based on two undescribed species from Borneo and Peninsular Malaysia. These cryptic living species were found in fine gravel sediments on the beds of brooks. A single specimen of a third species from Kerala (South India) was given to the author by Czech collectors and is described below.

Further, six specimens from the same locality, which belong to an unknown helotrephid genus, were presented to the author. This species, here described as *Indotrephes bufula* gen.n. et sp.n., is provisionally placed in the subfamily Idiocorinae ESAKI & CHINA, 1927. Up to now two Idiocorinae species are known: *Idiocoris lithophilus* ESAKI & CHINA, 1927, and *Paskia minutissima* ESAKI & CHINA, 1927. Both species occur in East and Central Africa (Tanzania, Zaire).

MAHNER (1993) has discussed the phylogenetic system of the family Helotrephidae. Following this analysis, *Indotrephes* gen.n. belongs to the Idiocorinae because of the following two synapomorphies: (1) cephalonotum without W-shaped cephalonotal sulcus, (2) body dorsoventrally flattened. Spiracles (which are closed in Idiocorinae) could not be detected on the laterosternites of *Indotrephes* gen.n. by means of SEM-investigations. The antenna in *Indotrephes* is two-segmented, but those of *Idiocoris* and *Paskia* are one-segmented. Further, *Indotrephes* gen.n. has the typical long and narrow meso-scutellum and a straight lateral margin of the pronotal part of the cephalonotum (concave in other Idiocorinae, convex in Helotrephinae), both typical of Idiocorinae. Pectinate bristles have been observed on the middle femur. An inverse U-shaped part of the cephalo-

notal sulcus, regarded as typical of Idiocorinae by PAPÁČEK & al. 1988), is lacking in *Indotrephes* gen.n. Differences between the presently known genera of Idiocorinae are discussed below. All examined specimens of *Indotrephes bufula* sp.n. are macropterous. As macropterous Idiocorinae were unknown before, knowledge about these morphs provides new hints as to the phylogenetic relationships among Helotrephinae, Idiocorinae, and Trephotomasinae. Some of these aspects are treated in the discussion part.

All types are deposited in the Natural History Museum Vienna.

Acknowledgements

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Fischerotrephes indicus sp.n. (Figs. 1, 3)

Holotype (♀, brachypterous): "S-INDIA Kerala\ Cardamom Hills 1000m\ 15 km SW Munnar\ Kallar Valley (K1)", "6.-18.12.1993\ 76°58'E/10°02'N\ Boukal D. +\ Kejval Z. lgt."

Description: Body length 1.6 mm; maximum body width (just behind middle of length) 1.08 mm; body with ovate shape (Fig. 1), depressed (but less than in other species of the genus).

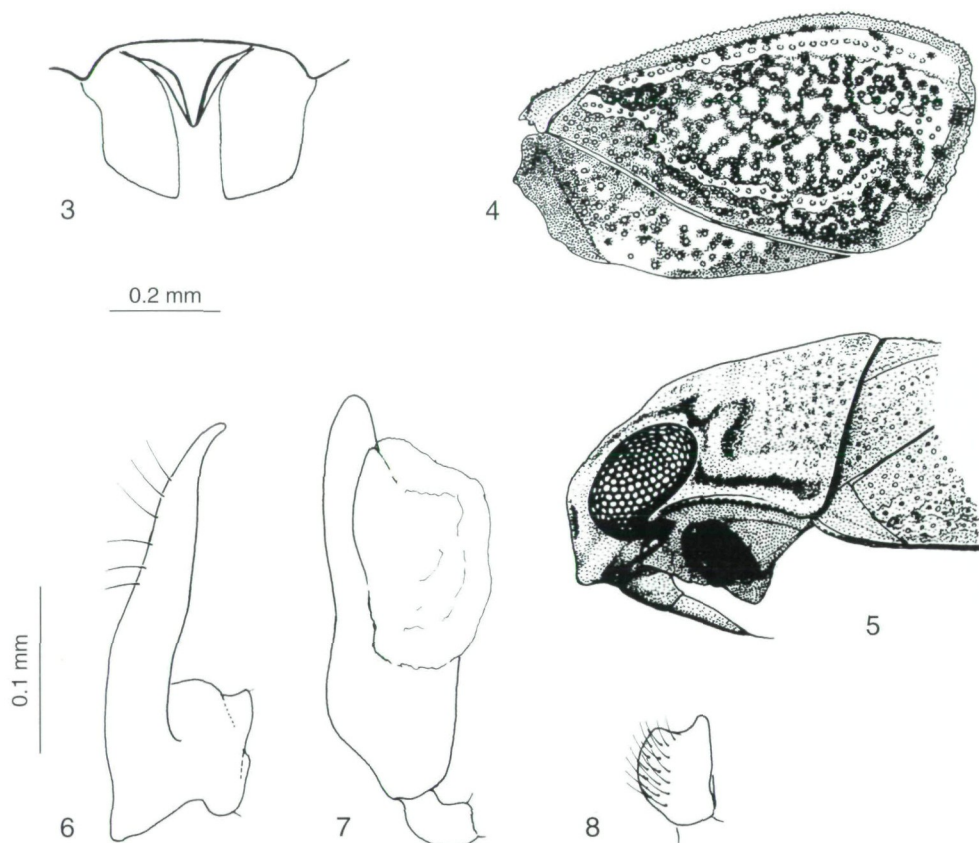
Colour dorsally dark brownish except head in front of eyes, along lateral margins, and a roundish mark in middle of posterior part of cephalonotum yellowish; ventrally yellowish (Fig. 1); legs yellow.

