21

ARTHROPODA (HEXAPODA; INSECTA)

A. J. Ross and E. A. Jarzembowski

In the first edition of *The Fossil Record*, Crowson *et al.* (1967) only included the stratigraphical ranges of insect superfamilies and higher taxa; in this work we have attempted a listing of all families which have a pre-Quaternary fossil record, for the latter, see Buckland and Coope (1991). For ease of reference, the families are listed alphabetically within their orders. Alternative names, spelling variations and groups included are given in parentheses.

Period, epoch and stage abbreviations follow Harland *et al.* (1982); however, we have used the European nomenclature for the Upper Carboniferous. We have attempted to give ranges of families and orders to stage level, but this has often proved impossible because of the absence of accompanying detailed stratigraphical information. Thus ages of Permian localities follow Wootton (1981). For C.I.S. locality names we have used the English transliteration unless an alternative is better known, e.g. Transbaikalia instead of Zabaikale. Where there is some uncertainty as to the exact age of species, e.g. those in Baltic amber, we have made a decision as indicated below. For first and last occurrences, an example is given where there is more than one species of the same age. We have distinguished between the author of a species and a reference in which the species is mentioned by giving the latter as '*in*'. We have also used '*in*' for references where specimens are figured but undescribed.

The insect part of the *Treatise* by F. M. Carpenter appeared while this work was in press. However, it is based on published work up to 1983, and therefore we have surveyed the literature in detail from January 1984 up to December 1991, although some of the ranges in Dmitriev and Zherikhin (1988) may be based on unpublished material. The ranges given here should be supplemented by Carpenter (1992) which gives the authors of higher taxa documented before 1984 (we have only included the authors of families described after 1983) and much more information besides on the occurrence of fossil insects.

The *Treatise* arrangement of classes is followed; however, Kukalová-Peck (1987a) unites Collembola and Protura in the Parainsecta and includes Diplura in the Insecta *s.s.* A phylogenetic classification of these and other extant hexapods is discussed by Kristensen (1991). For common names of orders see Jarzembowski (1990b). The earliest hexapod is as for Collembola. The Class/Order Protura is Recent only. Most insects are terrestrial, but Wootton (1988) gives a useful overview of the geological history of aquatic insect groups. 'Terr.' has been used below in the broadest sense, including aerial or freshwater adults or larvae/nymphs.

To keep this list up to date please send your reprints on fossil insects to AJR.

