

Wasps (Insecta: Vespida = Hymenoptera) from the Early Cretaceous of Spain

A.P. RASNITSYN⁽¹⁾ and X. MARTÍNEZ-DELCLÒS⁽²⁾

(1) Paleontological Institute, Russian Academy of Sciences, Moscow 117647, Russia. E-mail: rasna@online.ru

(2) Dep. d'Estratigrafia i Paleontologia, Fac. Geologia, Univ. Barcelona, 08071 Barcelona, Spain. E-mail: delclos@geo.ub.es

ABSTRACT

Wasps and their relatives from the Lower Cretaceous lithographic limestones of Spain have been studied. Thirty specimens representing 30 species (4 of them with undetermined placement), at least 21 genera and 11 families are recorded. We erect 1 new family - Andrenelidae-, 6 new genera and 11 new species: *Meiaghilarella cretacica* n.gen., n.sp. (Sepulcidae Ghilarellinae), *Eosyntexis catalonicus* n.sp., *Cretosyntexis montsecensis* n.gen., n.sp. (Anaxyelidae Syntexinae), *Montsecephialtites zherikhini* n.gen., n.sp. (Ephialtitidae Ephialtitinae), *Karataus hispanicus* n.sp. (Ephialtitidae Symphyopterinae), *Manlaya ansorgei* n.sp. (Gasteruptionidae Baissinae), *Andrenelia pennata* n.gen., n.sp. (Andrenelidae n. fam.), *Cretoserphus gomezi* n.gen., n.sp. (Mesoserphidae), *Montsecosphex jarzembowskii* n.gen., n.sp., *Angarosphex penyalveri* n.sp., *Pompilopterus (?) noguerensis* n.sp. (Sphecidae Angarospheciinae), *Cretoscolia conquensis* n.sp. (Scoliidae Archaeoscoliinae). The Mesozoic family Ephialtitidae is revisited based on the restudy of the type-species.

We compare these Spanish Cretaceous assemblages with other ones from various parts of the world: Central and Eastern Asia, England, Australia, and Brazil. The number of genera and families identified in the Spanish fossil-sites is almost the same as in the English Purbeck and Wealden. The absence of some hymenopteran groups as Xyelidae, is consistent with the warm climate known to exist in Spain during the Early Cretaceous.

We conclude that both La Cabrúa and La Pedrera assemblages - the two sites that have yielded the greatest number of species - correspond to the Lower Cretaceous "Baissin type" (*sensu* Rasnitsyn et al., 1998), but including some Jurassic "survivors". La Pedrera assemblage fits equally well in the "angarosphecine subtype", while La Cabrúa roughly corresponds to the "proctotrupid" one, although shows a comparatively high proportion of angarosphecins. This fact may suggest: a) possibly asynchrony between these two fossil-sites, b) environmental differences not reflected in the lithological record, c) different taphonomic processes and/or, d) insufficient sample size - to reflect the reality of the source populations-.

La Pedrera assemblage is very similar to those from Weald Clay (England), Bon Tsagan (Mongolia) and Santana (Brazil). La Cabrúa approaches to a some extent, though not quite agrees with the Purbeck (UK), Koonwarra (Australia), and most Lower Cretaceous Asian assemblages.

Keywords: Vespida. Hymenoptera. Wasps. New genera and species. Lower Cretaceous assemblages. Spain.

INTRODUCTION

Wasps and their relatives (Order Vespida = Hymenoptera) are not uncommon insects in the Early Cretaceous lithographic limestones of Sierra del Montsec in Spain, though only two species, *Ephialtites jurassicus* MEUNIER and *Angarosphex catalunicus* (ANSORGE) has been described until recently (Meunier, 1903; An-sorge, 1993). At the same time, hymenopterous insects represent the material of considerable potential importance for better understanding of both history of this insect group and palaeoenvironments of the eastern Spain in the mid Lower Cretaceous. Indeed, during last several decades a considerable amount of information has been accumulated about the Lower Cretaceous hymenopterans from various parts of the world: Central and Eastern Asia (Rasnitsyn, 1969, 1980, 1986, 1990a, 1991a,b, 1993a,b; Hong, 1983, 1988; Hong and Wang, 1990; Rasnitsyn and Sharkey, 1988; Ren et al., 1995; Zhang, 1992, and others), England (Rasnitsyn et al., 1998), Australia (Jell and Duncan, 1986) and Brazil (Darling and Sharkey, 1990). Basic features of the respective fossil assemblages have been outlined, including their composition, regional differences and possible stratigraphic and palaeoenvironmental implications (Rasnitsyn et al., 1998). This was not the case with the Spanish lithographic limestones of Sierra del Montsec, despite it is for almost a century that a hymenopteran fossil is known from there (Meunier, 1903). At the same time, the Spanish assemblage extends considerably the geographic representation of the mid-Lower Cretaceous hymenopteran fauna and could further elucidate its stratigraphic and environmental features.

Fortunately, more than two dozen of fossil Hymenoptera are housed during last years in five European institutions: Institut d'Estudis Ilerdencs (Lleida, Spain); Dept. Estratigrafia i Paleontologia, Fac. Geologia, Universitat de Barcelona (Barcelona, Spain), Muséum National d'Histoire Naturelle (Paris, France), Unidad de Paleontología, Fac. Biología, Universidad Autónoma de Madrid, and Bereich Paläontologie, Ernst Motitz Arndt Universität Greifswald (Greifswald, Germany) became available for study. Some of these fossils are already described (Rasnitsyn et al., 1999a; Rasnitsyn, 2000); Rasnitsyn and Martínez-Delclòs, 1999; Rasnitsyn and An-sorge, 2000 (in press).

The Spanish Lower Cretaceous record, as compressions, of fossil insects is directly related to two zones with lithographic limestones of lacustrine origin: the Montsec Range (Lleida Province) with two outcrops: "La Pedrera

de Meià" and "La Cabrúa" (Barale et al., 1994; Martínez-Delclòs, 1991, 1995), and the Serranía de Cuenca (Cuenca Province) with the "Las Hoyas" fossil site (Meléndez, 1995). The outcrops from the Montsec Range are Berriasian-Valanginian in age (but see Conclusion), while "Las Hoyas" was recently placed into the Barremian (Martín-Closas and López-Morón, 1995).

The descriptions below follow the standard used in the descriptive publications by one of us (A.P.R.). Morphological terms, including the vein and cell abbreviations, are standard (Fig. 1). The specimen depositories are specified using the following abbreviations: (IEI) Institut d'Estudis Ilerdencs (Lleida, Spain); (EP) Dept. d'Estratigrafia i Paleontologia, Fac.Geologia, Univ. Barcelona (Barcelona, Spain); (MNHN) Muséum National d'Histoire Naturelle (Paris, France); (LH) , Unidad de Paleontología, Fac. Biología, Universidad Autónoma de Madrid (MA) Bereich Paläontologie, Ernst Motitz Arndt Universität Greifswald (Greifswald, Germany), (MGA) Museu de Geologia de Barcelona (Barcelona, Spain).

SYSTEMATIC PALAEONTOLOGY

Class: Insecta LINNAEUS, 1758

Order: Vespida LAICHARTING, 1871
(=Hymenoptera LINNAEUS, 1758)

Suborder: Siricina BILLBERGH, 1820
(LATREILLE, 1802)

Superfamily: Tenthredinoidea LATREILLE, 1802

Family: Xyelotomidae RASNITSYN, 1968

GENUS *Leridatoma* RASNITSYN AND ANSORGE
2000

2000 *Leridatoma* RASNITSYN AND ANSORGE, pp. 50-51, figs. 1-2.

Diagnosis: Similar to *Xyelocerus* RASNITSYN 1968, *Undatoma* RASNITSYN 1977 and *Xaxexis* PAGLIANO AND SCARAMOZZINO 1990 (= *Protenthredo* HONG 1982 non PONGRAC 1928) in SC present neither as longitudinal vein nor as crossvein. It differs from *Xyelocerus* in having M and Cu present apocad of 3r-m and 2m-cu, respectively, and antennal flagellum 4-segmented, longer than and almost as thick as, the composite "third" segment. It differs from *Undatoma* and *Xaxexis* (whose antennal structure unknown in details) in short 1m-cu, and additionally from *Undatoma* in cell 1m-cu not much elongate basad and with cu-a reaching its second third, from *Xaxexis* in M joining RS well distant from R.

Leridatoma pulcherrima RASNITSYN AND ANSORGE.

Superfamily: Cephoidea NEWMAN, 1834
Family: Sepulcidae RASNITSYN, 1968

Species include: Type species.

Material: Holotype female, MA100, from La Cabría fossil-site, Montsec Range, Lleida (Spain). It is housed in the Museum für Naturkunde, Humboldt Universität Berlin, J. Ansoerge collection.

Sepulcidae is a diverse though not the most abundant group of siricomorph wasps characteristic of warmer climate in the Jurassic, Lower Cretaceous and Late Cretaceous (Rasnitsyn, 1993a; Rasnitsyn et al., 1998; Rasnitsyn and Ansoerge, 2000a). The family is divided into five subfamilies, two of which are recorded in both Jurassic

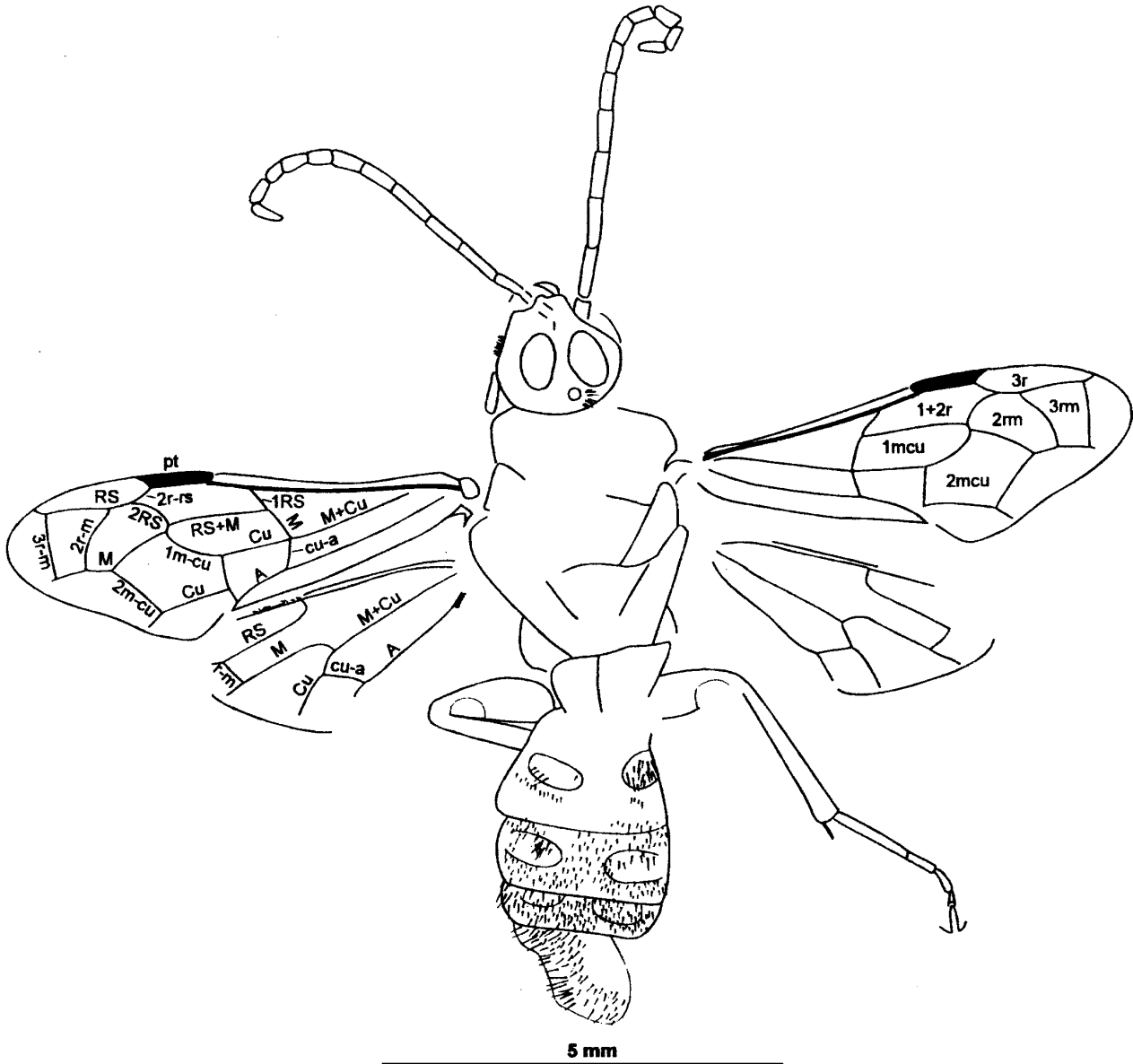
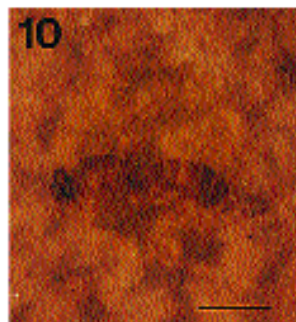
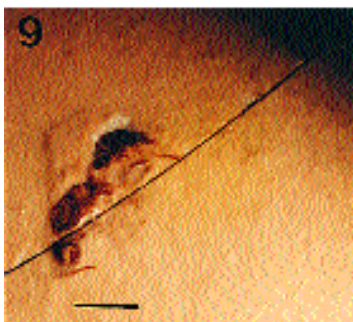
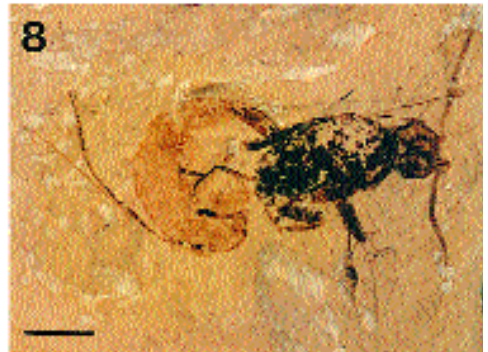
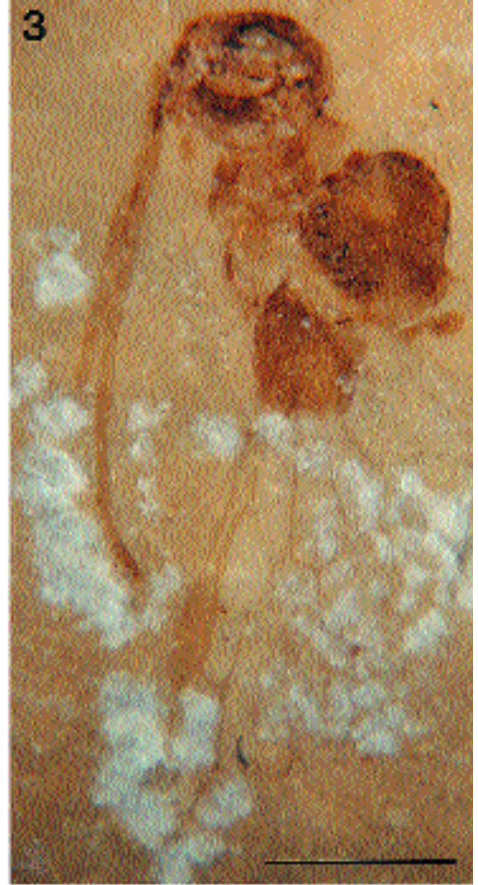
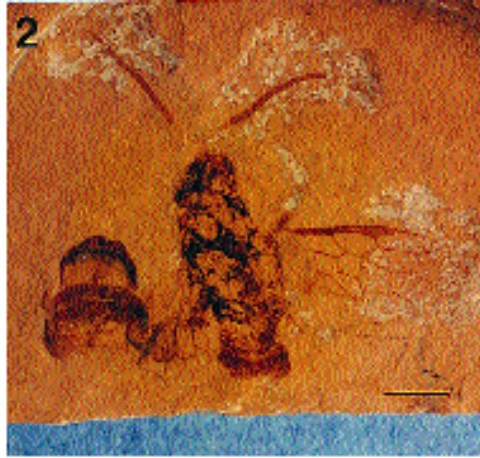


Figure 1. *Cretobestiola hispanica* (MARTÍNEZ-DELCLÒS AND RASNITSYN). Lower Cretaceous from La Pedrera. Abbreviations here and elsewhere: R, Rs, M, Cu, A - longitudinal veins; 1r-rs, 2r-rs, 2r-m, 3r-m, 1m-cu, 2m-cu, cu-a, a1-a2 - crossveins; 1r, 2r, 3r, 2rm, 3rm, 1m-cu, 2m-cu - cells; pt - pterostigma.



and Cretaceous (Parapamphiliinae and Xyelulinae) and two only in Cretaceous. The latter two, Ghilarellinae and Trematothoracinae, are found in the Spanish Lower Cretaceous.

Subfamily: Ghilarellinae RASNITSYN, 1988

Is known from two species of the type genus collected in the Aptian (or possibly Barremian) of Mongolia and in the Albian of NE Siberia (Rasnitsyn, 1993a).

GENUS *Meiaghilarella* n.gen.

Diagnosis: Unlike *Ghilarella* RASNITSYN, pronotum short, pterostigma inflated, RS comparatively long before RS+M, 2r cell small, 2r-rs before pterostigmal midlength, 3r-m more close to base rather than to apex of 3r cell, and close to 2m-cu, cu-a distant from a1-a2.

