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STUDIES IN NORTH AMERICAN CORTINARII V. NEW AND INTERESTING PHLEGMACIA FROM WYOMING AND THE PACIFIC NORTH WEST

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ABSTRACT. The taxa of *Cortinarius*, subgenus *Phlegmacium* reported here include five new species, *C. calojanthinus, C. citriolens, C. pseudovariegatus, C. variosimilis* and *C. sannio,* and three new varieties, *C. subfoetidus* var. *bubalinovelatus, C. cephalixus* var. *aurantiobrunneus* and *C. infractus* var. *flavus*. Included as well are comments on *C. subfoetidus* var. *subfoetidus, C. albobrunnoides* and *C. cephalixoides* and a closely related variant. *Cortinarius superbus* and *C. percomis* are reported from the Rocky Mountians for the first time, *C. superbus* f. *aromaticus* is described from Oregon, and the taxonomic position of the complex around *C. subfoetidus* and *C. citriolens* is discussed.

Key Words: *Cortinarius, Phlegmacium*, California, Idaho, Oregon, Washington, Wyoming, Rocky Mountains, Olympic and Cascade Mountains, Pacific Northwest.

Introduction

This paper presents a series of Phlegmacia that are characteristic of conifer forests of the Pacific Northwest and the Rocky Mountains, or to date are known from one or the other of these regions. Some taxa, for example *Cortinarius superbus* A.H.Smith, appear to be widely distributed but relatively uncommon in at least some parts of their range, others such as *Cortinarius variosimilis* are relatively common and widely distributed in conifer forests. These taxa all appear to be more or less characteristic of montane and subalpine conifer forests and likely grow throughout western North America where suitable habitats occur. Habitats for some of these taxa, for example, *Cortinarius subfoetidus* var.

bulbalinovelatus, may include species of hardwoods as well as conifers. Other papers by the authors, containing *Phlegmacium* species from western North America, include Moser et al. 1995, Moser and Ammirati 1996, Moser and Ammirati 1997, and Moser 1997a, 1997b.

The vegetation of the Pacific Northwest and Rocky Mountains has been classified by several plant ecologists (Franklin and Dearness, 1973, Barbour and Billings, 1988, Henderson et al., 1989). Forest habitat types have been studied by Steele et al. (1983). The *Phlegmacium* species reported from the Rocky Mountains are primarily from spruce-fir (*Picea/Abies)* subalpine forest habitats. In some areas *Pinus contorta* Dougl. is commonly mixed in with *Picea engelmannii* Parry and *Abies lasiocarpa* (Hook.) Nutt., the most common spruce and fir species. *Pseudotsuga menziesii* (Mirbel)Franco, *Pinus albicaulis* Engelm. and *P. flexilis* James occur in some habitats and *Alnus sinuata* (Regel) Rydb. and *Salix* species can be found in moist habitats, along streams, lake edges or seepage areas. The northern Idaho Cascade forest elements may be found in moister habitats. A first tentative attempt to correlate the occurrence of *Cortinarius* species with vegetation types has been made some years ago for the Greater Yellowstone area. (Moser et al. 1994).

In the Pacific Northwest, the vegetation of the Olympic and Cascade Mountains includes *Pseudotsuga menziesii-Tsuga heterophylla* forests from sea level up to 1000 m, and *Abies amabilis-Tsuga heterophylla* forests in montane regions, the latter often with *Abies procera* Rehder, *A.grandis* (Dougl.)Forbes, *Pseudotsuga menziesii, Pinus monticola* Dougl. and *Thuja plicata* Donn. depending on the site. At higher elevations or in more continental environments, *Pinus contorta, P. monticola, P. ponderosa* Dougl., *Abies lasiocarpa, A. grandis, Larix occidentalis* Nutt. and *Picea engelmannii* may be found in various combinations along the Cascades of Oregon and Washington. *Picea sitchensis-Tsuga heterophylla* forests occur in a rather narrow band along the Pacific Coast south to northern California. These forests may occur as pure stands of *Picea*, or as mixed stands that include *Thuja plicata, Myrica californica* Cham., *Pinus contorta* or *Pseudotsuga menziesii* in addition to *Tsuga heterophylla* (Raf.)Sarg.In inland coastal areas of northern California certain of these Phlegmacia, for example, *C.percomis* and *C. subfoetidus,* occur in forests with a mixture of conifers (*Pseudotsuga menziesii*) and hardwoods (*Castanopsis, Lithocarpus, Quercus*) species.

Materials and Methods

For methods of study see Moser 1993, Moser et al. 1995 and Moser and Ammirati 1996. Descriptions of microscopic characters were from sections mounted in 3% KOH. Spore measurements were made from spore deposits whenever possible. Abbreviations used to describe the basidiospore measures include: S = standard deviation, Q = quotient of spore length to spore width, V = approximate volume. To describe the density of the lamellae the following measurements are given: L = total number of lamellae reaching the stipe; l = number of lamellulae between two lamellae. Comparison of lamella width with the thickness of the pileus context was made at about half the radius of the pileus. Color codes include Munsel Soil color Charts (1975, example of notation, Mu 2.5YR2/4), Ridgway, Color Standards and Color nomenclature (1912, example, Carob Brown (R)), A. Cailleux, Code des Couleurs des Sols (1981, example, Caill 55S) and Methuen Handbook of Color (example, M 1D8). Macrochemical color reactions were made with 20% or 30% KOH and/or NH_4OH. Collections of Meinhard Moser are deposited in the Herbarium of the Institut für Botanik der Universität Innsbruck (IB) and those of Joe Ammirati and M. T. Seidl at the University of Washington Herbarium (WTU).

Taxonomic treatment.

1. Cortinarius Fr. subgen. Phlegmacium (Fr.:Fr.) J.G.Trog sect. Caerulescentes R.Hry. ex Brandr. & Melot

Cortinarius (Phlegmacium) calojanthinus **Mos. & Ammirati spec. nov.** (Fig.1, 2(1), 8a)

Pileo 40-85 mm lato, primo hemispherico, convexo, margine involuto, plano-convexo usque applanato, interdum centro depresso, margine primo pallide lilaceo, discum versus ochraceo vel brunneolo jam juventute, aetate totius flavo-brunneo, interdum fere albidulo; lamellis pallidis, bubalinis, dein argillaceis, adnatis vel leviter emarginatis, confertis, acie serrulato, 6-8 mm latis; stipite 40-70 mm longo, 15-25 mm crasso, bulbo marginato 25-50 mm lato, albo vel albidulo, sericeo, margine bulbi primo pallide lilacino, deinde albido, velo lilaceo usque albidulo; carne alba usque pallide bubalina, odore nullo vel leviter fragrante, sapore miti; Sporis 10.6-12.9x6.2-7.2 μm, in medio 11.7x6.8 μm (n=31), amygdaliformibus sublimoniformibusve, verrucosis. Basidiis 34-

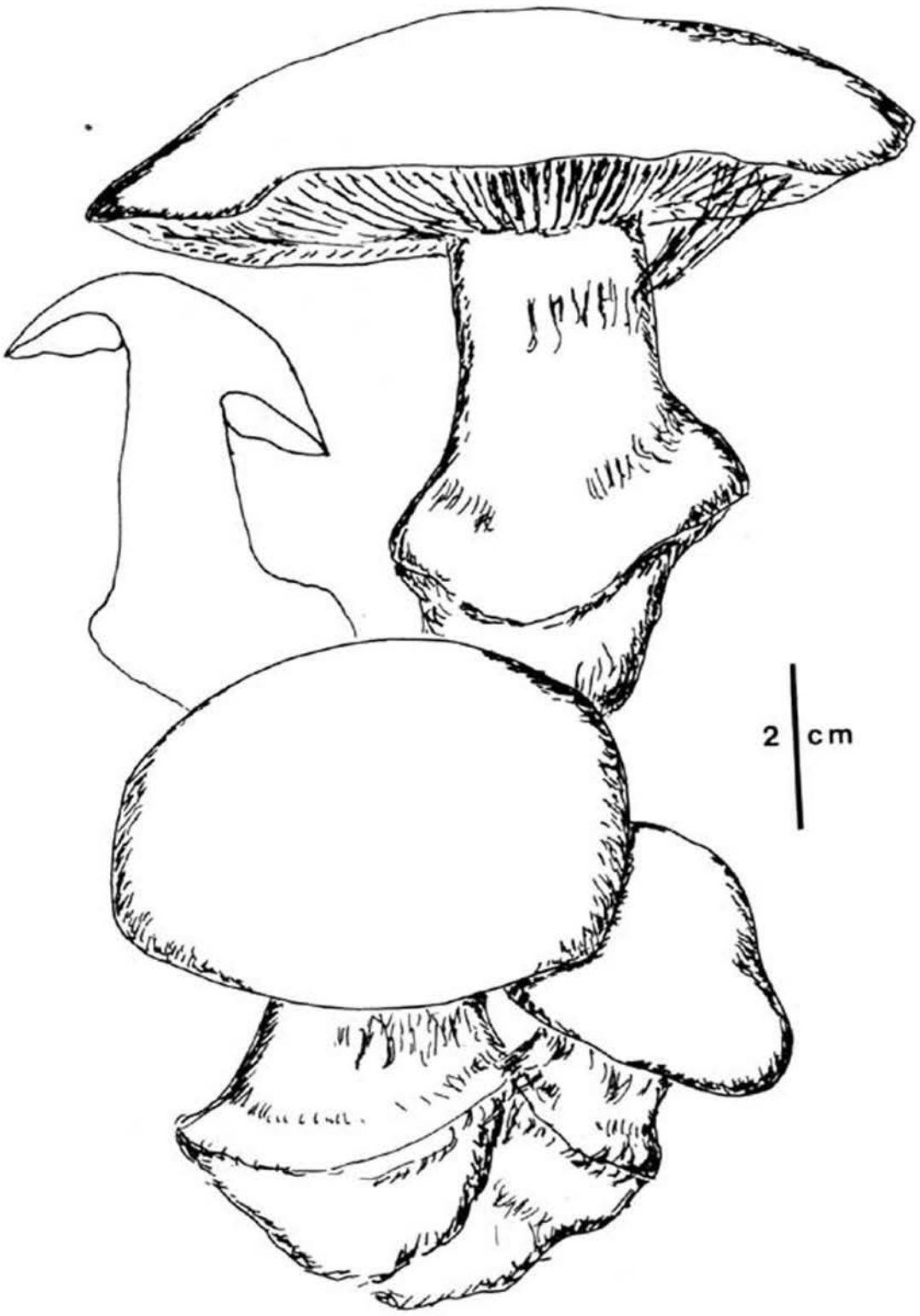

Fig.1. *Cortinarius calojanthinus.* Fruit-bodies (97/220) (nat.size)

