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A NYMPH OF THE GENUS CÆNIS.

(FAMILY EPHEMERIDÆ.*)

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THE name "Cænis" was derived from the mythology of ancient Greece, and applied to this genus of insects. Cænis was a woman beloved by Poseidon, and changed by him into an invulnerable man, who engaged in the wars between the Lapithæ and Centaurs. As they were unable to kill him, the Centaurs buried him alive, when he became changed into a bird, and afterwards into a woman again, whom Æneas is described by Virgil as meeting in Hades, in the "fields of mourning" set apart for the solitary wanderings of the shades of unhappy lovers. (*Æneid* vi., 448). The supposed resemblance between the entomological Cænis and its mythological prototype I leave to be explained by those who delight in efforts of the imagination.

Other generic names have been given by various authors to specimens of this genus, amongst which I may mention *Ephemera* by Linné and Fabricius, *Brachycercus* by Curtis, *Oxycypha* by Burmeister, *Macrocerus* by Westwood, and *Cloë* or *Cloëon* by others. The Entomological Society have, however, given their approval of the name *Canis*, by which the genus is at present known.

The imago is easily recognized, as it is the only two-winged British genus that has three caudal setæ or tails; the other two-winged genus, *Cloëon*, having only two tails. It may also be known by the comparative shortness and great breadth of its wing, the longitudinal nervures of which are simple, with few transverse nervures, and, in the typical species at least, without interneural veinlets arising from the terminal margin, which is ciliated in this genus; by the abdomen being little longer than the thorax and scarcely extending beyond the posterior margin of the wing; and by the size and width of the thorax and head, which proportionately exceed those of *Cloëon*. The compound eyes of the male consist of a single pair, the large pillared eyes of the male *Cloëon* being absent. The tarsi have five joints, the fifth joint being sometimes

*A paper read before the Manchester Microscopical Society on 2nd Feb.

absent on the intermediate pair. The setæ are nearly equal in length ; these appendages, as well as the segments of which they are composed, being usually much longer in the male than in the female. The male forceps are either jointless, two-jointed, or tipped with a minute sharp process. The type of the genus is *Cænis macrura*, which makes its appearance as an imago between May and September ; in summer the early morning and the cool evening being preferred by the insect for its final ecdysis. The Rev. A. E. Eaton, our greatest authority upon this family, has found the subimagines of this genus waiting at half-past five in the morning in June for the sun to dry the dew upon their wings before attempting their last moult. Spiders' webs and newly-painted wood in the neighbourhood of gentle streams and quiet lakes and ponds should be examined for specimens when they are not found in flight. Although not so common in the British Isles as the genus *Cloëon*, *Cænis* is sometimes found flying in swarms at the beginning and end of summer. Dr. Hagen describes the English species as appearing in such numbers in Prussia that objects near the water have been covered by them to the depth of an inch, which, considering the small size of these insects, would necessitate many layers placed one above another ; whilst, in the "*Curische Nehrung*," the pigs are sometimes fattened upon them. The length of the body of the mature female seldom exceeds one-fourth of an inch, the male being usually much smaller.

The typical attitude that the subimago assumes during repose is with the wings widely expanded, the fore-legs on the ground, and the caudal setæ nearly parallel.

The winged *Cænis* lives an exceptionally short time for even this short-lived family. Its eggs are soon deposited, and the object of its aerial life being accomplished, exhausted it expires. The chief characteristic of an Ephemeridous egg is, that the germinal matter is segregated in one part, the remaining portion containing some kind of formative material, serving, no doubt, as a store for the further development of the embryo until it becomes capable of leading an independent life. In the eggs of some of the genera there is a constriction between these two portions, more effectually separating them. This is the case in the eggs of *Cloëon* and *Ephemerella*. In other cases the germinal portion assumes the form of a crescentic protuberance from the rest, and this appears to be its character in the genus *Cænis*. The eggs having been laid in a cluster on the surface of the water, they sink to the bottom, where they may either be eaten by some hungry trout or other fish, or lie in unobserved security for a few weeks until they become hatched. In the struggle for existence these insects often have a hard time, for no sooner does the larva issue from the egg than other larvæ, of a larger growth, are waiting to attack it ; and

if, in spite of its aquatic foes, it succeed in arriving at maturity, the dragon-fly and other predaceous insects and numberless small birds are on the watch for the dainty morsel ; so that if it were not for the great number of eggs that are laid, the Ephemeridæ would soon become extinct.

