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HOST RELATIONSHIPS OF MOTHS OF THE GENERA DEPRESSARIA AND AGONOPTERIX, WITH DESCRIPTIONS OF NEW SPECIES

BY

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U. S. Bureau of Entomology and Plant Quarantine

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(With Six Plates)

In 1932 I began collecting larvae of the species of *Depressaria* and *Agonopterix* (Lepidoptera: Oecophoridae) for the purpose of rearing the moths and gaining some knowledge of their habits and distribution and with the hope that unknown species might be discovered. It soon became evident that undescribed species of these genera were numerous and that many of their habits were both intriguing and informative. Although interrupted, sometimes for several years, these investigations have continued sporadically over the past two decades with moderate success.

During the summer of 1950, by means of a grant-in-aid made by the American Philosophical Society which defrayed some of the expense of an extended trip through several western States, I was able to resume my explorations in this field.[1] My purpose, essentially, was to determine if possible whether the long-suspected host specificity of many species of *Depressaria,* particularly those attached to plants of the genus *Cicuta,* really existed. Unfortunately, only a few species of this genus of plants were found, and so the project was enlarged to include species of moths attached to other umbelliferous plants.

In the course of the summer's field work plants were examined at 80 localities, as shown in the list beginning on page 5. Infestations

[1] I wish to express my gratitude to the American Philosophical Society for the grant-in-aid that made these investigations possible and to the Smithsonian Institution for administering the grant. Also, I have many times been indebted to my friend Dr. Lincoln Constance, Department of Botany, University of California, for determinations of plants and for his stimulating company in the field. During the summer of 1950, in connection with the present studies, I again received his generous help, and again I thank him. I am indebted to Harry F. Clements for furnishing the photograph for plate 5, figure 2; all other photographs and drawings herein are of my own making. Unless otherwise indicated, all material for this paper was collected and reared by me.—J. F. G. C.

do not occur throughout the plants' ranges, the distribution of the moths being affected by other factors. In all, 34 species of umbels were examined. For the most part these food plants were situated along highways and so were readily accessible. I have used this method of roadside collecting for many years and have found that larvae can thereby be collected rapidly and with much saving of time.

On the westward journey I made observations and collections at several localities, but it was not until we reached Washington and Oregon that serious collecting really began. A brief discussion of some of the localities, with illustrations of the habitats and some of the food plants, seems appropriate in order to acquaint the reader with the diverse conditions under which these umbelliferous plants flourish.

The Umbelliferae are found throughout the continent from the seashore to the high altitudes of the Rocky, Cascade, and other mountains, in swamps, and in the deserts and prairies. By following the advent of spring from the lowlands to the high altitudes, it is possible to enjoy profitable collecting from March to August. Even in the lowlands of the Midwest and eastern United States and Canada, certain species of larvae will be found well into August.

After crossing the Rocky Mountains, going west, one encounters the Intermountain Area between the Rocky and Cascade Mountains. Throughout this inland empire Umbelliferae abound, and it is here that we find a vast number of species of *Lomatium*. One species of *Lomatium* is found as far east as Missouri; the rest are western. Perhaps the commonest species is *L. dissectum,* which covers vast areas from Alberta to British Columbia, Montana, Idaho, Washington, and Oregon to Colorado and California. This is host to *Depressaria leptotaeniae.*

In central Washington and Oregon, desert conditions, which extend north into southern British Columbia and south into California, prevail. In somewhat restricted, sandy habitats within this area will be found *Pteryxia terebinthina foeniculacea,* the host to *D. yakimae* (pl. 1, figs. 1, 2). In Ten Sleep Canyon, Wyo., another variety of this plant, *P. t. calcarea,* is host to *Depressaria pteryxiphaga,* described on page 16.

Continuing west to the eastern slopes of the Cascade Mountains one encounters a great array and succession of umbelliferous plants that are hosts to a considerable number of species of *Depressaria* and *Agonopterix.* One of the commonest species of these plants is *Cicuta occidentalis,* which is found in marshy areas and along creeks, rivers, and irrigation ditches. On plate 2, figure 1, is illustrated a

typical habitat at Rock Creek, Oreg., where Oregon State Highway 82 crosses it, in which the *Cicuta* grows in association with grasses, tule, and *Typha*. This particular stand of *C. occidentalis* was heavily infested with *D. juliella*. On plate 2, figure 2, are illustrated uninfested specimens of this plant at Carlton, Wash.

As one leaves the desert and arid spaces of the Intermountain Area and ascends the eastern slopes of the Cascade Mountains he passes through the Timbered Transition Zone. In this zone, usually on the open, rocky slopes, *Lomatium triternatum macrocarpum,* host to *D. betina,* is found. Also in this zone one encounters *Osmorhiza occidentalis* and *O. chilensis*. Both of these species are attacked by *Agonopterix rosaciliella,* but I have never found a *Depressaria* attached to either of these plants. *O. occidentalis* is found most abundantly at altitudes of 5,000 to 6,000 feet, and *O. chilensis* usually grows at lower altitudes and in the Humid Transition Zone of the west side of the Cascades. *O. chilensis* is not normally infested; in fact, the only infestation I have ever found was at Billy Goat, Okanogan County, Wash., where the host was attacked by *Agonopterix rosaciliella.*

The alpine meadows, which one encounters after passing through the foothills of the Cascade Range and the high ridges above them, provide the habitats for a great variety of umbels. At Harts Pass, which forms the boundary between Whatcom and Okanogan Counties, Wash., and Slate Peak, in the former county (pl. 3), there are no fewer than twelve species of Umbelliferae. These are: *Osmorhiza occidentalis, O. chilensis, Heracleum lanatum, Angelica arguta, Ligusticum purpureum, Lomatium dissectum, L. brandegei, L. geyeri, L. ambiguum, Angelica lyalli* Wats., *Lomatium gormani* (Howell) C. & R., and *L. triternatum* (Pursh) C. &. R., the last three being recorded by Muenscher.[2] In addition, *L. angustatum,* from which I have reared *D. angustati,* will be found on some of the high ridges such as Skyline Ridge, Mount Baker District, Whatcom County, Wash.

Proceeding westward, after passing through the alpine meadows and the Arctic Highland ridges, we enter the forested Hudsonian, Canadian, and Humid Transition Zones in that order. In the first two there is little of interest for one devoted to the study of the insects being discussed, but in the Humid Transition there is a wide variety of Umbelliferae.

Oenanthe sarmentosa (pl. 5, fig. 1), the host of *D. nervosa,* is

[2] Muenscher, W. C., The flora of Whatcom County, State of Washington, pp. 108-110, 1941.

abundant in practically every swale, swamp, marsh, and roadside ditch, and although *nervosa* is not found throughout the range of the host it is widespread in Oregon and Washington and undoubtedly will be found in British Columbia. I obtained *nervosa* in quantity on the American side of the international boundary at Blaine, Wash. On the dry prairies of the Humid Transition Zone, on the dry, gravelly slopes of some of the San Juan Islands, and along the seashore at Bellingham and Birch Bays, *Lomatium utriculatum,* host to *D. besma,* and *L. nudicaule* abound. *Sium suave, Cicuta douglasii,* and *Osmorhiza chilensis* are also found abundantly, *C. douglasii* being an occasional host of *D. nervosa.* In this zone also *Angelica arguta, A. lucida,* and *A. hendersonii* are encountered. *A. lucida* grows in the marshy, tidewater areas of the Siletz River, Oreg., and *A. hendersonii* (pl. 4, figs. 1, 2) is found along the rocky bluffs of the seashore of the Oregon coast. Both of these plants, together with *Ligusticum apiifolium* and *Conioselinum chinense,* are hosts to *A. rosaciliella* and *A. oregonensis.*

Throughout all these zones, with the exception of the Arctic, we are apt to find *Daucus carota, Heracleum lanatum,* and *Conium maculatum. H. lanatum* is frequently infested with *D. heracliana,* and the other two sometimes show injury, but I have not yet reared an oecophorid from either one.

The species of *Depressaria* adhere rather closely to a pattern of attack in which the young umbels are webbed by the larva or several larvae. Pupation takes place in a hollow stalk of the host or in debris at or near the base of the plant. Some exceptional variations are discussed under the pertinent species.

