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On the *Aster*- and *Solidago*-feeding Species of the Genus *Coleophora* in Nova Scotia (Lepidoptera, Coleophoridae)

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In the last paper published by the author on what has been referred to as the *ericoides-duplicis* group ("1946" [1947], Canadian Ent., vol. 78, pp. 147–163) particular attention was called to slight differences in the male and female genitalia in series of specimens collected in various sections of Nova Scotia (White Point Beach, Queens County; Smith's Cove, Annapolis County; Parrsboro, Cumberland County). Whether such genitalic variation might indicate specific differentiation could not be determined at the time from series collected merely as adult specimens, and it was suggested that breeeding from larval cases, carefully collected on individual food plants, might give better results in the solving of these problems.

Owing to the transference of entomological activities from Ottawa to New York City in 1946, the carrying out of such a project on my part was an impossibility for a period of four years. Having, however, become definitely domiciled in Halifax in the early summer of 1950, I was again afforded the opportunity to continue work on the group and to pay particular attention to the collecting of larval cases in the late fall on the various species of *Aster* and *Solidago* occurring in the Halifax area.

No cases could be found as long as the various plants were in flower, but with the formation of the seeds and the development of pappus immature cases began to make their appearance in early October. These consisted of thin, white, parchment-like tubes, slightly opened apically and more or less covered with pappus. They remained almost entirely

concealed in the general mass of pappus for a considerable period, gradually hardening, and, with the addition of strips of the inflorescence to their sides, producing a somewhat striped appearance; their apices showed a definite three-valved character. Mature cases, it was found, could be best collected in late October and early November when they generally became quite conspicuous, with their characteristic apices projecting well above the involucre. No marked differentiation in the appearance of cases from the various food plants was evident but certain minor differences in size and shape were noted, which are discussed later under the specific headings.

Most of the collecting was done in Point Pleasant Park, a natural reserve at the south end of the Halifax peninsula, although other sections of the Halifax area were kept under observation. In these areas the principal species of *Solidago* were found to be *S. graminifolia, S. rugosa,* and *S. puberula. Solidago graminifolia* is rare in the park and is practically confined to a single area in an old quarry. It grows very plentifully in other parts of the Halifax region, notably along the base of Citadel Hill and on the railway embankments. *Solidago rugosa* and *S. puberula* are commonly met with in most of the more open areas of the park and are also prevalent in many other sections of the city. One or two plants of *S. caesia* occur in the north area of the park, but no cases have been found on them.

Several species of aster occur in the Halifax region. In the park itself the common species are *Aster lateriflorus* and *A. novi-belgii,* the first-named being very generally distributed, the latter growing more particularly along the shore behind the beach. The occurrence in the park of *A. radula* and what has been doubtfully determined as *A. foliaceus* is so scarce as to be practically negligible, as far as the collection of cases is concerned. However, the latter species occurs quite plentifully along the railway embankments and on the roads adjacent to the north end of the park, and a number of cases were collected in early November, 1955, from such plants. These cases were generally almost entirely concealed in the partially closed involucre. The tall white aster, *A. umbellatus,* although very general along the roadsides of the province, is found only along the north edge of the park and the road bounding it in this section. Each year cases have been collected from the seed heads, unfortunately with no results as far as adults are concerned. The wood aster, *A. acuminatus,* is very common in the shaded areas of the park, and for the first time cases were secured in early November, 1955, in the quite mature seed heads.

The adults of this present coleophorid group are on the wing during

the latter part of August, and the method adopted was to make collections of the moths in a restricted area where one of the above-mentioned plants was predominant, a rather difficult procedure in some cases as there was a notable tendency for several of the species to grow indiscriminately together. In suitable areas the moths can be flushed out of the plants in the daytime, preferably on days that are cloudy and wind-still; by such means good series of adults may be obtained. In 1954 collections of adults were also made at White Point Beach, Queens County, particular attention being paid to the species of plants with which the moths appeared to be associated. In general the same species of *Aster* and *Solidago* occurred in this region as were found in the Halifax area. In the late fall the specific areas where adults had been collected were visited again and larval cases secured from the individual plants; such cases could usually be obtained in considerable numbers. The main difficulty occurred in bringing such cases through both hibernation and the following period of estivation until emergence of the adults in August of the following year. The result in many instances has been most unsatisfactory, but over a period of several years enough bred material has been secured to act as a check on the collected material.

As far as can be told at the present time concerning our maritime species, the *Aster*-feeders do not appear to be conspecific with the *Solidago*-feeders, and there is considerable evidence that in most cases a species is restricted to a single food plant. Whether or not such is the case with those species named by Annette Braun from material collected in southern Ohio is a matter entirely outside the scope of the present article and will require the same careful study of life histories as has been attempted here in Nova Scotia.

In the following section the results so far obtained are treated in greater detail. In all the species under consideration considerable variation in the individual genitalia has been evident; the cause of this is unknown, but the occurrence of a certain amount of hybridization might afford the explanation. Further study of the group will be very necessary, and of course the identity of the species the cases of which were collected on *Aster foliaceus* and *A. acuminatus* cannot be determined until the fall of 1956.

Coleophora triplicis McDunnough

Coleophora triplicis McDUNNOUGH, 1940 (Dec.), Trans. Roy. Soc. Canada, sect. 5, p. 61, pl. 1, fig. 8, pl. 3, fig. 5 (genitalia); "1946" [1947], Canadian Ent., vol. 78, p. 153.

