SILENT STORIES

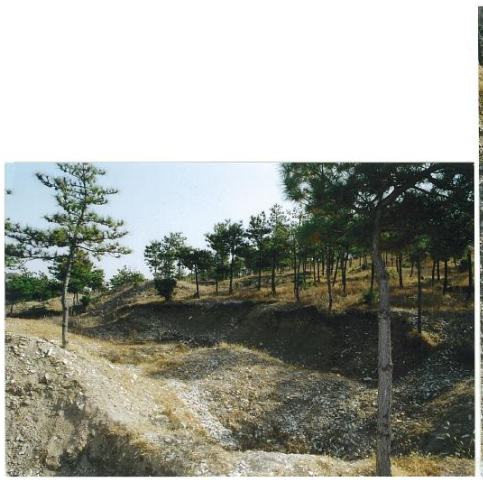
-- The Surprisingly Modern Roles of Insects in Two Mid Mesozoic Ecosystems of N.E. China

SHIH, CK, WANG, M, GAO, TP, LABANDEIRA, CC and REN, D

October 20, 2014 at GSA

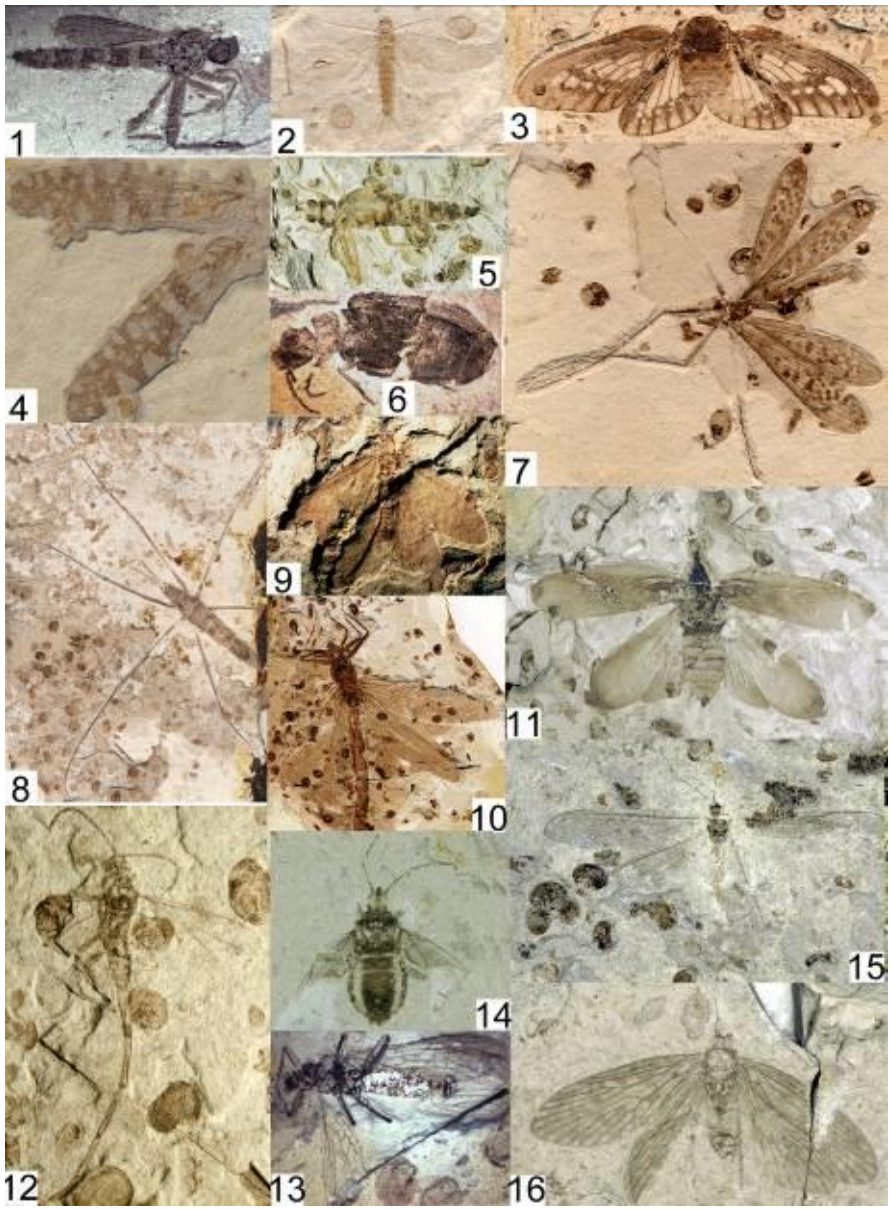

Fossil Sites
JINZHOU
BEIJING
SHANGHAI
Russia
Mongolia
China
North Korea
South Korea
Yellow Sea
East China Sea
Taiwan
Hong Kong
Philippines
Luzon
South China Sea
Gulf of Tonkin
Vietnam
Laos
Thailand
Cambodia
Myanmar (Burma)
Bay of Bengal
India
Bangladesh
Bhutan
Nepal
Pak.
75°
90°
105°
120°
135°
45°
30°
15°
0 500 km
0 500 mi

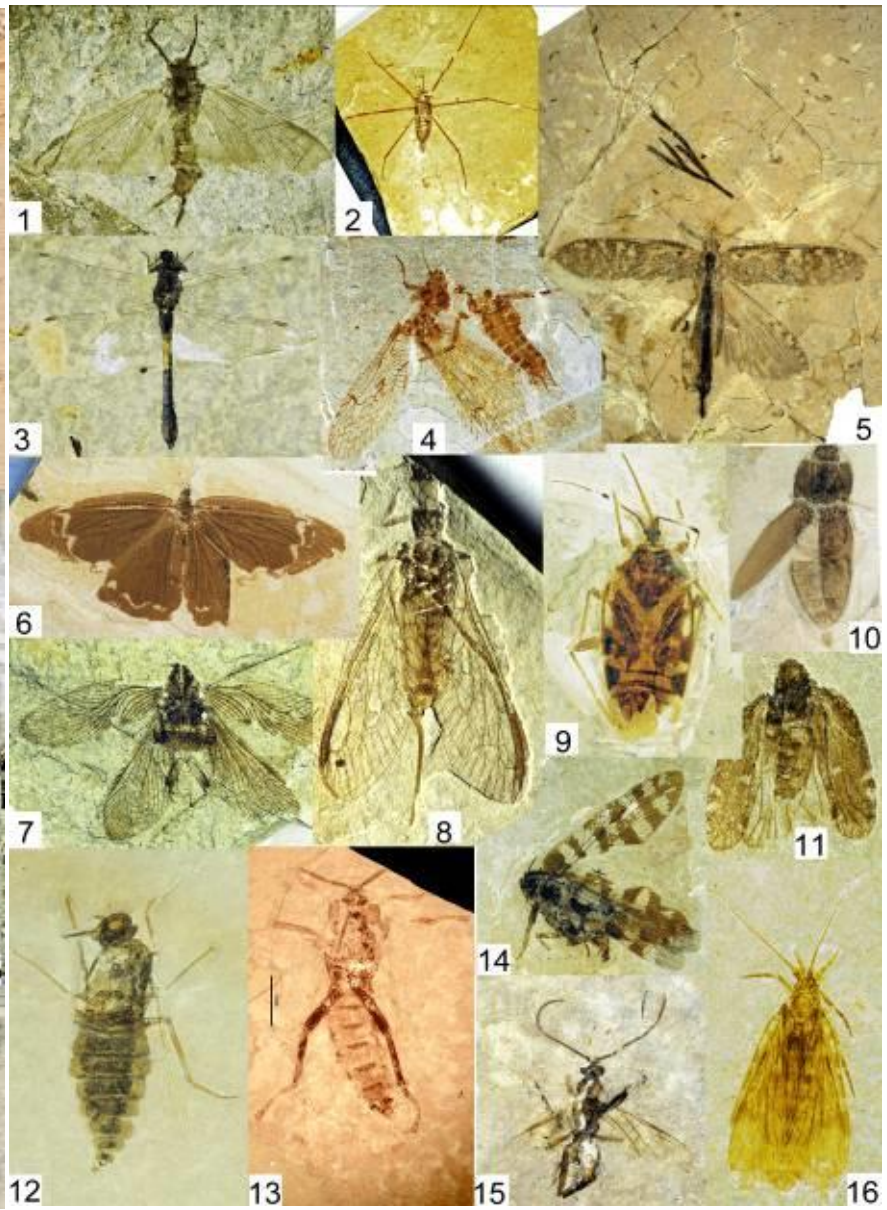
Two Formations in the Mesozoic of NE China



Insect Fossil Treasures – CNU Collection

more than 250,000 insect fossils





Insect associations with plants

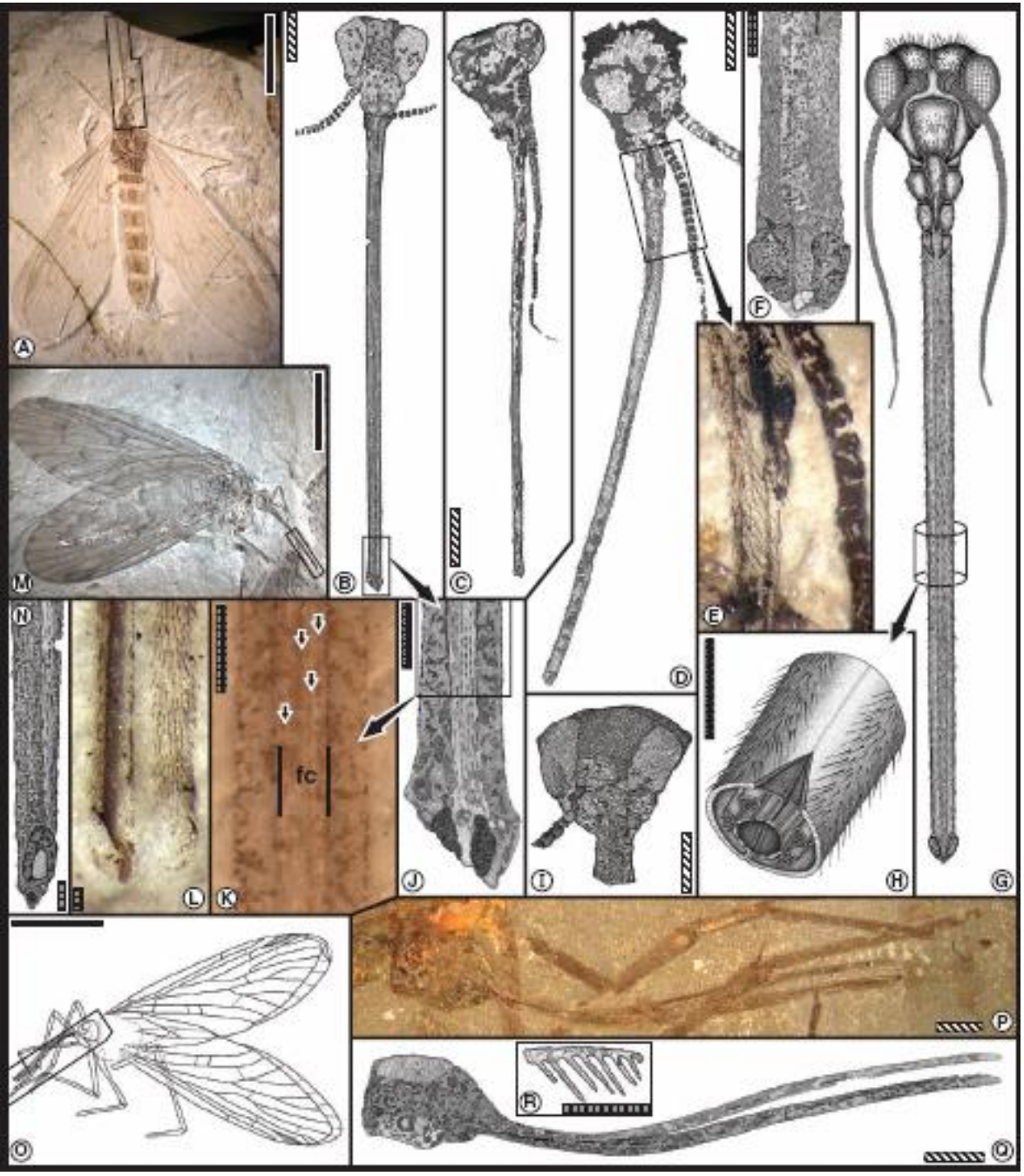
- Pollination or “flower” visits
- Mimesis or camouflage

Photos by Jason Shih or CK Shih

Siphonate Mecopterans

"A probable pollination mode before angiosperms: Eurasian, long-proboscid scorpionflies," Ren et al. 2009, Science

Lichnomesopsyche gloriae
Ren, Labandeira et Shih, 2010.