When the larva of this genus has escaped from the egg, its attempts at swimming, which are somewhat clumsy, are made in a wriggling manner, the abdomen being moved rapidly from side to side, in order to propel the body slowly forward. This being the usual mode of motion in swimming, it is occasionally varied by the adoption of a vertical motion, still performed in a wriggling fashion, and giving the larva the appearance of having some difficulty in making its way through the water. The same motions are observed when the larva has become a nymph by being sufficiently matured to have acquired rudimentary wing-cases. As all the characteristics of the insect, in its aquatic state, do not appear until the elements of the wings are present, it is more convenient to describe the nymph than the less developed larva.

The nymphs of this genus burrow in the mud or hide under the stones of the water they frequent, for which reason they are rather difficult to find. They are either unarmed, in which case they are provided with the usual ocelli, three in number, on the forehead ; or, in place of the ocelli, they are furnished with three short conical horns, which occupy the same position on the forehead that the ocelli do in the unarmed species. The unarmed nymphs are represented by the type of the genus, *Cænis macrura* (*Stephens*), in which the legs have the femora broad and strong, the tibiæ have their tips produced obliquely inwards and terminated by a bristle, and the claws are long and formidable. The armed nymphs are represented by the species *Cænis luctuosa* (*Pictet*), in which the femora are more slender, and the tibiæ and tarsi are more ciliated. All the English species have the lateral edges of the posterior abdominal segments considerably produced and terminated in the form of a bristle ; of the ten segments of the abdomen, the seventh and eighth are longer than the rest. The mandibles are well defined. The inner edge is extended into a molar plate, the outer anterior edge is furnished with two stout spinous processes, well adapted for prehension. Both the maxillary and labial palpi are three-jointed ; of the former the second joint is the shortest, the first and third being nearly equal in length ; of the latter the first joint is much the largest. The segments of the antennæ and tails are rather long in this genus, and are furnished at the joinings with a few short hairs. The second segment of the antenna is much longer than the first. The tails are comparatively short in the nymph and subimago, and this character is generally preserved in the female imago, but in the male imago these appendages appear

to undergo a rapid elongation after the last moult, until in many cases they are from three to six times their previous length. In one English species, however, according to Pictet's measurements, the female has tails nearly three times the length of the body. In the nymph and subimago they are usually shorter than the body.



Fig. 6.

The drawing represents an unarmed nymph, not quite arrived at maturity, and about one-tenth of an inch in length. The thorax is large, the head somewhat hammer-shaped, with two compound eyes and three ocelli, the femora compressed, the wing cases considerably developed, and the central caudal filament somewhat shorter than the other two. The shape of its limbs indicates its digging propensities. It is furnished with six pairs of external abdominal branchiæ, consisting of single plates, which are supplied with branches of the tracheal system for the aëration of the blood. The first pair have their origin in the antero-lateral portion of the first abdominal segment, near its junction with the metathorax.

