

New genera and species of Caenidae (Ephemeroptera) from
Iran, India and Australia

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Taxonomy, *Clypeocaenis* gen. n., 2 sp. n., *Pseudocaenis* gen. n., 2 sp. n., key to larvae

Abstract. Two new genera of the family Caenidae, *Clypeocaenis* gen. n. from Iran and India and *Pseudocaenis* gen. n. from Australia are established. Four new species, *Clypeocaenis bisetosa* sp. n. (male and female larva, subimago), *C. multisetosa* sp. n. (female larva), *Pseudocaenis queenslandica* sp. n. (male and female larva), *P. rieki* sp. n. (male and female larva), are described. A key to the genera of the Caenidae based on larval characters is presented.

The family Caenidae has hitherto comprised seven genera. The generic classification of this family has been dealt with by several authors (EATON, 1883; ULMER, 1924; LESTAGE, 1930, 1942; BARNARD, 1932; DEMOULIN, 1955). A detailed revision of the seven known genera was made by THEW (1960) who also studied the taxonomic and phylogenetic relationships within the family. Since then one further genus has been established (PUTHZ, 1975). Two new genera, *Clypeocaenis* gen. n. from Asia and *Pseudocaenis* gen. n. from Australia, each containing two new species are described in the present paper.

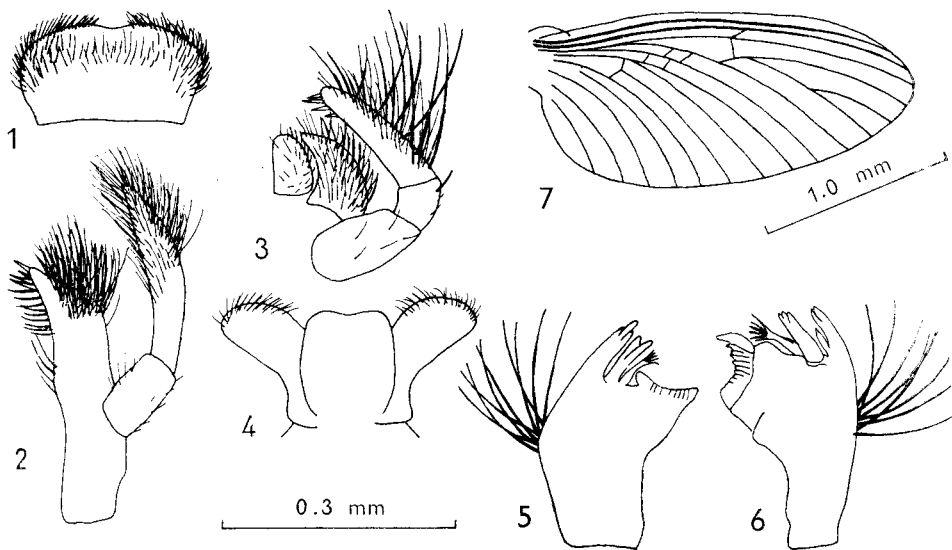
Clypeocaenis gen. n.

Derivatio nominis: *Clypeocaenis* fem.; from clypeatus = having conspicuous clypeus and *Cuenis*, related genus.

Type-species: *Clypeocaenis bisetosa* sp. n.

Subimago male (dissected from mature larva): Very small mayflies ranging in length of body 2.0—3.0 mm, in length of cerci 1.5—2.5 mm. Head without produced clypeus, ocelli without protuberances. Scapus approximately of the same length as pedicellus. Prosternum longer than broad. Forewings oval, with a few cross veins. Cross veins arranged singly; two cross veins in the fields of radial region. Penis lobes completely fused and produced laterally into a point. A few short bristles on the posterior margin of penis lobes. Forceps formed by one segment. Paracercus fully developed, as long as cerci.

Larva: Body flattened ventrally, ocelli without any protuberances. Head with conspicuously produced clypeus. Clypeal protrusion oblong-shaped. Long setae bearing hairs on the posterior margin of this protrusion. These haired setae as long as 1/3—1/2 of antennae. Scapus approximately of the same length as pedicellus. Distal antennal segments shorter than scapus or pedicellus. Genal toothed costae between the bases of antennae and composed eyes. Labrum broadly emarginate, about twice as wide as long. Mandibles with two lateral transversal rows of long setae. Outer incisors with three teeth, mesal ones with 2—3 teeth, inner incisors with a group of bristles. Maxillae narrow, with teeth and a large number of bristles. Maxillary palps



Figs. 1—6: *Clypeocaenis bisetosa* gen. n., sp. n., larva (holotype): 1 — labrum. 2 — maxilla with maxillary palp. 3 — glossa, paraglossa and labial palp. 4 — hypopharynx. 5, 6 — mandibles 7 — wing (dissected from larva).

