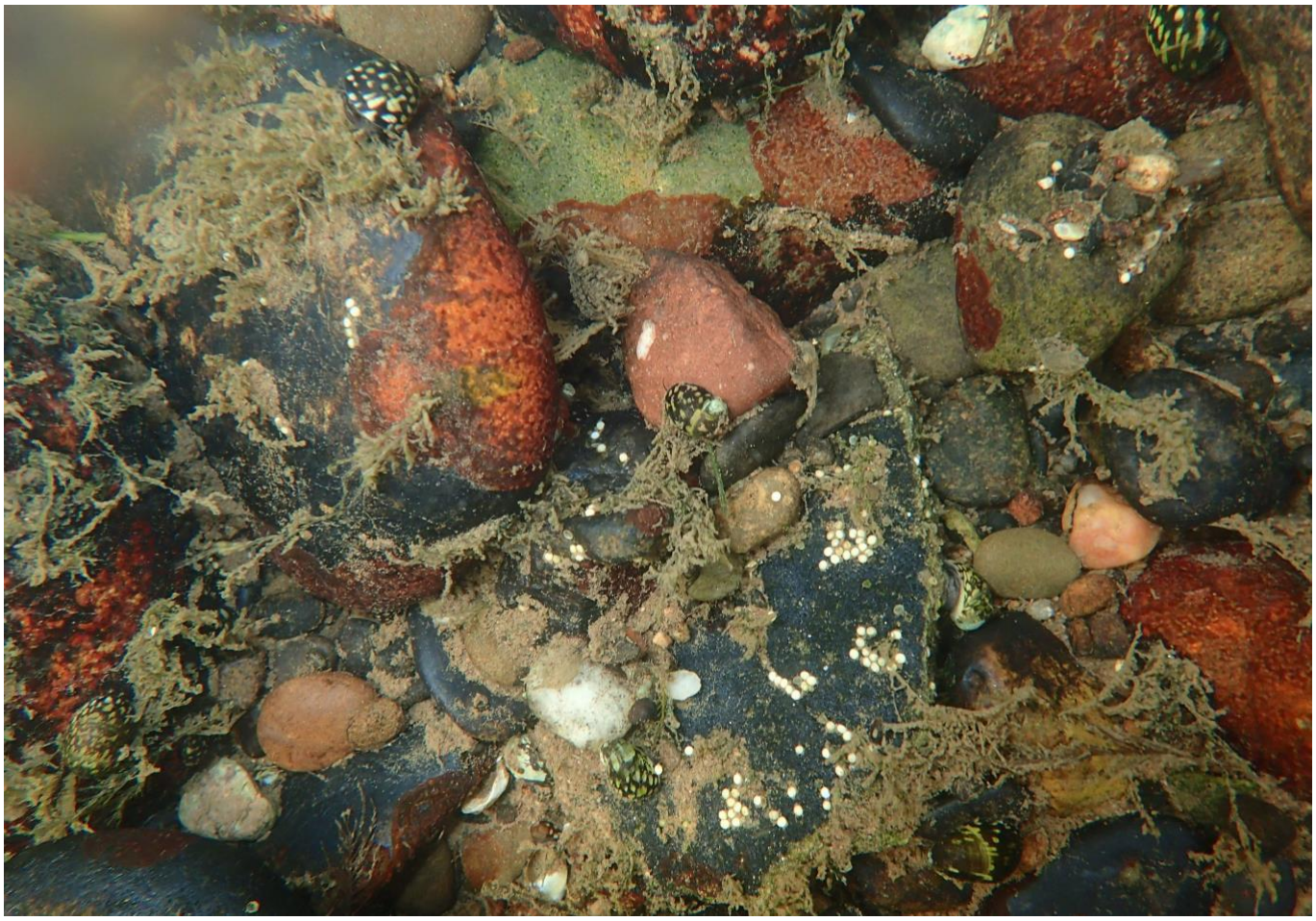
Three Algae - *Hildenbrandia, Haematococcus and Nostoc*.

Harry Green & Rosemary Winnall

This article is more about observers' curiosity than serious biological recording by expert algologists. While investigating the shallows of the River Severn where the bypass crosses the river near Bewdley we saw pebbles coated with a reddish growth – what was it? Whilst walking down a wet clay track on somewhat calcareous soil near Pershore there were brownish-green rather flabby structures scattered over the ground – what were they? A shallow concrete garden bird bath in which the water turned red – what caused that?