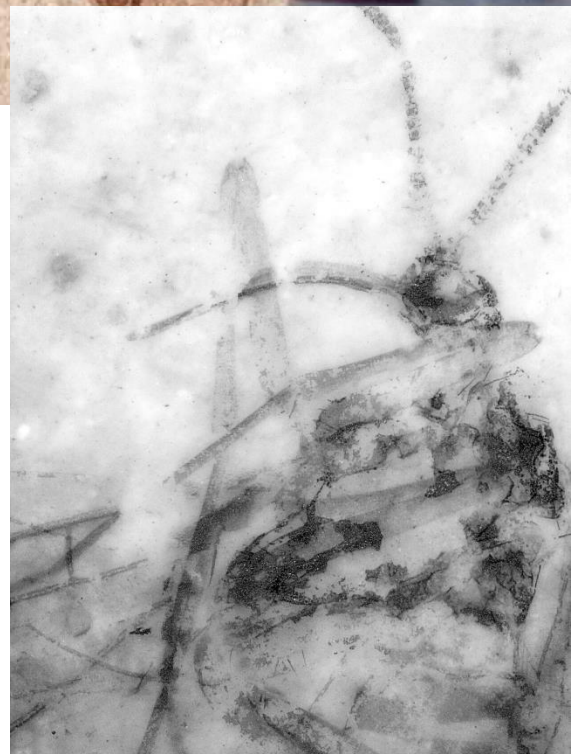


- Siphonate mouthparts, from 3-14 mm, associated with the ovular tube of gymnosperms
- Fed on gymnosperm pollination drops
- Engaged in pollination mutualisms with gymnosperms during the Mid-Jurassic

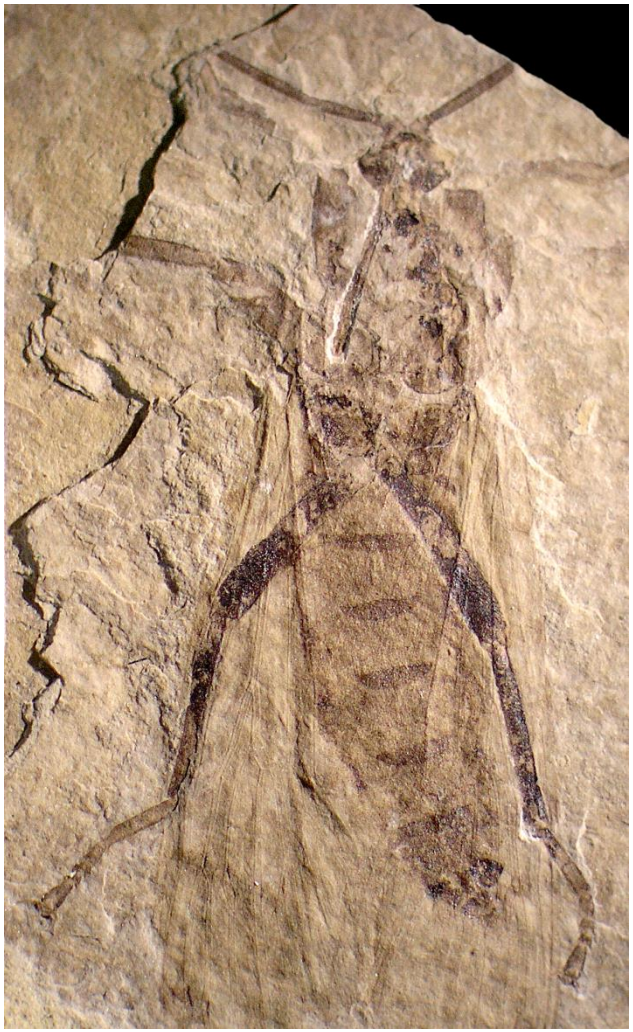
(Ren et al. 2009, Science)

Siphonate Mecopterans

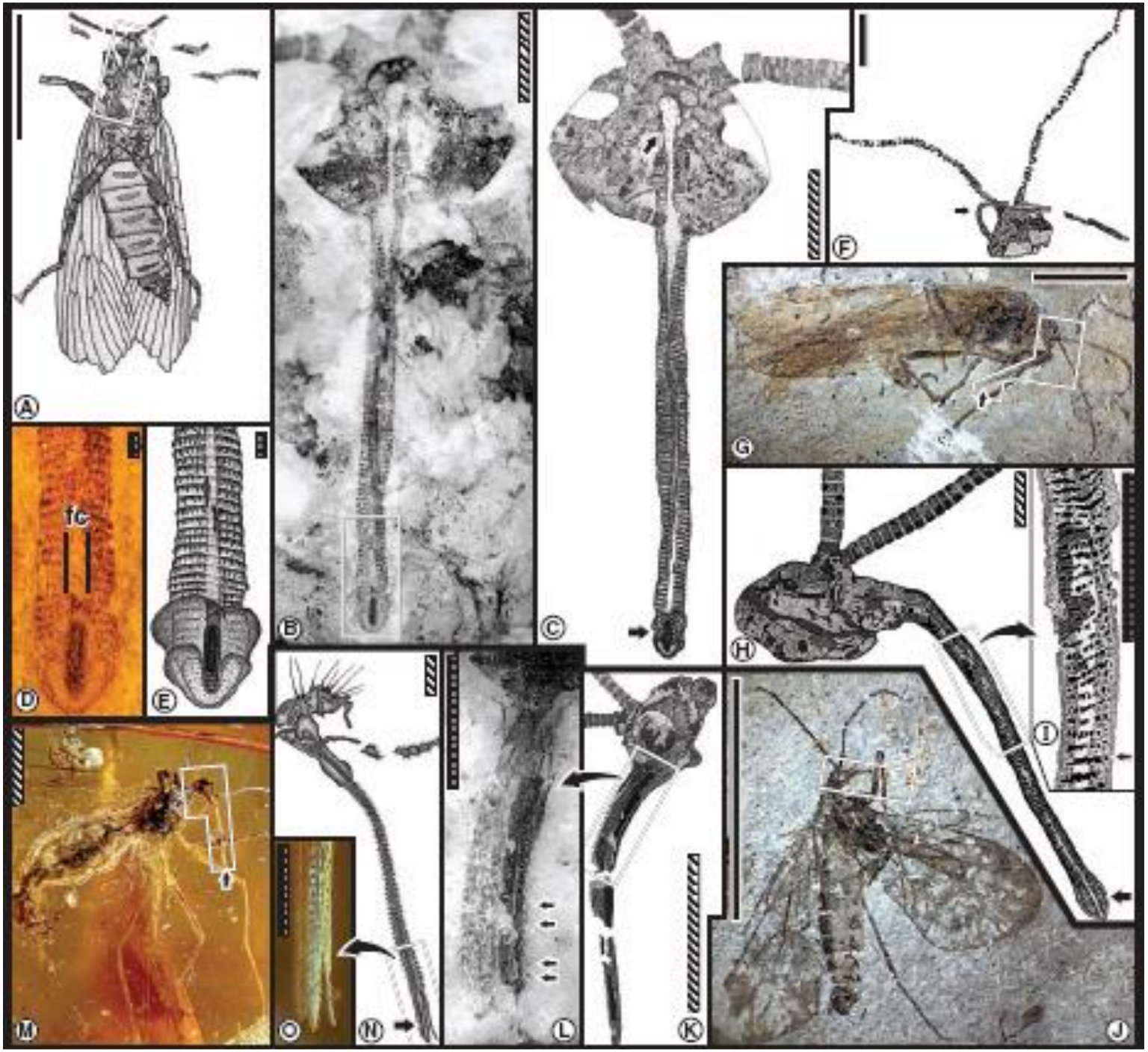
Pseudopolycentropus janeannae
Ren, Shih et Labandeira, 2010



