

WORLD IN THE EYE OF SCIENCE

V. V. GLUPOV

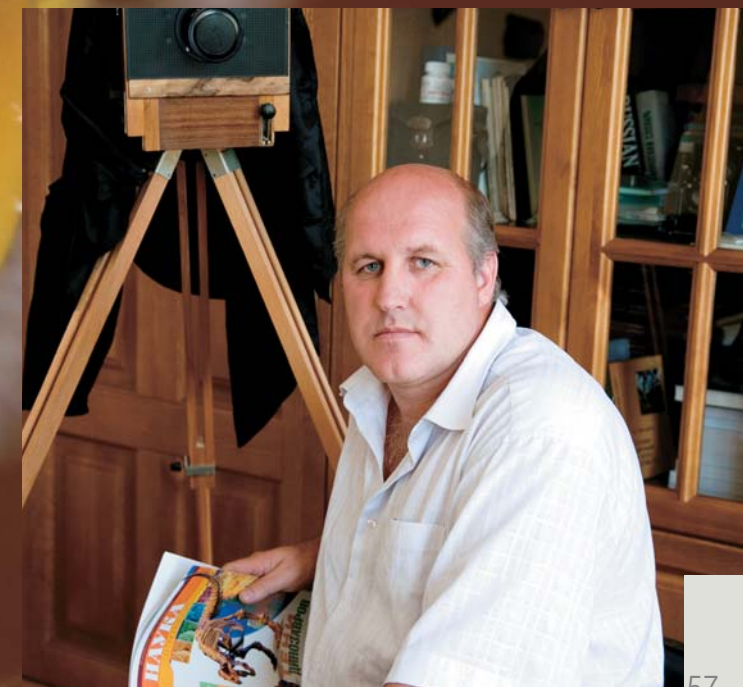
From an Insect's Point of View

It is believed that humans acquire up to 90% of knowledge about the external world through their stereoscopic vision. Unlike humans, hares have peripheral vision, which allows them to see objects located sideways and even behind them! The eyes of deep-sea fish can be nearly as large as half their head, and the lamprey's parietal "third eye" allows it to navigate aptly in the water. Snakes can only see a moving object, and the peregrine falcon is recognized to have the world's keenest eyesight, capable of tracking prey from a height of 8 km! But how do representatives of the most numerous and diverse class of living organisms on the Earth – insects – see the world? Surprisingly, but along with vertebrates, to whom insects are inferior only in body size, it is insects that have the most advanced vision and sophisticated eyes. More about this in a story that Viktor V. GLUPOV – a scientist, traveler and photographer, remarkable in his art of macrophotography – tells us through his images

In insects, the most advanced eyes are those of active daytime species, such as flies and dragonflies. The photo shows a four-spotted chaser (*Libellula quadrimaculata*) with its huge compound eyes. Photo by V. Glupov

