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BOOK REVIEW

GORB S.: ATTACHMENT DEVICES OF INSECT CUTICLE. Kluwer Academic Publishers, Dordrecht, 2001, 305 pp. ISBN 0-7923-7153-4. Price USD 179.00.

The ability of some animals to attach to and move on various substrates, including smooth and slippery ones (best known groups in this respect are insects and some reptiles), has been well known for a long time. But this is the only part of a broader phenomenon covering various attachment structures and their specific function. Most of them are present in insects and this book deals with this in complex detail. The last two decades, especially, saw the discovery of numerous insect attachment structures and their function – and Stanislav Gorb was one of the most active authors in this field. So, this recently published "big review" in book form is a logical step.

Contact and movement of animals across surfaces is closely connected with two basic phenomena: friction and adhesion. The first chapter of this book deals with these and other related phenomena like the contact between solids, surface textures, liquid films and viscosity, glue, surface irregularities etc. Also the nature of the contact between insects and surfaces are concisely explained. So, it is a very good introductory chapter to further detailed study. Chapters two and three deal with the structure and composition of insect cuticle (including its mechanical properties) and its protuberances. Why? Because cuticle and its microstructures are the interface between an insect's exoskeleton and the surrounding environment. So, cuticle is directly involved in the contact between an insect and the world around it. Gorb describes the basic structure of insect cuticle, synthesizing published data. He also introduces four published models of the spatial orientation of cuticular fibres: "helicoid", "screw-carpet", "perpendicular" and "integrative two systems". It is difficult to classify the many variations in the structure of insect cuticular protuberances. Gorb achieves this and adds data on their functions. Chapter four explains the principles of insect (and arthropod in general) cuticular attachment. So called "attachment devices" are very variable among arthropods. Their function, adaptations, evolution and environmental influences affect that variation. Their function, especially, is very different and includes hooking to the substrate, adhering to other animals (phoresy, parasitism, predation), interlocking of wings and other body parts, role during copulation etc. The author concludes the description of the functions with basic examples. Chapters five to twelve deal with the structure, function and consequences of various attachment systems. The role of cuticular microstructures in the biology of insects, especially how they attach to surfaces, is so important, that the author refers to insects as "animals of the surface". Firstly, Gorb gives an overview of frictional systems in insects including body and particular external organs like the micropapillae, acanthae, and microtrichia on the cuticle, large head-arresting systems, appendages, wing-locking microstructures and leg attachment pads. Description of these various morphological systems are followed by data on their function (for example, that on the leg attachment pads is very complex). Secretion plays an important role in frictional systems, so the ultrastructural data is supplemented with data on the composition and properties of the secretion. Further, protuberances and sensilla (and their fields) are described in more detail covering scale effects on macro- and microsculpture, directionality of such structures, relation to sexual dimorphism etc. The author establishes some general rules concerning, for example, the distribution of arrester sensilla. Chapter thirteen deals with the evolution of frictional systems, an important and innovative part of the problem. Gorb summarizes the evolution of various structures against the background of insect and hexapod phylogeny. I recommend this part to evolutionary entomologists – I am sure it will provide new data for their ideas. Ecological implications, like the role of plant surface in preventing insect attachment, role of trichomes in insect-plant interactions and other aspects are the basis of chapter fourteen. The book concludes with chapter fifteen, which is "slightly futuristic" and deals with the possible use of the knowledge on insect attachment devices in pest control. In addition, possible specific innovations in frictional systems like the widely spread velcro, which was inspired by plant hooking systems, surface microstructuring, composite materials, glues and others are mentioned here.

Stanislav Gorb is an excellent morphologist who has used electron microscopy to resolve zoological problems. He knows that biological structures are directly connected with their function and applies this rule throughout his book. The result is a concise book which is well written and based on the personal experiences of the author. Simplicity is a big advantage as there are too many examples of attachment structures, not only in insects, but in arthropods and in other groups of animals. So, it was necessary to select good examples and Gorb has done this very well. As a summary of the data on attachment structures, their function and other consequences in insects this book is the best in the field. It is of interest not only for biologists (including molecular biologists), zoologists, entomologists and ecologists, but also for specialists from material science and engineers. Development of such structures by "mother nature" and sophisticated analysis of their function is very inspirational for the development of human technology. Systems and devices constructed by man on the basis of such knowledge may be utilized by astronauts and in the development of new materials and technologies etc. I recommend this book to all students and scientists involved in the above mentioned fields, as it is clearly relevant to all modern biologists.

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