2-segmented. Segment 2 about twice as long as segment 1, its apical part covered with bristles. Glossae oval, paraglossae bent and pointed, broader than glossae. Labial palps 3-segmented; segment 3 much longer than segment 2, with teeth at tip and long setae on the outer margin. Two transversal rows of long filtering setae on the surface of fore tibiae. Setae of distal row reach to the top of claw. Claws slender, not hooked, with small teeth. Another longitudinal row of filtering setae on tarsus near the basis of claw. Gill 1 2-segmented, minute. Gill cover with simple, not forked ridge and marginal fringe of blunt scales. Gills 3—6 with fringe single or bifid. Medial protuberance on the posterior margin of abdominal tergum II. Cerci with short bristles, paracercus as long as cerci.

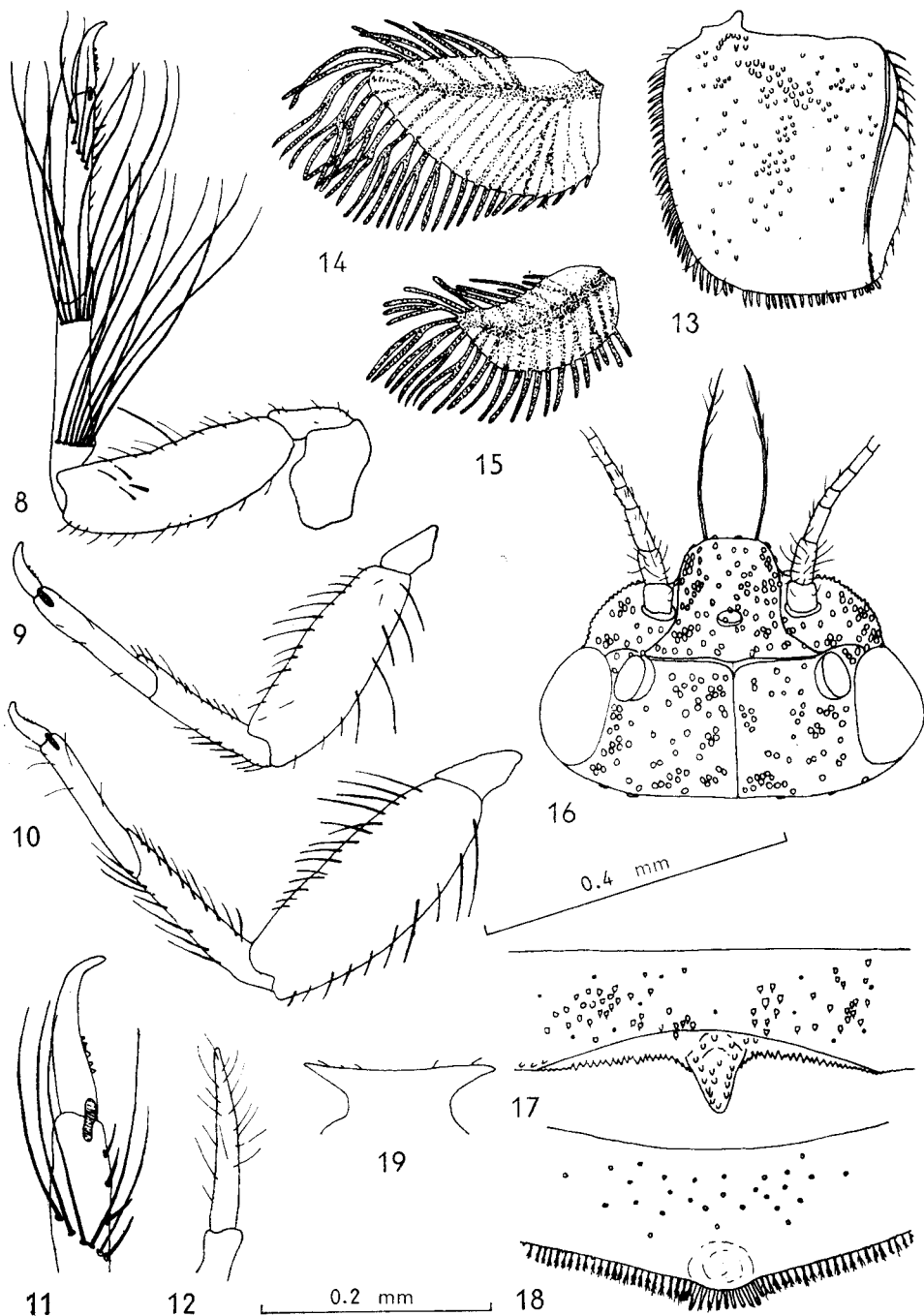
Bionomy: Judging from the arrangement of filtering setae of fore legs, larvae of this genus live in rapidly flowing water. These setae filter water and catch detritus which is passaged on to the mouthparts. This arrangement is unique within the family Caenidae. Similar setae occur in other families e. g. *Oligoneuriidae*.