Cephalonotum: Maximum width (at hind corners) 1.42 times as long as median length; lateral margins slightly but evenly convex; hind corners acute (nearly as in *F. jaechi*); with sparse punctuation and shining medio-posteriorly, but rugous and dull anteriorly and laterally; mesoscutellum small, triangular.

Hemelytron with strong punctuation and faint rugosity medially, becoming more distinct laterally (= costally); with thin inconspicuous hairs; with long and sharp ridge parallel to costal margin; hemelytra rounded posteriorly and therefore separated caudally.

Ventral aspect very similar to that of *F. depressus* (see ZETTEL 1994: figs. 7 - 10), except for the following characters: keels of sternite 2 fused in anterior third; sternite 7 with a longer and narrower tip (Fig. 3).

Discussion and comparative notes: Only two species of *Fischerotrephes* have been described before: *Fischerotrephes depressus* ZETTEL from Borneo (Sarawak) and *F. jaechi* ZETTEL from Peninsular Malaysia (ZETTEL 1994). *Fischerotrephes indicus* sp.n. corresponds to both species in all important (generic) characters but differs in dorsal colour pattern, a broader and less flat body, and posteriorly rounded hemelytra. Body length (1.6 mm) is slightly larger than that of *F. depressus* (1.45 - 1.55 mm) and distinctly larger than that of *F. jaechi* (1.3 mm). Female sternite 7 is longer than that of *F. depressus* but of similar shape (♀ of *F. jaechi* is unknown). In dorsal sculpture, *F. indicus* sp.n. is



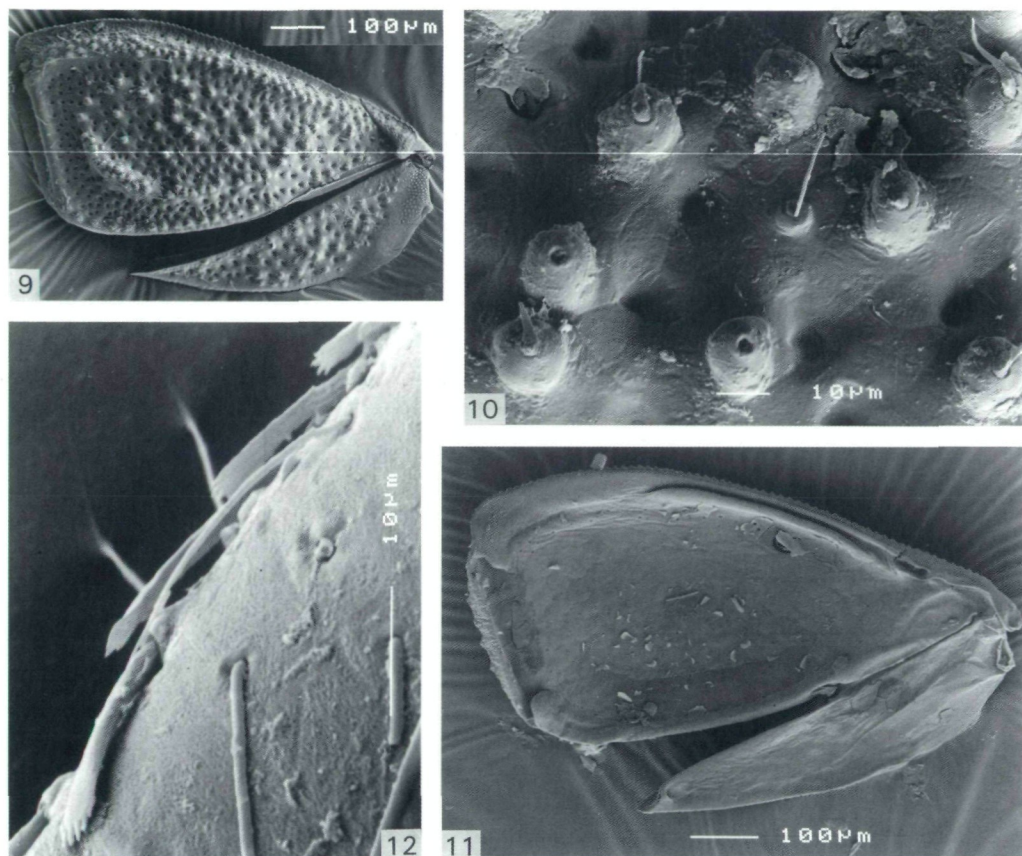
Figs. 3 - 8: (3) *Fischerotrephes indicus* sp.n., female: sternite 7 between the large, appendage-like laterotergites 7; 4 - : *Indotrephes bufula* gen.n. et sp.n., male: (4) Head and prothorax in lateral view; (5) hemelytron; (6) left paramere; (7) aedeagus; (8) right paramere.

