Reassessment of *Tympanis* based on types of ascospore germination within asci

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The genus *Tympanis* is reassessed in the light of criteria provided by characters of ascospores and patterns of their germination within asci, rather than classical criteria of host specificity and dimensions of apothecia, asci, and ascospores. Consequently, several taxonomic and nomenclatural changes were made, and included establishment of ***Tympanis neopithya*** sp. nov. replacing *T. pithya* auct. non Karst.; ***T. pulchella*** sp. nov. and ***T. pseudoalnea*** sp. nov. segregated from *T. alnea* sensu Groves; ***T. heteromorpha*** sp. nov., from *T. saligna*; and ***T. grovesii*** sp. nov., from *T. fasciculata*; and establishment of ***T. alpina*** sp. nov. *Tympanis pseudotsugae* Groves is transferred to *Claussenomyces* and a new species, ***C. luteoviridis*** Ouellette & Korf, is described.

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Nous avons montré divers modes de germination des ascospores à l'intérieur des asques dans le genre *Tympanis*. A l'aide de ces caractères, dont la spécificité a été vérifiée par la comparaison de cultures obtenues d'apothèces avec des ascospores germant de façon semblable, nous avons réévalué la validité des nombreuses espèces de ce genre, qui étaient classées antérieurement selon la nature de la plante hôte et la dimension des apothèces, des asques et des ascospores. Ainsi, outre certains changements taxonomiques et nomenclaturals nous proposons les noms nouveaux suivants: ***Tympanis neopithya*** sp. nov. au lieu de *T. pithya* auct. non Karst.; ***T. pulchella*** sp. nov. et ***T. pseudoalnea*** sp. nov. séparées de *T. alnea* sensu Groves; ***T. heteromorpha*** sp. nov. de *T. saligna*; et ***T. grovesii*** sp. nov. de *T. fasciculata*; et ***T. alpina*** sp. nov. *Tympanis pseudotsugae* Groves est transféré au genre *Claussenomyces* et une nouvelle espèce de ce genre, ***C. luteoviridis*** Ouellette & Korf, est décrite.

Introduction

In his early studies and subsequent monograph of the genus *Tympanis* Tode ex Fr., Groves (4, 6) relied mainly on host specificity, ascus size, and shape of ascospores to differentiate the species, but these characters proved unreliable in identification of individual species, as several are not as narrowly host specific as originally thought (11). In many species the asci and ascospores are similar, and the asci (being borne in succession) are often too few to permit proper assessment of size, which may vary with size of the apothecia or the type and condition of the substrate. Groves was aware of these problems but believed that the chief function of a monograph based on numerous, widely scattered, mainly herbarium specimens was to provide names, even at the risk of some names becoming redundant (personal communication with the senior author, 1969).

While working on *Tympanis* in Zürich, the senior author noted that in nature the type of ascospore germination within asci differed from species to species. This phenomenon has been previously described in detail by Brefeld (1), who showed that between the ascospore and the last-formed spore (variously referred to as spermatium, secondary ascospore, or ascoconidium) there occurred in the ascus a series of well-defined intermediate-stage cells. Brefeld described such sequences in what was then known as "*Tympanis pinastri Tul.*" and "*T. ligustri Tul.*" Groves (4) did not pursue this line of investigation beyond stating that "an intermediate stage is sometimes observed," nor has anyone else tried to analyze the complexity of germination patterns in *Tympanis* or to distinguish them from simple intraascal germination as occurring in several other members of Helotiales, or in the Nectriaceae, Geoglossaceae, etc. This has led to

much confusion, such as that involving *Tympanis rhabdospora*, *T. syringae*, *T. montanensis* etc., mentioned by Groves (4, 5).

In our opinion, the type of ascospore germination within asci of *Tympanis* is sufficiently characteristic of individual species to warrant the reclassification of this genus, the subject of this paper. The proposed reclassification (Table 1), while based mainly on the characters of ascospores and patterns of their germination, also uses the conventional criteria provided by apothecia and asci. The new and the conventional criteria appear to be correlated. Species with ascospores remaining one-celled generally have black, glabrous or pruinose apothecia, which are soft in consistency. Apothecia of species with ascospores becoming one-septate and budding fascicles of secondary cells are usually hard and brittle. Species with brown, semitranslucent apothecia exhibit germination patterns described in group B-2 and B-4 below.

The arrangement is tentative with much room left for revision and improvement, particularly in group B-4. It is to be used in conjunction with Groves's monograph of *Tympanis* (4). Discussing this monograph, Seaver (10) wrote: "There are about as many interpretations of the genus as there are workers on the group." We hope the reclassification proposed hereunder proves to be more than just another interpretation.

Materials and Methods

All collections of *Tympanis* deposited in DAOM, QFB, CUP, ZT, and FFB (herbarium symbols are those published in *Index Herbariorum, Part 1. The herbaria of the world.* 5th ed. 1964), as well as type specimens deposited in other herbaria, were examined. Type of ascospore germination within asci, apothecium morphology, and the host plant were recorded for each collection. To evaluate the genetical basis of the various types of ascospore germination, cultures were prepared from most of the collections made from 1968 to 1972 by the senior author, Mr. J. Bard, and other technicians from Laurentian Forest Research Centre.

Sections of specimens were made freehand with a sharp razor blade (cleaned between each specimen examined) or, in a few instances, with a Cryostat microtome. They were mounted in cotton blue (2% solution in lactophenol).[1] Leitz Ortholux microscope, Panatomic X film, and a green filter were used for most of the observations and photomicrographs recorded and reproduced in this paper.

Isolations were made from sections of apothecia with a determined type of ascospore germination. The sections were suspended in drops of water on a sterilized slide, covered with a sterilized bottle cap for a few minutes, and then streaked on potato dextrose agar in a Petri dish.

Observations

More than 900 specimens of *Tympanis* collected between about 1800 and 1972 were examined during this study. All but 25 contained asci with ascospores in various stages of "germination." In all specimens, the minute, bacillar or allantoid "secondary ascospores" (in this study referred to as "ultimate cells") that filled mature asci did not arise directly from the ascospores but invariably budded from intermediate cells borne by the "primary" ascospores. The shape and configuration of the systems of these intermediate cells is considered to be diagnostic for individual species or groups of species. This was confirmed by culture work involving 175 isolates that represent all species so far discovered in Quebec. Cultures obtained from collections with the same type of ascospore germination were consistently uniform and characteristic for the group, an aspect that will be discussed fully in a forthcoming publication. Accordingly, nine morphologically, and apparently genetically, distinct categories are distinguished as described below and are diagrammatically represented in Table 1.

Differences in the shape and size of the ultimate cells were also noted and found useful in differentiating some of the species. However, caution should be exercised when using this character, because frequently, what looks like an ultimate cell may continue to bud even smaller entities.

[1]We have discovered, after completion of this project, that fast green in lactophenol or lactic acid provides excellent staining, differentiation, and clearing of the germinating spores concerned.

SYNOPTIC KEY TO *Tympanis*

Type A. Ascospores remaining globose and one-celled, budding from one or both ends or sometimes laterally during germination

Group A-1. Simple or branched chains of cylindrical, narrowly ellipsoid, or clavate cells arising singly or in groups from each end of the ascospore, budding off secondary subglobose to ovoid cells which in turn yield allantoid ultimate cells.....p. 1891

Group A-1. *Tympanis alnea* and *T. neopithya*

Figs. 1–8

(A-1-1) *Tympanis alnea* (Pers.) ex Fr. Figs. 1–6

This very common species occurs on *Alnus* and other trees and shrubs. The ascospores remain one-celled throughout the budding phase, germinating generally at both ends into chains of large cylindrical to subclavate units with smaller, ovoid to subcylindrical branch cells, which in turn bud off subglobose secondary cells followed by allantoid ultimate cells.

Apothecia are stromatic and usually from lightly to intensely pruinose, depending on age.

Several isolates of this species derived from fresh collections from *Alnus*, *Betula*, *Kalmia*, *Malus*, and *Populus* yielded similar cultures.

Groves (4) described *T. alnea* as having black, glabrous or sometimes densely pruinose apothecia and unicellular or one-septate ascospores. Karsten's specimen (UPS) on *Alnus incana* (L.) Moench was selected as the neotype. Preparations from this specimen left by Dr. Groves in DAOM do indeed show one-septate ascospores and black, glabrous apothecia, which Groves apparently considered to be "the more typical form" encountered in this species. However, only one other specimen (DAOM 41366) assigned by Groves to *T. alnea* is of the "black glabrous type," all others having more or less pruinose apothecia, including DAOM 3317, which he described and illustrated (4, Fig. 23) as representing the "black glabrous form." All these specimens with pruinose apothecia have one-celled ascospores which germinate in the manner noted above. Accordingly, we do not consider the neotype chosen by Groves to be representative of the commonest species occurring on *Alnus* and generally referred to as *T. alnea*, and since neither the original protologue nor the validating description of Fries identifies the original material, we propose to select a new neotype.

Tympanis alnea is thus circumscribed to accommodate forms with pruinose apothecia and continuous ascospores, including those on *Malus* that Groves assigned to *T. conspersa*, which has one-septate ascospores, as will be shown later (p. 1905). Karsten's specimen selected by Groves as the neotype of *T. alnea* is here referred to *T. hysterioides* (p. 1904).

The North American fungus forming black, glabrous apothecia on *Alnus* (including DAOM

TABLE 1

Arrangement of *Tympanis* species according to type of ascospore germination within asci, with supplementary data on other morphological features and hosts

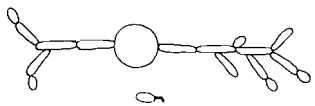
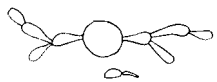
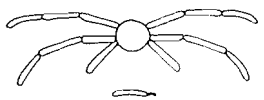
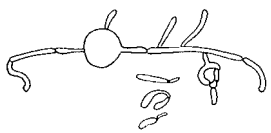
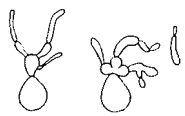
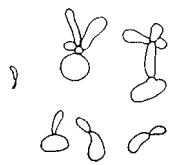
Group	Germination pattern	*Tympanis* spp.	Host spp.	Apothecia	Asci (size in μ)	Ascospores (size in μ)
A-1		*alnea* (p. 1891)	*Alnus, Malus,* Betula, Populus,* Kalmia,* Abies,* Larix,* Salix,* Tilia,* Crataegus,* Quercus,* Sorbus**(?)	E†-C-Ci/U-P/G-B	(110–)135–190(–215) × (14–)18–22(–25)	5–6 × 4–5
A-1		*neopithya** (p. 1896)	*Pinus*	E-S/C-Ci/U-(H)-P/G-B	85.0–125.0 × 11–19	3.5–6.0 diam
A-2		*saligna* (p. 1897)	*Salix*	I/E-C/S-Ci/U-P-B	(135–)160–210(–230) × (15–)18–23(–25)	5–8 × 4–7
		myricariae	*Myricaria*	I/E-S/C*-Ci/U-P-B	(145–)150–180(–190) × (14–)15–18	4.5–5.5 × 3.5–4.5
A-2		*pulchella** (p. 1897)	*Alnus, Acer*	E-C/S-U-Br-G	(85–)100–115(–150) × (10–16(–19)	3.0–4.5 diam
A-3		*heteromorpha** (p. 1897)	*Salix, Populus*	I-S-Ci-P-B	(80–)90–140(–160) × 10–15	(4.8–)6.0 × 8.0
A-3		*grovesii** (p. 1898)	*Viburnum*	E-C-Ci/U-G-B	(70–)90–150 × 10–16	3.5–7.0 diam

TABLE 1 (*Continued*)

