

Commentary: Ant Colonies in Science, Culture and Education

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Abstract

A recently published study by de la Fuente and Estrada-Peña (Description of fossil amber with ant syninclusions. *Frontiers in Ecology and Evolution* 2026; 14:1724595. <https://doi.org/10.3389/fevo.2026.1724595>) addresses the evolution of insects with reference to ant syninclusions with multiple fossil organisms in amber. The study provided information to better understand the possible impact of eusocial insects of the family Formicidae on the ecosystem such as symbiosis, phoresis and parasitism. Ants are considered an ecologically important species with specialized diversity since their origin in the late Mesozoic and eusociality in the Early Cretaceous (120 million years ago). The commentary in reference to this article use ant colonies to represent not only the origin and evolution of ants, but narrative histories with antique books (12th, 18th and 20th century ant colonies and swarm illustrations) showing how ants are relevant for the general population at both scientific, social and cultural levels with implication in education. This commentary further supports the relevance of the study of fossil ants in ecology, evolution and education.

Keywords: Amber; Ant; Antique; Book; Education; Evolution; Formicidae; Insect; Swarm.

1. Introduction

Ants (Arthropoda: Insecta: Hymenoptera: Formicidae, Latreille 1809) are ecologically relevant eusocial insects present on most Earth landmasses with diversity since Stem ants[†] including Hell ants[†], which did not leave modern descendants deriving from Crown ants [1]. Amber is a fossilized resin with insects and other life forms preserved as inclusions [2]. Accordingly, fossil ants in amber are the focus of scientific studies (e.g., [3, 4]), and as recently published [5], to address evolutionary coexistence and possible interactions with different organisms. Ant swarming is a temporary event when alates aggregate together for milling on the same spot, mating, defending their nests, moving together or migrating [6]. Ant colonies are represented by eusocial communities with egg-lying queens, workers, soldiers and winged sexual males and females [7]. Accordingly, amber possibly reflect ant colonies with multiple processes including swarms.

2. Antiques analysis

Antique fossils and books used for analysis originated from author's KGJ Collection (Ciudad Real, Spain). The amber pieces used in this article were from Eocene Baltic amber, ca. 40-50 million years ago (Mya) (Figs. 1 and 2) and were polished under natural conditions and certified by tests with UV light, saltwater floating, sinks in fresh water, acetone resistant, and heat-smell of pine resin with ensure that "amber provider knows that in line with the laws and regulations in his country it is allowed to sell/export these objects". Images of fossil pieces and inclusions originated from either amber providers or captured by microscopy as previously described in the study of fossil ants [5]. Larger resolution images are disclosed in Supplementary Information - Appendixes 1-4.

3. Origin and evolution of ants

The oldest Hell ant[†] fossil was identified in a limestone from the Lower Cretaceous of Brazil, ca. 113 Mya [8]. Previously, the oldest ant fossil was dated from ca. 92 Mya in amber from the Turonian stage of New Jersey, U.S.A. [9]. As recently described, fossil ants have been identified in amber inclusions from Cretaceous (Stem ants[†] and Hell ants[†], ca. 99 Mya), and Crown ants from Eocene, Oligocene and Pliocene epochs [5]. Accordingly, the hypothesis is that ants originated during Cretaceous (ca. 130 Mya) with diversification and dominance in terrestrial ecosystems during Tertiary (66-2.6 Mya) [5, 9-11].

4. Narrative history of ants

The known oldest book featuring ants came from a 6th-century (600 to 501 BC) collection of oral tales, "Aesop's Fables" [12] with the iconic moral tale, "The Grasshopper and the Ants" (Perry Index 373) [13]. Manuscripts with ant drawings appeared during Middle Ages (ca. 500-1500 AD) [14], including the *Saint Petersburg Bestiary* (also known as the Saltykov-Shchedrin Bestiary) *illuminated manuscript from 12th century (ca. 1175-1200)* [15-21]. Then, it is considered that the first book about insects was published in 1602 [22], and the first scientific book in 1665 [23, 24] with continued research like shown in a 1766 book [25] until present. Regarding fossil ants, the first scientific publication was in 1868 by Mayr [26] with description of multiple species in Baltic amber [4].

