Identification of the "grey" *Dioryctria* species of British Columbia (Lepidoptera, Pyralidae)

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ABSTRACT

The nine "grey" species of *Dioryctria* coneworms in British Columbia are difficult to distinguish because of very similar morphologies and confusing taxonomic literature. To aid in identifying these moths, illustrations of male and female genitalia, a key to species or groups based on these characters, and brief descriptions of each species or species group are presented here.

Key words: *Dioryctria*, coneworm, taxonomy, genitalia, fir, spruce, pine, hemlock, larch.

INTRODUCTION

The genus *Dioryctria* (Lepidoptera: Pyralidae) contains over fifty species in the Nearctic region (Richmond and Page 1995; Jactel *et al.* 1994; Grant *et al.* 1993; Neunzig 1990a, b; Mutuura and Munroe 1973; Mutuura and Munroe 1972; Mutuura *et al.* 1969a, b; Munroe 1959; Heinrich 1956), twelve of which have been recorded from British Columbia. Adults of nine of these are predominantly grey in colour: *D. abietivorella* (Grote), *D. pseudotsugella* Munroe, *D. reniculelloides* Mutuura and Munroe, *D. okanaganella*, *D. pentictonella*, *D. tumicolella*, *D. contortella*, *D. monticolella* (all of Mutuura, Munroe and Ross) and *D. cambiicola* (Dyar) (Hedlin *et al.* 1980 (e.g., Fig. 79); Mutuura and Munroe 1972, 1973; Mutuura *et al.* 1969a, b). This is in contrast to the other *Dioryctria* species of British Columbia, which are predominantly reddish brown in colour (e.g., Hedlin *et al.* 1980: Fig. 83). This group of grey *Dioryctria* species are important pests of at least six genera of conifers (Bennett 1994). The morphological

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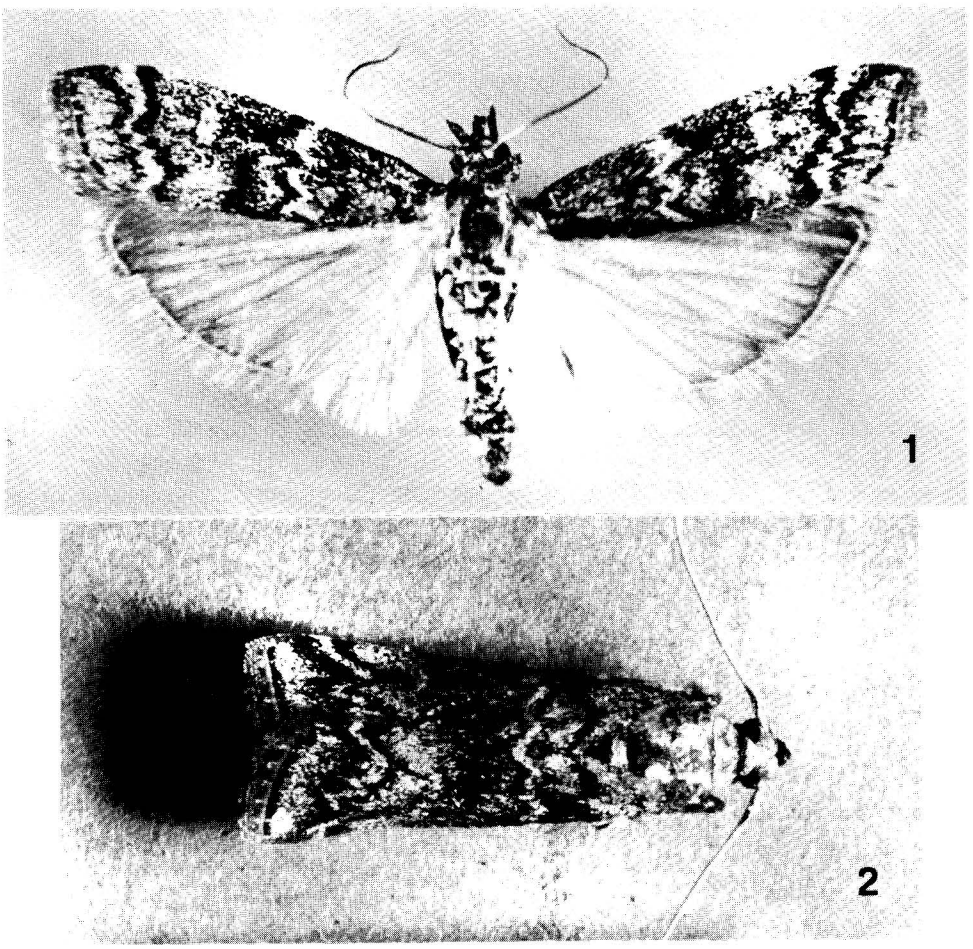
similarity of these species coupled with poorly understood life histories and a scattered and confusing taxonomic literature make reliable species identifications difficult.

We compared these species and sought to prepare a key to separate them, supplemented with illustrations of diagnostic features. We did not aim to revise the status of existing nominal species due to the limited scope of our work. We provisionally accepted these species and sought to differentiate them as clearly as possible. Our results raised more questions than they answered and underlined some of the taxonomic confusion that prevails in the genus. Some of the species seem to display a confusing array of variation in phenology, hosts, distribution, and apparent morphological variation, whereas other, morphologically indistinguishable forms have been recognized as separate species. We were unable, for instance, to find any reliable distinguishing morphological characters for *D. cambiicola*, *D. tumicolella*, *D. contortella*, and *D. monticolella*, thereby raising doubt about their validity as separate species. We found that several primary types had not been dissected and their genitalia not examined. In one instance (*D. okanaganella*) dissection and examination of the genitalia of the holotype significantly changed the species diagnosis from that previously published. Our (unpublished) work also highlighted the fact that the male vesica harbours excellent diagnostic characters to separate species.



Figures 1, 2. *Dioryctria abietivorella.* **1**, BCFS slide No. 992.1.3.13; **2**, lab colony adult at rest.

Everted vesicae have been used successfully to recognize a new *Dioryctria* species from Texas (Blanchard and Knutson 1983). This represents a virtually unexplored character set in the genus as well as in Phycitinae as a whole. Progress in unravelling several species problems will have to include the study of everted vesicae. DNA sequencing could also aid in further efforts to verify the status of closely related species.

Species of *Dioryctria* are reputedly among the most distinct members of the Phycitinae (Heinrich 1956; *idem* for a characterization of Phycitinae). The genitalia of each sex has a characteristic habitus, easily observed in slides or drawings (Heinrich 1956). In males the main distinguishing feature is the enlarged, sclerotized costa that is markedly produced at the apex, projecting beyond the apex of the cuculus (Figs.7-15). In females, the ductus bursae is long and heavily sclerotized, with dense clusters or bands of heavy spines in the entrance (Figs. 22-31).

The forewing pattern is remarkably similar among the grey *Dioryctria* species. All are grey and white with contrasting zigzagged crosslines (Figs. 1, 2), and some have patches of brown scales. The forewings of most species lack the usual black dot at the end of the cell present in other Phycitinae, which is replaced by a pale spot or line on the discocellular vein (located in the distal third of the wing anterior to the transverse postmedial band), analogous to the reniform spot of the Noctuoidea. The forewing patterns do not usually provide reliable diagnostic characters to separate species, especially when specimens have been collected in sticky pheromone traps. Species can only be separated reliably through examination of genitalia. We present illustrations of male and female genitalia of the grey *Dioryctria* species of British Columbia with keys to species or species groups based on these characters.

MATERIALS AND METHODS

Material examined in this study was supplied by the Canadian National Collection of Insects (CNCI -- Agriculture and Agri-Food Canada) and Canadian Forest Service (CFS). CFS specimens came from the Pacific Forestry Centre Forest Insect and Disease Survey (PFC, FIDS) and a Forest Pest Management Institute (Sault Ste. Marie, Ontario) lab colony. These loans comprised all the known grey *Dioryctria* species and subspecies found in British Columbia. Additional specimens of *D. abietivorella* were obtained through a 1995 pheromone trapping trial conducted by the British Columbia Ministry of Forests (BCFS) and Simon Fraser University. An ultraviolet light-trap set up periodically at the pheromone trapping sites provided further specimens. Host and distribution data were gathered from material examined and references cited in the introduction.

