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TAXONOMIC AND LIFE HISTORY NOTES ON NORTH AMERICAN *EUPITHECIA* (LEPIDOPTERA, GEOMETRIDAE)

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Since the appearance of McDunnough's "Revision of the North American species of the genus *Eupithecia*" (1949), some additional information has come to hand, and it is felt that this should be made available at this time. This includes both taxonomic and life history studies, the latter with the main emphasis on the pupae. Accordingly, this paper is divided into two parts to facilitate the handling of the material.

ACKNOWLEDGMENTS: The author wishes to acknowledge with thanks the cooperation and aid of the following people who have allowed him to study specimens in their charge and who have examined types not available to the author: Mr. D. S. Fletcher of the British Museum (Natural History); Mr. C. Herbulot of the Museum National d'Histoire Naturelle, Paris; Miss Margaret R. MacKay of the Forest Insect Investigations, Division of Forest Biology, Ottawa; and Dr. James H. McDunnough and Mr. Douglas C. Ferguson of the Nova Scotia Museum of Science, Halifax.

TAXONOMIC NOTES AND DESCRIPTIONS

***Eupithecia bryanti* Taylor**

Eupithecia bryanti TAYLOR, 1906, p. 392. MCDUNNOUGH, 1949, p. 569, pl. 27, fig. 7, text fig. 4D. MACKAY, 1951, p. 91.

A series of *Eupithecia* collected at Birch Creek Cabin, Steese Highway, Alaska, August 3, 1949 (G. E. Pollard), is referable

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to this species. The distribution as given by McDunnough is from central California to the Stikeen River, British Columbia; Utah; and Alberta. This is the first Alaskan record for the species.

***Eupithecia castigata* (Hübner)**

Geometra castigata HÜBNER [1809–1813], pl. 89, fig. 456.

Eupithecia castigata, MCDUNNOUGH, 1949, p. 575, pl. 27, fig. 16, text fig. 5B. MACKAY, 1951, p. 90.

Eupithecia implicata WALKER, 1862, p. 1241. MCDUNNOUGH, 1949, p. 672 [as synonym of *anticaria* Walker]. (New synonymy.)

Fletcher has made a genitalic preparation of the type of *implicata* and has found that it is referable to *castigata*.

***Eupithecia suspiciosata* Dietze**

Figure 1A

Eupithecia suspiciosata DIETZE, 1875, p. 252, pl. 2, fig. 4. MCDUNNOUGH, 1949, p. 596 (*partim*).

Fletcher has examined the cotype of this species in the British Museum and has made a genitalic preparation thereof. This shows that this specimen is a different species from that given by McDunnough in his revision. Through the kindness and courtesy of Mr. Fletcher, it was possible to borrow the slide of this cotype and to make the following description and accompanying drawing.

FEMALE GENITALIA: Dorsal plate of segment VIII weakly sclerotized, rectangular; anterior apophyses with well-developed caudal spurs, the latter ending in narrow sclerotized strips on the membranous ventral area of segment VIII; ostium membranous; ductus bursae with posterior portion membranous, anterior part sclerotized laterally with more membranous, narrow, median strip; bursa copulatrix subovate, membranous except for an elongate, narrow, very slightly S-shaped, sclerotized plate on right side near junction with ductus bursae, bursa copulatrix with lateromedian portions set with numerous fine, internal, hair-like setae on ventral surface, roughly semicircular in outline; between these areas of setae arises the broad ductus seminalis, extending caudad and curving to the right; dorsal surface of bursa copulatrix membranous except for a few scattered, hair-like setae in median area.

While it has not been possible to examine the type of *suspiciosata* in the Zoological Museum in Berlin, it is here assumed that

the cotype is conspecific with the type. If this is so, the species described and illustrated by McDunnough is without a name, so, at Fletcher's suggestion, the following is proposed:

***Eupithecia macdunnoughi*, new species**

Eupithecia suspiciosata McDUNNOUGH (not Dietze), 1949, p. 596 (*partim*), pl. 28, fig. 13, text fig. 7F.

The adult and both male and female genitalia were described and illustrated by McDunnough.

Types: Holotype, female, Spring Mountain, Napa County, California, March 14, 1947 (W. R. Bauer); allotype, male, San Anselmo, Marin County, California, February 22, 1947 (F. H. Rindge). Paratypes, two females: same data as holotype; Mill Valley, Marin County, California, February 22, 1947 (F. H. Rindge). All types are in the collection of the American Museum of Natural History. The holotype is the specimen illustrated on plate 28, figure 13 (McDunnough, 1949).

Also included under this name are the specimens from Provo, Utah, April 7, 1909 (Tom Spalding), and Saw Mill Spring, Charleston Mountains, Nevada, May 11, 1934 (G. H. and J. L. Sperry) mentioned by McDunnough.

***Eupithecia coagulata* Guenée**

Eupithecia coagulata GUENÉE, 1857, p. 339.

Eupithecia geminata PACKARD, 1873, p. 58. McDUNNOUGH, 1949, p. 615, pl. 29, figs. 4-6, text fig. 9F. (New synonymy.)

Herbulot has made a genitalic preparation of the male type of *coagulata* in the Paris Museum and finds that it is not the *coagulata* of the McDunnough revision but is the same as *geminata* Packard. Accordingly, the Packard name must be placed in the synonymy of *coagulata* Guenée.

***Eupithecia fumosa* (Hulst)**

Tephroclystis fumosa HULST, 1896, p. 269.

Eupithecia coagulata AUCT., nec Guenée. McDUNNOUGH, 1949, p. 613, pl. 29, fig. 1, text fig. 9D.

As *coagulata* Guenée is not referable to this species (see above), *fumosa* Hulst must be raised from the synonymy and is available for this species.

***Eupithecia johnstoni* McDunnough**

Figure 1B

Eupithecia johnstoni McDUNNOUGH, "1945" [1946], p. 173, pl. 9, fig. 7; 1949, p. 656, pl. 30, fig. 35, text fig. 14F.

A number of specimens of this species are in the author's collection. The localities are all northeastern California and are as follows: Coleville, Mono County, June 25 to July 7, 1948 (R. Coleman); Alturas, Modoc County, June 9-14, 1948 (R. Coleman); Hornbrook, Siskiyou County, June 16, 1948 (R. Coleman). These localities and dates extend the known range and flight periods of this species, as it was previously known only from the type locality, Lone Pine, Inyo County, California, May 4, 1940 (E. C. Johnston).

The original description and subsequent notes in the McDunnough revision adequately describe the adults and male genitalia. In expanse, the males range from 16 to 20 mm., the females, 16 to 17 mm. The female genitalic structures are similar to those found in *dichroma* McDunnough and *rindgei* McDunnough.

FEMALE GENITALIA: Segment VIII lightly sclerotized; ostium membranous; ductus bursae a long thin tube, only slightly expanded at junction with bursa copulatrix; ductus seminalis arising ventrad of junction of ductus bursae and bursa copulatrix, going to left side at approximately a right angle to the ductus bursae; bursa copulatrix entirely membranous, large, somewhat elongate, with faint indications of very fine spiculations on right side.