5. Discussion

The study of fossil ants is relevant for the general population and attracts attention of media and press (e.g., [27]). Focusing on ant colonies, fossil syninclusions represent ancient environment like in the Eocene epoch (Figs. 1 and 2, Supplementary Information

– Appendixes 1-4) [28]. Ant colony biology can be described with mating and foraging/defensive organisms (Fig. 1, Supplementary Information – Appendix 1). Mature ant colonies produce winged males and virgin queens for mating to maintain genetic diversity. Army ants do not swarm for reproduction but for foraging and defense.

As represented in Baltic amber pieces from Eocene epoch (Figs. 1 and 2, Supplementary Information – Appendixes 1-4), ants are found close to other arthropods such as a true bug nymph (Arthropoda: Insecta: Hemiptera: Cicadomorpha, Evans 1946; Fig. 1, Supplementary Information – Appendix 2) and a millipede (Arthropoda: Myriapoda: Diplopoda, Blainville in Gervais 1844; Fig. 2, Supplementary Information – Appendix 3). The interaction between ants and true bug nymphs range

from **mutualistic "farming"** where ants protect the nymphs from predators such as ladybugs and parasitoid wasps in exchange for sugary honeydew to **predator-prey** or **evasive avoidance behavior** [29-31]. The interaction between ants and millipedes is primarily driven by predator-prey dynamics in which some ants hunt millipedes but must avoid them due the potent toxins they secrete for survival [32]. Ants trapped in Baltic amber represented in Figure 1 reflect not only a colony but also a putative swarm.

Understanding ant behavior in multiple colonies and swarms also contributes to principles guiding decentralized collective intelligence in areas such as **computer science algorithms** and **robotics** [33].

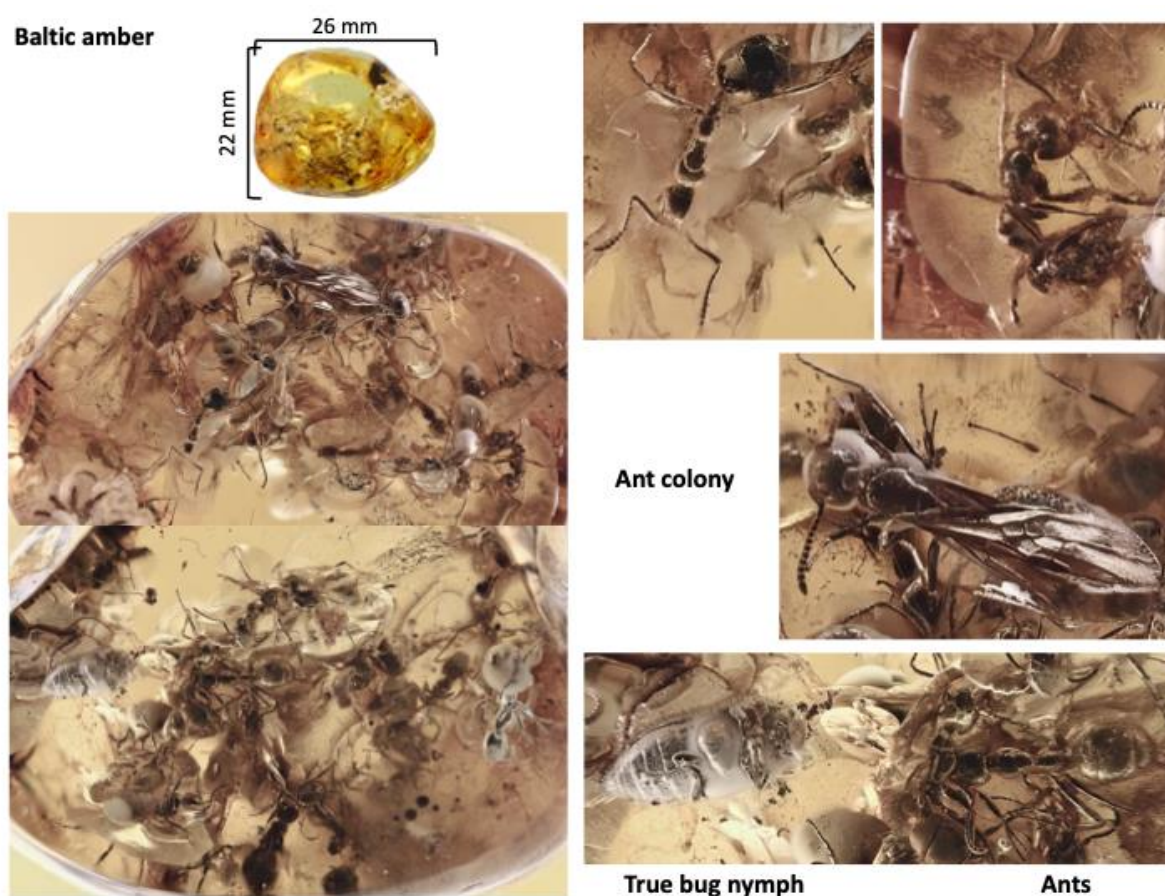


Figure 1. Ant colony and swarm in fossil amber, piece 1. Example of ant colony and possible swarm with more than 30 Formicidae and a true bug nymph fossil syninclusions in Eocene Baltic amber (ca. 40-50 million years ago; 26 x 22 x 17 mm, 6.3 g).