Siphonate Mecopterans



***Jeholopsyche liaoningensis* Ren, Shih et Labandeira, 2011.**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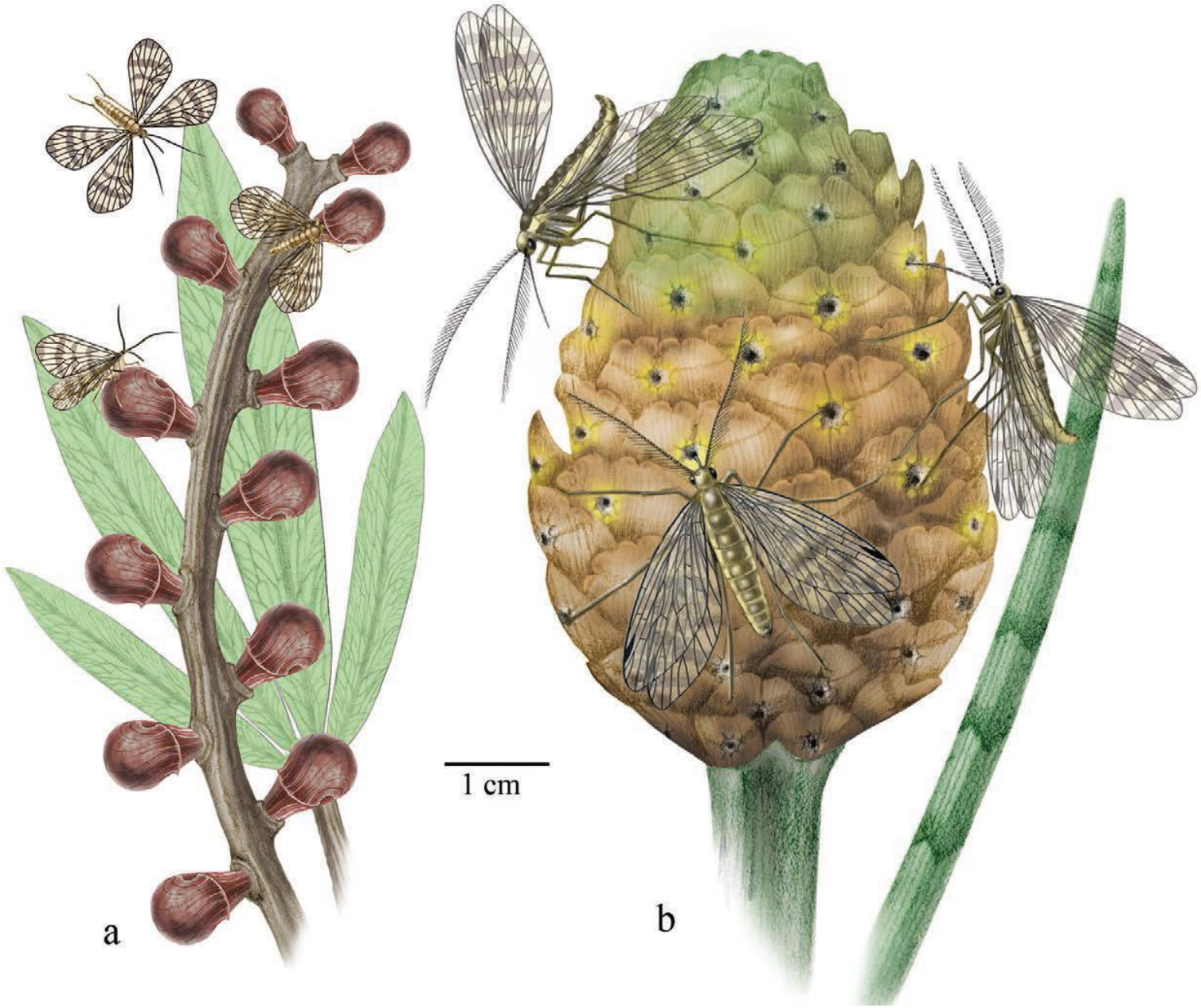
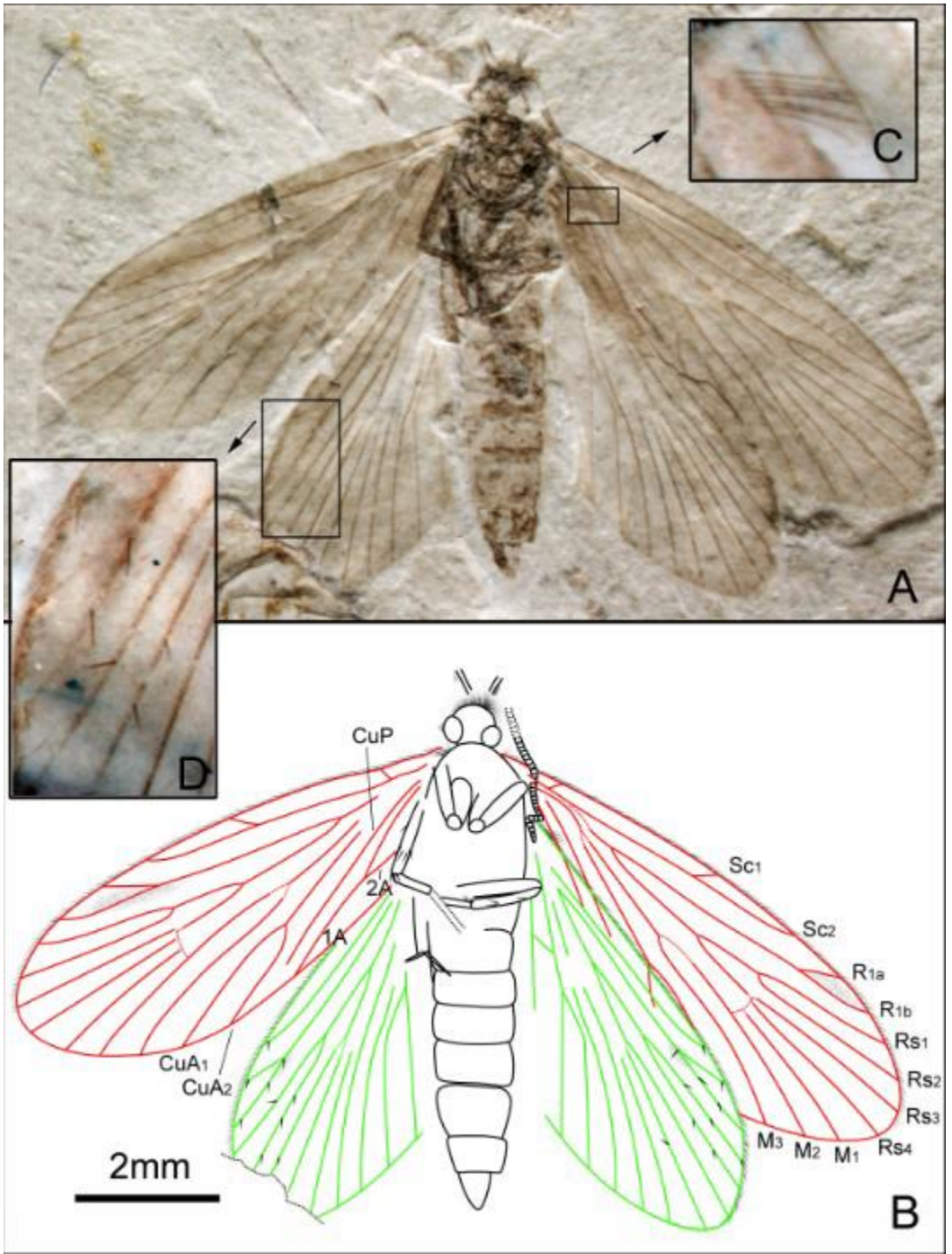


Pollination of a. *Pseudopolycentropus janeannae* b. *Lichnomesopsyche gloriae* for gymnosperms. (Art by Mary Parrish, National Museum of Natural History)

Lepidoptera – Beauty and Grace

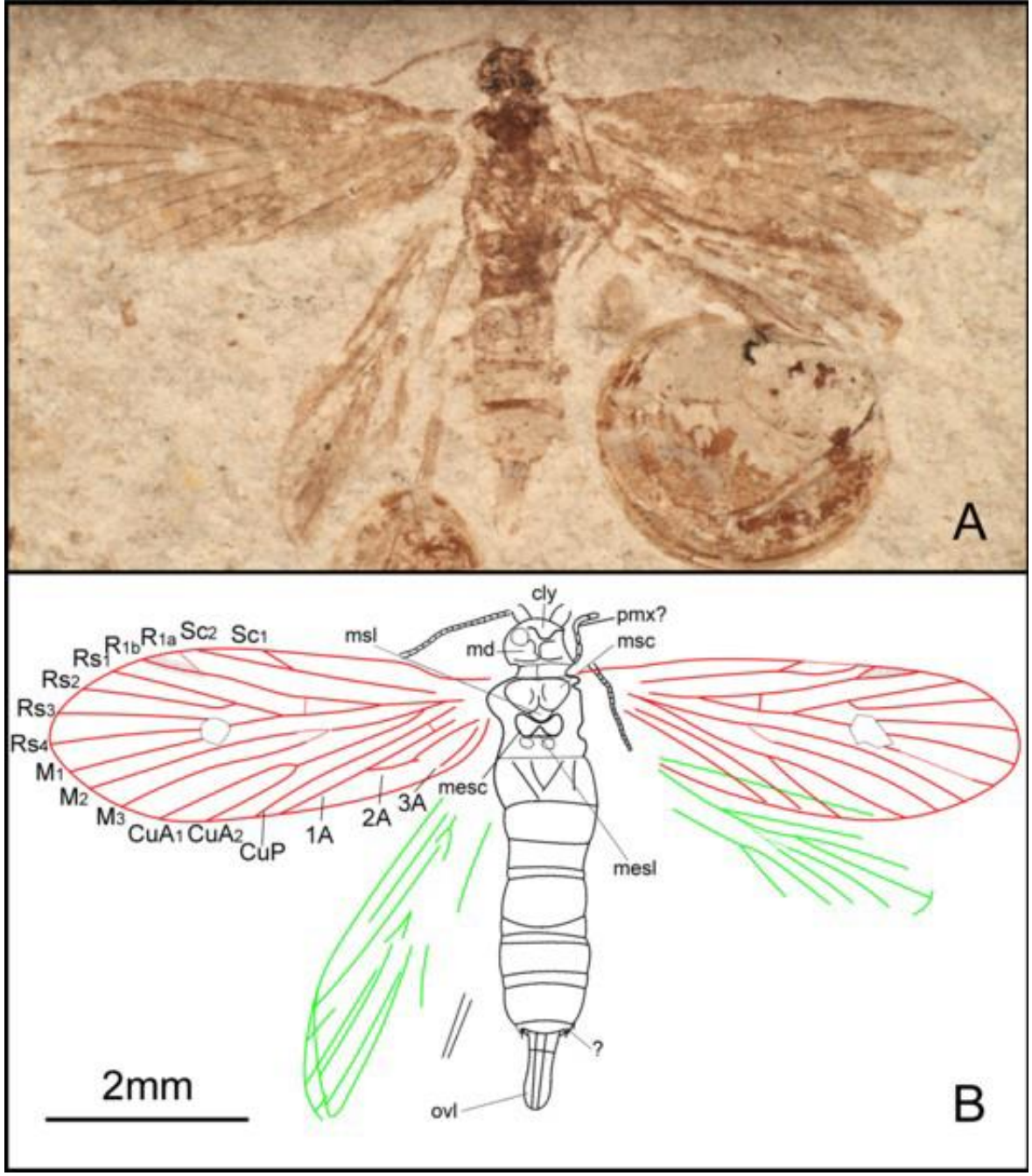
Photos by Chung Kun Shih

Lepidoptera



(A) (B) *Spiniferlepidopterix elachiptera* Zhang, Shih Labandeira et Ren 2013, (C) a cluster of bristles on hind wing. (D) spines on hind wing.

Zhang et al. 2013. PLoS ONE



Mouthparts most likely for pollen feeding

***Sinolepidopterix dualis* Zhang, Shih Labandeira et Ren 2013. PLoS ONE**

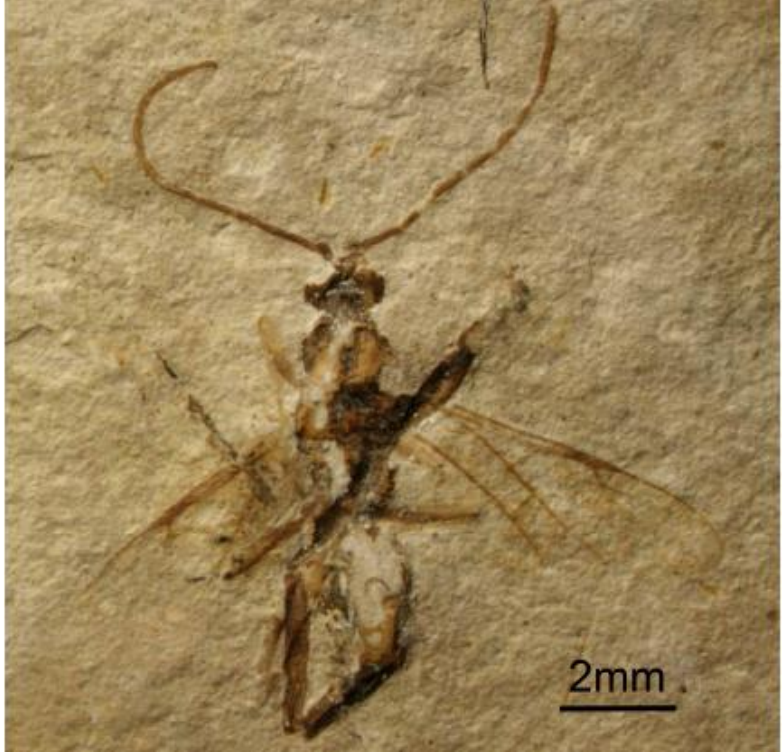
Hymenoptera – Pollination and Parasitoid

Photo by Chung Kun Shih

Photo by Jason Shih

Pelecinids

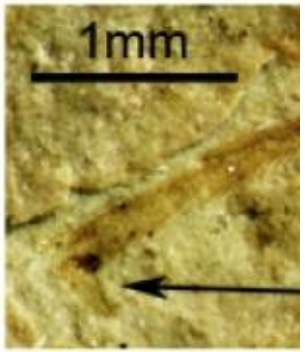
Archaeopelecinus tebbei Shih, Liu et Ren, 2009. An. of Ento. Soc. of Am.