Derivation of name: *Meiaghilarella*, from Santa Maria de Meià, village close to La Cabrúa fossil-site, and *Ghilarella*, type-genus of the subfamily.

Type species: *Meiaghilarella cretatica* n.sp.

Description: Head not very large, with mandibles short, triangular, and possibly with oral cavity not separated from occipital foramen (if structures seen at the fossil are really medial margins of head capsule). Antenna short, multisegmented. Pronotum rather short, with hind margin weakly emarginate. Notauli joining far from scutellar base. Legs thin. Forewing with R not much thickened toward base, running close to C except some distance before and beyond RS base, pterostigma wide, triangular, RS half as long as M before they join in RS+M, 1r-rs much shorter than pterostigma wide, 2r-rs and RS between RS+M and 1r-rs very short, 2r-rs before pterostigmal midlength, 2r cell very small, 3r cell acuminate, 3r-m oblique, meeting RS before midlength of 3r cell and M slightly beyond 2m-cu, Cu distinctly angled at cu-a, cu-a apicad of a1-a2 almost for a1-a2 length. Abdomen parallel-sided, acuminate apically, possibly with short apical horn (unless the structure seen there is poorly preserved ovipositor that is hardly extending the hind abdominal contour).

Remarks: The streamlined, subcylindrical body contour and, if correctly interpreted, the apical abdominal horn indicate xylobiotic development of the genus and possibly of the subfamily Hilarellinae in general. Another supposedly xylophagous subfamily of Sepulcidae is Trematothoracinae, as their long, needle-like ovipositor and general appearance suggest. Less likely is the similar habits of other Sepulcidae, which possibly retained that one of ancestral Xyelidae, that is development in the male cones of conifer trees (Rasnitsyn, 1969, 1980, 1996).

Meiaghilarella cretatica n.sp.

Figures 2.1 and 3.1

Diagnosis: as for genus.

Derivation of name: from the Cretaceous period.

Material: Only the holotype, LC-1360-IEI, from La Cabrúa fossil-site, Montsec Range, Lleida (Spain). It is housed in the Institut d'Estudis Ilerdencs (Lleida, Spain).

Description: Sex unknown. Ground colour dark, antenna and legs more light, mid and hind tibia with sub-basal dark band, fore tibia, hind femur and possibly mid femur dark in middle, pterostigma dark except basally and apically. No conspicuous surface sculpture or spines found. Antenna shorter than head and thorax combined, very slightly widened near midlength, slightly serrate subapically, with about 30 short (mostly subquadrate) segments, except narrow, elongate scape and distinctly elongate though rather short pedicel. Legs and particularly tarsi long, narrow, with segments several times longer than wide (possibly except 4th segment). Length of body 10.5 mm, of fore wing 5.7 mm.

Subfamily: Trematothoracinae RASNITSYN, 1988

These subfamily include three genera found in Lower Cretaceous and Late Cretaceous (Cenomanian) of Siberia, Mongolia, England, Brazil and Spain (Rasnitsyn, 1993a; Rasnitsyn et al., 1998; Rasnitsyn and Ansoerge, 2000a).

Figure 2. 1.- *Meiaghilarella cretatica* n.gen., n.sp., holotype: LC 1360-IEI; 2.- *Eosyntexis catalonicus* n.sp., holotype: LC 2456-IEI; 3.- *Cretosyntexis montsecensis* n.gen., n.sp., holotype: LC-035-EP, scale bar: 1 mm; 4.- *Manlaya ansorgei* n.sp., holotype: LC-2782-IEI; 5.- *Montsecephialites zherikhini* n.gen., n.sp., holotype: LC-033-EP; *Karataus hispanicus* n.sp., holotype: LC-1427-IEI=LC-1460-IEI; 7.- ? *Pompilopterus noguerensis* n.sp., holotype: LC-2673-IEI; 8.- *Andrenelia pennata* n.gen., n.sp., holotype: LC-036-EP; 9.- *Cretoserphus gomezi* n.gen., n.sp., holotype: LP-0652-G/IEI, 10.- Praeaulacidae genus and species indet. LC-3313-IEI; 11.- *Angarosphex penyalveri* n.sp., holotype: LP-0163-G/IEI. Scale bar: 2 mm.

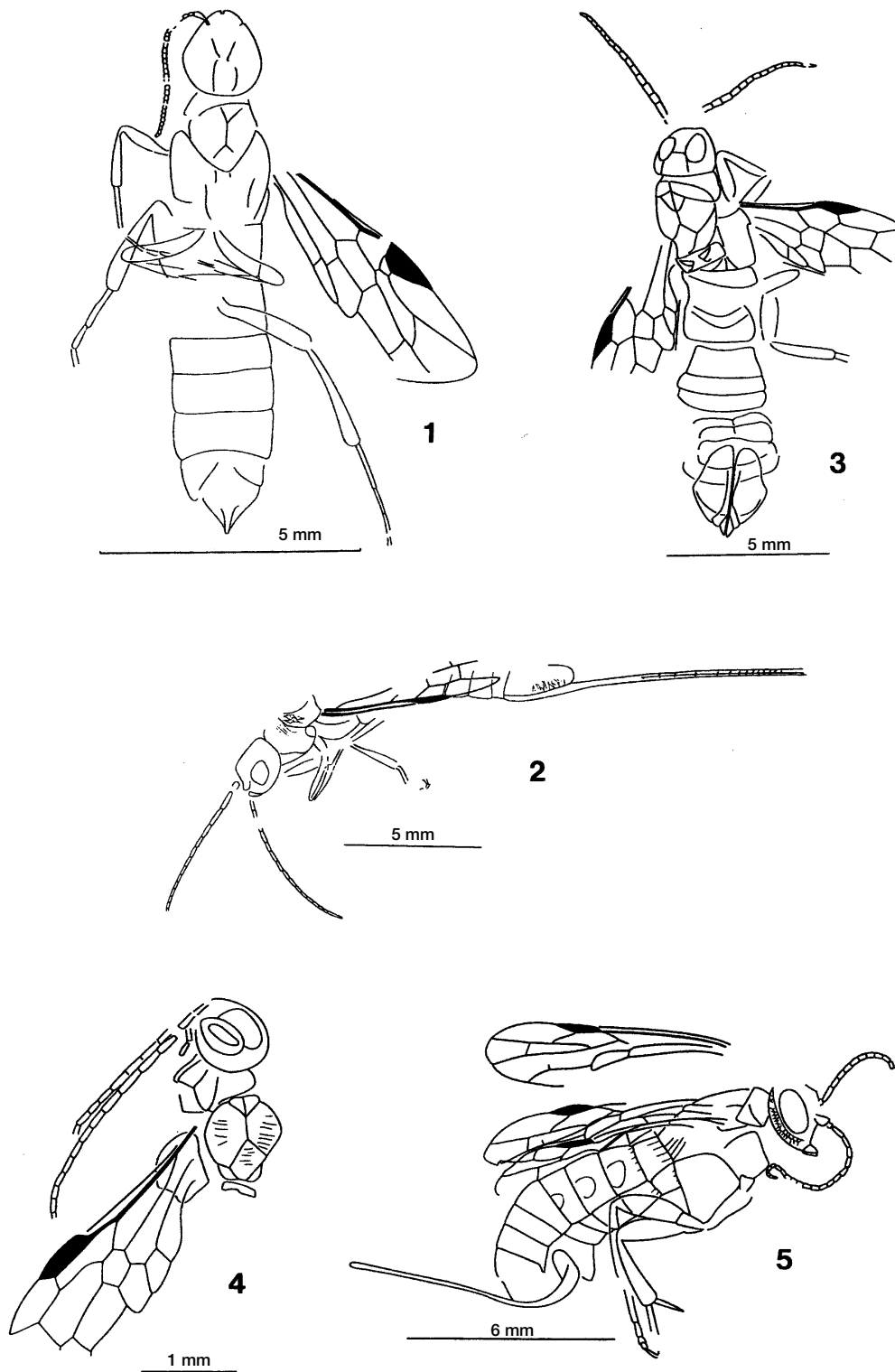


Figure 3. Camera lucida drawings. 1.- *Meiaghilarella cretacica* n.gen., n.sp., (Sepulcidae Ghilarellinae), holotype; 2.- *Prosyntexis montsecensis* RASNITSYN AND ANSORGE, holotype: MA 6; 3.- *Eosyntexis catalonicus* n.sp., Anaxyelidae: Syntexinae, holotype; 4.- *Cretosyntexis montsecensis* n.gen., n.sp., Anaxyelidae Syntexinae, holotype; 5.- *Montsecephialtites zherikhini* n.gen., n.sp., Ephialtitidae Ephialtitinae, holotype.

GENUS *Prosyntexis* SHARKEY 1990

The four species described into this genus are widely distributed in the mid Lower and Late Cretaceous of Mongolia, East Siberia, Spain and Brazil (Rasnitsyn and Ansoerge, 2000a).

Prosyntexis montsecensis RASNITSYN AND ANSORGE 2000a (in press)

Figure 3.2

2000 *Prosyntexis montsecensis* RASNITSYN AND ANSORGE (in press).

Diagnosis: Differs from other species, the type *P. gouleti* SHARKEY from the Aptian of Brazil, *P. gobiensis* (Rasnitsyn, 1993) from the Barremian or Aptian of Mongolia, and *P. ochotensis* (Rasnitsyn, 1993) from the Cenomanian of East Siberia, in narrow pterostigma with subapical 2r-rs, in cell 2r longer, and, at least from *P. gouleti* and *P. ochotensis*, in very long and narrow ovipositor.

Material: Only the holotype, MA6, from La Cabrúa fossil-site, Montsec Range, Lleida (Spain). It is housed in the Bereich Paläontologie, Ernst Motitz Arndt Universität Greifswald (Greifswald, Germany).

Superfamily: Siricoidea BILLBERGH, 1820
(LATREILLE, 1802)

Family: Anaxyelidae MARTYNOV, 1925

Anaxyelidae is a typical living fossil family first established from Mesozoic (Martynov, 1925) and only later in the Recent fauna (as Syntexidae BENSON, 1935). The family is recorded now in the Upper Jurassic and Lower Cretaceous, being very diverse and abundant in warm climate of the Upper Jurassic of South Kazakhstan, and less common though regularly encountered in the Early and mid Lower Cretaceous (Rasnitsyn, 1969, 1980). No Anaxyelidae are known since Lower Cretaceous yet, except for the single species *Syntexis libocedrii* ROHWER infesting the fire damaged wood of the incert cedar in SE USA (Middlekauff, 1974). Anaxyelidae comprise four subfamilies, three of which are entirely Mesozoic, and the fourth, Syntexinae, known both from Lower Cretaceous and in the contemporary fauna.

Subfamily: Syntexinae BENSON, 1935

Syntexinae includes three genera: the monotypic, extant genus *Syntexis* ROHWER and two Lower Cretaceous

genera, *Eosyntexis* RASNITSYN and one more from Spain which is described below.

GENUS *Eosyntexis* RASNITSYN 1990

Two species from Siberia and England are considered by Rasnitsyn et al. (1998), one more from Spain is described below.

Eosyntexis catalonicus n.sp.

Figures 2.2 and 3.3

Diagnosis: Unlike other species, 2m-cu cell about as long as high (clearly longer than high in both *E. senilis* RASNITSYN and *E. tuffinae* RASNITSYN AND JARZEMBOWSKI). Unlike *E. senilis* (the only other species with body more or less preserved), pronotum similar to that of extant *Syntexis libocedrii* in that it is angularly excised behind and bears medial suture, mesonotum with notauli join close to scutellum, fore wing slightly shorter (7.5 mm long in *E. senilis*), and ovipositor hardly extends over hind abdominal contour.

Derivation of name: Named after Catalonia, Autonomous Community from Spain where La Cabrúa outcrop is placed.

Material: Only the holotype: LC-2456-IEI, from La Cabrúa fossil-site, Montsec Range, Lleida (Spain). It is housed in the Institut d'Estudis Ilerdencs (Lleida, Spain).

Description: Ground colour dark, legs and antennal base pale. No conspicuous surface sculpture found. Head broadly touching pronotum (propleurae not elongate in neck), with eyes ovoid, narrowed rostrally, temples inflated behind eyes. Flagellum about 15-segmented, with segments ca. 1.7-2.0 times as long as wide, gradually reducing their length and width apically. Pronotum with medial longitudinal line, angularly emarginate behind. Mesonotum with notauli distant from scutellum for about half scutellar length, with scutellar base angulate. Mesothoracic venter with simple fore margin (lacking clefts characteristic of *Syntexis*), with pseudosternum ("mesosternum") short, triangular. Legs moderately short and narrow (lacking evident specialisation). Fore wing with R close to C in basal half or so, pterostigma moderately large, subtriangular, RS before junction with M longer than RS+M, 2r near pterostigmal midlength, about two third pterostigmal width, 3r m distant from 3r cell for about its length, 1m-cu co-inciding with RS+M apex, 2m-cu meeting second third of 2+3rm cell, 2m-cu cell with fore margin shorter than inner margin, Ovipositor half as

long as fore wing, sheaths extending beyond hind abdominal contour for less than their joint width. Length of body 12.5 mm, of fore wing (up to apex of cell 3r) ca. 8.5 mm.

GENUS *Cretosyntexis* n.gen.

Diagnosis: Unlike both *Syntexis* and *Eosyntexis*, pterostigma long, joining 2r-rs before apex, cell 1m-cu hexagonal, with RS+M distant from 1m-cu. Unlike all Anaxyelidae other than *Eosyntexis*, 1r-rs lost. Unlike possibly all other Anaxyelidae (except few Anaxyelinae), M+Cu widely arching in basal third.

Derivation of name: *Cretosyntexis*, from the Cretaceous period and *Syntexis* the Recent genus of the subfamily.

Type species: *Cretosyntexis montsecensis* n.sp., Early Cretaceous of Spain.

Description: In fore wing costal space apparently present throughout, pterostigma long near parallel sided, receiving 2r-rs subapically, 1r-rs lost, 3r cell closed apically, 2+3rm cell very long, receiving 2r-rs near its midlength, cell 1m-cu almost symmetrically hexagonal, with neither side very short.

Remarks: Arching M+Cu is characteristic of Sepulcidae rather than to Siricoidea, although it is recorded in few Anaxyelinae (e.g., Rasnitsyn, 1969: figs. 106, 109). Among Sepulcidae, some Trematothoracinae (e.g., *Prosyntaxis* and *Thoracotrema* RASNITSYN; Rasnitsyn, 1993a: figs. 29-34) remind *Cretosyntexis* n.gen. superficially, venationally. However, besides their loss of 2r-rs instead of 1r-rs in *Cretosyntexis* n.gen., they differ in having the important synapomorphy of advanced Sepulcidae, the costal space reduced in basal half. This feature, along with the plesiomorphic structure of the mesonotum, are taken as the evidence that new genus belongs to Anaxyelidae rather than to Sepulcidae (in Trematothoracinae, mesonotum is widely membranised along midline, cf. Rasnitsyn, 1993a: figs. 25, 27, 29, 31).

Cretosyntexis montsecensis n.sp.

Figures 2.3 and 3.4

Diagnosis: As for the genus.

Derivation of name: After the Montsec Range.

Material: Only the holotype: LC-035-EP, from La Cabrúia fossil-site, Montsec Range, Lleida (Spain). It is housed provisionally in the Dept. Estratigrafia i Paleontologia, Fac. Geologia, U.B., but its long-term home will be the Institut d'Estudis Ilerdencs (Lleida, Spain).

Description: Head and thorax moderately dark, antenna less dark. Head with eyes large, probably ovoid, with temples only moderately swollen. Antenna narrow, with segments (possibly including scape) 2-4 times as long as wide, only slightly decreasing in width toward apex, considerably decreasing in length both directions of seemingly third flagellar segment which about twice as long as 11th (last completely visible) segment. Pronotum apparently moderately short, with hind margin not distinctly excised. Propleurae short, contacting along all visible inner margins. Mesonotum transversely rugose, with notauli distant from scutellum for less than scutellar length, with scutellum angulate basally. Fore wing with pterostigma almost as long as cell 3r, 2r-rs shorter than pterostigma wide, RS+M longer than RS before junction with M, shorter than M between RS+M and 1m-cu, 3r-m distant of cell 3r apex for less than its length, M between 3r-m and 2m-cu much shorter than these crossveins, 2a cell receiving cu-a near its midlength. Length of fore wing 3 mm.

Family: Ephialtitidae HANDLIRSCH, 1906

It is the second most archaic family of apocritan hymenoptera (Suborder Vespina), the first being the Jurassic Karatavitidae (Rasnitsyn, 1988a). Ephialtitidae were one of the numerically dominant groups in thermophilous assemblages of the Upper Jurassic. In the Lower Jurassic, Middle Jurassic, and in Lower Cretaceous Ephialtitidae shown only modest participation (Rasnitsyn, 1975, 1977, 1990; Zessin, 1981, 1985; Zhang, 1986; Darling and Sharkey, 1990). They were widely distributed over the present day Eurasia, being encountered in China, Mongolia, Siberia, Kazakhstan, Germany, and Spain, and otherwise are found only in Brazil. The family is divided into two subfamilies both recorded in Spain.

Subfamily: Ephialtitinae HANDLIRSCH, 1906

The subfamily comprises eleven described genera characterised by the long ovipositor and distal position of cu a in fore wing, with total distribution so incising with that of the family (for taxonomic position of the Brazilian species see Remarks to *Karataus* genus below).