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ORDER INDEX

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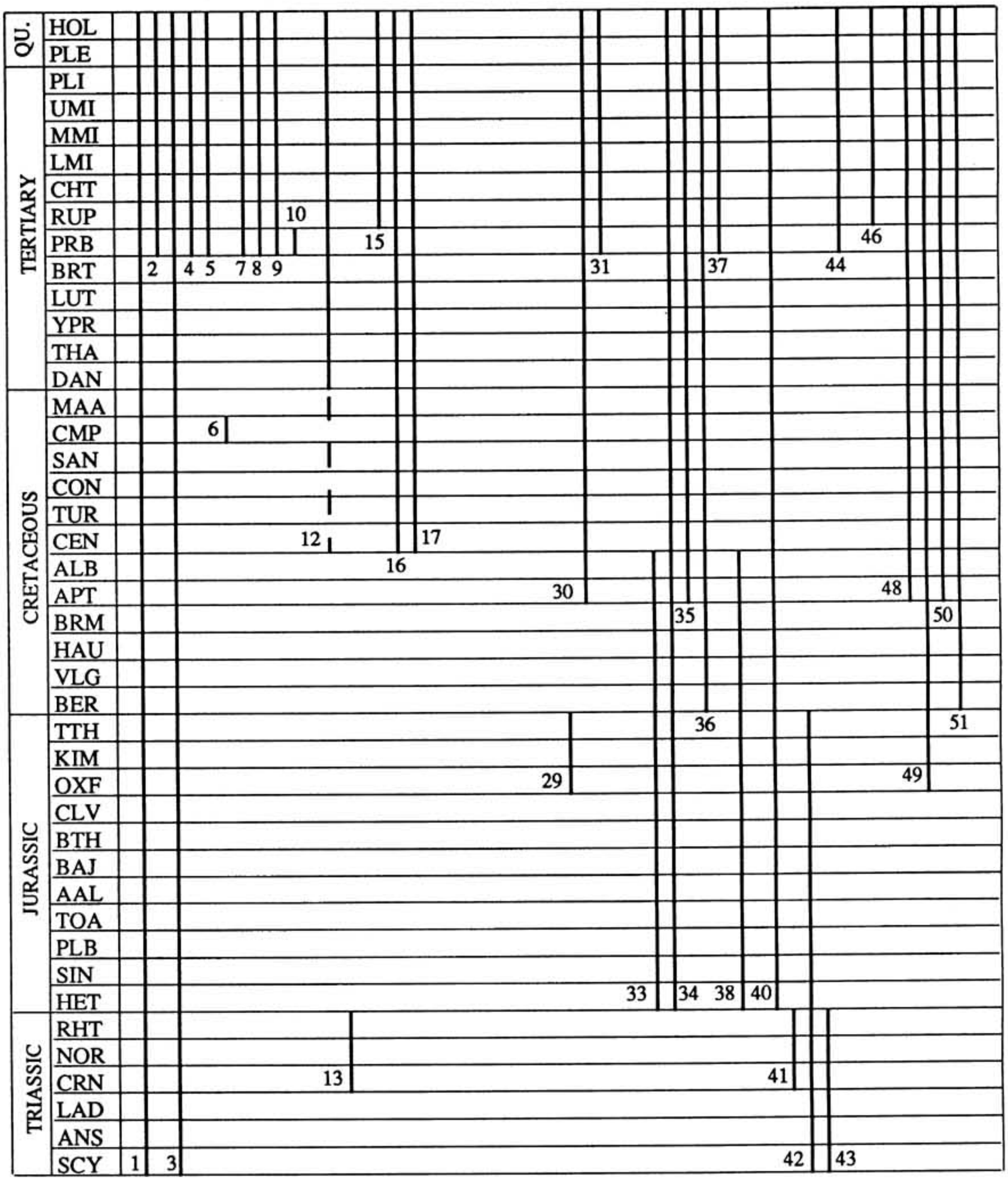

Fig. 21.1

Megasecoptera	367	Strepsiptera	419
Miomoptera	378	Thysanoptera	394
Monura	366	Trichoptera	419
Neuroptera	417	Zoraptera	395
Odonata	369	Zygentoma	366
Orthoptera	378		
Palaeodictyoptera	372		
Phasmatodea	379		
Phthiraptera	393		
Plecoptera	380		
Protelytroptera	382		
Protodonata	373		
Protorthoptera	383		
Psocoptera	393		
Raphidioptera	418		
Siphonaptera	419		

Superclass HEXAPODA (Insects *sensu lato*)

Class/Order COLLEMBOLA D. (SIG)–Rec.

The Miocene family Paleosminthuridae belongs in the Hymenoptera: Formicidae, see Najt (1987). First as for Isotomidae.