01. 01. Underwater picture, River Severn, Bewdley bypass bridge. R. Winnall. Red pebbles are encrusted with Alga *Hildenbrandia rivularis*. The greenish patches are freshwater sponge. The small black spotted with white objects are the mollusc *Theodoxus fluviatilis* and the clusters of round white objects are its eggs.

The red pebbles.

Rosemary Winnall writes:

In the autumn of 2009 a few of us from the Wyre Forest Study Group decided to explore the River Severn by boat between Arley and Blackstone south of Bewdley. We used an inflatable dinghy, and came gently down the river over two days, slowly examining the river bank for bryophytes, riverside plants, dragonfly exuviae, and otter prints. At a number of suitable beaching spots we stopped to dip nets in the river to check for aquatic invertebrates, especially the underwater bug *Aphelocheirus aestivalis*.

Paddling under the Bewdley bypass bridge we saw coloured pebbles in the water: some bright red and others green. We were not sure what caused the colours so I promised to go back and explore further when water conditions allowed. However it was not until 2017 that I managed to get a good look at the site again. I had just purchased a new Olympus Tough TG4 waterproof camera and I needed to check out its capabilities.

I waited until the river was low and, on a nice sunny warm day in July, I waded into the water under the Bewdley bypass bridge from the east bank. The water here runs over a rock band in a series of riffles and was once a fording place across the Severn. The shallow water provided good light conditions for taking still photographs and movies in the river. One problem with using this camera underwater is that you can't easily see what you are taking and it involves a lot of trial and error. But some of the many shots taken were successful and surprisingly colourful (01, 02, 03)). I recognised the red and green pebbles that I'd seen in 2009 so I collected a few to examine at home. The green was definitely a sponge, but which one? The red ones I passed round, but folk were perplexed. So I gave them to Harry to provide us with an answer.

The camera and thanks.

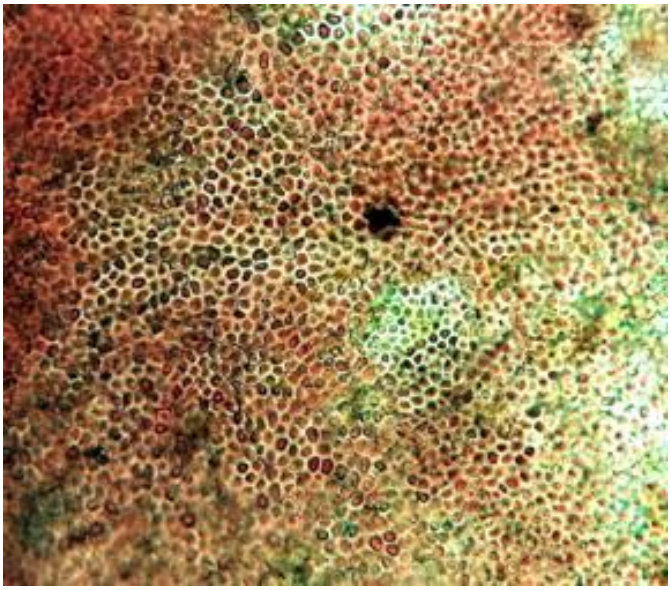
Although I can activate the Olympus Tough TG4 camera to take still photos from an app on my iPhone I can't get this to work under water. (Yes, I received a snorkel and mask for my next birthday!). Nevertheless I am very pleased with the results on this little camera and have become a bit of a TG4 evangelist. Thanks are due to friends who, like me, like messing about in rivers: Mike Averill, Brett Westwood, Harry Green, Mark Lawley, and Will Watson.

02. Underwater picture River Severn, Bewdley bypass. R. Winnall. Pebbles coated with freshwater sponge (L) and *Hildenbrandia rivularis* (R)

03. Underwater picture River Severn, Bewdley bypass R. Winnall. Pebble encrusted with *Hildenbrandia rivularis* (centre) and greenish freshwater sponge (L & R).