***Prorella emmedonia* (Grossbeck), new combination**

Figure 1C, D

Eupithecia emmedonia GROSSBECK, 1908, p. 24. McDUNNOUGH, 1949, p. 643, pl. 30, fig. 19.

A specimen from Moro Bay, California, August 30, 1945 (A. L. Melander), *ex* collection G. H. and J. L. Sperry, now in the collection of the British Museum, is apparently referable here. The specimen agrees well with the original description and the photograph of the type as given by McDunnough; it has a wing expanse of 16.5 mm. McDunnough, in his revision, expressed doubt as to its being a true *Eupithecia*, and lack of material prevented him from accurately placing it.

A slide of the male genitalia shows a close relationship to the corresponding structures of *Prorella mellisa* (Grossbeck) (McDunnough, 1949, p. 702, pl. 32, fig. 26, text fig. 20F). The ventral plate of segment VII is conical, concave medially at the base, and terminates in two fairly strong, elongate projections; the plate of the type of *mellisa* is missing, as mentioned by McDunnough. Segment IX has the hair pencils strongly developed in *emmedonia*. As far as can be told, the genitalia are very similar; in the aedeagus, both species have the same fan-shaped sclerotized piece, a feebly dentate bar, and a short spine in the apical areas. In *emmedonia*, the fan-shaped piece appears smaller

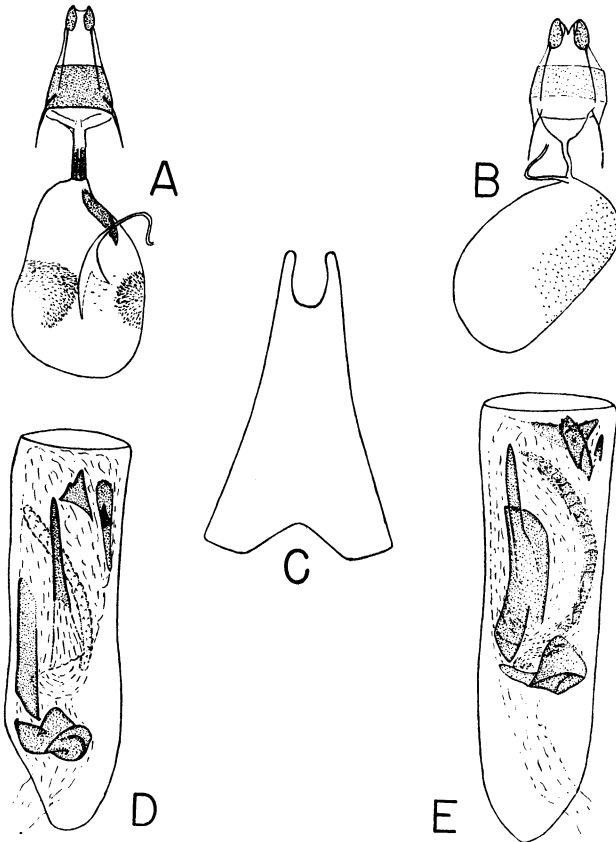


FIG. 1. Genitalia. A. *Eupithecia suspiciosata* Dietze, cotype female. B. *E. johnstoni* McDunnough, female. C, D. *Prorella emmedonia* (Grossbeck) male ventral plate and aedeagus. E. *P. mellisa* (Grossbeck), holotype male aedeagus.

and not so broadly triangular, the dentate bar is more elongate, and the short spine is located slightly more basad as compared with the holotype of *mellisa*. The long thin spine and the underlying, semicylindrical, chitinous bar are very similar in both, while the basal twisted end piece appears to be more strongly twisted in *emmedonia*. The thin, curved, spiculate band running through the central section of the aedeagus is apparently not so strongly developed in *emmedonia* as in the type of *mellisa*. Drawings are given to show the aedeagus of both species; owing to their being mounted at slightly different angles, the differences shown may be more apparent than real.

In the collection of Mr. Sperry is a single female, labeled Moro Bay, California, August 28, 1945 (A. L. Melander), that is apparently this species. The maculation is very similar to that of the type of *mellisa*, although this specimen is fresher and has a well-defined ochreous median band. The wing expanse is 17.0 mm. It has the same frontal structure as *mellisa*, but differs in having two pairs of spurs on the hind tibia. The genitalia are of the same type as those found in the *mellisa* group, although the apophyses of the ovipositor are only two-thirds as long as those in *mellisa*, and the central area of the ventral surface lacks the spined area. The dorsal plate of segment VIII is weakly sclerotized and has the ventral margin rather deeply indented medially, more sharply so than in *mellisa*. The ductus seminalis arises on the right side but farther laterad, and the sclerotized area basad of this has heavier spines, especially on the ventral side, than related species. The fundus area shows a reduction of spining at the caudal end that is not present in the other species.

The similarity of maculation, the shape of the front, and the type of genitalia in both sexes of *emmedonia* show a relationship to *Prorella*, while the two pairs of spurs on the hind tibia and the shorter apophyses of the ovipositor lobes are characters found in *Eupithecia*. It is thought advisable to transfer this species to *Prorella*, as this is where the species fits best. McDunnough has already called attention to the rather heterogeneous nature of this group in his discussion of *Prorella* (1949, p. 692).

***Prorella mellisa* (Grossbeck)**

Figure 1E

Gymnocelis mellisa GROSSBECK, 1908, p. 19.

Prorella mellisa, MCDUNNOUGH, 1949, p. 702, pl. 32, fig. 26, text fig. 20F.

It might be noted while discussing the *mellisa-insipidata* complex that three, unfortunately somewhat worn, females of this complex were collected 1 mile west of Portal, Chiricahua Mountains, Cochise County, Arizona, 5000 feet elevation, September 10, 1950 (W. J. Gertsch and M. Cazier). One of these shows a definite ochreous suffusion on the forewings above, as in *mellisa*. A second specimen is a rather dark smoky brown without any traces of ochreous suffusion, as in *insipidata*. The third specimen is somewhat intermediate between the other two. No genitalic differences have been noted. Without more material it is still impossible to ascertain the exact relations of *mellisa* and *insipidata*, but they may be only color forms of one species.

A single female in the British Museum collection labeled "Mt. Lowe, So. Californ., 3 Sept. 1918 (E. Piazza)" is also referable to this complex and is the first California record.

LIFE HISTORY NOTES

The question arose as to the possible taxonomic value of the pupa in this genus. A search of the literature showed that practically nothing had been published on pupal characters, although they had been briefly characterized (under the name *Tephroclystis* Hübner) by Mosher, and the caudal abdominal segments and cremaster of one species had been figured (1916, p. 128, pl. 27, fig. 111). Thanks to the cooperation of Miss MacKay and Dr. McDunnough, plus a few species in the author's collection, it was possible to examine the pupae of 25 species, or approximately one-sixth of the genus occurring in North America. As nearly every example studied was the cast pupal skin, attention was directed to the terminal abdominal segments and the spines of the cremaster rather than to an examination of the entire structure, as there was much less chance that the terminal segments were torn and distorted when the moth emerged. When either living or preserved pupae can be studied, an examination of the entire pupa should be undertaken to see what characters occur in the remainder of the pupa. Longer series of most species should be studied to find the extent of the individual variation within the species; some of the species studied appeared to be rather variable, and this is noted in the text.