Genitalia were prepared by removing abdomens of pinned specimens and macerating them for approximately ten minutes in warm 20% aqueous potassium hydroxide. Then, in 30% ethanol, scales were removed from the abdominal pelt and genitalia severed from abdomens. Dissected parts were examined in glycerine and stored in pure lactic acid. Moths caught in sticky traps were removed from the traps by soaking in ethyl acetate until free of the sticky material (Murphy 1985). The abdomens were subsequently removed and the genitalia dissected as above.

Unsuccessful attempts were made to evert vesicae of male *D. abietivorella* using both an injection technique performed on preserved specimens (by Jim Troubridge, Agriculture Canada, Vancouver, British Columbia, Canada) and chemical induction in which dimethoate was applied directly to live, virgin males (Dang, 1993). The standard eversion technique using a syringe did not work because the numerous cornuti jammed inside the membranous aedeagus tube. Subsequently, we succeeded in pulling vesicae out

carefully with fine tweezers and inflating them with a syringe. Although the vesicae were not perfectly inflated, we observed striking differences between some species. However, technical difficulties, which we are still resolving, prevented us from studying vesicae in sufficient detail to be able to present our results in this paper. We mention briefly under the pertinent species some significant features observed in everted vesicae, but do not illustrate any here and do not use the characters in the key.

Drawings of male and female genitalia were prepared for all available *Dioryctria* species and subspecies with the aid of Wild M3C and Zeiss stereo dissecting microscopes with squared grid lens reticles. Genitalia were drawn in glycerine on depression slides, except for males and females of *D. contortella* and *D. monticolella* which were drawn from permanent CNCI slide mounts.

Scanning electron microscopy was performed using a Jeol JSM-35 SEM at PFC. Specimens were prepared with a Ladd Industries critical point dryer and Hummer IV sputter coater (gold palladium) after mounting on standard SEM stubs. Photographs of female genitalia were taken using a Nikon SMZ-U stereoscope, at magnifications between 20-40x, with transmitted illumination. Ductus bursae were mounted unstained on slides in lactic acid under a cover slip. Close-ups of surface texture of ductus bursae were taken at 100x through a Nikon Optiphot compound microscope.

Key to Grey *Dioryctria* Species of British Columbia

MALES

1. Apical portion of costa with a single, broad, curved process, ventral margin smoothly rounded, without a notch or denticle (Fig. 11) ..... *D. okanaganella*
1'. Apical portion of costa with two teeth or denticular processes, the dorsal larger and more protruded, the ventral smaller (reduced in some specimens, but usually distinct) (Figs. 7-10, 12-15) 2
2. Aedeagus with large anterior cornutus (Figs. 3, 5, 6) 3
2'. Aedeagus without large anterior cornutua (Fig. 4) ..... *D. pseudotsugella* or *D. reniculelloides*
3. Distance between two processes at tip of costal arm of valva approximately half the width of central part of valva (Fig. 7); dorsal process of costal arm short and broad (Figs. 7, 36) ..... *D. abietivorella*
3'. Distance between two processes at tip of costal arm of valva approximately equal to width of central part of valva; dorsal process of costal arm long and narrow (Figs. 10, 12-14) 4
4. Uncus broadest at mid-length (Figs. 20, 21); dorsal process of costal arm of valva strongly recurved into a hook (Figs. 12-15) ..... *D. cambiicola*, *D. tumicolella*, *D. contortella*, or *D. monticolella*
4'. Uncus broadest at base (Fig. 19); dorsal process of costal arm of valva slightly recurved or nearly straight (Fig. 10) ..... *D. pentictonella*

FEMALES

1. Ductus bursae with marked, thick, longitudinal wrinkles (Fig. 25) ..... *D. okanaganella*
1'. Ductus bursae with, at most, very fine longitudinal wrinkles (Figs. 22-24, 28-31), or without wrinkles (Figs. 26, 27) 2
2. Sclerotized portion of ductus bursae with central longitudinal membranous (clear) area (Fig. 22) ..... *D. abietivorella*

2'. Sclerotized portion of ductus bursae without central longitudinal membranous area (Figs. 22-31) 3
3. Surface of sclerotized portion of ductus bursae with reticulate, isodiametric and finely spiculate microsculpture (Fig. 33), of granular appearance at low magnification (Figs. 26, 27), without longitudinal wrinkles ..... *D. pentictonella*
3'. Surface of sclerotized portion of ductus bursae with or without microsculpture, with fine longitudinal wrinkles (Figs. 23, 24, 28-31) 4
4. Sclerotized portion of ductus bursae with recurved process on left side of anterior end (Figs. 23, 24) ..... *D. pseudotsugella* or *D. reniculelloides*
4'. Sclerotized portion of ductus bursae without recurved process on left side of anterior end (Figs. 28-31) .. *D. cambiicola*, *D. tumicolella*, *D. contortella* or *D. monticolella*

Dioryctria abietivorella (Grote), 1878
(Figs. 1-3, 7, 16, 22, 36, 37)

Diagnosis. Genital characters distinguish male and female *D. abietivorella* from all other *Dioryctria* species discussed here. Males are distinguished by a broad valva and a short distance between the two processes at the tip of the costal arm (width of valva about twice the distance between the two costal processes, Fig. 7). Also, in males the aedeagus contains a large anterior cornutus, a cluster of anterior setae and a posterior cluster of smaller cornuti (Fig. 3), and the apical process of the costal arm is short and broad (Figs. 7, 36). Females are distinguished by a central longitudinal membranous area within the sclerotized portion of the ductus bursae (Fig. 22). Additionally there is a small lobe on the right side of the anterior end of the ductus bursae (Fig. 22). Approximately 60 male and 10 female genital preparations were examined.

Hosts. Broad range. Hosts recorded from museum specimens include amabilis fir (*Abies amabilis*), spruces (*Picea abies*, *P. glauca*), yellow (ponderosa) pine (*Pinus ponderosa*) and Douglas-fir (*Pseudotsuga menziesii*); other hosts reported in British Columbia are grand and subalpine firs (*Abies grandis*, *A. lasiocarpa*), various pines (*Pinus banksiana*, *P. contorta*, *P. flexilis*, *P. monticola*) and spruces (*Picea mariana*, *P. sitchensis*, *P. engelmanni*), western larch (*Larix occidentalis*) and western hemlock (*Tsuga heterophylla*) (hemlock record from BCFS unpublished data).

Distribution. *Dioryctria abietivorella* is widespread in Canada and the north eastern United States and is found in the west from Alaska to northern Mexico.

Material examined. CAN: BC: Woss, 5/iii/1991, 1 male, 1 female ex *Abies amabilis* (PFC); near Keremeos and on southern Vancouver Is., summer 1994, from BCFS pheromone trial, about 50 males (BCFS); NB: St. Basile, 16/viii/1987, at light, 1 female (CNCI); York County, Scotch Lake, 21/iii/1995, 1 female ex *Picea glauca* (CNCI); ON: (CFS lab colony), numerous males and females (BCFS); SK: Indian Head, 22/ii/1953, 1 female ex *Picea abies* (CNCI).

Dioryctria okanaganella Mutuura, Munroe and Ross, 1969b
(Figs. 11, 25, 32)

Diagnosis. Genital characters distinguish male and female *D. okanaganella* from all other *Dioryctria* species discussed here. Males are distinguished by the apical portion of the costal arm of the valve which has a single recurved process without a smaller ventral tooth or process (Fig. 11). Additionally, in males the uncus is widest at mid-length, similar to the *cambiicola* complex (see below) and the aedeagus has one or two moderately large cornuti at the anterior end in most specimens. Mutuura *et al.* (1969b) illustrated and diagnosed the male genitalia of this species based on a specimen lacking a

large anterior cornutus but this assessment was based on an aberrant or damaged specimen. All other specimens we examined had at least one large anterior cornutus. Females are recognized by the strong longitudinal wrinkling of the ductus bursae, which is markedly more pronounced than in the other species treated here (Fig. 25). Twelve male (including holotype) and 16 female genital preparations were examined.