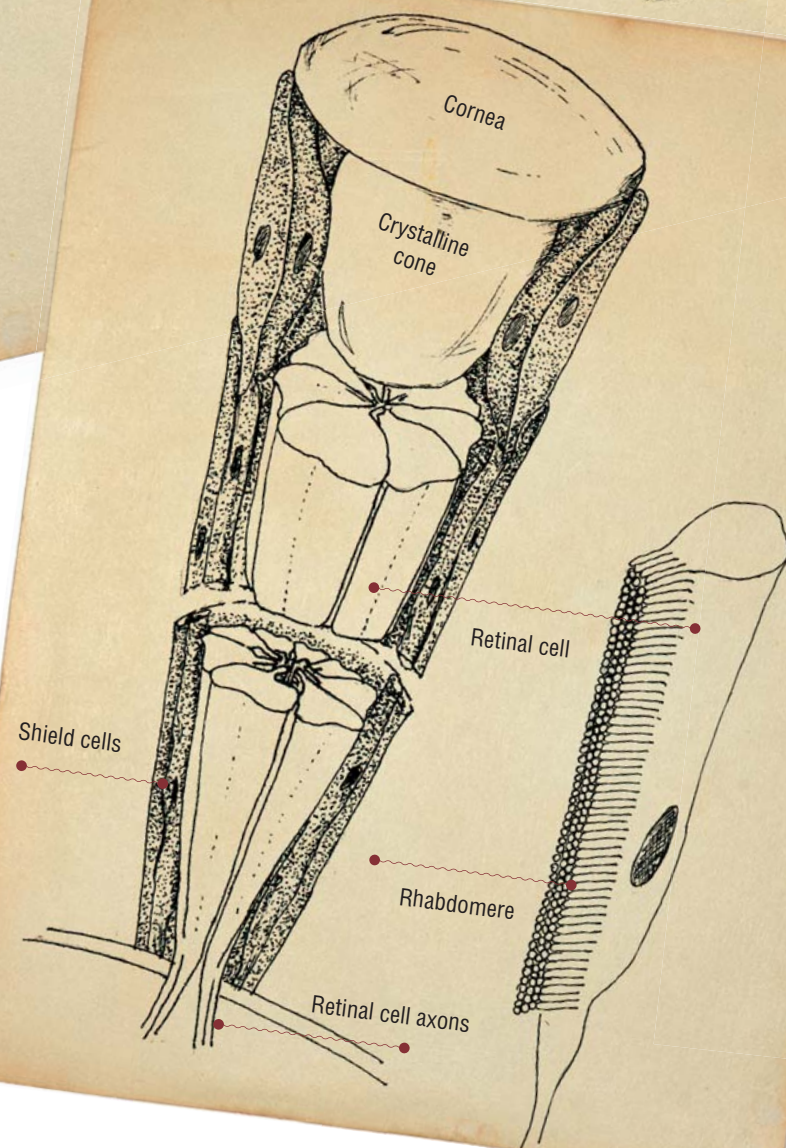
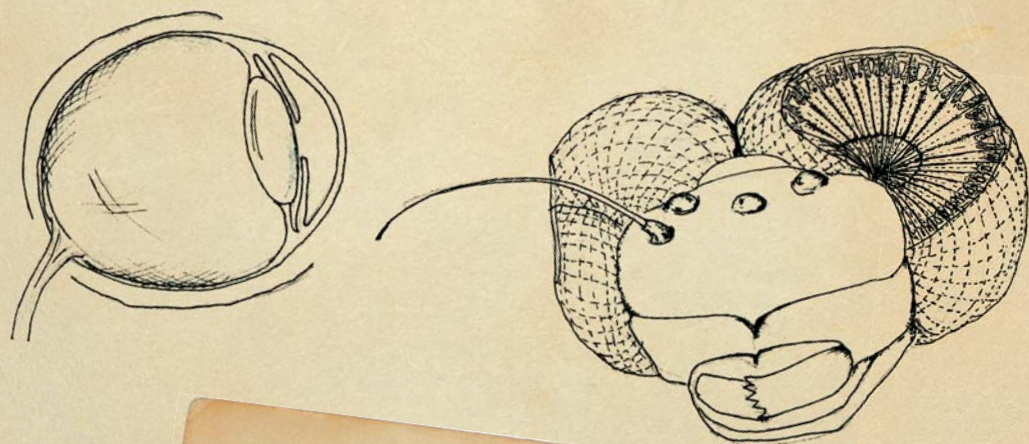
Above is a section of the compound eye of a sylph fly from the genus *Cheilosia*. Scanning electron microscopy. Photo by R. Dudko, Institute of Systematics and Ecology of Animals SB RAS, Novosibirsk