As had previously been suggested, the larva has now definitely been proved to be a feeder on the seeds of *Solidago sempervirens*. This plant does not occur in Point Pleasant Park but is very plentiful on the marshes at Wolfville, Kings County, and cases were collected in the fall of 1951 by Douglas Ferguson which produced a good series of adults of this species in late August and early October of 1952. In the fall of the same year collections of adults were made at the near-by town of Grand Pré around the same plant. At White Point Beach, Queens County, a small isolated growth of *sempervirens* was discovered by the author in 1954 in a marshy area adjacent to the so-called river; adults of *triplicis* were quite plentiful around the plants in late August. The specimens mentioned in the original description as having been collected in 1935 and 1936 at White Point Beach along the main highway (No. 3) should, in all probability, be referred to *dextrella* Braun, a species undescribed at the time the article was written and which shows great similarity with *triplicis* in the structure of the genitalia.

As regards the specific distinctness of *triplicis* from *dextrella,* the characters mentioned in a previous paper (1947), based on a lighter color of the primaries and certain features of the female genitalia, hold in general fairly well. However, it must be admitted that a study of considerable female genitalic preparations made from the above-mentioned bred material shows that variation occasionally occurs, notably in the width and length of the distal portion of the initial chitinized section of the ductus bursae and also in the length of the following spiculate area which in a few cases is just as long as the same section in *dextrella.* For the sake of comparison with *dextrella* a genitalic figure (fig. 1) of a bred female from Wolfville is given. In spite of the occasional individual variation the author is still of the opinion that *triplicis* is a species distinct from *dextrella.* The differences in food plants of the larvae and in the habitats of the adults (*triplicis* occurs only on salt marshes) would appear to bear out this contention.

The time of flight varies apparently with climatic and seasonal conditions. At Parrsboro, Cumberland County, in 1944 adults were on the wing during the first two weeks of August. The specimens collected at Grand Pré were taken on August 28, 1952, and those at White Point Beach had their main flight on August 30, 1954, with occasional specimens appearing on September 1 and 2.

LARVAL CASES: These are of the usual chunky type with a three-valved apex. When collected in late fall little of the pappus remains attached and the cases appear smooth, of a deep brown color, slightly striped with darker-colored portions of the inflorescence. As compared with the cases

of *dextrella* they are noticeably larger, having a length of approximately 5.5 mm., while those of *dextrella* average about 4 mm.

Coleophora dextrella Braun

Coleophora duplicis BRAUN, 1921, Ent. News, vol. 32, pp. 16, 17 (*partim*).
Coleophora dextrella BRAUN, 1940 (Sept.), Canadian Ent., vol. 72, p. 180, pl. 12, figs. 1, 3. MCDUNNOUGH, "1946" [1947], Canadian Ent., vol. 78, p. 153.
Coleophora triplicis MCDUNNOUGH, 1940 (Dec.), Trans. Roy. Soc. Canada, sect. 5, p. 61 (*partim*).

This species was described from 11 specimens, bred from larval cases collected on *Aster cordifolius,* which had been included erroneously amongst the type material of *C. duplicis.* As the name indicates, the apical tooth of the aedeagus is situated on the right rod and not on the left one as in *duplicis,* a feature duplicated only in *triplicis* as already noted.

Aster cordifolius, one of the broader-leaved asters, does not occur in the Halifax region nor along the south shore of Nova Scotia but according to Roland (Flora of Nova Scotia, p. 492) is found in the Annapolis Valley, extending eastward to Cape Breton. It is not surprising, therefore, to find that other aster species have been chosen as alternate food plants in areas where *A. cordifolius* does not grow. In the Halifax area *Aster lateriflorus* appears to be the favored food plant of the larvae. A series of adults was captured on August 20 and 27, 1952, in a large isolated patch of this plant in the southern section of Point Pleasant Park, and cases were collected later in the same area; unfortunately no adults emerged from these, as they probably were collected before maturity. However, from cases found on the same plant in adjacent areas a small series emerged in early September of the following year which agreed with the afore-mentioned captured material.

As was already hinted in a previous paper (1947), *Aster novi-belgii,* which is common along the shore areas of the park, has also been proved to be a larval food plant, although cases were not nearly so plentiful on this plant as on *A. lateriflorus,* probably owing to the late appearance of the flowers. A few specimens were captured in the shore area in late August of 1951 and 1952, and half a dozen adults were reared in early September of 1952 from cases collected the previous year. On the whole the breeding results were most unsatisfactory, as no emergences occurred in either 1953 and 1954 although numerous cases had been secured. Evidently the collecting of cases should be postponed until the latest possible date in the fall in order to insure maturity of the larvae. At White Point Beach in 1954 a few adults were secured. These were evidently

associated with *Aster novi-belgii,* a species much more commonly met in this region than *A. lateriflorus.* Specimens from this same locality, determined in a previous paper (1940) as *triplicis,* should be referred to the present species.

The specific distinctions between this species and *triplicis* have already been discussed and, apart from the deeper gray color of the primaries in the present species, are based largely on slight differences in the respective female genitalia. For comparison two figures are given of the genitalia, one (fig. 2) of a female bred from a case found on *A. lateriflorus* and another (fig. 3) of a female belonging to a series collected in the above-mentioned aster patch. These represent variations in genitalia, the most striking differences being in the shapes of the hourglass portions of the ducti. It should further be pointed out that no two preparations are absolutely similar, and in some cases considerable variation occurs in the length of the spiculate section of the ductus bursae which at times is much shorter than that of the figured specimens. Captured specimens with no particular association with a given plant are often very difficult to place correctly, and, when considerable variation from the norm is evident, there is a possibility of hybridization between *Aster-* and *Solidago*-feeding species, the plants being frequently found in close proximity to one another and the adults on the wing at approximately the same time.

LARVAL CASES: Very similar to those of *triplicis,* differing chiefly in their shorter length (4 mm.). The color is a dull brown, with little trace of striping; generally considerable pappus adheres closely to the cases.