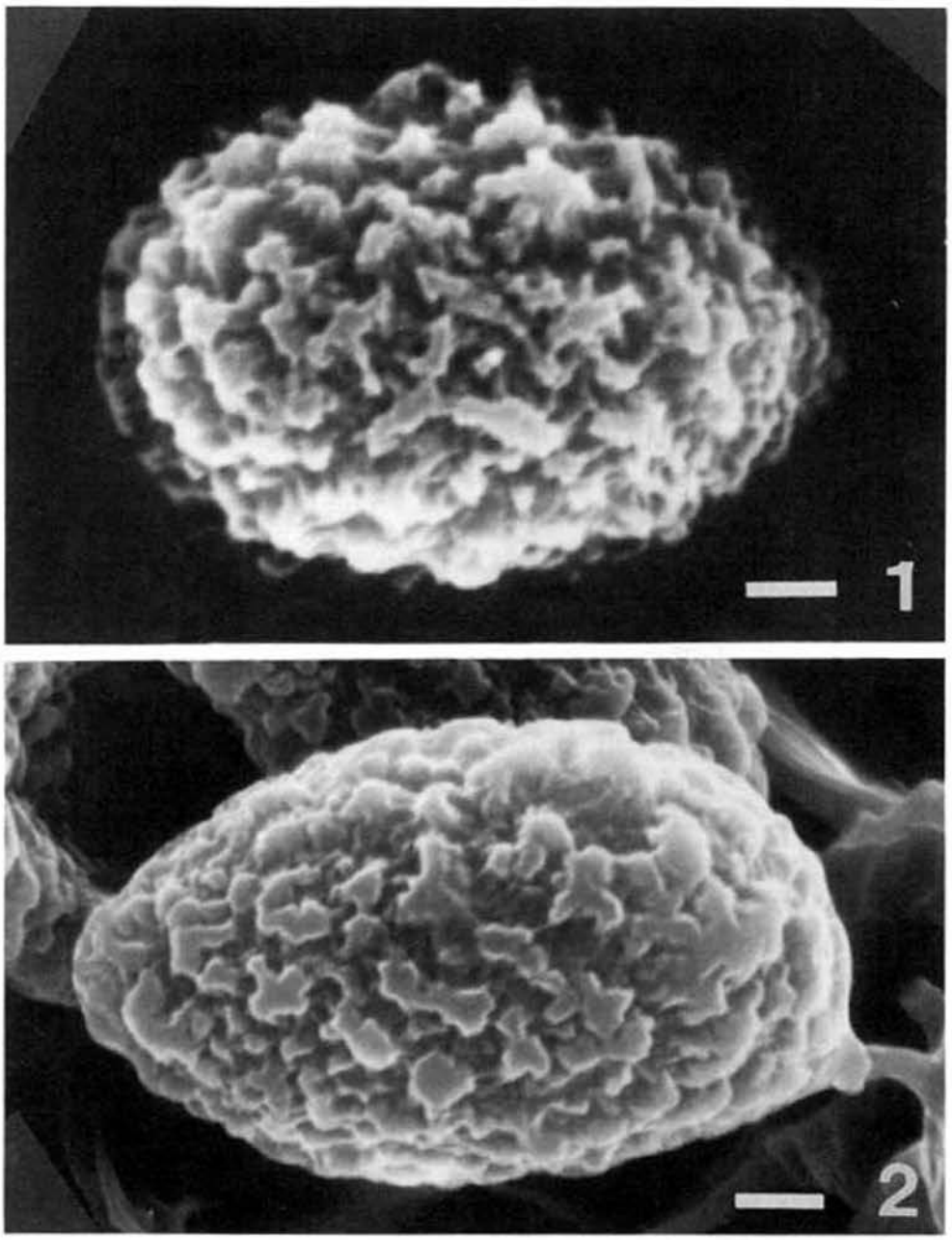

Fig.2. Spores in SEM of: 1. *Cortinarius calojanthinus* (97/220).- 2. *Cortinarius citriolens* (97/122). (Bar= 1 μm)

40x10-11 µm, clavatis, absque cheilocystidiis, fibulis praesentibus.
Habitatio: in silvis coniferis subalpinis (*Picea engelmannii, Abies lasiocarpa*). Holotypus IB 97/220, Flagstaff Road, in silva nationalis "Teton", 21.8.1998, leg. M. Moser & J.Ammirati.
Pileus 40-85 mm diam., at first hemispheric, convex with involute margin, later convex to applanate, sometimes center becoming depressed, nonstriate, surface glutinous, in young specimens margin dingy pale lilac, R Lavender to Bluish Lavender (R) (somewhat paler), disc already in young buttons ochraceous to pale brownish, between Pinkish Buff (R) and Warm Buff (R), Caill 69M, later disc yellow-brown marbled (Caill 57N), with age becoming totally yellow-brown, Caill 65M, 60N, center also browner, Caill 57N, with Clay Color to somewhat reddish brown colors developing centrally in age, sometimes, however, much paler, nearly whitish, Caill 69M and margin with slight grayish flush, lilac colors fade quickly and disappear in mature basidiomata completely, not or only slightly innate fibrillose, sometimes center becoming slightly areolate. **Lamellae** pallid already in buttons, Pale Pinkish Buff (R), later argillaceous, near Avellaneous (R) or between Avellaneous (R) and Vinaceous Buff (R), with age Clay Color (R); edges eroded to serrulate, rounded adnate to slightly emarginate, close to crowded, L=120-130, l=1-3, 16-17/cm at margin, 6-8 mm wide, equals 1-1.5 times pileus context thickness. **Stipe** 40-70 mm long, 15-25 mm thick, the marginate bulb 25-50 mm, white to whitish, silky, bulb margin in young specimens slightly lilac, in age dingy whitish, bulb underneath white. **Veil** lilac to whitish. **Context** up to 12-13 mm on disc, abruptly then gradually thinner to edge, solid, firm, white to whitish or pale buff in pileus, Pale Pinkish Buff (R), in stipe, whitish to slightly buff and with yellow-brown to brownish discolorations in base, sometimes watery mottled in cortex. Without distinctive **odor** or odor very faint, difficult to define, taste mild.
Chemical characters: KOH on pileipellis somewhat brown, on context negative, NH_4OH negative. Under UV pileus dingy red, with age more yellow-brown with some red, mixed with some bright yellow areas, stipe violaceous, bulb margin and underneath bright yellow.
Microscopic characters: Basidiospores 10.6-12.9x6.2-7.2 µm, mean 11.7(S=0.66)x 6.8(S=0.3) µm, Q=1.5-1.9, mean 1.7 (S=0.08), V=223-349 μm^3, mean 287 μm^3, almond-shaped to slightly sublimoniform, verrucose, apex smooth. Basidia 34-40x10-11 µm, clavate. Without cheilocystidia. Lamellae edge with basidia and basidioles and some degenerated basidia; Lamellar trama with lateral stratum hyphae (5)6-8 µm wide, in mediostratum up to 12 µm, occasionally up to 21 µm wide, colorless, clamp connections present. Pileipellis with gelatinous pellicle of 3-4.5(-5)

μm thick, colorless hyphae with clamp connections, subrepent in basal layer to somewhat ascending in upper layer, epicuticular hyphae 6-8 μm thick, walls ochraceous in KOH, without distinct hypocutis or hyphae up to 12 μm thick. Cortina hyphae 3-4.5 μm thick, colorless, with clamp connections.

Habitat: subalpine forest under *Picea engelmannii* and *Abies lasiocarpa*.

Collections examined: IB 97/220 (holotype) and JFA 12443 (WTU), Flagstaff Road, Calypso Creek, Teton National Forest, leg. M. Moser & Ammirati, 21 Aug. 1997 and 97/220b, same locality on 26 Aug. 1997, leg. M. Moser.

Comments: *Cortinarius calojanthinus* belongs to section Caerulescentes Hry. ex Brandr.& Melot because of the lilac coloration and negative reaction with KOH and NH_4OH. It is similar in macroscopic appearance to members of the *Dibaphus* group, but these taxa give a strong pink to red reaction with KOH.

2. The complex around *Cortinarius subfoetidus* A.h.Smith.

Species with bright blue or bluish violet colors on pileus, lamellae and stipe, with clavate, dry stipe and glutinous pileus. Stipe equal or clavate. Spores amygdaliform to sublimoniform. Without reactions with KOH, NaOH and NH^4OH. Often with fragrant odor.

Key to North and South American taxa (several taxa from the Borneo and Malaysia are not yet published.)

1. Stipe blue to violet, glutinous. Spores subglobose to elliptic or almond-shaped Subgen. Myxacium sect. Archeriani
1* Stipe dry **2**
2. Spores fusoid to slender elliptic. Lamellae argillaceous, rarely pale bluish. Stipe pallid, without or with few patches only of bluish veil group Cumatilis
2* Spores ellipsoid to almond-shaped. Lamellae pale to dark bluish at least when young. Stipe distinctly blue up to the cortina or even to apex **3**
3. Basidiomata with fragrant odor, growing under conifers in North America **4**
3*.Without fragrant odor. Under *Nothofagus* in South America **5**
4. Spores 10.6-13.1x5.9-7.1 mm, almond-shaped to sublimoniform. Strong odor of lemon pelargonium *C. citriolens* Ammirati & Mos.
4*. Spores 7.6-10.6x4.4-5.9 μm, ellipsoid to subalmond-shaped. Odor sweetish aromatic to foetid (difficult to describe) *C. subfoetidus* A.H.Smith
With buffy veil var.*bubalinovelatus* Mos. & Ammirati
5. Spores 8.8-12x(3.5)-4.3-5.6(-6) mm, ellipsoid to almond-shaped. Odor somewhat polyporoid. Pileus 4-8 cm withbright violet to blue colors *C. columbinus* Mos. & Horak
5*. Spores 7-8.8(-9.2)x4.8-5.6 μm. Without distinct odor. Colors bluish violet, gray-

blue, margin slightly striate. Pileus 2-6 cm. *C. caelicolor* Horak & Mos.

Cortinarius (Phlegmacium) citriolens Ammirati & Mos. sp. nov.
(Fig. 2(2), 3, 8b)

Pileo 50-160 mm lato, primo hemispherico, dein convexo, margine involuto, aetate applanato, glutinoso, laete violaceo maculis obscurioribus praedito, disco sordide albido-griseo, demum griseo vel ochraceo, margine innato fibrilloso, juventute appendiculato e velo violaceo; lamellis juventute pallide caeruleis, in pileo expanso plus minusve decoloratis, bubalinis, adnatis usque emarginats, confertis, 7-10 mm latis; stipite 50-95 mm longo, 20-50 mm crasso, aequali sive clavato, interdum apice dilatato, ad apicem albidulo, infra cortinam caeruleo-violaceo, basi albido vel ochraceo; carne pilei corticeque stipitis leviter caerulea, aliter albida; odore forte dulcidulo, citriodoro, similis Pelargonii odorati; velo albido usque caeruleo; sporis amygdaliformibus, raro sublimoniformibus, 10,6-13,1x5,98-7,1 μm, medio 11.8x6.5 μm, basidiis tetrasporigeris, 34-38x8-10,5 μm, subcylindraceis vel clavatis, absque cystidiis, fibulis praesentibus.
Habitatio: in silvis coniferis subalpinis (*Picea engelmannii, Abies lasiocarpa*). Holotypus IB 97/122, Flagstaff Creek, Teton National Forest, 6.Aug.1997, leg. M. Moser & J.Ammirati.