Every species examined is illustrated in dorsal and lateral views, and all are drawn to the same scale. Hence it is easy to see that a considerable range in size occurs within the genus. Notwithstand-

ing the apparently rather large individual variation found in some species, it is felt that the pupae do have some good taxonomic characters and that they may serve as a basis for specific determinations. Even now, with our limited knowledge, it is possible to begin to distinguish certain general groupings within the genus, and these correspond quite well with the groupings of the adults as given by McDunnough.

***Eupithecia palpata* Packard**

Figure 2A, B

Eupithecia palpata PACKARD, 1873, p. 58. McDUNNOUGH, 1949, p. 546, pl. 26, fig. 1, text fig. 1A. MACKAY, 1951, p. 77, pl. 1, figs. 5-9, pl. 4, figs. 3, 4.

The cast pupal skins of three specimens reared on *Pinus strobus* Linnaeus (white pine) from Mount Uniacke, Nova Scotia, by Douglas Ferguson, have been examined. One of these is illustrated (fig. 2A). They are distinguished by the long, attenuate, terminal portion of the cremaster, with the eight slender spines being located near the apex. In addition, five pupal skins from several localities in British Columbia, two having been reared from *Pinus monticola* Douglas and three from *Pinus contorta* Loudon, have been studied. The specimens from *P. monticola* have the terminal portion of the cremaster slightly shorter and the apex more bluntly rounded than in the Nova Scotia specimens. They tend to have the surface more wrinkled, and there is more space between the caudal pair of spines and the other three pairs. One of these specimens is figured, and is labeled Anstey Arm (fig. 2B). On the other hand, the three specimens from *Pinus contorta* appear to be intermediate between the above, with the terminal portion of the cremaster slightly shorter than the ones from Nova Scotia but having the apex rather bluntly rounded and with the caudal pair of spines well separated, as in the other British Columbia examples.

It is not possible to draw any valid conclusions from the above, as the number of specimens examined is much too small. The results appear to suggest, however, that slight differences may occur within a species where the larvae feed on more than one host. Much field work and rearings will be necessary to show whether or not this is actually so.

Eupithecia transcanadata MacKay

Figure 2C

Eupithecia transcanadata MacKAY, 1951, p. 77, pl. 1, figs. 1-4, pl. 4, figs. 1, 2.

A series of 18 specimens, with their cast pupal skins, have been studied. As might be expected, the pupae appear very similar to those of *palpata*, from which this species has only recently been separated. In *transcanadata* the terminal segment of the cremaster is slightly smaller than in specimens of *palpata* reared from *Pinus monticola*, and, when viewed from the side, the apical portion is usually more sharply set off at the base. The specimen figured was from Anstey Arm, British Columbia.

Eupithecia ornata (Hulst)

Figure 2D

Tephroclystis ornata HULST, 1896, p. 267.*Eupithecia ornata*, McDUNNOUGH, 1949, p. 549, pl. 26, fig. 6, text fig. 1F. MacKAY, 1951, p. 90.

Two specimens from British Columbia have been examined: the one illustrated is labeled as being raised on *Pinus contorta* Loudon at Kleena Kleene. The terminal segment of the pupa is rather large, with short cremaster spines. The dorsal groove, while being different in the two specimens, has a median indentation more or less strongly developed.

Eupithecia columbiata columbiata (Dyar)

Figure 3A

Tephroclystis columbiata DYAR, 1904, p. 891.*Eupithecia columbiata columbiata*, McDUNNOUGH, 1949, p. 551, pl. 26, fig. 9, text fig. 1I. MacKAY, 1951, p. 84.

A single specimen reared from *Betula* at Quesnel, British Columbia, has been examined. The terminal segment of the pupa is the size of *transcanadata* but is quite distinctive therefrom. The four pairs of spines appear to lie in a horizontal plane rather than with the caudal pair being dorsad, as in most of the species examined. The terminal two pairs of spines arise from a common raised base, which also appears to be a distinctive character.

Eupithecia maestosa maestosa (Hulst)

Figure 3B

Tephroclystis maestosa HULST, 1896, p. 269.

Eupithecia maestosa maestosa, McDUNNOUGH, 1949, p. 552, pl. 26, figs. 12, 13, text fig. 2A.

A single specimen reared from *Alnus* at Toby Creek Road, British Columbia, has been examined. In general, the terminal segment of the pupa is similar to that in the two preceding species, but a number of differences are present, such as the wider spacing of the cremaster spines and the more indented nature of the dorsal groove.

Eupithecia placidata Taylor

Figure 3C

Eupithecia placidata TAYLOR, 1908, p. 56. McDUNNOUGH, 1949, p. 559, pl. 26, figs. 26, 27, text fig. 3C. MACKAY, 1951, p. 90.

Four examples from British Columbia, all females, have been examined. The specimen figured is topotypical, being from Kaslo, British Columbia, and reared from *Thuja*. The terminal segment of the pupa is quite large and extends to the rear as an elongate and rather narrow cremaster. The dorsal groove is variable in the amount of indentations; two specimens have rather marked notches, while the other two are merely waved.

Eupithecia unicolor (Hulst)

Figure 4A

Tephroclystis unicolor HULST, 1896, p. 271.

Eupithecia unicolor, McDUNNOUGH, 1949, p. 560, pl. 26, fig. 28, text fig. 3D. MACKAY, 1951, p. 90.

Eupithecia placidata, McDUNNOUGH (not Taylor), 1949, p. 559 (early stages).

The single specimen reared by the author, mentioned by McDun-
nough, has been carefully examined and has now been placed as *uni-
color*, as the maculation, color, and male genitalia seem to agree
better with those of this species than of *placidata*. The
larva, while being reared at Berkeley, was collected at Viola,
Shasta County, California, June 27, 1947, on *Libocedrus decurrens*
Torrey; the imago emerged August 5, 1947.

The terminal segment of the pupa is elongate, somewhat
tapering in outline, with the terminal pair of spines of the cre-

master slightly thicker than the other three pairs. It is very similar to the pupa of *placidata*, and more material is needed before an adequate comparison can be made. However, it would appear that the terminal segment is more tapering in *unicolor* and is slightly larger at the base.

***Eupithecia pseudotsuga* MacKay**

Figure 4B

Eupithecia pseudotsuga MACKAY, 1951, p. 80, pl. 2, figs. 1-5, pl. 4, figs. 5, 6.

Five specimens, all from British Columbia, were examined. The example figured was labeled Princeton. The terminal segment of the cremaster is similar to that found in *placidata* and *unicolor* but is smaller in size, and the spines of the cremaster in *pseudotsuga* are spaced farther apart. The dorsal groove has a tendency to have a number of small indentations, although this is not a constant feature.

***Eupithecia miserulata zela* Swett and Cassino**

Figure 4C

Eupithecia zela SWETT AND CASSINO, 1919, p. 109.