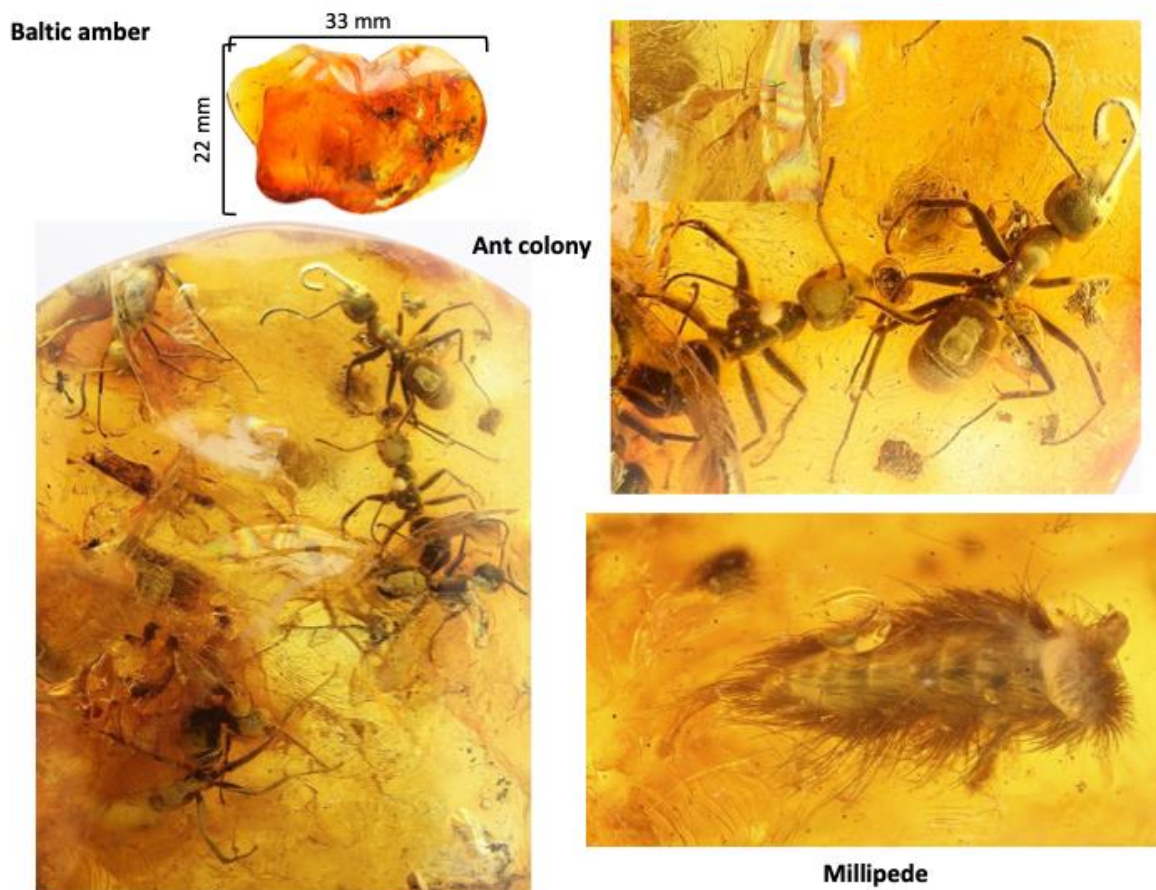


Figure 2. Ant colony in fossil amber, piece 2. Example of ant colony with more than 6 Formicidae and a millipede fossil syninclusions in Eocene Baltic amber (ca. 40-50 million years ago; 36 x 24 x 8 mm).

Ants have been included in multiple ancient studies as shown for example in antique books from 12th (Fig. 3, [15]) and 18th (Fig. 4A, [25]) centuries.