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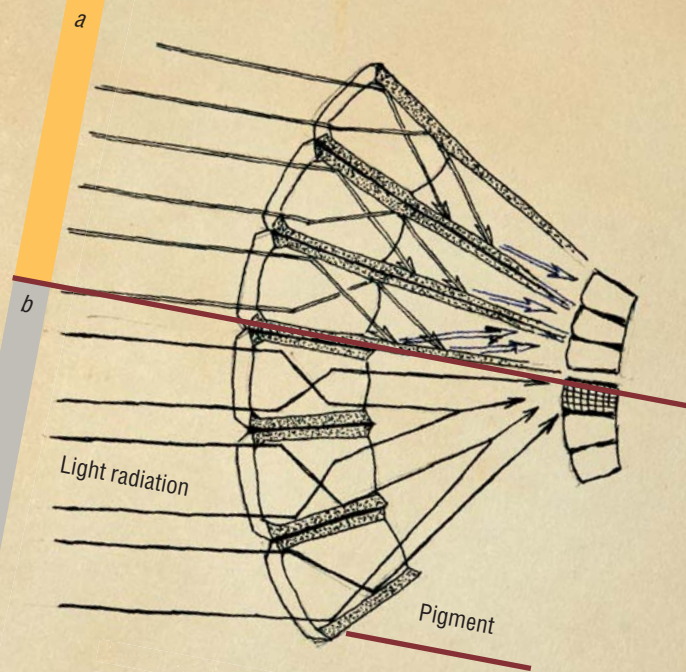
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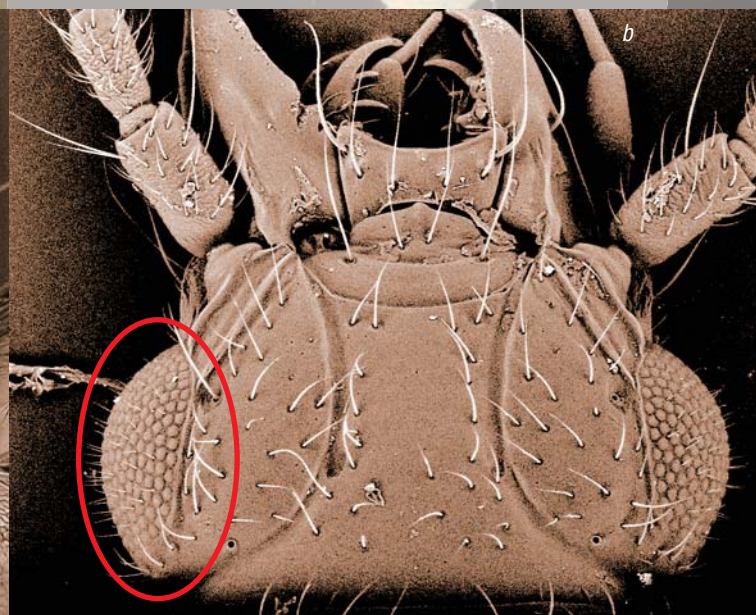
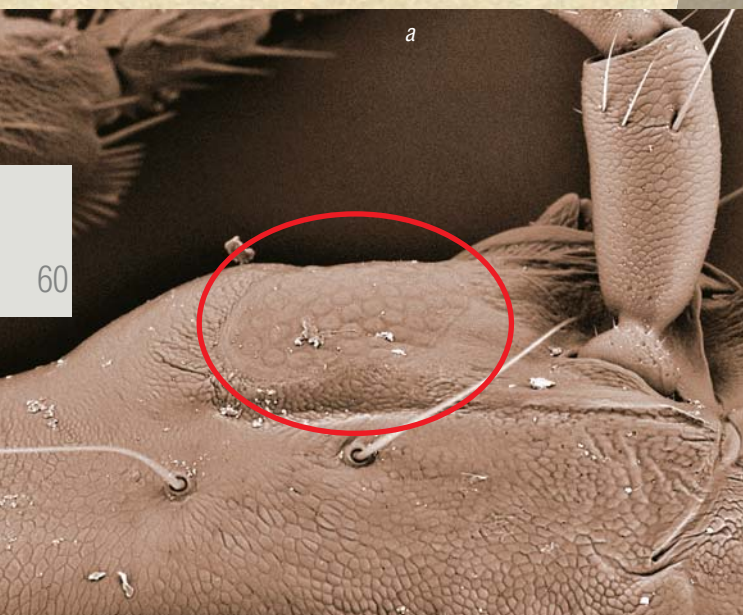
The compound eye of an insect consists of individual units, i. e., hexagonal facets, or ommatidia. Each ommatidium is a multicellular formation that includes dioptric structures (cornea and crystalline cone); photoreceptors (retinal cells with the photosensitive pigment rhodopsin); and shield cells with light-absorbing pigments. Rhodopsin is contained in the membrane of the numerous microscopic tubes called villi, which make up the rhabdomere.
Drawing by N. Kryukova, Institute of Systematics and Ecology of Animals SB RAS, Novosibirsk