Host. *Dioryctria okanaganella* is associated with old pitch masses or blister rust swellings on *Pinus ponderosa*. The only known reared material with host data appears to be the type series.

Distribution. *Dioryctria okanaganella* is known from the southern interior of British Columbia, through Washington and the Sierra Nevada in California.

Material examined. (All specimens in CNCI): CAN: BC: Type series, 5 males, 13 females, material listed in Mutuura *et al.* 1969b:1047. USA: CA: El Dorado Co., Blodgett Forest, 13 mi E Georgetown, 14/vii/1967, 2 males, 1 female; Tuolumne Co., Twain Harte, 17-26/vii/1961, 1 male, 1 female; Yosemite Ntl Park, 1 mi ESE Yosemite Village, 18/ix/1966, 1 male; WA: 6 mi NW Spokane, 3/ix/1961, 2 males; 8 mi S Tonasket, 11/ix/1960, 1 male, 1 female.

Dioryctria pentictonella Mutuura, Munroe and Ross, 1969b
(Figs. 5, 10, 19, 26, 27, 33)

Diagnosis. Mutuura *et al.* (1969b) separated *Dioryctria pentictonella vancouverella* from the nominal species on the basis of slight colour differences and distribution. For the purposes of this paper, we recognize only the nominal species which may be distinguished from all other species discussed here by the following genitalic characters. In males the dorsal process of the costal arm is long, narrow and not curved into a hook (Fig. 10) and the uncus is widest at its base (Fig. 19). Additionally in males the distance between the two costal arm processes is approximately equal to the width of the central part of the valva (Fig. 10). In females the sclerotized portion of the ductus bursae has granular and finely spiculate microsculpture (Figs. 26, 27, 33) and the anterior portion is folded on itself (Fig. 27) although the fold is easily stretched out during preparation (Fig. 26). Five male and seven female *D. pentictonella* preparations were examined.

Host. *Dioryctria pentictonella* is recorded from *Pinus contorta*, *P. ponderosa*, and *P. sylvestris* (data from museum specimens) and from *P. mugho*, *P. nigra*, and *P. radiata* (Furniss and Carolin 1980, Mutuura *et al.* 1969b).

Distribution. Southern British Columbia.

Material examined. *Dioryctria pentictonella*: CAN: BC: all ex *Pinus ponderosa*: Kamloops, 8/vii/1974, 1 male (PFC); Penticton, 11/v/1966 and 13/v/1966, 2 paratype males (CNCI); Penticton, 22/vi/1966 and 23/vi/1966, 2 paratype females (CNCI); Field Rd., 29/vi/1966, 1 paratype female (PFC). *Dioryctria pentictonella vancouverella*: CAN: BC: Port Moody, 13/vii/1964, 1 female ex *Pinus contorta* (CNCI); all from Vancouver: 24/vii/1961, 1 male ex *P.contorta* (PFC); 9/vii/1963, 1 paratype male ex *P. contorta (CNIC)*; 14/vii/1964 and 16/vii/1964, 2 paratype females ex *P. contorta (CNIC)*; 13/x/1965, 1 paratype female ex *Pinus sylvestris (CNIC)*.

Dioryctria pseudotsugella group
(*D. pseudotsugella* Munroe, 1959 (Figs. 4, 8, 17, 23) and
D. reniculelloides Mutuura and Munroe, 1973 (Figs. 9, 18, 24))

Diagnosis. We could not separate these nominal species confidently. Mutura and Munroe (1973) only discussed alleged differences between *Dioryctria pseudotsugella* and *D. reniculelloides* in relative terms. Some specimens we examined match one or the

other of the original descriptions, but others are intermediate. Alleged differences could be real and significant but proper assessment would require a detailed analysis beyond the scope of this work. Examination of the inflated vesicae of males of both nominal species did not show any differences.

The ranges of the two species (and their hosts) are broadly sympatric. There is no host information on the holotype and allotype of *D. pseudotsugella* (from Seton Lake, BC). Neither the genitalia of the female allotype of *D. pseudotsugella*, nor the primary type of *D. reniculelloides* have been dissected. Given that the reported differences between these two species are inconsistent, the association of the types with other reared specimens of *D. pseudotsugella* cannot be confirmed. A detailed analysis, morphometric and molecular, will be necessary to clarify the status of *D. pseudotsugella* and *D. reniculelloides*.

Both *D. pseudotsugella* and *D. reniculelloides* may be distinguished from the other *Dioryctria* species discussed here by characters of the genitalia as follows: males with aedeagus lacking large anterior cornutus (Fig. 4); females with recurved process on left side of anterior end and without central longitudinal membranous area (Figs. 23, 24). Five male and three female *D. pseudotsugella* and eight male and six female *D. reniculelloides* preparations were examined.

Hosts. *Dioryctria pseudotsugella*: *Pseudotsuga menziesii* and *Picea glauca* were recorded in museum specimen data; other material has been reared from *Abies* sp., *Picea engelmanni*, *Picea* sp. and *Tsuga* sp. (Furniss and Carolin 1980, Mutuura and Munroe 1973). *Dioryctria reniculelloides*: broad host range; material recorded in museum specimen data includes *Picea engelmanni*, *P. glauca* and *Pseudotsuga menziesii;* other reported hosts are *Abies amabilis*, *A. lasiocarpa*, *Larix laricina*, *Picea mariana*, *P. sitchensis*, *Pinus contorta*, and *Tsuga heterophylla* (Furniss and Carolin 1980, Mutuura and Munroe 1973).

Distribution. *Dioryctria pseudotsugella* is found in the southern half of British Columbia and extends to northern California coastally and to the northern interior of Mexico following the Rocky Mountain range. *Dioryctria reniculelloides* is widespread in Canada and the north eastern United States and is found in the west from Alaska to northern Mexico.

Material examined. *Dioryctria pseudotsugella*: CAN: BC: 10 mi E Cranbrook, 28/vii/1960, 1 female (CNCI); Gold Bridge, 22/vii/1974, 1 male ex *Pseudotsuga menziesii* (PFC); Hedley, 3/vii/1975 and 7/vii/1974, 2 males ex *P. menziesii* (PFC); Sidmouth, 4/vii/1953, 1 male ex *P. menziesii* (CNCI); Merritt, 5/viii/1976, 1 female ex *P. menziesii* (PFC); Quesnel, 22/vii/1976, 1 male ex *Picea glauca* (PFC); 25/vii/1945 , 1 female (CNCI). *Dioryctria reniculelloides*: CAN: BC: ex *Picea engelmanni*: Bestwick, 11/vii/1953, 1 paratype male (CNCI); 17/vi/1958, 1 paratype male (CNCI); Smithers, 17/vii/1972, 1 male (PFC); ex *P. glauca*: Azela Lk., 22/vii/1954, 1 paratype female (CNCI); Burns Lk., 10/vii/1972 and 13/vii/1972, 2 males (PFC); Hazelton, 11/vii/1974, 1 male (PFC); Houston, 25/vii/1972, 1 male (PFC); Laird, 4/vii/1972, 1 female (PFC); ex *Pseudotsuga menziesii*: Beechy Head, 9/vii/1956, 1 female (CNCI); Dutch Dairy Log Rd., 25/vii/1949, 1 female (CNCI); Premiere Lk., 5/vii/1961, 1 female (CNCI). US: ID: 4th of July Creek, N of Salmon, 3/viii/1961, 1 female (CNCI); NY: Jefferson Co., Picton Isl., 9/vii/1967, 1 paratype male (CNCI).