Eupithecia miserulata zela, MCDUNNOUGH, 1949, p. 563, pl. 26, fig. 32.

Larvae of this western subspecies of *miserulata* have been reared from sunflowers at Rancho La Sierra, Arlington, Riverside County, California, by Samuel H. Rindge and the author, with the adults emerging in June and July.

The terminal segment of the pupa is elongate, bluntly rounded, with the terminal pair of cremaster spines thicker than the other pairs. The lateral grooves have a dorsal and ventral fringe of very slender spines.

***Eupithecia misturata misturata* (Hulst)**

Figure 5A

Tephroclystis misturata HULST, 1896, p. 266.

Eupithecia misturata misturata, MCDUNNOUGH, 1949, p. 563, pl. 26, figs. 33-36, pl. 27, fig. 1, text fig. 4B. MACKAY, 1951, p. 91.

A single larva of this species was obtained in October, 1948, 3 miles south of Kings Mountain Inn, Kings Mountain, San Mateo County, California, by the author while beating *Baccharis pilularis* De Candolle. It formed the pupa very shortly

thereafter, and no larval notes were taken. The adult emerged December 4.

The pupa is a pale cream buff with a light green cast; the terminal segment is dark brown and bluntly rounded, with the terminal pair of spines thicker than the other pairs. The dorsal groove has a median and a lateral pair of distinct indentations.

***Eupithecia castigata* (Hübner)**

Figure 5B

Geometra castigata HÜBNER, [1809–1813], pl. 89, fig. 456.

Eupithecia castigata, McDUNNOUGH, 1949, p. 575, pl. 27, fig. 16, text fig. 5B.
MACKEY, 1951, p. 90.

A single larva feeding on alder was secured at Sackville, Halifax County, Nova Scotia, by Douglas Ferguson. This food plant has also been recorded by MacKay (1951) from British Columbia. A female emerged on April 7. The following larval description was drawn up:

“Ground color medium brown; the dorsum of the abdomen, between the thoracic segments and the first pair of prolegs, is marked by five distinct and complete diamond patches of dark brown; these are connected by a fairly evident mid-dorsal line of the same shade. On the thoracic segments the patches are reduced to mere broadenings of the dorsal line. A sixth diamond patch is faintly indicated on the segment bearing the first proleg, but this is ill defined and fades out to the more or less complete suffusion found on the posterior abdominal segments in the dorsal area. The anal plate is paler, being of the ground color and showing the continuation of the dorsal line. There is a broad, blackish brown, sublateral line, sharply defined on its dorsal edge, and sending a short oblique projection dorsad and cephalad along the lateral anterior edge of each diamond patch. This sublateral line gradually merges into the ground color in the subventral area. There is a thin but distinct mid-ventral line. Head dark brown, marked on the lobes with vertical bars of a paler shade. The skin shows the usual glandular character with fairly long setae.”

The terminal segment of the pupa is rather small and tapering. The caudal pair of spines is thicker than the others are, and the dorsal groove is irregularly indented.

Eupithecia albipunctata (Haworth)

Figure 5C

Phalaena albipunctata HAWORTH, 1810, p. 360.*Eupithecia albipunctata*, MCDUNNOUGH, 1949, p. 576, pl. 27, figs. 17, 18, text fig. 5C.

Five specimens reared from *Heracleum lanatum* Michaux at Bolean Lake, British Columbia, were examined. The terminal segment of the pupa is quite broad, with the terminal pair of cremaster spines noticeably heavier than the other three pairs.

Eupithecia luteata bifasciata (Dyar)

Figure 5D

Tephroclystis bifasciata DYAR, 1904, p. 891.*Eupithecia luteata bifasciata*, MCDUNNOUGH, 1949, p. 579, pl. 27, fig. 21. MACKEY, 1951, p. 90.

Five examples were examined. The one illustrated was reared from *Pseudotsuga taxifolia* (Poiret) Britton at Fernie, British Columbia, and is a female. The terminal segment of the pupa is rather short and stout, with the apical two pairs of cremaster spines situated much closer to one another than to the other pairs, and with the terminal pair much thicker than the other three pairs.

Eupithecia fletcherata Taylor

Figure 6A

Eupithecia fletcherata TAYLOR, 1907, p. 200. MCDUNNOUGH, 1949, p. 579, pl. 27, figs. 22-24, text fig. 5E. MACKEY, 1951, p. 91.

Two larvae were found by Douglas Ferguson feeding on the blossoms of *Prenanthes trifoliata* Fernald at Purcell's Cove, Halifax County, Nova Scotia. From a pupa of one of these a male of *fletcherata* emerged on April 9. Up to the present the only known larval food plants have been recorded as larch, spruce, and alder. It would appear, therefore, that the larva is a more general feeder than was expected. The following notes on the larva were made:

"Ground color very pale brown, the color of dead grass or even paler. There is a variably distinct mid-dorsal line of pale brown, slightly darker than the ground color. This line is expanded on the first five abdominal segments, forming diamond-shaped

patches. The lateral apices of these patches are distinctly darker especially along the anterior margins which are edged with a shade paler than the ground color and almost white in appearance. There is a brown lateral shade, approximately matching the diamond patches in color, which pales gradually on the ventral side; dorsally it is sharply defined from the ground color and is projected dorsad just anterior to the lateral apex of each diamond patch. Head medium brown, nearly concolorous with the ground color of the abdomen; two vertical bars of a slightly paler color on the lobes. Legs concolorous with the abdomen or not noticeably different."

The pupa is typically eupitheciid, the cremaster being rather long, bluntly cone shaped, and furnished with two stout apical hooks and a series of three much finer ones, equally spaced and situated laterally.

***Eupithecia arceuthata* (Freyer)**

Figure 6B

Larentia arceuthata FREYER, 1842, p. 145, pl. 372.

Eupithecia arceuthata, McDUNNOUGH, 1949, p. 601, pl. 28, fig. 18.

Five specimens reared from *Juniperus scopulorum* Sargent in British Columbia were examined. The terminal segment of the pupa is rather variable in outline, in the length of the cremaster spines, and in the configuration of the dorsal and lateral grooves. The specimen figured is a more or less average representation based on the specimens available. In some specimens the cremaster spines are shorter than those figured. In some the dorsal groove shows less indentations, while in others there is a larger central indentation. In most of the specimens the lateral groove is broader and more triangular than that figured.

***Eupithecia satyrata fumata* Taylor**

Figure 6C

Eupithecia fumata TAYLOR, 1910, p. 82.

Eupithecia satyrata fumata, McDUNNOUGH, 1949, p. 604, pl. 28, fig. 19, text fig. 8D.

Several new larval food plant records were secured for this species. At Baddeck, Cape Breton Island, larvae were found by Douglas Ferguson, feeding on the fruit of *Viburnum cassinoides* Linnaeus and in the flowers of *Chelone glabra* Linnaeus.

