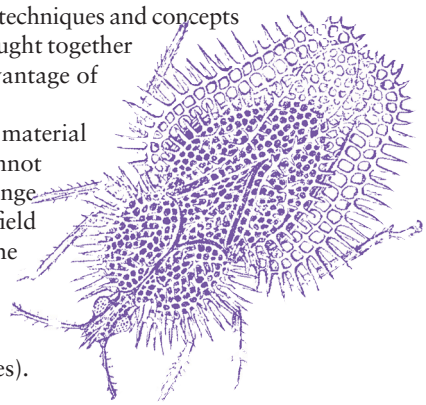
Instant Symposium

Mechanical Properties of Arthropod Structures: Engineering the Future

Michael Breed and Catherine Loudon, Organizers

How do insects hang from the ceiling? What makes insect teeth hard? How does air circulate in a termite mound? Questions like these are best answered using techniques and concepts adopted from engineering fields. In this symposium, we brought together a group of biologists who, in their studies of insects, have taken advantage of contemporary engineering techniques.



The mechanical properties of a structure arise from a blend of the material used in construction and the design of the structure; good design cannot overcome bad materials, and vice versa. The papers collected here range from studies of material, relatively independent of structure (Schofield on the hardness of cuticular structures, Breed and Buchwald on the properties of beeswax), through the mechanical properties of structures (Loudon on antennae, Combes on wings), to the behavior of elaborate structures in their functional or ecological context (Gorb on adhesion to surfaces, Turner on ventilation in termite colonies).

A brief lexicon will help the reader with these papers.

Yield stress is the amount of force per unit area a material or structure can absorb before permanent deformation. When you apply a stress to a material, the energy is absorbed (and strain accumulates) until finally the material gives (yield stress, or strength).

Stiffness expresses the relationship between the amount of force applied to a structure and the magnitude of the resulting deformation—a stiff structure bends little, a less stiff structure will bend greatly under the same force.

Hardness is how well a material resists indentation. The contrast between a hard mineral, diamond, and a soft mineral, talc, gives a good mental image of how hardness might be measured.

These simple definitions belie the technical difficulties of measuring these properties in biological materials; the papers collected here represent a technical tour de force in modern biomechanics.