Dioryctria cambiicola group

(*D. cambiicola* (Dyar), 1965 (Figs. 6, 12, 20, 28, 35),
D. contortella Mutuura, Munroe and Ross, 1969a (Figs. 14, 29),

D. monticolella Mutuura, Munroe and Ross, 1969a (Figs. 15, 30), and
D. tumicolella Mutuura, Munroe and Ross, 1969a (Figs. 13, 21, 31))

Diagnosis. The four species *D. cambiicola*, *D. contortella*, *D. monticolella*, and *D. tumicolella* closely resemble each other in external morphology and no differences in genitalic characters are apparent. It seems the latter three species were described by Mutuura *et al.* (1969a) solely on the basis of host differences. These species have been treated as a group and may be separated from all others discussed here by characters of both male and female genitalia. In males the dorsal process of the costal arm is long, narrow and curved into a hook and the uncus is widest at mid-length (Figs. 12, 20 (*D. cambiicola*); 13, 21 (*D. tumicolella*); 14 (*D. contortella*) and 15 (*D. monticolella*)). Additionally in males the aedeagus contains a large anterior cornutus and a posterior cluster of smaller cornuti (Fig. 6), and the distance between the two costal processes is approximately equal to the valva width (Fig. 12). In females the sclerotized portion of the ductus bursae is more slender than in previous species, is longitudinally finely wrinkled and has no central longitudinal membranous area, granular-spiculate microsculpture, nor a process on the anterior end (Figs. 28 (*D. cambiicola*), 31 (*D. tumicolella*), 29 (*D. contortella*), and 30 (*D. monticolella*)). The anterior portion of the ductus bursae is folded on itself somewhat as in *D. pentictonella* but the fold is thicker and broader (Figs. 29, 31); it is also easily stretched out in preparations (Figs. 28, 30).

Four male and two female (*D. cambiicola*), four male and six female (*D. contortella*), two male and three female (*D. monticolella*), and six male and two female (*D. tumicolella*) preparations were examined.

Hosts. *Dioryctria cambiicola*: *Pinus ponderosa* was recorded from museum specimens; *P. contorta* and *P. coulteri* are also reported (Furniss and Carolin 1980, Mutuura *et al.* 1969a). *Dioryctria contortella*: *P. contorta*; *D. monticolella*: *P. monticola*; *D. tumicolella*: *P. ponderosa*.

Distribution. *Dioryctria cambiicola* occurs throughout British Columbia and the western United States, including Washington, Oregon, California, Montana, Colorado, Arizona, and New Mexico. *Dioryctria contortella* is recorded from British Columbia, Alberta, and the state of Washington. *Dioryctria monticolella* is recorded from southern British Columbia. *Dioryctria tumicolella* is recorded from southern British Columbia and the states of Washington, Montana, and Colorado.

Material examined. *Dioryctria cambiicola*: CAN: BC: all ex *Pinus ponderosa*: Anarchist Mtn., 7/viii/1951, 1 male (CNCI); Eneas Cr., 26/viii/1951, 1 male (CNCI); Oliver, 29/viii/1953, 1 female (CNCI); Phillips Canyon, 21/vii/1958, 1 female (CNCI); Glenemma, 20/vii/1967, 2 males (PFC). *Dioryctria contortella* (all specimens in CNCI): CAN: BC: all ex *Pinus contorta*: Barriere, 3, 12, 15, 17/vii/1967, 4 paratype males; Beaverdell, 25/vii/1956, 1 female; Carmi, 26/vii/1956, 3 females; Kersley, 22/vii/1966, 1 female. US: CO: Rock Creek Canyon, 27/ix/1957, 1 female. *Dioryctria monticolella* (all specimens in CNCI): CAN: BC: all paratypes ex *Pinus monticola*: Magna Bay, 1 male; 15/iv/1953, 1 allotype female; Salmon Arm, 6/viii/1956, 1 male; 5,6/viii/1955, 2 females. *Dioryctria tumicolella* (all specimens in CNCI): CAN: BC: all paratypes ex *Pinus ponderosa*: Commonage, 13/vii/1967, 1 male; Summerland, 12, 29, 30, 31/vii/1967 and 1/viii/1967, 5 males; 12/vii/1967, 1 female. US: WA: 6 mi NW Spokane, 3/ix/1961, 1 female.