From the resulting pupae, one male and two females emerged on March 9 and 17 and April 9. At Sackville, Halifax County, Nova Scotia, a single larva was secured by McDunnough on the blossoms of *Spiraea*. From this, in due course, a male imago emerged on April 6. The larvae are quite variable in depth of ground color and distinctiveness of maculation. From the Sackville larva the following description was drawn up:

"Head pale creamy, strongly speckled on the lobes with smoky brown dots. Body pale creamy, granulate as usual. The thoracic segments show a rather broad, reddish brown, mid-dorsal band, slightly expanding into incipient diamond patches in the central areas of each segment, and with a pale central line; there are also red-brown, irregular, subdorsal bands. On the first five abdominal segments large, similarly colored patches, shaped like an inverted V, are formed, representing incompletely the normal diamond patches often found in the same species; these patches are bordered with deep brown, ventrad of which a paler edging of ground color is evident. The anterior portions of the segments are strongly shaded transversely with reddish. Oblique, lateral, reddish bands run from the anterior subdorsal margin of each segment to the spiracular area where they become deep brown and are connected with a light reddish subspiracular band that extends the full length of both thoracic and abdominal segments. On the sixth abdominal segment the dorsal markings are reduced, lacking the dark margins, and on the remaining posterior segments further reduction to a broad irregular band is evident. The oblique streaks are not apparent but are represented by two irregular, parallel, reddish lines. Legs, prolegs, and ventral surface pale creamy."

The terminal segment of the pupa is tapering, with the terminal pair of spurs somewhat heavier than the other pairs.

***Eupithecia strattonata* Packard**

Figure 6D

Eupithecia strattonata PACKARD, 1873, p. 60. McDUNNOUGH, 1949, p. 608, pl. 28, fig. 29, text fig. 8H.

A single specimen from Sackville, Halifax County, Nova Scotia (D. C. Ferguson), reared on alder, has been examined. Unfortunately, the spines of the cremaster have been broken off, but the terminal pair appears to be much heavier than the other

pairs. The terminal segment is very elongate, tapering down to the caudal pair of spines.

***Eupithecia russeliata russeliata* Swett**

Figure 7A

Eupithecia russeliata SWETT, 1908, p. 245.

Eupithecia russeliata russeliata, McDUNNOUGH, 1949, p. 611, pl. 28, figs. 33, 34, text fig. 9B.

From a single larva found several years ago by Douglas Ferguson on *Kalmia*, a much crippled female was secured, the determination of the species being made from a genitalic preparation. Hitherto the only records of food plants have been those of various coniferous species. No description of the larva was made.

In the pupa, the terminal segment is rather small and tapering. The posterior three pairs of cremaster spines arise from more or less well-defined bases, and the terminal pair of hooks is only very slightly thicker than the other pairs.

***Eupithecia filmata* Pearsall**

Figure 7B

Eupithecia filmata PEARSALL, 1908, p. 129. McDUNNOUGH, 1949, p. 632, pl. 30, figs. 1, 2, text fig. 11G. MACKAY, 1951, p. 86.

Five specimens, four females and one male, have been studied. They were all reared from *Picea* in British Columbia. The specimen figured is based on a female from "Nachacko R." The terminal segment is broadly rounded, with the apical pair of cremaster spines heavier than the other three pairs. The dorsal groove is variously indented, usually with three fairly prominent indentations, the largest being mediad.

***Eupithecia annulata* (Hulst)**

Figure 7C

Tephroclystis annulata HULST, 1896, p. 267.

Eupithecia annulata, McDUNNOUGH, 1949, p. 634, pl. 30, figs. 3-5, text fig. 11H. MACKAY, 1951, p. 86.

Three males and two females reared from *Pseudotsuga taxifolia* (Poiret) Britton in British Columbia, have been examined. The specimen figured is a male from Wynndel. The terminal segment of the pupa is similar to that of *filmata*, but tends to differ in the

slightly narrower lateral groove, the more slender apical portion of the cremaster (when seen in dorsal view), and by the fact that the terminal pair of cremaster spines is not thicker than the other pairs. There appears to be sexual dimorphism in the nature of the dorsal groove; all three males had at least three well-defined indentations, while both females had a weakly sinuate dorsal groove. This sexual dimorphism does not appear to be present in *filmata*. Much more material must be examined before this question can be settled.

***Eupithecia georgii* McDunnough**

Figure 7D

Eupithecia georgii McDUNNOUGH, 1929, p. 67, fig. 4a-c; 1949, p. 639, pl. 30, figs. 13, 14, text fig. 12A. MACKAY, 1951, p. 88.

A single male reared from *Ceanothus* at Squilax, British Columbia, was examined. The terminal segment of the pupa is broadly triangular, with the terminal pair of cremaster spines thicker than the other three pairs. The tips of the spines appear to be merely recurved rather than more sharply coiled, as in many of the species.

***Eupithecia acutipennis* (Hulst)**

Figure 8A

Tephroclystis acutipennis HULST, 1898, p. 115.

Eupithecia acutipennis, McDUNNOUGH, 1949, p. 666, pl. 31, fig. 14, text fig. 16D.

Mr. W. H. Evans has reared this species from eggs obtained from a female collected in La Tuna Canyon, California. The food plant is *Artemisia californica* Lessing.

The pupae have the wing cases and appendages a translucent yellow-green or green; the abdomen is yellow-brown, being slightly darker brown on the anterior portions of the segments. The terminal segment is bluntly rounded and quite broad, with a cremaster of eight slender spines, equal in size; the basad pair of spines arises from the dorsal surface of the terminal segment. There is a noticeable constriction on the abdomen just posterior to the end of the wing cases, with fairly prominent ones between the next two segments; posterior to this they are not marked.

***Eupithecia shirleyata* Cassino and Swett**

Figure 8B

Eupithecia shirleyata CASSINO AND SWETT, 1922, p. 165, fig. on p. 162. McDUNNOUGH, 1949, p. 668, pl. 31, fig. 16, text fig. 16F.

Mr. W. H. Evans has also reared this species from eggs obtained from adults collected in La Tuna Canyon, California. The larval food plant is *Echinocystis macrocarpa* Greene.

The pupa is dark brown, with the wing cases slightly lighter in color, and the terminal segment somewhat darkened. The terminal segment is somewhat ovoid, with a cremaster of eight slender spines, equal in size; the basad pair of spines arises from the dorsal surface of the terminal segment.

***Eupithecia anticaria* Walker**

Figure 8C

Eupithecia anticaria WALKER, 1862, p. 1241. McDUNNOUGH, 1949, p. 672, pl. 31, figs. 23, 24, text fig. 17D. MacKAY, 1951, p. 91.

Larvae of this species were taken on the flowers of *Spiraea latifolia* (Aiton) Borkhausen at Purcell's Cove, Halifax County, Nova Scotia, by Douglas Ferguson. The larva, as compared with the normal type of *Eupithecia* larva, is quite distinctive. It is long and slender, bright green, with a red lateral stripe edged dorsally with white and no other maculation. The head is small, flattened, dirty green in color. At rest, the larva usually grasps the plant with its abdominal legs only and frequently waves back and forth in a snake-like fashion. In the pupa the cremaster is short, broad, and semiglobular in shape; it is furnished with the same arrangement of hooks as in other species, but the lateral rows of three are stronger, especially the most caudal one of the group.

