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Apatidea auricula Forsslund from a Norwegian Mountain Lake.

Description of the Imago and Notes on the Biology.

By

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During a short recreation-trip to Norway in the summer of 1936 I made some few and scattered freshwater-biological observations in Jotunheimen, the highest, and some of the wildest, of the Norwegian mountains (between 61° and 62° northern latitude). The most interesting of these was the fairly abundant occurrence of a species of *Apatidea* at Ulatjern. This small lake (fig. 1) is situated 1592 m above sea-level, surrounded on all sides by snow- and ice-covered peaks. The estimations of the snow-line in central Jotunheimen vary between 1700 and 1850 m, but when I visited the lake (August 4th), larger and smaller snow-covered areas were seen at much lower levels, for instance near the edge of the tarn.

The lake is divided into two basins connected by a small channel or brook. The area is 0.11 (northern basin) + 0.28 sq. km (southern basin). The shores are made up of large boulders, which also form the bottom of the lake as far out as the eye can reach. In places small patches of soil are found among the stones, in which the glacier-crowfoot (*Ranunculus glacialis* L.) — the only seed-plant at these altitudes — is common.

The water has the intense, opalescent green colour characteristic of lakes fed by melt-water.

No meteorological data concerning this locality are available, but Strøm has given the following particulars regarding other mountain-lakes in adjacent parts of Norway: At Flakevatn (1448 m above sea-level) the

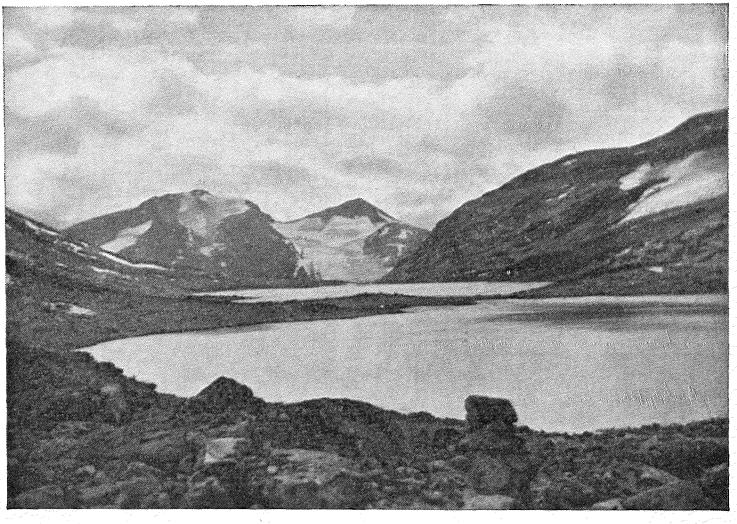

Fig. 1. Ulatjern, looking towards the SW. 4/8 1936.

mean temperature in centigrades (7, p. 16) is: year — 3.9, June 2.8, July 4.7, August 4.4, September 0.9; only in these four months does the temperature rise above zero, and no month is normally without frost. The temperature at Ulatjern may be about 1 degree lower. In Feforvatn (878 m above sea-level; 6, p. 501) the ice breaks in the first half of June, and the lake freezes again in the first half of November, in Finsevatn (1214 m above sea-level; 7, p. 23) the time of the melting of the ice varies from the latter half of June to the first half of August. The highest surface temperature measured in

Flakevatn (7, p. 22) is 7.05°. Thus the ice-free period in Ulatjern hardly extends over much more than two months, and in cold summers it is no doubt shorter. Indeed, the life-conditions are of an extreme character, and — as far as I am aware — Trichopterons have not previously been recorded from Scandinavia from such a great altitude.

In the early afternoon the caddis-flies flew lively about along the shore, but in the very moment the sun was hidden behind a cloud, they all settled down upon the stones. They eagerly visited the glacier-crowfoot, where they sat with their heads buried between the stamens, no doubt sucking honey. As I was unable to detect any other insect which could be responsible for the fertilization of this plant, I think that in this respect *Ranunculus glacialis* must depend on the caddis-flies, at any rate at these altitudes.