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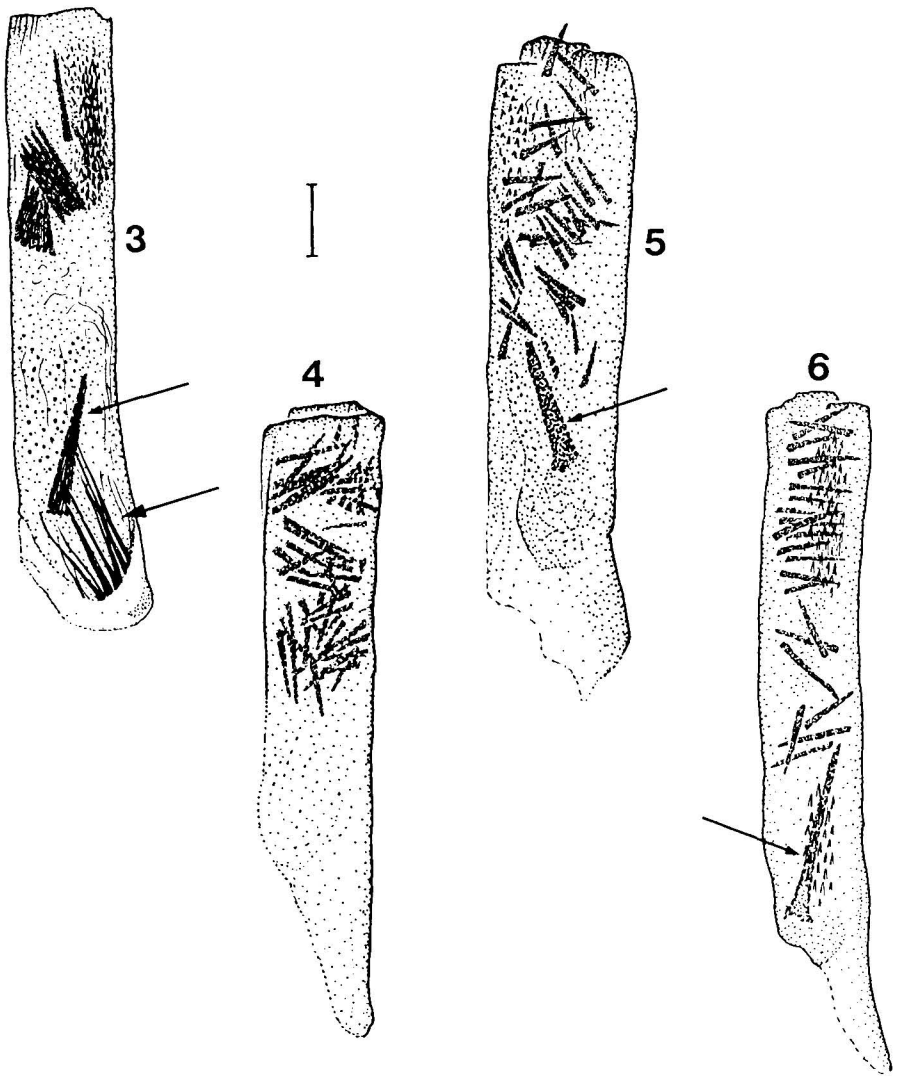
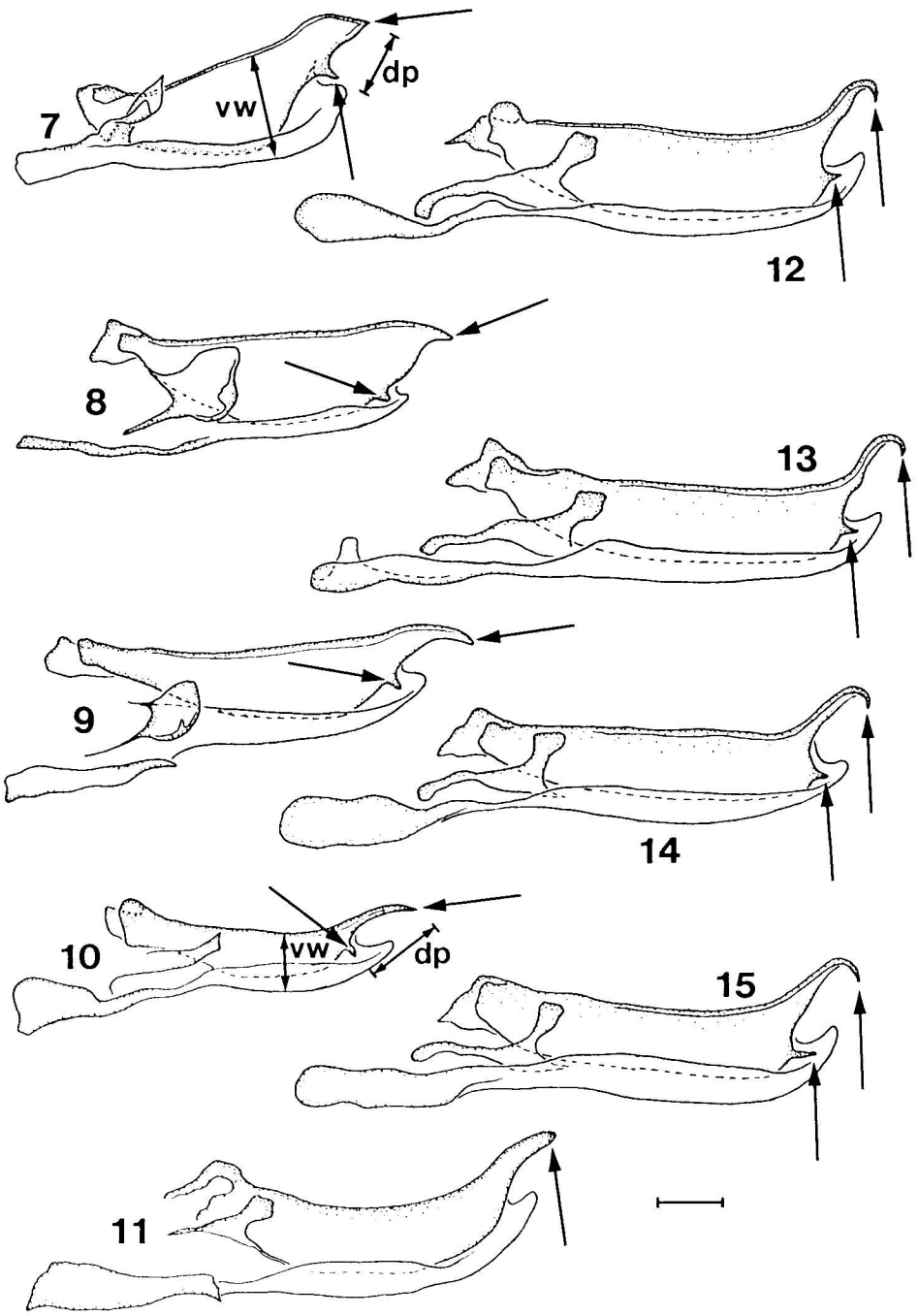
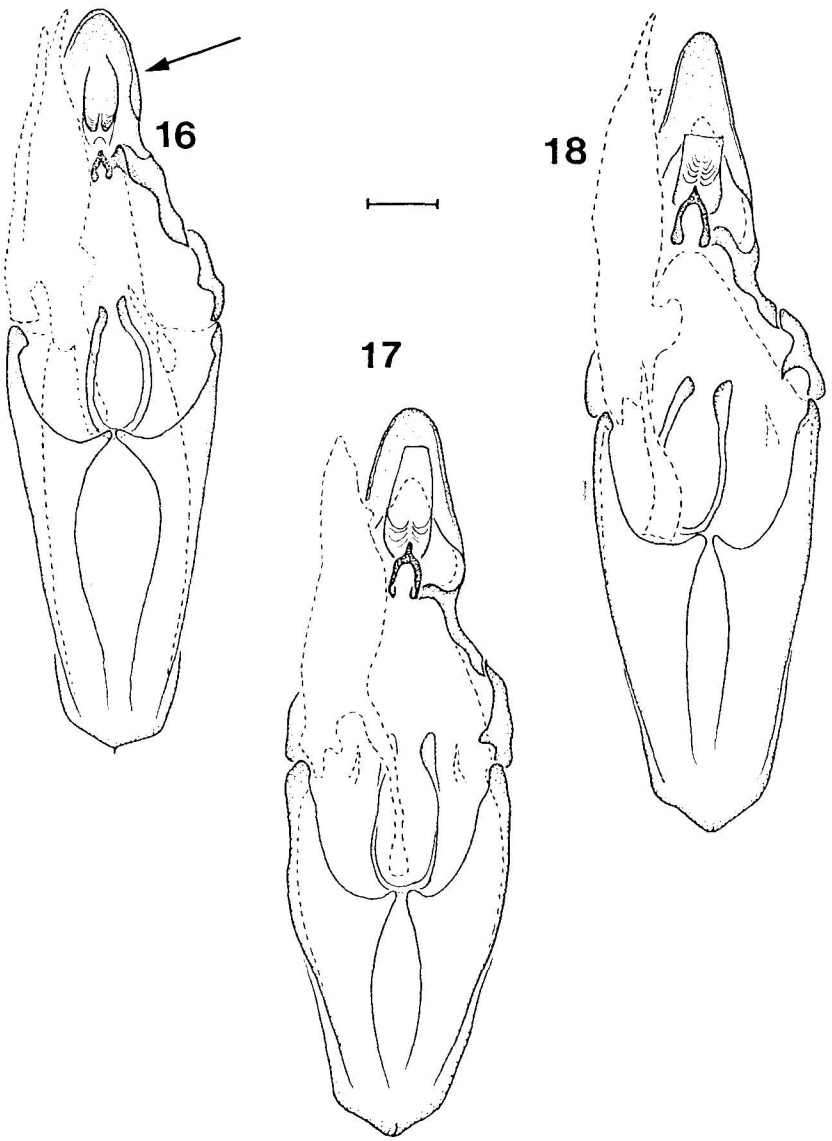