Coleophora intermediella McDunnough

Coleophora intermediella MCDUNNOUGH, 1940, Trans. Roy. Soc. Canada, sect. 5, p. 58, pl. 1, fig. 7, pl. 3, fig. 9 (genitalia); "1946" [1947], Canadian Ent., vol. 78, p. 150, pl. 13, fig. 1 (allotype genitalia).

As the type series of this species had been collected around *Solidago graminifolia* and as later collections (Parrsboro, Smith's Cove) had also been made around the same species of *Solidago,* is was not surprising to find in the fall numerous cases on this plant in various sections of the Halifax area, notably at the base of Citadel Hill and along the railway embankments; in both places *graminifolia* was quite common. Unfortunately from collections made at these points no adults emerged in the following year for some unknown reason. However, in Point Pleasant Park, where *graminifolia* is rarely met with, an isolated clump of the plant was discovered in an old quarry. A good series of very fresh speci-

mens was collected on August 9, 1952, and from cases secured on the same spot in the fall of the previous year a small series of five males and two females emerged between August 7 and 20, 1952. Genitalic slides of both sexes from the bred material matched excellently slides made from a number of the collected specimens and also agreed with the figures given with the original description.

In maculation of the primaries of the adults the distinguishing characteristic is the light fawn-brown ground color, deepening appreciably in the terminal third where the paler cream-colored veins show up quite distinctly; there is no trace of any smoky sprinkling. Judging from the above-mentioned slides, the normal male genitalia are without any terminal tooth on the left rod of the aedeagus but show a mediobasal, longitudinal row of two or three small teeth, of which the distal one is the largest. In only a single case was a small apical tooth present on the left rod. In the female genitalia most of the slides were almost an exact counterpart of the figure of the allotype genitalia given in 1947. This similarity applies to the caudal projections of the genital plate, the initial hourglass section of the ductus bursae, and the length of the following spiculate section; in two instances, however, this latter was somewhat shorter than normal. Such variations in structure of the genitalia appear to occur throughout the whole group and indicate a certain amount of individual instability or possibly, as has already been suggested, a tendency towards hybridization.

LARVAL CASES: These are of the usual type, but are rather chunkier than those of most of the other species and are covered quite heavily with fine granules. They project, when mature, considerably above the seed heads and are consequently easily seen; frequently several cases occur close together on a single head. The cases remain in the same positions for a considerable time after feeding has ceased and can still be collected late in the fall. As *graminifolia* is one of the earliest flowering goldenrods in Nova Scotia, the moths appear somewhat earlier in August than most of the species, and the cases in consequence are the first of the group to mature.

Coleophora puberuloides, new species

In both 1951 and 1952, series of a coleophorid belonging to the present group were collected around a patch of *Solidago puberula* at the south end of Point Pleasant Park where this species of *Solidago* is prevalent, although at times in close association with *S. rugosa* and *Aster novi-belgii.* In the latter year good series of the same species were collected at light by Douglas Ferguson at both Aylesford and Auburn in Kings

County on August 26 and August 27, respectively. In this region according to the collector there was a plentiful growth of *S. puberula.* From cases collected by the present author in late fall of 1951 from *S. puberula* in the identical area of Point Pleasant Park where the above-mentioned adults had been secured, a small series of five males and six females emerged during the last week of August, 1952. Another bred series was secured in 1952 from cases collected in the Point Pleasant quarry in 1951. Further collections in 1952 and 1953 failed to produce adults, but in 1955, from cases collected in a different area of the park in the preceding fall, one male and three female adults were bred. At White Point Beach in 1954 a small series of four males and seven females was secured at dusk on August 19–25 in an area behind the boathouse where a good growth of *S. puberula* occurred. In the afternoon of August 24 and 25 a mixed series of six males and 10 females were captured in a drier section of a small bog adjacent to the main highway, No. 3. *Solidago puberula* was quite common here, but other solidagos and asters were also present.

Study of the above material, including numerous slides of both male and female genitalia, indicates an undescribed species which shows close affinities to both *intermediella* and *duplicis.* The coloration of the primaries is considerably darker than that of *intermediella* and somewhat similar to that of a feeder on *Solidago rugosa* to which the name *duplicis* is tentatively applied and which is discussed below in this article. The salient features of the male genitalia consist of a small apical tooth on the left rod of the aedeagus as in *duplicis* and a mediobasal, longitudinal row of two to four small teeth much as in *intermediella,* thus combining the characters of both species. In the female genitalia the most striking character is the short length of the spiculate area of the ductus bursae, much shorter than in either *intermediella* or *duplicis.* The width of the ductus in the first large convolution is also considerably broader than usual. Unfortunately these genitalic characters seem to be in a rather unstable condition, especially those of the male sex, and more particularly in the small series of bred specimens available for study. The apical tooth of the left rod in the aedeagus is always present, but the mediobasal row of teeth is frequently either barely visible or entirely absent. In the female genitalia there is a certain amount of variability in the length of the short spiculate area of the ductus bursae, but even when somewhat longer than usual it is still noticeably shorter than the same section in other species of the group. A summary of these genitalic variations in the material under examination is given as follows:

SPECIMENS COLLECTED IN POINT PLEASANT PARK IN 1951

FOUR MALES: One specimen with well-developed median row of teeth; two others with all teeth present but much reduced in size; one with median row lacking.

THREE FEMALES: Two with very short spiculate section of ductus; one with this section somewhat longer.

SPECIMENS COLLECTED IN SAME AREA OF POINT PLEASANT PARK IN 1952

TEN MALES: All teeth present in eight; apical left tooth at times reduced in size. Two males entirely without teeth but could not be separated on maculation from the others.

TEN FEMALES: All with short spiculate section; in two it is slightly longer than normal.

