

An extremely primitive aculeate wasp in the Cretaceous amber from New Jersey (Vespida: ?Sierolomorphidae)

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Abstract

Loreisomorpha nascimbenei, new genus, new species, is described from the Upper Cretaceous (Turonian) amber from Sayreville, New Jersey, U.S.A. The fossil is tentatively attributed to Sierolomorphidae (Scolioidea), based on symplesiomorphies only, because the new genus shows no apomorphies beyond those characterizing Aculeata s.str.

Introduction

In the extensive collection of hymenopterous insects from the Late Cretaceous amber of New Jersey (Turonian, Raritan Formation) kept at the American Museum of Natural History, is a minute wasp that, despite its rather poor preservation state, presents a significant interest because of a unique combination of plesiomorphic features. For details on the amber, its age, distribution, etc., see Grimaldi et al., 2000.

The fossil record of aculeate wasps begins in the earliest Cretaceous. At this time they are represented mostly by archaic Sphecidae, with minor participation of Vespidae and various Chrysidoidea, viz. Embolemidae, Bethyridae, Chrysididae, and possibly Dryinidae (Rasnitsyn, 1980, 1990, 1996a; Carpenter and Rasnitsyn, 1990; Rasnitsyn et al., 1998). Unlike these groups, the Scolioidea (including Rhopalosomatidae) are known not before the later part of the Lower Cretaceous (probably since the Aptian stage; Darling & Sharkey, 1990), while Pompiloidea are not yet even found in the Cretaceous (*Pompilopterus* Rasnitsyn belongs in the Sphecidae; Rasnitsyn et al., 1998).

One would have expected the wasp described below to come from the earliest Cretaceous or

Late Jurassic, for it shows no synapomorphies other than those characteristic of all Aculeata s.s., that is aculeate wasps other than Chrysidoidea, yet it is encountered in the Upper Cretaceous (Turonian) amber of New Jersey. This could be just a matter of chance, for our knowledge of the Lower Cretaceous wasp fauna is far from complete. A more obvious cause cannot be excluded either, namely the small body size of this wasp. The majority of Lower Cretaceous fossil insects are impression fossils that are predominantly of larger size compared to those known as inclusions in fossil resins. If the ancestral aculeate wasps were minute creatures, they were less likely to be both collected as impression fossils and identified correctly. Indeed, discrimination of impression fossil wasps relies particularly on their wing morphology, because crucial body structures are not always easy to discern or see at all. In contrast, the present fossil is identifiable as an archaic wasp based mostly on its body characters (posterolateral pronotal margin and mesosternal venter unmodified, tibiae not armed), while its wing venation is similar to that of the early Sphecidae. Thus it cannot be excluded that some of the Lower Cretaceous fossils currently considered as Sphecidae will be found to belong to the stem-group of Aculeata s.s.

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Systematics

Family ?*Sierolomorphidae* Krombein, 1951
LOREISOMORPHA RASNITSYN,
 NEW GENUS

Description: Moderately small wasp of *Sierolomorpha*-like general appearance (fig. 1), of moderate stature (neither conspicuously stout nor very elongate) at least in female sex, with moderately stout appendages and rather long metasoma. Head not enlarged, somewhat elevated (possibly even tuberculate) above antennal bases, with eyes neither reduced nor evidently reniform, with temples narrow. Antenna moderately thick, 12-segmented, with scape short and flagellomeres not conspicuously elongate. Clypeus without striking modifications, mandibles possibly short. Pronotum looking rather short dorsally, medially, dorsally narrower than mesonotum, reaching tegula, widely rounded posterolaterally but not forming evident angles nor with a particularly prominent spiracular lobe. Mesothoracic venter with no distinct lobes anterior to mid coxae, metathoracic venter with no elevated structures seen between mid- and hind coxae. Propodeum angulate and possibly carinate at junction of dorsal and rear surfaces. Legs short, moderately stout, lacking distinct trochantellus, tibiae without strong

spines. Forewing with 3 submarginal and 2 discoidal cells delimited by tubular veins (unknown for most of 2m-cu crossvein). Basal vein reaching R near to pterostigma, reaching Cu distinctly beyond cu-a, with its portions of RS and M not perfectly aligned. Marginal cell (3r) wide sub-basally, acuminate at wing foremargin. 1m-cu subparallel to basal vein, reaching RS+M well basad of 2rm cell, 2m-cu reaching 2rm cell. Hind wing with r-m distant of RS base, cu-a reaching Cu well beyond M+Cu fork. Metasomal apex conical, supposedly modified to accommodate transformation of ovipositor into sting (as observed, the metasomal apical cone looks very long, but its length may be exaggerated due to partly exposed sting).