The larvæ (the last three instars, but mainly the oldest) were seen scrambling rapidly over the stones near the water's edge. It was, of course, impossible to ascertain how far out in the lake they lived. An examination of the intestine-content proved that it consisted of small diatoms and minute algæ, mixed to a very great extent with clay-particles and minute sand-grains, which formed, perhaps, more than half of the content. The food is thus of the same kind as in *A. muliebris* (5, p. 585 and 619), but in order to secure it, *A. auricula* must swallow enormous quantities of worthless inorganic matter. No doubt the "microflora" is but poorly developed in such localities, and this may explain the great activity of the larvæ as compared with *A. muliebris*.

Strøm (7, p. 23) thinks that in exceptionally cold summers Flakevatn has no ice-free period at all. If this be true, the same must be the case with Ulatjern, which would seem fatal to the caddis-flies. However, it has been found that in the springs of Himmerland, at a tem-

perature of 7.5 centigrades, *A. muliebris* spends the winter in its closed case beneath stones (5, pp. 587 and 624), and the same is very likely the case with *A. auricula,* too. Considering the much lower temperature (no doubt below 1° C.) it is perhaps not quite impossible that *A. auricula* may spend two winters and one summer in this way.

The imago is described below, while a description of the larva will be published later. — The description given by Forsslund (1) is not quite easy to under-

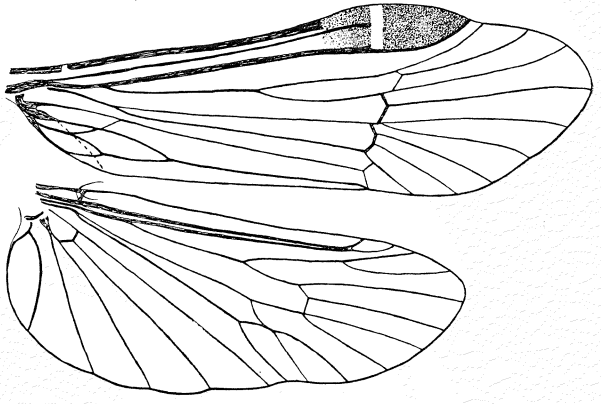

Fig. 2. Right wing of ♂. 8/1.

stand, being rather brief and without illustrations. In some details, especially regarding the shape of the second joint of the lower appendages and of the titillators, it does not seem to agree very well with the species in question. Still I have preferred to describe it under this name rather than to erect a new doubtful species.

Body-length 5.0—7.2 mm, length of fore-wing 7.1—10.6 mm. The species has the general appearance of the genus, i. e. head, thorax, and coxæ blackish-brown, abdomen and distal joints of the legs of a lighter colour. The fore-wings are smoke-brown, the hind-wings lighter. The pterostigma is prominent in the ♂ (fig. 2), rather

inconspicious in the ♀. In the posterior wings M_{3+4} and Cu_1 are confluent for a short distance. Spur-formula 1, 2, 4; on the hind-tibia the apical spurs are twice as long as the subapical ones, and of these the oral (outer) one is much larger than the anal one.

♂ (fig. 3): Segment IX is short dorsally, where the rear margin is concave, longer ventrally. Segment X (fig. 4 A) is large and in its distal half divided into three horns, a paired dorso-lateral and an unpaired medio-ventral one. The former are a little compressed from side to side and very slightly downward curved; the lower edge bears two or three short thorns distally, two behind each other in the middle, and a small one rather basally; (perhaps the number of thorns varies a little more). The median horn is only half as long as the lateral ones; it is beak-like with a convex upper and a plane lower surface. Basally and laterally on the upper surface segment X bears the upper genital appendages, which are small (scarcely half as long as the lateral horns) and flattened. The lower appendages rather porrect, two-jointed. The basal joint is stout with a very convex outer surface and a plane inner surface, which is produced distally into a backward-directed tongue-shaped process. Between this and the apex — thus a little medially — there is a depression in which the distal joint lies. This joint is very short ("flat"), and its distal end is half-cylindrically excavated in a transverse direction, so that a dorsal and a ventral lip arise. The latter is rounded, the former, much larger, is produced into a point directed a little inwardly. The dorsal surface of the upper appendage and the outer surface of the basal joint of the lower appendages are mat with minute wrinkles, the other parts mentioned are smooth and shining. Segment IX is furnished latero-ventrally with rather long bristles; on the outer surface of the basal joint of the lower appendages numerous