On plate 5, figure 1, are figured characteristic examples of umbels of *Oenanthe sarmentosa* in which the rays are drawn together and the inflorescence is distorted by the larvae of *Depressaria nervosa.* In figure 2 of the same plate is an illustration of an umbel of *Lomatium dissectum multifidum* webbed and damaged by larvae of *D. leptotaeniae.* When this photograph was taken the fruits were maturing, but the typical damage is well illustrated.

The larvae of *Agonopterix* species are chiefly leafrollers, but occasionally they web the rays and feed in the fruits. As far as I know the larvae never pupate in a hollow stalk.

Above I have discussed the more important plants, of a rather limited region of the continent, attacked by larvae of the two genera under consideration and have indicated some of the places where they may be found. Obviously I have not shown the extent of the entire ranges of the plants, nor have I recorded all the exact localities from which the plants have been collected.

LIST OF LOCALITIES WHERE FOOD PLANTS (UMBELLIFERAE) OF DEPRESSARIA AND AGONOPTERIX WERE COLLECTED

["x" indicates infestations of larvae and/or collections that produced adults; "o" indicates no occurrence of the insects.]

Localities	Food plants *	Larvae	Adults
1. Oelwein, Iowa	*Zizia aurea* (L.) Koch	x	o
2. Quinn, S. Dak.	*Lomatium* sp.	x	o
3. Ten Sleep, Wyo.	*Pteryxia terebinthina calcarea* (M. E. Jones)	x	x
4. Deer Lodge, Mont.	*Lomatium dissectum multifidum* (Nutt.) M. & C.	x	x
5. Alberton, Mont.	*Lomatium ambiguum* (Nutt.) C. & R.	x	x
	Lomatium macrocarpum (H. & A.) C. & R.	x	x
6. Hooper, Wash.	*Cicuta occidentalis* Greene	o	o
	Conium maculatum L.	o	o
7. Washtucna, Wash.	do.	o	o
8. 8 miles west of Moses Lake, Wash.	*Pteryxia terebinthina foeniculacea* (T. & G.) Math.	x	x
9. 10 miles east of Burke, Wash.	do.	x	x
10. Pomona, Yakima County, Wash.	*Lomatium* sp.	o	o
11. Cliffdell, Kittitas County, Wash.	*Lomatium triternatum macrocarpum* (C. & R.) Math.	x	x
	Osmorhiza occidentalis (Nutt.) Torr.	o	o
12. Sawmill Flat, Kittitas County, Wash.	*Lomatium triternatum macrocarpum*	x	x
13. Marietta, Whatcom County, Wash.	*Oenanthe sarmentosa* Presl.	o	o
14. Lake Samish, Whatcom County, Wash.	do.	x	x
15. Bellingham, Wash.	do. (Numerous observations)	o	o
16. Lawrence, Whatcom County, Wash.	*Oenanthe sarmentosa*	x	x
17. Blaine, Wash.	do.	x	x
	Heracleum lanatum Michx.	o	o
18. Ferndale, Wash.	*Oenanthe sarmentosa*	o	o
19. Birch Bay, Whatcom County, Wash.	do.	x	x
	Lomatium nudicaule (Pursh) C. & R.	o	o
20. Hamilton, Skagit County, Wash.	*Oenanthe sarmentosa*	x	x
21. Vogler Lake, Skagit County, Wash.	do.	o	o
	Osmorhiza chilensis Hook. & Arn.	o	o
22. Toad Lake, Whatcom County, Wash.	do.	o	o
	Heracleum lanatum	o	o
	Oenanthe sarmentosa	x	x

* Botanical authority is given only after the first occurrence of the name.

Localities	Food plants *	Larvae	Adults
23. Fazon Lake, Whatcom County, Wash.	*Oenanthe sarmentosa*	o	o
	Cicuta douglasii (DC.) C. & R.	x	x
24. Olympia, Wash.	*Oenanthe sarmentosa*	o	o
25. Centralia, Wash.	do.	o	o
26. Chehalis, Wash.	do.	o	o
27. Kelso, Wash.	*Daucus carota* L.	o	o
28. Oregon City, Oreg.	*Oenanthe sarmentosa*	o	o
	Osmorhiza chilensis	o	o
	Heracleum lanatum	o	o
29. Molalla, Oreg.	*Oenanthe sarmentosa*	o	o
30. Wilhoits Springs, Oreg.	do.	x	x
31. Clackamas River, Oreg.	*Ligusticum apiifolium* (Nutt.) A. Gray	x	x
32. Depoe Bay, Oreg.	*Angelica hendersonii* C. & R.	x	x
	Conioselinum chinense (L.) BSP	x	x
	Daucus pusillus Michx.	o	o
	Oenanthe sarmentosa	o	o
	Heracleum lanatum	o	o
33. Hogarty Creek, Oreg.	*Oenanthe sarmentosa*	o	o
34. Whale Cove, Depoe Bay, Oreg.	*Conioselinum chinense*	x	x
	Oenanthe sarmentosa	o	o
35. Beverly Beach, Oreg.	do.	o	o
36. Agate Beach, Oreg.	do.	o	o
37. Siletz River, Oreg.	*Angelica lucida* (L.)	x	x
38. Toledo, Wash.	*Oenanthe sarmentosa*	o	o
39. Tumwater, Wash.	do.	o	o
40. 3 miles west of Monroe, Wash.	*Angelica arguta* Nutt.	o	o
41. Tye River, U. S. Highway 2, Wash.	do.	o	o
	Heracleum lanatum	o	o
42. Rayrock Springs, Stephens Pass, Wash.	*Angelica arguta*	x	x
	Osmorhiza chilensis	o	o
43. Winton, Wash.	*Angelica canbyi* C. & R.	o	o
	Cicuta douglasii	o	o
	Heracleum lanatum	o	o
44. Azwell, Wash.	No umbels found	o	o
45. Carlton, Wash.	*Cicuta occidentalis*	o	o
46. Billy Goat, Okanogan County, Wash.	*Osmorhiza occidentalis*	x	x
47. 2 miles south of Billy Goat, Wash.	*Osmorhiza chilensis*	x	x
48. Eight Mile Creek Guard Station, Okanogan County, Wash.	*Angelica arguta*	o	o
49. Sherman Guard Station, Okanogan County, Wash.	do.	o	o
50. Winthrop, Wash.	*Cicuta occidentalis*	o	o
51. Robinson Creek, Okanogan County, Highway 16, Wash.	do.	o	o

* Botanical authority is given only after the first occurrence of the name.

Localities	Food plants *	Larvae	Adults
52. Harts Pass, Okanogan County, Wash.	*Lomatium brandegei* (C. & R.) F. Macbr.	o	o
	Lomatium geyeri (S. Wats.) C. & R.	o	o
	Lomatium ambiguum	o	o
	Osmorhiza occidentalis	o	o
	Angelica arguta	o	o
53. Lower Harts Pass, Okanogan County, Wash.	*Heracleum lanatum*	o	o
	Angelica arguta	o	o
	Ligusticum sp.	o	o
54. Slate Peak, Whatcom County, Wash.	*Lomatium ambiguum*	x	x
	Lomatium geyeri	o	o
	Lomatium brandegei	x	x
	Lomatium dissectum (Nutt.) Math. & C.	o	o
55. Ingalls Creek, Blewett Pass, Wash.	*Angelica arguta*	o	o
56. Peshastin Creek, Blewett Pass, Wash.	do.	o	o
57. Touchet, Wash.	*Daucus carota*	o	o
58. Freewater, Oreg.	*Cicuta occidentalis*	o	o
59. Langdon Lake, Oreg.	*Angelica arguta*	o	o
60. 16.5 miles north of Elgin, Oreg.	do.	o	o
61. 10 miles north of Elgin, Oreg.	do.	o	o
62. Minam, Oreg., Wallowa River	*Cicuta occidentalis*	o	o
63. Rock Creek, Highway 82, Oreg.	do.	x	x
64. Joseph, Oreg.	*Heracleum lanatum*	o	o
65. Wallowa Lake, Oreg.	do.	o	o
	Angelica arguta	o	o
66. Aneroid Lake Trail, Oreg.	do.	o	o
	Osmorhiza occidentalis	o	o
	Ligusticum sp.	o	o
	Heracleum lanatum	o	o
67. Oregon City, Oreg.	*Oenanthe sarmentosa*	o	o
	Osmorhiza chilensis	o	o
68. Bridal Veil Falls, Oreg.	*Lomatium angustatum* (Coult. & Rose) St. John	x	o
	Lomatium triternatum macrocarpum	o	o
	Lomatium dissectum multifidum	o	o
	Heracleum lanatum	x	x
	Angelica sp.	o	o
	Daucus carota (injury only detected)	o	o
	Oenanthe sarmentosa	o	o
	Osmorhiza chilensis	o	o
69. Oneonta Gorge, Oreg.	*Lomatium angustatum*	o	o
70. Lake Padden, Whatcom County, Wash.	*Cicuta douglasii*	x	x
	Sium suave Walt.	o	o

* Botanical authority is given only after the first occurrence of the name.