Pileus 50-160 mm diam., at first hemispheric, later convex with involute margin, finally expanding and margin straight and applanate with age, glutinous, with bright violet colors,(R) Deep Grayish Lavender with small and some larger darker spots, from (R) Dark Grayish Lavender, (R) Ramier Blue to (R) Deep Hyssop Violet, (R)Grayish Blue Violet, (R) Wisteria Violet, toward the disc even in buttons with a dingy whitish-gray overcast, later more grayish or more ochraceous, Caill near 75L, Mu 10YR 7/4, (R) Tileul Buff, toward margin innate fibrillose, margin in young specimens appendiculate from veil, in older specimens only toward margin deep violet, (R) Deep Lavender to (R) Lobelia Violet, disc (R) Clay Color to (R) Cinnamon Buff, in age over most of the surface discoloring to (R) Pinkish Buff with some darker spots. **Lamellae** in buttons pale bluish, (R) Deep Grayish Lavender, (R) Lavender Gray, (R) Plumbago Blue, but when opening mostly discolored, (R) Tileul Buff or between (R) Tileul Buff and (R) Vinaceous Buff to (R) Pinkish Buff, with age (R) Cinnamon Drab, some violet shades may be retained near the pileus margin, emarginate, edges entire to eroded, adnate to emarginate, crowded, L=110-120, l=1-3, 14-20/cm at pileus margin, 7-10 mm wide (= about thickness of pileus context). **Stipe** 50-95 mm long, 20-50 mm thick, equal or slightly clavate, sometimes apex also enlarged, apex whitish, below the cortina bluish, (R) Deep Grayish Lavender, (R) Bluish Lavender, (R) Pale Wisteria Violet, (R) Verbena Violet, the base whitish to ochraceous yellowish, slightly wrinkled or floccose below the cortina.

Veil white to pale bluish. **Context** bluish in pileus and cortex of stipe of young fruit-bodies, otherwise white to (R) Pale Pinkish Buff. **Odor** rather strong and fragrant, sweetish of lemons or lemon pelargonium (*Pelargonium odoratum*). Taste mild.
Chemical reactions: KOH negative on context, but discoloring the blue parts of the pileus and stipe to ochraceous. Under UV pileus red and yellow, stipe violaceous, context blue, in older specimens rather negative.
Microscopic characters: Basidiospores 10.6-13.1x5.9.2-7.1 μm, mean 11.8(S= 0.6) x 6.5 (S= 0.25) μm, Q= 1.6-2 , mean 1.8 (S= 0.08), V= 197-337 μm^3, mean 267 (S= 31) μm^3 almond-shaped, rarely slightly sublimoniform, verrucose. Basidia 4-spored, subcylindric to clavate, 34-38x8-10.5 μm. Without cheilocystidia in older specimens, in young specimens with cylindric or clavate to somewhat ventricose cells 30-45x4-15 μm. Subhymenial hyphae 2.5-4 μm, in lateral strata hyphae 5-6-(7) μm, in mediostratum 7-9 (-13) μm, colorless in KOH, clamp connections present. Pileipellis with gelatinous pellicle of repent to subrepent or slightly irregular hyphae of 2.5-4.5 μm width, colorless, clamp connections present, epicuticular hyphae 4-7 μm, walls in KOH pale ochraceous, hypocutis not much different, hyphae 7-9.5 μm, less colored. Cortina hyphae 4-5 μm, colorless, with clamp connections.

Habitat: subalpine conifer forests, *Picea engelmannii, Abies lasiocarpa,*.

Collections examined: IB 97/122 , leg. M. Moser & J.Ammirati, Flagstaff Creek, Teton National forest, 6 August 1997,(holotype), 97/154, same area 10 August 1997, leg. M. Moser, 97/339, near small lake below Lost Lake, Togwotee Pass area, 7 Sept. 1997 leg. M. Moser

Comments: This beautiful species seems to be related to *C. subfoetidus* A.H. Smith. This may be corroborated by the bright colors. In both species the stipe is blue up to the cortina (which sometimes is suggesting of taxa of subgenus Myxacium (e.g. *C. salor*-group). Both have a fragrant odor. The odor, however, is different, in *C. subfoetidus* also somewhat sweetish, but difficult to define. Spores in *C. subfoetidus* are distinctly smaller and more elliptic, 7.6-10.6 x 5-5.8 μm, mean 9.0(S=0.3)x5.4(S=0.2) μm, Q=1.6-1.9, mean 1.7, V= 123-184 μm^3, mean 145 (S=13) μm^3. This species has not been observed in Wyoming but we have studied numerous collections from Washington and Oregon.
A chemical analysis of the violet pigment would be desirable. In *C. subfoetidus* we observed that the pigment is rather persistent and does not discolor even after some days in contrast to most other blue Cortinarii. The junior author has observed a similar taxon in the Cascades and Olympic Mountains, which we at first thought to be identical. There are,

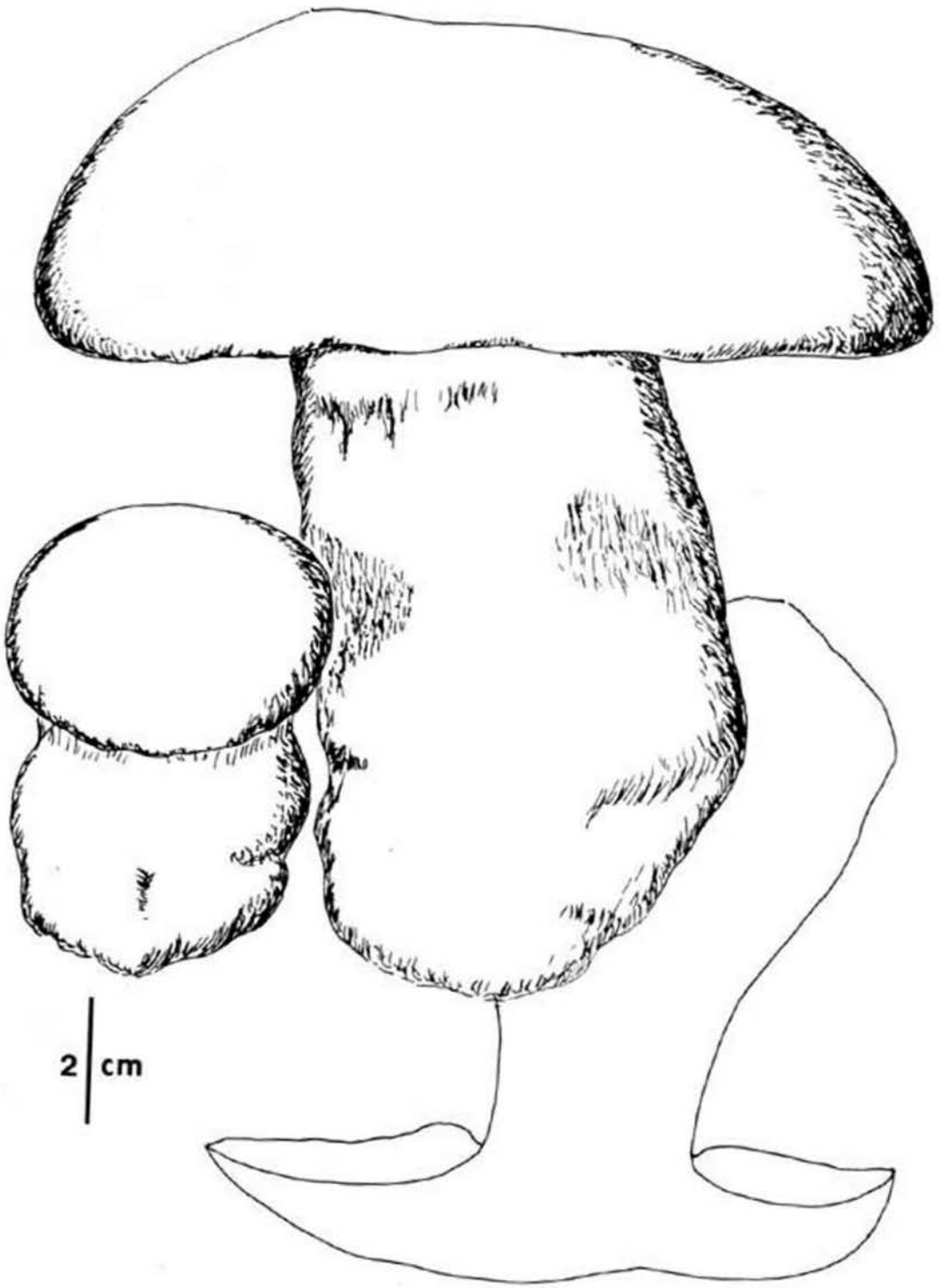

Fig.3. *Cortinarius citriolens* Fruit-bodies (97/159) (2/3 nat. size)

however, several differences and this taxon needs further study. It may be another species or variety of this section.
Molecular studies will be necessary to elucidate eventual relationships to the groups around *C. salor, C. iodes* etc. with glutinous stipe.

Cortinarius (Phlegmacium) subfoetidus **A.H.Smith** 1944 **var.** ***subfoetidus***
Lloydia 7, 191-192, 1944.
(Fig. 9 b, c)

Recently a description and colored plate were published in Europe as *C. subfoetidus* (Bidaud et al. 1996), however, these represent a misinterpretation of this American fungus. We are providing a complete description of *C. subfoetidus* below in the hopes of preventing future misinterpretation of this taxon in Europe and elsewhere.

Pileus 70-90-(100) mm, convex with margin involute, then applanate and margin incurved and often remaining sharply so, glutinous, with a very bright and beautiful bluish violaceous color, Wisteria Violet (R), Soft Blue Violet (R), Grayish Blue Violet(1)(R), when drying becoming somewhat paler, but retaining this color even with age, only central part discoloring and becoming grayish blue or grayish, rarely somewhat ochraceous or slightly brownish, sometimes spotted. **Lamellae** in young buttons pale grayish, Pale Violet Gray (R), later near the pileus margin pale grayish-blue, slightly Grayish Lavender (R), but most part buff to gray-brown (Cinnamon Buff (R) to Avellaneous (R)), sometimes with these colors already present when expanding, emarginate, edges uneven to serrulate, close, L=55-70, l=1-3, 1213-15/cm at margin, 5-10 mm wide, strongly tapering toward the pileus margin. **Stipe** 40-130 x 8-25 mm, clavate, bluish violaceous, Dark Grayish Lavender (R), Grayish Lavender (R) sometimes only up to the cortina, occasionally also up to the top, the base dingy whitish to Light Buff (R), dry, smooth to floccose up to the cortina, but occasionally some slightly glutinous spots can be observed due to slime dropping down from the pileus. **Cortina** pale bluish, unversal veil pale bluish. **Context** pale bluish (Grayish Lavender (R)) in pileus, in some areas darker marbled, in stipe whitish. **Odor** strong, sweetish, aromatic, foetid, difficult to describe, but certainly not related to odors occurring in the Variecolor group. Taste mild. **Chemical reactions**: KOH 20% no reaction on context and pileus surface, NH_4OH negative, Lugol negative. Under UV pileus blue (at least partly, lamellae dark, stipe blue, context blue with yellow areas.

Microscopic characters: Spores 7.6-10.6x4.4-5.9 μm, mean 8.7(S=0.7)x5.5 (S=0.3) μm, elliptic to subalmond-shaped, moderately verrucose, basidia 30-35x7-8 μm, subcylindric to clavate, 4-spored, without cheilocystidia, subhymenial hyphae 3-4 μm, colorless, lamellae trama hyphae 3-6 μm, in mediostratum 6-7 μm, colorless. Pileipellis with gelatinous layer of 3-5.5 (-6) μm thick, repent hyphae with clamp connections, colorless but in mass slightly lilac, epicuticular hyphae 4-6 μm, more or less colorless, with clamp connections. Hypocutis not differentiated.
Habitat: in conifer forests under *Pseudotsuga menziesii, Tsuga heterophylla, Pinus monticola.* The main mycorrhizal host seems to be *Pseudotsuga* and/or *Tsuga.*
Collections examined: Washington: Smith 17778 (holotype) Olympic Hot Springs, Olympic Natl. Park, 11 Oct 1941.; IB 95/241, Lake Angeles Trail, Olympic Natl. Park, 5 Oct 1995 leg. M. Moser, 95/326 and JFA 11581 (WTU), Cougar Rock Camp ground, Mt. Rainier Natl. Park, leg. M. Moser 18 Oct 1995 ; **Oregon**: 95/458. Bull. Run Watershed Management, Clackamas Co., 2 Nov. 1995, leg. J. Rogers, 95/494 Bull Run Watershed Management, Clackamas Co., 8 Nov. 1995. leg. M. Moser. In this area the species was extremely frequent and often luxuriant and in larger groups. **Idaho**: Smith 83009. Tule Bay, Priest Lake, Bonner Co., 18 Oct 1972.