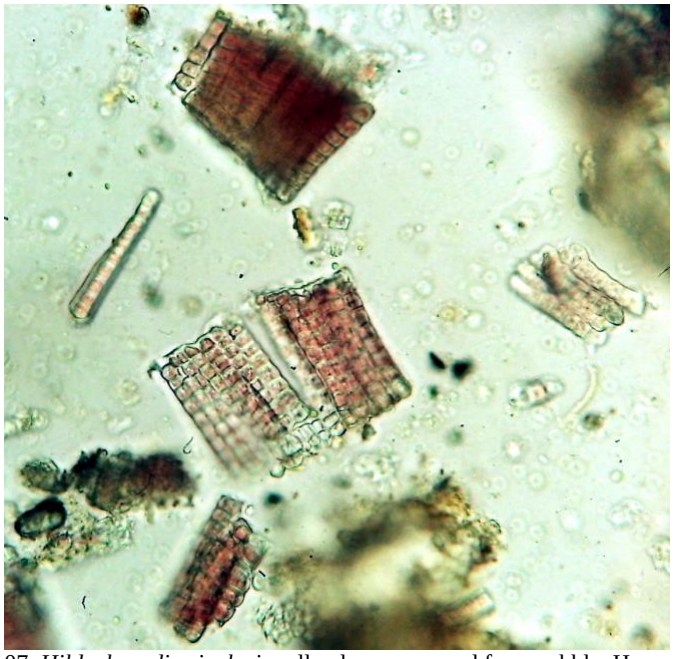
04. *Hilldenbrandia rivularis* on pebble from River Severn. H. Green.

Harry Green writes:
Ever since learning about them at school I have been fascinated by Algae and have enjoyed looking as microscopic freshwater life including protozoa, algae, rotifers, tardigrades and the others without becoming an expert so I enthusiastically scraped red material from the Severn pebble to examine microscopically. At first I had little idea of what I was looking at apart from concluding it was not a freshwater sponge. Fortunately I have a large somewhat unused book on *Freshwater Algae* (John et al 2002) and a miscellaneous collection of older Algal tomes. Turning the pages and looking at pictures on the CD accompanying the book soon revealed that the red coating was an Alga *Hildenbrandia rivularis* (Liebmann) J.Agardh 1851 of the Order Hildenbrandiales. This group and that species forms crustose reddish patches closely adherent to stone surfaces (04) in running water which is usually on the basic side at pH7.2-8.8. Viewed face-on or in section the crusts are made of files of cells each about 8µm in diameter (05) packed together in stacks of 5-11 cells overall about 60µm long. The view of the surface and scraped off flakes clearly showed the cells packed together. The crude scrapings showed detached fragments showing the files of cells (06, 07 high magnification taken with microscope.).



05. *Hilldenbrandia rivularis* surface showing cells. H. Green.

06. *Hildenbrandia rivularis* cell columns scraped from pebble. H. Green. High magnification taken with microscope.



07. *Hildenbrandia rivularis* cell columns scraped from pebble. H. Green. High magnification taken with microscope.

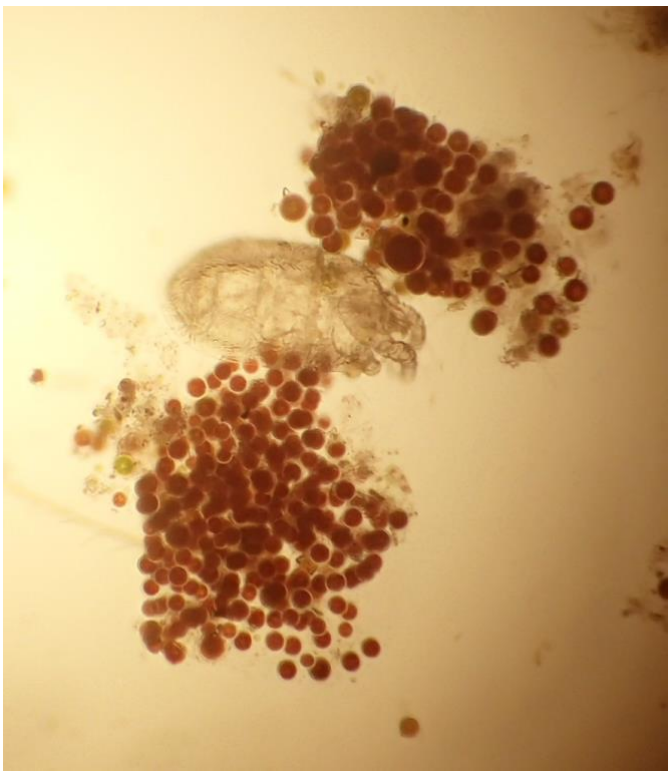
The red birdbath.