Localities	Food plants *	Larvae	Adults
71. Waterville, Wash.	*Cicuta occidentalis*	x	x
72. Coeur d'Alene Lake, Idaho	*Lomatium dissectum multifidum*	o	o
73. Denna Mora Creek, U. S. Highway 10, Mont.	*Ligusticum canbyi* C. & R.	o	o
	Angelica arguta	o	o
74. Clinton, Mont.	*Sium suave*	o	o
75. McDonald Pass, Mont.	*Angelica arguta*	x	x
	Heracleum lanatum		
	Osmorhiza occidentalis	o	o
76. Jackson Lake, Wyo.	*Ligusticum filicinum* S. Wats.	o	o
77. Togwotte Pass, Wyo.	do.	x	o
78. 25 miles southeast of Lander, Wyo.	*Lomatium* sp.	o	o
79. 13 miles east of North Platte, Nebr.	*Cicuta maculata* L.	x	x
80. Lucas, Iowa	do.	x	x

* Botanical authority is given only after the first occurrence of the name.

As pointed out at the beginning of this discussion, the object of the field work undertaken was to endeavor to induce larvae to accept substitute foods, and to rear the moths. On page 9 is a chart in which I have tabulated the food plants and the species of *Depressaria* and *Agonopterix* that have been reared to date. It will be noticed at once that the differences in feeding habits between the species of the two genera follow different patterns. The three species of *Agonopterix* are definitely polyphagous, one species feeding on no less than 14 species of umbels. The species of *Depressaria,* on the other hand, show a *distinct* monophagous tendency, although three species feed on more than one plant. Even so, the range of acceptance is very narrow and, indeed, though not lethal, may be accidental.

The first attempt to induce larvae to feed on substitute food was made in 1933 when larvae of *Depressaria multifidae* were offered, in place of *Lomatium grayi,* the normal food, *L. dissectum multifidum,* which they refused. In 1946,[3] however, a series of moths was reared from *L. columbianum* which are indistinguishable from a long series of *multifidae.*

In the summer of 1950 numerous attempts at substitution of foods were made, but without success. Larvae of *D. betina* found on *L. triternatum macrocarpum,* the normal food plant, were offered *Osmorhiza chilensis.* Most larvae refused this substitute, but some ate it voraciously; all died. Although *L. triternatum macrocarpum* is the normal food, occasionally scattered larvae from which moths were reared were found on *L. dissectum* and *L. columbianum.* All

[3] Clarke, J. F. Gates, Journ. Washington Acad. Sci., vol. 37, p. 13, 1947.

these species of *Lomatium* are frequently found growing in close association.

Depressaria nervosa was found in great abundance in the extreme western parts of Whatcom and Skagit Counties, Wash., and less

	DEPRESSARIA	*heracliana*	*juliella*	*eleanorae*	*cinereocostella*	*whitmani*	*leptotaeniae*	*yakimae*	*multifidae*	*angustati*	*togata*	*constancei*	*betina*	*schellbachi*	*moya*	*besma*	*thustra*	*angelicivora*	*armata*	*pteryxiphaga*	*nervosa*	*AGONOPTERIX*	*oregonensis*	*rosaciliella*	*muricolorella*
Angelica arguta																		x						x	
hendersonii																							x	x	
lucida																							x		
Cicuta douglasii																					x				
maculata					x																				
occidentalis			x	x																					
Conioselinum chinense																								x	
Daucus carota		?																							
Eryngium vaseyi																							x		
Heracleum lanatum		x																							
Ligusticum apiifolium																							x	x	
Lomatium ambiguum																	x								
angustatum										x															
brandegei																			x						
californicum													x												
caruifolium																							x		
columbianum									x				x												
dissectum													x												
dissectum multifidum							x																		
grayi									x																x
macdougali														x											
macrocarpum						x																			x
marginatum																							x		
nudicaule																							x		
triternatum macrocarpum													x				x								
utriculatum															x								x		
vaginatum														x											
Oenanthe sarmentosa																					x		x	x	
Osmorhiza chilensis																								x	
occidentalis																								x	
Pastinacea sativa		x																							
Pteryxia terebinthina calcarea																				x					
terebinthina foeniculacea								x																	
Sanicula bipinnata																							x		
bipinnatifida																							x		
laciniata																							x		
nevadensis																							x		
tuberosa																							x		

commonly in one locality in Oregon, feeding on *Oenanthe sarmentosa.* Larvae of this moth feed on a species of *Oenanthe* in Europe and, undoubtedly, in Asia. At Fazon Lake and Lake Padden, both in Whatcom County, Wash., I found a few larvae on *Cicuta douglasii,* which was quite acceptable to them, and they completed their metamorphosis. The food plant at Lake Padden was growing intermingled with *Sium suave,* which the larvae did not infest and which was refused by them when offered as a substitute. Larvae of *nervosa* were

offered umbels of *Angelica arguta* and *Cicuta occidentalis,* which also were refused.

At Slate Peak, Whatcom County, Wash., a large quantity of larvae of an undescribed species of *Depressaria* was collected on *Lomatium brandegei.* Six larvae were offered *Oenanthe sarmentosa,* six more *Osmorhiza chilensis,* but all refused these substitutes and died. One larva accepted *L. angustatum,* from the Columbia River Gorge, Oreg., but died.

Other larvae collected at Slate Peak, feeding on *L. geyeri,* were offered *L. angustatum* and *O. chilensis,* which were refused, and all the larvae died.

Larvae of *D. juliella* were found on the usual food plant, *Cicuta occidentalis,* where Oregon State Highway 82 crosses Rock Creek, Oreg., a tributary of the Wallowa River. Four of these larvae were offered *Angelica arguta,* but they refused to eat it and remained inactive in the rearing tin.

Only one substitution in the genus *Agonopterix* was attempted and that for *A. rosaciliella.* Larvae collected on *Osmorhiza chilensis* were given *O. occidentalis,* which they readily accepted. All produced moths.

We can therefore infer that in *Depressaria* a high degree of host specificity exists and that, although larvae can develop on more than one food plant when once established, no tolerance exists for substitutes in diet. It is equally clear that no host specificity exists in *Agonopterix* and that there is a correspondingly high degree of tolerance for substitutes.

AGONOPTERIX MURICOLORELLA (Busck)

Depressaria muricolorella Busck, Proc. U. S. Nat. Mus., vol. 24, p. 741, 1902.

Type—U.S.N.M. No. 6125.

Type locality.—Golden, Colo.

Food plants.—*Lomatium grayi* C. & R.[4] and *L. macrocarpum.*

Remarks.—Of this species I now have two specimens from Alberton, Mont., reared from *Lomatium macrocarpum,* recorded here for the first time. Both specimens are males and emerged July 11-13, 1950. The larvae were found feeding in the immature fruits of the host.