Distribution: So far known only from India and Iran. Probably an endemic genus distributed only in Asia.

Clypeocaenis bisetosa sp. n.

(Figs. 1—19)

Larva (holotype): Head yellowish brown, eyes black, ocelli lighter. Antennae yellowish, transparent distally. The basis of pedicellus dark brown. Pedicellus covered with hairs. Epicranial suture paler. Two long setae with hairs on the posterior margin of clypeal protrusion. Pronotum with dark



Figs. 8—19: *Clypeocaenis bisetosa* gen. n., sp. n., larva (holotype): 8, 9, 10 — fore, middle and hind leg. 11 — tarsal claw of fore leg. 12 — gill 1. 13 — gill cover. 14, 15 — gill 3, 6. 16 — head, dorsal view. 17, 18 — abdominal sterna II, VII. 19 — penis lobes (dissected from larva).

brown smudges, yellowish brown laterally. Anterolateral areas of pronotum rounded, slightly produced. Meso- and metanotum light brown with dark smudges. Abdominal terga yellowish brown, dusted dark brown. Terga II, VIII and IX with medial projections. Unevenly scattered groups of scales on the surface of terga I and II. Pointed spines of different length on the posterior margin of terga I and II. Terga III—VII without scales and spines. A row of branched setae on the posterior margin of terga VIII and IX. Lateral abdominal spines with convex margins, covered with setae. Ventral side of body yellowish, abdominal sterna VII—IX darker. Labrum twice as broad as long. Distal row of setae on the surface of mandibles with 2—3 setae, proximal one with 5—7 setae. Glossae of hypopharynx with hairs. Inner margin of maxilla with teeth and about 10—13 setae. Segment 2 of maxillary palps 2.5 times longer than segment 1. Distal part of segment 2 covered with setae and hairs. Setae on the outer margin of segment 3 of labial palps as long as segment. Segments 1 and 2 with only a few setae and hairs. Glossae rounded, paraglossae bent and pointed. Both glossae and paraglossae covered with setae and hairs. Legs yellowish brown. Distal part of femora dark brown. Tibiae and tarsi with wide transversal dark brown strips. Femora of fore legs with a group of about 4 setae. Only 1—2 longer setae on the anterior margin of fore femora. Setae on the margins of middle and hind femora shorter than the width of femora. Claws with 6—8 teeth. Distal segment of gill 1 with hairs, bluntly pointed. Gill cover brown, with simple ridge. About 7 short bristles on the ridge near the anterior margin of gill cover. The surface of gill cover as well as the surface of head, mandibles, pronotum and femora coarsely chagrinated. Gills 3—6 with a dark brown dusting. Cerci yellowish brown.

Length of body: 3.0 (2.5—3.0) mm. Length of cerci: 1.8 (1.5—2.5) mm.

Subimago male (dissected from larva): Head blackish brown, epicranial suture paler. Near ocelli pale strips. Eyes black. Thorax with a dark brown dusting. Wings whitish grey, with diffuse brownish spots near the bases; the first two fields dark rusty brown. Penis lobes pointed, produced laterally, the posterior margin bearing bristles.