F. ENTOMOBRYIDAE P. (ROT)–Rec. Terr.

Extant

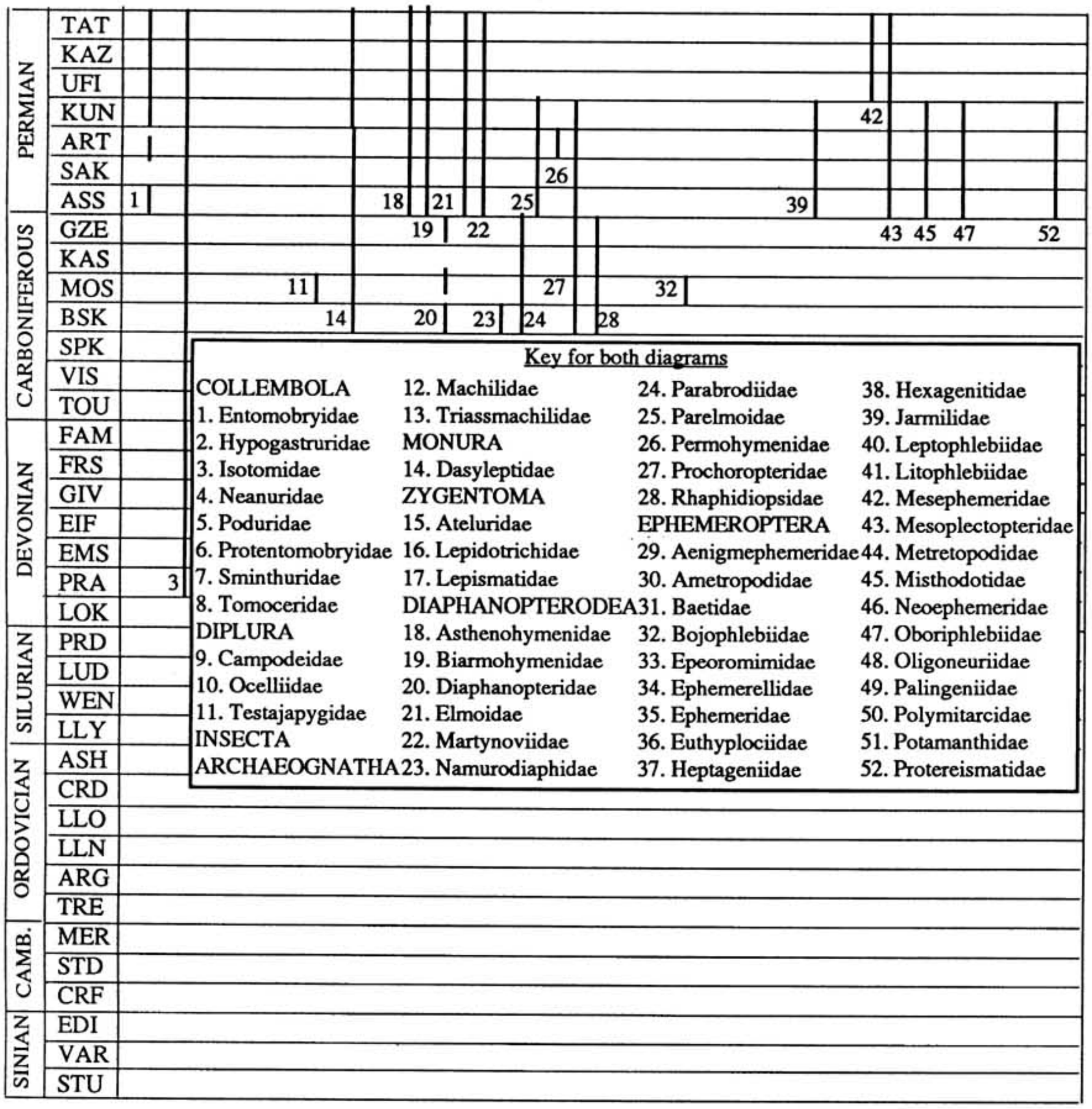

Fig. 21.1

F. HYPOGASTRURIDAE T. (PRB)–Rec. Terr.

First: e.g. *Hypogastrura* (*Ceratophysella*) sp., *in* Lawrence (1985), Baltic amber, Gdańsk, Poland. **Extant**

F. ISOTOMIDAE D. (SIG)–Rec. Terr.

First: *Rhyniella praecursor*, *in* Greenslade and Whalley (1986), Rhynie Chert, Rhynie, Scotland, UK. **Extant**

F. NEANURIDAE T. (PRB)–Rec. Terr.

First: *Pseudachorutes* sp., *in* Lawrence (1985), Baltic amber, Gdańsk, Poland. **Extant**

F. PODURIDAE T. (PRB)–Rec. Terr.

First: e.g. *Podura fuscata*, *in* Spahr (1990), Baltic amber. **Extant**

F. PROTENTOMOBRYIDAE K. (CMP) Terr.

First and Last: *Protentomobrya walkeri in* Spahr (1990), Canadian amber, Canada.