[4] Authorities for botanical names are given only for those names not appearing in the list, p. 5 *et seq.*

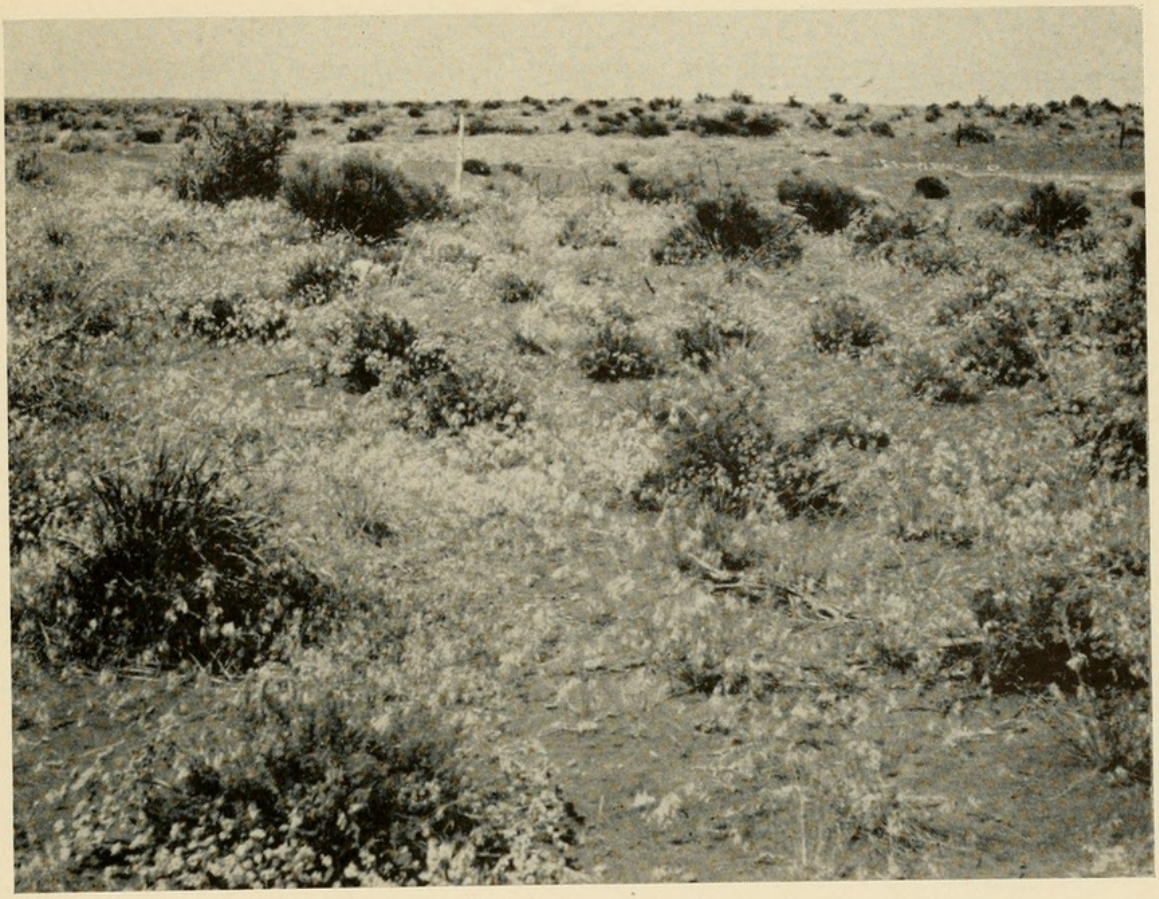


Fig. 1, upper: *Pteryxia terebinthina foeniculacea* growing in association with grasses, *Artemisia,* and *Chrysothamnus* 8 miles west of Moses Lake, Wash. Fig. 2, lower: *Pteryxia terebinthina foeniculacea,* same locality.

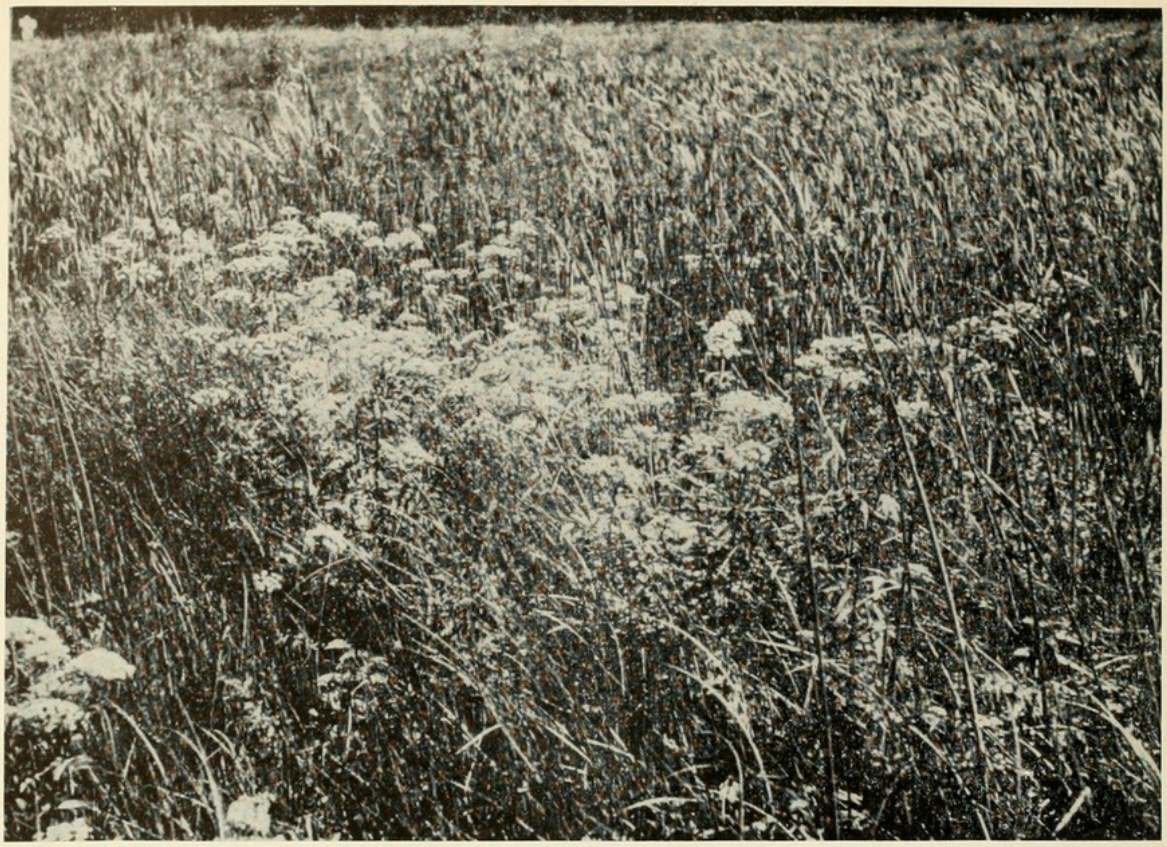


Fig. 1, upper: *Cicuta occidentalis* growing in association with tule, grasses, and *Typha* at Rock Creek, Oreg., at the junction with State Highway 82. Fig. 2, lower: *Cicuta occidentalis,* uninfested, at Carlton, Wash.