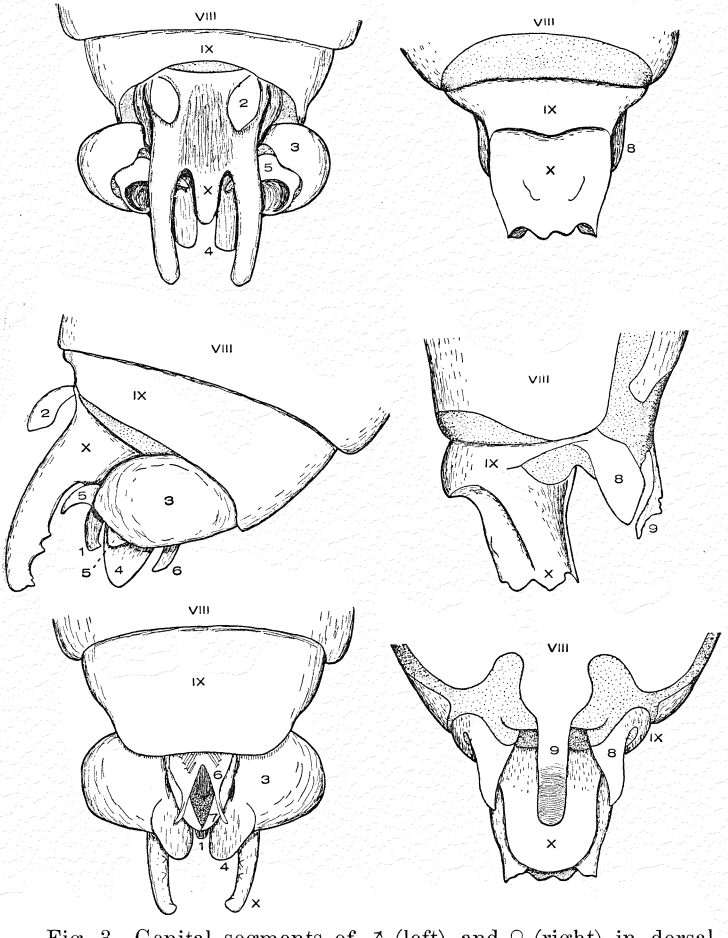

Fig. 3. Genital segments of ♂ (left) and ♀ (right) in dorsal, lateral (right), and ventral view. 56/1. VIII—X) segment VIII—X, 1) medio-ventral horn of X, 2) superior appendage, 3) proximal joint of lower appendage, 4) distal projection of proximal joint, 5) distal joint of lower appendage, 6) ædeagus, 7) titillators, 8) side-lobes, 9) vulvular scale. In order not to make the figure too complicated, the bristles (except those of the ædeagus) are omitted. In this and the following figures soft parts are indicated by dots.

big, light-brown and slightly curved bristles are found, on the edges of the second joint there are some few and small, but relatively thick, yellow bristles; about 10—12 of the same kind are seen on the ventral surface of the lateral horns of segment X, and on the upper surface of the median horn is a pair of small, pale bristles; finally, the dorsal surface of the upper appendages bears numerous small and thin bristles. The ædeagus (fig. 4 B, C) is large, constricted distally to the middle and again dilated towards the apex, which is cleft and produced into two thin vertical lamellæ. The distal part of the ædeagus is excavated dorsally; the concavity thus formed is open at the rear end, and at the sides limited by sharp ridges, which continue in the dorsal edges of the above-mentioned lamellae; on its front margin opens the ejaculatory duct. Behind this opening there is a tuft of about 16 very stout, copperyshining, backwardly directed spurs, which, less magnified, suggest a median unpaired lobe projecting between the lamellae. On the plane ventral surface spurs of the same kind are arranged in two oblique rows with 4—5 in each. The titillators (fig. 4 B, D) are thickest near the apex and attenuate towards both ends, particularly towards the distal end, which is flattened and curved inward.