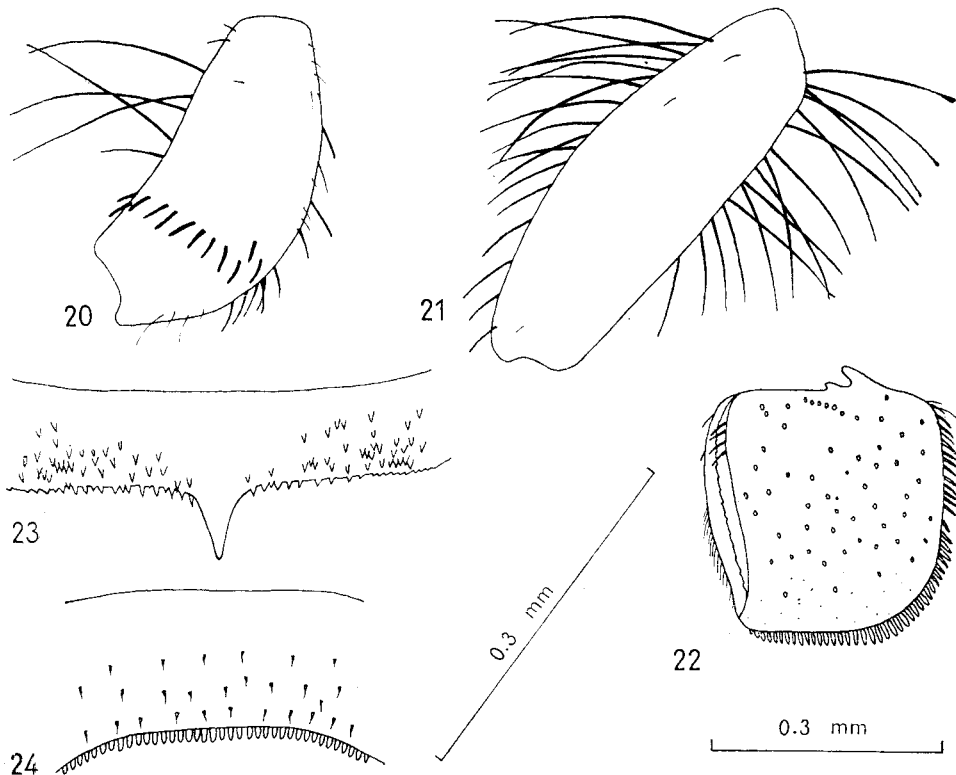
Bionomy and distribution: Larvae found at very different localities. They live in submontane rivers and large streams together with *Rhithrogena* and *Baetis* spp. larvae (Iran, Gazenak) or with *Caenis*, *Ephemerella* and *Baetis* spp. larvae (India, Poona). Adults flying in February (India, Poona). Taking into account the finding of mature larva in August (Iran, Gazenak) this species has probably two generations a year. So far known only from Iran and India.

Holotype (mature female larva), paratype No. 1 (male larva), further paratypes (3 larvae): India, Mula-mula Riv., Poona, 6. 2. 1960 leg. V. Landa, further paratype (larva): Iran, mountain stream, Gazenak, 1400 m, 20. 7. 1970 leg. L. Hoberlandt, coll. Landa, Institute of Entomology, Czechoslovak Academy of Sciences, Praha.

Clypeocaenis multisetosa sp. n.

(Figs. 20—24)

Larva (holotype): Head blackish brown, eyes black. Ocelli pale, dark bordered. Clypeal protrusion paler, light brown. A group of about 10—15 long setae with hairs on the anterior margin of the clypeal protrusion. Antennae yellowish, transparent distally. Pedicellus covered with hairs.



Figs. 20—24: *Clypeocaenis multisetosus* gen. n., sp. n., larva (holotype): 20, 21 — femur of fore and hind leg. 22 — gill cover. 23, 24 — abdominal sterna II, VII.

Pronotum dark brown, paler on the sides. Anteriolateral areas of pronotum produced. Mesonotum dark brown, with black smudges between the wing pads; metanotum brown, unicolorous. Abdominal terga unicolorous, dark brown, paler laterally. Tergum II with narrow medial projection, posterior margin of tergum as well as the surface with pointed spines, medial projection without spines or scales. Terga VIII and IX without any projections, with teeth on the posterior margins; small scales with hairs on the surface of these terga. Labrum, mandibles, maxillae and labium as in *C. bisetosus* sp. n. Legs light brown. A regular transversal row of stout spines on the surface of fore femora and long setae on the anterior margin. Middle and hind femora with a large number of long setae on the anterior and posterior margins. These setae longer than the width of femora. Claws as in *C. bisetosus* sp. n. but more bent and somewhat shorter. Distal segment of gill 1 bluntly pointed, about three times longer than segment 1. Gill covers dark brown. The ridge and the medial projection of tergum II intensively black. On the ridge a medially situated toothed costa, and a group of about 3—4 bristles near the anterior margin of gill cover. The surface of gill cover coarsely chagrinated. Gills 3—6 roughly triangular, with brown dusted tracheae. Cerci light brown.

Body length: 2.8 (3.0) mm. Length of cerci: 2.0 (2.4) mm. Adult and subimago unknown.