Shoushida regilla Liu, Shih et Ren, 2009

Pelecinus polyturator (Drury) Schletterer, 1890

Pelecinids



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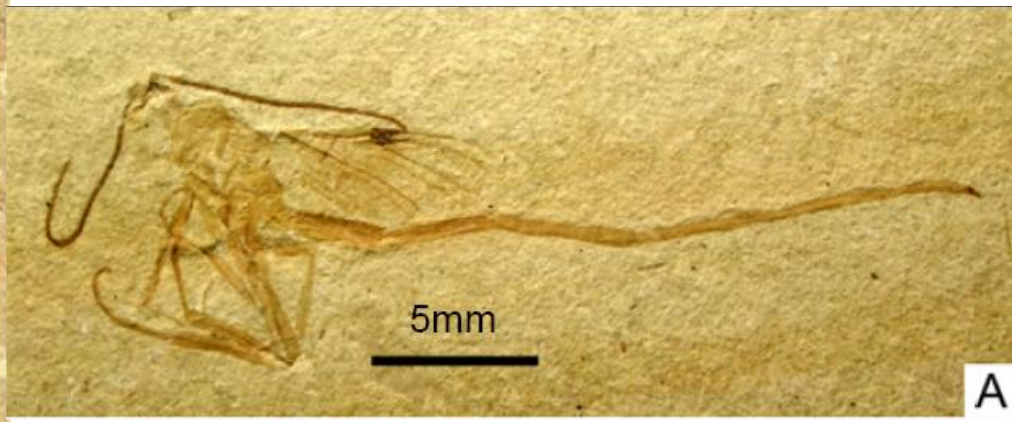
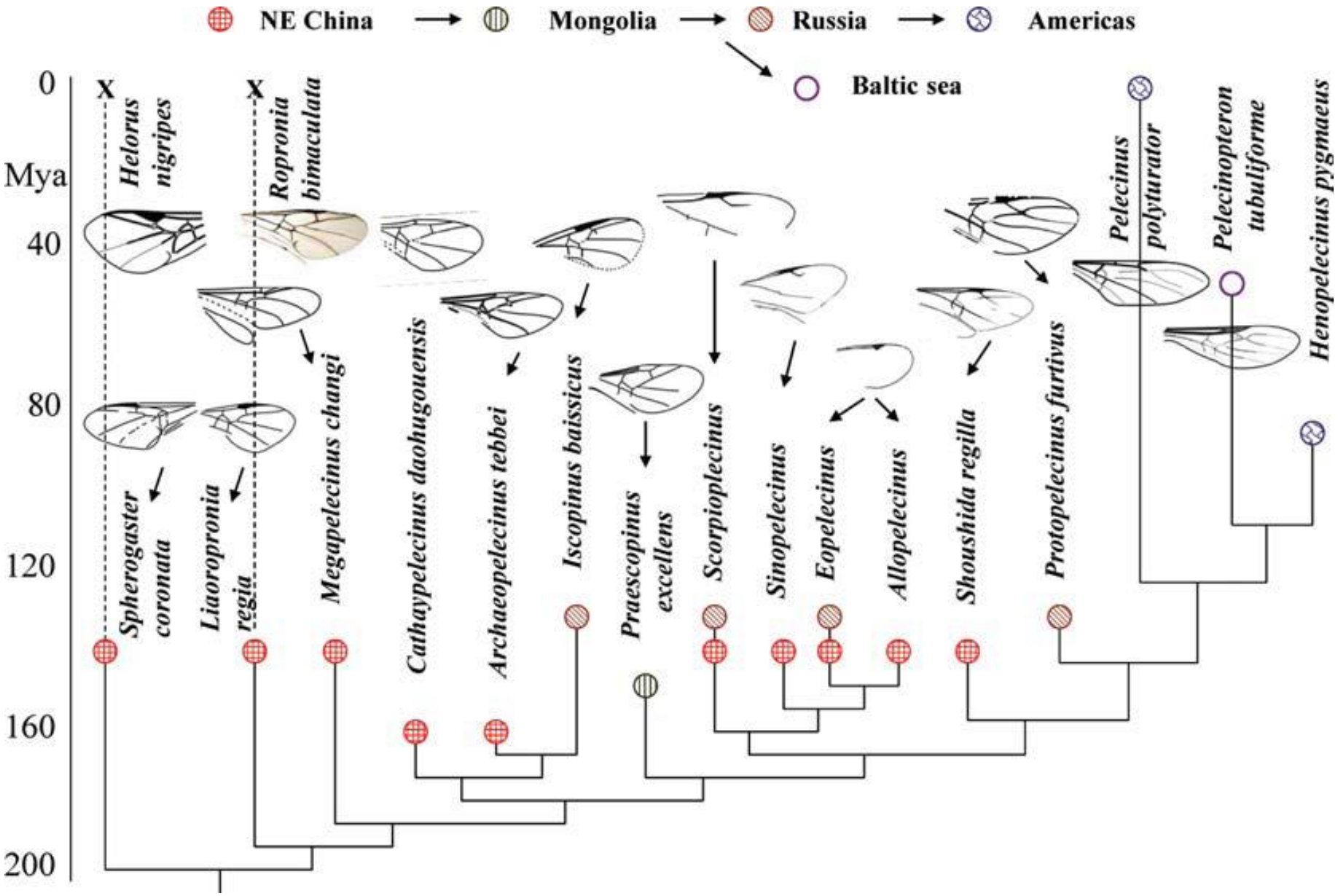


Megapelecinus nashi **Shih et al. 2010**

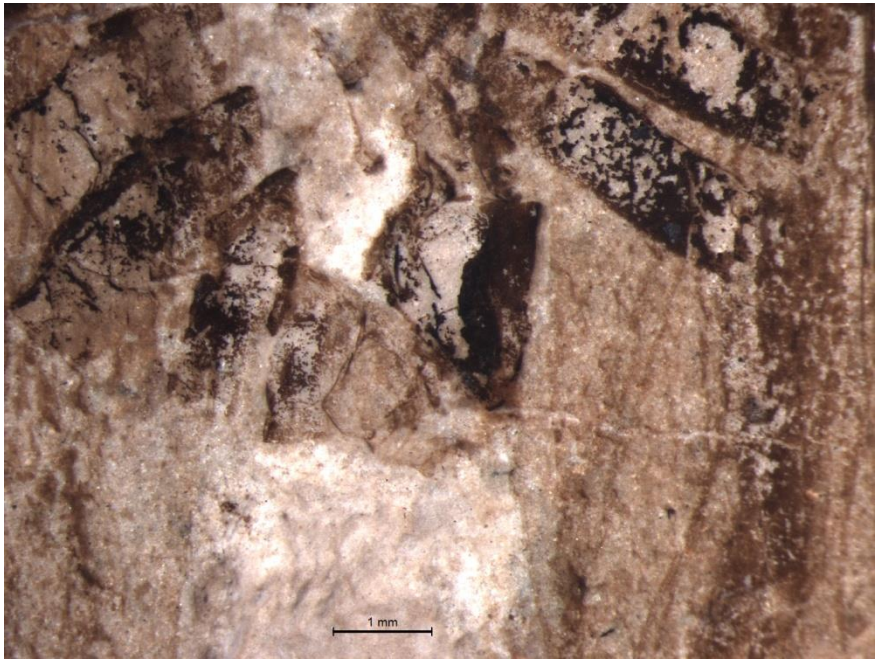
Megapelecinus changi **Shih et al. 2010, An. of Ento. Soc. of Am.**

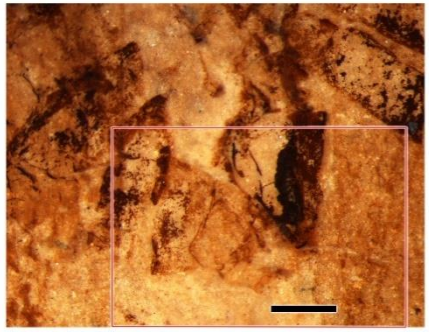
Pelecinidae and two outgroups with their respective characteristic forewings in geological context

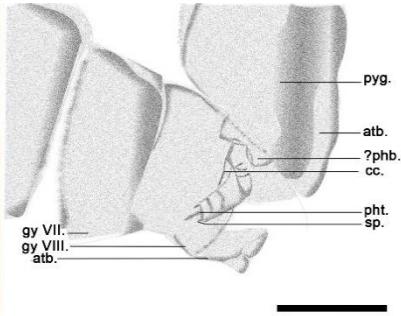


Reproduction

Forever Love: The Hitherto Earliest Record of Copulating Insects







Anthoscytina perpetua **Li, Shih et Ren, 2013. PLoS ONE**

Artwork by Chen Wang

Photo by Jason Shih

Reported by the New York Times on page A-12, 11/7/2013, and by numerous on-line media.