more similar to *F. jaechi*, from which it differs in the lateral margin of the cephalonotum, which is slightly convex behind eyes, and the hemelytron, which is less dull and bearing only thin and sparse hairs.

Indotrephes gen.n.

Type species: *Indotrephes bufula* sp.n.

Diagnosis: Small, body length about 1.2 mm; body dorsoventrally flattened, dorsally coarsely sculptured; cephalonotum rather small, behind head with straight lateral margins; head not separated from pronotum by a suture; eye large, distinctly protruding from surface of head (Fig. 2), interrupting lateral margin of cephalothorax which indents the eye in posterior half (Fig. 5); antenna two-segmented; rostrum reaching posterior corner of pronotal keel, only the two distal segments clearly visible (Fig. 5); scutellum long and narrow; hemelytron with two ridges (consisting of tubercles) and several tubercles



Figs. 9 - 12: *Indotrephes bufula* sp.n., ♂, SEM-photos: (9) Left fore wing; (10) tubercles with sensory organs on fore wing; (11) right fore wing, internal view, showing locking mechanism; (12) pectinate hairs on dorsal margin of mesofemur.

each bearing a short hair (Figs. 9 - 10); macropterous morph with claval suture, which is nearly pointing to apex of mesoscutellum (in rest position, Fig. 2), and with separated embolium; costal margin of hemelytron finely serrate (Fig. 4); propleural plate partly separated from pronotal plate, both at same level; propleural plate medially narrowed and acuminate (Fig. 5); thoracic median keel simple, sharp and low; abdominal keel low, extending to abdominal sternite 4; tarsal formula 1-1-2; claws of fore tarsus subequal in length; mesofemur basoventrally with several stout spines, dorsally with pectinate bristles (Fig. 12); male genitalia: right paramere reduced, very small (Fig. 8); left paramere long, with slender distal part (Fig. 6); female sternite 7 symmetrical, broadly triangular.

Comparative notes: The phylogenetic position of *Indotrephes* gen.n. is discussed below; it will be shown that *Indotrephes* gen.n. belongs to a group of genera containing the Limnotrephini and Idiocorinae as presently defined by different authors (PAPÁČEK & al. 1988, POLHEMUS 1990, MAHNER 1993). *Indotrephes* gen.n. differs from Limnotrephini in the dorsoventrally flattened body, the lack of a cephalonotal sulcus, and the long and

narrow mesoscutellum. It can be distinguished from the idiocorine genera *Idiocoris* and *Paskia* by the following characters: postero-lateral margin of cephalonotum straight, antenna two-segmented (? - see discussion below), and hemelytron with irregular ridges and tubercles.

Further, *Indotrephes* gen.n. differs from all presently known genera of Helotrephidae in the reduced, very small right paramere of the males, and from most genera (except *Neotrephes* CHINA, 1936, with the primitive tarsal formula 3-3-3) in the coarsely sculptured dorsal surface, especially that of the hemelytra, and in the slightly elevated dorsal part of the eyes.

Etymology: "*Indo*" from India; and "*trephes*" (latinized form of the Greek word "*trephos*" = inhabitant), traditionally used for generic epithets within the family Helotrephidae. Gender: masculine.