Holotype (mature female larva), paratype (female larva): India, Mula-mula Riv., Poona, 6. 2. 1960 leg. et coll. V. Landa, Institute of Entomology, Czechoslovak Academy of Sciences, Praha.

The larva of *Clypeocaenis multisetosa* sp. n. differs from that of *C. bisetosa* sp. n. in the following critical characters: numerous long setae on the anterior margin of clypeal protrusion, transversal row of stout spines on fore femora, setae on the margins of middle and hind femora longer than the width of femora, no spines on medial projection of tergum II, blunt teeth on the posterior margins of terga VIII and IX.

Bionomy and distribution unknown.

Pseudocaenis gen. n.

Derivatio nominis: *Pseudocaenis* fem.; from *Caenis*, related genus.

Type-species: *Pseudocaenis queenslandica* sp. n.

Larva: Small mayflies, length of body 4.0–5.0 mm. Body flattened ventrally. Ocelli without any protuberances. Pedicellus twice or three times as long as scapus, covered with long conspicuous setae. Antennal segments diminishing toward scapus; apical segment very long, longer than the first three segments. The sides of pronotum with a few long hairs. Wing pads covered with hairs. Labrum three times broader than long, bearing setae and hairs. Mandibles with a group of setae on the outer margins. Outer incisors with 3–4 teeth, mesal ones with 2–3, inner incisors with a large number of bristles. Glossae of hypopharynx neither produced nor bent, covered with stout setae. Maxillae slender, slightly s-curved, with teeth and an apical group of setae. Maxillary palps 3-segmented; segments 2 and 3 approximately the same length. Glossae oval, paraglossae bent and bluntly pointed. Labial palps 3-segmented; distal segment triangular, bearing 2–3 longitudinal rows of stout spines. Legs evenly covered with setae, with a regular rows of setae on the margins of tibiae. Claws long and slender, slightly bent, bearing two kinds of teeth: bigger and blunt teeth near the basic, and a smaller pointed tooth situated distally. Gill 1 2-segmented, with long setae. Gill cover oval with triangular ridge. Mesal fork with only a few setae, posterior one reduced, not reaching to the posterior margin of gill cover. Marginal fringe and submarginal row of scales with bristles present. Gills 3–6 triangular or oval, with fringe multifid. Longitudinal band of short bristles on the surface of gills 3–6. Paracercus as long as cerci.

Bionomy: Larvae living in temporary pools and water reservoirs, probably also in ponds and larger rivers; adults flying in January or February.

Distribution: So far known only from Australia (Queensland, New South Wales). With the exception of *Tasmanocaenis* LEST. from Tasmania and New South Wales, no genus of the family Caenidae occurs in Australia (RIEK, 1970). *Pseudocaenis* gen. n. seems to be endemic and probably replaces the cosmopolitan genus *Caenis* in Australia. Larvae of a similar type found in the South Australia and Victoria are mentioned by PUTHZ (1975).

Pseudocaenis queenslandica sp. n.

(Figs. 25–35)

Larva (holotype): Head dark yellow or yellowish brown. Eyes black, ocelli whitish, with a dark border. A wide, conspicuous black spot between the lateral ocelli. Antennae yellowish, scapus darker, pedicellus covered

with setae. Pronotum brown with darker smudges. Mesonotum paler, with diffuse dark spots near the basis of wing pads. Lateral margins of pronotum convex, anterolateral areas not produced. Abdominal terga I, II and VII—X brown, terga III—VI with a brown dusting. A pair of narrow pale stripes on terga VII—X. Tergum II with pointed medial projection. Pointed teeth on the posterior margin of terga I and II. Posterior margin of terga VII—IX with a row of long setae. Ventral side of body yellow, abdominal sterna VI—IX light brown. Sterna with a whitish hyaline nerve band. Dark brown spots on the middle of terga in several specimens. Labrum broadly emarginate. Outer incisors of mandibles with 3—4 teeth, mesal one with 2 teeth. Lateral margins of hypopharyngeal glossae with blunt teeth. A group of about 5 teeth on the top of maxillae. Segments 2 and 3 of maxillary palps approximately equal in length; distal segment shorter by $2/3$ than segment 2, the inner margin which is concave with rows of stout spines. Gill 1 2-segmented, distal segment 2.5 time longer than segment 1. Gill cover oval, with a dark dusting, evenly covered with setae and minute teeth. Mesal fork of triangular ridge with 6—8 setae. Submarginal row of scales simple; these scales with 10—12 bristles. Gills 3—6 roughly triangular. Pigmented areas of the gill surface alternating with non-pigmented transparent tracheae. Legs whitish yellow, tibiae and tarsi light brown. Femora with diffuse dark spots on the surface; anterior and posterior margins with long setae. Tibiae and tarsi with setae and long hairs. Cerci yellowish brown, with paler cilia.