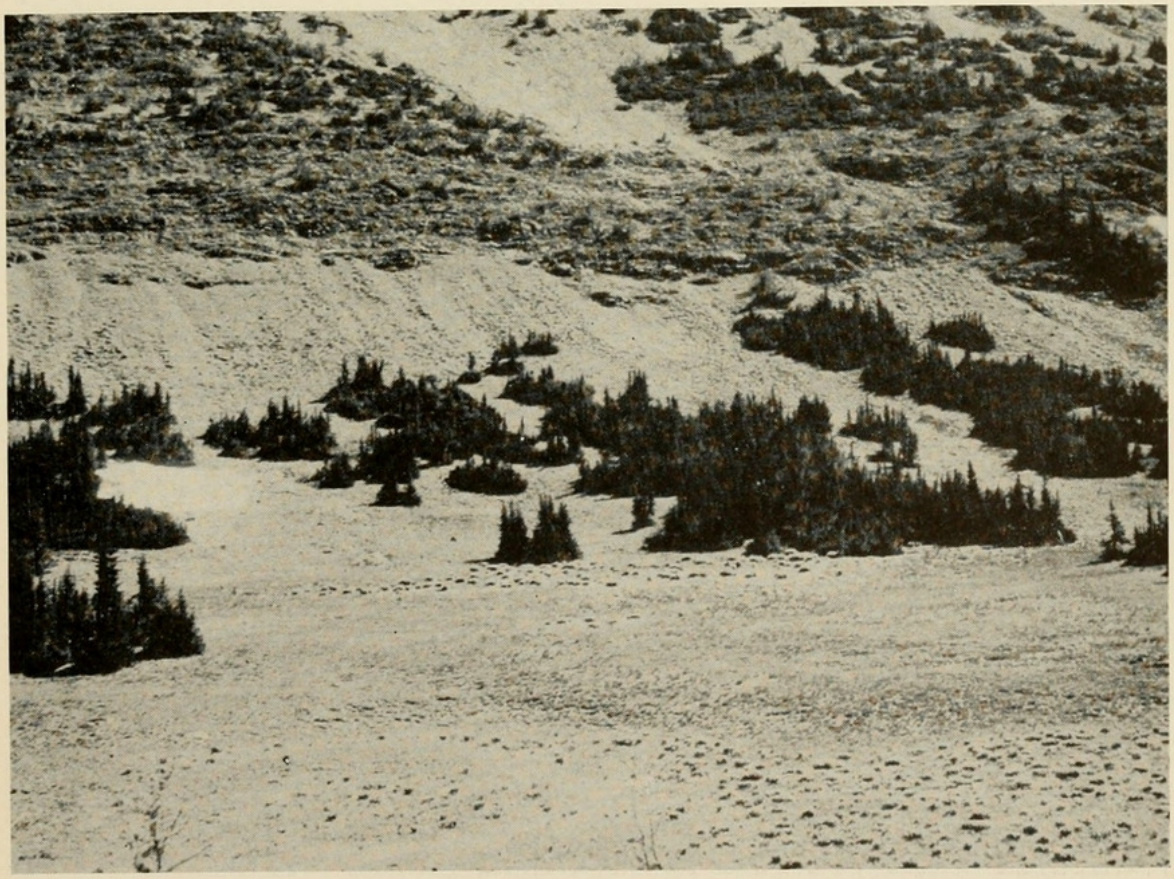


Fig. 1, upper: Slate Peak, Whatcom County, Wash. Four species of *Lomatium* are found on the slopes shown in the center of the photograph. These are *L. ambiguum, L. brandegei, L. dissectum,* and *L. geyeri.* Fig. 2, lower: The same locality as above but farther east. On the steep shale slopes in the upper part of the illustration the same four species of *Lomatium* listed above are found.

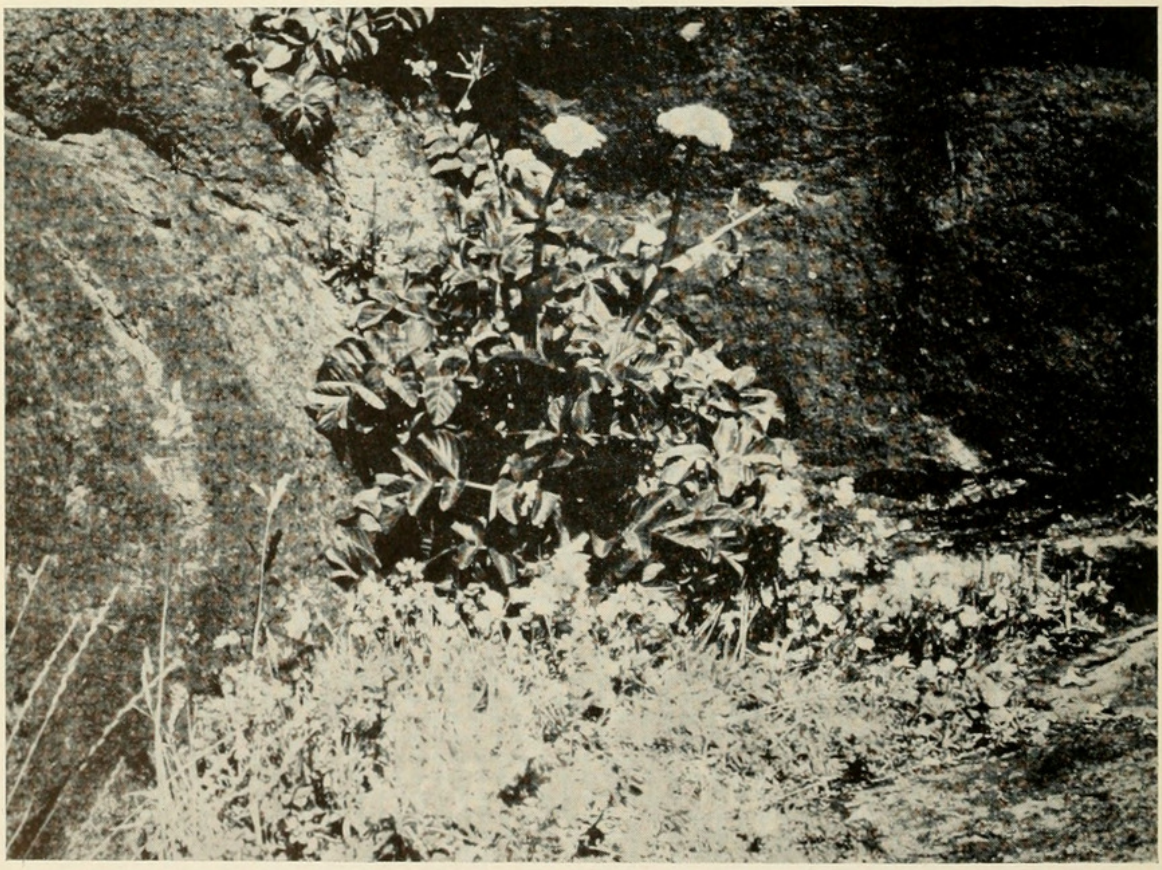
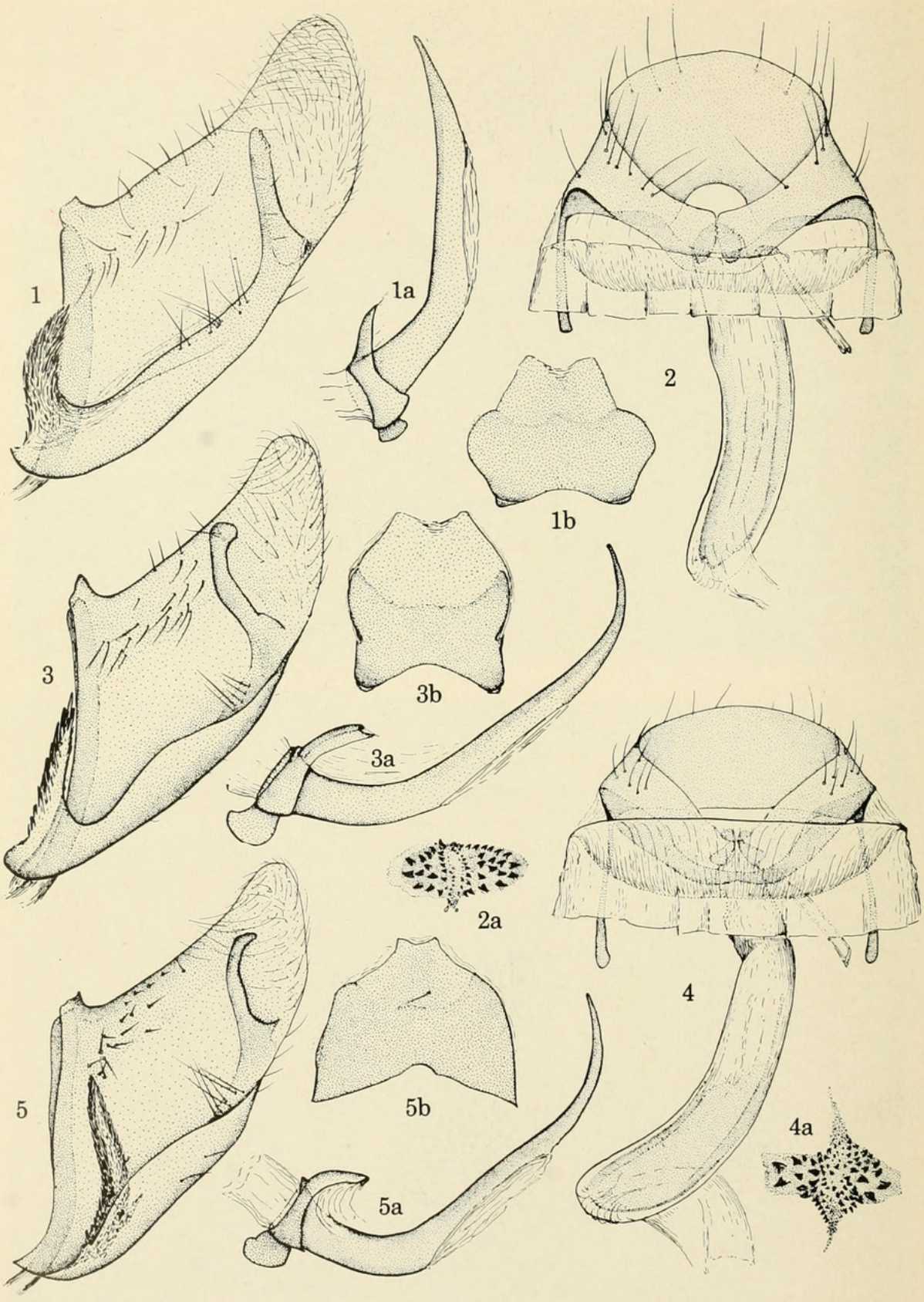