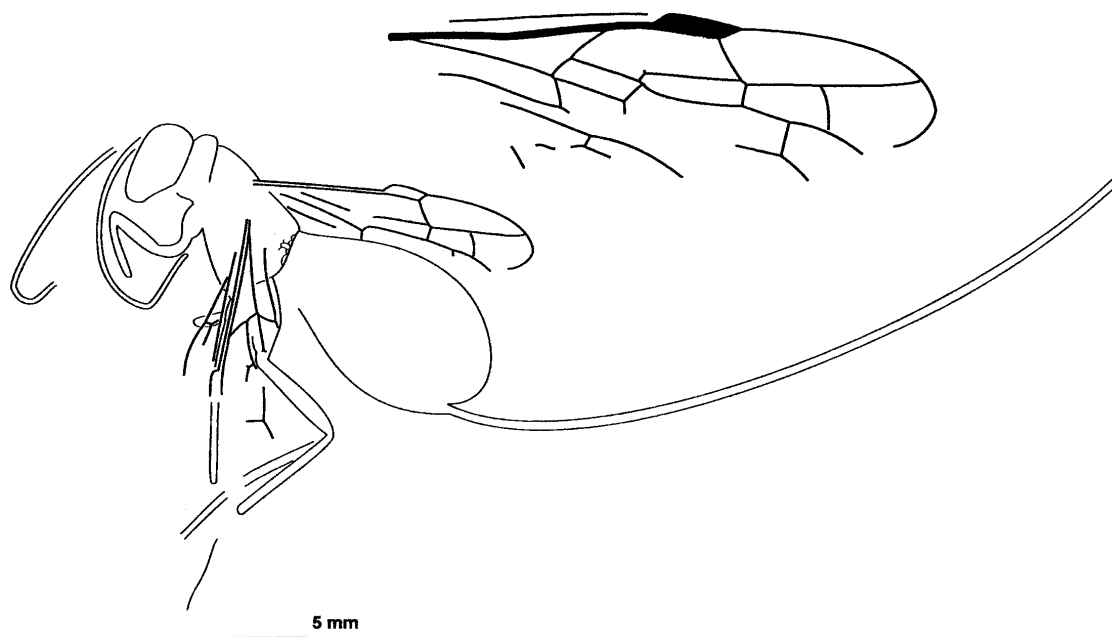


Figure 4. *Ephialtites jurassicus* MEUNIER, holotype: MGB-517. Camera lucida drawings of the fore wing and complete body.

GENUS *Ephialtites* MEUNIER 1903

Type species: Ephialtites jurassicus MEUNIER 1903, Lower Cretaceous of Spain.

Diagnosis: Unlike all other Ephialtitidae, cell 2rm very long, hind wing with RS vertical to R basally, and ovipositor very long, evenly bent upward; otherwise indistinguishable from *Leptephalitites* RASNITSYN.

Description: Antenna long, thin. Head elongate downward in side view. Hind legs long, thin, hind coxa almost as long as head but possibly thin. Fore wing with venation complete except possibly 2A and a1-a2, RS distant of pterostigma, directed obliquely basad, 1r-rs rudimentary, cell 2rm longer than any of 3rm and 1mcu, with length 4 times width, reaching level of pterostigmal base, cell 2mcu length almost 5 times width, reaching midlength of cell 3rm, cu-a slightly apicad of M+Cu apex. Hind wing with RS before r-m short, vertical, after it also short (far from reaching wing margin), r-m oblique. Metasoma short and wide, broadest slightly beyond midlength, with smooth contours, widely attached to propodeum. Ovipositor with sheath 1.7 times body length, bent upward.

Species included: Type species.

Ephialtites jurassicus MEUNIER 1903

Figure 4

- 1903 *Ephialtites jurassicus*, Meunier, pp. 462-463, figs. 1-2
- 1908 *Ephialtites jurassicus* Meunier, Handlirsch, p. 578, taf. XLVI, fig. 25
- 1917 *Ephialtites jurassicus* Meunier, Vidal, p. 125, lám. XI, fig. 1
- 1926 *Ephialtites jurassicus* Meunier, Font, p. 242, fig. 218
- 1932 *Ephialtites jurassicus* Meunier, Broili, p. 8, pl. II, fig. 3
- 1932 *Ephialtites jurassicus* Meunier, Chevalier, p. 64, fig. 2
- 1951 *Ephialtites jurassicus* Meunier, Ferrer, pp. 13-14, lám. III, fig. 2
- 1952 *Ephialtites jurassicus* Meunier, Bataller et al., p. 27, lám. VII, fig. 4
- 1975 *Ephialtites jurassicus* Meunier, Rasnitsyn, pp. 23-26, pl. I, fig. 2
- 1976 *Ephialtites jurassicus* Meunier, Hughes, p. 58, fig. 6.4-F
- 1981 *Ephialtites jurassicus* Meunier, Lacasa, p. 110, fig. 64
- 1985 *Ephialtites jurassicus* Meunier, Whalley and Jarzembowski, pp. 406-407, fig. 25.
- 1990 *Ephialtites jurassicus* Meunier, Martínez-Delclòs, pp. 110-112, lám. 3, figs. A, B
- 1991 *Ephialtites jurassicus* Meunier, Martínez-Delclòs, pp. 98-99, fot. 14
- 1993 *Ephialtites jurassicus* Meunier, Martínez-Delclòs and Martinell, p. 141, pl. 4, fig. A

Description: Colour pattern currently not preserved but originally (judging from the photograph in Meunier, 1903)

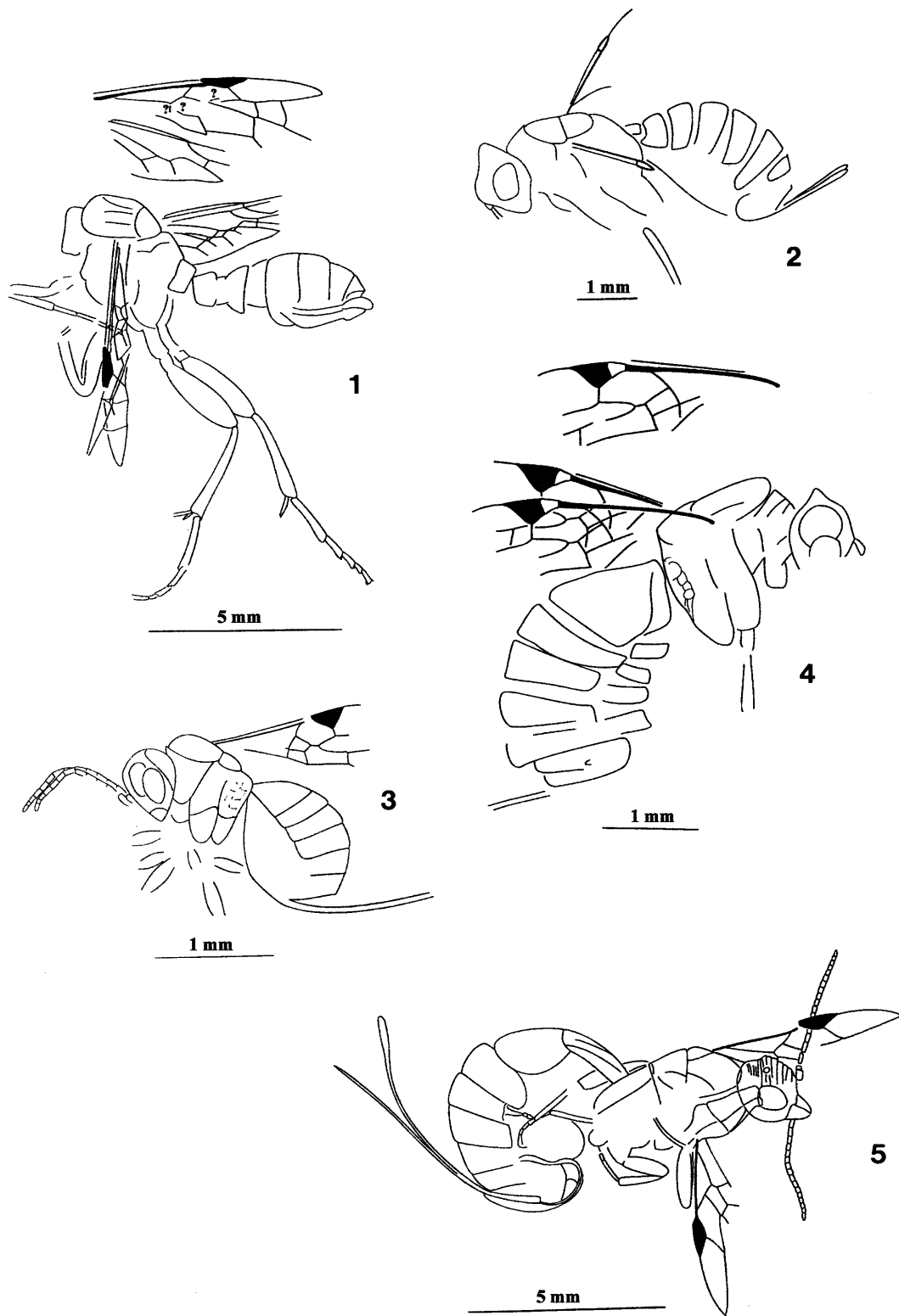


Figure 5. Camera lucida drawings. 1.- *Karataus hispanicus* n.sp., Ephialtitidae: Symphytopterinae, holotype. 2.- Praeaulacidae genus and species indet. LC-3313-IEI; 3.- *Manlaya lacabrua* RASNITSYN AND ANSORGE, holotype: MA 15; 4.- *Manlaya ansorgei* n.sp., Gasteruptionidae: Baissinae, holotype. 5.- *Andrenelia pinnata* n.gen., n.sp., type-species of Andreneliidae n. fam., holotype.

possibly dark including antenna and legs. Surface sculpture not preserved except some areolation on propodeal apex. Length of body without ovipositor 7.7 mm, antenna ca. 4.5 mm, head 1.6, fore wing 5.4 mm, fore femur 1.0 mm, hind coxa 1.4 mm, hind femur ca. 1.8, hind tibia 2.2, metasoma 4.3 mm, ovipositor sheath ca. 13.5 mm.

Material: holotype MGB 517, housed in the Museu de Geologia de Barcelona; from La Pedrera de Rúbies, originally well preserved but damaged due to being covered by varnish for long time.

GENUS *Montsecephialtites* n.gen.

Diagnosis: Unlike all other Ephialtitidae, 2r-m lost while 3r-m present (as identified after its position far apicad of 2m-cu), otherwise indistinguishable from *Lep-tephialtites* RASNITSYN.

Derivation of name: *Montsecephialtites*, named after the Montsec Range and the genus *Ephialtites*.

Type species. *Montsecephialtites zherikhini* n.sp., Early Cretaceous of Spain.

Description: Antenna thin, with more than 15 segments. Hind coxa very large, hind legs only moderately increased. Fore wing with RS leaving R next to pterostigma, directed obliquely basad, 1r-rs and 2r-m lost, cell 2+3rm not reaching level of pterostigmal base, 3r-m distant from both 2r-rs and 2m-cu for about their length, cu-a slightly apicad of M+Cu apex, a1-a2 and 2A possibly lost. Metasoma very widely attached to propodeum, broadest subapically, with upper and lower basal contours almost smooth, very gradually diverging. Ovipositor moderately long, straight.

Montsecephialtites zherikhini n.sp.
Figures 2.5 and 3.5

Derivation of name: Named in honour to Prof. Vladimir Zherikhin, from the Russian Academy of Sciences.

Material: Only the holotype, LC-033-EP from La Cabría fossil-site, Montsec Range, Lleida (Spain). It is housed provisionally in the Dept. Estratigrafia i Paleontologia, Fac. Geologia, U.B., but its long-term house will be the Institut d'Estudis Ilerdencs (Lleida, Spain).

Description: Ground colour pale, flagellar segments 4 or 5 through apex, head behind eyes, thorax (mostly

mesonotum and hind coxa), metasomal segments 1-4 except posterior lateral pale spots on segments 2-4, and ovipositor sheaths more dark. Antenna short, setiform, very slightly widened near midlength, 2-3 segmented, with scapus thick, about 1.5 times as long as wide subapically, pedicell small, subquadrate, 1st flagellar segment longest, about 3 times as long as wide, following shorter and, for several apical segments, narrower, about 4 penultimate segments subquadrate. Head with eyes elongate ovate, temples much narrower than eye, with longitudinal carina and reticulation behind it, mandibles somewhat prominent. Pronotum with hind margin weakly or not at all excised. Hind leg with coxa very large, subtriangular (with fore and hind margins more or less straight), trochanter somewhat elongate, femur short, not much thickened, tibia rather thick, with thick and rather long spur, basitarsus longer than 3 following tarsomeres combined, tarsomeres 3 and 4 only slightly or not at all elongate. Propodeum longitudinally rugose at least in part, with dorsal contour straight (not arching toward metasomal base), basal metasomal segments longitudinally rugose at base, terga 2-3 and sternum 6 longest (the latter not reaching metasomal apex). Ovipositor straight beyond metasoma, sheath shorter than metasoma and wing. Length of body 8.8 mm, of fore wing 5.9 mm, of ovipositor sheath 4.2 mm.

GENUS *Cretephialtites* RASNITSYN AND ANSORGE 2000

2000 *Cretephialtites*; RASNITSYN AND ANSORGE, pp. 52-53; figs. 3-4.

Diagnosis: differs from other Ephialtitinae in 2r-m and 3r-m both oblique, sinuate, and 2m-cu meeting M basad of 2r-m.

Type species: *Cretephialtites pedrerae* RASNITSYN AND ANSORGE, Lower Cretaceous of Spain.

Species included: Type species.

Material: *C. pedrerae* RASNITSYN AND ANSORGE, holotype forewing, MA101, from La Pedrera de Rúbies fossil-site, Montsec Range, Lleida (Spain). It is housed in the Museum für Naturkunde, Humboldt Universität Berlin, J. Ansoerge collection.

Subfamily: Symphytopterinae RASNITSYN, 1980

GENUS *Karataus* RASNITSYN 1977

Type species: *K. pedalis* RASNITSYN 1977, Upper Jurassic of Kazakhstan.

Species included: Besides type species, the species described below.

Remarks: "K". *koiurus* SHARKEY (Darling and Sharkey, 1990) have recently placed in the new genus *Cratephialtites*, closely related to *Leptepialtites* RASNITSYN (Rasnitsyn, 1999).

Karataus hispanicus n.sp.
Figures 2.6 and 5.1

Diagnosis: Differing from the type species in that 2-3r-m arching, 3r-m more distant from 3r cell apex, 2m-cu received by 2r-m cell, hindwing cu-a meeting M+Cu well before fork, and different coloration (in *K. pedalis* thorax entirely dark, metasomal segments 1-4 and hind tibia pale). Different coloration may depend on sex (for *K. pedalis* only male is known), but this is hardly the case for the venational characters.

Derivation of name. From Hispania, roman name of Spain.

Material: Only the holotype: LC-1427-IEI (print) and LC-1460-IEI (counterprint), from La Cabrúa fossil-site, Montsec Range, Lleida (Spain). It is housed in the Institut d'Estudis Ilerdencs (Lleida, Spain).

Description: Ventral and, patchy, dorsal thorax, hind tibia basally, and metasoma moderately dark, rest of hind tibia, hind tarsus and rest of thorax less dark, hind femur and spurs and mid tarsi still less dark, mid femur and tibia, hind trochanter and trochantellus pale. Fore leg thin, mid and hind femora incrassate, hind coxa moderately large, trochanter elongate, trochantellus distinct, subquadrate, tibia rather thin, with spurs rather thick, not long, tarsus with all segments elongate, tarsomeres 1-3 with planta and short lateral spines, basitarsus as long as 3 following tarsomeres combined, tarsomere 5 shorter than 3. Fore wing with pterostigma most wide at junction with 2r-rs, 2-3r m both arching (almost sinuate), 2r-m slightly apicad of 2m-cu, 3r distinctly nearer to 2r-m than to 3r apex. Hind wing with cu a joining M+Cu basad of fork for almost cu-a length.

Metasoma rather narrow basally, widest beyond mid-length. Ovipositor hardly extending beyond metasomal apex, sheath rather wide, with upper contour convex and

lower one concave. Length of body without head 8 mm, fore wing 6 mm, ovipositor sheath 0.8 mm.

Family: Praeaulacidae RASNITSYN, 1972

GENUS and SPECIES Undetermined
Figures 2.10 and 5.2

Material: Only the specimen: LC-3313-IEI, from La Cabrúa fossil-site, Montsec Range, Lleida (Spain). It is housed in the Institut d'Estudis Ilerdencs (Lleida, Spain).

Description: Ground colour moderately pale, head darker. Head rather thick, almost cube shaped, with eye short, wide. Thorax elongate (not short and high), with pronotum long medially, hind margin weakly excised. Hind coxa moderately long and thick. Fore wing with costal space moderately wide, pterostigma small, otherwise venation unknown (veins probably pale and thin). Metasoma subovate, narrowed toward base, attached to near propodeal mid height apparently by small, conical segment, following terga of comparable length. Ovipositor straight, extending for about half metasomal length. Length of body (as preserved, with metasoma exaggerated by decomposition) 5.4 mm, ovipositor 2.0 mm, sheath 1.4 mm.