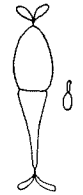
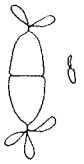
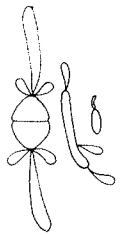
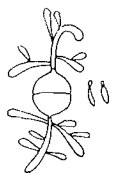
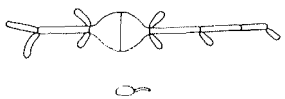
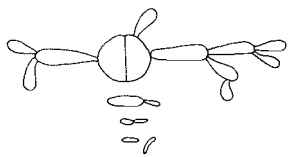
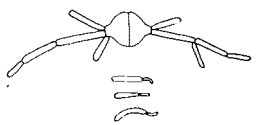
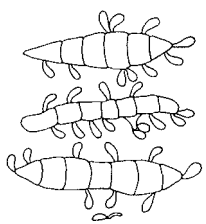
Group	Germination pattern	*Tympanis* spp.	Host spp.	Apothecia	Asci (size in μ)	Ascospores (size in μ)
B-1		*laricina* (p. 1898)	*Larix, Picea,* Pinus,* Thuja,**	E-S/C-Ci/U-G-B	(70–)80–110(–120) × (11–)13–15(–17)	7–10 × 3–4
		= *abietina*	*Abies*	"	(65–)75–95(–110) × (8.5–)9.5–12(–14)	7–10 × 2–3
		= *juniperina*	*Juniperus*	"	70–90(–100) × 9.5–11.0	5–7 × 2–3
		= *hansbroughiana* (pro parte non typica)	*Pseudotsuga*	"	(65–)75–95(–105) × 11–13(–14)	7–10 × 2.5–3.0
B-1		*hypopodia* (p. 1900)	*Abies,* Pinus, Tsuga**	E-S/C-Ci/U-G-B	(60–)70–90(–110) × (8.5–)9.0–12.0(–14.0)	(6–)8–10(–12) × 2–4
		= *piceina*	*Picea*	"	(65–)75–95(–105) × (10–)11–13(–14)	5–8 × 2.5–3.0
		spermatiospora (p. 1902)	*Populus, Salix*	E-S/C-Ci/U-G-B	(55–)70–90(–100) × (9–)10–13(–15)	5–8 × 3–4
		malicola	*Malus*	E-S-Ci/U-G-B	70–85(–100) × 10–12(–13)	4–7 × 3–4
		mutata	*Betula*	"	(80–)85–110 × 13–16	4–5 × 3–4
		salicina (p. 1902)	*Salix*	E-S/C-Ci/U-G-B	(95–)110–135(–145) × (14–)15–17(–18)	5–6 × 2–3
B-2		*truncatula* (p. 1903)	*Abies, Pinus,* Picea,* Larix,* Alnus**	E-C/S-Ci/ U-G*-LBr*	(85–)100–130(–150) × (10–)12–15(–18)	5–7 × 3–4
		= *acericola*	*Acer*	"	(80–)90–115(–130) × (10–)12–15(–19)	4–5 × 2–4
		= *hansbroughiana* (pro parte typica)	*Pseudotsuga*	"	*(85–)95–120(–125) 11–13(–14)	4.5–6
		= *sorbi*	*Sorbus*	"	(75–)90–115 × (8.5–)11–13	4–5.5 × 3.5–4.5
		*pseudoalnea** (p. 1903)	*Alnus*	E-C-Ci/ U-(H)-G-B	(90–)110–125(–140) × (8–)10–13(–16)	(5.6–)7.0–8.4 (–10.5)
B-3		*tsugae* (p. 1904)	*Tsuga, Abies,* Pinus**	E-C/S*-Ci/ U-G-Br	(70–)90–125(–140) × (9–)11–14(–17)	5–7 × 3–4
		= *piceae*	*Picea*	"	(100–)115–130(–140) × (12–)14–16(–19)	5–7.5 × 3–4

TABLE 1 (*Concluded*)

Group	Germination pattern	*Tympanis* spp.	Host spp.	Apothecia	Asci (size in μ)	Ascospores (size in μ)
B-4		*hysterioides* (p. 1904)	*Alnus*	E-S/C*-Ci/ U-(H)-G-LBr*	(110–)135–190(–215) × (14–)18–22(–25)	5–6 × 4.5
B-4		*conspersa* (p. 1905)	*Sorbus*	E-C-Ci/U-P-B	*(80–)100–130(–150) × 16–18.4	4–8 × 3–6
		prunicola (p. 1905)	*Prunus*, *Tsuga**	E-C-Ci/U-G/P-B	(95–)110–145(–175) × (13–)15–20(–22)	5–7 × 3–4
		amelanchieris (p 1906)	*Amelanchier*	E-C-Ci/U-P/G-B	(90–)110–150(–160) × (14–)15–17	4–5 × 3–4
B-4		*oxydendri* (p. 1906)	*Oxydendrum*	E-C/S-Ci/U-G-B	(110–)120–150(–165) × (16.5–)18–22	5–8 × 4.5–5
		hydrangeae (p. 1907)	*Hydrangea*	E-S/C-Ci/U-G-B	(75–)90–110(–115) × 18–20(–22)	4–5 × 3–4
		montanensis (p. 1907)	*Artemisia*	E-Ci-G-B	(90–)100–145 × 12–14(–15)	5–6 × 3–5
		fasciculata (p. 1906)	*Viburnum*, *Cornus**	E-S-Ci/U-G-B	*(75–)90–120(–145) × 10–16(–20)	5–8 × 3–4
		*alpina** (p. 1907)	*Salix*, *Populus*	I/E-S/C-Ci/ U-(H)-G-B	(95–)110–145 × 15–18	5–6 × (2–)3–4
B-5		*ligustri* (p. 1908)	*Ligustrum*	E-S/C-Ci/U-G-B	(100–)110–140(–155) × (12–)15–18(–21)	4–6 × 4.5
		= *syringae*	*Syringa*	"	(95–)110–130(–150) × (15–)18–20(–23)	3–6 × 3–4.5
		= *columnaris*	*Fraxinus*	"	(110–)125–150(–160) × (13–)14–16(–18)	4–5 × 3.5–4.5
		rhabdospora (p. 1908)	*Viburnum*, *Azalea*,* *Larix*,* *Oxydendrum**	E-C/S-Ci/U-G-B	*(100–)120–150 × 14–18	4 × 5
		= *diospyri*	*Diospyros*	"	(125–)145–165 × 19–22	4–5 × 3.5–4.5
C		*confusa* (p. 1908)	*Pinus*	E-S/C-Ci-G-B	(80–)85–120(–150) × (10–)12–16(–21)	13–20 × 2–4

*Original observations. Otherwise data according to Groves (4).
†E, erumpent; I, immersed; C, caespitose (ordinarily stromatic); S, separate; Ci, circular; U, undulate; (H), hysteriform; G, glabrous; P, pruinose; B, black; Br, brown; LBr, light brown.

41366, mentioned above) is described here as a new species (p. 1903). In culture it is quite distinct from *T. alnea*.

NEOTYPUS: In *Alno glutinosa*, Riva, Italy, 1864, A. Carestia leg. Rabenh. Fung. Eur. 719 (in DAOM and ZT).

Specimens Examined

EXSICCATI: Syd. Myc. Germ. 1954; Lund. & Nannf. Fung. Exsic. Suec. 1394; and Ellis, N. Amer. Fung. 376 (CUP-D 3314) as *T. alnea*, on *Alnus*. Krieg. Fung. Sax. 2276; Libert, Fl. Crypt. Ard. 129; Barth. Fung. Columb. 4588 (ZT and CUP-D 10398); Rel. Farl. 153; Jacz. Fung. Ross. 242 (slide in DAOM); and Lind, Fl. Danica (CUP-D 9860) as *T. conspersa* and *T. aucupariae*, on *Malus*. Rabenh. Fung. Eur. 353 (CUP-D), as *T. crataegi* Lasch, on *Crataegus* sp. Incidentally, Fckl. Fung. Rhen. 768 (which we did not examine) is listed by Groves (4) under both *T. alnea* and *T. conspersa*.

On *Alnus* spp. CANADA: DAOM specimens listed by Groves (4) (2521, 87480 (JWG 249), 87481 (JWG 240), 87482 (JWG 183), 55989 (JWG 482), and 87483, 87485, 87486, 55984, 55985, 55988, 55990, 55991, and 55994 (from Timagami For. Reserve, J. W. Groves from 1934–1936); 55987, 19877, 19889, 15515, 14854, 4190, 5299, 56000 (from Ottawa arboretum), 3317, 3797, 56009 (JWG 470), 7988, 5733 (from Meridian Road, Petawawa For. Exp. Sta. Ont.) and the following. Newfoundland: CUP-D 7435 (Waghorne 660) and 7444 (Waghorne 829, as *T. conspersa*). New Brunswick: QFB 19395, 19402, and 19403, Saint-Hilaire, Madawaska Co., VII 1970 and 1971; QFB 19397, Verret, Madawaska Co., 1 X 1971. Quebec: DAOM 113844, La Vérendrye Park, 16 IX 1965, J. W. Groves; QFB 19399 and 19401, Lac Normand, Laviolette Co., VII 1971 and IX 1969; QFB 19400, Riv. Mégiscane, Abitibi-East Co., X 1961; QFB 19393, Saint-Romuald, Lévis Co., 28 IX 1972; QFB 19579 and 19578, Holliday, Kamouraska Co., 31 X and 10 XI 1972; QFB 19580, Deschambault, Portneuf Co., 7 XI 1972; QFB 3839, Lac Remi, Papineau Co., 27 VII 1967. Ontario: DAOM 114781, Kingston, 9 IX 1966, J. W. Groves; DAOM 115228, Nashville, 23 IX 1961, R. F. Cain; CUP 24262, Constance Bay (TRT 4843); ZT Bear Island, VII 1939, H. S. Jackson. Also Macoun collections in DAOM and CUP. Alberta: DAOM 48055, Kananaskis, 8 VII 1955, J. W. Groves; DAOM 55400, Robb, 4 IX 1956, R. J. Bourchier. British Columbia: DAOM 113839, Vanderhoof, 10 VI 1965, J. Holms (DAVFP 16493). U.S.A.: Maine: CUP-D 2200, Wells, P. L. Ricker and CUP-D 7437, Rev. J. W. Blake. New York: CUP-D 6178, 6179, 6180, 6183, and 6184, Peck Coll.; CUP-D 1087 and CUP-D 5724 (as *T. conspersa*), McLean, 31 X 1896; DAOM 56006 (as *T. alnea* var. *hysterioides*), McLean, 31 VIII 1934, G. E. Thompson; CUP-D 6190 (as *T. conspersa*), N. Elba, Peck; CUP 23378, Slaterville, 4 VIII 1934, W. W. Ray. West Virginia: CUP 25867, Morgantown, 4 V 1937, White. Minnesota: CUP-D 10680, Echo Lake, 1918; CUP-A (from FH), Island Lake Superior, VIII 1891, Dewart. North Dakota: ZT VI 1921, J. F. Brenckle. GERMANY: ZT Brandenburg, IX 1901, W. Kirschstein. DENMARK: ZT Jutland. CZECHOSLOVAKIA: ZT (Fl. Moravica, ex Herb. Petrak).

On *Malus* sp. (mostly as *T. conspersa*, except QFB collections). Specimens listed by Groves: DAOM 56085 (JWG 445), 56080 (JWG 431), 56083 (JWG 466), and 932 (Old Chelsea Road, Quebec, 10 V 1949, J. W. Groves), 84610 (ex UPS, Uppland, on *Prunus spinosa*) and the following. Nova Scotia: QFB 19407, Junction Trans-Canada Hwy and Route 242, 8 VIII 1972. New Brunswick: QFB 19398, Colin, Madawaska Co., 12 IV 1971; QFB 19406, Fundy Natl. Park, 10 VIII 1972. New York: CUP-D 6185 and 6186, Peck Coll. and CUP-D 523, Farmington, XII 1888, E. Brown; CUP-D 1496 and 1497, Canandaigua, 17 VII 1902; CUP-D 1796, McLean, 25 X 1902; DAOM 56006 (as *T. alnea* var. *hysterioides*), McLean, 31 VIII 1934; CUP-D 2098, Wellsboro Point, 22 XII 1902, C. O. Smith; CUP-D 4027 (also CUP 19125) and 1367 (also CUP 9532), Ithaca, V 1905, H. Whetzel. Maine: CUP-D 310, 1904, ex J. C. Bennett herb. West Virginia: CUP-D 6455 and 6478, 1904, J. L. Sheldon. Maryland: CUP-D 6485, 16 IX 1903, J. L. Sheldon. New Jersey: CUP-D 7442, Newfield, 29 X 1897, Ellis. SWEDEN: DAOM 56999, Gåstrikland, 9 VII 1963, J. A. Nannfeldt. DENMARK: DAOM 67508, Bergsbrunna, 14 IX 1948, A. Meldens. FINLAND: DAOM 105381, Sippola, Ruotila, 11 V 1944, V. Kujala.

On *Betula* spp. Alberta: DAOM 41350, Kananaskis, 9 VII 1955, R. Horner and J. W. Groves. Ontario: DAOM 55996, Algonquin Park, 23 IX 1952, R. Horner and J. W. Groves. Quebec: QFB 19396, Riv. Sainte-Anne, Mont-

morency Co., 1 VI 1971; QFB 19581 and 19582, Holliday, X and XI 1972.

On *Salix* sp. Alberta: DAOM 41347, Robb, 6 VII 1955, R. Horner *et al.*

On *Populus* spp. Quebec: QFB 19394, Saint Joachim, Montmorency Co., 23 IX 1971; QFB 19444, Matapedia River, Gaspé, 14 IX 1962. Ontario: JWG 1097, Leeds, Grenville, 14 IX 1967. British Columbia: DAOM 63343 (DAVFP 11079), Prince George (as *T. spermatiospora*).