♀ (fig. 3): Segments IX and X are fused, but dorsally their outlines are easily made out, since the upper surface of segment X is lowered in relation to that of segment IX. In the middle the rear margin of the latter is drawn a little backward. The lover surface of segment X forms a spade-shaped supragenital plate, which is nearly plane with a rounded rear margin and the middle of the front margin produced into a very short stalk. The vulvular scale has parallel sides and a rounded apex; in the distal two-thirds it is transversely wrinkled. The side-lobes are nearly triangular,

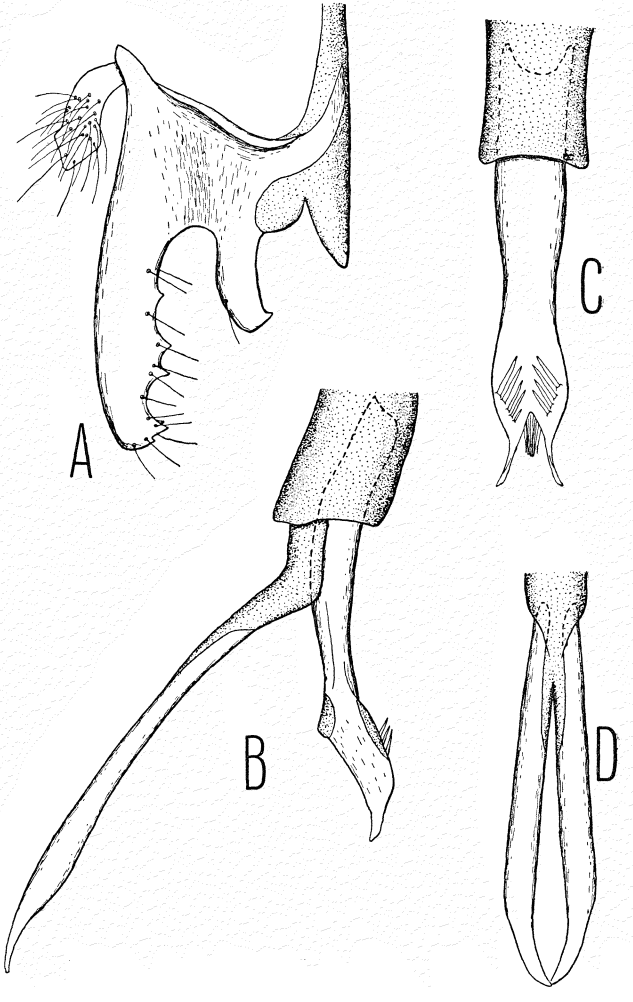

Fig. 4. Details of ♂ genitals. A 105/1, C—D 70/1. A, segment X seen from the right, B, ædeagus and titillators seen from the right, C, ædeagus, seen from below, D, titillators seen from above.

a little shorter than the vulvular scale; in lateral view they are clearly seen to be outgrowths of segment IX, and are thus perhaps homologous with the lower appendages of the ♂. The distal parts of the dorsal and lateral surfaces of segment X and the outer surface of the side-lobes are provided with numerous fine bristles.

