



Aciospores in cross-section, with partial surface view shown within broken line; urediniospore, with pore positions indicated by refractive internal caps; acial paraphysis; teliospore in section. Scales = 10 $\mu$ .

**Phragmidium occidentale** Arth. apud Earle in Greene, Pl. Baker. 2: 3. 1901.  
= *Phragmidium rubi-odorati* Diet., Hedw. 44: 120. 1905.

PYCNIA appanate, epiphyllous, small, few and inconspicuous, absent on few to many sori of all collections seen. AECIA caecomoid, hypophyllous (to sparingly epiphyllous), light yellow fading to white; incurved paraphyses occasional to abundant, to 75 $\mu$  long  $\times$  7.5-18(-21) $\mu$  wide, wall 0.6-0.8(-1.0) $\mu$  below, increasing on convex side and at apex to (1.0-)1.3-4.5(-6) $\mu$ . AECIOSPORES (17-)18-27(-29)  $\times$  (14.5-)16-21(-23) $\mu$ ; wall ca. 0.5-0.8 $\mu$ , excluding warts, hyaline; warts flat, irregularly elongate, labyrinthiform-tessellate, 0.5-0.8(-1.0) $\mu$  high, (0.5-)0.7-3.5 $\mu$  wide, 0.8-11(-13) $\mu$  long; germ pores invisible, but indicated by occasionally visible refringent hemispheric internal caps 1.5-2.0 $\mu$  high  $\times$  4-5 $\mu$  wide to be 7-8(-9) and scattered. UREDINIA hypophyllous, often partly or completely suppressed, with paraphyses as in aecia or somewhat smaller. UREDINIOSPORES 17.5-23(-25)  $\times$  15-20 $\mu$ ; wall ca. 0.5-1.0 $\mu$ , hyaline; echinulations 0.7-1.0(-1.2) $\mu$  high, 0.5-0.8(-1.0) $\mu$  diam., at 1.0-2.2(-2.5) $\mu$  spacing; pores 6-8, scattered, as indicated by refringent hemispheric internal caps 1.5-2 $\mu$  high  $\times$  3.0-4.5 $\mu$  wide. TELIA hypophyllous, black in mass; paraphyses apparently present only in sori transformed from aecia or uredinia. TELIOSPORES, measured only from fully cleared and expanded spores in heated lactophenol mounts, (4-5-)6-9(-10)-celled, (42-)62-112(-125)  $\times$  (25-)26-32(-33) $\mu$ , including apiculus and warts; wall (2.5-)3.0-4.5(-5.5) $\mu$ , excluding warts, trilaminar, inner layer chestnut, middle yellow-brown and outer yellow in cleared spores; apiculus (0-)3-14(-17) $\mu$  long, finely verrucose in lower part; warts 0.7-2.0(-2.2) $\mu$  high, 0.8-3.0(-3.5) $\mu$  wide, occasionally to 4.0(-5.5) $\mu$  long; germ pores (2-)3(-4) per cell, approximately equatorial; pedicels (55-)72-127(-144) $\mu$  long, swelling gradually in lower 3/5 to 3/4 with shallowly dextrorse-helical striae crossing axis of pedicel at 40-60°. Based on all DAOM specimens to date.

HOSTS: *Rubus* spp., subgenus *Anaplobatus*.

**DISTRIBUTION:** British Columbia north to 55°30'N, western Alberta, Ontario adjacent to L. Superior, eastern Ontario and southwestern Quebec (and southward in United States).

**COLLECTIONS (selected):** *Rubus odoratus* L.: Ont., 4 collns., York Co. to Ottawa (DAOM 76899, 148679, 148680); Que., 2 collns., Gatineau Co. (DAOM 14550, 2587). *R. parviflorus* Nutt.: B.C., 24 collns., S from Pine Pass and Massett (DAOM 40954, 148681, 118714, 5413, 3342, 3341, 40935, 25188, 148683, 24332, 108289, 108290, 126009, 108291); Alta., 6 collns., south from near Whitecourt (DAOM 105157, 105156, 107292, 105159, 105158, 1328); Ont., 2 collns., north shore L. Superior (DAOM 114454, 126008).

**NOTES:** The above description is based on the 38 available Canadian specimens, plus extralimital collections from Washington, Idaho, Wyoming, Michigan and New York.

Increasingly abundant material on *Rubus parviflorus* from British Columbia has eliminated all morphological distinction between *Phragmidium rubi-odorati* and *Ph. occidentale*. Arthur (Manual, 1934) described *Ph. rubi-odorati* as lacking, and *Ph. occidentale* as possessing, pycnia; but pycnia occur irregularly in both rusts. Cummins (Mycologia 23: 433-445, 1931) separated the aecia by apically thickened paraphyses in *Ph. rubi-odorati* vs. unthickened paraphyses in *Ph. occidentale*; and separated the telia by pedicels once and one-half the spore length in *Ph. rubi-idaei* vs. once the spore length in *Ph. occidentale*; but neither separation holds when an adequate series of specimens is examined. On each host the aecial paraphyses vary markedly in abundance from sorus to sorus; and the apical thickening recorded in my study has a slightly higher maximum on *Rubus parviflorus*, but surely only because of a long series of aecial specimens. Similarly the range of teliospore and pedicel lengths are very similar on both hosts. One out of six telial specimens on *R. odoratus* has slightly longer maximum spore and pedicel lengths than found on *R. parviflorus*, but this is presumably a phenotypic reaction to moister growing conditions than are commonly found in the dry British Columbia valleys and southwestern Alberta, a reaction commonly seen in other *Phragmidium* spp.

There probably is little genetic difference between the eastern and western rusts. The relict occurrence of *Rubus parviflorus* (and its rust) adjacent to L. Superior and L. Huron indicates that this plant, like many others, spread across the continent south of the ice front during the Wisconsin glaciation, reducing, if not eliminating, separation of the two host species.

Arthur (Manual, 1934) reports *Ph. occidentale* to occur in Central America. A Holway collection on *Rubus trilobus* from Guatemala, in DAOM, has teliospores very similar to those of *Ph. occidentale*; but the telia contain numerous erect, acicular-pointed paraphyses that overtop the very young spores, probably protecting them from small spore-eating animals.

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