***Indotrephes bufula* sp.n.** (Figs. 2, 4 - 14, 17, 18)

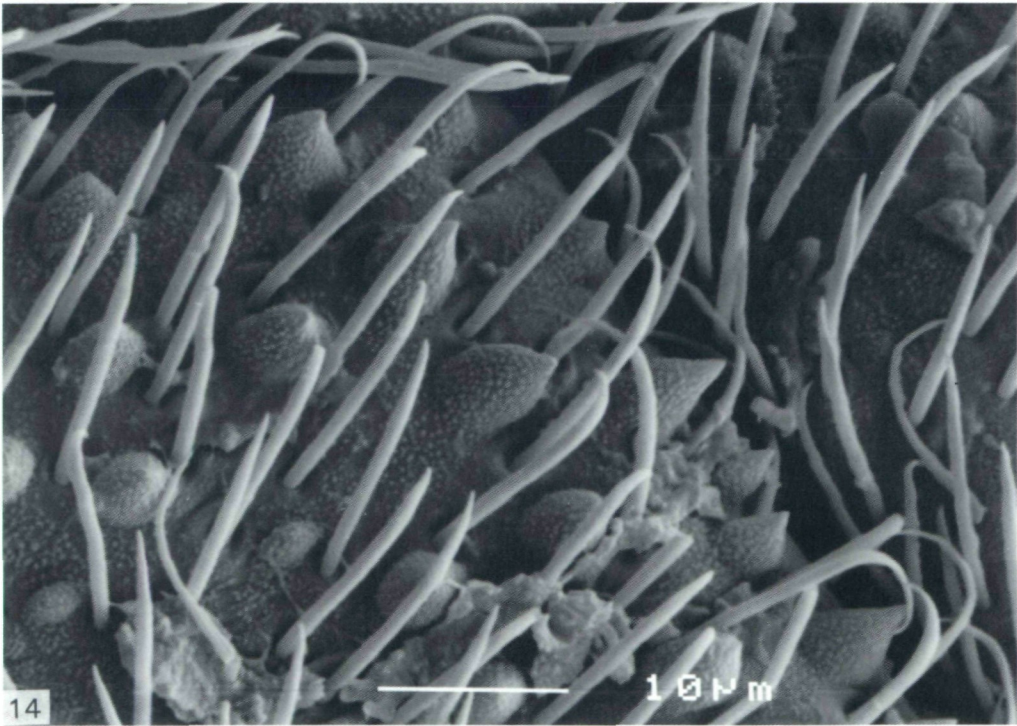
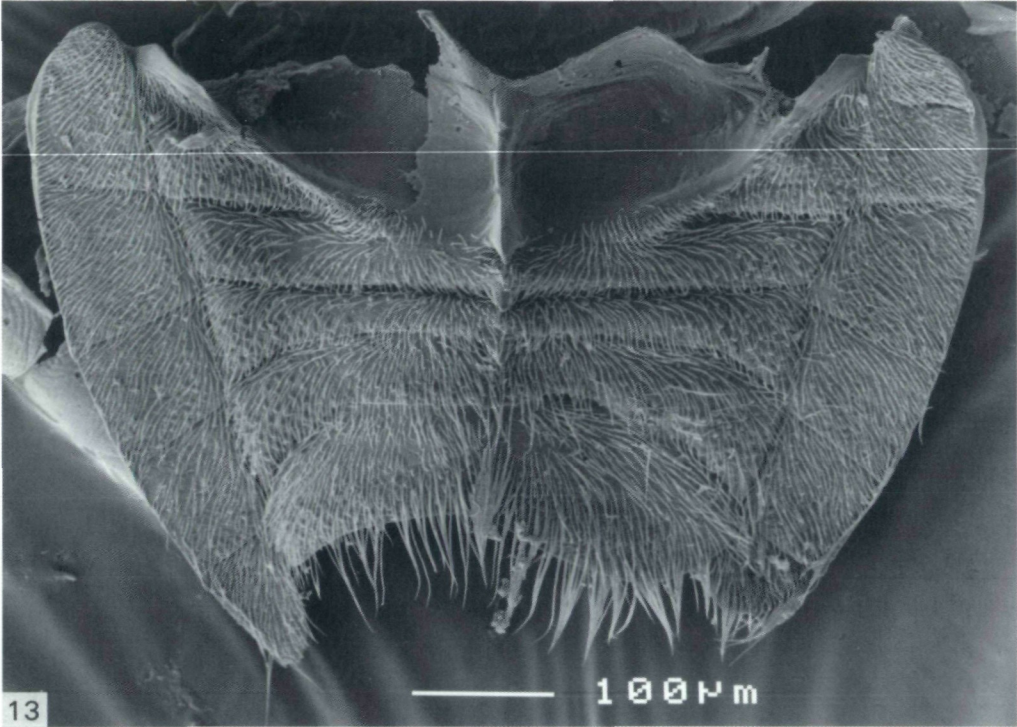
Holotype (macropterous ♂): "S-INDIA Kerala\ Cardamom Hills 1000m\ 15 km SW Munnar\ Kallar Valley (K2)", 6.-18.12.1993\ 76°58'E/10°02'N\ Boukal D. +\ Kejval Z. lgt."; **paratypes:** 1 ♂, 3 ♀♀ (macropterous), same locality data as holotype except sampling site number "(7)"; 1 ♂ (macropterous) same locality data as holotype except "(K1)".

