The Bionomics and Anatomy of Stenoperla Prasina. (Newman).

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INTRODUCTION AND HISTORICAL.

IT is the object of this paper to investigate the bionomics and anatomy of the hitherto little known, archaic, but highly specialised stone-fly, *Stenoperla prasina.*

Newman (1845) first described it as *Chloroperla prasina* from a dried specimen in the British Museum, but observed that " This large and striking species agrees but indifferently with the genus *Chloroperla,* or, indeed, with either of the restricted genera of Perlidae."

Walker (1852) placed it in the genus *Hermes,* retaining the specific name, but McLachlan (1867) finally made a new genus of Perlidae, *Stenoperla prasina,* basing his classification on the similarity between the maxillary palpi, and the distribution of the transverse veins on the posterior wings of this genus, to that of *Eusthenia.*

Hutton (1898) gives a brief description dealing only with the morphological characters both of the genus and of the species, but makes no further reference to other parts.

Hudson (1892) describes and figures it in his Manual of New Zealand Entomology. In 1904 he gives a general description of the genus, figuring the adult and the nymph. For the first time the bionomics are recorded, where he gives the type of stream in which the insect is found; its location; its food and manner of catching; and observes that it might prove fatal to young trout. A description of the larva is given together with its manner of hatching and the various places where the latter takes place. Finally, he says that the perfect insect appears in November, December, and a few in January. No detailed account of the insect is, however, attempted.

Tillyard (1921) revised the classification of the Order Perlaria based on a study of world fauna, particularly in reference to the archaic types of the Southern Hemisphere. Here the Eustheniidae are for the first time recognised as a distinct family with their

characters clearly defined. The distinguishing feature of the family, apart from its archaic structures, is that the anal area of the hindwings is very large, its margin forming a continuous curve with the rest of the wing.

In the same paper he points out that the " larvae of an unknown species of *Stenoperla* have long been known to me as occurring quite commonly in the fast streams of the Blue Mountains and South Coast districts of New South Wales." The relation between *Stenoperla prasina* and *Diamphinoa* is so close that he proposed associating them together in a new sub-family *Stenoperlinae,* which is found in Australia, Chile, and New Zealand, and nowhere else throughout the world. Finally he splits the genus into two, naming his unknown species *Stenoperla australis.*

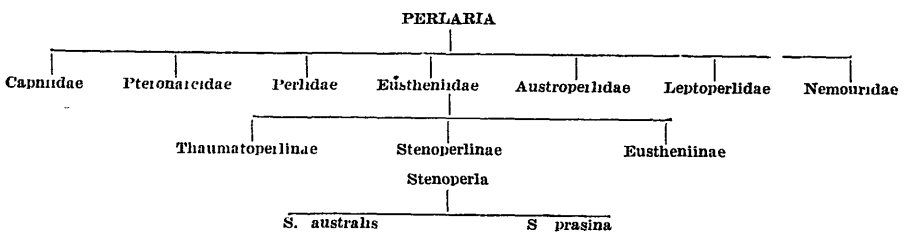
In 1923 he published, for the first time, a key to the family of New Zealand Perlaria, describing both the sub-families and the genus; he figures the wing venation. This classification is the one adopted in the present paper.

Imms (1925) mentions *Stenoperla* in his classification, which is based on Tillyard's, and figures Tillyard's wing venation, but makes no mention beyond this.

Tillyard (1926) figures the adult and wing venation, but does not enter into a description of it.

This concludes the review of the literature to date, from which it is seen that the knowledge of the more minute structures of this genus is very meagre, and that of the internal anatomy is entirely lacking.

Classification.



The Order Perlaria comprises the stone-flies which are cosmopolitan and possess aquatic nymphal stages. Tillyard (1921) formed the new family Eustheniidae, giving the following characters in his key:—

" Large insects with numerous cross-veins on all parts of the wing, including the anal fan, whose margin forms an unbroken contour with that of the rest of the hindwing. This latter distinguishes the Eustheniidae from all other Perlaria. Larvae with visible gills, which are a series of paired latero-ventral abdominal appendages on segments one to five, or one to six."

In (1923) the same author split this family into three different sub-families all closely allied, and defined the Stenoperlinae as being:

" Insects of large size, slender build, and of green, yellow, brown, or grey coloration. Forewing about five times as long as broad, the costa not dilated basally. Cerci short. Male with short superior appendages and short upturned copulatory hook."