F. SMINTHURIDAE T. (PRB)–Rec. Terr.

First: e.g. *Sminthurinus* sp., *in* Lawrence (1985), Baltic amber, Gdańsk, Poland. **Extant**

F. TOMOCERIDAE T. (PRB)–Rec. Terr.

First: e.g. *Tomocerus* cf. *minor*, *in* Lawrence (1985), Baltic amber, Gdańsk, Poland. **Extant**

Class/Order DIPLURA C. (WES D)–Rec. Terr.

First as for Testajapygidae.

F. CAMPODEIDAE T. (PRB)–Rec. Terr.

First: *Campodea darwinii in* Spahr (1990), Baltic amber. **Extant**

F. OCELLIIDAE Spahr, 1990 T. (PRB) Terr.

First and Last: *Ocellia articulicornis*, *in* Spahr (1990), Baltic amber.

F. TESTAJAPYGIDAE Kukalová-Peck, 1987
C. (WES D) Terr.

First and Last: *Testajapyx thomasi* Kukalová-Peck (1987), Carbondale Formation, Mazon Creek, Illinois, USA.

Class INSECTA (SCARABAEODA; insects *sensu stricto*) D. (EMS?)–Rec.

First as for Archaeognatha. The Lower Devonian *Rhyniognatha hirsti* in Kukalová-Peck (1991) is a possible myriapod.

Subclass APTERYGOTA *s.s.* (LEPISMATONA; primitively wingless insects; THYSANURA *s.l.* of older classifications) D. (EMS?)–Rec.

First as for Archaeognatha.

Order ARCHAEOGNATHA (MACHILIDA *pars*) D. (EMS?)–Rec. Terr.

First: *Gaspea palaeoentognathae* (*nomen nudum*) Labandeira *et al.* (1988), Battery Point Formation, Gaspé Peninsula, Canada. This species has not been placed in a family. Jeram *et al.* (1990) do not consider that this species is a fossil hexapod. **Extant**

F. MACHILIDAE K (u.?)–Rec. Terr.

F. TRIASSOMACHILIDAE Tr.(u.)

Kukalová-Peck (1991) considers *Triassomachilis* to be a mayfly nymph.

Order MONURA (MACHILIDA *pars*) C. (u.)–P. Terr.

Only one recognized family.

F. DASYLEPTIDAE C. (u.)–P. Terr.

First: e.g. ?*Dasyleptus* sp. Kukalová-Peck (1985), Carbondale Formation, Mazon Creek, Illinois, USA.
Last: e.g. *Leoidodasypus sharoui*, *in* Labandeira and Beall (1990), Kansas, USA.

Order ZYGENTOMA (THYSANURA *s.s.*; LEPISMATIDA) C. (WES D)–Rec. Terr.

First: *Ramsdelepidion schusteri* Kukalová-Peck (1987), Carbondale Formation, Mazon Creek, Illinois, USA. Kukalová-Peck (1987) did not place this species in a family. **Extant**

F. ATELURIDAE T. (Oli.)–Rec. Terr.

Extant

F. LEPIDOTRICHIDAE (LEPIDOTHRICIDAE) K. (u.)–Rec. Terr.

Extant

F. LEPISMATIDAE K (u.)–Rec. Terr.

Extant

Subclass PTERYGOTA (SCARABAEONA; winged insects) C. (NAM A)–Rec. Terr.

The Order Archaeoptera is based on crustacean rather than insect remains (Rodendorf, 1972). First as for Protorthoptera.