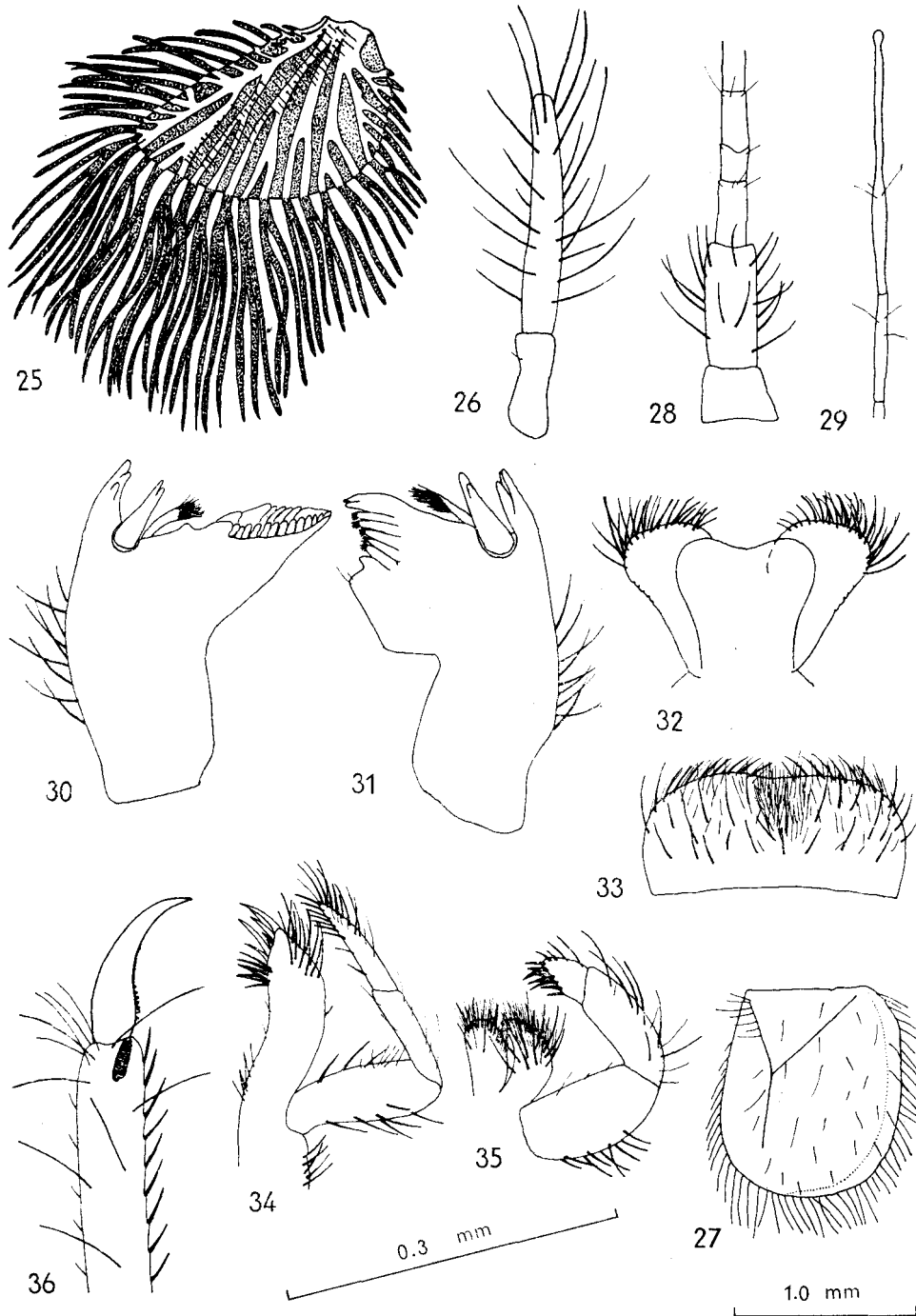
Body length: 5.3 (4.0—5.5) mm. Length of cerci 3.8 (3.0—4.0) mm. Adult and subimago unknown.

Holotype (mature female larva), paratype (male larva), further paratypes (5 larvae): Australia, Queensland, temporary pools near Rockhampton, 17. 2. 1970 leg. J. Dvořák, coll. Soldán, Institute of Entomology, Czechoslovak Academy of Sciences, Praha.