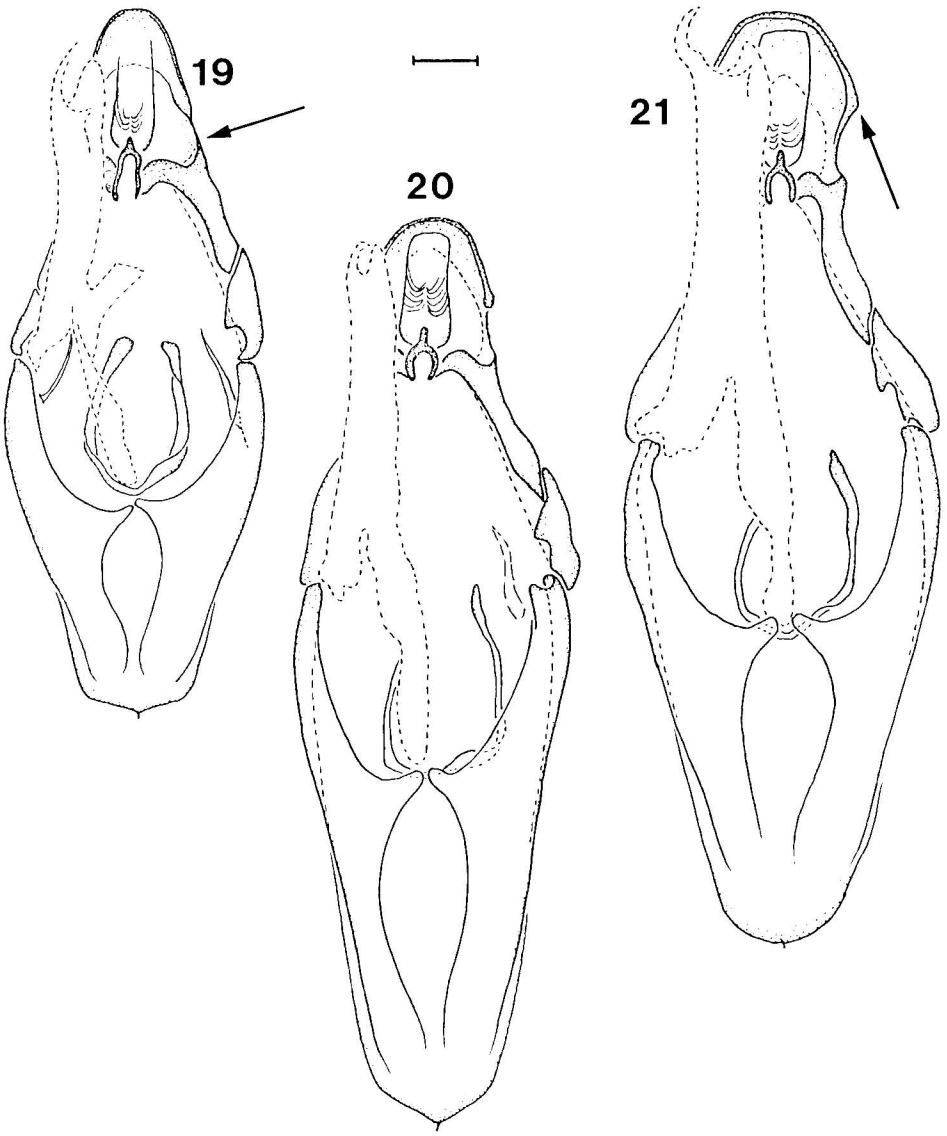
Figures 3-6. *Dioryctria* spp. aedeagi. **3**, *D. abietivorella*, CFS lab colony specimen; **4**, *D. pseudotsugella*, Hedley, BC, ex. *Pseudotsuga menziesii*; **5**, *D. pentictonella vancouverella*, Vancouver, BC, ex. *Pinus contorta*; **6**, *D. cambiicola*, Eneas Cr., BC, ex. *Pinus ponderosa*. Large arrow indicates anterior setal patch (**Fig. 3**), smaller arrows indicate large anterior cornuti. Scale bar = 0.25 mm.



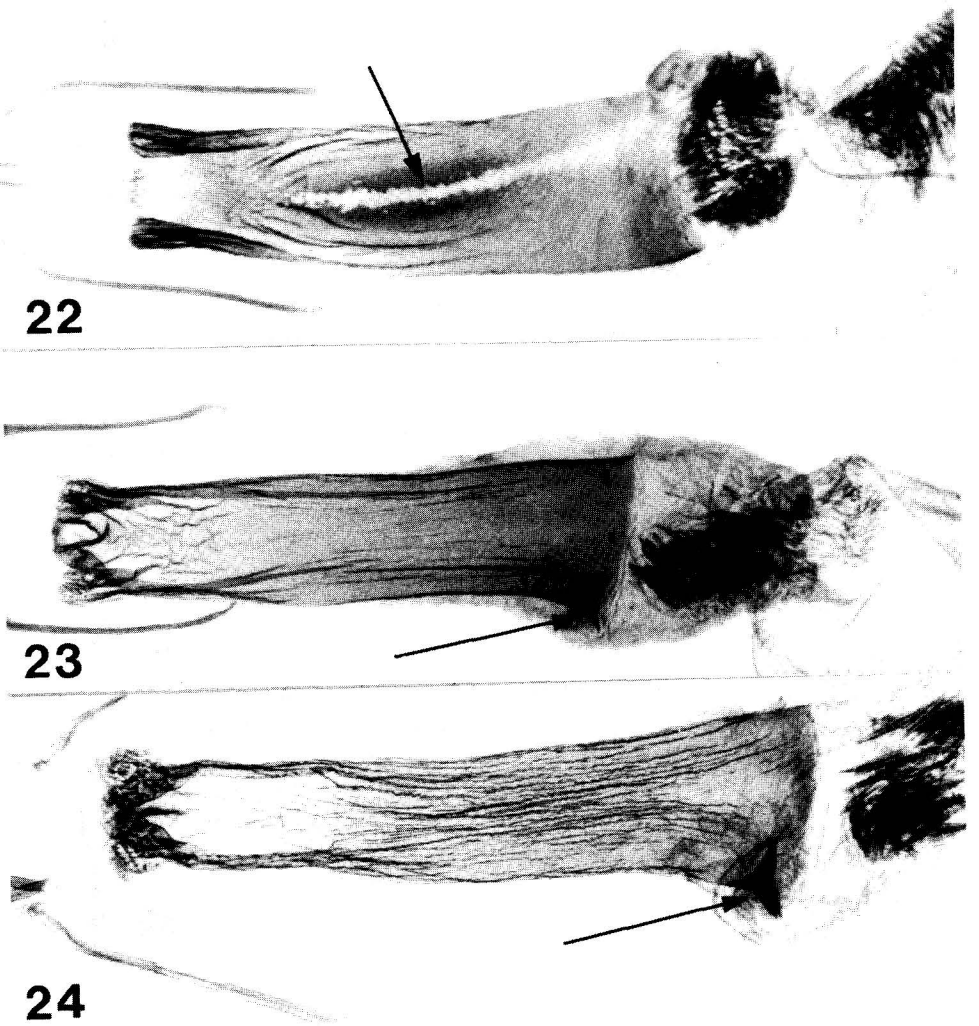
Figures 7-15. *Dioryctria* spp. valvae. **7**, *D. abietivorella*, Keremeos, BC, ex. *Pseudotsuga menziesii*; **8**, *D. pseudotsugella*, Sidmouth, BC, ex. *Pseudotsuga menziesii*; **9**, *D. reniculelloides*, Bestwick, BC, ex. *Picea engelmanni*; **10**, *D. pentictonella*, Penticton, BC, ex. *Pinus ponderosa*; **11**, *D. okanaganella*, El Dorado Co., CA; **12**, *D. cambiicola*, Eneas Cr., BC, ex. *Pinus ponderosa*; **13**, *D. tumicolella*, Summerland, BC, ex. *Pinus ponderosa*; **14**, *D. contortella*, ex. *Pinus contorta*; **15**, *D. monticolella*, ex. *Pinus contorta*. Arrows indicate two processes at tip of costal arm; dp=distance between two processes, vw=valva width. Scale bar = 0.25 mm.