Fig. 1, upper: *Angelica hendersonii* growing along the rocks of the Oregon coast at Finistere Lodges, Depoe Bay. On the ground above *Conioselinum chinense* and *Heracleum lanatum* are abundant. Fig. 2, lower: *Angelica hendersonii* in the same locality as above.

Fig. 1, upper: *Oenanthe sarmentosa* growing in association with ferns, *Lysichiton, Mimulus,* and grasses at Lawrence, Whatcom County, Wash. Note three distorted umbels in center of photograph which are infested. Fig. 2, lower: *Lomatium dissectum multifidum* from Pullman, Wash. Note the characteristic damage and webbing done by larvae of *Depressaria leptotaeniae.*



Figs. 1-1b, *Depressaria angelicivora,* new species: 1, Right harpe; 1a, aedeagus; 1b, anellus. Figs. 2, 2a, *Depressaria angelicivora,* new species: 2, Female genitalia with ovipositor and bursa copulatrix removed; 2a, signum. Figs. 3-3b, *Depressaria pteryxiphaga,* new species: 3, Right harpe; 3a, aedeagus; 3b, anellus. Figs. 4, 4a, *Depressaria pteryxiphaga,* new species: 4, Female genitalia with ovipositor and bursa copulatrix removed; 4a, signum. Figs. 5-5b, *Depressaria armata,* new species: 5, Right harpe; 5a, aedeagus; 5b, anellus.

AGONOPTERIX OREGONENSIS Clarke

Agonopterix oregonensis CLARKE, Proc. U. S. Nat. Mus., vol. 90, p. 65, 1941.

Type.—U.S.N.M. No. 52079.

Type locality.—Salem, Oreg.

Food plants.—*Angelica hendersonii, A. lucida, Eryngium vaseyi* C. & R., *Ligusticum apiifolium, Lomatium caruifolium* (H. & A.) C. & R., *L. marginatum* (Benth.) C. & R., *L. nudicaule* (Pursh) C. & R., *L. utriculatum* (Nutt.) C. & R., *Oenanthe sarmentosa, Sanicula bipinnata* H. & A., *S. bipinnatifida* Dougl., *S. laciniata* H. & A., *S. nevadensis* S. Wats., and *S. tuberosa* Torr.

Remarks.—Only four of the food plants listed above, *A. hendersonii, A. lucida, Ligusticum apiifolium,* and *Oenanthe sarmentosa,* are recorded here for the first time; the others, recorded previously by me,[5] are entered for completeness.

The localities for the specimens reared in 1950 are as follows: Oregon: Depoe Bay, 5 ♂♂, 2 ♀♀ (July 26-28, 1950); Siletz River, 2 miles east U. S. Highway 101, 2 ♂♂ (August 3, 1950). Washington: Lawrence, Whatcom County, ♀ (July 22, 1950); Toad Lake, Whatcom County, ♂ (July 21, 1950).

AGONOPTERIX ROSACILIELLA (Busck)

Depressaria rosaciliella BUSCK, Proc. U. S. Nat. Mus., vol. 27, p. 763, 1904.

Type.—U.S.N.M. No. 7815.

Type locality.—"Camp Watson," Oreg.

Food plants.—*Angelica arguta, A. hendersonii, Conioselium chinense, Ligusticum apiifolium, Oenanthe sarmentosa, Osmorhiza chilensis,* and *O. occidentalis.*

Remarks.—In my revision of this family (p. 84) [6] I recorded the food plant of this species as *Osmorhiza occidentalis* and stated that the larvae of *rosaciliella* were not found on *O. chilensis.* On a preceding page of the present paper I have indicated that the species is found on both plants. I have before me 19 specimens of *rosaciliella* reared during the summer of 1950 from the above list of hosts. These show a wide degree of variation, including specimens that match the Blue Mountains material recorded previously (p. 84) [6] and also moths that are of the exact color and contrasting markings as the series

[5] Clarke J. F. Gates, Journ. Washington Acad. Sci., vol. 37, p. 3, 1947.

[6] Clarke, J. F. Gates, Revision of the North American moths of the family Oecophoridae, with descriptions of new genera and species. Proc. U. S. Nat. Mus., vol. 90, pp. 33-286, pls. 1-48, 1941.

of 90 specimens I recorded from Skyline Ridge, Whatcom County, as *A. r. echinopanicis,* which were reared on *Echinopanax horridum* (p. 86) and which I described as a food-plant race of *rosaciliella.* There is no doubt that all these color variations represent entities of a single species. There appears to be no justification for the racial designation of *echinopanicis,* although those who wish to use this name for the population feeding on *E. horridum* may do so for this contrastingly marked form.

The localities for the moths reared in 1950 are as follows: Oregon: Clackamas River, 15 miles east of Estacada, 2 ♂♂ (July 28, 1950), ♀ (July 27, 1950); Depoe Bay, 3 ♂♂ (July 27-August 2, 1950), 5 ♀♀ (July 28-August 2, 1950). Washington: Billy Goat, Okanogan County, 2 ♂♂, 4 ♀♀ (July 29-August 2, 1950); Lawrence, Whatcom County, ♀ (July 24, 1950); Rayrock Springs, Stephens Pass, ♀ (August 2, 1950).

DEPRESSARIA CINEREOCOSTELLA Clemens

Depressaria cinereocostella CLEMENS, Proc. Ent. Soc. Philadelphia, vol. 2, p. 422, 1864.

Type.—In the Academy of Natural Sciences of Philadelphia.

Type locality.—"Virginia."

Remarks.—In my revision I listed three food plants for this species, *Carum carvi* L., *Sium lineare* Michx., and *Ligusticum scoticum* L. It is impossible to check the identities of the plants from which the specimens are supposed to have been reared, but it seems certain that there has been some confusion regarding some of the identifications of the plants made many years ago, before the Umbelliferae were properly revised by Mathias and Constance. One of the plants listed above, *S. lineare,* is a synonym of *S. suave* Walt., as is also *S. cicutaefolium* Benth. & Hook. I have before me a series of *cinereocostella* labeled "Rf. *Sium cicutaefolium,*" which I collected at the junction of South River and U. S. Highway 50, Maryland. These bear emergence dates of August 11-20, 1939. The identity of this plant has not been verified by competent authority.

In August 1950 larvae of *cinereocostella* were encountered commonly in several places in Nebraska and Iowa, feeding in the umbels of *Cicuta maculata.* I have before me a series of 12 males and 12 females from 13 miles east of North Platte, Nebr., and 7 males and 6 females from Lucas, Iowa. Emergence dates range from August 8-21, 1950.