The interest and significance of ant colonies was described in the 12th century *Saint Petersburg Bestiary* with a narrative cultural-religious perspective (Fig. 3). On section f.32v, “of the ant (*formica*), Solomon says, ‘Go to the ant, you sluggard; consider it, for though that although it is rather weak in strength, it stores up much grain during the summer’. The physiologist says that the ant has three natural characteristics”. On section f.33, “its first characteristic is when ants leave the anthill, they walk in an orderly fashion and search for grains of any kind of seed. When they find some, they pick them up with their mouths and carry each grain back to their anthill. Then, when other ants come from the opposite direction, without carrying grain in their mouths, they don't say to them, ‘Give us some of your provisions’, but rather they walk in search of grains following the trail of those ants, and just like them, they pick up and carry it back to their anthills. The second characteristic of the ants is that when they store grains in their anthill, distributes them according to the seasons of the year not to die of hunger in winter due to a lack of seeds because of their ignorance. On section

f.33v, “Finally, Job says, ‘It is called an ant because it carries grains (*fert micas*) of wheat’. Their ingenuity is very great. They provide for the future and prepare what they will eat in winter; They choose the wheat but does not touch the barley, and during the time that rain falls on the wheat, they carry it out. It is said that in Ethiopia there are ants shaped like dogs. They extract gold-bearing sands with their paws, which they guard so that no one will steal them, and those who take them they pursue until they kill. But those who want to take the gold from them take horses with their young and starve them for three days, section f.34. Then they tie the foals by the bank of the water that flows between them and the ants, and they cross the water after having placed the pack saddles on the backs of the horses which, when they see the green grass on the other side of the river, go to graze in the fields. The ants also carry gold they put it in the packsaddle and the chests, wanting to hide it there. When evening comes, after the horses are full of food and loaded with gold, they hear their foals whinnying with hunger, and so they return to them without anyone to guide them, carrying much gold. There is another animal called the antlion (*fomicaleon*) because it is the lion of the ants or because it is both ant and lion”.

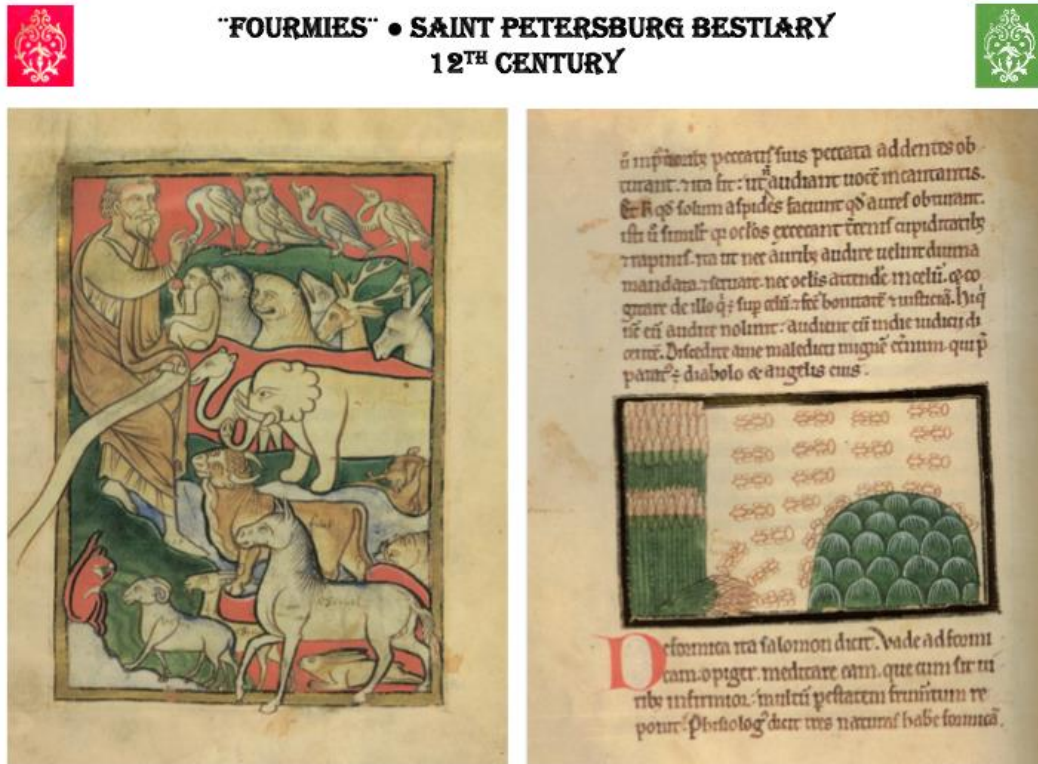


Figure 3. Ant colony in antique manuscript from 12th century. Ant colony in "Fourmies" (Lat. Q.v.V.No. 1, p. 50, ordinal number 29, folio number f.32v, 55/57 - 90/91 mm) in *Saint Petersburg Bestiary illuminated manuscript* (ca. 1175-1200), limited facsimile edition (599/995). Reference [15].