Description: Macropterous morph: Body length 1.15 - 1.20 mm; maximum body width (just behind middle of length) 0.78 - 0.82 mm; body ovate, depressed, completely dull.

Colour dorsally yellow, with numerous small confluent blackish spots, which gives the specimen a brownish appearance (hemelytron: see Fig. 4); only head with more clear colour pattern with two black median stripes which are connected with posterior margin of eyes (Fig. 2); ventrally yellow to brownish, abdominal sternites and lateral plates blackish; legs yellow.

Cephalonotum: strongly punctate, especially in pronotal area; maximum width (at hind corners) 1.25 times as long as median length in dorsal view; unevenly sculptured, with a transverse elevation between anterior margin of eyes, shallow grooves behind eyes and longitudinal bulges parallel to postero-lateral margin (Fig. 2); anterior part (in front of eyes) strongly deflected (Fig. 5), anterior margin parabolic, slightly raised; postero-lateral margin nearly straight (Fig. 2), weakly serrate, indenting the eye in posterior half (Fig. 5). Eye large, dorsally distinctly raised from surface of head (Fig. 2); rostrum rather short, extending to apex of pronotal keel; antenna two-segmented, in a shallow groove postero-medially of eye (Fig. 5). Mesoscutellum triangular, long, 1.1 times as long as width at base, uneven, coarsely punctate (Fig. 2). Hemelytron (winged morph) with separated clavus and embolium, with denticulate area at base, with serrate lateral (= costal) margin (Fig. 4); corium very uneven, with numerous "pores" which are surrounded by blackish spots; with two more distinct ridges, one parallel with costal margin and one parallel with claval suture, and with some smaller raised dimples in apical part (Figs. 9 - 10); pseudomembrane reduced to a narrow apical stripe; ala thin, transparent, veins not sclerotized, venation as in other helotrephids.

Figs. 13 - 14: *Indotrephes bufula* sp.n., ♂, SEM-photos: (13) Sternites and laterosternites (posterior segments lacking); (14) microstructures on lateral part of sternite 3.



Ventral aspect (see also generic description): Pronotal keel very sharp, rather low, posteriorly obtusely rectangular (Fig. 5); mesosternal keel anteriorly low, then abruptly raised; metasternal keel evenly raised, with acute tip; keel on sternite 2 with acute tip, on sternite 3 very low; sternite 4 medianly slightly raised, only on posterior margin with low keel. Ventral keel similar in both sexes. Sternites with short, semierect pubescence (Fig. 13).

Male genitalia: Aedeagus broad, with obtuse tip (Fig. 7); left paramere long and narrow, with broad base and long, slender apical part bearing a few erect hairs posteriorly (Fig. 6); right paramere extremely reduced, about one fourth as long as left paramere, with an acute anterior tip and a posterior lobe, posteriorly densely set with short hairs (Fig. 8).

Female sternite 7 symmetrical, broadly triangular, with slightly convex sides.

Brachypterous morph unknown.

Comparative notes: As *Indotrephes* gen.n. is monotypic, the generic differences are also diagnostic for *Indotrephes bufula* sp.n.. But, as a comparison with another taxon of the same rank may be required by ICZN¹, for formalistic reasons *Indotrephes bufula* sp.n. is compared with *Idiocoris lithophilus*: *Indotrephes bufula* sp.n. can be distinguished from this species e.g. by the anteriorly strongly deflected cephalonotum, the straight lateral margin of the cephalonotum behind the eye, the coarse sculpture of the hemelytron, and the structure of the male genitalia, especially by the small right paramere.

Etymology: "*bufula*", Latin, diminutive form of "*bufo*", = small toad; named after the dorsal appearance which is strikingly similar by colour, slightly raised eyes, and coarse sculpture (e.g. the lateral ridges of cephalonotum "imitating" the ear glands) to the Common Toad (*Bufo bufo* L.); used as a noun in apposition.

Discussion

The position of *Indotrephes bufula* sp.n. within the Idiocorinae is uncertain, because all the characters supporting this thesis may be regarded either as plesiomorphic or as "Lebensform-Merkmale" sensu REMANE (1943). MAHNER (1993) gives a discussion of the arrangement of the helotrephid subfamilies, stating that the monophyly of "Helotrephinae?+Idiocorinae" is proved by two characters, i.e. the tarsal formula 1-1-2 (reduction of segments) and the elongated mesoscutellum. Both characters are present in *Indotrephes bufula*.

Following MAHNER (1993), the subfamily Idiocorinae is justified by four autapomorphies: (1) Cephalonotum without w-shaped sulcus, i.e. head and pronotum completely fused, (2) (?) antenna one-segmented, (3) spiracles closed, (4) body (secondarily) dorsoventrally flattened.