Within the vaginal chamber there is an elaborate apparatus. Morton (3) was the first to draw attention to this "internal apparatus" as a means to distinguish the ♀♀ of this subfamily, but a satisfactory description seems never to have been published, and the existing figures do not convey any idea of the real nature of these structures. The vaginal chamber (fig. 5) is formed by fusion of the distal parts of the common oviduct and the common duct of the large bilobed colleterial glands, the former being ventral, the latter dorsal in position. At the point of junction a somewhat sclerotizised, tongue-shaped and distally bluntly pointed lobe projects backward into the vaginal chamber, thus forming a boundary — though anally rather incomplete — between the dorsal and ventral parts of this chamber. The lobe (perhaps Morton's "central triangular piece") on its ventral surface bears a highly sclerotizised longitudinal ridge (Morton's "foot-shaped piece"), which is bluntly pointed distally and constricted near the knob-shaped proximal end. (This ridge, in particular, may be of value for a distinction of the species). The ventral surface is all around separated from the body of the lobe by a furrow, which is deepest at both ends. The narrow duct of the bursa copulatrix penetrates the lobe and opens distally on the ventral surface of the ridge. The wide duct of the receptaculum seminis (the function of this organ is obscure) opens beneath the lobe; the lip between it and the oviduct is heavily sclerotizised and fits into the furrow between the lobe and its ventral ridge. At the floor of the vaginal chamber there is a

pair of folds, proximally low and indistinct, but distally forming a common, sclerotizised spout, which fits the distal end of the ridge. (This spout may perhaps also be the "central triangular piece" of Morton). At the

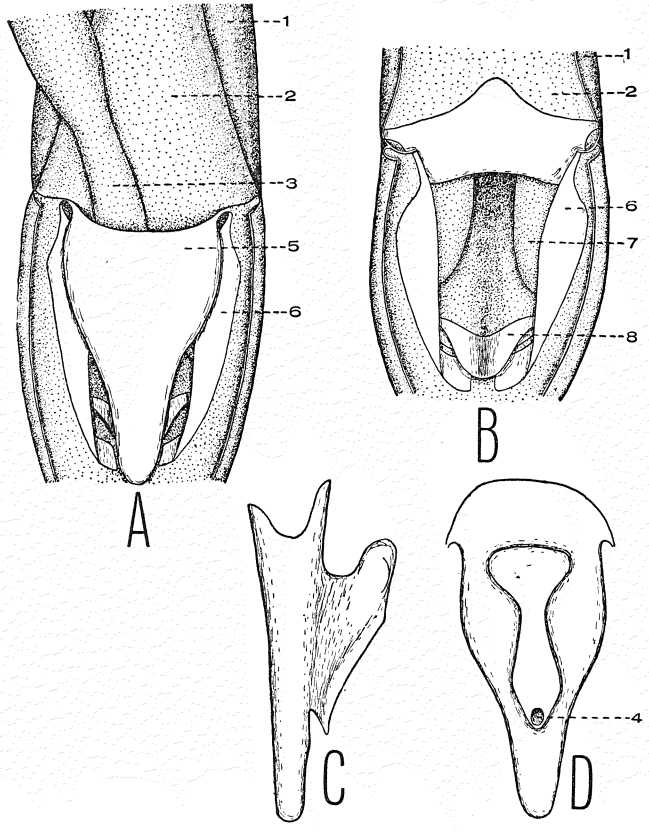

Fig. 5. "Internal apparatus" of ♀, 105/1. A, in dorsal view, colleterial duct and dorsal wall of vaginal chamber removed. B, same after removal of tongue-shaped lobe and dorsal wall of duct of receptaculum seminis. C, tongue-shaped lobe in lateral (right) view. D, same in ventral view. 1) common oviduct, 2) duct of receptaculum seminis, 3) duct of bursa copulatrix, 4) opening of this, 5) tongue-shaped lobe, 6) dorso-lateral, 7) ventro-lateral, and 8) ventral fold of vaginal chamber.

sides of the ventral part of the vaginal chamber there is a ventral pair of thick soft folds, which do not reach the posterior extremity, and a dorsal pair of rather thin, at the rear end sharp, folds, whose edges are sclerotizised (no doubt Morton's "lateral blades"). The distal ends of their sclerites continue — though rather faintly developed — on the floor of the vaginal chamber, the attenuate proximal ends are connected with the edges of the ventral surface of the dorsal lobe. Finally there are two pairs of longitudinal, rod-shaped sclerites at the lateral walls of the upper part of the vaginal chamber (which is derived from the colleterial duct). — During copulation the distal end of the ridge probably fits into the cleft apex of the ædeagus, and the tuft of spurs may play a role in conducting the sperma to the opening of the bursa copulatrix. The dorsal lobe, whose ventral ridge in a resting position closes the exit of the oviduct, may also play an important part in the egg-laying.

