

# Cover illustration

## All the better to see you with . . .

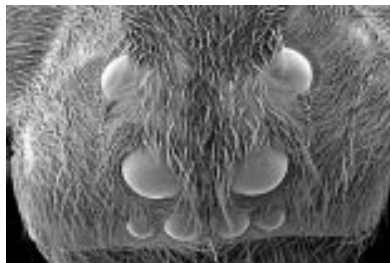
**D**istributed worldwide, the wolf spiders (lycosids) are descendants of the first terrestrial predators from the Devonian period, approximately 410–360 million years ago. These peripatetic hunters are one of only a few families of spiders that generally do not spin webs, although some in the family do use silk to line their burrows or to wrap their eggs.

Without the stationary death traps of their kin, these species must rely upon mechanical and visual senses for all matters of their behaviour from courtship to prey capture to predator avoidance. Since these behaviour traits are closely related, the species have probably been successful for 400 million years and their senses have been honed to razor sharpness, but are not exclusively visually based.

The cover photograph illustrates a scanning electron micrograph of the eyes of a common lycosid spider (*Hogna* spp) with four pair of eyes. In the lycosid family, the anterior row, found near the bottom of the electron micrograph, include two pairs that can be described as anteromedian or AM (principal eyes that point forward) and anterolateral, or AL, that point frontally and laterally. The larger single pair positioned just above the anterior row are called the postero-medial, or PM, and the pair seen highest on the photograph are the posterolateral, or PL, eyes. Each pair probably has different functions.

The AM pair of eyes has been shown to provide orientation and homing by the interpretation of the linear polarisation of light (Ortega-Escobar J, *J Arachnol* 1999;27:663–71). The AM eyes are the principal eyes and are devoid of a tapetum—the layer that causes eyeshine. The PM pair and the other secondary eyes do have tapeta. The PM pair are larger, approximately 400 µm in diameter, and are probably specialised for nocturnal vision, although these spiders may also be crepuscular or even diurnal. The principal eyes and secondary eyes are different embryologically and anatomically. All of the eyes are different morphologically from most insect compound eyes. All spider eyes are “simple”

eyes. The first surface is the principal refracting surface. It is called the cornea but is, in essence, a single lens. This cornea/lens is a biconvex structure bulging into the centre of the eye cup in direct contact with the multiple individual vitreous cells.



The principal eyes have rhabdoms—the cells that contain the photopigment—and are analogous to our photoreceptors. These cells have their visual pigments on the microvilli distal to the cell body and immediately proximal and adjacent to the individual vitreous cells. This arrangement prevents the light traversing the lens from being scattered by the proximal nucleus and axon, and thus provides a sharper image. In the secondary eyes, the nucleus is distal to the photoreceptor pigment. This allows for closer approximation of the tapetum to the photosensitive portion of the rhabdom, and all secondary eyes have a tapetum. The secondary eyes have a “gridiron” tapetum that, in effect, doubles the effective length of the receptors, and markedly increases photon capture. As a result, the secondary eyes of the wolf spiders are approximately 100 times more light sensitive than those of the jumping spiders who probably have the best arachnid vision. Because of the retinal arrangement, the lycosid secondary eyes may have sacrificed acuity for sensitivity. Photopigment spectral sensitivity ranges from 360 nm to 510 nm, but different eyes have different ranges, and the wavelengths in between are covered.

All eight eyes enjoy a stunningly low f-number (discussed in the *BJO* February 2002 cover essay), that would be essential for nocturnal predators. A centid

spider, closely related to the lycosids spiders and with similar eyes, has been recorded as having an f-number of 0.74 for the principal eyes and as low as 0.58 for the secondary eyes. They would have light gathering potential to provide astonishingly bright images even at night (Land *et al*, *J Exp Biol* 1992:227).

The eyes of wolf spiders are necessarily quite small and have a very short focal length. They have no accommodative abilities, but do have relatively good vision and depth of field at short distances. The inter-receptor angle is approximately 1–2 degrees in the PM eyes. The AM eyes probably do form a relatively low resolution image on their inverted retinas.

Since these spiders must “hunt” their prey, they are rapacious and very fast with speeds up to two feet per second over short distances. Nevertheless, they usually remain stationary for long periods and wait for unsuspecting insects to happen along, and then quickly dispatch them.

Mechanoreception has a role in the lycosid lifestyle, as it does even in certain vertebrates, such as alligators and crocodiles. Vibrations are detected by the legs and bristles along the body. The vibratory recognition allows for agonistic display, mate detection, or ritualised fighting (Rovner JS, *J Arachnol* 1996;24:16–23). The “hairs” that are seen on the surface of the spider’s body are astonishingly sensitive, and may even feel the wavefront of air pushed forward by a moving insect and especially the wing movement of insects flying nearby. How the “hairs” and the visual system interact neurologically is not known.

Wolf spiders have remarkable sensory abilities and can “see” their prey with numerous organs. It is no surprise these species have been on earth, virtually unchanged, for eons.

**Ivan R Schwab**

University of California, Davis, Department of Ophthalmology, 4860 “Y” Street, Suite 2400, Sacramento, CA 95817, USA; [irschwab@ucdavis.edu](mailto:irschwab@ucdavis.edu)

Scanning electron microscopy by Kimberley Butler-DeRose, EM Laboratory, Department of Pathology, UC Davis, CA, USA.



## All the better to see you with . . .

Ivan R Schwab

*Br J Ophthalmol* 2002 86: 1199  
doi: 10.1136/bjo.86.11.1199

---

Updated information and services can be found at:  
<http://bjo.bmj.com/content/86/11/1199.full.html>

---

*These include:*

### References

This article cites 1 articles  
<http://bjo.bmj.com/content/86/11/1199.full.html#ref-list-1>

### Email alerting service

Receive free email alerts when new articles cite this article. Sign up in the box at the top right corner of the online article.

---

### Notes

---

To request permissions go to:  
<http://group.bmj.com/group/rights-licensing/permissions>

To order reprints go to:  
<http://journals.bmj.com/cgi/reprintform>

To subscribe to BMJ go to:  
<http://group.bmj.com/subscribe/>