In more recent books from 20th century, ants are used for education to describe ant colonies with battle (Fig. 4B, [34]) and swarm with a flying ant moving small ants (Fig. 4C, [35]).

"INSECTS" • NATUURLYKE HISTORIE OF UITVOERIGE BESCHRYVING DER DIEREN, PLANTEN EN MINERAALLEN, VOLGENS HET SYSTEEM VAN LINNAEUS, 18TH CENTURY

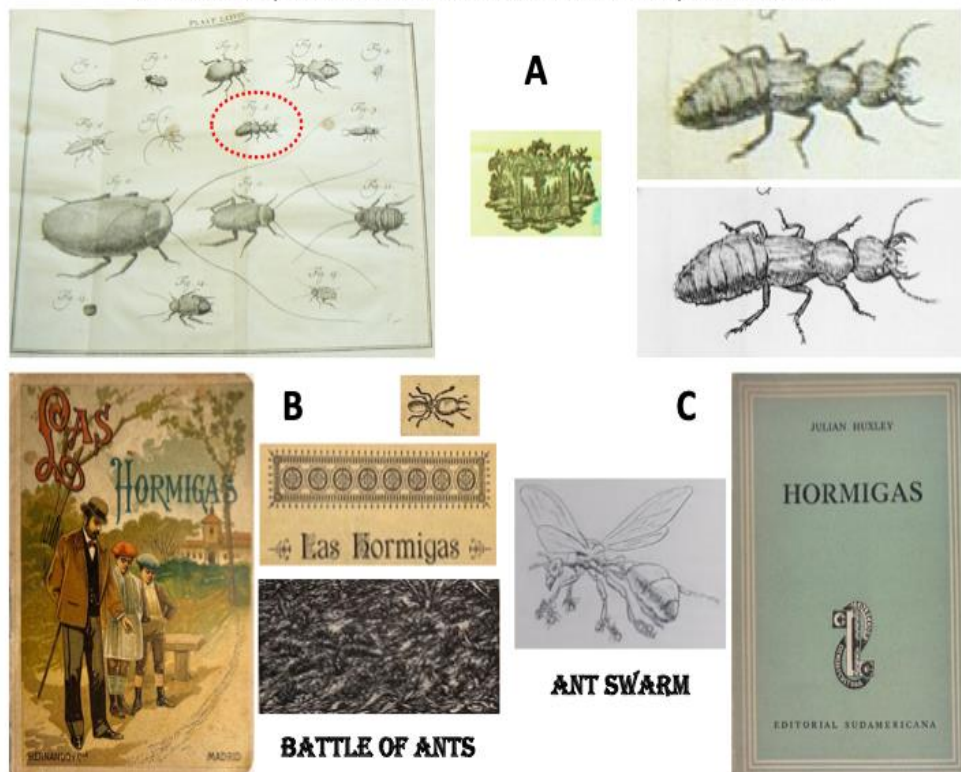


Figure 4. Ant in antique books for education. (A) Ant in Figure 8 of Plate LXXVIII in the Natural History book from 18th century, reference [25]. (B) Battle of ants in *The Ants (Las Hormigas)* book from ca. 1910, reference [34]. (C) Ant swarm in *Ants (Hormigas)* book from 1949, reference [35].

6. Conclusions

In conclusion, ant colonies and swarms are relevant for science and culture (e.g., [36-39]). Ants preserved in amber are used to study fossil insect behavior and evolution. Ant social impact has been illustrated and described as shown here in antique books with implications in education.

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Supplementary Information

Appendix 1. High resolution image. Ants with possible swarm in Baltic amber (Fig. 1).





Appendix 2. High resolution image. True bug nymph with ants in Baltic amber (Fig. 1).



Appendix 3. High resolution image. Millipede with ants in Baltic amber (Fig. 2).



Appendix 4. High resolution image. Ants in Baltic amber (Fig. 2).