08. Red Alga *Haematococcus* in birdbath. H. Green

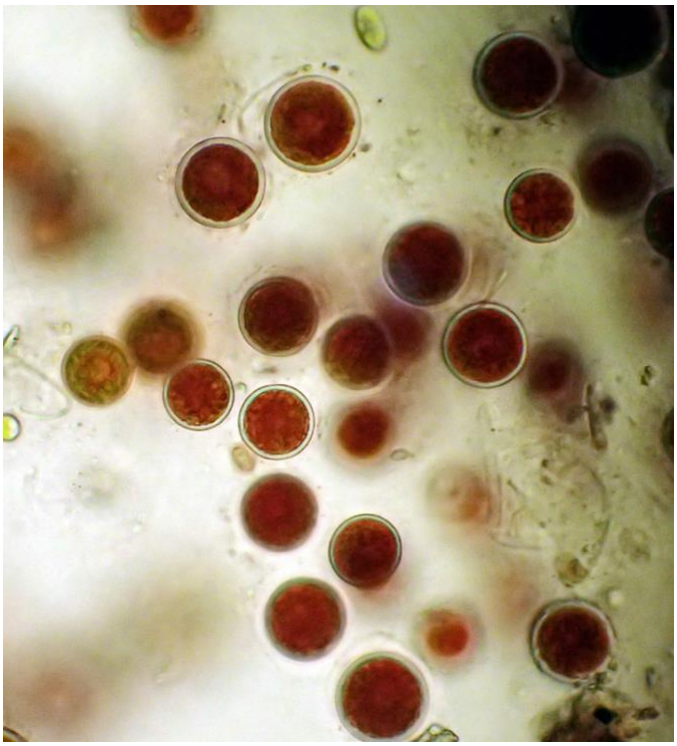
Harry Green writes:
We have a concrete birdbath in our garden and not long after we bought it some years ago the water turned reddish and when it dried out the bowl was covered with red dust (08). I mentioned this to an expert algologist who simply said "*Haematococcus*". Microscopically numerous red roughly round cells could be seen and again referring to John et al (2002) and its accompanying CD suggested *Haematococcus pluvialis* Flotow emend. Wille 1903, a cosmopolitan species of small rock pools, cattle troughs, bird baths and the like. The vegetative cells, 10-30µm long, are green and motile. They accumulate a red pigment and under less nutritious conditions form round aplanospores 30-50 µm in diameter packed with red pigment (10). If the container dries out they form red dust. Up to this point I had resisted an internet search! On doing so I was astonished to find a whole industry surrounding this organism producing an antioxidant on a commercial scale. Wikipedia states *"This species is well known for its high content of the strong antioxidant astaxanthin, which is important in aquaculture, and cosmetics".* You can even buy it on Amazon as a diet supplement!

Personally I shall simply enjoy looking at it with a microscope and marvelling at the other organisms seen with it including the invertebrate larvae less than 1 mm long with guts were full of it! (13, 14).

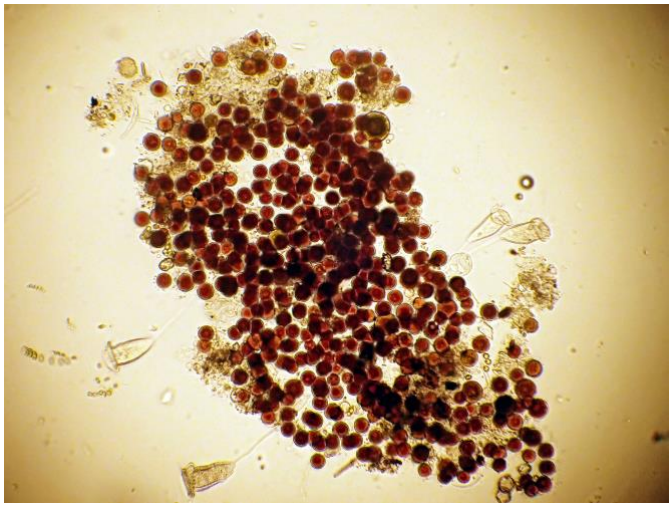
Mick Blythe's comment on the larvae :
They are certainly Chironomidae *(Diptera) but as we have 625 species in the UK (and that is almost certainly not all) that doesn't get us very far. I expect they belong to the subfamily Orthocladiinae which are often small and semi-terrestrial; probably not early instars of a larger species if they came from a bird bath.*



09. *Haematococcus* with a tardigrade. H. Green.