On *Tilia americana*. New York: CUP-D 7445 as *T. conspersa*, Cazenovia, X 1887, A. F. Cook.

On *Kalmia angustifolia*. Quebec: QFB 19392, Holliday, X 1971.

On *Sorbus aucuparia*. SWITZERLAND: ZT, as *T. conspersa*, Arosa, Graubünden, 24 VI 1964, E. Rahm.

On *Quercus subtomentosus*. GERMANY: ZT, as *T. sorbi* Fr., Westfalen, VIII 1927, A. A. Ludwig.

On *Abies balsamea*. DAOM 56440, 23428, and 56459 as *T. truncatula*.

On *Larix laricina*. Quebec: QFB 19583, Laurentide Park, 18 IX 1969, G. B. Ouellette and E. Müller. The culture obtained from this specimen is similar to those derived from specimens on *Alnus*.

(A-1-2) *Tympanis neopithya* sp. nov. Figs. 7–8

This fungus resembles *T. alnea* in the type of ascospore germination. The apothecia are stromatic, broad at the base, circular except when gregarious and flattened by mutual pressure, and often faintly pruinose. The ascospores remain continuous and germinate into chains of stout, clavate cells bearing shorter, clavate branch cells. These bud off subglobose secondary cells giving rise to allantoid ultimate cells, which are shorter than those of *T. alnea*.

Groves (4) described this fungus as *T. pithya* (Karst.) Karst. However, in the type specimen of *T. pithya* examined by us (Karsten: Fung. Fenn. 661 in K) and the slide in DAOM the ascospores become one-septate and germinate into a system of cells resembling those observed in the type specimen of *T. truncatula* (Pers. ex Fr.) Rehm. This may explain why Groves described the ascospores of his *T. pithya* as "one- or two-celled."

We consider *T. pithya* (Karst.) Karst. to be conspecific with *T. truncatula* (p. 1903) and propose to describe *T. pithya* Groves pro parte as follows.

Tympanis neopithya Ouellette & Pirozynski, sp. nov.

Apotheciis sessilibus rario ad basim attenuatis, orbicularibus vel undulatis, solitariis vel caespitosis pluries coalescentibus, 0.5–1.3 usque ad 2.5 mm diam si coalescentes, 0.3–0.8 mm altis, atris, pluries tenuiter griseo-pruinosis, marginibus crassis, tenuiter fimbriatis et plerumque involutis; ascis cylindraceo-clavatis, octoascosporis, dein multisporis, 85.0–125.0 × 11.0–19.0 μ; ascosporis globosis, hyalinis, continuis, 3.5–6.0 μ diam; cellulis primariis ampulliformibus, in seriem germinantibus; cellulis secundariis subglobulosis; ultimis cellulis continuis, allantoideis; paraphysibus, hyalinis, filiformibus, septatis, ad apicem ramosis et leviter incrassatis, agglutinatisque, epithecium nigricans formantibus.

HOLOTYPUS: DAOM 56346 (JWG 265), in ramulis *Pini strobi*, Timagami Forest Reserve, Ontario, 10 IX 1934, J. W. Groves leg.

In culture, *T. neopithya* has a type of growth similar to that of *T. alnea*, but pycnidia are formed abundantly in the latter and scarcely in the former.

Specimens Examined

On *Pinus* spp. DAOM collections listed by Groves (4): 56356 (JHR 1144), 56353 (JHR 1105), 56377 (JHR 1513), 56365 (JHR 1102), 84198 (O. Rostrup, Denmark), 56344 (JWG 481), 56345 (JWG 39), 56375 (JWG 377), 3788, 56363 (TRT 3127), 56367 (JWG 645), 3828, 56342 (JWG 501), 56382 (JWG 112), 56340 (TRT 3526), 56339 (JWG 302), 56380 (JRH 1145), 56145 (JWG 327, as *T. hypopodia*), 25847 (Hogg's Hollow, Toronto) and the following. Ontario: DAOM 56337 (JWG 207), Timagami, 26 VII 1934, H. S. Jackson and J. W. Groves; DAOM 56156 (JWG 879 in part, as *T. hypopodia*), Corkery. Quebec: QFB 5149 and 19411, Pont Rouge, 18 X 1966; QFB 19409 and QFB 19571, Valcartier, 3 I 1971 and 20 IX 1967; QFB 19584, St. Raymond, 28 X 1972, the last three localities in Portneuf Co.; QFB 19568, 19569, and 19572, Saint-Urbain, Charlevoix Co., VI 1966 and 1965, E. Smerlis; QFB 19408, Lac Normand, Laviolette Co., 17 IX 1969, G. B. Ouellette and E. Müller; QFB 19410, Godbout, Saguenay Co., 10 X 1970; QFB 19412, Berthierville, Berthier Co., 5 XI 1970; QFB 19413, Point Comfort, Gatineau Co., 19 IX 1963; QFB 19504, Saint-Joachim, Montmorency Co., 23 IX 1971;

QFB 19415, Sainte-Marguerite, Dorchester Co., 5 X 1972. North Carolina: DAOM 56381, Highlands, 6 IX 1947, J. H. Miller. Michigan: DAOM 56374, Cross Village, 16 VI 1948, J. W. Groves. SWITZERLAND: Lötschental, ZT (also QFB 19414), mixed with *Nectria cucurbitula*, VII 1925, Fr. Wille; ZT Bever, Graubünden, 18 VII 1963, E. Müller. JAPAN: DAOM 124690 and 124701, Hokkaido, 21 VI 1967, H. Saho.

Group A-2. *Tympanis saligna*, *T. myricariae*, and *T. pulchella*

Figs. 9–15

(A-2-1) *Tympanis saligna* Tode ex Fr. and *T. myricariae* Höhn. & Rehm. Figs. 9–10

The ascospore germination is of the type described above under *T. alnea*, except for the secondary cells, which in this group of species are narrowly clavate to cylindric and usually curved. The apothecia in typical specimens of *T. saligna* and of *T. myricariae* are immersed in bark, erumpent, and sometimes fused like those of *T. alnea*. Their asci are also quite similar to those of *T. alnea*. These observations are based on examination of the type specimen of *T. myricariae* and of the neotype (Jaap: Fung. sel. Exsic. 414 in FH) and another specimen (Krieger: Fung. Saxon. 2230 in CUP) chosen by Groves (4) to represent *T. saligna*. These specimens may simply be variants of *T. alnea*. However, until cultures can be obtained from fresh samples (on *Myricaria* and *Salix*) showing these same characteristics, this question cannot be solved.

Most of the remaining herbarium specimens previously referred to *T. saligna*, as well as numerous specimens collected by the senior author on *Salix* and *Populus*, are considered to be different and are recorded elsewhere (p. 1898) under *T. heteromorpha*.

The other representative of this group is described as follows.

(A-2-2) ***Tympanis pulchella*** Ouellette & Pirozynski, sp. nov. Figs. 11–15

Apotheciis erumpentibus, caespitosis vel raro solitariis, plerumque undulatis, versus basim attenuatis vel raro sessilibus, glabris, furfurosis, marginibus crassis, primo concavis dein fere planis, 0.5–1.5 usque ad 3.6 mm latis si coalescentes, 0.7–1.0 altis; ascis cylindroideis, breve stipitatis, primo octoascosporis, dein ultimo multisporis, (85–)100–115(–150) × 10–16(–19) μ; ascosporis hyalinis, globosis, continuis, 3.0–4.5 μ diam, in ascis in minutos, longos, septatos filamentes germinantibus; cellulis secundariis multum curvatis, multiformibus; ultimis cellulis allantoideis, tenuibus; paraphysibus, filiformibus, septatis, ad apicem leviter incrassatis agglutinatisque, epithecium fuscum formantibus.

HOLOTYPUS: QFB 19460, in ramulis *Aceris pensylvanici*, Duchesnay, Portneuf Co., Quebec, 29 IX 1969, René Cauchon et Emil Müller leg. Isotypus in DAOM.

Rehm's Ascomyceten 957 (CUP-D 7433) collected on *Alnus glutinosa* in Belgium is the same fungus. Rehm (9) recorded it under *T. alnea* and accurately noted the stages of ascospore germination.

Tympanis fraxini sensu Phill. listed by Groves (4) as a synonym of *T. columnaris* is, judging from Phillips' specimen in BM (now at K), very similar to, and possibly conspecific with, *T. pulchella*. A specimen distributed by Roumeguère under *T. fraxini* f. *rhoidis* (Fung. sel. Gall. Exsic. 1272 in DAOM and CUP) may also be the same fungus, but immature.

Group A-3. *Tympanis heteromorpha* and *T. grovesii*

Figs. 16–26

In both species the ascospores germinate from one point to produce a tuft of irregular cells.

(A-3-1) ***Tympanis heteromorpha*** Ouellette & Pirozynski, sp. nov. Figs. 23–26

Apotheciis immersis, solitariis, rario subcaespitosis, griseopruinosis vel glabris si vetes, marginibus crassis et involutis, 0.5–0.9 mm latis, 0.4–0.7 mm altis; ascis cylindroideis, octoascosporis dein ultimo multisporis, (80–)90–140 (–160) × 10–15 μ; ascosporis hyalinis, globosis, continuis (4.8–)6.0–8.0(–10) μ diam, plerumque in cellulas convolutas germinantibus; cellulis secundariis longis, cylindrato-curvatis; ultimis cellulis cylindrato-allantoideis; paraphysibus filiformibus, septatis, epithecium fuscum formantibus.

HOLOTYPUS: QFB 19442, in ramulis *Salicis* sp., Route 242 + Trans-Canada Hwy, N.S., Can., 9 VIII 1972, G. B. Ouellette leg.

This fungus was repeatedly collected in recent years on *Salix* and *Populus*. Cultures derived from several of these specimens are identical but easily distinguished from those derived from

other species of *Tympanis*. *T. heteromorpha* occurs in North America and differs from the European *T. saligna* in its consistently embedded, solitary apothecia and the irregularly twisted cells budded from one end of germinating ascospores. However, in some collections, mainly on *Populus*, the ascospores first germinate into one or two clavate primary cells. This fungus was previously reported as *Tympanis* sp. (and, erroneously, as *Pleurostromella* sp.) attacking young branches of *Populus tremuloides* Mich. damaged by frost (8).

Other Specimens Examined

On *Salix* spp. Ontario: DAOM 26179 (JWG 952 as *T. saligna*) Ottawa, 12 X 1949. Quebec: QFB 19443, Saint-Romuald, Levis Co., 28 IX 1972; QFB 19445, Holliday, 14 XI 1970; QFB 19446, Saint-Jean de Standen, Dorchester Co., 9 X 1970; QFB 19448, Valcartier, 26 X 1970. New Brunswick: QFB 19447, Colin, Madawaska Co., 12 IV 1971.

On *Populus tremuloides*. Nova Scotia: DAOM 4651 (JWG 555, as *T. spermatiospora*), Casey's Corner, 27 VII 1937, K. A. Harrison. Quebec: DAOM 82747 as *T. spermatiospora*, North Onslow, Pontiac Co., 17 VI 1961, G. D. Darker; QFB 19449–19452 Causapscal, Matapedia Co., 31 VII 1963 and 14 IX 1967; QFB 19453, Valcartier, 28 X 1970; QFB 19454, La Tuque, Laviolette Co., 10 IX 1969, G. B. Ouellette and E. Müller; QFB 19455, Lac Aigremont, Chibougamau Park, 25 VIII 1970; QFB 19456, Sainte-Marguerite, Dorchester Co., X 1972; QFB 3842 Lac Sainte-Anne, L'Islet Co., 14 XI 1967.

(A-3-2) *Tympanis grovesii* sp. nov. Figs. 16–22

This species was repeatedly collected on *Viburnum*. It also has unicellular globose ascospores with a single point of germination but primary budding cells are pyriform to cylindrical or somewhat cruciate. Its ultimate cells are stout cylindrical-allantoid. Two other species have been described from *Viburnum*: *T. fasciculata* Schw. and *T. rhabdospora* Berk. & Curt. Groves (4) considered the collections on *Viburnum* to represent a single species for which he adopted the earliest name, *T. fasciculata*. However, in both this species and *T. rhabdospora* the ascospores become one-septate, as in groups B-4 and B-5. This fact necessitates segregation of the fungus under discussion into a separate taxon described here as follows.

Tympanis grovesii Ouellette & Pirozynski, sp. nov. Figs. 16–22

Apotheciis erumpentibus, pluries caespitosis, stromaticis, marginibus crassis primo involutis, atris, orbicularibus vel undulatis, 0.3–1.2 mm diam, 0.2–0.9 mm altis; ascis cylindroideis, breve stipitatis, octoascosporis, dein multisporis (70–) 90–150 × 10–16 μ; ascosporis globosis vel subglobosis, unicellularibus, hyalinis, 3.5–7.0 μ diam; cellulis primariis piriformibus vel cylindratis vel cruciformibus (tum septatis), crassis, et secundariis ovatis ad cylindrateas; ultimis cellulis cylindrato-allantoideis; paraphysibus filiformibus, septatis, epithecium viridiantem formantibus.