Comments: *Cortinarius subfoetidus* certainly does not belong to the Variecolor group because of the type of pigmentation, the lack of the typical yellow reaction of the context with KOH, and the quite different odor. The pigment is rather peculiar. While in other taxa blue pigments tend to discolor rather quickly and to change to brownish or ochraceous tints, however,the very bright blue-violet colors in *C. subfoetidus* do not change except after many days and in age only slightly on the disc. So it seems that the chemical nature of the blue pigments in *C. subfoetidus* is different from those in the Variecolor group. The fungus of our French colleagues on the other hand is a typical member of the Variecolor group (Bidaud et al.1996). The blue covering on the stipe of *C. subfoetidus* invokes the impression of a blue sheath and resembles more the blue stipe of some blue Myxacia and so does the habit of the basidiomata. The spore shape, however, is different from those in the blue Myxacia. And the stipe surface showes no trace of gelatinized hyphae.
With respect to the taxonomic position of the group we consider three possibilities.

1. *C. subfoetidus* together with *C. citriolens* form a distinct group which deserves infrageneric recognition. A comparison must still be made with the taxa of the *C. columbinus, C. caelicolor*-group from South America and some species from Malaysia (Borneo). Moser & Horak (1975) included these with some hesitation in subgenus Myxacium in the Stirps

Iodes in spite of the dry stipe. We think now that this was incorrect and that these species together with *C. subfoetidus* and *C. citriolens* may form a natural group within Phlegmacium which has its distribution area in the pacific region. A special feature of this group seems to be the type of pigmentation. From observations of many collections of *C. subfoetidus* and *C. citriolens* we have the impression that the very bright blue pigment is of another chemical nature as in other blue Cortinarii and does not or only slightly decompose with time. For the South American and Malaysian taxa we have not sufficient observations in this regard.

2. A relationship with the *C. cumatilis*-group. In this group the stipe is not blue except of some veil remains, the gills are normally pale to argillaceous, the pigment type seems different, the spores are more subfusoid to slender almond-shaped.

3. A relationship to Myxacium sect. Archeriani. Moser and Horak (1975) includes *C. columbinus* and related taxa in this section stirps Iodes inspite of a non-glutinous stipe surface. *C. subfoetidus* and *citriolens* often remind much of taxa of the Salor-group, but too have a dry stipe and are much larger. The spores of European and many North American representatives of the Salor-group are more or less subglobose. In North and South America we find taxa with elliptic to amygdali- or even sublimoniform spores, e.g. *C. iodes* Bk. & Curt., *C. iodeoides* Kauffm., *C. austrosalor* Mos. ap. Mos. & Horak., *C. opulentus* Mos. The last two taxa are also rather large. The pigments in *C. iodes* and *magellanicus* are also very bright and relatively stable.
This problem can probably only be solved with a study of the chemical nature of the pigments and with molecular methods.

Cortinarius subfoetidus A.H.Smith var. ***bubalinovelatus*** Mos. & Ammirati n. var. (Fig. 9 a)

Differt a typo colore veli bubalino. Holotypus IB 95/607 Big Flat, Smith River South Fork, Del Norte Co., California, 21 Nov. 1995, leg. M. Moser

This variety agrees with the type variety in all characters except the color of the veil which has a buffy color and forms a thin belt and patches in the lower part of the stipe.

Collections examined: IB 95/607, Big Flat, Smith River South Fork, Del Norte Co., California, under *Pseudotsuga menziesii, Lithocarpus and Castanopsis.* 21 Nov. 1995, leg. M. Moser, JFA 11806 (WTU), same location and date, under mixture of *Pseudotsuga, Pinus, Lithocaprus, Quercus* and *Vaccinium*, leg. J. Ammirati.

3. Notes on Cortinarius (Phlegmacium) albobrunnoides Mos. & McKnight.

In 1997 this taxon was very frequent and could be seen on almost every excursion. In other years it was relatively rare in the Greater Yellowstone ares. Moreover it was also observed in the Medicine Bow Mts. and in Colorado in 1997. In addition the variety *violaceovelatus* Mos. & Ammirati, which we knew only from Washington, was frequent in the same areas as the type variety. For descriptions see Moser and Ammirati (1996).

Collections examined: *var. albobrunnoides*: **Wyoming:** IB 97/162, Flagstaff Creek near dam, Teton Natl. Forest, leg. M. Moser 10 Aug 1997, IB 97/303, Lake east of Two Ocean Mtn. Shoshone Natl. Forest, leg. M. Moser, 31 Aug 1997.- **Colorado:** IB 97/194, above Mtn. Research Station, University of Colorado, Nederland, Boulder Co., Colorado, 18 Aug. 1997 leg. M.Moser.
Var. *violaceovelatus* Mos. & Ammirati.: JFA 12401 (WTU) and IB 97/162b, Flagstaff Creek near dam, Teton Natl. Forest, leg. M.Moser 10 Aug 1997, IB 97/207, Medicine Bow Mts., Snowy Range, 19 Aug.1997, leg. M.Moser, 97/264, southwest of Brooks Lake Lodge, Shoshone Nat. Forest, 27 Aug. 1997, leg. M.Moser.

4. *Cortinarius (Phlegmacium) pseudovariegatus* Mos. spec. nov.
(Fig. 4a, 5(3), 8c)

Pileo 34-63 mm lato, convexo, glutinoso, flavo-brunneo, e velo violaceo obtecto, in stratis tenuibus aspectu argenteo-albido; lamellis pallide ochraceis, adnatis usque leviter emarginatis, acie serrulato, confertis, angustis, 3-5 mm latis; stipite 45-60mm longo, 11-20 mm crasso, basi usque ad 25 mm, clavato, primo albido, dein pallide flavescente, basin versus e velo violaceo ornato vel dispersim maculato; carne albida, odore nullo vel panis recentis, sapore miti, KOH ope carne reactionem flavum vel flavo-brunneum, NH_4OH ope leviter flavum praebente; Sporis 9,4-12,3x4,7-5,9 μm, in media 10,9x5,2 μm, fusoideis, fere glabris, subtiliter rugosis, basidiis tetrasporigeris, clavatis, 29-33x7,5-8,5 μm, absque cheilocystidiis, fibulis praesentibus.
Habitatio: in silvis coniferis subalpinis (*Picea engelmannii, Pinus albicaulis).* Holotypus IB 97/296, prope lacum ad orientem montis dicto "Two Ocean Mountain", Shoshone Natl. Forest, Wyoming, USA, altitudine 2950 m, 31.8.1997 leg. M. Moser

Pileus 34-63 mm diam., convex, with marginella inrolled, glutinous, ground color yellow-brown (Caill 59M to 57N or some areas 57P), but the pilei covered to a large extent by the universal veil appearing like sugar coated and iced, veil violaceous particularely over the margin, in thin layers appearing silvery whitish. **Lamellae** rather pale ochraceous, between Light Buff (R) and Light Ochraceous Buff (R), Caill near 67L, adnate to shallowly emarginate, edges eroded, crowded, L = 120-130, l = 3,

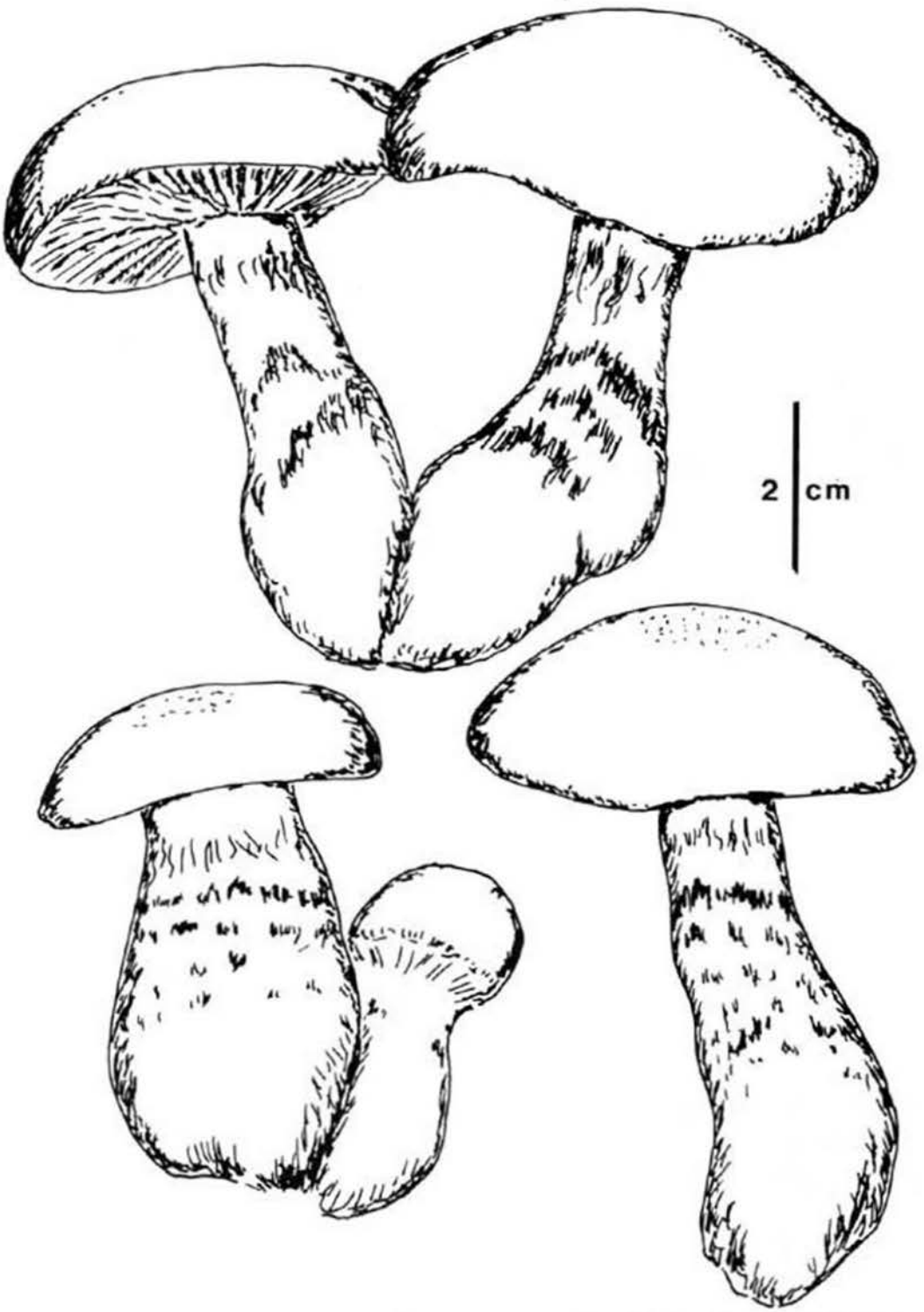

Fig.4.a. *Cortinarius pseudovariegatus*.Fruit-bodies (97/296)
b. *Cortinarius cephalixus* var. *aurantiobrunneus* .
Fruit-bodies (94/189)(nat. size)

17/cm at margin, narrow, 3-5 mm wide (= one third of thickness of pileus context). **Stipe** 45-60 mm long, 11-20 mm above, the clavate base 12-25 mm, whitish at first, then pale yellowish, Cream Color (R), in most specimens toward the base with some patches of the violaceous veil, on one only white patches. **Veil** violaceous (eventually fading to white). **Context** white, in stipe apex slightly marbled, odor very slightly of hot baked bread or none. Taste mild.
Chemical reactions: KOH on context yellow to yellow-brown, NH_4OH slightly yellow, on pileipellis negative. Under UV pileus surface red, stipe, gills and context yellow, veil violet both on pileus and stipe.

