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HEPTAGENIA LONGICAUDA.

(Family-Ephemeridæ.)

By W. Blackburn, F.R.M.S.

IN the *Northern Microscopist* for September last, some aquatic forms of the genus Heptagenia are mentioned as having been found at Bramhall during a ramble of the members of the Manchester Microscopical Society in that neighbourhood. Being desirous of ascertaining the species to which they belonged, I reared some specimens collected on that occasion through the subimago into the imago state, and then found them to be *Heptagenia longicauda* (Eaton). Stephens has described this species under two different names, *Baetis longicauda* and *B. subfusca.* It appears to be peculiar to the British Isles, although the genus to which it belongs is one of the most widely distributed throughout Europe and America. The eight species found in Great Britain are *H. semicolorata, volitans, flavipennis, elegans, venosa, longicauda, insignis,* and *lateralis.*

The Rev. A. E. Eaton in his valuable monograph describes the nymph of this genus as "Nympha agile reptans, laminis branchialibus utrinque septem; laminæ simplices integræ, fasciculis e radicibus singulis filamentorum branchialium." Herein is an important omission, for bundles of branchial filaments which are attached to the roots of the first six pairs of plates, forming the external abdominal gills, are in fact absent from the seventh pair. Westwood, in his description of the aquatic form of Baetis of De Geer, which is the same genus, notices this peculiarity of the nymph. Some other characteristics of the nymph are a very broad head and thorax, comparatively short antennæ, maxillary palpi two-jointed, and the legs with the femora widely compressed. Altogether the insect has an appearance of stoutness and strength, when in the water, differing most materially from the slender and graceful form it assumes when it casts off its swaddling clothes and emerges as a subimago. In the latter condition it assumes the characteristic attitude of the genus when at rest, with all its feet on the ground, the wings erect, and the two caudal setæ divergent, the central filament of the tail having been left in the water. It has four wings, but they appear to be unnaturally small and wanting transparency, owing to their being folded up in the cases of the subimaginal skin. It now waits in quietude for this skin to dry, and then endeavours to extricate itself, and, escaping through an opening in the thorax, appears in its final form of an imago. In a few minutes the wings expand to their full dimensions, and appear of a more glassy nature, with the nervures more clearly

defined, the posterior wings being of course much smaller than the anterior, but bearing some similitude to the latter in the character of neuration; the neuration of the anterior wing is somewhat complex, the longitudinal and transverse nervures being rather numerous, the latter especially so in the costal area, and the interneural veinlets of the terminal margin being continuous with either the transverse or longitudinal nervures. The legs are thin, the forelegs of the male having extended considerably in length; the tarsi have five joints, the second, third, and fourth gradually decreasing in length, the fourth joint being the shortest, and the fifth terminating in a single claw with an oval pulvillus or pad. The antennæ are somewhat shorter than before, but the caudal setæ have undergone a sudden elongation, so that in some species they are several times their former length. This is notably the case in Heptagenia longicauda, as its specific title indicates.

I observed the transformations of the tail in one specimen. It was a male, having the three-jointed abdominal claspers common to the sex in this genus. The length of its body was 11 millimetres. The mature nymph had the central seta of the tail 9 mm. in length, and the external setæ 8 mm., each of the latter consisting of 71 segments. In the subimago, these setæ expanded to 13 mm., with the same number of segments as before. In the imago, however, the setæ had undergone a sudden extension to about 27 mm.; but upon observing that one of them possessed only 60 and the other 64 segments, I looked for the lost segments in the last caudal moult, and there found an opacity in the terminal segments indicative of the presence of the missing extremities. Adding a proportionate amount for the inclosed segments, when expanded, to the previously ascertained length of the setæ, I found that each seta, when perfect, would be about 32 mm. long, or four times its length in the nymph; and that its rapid extension was doubtless due to the sudden relief from compression which the segments had undergone during growth in the two previous states, the segments being then probably in a state of intussusception, to use a medical term with an appropriate signification. This specimen had considerable difficulty in extricating itself from its subimago skin, owing to an accident which it met with in leaving the water. Observing the nymph to be rather restless, and to be making frequent essays to the surface of the water, I placed it in a small glass trough, about half full of water, to watch the process of moulting. I had not long to wait, for the insect set about it as soon as it had familiarised itself with its new environment; but, in escaping from the trough, one wing-case was caught by the top of the wet glass, and dragged along it for a short distance, flattening its tip. This tip, belonging to one of the anterior wings, the imago was unable to extricate when engaged in its final moult; so

that it was compelled to carry the subimaginal skin poised above its body at the tip of the damaged wing for some hours, presenting the most curious appearance of carrying its own exquisitely made garment, until I summoned the aid of chloroform and detached it. One specimen was unable to extricate itself from its nymphal skin, being drowned in the attempt. This I have preserved in my cabinet in the act of escaping.

This species is to be found from July to September emerging from cool streams to assume its final forms of short-lived aërial beauty.

EXTRACT FROM

PROF. MARTIN DUNCAN'S ADDRESS

TO THE MEMBERS OF THE ROYAL MICROSCOPICAL SOCIETY, FEBRUARY 8TH, 1882.

The Abbe Theory of Microscopical Vision.

(Continued from page 278.)

AS Fellows of this Society we may, I think, be proud of the able communications, relating to this subject, which were published last year in the April and June numbers of the Journal.

Numerical Aperture.

The abandonment of the angular notation for aperture necessarily follows, as soon as the correct view of aperture is appreciated; for when we know that the apertures of three objectives are, for instance, as 98, 126, and 138, no one would insist that they should be designated 157°, 142°, and 130°. A notation can have no title to be considered a scientific one, which denotes things as the same when they are really different (60° in air and oil) or different when they are the same (180° in air and 82° in oil).

Until, however, the "law of aplanatic convergence" had been demonstrated by Professor Abbe, no principle had been established by which the ratio between emergent beam and focal length, could be conveniently denoted.

It would not be possible for me to condense, without a sacrifice of intelligibility, the steps by which he subsequently showed, in a very beautiful manner, that the ratio in question can be expressed by the product of the refractive index of the medium in front of the objective, and the sine of half the angle of aperture, that is by $n \sin u$.