Characters of *Indotrephes* are as follows: (1) Cephalonotum without sulcus (may be due to the coarsely sculptured dorsal surface of cephalonotum). (2) Antenna two-segmented: MAHNER (1993) suspects that the one-segmented antenna of Idiocorinae may be a character of brachypterous and micropterous morphs as in *Neotrephes* (see CHINA 1940).

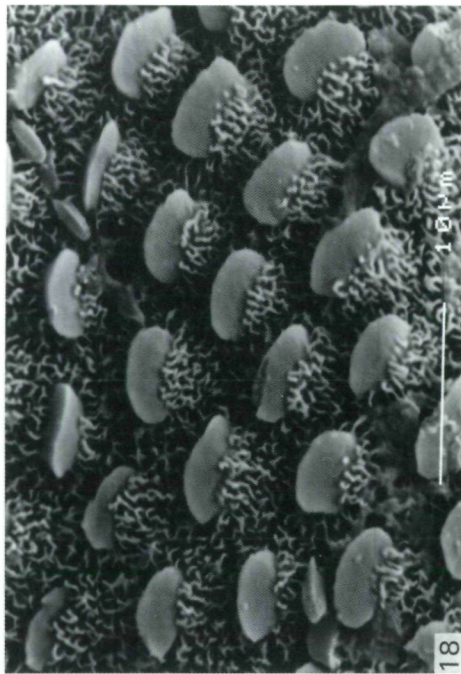
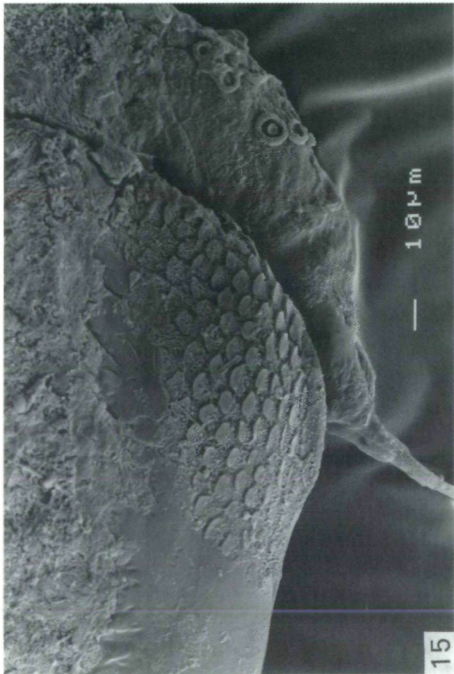
¹ see: "Discussion Draft of the Fourth Edition of the International Code of Zoological Nomenclature" (1995) published by the International Code of Zoological Nomenclature in the Bulletin of Zoological Nomenclature 52(2) Art 16a (Example).

All examined specimens of *Indotrephes* are macropterous so that, at present, this character cannot be evaluated. (3) Even by SEM-studies no spiracles could be detected on the laterosternites (Fig. 13). (4) Body dorsoventrally flattened.