Discussion: Among the Cretaceous fossils, wing venation of the genus is reminiscent of the sphecoid genus *Angarosphex* Rasnitsyn (Rasnitsyn, 1975, 1986; Rasnitsyn *et al.*, 1998). Yet it does not belong to the Sphecidae because of the widely rounded posterior pronotal lobe, which reaches the tegula, and it shows no inflated spiracular lobe. No other Cretaceous form shows significant similarity to the new genus, making more comprehensive comparisons necessary.

The characteristic general appearance, including an acuminate metasomal apex with a (supposedly) short, mostly internal ovipositor, combined with the hardly modified venation (particularly in the hind wing) and 12-segmented female antenna clearly indicates an aculeate wasp. The pre-aculeate family Bethyloxygidae is excluded from consideration because the metasomal apex is not yet modified in this family (Rasnitsyn, 1975).

Within Aculeata, the new genus shows no reliable synapomorphy with any group, possibly also because of incomplete information on the fossil. Relationships within Chrysidoidea are unlikely because of the 12-segmented female antenna combined with several plesiomorphies unknown for the Chrysidoidea: hind wing having aculeate groundplan veins that are tubular, with r-m and cu-a crossveins having a distal position¹, and forewing 2m-cu tubular. In con-

trast, the Chrysidoidea have reduced venation: even the Plumariidae have lost 2m-cu in the forewing and in the hind wing r-m is shifted basad. At the same time, the chrysidid groundplan antenna is 13-segmented, while a 12-segmented one is known only in variously modified forms.

Among Aculeata other than Chrysidoidea (Aculeata s.s.: Rasnitsyn, 1980, 1988), *Loreisomorpha* appears plesiomorphic in all its known characters. This permits only a preliminary, phenetic classification of the genus, being based on symplesiomorphies. The most important plesiomorphy in this case is the basal position of 1m-cu with respect to the second submarginal cell (2rm), which is otherwise known only in some Sphecidae, including the majority of their Cretaceous representatives (Rasnitsyn, 1975, etc.), Sierolomorphidae and some ants. However, the new genus lacks decisive sphecid and ant synapomorphies, such as a modified pronotum in the former, modified metasomal base and reduced venation in the latter. As for the Sierolomorphidae, its only genus *Sierolomorpha* retains in its forewing, despite some evident modification, all the aculeate groundplan veins, at least the nebulous ones (*sensu* Mason, 1986), and in general its forewing venation is comparable to that of *Loreisomorpha* (fig. 2). An exception is the loss of the section of RS delimiting 2r and 2rm in *Sierolomorpha*. However, a remnant of RS is retained in this genus in the same position as in *Loreisomorpha*. The hind wing is considerably different in *Sierolomorpha*: crossveins are shifted basad, and the veins become nebulous distad of crossveins. These modifications are, however, generally characteristic of various minute wasps. It is

possible to tentatively consider the new genus as close to, although not necessarily holophyletic with *Sierolomorpha*, and to consider it a relative of Sierolomorphidae until there is more information on the genus. This decision should not obscure the fact that *Loreisomorpha* might represent a group ancestral for the entire Aculeata s.s.

Type species: *L. nascimbenei* Rasnitsyn, new species; Upper Cretaceous, Turonian; New Jersey, U.S.A. Monotypic.

Etymology: the generic name is an anagram of *Sierolomorpha*.