Cohort PALAEOPTERA C. (NAM B)–Rec. Terr.

First as for Megasecoptera.

Order DIAPHANOPTERODEA (DIAPHANOPTERIDA) C. (NAM B)–P. Terr.

First as for Namurodiaphidae.

F. ASTHENOHYMENIDAE (DOTERIDAE) P. Terr.

e.g. *Doter minor*, *in* Hubbard (1987), Kansas, USA.

F. BIARMOHYMENIDAE P. Terr.

F. DIAPHANOPTERIDAE C. (u.) Terr.

F. ELMOIDAE P. Terr.

F. MARTYNOVIIDAE P. Terr.

F. NAMURODIAPHIDAE Kukalová-Peck and Brauckmann, 1990 C. (NAM B) Terr.

First and Last: *Namurodiapha sippelorum* Kukalová-Peck and Brauckmann (1990), Vorhalle Beds, Hagen-Vorhalle, Germany.

F. PARABRODIIDAE C. (u.) Terr.

F. PARELMOIDAE P. (ROT) Terr.

F. PERMOHYMENIDAE P. (ART) Terr.

First and Last: *Permohymen schucherti*, *in* Kukalová-Peck and Brauckmann (1990), Kansas, USA.

F. PROCHOROPTERIDAE C. (u.)–P. (ROT) Terr.

First: e.g. *Prochoroptera calopteryx*, *in* Kukalová-Peck and Brauckmann (1990), Carbondale Formation, Mazon Creek, Illinois, USA.

F. RHAPHIDIOPSIDAE C. (u.) Terr.

Order EPHEMEROPTERA (EPHEMERIDA, PLECTOPTERA) C. (WES C)–Rec. Terr.

Data taken from Hubbard (1987), unless stated otherwise. First as for Bojophlebiidae. The Triassomachilidae may prove to belong here (see Order Archaeognatha).

F. AENIGMEPHEMERIDAE J. (u.) Terr.

First and Last: *Aenigmephemera demoulini*, Karatau, Kazakhstan, former USSR.

F. AMETROPODIDAE K. (APT)–Rec. Terr.

Extant

F. BAETIDAE T. (PRB)–Rec. Terr.

First: e.g. *Baetis gigantea*, Baltic amber. Sinichenkova (1985a, 1989) included the Jurassic genus *Mesobaetis* in the Siphlonuridae, but Hubbard (1987) placed it in the Baetidae without discussion. Here, we have followed Sinichenkova (1985a, 1989). **Extant**

F. BOJOPHLEBIIDAE Kukalová-Peck, 1985 C. (WES C) Terr.

First and Last: *Bojophlebia prokopi*, Whetstone Horizon, Bohemia, Czechoslovakia. Klyuge (1989), however, considers that the 'nymph' of this species may belong in another order, 'probably Thysanura'.

F. EPEOROMIMIDAE (EPEOROMIDIDAE) J. (l.)–K. (l.) Terr.

First: e.g. *Epeoromimus kazlauskasi*, western Siberia, former USSR.
Last: e.g. *Epeoromimus cretaceus*, Transbaikalia, former USSR.

F. EPHEMERELLIDAE J. (l.)–Rec. Terr.

First: e.g. *Clephemera clava* Lin (1986), south China. The systematic position of this species is doubtful. **Extant**

F. EPHEMERIDAE (ICHTHYBOTIDAE) K. (APT)–Rec. Terr.

First: e.g. *Australiphemera revelata* McCafferty (1990), Santana Formation, Ceará, Brazil. The Upper Jurassic *'Ephemera' deposita* Weyenbergh does not belong to this family (McCafferty, 1990). **Extant**

F. EUTHYPLOCIIDAE K. (l.)–Rec. Terr.

First: e.g. *Pristiplocia rupestris* McCafferty (1990), Santana Formation, Ceará, Brazil. **Extant**

F. HEPTAGENIIDAE (ECDYURIDAE, ECDYONURIDAE) T. (PRB)–Rec. Terr.

First: e.g. *Heptagenia (Kageronia) fuscogrisea*, *in* Klyuge (1986), Baltic amber. **Extant**

F. HEXAGENITIDAE (PAEDEPHEMERIDAE, STENODICRANIDAE) J. (l.)–K. (l.) Terr.

First: e.g. *Siberiogenites angustatus*, Transbaikalia, former USSR.
Last: e.g. *Protoligoneuria limai*, *in* McCafferty (1990), Santana Formation, Ceará, Brazil.