Remarks: The fossil, however imperfectly preserved, can be attributed to Praeaulacidae basing on the upper metasomal attachment on propodeum (characteristic of Evanioidea) and wide pronotum (that of Praeaulacidae). Within Praeaulacidae, small pterostigma and ovipositor, which is straight and not arching downward, rules out Cretocleistogastrinae, leaving us the choice between two Upper Jurassic subfamilies Praeaulacinae and Anomopterellinae. Neither may be selected basing on the features available. At the same time, very short and narrow basal metasomal tergum (or entire segment) is unknown in Praeaulacidae, and low, elongate thorax is not characteristic of the family as well. That is why the fossil is hardly congeneric with any described before. However, poor preservation state makes description of a new genus impractical.

Family: Gasteruptiidae ASHMEAD, 1900
(KIRBY, 1837)

Subfamily Baissinae RASNITSYN, 1975

GENUS *Manlaya* RASNITSYN 1980

Manlaya lacabrua RASNITSYN AND ANSORGE 2000
(in press)
Figure 5.3

2000 *Manlaya lacabrua*; Rasnitsyn and Ansoerge (in press).

Diagnosis: In its small size the species is only comparable to *M. oculatissima* RASNITSYN AND JARZEMBOWSKI from the Purbeck of England, but differs in having eyes smaller, RS base close to pterostigma, and cells 2_{rm} and 1_{mcu} more distant.

Material: Only the holotype, MA15, from La Cabrúa fossil-site, Montsec Range, Lleida (Spain). It is housed in the Bereich Paläontologie, Ernst Moritz Arndt Universität Greifswald (Greifswald, Germany).

Manlaya ansorgei n.sp.
Plate 2, fig. 4

Diagnosis: In the key by Rasnitsyn et al. (1998), it runs to *M. pinguis* RASNITSYN from the Lower Cretaceous of Mongolia, but unlike that species eye larger, ground colour dark, and pterostigma dark with pale base.

Derivation of name: In honour to Dr. Jörg Ansoerge from the Geologisch-Paläontologisches Institut der Ernst-Moritz-Arndt-Universität Greifswald (Germany).

Material: Only the holotype, LC-2782-IEI, from La Cabrúa fossil-site, Montsec Range, Lleida (Spain). It is housed in the Institut d'Estudis Ilerdencs (Lleida, Spain).

Description: Ground colour dark, pterostigmal base and, probably, antenna and legs pale. Eye large, subcircular. Thorax high and short, propodeum reticulate at least in part. Fore wing with pterostigma symmetrical (receiving 2_r-rs at midlength), 1_{mcu} cell about 1.5 times as long as high, 1_{m-cu} distant of fork RS+M for near 0.7 its length, cu-a interstitial (coinciding with M+Cu fork). Apparently 1st metasomal tergum as long as 3 following terga combined. Ovipositor sheath thin at least basally. Length of body 4.4 mm, of fore wing about 3 mm.

Family: Andreneliidae n. fam.

Diagnosis: The new family belongs to superfamily Evanioidea, because its metasoma attaches the upper propodeal surface, and no reliable contradictory similarity is found. Within Evanioidea, Andreneliidae n. fam. takes an intermediate position between other families and cannot be easily included in any of them. It is symple-

siomorphic with Praeaulacidae in multisegmented antenna (18 or 19 antennomeres in the only known species) and in cu a far postfircal (meeting Cu well distant of M+Cu fork). It is synapomorphic with Gasteruptiidae s.l., Evaniidae and Cretevaniidae in pronotum short medially, resulted from its hind margin being deeply excised, and in loss of the median mesoscutal sulcus. It is similar (synapomorphic or homoplastic) with Evaniidae and Cretevaniidae (as well as with several praeaulacid genera) in long, subcylindrical first metasomal segment, and with Gasteruptiidae in wide pterostigma, albeit not so exaggerated as in their most archaic representatives (Baissinae and some Aulacinae). Depending on which of these similarity sets represents the real synapomorphy (if any), the new family may be considered a sister group of either Gasteruptiidae or the clade comprising Evaniidae and Cretevaniidae. Andreneliidae n. fam. is also autapomorphic in the following character states: head dorsum and not thoracic dorsum transversely ridged; fore wing apparently lacking the following veins as tubular ones: C, 2-3_r m, 2_{m-cu} - entirely, M and Cu - shortly beyond 1_{m-cu} and A - shortly beyond cu-a; tarsomeres with exaggerated heteronomy. Some of these character states may appear apomorphies of the type genus or even type species, and not of the family itself, though this possibility is entirely depends on future discoveries.

Genera included: *Andrenelia* n.gen.

GENUS ***Andrenelia*** n.gen.

Diagnosis: as in family.

Derivation of name: In honour to Dr. André Nel, from the Muséum National d'Histoire Naturelle, Paris (France).

Type species: *Andrenelia pinnata* n.sp., Early Cretaceous of Spain.

Description: Antenna more than 15 segmented, with scape not elongate. Mandibles protruding. Frons and vertex regularly transcarinate. Thorax rather long and low, not heavily sculptured, with propleurae somewhat elongate but not forming long neck, no external prosternum present, notauli widely diverging, well disant on transscutal suture. Legs ordinary as preserved, except that fore coxa attenuate apically, and at least mid and hind basitarsi very long in contrast to short following tarsomeres. Forewing with only 5 enclosed cells: 1+2_r (1st submarginal), 3_r (marginal), 1_{rm} (basal), 1_{mcu} (1st discoidal)

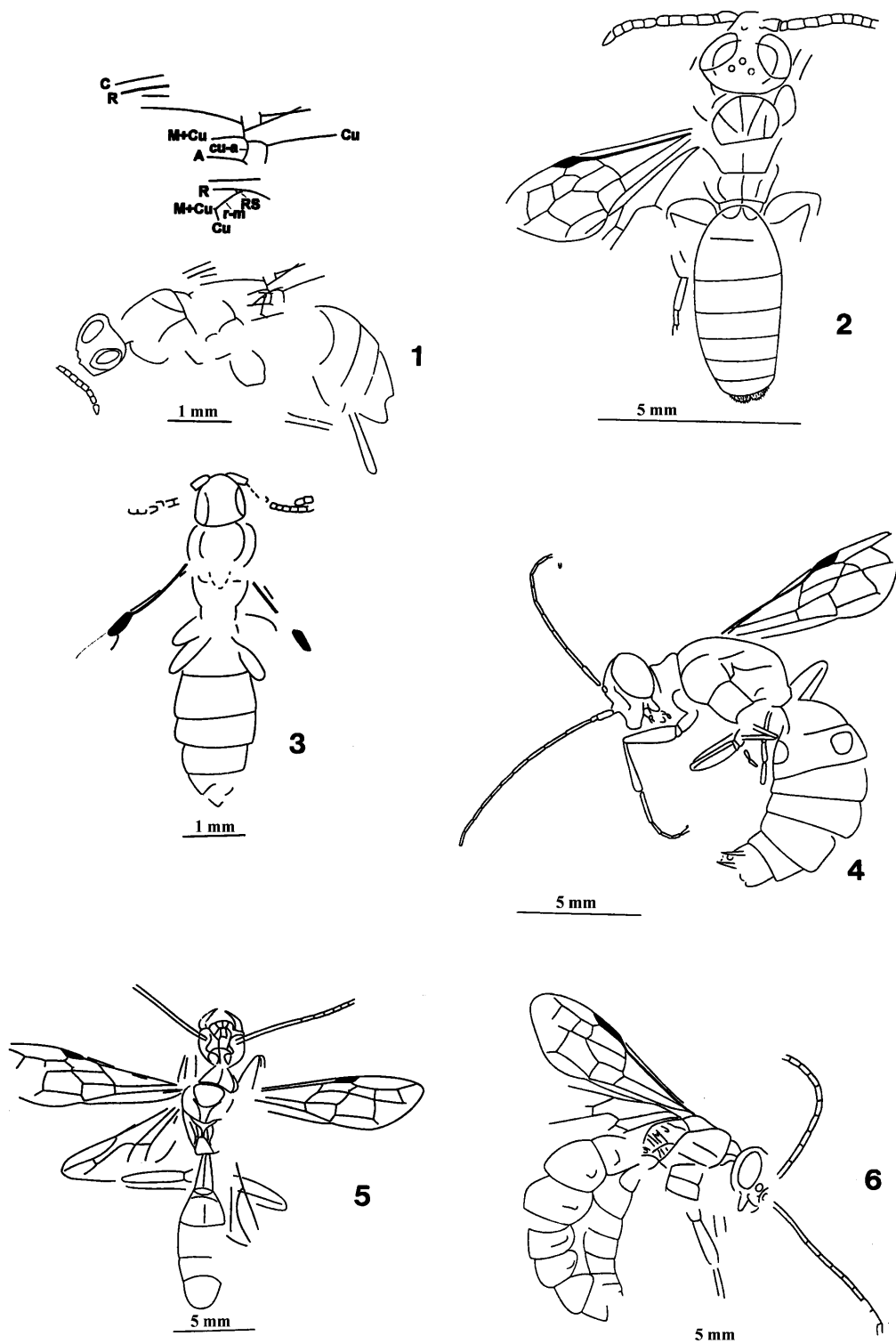


Figure 6. Camera lucida drawings. 1.- *Cretoserphus gomezi* n.gen., n.sp., Mesoserphidae, holotype; 2.- *Meiagaster cretaceus* ANSORGE AND RASNITSYN, holotype: MA 22; 3.- ? Bethylidae, genus and species indet., LC-2987-IEI; 4.- *Lleidosphex wenzii* RASNITSYN, holotype: S11456; 5.- *Montsecosphex jarzembowskii* n.gen., n.sp., Sphecidae: Angarosphecinae, holotype; 6.- *Angarosphex lithographicus* RASNITSYN AND ANSORGE, 2000, holotype: MA 7.

and 1cua (subbasal), C lost or very weak, pterostigma almost as large as in Baissinae, receiving 2r-rs slightly beyond its midlength, basal sections of RS and M aligned in smooth basal vein, 1mcu reaching M very slightly distad of RS+M apex, cu-a distant from apex of M+Cu for more than half of its length, M and Cu lost shortly beyond 1mcu, A- shortly beyond cu-a. 1st metasomal segment near as long as mesonotum with scutellum, very slightly arching, with longitudinal carinae, 2nd tergum almost as long as 1st, much longer than high, following terga short and high. Ovipositor considerably extending, very slightly sinuate.

***Andrenelia pinnata* n.sp.**

Figures 2.8 and 5.5

Derivation of name: *pinnata*, from the latin “with wings”.

Material: Only the holotype, LC-036-EP, from La Cabría fossil-site, Montsec Range, Lleida (Spain). The holotype is housed provisionally in the Dept. Estratigrafia i Paleontologia, Fac. Geologia, UB, but its long-term house will be the Institut d’Estudis Ilerdencs collection (Lleida, Spain).

Description: Ground colour dark, metasoma pale, its 1st segment intermediate in colour. Antenna with 18 or 19 segments, scape subcylindrical, about 1.5 times as long as wide, pedicell small, transverse, flagellum rather short, filiform, slightly widened beyond midlength, its 1st segment about 2.5 times as long as wide, penultimate one scarcely elongate. Head with eye slightly elongate, of moderate size, with temples somewhat inflated. Propleuron as long as scutum, not much widened toward coxa. Fore coxa less than twice as long as wide, less than half as wide subapically as subbasally. Mid femur and tibia much shorter than fore ones, mid and hind basitarsus much elongate, hind one longer than all following combined, hing tarsomeres 2-4 all slightly elongate. Ovipositor extending for about metasomal length, sheath distinctly widened apically. Length of body near 9 mm, of fore wing 5 mm, of ovipositor 7 mm, of sheath 6.4 mm.

Family Mesoserphidae KOZLOV, 1970

GENUS *Cretoserphus* n.gen.

Diagnosis: Attribution to Mesoserphidae is based on the very characteristic hind wing venation, with no serious contradiction found. In the key of the mesoser-

phid genera (Rasnitsyn, 1986a), which is not affected by following descriptions (Rasnitsyn, 1986b, 1990, 1991) in what concerns the present fossil, the latter agrees *Mesoserphus* almost perfectly, except for the lower size. It differs from *Mesoserphus* additionally in indented Cu and distinctly postfurcal cu-a. It differs from *Auliserphus* RASNITSYN and *Campturoserphus* RASNITSYN by short last sternum, from *Campturoserphus*, *Scoliuoserphus* RASNITSYN and *Lordoserphus* RASNITSYN in straight ovipositor, from *Udaserphus* RASNITSYN, *Turgiserphus* RASNITSYN and *Oxyuroserphus* RASNITSYN in soft metasoma, and from *Udaserphus*, *Lordoserphus*, *Karataoserphus* RASNITSYN and *Karataoserphinus* RASNITSYN in different hind wing venation (r-m long, reclivous, cell r low, open apically). Distinctly indented Cu and high cell 2cua possibly differ new genus from all other Mesoserphidae.

Derivation of name: From the Cretaceous period.

Type species: *Cretoserphus gomezi* n.sp., Early Cretaceous of Spain.

Description: Costal space moderately wide at least basally, Cu including M+Cu not entirely straight (indented at junctions with cu-a and A?), though keeping general direction well, cu-a slightly postfurcal, cell 2cua higher than long, apparently open behind except subbasally; otherwise venation obscure or difficult to interpret. Hind wing with long, oblique r-m meeting RS near its base, with cell r rudimentary, open apically, narrowly, with M bent backward at junction with r-m. Metasoma somewhat elongate but possibly short, not heavily sclerotised, with last sternum short. Ovipositor straight, issued subapically.

Remarks: Despite the poor preservation state of the unique fossil and connected problems in its venational interpretation, the differences from other genera are apparent enough to permit description of the new genus.

***Cretoserphus gomezi* n.sp.**

Figure 2.9 and 6.1

1986 Himenóptero, Gómez, p. 731, photo 36.

Diagnosis: as for the genus.

Derivation of name: in honour to Mr. Gómez-Pallero la he found the specimen.

Material: Only the holotype: LP-0652-G/IEI, from La Pedrera de Rúbies fossil-site, Montsec Range, Lleida (Spain). The holotype is from the Gómez-Pallerola collection, housed in the Institut d'Estudis Ilerdencs (Lleida, Spain).

Description: Ground colour dark, flagellum less dark, legs and antennal base evidently pale (not preserved). Flagellum filiform, with 8 apical flagellomeres ca. 1.5 - 1.7 times as long as wide. Head with eye large, elongate ovate, temples slightly swollen, clypeus with small, rounded, slightly prominent central lobe, excised laterally. Notauli approaching each other on transscutal suture, widely diverging cephalad. Hind coxa large. Ovipositor moderately short, with sheath about half as long as metasoma. Length of body as preserved (probably exaggerated because the metasoma is thrown out and somewhat displaced) 5 mm, of fore wing about 3 mm, of sheath 1.0 mm.

Family: Bethyloynymidae RASNITSYN, 1975

GENUS *Meiagaster* RASNITSYN AND ANSORGE 2000 (in press)
Figure 6.2

2000 *Meiagaster cretaceus* RASNITSYN AND ANSORGE (in press).

Diagnosis: The new genus is similar to *Bethyloynymus* RASNITSYN in complete venation (except free apex of Cu lost in hind wing) but differs in having clypeus much protruding, notauli more converging backward, forewing cells 2_{rm} and 1_{mcu} widely overlapping, and hindwing RS with basal abscissa long.

Meiagaster cretaceus RASNITSYN AND ANSORGE 2000

Species included: Type species.

Material: *Meiagaster cretaceus* RASNITSYN AND ANSORGE, 2000, Holotype, MA22, from La Cabrúa fossil-site, Montsec Range, Lleida (Spain). It is housed in the Bereich Paläontologie, Ernst Motitz Arndt Universität Greifswald (Greifswald, Germany).

Family: ? Bethylidae HALIDAY, 1833

GENUS AND SPECIES Undetermined
Figure 6.3

Material: LC-2987-IEI, from La Cabrúa outcrop, Montsec Range, Lleida (Spain). It is housed in the Institut d'Estudis Ilerdencs (Lleida, Spain).

Description: Ground colour dark, flagellar base and probably tibiae and tarsi pale. Antenna apparently 13 segmented, not geniculate, with scape elongate (about 2.5 times as long as wide), thicker than flagellum, flagellomeres becoming slightly thicker and distinctly longer toward apex, with basal ones subquadrate and apical ones about 1.5 times as long as wide. Head longer than wide, widest at rear margin, with sides roundly converging forward, with antenna attached near fore margin. Pronotum not apparent, possibly short, mesothorax distinctly wider than metathorax and propodeum, with obscure details. Legs comparatively short, femora not distinctly swollen. Fore wing with no tubular and possibly even nebuloise veins other than elongate ovate pterostigma, C and R only before it, and short vein comprising 2_{r-rs} aligned with RS rudiment, with costal space distinct. Metasoma moderately long and thick, acuminate apically, with terga seemingly, gradually decreasing in length rearward, with no apparent specialisation. No external ovipositor found. Length of body 5.3 mm, of fore wing R and pterostigma 1.7 mm.

Remarks: The very tentative attribution of the incompletely preserved unique fossil to Bethylidae is based on the general appearance of small, bethylid-like wasp with non geniculate, 13-segmented antenna in supposedly female sex (hypothesised solely from acuminate metasomal apex). Non vespomorph apocritans rarely, if at all, have wasp like general appearance combined with 13-segmented, non geniculate, near filiform antenna. Within Vespomorpha Bethyloynymidae are unknown to have so reduced wing venation, and aculeate wasps other than Chrysoidea never have 13-segmented antenna in female sex. It cannot be ruled out definitely that the fossil under study represents a male of a non-chrysidoid aculeate wasp. In these wasps, however, we are not aware of a male with the full grown wing displaying so deeply reduced venation. Within Chrysoidea only Bethylidae and, to a lesser extent, Scolebythidae display the deeply reduced venation along with the comparatively plesiomorphic antenna and metasoma. The present fossil is unlike Scolebythidae in the form of head and thorax, especially in that the head seemingly appressed to thorax, as well as in the particular mode of wing venation. This is the main reason to attribute the fossil tentatively to Bethylidae.