Microscopic characters: Basidiospores 9.4-12.3x4.7-5.9 μm, mean 10.9(S=0.7)x 5.2(S=0.35) μm, Q= 1.7-2.6, mean 2.1, V= 119-209 μm^3, mean 157μm^3, fusoid, slightly marbled, nearly smooth. Without cheilocystidia, basidia clavate, 4-spored, 29-33x7.5-8.5 μm, subhymenial hyphae 3-4 μm, hyphae in lateral strata 5-12 μm, in mediostratum 10-14 μm, colorless, with clamp connections. Pileipellis with gelatinous pellicle of 3-4 μm wide more or less repent hyphae, colorless, with clamp connections, epicutis a mixture of hyphae 5-7 μm wide and some subcellular elements 7-20x7-12 μm, hypocutis with larger subcellular elements, 10-25(-80)x10-20 μm, walls yellow-brown.

Habitat: subalpine forest under *Picea engelmannii* and *Pinus albicaulis*.
Collection examined: Holotype: IB 97/296, Lake east of Two Ocean Mountain, Shoshone Natl. Forest, Wyoming, 2950 m, leg. M. Moser, 31 August 1997.

Comments: This species comes very close to *C. variegatus* Bres. It has the same type of colors, the violaceous veil and the same type of spores. However, the spores are significantly larger (*C. variegatus :* Spores 6.2-8x3.2-3.8 μm, mean 7.1(S=0.36)x3.6(S=0.16) μm, Q=1.8-2.3, mean 1.96, V=34-61 μm^3, mean 48 (S=5.8) μm^3), and the veil is more strongly developed particularly on pileus surface..

5. *Cortinarius (Phlegmacium) cephalixus* Fr. var. *aurantiobrunneus* Mos. & Peintner var. nov.
(Fig. 4b,9d)

Differt a typo coloribus pilei velique aurantio-brunneis.
Habitatio in silva humida sub *Picea engemannia* et *Alno sinuata*.
Holotypus IB 94/189 ad occidentem lacus Taggart, Teton Natl. Park, Wyoming , 26 Aug 1994 leg. M. Moser & U. Peintner

Pileus 3-4.5 (-5) cm diam., convex, margin involute, viscid, color orange

brown, yellow-brown, Caill 60N on the disc, 65M near the margin, slightly granulose on disc in some specimens. **Lamellae** pale ochraceous to pale argillaceous, adnate to emarginate, edges uneven, crowded, L=100-110, l=3, 25/cm at margin, 3-4 mm wide corresponding to 1/2 thickness of pileus context. **Stipe** 40-60 mm long, 12-15 mm thick, base 15-23 mm, clavate, apex whitish, pallid, below the cortina with yellow-brown belts and patches from the universal veil. **Context** white. **Odor** of freshly cut grass, taste mild. Under **UV** pileus purplish red, lamellae and stipe blue, veil bright orange, context bluish with yellow areas.

Microscopic chracters: Basidospores 8.8-11.7x5-5.9 μm, mean 9.9(S=0.6)x5.3(S=0.25) μm, Q=1.6-2.2, mean 1.85, V= 115-192 μm^3, mean 148 (S=17) μm^3, marbled to finely verrucose, slender, almond-shaped. Basidia 4-spored, clavate, 34-37x7-8 μm, subhymenial hyphae 2.5-4 μm, lamella trama hyphae 5-10 μm, in mediostratum up to 14 μm, more or less colorless, clamp connections present. Pileipellis with gelatinous pellicle of 2.5-4 μm wide, repent hyphae, partly with yellowish content, clamp connections present, epicuticular hyphae 5-7 μm, walls pale yellowish ochraceous, hypocutis hyphae up to 13 μm, more irregular, pale yellowisch. Cortina hyphae 3-4 μm, colorless, clamp connections present, universal veil hyphae from stipe 3-5 μm, walls yellowish ochraceous, clamp connections present.
Habitat: under *Picea engelmannii* and *Alnus sinuata* in a relatively moist site.
Collection examined: IB 94/189 (holotype), west side of Taggart Lake, Teton National Park, Wyoming 26 Aug. 1994, leg. U. Peintner & M.Moser.

Comments: The specimens were rather young and fresh. At first we considered a possible identity with *C. luteoarmillatus* A.H.Smith, a species which also seems to belong to the Cephalixus group. This species, however, has very pale colors on the pileus, a paler yellow universal veil and the spores of the type are slightly smaller and more ellipsoid, 8.2-10.6 x5-5.9 μm, mean 9.1 (S=0.5)x5.5 (S=0.2), Q=1.45-1.9, mean 1.65, V=123-173 μm^3, mean 143 μm^3.). From European *C. cephalixus* our collection differs by more orange-brown colors. The spores fall in the range of European material ((7.4)-8.2-9.4(-11.7)x4.4-5.3(-5.9) μm, mean 8.6(S=0.3)x4.9(S=0.16) μm, Q=1.6-1.9(-2.0) mean 1.8, V=96-133 μm^3, mean 112 (S=9)μm^3, the Q- values and volumes are slightly lower. Although we have only one record we found it so characteristic that it seems worth while to propose a new variety.

6. Cortinarius (Phlegmacium) variosimilis **Mos. & Ammirati spec. nov.** (Fig. 5(4), 8d)

Pileo 30-85 mm lato, hemisphaerico, dein convexo, convexo-umbonato, margine inflexo, glutinoso, laete flavo-brunneo, margine pallidiore; lamellis argillaceis leviter lilaceo tinctis, confertis, 4-8 mm latis; stipite clavato, 40-110 mm longo, 7-20 mm crasso, ad basin usque ad 15-32 mm, albido sive pallide bubalino, infra cortinam e velo albido peronato-floccoso; carne albida, pallide bubalina, absque odore proprio, sapore miti, sporis 8,8-11,25x 5,9-6,9 μm, amygdaliformibus, verrucosis, basidiis 35-38x8.5-9.2 μm, tetrasporigeris, clavatis, absque cheilocystidiis, fibulis praesentibus. Habitatio; in silvis coniferis subalpinis (*Picea engelmannii, Abies lasiocarpa).* Holotypus IB 89/493, in calle jugum versus dicto "Easy Pass", Washington , USA, 12.9.1989, leg. M. Moser.

In Wyoming we observed a Phlegmacium relatively frequently that we regarded as a pale form of *C.varius* Fr. A detailed study, however, revealed, that there are several differences between these two taxa, including the paler colors both of pileus surface and particularly the lamellae, weaker reactions with KOH and NH_4OH, and constant and significant differences in spore size.

Pileus 30-85 mm diam., hemispheric, convex to convex umbonate, margin incurved but not inrolled, glutinous, bright yellow-brown, center Caill 59P,57N, 60L - 65M,60N, toward margin paler and often covered by strong white veil remains, Caill 57N, 59M, 60N, 60M, Mu 2.5Y 8/8, not innate fibrillose. **Lamellae** pale lilac to argillaceous with slight lilac tinge, rarely R Plumbago Blue, Caill 70M, 53M, Mu 10YR7/6, rather pale, later gray-brown, Avellaneous, Caill 70 L to 70M in older specimens 69M or Mu 10YR 7/4, Met 18A2 or paler, edges strongly eroded to serrulate, emarginate, crowded, L=90-100, l=3, 4-8 mm wide (1/2-2/3-1 x pileus context). **Stipe** clavate, 40-110 mm long, 7-20 mm thick, the clavate base 15-32 mm, white or Pale Pinkish Buff (R), below the cortina floccose from strongly developed, peronate wooly whitish veil, sometimes with an almost membranaceous ring when fresh, discoloring buffy ochraceous. **Universal veil** white. **Context** whitish, Pale Pinkish Buff (R) to slightly yellowish in the base. Without distinctive odor, taste mild. **Chemical reactions**: KOH pale yellow on context, NH_4OH pale yellow on context. Under UV: pileus and stipe purplish with yellow areas, context bluish-violaceous with yellow areas.

Microscopic characters: Basidiospores 8.8-11.2 x 5.9-6.9 μm, mean 10.1 (S=0.5)x6.3(S=0.2) μm, Q=1.4-1.8, mean 1.6 (S==.08), V= 170-252 μm^3, mean 212 (S=20.6) μm^3, almond-shaped, verrucose. Basidia (30)-35-38-(39)x(8.5)-9-10-(10.4) μm, 4-spored, clavate, subhymenial hyphae 3-4 μm,