The Stenoperlinae contains two genera each with two species, of which *Stenoperla* is distinguished as being " moderately large insects with a wing expanse of from fifty to seventy millimetres. Antennae from one-half to one-third as long as forewing. Pronotum somewhat heart-shaped, about as wide as long. Costal series of veinlets few and incomplete, there being always a long gap between the humeral veinlet and the next one. Medio-cubital cross-veins in the forewing forming a single row of cellules, only occasionally connected by a cross-bar."

Stenoperla prasina is easily recognised by its large size and by the bright green colouration of the wings.

Habitat.—It is found in all parts of New Zealand, being most abundant in the cold mountain torrents, and occurring less frequently in the shingle rivers of the plains. It is not nearly so numerous as Hudson (1904) states, and is not always found wherever there is running water. Occasionally a yellow variety is found in which, according to Tillyard, the wings are somewhat shorter than in typical specimens.

Type.—In British Museum Collection.

The only other species in this genus so far described is *Stenoperla australis,* which occurs in eastern Australia, but it is probable that other species will be discovered when more extensive collecting and work has been accomplished on this genus.

DISTRIBUTION.

The distribution of the Stenoperlinae is extremely interesting in that it brings out the relationship between Chile, New Zealand, and Australia, as indicated by other distributions. This sub-family occurs in South Chile, the whole of New Zealand and eastern Australia, including South Australia, but excluding Tasmania, and nowhere else in the world. Its absence from Tasmania is probably due to the fact that extensive collecting as yet has not been carried out in this area. *Stenoperla* occurs in eastern Australia and New Zealand, whilst the closely allied genus *Diamphinoa annulata* (Brauer) occurs in Chile, which might be taken as evidence supporting a southern connection between these land masses.

METHODS AND MATERIAL.

Collecting.—Nymphs were collected from a number of different localities described later in the section dealing with Bionomics. They were collected at different times of the year by means of a net of about ten to twelve inches diameter, made of Aertex material supported on a wire frame. This net was placed on the down-stream side of the stone to be lifted, and, as this was performed, quickly brought into position beneath it. By this means all nymphs clinging to the underside of the stone were swept into the net by the force of the current. Living nymphs were transported to the laboratory in glass jars whose stoppers were pierced with holes. These jars were filled with damp moss and fern and all the water poured off. Fresh water was flowed on and then poured off again each day. Nymphs

were kept alive by this means for considerable periods, and, indeed, four overlooked after one field expedition lived in the damp moss for six weeks.

Rearing.—At first nymphs were found difficult to rear, due to variations in temperature and oxygen content, but these two difficulties were finally overcome; firstly, by setting up the cages in a position in the laboratory where very slight change of the temperature of the surrounding atmosphere took place, and, secondly, by using watertight cages with gauze tops and glass fronts. These cages were connected to an aeration system whereby a continuous stream of air was kept passing through the water. Sand and stones were placed on the bottom of the cages, and nymphs were fed on the nymphs of mayflies, *Deleatidium sp.*, and *Coloburiscus sp.*

Material.—Material for fresh dissection was killed in hot water and dissected in Ringer's Solution, while the major portion of dissections was performed on material killed and fixed in five per cent. formalin. For the dissection of very small systems such as the sympathetic nervous, etc., very fine glass needles, made by drawing out glass rods to various shapes and thicknesses, were found indispensable.

Reactions to Light.—Reactions to light were conducted in a wooden box (Pl. 43, Fig. 41) divided into two compartments communicating with one another at the bottom. Each compartment was capable of being rendered dark by means of a lid, and each was connected to the aeration system so that the oxygen content on each side would be approximately the same. By this means the oxygen factor was eliminated. No food, stones, vegetable matter, or anything likely to cause the attraction of the nymphs was placed in the apparatus.

Mounting.—Whole mounts of legs, mouth-parts, tentorium, and wing-buds, after maceration—except the last—were mounted in De Faure's Fluid (Imms 1929). This gave better results than Canada balsam, rendering structures clearer, especially after a day or two. Picro-nigrosin or Fuchsin was used to stain chitinous structures including, besides those mentioned above, the sclerites and genitalia. Wing-buds were mounted by the Comstock-Needham method for tracheation.

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