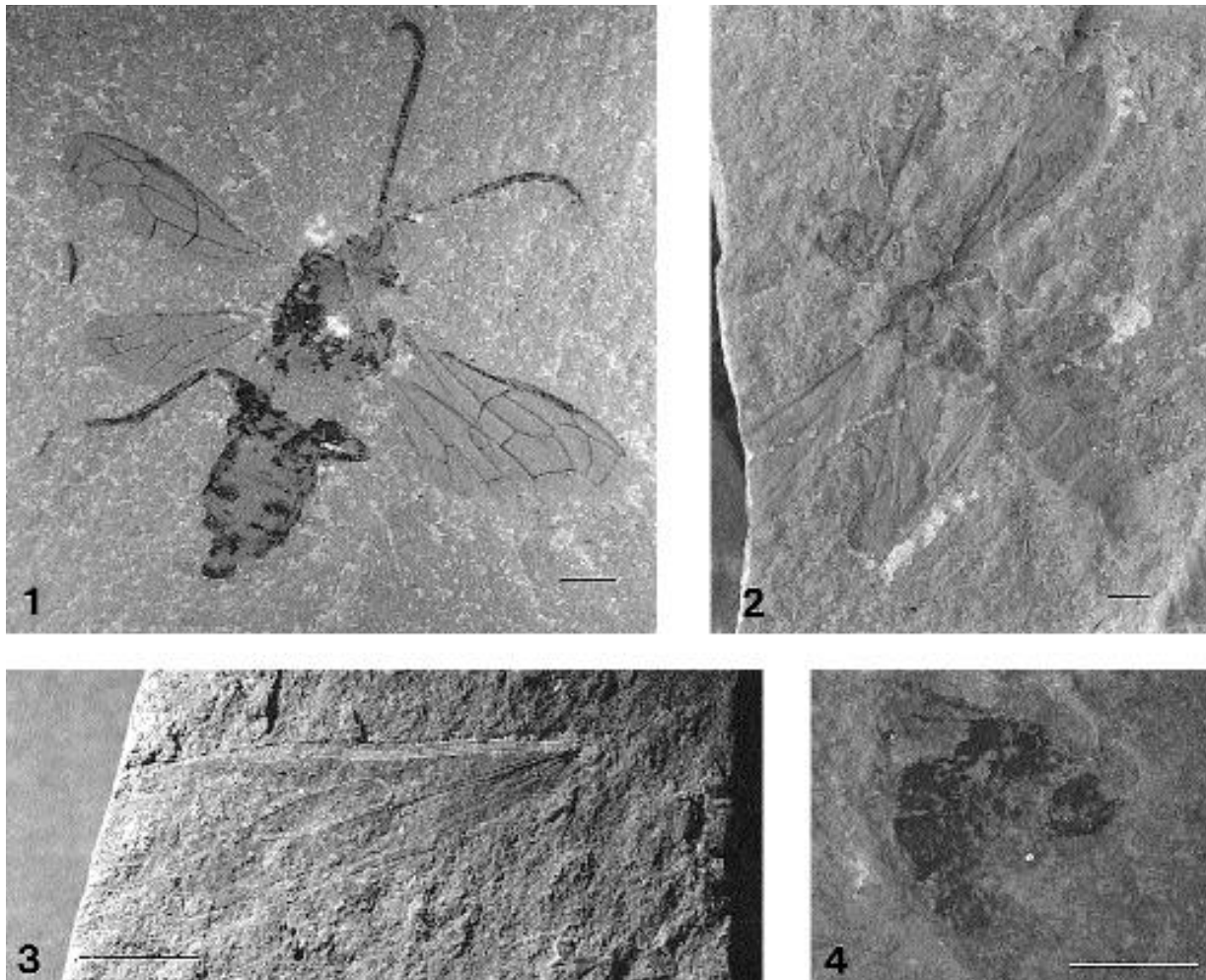


Figure 7. 1.- *Cretobestiola hispanica* (MARTÍNEZ-DELCLÒS AND RASNITSYN), holotype: LP92/SC/3662; 2.- *Montsecosphex jarzembowskii* n.gen., n.sp., holotype: LP-4132-IEI; 3.- *Cretoscolia conquensis* n.sp., holotype LH-17331; 4.- ? Sphecidae, genus and species indet. 2, LC-1707-IEI. Scale bar: 2 mm.

Family: Sphecidae LATREILLE, 1802

Subfamily: Angarosphecinae RASNITSYN, 1975
 (= Angarosphecidae RASNITSYN, 1975, = Baissodidae RASNITSYN, 1975)

The composition and taxonomic state of the subfamily Angarosphecinae are discussed by Rasnitsyn et al. (1998) and by Pulawski et al. (1999). Angarosphecinae are archaic Mesozoic wasps, a paraphyletic assemblage that lacks synapomorphies of other sphecid subfamilies. They are the most abundant taxa among the Early-Lower Cretaceous Hymenoptera, particularly in the middle interval of that time, probably after Berriasian and before Albian, 140-113 m.yr BP, so as the name Angarosphecinae was taken to denote this type of assemblages (Rasnitsyn et al., 1998). Few

sphecid fossils have been described before from the Spanish Lower Cretaceous (Ansorge, 1993; Ansorge and Rasnitsyn, 2000a; Rasnitsyn et al., 1999; Rasnitsyn, 2000). Following is their review and description of the remaining available material kept in various Spanish museums.

GENUS *Cretobestiola* (PULAWSKI AND RASNITSYN 2000) (in Rasnitsyn et al., 1999, but see Pulawski and Rasnitsyn, 2000)

1999 *Bestiola hispanica* MARTÍNEZ-DELCLÒS AND RASNITSYN, Pulawski et al., p. 27, fig. 1.

Diagnosis: *Cretobestiola* is easily recognised by its unique wing venation: cells 2rm and 3rm present, cell

2r_m receiving veins 1m-cu and 2m-cu, and the combination of three unusual aspects differentiates it from all other sphecids genera with these characteristics, both extinct and extant: cell 3r_m broader on the costal side than on the anal side, crossvein 3r-m joining RS near the distal end of the latter, and crossvein 2r-m equidistant from 2m-cu and 3r-m or closer to the latter.

Cretobestiola hispanica (MARTÍNEZ-DELCLÒS AND RASNITSYN 1999)
Figures 1 and 7.1

Species included: Four species from the Early Cretaceous of Spain, Eastern Siberia, and Mongolia.

Material: *C. hispanica*, holotype male: LP92/SC/3662, Spain: Lleida Province: La Pedrera de Rúbies, 5 km W Santa Maria de Meià, housed in the Institut d'Estudis Ilerdencs, Lerida, Spain.

GENUS *Ilerdosphe* RASNITSYN 2000

1984 *Ephialtites jurassicus*, Barale et al. , p. 285, pl. 1, fig. 4
2000 *Ilerdosphe wenzii*; Rasnitsyn, p. 46, figs. 1.1.

Diagnosis: *Ilerdosphe* differs from other Cretaceous Sphecidae in having cell 2r_m petiolate; from the Cenozoic Sphecidae with petiolate 2r_m in having cells 2r_m and 1m-cu not overlapping, 2m-cu present and received by cell 3r_m, and 3r-m present.

Ilerdosphe wenzii RASNITSYN 2000
Figure 6.4

Species included: Type species.

Material: *I. wenzii* RASNITSYN, holotype male: MNHN LP S.11456 a, b; Spain: Lleida Province; La Pedrera de Meià outcrop, at 5 km W Santa Maria de Meià, housed in the Muséum National d'Histoire Naturelle, Paris, France.

GENUS *Montsecosphe* n.gen.

Diagnosis: New genus is unique in Angarosphecinae in having eye deeply emarginate and metasoma long petiolate. Within the entire family Sphecidae, eye is comparably emarginate only in tribes Trypoxylini and Philantini: the former differs in having the cell 2r_m either petiolate or lost, the latter in 2m-cu distinctly received by

the cell 3r_m, cells 2r_m and 1m-cu far overlapped, and cell 2r_m shorter.

Derivation of name: Named after the Montsec Range and the genus *Sphe*.

Type species: *Montsecosphe jarzembowskii* n.sp., Early Cretaceous of Spain.

Description: Slender wasp with thin appendages. Mandible acute, unidentate, bent subbasally. Head about as long as wide, widest near mandibular bases. Clypeus wide, protruding, with fore margin widely rounded, bearing several keels (unless these are structures on the inner surface of the head capsule). Occipital carina complete at least below, distant from mouth cavity. Eye occupying most part on head sides, almost reaching mandibular bases, deeply emarginate medially, with rear lobe smaller but much closer to contralateral one than front lobe. Mesoscutellum long, narrow. Propodeal enclosure (metapostnotum) long medially, otherwise short. Propodeum with two pairs of dorsal longitudinal carinae and with narrow hind surface delimited by carinae. Hind femur and tibia long, femur very thin, fore femur more short and, subbasally, thick. Fore wing with basal section of RS distant from pterostigma for more than its length, meeting M at shallow but distinct angle, pterostigma very slightly widened beyond middle at junction with 2r-rs, cell 3r acuminate at wing fore margin, RS bent at very short rudiment of 1r-rs, 2r-rs about as long as pterostigma wide, 2r-m and 3r-m straight, 3r-m oblique, shorter than distance to cell 3r apex, cells 2-3r_m each about twice as long as high, 1m-cu co-inciding with RS+M fork, 2m-cu - with 2r-m, cu-a - with M+Cu fork. Hind wing with cu-a received by M+Cu slightly before apex. 1st metasomal segment narrow conical, with sternum flat longitudinally (convex or bent transversally), shallowly excised apically, second sternum also with fore margin excised, resulting in distinct gap in between, last visible sternum large, widely rounded apically.

Montsecosphe jarzembowskii n.sp.
Figure 6.5 and 7.2

Diagnosis: As for the genus.

Derivation of name: In honour to Dr. Edmund A. Jarzembowski, from the Maidstone Museum and Art Gallery (UK).

Material: Only the holotype, LP-4132-IEI, from La Pedrera de Rúbies fossil-site, Montsec Range, Lleida

(Spain). It is housed in the Institut d'Estudis Ilerdencs (Lleida, Spain).

Description: Sex possibly male, as indicated by widely rounded metasomal apex. Colour pale throughout. Flagellum at most becoming very slightly narrower from base to unknown distance before apex, with medial and, possibly, subapical flagellomeres becoming considerably shorter apicad (from almost 4 times to near 2 times as long as wide). Hind femur very slightly swollen toward base, about 0.7 times as long as thorax and 0.8 times as long as 1st and 2nd sterna combined. 1st metasomal segment two times as long as wide apically, about two times as wide apically as basally, with straight sides and medial longitudinal carina. 2nd sternum with incomplete medial carina and arching transversal carina approaching fore margin medially. Length of body 17.5 mm, of fore wing 11.5 mm, of hind femur 3.8 mm.

GENUS *Angarosphex* RASNITSYN 1975

Angarosphex lithographicus RASNITSYN AND ANSORGE 2000

Figure 6.6

2000 *Angarosphex lithographicus* RASNITSYN AND ANSORGE (in press).

Diagnosis: In the key to *Angarosphex* by Rasnitsyn et al. (1998) the new species runs to *A. bleachi* RASNITSYN AND JARZEMBOWSKI 1998, but differs in the small size and short cell 2rm.

Material: Only the holotype, MA7, from La Cabrúa fossil-site, Montsec Range, Lleida (Spain). It is housed in the Bereich Paläontologie, Ernst Moritz Arndt Universität Greifswald (Greifswald, Germany).

Angarosphex penyalveri n.sp.

Figures 2.11 and 8.1

1986 Diptera, Gómez, p. 721, fig. 2 and p. 731, photo 35.

Diagnosis: In the key to *Angarosphex* by Rasnitsyn et al. (1998) the new species runs to *A. bleachi* RASNITSYN AND JARZEMBOWSKI 1998, and to *A. pallidus* RASNITSYN 1986, but differs from both, as well as from similar *A. penyalveri* n.sp., in thick pterostigma. More similar to *A. bleachi* in long cell 2rm and bent 3r-m, but additionally differs from that in RS approaching

pterostigma basally, in 3r-m more distant from 3r cell apex, and in smaller size.

Derivation of name: In honour to Mr. Enrique Peñalver from the Dept. Geologia, University of València (Spain).

Material: Only the holotype, LP-0163-G/IEI, from La Pedrera de Rúbies fossil-site, Montsec Range, Lleida (Spain). It is from the Gómez-Pallerola collection, housed in the Institut d'Estudis Ilerdencs (Lleida, Spain).

Description: Sex unknown. Thorax short and wide, pronotum short, with sides converging cephalad, mesonotum lacking deeply impressed notauli and adlateral lines, mesoscutellum scarcely or not at all wider than long. Legs short, thick, femora widest subbasally, hind femur shorter than tibia, hind tibia with 2 spurs, shorter than tarsus. Metasoma wide subbasally, with anterior segments much longer than wide. Length of fore wing 7.3 mm.

GENUS *Archisphe* EVANS 1969 (= *Cretosphex* RASNITSYN 1975, = *Mateosphex* ZHANG 1985, = *Palaeapis* HONG 1984; synonymy after Rasnitsyn et al., 1998).

Archisphe catalunicus (ANSORGE 1993)

1993 *Cretosphex catalunicus*, ANSORGE, p. 29, figs. 13-15.

Diagnosis: Keyed out by Rasnitsyn et al. (1998) as differing from other congeners by combination of 3r-m distant from 3r cell apex, and 2m-cu distant from 2r-m.

Material: Described from single incomplete specimen from La Cabrúa outcrop, housed in the Fachrichtung Geologie, Ernst Moritz Arndt Universität, Greifswald, Germany (not examined).

GENUS *Pompilopterus* RASNITSYN 1975

Pompilopterus montsecensis RASNITSYN 2000

Figure 8.2

2000 *Pompilopterus montsecensis*, RASNITSYN, p. 46, fig. 1,2.

Diagnosis: In the published key (Rasnitsyn et al., 1998) the species runs toward *P. ciliatus* RASNITSYN but differs from that in having pterostigma narrow basal-

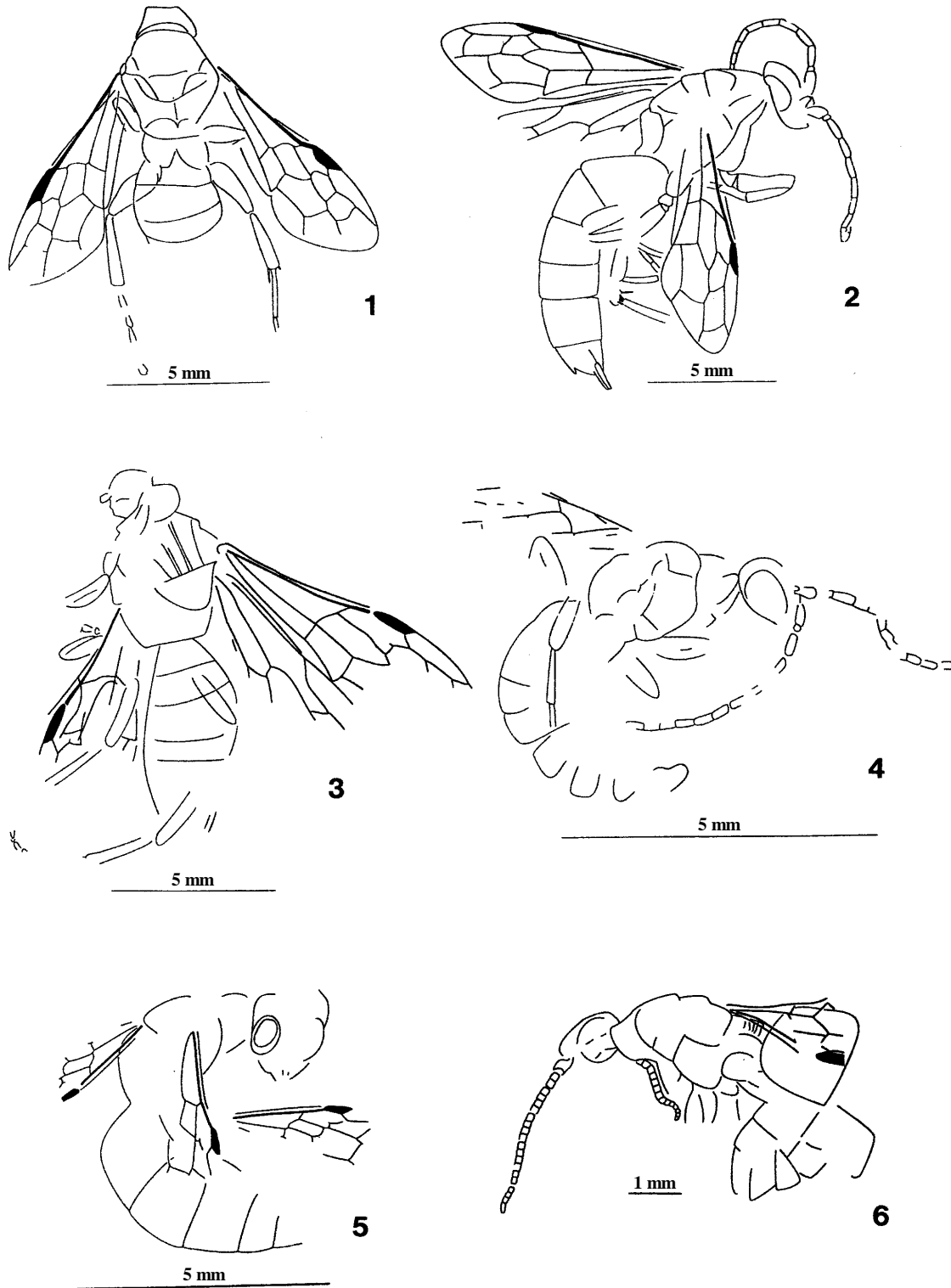


Figure 8. Camera lucida drawings. 1.- *Angarosphex penyalveri* n.sp., Sphecidae: Angarosphecinae, holotype. 2.- *Pompilopterus (?) montsecensis* RASNITSYN, holotype: B 848826. 3.- *Pompilopterus noguerensis* n.sp., Sphecidae: Angarosphecinae, holotype. 4.- ? Sphecidae, genus and species indet. 1, LC-4509-IEI; 5.- ? Sphecidae, genus and species indet. 2, LC-1707-IEI; 6.- *Apocrita incertae sedis*, LC-4609-IEI.

ly and RS with apical abscissa shorter. Differing from all other *Pompilopterus* in longer forewing.