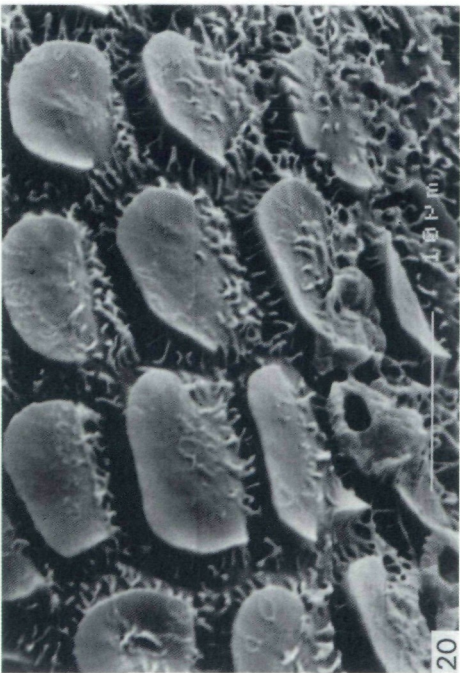
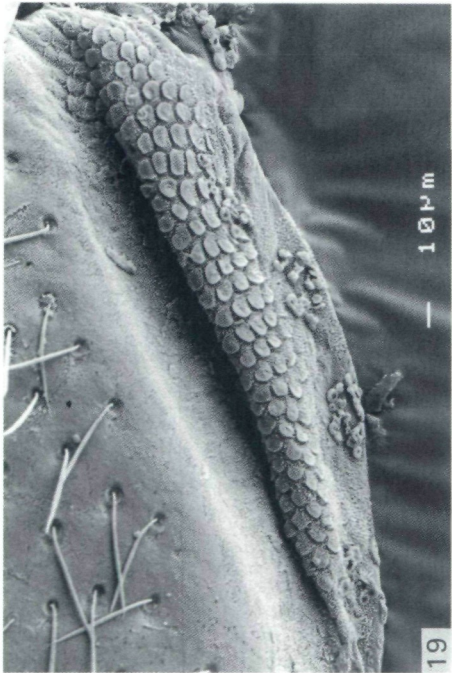
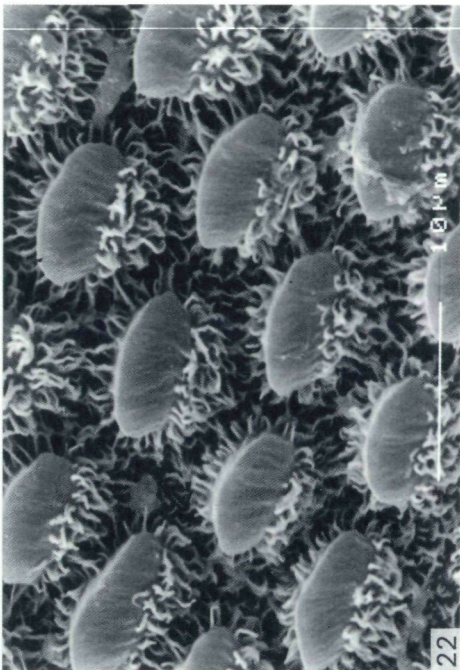
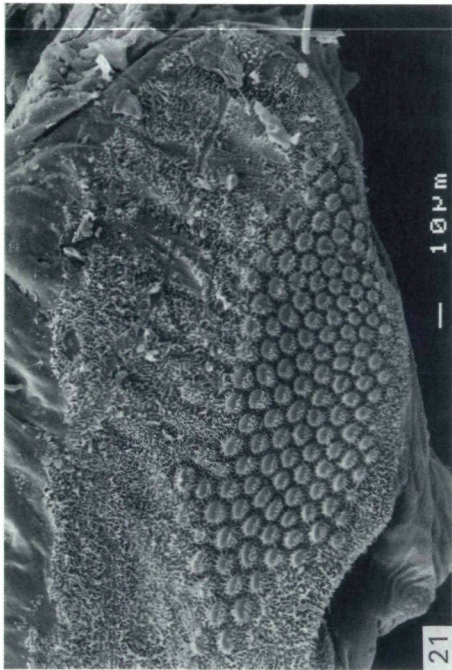
Habitually, *Indotrephes* appears to take an "intermediate position" between Idiocorinae and Limnotrephini. Therefore a short discussion on the taxa Helotrephinae, Helotrephini, Limnotrephini, and Idiocorinae seems to be useful:

Helotrephinae: Following MAHNER (1993), the monophyletic status of Helotrephinae (= Helotrephini+Limnotrephini) is doubtful and based on only one weak autapomorphy, i.e. the claval suture of macropterous morphs (which are unknown in the idiocorine genera *Idiocoris* and *Paskia*): In Helotrephinae the claval suture crosses the lateral margin of the mesoscutellum. This character is understood in contrast to the "claval suture" (sensu PAPÁČEK & al. 1988) in brachypterous specimens of *Trephotomas* (Trephotomasinae: *T. compactus* PAPÁČEK & al., 1988) which forms the adelphotaxon of "Helotrephinae+Idiocorinae". ZETTEL (1996) shows that the "clavus" sensu PAPÁČEK & al. (1988) is a unique character of *Trephotomas* ("pseudendocorium" sensu ZETTEL 1996) and that the true clavus of *Trephotomas compactus* (as in other helotrephids only present in macropterous specimens) is similar to that of Helotrephinae. In *Indotrephes* the claval suture is also similar, but crosses the lateral margins of the mesoscutellum more posteriorly than in Helotrephinae and *Trephotomas compactus* although the mesoscutellum of *Indotrephes* is long and narrow (Fig. 2). This should be evaluated as a more plesiomorph condition of the clavus in *Indotrephes*. Therefore the course of the claval suture is not an apomorphy of Helotrephinae but a possible synapomorphy of Trephotomasinae, Helotrephinae (sensu auctt.), and *Indotrephes* (unknown in the Idiocorinae sensu auctt.).