SPECIMENS BRED FROM CASES ON *S. puberula* IN ABOVE AREA

FOUR MALES: Apical tooth present in all four but quite small in three; mediobasal row of teeth lacking in all four.

FIVE FEMALES: Three with short spiculate section; two with slightly longer section.

SPECIMENS BRED FROM CASES ON *S. puberula* IN QUARRY

SIX MALES: Four show well-developed median row of teeth; two without this row. Apical tooth present in all but sometimes reduced in size.

EIGHT FEMALES: Six with normal, short, spiculate section; two with somewhat longer section.

SPECIMENS COLLECTED AT AUBURN IN 1952

NINE MALES: All show both apical tooth and median row of teeth.

THREE FEMALES: Spiculate section in all three somewhat longer than normal.

SPECIMENS COLLECTED AT AYLESFORD IN 1952

FIVE MALES: Median row present in four; in one rather vestigial; entirely lacking in one. Apical tooth present in all but variable in size.

THREE FEMALES: Spiculate section matches that of Auburn specimens in size.

SPECIMENS COLLECTED AT WHITE POINT BEACH BEHIND BOATHOUSE

FOUR MALES: All with apical tooth but only one with median row.

SEVEN FEMALES: All show a very short spiculate section of ductus.

SPECIMENS COLLECTED AT WHITE POINT BEACH IN DRY AREA OF BOG

One male and four females show definite characters of this species.

The other specimens are doubtful and cannot be placed with certainty.

From a study of the above records it appears evident that the female genitalia are more constant in their differentiating characters than are the male organs. For this reason in the following detailed description a female has been chosen as the holotype and the type series limited to specimens from well-defined areas which in the male genitalia show both apical tooth and the mediobasal row of teeth. No reason can be offered for the frequent lack of the mediobasal row in bred specimens. There still remains the possibility that such specimens represent the species in which the larva normally feeds on *Solidago rugosa* but which may occasionally be found on *S. puberula.* No differences in the maculation of the forewings of the adults can be detected that would disprove such a suggestion. As a further proof that *S. puberula* is the normal larval food plant, it should be stated that in 1955 in an area along the railroad embankment, cases were quite numerous on this species of goldenrod while on *S. rugosa,* which grew quite commonly in close proximity to *puberula,* no cases of any description could be found.

FEMALE: Palpi dull whitish, the second joint outwardly light sepia-brown, with a short ventro-apical tuft; third joint slightly upturned, somewhat more than half of the length of the second. Front dull whitish. Antennae with basal joint dull whitish, rather rough-scaled but with little sign of ventro-apical tufting; remaining segments whitish, smooth, with a weak, brown annulation on the under side, most evident in the basal area. Thorax and patagia dull whitish; primaries light sepia-brown; costa and veins narrowly white, the pale venation most prominent in the apical half of wing (frequently obsolescent in the basal half of wing); a slight sprinkling of dark scales, most evident in the apical area (amount variable in individual specimens); fringes somewhat paler than the ground color of wing. Secondaries smoky, with color of fringes as on primaries. Legs whitish, hind tibiae longitudinally streaked with brown. Expanse 11 mm. (smaller specimens only 9 or 10 mm.).

MALE: Not noticeably distinct from female in coloration and maculation.

FEMALE GENITALIA (HOLOTYPE; FIG. 4): Genital plate somewhat broader than long, inner and outer projections on the caudal margin well developed and subequal, the inner one rounded, the outer one pointed (often the more prominent of the two). Ostium broadly V-shaped, its apex reaching a point at slightly less than half of the length of the genital plate. Initial section of the ductus bursae hourglass-shaped, the caudal half slightly the longer, with well-rounded outer margins, the distal half extending shortly beyond the cephalic margin of the genital plate, with right edge well rounded outwardly and left edge more or less obliquely

straight, the sides strengthened with chitin of a dark brown color. Following a very short membranous section is the usual spiculate section which is shorter than usual (in some specimens even shorter than in the holotype) and contains a narrow median band of chitin extending into the large convolution; the ductus in this convolution is membranous and considerably broader than the same section in allied species; it bends into another partial convolution of similar width which is feebly spiculate and from which the ductus seminalis arises. Narrowing at this point the ductus forms a number of small convolutions to enter the globular bursa which is armed with a curved, blunt, chitinous hook, larger than usual, on a broader base (variable in size), and a short, narrow, spined strip of chitin (also variable). The membrane of the ductus throughout the small convolutions as well as that of the bursa is feebly granulate.

MALE GENITALIA (ALLOTYPE): Quite similar to the figures given of *duplicis* and *intermediella* (1940, Trans. Roy. Soc. Canada, sect. 5, pl. 1, figs. 6, 7), with the exception that the aedeagus combines the armature of both species, showing an apical tooth (occasionally slightly subapical) on the left rod and a mediobasal, longitudinal row of several teeth of which the anterior one is the largest.

LARVAL CASES: When nearly mature the cases are whitish, heavily and roughly covered with pappus and bits of brown inflorescence, and frequently lightly sprinkled with small grains of excrement. Later the color becomes browner, at times almost black, with the exception of the trilobed apex which remains pale, projecting, as usual, from the whole involucre to a varying degree. This latter feature is helpful in the locating of cases.

HOLOTYPE: Female, quarry in Point Pleasant Park, Halifax, Nova Scotia, August 24, 1952, bred from case on *Solidago puberula;* in Canadian National Collection.

ALLOTYPE: Male, same data, except September 5; in same collection.

PARATYPES: Three males, same data, but emerged August 31, September 5; five females, same data, emergence August 22, 24, September 1, 3, and 5. Five males, five females, collected south end, Point Pleasant Park, Halifax, Nova Scotia, August 25, 1952. Two pairs are to be deposited in the American Museum of Natural History; the others are in the author's collection.