Pseudocaenis rieki sp. n.

Derivatio nominis: Named after Dr. E. F. Riek, a distinguished specialist of Australian mayflies.

Larva (holotype): Head pitch brown, unicolorous. Eyes black, ocelli whitish with a dark border. Antennae light brown, apical part of flagellum translucent. Pronotum dark brown, translucent laterally; ventral margins straight or very slightly convex. Anterolateral projections developed, rounded. Mesonotum dark brown; wing pads blackish brown, their surface covered with numerous hairs. Abdominal terga light brown. Terga I—VI unicolorous, without markings. Terga VII—X with two pale stripes and a pair of diffuse spots laterally. Tergum II with narrow medial projection and teeth on the posterior margin. Posterior margins of terga III—VI smooth; long setae on those of terga VII—IX. Ventral side of body yellowish, abdominal sterna VII—IX brownish. Labium as in *P. queenslandica*. Outer incisors of mandibles with 4 teeth, mesal ones with 2—3 teeth. Ventral margin of hypopharyngeal glossae without teeth. Maxillae slender, slightly s-curved, with teeth and only a few setae on the top. Distal segment of maxillary palps slightly longer than segment 2; a regular row of setae on the inner margin of segment 3. Segment 3 of labial palps triangular, bluntly pointed with three rows of spines, its inner margin convex. Legs whitish, tibiae and tarsi with wide, dark brown transversal stripes. V-shaped spots on femora near the basis of tibia. Gill 1 as in *P. queenslandica* sp. n. Gill cover dark brown. Mesal



Figs. 25—36. *Pseudocuenis queenslandica* gen. n., sp. n., larva (holotype): 25 — gill 3. 26 — gill 1. 27 — gill cover. 28 — basal part of antenna. 29 — distal part of antenna. 30, 31 — mandibles. 32 — hypopharynx. 33 — labrum. 34 — maxilla with maxillary palp. 35 — glossa, paraglossa and labial palp. 36 — tarsal claw of fore leg.

fork of triangular ridge with 3—5 setae. Gills 3—6 oval; the surface evenly pigmented. Cerci yellowish, with pale cilia.

Body length: 7.5 (5.5—7.8) mm. Length of cerci: 4.5 (3.5—4.5) mm. Adult and subimago unknown.

Holotype (mature female larva), paratype (male larva), further paratypes (5 larvae): Australia, New South Wales, Nerolyn reservoir, 25. 11. 1969 leg. E. F. Riek, coll. V. Landa, Institute of Entomology, Czechoslovak Academy of Sciences, Praha.

The larva of *Pseudocaenis rieki* sp. n. differs from that of *P. queenslandica* in the following critical characters: head without black spots, lateral margins of pronotum straight or very slightly convex hypopharyngeal glossae, without blunt teeth, the inner margin of segment 3 of labial palps convex, mesal fork of triangular ridge of gill cover with 3—5 setae, gills 3—6 oval, evenly pigmented, femora with v-shaped spots, tibiae and tarsi with broad, dark brown stripes.

Differential diagnosis

Clypeocaenis gen. n. is in a comparatively independent position. The larvae of this genus markedly differ from those of other genera of the family Caenidae in the following characters: filtering setae of fore legs present, clypeus with protrusion bearing long setae on the anterior margin, gill cover with simple ridge (larva), bristles on the posterior margin of penis lobes (adult male).

Larval characters of *Pseudocaenis* gen. n., particularly the arrangement of gill covers, approach those of the genera *Caenis* STEPH., *Caenodes* ULM. and *Caenomedea* THEW. *Pseudocaenis* is distinguished from these genera by the following combination of characters: mandibles with marginal setae, the apical antennal segment longer than the first three basal ones, scapus with long setae, tarsal claws of fore legs with two kinds of teeth, the posterior fork of ridge of gill covers reduced and not reaching the anterior margin, mesal one without spines, submarginal row of scales present.

Critical larval characters distinguishing *Clypeocaenis* gen. n. and *Pseudocaenis* gen. n. from other genera of Caenidae are apparent in the key below.

