

# *SEM Diaries - 28*

## *The eyes have it*

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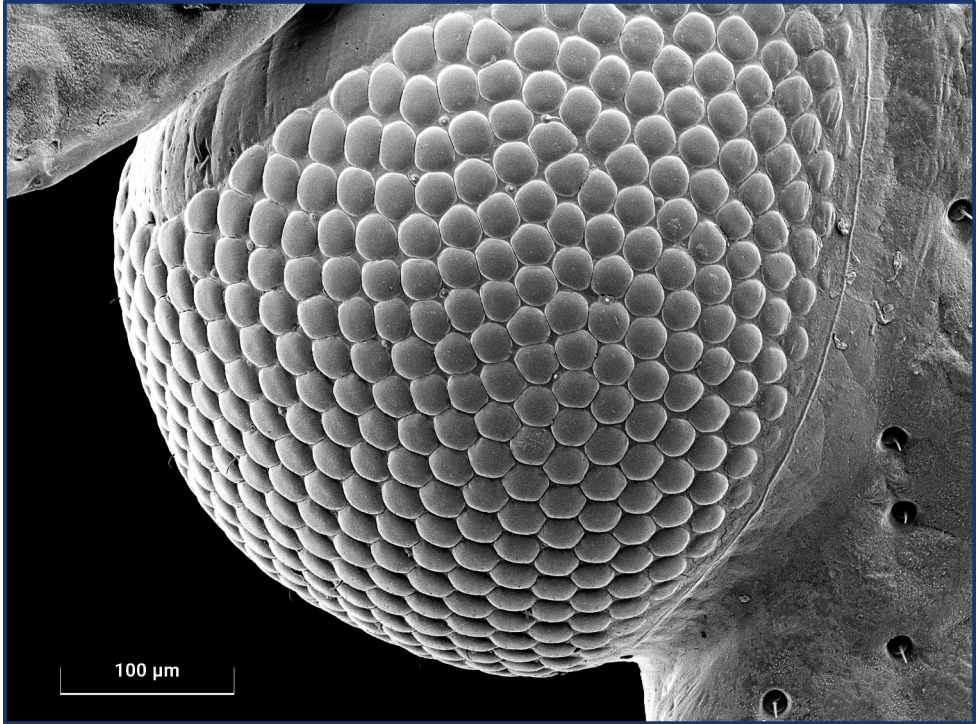


Fig. 1: Right eye of a fifth instar of the green shield bug *Palomena prasina*

I have recorded in a number of articles, as well as in my book, that it was observing the somewhat fuzzy image of an insect's eye on the green long-persistence cathode ray tube of a Cambridge Stereoscan SEM, in 1968, that set in motion my almost lifelong interest in the SEM.

Well, this subject matter has not lost any of its magic in the years since then. In fact I find insect compound eyes a lot more picturesque than the simple eyes of spiders. So, when going through some "by-catch" from a spider survey I decided to image the compound eyes of as many

different insects as I could find in that tube of alcohol. Although I had known that insects were a very diverse group I was amazed by exactly how many different eye arrangements there are within the Insecta.

Figure 1 is the cover image from my book "Big Pictures of Small Things" plugged in SEM Diaries - 26. So, to be fair, this image is not from recent by-catch, but does illustrate the nature of an insect's compound eye (or perhaps I should say a "bug's" eye, as they vary greatly between genera). I showed this to a photographer friend recently and he commented that I



Fig. 2: Head of the same specimen as used for Fig. 1.

should remove the scale bar and then it would be suitable for hanging on a lounge wall, irrespective of whether the resident was an entomologist or not. I had to point out that in microscopy and entomology circles (and indeed in RPS distinction circles) this was not an option, although the scale bar is on a separate Photoshop layer so could be removed easily enough.

Although Figure 1 does convey a pleasant “abstract” appearance, in microscopy and entomological circles it is always good to put such an image in its context, so in Figure 2 I show the complete head of the same specimen, in the same orientation as Figure 1. Overall, the eyes on this instar occupy a relatively small area of the head. The area occupied by the compound eyes on the adult is similar to that of the instar, so there is no great transformation at final moult, other than the appearance of two ocelli.