Coleophora duplicis duplicis Braun

Coleophora duplicis BRAUN, 1921, Ent. News, vol. 32, p. 16 (*partim*); 1940 (Sept.), Canadian Ent., vol. 72, p. 180, pl. 12, figs. 4, 6 (genitalia of types).

Coleophora duplicis, HEINRICH, 1923, *in* Forbes, Mem. Cornell Univ. Agr. Exp. Sta., no. 68, pp. 207, 215 (*partim*).

Haploptilia duplicis, McDUNNOUGH, 1936, Canadian Ent., vol. 68, p. 54, fig. 2 (male genitalia).

Coleophora duplicis, McDUNNOUGH, 1940 (Dec.), Trans. Roy. Soc. Canada, sect. 5, p. 60, pl. 1, fig. 6, pl. 3, fig. 8 (genitalia of paratypes); "1946" [1947], Canadian Ent., vol. 78, p. 151, pl. 13, fig. 3 (female genitalia).

Following my note of 1936, this species was restricted by Braun to the series of specimens, 12 in number including the female holotype, reared from *Aster shortii* at Cincinnati, Ohio. She also included 20 specimens bred from *Solidago caesia* and two specimens bred from *S. latifolia* which, according to Rowland (Flora of Nova Scotia, p. 484), is a synonym of *S. flexicaulis*. The specific identity of the specimens bred from aster and goldenrod was doubted by the present author in his 1946 paper. This opinion was based on genitalic differences in the female sex, figures from specimens of both rearings being given (pl. 13, figs. 3 and 4); differences in the genitalia of the male sex could not be noted. *Aster shortii* is distinctly a plant of the middle states and does not occur in Nova Scotia; *Solidago caesia* and *S. flexicaulis* do occur in the province but have so far not been found to any extent in the Halifax area.

On loan from the Canadian National collection I have before me five of Braun's paratypes—a pair reared from *Aster shortii* and two males and a female reared from *Solidago caesia* with their respective genitalic slides. As far as maculation goes, the specimens resemble one another very closely, showing on the primaries, as stated by Braun in her 1940 paper, "more or less whitish costal suffusion with scattered dark scales." The genitalic differences between the two bred series, especially in the female sex, as noted above, have been verified. Until extensive breeding from cases collected on both aster and goldenrod in the type locality has been done and a study of a long series of genitalic slides made, it is impossible to determine whether such differences have specific value or are merely individual variants. From the breeding experiments carried on in the Halifax area, it would appear that a certain amount of individual variation does occur in the group in question.

In the meantime a series of specimens bred from cases collected from *Solidago rugosa* in Point Pleasant Park and also captured at White Point Beach in a large stand of the same plant are being here treated as a racial form of *duplicis* as follows.

Coleophora duplicis rugosae, new subspecies

Cases were first found on *S. rugosa* at the south end of the park in 1951, a small series of quite small adults emerging in late August and early September of the following year. In 1952 and 1953 cases were

found quite commonly on the same food plant throughout the park and also in other sections of Halifax, but emergences of adults were very disappointing, and only a very few specimens were secured. However, in 1955 a good series of 11 males and 16 females was obtained from cases collected in early November, 1954, at the north end of the park; these emerged between August 14 and August 31. At White Point Beach adults were found at dusk to be quite plentiful but somewhat worn in a large patch of *S. rugosa* between August 20 and 30, 1954. The type series is being restricted to the 1955 bred specimens.

The coloration of the head, thorax, and primaries is a light sepia-gray. The primaries show only a faint marking of the venation in dull whitish, and the costal area lacks the broad whitish suffusion found in *duplicis duplicis;* there is considerable sprinkling of minute black particles over the entire wing, slightly heavier in the fold; the apical costal area shows, as a rule, two or three short, black, longitudinal dashes between the branches of the radial vein. The fringes are pale smoky. The antennae are feebly annulate with brown, most evident on the under side. The size is smaller than that of *duplicis duplicis,* seldom exceeding 10 mm. in wing expanse.

MALE GENITALIA: Twenty-seven slides of genitalia have been made from the entire material studied, including four from the type series. In all specimens the only armature of the aedeagus consists of a triangular tooth placed at the apex of the left lateral chitinous rod. This tooth shows considerable variation; it may be of a moderate size and upright as in the holotype and one paratype, or quite minute and flat in position as in two other paratypes. The figure given in the 1940 paper (pl. 1, fig. 6) agrees well with the genitalia of the holotype.

FEMALE GENITALIA: Twenty-three slides of female genitalia have been examined, including four from the type series. As in the male sex considerable variation is shown. A number of specimens, including the allotype and two paratypes, agree closely with those in my 1940 figure (pl. 3, fig. 7), showing a long and narrow distal half of the hourglass protion of the ductus, a fairly deep, V-shaped ostium, slight projections on the caudal edge of the genital plate, and a rather long spiculate section, much longer than that of *puberuloides.* Other specimens, including one paratype, approach quite closely Braun's figure of the holotype of *duplicis duplicis* in which the distal half of the hourglass portion of the ductus is shorter and broader, the left side bulging considerably outward. In the whole series of slides minor variation occurs in the length of the spiculate section, the size of the caudal projections of the plate, and the depth of the ostium.

LARVAL CASES: Rather short and slender, less chunky than cases found on *Solidago puberula*. When freshly made, the color is a pale brown, with thin strips of a slightly darker-colored inflorescence attached and a variable amount of pappus adhering to the case. The trilobed apex is pale and projects rather noticeably from the involucre. When mature, many of the larvae hide very effectively beneath the pappus of the entire flower head, attaching their cases to the stem or to small leaflets. Later the cases assume a darker appearance, becoming at times quite blackish.