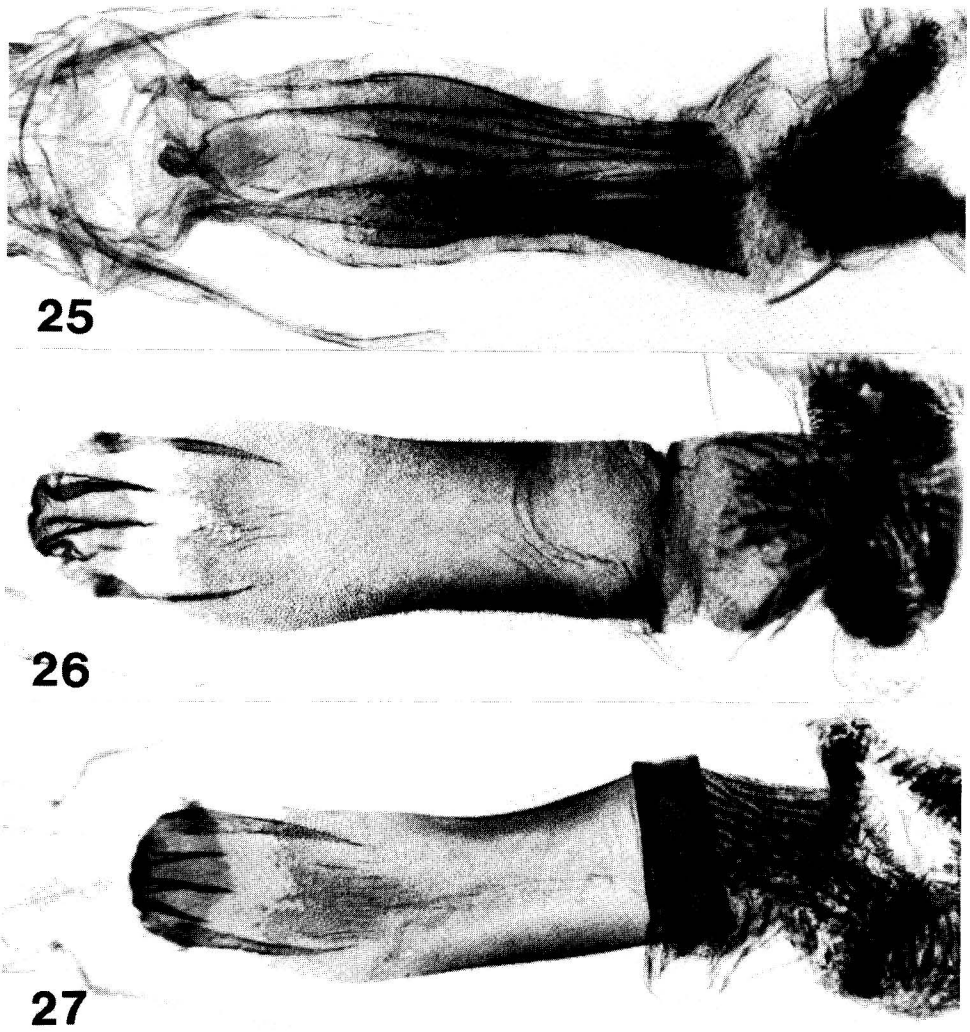
Figures 16-18. *Dioryctria* spp. male genitalia, right valvae and aedeagi removed. **16**, *D. abietivorella*; **17**, *D. pseudotsugella*; **18**, *D. reniculelloides*. Specimens as in **Figs. 7-9**, respectively. Arrow indicates uncus. Scale bar = 0.25 mm.



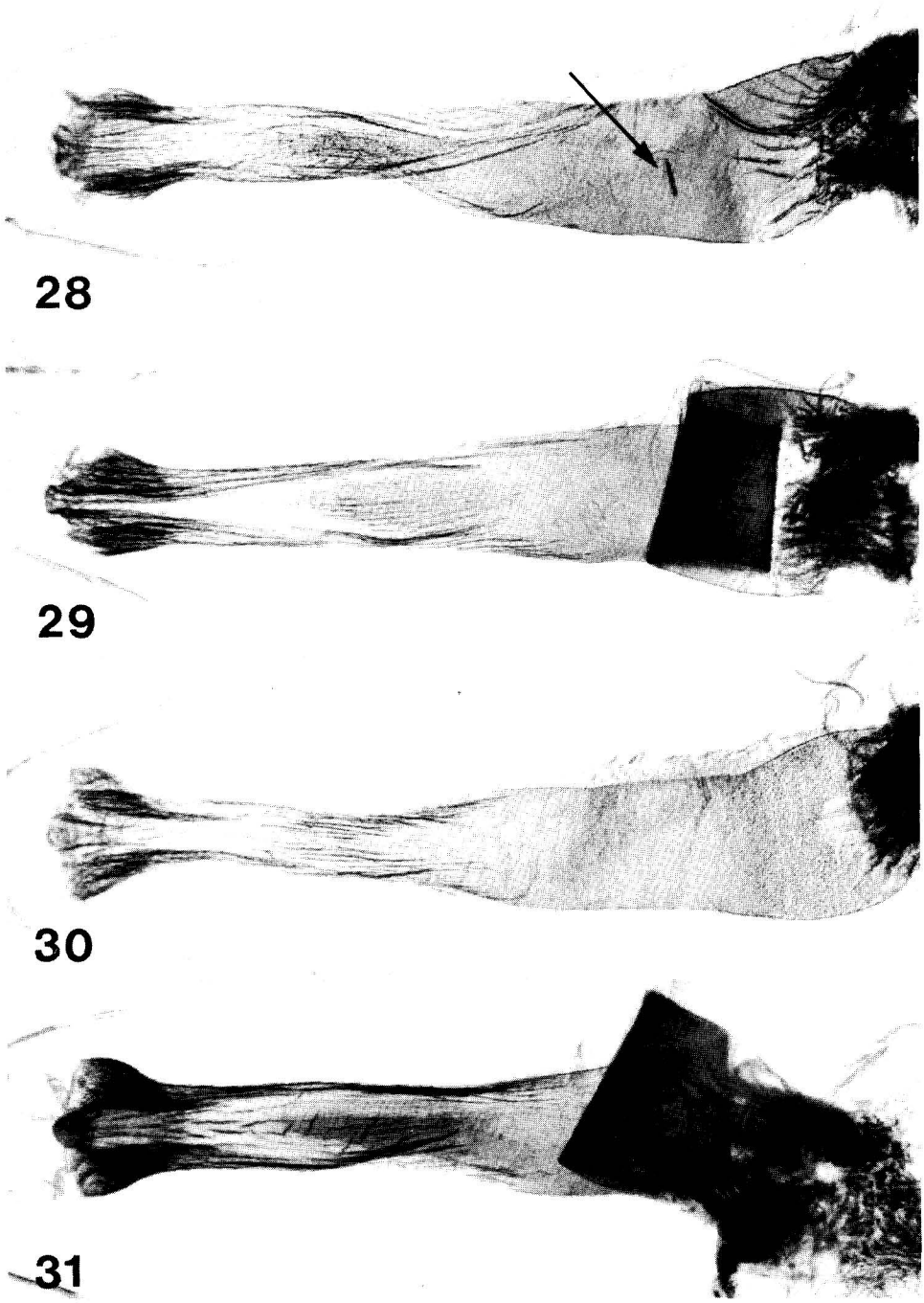
Figures 19-21. *Dioryctria* spp. male genitalia, right valvae and aedeagi removed. **19**, *D. pentictonella*; **20**, *D. cambiicola*; **21**, *D. tumicolella*. Specimens as in **Figs. 10, 12, 13,** respectively. Arrows indicate widest part of unci. Scale bar = 0.25 mm.