***Eupithecia ravocostaliata* Packard**

Figure 8D

Eupithecia ravocostaliata PACKARD, 1876, p. 60, pl. 8, fig. 9. McDUNNOUGH, 1949, p. 686, pl. 32, figs. 10, 11, text fig. 18H.

Three British Columbia specimens reared from *Salix* have been examined. The specimen illustrated is from Knouff Lake. The terminal segment of the pupa is very blunt and broad, appearing almost truncate in the dorsal view. The spines of the

cremaster are rather heavy and straight, with the anterior pair arising well up on the dorsal surface and cephalad of the next pair. There is some variability in the amount of indentations in the dorsal groove. In this respect the specimen illustrated is intermediate between the other two specimens studied.

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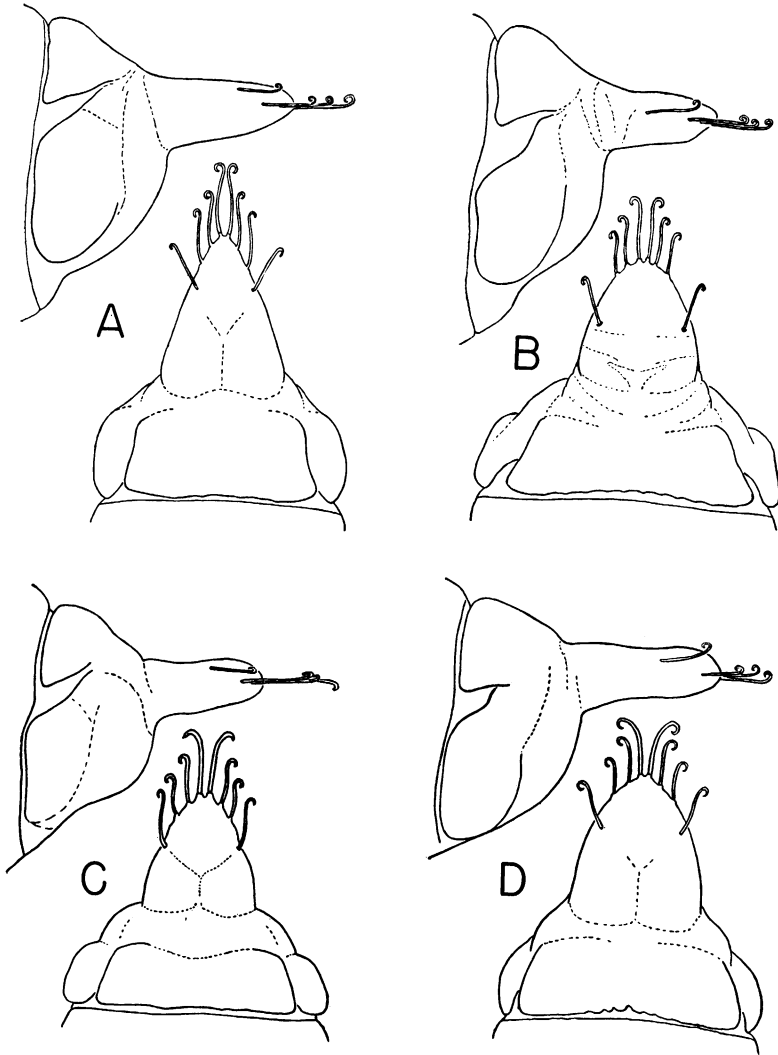


FIG. 2. Terminal portion of *Eupithecia* pupae, lateral and dorsal views. A. *E. palpata* Packard, Nova Scotia. B. *E. palpata* Packard, British Columbia. C. *E. transcanadata* MacKay. D. *E. ornata* (Hulst).

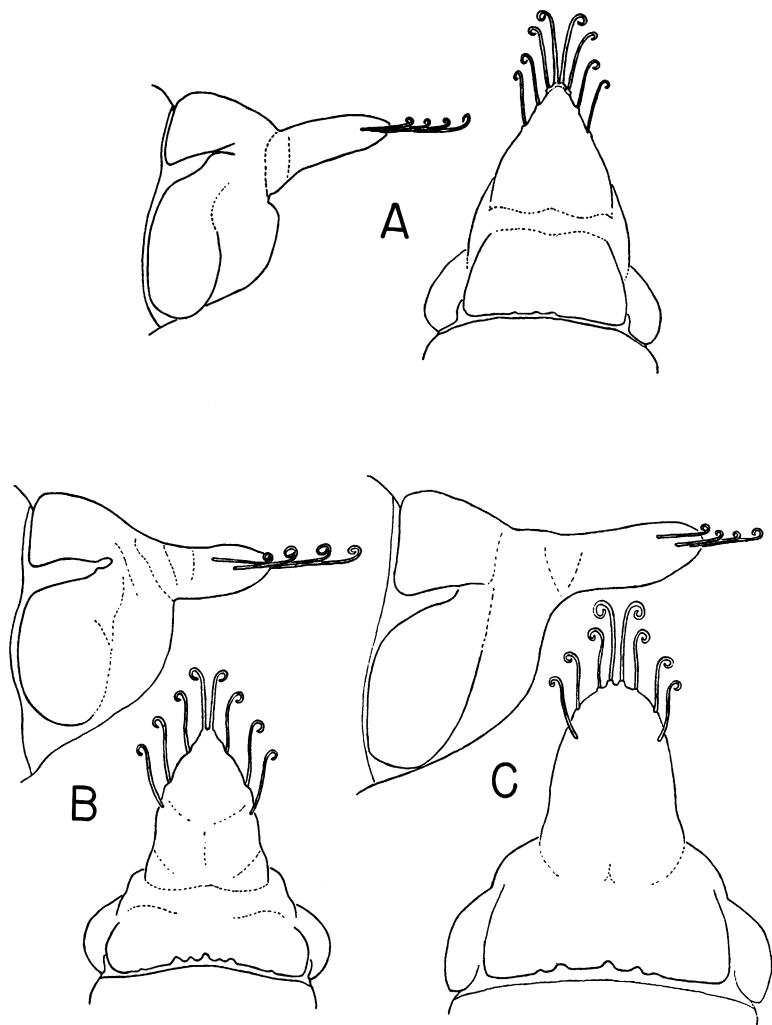


FIG. 3. Terminal portion of *Eupithecia* pupae, lateral and dorsal views. A. *E. columbiata columbiata* (Dyar). B. *E. maestosa maestosa* (Hulst). C. *E. placidata* Taylor.