Loreisomorpha nascimbenei Rasnitsyn,
new species

Fig. 1

Description: Color unknown except for wings with R and pterostigma dark (R before apex and pterostigma at base and very short apex lighter), other veins light piceous. Antennomere proportions difficult to discern, scape and most flagellomeres possibly 1.5-1.7 times as long as wide, pedicel transverse, apical flagellomere relatively thin. Mid coxa the shortest, hind one the longest; femora only slightly differing in size, with hind femur the longest and much shorter than head width; tibiae of nearly equal length to respective femora; tarsi much longer, with basitarsus longer than two following tarsomeres combined; arolium well-developed. Forewing with cell 2rm subtriangular (very short between r-rs and 2r-m), 3rm shorter than high, only slightly converging toward forewing margin, receiving 2m-cu before its midlength, 2r-m and 3r-m almost straight

1 Distal position of the hind wing cu-a is commonly considered apomorphic (*e.g.*, Brothers, 1975), but this inference appears unsound. In sawflies, for instance, the reverse is definitely true. Lower parasitic wasps are variable (Ephialtitidae have cu-a usually at or basad of the end of M+Cu, Karatavitidae, Praeaulacidae and lower ichneumonoids *Pareichneumon* Rasnitsyn and *Tanychora* Townes - in the distal position). Pre-aculeate Bethyloynymidae usually have cu-a in a distal position in forms of larger size (*Bethyloynymus* Rasnitsyn, *Karataviola* Rasnitsyn) and basal cu-a in smaller ones (*Bethyloynymellus* Rasnitsyn). A majority of the Lower Cretaceous Aculeata s.s. (Sphecidae: Angarosphecinae s.l., Tiphiidae: *Architiphia* Darling, Vespidae: *Priorvespa* Carpenter and Rasnitsyn) show cu-a meeting Cu distad of the end of M+Cu.

(arching very slightly outward). Hind wing with r-m distant from RS base for more than two times its length, cu-a distant of M+Cu fork for less than its length. Metasoma looks widest sub-basally, possibly due to postmortem distortion and/or uneven thickness of the milky coating.

Measurements (mm): body length ca. 5.5, head height co. 1.2, mid femur, tibia, and basitarsus length ca. 0.7, 0.7, and 0.25, respectively; forewing length up to apex of marginal cell 3.0.

Type: Holotype: AMNH NJ-380. Department of Entomology, AMNH, a complete female wasp with slightly cut head (both sides), thorax (one side), and part of legs, and badly obscured by a milky coating (except wings). Labelled: "Amber: Late Cretaceous/ New Jersey/ Middlesex Co/ Sayreville, White Oaks Pit/ 1995, coll. Paul Nascimbene/AMNH no. NJ-380 (PN-119)".

Etymology: specific name after the collector, Mr. Paul Nascimbene.

References

- Brothers, D.B. 1975. Phylogeny and classification of the aculeate Hymenoptera, with special reference to Mutillidae. University of Kansas Science Bulletin 50: 483-648.
- Carpenter, J.M. & A.P. Rasnitsyn 1990. Mesozoic Vespidae. *Psyche* 97: 1-20.
- Darling, C.G. & M.J. Sharkey 1990. Chapter 7. Order Hymenoptera. Pp. 123-153 *In*: D. Grimaldi (ed.). Insects from the Santana Formation, Lower Cretaceous, of Brazil. Bull. Amer. Mus. Nat. Hist. 195: 1-191.
- Grimaldi, D., A. Shedrinsky & T.P. Wampler 2000. A remarkable deposit of fossiliferous amber from the Upper Cretaceous (Turonian) of New Jersey. Backhuys Publishers, Leiden: 1-76 [this volume].
- Mason, W.R.M. 1986. Standard drawing conventions and definitions for venational and other features of wings of Hymenoptera. *Proc. Ent. Soc. Wash.* 88: 1-7.
- Rasnitsyn, A.P. 1975. Hymenoptera Apocrita of Mesozoic. Trans. Paleontol. Inst. Acad. Sci. USSR. 147. Nauka Press, Moscow. 134 p. (in Russian).
- Rasnitsyn, A.P. 1980. Origin and evolution of Hymenoptera. Trans. Paleontol. Inst. Acad. Sci. USSR. 174. Nauka Press, Moscow. 192 p. (in Russian).
- Rasnitsyn, A.P. 1986. Vespida (= Hymenoptera). *In*: Rasnitsyn A.P. (ed.). Insects in the Early Cretaceous Ecosystems of the West Mongolia. Trans. Joint Soviet-Mongol. Paleontol. Exped. No. 28. Nauka Press, Moscow. pp. 154-164 (in Russian).
- Rasnitsyn, A.P. 1988. An outline of evolution of the hymenopterous insects (order Vespida). *Oriental Insects* 22: 115-145.
- Rasnitsyn, A.P. 1990. Hymenoptera. *In*: Ponomarenko A.G. (ed.). Late Mesozoic insects of Eastern Transbaikalian. Trans. Paleontol. Inst. Acad. Sci. USSR. 239. Nauka Press, Moscow: pp. 177-205 (in Russian).
- Rasnitsyn, A.P. 1996a. New Early Cretaceous Embolemidae (Vespida = Hymenoptera: Chrysidoidea). *In*: B.B. Norden and A.S. Menke (eds.). Contributions on Hymenoptera and associated insects dedicated to Carl V. Krombein. Mem. Entom. Soc. Washington 17: 183-187.
- Rasnitsyn, A.P. 1996b. Conceptual issues in phylogeny, taxonomy, and nomenclature. *Contributions to Zoology* 66 (1): 3-41.
- Rasnitsyn, A.P., E.A. Jarzembowski & A.J. Ross 1998. Wasps (Insecta: Vespida = Hymenoptera) from the Purbeck and Wealden Supergroups (Lower Cretaceous/?uppermost Jurassic) of Southern England and their biostratigraphical and paleoenvironmental significance. *Cretaceous Research* 19: 329-391.