HOLOTYPUS: DAOM 19656a in ramulis *Viburni cassinoidis*, Petawawa For. Exp. Sta., 2 IX 1947, J. W. Groves leg.

Other Specimens Examined

Ontario: DAOM specimens listed by Groves as *T. fasciculata* (4) 56148 (JWG 229), 56152 (JWG 252), 56197 (in part, JWG 277), 7323, 14855 (TRT 15754), and 126100 (Timagami, 23 VII 1968, J. W. Groves), and the following. Quebec: DAOM 56147 (JWG 836); DAOM 87496, Ste-Catherine, 25 VIII 1938, R. F. Cain and J. W. Groves; QFB 19457, Ste-Foy, 18 XI 1970; QFB 19458 and 19459, Saint-Isidore, Dorchester Co., 5 X 1972; QFB 19462 and 19463, Saint-Romuald, Lévis Co., 28 IX 1972; QFB 19464, 19585 and 19586, Holliday, 30 IX 1970, 31 X 1972, and 11 XI 1972. New Brunswick: QFB 19461, Saint-Hilaire, Madawaska Co., 5 X 1971. Nova Scotia: DAOM 39717, Aylesford Lake, 1 X 1953, K. A. Harrison.

Group B-1. *Tympanis laricina*, *T. hypopodia*, *T. spermatiospora*, *T. malicola*, *T. mutata*, and *T. salicina*

Figs. 27–37

The species classified in this category have erumpent apothecia, which are solitary to gregarious, black, soft, and usually with a stout stipe. The ascospores are clavate or broadly ellipsoid to fusiform, invariably become one-septate, and germinate first into a tuft of bud-like cells of similar size at each end.

(B-1-1) *Tympanis laricina* (Fckl.) Sacc. Fig. 27

The ascospores of *T. laricina* are characteristically clavate, sometimes very narrowly so, straight or curved, and germinate at each end

into tufts of subglobose, ovoid, or pyriform cells (Fig. 27) producing short, allantoid, almost rod-shaped ultimate cells. More than 20 cultures showing this type of ascospore germination were obtained from specimens collected from *Larix*, *Abies*, *Picea*, *Pinus*, and *Thuja*. The cultures were similar, indicating a host range much wider than previously believed.

Groves (4) described the ascospores of *T. laricina* as "ellipsoid-fusiform." Judging from this and other statements (mentioned below), as well as from his illustrations of the ascospores, it appears that Groves, while distinguishing between globose and ellipsoid-fusiform-clavate ascospores, did not use the latter category with any precision.

In the type specimen of *T. laricina* the ascospores are distinctly clavate, but it should be mentioned that some asci contain only one to four ascospores and these ascospores are correspondingly larger and distorted.

In *T. abietina*, Groves (4) described the ascospores as fusiform, but in the type specimen which we have examined they are distinctly clavate, like those of *T. laricina*. The same is true of *T. juniperina* (Sacc.) Sacc. The similarities between the three species extend beyond ascospore shape, so much so that we consider the three names synonymous. Only one specimen of those listed by Groves under *T. abietina* was found to have elliptic-fusiform ascospores. This, together with other more recent specimens from *Abies* and cultures derived from them, is treated below under *T. hypopodia* (p. 1900).

Tympanis rehmiana Groves is based on a single specimen, a European collection supposedly on *Fagus*. The ascospores were described as fusoid-clavate and the measurements given as 12–15 × 3–4 μ. Our reexamination of the type (Wurttemberg, leg. Tavel, 1889 sub. *T. truncatula* in ZT) revealed the presence of ascospores as short as 7 μ. This puts *T. rehmiana* within the ascospore size range of *T. laricina* (Table 1). Furthermore, we question the identity of the host as *Fagus*. The species may well belong in *T. laricina*, but until further collections are made or the identity of the host plant is established, no definite redisposition is proposed.

The ascospores of *T. hansbroughiana* Groves, which occurs on *Pseudotsuga*, were also described as clavate-fusiform. Of the three specimens assigned to this species by Groves (4), only the type and cultures from it and one other specimen were located and examined. In the type specimen, as well as in the apothecia formed on sterilized twigs of *Abies* inoculated with the culture obtained from that specimen, the ascospores are broadly ellipsoid to globose and germinate like those of *T. truncatula*. Their apothecia are also similar.

As the other specimen of *T. hansbroughiana* in DAOM identified by Groves has ascospores fitting the description he gave for that species but similar to *T. laricina*, as indicated below, it seems clear that *T. hansbroughiana* was based on discordant elements. The latter is thus considered to be an obligate synonym of *T. truncatula*; the other specimens are considered to belong to *T. laricina*.

The revised synonymy of *T. laricina* is as follows.

Tympanis laricina (Fckl.) Sacc. Syll. Fung. 8: 853. 1889.
≡ *Cenangium laricinum* Fckl., Symb. Myc. p. 270. 1870.
= *Cenangium juniperinum* Sacc. Michelia, 1: 419. 1878.
≡ *Tympanis juniperina* (Sacc.) Sacc. Syll. Fung. 8: 584. 1889.
= *Tympanis abietina* Groves, Can. J. Bot. 30: 599. 1952.
= *Tympanis rehmiana* Groves, Can. J. Bot. 30: 638. 1952.

Specimens Examined

EXSICCATI: Fckl. Fung. Rhen. 2473 (Type, FH and K and slide in DAOM). Rabenh. Fung. Eur. 1231 (as *T. pinastri* CUP and ZT, also slide in DAOM); Rehm Ascom. 356 and 773 (as *T. pinastri* CUP-D 7466 and 7467); Phill. Elv. Brit. 145 as *C. laricinum*, CUP-D 11147), and Karsten Fung. Fenn. 754 (slide in DAOM, as *T. hypopodia*).

SPECIMENS LISTED BY GROVES: DAOM 56159 (JWG 427), 56146 (JWG 322), 12055, 12057, and 56164 (JWG 747) as *T. laricina*; DAOM 14857 (Type), 87493, 87494 (JWG 191), 5306 (not *Abies*, but *Picea*), 4684, 7990, 56017 (JWG 527), 56011 (JWG 953), 56013 (JWG 343), 56014 (JWG 301), 56015 (in part), and 56016 (JWG, Timagami), as *T. abietina*; DAOM 56101 (JWG 354), as *T. hansbroughiana*; DAOM 55995 (JWG 355), as *T. confusa*; DAOM 56097 (JWG 707), 16615 ex herb. J. R. Weir, 4866 (in part, JWG 564), as *T. hypopodia*; Speg. 1879 (Type, K, as

T. juniperina), and the following. On *Larix* spp. Quebec: QFB 19426 and 19427, IX 1969; QFB 1000, 16 VIII 1962, and QFB 19542 (as *T. abietina*), 12 VI 1965, E. Smerlis, these in Laurentide Park; QFB 19440, 28 X 1970, and QFB 19555 (as *T. hansbroughiana*), 6 IX 1968, E. Smerlis, these in Valcartier. Manitoba: DAOM 124501, Norgate Rd., 7 VII 1967, B. C. Sutton. Alberta: DAOM 71187, Settlers Rd., 6 VIII 1960, S. J. Hughes and J. W. Groves. British Columbia: DAOM 56804, Makinson Flats, 10 VI 1950, A. K. Parker. SWITZERLAND: ZT Graubünden, Val S-Charl, 21 IX 1969, E. Müller *et al.*; ZT Davos, 17 IX 1963, E. Müller; ZT Arosa, 24 VIII 1963, E. Rahm; ZT Aletschwald, Wallis, 24 VII 1964, E. Müller; ZT (also QFB 19431) Nante, Tecino, 12 VII 1963, E. Müller. FRANCE: ZT Hautes Alpes, 29 VIII 1954, and 24 VI 1952, H. Kern; ZT (as *T. pinastri*) Val Fontanalba, Alpes Maritimes, 1 VIII 1955, E. Müller and Y. Schwepp. JAPAN: DAOM 124702, Hokkaido, 27 IX 1967, H. Saho (3702).

On *Abies* spp. (those in DAOM as *T. abietina*). Newfoundland: CUP-D 7456 (Waghorne 203), Bay of Islands. New Brunswick: DAOM 43145 (=FFB 2596), Green River, Restigouche Co., 29 V 1956, M. A. Stillwell and H. Deichmann; QFB 19422, 19435, 19436, 19437, and (mixed with *T. hypopodia*) 19479, 19480, and 19481, Verret and Saint-Hilaire, Madawaska Co., X 1970 and 1971. Quebec: QFB 19417, Laurentide Park, 22 IX 1969; QFB 19552 and 19550 (as *T. hansbroughiana*), Laurentide Park, VII and IX 1963, E. Smerlis; QFB 19418, Harrington Farm, Argenteuil Co., 19 IX 1969, G. B. Ouellette and E. Müller; QFB 19424, Saint-Isidore, Dorchester Co., 5 X 1972. Ontario: DAOM 124580, Timagami Forest, 22 VII 1968, J. W. Groves; DAOM 115227, Manitowadge, 18 VI 1963, R. F. Cain; Net Lake, 10 IX 1963, G. D. Darker. British Columbia: DAOM 41393, Crescent Spur, 19 IX 1951, N. T. Engelhardt. Maine: CUP-D 7497, Auburn, 1897, E. D. Merrill. New York: CUP-D 1987, Lake Placid, 30 VIII 1894. Utah: DAOM 89519 (G. D. Darker 5797), Bringhtom, 30 VII 1936. Wyoming: DAOM 58025 (also in ZT and QFB 19419) Medicine Bow Mts., 12 VII 1955. EUROPE: Pers. Herb. 910.261.381 (DAOM 84608).

On *Pinus* spp. Quebec: QFB 19421 and 19423, Berthierville, 5 XI 1970; QFB 19425, Chute aux Galets, Chicoutimi Co., 20 IX 1972; QFB 19428, 19438 and 19441, Chibougamau Park, VIII 1970; QFB 19429, Pont Rouge, 2 IX 1972; QFB 19541 (as *T. abietina*), 19553, 19554, and 19556 (as *T. hansbroughiana*), Valcartier, Portneuf Co., 14 VI 1967, V and VIII 1968, E. Smerlis; QFB 19430, Saints-Anges, Beauce Co., 8 VIII 1971; QFB 19433, Holliday, 15 XI 1970; QFB 19434, Sept-Iles, 21 X 1970; QFB 19543 (as *T. abietina*), Quebec City, 30 V 1965, E. Smerlis; QFB 19551 (as *T. hansbroughiana*), Saint-Louis de Blandford, Arthabaska Co., 31 VII 1963, E. Smerlis. Ontario: JWG 790, Petawawa For. Exp. Sta., 7 IX 1943, J. W. and E. Groves. Alberta: DAOM 100200 (as *T. confusa*), Banff Natl. Park, 9 VIII 1960, R. J. Bourchier. New York: CUP 17754, Newcomb, 18 IX 1928, D. S. Welch. FRANCE: ZT (as *T. confusa* also QFB 19492) Hautes Alpes, Col Matachard sur Montmard, 26 VI 1952, H. Kern. JAPAN: DAOM 124698 and 124692 (as *T. hypopodia*), Hokkaido, VI and VIII 1967, H. Saho and J. W. Groves.

On *Picea* spp. New Brunswick: QFB 19439 and 19474 (in mixture with *T. hypopodia*), Verret, 1 X 1971. Quebec: QFB 19432, Valcartier, 28 X 1970; QFB 19557, Laurentide Park, 24 V 1968, and QFB 19558, Lac à la Tortue, Champlain Co., 28 IV 1968, E. Smerlis (as *T. hansbroughiana*). SWITZERLAND: ZT Käsbalde, Graubünden, 20 VI 1964 (ex herb. Volkart, as *T. pinastri*).

On *Thuja occidentalis*. Quebec: QFB 19416, Ile aux Coudres, Charlevoix Co., 28 VII 1970.

On undetermined host, probably *Abies*. Quebec: NY, Duchesnay, 28 VIII 1938, F. J. Seaver.

(B-1-2) *Tympanis hypopodia* Nyl. Figs. 28–31

The ascospores, which may number fewer than eight in an ascus, are ellipsoid-fusoid, sometimes subclavate and curved, narrow or wide, and bud off ovoid cells from each tip during germination. The first cells formed are often slightly larger. The ultimate cells are allantoid, apparently slightly longer than those of *T. laricina*, and the epithecium is greenish black. The ascospores vary considerably in size and, to some extent, in shape, not only in different collections but in different apothecia of the same specimen or even different asci of the same apothecium. However, cultures obtained from numerous specimens collected from diverse conifers and showing the full range of variation were identical with and similar to dried cultures of *T. hypopodia* in DAOM. The specimens and cultures of *T. piceina* Groves are

not specifically distinct. The following synonymy is therefore proposed.