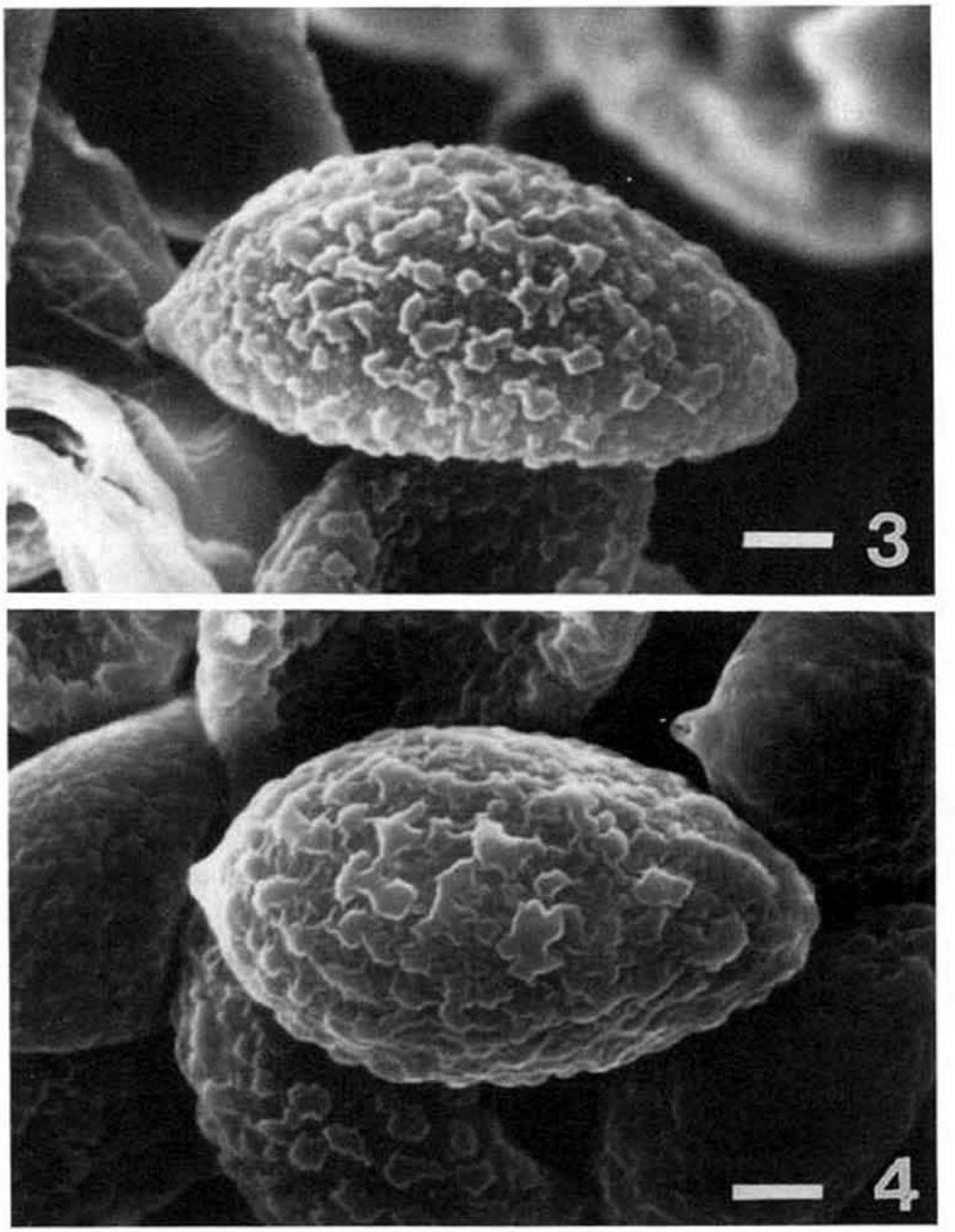

Fig. 5. Spores in SEM of : 3.*Cortinarius pseudovariegatus* (97/296)
4. *Cortinarius variosimilis* (89/493). (Bar = 1 μm)

lamellae trama hyphae 4-8 μm, in mediostratum up to 12 μm. Pileipellis with gelatinous pellicle of hyphae 3.5-4.5 μm thick, colorless but with colorless to yellowish granulose encrustation, with clamp connections. Epicuticular hyphae 5-10 μm, walls from colorless to pale yellow-brown, often encrusted, in hypocutis hyphae 12-15-21 μm, walls ochraceous to darker yellow-brown, encrusted. Cortina hyphae 3.5-4.5 μm, colorless, with clamp connections.

Habitat: conifer forest under *Picea engelmannii, Abies lasiocarpa* in Wyoming. In Oregon, Washington and California the habitats for this species are more variable, ranging from coastal interior forest with *Pseudotsuga, Lithocarpus, Umbellularia* and *Quercus* in California, to *Pseudotsuga* or mixed *Pseudotsuga, Tsuga* and *Abies* forests in Oregon and Washington.

Collections examined: Wyoming : IB 83/181 and 83/181a, Snake River, Southeast of Signal Mtn, Teton Natl. Park, 3 Aug. 1983 leg. M. Moser,.IB 83/187, IB 87/70, Snake River southeast of Signal Mtn., Teton Natl. Park. 24. Jul. 1987 leg. M. Moser, IB 87/150, Lower Slide Lake, Gross Ventre Valey, Teton Natl. Forest. 4 Aug. 1998 leg. H.Thiers, IB 87/169, Mt. Washburn, west slopes, Yellowstone Natl. Park, 6 Aug. 1987, leg. M. Moser, IB 87/181, Flagstaff Rd., Teton Natl. Forest., 8 Aug. 1987, 87/234, Gros Ventre Valley near Upper Slide, Teton Ntl. Forest, 15.Aug. 1987 leg. M. Moser IB 87/323, trail to Union Peak, Teton Natl. Forest, 26 Aug. 1987, leg. M. Moser,, IB 89/259 Trail to Turbid Lake, Yellowstone Natl. Park, IB 97/121, Fourmile Meadow, Teton Natl. Forest, leg. M. Moser, 5 Aug. 1997. JFA 12398 (WTU),Taggart Lake, Teton Natl. Park, leg. J. Ammirati 9 Aug. 1997. **Washington**: IB 89/493 (holotype) Trail to Easy Pass, Skagit Co., Washington, 12.Sept 1989, IB 95/230, Olympic Hot Springs, Olympic Natl. Pak., Clallam Co., Washington, 3.Oct. 1995 leg. M. Moser.- **Oregon**: IB 95/384, Bear Springs, Mt. Hood, Wasco Co., Mt. Hood, Oregon, 27 Oct 1995, leg. M. Moser; JFA 11643 (WTU) same locality and date. IB 95/401 Clear Creek Camp ground, Wasco Co., Mt.Hood, 28 Oct. 1995 leg. M. Moser. **California**: IB 95/566 and JFA 11770 (WTU), Patrick's Creek Camp Ground, on High Way 199, Del Norte Co., California, 17.11. 1995, leg. M. Moser and J. Ammirati

Comments: A collection (IB 87/242 Trail to Arizona Lake, Teton Natl. Forest, 16. Aug. 1987 leg. M. Moser), has somewhat larger spores (10.6-11.8(-12) x 5.6-6.8 μm which come closer to *C. varius*. Spore measurements in European collections of *C. varius* : 10-12-13x5.5-6 μm. Context with KOH, NaOH and NH_4OH deep chrome yellow.

7. Key to American species of section Percomes Brandr. & Melot

1. Odor very strong and unpleasant earthy or of green corn. Basidiomata rather robust species *C. superbus* A.H.Smith

1*. Odor more aromatic and spicy or of green apples **2**
2. Lamellae yellow or greenish yellow **3**
2*. Lamellae at first argillaceous. *C. cephalixoides* Mos. & Thiers
3. Lamellae lemon yellow when young. Odor sweetish aromatic, spicy, (majoram etc.) *C. percomis* Fr.
3*. Lamellae dingy greenish yellow . Habit of *C. superbus*
C. superbus var. aromaticus

Note: If basidiomata have a more or less marginate bulb, check *C. guttatus* R. Hry. (Moser & Ammirati 1996)

Notes on *Cortinarius percomis* Fr.

This taxon, common in the Pacific states, is rather rare in the Greater Yellowstone Area in most years. It has been observed only three times in the years from 1983 to 1995. In 1997 it was rather common and was observed as large specimens, sometimes in fairy rings and in clusters of seven to eight specimen. Only a few samples have been collected, as it is otherwise a well known species. In collection IB 97/239 fruit-bodies with pilei from 45-90 mm and stipes from 40-90 x 20-40 mm were observed, growing in clusters.

Collections examined: IB 83/345, Northeast entrance to Yellowstone National Park, 23 Aug 1983, IB 97/217, Medine Bow Mts., Snowy Range, near origin of Barretts Creek, Wyo, leg. M. Moser, 19 Aug. 1997, 97/239, Southwest Brooks Lake Lodge, Shoshone Natl. Forest, leg. M. Moser, 23 Aug 1997. JFA11410 (WTU) Brooks Lake Lodge, Shoshone Natl. Forest, leg. J. Ammirati 27 Aug. 1995, MTS 4130 (WTU) Flagstaff Road, Teton Natl. Forest, 19 Aug. 1995, leg. M. T. Seidl and J. Ammirati, JFA 11431 (WTU), same location, 30 Aug. 1995, leg. J. Ammirati, MTS 4134 (WTU) Four Mile Meadow, Teton Natl. Forest, 31 Aug 1995, leg. M. T. Seidl.

First record of *Cortinarius superbus* A.H. Smith for Wyoming.

This striking robust and often large species with very strong disagreable earthy (green corn) odor was collected at Taggart Lake, Teton National Park, Wyo, coll. IB 97/147 on 9 August 1997. We have a number of records from Washington, Oregon, and California. This provoked a discussion, whether *C. russeoides* Mos. from Europe could be identical with *C. superbus*. Both species have the same very unpleasant, penetrating odor which can be perceived even from herbarium specimens and even plastic bags in which this fungi were kept for some time, retain the odor for several years. However, *C.*

russeoides is very common on calcareous soils in conifer forests of several parts of Europe, particularely in the Alps and the senior author has seen many thousends of basidiomata. There is a constant difference in size and habit of the basidiomata, which are slender in the European taxon (pileus 30-70 mm, stipe 40-100 mm long, 7-20(-25) mm thick, spores of coll.IB 51/179 9-12x5.5-7.5(-8) µm), whereas the American taxon is constantly rather robust and large (pileus 40-120 mm, stipe 45-130 x 25-30 mm). Colors and veil condition are similar as well as the spore size and shape. Spore measurements for *C. superbus* in Smith coll. 17680 : 12.3-14.1x6.9-7.9 µm, mean 13.1(S=0.5)x7.5(S=0.3) µm, Q=1.6-1.9, mean 1.7 (S=0.06), V=311-466 µm^3 , mean 391 µm^3. IB 91/655: 10.6-12.4x6.5-7.4 µm, mean 11.6(S=0.5)x7.1 (S=0.16) µm, Q=1.5-1.8, mean 1.65, V= 260-345 µm^3, mean 306 µm^3; IB 95/245: 10.9-13.5x6.5-7.7 µm, mean 12.1(S=0.6)x7.0 (S=0.28) µm, Q=1.5-1.8 , mean 1.7, V=258-414 µm^3, mean 313 (S=35) µm^3.
Collections examined: Washington: A.H. Smith 17680 (holotype, MICH) Olympic Hot Springs, Olympic Natl. Park, 8 Oct. 1941.; IB 95/245, Lake Angeles Trail, Olympic Natl. Park, 5 Oct. 1995, leg. M. Moser.- **Wyoming**: 97/147, Taggart Lake, Teton Natl. Park, 3 Aug. 1997, leg. M. Moser.- **California**: IB 91/655, Russian Gulch State Park, Mendocino, 5 Dec. 1991 leg. M. Moser,

From the Mt. Hood area in Oregon we collected a variety which had a green-corn odor only when freshly collected, but when cut or lying around for some time this odor disappeared and became a distinctly aromatic, sweetish odor, mixed fruity and of green apples or even slightly sweetish, spicy (of majoram).
The spores slightly larger, 10.6-15.6x5.9-7.7 µm, mean 12.3(S=1.2)x6.7(S=0.4), Q=1.6-2.2 , mean 1.8 , V=202-4.77 µm^3, mean 296 (S=61)µm^3 .
Collection examined: IB 95/370, Clear Creek Camp Ground , Mt. Hood area, Oregon, mixed conifer forest (*Abies lasiocarpa, A. grandis, Larix, Picea engelmannii, Tsuga, Pseudotsuga)* 25. Oct. 1995 leg. M. Moser

This above described taxon seems to deserves recognition as a form :

***Cortinarius (Phlegmnacium) superbus* A.H.Smith forma *aromaticus* Mos. fm. nov.**
Differt a typo odore variabili, aromatico, fruticoso.
Holotypus IB 95/370, Clear Creek Camp Grd., Clallam.Co., Oregon, 25 Aug. 1995, leg. M. Moser

Comments: Melot (1987) synonymizes *Cortinarius nanceiensis* R. Mre. with *C. mussivus* (Fr.) Melot and regards *C. russeoides* Mos. as synonym of *C. mussivus* var. *sulphureus* (Lindgren) Melot. Brandrud et al. (1998)

synonymize *C. russeoides* with *mussivus*, but maintain *C. nanceiensis* as distinct taxon. We can not agree with either of this synonymies. Fries described *Agaricus (Hebeloma) mussivus* in Epicrisis (1838). This description contains several characters which can not be found in *C. russeoides*. These are "lamellis flavidis", "pileus flavus l. disco crustallino","caro flava","odor debilis not ingratus". In Monographia (1857) he calls the colors bright, the stipe very fleshy, 10 cm long, mostly 2.5 cm thick, yellow, ... veil fibrillose, very fugacious. The pileus 5-10 cm broad, dissolved in squamules or unicolorous yellow or disc darker brown, flesh yellow, gills at first yellow, flesh becoming yellow and again odor weak, not unpleasant. *Cortinarius russeoides* to the contrary has greenish, greenish yellow to olive-yellow and olive-brown colors in the lamellae and on the stipe. The pileus is never yellow, the veil is not fugacious but persistent and brownish to grayish violaceous and the odor is extremely unpleasant and strong and persists even in exsiccati for years. This all is in clear contradiction to the description of *Agaricus mussivus* Fr.