F. JARMILIDAE P. (ROT) Terr.

First and Last: *Jarmila elongata*, Czechoslovakia.

F. LEPTOPHLEBIIDAE J. (l.)–Rec. Terr.

First: e.g. *Mesoneta antiqua*, Transbaikalia, former USSR. **Extant**

F. LITOPHLEBIIDAE (XENOPHLEBIIDAE) Tr. (u.) Terr.

First and Last: *Litophlebia optata*, Molteno Formation, Bird's River, South Africa. Hubbard (1987) believes this is a megasecopteran.

F. MESEPHEMERIDAE (PALINGENIOPSIDAE) P. (ZEC)–J. (TTH) Terr.

First: *Palingeniopsis praecox*, former USSR.
Last: e.g. *Mesephemera lithophila*, Lithographic Limestone, Solnhofen, Germany.

F. MESOPLECTOPTERIDAE P.–Tr. Terr.

e.g. *Mesoplectopteron longipes*, western Europe.

F. METRETOPODIDAE T. (PRB)–Rec. Terr.

First: e.g. *Metretopus henningseni*, Baltic amber. **Extant**

F. MISTHODOTIDAE (EUDOTERIDAE) P. (ROT) Terr.

e.g. *Misthodotes obtusus*, Wellington Formation, Kansas, USA.

F. NEOEPHEMERIDAE T. (Oli.)–Rec. Terr.

First: *Potamanthellus rubiensis*, Ruby River Basin, Montana, USA. **Extant**

F. OBORIPHLEBIIDAE P. (ROT) Terr.

e.g. *Oboriphlebia moravica*, Czechoslovakia.

F. OLIGONEURIIDAE (ISONYCHIIDAE) K. (APT)–Rec. Terr.

First: *Colocrus indivicum* McCafferty (1990), Santana Formation, Ceará, Brazil. McCafferty (1990) transferred the previously supposed oldest species *Protoligoneuria limai* to the Hexagenitidae. **Extant**

F. PALINGENIIDAE J. (u.)–Rec. Terr.

First: *Mesogenesia petersae*, Transbaikalia, former USSR. **Extant**

F. POLYMITARCIDAE (POLYMITARCYIDAE) K. (APT)–Rec. Terr.

First: *Caririnympha mandibulata* Martins-Neto and Caldas (1990), Santana Formation, Ceará, Brazil. **Extant**

F. POTAMANTHIDAE K. (l.)–Rec. Terr.

First: e.g. Potamanthidae (?) sp. 1 McCafferty (1990), Santana Formation, Ceará, Brazil. **Extant**

F. PROTEREISMATIDAE P. (ROT) Terr.

e.g. *Protereisma permianum*, Wellington Formation, Kansas, USA.

F. SIPHLONURIDAE J. (l.)–Rec. Terr.

First: e.g. *Mogzonurus elevatus*, Transbaikalia, former USSR. **Extant**

F. SYNTONOPTERIDAE C. (WES D) Terr.

e.g. *Syntonoptera schucherti*, *in* Carpenter (1988), Carbondale Formation, Mazon Creek, Illinois, USA. Carpenter (1988), however, preferred to place this family in Order Uncertain because important body structures, such as the mouth-parts, are not yet known.