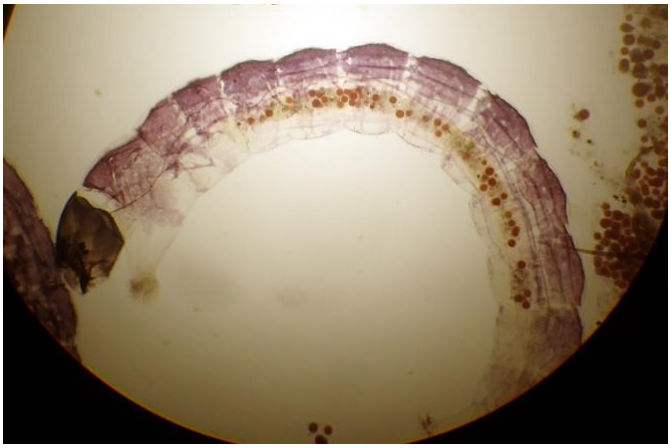
10. *Haematococcus* aplanospores. H. Green



11. *Haematococcus* with protozoans probably *Vorticella*. H. Green

12. Rotifer with *Haematococcus*. H. Green

13. Chironomidae larvae with Haematococcus in gut. H. Green



14. Chironomidae larva with Haematococcus in gut. H. Green

The brownish-green flab.

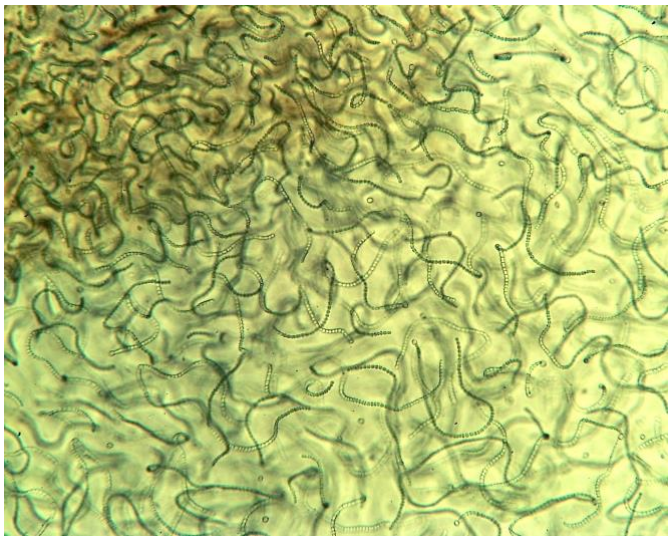
Harry Green writes:

This is actually less of a mystery as it is not uncommon on muddy tracks on calcareous soils with little vegetation. I first saw it on such a new track in Tiddesley Wood near Pershore many years ago and discovered it was an Alga genus *Nostoc* with many colloquial names. The one that stuck in my mind was Manna from Heaven, a name associated with its sudden appearance on the ground after rain and, in some parts of the world, it is eaten – indeed manna. The most recent sighting had been on a newly made clayey track at Rough Hill Orchard near Pershore. Patches of brownish-green gelatinous material appeared in flattish lumps on the track. The species commonly seen on muddy tracks is *Nostoc commune* [Voucher 1803] Bornet et Flahault 1886 and is probably the one found at Rough Hill (15, 16, 17).

15. *Nostoc commune*, Rough Hill Orchard. H. Green.

16. *Nostoc commune*, Rough Hill Orchard. H. Green.

17. *Nostoc commune*, Rough Hill Orchard. H. Green.



18. *Nostoc commune*, low magnification of strings of cells. H. Green.

19. *Nostoc commune*, high magnification of strings of cells. H. Green.

John et al (2002) describes 16 species of *Nostoc*. Some are aquatic and many form only small colonies. *N. commune* colonies are the largest and commonest on soils, sometimes producing large masses many centimetres in size. Microscopically the mass shows chains of barrel-shaped cells about 5-6µm wide embedded in communal mucilage (18, 19).

I placed a few fragments, roughly 5 cm in diameter, of the Rough Hill material in a sealed polythene box 17×11 cms and kept it moist. Within a few weeks it had expanded into a mass about 2 cm thick and filled the base of the container. Microscopically the mucilaginous mass contained long chains of cells including occasional slightly larger ones which are apparently nitrogen fixing cells. When the mass dries on the track it forms thick papery fragments which swell to life again in wet weather, often in winter or spring.

Nostoc are within the Phylum Cyanophyta (Cyanobacteria), the blue-green algae, order Nostocales. *Nostoc* species are often associated with other organisms especially in those lichens where the algal element is a blue-green alga.

Reference

John, D. M., Whitton, B. A. & Brook, A. J. (eds.). 2002. *The Freshwater Algal Flora of the British Isles*. Cambridge University Press.

Images

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