The Earliest Case of Extreme Sexual Display with Exaggerated Male Organs

Artwork by Chen Wang

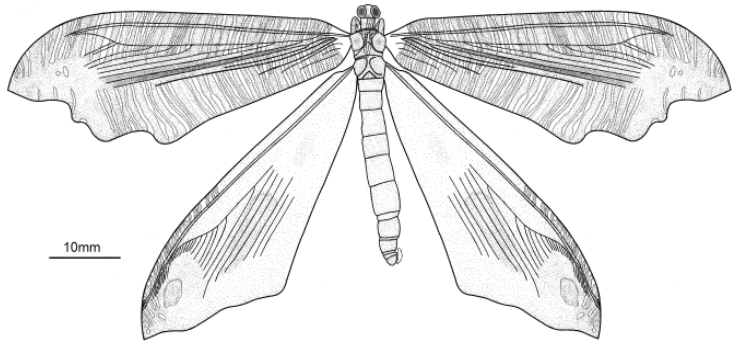
***Fortiholcorpa paradoxa* Wang, Shih et Ren 2013. PLoS ONE**


Mimesis

Neuroptera - ancient pinnate leaf mimesis among lacewings

Pre angiosperm origin for leaf mimesis

Bellinympha filicifolia **Wang, Ren, Liu et Engel, 2010. PNAS**



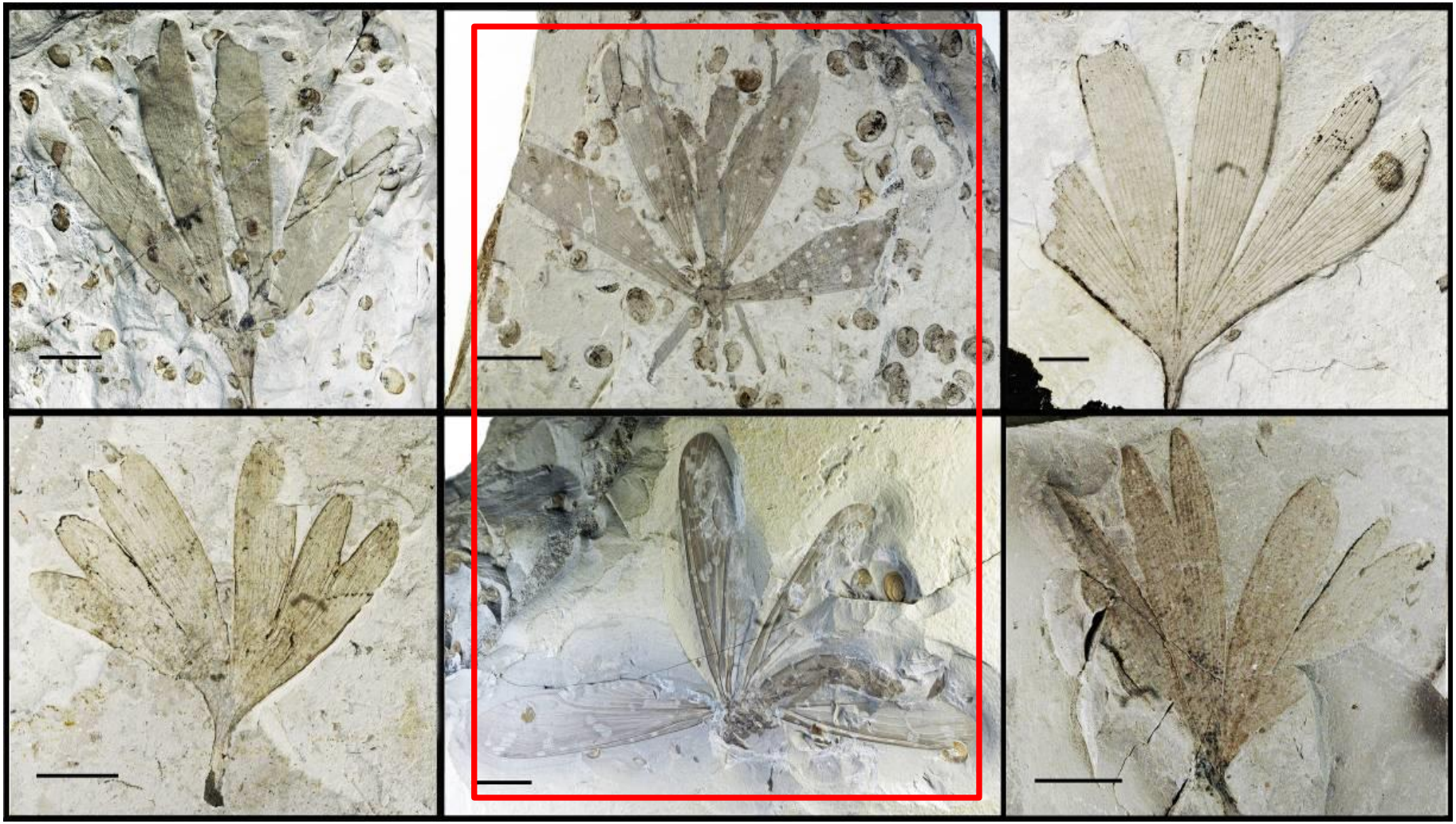
***Bellinympha dancei* Wang, Ren, Shih et Engel 2010. PNAS**

Artwork by Zhihua Ma

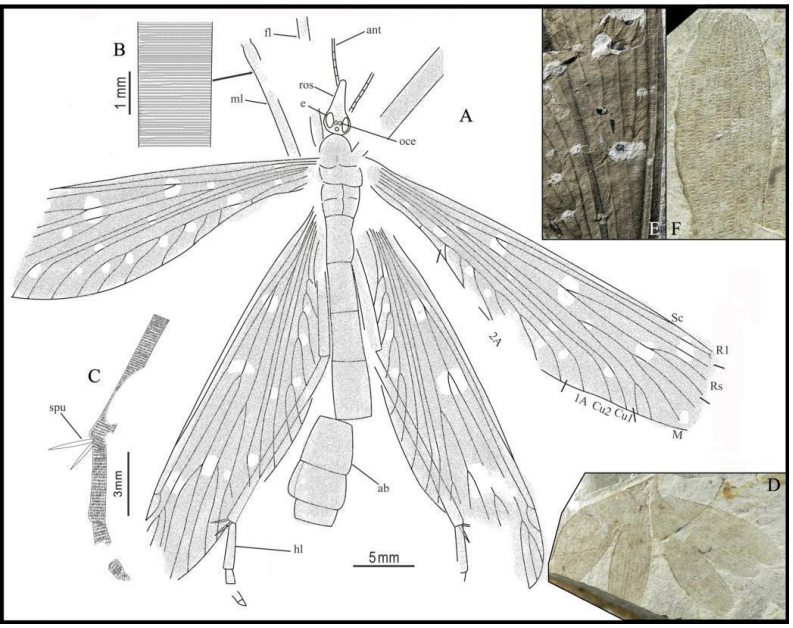
Venation of *Bellinympha filicifolia* imitated leaves of gymnosperms

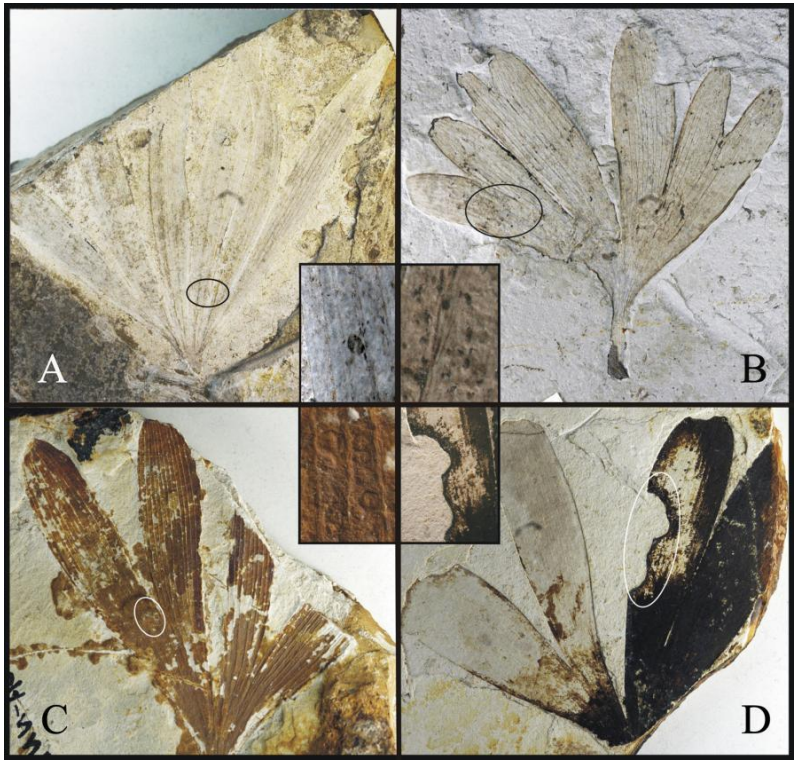
(Wang et al. 2010. PNAS)

Jurassic mimicry between a hangingfly and a ginkgo leaf from China

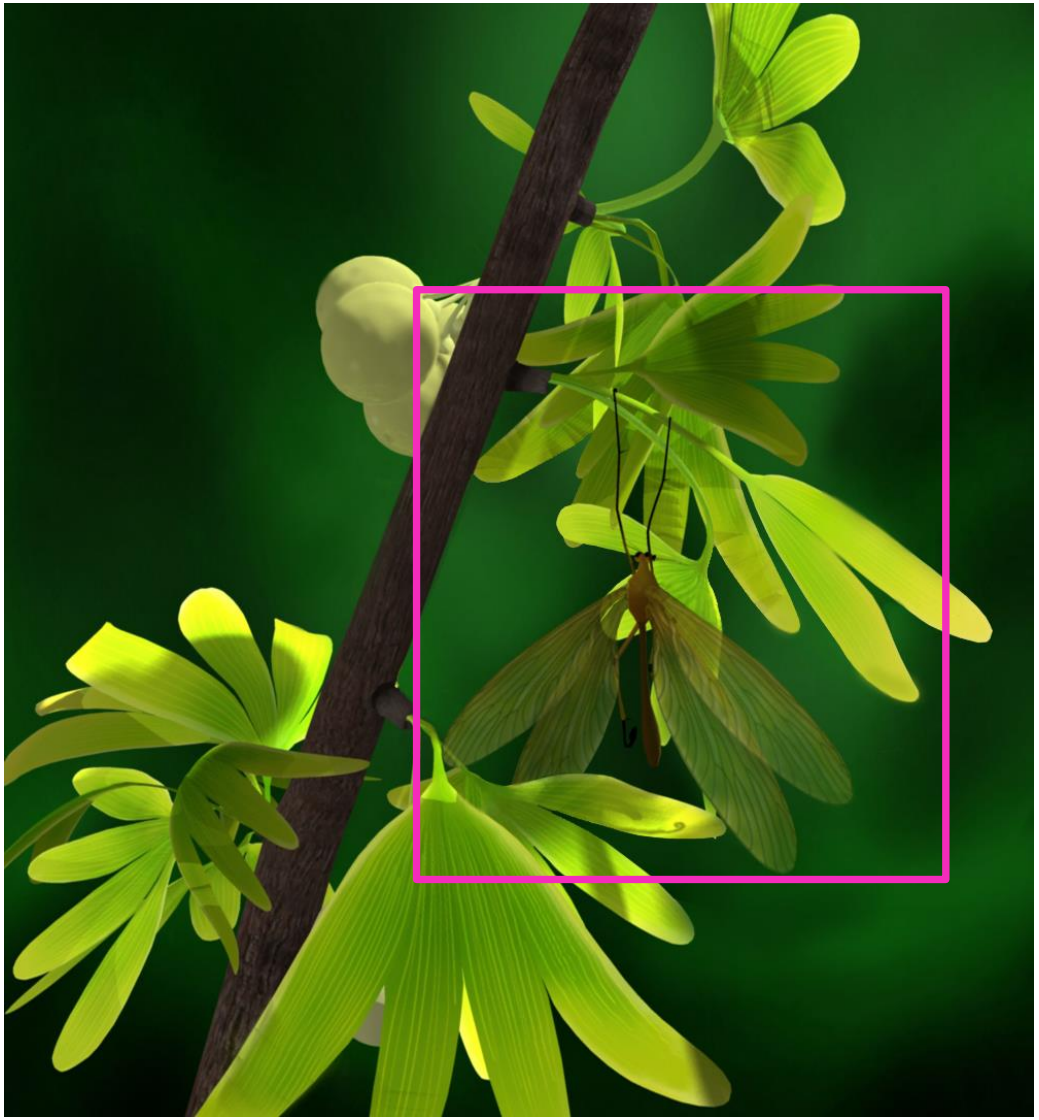


Juracimbrophlebia ginkgofolia **Wang, Labandeira, Shih and Ren, 2012. PNAS**





Named as one of the top 10 new species in 2012 by International Institute for Species Exploration (IISE)