Key to genera of Caenidae based on larvae

- 1 (4) Fore legs situated ventrolaterally. Prosternum broader than long with the fore coxae widely separated.
- 2 (3) Head with three (medial and two lateral) protuberances bearing ocelli. Maxillary and labial palps 2-segmented. Mandibles with lateral marginal setae. Tarsal claws long and slender, without teeth. Body dorsally flattened (Europe, northern and eastern Asia, North America) *Brachycercus* CURTIS, 1834
- 3 (2) Head without protuberances. Maxillary and labial palps 3-segmented. Mandibles without lateral marginal setae. Tarsal claws hooked and toothed. Body ventrally flattened (South Africa) *Austrocaenis* BARNARD, 1932
- 4 (1) Fore legs situated ventrally. Prosternum longer than broad, with the fore coxae nearly contiguous.
- 5 (6) Fore tibiae with two transversal rows of filtering setae. Head coarsely chagrinated. Clypeus with conspicuous protrusion bearing long setae with hairs. Gill cover with simple ridge. Maxillary palps 2-segmented, labial ones 3-segmented (Iran, India) *Clypeocaenis* gen. n.
- 6 (5) Fore tibiae lacking filtering setae. Only scattered setae and hairs on legs. Head without chagrination, clypeus without protrusion. Gill covers with triangular or y-shaped ridge. Maxillary and labial palps 3-segmented.
- 7 (10) Mandibles without lateral margins setae. Distal segment of labial palpi small, about 1/4 length of second. The first gill 3—4 or 2—3 segmented.

- 8 (9) Gill covers with triangular ridge and marginal fringe of setae. Gills 3—5 with fringe multifold. Labrum hirsute, broadly emarginate medially. Maxillae and labium with a large number of setae. The first gill 2—3 segmented. Outer incisors of mandibles with 3 teeth. (Africa, Papua New Guinea)..... *Caenomedeia* THEW, 1960
- 9 (8) Gill covers lacking triangular ridge and marginal fringe of setae. Only a few setae on the margin of gill cover. Gills 3—5 with fringe single or bifid. Labrum sparsely haired. Maxillae and labium with only a few setae. The first gill 3—4 segmented. Outer incisors of mandibles with 1—4 teeth (Australia, Tasmania) ... *Tasmanocoenis* LESTAGE, 1930
- 10 (7) Mandibles with marginal setae on one or both sides. Distal segment of labial palps longer than segment 2 or about 1/3—2/3 of segment 2. The first gill always 2-segmented.
- 11 (12) Coxae laterally produced and pointed, broader than the width of femur. Segment 3 of maxillary palps nearly twice as long as segment 2. Segment 3 of labial palps approximately of the same length as segment 2 (Brasil) *Brasilocoenis* PUTHZ, 1975
- 12 (11) Coxae rounded or oblong-shaped, the width of femur broader than the width of coxae. Segment 3 of maxillary palps approximately the same length as segment 2. Segment 3 of labial palps shorter by 1/3—2/3 than segment 2.
- 13 (14) Gill cover with stout spines on mesal fork of triangular ridge. Row of submarginal spines absent. Tarsal claws small, broad and hooked. Labrum usually narrowly emarginate (Africa, Italy, China, Sunda Islands) *Caenodes* ULMER, 1924
- 14 (13) Gill cover without spines on forks of triangular ridge. Row of submarginal spines present. Labrum broadly emarginate. Tarsal claws longer, sometimes hooked.
- 15 (16) Apical antennal segment longer than the three basal ones, pedicellus covered with stout setae. Posterior fork of triangular ridge on gill covers reduced, not reaching posterior margin of gill cover, mesal one with only 3—8 setae. Tarsal claws of fore legs with two kinds of teeth (Australia) *Pseudocaenis* gen. n.
- 16 (15) Apical antennal segment much shorter than the first basal ones. Pedicellus without setae or covered only with hairs. Posterior fork of triangular ridge on gill cover with row of setae, reaching posterior margin of gill cover, mesal one with about 10—15 setae. Tarsal claws of fore legs with teeth of the same shape (cosmopolitan, with exception of Australia) *Caenis* STEPHENS, 1835

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Новые роды и виды семейства Caenidae (Ephemeroptera) из Ирана, Индии и Австралии

Clypeocaenis gen. n., 2 spp. n., *Pseudocaenis* gen. n., 2 spp. n., определитель личинок

Резюме. Описания двух новых родов из сем. Caenidae: *Clypeocaenis* gen. n. из Ирана и Индии и *Pseudocaenis* gen. n. из Австралии. Далее описаны четыре новых вида: *Clypeocaenis bisetosa* sp. n. (личинка самца и самки, субимаго), *C. multisetosa* sp. n. (личинка самки), *Pseudocaenis queenslandica* sp. n. (личинка самца и самки) и *P. rieki* sp. n. (личинка самца и самки). Дается определитель родов сем. Caenidae на основании личиночных признаков.

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