Going from the sublime to the ridiculous, Figure 3 is the eye of a small fly that was stored in my tube of by-catch. There is hardly an area anywhere on this front view that is not occupied by facets of its compound eyes, apart from the mouth-parts, the antennae, and the ocelli that can just be made out right at the top of the head. Sadly I know neither the genus or species of this specimen, although it is of the order Diptera. It is disappointing that there is a crack in the surface of the

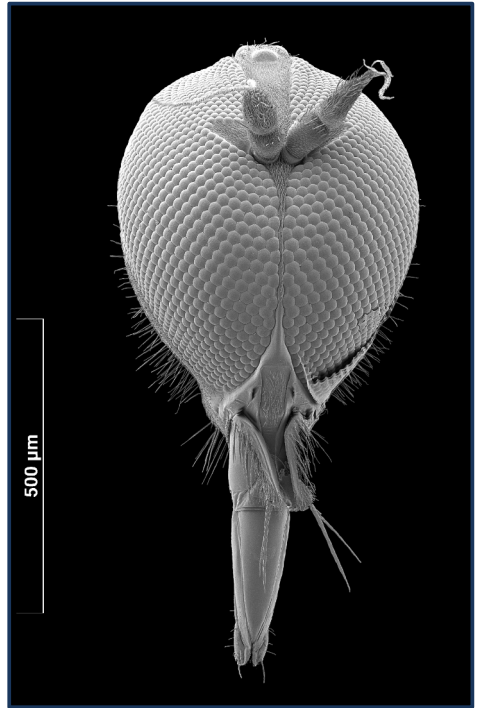


Fig. 3: Head of small fly, with large area of compound eye.

specimen on the right (as viewed on the page), possibly arising when I pushed the head down onto cement.

Another insect in the same tube of by-catch was a springtail. As for most insects I know very little of their lifecycles, so I was unsure whether this was a nymph or adult (although it looked fully developed). Its eyes certainly looked primitive. An image of the whole specimen (complete, again, with damage caused during mounting), is shown in Figure 4.

I homed in on the eyes, at magnifications of x1k and x5k (as set on my SEM, not reproduced on the page) with the results shown in Figures 5 and 6.

Having been convinced, up to this point, that all insects have compound eyes, I was somewhat perplexed by what I was looking at, so turned to the Internet for assistance, where I found the following helpful elucidation:

*Springtails do not have compound eyes, as is the case with almost all*

*insects. Their vision is made from a group of simple or ocellated eyes grouped in the ocular plates and whose number and disposition vary according to the species. [1]*

One is never too old to learn something new.

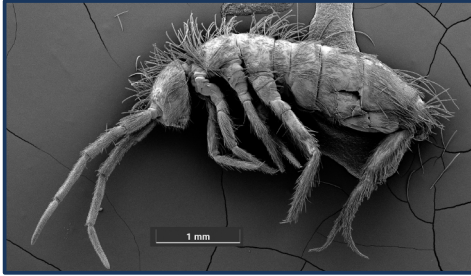


Fig. 4: Complete springtail. Field width 5.6 mm

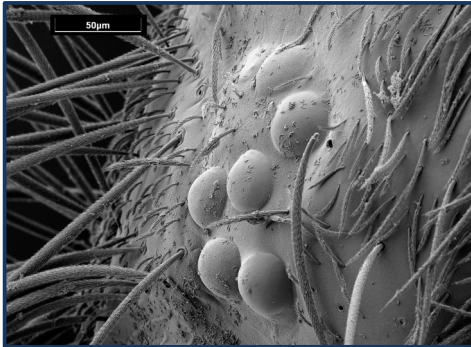


Fig. 5: Left eye group of springtail (field width 274 μm)

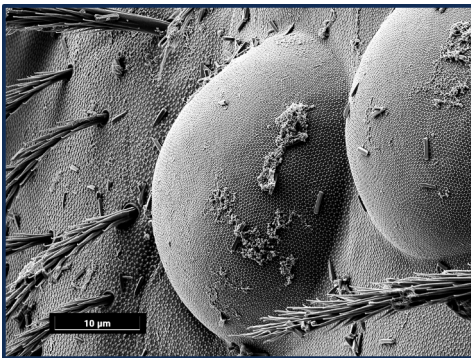


Fig. 6: Higher magnification view of left eye group of springtail (field width 56 μm, stack of 5 frames)

Another insect from the by-catch was the weevil *Apion pomonae*. A lateral view of the head is shown below. In this insect it would seem that the horizontal coverage of the two eyes does not overlap at all, given their location on the head, although presumably there is some overlap when looking up or down.