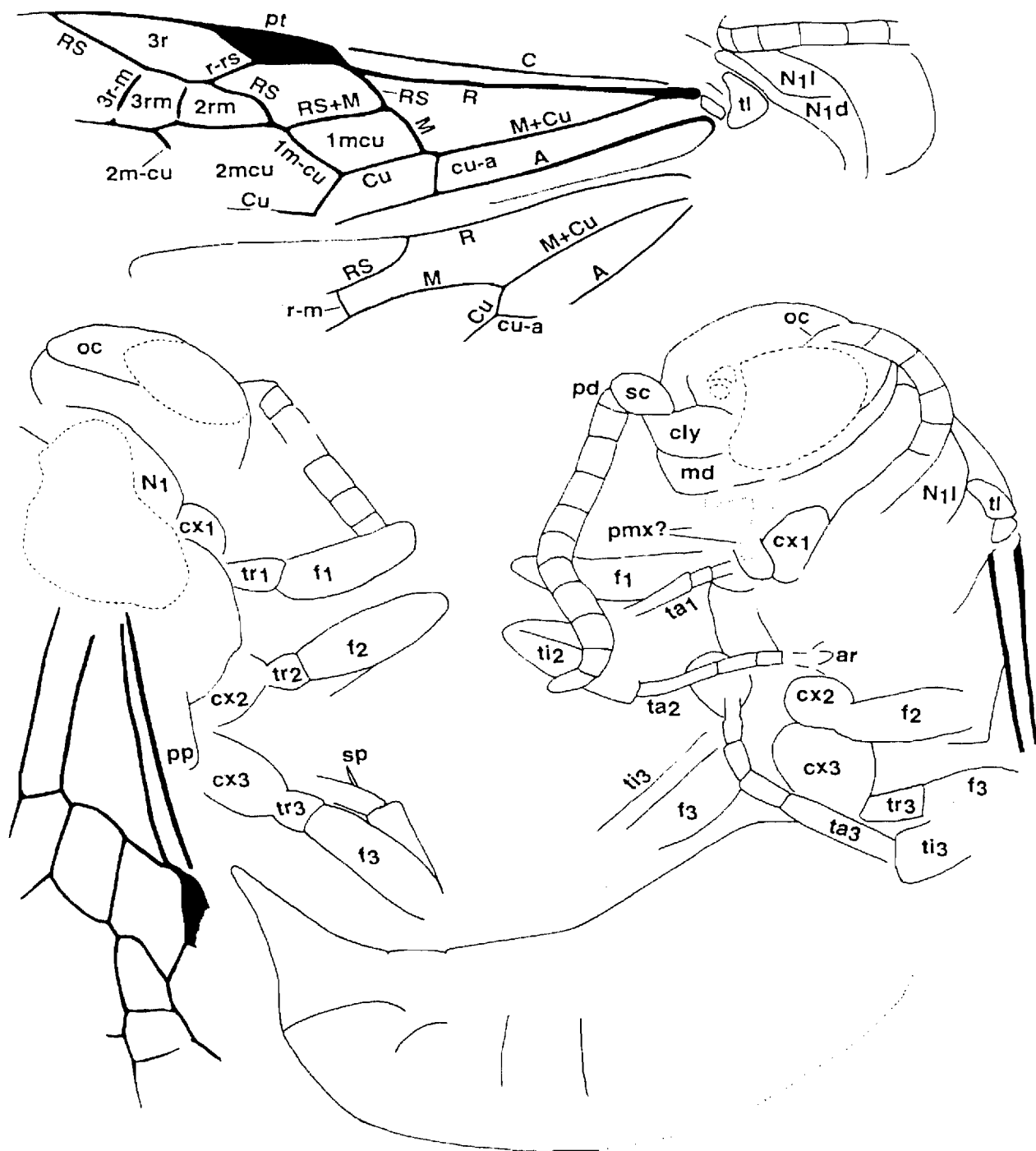


Fig. 1. *Loreisomorpha nascimbenei*, new species, holotype no. NJ-380, New Jersey amber, Sayreville; Late Cretaceous, Turonian Stage, Raritan Formation; fossil in three aspects. Scale bar 1 mm (as in fig. 2). Dashed line shows cut off head and thoracic parts (two small holes on the head represent antennal base - below, and supra-antennal projection - above); dots outline structures obscured by a milky cover. Venational nomenclature standard; other