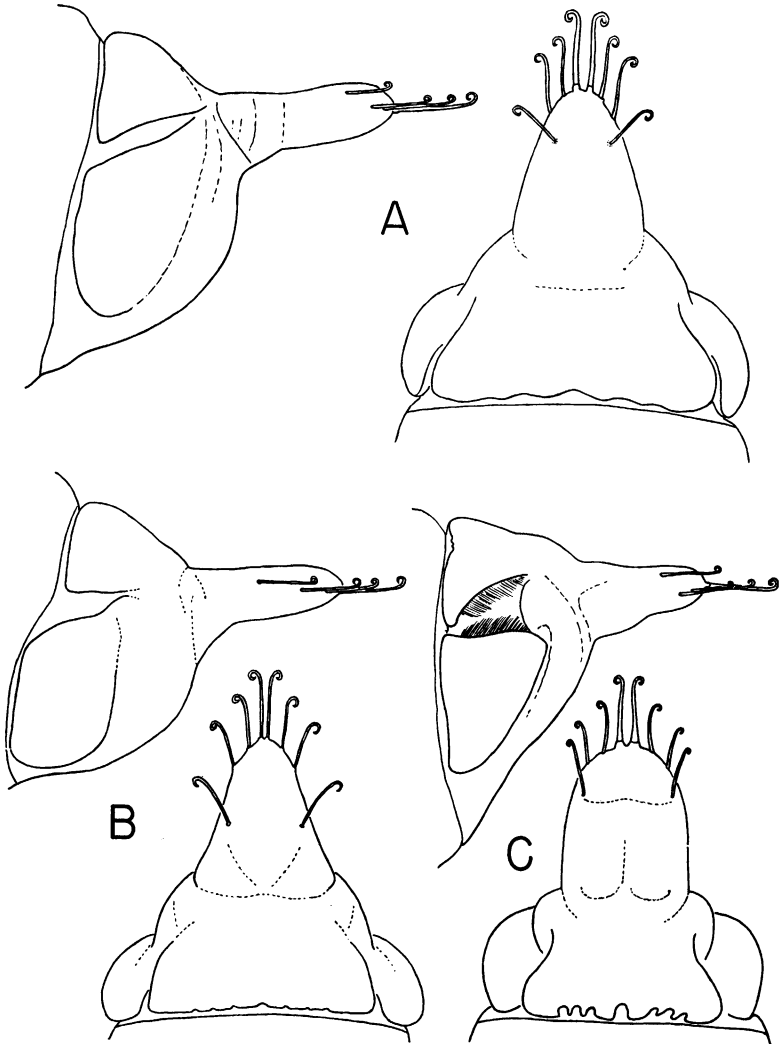


FIG. 4. Terminal portion of *Eupithecia* pupae, lateral and dorsal views. A. *E. unicolor* (Hulst). B. *E. pseudotsuga* MacKay. C. *E. miserulata zela* Swett and Cassino.

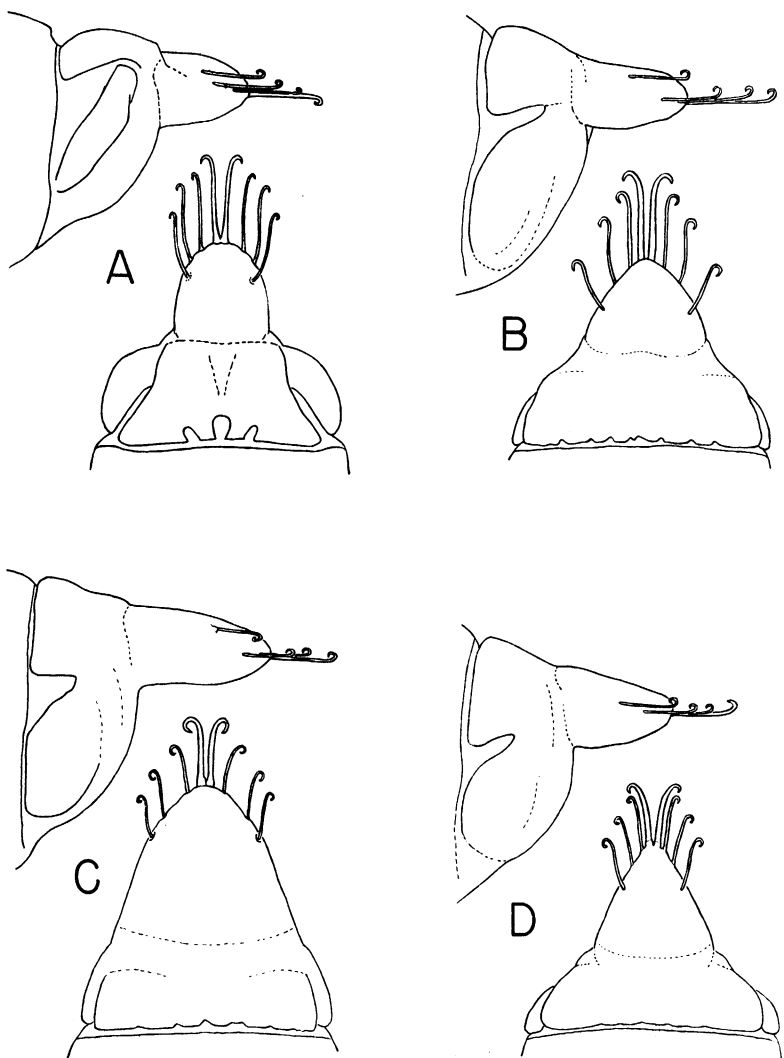


FIG. 5. Terminal portion of *Eupithecia* pupae, lateral and dorsal views. A. *E. misturata misturata* (Hulst). B. *E. castigata* (Hübner). C. *E. albipunctata* (Haworth). D. *E. luteata bifasciata* (Dyar).