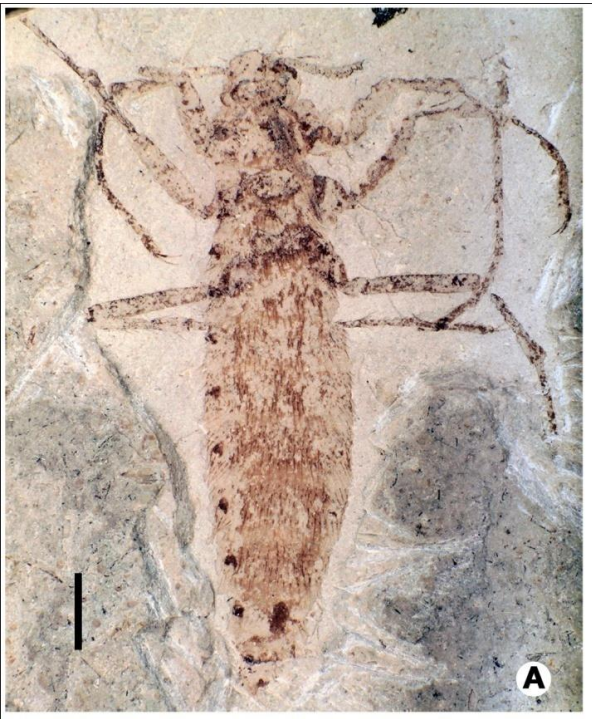
Artwork by Chen Wang

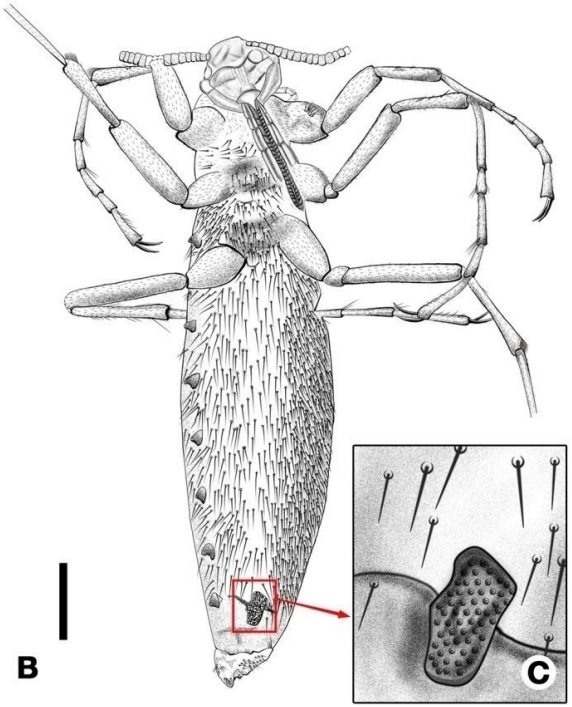
Insect Associations with Vertebrates

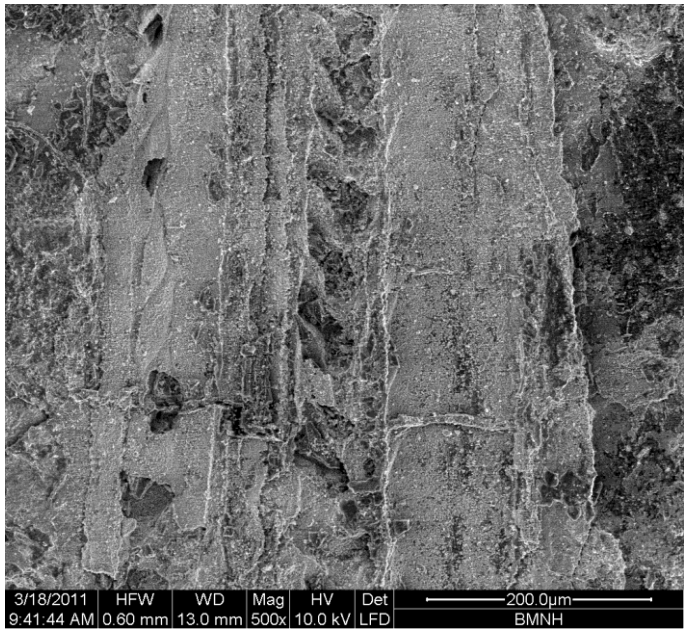
Blood-Sucking Insects – the earliest fleas

- Long serrated stylets for piercing tough and thick skin or hides of hosts
- Primitive ectoparasites: lived on and sucked the blood of relatively large hosts, eg. feathered dinosaurs, pterosaurs, and medium-sized mammals

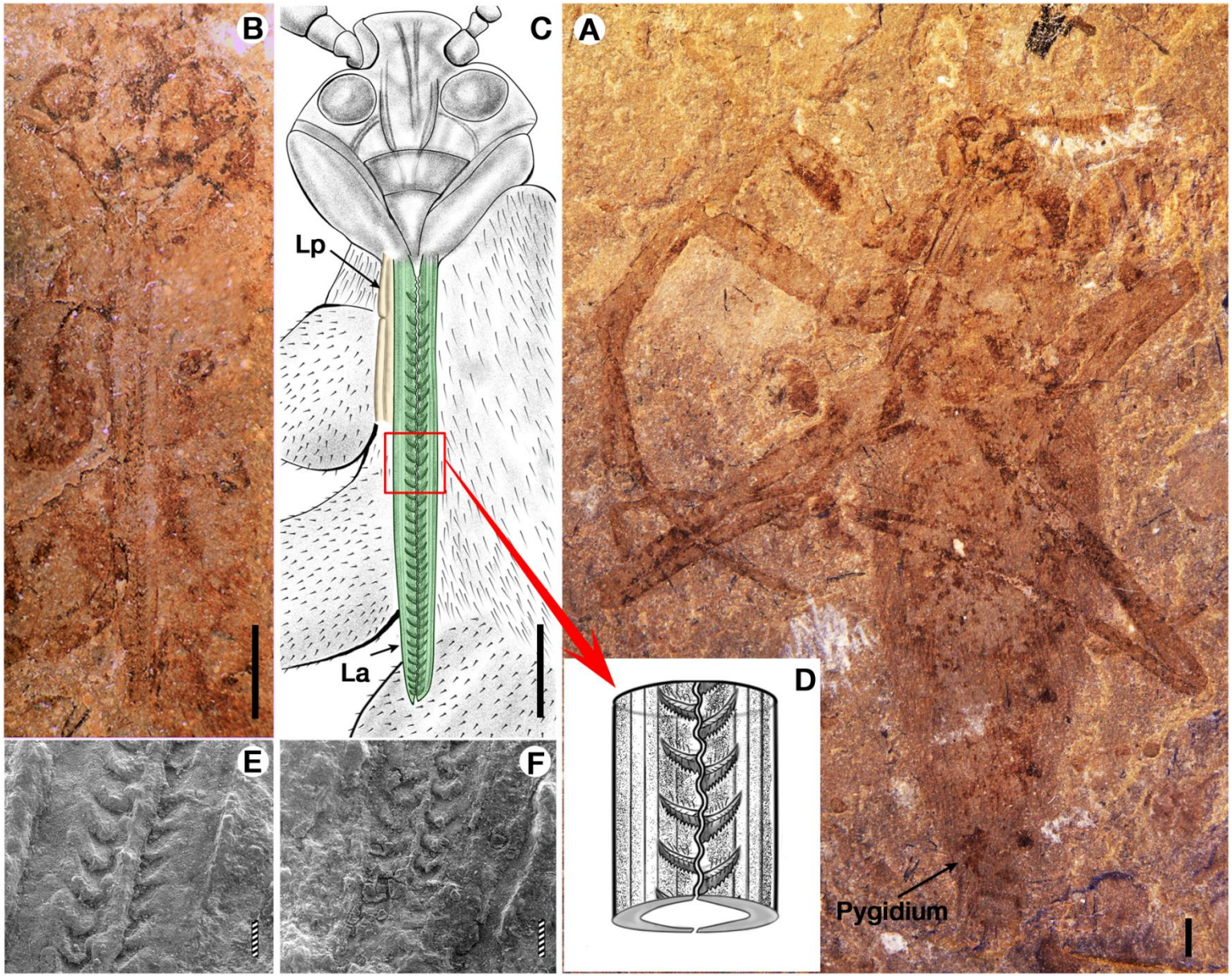
Pseudopulex jurassicus **Gao, Shih et Ren 2012.**





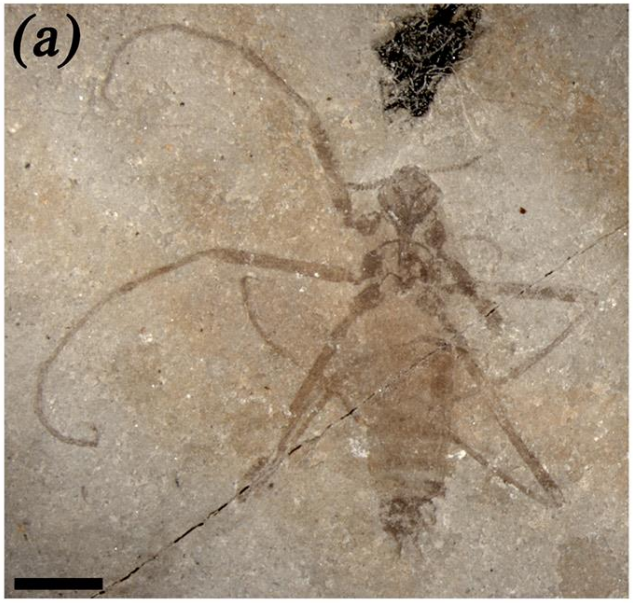


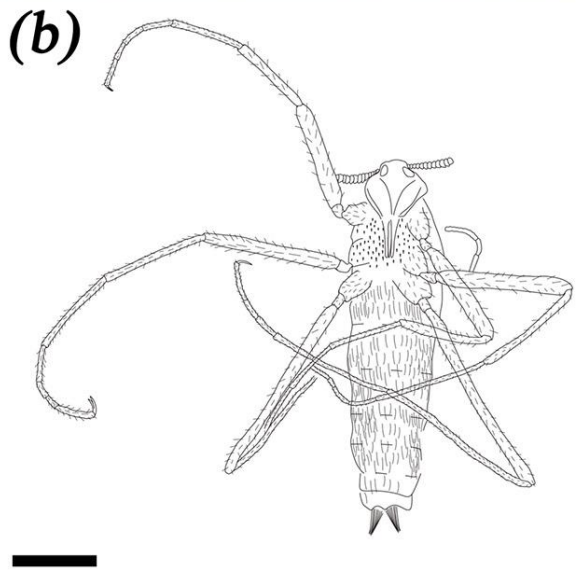
Blood-Sucking Insects: Basal Fleas

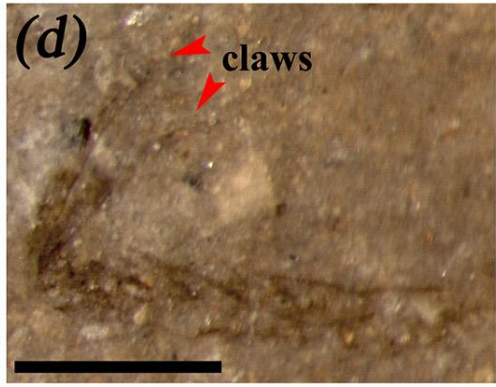


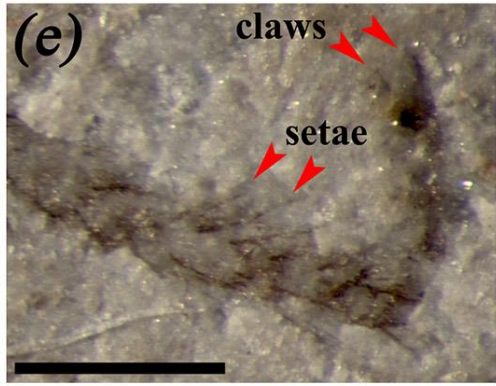
Pseudopulex magnus **Gao, Shih et Ren 2012. Current Biology**