Cortinarius (Phlegmacium) cephalixoides Mos. & Thiers (1995)

This species was described in part I of this series (Moser, McKnight and Ammirati 1995). We assumed at that time, that the species would be related to the group which includes *C. cephalixus*. A new record, however, made it clear, that this taxon is very closely related to the European species *C. citrinoolivaceus* Mos. and we can not fully exclude this as the correct name. Both taxa seem to be very rare and thus it is difficult to judge the full range of variability. We provide a description of the new record below.

Pileus 40-50 mm diam., convex to obtusely conico-campanulate, glutinous, with yellow-brown colors, margin with more yellow, Caill 79M, toward the disc more brown, Caill 60P, and only very slightly and indistinctly innately fibrillose. **Lamellae** argillaceous, Tilleul Buff(R) or slightly darker, rounded adnate to emarginate, edges uneven to eroded, close to crowded, L= 100-105, l=1-3, 24-25/cm at margin, 3-5 mm wide (equalling 1-0.7x thickness of pileus context). **Stipe** 50-75 mm long, 15-16 mm thick above, 20-23 at the base, clavate, pale yellow, with yellow veil remains which can discolor with age and become slightly brownish.
Context whitish in pileus, yellow in stipe. Odor when cut strongly grassy or of green apples. Taste mild. **Chemical reactions**: KOH greenish on context and pileipellis. Under **UV** pileus and stipe red, gills

yellow, context in pileus partly bluish, in upper stipe yellow, in lower stipe reddish.
Microscopic characters: Basidiospores 10.9-13.7x6.7-8.1 μm, mean 12.6 (S=0.8) x 7.36 (S=0.34) μm, Q=1.5-1.86, mean 1.7 , V= 282-471 μm^3, mean 360 μm^3, almond-shaped, verrucose, apex more or less glabrous. Without cheilocystidia. Basidia 4-spored, clavate, subventricose, 38-44x9-10 μm, subhymenial hyphae 2-4, hyphae in lateral strata 4-7 μm, in mediostratum 11-14 μm, very pale yellowish, nearly colorless, clamp connections present. Pileipellis with gelatinous pellicle of 4-7 μm wide hyphae, rather irregular, clamp connections present, partly colorless, partly with olivaceous content. Epicuticular hyphae 6-8 μm, with pale to darker olivaceous content, hypocutis subcellular.

Habitat: under *Picea engelmannii, Abies lasiocarpa*, at "Calypso" Creek, Flagstaff Road, Teton National Forest,
Collections examined: **Wyoming**: IB 97/222 and JFA 12444 (WTU) leg. J. Ammirati, 21 Aug. 1997

We have one other record which belongs to this group but differs by having a smaller habit, a rather strong odor of green apples, and slightly narrower spores.

Pileus 70 mm diam, convex, margin already straight in young specimen, glutinous, brown with some olive tints, center darker, margin paler, margin near Clay Color (R), center near Sayal Brown (R) but with an olive cast, surface not innately fibrillose. **Lamellae** near Sayal Brown (R) but paler, not greenish or yellowish at first, crowded, L=100, l=1-3, about 15/ cm at margin, 6-7 mm broad (which equals thickness of pileus context), emarginate, edges uneven. **Stipe** 60 mm long, 18 mm thick, base 28 mm, greenish yellow, Sulphur Yellow (R). **Veil** yellowish ? (not visible in the collected specimen). **Context** whitish or pallid towards margin of pileus yellow in the center, deeper greenish yellow in stipe, between Caill 85L and 85M, in stipe base discoloring brownish to reddish brown, the surface of stipe base also slightly so. **Odor** rather strong of green apples, also slightly of fresh baked bread. **Chemical reactions**: KOH on context greenish, slowly olive-grey-brown on pileipellis. Under **UV** pileus red mixed with some dingy yellow, stipe purplish, apex bluish, context orange-yellow in stipe.
Microscopic characters: Basidiospores 12.2-15x6.5-7.4 μm, mean 13.5(S=0.6)x6.8(S=0.2) μm, Q=1.8-2,3, mean 2.0(S=0.09), V=268-425 μm^3, mean 332 (S=33) μm^3, slender almond-shaped, verrucose. Basidia 36-39(40) x9-9.5(-10) μm, 4-spored, clavate, subhymenial hyphae 4-5 μm,

trama hyphae 6-12(-15) μm, in mediostratum up to 25 μm, colorless or very pale olivaceous, clamp connections present. Without cheilocystidia, Pileipellis with gelatinous layer with ascending to irregularly erect hyphae, 2.5-3.5(-4) μm, with olivaceous content, clamp connections present. Epicuticular hyphae 5-11 μm, nearly colorless or with pale olivaceous brown walls, easily separating from pileus trama.

Habitat: Under *Picea engelmannii*. IB 89/207 and JFA 9909 (WTU), Fourmile Meadow, Teton Natl. Forest, Wyoming, 11 Aug. 1989.

Comments: The yellow or greenish tints in the lamellae, the size of the spores, and the type of KOH reaction could indicate that this collection may also belong to *C. cephalixoides*. The spores are narrower, however. The locality of collection 97/222 is about 0.3-0.5 mile from the site of the collections from 1987. Collection 89/207 was found about 1.5 miles away on the northern side of the Blackrock Creek. In *C. citrinoolivaceus* Mos. the spores are of the same shape and size, 11.2-13.5x6.5-7.8 μm, mean 12.6(S=0.6)x7.2(S=0.3) μm, Q=1.6-1.9, mean 1.76, V=245-434 μm^3, mean 342(S=39) μm^3, almond-shaped and strongly verrucose. This agrees well with the collections from Flagstaff Rd. The colors of pileus, gills and stipe are similar, however, the color of the veil is brownish-violaceous in the European taxon.

8. Section Infracti Brandr. & Melot

Cortinarius (Phlegmacium) infractus Fr. var. flavus Mos. var. nov. (Fig.6(5), 8e)

Differt a typo coloribus pilei flavo-brunneis usque flavis, lamellarum pallidiore, olivaceo-brunneis, sapore leviter amariusculo, fere miti.
Habitatio in silvis coniferis subalpinis (*Picea engelmannii, Abies lasiocarpa).*
Holotypus IB 97/169, prope Brooks Lake Lodge, Shoshone Natl. Forest, Wyoming, 12 Aug. 1997 leg. M. Moser.

Since 1983 we have observed many times a fungus which clearly belongs to the *C. infractus* complex but certainly deserves the status of a variety.

Pileus 20-80 mm diam, convex, margin at first involute, glutinous, margin hygrophanous, color yellow-brown to almost yellow, (Caill 60M to N to 65M), marginal zone with olivaceous grayish color, (Caill 69N to 70N, 90M, 90N, 91N or also paler 89L, 90L or yellow 89K to 87L). **Lamellae** olivaceous brownish, (Caill 67N, 70P to 69N, 69P, Mu

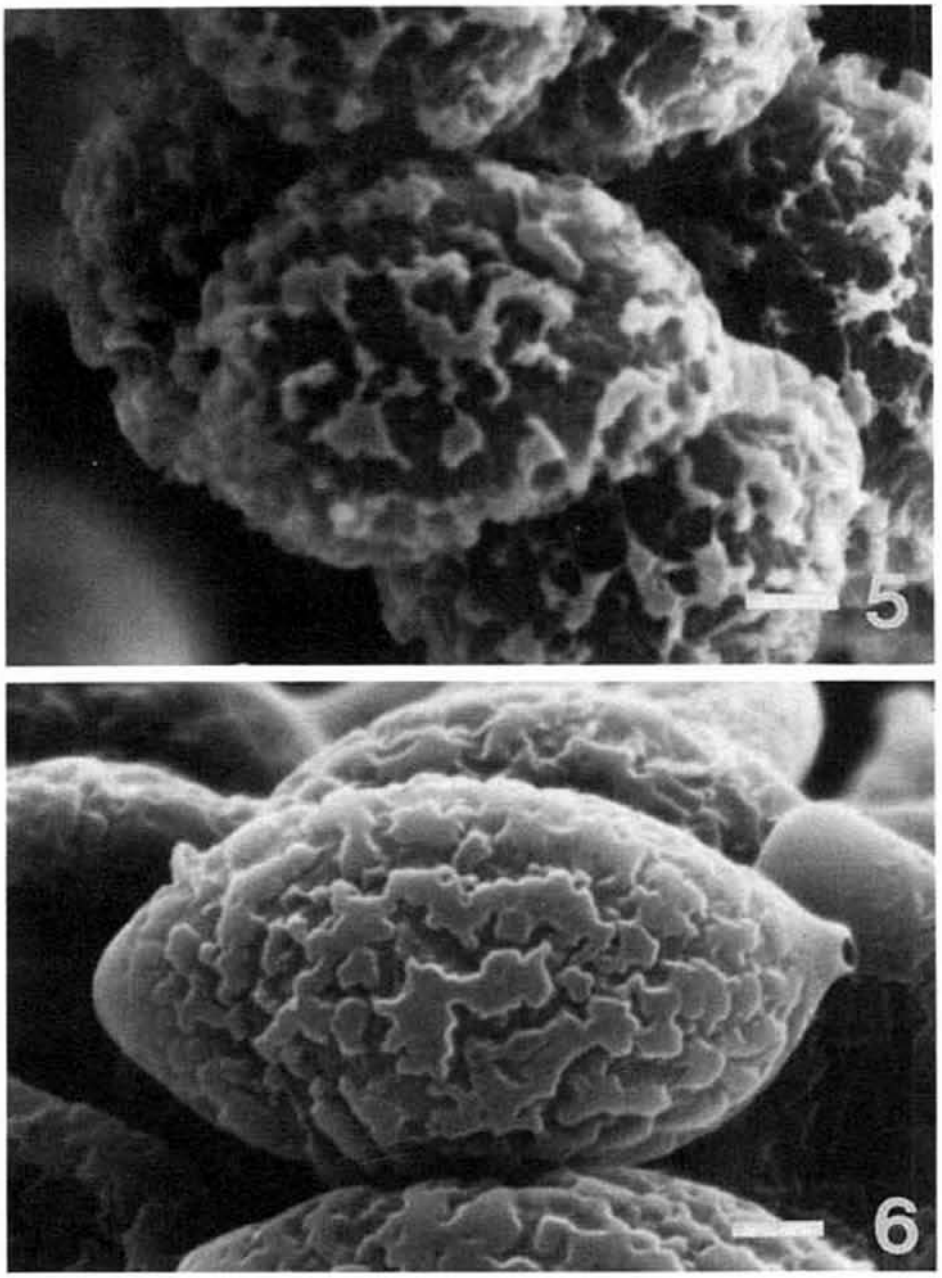

Fig. 6. Spores in SEM of : 5. *Cortinarius infractus* var. *flavus* (97/189). 6. *Cortinarius sannio* (97/352) (Bar = 1 μm).