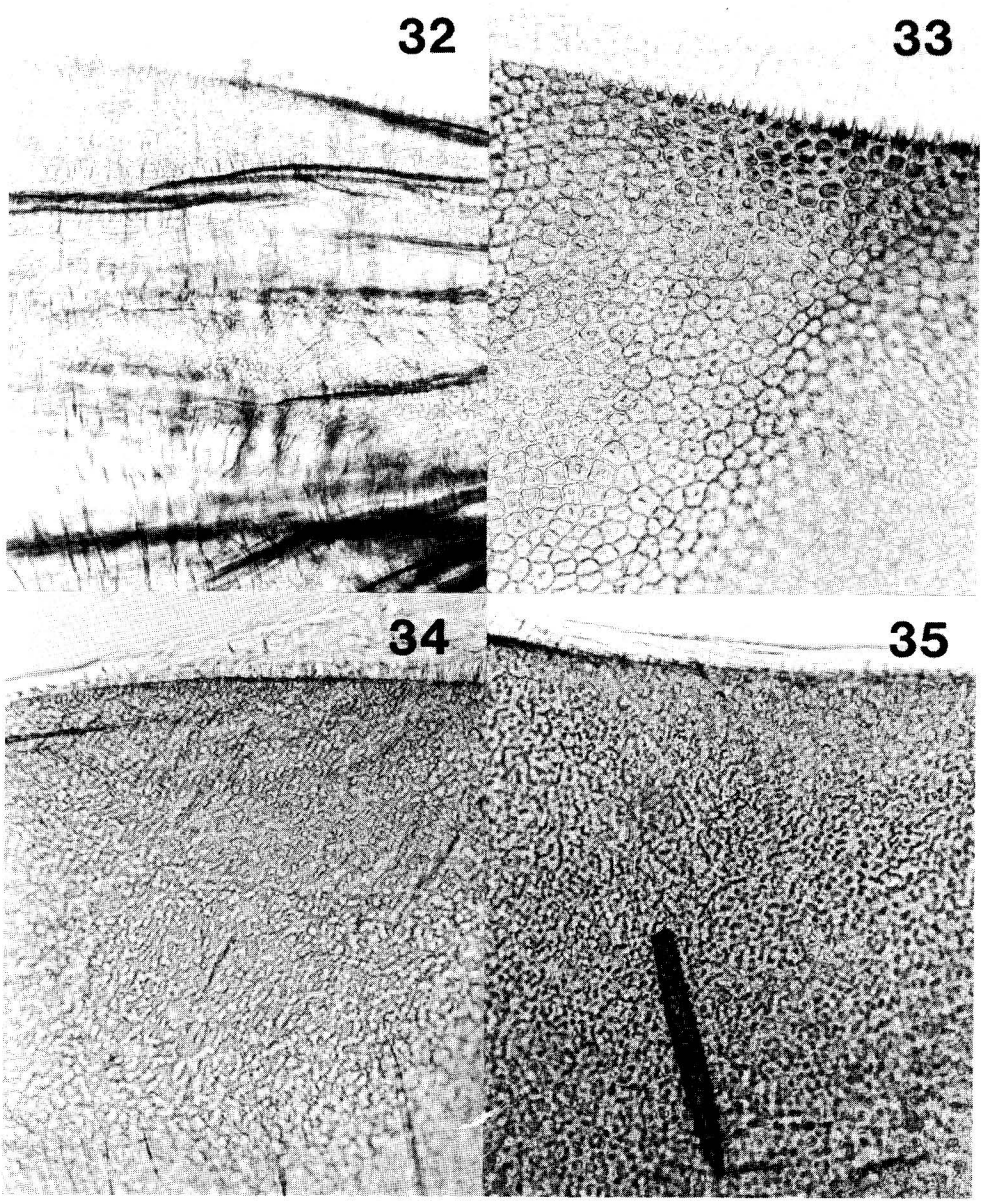
Figures 22-24. *Dioryctria* spp. ductus bursae. **22**, *D. abietivorella*, St. Basile, NB; **23**, *D. pseudotsugella*, Cranbrook, BC; **24**, *D. reniculelloides*, Salmon, ID. Arrows indicate membranous area (**Fig. 22**) and recurved process (**Figs. 23, 24**).



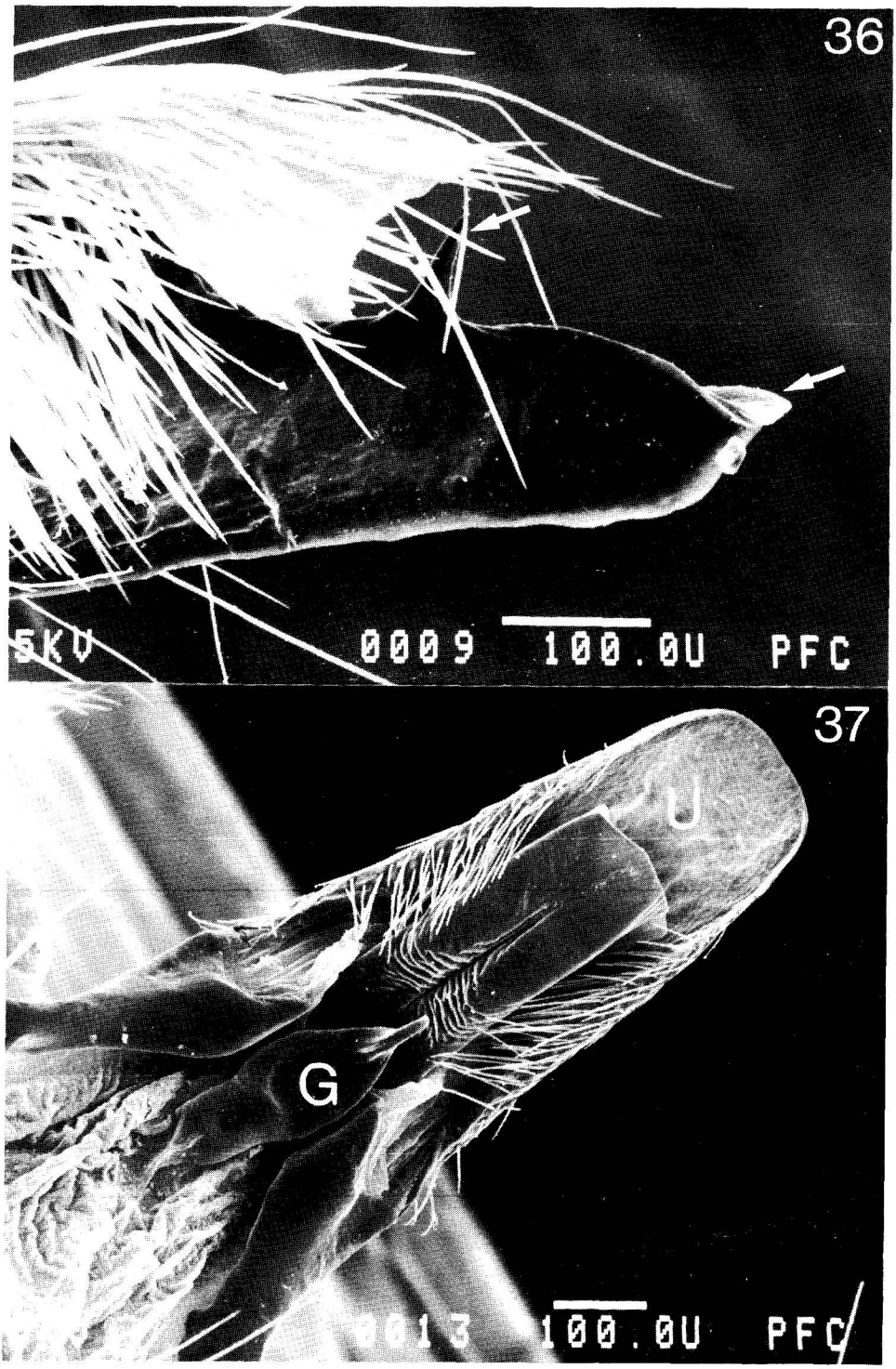
Figures 25-27. *Dioryctria* spp. ductus bursae. **25**, *D. okanaganella*, specimen data as in **Fig. 11**; **26**, *D. pentictonella*, Penticton, BC, ex. *Pinus ponderosa*, with fold stretched out in preparation; **27**, *D. pentictonella vancouverella,* Port Moody, BC, ex. *Pinus contorta.*



Figures 28-31. *Dioryctria* spp. ductus bursae. **28**, *D. cambiicola*, Oliver, BC; **29**, *D. contortella*, Rock Creek Canyon, CO; **30** *D. monticolella*, Magna Bay, BC, ex. *Pinus monticola*; **31**. *D. tumicolella*, Spokane, WA. Arrow indicates cornutus broken from male aedeagus. The fold visible in **Figs. 29** and **31** was stretched out in the preparations illustrated in **Figs. 28** and **30.**



Figures 32-35. *Dioryctria* spp. ductus bursae, surface texture. **32**, *D. okanaganella*; **33**, *D. pentictonella*; **34**, *D. monticolella*; **35**, *D. cambiicola* (note broken cornutus from male vesica). Specimens as in **Figs 25, 26, 30** and **28**, respectively.



Figures 36-37. *Dioryctria abietivorella* male genitalia. **37**, valva; **38**, uncus (U) and gnathos (G). Sechelt, BC, ex. *Pseudotsuga menziesii*. Arrows indicate two processes at tip of costal arm.