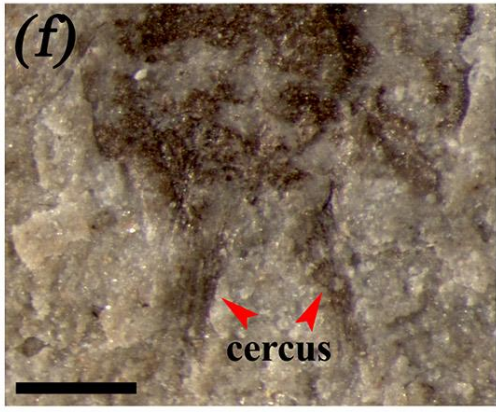
Transitional Fleas





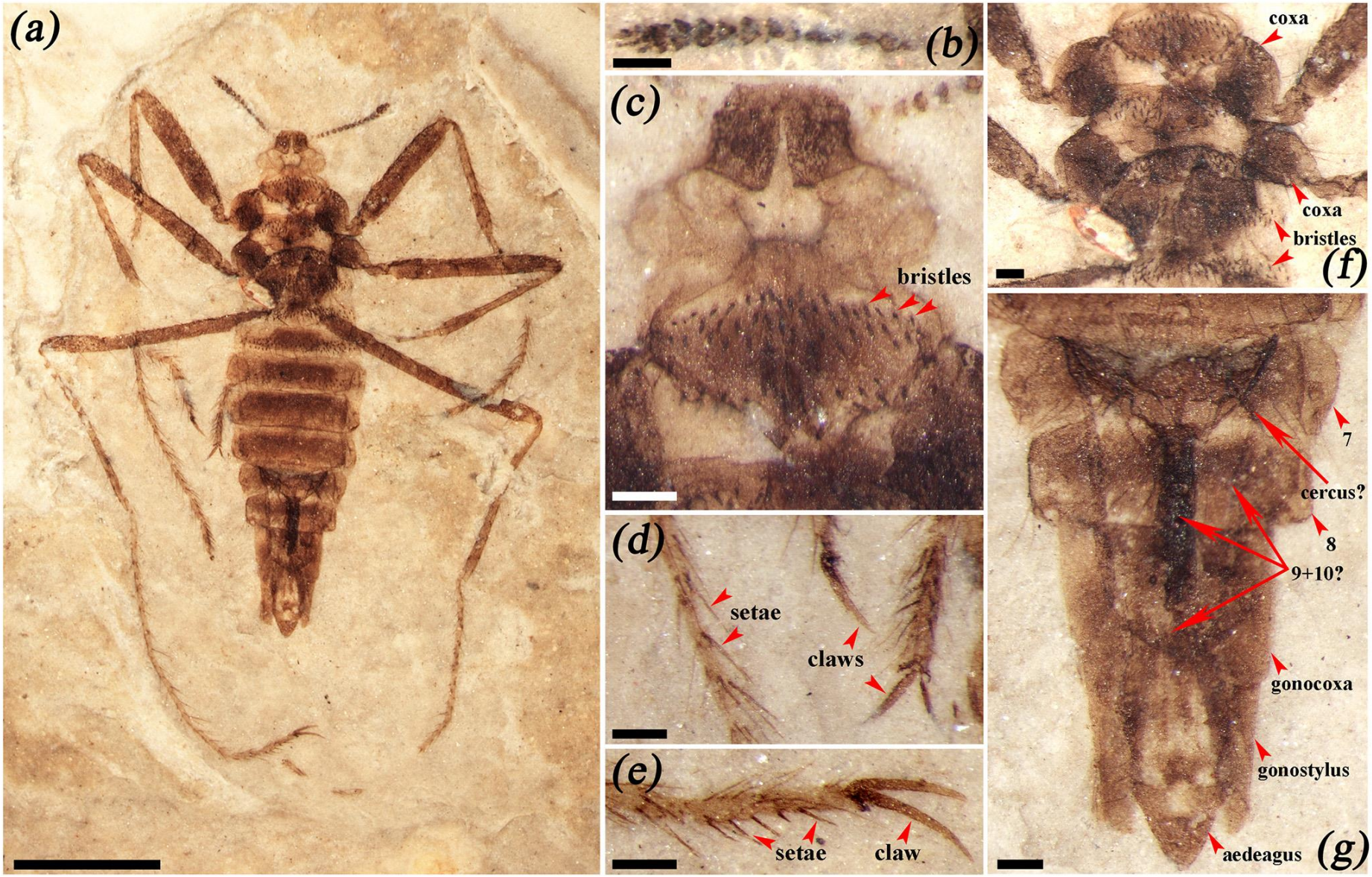






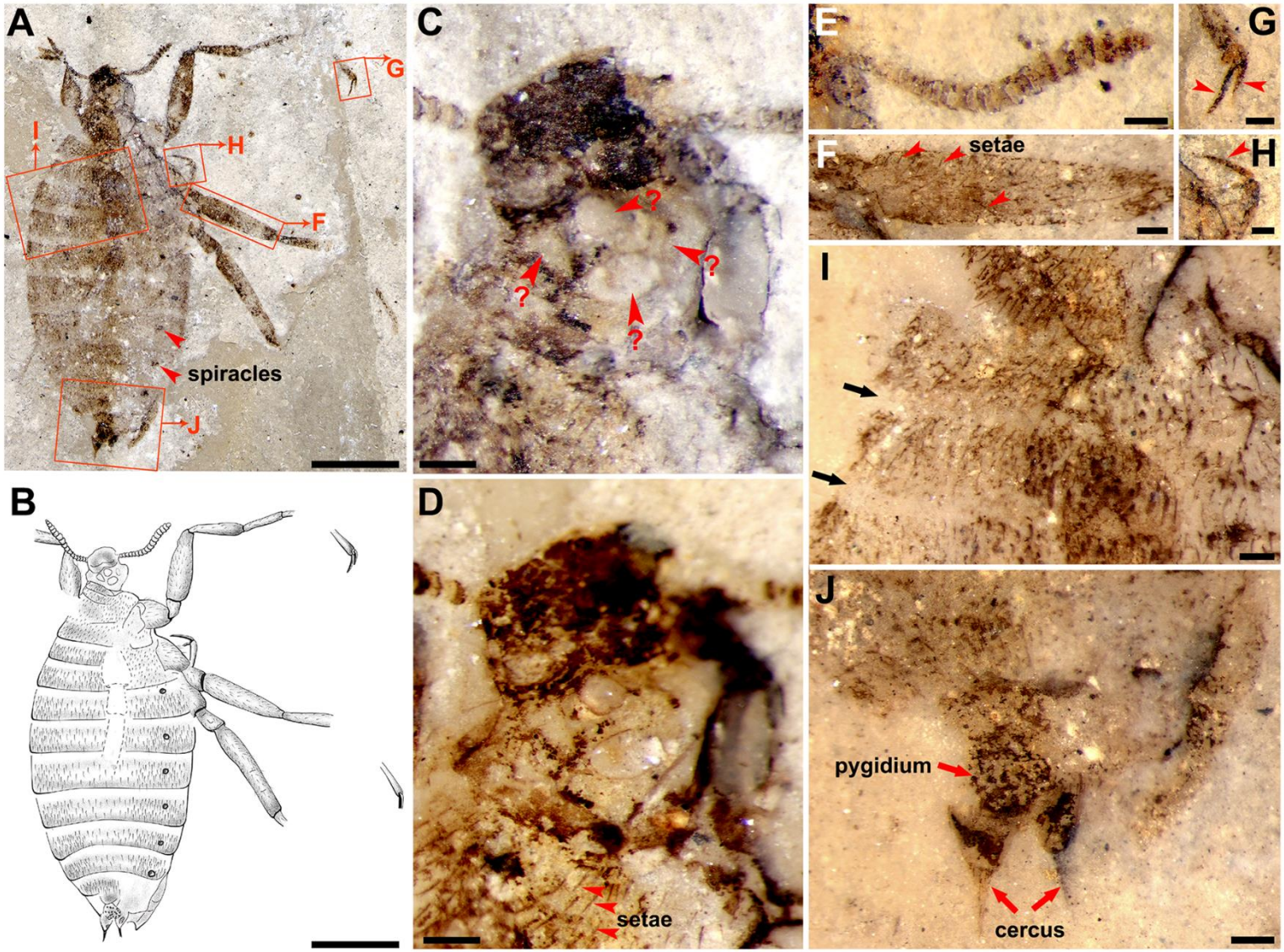
Saurophthirus exquisitus **(female) Gao, Shih, Rasnitsyn, et Ren 2013. Current Biology**

Transitional Fleas

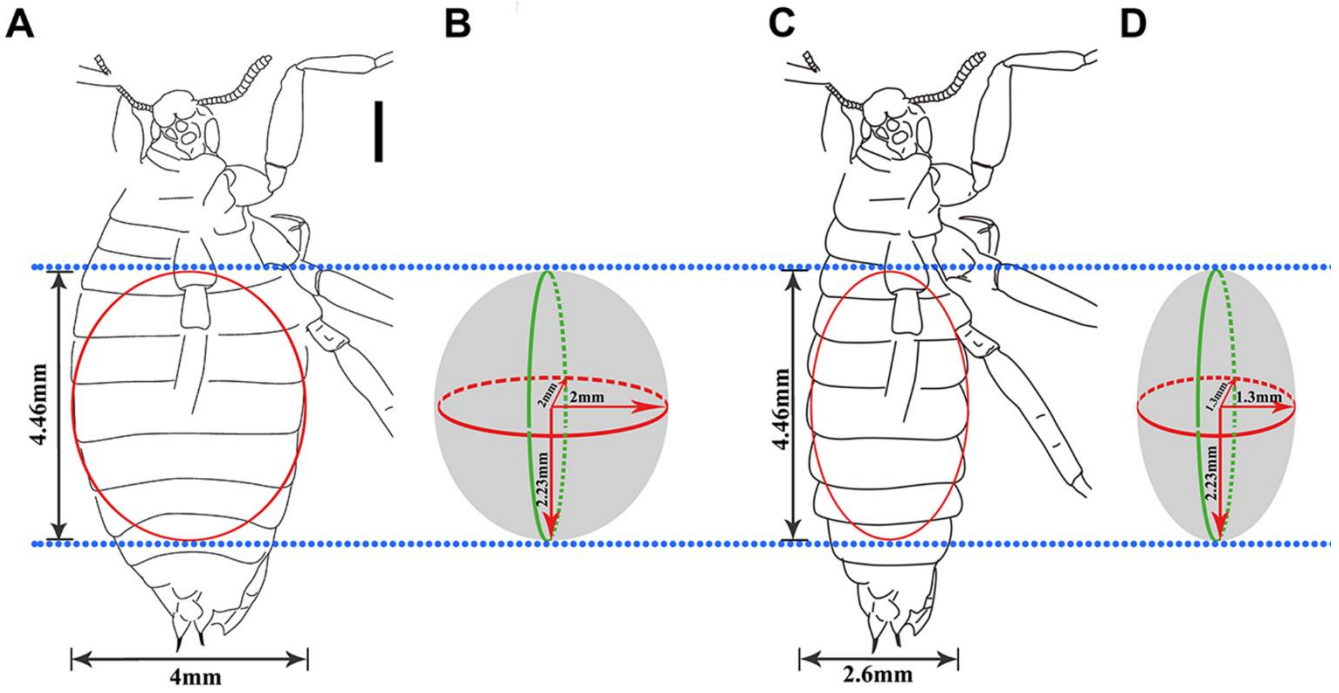


Saurophthirus exquisitus (male) Gao, Shih, Rasnitsyn, et Ren 2013. Current Biology