Tympanis hypopodia Nyl. Obs. Pez. Pg. Fenn. p. 72. 1868.

= *Tympanis piceina* Groves, Can. J. Bot. 30: 601. 1952.

Specimens Examined

SPECIMENS LISTED BY GROVES: DAOM 12054 (JWG 763), 56143 (JWG 780, also in NYBG), 139446 (JWG 300), 4866 (in part, JWG 564), 56156 (in part, JWG 879), 56160 (JWG 334), 56157 (JWG 346, but on DAOM label listed as from Wolfboro, N.H., not East Granby, Conn.; the latter collection bears No. 56161), and 56163 (JWG 375), as *T. hypopodia*; 56079 (JWG 400), as *T. confusa*; 26991, 56358 (JWG 387), 56357 (JWG 352), 26989, and 41349 (JWG 838), as *T. piceina*; DAOM 56010 (JWG 758), as *T. abietina*; DAOM 56430 (JWG 164), 56408 (JWG 755), and 56448 (JWG 526), as *T. truncatula*; DAOM 56366 (JWG 781, also NY), 56383 (JWG 142), 56361 (JWG 365), 56338 (JWG 833, W. Bridge Cooke 18043, also in CUP), 84262 (Coll. Rostrup), as *T. pithya*, and the following.

On *Pinus* spp. Nova Scotia: FFB 2467, Eden Lake, 5 VII 1955, Lister and Deichmann. New Brunswick: FFB 4132, Acadia Forest Exp. Sta., 2 VII 1965, L. P. Magasi; QFB 19470, Saint-Hilaire, 12 X 1970; FFB 3980 (also DAOM 107192 and QFB 19473), Bathurst, 28 VIII 1964, G. F. Estabrooks; DAOM 41402 (as *T. pithya*), Univ. N.B. Woodlot 17 VI 1949. Quebec: QFB 999, Petit Saguenay, Roberval Co., 1 VIII 1962; QFB 18957, Parke Reserve, Kamouraska Co., 23 VIII 1961; QFB 18873 and 19467, Valcartier, 6 VII 1961 and 28 X 1970; QFB 19559, 19560, 19561, and 19562, and 19570 (as *T. pithya*), Valcartier, VIII and X 1968, E. Smerlis; QFB 19563, Lac à la Tortue, 28 IV 1968, E. Smerlis; QFB 19469, Berthierville, 5 XI 1970; QFB 19471, Chibougamau Park, 25 VIII 1970; QFB 19476, L'Ascension, Chicoutimi Co., 20 IX 1972; QFB 18908, Vallée-Jonction, Beauce Co., 21 IX 1961; QFB 19465 and 19587, Sainte-Marguerite, Dorchester Co., 5 X 1972; QFB 19590, Lac du Chevalier, St. Maurice Co., 27 IX 1968; QFB 19588, Pont-Rouge, Portneuf Co., 28 X 1972. Saskatchewan: DAOM 124510, Express Hills, 13 IX 1966, B. C. Sutton. Idaho: DAOM 58023, Shoshone Natl. For., 2 VII 1955, R. F. Cain. Massachusetts: CUP 25086 (as *T. pinastri*), Milton, 30 XI 1935, D. H. Linder *et al.*; DAOM 24927, Canton, II 1922, Linder. Connecticut: JRH 1124 (DAOM 56155), Windsor, 7 III 1934; DAOM 82942 (C. T. Rogerson 3947), Big Creek, Horse Cove, Macon Co., 21 X 1960. AUSTRIA: Herb. Barbey-Boissier 1103 (CUP and DAOM 126338), Nassau. SWITZERLAND: ZT (as *T. pithya*) Davos, 17 IX 1963, E. Müller; ZT Landquartaü, 5 IV 1903, H. Volkart; ZT (as *T. pinastri*) Bern, 31 VIII 1893, V. Tavel; QFB 19468 and 19472, Swiss Natl. For., Tanter Mozza, 28 and 29 VIII 1968. GERMANY: ZT (ex F. Petrak herb.) Westfalen, XI 1926, A. Ludwig; ZT (as *T. pinastri*) Munster, Tavel. SWEDEN: ZT (as *T. pinastri*) Bjurfors, Kronepark, 1 VIII 1936, C. Terrier. FINLAND: DAOM 105382 (JWG 863), Nylandia, Helsinki, 10 XI 1946. JAPAN: DAOM 116814, Hokkaido, 21 VI 1967, H. Saho and T. Takahashi.

On *Picea* spp. New Brunswick: QFB 19474, 19475, and 19589 (in mixture with *T. laricina*), Verret and Saint-Hilaire, X 1970 and 1971. Quebec: QFB 19565 and 19557, Laurentide Park, 7 VI 1965, and 24 V 1968; QFB 19566, Lac à la Tortue, 14 IV 1968; QFB 19567 and 19544 Saint-Cyprien, 6 V and 16 VIII 1965 (collections by Smerlis but identified as other species of *Tympanis*). SWITZERLAND: ZT (determined as *T. pinastri* by Rehm) Arosa, VIII 1890, Wegelin.

On *Abies* spp. (those in DAOM, as *T. abietina*). New Brunswick: QFB 19479, 19481, and 19480 and 19435 (in mixture with *T. laricina*), Saint-Hilaire and Verret, X 1971. Quebec: QFB 19477, Ile aux Coudres, 28 VII 1970; QFB 19478, Valcartier, 28 X 1970; QFB 19545 (as *T. abietina*), Saint-Cyprien, 1 XII 1964, E. Smerlis. Ontario: DAOM 35816 (as *T.* sp.), Stittsville, 14 IV 1953, S. J. Hughes. Alberta: DAOM 71924, Jasper Natl. Park, 29 VII 1960, S. J. Hughes. PAKISTAN: DAOM 56018 (E. K. Cash 4367), Shorgan, Kagan Valley, 18 VII 1941.

On *Tsuga canadensis* (as *T. tsugae*). Quebec: QFB 19575, Saint-Louis de Blandford, 2 XI 1967, E. Smerlis. Connecticut: DAOM 56467 (JRH 1523), N. Bloomfield.

A culture made from the specimen QFB 19575 was used by Smerlis (11) for inoculation tests on various conifers. Although this specimen and culture are clearly identical with those of *T. hypopodia* obtained from other conifers, the results of his inoculations indicated possible existence of physiological specialization.

(B-1-3) *Tympanis spermatiospora* (Nyl.) Nyl., *T. malicola* Groves, *T. mutata* (Fckl.) Rehm, and *T. salicina* Groves Figs. 32–37

These four species appear to be closely related if characters of apothecia and ascospores are taken as an indicator of relationship. The apothecia were adequately described by Groves (4), but the ascospores were said to be "one-celled" and "ellipsoid to subglobose" and "ellipsoid to fusiform" in *T. mutata* and *T. salicina*, respectively, and "one- or two-celled, ellipsoid to subglobose" in *T. spermatiospora* and *T. malicola*. We have examined his preparations made from type or authenticated material of the four species and found in all, broadly ellipsoid-fusoid to subglobose ascospores, becoming one-septate during germination and producing at each end a group of pyriform to subglobose cells (Figs. 32–37) similar to those of *T. hypopodia*. However, as indicated by recent collections from *Salix* (QFB 19538 and 19539), in *T. salicina* the first primary cell is sometimes longer and more cylindrical than the peripheral cells as in members of group B-2 below.

Several cultures from the more recent collections of *T. spermatiospora* from *Populus* were established, but only one of *T. malicola* from *Malus* and one of what appears to be *T. salicina* from *Salix*. A culture of *T. mutata* from DAOM 35348 was also examined and found to be similar to *T. spermatiospora*. The culture of *T. malicola* is also quite similar to the latter, whereas that of *T. salicina* is different. Additional studies on *T. malicola* and *T. mutata*, particularly in culture, are therefore needed before their relationship to *T. spermatiospora* is established.

Specimens Examined, Tympanis spermatiospora

EXSICCATI: Rehm, Ascom. 357 (CUP-D 7479) and Herb. E. Haglund (CUP-D 2553) Suecia; DAOM specimens listed by Groves: 56429 (JWG 34), 25818 (Waugh), 126741 (Wakefield), 2536, 19882, 126742 (also CUP-D 7469), 4723, 7989, 3315 (also CUP 24269 and QFB 19489), 56456 (TRT 7397), 48672 (JRH 2224), 56462 (JWG 336), and 12058 (JWG 750); slide from Type ex H and the following.

On *Populus* spp. Newfoundland: DAOM 39910 (FFB 385) North Pond, 23 VI 1953, A. G. Davidson. Nova Scotia: DAOM 45351, Casey's Corner, 27 VII 1937, K. A. Harrison; DAOM 11966, Kentville, 27 II 1953, K. A. Harrison. New Brunswick: FFB 5748, Stewarton, Kings Co., 31 V 1968, C. D. MacCall; QFB 19483 and 19484, Saint-Hilaire, X and XI 1970. Quebec: QFB 19485, Chibougamau Park, 25 VIII 1970; QFB 19482 and 19486, Valcartier, 28 X 1970; QFB 19487, Canton Quesnel, Roberval Co., 21 VII 1950; QFB 18241, Saint-Narcisse, Champlain Co., 5 X 1960; QFB 1015, Lachute, Argenteuil Co., 23 V 1964. Ontario: DAOM 38840 (d), Merwall, I X 1953, S. J. Hughes; DAOM 29605 and 85096, Kleinburg, York Co., 24 X 1950, R. F. Cain (2335); DAOM 87490, 25848, and 85095, Timagami For. Reserve, 16 VIII 1931 and 20 VIII 1946; DAOM 87488, Agincourt, 9 X 1934, H. S. Jackson; DAOM 114769, Kingston, 11 IX 1966, J. W. Groves. Connecticut: CUP-D 6445, Central Village, 24 VIII 1908, J. Sheldon. Maine: CUP-D 13884 (as *T. conspersa*), Westbrook, XII 1892, P. L. Ricker 373. SWEDEN: DAOM 67510, Uppland, 5 IX 1948, A. Melderis; DAOM 67509 (also QFB 19488), Bergsbrunna, 29 IX 1950, A. Melderis; DAOM 36536, Sodermanland, 1 V 1937, S. Lundell & K. G. Ridelius.

Specimens Examined, Tympanis salicina

Quebec: DAOM 5341 (Type); JWG 590; DAOM 56550 (JWG 588); QFB 19539 and 19538 Saint-Isidore, Dorchester Co., 5 X 1972; and QFB 19540, Saint-Féréol, Montmorency Co., 2 X 1972. New York: West Albany, Peck (as *T. saligna*), CUP-D 6195.

Specimens Examined, Tympanis mutata

Ontario: DAOM 35348, Algonquin Park, 23 IX 1952, Ruth Horner. SWEDEN: S, Ostrogothia.

Specimens Examined, Tympanis malicola

DAOM 39529 and 116824 (Type) and 56359 (JWG 363); QFB 19490, Holliday, Kamouraska Co., 18 XI 1970. PAKISTAN: E. K. Cash 4352 (JWG 974 and 1017) Shogran Valley, 19 VII 1951, on *Prunus cornuta*.

Group B-2. *Tympanis truncatula* and *T. pseudoalnea*
Figs. 38–41

In this group of species the ascospores are typically globose or subglobose, sometimes ellipsoid and curved, one- (rarely two-) septate during budding stage, germinating from each end to produce a fascicle of ellipsoid to pyriform cells, of which the first-formed, central cell is cylindrical and markedly longer.

The two species also differ from those listed

in the preceding category in morphology of the apothecia.

(B-2-1) *Tympanis truncatula* (Pers. ex Fr.) Rehm. Figs. 38–40

The apothecia are erumpent, usually stalked, and typically convex, light brown and translucent when sectioned. Groves (4) described them as usually greyish pruinose, obviously to account for the few collections from *Abies* which are *T. alnea* and are listed under that name (p. 1891).

As already mentioned, the respective type specimens of *T. pithya* (p. 1896) and *T. hansbroughiana* are conspecific with *T. truncatula*. Furthermore, we are of the opinion that *T. acericola* Groves in Wehmeyer and *T. sorbi* Groves are also this species. The cultures obtained from fresh collections of *T. acericola* match those of *T. truncatula*.

Consequently the following synonymy is proposed.

Tympanis truncatula (Pers. ex Fr.) Rehm, Rabenh. Kr.-Fl. 1.3: [Lief. 32] 277. 1890. Figs. 38–40

= *Tympanis pithya* (Karst.) Karst. Hedwigia, 10: 58. 1871.