The larvae of the South River specimens pupated in the hollow

stalks of the host, a habit found commonly among Depressariae. The larvae of the Nebraska and Iowa specimens, however, pupate in a tightly webbed umbel. Actually the rays of the umbels are left free, but the flowers are webbed into a compact mass.

Despite these differences in habits I can find no structural or colorational differences that suggest specific separation.

DEPRESSARIA NERVOSA Haworth

Depressaria nervosa HAWORTH, Lepidoptera Britannica, vol. 3, p. 560, 1811.

Type.—In the British Museum (Natural History).

Type locality.—London, England.

Food plants.—*Oenanthe crocata* L., *O. sarmentosa,* and *Cicuta douglasii.*

Remarks.—Walsingham [7] recorded this species from "Southern Oregon" in 1881, but there has always been some doubt about the accuracy of his identification, and the name of the European *nervosa* has been dropped from the North American lists. Busck [8] believed that Walsingham's specimens were probably referable to *D. juliella* Busck, and the name *nervosa* was omitted from Busck's revision of the family.[9] The similarity between *nervosa* and *juliella* is apparent, but the latter is much brighter and lighter than the former and their food plants are different.

In England *D. nervosa* larvae feed in the umbels of *Oenanthe crocata* and in western North America in the umbels and on the leaves of *O. sarmentosa* and *Cicuta douglasii.* Despite these differences in the food plants there is no doubt that the American specimens are referable to *nervosa,* although the Washington and Oregon series might warrant subspecific designation.

I have before me a reared series of 173 specimens as follows: Oregon: Clackamas County, Wilhoits Springs, 3 ♂♂, 3 ♀♀. Emergence dates, July 25-29, 1950. Washington: Skagit County, Hamilton, ♂, 4 ♀♀; Whatcom County, Birch Bay, 3 ♂♂, 6 ♀♀; Blaine, ♂; Fazon Lake, ♂, 2 ♀♀; Lake Padden, 2 ♂♂, ♀; Lawrence, 72 ♂♂, 57 ♀♀; Samish Lake, 5 ♂♂, 8 ♀♀; Toad Lake, 2 ♂♂, ♀. In addition to the above there are 24 specimens deposited in the British Museum (Natural History).

The emergence dates range from July 17 to August 18, 1950. The August dates are for specimens collected at Lake Padden and reared from *Cicuta douglasii.*

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[7] Proc. Zool. Soc. London, 1881, p. 317.

[8] Proc. Ent. Soc. Washington, vol. 9, p. 91, 1908.

[9] Proc. U. S. Nat. Mus., vol. 35, pp. 187-207, 1908.

I am indebted to John Bradley, of the British Museum, who has kindly compared some of the American specimens with the European series in the British Museum collections and who has confirmed my identification. The European specimens in the U. S. National Museum are lighter and more olivaceous than the moths from Oregon and Washington, but the latter vary from olivaceous to rather bright red although the majority are predominantly brownish red.

DEPRESSARIA WHITMANI Clarke

Depressaria whitmani CLARKE, Proc. U. S. Nat. Mus., vol. 90, p. 182, pl. 36, figs. 200, 200a; pl. 48, fig. 286, 1941.

Type.—U.S.N.M. No. 52083.

Type locality.—Snake River, Whitman County, Wash., opposite Clarkston.

Food plant.—Lomatium macrocarpum.

Remarks.—In addition to the type series, I now have a female, reared from the normal food plant, from Montana. The larva was collected 3 miles east of Alberton, on U. S. Highway 10, feeding in the fruits of the host on June 15 and the moth emerged July 7, 1950. The food plant was growing on rocky ground in association with pine, grasses, and balsam root. The occurrence of this species in Montana extends the range over 200 miles east of the type locality.

DEPRESSARIA YAKIMAE Clarke

Depressaria yakimae CLARKE, Proc. U. S. Nat. Mus., vol. 90, p. 185, 1941.

Type.—U.S.N.M. No. 52073.

Type locality.—Yakima, Yakima County, Wash.

Food plant.—Pteryxia terebinthina foeniculacea.

Remarks.—When I described this species I predicted that the larva would be found on some species of *Lomatium,* but I have now found *yakimae* attached to *Pteryxia,* a closely related genus.

I now have six reared specimens that were obtained from pupae, the larval stage having passed by mid-June. The pupae were collected at a point 8 miles west of Moses Lake, Wash., on U. S. Highway 10, and also 10 miles east of Burke, Grant County, Wash., on U. S. Highway 10. The dates were June 17 and 21, 1950, respectively. Moths began to emerge June 18 and the last appeared June 23, 1950.

The larva of this species spins a tough though rather loose cocoon between the rays of the flowers where pupation takes place. This is a departure from the usual habit for pupation in this group and

is parallel only to *cinereocostella* among the known species. The pupa is always found with the ventral surface down and the caudal end elevated, sometimes almost to the vertical position.

DEPRESSARIA ANGELICIVORA, new species

Plate 6, figures 1-1b, 2-2a

Description.—Alar expanse, 25-27 mm.

Labial palpus with second segment creamy white strongly tinged with pink inwardly, with scattered fuscous scales outwardly and the brush suffused with fuscous; third segment fuscous sparsely irrorate with pink scales and with pink tip. Antenna fuscous except underside of scape, which is pink, and underside of about one-third of shaft, which is pink to cream color. Head and thorax whitish ocherous with admixture of fuscous on vertex and anteriorly on thorax and tegula. Forewing with basal third blackish fuscous shading to paler fuscous at apex, streaked with blackish fuscous along veins in some specimens and costa edged with pink, the whole with a washed, faded appearance; from costa at middle an inwardly oblique whitish ocherous line to middle of cell continuing as an outwardly oblique though more indefinite line of the same color to middorsum; from slightly beyond inception of the above line a similar, outwardly oblique line to apical fourth at center of wing, thence inwardly oblique to slightly before tornus; these two lines are shaded and streaked with pale-brownish scaling and outline a more or less diamond-shaped area in center of wing; at end of cell a whitish ocherous spot; from apical third of costa around termen to middorsum a somewhat broken blackish fuscous line; cilia fuscous basally, lighter distally with some pinkish suffusion. Hindwing whitish basally shading to fuscous around margins; cilia pale yellowish fuscous with fuscous basal line and suffused with pink. Legs whitish ocherous banded and suffused with fuscous and pink. Abdomen whitish ocherous suffused with fuscous above and with blackish fuscous longitudinal lateral band beneath.

Male genitalia.—Similar to other members of this group, but the basal process of sacculus about as long as half the width of harpe at base and the clasper straight, digitate.

Female genitalia.—Genital plate narrow and anterior pockets shallow; sclerotized section of ductus bursae very short, about one-fourth total length.

Type.—U.S.N.M. No. 61133.

Type locality.—McDonald Pass, 14 miles west of Helena, Mont. (6,100 feet).

Food plant.—Angelica arguta.

Remarks.—Described from the type ♂, 5 ♂ and 3 ♀ paratypes, all from the type locality. Emergence dates August 9-12, 1950. Paratypes in the U. S. National Museum and the British Museum (Natural History).

The food plant of this species is widespread, but the only examples found infested were the specimens from which this series of moths was reared. The plants were growing in moist ground at a spring with its resulting drainage, and were growing in association with *Heracleum, Mimulus, Epilobium, Alnus,* and other species comprising a lush growth.

The larva of this species attacks the young umbels before they have opened completely and causes great distortion and discoloration of the inflorescence. Pupation occurs in the leaf bracts near the main stalk of the host. This is a departure from the usual habit of members of this group, which almost always pupate in debris near the base of the plant or in the hollow stalks. As many as five pupae were found in a single bract, each larva having constructed a heavy web before pupation.

In the key to species in my revision, this species runs to *betulella* by reason of the longitudinal stripes on the ventral side of the abdomen. However, *angelicivora* belongs in the *angustati-multifidae* complex and can be separated from all the species of this group by the washed-out, faded appearance of the forewing. The male genitalia of *angelicivora* place it nearest *schellbachi,* but it differs from the latter by the shorter basal process of the sacculus, which is a little more than half the length of that in *schellbachi,* and by the straight clasper as compared to the curved clasper of *schellbachi.* The aedeagus of *angelicivora* is more like those of *leptotaeniae* and *yakimae.* The female genitalia are similar to *thustra,* but the sclerotized section of the ductus bursae is slightly more than half as long.