A Transitional Flea with Fully Distended Abdomen

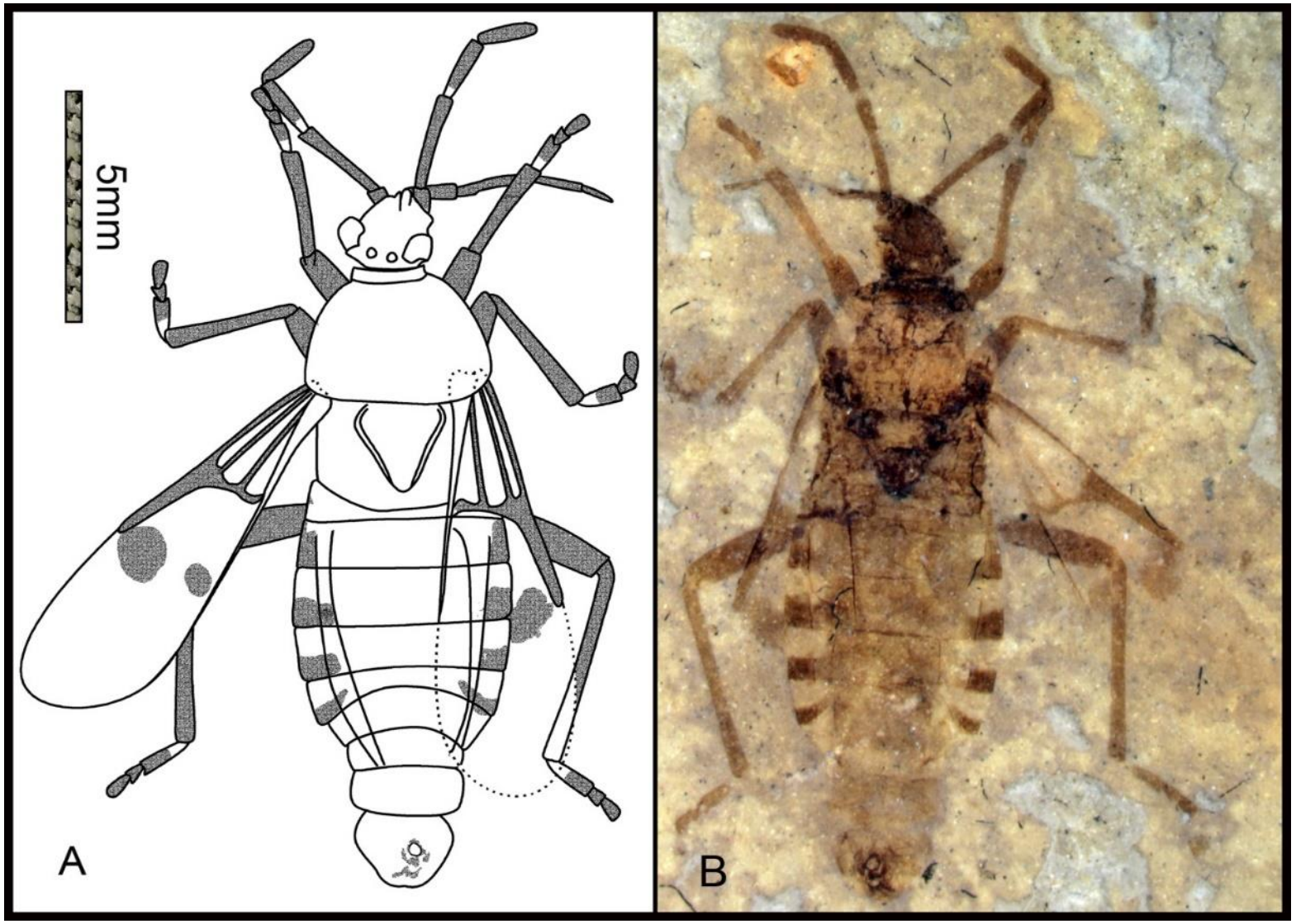


Pseudopulex tanlan (female) Gao, Shih, Rasnitsyn, et Ren 2014. BMC – Evo. Biology

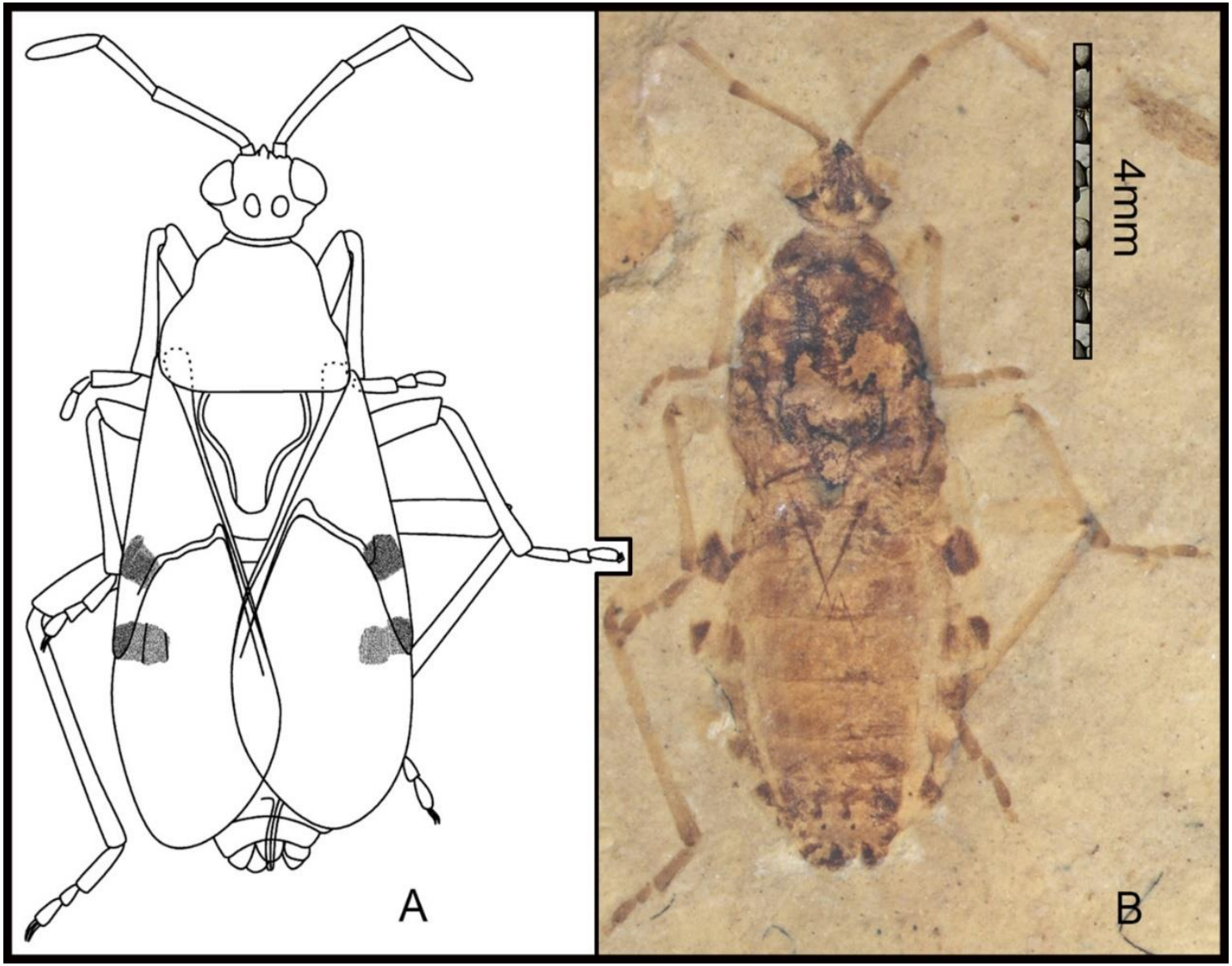


P. tanlan **might have consumed 0.02 milliliter (ml) of blood, which is about 15 times of the intake volume by extant fleas.**

The Earliest Record of Blood-feeding True Bugs from the Early Cretaceous of China



Torirostratus pilosus **(male) Yao, Shih, et Engel, 2014. Current Biology**



Flexicorpus acutirostratus **(female) Yao, Cai, et Engel, 2014. Current Biology**

Ecological reconstruction of blood-feeding torirostratid true bugs feeding on blood from a sleeping feathered dinosaur. (Artwork by Ms. Chen WANG).

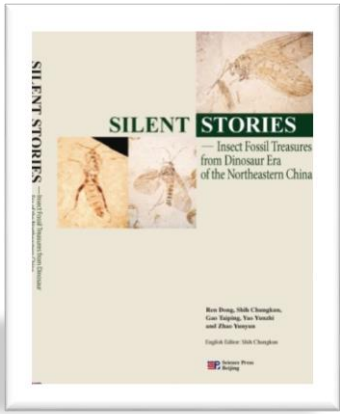
Summary

1. The Mesozoic Era was biotically richer and more complex than previous realized.
2. Insects in both Yanliao and Jehol Biota were diverse systematically, biologically and ecologically.
3. In the ecosystems, insects played important roles in maintaining food chains and circulation of substances and energy by close interactions with plants and vertebrates.
4. Our research provide a rare glimpse of lost worlds of interactions among insects and plants and vertebrates, some of which were now extinct or less diverse.

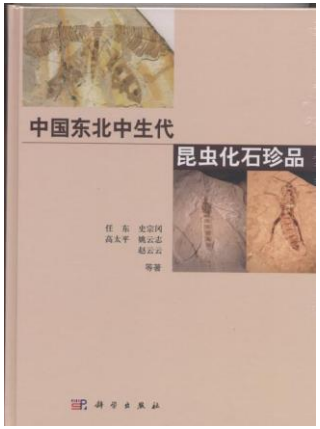
Papers

More than 200 SCI papers including 7 respectively in **Science** (2009), **PNAS** (2010, 2012a, 2012b) and **Current Biology** (2012, 2013, 2014).

Books



2010



2012

Future Action Plans

- To continue building on our strengths & upgrading our research capabilities
- To enhance cooperation with collaborators in China and internationally
- To apply high-tech instruments and better methodologies
- To publish high-quality papers and books on our research
- To arrange for exhibitions in CNU or in museums outside China

Thank you for your attention!

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