= *Tympanis acericola* Groves in Wehm. Can. J. Res. C, 18: 544. 1940.

= *Tympanis hansbroughiana* Groves, Can. J. Bot. 30: 602. 1952. (pro parte typica).

= *Tympanis sorbi* Groves, Can. J. Bot. 30: 636. 1952.

Specimens Examined

Pers. Herb. 910.261.592 (Type, also DAOM 35244) and 910.261.382 (both in NBV); specimens listed by Groves: DAOM 56407 (JWG 766), 56460 (JRH 885), 56428 (JRH 1508), 56468 (JWG 342), 56411 (JWG 364), 12052 (JWG 756, as *T. confusa*), 89160 (ex Lundell & Nannf. Fung. Exs. Suec. 1395, as *T. pithya*), Rel. Farl. 156b (in CUP, as *T. pinastri*); and the following.

On *Abies* spp. Newfoundland: CUP-D 7455 and 10092 (as *T. laricina*), Bay of Islands, 19 IX 1894. Quebec: QFB 19494, Saint-Joachim, 23 IX 1971; QFB 19495, Rivière Sainte-Anne, Montmorency Co., 16 VIII 1972; QFB 19496, Valcartier, 28 X 1970; QFB 19502, Saint-Augustin, Portneuf Co., 16 X 1969; QFB 19573 and 19574, Laurentide Park, VIII and X 1963, E. Smerlis; QFB 19505, Sainte-Foy, 4 X 1970. Ontario: DAOM 41348, Algonquin Park, 18 IX 1938, H. S. Jackson; DAOM 2548, 7 VIII 1935, J. W. Groves; 25846, 11 IX 1930, H. S. Jackson; 116832 (as *T. abietina*), Timagami For. Res., 9 VIII 1967, J. W. Groves. New York: CUP-D 6193, Elba, 16 VIII 1898, Peck; CUP-A 9022 (as *T. laricina*), Lake Placid, 30 VIII 1894.

On *Pinus* spp. Quebec: QFB 19466, La Tuque, Laviolette Co., 3 X 1972; QFB 19501, Berthierville, 19 IX 1969, G. B. Ouellette & E. Müller; QFB 19503, Pont Rouge, 30 IX 1972. FINLAND: DAOM 39758 and 39721 (as *T. pithya*), Ruotsinkyla, Prov. N. Par. Tunsula, 17 X 1947, V. Kujala (177 and 180).

On *Picea* sp. FRANCE: QFB 19498, Haguenau, 8 XI 1968.

On *Larix* spp. Quebec: QFB 19497, Harrington Farm, Argenteuil Co., 5 IX 1969, G. B. Ouellette & E. Müller. Ontario: DAOM 15943 (as *T. laricina*), Algonquin Park, 6 IX 1939, R. F. Cain (14856).

On *Acer* spp. DAOM 56021 (Type, JWG 516), 13615, and 56020 (JHR 3222 as *T. acericola*) and Groves slides in DAOM. Quebec: QFB 19499 and 19500, Duchesnay 18 X 1971, and 24 IX 1969.

On *Sorbus* sp., as *T. sorbi*. DAOM 26157 (Type), and Groves slides in DAOM.

On *Pseudotsuga*, as *T. hansbroughiana*. DAOM 23430 (Type).

On *Alnus* sp. New Brunswick: QFB 19493, Verret, 1 X 1971.

(B-2-2) *Tympanis pseudoalnea* sp. nov.

This fungus was briefly discussed under *T. alnea* (p. 1891). It has black, glabrous, caespitose apothecia, usually 10–40 crowded on a stroma, and globose, one-septate ascospores which germinate first into a cylindrical, often somewhat truncate cell, followed by smaller, ovoid or cylindrical cells usually arising from the base of the first-formed cell. These in turn bud off subglobose secondary cells which yield the ultimate cells. These, usually less than 1 μ in diameter, are the smallest encountered during this study. The culture of this species is also quite distinctive.

Tympanis pseudoalnea Ouellette & Pirozynski, sp. nov. Fig. 41

Apotheciis erumpentibus, caespitosis, glabris, atris, 0.3–0.8 mm latis, 0.7–0.8 mm altis cum stroma, orbicularibus vel tenuiter hysteriiformibus, confertis; ascis cylindratis, breviter stipitatis, octoascosporis dein multisporis, (90–)110–125

(–140) × (8–)10–13(–16); ascosporis subglobosis vel tenuiter ellipsoideis, uniseptatis, (5.6–)7.0 × 8.4–10.5 μ; prioribus cellulis cylindratis, longis, aliquando truncatis, et secutariis, ovoideo-cylindratis, saepe curvatis, multum brevioribus; cellulis secundariis subglobulosis, et ultimis bacilliformibus, curvatis; paraphysibus filiformibus, septatis, ramulosis, ad apicem leviter incrassatis agglutinatisque, epithecium nigrescens formantibus.

HOLOTYPUS: QFB 19506, in ramulis *Alni rugosae*, Lac Normand, Laviolette Co., Que., Canada, 19 IX 1969, G. B. Ouellette & E. Müller, leg.

Other Specimens Examined

On *Alnus* sp. Quebec: QFB 19507 (Type locality, 24 VII 1971); QFB 19508 and 19509, Holliday, Kamouraska Co., 31 X 1972, and DAOM 41366 (JWG 842, as *T. alnea*). New York: CUP-D 1797 (in part), McLean, 25 X 1902; CUP-D 6181, Berlin, Peck.

Group B-3. *Tympanis tsugae*
Figs. 42–45

In *T. tsugae*, the sole representative of this group, the ascospores are globose to broadly ellipsoid and germinate from each end to produce a system of narrow, cylindrical, curved cells arising laterally from each other in an antler-like configuration. These bud off ellipsoid, pyriform or broadly allantoid secondary cells and, in turn, ovoid ultimate cells. The apothecia are small, mostly gregarious, and pale brown in color. Groves (4) remarked that the apothecia are sometimes greyish pruinose. This, no doubt, was to account for the larger, pruinose apothecia which are also present on parts of the type material. These are considered to be of *T. prunicola* described below (p. 1905). This fungus differs from *T. tsugae* in the type of ascospore germination and in cultural characters. The cultures derived from grey, pruinose apothecia on *Tsuga* were quite different from a fresh culture of *T. tsugae*. On the other hand, the latter matches the dried culture from the type of *T. tsugae* (DAOM 23808) as well as that from the type of *T. piceae* Groves (DAOM 23805) and DAOM 56341 (sub *T. pithya*). All three were derived from apothecia matching the description of *T. tsugae* and considered to represent the same species.

(B-3-1) *Tympanis tsugae* Groves, Can. J. Bot. 30: 595, 1952. Figs. 42–45
= *Tympanis piceae* Groves, Can. J. Bot. 30: 590.

We have chosen the name *T. tsugae* because it is typified by better and more abundant material. *T. piceae* is represented only by its type specimen, the other collection listed by Groves (DAOM 26990 from Sweden) being overmature and possibly belonging in *T. truncatula*.

Specimens Examined

On *Tsuga canadensis*. Ontario: DAOM 23808 (Type); DAOM 50228, Algonquin Park, 7 X 1954, M. K. Nobles. Quebec: DAOM 56427 (JWG 114), 56410 (JWG 823), and 56464 (JWG 510).

On *Abies* spp. DAOM 56019 (JWG 191) and 56015 (in part), as *T. abietina*. Quebec: QFB 19511, Lac Normand, 17 IX 1969, G. B. Ouellette & E. Müller; QFB 19417 (in mixture with *T. laricina*), Lac Piché, Montmorency Co., 22 IX 1969, G. B. Ouellette and E. Müller. New Brunswick: QFB 19513, Saint-Hilaire, 4 X 1971. New Hampshire: DAOM 56463 (JWG 386, as *T. truncatula*). North Carolina: CUP-D 9489, Grandfather Mt., 11 IX 1901, E. J. Durand.

On *Pinus* spp. Quebec: QFB 19512, Godbout, Saguenay Co., 24 X 1970. California: DAOM 56341 (JWG 867, as *T. pithya*).

On *Picea* spp. DAOM 23805 (Type of *T. piceae*, Timagami For., 11 IX 1935 (JWG 424).

Group B-4. *Tympanis hysterioides*, *T. conspersa*, *T. prunicola*, *T. amelanchieris*, *T. oxydendri*, *T. fasciculata*, *T. hydrangeae*, and *T. alpina*
Figs. 46–55, 58–61

The ascospores of the species classified in this category are subglobose to ellipsoid, one-septate, and germinate from each end into simple or branched chains of cylindrical or clavate cells. The secondary cells budding from these are ovoid or ellipsoid.

While some of the species included here are well defined, the limits of others are obscure. Consequently, the group may be heterogeneous and requires further study when additional material is obtained and cultures are established.

(B-4-1) *Tympanis hysterioides* Rehm, Rabenh. Kr.-Fl. 1,3:[Lief. 31] 268. 1889. Figs. 46–48
= *Tympanis alnea* var. *hysterioides* (Rehm)Rehm, Ber. Bay. Bot. Ges. 13: 203. 1912.

Apart from occurring on the same host, this fungus and *T. alnea* have little in common and we prefer to treat *T. hysterioides* as a separate species rather than a variety of *T. alnea*. It differs from *T. alnea* in having one-septate ascospores and ultimate cells which are intermediate in size between those of *T. alnea* and *T. pseudoalnea*. The apothecia are pale brown when sectioned and hysteriform in outline; this, however, is mainly due to their gregarious habit; the few solitary apothecia remain orbicular. Also, a culture of *T. hysterioides* was obtained and is different from cultures of *T. alnea*.

Specimens Examined

On *Alnus* spp. Newfoundland: CUP-D 10068, Saint John's, 12 VIII 1894, Robinson and Schrenk. Nova Scotia: DAOM 55993 (LEW 326). Quebec: DAOM 14854 (in part) and 5299 (in part), as *T. alnea*, and 5320; DAOM 113858, La Vérendrye Park, 16 IX 1965; QFB 19514, Valcartier, 28 X 1970; and J. Macoun 285 (CUP-D 7436), Hull, 9 X 1896. Ontario: DAOM 56001 (JWG 413), 55984 (in part, as *T. alnea*); J. Macoun 545 (in part, DAOM), Coves Swamp, 21 IX 1897; J. Macoun 116 (DAOM), Ottawa, 16 X 1887. British Columbia: DAOM 56726, Saxon Lake, 27 VI 1957, Woods and Taylor. New York: CUP-D 1797 (in part), McLean, 25 X 1902. EUROPE: Rehm Ascom. 957b (CUP-D 11806); CUP-D 3341 (Uppsala ex Fr.). FINLAND: DAOM 84609 (as *T. alnea*), Mustiala, Karsten. GERMANY: ZT Brandenburg, H. Volkart. DENMARK: DAOM 90291, Aesevang, 20 V 1891, O. Rostrup, as *T. conspersa*.

(B-4-2) *Tympanis conspersa* Fr. Syst. Myc. 2: 175. 1822. Figs. 49–50

As already mentioned under *T. alnea* (p. 1891) the ascospores of *T. conspersa* are also one-septate, a point which was previously overlooked. The apothecia are gregarious and always pruinose and the ultimate cells are usually ovoid rather than allantoid, which is the usual shape encountered in the genus. Cultures of three recently collected specimens were found to be similar to but distinctive from *T. alnea* cultures.

Specimens Examined

On *Sorbus* spp. EXSICCATI: Fries Sclerom. Suec. 12 (Type, CUP-D 3340); type of *T. aucupariae* Fr. (as *T. conspersa*, CUP-D 6373); Lind, Fl. Suecia, Stockholm, 19 V 1905, (CUP-D 6908); Fries, Swäland, as *Cenangium aucupariae* (CUP-D 3337), as *T. aucupariae*); Moug. & Nestl. Stirp. Crypt. Vog. 789 (CUP-D 6290, as *Peziza aucupariae*); Roum. Fung. Sel. Gall. Exs. 445 (CUP-D 11256, also DAOM 58822 imperfect state only); ex Herb. L. Romell, Stockholm, 21 V 1896 (CUP-D 133); Fckl. Fung. Rhen. 769 (also as Herb. Barbey-Boissier 1108 in CUP).

AUSTRIA: ZT Sonntagsberg, P. Fraser. GERMANY: ZT Munster, Westfalen, V. Tavel. SWITZERLAND: ZT Davos, 27 V 1969, E. Müller. SWEDEN: DAOM 56081 (JWG 574), 56082 (JWG 575), and 25835 (JWG 960). GREAT BRITAIN: CUP 47220 and DAOM 48366, Yorks, 10 IV 1948, S. J. Hughes. New Brunswick: QFB 19515, St-Hilaire, 12 V 1971. Manitoba: DAOM 124509, Wasagaming, 4 VII 1967, D. Shepherd (1178). Quebec: QFB 19516, Rivière Sainte-Anne, Montmorency Co., 20 VII 1972; QFB 19517, Ile aux Coudres, Charlevoix Co., 24 VII 1970. Maine: CUP-D 309 (ex Herb. J. L. Bennett), 1904. New York: CUP-D 6199, Landlay, Peck.