Compound eye of the wax moth (*Galleria mellonella*)

The eyes of insects leading a crepuscular or nocturnal lifestyle are distinguished by special scotopic ommatidia. The pigments of their shield cells are able to migrate: (a) they spread evenly under sufficient light or (b) accumulate in the upper part of the cells under insufficient light. As a result, in the dark, light radiation from one ommatidium can reach the receptor cells of neighboring ommatidia. Drawing by N. Kryukova



The eyes of many insects living in low-light environments become largely simpler. For example, the eyes of the ground beetle of the species *Amerizus teles* (a), which lives under stones, consist of several dozen facets located almost in one plane. The ground beetle of the species *Perileptus japonicus* (b), which leads a completely different way of life, has convex compound eyes with a large number of facets. Scanning electron microscopy. Photo by R. Dudko



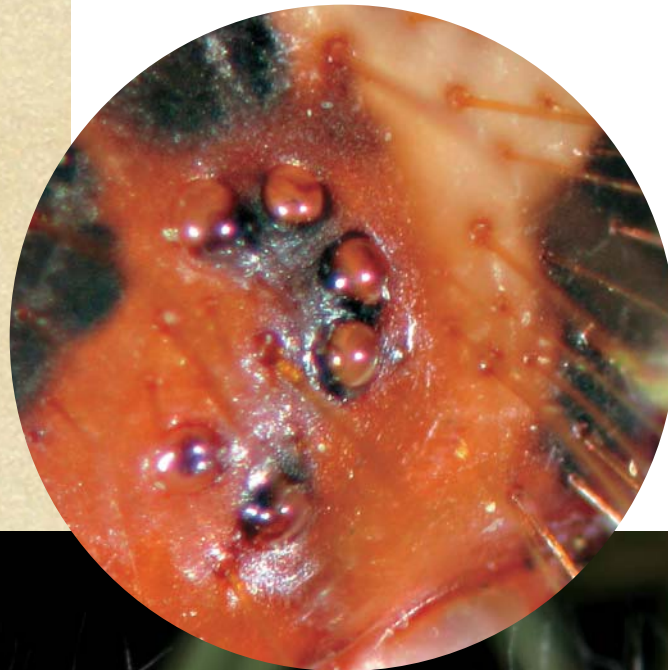
This fly of the genus *Helophilus* has, in addition to its large compound eyes, three simple accessory ones (ocelli)



Along with the sophisticated compound eyes, insects may also have simple ones, which are, in fact, analogues of single facets. *The photo* shows a bug of the genus *Carpocoris* with two accessory eyes, or ocelli

In insects, in contrast to vertebrates, the molecule of the light-sensitive pigment rhodopsin does not disintegrate when hit by a photon, but turns into metarhodopsin. This activates the entire complex chain of phototransduction, i.e., the process of converting a light signal into electrical impulses in photoreceptor neurons, which underlies the formation of visual images. Eventually, metarhodopsin restores to rhodopsin under the influence of the photon; i.e., absorbing two photons is necessary to complete a full transduction cycle

Larva of a lappet moth of the genus *Malacosoma* with stemmata, a class of simple eyes



All facets in the compound eyes of *Lepidoptera* can usually perceive both normal and polarized light. The photo shows a brush-footed butterfly of the genus *Melitaea*

Bees are almost as capable of distinguishing the polarization of light as its wavelength (color) and brightness. The photo shows a honey bee (*Apis mellifera*) on a lupine. On the bee's hind legs, one can see a pollen pellet, i. e., a lump of flower pollen collected by the insect





The name of this insect species – red-eyed damselfly (*Erythromma najas*) – speaks for itself

This is what your pet might look like if vertebrates had chosen to develop compound eyes.
Photo collage by the author

This publication uses photos made by the author