Material: Holotype female, MNHN LP B. 848826 a, b; Spain: Lleida Province; La Pedrera de Rúbies fossil site - 5 km W Santa Maria de Meià, housed in the Muséum National d'Histoire Naturelle, Paris, France.

? *Pompilopterus noguensis* n.sp.
Figures 2.7 and 8.3

Diagnosis: The new species does not fit the published key (Rasnitsyn et al. 1998) easily, but clearly belongs to the species with M weakly or not at all bent at the RS+M fork, and with cu-a placed near the M+Cu fork (not distinctly basad of it). In this group consisted by *P. keymerensis* RASNITSYN AND JARZEMBOWSKI, *P. ciliatus* and *P. montsecensis* n.sp., it is closest to two latter species by large size and differs from both in having 2r-rs longer than pterostigma high and received near pterostigmal apex, and also in having RS between M and 2r-s long, bent near midlength, and receiving a distinct 1r-rs rudiment there. The body stature is robust like in *P. corpus* RASNITSYN AND JARZEMBOWSKI and dissimilar to *P. montsecensis* n.sp. in this respect.

Derivation of name: Named after La Noguera, region where is located the La Cabrúa outcrop.

Material: Only the holotype, LC-2673-IEI, from La Cabrúa fossil-site, Montsec Range, Lleida (Spain). It is housed in the Institut d'Estudis Ilerdencs (Lleida, Spain).

Description: Ground colour dark, tarsi, fore and mid femora and tibiae less dark. Thorax wide and high, pronotum probably short, mesonotum with scutellum long and wide notauli (or possibly notaulus and medial scutal sulcus) deeply impressed, long (at least notaulus percurrent), not much spaced, weakly diverging cephalad, adlateral line percurrent, thin but distinct. Propodeum short. Legs short and thin, hind tarsomere 3 small, elongate, mid and hind tarsomere 4 transverse, mid tarsomere 5 short. Fore wing with pterostigma almost parallel-sided, distant from RS base for less than its (pterostigma) length, receiving 2r-rs subapically, less high than 2r-rs long. RS between RS+M and 2r-rs about twice as long as 2r-rs, bent at about midlength and with distinct though short rudiment of 1r-rs there. Cell 3r acuminate at wing fore margin. 2r-m and 3r-m both oblique, 2r-m distant from 2r-rs for about 1.5 length of 2r-m, from 3r-m for

about two its length, 3r-m distant from cell 3r apex for about length of 2r-rs. M hardly bent backward at RS+M fork, about as long between RS+M and 1m-cu as RS between RS+M and 1r-rs. Apex of M+Cu co-inciding with cu-a. Hind wing cu-a received by Cu distant from M+Cu for about half of cu-a length. Metasoma narrow, hardly long, smoothly narrowing from near midlength toward propodeum. Length of body, as preserved, some 10 mm, of fore wing ca. 9 mm.

Remarks: The new species is tentatively attributed to *Pompilopterus* because the fore wing venation is incompletely preserved and displays a rather weak development of the characteristic feature of that genus, namely the cells 1m-cu and 2r-m which are widely overlap each other, a unique character state in the Lower Cretaceous Sphecidae that becomes widespread in Cenozoic. Indeed, *Angarosphex penyalveri* n.sp. (Pl. 4, fig. 1) does vary venationally so as one of its wing approaches considerably to the state found in the present species. The subparallel notauli separated in the new species only by a short distance create another problem: an alternative interpretation can not be excluded that the left one is not a notaulus but the medial scutal sulcus well developed in *Baissodes* RASNITSYN. However, cells 1m-cu and 2r-m never overlap in *Baissodes*. The species under study may thus belong to an undescribed genus, but the information available is insufficient to make the case clearer.

Family: ? Sphecidae LATREILLE, 1802

GENUS AND SPECIES Undetermined 1
Figure 8.4

Material: Specimen LC-4509-IEI, from La Cabrúa fossil-site, Montsec Range, Lleida (Spain). It is housed in the Institut d'Estudis Ilerdencs (Lleida, Spain).

Description: Sex male judging from form of metasomal apex reminding male genitalia. Flagellum, head, thorax (possibly except pronotum) and probably metasomal base dark, scape, pedicell and rest of metasoma less dark, legs pale (mostly not preserved). Antenna longer than head and thorax combined, with segments of near constant length and width (about 2 times as long as wide) including scape but excluding pedicell which is slightly narrower than other segments and about as long as wide. Head rather small with temple almost non-existent in side view and eye long and wide, somewhat narrowed toward mouthparts, occupying most of head side. Pronotum long,

with dorsum distinctly in lower plane than mesonotum. Mesopleuron possibly with episternal-scrobal and precoxal sulci, as defined by Bohart and Menke (1976). Propodeum short, high, smoothly rounded toward metasomal base. Legs short, femora possibly moderately thick. Wings very incompletely preserved, demonstrating only that 1-2m-cu and cu-a present at least in part, cu-a distinctly basad of M+Cu fork, RS+M possibly reaching or approaching to 1m-cu, RS extending apicad of level of 2m-cu. Metasoma rather long, depressed dorsally between first and second terga, first tergum more convex dorsally than following, second tergum much longer than other terga. Male genitalia, if correctly identified, changing rather steeply from wide basal half to narrower distal one, widely rounded apically. Length of body about 7 mm, of fore wing about 3 mm.

Remarks: The poor preservation state does not permit to identify the taxonomic position of the fossil at hand with sufficient certainty. However, the general appearance is rather characteristic of small aculeate wasps. Presence of possibly incomplete but most probably tubular 2m-cu excludes Chrysoidea. Other aculeate wasps common in the Lower Cretaceous are only Sphecidae (Angarosphecinae) and, to much lesser extent, Scoliidae with radically different venation, and still more different ants. This is the main reason to ascribe the fossil to Angarosphecinae, where its position remains obscure. The only possible to infer for the present is that, because of the very small size and elongate pronotum, the present fossil hardly can be even congeneric with those described yet in the subfamily.

GENUS AND SPECIES Undetermined 2

Figures 7.4 and 8.5

Material: Specimen LC-1707-IEI, from La Cabrúa fossil-site, Montsec Range, Lleida (Spain). It is housed in the Institut d'Estudis Ilerdencs (Lleida, Spain).

Description: Sex unknown. Colour moderately dark. Head large, longer than wide, with occipital sides swollen, eye short ovate, of moderate size, approaching mandibular base. Pronotum long, with dorsum distinctly in lower plane than mesonotum. Propodeum rather short, high, smoothly rounded toward metasomal base. Fore wing with pterostigma rather short and high, highest at junction with 2r-rs at about apical 0.3, distant of RS base for about its (pterostigma) length. First sections of RS and M meeting at distinct angle. RS between RS+M and 2r-rs bent at about hind 0.3, with short 1r-rs rudiment there. 2r-

rs about as long as pterostigma high. Cell 2rm about as long as 1m-cu and slightly shorter than 1+2r. 1m-cu received by RS+M distinctly before its fork, 2m-cu distinctly after 2r-m, cu-a before M+Cu fork. Metasoma rather long, widest near base, gradually narrowing toward apex, with fore and upper surfaces of first tergum clearly separated in side view as almost straight lines connected by rather short and steep curve. Length of body about 9 mm, of fore wing, as preserved, 2.7 mm, estimated length some 3.3 - 3.6 mm.

Remarks: Except for the large head, medium size eyes and, possibly, more robust stature, the present fossil, as is known, is structurally and in wing size similar to the previous one. If to ascribe their differences to the sexual dimorphism (the larger head and smaller eyes may indicate female sex), they might be considered congeneric unless conspecific. However, Angarosphecinae were rather modest in extent of their sexual dimorphism, so at least the conspecificity of the fossils in question looks unlikely, though their belongingness to one and the same genus cannot be ruled out at present.

Family: Scoliidae LATREILLE, 1802

Scoliidae is a rather small family of aculeate wasps embracing some 500 extant species (Brothers, 1975). Extant scoliids form two subfamilies, the primitive Proscoliinae with only two species from the eastern Mediterranean in a single relict genus (Rasnitsyn 1977, Day et al., 1981), and the diverse and world wide distributed Scoliinae. Fossil history of the family is little known. Besides several Tertiary findings reviewed by Rasnitsyn (1993), three Cretaceous fossils have been described in that publication, all placed in the subfamily of their own that includes two genera and three species. Three more Lower Cretaceous species are described recently by the present authors (Rasnitsyn and Martínez-Delclòs, 1999). Of these, two Spanish species are additions to each of two genera of Archaeoscoliinae already described from the Asian Cretaceous (see below), while the third one, from the Lower Cretaceous of Brazil, represents the new genus, first fossil in Proscoliinae.

GENUS *Archaeoscolia* RASNITSYN 1993

Archaeoscolia hispanica RASNITSYN AND MARTÍNEZ-DELCLÒS 1999

1999 *Archaeoscolia hispanica*; RASNITSYN AND MARTÍNEZ-DELCLÒS, pp. 768-769, figs. 1 and 2a

Diagnosis: Unlike *A. senilis* RASNITSYN 1993 from the Lower Cretaceous (supposed Aptian) of Mongolia, occipital carina subcircular and not bending toward mandibular bases, most flagellomeres (except two apical ones) of subequal width, pterostigma narrow. Additionally, size is small (forewing length near 10 mm vs 15 mm in *A. senilis*) and body and legs less robust, but these differences may be of sexual and not taxonomic nature.

Material: Holotype male. LH-13827 from Las Hoyas in Serranía de Cuenca (Cuenca Province). It have been deposited provisionally in the Unidad de Paleontología, Universidad Autónoma de Madrid, Spain. Its long term home will be the Museo de Cuenca, Cuenca, Spain.

GENUS *Cretoscolia* RASNITSYN 1993

Cretoscolia montsecana RASNITSYN AND MARTÍNEZ-DELCLÒS 1999

1999 *Cretoscolia montsecana*, RASNITSYN AND MARTÍNEZ-DELCLÒS, pp. 769-770, figs. 2b and 3

Material: Holotype male. LC-1962-IEI from La Cabría outcrop, housed in the Institut d'Estudis Ilerdencs (Lleida, Spain).

Diagnosis: Differing from both Upper Cretaceous species, *C. promissiva* RASNITSYN 1993 from the NE Siberia and *C. patiens* RASNITSYN 1993 from North Kazakhstan, in particularly slender stature (including long, narrow legs) and, venationally, in 2r-rs almost coinciding with 2r-m, and in R leaving wing margin at angle to reach apex of 3r cell. Unlike this, both other species have 2r-rs distant from 2r-m, and also in R that in *C. promissiva* leaves wing margin very gradually to reach distant 3r cell apex, and in *C. patiens* does not leave wing margin at all because 3r apex is rounded at wing margin.

Cretoscolia conquensis n.sp. Figure 7.3 and 9

Diagnosis: The new species differs from all congeners in RS leaving R near pterostigma, and in cu-a oblique: three other species of *Cretoscolia* have RS base distant of pterostigma and cu-a subvertical. Additionally, it differs from *C. promissiva* RASNITSYN 1993 and *C. montsecana* RASNITSYN AND MARTÍNEZ-DELCLÒS 1999, in 3r cell closed near wing margin and 2r-rs reaching RS

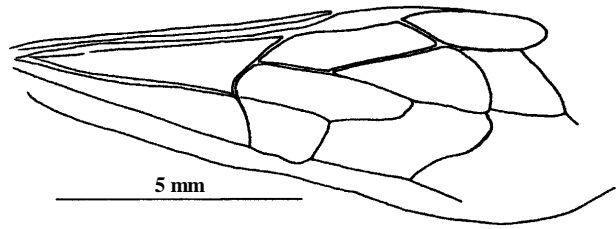


Figure 9. Camera lucida drawing. *Cretoscolia conquensis* n. sp., Scoliidae, holotype.

far from 2r-m, and from *C. patiens* RASNITSYN 1993 in 3r-m distant from 3r apex for less than half its length.

Derivation of name: from Cuenca, Spain.

Material: Only the holotype, detached forewing LH-17331 from Las Hoyas in Serranía de Cuenca (Cuenca Province). It have been deposited provisionally in the Unidad de Paleontología, Universidad Autónoma de Madrid, Spain. Its long term home will be the Museo de Cuenca, Cuenca, Spain.

Description: Pterostigma moderately narrow, with oblique base and apex, close to RS base. 3r cell rounded slightly away of wing margin apically. 2r-rs distant of 2r-m for almost half its (2r-rs) length. 3r-m reaching 3r at about apical 0.15 of 3r length. 3rm cell oblique, longer on M than on RS. 2m-cu reaches M next to 2r-m. Crossvein cu-a at M+Cu apex, strongly oblique. Forewing length up to 3r apex 21.7 mm, full wing length probably 25-27 mm.

APOCRITA INCERTAE SEDIS

GENUS AND SPECIES Undetermined Figure 8.6

Material: Specimen LC-4609-IEI, from La Cabría fossil-site, Montsec Range, Lleida (Spain). It is housed in the Institut d'Estudis Ilerdencs (Lleida, Spain).

Description: Ground colour dark, flagellum less dark, legs still less dark, femur (mid one?) infuscate basally. Scape with elongate curved base, otherwise as long as wide, distinctly wider than flagellum. Pedicell either not preserved or indistinguishable of flagellomeres. Flagellum (possibly including pedicell) 20 segmented, since near midlength gradually becoming narrower toward apex, with flagellomeres subquadrate except apical one which about twice as long as wide and almost half as

Taxon	La Cabrúa	La Pedrera	Las Hoyas
Xyelotomidae			
<i>Leridatoma pulcherrima</i> RASNITSYN AND ANSORGE	1		
Sepulcidae Ghilarellinae			
<i>Meiaghilarella cretatica</i> n.gen., n.sp.	1		
Sepulcidae Trematothoracinae			
<i>Prosyntaxis montsecensis</i> RASNITSYN AND ANSORGE	1		
Anaxyelidae Syntexinae			
<i>Eosyntaxis catalonicus</i> n.sp.	1		
<i>Cretosyntaxis montsecensis</i> n.gen., n.sp.	1		
Ephialtitidae Ephialtitinae			
<i>Ephialtites jurassicus</i> MEUNIER		1	
<i>Montsecephialtites zherikhini</i> n.gen., n.sp.	1		
<i>Cretephialtites pedrerae</i> RASNITSYN AND ANSORGE		1	
Ephialtitidae Symphytopterinae			
<i>Karataus hispanicus</i> n.sp.	1		
Pracaulacidae			
Genus and species indet.	1		
Gasteruptiidae Baissinae			
<i>Manlaya lacabrúa</i> RASNITSYN AND ANSORGE	1		
<i>M. ansorgei</i> n.sp.	1		
Andreneliidae n. fam.			
<i>Andrenelia pennata</i> n.gen., n.sp.	1		
Mesoserphidae			
<i>Cretoserphus gomezi</i> n.gen., n.sp.		1	
Bethylonymidae			
<i>Meiagaster cretaceus</i> RASNITSYN AND ANSORGE	1		
?Bethylidae			
Genus and species indet.	1		
Sphecidae Angarosphecinae			
<i>Cretobestiola hispanica</i> (MARTÍNEZ-DELCLÒS AND RASNITSYN)		1	
<i>Lleidosphex wenzii</i> RASNITSYN		1	
<i>Montsecosphex jarzembowskii</i> n.gen., n.sp.		1	
<i>Angarosphex lithographicus</i> RASNITSYN AND ANSORGE	1		
<i>A. penyalveri</i> n.sp.		1	
<i>Archisphex catalunicus</i> (ANSORGE)	1		
<i>Pompilopterus (?) montsecensis</i> RASNITSYN		1	
<i>P. (?) noguerensis</i> n.sp.	1		
?Sphecidae Genus and species indet. 1	1		
?Sphecidae Genus and species indet. 2	1		
Scoliidae Archaeoscoliinae			
<i>Archaeoscolia hispanica</i> RASNITSYN AND MARTÍNEZ-DELCLÒS			1
<i>Cretoscolia montsecana</i> RASNITSYN AND MART.-DELCLÒS	1		
<i>C. conquensis</i> n.sp.			1
Apocrita <i>incertae sedis</i>			
Genus and species indet.	1		
Totally	20	8	2

Table 1. The hymenopterans found in the lithographic limestones from Spain (specimens per fossil-sites).

wide as thickest flagellomeres. Head of moderate size, longer than wide, apparently of unusual form (possibly widest at fore margin with no mandibular base there: highly tentative interpretation), with occipital carina sub-circular. Thorax comparatively long. Pronotum moderately long, with hind margin distinctly excised, without clear differentiation into vertical and two horizontal zones. Mesopleural (?) sides somewhat swollen in lower part. Propodeum with rather long, in part transversely rugose horizontal surface. Fore wing (incompletely known and in part possibly deformed) with costal space distinct though not very wide, pterostigma of medium size, becoming wider (higher) apicad. Basal section of RS reclivous, somewhat shorter than that of M, RS+M complete, forking slightly before 1m-cu reaching M, cu-a received by Cu slightly distad of M+Cu fork. Possibly pterostigma receiving r-rs subbasally (that case this should be either 1r-rs or much displaced 2r-rs, but more likely, all of this is a result of postmortem wing deformation). Metasoma much deformed but looking rather long and thick, roundly acuminate apically, with first or second tergum considerably enlarged. No external ovipositor present. Length of body probably some 8 mm, of wing fragment, 2.6 mm, possible length of entire wing some 4 mm.