(B-4-3) *Tympanis prunicola* Groves, Can. J. Bot. 30: 614. 1952. Figs. 51–52

The apothecia are usually glabrous, separate or grouped on a stroma. Cultures obtained from fresh collections were different from those of *T. conspersa*, to which it seems to be related. The ultimate cells are cylindrical to allantoid and smaller than in *T. conspersa*. *T. prunicola* occurs also on *Tsuga* but, as in the case with *T. alnea* (p. 1891), its occurrence on conifers appears to be only occasional.

A few atypical specimens of *T. prunicola* were collected on *Prunus pensylvanica* L. in New Brunswick. In these, the apothecia are very small and superficial in lenticels or cracks in the bark, and the ascospores, though one-septate, are small, fusiform, and give rise to cylindrical cells and very few ultimate cells. Cultures derived from these specimens are brilliant red but lose pigment and become more typical of *T. prunicola* after several transfers. Similar cultures were often obtained in previous isolations from twigs of *Prunus* damaged by hail (Ouellette, unpublished information). A similar reddish pigment was also found in the subhymenial hyphae of the apothecia. Its presence, location, and instability

suggest a physiologic disorder of the material possibly due to a disease.

Judging from Dr. Groves's microscope preparation from the type specimen of *T. rhoina* Groves (in DAOM), this species appears to be *T. prunicola*. However, the type or authenticated material has not been located and additional material is needed before the relationship can be firmly established.

Specimens Examined

On *Prunus* spp. EUROPE: Suecia, VII 1884, Slottet & S. Stärback (UPS in DAOM, as *T. conspersa*). Ontario: DAOM 23806 (Type, JWG 405); 87491 and 56347 (TRT 5947), 56348 (TRT 6982), 56343 (TRT 6984), 5738 (JWG 651); DAOM 116833 (JWG 1088), Timagami For. Reserve, 9 VIII 1967. Quebec: DAOM 7706 (JWG 731), 41345 (JWG 839); QFB 19518 and 19519, Duchesnay, 21 X 1971. New Brunswick: QFB 19521–19524, Bakerbrook, III and X 1971. New Hampshire: DAOM 54755, Camp Sargent, 24 VIII 1956, R. Horner. Connecticut: (JRH 3034, JWG 937), E. Granby. New York: CUP-D 2429 & CUP 1844 & 15441 (as *T. conspersa*), Ithaca, VI 1903, H. Whetzel. New Jersey: Ellis, N. Amer. Fung. 66 (CUP-D 9218 & CUP, as *T. conspersa*, on *Malus*, but probably *Prunus*). Michigan: DAOM 120313 (LEW 3801, JWG 103), Ann Arbor, 2 I 1972.

On *Tsuga canadensis*. Ontario: DAOM 23808 (JWG 140, in part, as *T. tsugae*), Toronto. New York: QFB 19525, North Syracuse, 11 XI 1970.

(B-4-4) *Tympanis amelanchieris* Groves, Can. J. Bot. 30: 617. 1952.

In apothecium and ascospore morphology and in the type of germination, this fungus closely resembles *T. conspersa* and *T. prunicola* but differs in having smaller ultimate cells. However, fresh material and cultures of *T. amelanchieris* are needed before the taxonomic significance of these minor differences can be properly assessed.

Specimens Examined

Those listed by Groves (4).

(B-4-5) *Tympanis oxydendri* Ell. & Ev. Proc. Acad. Phila. 46: 352. 1894. Figs. 53–54

The ascospores and germination pattern are of the type characteristic of the group, but as in the case of *T. amelanchieris*, additional data is required before the status of this fungus can be more definitely established.

Specimens Examined

West Virginia: CUP-D 7463, Fayette Co. (Type, L. W. Nuttall); Nuttallberg, Ell. & Ev. Fung. Columb. 247 (CUP-D 7462 and DAOM), and Ell. & Ev. N. Amer. Fung. 3043 (CUP-D 9219).

(B-4-6) *Tympanis fasciculata* Schw. Trans. Am. Phil. Soc. 2,4: 237. 1832. Figs. 60–61

As already pointed out (p. 1898), Groves (4) considered all members of *Tympanis* occurring on *Viburnum* to represent a single species and reduced *T. rhabdospora* Berk. & Curt. and *T. micheneri* Berk. & Curt. nom. herb. to synonymy with *T. fasciculata*. He described the ascospores as ellipsoid to ovoid or subglobose and "one- or two-celled." *T. fasciculata*, as exemplified by a microscope preparation (now in DAOM) made by Dr. Groves from the type, has one-septate, globose to broadly ellipsoid ascospores, which germinate into branched chains of clavate or wide-cylindrical primary cells budding smaller secondary cells of similar shape and, in turn, allantoid, almost cylindrical ultimate cells. The specimen referred to as *T. micheneri* is the same species. The fungus with one-celled ascospores which Groves (4) incorporated into *T. fasciculata* is different and was described earlier (p. 1898) as *T. grovesii* sp. nov. We also consider *T. rhabdospora* (p. 1908) to be distinct. Both this and *T. grovesii* appear to be pathogenic and are commonly associated with cankers. *T. fasciculata* is saprophytic, and although it may occur together with one of the other two species, their apothecia are usually at different stages of development. Furthermore, the hymenium of *T. grovesii* and *T. rhabdospora* appears yellowish green when sectioned, whereas that of *T. fasciculata* is pale brown. Cultures derived from fresh material of *T. grovesii* and *T. fasciculata* provide further points of difference.

Specimens Examined

On *Viburnum* spp. Ontario: DAOM-56153 (JWG 147), 15511, 19656 (in part, JWG 865), 56100 (JWG 269), 56197 and 87497 (in part, JWG 277), 56198 (JWG 572), and TRT 15754 (ZT). Quebec: QFB 19526, 19527, 19528, and 19464*b*, Holliday, Kamouraska Co., X and XI 1972; 19463 (in part), Saint-Romuald, Levis Co., 28 IX 1972; 19529, Duchesnay, 18 X 1970; 19530 and 19531, Saint-Isidore, Dorchester Co., 5 X 1972. New Hampshire: Rel. Farl. 154b (in CUP,

apothecia overmature and parasitized), Chocorua. Massachusetts: DAOM 56099, Petersham, 19 VIII 1949, I. L. Conners. New York: CUP-D 10474, Long Island. New Jersey: CUP-D 7448 (Rehm Ascom. 423). Pennsylvania: CUP-D 6434 (Michener), CUP-D 3613 (Michener 4344), CUP-D 3615 (Michener 3975) and CUP-D 6439 (Michener).

On *Cornus circinata*. Ontario: CUP-D 7447 and 1058 (over-wintered apothecia), Muskoka, J. Dearness.

(B-4-7) *Tympanis hydrangeae* Groves, Can. J. Bot. 30: 627, 1952. Fig. 55

This species is known only from the type specimen cited by Groves (4), which we have examined. The apothecia are erumpent but often appear superficial, non-stromatic, with rugulose hymenium and somewhat fimbriate margin. The ascospore morphology and pattern of germination is as described above under *T. fasciculata*, which *T. hydrangeae* closely resembles and with which it may prove to be conspecific when additional material and cultures become available for further studies.

Tympanis montanensis (Seaver) Groves (5), as exemplified by a portion of the type material in DAOM, appears to be the same fungus.

(B-4-8) *Tympanis alpina* sp. nov. Figs. 58–59

This fungus occurs on *Salix* and *Populus* at high altitudes in Switzerland and Colorado. It has stromatic, single or gregarious, thick-rimmed apothecia and broadly ellipsoid, one-septate ascospores which germinate into branched chains of either ovoid to clavate or cylindrical and hypha-like cells.

This type of germination is similar to that in *T. hysterioides*. However, in apothecium morphology it resembles *T. prunicola*, *T. fasciculata*, *T. oxydendri*, and, particularly, *T. salicina*, but differs from all (except *T. oxydendri*, which remains to be grown) in culture. On the other hand, in culture it resembles *T. conspersa*, but the apothecia of the two fungi are quite different.

Because of these differences, we propose a new species to accommodate this entity. However, this decision is not taken without hesitation, as this group, as already mentioned, is still in need of much further study.

Tympanis alpina Ouellette & Pirozynski, sp. nov.

Apotheciis pluriter immersis, dispersis, solitariis vel raro caespitosis, sessilibus, glabris, atris, subhysteriiformibus vel orbicularibus, marginibus crassis, 0.4–0.9 mm latis, 0.2–0.5 mm altis; hypothecio plectenchymato; ascis cylindratis, breviter stipitatis, primo octoascosporis, dein multisporis, (95–)110–145 × 15–18 μ; ascosporis tenuiter ellipsoideis, hyalinis, uniseptatis, 5–6 × (2–)3–4 μ, in septatos filamentos vel cellulas ampulliformes germinantibus; secundariis cellulis ovoideo-cylindratis; ultimis cellulis allantoideis; paraphysibus filiformibus, septatis, ramulosis, ad apicem agglutinatis, epithecium nigrescens formantibus.

HOLOTYPUS: QFB 19534, in ramulis *Populi tremulae*, Aletschwald, Wallis Kt., Switzerland, 12 X 1968, G. B. Ouellette & E. Müller leg.

Specimens Examined

SWITZERLAND: ZT Aletschwald, 24 VII 1964, E. Müller (on *Populus*, as *T. spermatiospora*), and 21 IX 1965, E. Müller & L. Casagrande (on *Salix*, as *T. saligna*, also QFB 19535); and ZT (as *T. saligna*) Davos, 28 V 1964, E. Müller. Colorado: DAOM 107193, Fourth of July Camp Ground, 21 VIII 1964, J. W. Groves.

In identifying DAOM 107193 as *T. saligna*, Groves considered it different from *T. salicina*. However, that specimen cannot be placed in *T. saligna*, because this species has non-septate ascospores and pruinose apothecia. A number of exsiccati and other collections from Europe previously identified as *T. saligna* and placed by Groves in *T. spermatiospora* were not examined to determine which species they represent. However, Groves's preparations from Rehm 1888 and the Bloxam specimen listed under *T. salicina* were examined and found to be similar to the fungus under discussion.

Group B-5. *Tympanis ligustri* and *T. rhabdospora* Figs. 56–57, 62–64

The apothecia are erumpent, solitary or grouped on a stroma, black, typically with a markedly thickened margin. The ascospore germination is like that in members of the preceding group but with longer and more cylindrical primary and secondary cells and smaller ultimate cells.

The treatment of the two accepted species is somewhat tentative because of the lack of adequate material, particularly in culture.

(B-5-1) *Tympanis ligustri* Tul. Figs. 56–57

The ascospores are typically ellipsoid, one-septate, germinating from each end into hypha-like chains of cylindrical cells. Secondary cells are small and narrowly ovoid to cylindrical.

The type specimen of *T. syringae* Fuckel (Fung. Rhen. 2144 in G and FH) and collections of *T. columnaris* Höhn. in NY proved to be identical with the material of *T. ligustri* examined, constituting part of the type in DAOM (84611). The identification of type hosts of *T. syringae* and *T. columnaris* needs confirmation, particularly of the host of *T. columnaris* collected by Fautrey (in NY). This specimen is very similar to another collection made by Fautrey and identified as *T. ligustri* (Roum. Fung. Sel. Exsicc. 5016 and 7197 in CUP). A note on the label of 7197 "Numéro réédité pour faire l'expérience indiquée dans la Revue, 1897, p. 56, sur *Tympanis fraxini* [= *T. columnaris*] réussissant aussi bien sur *T. ligustri*" supports our belief that *T. columnaris* and *T. syringae* are synonymous with *T. ligustri*.

Tympanis ligustri Tul. Sel. Fung. Carp. 3: 154. 1865. Figs. 56–57

= *Tympanis syringae* Fckl., Fung. Rhen. 2144. 1867.

= *Tympanis columnaris* Höhnel, Hedwigia, 59: 283. 1918.

Other Specimens Examined

Phill. Elv. Brit. 93 (CUP-D 11095), Rehm Ascom. 864 (ZT and CUP-D 7481, as *T. syringae*). SWITZERLAND: ZT Bern. ITALY: ZT Roncoballo, 24 VI 1964, E. Müller; QFB 19532, Torre, V 1969, G. B. Ouellette and E. Müller.

A preparation of Rehm's specimen of *T. acerina* was also examined (Groves's slide in DAOM); it showed a type of ascospore germination similar to that of *T. ligustri*.