F. TOREPHEMERIDAE Sinichenkova, 1989 J. (u.)–K. (l.) Terr.

First: *Archaeobehningia edmundsi*, *in* Sinichenkova (1989), Udinskaya Formation, Transbaikalia, former USSR. Sinichenkova (1989) transferred this genus from the Behningiidae thus reverting the latter family back to Recent only.
Last: *Torephemera longipes* Sinichenkova (1989), Tsagantsabskaya Formation, Khutel-Khara, Mongolia.

F. TRIPLOSOBIDAE C. (STE) Terr.

First and Last: *Triplosoba pulchella*, Commentry, France.

Order MEGASECOPTERA (MISCHOPTERIDA) C. (NAM B)–P. Terr.

First as for Brodiopteridae, although *Xenoptera riojanaensis* ('Xenopteridae') may be older. The Upper Triassic Litophlebiidae (Ephemeroptera) may prove to belong to this order.

F. ALECTONEURIDAE P. Terr.

F. ANCHINEURIDAE C. (u.) Terr.

F. ANCOPTERIDAE P. Terr.

F. ARCIONEURIDAE P. Terr.

F. ASPIDOHYMENIDAE P. Terr.

F. ASPIDOTHORACIDAE C. (WES D–STE) Terr.

First: *Aspidothorax aestalis* Brauckmann (1991), Piesberg, Osnabrück, Germany.
Last: *Aspidothorax triangularis*, *in* Brauckmann (1991), Commentry, France.

F. BARDOHYMENIDAE C. (NAM B)–P. (KUN) Terr.

First: *Sylvohymen peckae* Brauckmann (1988b), Vorhalle Beds, Hagen-Vorhalle, Germany.

Ulm, Minnesota, USA. Sukacheva (pers. comm.) considers that the position of these specimens is doubtful. **Extant**

F. MICROPTYSMATIDAE P. (ART–ZEC) Terr.

First: *Microptysmella moravica* Kukalová-Peck and Willmann (1990), Bavcov Beds, Obora, Czechoslovakia.
Last: e.g. *Microptysmodes uralicus*, *in* Willmann (1989b), Tatar ASSR, former USSR.

F. MOLANNIDAE T. (PRB)–Rec. Terr.

First: e.g. *Molanna crassicornis*, Baltic amber. **Extant**

F. NECROTAULIIDAE (NECROTAULIDAE) Tr. (u.)–K. (u.) Terr.

F. ODONTOCERIDAE (ODONTOCERATIDAE) K. (u.)–Rec. Terr.

Extant

F. PHILOPOTAMIDAE Tr. (u.)–Rec. Terr.

Extant

F. PHRYGANEIDAE (PHRYGANAEIDAE) K. (l.)–Rec. Terr.

Extant

F. POLYCENTROPODIDAE K. (u.)–Rec. Terr.

First: e.g. *Archaeopolycentra zherikhini*, *in* Spahr (1989), Siberian amber, Taimyr, former USSR. **Extant**

F. PRORHYACOPHILIDAE Tr. (u.) Terr.

F. PROSEPIDIDONTIDAE J. (l.) Terr.

F. PSYCHOMYIIDAE (PSYCHOMYIDAE) T. (PRB)–Rec. Terr.

First: e.g. *Lype sericea*, Baltic amber. **Extant**

F. RHYACOPHILIDAE J. (u.)–Rec. Terr.

First: ?*Rhyacophila* sp. Sukacheva (1985), Mogzon, Transbaikalia, former USSR. **Extant**

F. SERICOSTOMATIDAE K. (u.)–Rec. Terr.

Extant

F. STENOPSYCHIDAE T. (PRB)–Rec. Terr.

First: *Stenopsyche imitata*, Baltic amber. **Extant**

F. TAYMYRELECTRONIDAE K. (SAN) Terr.

First and Last: *Taymyrelectron sukatshevae*, *in* Botosaneanu and Wichard (1984), Siberian amber, Taimyr, former USSR. **Extant**

F. VITIMOTAULIIDAE J. (u.)–K. (u.) Terr.

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