symbols: ar - areolium, cly - clypeus, cx - coxa (cx₁, cx₂, cx₃ - fore-, mid-, and hind coxa, respectively), f - femur, md - mandibles, N₁ - pronotum (N₁d, N₁l - its dorsal and lateral surfaces, respectively), oc - eye, pmx - maxillary palp, pp - propodeum, sp - tibial spur, ti - tibia, tl - tegula.

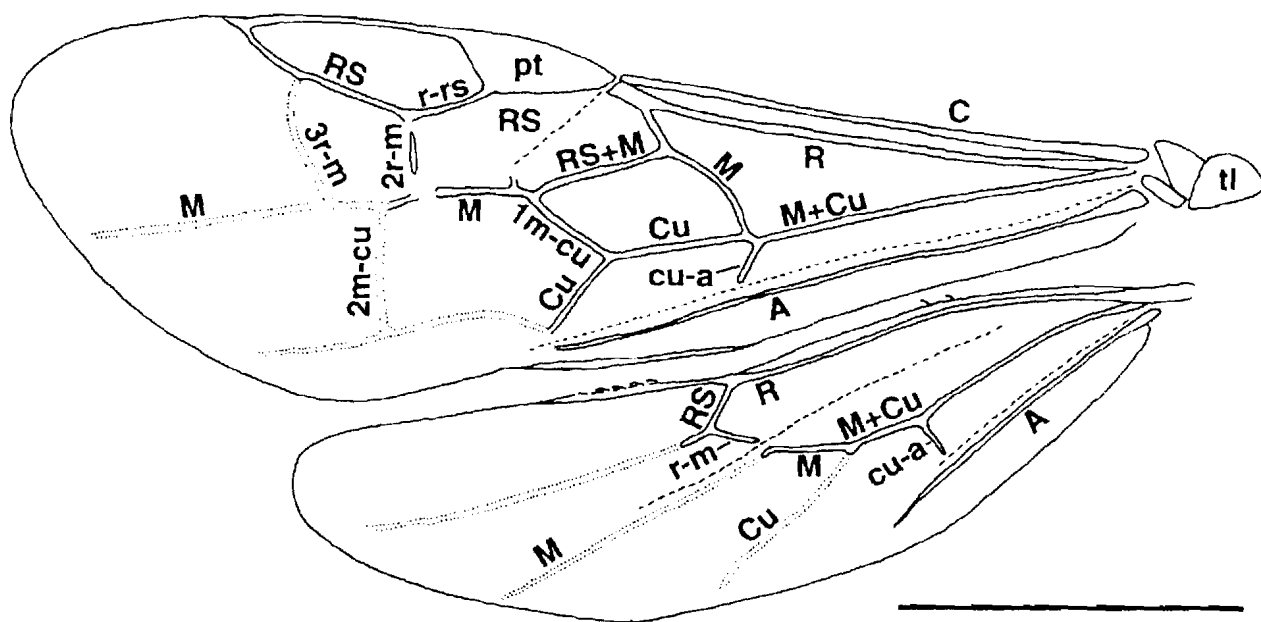


Fig. 2. *Sierolomorpha nigrescens* Evans, fore- and hind wings. Double dotted lines show nebulous veins, dashed line shows wing folds. Scale line 1 mm.