(B-5-2) *Tympanis rhabdospora* Berk. & Curt. Figs. 62–64

This is the third species of *Tympanis* occurring on *Viburnum* that is recognized in this paper. A comparison with the other two, viz. *T. grovesii* and *T. fasciculata*, is given on p. 1906.

Tympanis rhabdospora resembles *T. ligustri* also in the characters of apothecia, which are stromatic, at first widely marginate, later expanded to attain a relatively large size.

According to Dr. Groves's unpublished notes and our own observations on the type material (DAOM 23429), *T. diospyri* Groves is conspecific with *T. rhabdospora*. The type specimen of *T. diospyri* was collected in the same locality as DAOM 56354 on *Oxydendrum* which Groves placed in *T. oxydendri*, but which we consider to be *T. rhabdospora*.

Tympanis rhabdospora Berk. & Curt. Grevillea, 4: 3. 1875. Figs. 62–64

= *Tympanis diospyri* Groves, Can. J. Bot. 30: 620. 1952.

Specimens Examined

On *Viburnum* spp. New England: CUP-D 3626 (Type, Sprague 5831, reported on *Acer* but shown to be *Viburnum* (4)). New Jersey: Ellis N. Amer. Fung. 65 (CUP-D 9825 and 7446, CUP-A and Ell. & Ev. Fung. Columb. 814; all four as *T. fasciculata*), Newfield. Nova Scotia: QFB 19536, Marian Falls, Cape Breton, 7 VIII 1972 (left to mature outdoors in Quebec until Oct.). New Brunswick: DAOM 20730, Dawson, 27 VII 1948, J. T. B. Kingston. Quebec: DAOM 7648 (JWG 732) and 5303 (JWG 605) as *T. fasciculata*; QFB 19537, Sault au Mouton, Saguenay Co., 4 XI 1971. Ontario: DAOM 19838 (JWG 864) and JWG 924a, as *T. fasciculata*, and DAOM 7337B (JWG 723) as *T. alnea*, (mixed collections).

On *Azalea* sp. & *Rhus* sp. New Jersey: CUP-D 7450 (Ellis, IV 1879) and 7449 (Ellis, 8 VII 1875).

On *Diospyros* sp. and *Oxydendrum arboreum*. Georgia: DAOM 23429 (as *T. diospyri*) and 56354 (JWG 829 as *T. oxydendri*), Athens.

On *Larix* sp. Quebec: QFB 19564 (as *T. laricina*), Saint-Louis de Blandford, Arthabaska Co., 28 X 1965, E. Smerlis.

Group C. *Tympanis confusa*

This species resembles *T. laricina* in morphology of the apothecia and in characters of ascospores, which are clavate and become more than one-septate. However, whereas in *T. laricina* the ascospores are one- or occasionally two-septate, in *T. confusa* they are invariably more than two-septate, with each cell germinating into one or more ovoid or pyriform primary cells.

(C-1) *Tympanis confusa* Nyl. Obs. Pez. Fenn. p. 69. 1868. Figs. 65–66

Specimens Examined

All specimens in DAOM listed by Groves (4), except Karsten's Fung. Fenn. 753, and the collection of Rostrup. A few collections in DAOM as *T. confusa* seem to belong to other

species as stated in preceding parts. In addition to these, the following were examined. Michigan: DAOM 120318 (this collection also contains *T. laricina*), Ann Arbor, VI 1936, D. V. Baxter. CANADA: Quebec: QFB 19546 and 19549, Saint-Urbain, Charlevoix Co., 19 VII and 28 V 1966, E. Smerlis; QFB 19548, Lac à la Tortue, 10 XI 1967, E. Smerlis; QFB 19576, Ayer's Cliff, Stanstead Co., 28 VIII 1964, G. Bard; QFB 19577, Godbout, Saguenay Co., 10 X 1970, G. Bard. SWITZERLAND: ZT Graubunden, 16 XI 1955, H. Kern.

Excluded Species

Tympanis pseudotsugae

Groves (4) placed this distinctive fungus next to *T. confusa* because of its pluriseptate ascospores and similar pattern of germination. However, in *T. confusa* and all other species of *Tympanis* the ultimate cells are formed from intermediate structures and not directly from the ascospores as in *T. pseudotsugae*, on tiny phialide-like filaments (Fig. 67). Also, although the mode of conidium formation is probably phialidic in both the imperfect states of the recognized species of *Tympanis* and that of *T. pseudotsugae*, the conidia in the latter arise only terminally (Fig. 73) and not at the septa and alongside the conidiophores as in the former. Also, apothecia of *T. pseudotsugae* are ionomydotic as in some of the species of *Claussenomyces* Kirscht., a genus recently revised by Korf and Abawi (7) to include four fungi with multiseptate ascospores which also give rise directly to ultimate cells, phialidic in origin. The pigments of *T. pseudotsugae* were studied by Funk (3).

Consequently we do not consider *T. pseudotsugae* to be congeneric with other members of *Tympanis* and propose to transfer it to *Claussenomyces*.

Claussenomyces pseudotsugae (Groves) Ouellette & Pirozynski, comb. nov. Figs. 67, 73
= *Tympanis pseudotsugae* Groves, Can. J. Bot. 30: 585. 1962

Specimens Examined

DAOM 23807 (Type), 56351 (JWG 353), 56352 (JWG 637), and the following. British Columbia: DAVFP 15678, Caycuse, Vancouver Island, 21 IV 1964, R. B. Smith & H. M. Craig, and DAVFP 15693, Lake Cowichan, Vancouver Island, 27 V 1964, Craig & Smith.

A congeneric fungus labelled "*Tympanis* sp." was found in Herb. CUP-PR. It has yellowish-green, rugulose, short-stalked, solitary or grouped apothecia and pluriseptate ascospores resembling those of *C. pseudotsugae*. The allantoid ultimate cells arise from very inconspicuous phialides (Figs. 69–70). The associated pycnidia are globose, yellowish green, and the conidia are produced from branched phialides resembling those of *C. pseudotsugae*. However, unlike *C. pseudotsugae*, this fungus does not give ionomydotic reaction in KOH. Two other species of *Claussenomyces*, *C. atrovirens* and *C. prasinulus*, are also non-ionomydotic. The first has black apothecia and subglobose ultimate cells; in the second the ascospores are short and only three-septate, and its conidial state is a stilbaceous hyphomycete (2). In view of these differences the CUP specimen is described as follows.

Claussenomyces luteoviridis Ouellette & Korf, sp. nov. Figs. 69–72

Apotheciis superficialibus in putre ligno, luteoviridibus, rugulosis, singularis vel gregariis, breve stipitatis, concavis, marginibus fimbriatis, 0.2–1.0 mm latis, 0.2–0.4 mm altis; ascis cylindrico-clavatis, octoascosporis, dein multisporis, 85–110 × 9–14 μ; ascosporis, hyalinis, finaliter biseriatis, fusoideo-clavatis, pluriseptatis, medii cellulis muriformibus, 17.0–26.0 × 3.0–4.0 μ, ultimis cellulis directo, in occultis phialidis, formantibus; ultimis cellulis, hyalinis, tenuiibus, bacilliformibus, curvatis; paraphysibus, filiformibus, septatis, ramosis.

HOLOTYPUS: CUP-PR 3937, in putre ligno, El Yunque, Porto Rico, 9 VI 1970, R. P. Korf *et al.* leg., Isotypus NY, "sub" *Tympanis* sp.

Pycnidia on this specimen were not sufficiently abundant to permit accurate description of the imperfect state.

Doubtful Species

Tympanis cephalanthi Dearn. & House, Bull. N.Y. State Mus. 39–45. 1887.

Our reexamination of the type specimen (Herb. Dearness 4997 in DAOM and Rel. Farlow. 103 in NY) confirmed Groves's conclusion that the material is in too poor a condition to allow accurate determination of the species.

Tympanis forsythiae Groves, Can. J. Bot. 30: 628. 1952.

As indicated by Groves, the type material is

scant and lacks primary ascospores, which play a leading role in the classification proposed in this paper. It appears that no species of *Tympanis* have been reported from *Forsythia* since 1886 when Ellis collected the specimen of the fungus under discussion.

Tympanis magnoliae Groves, Can. J. Bot. 30: 618. 1952.

The two specimens referred by Groves to this species and said to be in FH could not be located.

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Explanation of Figures

Figs. 1–66. Types of ascospore germination in various species of *Tympanis*. Germinating ascospores within asci or forced out from asci and intermediate cells budded from these, with some giving rise to ultimate cells (arrows). From × 1000 to 1100, except where stated otherwise.

Figs. 1–6. *Tympanis alnea*. Fig. 1. From DAOM 55996 (left part) and CUP-D 6184 (right part). Fig. 2. CUP-D 6184. Fig. 3. From CUP-523 (on *Malus*); inset, a view of an ascospore and intermediate cell at lower magnification, from DAOM 5299. Figs. 4–5. From CUP 25867 and CUP-D 523. Fig. 6. Tertiary cells (right) apparently formed freely in an ascus. Figs. 7 and 8. *T. neopithya*. Germinating ascospores and secondary cells, one giving rise to an ultimate cell, from ZT, Lötschental. Figs. 9 and 10. *T. saligna*. From Type. Figs. 11–15. *T. pulchella*. From Rehm Ascomyceten 957.

Figs. 16–22. *T. grovesii*. From QFB 19457 (16) and DAOM 19656. Figs. 17–21. About × 375. Fig. 17. Free-hand section from a stromatic apothecium. Figs. 23–26. *T. heteromorpha*. Figs. 23–25. On *Salix* from DAOM 26179. Fig. 26. *Populus*, from QFB 19449. Fig. 27. *T. laricina*. On *Abies* from DAOM 58025.

Figs. 28–31. *T. hypopodia*. On *Abies* (28 (except ascus at right), 29, and 31 from QFB 19478), *Pinus* (ascus at right in 28, from DAOM 56079), and *Picea* (30 from ZT, Arosa). Figs. 32 and 33. *T. spermatiospora*. From DAOM 25818 and 3315. Inset in 32, about × 275. Fig. 34. *T. mutata*. From DAOM 35348. Germinating ascospores (ascus on the left), intermediate cells and ultimate cells within asci. Figs. 35–37. *T. salicina*. From DAOM 56550, except 36, from CUP-D 6195. Figs. 38–40. *T. truncatula*. On *Abies*, from DAOM 2548, 56411, and 56428 (38 and 39); *Alnus* (39, lower inset from QFB 19493); and *Sorbus* (40, from DAOM 26157).

Fig. 41. *T. pseudoalnea*. From QFB 19506. Insets, about × 1300. Figs. 42–45. *T. tsugae*. From DAOM 23808 (42 and 45), *Pinus* (43, from DAOM 56341), and *Abies* (44, from DAOM 56463). Figs. 46–48A. *T. hysterioides*. From CUP-D 1797 (46), DAOM 5299, (47, about × 400), DAOM 5320 (48), and CUP-D 3341 (48A).

Figs. 49 and 50. *T. conspersa*. From ZT Davos, and CUP-D 133. Note: ultimate cells (arrows) are mostly oval. Figs. 51 and 52. *T. prunicola*. From DAOM 23806 (51), CUP-D 2429 and CUP 1844 (52, bottom part). Figs. 53 and 54. *T. oxydendri*. From CUP-D 9219 and Ell. & Ev. Fung. Columb. 247. Fig. 55. *T. hydrangeae*. From Type. Figs. 56 and 57. *T. ligustri*. On *Syringa* from Rehm Ascom. 864; and CUP-D 11593. Figs. 58 and 59. *T. alpina*. On *Populus*, from QFB 19534, and on *Salix*, from DAOM 107193. Note different stages in ascospore germination in insets of 59.

Figs. 60 and 61. *T. fasciculata*. From QFB 19526 and DAOM 56197; in 61, from CUP-D 3615. In 61, note tip of young ascus (central part) with uniformly stained cytoplasm. Figs. 62–64. *T. rhabdospora*. On *Oxydendrum* (62, from DAOM 56354); and *Viburnum* (63, from CUP-D 7446 = Ellis 65, and 64, from Type). Insets in 63 from QFB 19536. About × 1200.

Figs. 65 and 66. *T. confusa*. From QFB 19577 and DAOM 5752. Figs. 67–73. *Claussenomyces* spp. Figs. 67 and 73. *C. pseudotsugae*. From DAOM 56352. In 67, asci giving rise directly to ultimate cells (phialoconidia), and 73, phialides and phialoconidia, from pycnidia. Fig. 68. *C. atrovirens*. Asci giving rise directly to phialoconidia. From Rehm Ascom. 358 (in CUP). Figs. 69–72. *C. luteoviridis*. From Type. In Fig. 70, germinating ascospore. In Fig. 71, phialides from pycnidia, and in 72, ascospores within asci. Fig. 72. About × 625.

NOTE: Figs. 1–72 follow.