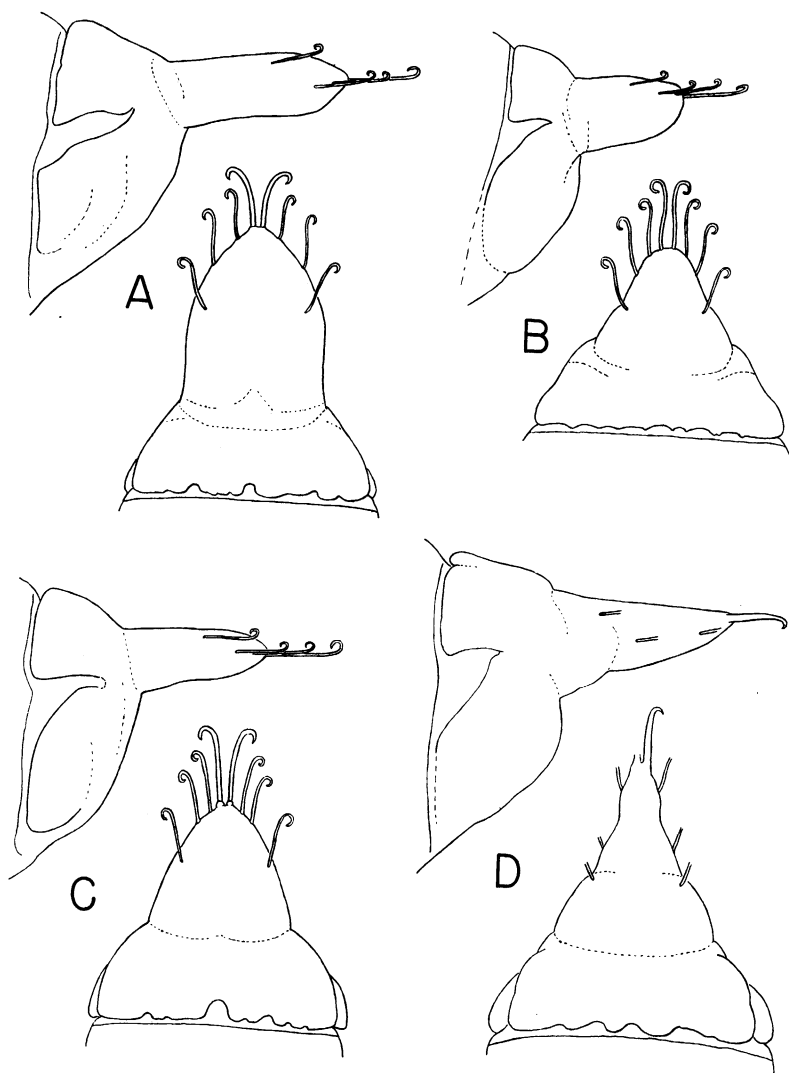


FIG. 6. Terminal portion of *Eupithecia* pupae, lateral and dorsal views. A. *E. fletcherata* Taylor. B. *E. arceuthata* (Freyer). C. *E. satyrata fumata* Taylor. D. *E. strattonata* Packard.

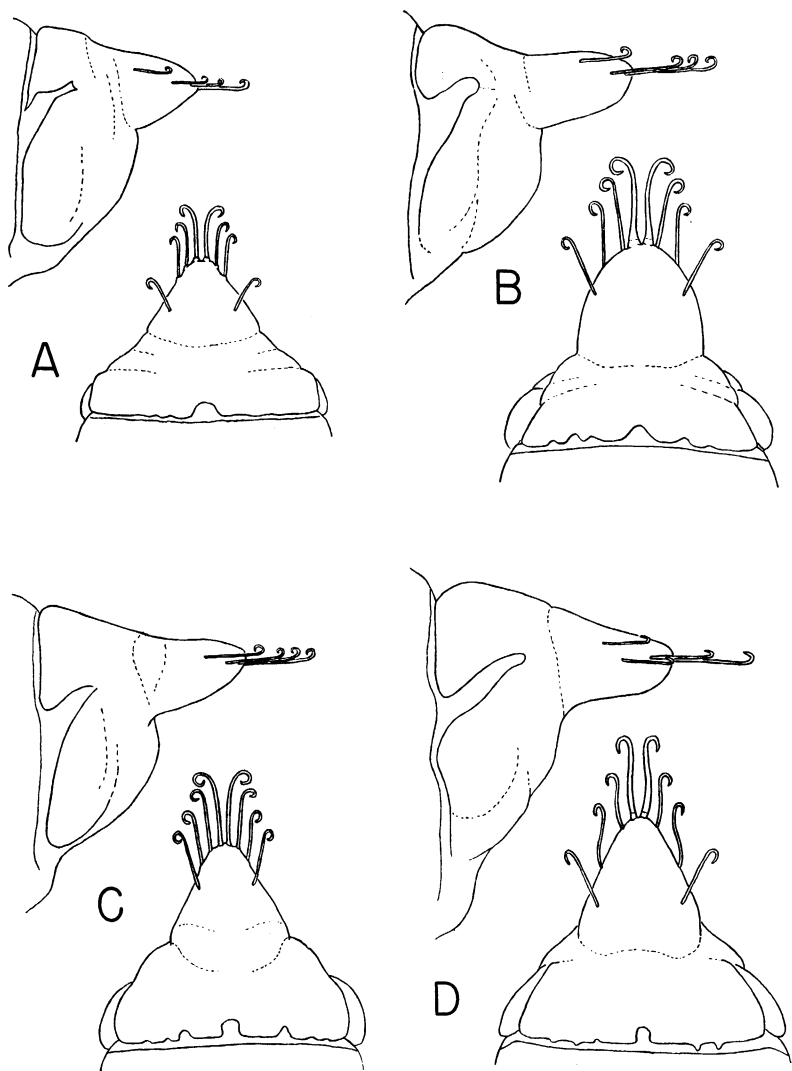


FIG. 7. Terminal portion of *Eupithecia* pupae, lateral and dorsal views. A. *E. russeliata russeliata* Swett. B. *E. filmata* Pearsall. C. *E. annulata* (Hulst). D. *E. georgii* McDunnough.

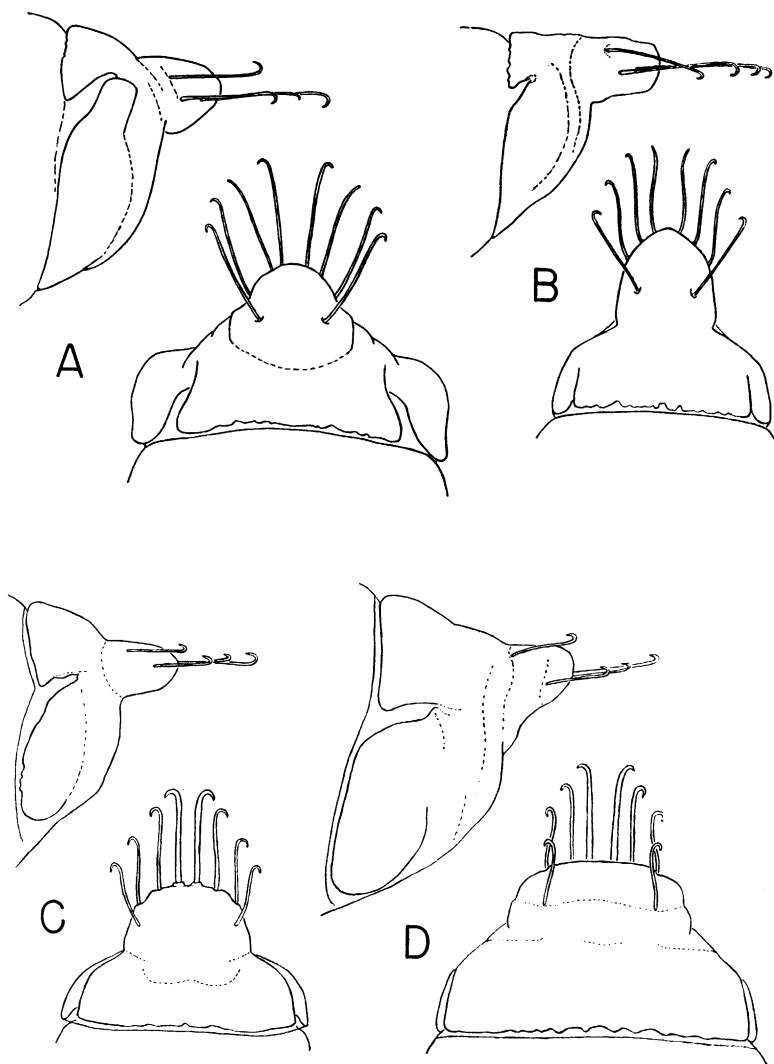


FIG. 8. Terminal portion of *Eupithecia* pupae, lateral and dorsal views. A. *E. acutipennis* (Hulst). B. *E. shirleyata* Cassino and Swett. C. *E. anticaria* Walker. D. *E. ravocostaliata* Packard.