They are small and narrow, somewhat lance-shaped, and are fringed with a few long filaments, each of which receives a small branch of the tracheal vessel that runs through the length of the plate. A slight constriction near the middle of each plate appears to divide it into two parts, but it can scarcely be called an articulation. These plates are held nearly at right angles to the sides of the segment on which they are placed, and they do not vibrate during respiration. The second abdominal segment is without branchial appendages. The second pair of plates arise from the junction of the second and third abdominal segments, fitting underneath the dorsal projection of the second segment, against which the plates are raised and kept rigid during respiration. They are very large and thick, obtusely oval, somewhat conical anteriorly, ciliated on the margin, and in the full-grown nymph they cover the remaining posterior gills during repose, the left plate slightly overlapping the right. In the specimen represented in the drawing the length of these plates was about $\frac{1}{40}$ of an inch. On the under surface of each of these plates a trachea runs in a longitudinal direction, giving off branches at each side. The remaining gills, of which there are four pairs, are situated on the dorsal surface of the fourth, fifth, sixth, and seventh abdominal segments. They are thin and delicate, somewhat ovoid in form, and are fringed with long filaments on the margins. The trachea divides near the base of each plate into several branches, the sub-divisions of which are continued into the marginal filaments, *i.e.*, each filament receives a single branch. The plates on the fourth segment are about half the length of the large protecting plates, those on the posterior segments gradually diminishing in size from the fourth to the seventh segments, the last being about $\frac{1}{100}$ of an inch in length. In the full-grown nymph each of these plates covers to some extent the posterior plate contiguous to it, and their terminal filaments are intermingled when the insect is not engaged in the visible act of respiration. This provision prevents the introduction of foreign matter between the plates, a protection which appears to be necessary on account of their delicacy and the burrowing propensity of the nymph.

When the nymph respire, the large plates on the third segment are raised and fixed against the edges of the second segment at an angle of about 50° above the dorsal surface. They never vibrate. The four posterior pairs of membranous gills also are raised, and are kept in rapid vibration until they are lowered again. The first pair are held nearly parallel to the protecting pair, whilst vibrating through a small angle. The second pair are more depressed, the third still more so, the last pair being raised not more than 20° or 25° above the dorsum. The number of vibrations which I counted during one observation amounted to about 250 per minute. The

sight of this phenomenon through the microscope is one of considerable interest. The protecting plates are first raised, when the four pairs underneath are immediately seen in their proper positions in rapid and rhythmical motion, the long fringes lashing the water and creating currents that send the floating particles of matter eddying in the most tortuous courses; when, after continuing in action for a minute or two, the protecting plates suddenly descend upon the rest, and, instantly pressing them out of sight, leave nothing visible but the upper surfaces of the large plates in perfect repose. Those who delight in witnessing such sights as the circulation of the blood, as seen in the vascular plexus of the frog's web, or the beautiful contortions of the tentaculated crowns of the polyzoa, may perhaps find a new sensation in witnessing the branchial performance of the nymph of the genus *Cænis*.

An interesting discovery in relation to the circulation of the blood in the Ephemeriðæ has comparatively recently been made by Herr O. Zimmermann, and recorded in the *Zeitschrift für wissenschaftliche Zoologie*, for 1880. A note alluding to this discovery will be found in the Journal of the Royal Microscopical Society for last year. It had been long known that the valves which separate the dorsal vessel into chambers open in an anterior direction, the contractions of each chamber propelling the blood forward towards the head; but how this fluid not only entered the long caudal appendages, but was also maintained in active circulation through the greater portion of their length, was a problem which entomologists had not satisfactorily solved. The German investigator has found in some of the smaller larvæ, such as *Cloëon* and *Cænis*, a provision for this purpose. In the last chamber the valve, instead of opening forwards, opens backwards, so that when that chamber contracts the blood is forced backwards into the central vessel of each seta, from which it finds its way through a long oval aperture into the peri-vascular cavity, and is then propelled forwards again by what physiologists call the *vis a tergo* of the current. The walls of these appendages being very thin, allowing the return current of the blood to come very close to the surface, it is supposed that the circulation here has a respiratory function as well as a nutritive one.

There is still much to be learned with regard to the aquatic forms of this family of insects. Some of the nymphs are imperfectly known, especially in the early stages of their growth; and any scientific microscopist who will trace the life-history of some of the rarer species from the egg to the imago, will not only throw some light upon the development of the Ephemeriðæ, but may possibly be a contributor of important facts to the domain of entomological physiology.