HOLOTYPE: Male, Point Pleasant Park, Halifax, Nova Scotia, August 19, 1955, bred from *Solidago rugosa* (J. McDunnough).

ALLOTYPE: Female, same data, but emerged August 17.

PARATYPES: Nine males, 12 females, same data, but dates of emergence August 14–31.

The holotype and several paratypes will be deposited in the Canadian National Collection; the allotype and other paratypes, in the American Museum of Natural History. The balance of the material remains in the author's collection for the present.

REMARKS: Besides the above-mentioned material, there is a small series of specimens in the collection which has no definite relation to any food plant; they were mostly taken at light by Douglas Ferguson in various sections of the province, but a few were collected at odd times in the Halifax area. These specimens are considerably larger than the *rugosa*-feeders and in the maculation of the primaries show a much more definite white striation along the veins and a generally slightly deeper ground color, approaching in these respects, but not in genitalia, Braun's diagnosis of *ericoides*. In the male genitalia the triangular apical tooth of the left rod of the aedeagus is upright and larger than usual. In the female genitalia the caudal projections of the genital plate are quite well developed, the ostium is rather deeply V-shaped, the spiculate section of the ductus bursae is very long, and the width of the ductus in the first large convolution is slightly greater than in the *rugosa*-feeders, the whole organ bearing considerable resemblance to figure 7 of my 1946 paper. At the present time it is impossible to determine whether these specimens represent merely a form of the *rugosa*-feeder or are distinct from it.

Coleophora ericoides Braun

Coleophora ericoides BRAUN, 1919, Ent. News, vol. 30, p. 128; 1940, Canadian Ent., vol. 72, p. 178, pl. 12, figs. 2, 7 (genitalia). MCDUNNOUGH, 1940, Trans. Roy. Soc. Canada, sect. 5, p. 57, pl. 1, fig. 5, pl. 3, fig. 4 (genitalia); "1946" [1947], Canadian Ent., vol. 78, p. 148 (*partim, nec* pl. 13, fig. 2).

Coleophora ericodes, HEINRICH, 1923, *in* Forbes, Mem. Cornell Univ. Agr. Exp. Sta., no. 68, pp. 207, 214.

The species was described from a series of seven specimens bred from larvae mining "the seeds and receptacle of a wild aster (*Aster ericoides* L.)." The larval cases are described in detail and evidently are very similar to those of other species in this same group. Braun, in her second paper (1940), gives figures of the male and female genitalia, based on specimens of the type series, but neglects to state the sex of the holotype specimen, the genitalia of which were evidently not figured. Further specimens were taken by Braun in 1928 at Mineral Springs, Adams County, Ohio, and the genitalia of a female from this series were figured by the present author in his 1940 paper (pl. 3, fig. 4); this figure is a fairly close match to Braun's figure from a paratype. In a later paper (McDunnough, 1947) some variation in the female genitalia of the few Ohio specimens in the Canadian National Collection was noted, and an attempt was made to designate the salient features of such genitalia. A doubt was also expressed as to whether certain Nova Scotian specimens, placed as *ericoides* in the earlier paper on account of similarity of male genitalia, could really be considered as belonging to this species. Four Ohio specimens in the Canadian National Collection with their respective genitalic slides have been lent for examination. These consist of one male paratype and one male and two females taken by Braun at Mineral Springs, Adams County, on September 12, 1928. As regards maculation of the primaries, the male paratype is rather blurred, as often happens in bred specimens. The three Mineral Springs specimens agree well with one another and with the original description, the ground color being a light brownish and the costa and radial veins narrowly marked with white. There is also a faint white streak through the fold. There is no trace of any black sprinkling. The secondaries with their fringes are smoky. The antennae are faintly annulate on the under side. In the genitalia the two male specimens agree, both lacking any terminal teeth in the aedeagus. In the female genitalia one specimen agrees fairly well with Braun's figure (pl. 12, fig. 7) as far as the caudal lobes of the genital plate and the general shape of the hourglass portion of the ductus are concerned, although the lower half is somewhat broader as a comparison with my 1940 figure (pl. 3, fig. 4) will show. Unfortunately the entire spiculate portion of the ductus and the first large convolution have been omitted from Braun's figure, rendering a comparison of these sections impossible. It is presupposed, therefore, that in this respect figure 4 is correct. The stress laid by Braun on the comparative lengths of the spined strip and the small hook in the bursa must, in the author's opinion, be disregarded as of little value as a specific character. The other female specimen shows the lower half of the hourglass section to be closer in

shape to Braun's figure, but the upper half is narrower; in consequence the invagination separating the two sections is very slight; the spiculate portion is also somewhat longer. Such differences are probably merely due to individual variation, if one may judge by what occurs in other species of the group.

In view of a study of further Nova Scotia material, collected mostly by the present author in 1954 in connection with a certain species of plant, it has been decided that our maritime species is not conspecific with *ericoides,* and a description as an undescribed species follows.

Coleophora nemorella, new species

Coleophora ericoides, McDUNNOUGH (*nec* Braun), 1940, Trans. Roy. Soc. Canada, sect. 5, p. 57 (*partim*); "1946" [1947], Canadian Ent., vol. 78, p. 148 (*partim*).

In 1954 a series of a coleophorid species was taken by the author in a small, wet bog adjacent to the main highway in White Point Beach village. These specimens were all flushed out of a growth of *Aster nemoralis* which occurred quite plentifully in the area. As no other aster or goldenrod species grew in the bog except an odd specimen or two of *Solidago uliginosa,* it seems fairly evident that, for the present at least, the above-mentioned aster may be considered as the larval food plant. A total series of 15 males (one without abdomen, presumably male) and five females was taken, a few specimens on August 19 and 20 but the majority on August 21. On August 24 a pair was taken *in coitu* along with a single female. After this date no other specimens were observed.