MacLachlan (2) recognized three palæarctic genera of *Apataniinæ*, separated by the spur-formulæ (*Apatania* 1, 2, 4; *Apatidea* 1, 2, 2; *Radema* 1, 2, 3). Wallengren (8) later subdivided *Apatania* into the genera *Apatania* and *Apatelia*, characterized as follows: *Apatania:* superior appendages absent in the ♂, in the hind-wing subcosta and radius are parallel throughout their course; *Apatelia:* superior appendages present in the ♂, in the hind-wing subcosta and radius are confluent near the apex. The latter character is somewhat obscure, but another character of the veins seems also to hold good (even if it does not appear so from Wallengren's statement): in the hind-wing of *Apatania* M_{3+4} and Cu_1 are connected by a small cross-vein, in *Apatelia* they are confluent for a short distance. However, Mosely (4) points out, that the spur-formulæ of *Apataniinæ* can be attributed but specific value, and that in all other

respects *Apatelia* shows conformity with *Apatidea;* hence the genus *Apatelia* should be included in the genus *Apatidea,* the latter name having the priority. The conditions in the present species fully confirm the opinion held by Mosely; the development of the spurs of the hind-tibia forms a transition to both the spur-formulæ: 1, 2, 3 and 1, 2, 2.

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Dansk Oversigt.

Under en kort ferierejse i Norge i 1936 havde jeg lejlighed til at gøre nogle faa og spredte ferskvandsbiologiske iagttagelser. Den mest interessante af disse var forekomsten i temmelig stort antal af en vaarflueart af slægten *Apatidea* ved Ulatjern. Denne lille sø, der er paa størrelse med Lyngby sø, ligger midt i Jotunheimen, 1592 m over havet, paa alle sider omgivet af sne- og isklædte tinder. Kysten og søens bund — saa langt ud som den kan ses — bestaar af storstenet ur. Vandet har den opalescerende

grønne farve, der er saa karakteristisk for smeltevandssøer. Angivelserne af snegrænsen i Midt-Jotunheimen varierer fra 1700—1850 m, men da jeg besøgte søen (4. august), saas større og mindre sneklædte partier i langt lavere højde, bl. a. nær søens bred. Efter de oplysninger, der kan faas om klimaet i tilgrænsende norske fjeldegne, maa det antages, at middeltemperaturen ved Ulatjern kun i 3—4 maaneder hæver sig over 0°, at den i den varmeste maaned er knapt 4°, og at søen næppe er isfri mere end to maaneder, ja, at isen maaske slet ikke bryder op i særlig kolde somre. Livskaarene er saaledes af meget ekstrem karakter, og vaarfluer er — saa vidt jeg ved — ikke tidligere fundet i en saadan højde i Skandinavien. — Det blev iagttaget, at imagines, der i den tidlige eftermiddag fløj livligt rundt i solskinnet, sugede honning af isranunklens blomster, som voksede almindeligt ved søens bred. Da der ikke saas andre blomsterbestøvende insekter i denne højde, er isranunklen sikkert afhængig af vaarfluerne i saa henseende. Larverne fandtes paa stenene nær stranden. De ernærer sig ved at skrabe diatomeer og encellede alger af stenene. — Arten (længde 5.0—7.2 mm, vingefang 15—22 mm) er formentlig identisk med den af Forsslund kort beskrevne *A. auricula*. En udførlig beskrivelse af artskaraktererne er givet. Herved er for første gang givet en virkelig beskrivelse af de komplicerede dannelser, som findes i de hunlige udførselsveje hos *Apataniinae*.