POLHEMUS (1990) regards the denticulate area at the base of the the hemelytron (which is situated at the base of the clavus) as an autapomorphy of Helotrephinae. Following POLHEMUS (1990), the area has "rows of denticles" in Limnotrephini, but "pads instead of denticles" in *Hydrotrephes* (Helotrephini); it is hypothesized either as a stridulatory device or a secondary wing-locking mechanism or "sensory in nature as suggested by Poisson". I could not find principal differences in the pad-like microstructures in *Helotrephes* sp. (Helotrephini), *Distotrephes sarawakensis* ZETTEL, 1994 (Limnotrephini), *Idiotrephes lithophilus* (Idiocorinae), and *Indotrephes* gen.n. by using microscopic techniques (magnification up to 400x), but the pad field is more extended in *Distotrephes*, and SEM studies show that the pads are more erect in *Helotrephes* (comp. Figs. 15 - 22). POLHEMUS (1990) states that this denticulate area is present neither in a few species of Pleidae he examined nor in the subfamilies Neotrephinae and Trephotomasinae, and that he did not check the Idiocorinae. He (and also MAHNER 1993) overlooked that this character had already been figured by ESAKI & CHINA (1927: fig. 4b, c) for both idiocorine species, *Idiocoris lithophilus* and *Paskia minutissima*. Therefore it cannot be an autapomorphy of Helotrephinae, but is a very important synapomorphy of Helotrephinae and Idiocorinae. In the course of this study, I examined a single male paratype of *Idiocoris lithophilus* for this character: The denticulate field is present, but less obvious, due to a weakly sclerotized base of the hemelytron (Fig. 15 - 16). Ventrally, the hemelytra are firmly attached to the mesothorax and difficult to remove (even after dissection of the prothorax); some yet undetected locking mechanism may be a reason for the weak development of the pad field if this has the same function. Further, the specimen investigated



Figs. 15 - 18: "Denticulate area" at base of clavus and larger magnifications of microstructures in (15 - 16) *Idiocoris lithophilus* and (17 - 18) *Indotrephes bufula* sp.n.



Figs. 19 - 22: "Denticulate area" at base of clavus and larger magnifications of microstructures in (19 - 20) *Distotrephes sarawakensis* and (21 - 22) *Helotrephes* sp. (from Thailand).

lacks any remnants of alae. These conditions should be seen in connection with the special habitats of *Idiocoris* and *Paskia*, which live in large lakes (Lake Tanganyika, Lake Kivu) under stable conditions. Ecologically, there is no need for them to fly; no macropterous specimen of these genera has ever been reported.

Helotrephini (5 genera, see POLHEMUS 1990) seem to be a monophyletic group based on the character of presumed stridulatory devices on the costal margin of the hemelytron and the ridge distally on the metafemur (POLHEMUS 1990, MAHNER 1993). Additionally, the complete separation of the propleuron into a "pronotal plate" and a "pleural plate" (terminology after ESAKI & CHINA 1928) and the position of these plates in different levels may be an autapomorphy of Helotrephini. This character is discussed by PAPÁČEK & al. (1990: 124) who regard this configuration to be plesiomorphic because of similar conditions in Pleidae and Aphelocheiridae. But, this special position of "pronotal plate" and "pleural plate" has not been found in any other species of any subfamily or tribe (except Helotrephini) of Helotrephidae which I checked (e.g. *Neotrephes usingeri* CHINA, 1936, *Fischerotrephes depressus*, *Idiocoris lithophilus*, *Tiphotrephes indicus*, *Idiotrephes chinai* LUNDBLAD, 1933, *Distotrephes stysi* POLHEMUS, 1990, *Indotrephes bufula*, *Trephotomas compactus*). In all these cases the plates are not separated, partly separated, or, if completely (and weakly) separated, laying at the same level. This is strong proof for an apomorphic evaluation of the arrangement in Helotrephini, regardless of the homologies of these plates, which are complicated by the fusion of the head and prothorax in Helotrephidae.

Limnotrephini (6 genera, discussed by POLHEMUS 1990) are defined by the lateral cephalonotal carina which runs across the eye (POLHEMUS 1990, MAHNER 1993), either dividing or incising or indenting the eye, but not running ventrally of the eye as in Helotrephini and Trephotomasinae. But in **Idiocorinae** the situation is the same as in some limnotrephine genera, i.e. the eyes are incised and have a ventrally directed part. This character may be understood as a synapomorphy of Limnotrephini and Idiocorinae. There is in fact no convincing apomorphic character of Limnotrephini which would separate them from the (well-defined) Idiocorinae. It can be suspected that the Idiocorinae sensu auctt. are "very aberrant Limnotrephini" due to very special life conditions, and *Indotrephes* is the adelphotaxon of the monophylum *Idiocoris*+*Paskia*. If this is true, Limnotrephini sensu auctt. is either a monophyletic tribe of Idiocorinae or a paraphyletic group (and synonymous with Idiocorinae). To answer this question a character analysis and an extended study of the phylogenetic relationships of all genera of "Limnotrephini" and "Idiocorinae" will be necessary.

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