At the time of capture the specimens presented to the naked eye a pale, almost whitish appearance and were certainly considered as belonging to a single species. Later a series of genitalic slides was made, and it was discovered that five of the males agreed with *ericoides* in showing no terminal teeth on either of the chitinous rods of the aedeagus. However, nine other males, including the one taken *in coitu,* resembled *duplicis,* possessing a small, upright, triangular tooth at the apex of the left rod, quite variable as regards size. In the five females the genitalia showed a certain amount of variation; three of the specimens agreed fairly closely with the one taken *in coitu,* in which the spiculate portion of the ductus is quite short, resembling in this respect *puberuloides* rather than *duplicis.* The fifth specimen showed more variation, notably in the greater length of the spiculate section. As nothing could be noted in the maculation of the wings that would indicate that two species were involved, it is presupposed that one is again dealing with a case of variable genitalia in a

single species. However, to avoid any controversy, the type series has been selected from specimens of both sexes that match the pair taken *in coitu,* the other specimens being included under the same specific name but not labeled as paratypes. Besides the White Point Beach series there are four specimens, three males and one female, taken at light by Douglas Ferguson at Peggy's Cove, Halifax County, on August 20, 1952, which obviously belong here. In slides made of the genitalia of two of the males a similar variability was noted, one of the males showing a small apical tooth on the left rod of the aedeagus, the other being without this tooth. The female genitalia matched quite closely those of White Point Beach material. The occurrence of *Aster nemoralis* in the bogs at Peggy's Cove has also been noted. Although the material has not been recently examined, it seems quite probable that the specimens doubtfully placed under *ericoides* in my 1940 paper belong to the present species; in former visits to White Point Beach collecting was done in this same bog area.

In maculation of the primaries the species is close to *ericoides,* the costa and veins being sharply and rather broadly marked with white, the remainder of the wing being light gray-brown. There is a faint sprinkling of blackish dots, most noticeable in the fold and in the apical section where they show a slight tendency to form short streaks. This dark sprinkling, as well as the broader nature of the white streaks, at times very obvious, serves to separate the species from *ericoides.* There is also a great similarity in maculation to *puberuloides* which is in general somewhat smaller and darker in color and of course differs, as a rule, in the armature of the male aedeagus. The palpi are much as usual in color, being pale inwardly and streaked with smoky brown outwardly; the second joint shows a rather long, ventro-apical tuft of scales. The antennae are pale, with only faint traces of darker annulation, most evident on the under side. The secondaries are rather deep smoky. The wing expanse is 11–13 mm. In worn specimens the pale striation and the brown ground color of the primaries disappear to a great extent, and the wings assume a dull whitish coloration. The habitat in a wet bog as compared with that of both *ericoides* and *puberuloides,* which are found in dry, open spaces, would seem to point to specific distinctness. Naturally the suggestion as to the larval food plant remains to be verified.

MALE GENITALIA: These organs in the typical form cannot be separated from those of *duplicis* as figured by Braun (1940), the aedeagus showing an armature of a small tooth of variable size at the apex of the left chitinous rod. In the variant this tooth is lacking, and the genitalia in consequence are inseparable from those of *ericoides.*

FEMALE GENITALIA: (See fig. 5, based on the female taken *in coitu*).

Scarcely separable from those of *ericoides* or *puberuloides*. Genital plate somewhat higher than broad; caudal lobes well developed but the inner rounded one not so strongly projecting as in *ericoides*. Ostium deep and rather broadly V-shaped. Hourglass portion of ductus with the median invagination distinct, the upper half slightly longer than the lower one, its sides distinctly convex; lower half upright, the sides projecting considerably beyond the cephalic margin of the genital plate, the right side slightly more convex than the left one and with its chitinization extending to a small degree farther cephalad than on the opposite side. Following a very short membranous section the spiculate portion projects to the left and is short, being about one-third longer than the genital plate. As usual it is bisected by a thin chitinous strip which extends beyond it through the following membranous portion to the end of the first large convolution, the membrane of which is broader than usual and almost as broad as in *puberuloides*. The following sections show no obvious differences from those of other species in the group. The bursa is armed with the usual hook on a broader base and a smaller, spiculate strip of chitin, considerably shorter than the hook in the present specimen but variable in others. Minor variations also occur in other specimens in the width of the lower half of the hourglass and in the length of the spiculate portion.

HOLOTYPE: Male, White Point Beach, Queens County, Nova Scotia, August 24 (J. McDunnough) taken *in coitu*.

ALLOTYPE: Female, same data, but August 21, around *Aster nemoralis*.

PARATYPES: Seven males, three females, same data, but dates varying between August 19 and 24. The female taken *in coitu* is a poor speciman and was therefore merely made a paratype.

The holotype and allotype are to be deposited in Canadian National Collection; paratypes in the American Museum of Natural History; the balance in author's collection.

Coleophora bidens Braun

Coleophora bidens BRAUN, 1940, Canadian Ent., vol. 72, p. 182, figs. 9, 10 on p. 181 (genitalia). MCDUNNOUGH, "1946" [1947], Canadian Ent., vol. 78, p. 60.