DEPRESSARIA PTERYXIPHAGA, new species

Plate 6, figures 3-3b, 4-4a

Description.—Alar expanse, 18-20 mm.

Labial palpus with second segment ocherous-white, suffused with pinkish in most specimens, marked with fuscous and pink-tipped fuscous scales exteriorly and in the brush; third segment blackish fuscous, apex ocherous-white. Antenna scape blackish fuscous, shaft grayish fuscous with paler annulations. Head and thorax ocherous-white to ocherous with a strong pinkish suffusion in most specimens;

thorax anteriorly, and tegula basally, edged with fuscous. Forewing blackish fuscous basally shading to fuscous apically; extreme edge of costa ocherous-white to ocherous suffused with pinkish; slightly before middle of costa and at apical third of costa large blotches of the same color with similar, smaller spot at base of costa; at end of cell an ocherous-white to ocherous discal spot followed by a slender black dash; at basal third, on vein 11, a black spot followed by an oblique dash of the same color on vein 10; from apical third of costa, around termen to tornus, an indistinct series of small black spots; cilia grayish fuscous, darker basally. Hindwing whitish basally shading to pale fuscous around margins; cilia light buff to grayish around apex with narrow, pale-fuscous subbasal line; sometimes cilia suffused with pinkish. Legs ocherous-white marked and banded with fuscous and paler areas sometimes pinkish. Abdomen ocherous-white suffused with grayish above and strongly marked fuscous beneath, especially laterally.

Male genitalia.—Similar to the *angustati-multifidae* group but with straight basal process from sacculus with few dentate processes and with distal end of clasper dilated.

Female genitalia.—Genital plate narrow and strongly sclerotized along anterior edge; anterior pocket narrow; ductus bursae sclerotized for about one-third its length.

Type.—U.S.N.M. No. 61134.

Type locality.—Ten Sleep, Wyo.

Food plant.—Pteryxia terebinthina calcarea.

Remarks.—Described from the type ♂, 2 ♂ and 4 ♀ paratypes, all from the type locality. Emergence dates July 5-9, 1950. Paratypes in the U. S. National Museum and the British Museum (Natural History).

The food plant of this species is common in the Ten Sleep Canyon, just east of Ten Sleep, Wyo., and the actual locality in which the larvae of this species were collected was at the foot of the canyon alongside U. S. Highway 16 at 4,600 feet. Here the plant grows in association with *Artemisia, Balsamorhiza,* and grasses on the steep slopes of the sides of the canyon.

The larva of *pteryxiphaga* feeds on the leaves of the food plant and webs them together. Larvae were collected June 13, 1950, and pupation began June 16, 1950.

A brief color description follows: Larva pale yellowish green with dorsal and broad subdorsal longitudinal stripes gray-green; tubercles pale whitish green with brown at insertion of setae. Head pale

yellowish brown with sparse brown mottling posteriorly and the sutures dark brown. Thoracic shield yellowish narrowly edged with brown laterally; on each side, dorsolaterally, a few dark-brown spots. Anal plate yellowish green.

In my key this species runs to the *yakimae-leptotaeniae* couplet but is easily distinguished from both by the pale costal blotches. Occasional specimens of *pteryxiphaga* lack the pink costal edge, in which cases the examples would run to the *angustati-multifidae* couplet. In such examples the genitalia must be used for identification. In all cases, as a matter of fact, the genitalia should be used in determination of species of this complex.

The genitalia of this species suggest a close affinity with *multifidae* on the one hand and *thustra* on the other. The twisted basal process of the sacculus of *thustra* immediately separates *pteryxiphaga* from it, and the latter can be distinguished from *multifidae* by the straight basal process of sacculus. The female of *pteryxiphaga* can be separated from *multifidae* by the narrow genital plate and shallow anterior pocket and from *thustra* by the strongly sclerotized anterior edge of the genital plate and the shorter sclerotized section of ductus bursae.

DEPRESSARIA LEPTOTAENIAE Clarke

Depressaria leptotaeniae CLARKE, Can. Ent., vol. 65, p. 87, pl. 4, 1933.

Type.—U.S.N.M. No. 44742.

Type locality.—Pullman, Wash.

Food plant.—*Leptotaenia dissectum multifidum* (Nutt.) M. and C.

Remarks.—Larvae of this species were collected on the host on a hillside 11 miles northwest of Deer Lodge, Mont., on June 15. Pupation began the following day, and the moths, one male and two females, emerged July 8-9, 1950. The food plant was growing in association with sagebrush, balsamroot, grasses, and other prairie plants on open ground.

This species has not been recorded previously in Montana, and the distribution is thus extended eastward considerably.

DEPRESSARIA THUSTRA Clarke

Depressaria thustra CLARKE, Journ. Washington Acad. Sci., vol. 37, p. 15, figs. 7-7a, 14, 1947.

Type.—U.S.N.M. No. 58009.

Type locality.—Gilmer, Klickitat County, Wash.

Food plants.—*Lomatium triternatum macrocarpum* and *L. ambiguum.*

Remarks.—Originally I described this species from the first-named food plant from a low altitude. I have before me, however, a single specimen from *L. ambiguum,* from Slate Peak, Whatcom County, Wash., 6,500 feet, which is indistinguishable from the original series. The twisted basal process of the sacculus is characteristic and distinguishes *thustra* from all other described species.

The Slate Peak specimen emerged August 4, 1950; larva collected July 18, 1950.

The food plant (*ambiguum*) of this species was found at Harts Pass and on the rocky slopes of Slate Peak (pl. 3), but larvae were found only at the latter place where they were observed tying and feeding in the umbels.

When the supply of the original food plant became exhausted I substituted *L. angustatum* and *O. chilensis,* but both of these substitutes were refused and the larvae died.

DEPRESSARIA ARMATA, new species

Plate 6, figures 5-5b

Description.—Alar expanse, 17 mm.

Labial palpus with second segment light buff with moderate grayish-fuscous scaling in brush; exteriorly and interiorly shining silvery fuscous; third segment grayish fuscous, buff-tipped. Antenna fuscous; underside of scape and proximal third of shaft shining silvery fuscous. Head and thorax buff mixed with grayish fuscous; anterior edge and posterior tip of thorax and basal third of tegula grayish fuscous. Forewing grayish fuscous becoming considerably lighter toward apex; at basal third, in cell, a longitudinal blackish dash followed, at end of cell, by a blackish-edged whitish-buff spot; at three-fifths of costa an obscure blackish subquadrate spot; from apical fifth of costa, around termen to tornus, a series of obscure blackish spots; cilia grayish with a darker basal band. Hindwing very pale basally shading to light grayish fuscous at apex; cilia grayish with darker subbasal band. Legs whitish buff shaded and banded with grayish fuscous.

Male genitalia.—Basal process armed with fine, spinulate spines except at base where they are shorter and coarser. Anellus very broad, broader than long.

Female genitalia.— Female unknown.

Type.—U.S.N.M. No. 61135.

Type locality.—Slate Peak, Whatcom County, Wash., 6,500 feet.

Food plant.—Lomatium brandegei.

Remarks.—Described from the unique type male. The adult emerged August 4, 1950.

This species is nearly related to *angustati,* and keys to the same place in my key, but there are abundant points of difference between them. The costal spot and the lack of any transverse fasciae on the forewing of *armata* immediately distinguish it from *angustati.* The basal process of the sacculus of *armata* is turned away from the cucullus and that of *angustati* is turned toward it. The habits of the two are also different, the larva of *angustati* feeding in the leaves and the larva of *armata* inhabiting the umbels.

The larvae of *armata* were found abundantly at between 6,400 and 6,700 feet, being absent at Harts Pass at 6,200 feet and absent above 6,700 feet.

Although a considerable quantity of larvae were collected, only one moth was obtained owing to lack of sufficient food plant and to substitution attempts. Larvae were offered *Oenanthe sarmentosa* and *Osmorhiza chilensis,* which they refused, and all died. Others were offered *L. angustatum,* but only one accepted this substitute and all died.