Fig. 7: Right side view of *Apion pomonae*

While not in the same league as the fly illustrated in Figure 3, wasps also have eyes that cover a significant area of the head, as is illustrated in Figure 8. In fact, it is the gap, or lack of gap, between the bottom of the eye area and the jawline that is a key distinguishing feature between individual species.

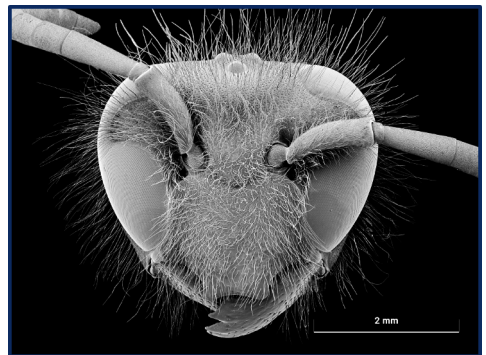


Fig. 8: Head of wasp *Vespula germanica*

Although I said on the first page of this edition of Diaries that spider eyes are significantly less interesting than those of insects, there are exceptions. One such is the linyphiid *Walckenaeria acuminata*, illustrated in Figure 9. Although the eyes

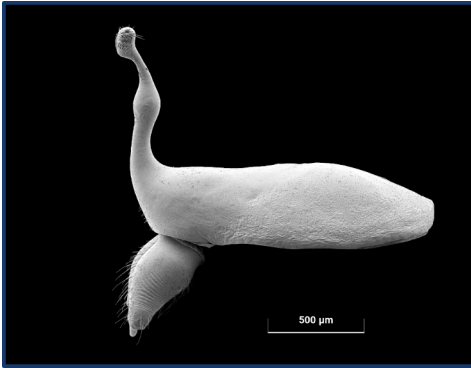


Fig. 9: Cephalothorax and chelicerae of *Walckenaeria acuminata*

themselves are not easily discerned in the figure there are two pairs of simple eyes on the bulge half way up the, for want of a better word, “stalk”, and two more pairs at the top of the “stalk”. (In most spiders the eyes are grouped around the front of the cephalothorax.)

So much for arthropod eyes. You may be wondering how I am getting on with tackling my list of things that need better organisation, as outlined in Diaries - 27. The answer is not too badly! Writing the list encouraged me to address most of the points raised. For example, any spiders I have caught recently I have identified and labelled promptly. Mind you, most of these have been in my lab, where all the requisite equipment and literature is readily to hand. The subject matter discussed above demonstrates that I have made inroads into my tubes of samples to be prepared and imaged. All but a very few specimens from my spider surveys in 2021 have now been determined, and I have even sent in the report to the owner of the nature reserve where I carried out the surveys. My spiders website is now up to date.

In fact the only item on the list that has not progressed is my article for *infocus*. This is intended to be a light-hearted summary of my learning curve for preparing mounts for SEM. The current draft, such as it is, is more likely to send the reader to sleep than to make him or her chuckle.

When attempting to identify spiders or insects, or indeed wild flowers (and hence their pollen) I tend to consult a number of

different books. There is no room on the bench at which I use my stereo microscope for a single book, so my library tends to be spread out across any flat surface that may exist, including the desk of my SEM as well as the space in front of the chamber door on the column console. I was becoming increasingly fed up with having to move the pile of books in front of the chamber door every time I wanted to load different specimens, so I decided that I would construct a bookcase. This would keep the books close at hand but free up the flat surfaces.

Both my workshop and my lab are pretty cluttered with equipment, so if I want to access the flammable liquids cupboard in the workshop I have to move the Bandsaw, for example. In the lab, if I want to gain access to drawers or the fridge I might well have to move something, such as a stool, out of the way first. Such would be the case with the bookcase, which I have located adjacent to the SEM desk. This enables me to simply reach out for a book when seated at the SEM, but in this location it blocks off service access to items such as the compressor and scroll pump used by the SEM. I have thus mounted the bookcase on castors so I can move it out of the way when required. Comparisons to a “Rubik’s Cube” are not out of place!



Fig. 10: The bookcase in position. Note the laser printer (again on castors) beside it, and also the desk drawer on the left - an earlier answer to becoming organised.

## Reference

1. <https://tinyurl.com/yb8mesty>