Remarks: The head and antenna of this enigmatic fossil reminds those of female Sclerogibbidae, and the rest body structures do not contradict this definitely. However, sclerogibbid females are all wingless now (though this was certainly not the case in their stem group), and the male venation does not remind that is known for the fossil as well. Sclerogibbidae is extremely specialised group of chrysidoid wasps which are cryptic, very uncommon now and still more rare as fossils: the only known one is recorded though not yet described in the Miocene amber of Dominican Republic (Ronquist et al., 1999). The present incomplete and deformed fossil with the contradictory wing morphology is certainly not an appropriate occasion to claim the Cretaceous age of Sclerogibbidae. That is why the fossil is described here as an apocritan wasp with the obscure taxonomic position.

DISCUSSION

Up to now the total number of hymenopterans found in the Spanish lithographic limestones is 30 specimens representing 30 species, at least 25 genera and 11 families (Table 1). The number of genera and families identified there, is not very high but sufficient to compare to other Lower Cretaceous assemblages of comparable size, and to draw some inferences from this comparison.

Climate

As is explained in the publication cited above, the Late Mesozoic hymenopteran assemblages are indicative of past climatic conditions. Those rich in thermophilous insects and plants have a low representation of Xyelidae, while those rich in Xyelidae are poor in animals and plants characteristic of a warmer climate. Hence an abundance of Xyelidae indicate the climate as not particularly warm, though the implied temperature interval is not identified precisely yet. Like in the English Lower Cretaceous, the present study revealed not a single member of Xyelidae in the Spanish Lower Cretaceous, which is consistent with a warm climate in the time of origin of the respective sediments.

Diversity

Three localities of the Spanish lithographic limestones yield markedly different number of the hymenopteran fossils. In La Cabrúa fossil-site: 20, representing 20 species, at least 17 genera and 10 or 11 families; in La Pedrera fossil-site: 8, belonging to 8 species, 8 genera and 3 families, and Las Hoyas fossil-site: two species and genera and one family (Table 2). The first assemblage gives a sufficient material for comparison, while the second and third permit to consider only striking differences.

The most reliable reference points in evaluating the hymenopteran assemblages considered represent the English Lower Cretaceous assemblages, as described by Rasnitsyn et al. (1998), because they are rather evenly studied and not too small. The Australian (Koonwarra) and Brazilian (Santana) assemblages (Jell and Duncan, 1986 and Darling and Sharkey, 1990, respectively) are also of importance. As to the East Asian hymenopteran assemblages, they are incomparably more rich and, being more evenly described, they would represent still much better standard point for comparison. Unfortunately, this is generally not the case, because the majority of localities there, including all the richest ones (Baissa in Transbaikalia, Bon Tsagan in Mongolia), have only a part of their material described formally. The only exception represents the Turga assemblage in the Eastern Transbaikalia (see below).

In the English Lower Cretaceous the total number of the hymenopterans identified by Rasnitsyn et al. (1998) is 48 specimens, minimum 42 species, 22 genera and 12 families. Particularly, in the Purbeck Group 23 specimens represent 18 species, at least 17 genera and 13 families,

Assemblage	Specimens	Species	Genera	Families
La Cabrúa (Spain)	20	20	17	10
La Pedrera (Spain)	8	8	8	3
Las Hoyas (Spain)	2	2	2	1
Purbeck (UK)	23	18	17	13
Weald Clay (UK)	24	19	10	6
Santana (Brazil)	26	9	8	7
Koonwarra (Australia)	7	7	7	6
Turga (Transbaikalia)	27	27	23	18

Table 2. Minimum number of taxa of different rank in the Lower Cretaceous hymenopteran assemblages.

and the Weald Clay Group has yield 24 specimens which belong to 19 species, at least 10 genera and 6 families (Table 2).

The Santana assemblage (Brazil), as described by Darling and Sharkey (1990), and taking into consideration the taxonomic changes suggested above (see *Karataus*) and elsewhere (as cited above concerning *Prosyntexis*), includes Sepulcidae (Trematothoracinae), Mesoserphidae, Proctotrupidae, and Tiphidae (Anthoboscinae?), each represented by a single specimen; Ephialtitidae (Ephialtitinae) with 1 species and 2 specimens; Rhopalosomatidae, also with 1 species but possibly with 4 specimens; Sphecidae with 2 genera, 3 species and 6 specimens (Angarosphecinae represented by one genus, 2 species and 5 specimens, and one specimen of Ampulicinae, identified as such by APR); and two unidentified aculeate wasps whose conspecificity to one of the above angarosphesine species cannot be excluded. Additional material kept in the American Museum of Natural History and identified by APR during his short visit (July, 1999) consists of *Prosyntexis ? gouleti* SHARKEY, "*Karataus kourios* SHARKEY, *Angarosphex magnus* DARLING (2 specimens), *A. parvus* DARLING, possibly *Mesorhopalosoma cearae* DARLING and *Architiphia rasnitsyni* DARLING (both bad preserved), and one unidentified, possibly aculeate wasp (except *A. magnus*, single specimen is identified for each species). This gives 26 specimens which comprise 1 specimen, 1 species and 1 genus of each Mesoserphidae and Proctotrupidae; 2, 1, 1 of each Sepulcidae and Tiphidae; 3, 1, 1 of Ephialtitidae; possibly 5, 1, 1 of Rhopalosomatidae; and 9, 3, 2 of Sphecidae, respectively). The total for these 26 specimens is, besides 3 unidentified wasps, 9 species, 8 genera and 7 families.

The original taxonomical description of the Australian hymenopterans from Koonwarra (Jell and Duncan, 1986) is imperfect, but it can be somewhat improved basing on the published photographs. The assemblage is based on 7 specimens (10 were claimed in the original publication, but three of these represent true bugs: ## 102740, 103009, 103320). Of these seven, the type specimen of *Westratia nana* JELL AND DUNCAN belongs to Praeaulacidae (Cretocleistogastrinae), that of *Cretaciformica explicata* JELL AND DUNCAN - to Diapriidae (not to Formicidae), *Eoichneumon duncanae* JELL AND DUNCAN - to Eoichneumonidae, specimens ## 103106, 103348 represent most probably two different species and genera of Proctotrupidae, # - 103324 - the first discovered fossil of Monomachidae, and the taxonomic position of the specimen # 103168 cannot be identified at present more precisely that a parasitic wasp differing of any others recorded in Koonwarra assemblage probably at the family level. As a result, Koonwarra census apparently gives 7 specimens, 7 species, 7 genera and 6 families.

In the East Asia, the Turga assemblage (Rasnitsyn, 1990) is known after 27 specimens that represent 27 species and not less than 23 genera and 18 families.

The results compiled in the Table 2 indicate that among the better known assemblages (those based on 20 or more fossils collected), La Cabrúa, Purbeck and Turga probably have the highest diversity at all taxonomic level. Weald Clay assemblage looks far behind in respect its family and generic level diversity, while Santana shows low diversity at all family, generic and species level. The minor assemblages of La Pedrera and Koonwarra show the maximum diversity at the generic and species levels, but the family level diversity is lower in the case of La Pedrera. Of course, the limited material calls for explanation by chance. How-

ever, the fact that, like in the case of Weald Clay, low diversity of the La Pedrera assemblage is caused by abundance of Sphecidae (five out of eight La Pedrera hymenopterans), makes risky the appellation to the chance. As to the Las Hoyas, the chance looks the only reasonable explanation of taxonomic composition of this assemblage. This conclusion might be premature as well, because both wasps found there belong to Scoliidae which otherwise are very rare. To our mind, the only correct inference from this observation is that Las Hoyas locality deserves very careful paleoentomological exploration.

The observed differences of the assemblages considered in respect of their taxonomic diversity may have a variety of causes. The first question in that connection is if these differences are because the source faunae were different, or these are due to some post-mortem (taphonomic) processes. Our hypothesis is that the first is the case, for otherwise we should indicate post-mortem processes which might, for instance, reduce the taxonomic diversity in Weald Clay, Santana and, possibly, in La Pedrera, but not to affect that in La Cabrúa, Purbeck, Turga and, possibly, in Koonwarra (or *vice versa*). We are aware of no such processes, and this is the reason for above hypothesis. The features of the source faunae which might be responsible for pattern observed are discussed below.

Types of assemblages

Rasnitsyn et al. (1998) have defined three assemblage types and two subtypes of the hymenopteran impression fossils described from the Cretaceous and upper half of Jurassic (Rasnitsyn et al., 1998: Table 8).

The oldest of them is called the “ephialtitid-praeaulacin” or “aculeate-free” type of assemblages: it is dominated by individuals of the families Ephialtitidae, Cleistogastrinae (Megalyridae), Praeaulacinae (Praeaulacidae), Mesoserphidae and Protocheloridae (Heloridae), with lack of Gasteruptiidae *s.l.*, Proctotrupidae, Ichneumonoidea, and archaic Sphecidae. It is followed, probably from slightly before the Jurassic/Cretaceous boundary, by the “Baissin” type which is characteristically dominated by Baissinae (Gasteruptiidae), Proctotrupidae, Ichneumonoidea, and archaic Sphecidae. In contrast, Ephialtitidae, Cleistogastrinae, Mesoserphidae, and Protocheloridae are rare, Praeaulacinae and ants are absent.

The “Baissin” type consists of two subtypes, the “proctotrupid” one characterised as dominated by various parasitic wasps (usually Baissinae and Proctotrupidae) or,

in the least warm environments, by Xyelidae, and the “angarosphecine” subtype which is abundant in these archaic sphecid wasps. Shortly before the mid-Cretaceous boundary, the “Baissin” type is replaced by the “Armaniin” type identified after the presence of archaic ants of the subfamily Armaniinae (described as the full family but now tend to be lowered in its rank). The type is additionally characterised by its abundance in Ichneumonidae and lack of Ephialtitidae, Cleistogastrinae, Praeaulacidae and Baissinae.

Basing on the above definitions, we may conclude that both the La Cabrúa and La Pedrera assemblages perfectly agree with the “Baissin” type. The latter assemblage is equally well fit the “angarosphecine” subtype, while La Cabrúa roughly corresponds to the “proctotrupid” subtype but shows a comparatively high proportion of angarosphecine wasps. Thus, La Pedrera assemblage can be co-ordinated with those from Weald Clay and Santana, as well as Bon Tsagan in Mongolia. In contrast, La Cabrúa approaches to a some extent, though not quite agrees with, the Purbeck, Koonwarra, and majority of Lower Cretaceous Asian assemblages. Las Hoyas assemblage with its scoliids is exceptional again.

Stratigraphic ranges of particular taxa

Most hymenopteran taxa recorded thus far in the Spanish lithographic limestones agree with the suggested Lower Cretaceous age of the respective deposits. However, more close analysis reveals details deserving special consideration

In the La Cabrúa assemblage, two species represent either new or unknown family and make no bearing to the present discussion. Among the rest eighteen, eight belong either to characteristic taxa of the “Baissin” type as a whole (*Manlaya* and angarosphecins), or started in the “proctotrupid” subtype and ranged over the “angarosphecine” one (Bethylidae). Of the remaining ten species, one belongs to a taxon (Praeaulacinae) known otherwise only from Jurassic, four to those (Xyelotomidae, Ephialtitidae, and Bethylonymidae) more characteristic of the Jurassic, “Aculeate-free” type of assemblages, but also found in the “Baissin” type. Two species represent the group (Syntexinae) of the “proctotrupid” subtype, two other (Ghilarellinae and *Prosyntexis*) of the “angarosphecine” subtype, and one (*Cretoscolia*) is related to the Upper Cretaceous forms of the “Armaniid” type of assemblages. In all, the La Cabrúa assemblage reveals an array of relations of the constituent taxa, more wide than

any other studied thus far, but centred at between the two “Baissin” subtypes, or somewhat shifted toward the “proctotrupid” one. The above “Jurassic” taxa probably represent relicts survived in the warm climate of Spanish Lower Cretaceous but went extinct or became rare under harsher conditions in England and particularly in Siberia.

In spite of its lower volume and diversity, the La Pedrera assemblage also displays some contradictory ranges of its constituent taxa. Three species of eight (all the parasitic wasps, Ephialtitidae and Mesoserphidae) are of the Jurassic (“Aculeate-free”) rather than Cretaceous relationships. The remaining five angarosphecine wasps range over both “Baissin” subtypes but are particularly characteristic of the younger, “angarosphecine” subtype. Because of their abundance, the assemblage should be eventually subordinated to the latter, while presence of the Jurassic elements might be again ascribed to the particularly warm climate of the locality during the respective time interval.

Both wasps from Las Hoyas belong to the genera known otherwise from the “angarosphecine” subtype of the “Baissin” type (*Archaeoscolia*), or the “Armaniid” type (*Cretoscolia*).

The above analysis of biostratigraphic ranges of particular hymenopteran taxa agrees with the result of more general approach employed in the previous section, viz. that the La Pedrera assemblage represents the angarosphecine subtype, and that from La Cabrúa is intermediate between the “angarosphecine” and of the “Baissin” type. In the well resolved English stratigraphic scheme, the “proctotrupid” subtypes is fixed within Berriassian, the “angarosphecine” one - around the Hauterivian-Barremian boundary, with unknown position of the stratigraphic borderline between the subtypes (Rasnitsyn et al., 1998). This indicates that La Pedrera limestones might take somewhat higher level within the Lower Cretaceous comparing La Cabrúa ones. As to Las Hoyas, its hymenopteran fossils, however few, suggest their high stratigraphic position, possibly the highest of the three fossil sites considered.

This result sheds some light on the cause of the observed differences in the taxonomic diversity of the hymenopteran assemblages under comparison. In the English Lower Cretaceous, the younger Weald Clay (“angarosphecine”) assemblage is less diverse than the older Purbeck (“proctotrupid”) one. Basing on this observation, a real evolutionary decrease of taxonomic diversity was hypothesised (Rasnitsyn et al., 1998). This inference is in agreement with another one that the extinction

rates are generally higher during the Lower Cretaceous than rates of origin of new taxa (Rasnitsyn, 1988b, 1989), which should result in decreasing taxonomic diversity. In the Purbeck time the climate was “hot, semi-arid and ‘Mediterranean’...[then] an irregular long-term trend of increasing rainfall...and slightly lower average annual temperatures thereafter until Barremian [Upper Weald Clay] time” (Allen, 1998). This gives little support to the hypothesis of the climatically driven decrease of diversity of the Weald Clay hymenopterans. Still less reason exists to suppose the warmest climate for the Siberian locality Turga where the highest diversity is observed, and the most cold one for Santana in Brazil (Table 2). In other words, the climatic changes are hardly responsible for the observed differences between the studied hymenopteran assemblages in their taxonomic diversity. This implies that in the Spain Lower Cretaceous, like in the English one, the hymenopteran assemblages decrease their taxonomic diversity with time (from La Cabrúa to La Pedrera and possibly further to Las Hoyas).

CONCLUSION

The above biostratigraphic inferences are in incomplete agreement with the current locality correlation. The lithographic limestones of Las Hoyas are correlated to the Barremian (Meléndez, 1995), while La Cabrúa and La Pedrera are usually considered to represent one and the same stratigraphic unit correlated to either the Upper Berriassian - Lower Valanginian (Brenner et al., 1974) on the basis of the ostracods study. This correlation remains under discussion, however; for instance, Ansoorge (1993) and Martín-Closas and López-Morón (1995) correlate the limestones to the Barremian and to the Uppermost Hauterivian-Lower Barremian, respectively, on the basis of the regional stratigraphy and charophyte studies. At the same time, we are not aware of claims inferring any appreciable stratigraphical or palaeoenvironmental differences between La Cabrúa and La Pedrera.

The contradiction outlined implies three explanatory hypotheses to question either synchrony or environmental uniformity of the La Cabrúa and La Pedrera limestones, or else the differences between the respective hymenopteran assemblages. In other words, the present results invite to re-consider if: (1) the respective limestones were asynchronous, and/or (2) environmentally dislike in spite of their undoubted lithological similarity, and (3) the taphonomic factors because the La Pedrera fossil-site represents a more off-shore/distal and depth sedimentation than La Cabrúa (more near-shore, near to the slope of the

lake - more energy) (Fregenal-Martínez and Meléndez, 1995; Gibert et al., 2000), or if (4) the described differences between the hymenopteran assemblages were of occasional nature (due to the insufficient sample size) and thus did not reflected the real dissimilarity of the source populations. It is evident that further field work would be extremely useful in replying the questions posed. At the same time, thorough researches of the accumulated palaeontological material could equally help meeting the challenge arisen.