This well-known feeder on *Aster umbellatus* was discussed at some length in my 1946 paper, and the numerous variations in the armature of the male aedeagus were noted. *Aster umbellatus* is very common along the roadsides in Nova Scotia but in the Point Pleasant Park area is met with only occasionally, occurring for the most part along the road bordering the park on the north side. Cases collected in this area have unfortunately produced no adults, but a good number of mature cases have

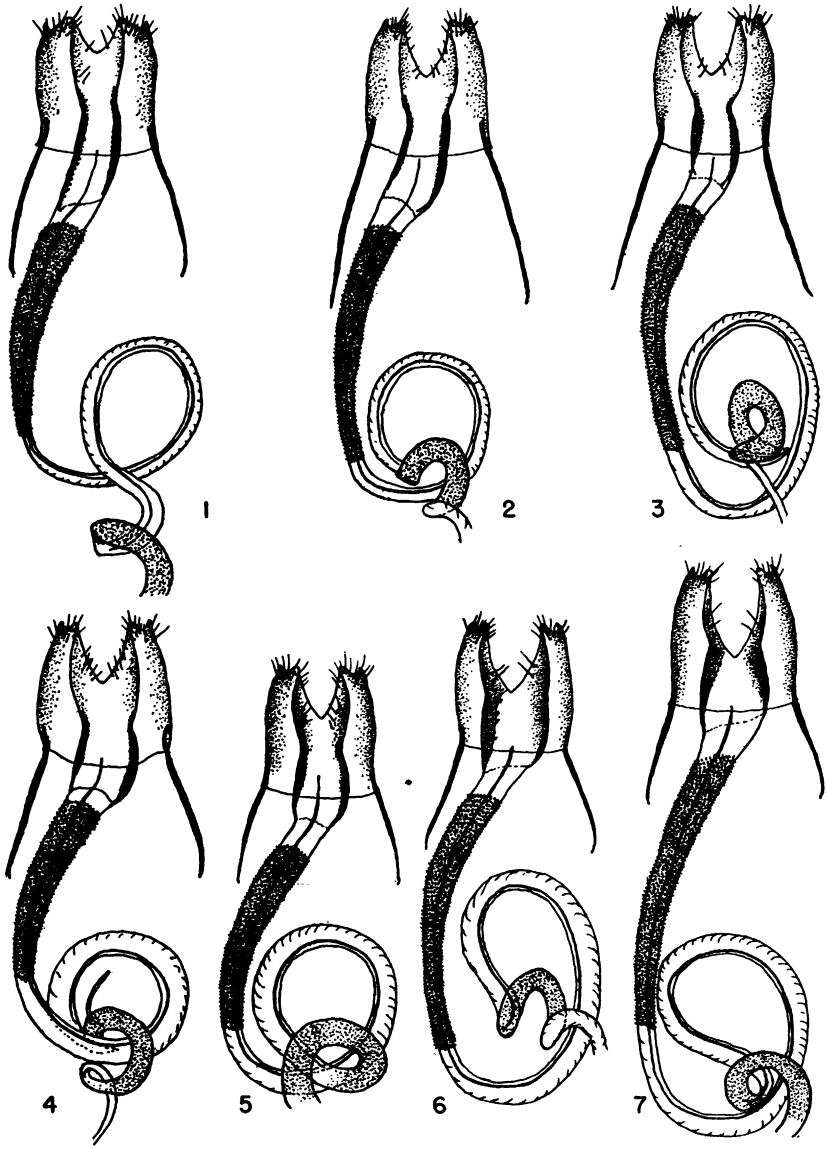
again been found during the latter half of October, 1955, and it is hoped that rearing of adults from these will be more successful.

The only specimens at present available for study include a series of six males and five females collected by the author in late August at White Point Beach, Queens County, in a large patch of *A. umbellatus* growing near the junction of the main highway with the side road leading to the lodge. Single females were also taken at light by Douglas Ferguson at Peggy's Cove, Halifax County, on August 20, 1952, and at Petite Riviere on August 14, 1954. The following results were obtained from a study of genitalic slides of the above material.

MALE GENITALIA: Of six slides examined two show only a large, slightly subapical tooth on the right chitinous lateral rod; in two others the subapical tooth is much reduced in size, but there is an addition of a minute median tooth; in another one the small subapical tooth is present, but the median one is lacking; finally one other is without any teeth. This is a further confirmation of my findings in the 1946 article as to the variability of the armature of the aedeagus. As characteristic for the present species it should be noted that the claspers are much longer than in other species of the group; the aedeagus is dorsally much flatter and broader, the lateral, chitinous rods being also flat and well separated from each other by a membranous area.

FEMALE GENITALIA: Of the six slides examined five agree fairly well with Braun's figure (fig. 9) as regards the deep invagination of the ostium. The chitinized walls, however, of the lower half of the so-called "hourglass" portion of the ductus show a greater asymmetry than in this figure, that on the left side being longer and projecting well beyond the cephalic edge of the genital plate, while on the right side the chitinized section barely attains this edge. The spiculate section of the ductus (not figured in its entirety by Braun) is very long and the initial convolution much larger than usual. In a single White Point Beach specimen the resemblance to Braun's figure of *subapicis* is quite marked (1940, Canadian Ent., vol. 72, p. 179, pl. 12, fig. 5), the walls of the initial portion of the ductus being parallel, without the usual median constriction, and the ostium being less deep than in the other slides. Figures of both types of genitalia are given here (figs. 6, 7).

LARVAL CASES: Much larger in general appearance than any of the other cases in the group but showing the same trilobed apex and having the same tendency to remain largely hidden in the pappus. Descriptions of the two color forms were given in the 1946 article; it might be mentioned that both the light brown and the black-striped forms occur in the Halifax area, but the latter appear to predominate.



FIGS. 1–7. Female genitalia of *Coleophora*. 1. *C. triplicis* McDunnough. 2. *C. dextrella* Braun (bred specimen). 3. *C. dextrella* Braun (captured specimen). 4. *C. puberuloides* McDunnough (holotype). 5. *C. nemorella* McDunnough (specimen taken *in coitu*). 6. *C. bidens* Braun (aberrant form). 7. *C. bidens* Braun (normal form).