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## UNDER-WATER EMERGENCE OF THE SUB-IMAGO OF *HEPTAGENIA LATERALIS* (CURTIS) (EPHEMEROPTERA).

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THE following notes seem worthy of record, as this particular form of emergence is not mentioned by Needham (1935). The observations were made under laboratory conditions, but similar behaviour was subsequently observed in the open, under natural conditions.

Full-grown nymphs of *H. lateralis* were observed coming to the surface of the water by climbing projecting stones, and were apparently gulping in air, as has been recorded of other species of Ephemeroptera by Morgan (1913). The mouth and sometimes the whole head was forced above the surface film, the mouth-parts working vigorously the while, as though feeding. In some instances the nymph would relinquish its hold by its anterior legs on the stone, leaning backwards as though trying to walk on the underside of the surface-film. If disturbed by movement visible to it, or by vibration, the nymph withdrew to cover, but soon returned to renew the gulping movements.

These nymphs were of the normal colour, not the dusky form of the nymph just on the point of emergence. They were under observation for more than an hour and during that period underwent no visible change in colour. The process of filling the gut with air, as well as of forcing air between the nymphal and sub-imaginal skins, is evidently a lengthy one, and it is my belief that as much as a day may elapse between commencing absorption of air and ecdysis.

Mosely (1939) suggests that it is unlikely that the nymph would be floated up to the surface by the agency of the engulfed air. I have actually seen this happen with some nymphs of *H. lateralis* just before emergence. They were so buoyant that they could only remain at the bottom by clinging on to submerged stones. These nymphs were distinctly darker than normal, and the presence of air between the nymphal and sub-imaginal skins could be detected by their silvery appearance in certain lights. One of these nymphs, after a period of restlessness, took up a position beneath an overhanging ledge of stone and there, beneath the surface of the water, underwent its transformation to the sub-imaginal stage. The "dun," with its wings still only partly expanded, crawled up out of the water in a perfectly dry condition, and completed the

extension of its wings on the top of the stone. The whole operation occupied only about two minutes.

On first emerging, the wings are a very pale grey, which rapidly darkens to a fairly uniform blackish-grey, or in the case of some sub-imagines from the shore of Windermere, the wings bear indications of faint but definite darker transverse banding.

Should the nymph, either by its own exertions or by disturbance of the water, become dislodged from its foothold beneath the surface, it floats up and completes its moult on the surface, after the fashion of *Ephemera* or *Cloëon*. The habit of under-water transformation is not rigidly followed by all nymphs of this species, but the majority of examples I have had under observation have shed the nymphal skin below the surface.

It is a little difficult to suggest a reason why *H. lateralis* should exhibit this divergence from the more usual behaviour of Ephemeroptera. A possible solution may be found in the fact that in Windermere, and I imagine in other lakes also, emergence takes place in shallow water almost at the margin of the lake, a region which is subject to considerable movement of water due to the action of waves. A nymph transforming beneath the surface would probably be less liable to disturbance by these conditions than one hatching on a stone at water-level. Admittedly the "dun" has still to pass through the surface-film, but the time taken for this operation is much less than the period required for actual emergence, during which a nymph at water-level would be exposed to the risk of being swept from its foothold and knocked against stones.

Against this theory may be set the fact that other species such as *Leptophlebia marginata*, living under similar conditions, do not adopt this method of emergence, but generally transform on a stone at water-level. *Ephemera danica* also emerges at water-level from a floating nymph, but as this usually takes place in deeper water, the nymph has not to contend with the risk of contact with stones.

#### REFERENCES.

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HONOURS FOR ENTOMOLOGISTS.—Congratulations to Dr. Hugh Scott of the British Museum (Natural History) on his election to the Royal Society recently; and Dr. S. A. Neave, Assistant Director of the Imperial Institute of Entomology, on the C.M.G. conferred upon him in the King's Birthday Honours List.—N. D. RILEY.