ACKNOWLEDGEMENTS

We are grateful to J. Borrell and A. Lacasa of the Institut d'Estudis Ilerdencs and J. Gómez-Alba (MGB) for consultation on the material studied. APR is thankful to D.A. Grimaldi of the American Museum of Natural History for the possibility to study the fossils under his care. This work was supported by the Fossil Insects Network of the ESF and is within the limits of Grant DGES PB97-0061 of the Ministerio de Educación y Cultura de España. The field work at El Montsec and Las Hoyas was founded by the Fundació Pública Institut d'Estudis Ilerdencs (Diputació de Lleida) and by the Junta de Comunidades de Castilla-La Mancha, respectively.

REFERENCES

- Allen, P., 1998. Purbeck-Wealden (Early Cretaceous) climates. *Proceedings of the Geologists' Association*, 109, 197-236.
- Ansonge, J., 1993. Bemerkenswerte Lebensspuren und ?*Cretosphex catalunicus* n.sp. (Insecta; Hymenoptera) aus den unterkretazischen Plattenkalken der Sierra del Montsec (Provinz Lerida, NE Spanien). *Neues Jahrbuch für Geologie und Paläontologie Monatshefte*, 190, 19-35.
- Barale, G., Blanc-Louvel, C., Buffetaut, E., Courtinat, B., Peybernes, B., Via, L., Wenz, S., 1984. Les gisements de calcaires lithographiques du Crétacé inférieur du Montsec (Prov. Lérida, Espagne). *Considerations Paléoécologiques*. *Geobios*, M.S. n° 8, 275-283.
- Barale, G., Martinell, J., Martínez-Delclòs, X., Poyato-Ariza, F.J., Wenz, S., 1994. Les gisements de calcaires lithographiques du Crétacé inférieur du Montsec (Province de Lérida, Espagne): Apports récents à la paléobiologie. *Geobios*, M.S. no. 16, 177-184.
- Bataller, J.R., Masachs, V., De Gálvez-Cañero, A., 1953. Mapa Geológico de España, hoja 290 Isona, 1:50.000, Instituto Geológico y Minero de España, 1-113.
- Benson, 1935. On the genera of Cephidae, and the erection of the new family Syntexidae. *Annals and Magazine of Natural History* (Ser. 10) 16, 534-553.
- Bohart, R.M., Menke, A.S., 1976. *Sphecid wasps of the world. A generic revision*. University of California Press, ix + 695 pp., Berkeley, Los Angeles, London.
- Broili, F., 1932. Der obere Jura von Montsec (Prov. Lerida) im Vergleich mit den ob. Jura-Vorkommen von Cerin (Dept. Ain) und von Franken. *Assoc. Étude Geol. Méditerranée Occidentale*, 2(16), 2-11.
- Brothers, D.R., 1975. Phylogeny and classification of the Aculeate Hymenoptera, with special reference to Mutillidae. *University of Kansas Scientific Bulletin*, 50, 483-648.
- Chevalier, M., 1932. *Geologia de Catalunya, II: l'Era Secundària*, Geografia General de Catalunya, Valencia i Balears, Ed. Barcino, 12-169, Barcelona.
- Darling, D.Ch., Sharkey, M.J., 1990. Order Hymenoptera. In: D.A. Grimaldi (ed.). *Insects from the Santana Formation, Lower Cretaceous, of Brazil*. *Bulletin of the American Museum of Natural History*, 95, 124-129.
- Day, M.C., Else, G.R., Morgan, D., 1981. The most primitive Scoliidæ (Hymenoptera). *Journal of Natural History*, 15, 671-684.
- Evans, H.E., 1969. Three new Cretaceous wasps (Hymenoptera). *Psyche*, 76, 251-261.
- Ferrer, L., 1951. Nuevos hallazgos en el Jurásico superior del Montsec. *Notas y Comunicaciones Instituto Geológico y Minero de España*, 23, 45-61.
- Font, N., 1926. *Curs de Geologia Dinàmica i Estratigràfica Aplicada a Catalunya. La Neotipia*, 236-245, Barcelona.
- Fregenal-Martínez, M.A., Meléndez, N., 1995. Geological setting. In: X. Martínez-Delclòs (ed.). *Montsec and Mont-Ral-Alcover, two Konservat Lagerstätten*. Lleida, Catalonia, Spain. 12-24, Institut d'Estudis Ilerdencs.
- Gauld, I., Bolton, B., 1988. *The Hymenoptera*. British Museum (Natural History) and Oxford University Press, Oxford, 332 pp.
- Gibert de, J.M., Fregenal-Martínez, M.A., Buatois, L.A., Mángano, M.G., 2000. Trace fossils and their palaeoecological significance in Lower Cretaceous lacustrine conservation deposits, El Montsec, Spain. *Palaeography, Palaeoclimatology, Palaeoecology*, 156, 89-101.
- Gómez, J.E., 1986. Nuevos insectos fósiles de las calizas litográficas del Cretácico Inferior del Montsec (Lérida). *Boletín Geológico y Minero*, 97, 717-736.
- Handlirsch, A., 1906-08. *Die fossilen Insekten und die Phylogenie der rezenten Formen*. Leipzig, Engelmann, 1430 pp., 51 pls.
- Hong, Y.C., 1983. Middle Jurassic fossil insects in north China. *Geological Publishing House*, 1-223, Beijing 1983: [in Chinese, LS: English].
- Hong, Y.C., 1984. New fossil insects of Liayang Group from Liayang Basin, Shandong Province. *Professional Papers of Stratigraphy and Palaeontology*, 11, 31-41.

- Hong, Y.C., 1988. Early Cretaceous Orthoptera, Neuroptera, Hymenoptera (Insecta) of Kezuo in West Liaoning Province (China). *Entomotaxonomia*, 10, 119-130, [in Chinese].
- Hong, Y.C., Wang, W., 1990. Fossil insects from the Laiyang Basin, Shandong Province. In: *The stratigraphy and paleontology of the Laiyang Basin, Shandong Province*, 44-189. Beijing, Geological Publishing House.
- Hughes, N.F., 1976. Palaeobiology of angiosperm origins. *Problems of Mesozoic seed-plant evolution*. Cambridge Earth Sciences series, Harland W.B. et al., 1-242.
- Jarzembowski, E.A., 1991. New insects from the Weald Clay of the Weald. *Proceedings of the Geologists' Association*, 102, 93-108.
- Jell, P.A., Duncan, P.M., 1986. Invertebrates, mainly insects, from the freshwater, Lower Cretaceous, Koonwarra Fossil Bed (Korumburra Group), South Gippsland, Victoria. *Memiors Association Australasian Palaeontologists*, 3, 111-205.
- Lacasa, A., 1981. Estudio del yacimiento infracretácico del Montsec de Rúbies, "La Pedrera de Meià". *Ilerda*, 42, 61-159.
- Martín-Closas, C., López-Morón, N., 1995. The Charophyte Flora. In: X. Martínez-Delclòs (ed.). *Montsec and Mont-Ral-Alcover, two Konservat Lagerstätten*. Lleida, Catalonia, Spain. 29-31, Institut d'Estudis Ilerdencs.
- Martínez-Delclòs, X., 1990. Insectos del Cretácico inferior de Santa Maria de Meià (Lleida): Colección Lluís Marià Vidal i Carreras. *Treballs del Museu de Geologia de Barcelona*, 1, 91-116.
- Martínez-Delclòs, X., (ed.) 1991. *Les calcàries litogràfiques del Cretaci inferior del Montsec*. Deu anys de Campanyes Paleontològiques. Lleida, 162 pp. [+ 106 pp. of English translation], Institut d'Estudis Ilerdencs.
- Martínez-Delclòs, X., (ed.) 1995. *Montsec and Mont-Ral-Alcover, two Konservat Lagerstätten*. Lleida, Catalonia, Spain. 97 pp., Institut d'Estudis Ilerdencs.
- Martínez-Delclòs, X., Martinell, J., 1993. Insect taphonomy experiments. Their application to the Cretaceous outcrops of lithographic limestones from Spain. *Kaupia*. Darmstädter Beiträge zur Naturgeschichte, 2, 133-144.
- Martynov, A., 1925. To the knowledge of fossil insects from Jurassic beds in Turkestan. 3. Hymenoptera, Mecoptera. *Bull. Acad. Sci. URSS*, 1925, 753-762.
- Meléndez, N., (ed.) 1995. *Las Hoyas. A lacustrine Konservat-Lagerstätte*. Cuenca, Spain II International Symposium on Lithographic Limestones. 89 pp. Universidad Complutense de Madrid, Madrid.
- Meunier, F., 1903. Nuevas contribuciones a la fauna de los himenópteros fósiles. *Memorias Real Academia Ciencias y Artes de Barcelona*, 4(34), 461-465.
- Middlekauff, W.W., 1974. Larvae of the woodboring sawfly *Syntexis libocedrii* Rohwer (Hymenoptera: Syntexidae). *Pan-Pacific Entomologist*, 50, 288-290.
- Pulawski, W.J., Rasnitsyn, A., 2000. *Cretobestiola*, a replacement name for *Bestiola* Pulawski and Rasnitsyn, 1999 (Hymenoptera: Sphecidae). *Acta Geologica Hispanica*, 35 (1-2), 53.
- Rasnitsyn A.P., 1969. Origin and evolution of Lower Hymenoptera. *Transactions of the Paleontological Institute, Academy of Sciences of the USSR*. 123, 196 pp. [in Russian, translated into English by Amerind Co., New Delhi, 1979].
- Rasnitsyn, A.P., 1975. Hymenoptera Apocrita of Mesozoic. *Transactions of the Paleontological Institute, Academy of Sciences of the USSR*. 147, 134 pp. [In Russian].
- Rasnitsyn, A.P., 1977. A new subfamily of scoliid wasps (Hymenoptera). *Zoologicheskii Zhurnal*, 66, 522-529 [in Russian].
- Rasnitsyn, A.P., 1980. Origin and evolution of Hymenoptera. *Transactions of the Paleontological Institute, Academy of Sciences of the USSR*, 174, 192 pp. [in Russian].
- Rasnitsyn, A.P., 1986. Vespida (= Hymenoptera). In: A.P. Rasnitsyn A.P. (ed.). *Insects in the Early Cretaceous Ecosystems of the West Mongolia*. *Trans. Joint Soviet Mongol. Paleontol. Exped. No. 28*, 154-164. Nauka Press, Moscow [in Russian].
- Rasnitsyn, A.P., 1988a. An outline of evolution of the hymenopterous insects (order Vespida). *Oriental Insects*, 22, 115-145.
- Rasnitsyn A.P., 1988b. Problem of the global crisis of the non-marine biocenoses in the Mid-Cretaceous. In: Ponomarenko A.G. (ed.). *Cretaceous biocenotic crisis and evolution of the insects*. Nauka Press, Moscow: 191-207 [in Russian].
- Rasnitsyn A.P., 1989. Dynamics of insect families and a hypothesis of the Cretaceous biocenotic crisis. In: Sokolov B.S. (ed.). *Sediment cover of the Earth in space and time*. *Stratigraphy and paleontology*. Nauka Press, Moscow: 35-40 [in Russian, with English summary].
- Rasnitsyn, A.P., 1989. Phytospreading from the selectionist's viewpoint. *Zhurnal obshchey biologii*, 50, 581-583 [in Russian with English summary].
- Rasnitsyn, A.P., 1990. Hymenoptera. In: A.G. Ponomarenko (ed.). *Late Mesozoic insects of Eastern Transbaikalian*. *Transactions of Paleontological Institute, Academy of Sciences of the USSR*, 239, 177-205. [In Russian].
- Rasnitsyn, A.P., 1991a. New Hymenopterans of the genus *Baisa* (Gasteruptiidae s.l.) from Early Cretaceous in Buryatia and Mongolia. *Vestn. zool.*, 1, 78-79 [in Russian, with English summary].
- Rasnitsyn, A.P., 1991b. Early Cretaceous members of Euanomorphous hymenopteran families Stigmaphronidae, Cretevaniidae, and subfamily Kotujellitinae (Gasteruptiidae). *Paleontol. Zhurn.*, 4, 128-132 [in Russian, translated into English in *Paleontol. J.*, 25, 172-179].
- Rasnitsyn, A.P., 1993a. New taxa of Sepulcidae. Mesozoic insects and ostracods from Asia. *Transactions of the Paleontological Institute*, 252, 80-99 [in Russian].

- Rasnitsyn, A.P., 1993b. Archaeoscoliinae, an extinct subfamily of scoliid wasps (Insecta:Vespida = Hymenoptera: Scoliidae). *Journal Hymenopteran Research*, 2, 85-96.
- Rasnitsyn A.P., 1996. Conceptual issues in phylogeny, taxonomy, and nomenclature. *Contributions to Zoology*, 66(1), 3-41.
- Rasnitsyn, A.P., 1999. *Cratophialtites* gen. nov. (Vespida = Hymenoptera: Ephialtitidae), a new genus for *Karataus koiurus* Sharkey, 1990, from the Lower Cretaceous of Brazil. *Russian Entomological Journal*, 8(3), 135-136.
- Rasnitsyn, A.P., 2000. New genus and two new species of the Lower Cretaceous Digger Wasps from Spain (Hymenoptera: Sphecidae, Angarosphecidae). *Acta Geologica Hispanica*, 35(1-2), 55-58.
- Rasnitsyn, A.P., Ansoerge, J., 2000a (in press). New Lower Cretaceous hymenopterous insects from Sierra del Montsec (Spain). *Paläontologische Zeitschrift*, 74, xx-yy.
- Rasnitsyn, A.P., Ansoerge, J., 2000b. Two new Lower Cretaceous hymenopterous insects (Insecta: Hymenoptera) from Sierra del Montsec, Spain. *Acta Geologica Hispanica*, 35(1-2), 59-64.
- Rasnitsyn, A.P., Jarzembowski, E.A., Ross, A.J., 1998. Wasps (Insecta: Vespida = Hymenoptera) from the Purbeck and Wealden Supergroups (Lower Cretaceous/ ?uppermost Jurassic) of Southern England and their biostratigraphical and palaeoenvironmental significance. *Cretaceous Research*, 19(3/4), 329-391.
- Rasnitsyn, A.P., Martínez-Delclòs, X., 1999. New Cretaceous Scoliidae (Vespida = Hymenoptera) from the Lower Cretaceous of Spain and Brazil. *Cretaceous Research*, 20, 767-772.
- Rasnitsyn, A.P., Pulawski, W.J., Martínez-Delclòs, X., 1999. Cretaceous Digger Wasps of the New Genus *Bestiola* Pulawski and Rasnitsyn (Hymenoptera: Sphecidae: Angarosphecinae). *Journal Hymenopteran Research*, 8(1), 23-34.
- Rasnitsyn, A.P., Sharkey, M., 1988. New Eoichneumonidae from Early Cretaceous in Siberia and Mongolia. In: V.K. Gupta (ed). *Advances in Parasitic Hymenoptera Research*, 169-197.
- Ren, D., Lu, L., Guo, Z., Ji, Sh., 1995. Fauna and stratigraphy of Jurassic Cretaceous in Beijing and the adjacent areas. Seismic Publishing House, 222 pp., Beijing.
- Ronquist, F., Rasnitsyn, A.P., Roy, A., Eriksson, K., Lindgren, M., 1999. A cladistic reanalysis of Rasnitsyn's data on the higher level phylogeny of the Hymenoptera. *Zoologica Scripta*, 28, 13-50.
- Sinitza, S.M., 1993. Jurassic and Lower Cretaceous of the Central Mongolia. *Transactions of the Joint Soviet Mongolian Paleontological Expedition*, 42, 239 pp. [in Russian].
- Zessin, W., 1981. Ein Hymenopterenflügel aus dem oberen Lias bei Dobbertin, Bezirk Schwerin. *Z. geol. Wiss.*, 9, 713-717.
- Zessin, W., 1985. Neue oberliassische Apocrita und die Phylogenie der Hymenoptera (Insecta, Hymenoptera). *Deutsche Entomologische Zeitschrift*, 32 (1-3), 129-142.
- Zhang, J.F., 1985. New data on the Mesozoic fossil insects from Laiyang in Shandong. *Geology of Shandong*, 1, 23-39.
- Zhang, J.F., 1986. A new Middle Jurassic insect genus *Sinephiltites* of Ephialtitidae discovered in China. *Acta Palaeontologica Sinica*, 25(5), 585-590.
- Zhang, J.F., 1992. Descriptions of two new genera and two new species of Baissodidae from China (Sphecidae, Hymenoptera). *Acta Entomologica Sinica*, 35, 483-489.
- Zherikhin, V.V., 1978. Development and changes of the Cretaceous and Cenozoic faunistic assemblages (Tracheata and Chelicerata). *Transactions of Paleontological Institute, Academy of Sciences of the USSR*, 165, 200 pp. [in Russian].
- Vidal, L.M., 1917. *Geologia del Montsec*. Junta de Ciències Natural, Anuari 2, 115-128.
- Whalley, P.E.S., Jarzembowski, E.A., 1985. Fossil insects from the lithographic limestone of Montsec (late Jurassic-early Cretaceous), Lerida Province, Spain. *Bulletin of the British Museum Natural History (Geology)*, 38, 381-412.