10YR4/6), rounded adnate, edges eroded, paler, close to moderately crowded, L=(40)-100-120, l=1-3, 17-18/cm at margin, 4-8 mm wide, equal to about 1/2 to 1x thickness of pileus context. **Stipe** 25-70 mm long, 10-16 mm thick, the base 12-20 mm, equal or clavate, pale gray at first, below the cortina often with yellowish covering (veil remains ?), then grayish brown with an olivacous cast and innately fibrillose (darker and paler).
Veil whitish. **Context** Pale Olive Buff (R) to Tileul Buff (R), in stipe grayish marbled. **Odor** very slightly of cedar wood (?) or fungaceous, taste only very slightly bitter, nearly mild.
Chemical characters: KOH negative, NH_4OH negative on context and pileus surface, lugol brown, silver nitrate blackish. Under **UV** pileus dingy red with dingy yellow areas, stipe dingy red, context blue.
Microscopic characters: Basidiospores 6.7-8.5x4.8-6.1 (6.6) µm, mean 7.6(S=0.4)x5.4(S=0.2) µm, Q= 1.25-1.6, mean 1.4 (S=0.08), V= 86-161 μm^3, mean 118 (S=14) μm^3, drop-shaped to subglobose or subamygdaliform. Cheilocystidia absent, basidia clavate, 4-spored, 30-32x7.5-8 µm, subhymenial hyphae 2-3.5 µm, trama hyphae 5-7(-8), in mediostratum up to 12 µm, colorless to very pale yellowish gray, slightly encrusted, clamp connections present. Pileipellis with gelatinous pellicle, hyphae irregular, 2-3(-4) µm wide, pale yellowish, with clamp connections. Epicutis a thick layer of hyphae 5.5-8 µm, walls pale yellow, with clamp connections, in hypocutis up to 12 µm, walls paler yellowish, more irregular.

Habitat: in conifer forests under *Picea engelmannii, Abies lasiocarpa.*
Collections examined: IB 83/182, west of Teton Pass, Targhee Natl. Forest, 2 Aug. 1998, leg. M. Moser; IB 87/65, above Turpin Meadow, Teton Natl. Forest, 23 Jul. 1987 leg. M. Moser; IB 97/169, southwest of Brooks Lake Lodge, Shoshone Natl. Forest, Wyoming, leg. M. Moser 12 Aug. 1997, (holotype) - IB 97/265, same area 27 Aug. 1997

Comments: This variety differs from typical *C. infractus* by the yellowish colors of the pileus surface, the distinctly paler gills, and a very slightly bitterish, sometimes nearly mild taste. This variety is actually the common form in the whole Greater Yellowstone area, while the typical variety is relatively rare.

9. Cortinarius (Phlegmacium) sannio **Mos. spec. nov.**
ethymology: sannio = harlequin
(Fig.5(6), 7, 9e)

Pileo 55-75(-10) mm lato, convexo, margine primo involuto, disco mox applanato, glutinoso, coloribus mixtis, primo olivaceo-ochraceis, dein pallide ochraceis leviter olivaceo tincto praecipue marginem versus, disco magis olivaceo-brunneo, variegato vel innato fibrilloso, aetate olivaceo-brunneo vel in fundo bubalino brunneo innato-fibrilloso; lamellis primo pallide rosaceo-bubalinis, vinaceo-bubalinis, dein avellaneis, argillaceis, adnatis usque emarginatis, confertis, acie subserrulato, 5-10 mm latis; stipite 35-50 mm longo, 15-28 mm crasso, bulbo marginato 25-45 mm, primo pallide flavo, demum e velo violaceo, interdum solo in parte inferiore, bulbo infra violaceo, mycelio albido, cortina flavidula, velo universale violaceo, carne albida, odore grato condimenti; sporis 9.1-11.7x4.7-5.9 µm, amygdaliformibus usque sublimoniformibus, verrucosis, basidiis 30-35x7.5-9 µm, clavatis, tetrasporigeris, absque cheilocystidiis.
Habitatio; in silvis coniferis subalpinis (*Picea engelmannii, Abies lasiocarpa, Pinus albicaulis).* Holotypus IB 97/352, infra lacum dicto "Lost Lake", Teton Natl. Forst, Wyoming, U.S.A., 10 Sept. 1997, leg. M. Moser.

Pileus 55-75 (105) mm diam, convex, margin at first involute, but sometimes disc already applanate in young specimens, marginella remaining involute also in mature specimens, glutinous, colors rather mixed, in buttons margin olivaceous ocher, Caill 89K, later pallid, ochraceous with slight olivaceous cast particularely near margin, in old specimens retaining some of these colors but brown areas extending more to the margin, towards disc with olive-brown colors, Caill 87L, 77L, 77N, 65N 69P to 69R, finely marbled or innate fibrillose, and with some darker spots, Bister (R), in old specimens becoming pale olive-brown, Caill 77N and disc more brown, 57P, 59P, toward margin somewhat innate fibrillose, in age also occurring with Pinkish Buff (R) ground color and brown innate fibrils. **Lamellae** in young stages Pinkish Buff (R) to Vinaceous Buff (R), later Avellaneous (R), finally Clay Color (R), edges uneven to eroded, rounded adnate to emarginate, crowded, L = 120-130, l = 1-3, 18-22/cm at margin, 5-10 mm wide, equal to thickness of pileus context or less. **Stipe** 35-50 mm long, 15-28 mm thick, the marginate bulb 25-45 mm, in young specimens pallid, Marguerite Yellow (R), later violet often up to the apex but often only in lower part and the violet color comes from the veil, Grayish Lavender (R), bulb underneath violet but basal mycelium white. Bulb margin sometimes becoming ochraceous. **Cortina** yellowish, universal **veil** violaceous. **Context** whitish, Pale Pinkish Buff (R). **Odor** weak but pleasant, somewhat spicy, taste mild. **Chemical reactions**: KOH negative or slightly brownish on context, darker brown on pileipellis. No reaction on violet parts. Under **UV** pileus dull yellow with dingy reddish areas, stipe bluish or partly yellow, gills bluish gray, context blue mixed with yellow areas.

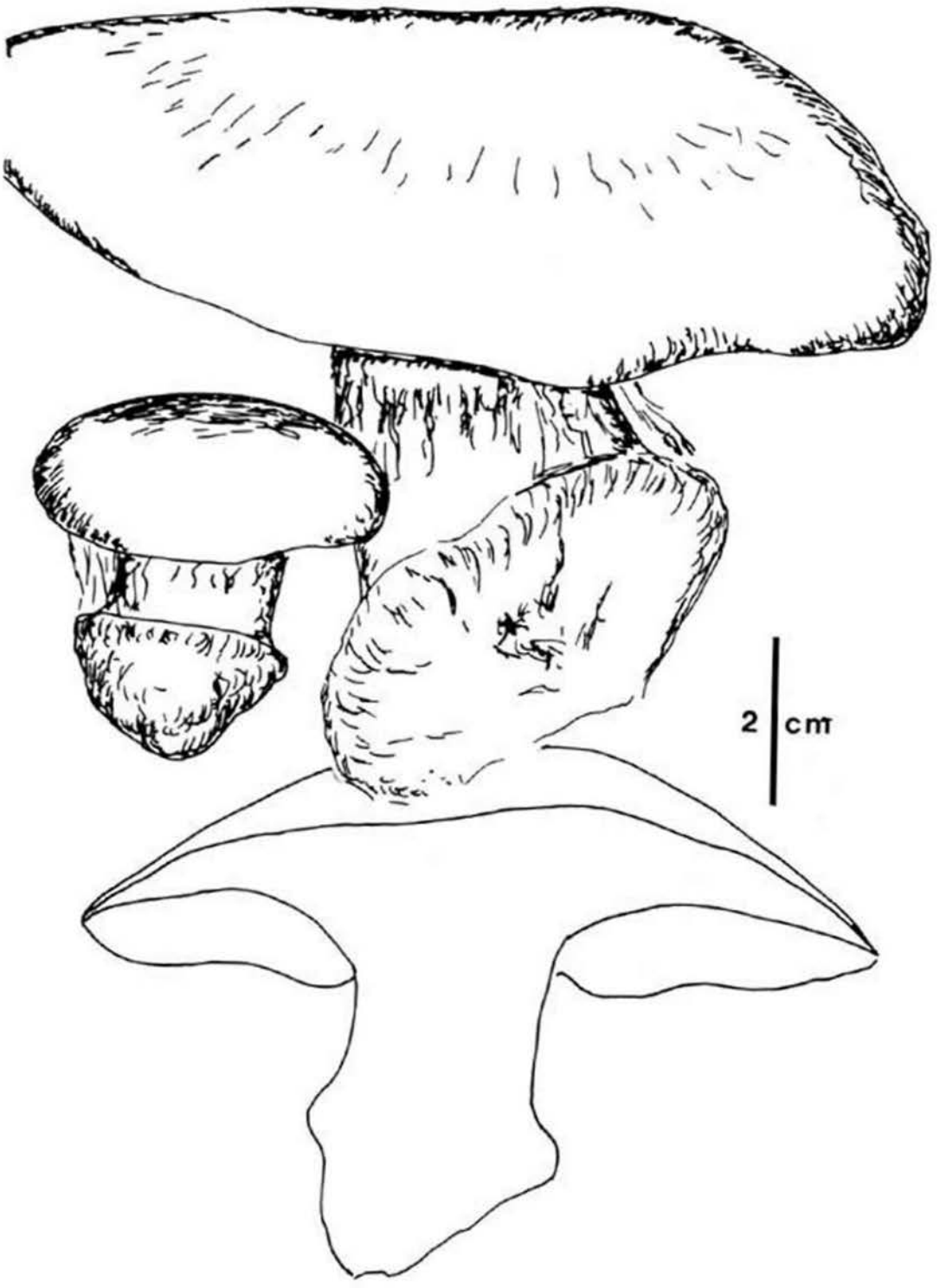

Fig.7. *Cortinarius sannio*. Fruit-bodies (97/352) (nat. size).

Microscopic characters: Spores almond-shaped to mostly sublimoniform, 9.1-11.7x 4.7-5.9 μm, mean 10.3 (S=0.5)x 5.5 (S=0.3) μm, verrucose, apex smooth, without cheilocystidia, basidia clavate, 4-spored, 30-35x7.5-9 μm, subhymenial hyphae 3-4 μm, trama hyphae 6-9 μm, in mediostratum up to 20 μm, colorless or walls very pale ochraceous, with clamp connections. Pileipellis with gelatinous pellicle of 2.5-5.5 μm wide hyphae, walls colorless to slightly ochraceous or yellowish, with clamp connections, subrepent to irregular, epicuticular hyphae 5.5-8 μm, walls yellow-brown, in hypocutis hyphae 10-15(16) μm, walls yellowish to yellowish brown, paler than in epicutis, segments moderately long, narrowed at septae.

Habitat. Subalpine conifer forests, with *Picea engelmannii, Abies lasiocarpa, Pinus albicaulis.*

Collections examined: IB 97/297, Lake east of Two Ocean Mtn, 2900m, Shoshone Natl. Forest, Wyoming, leg. M.Moser 31 Aug 1997; IB 97/352, below Lost Lake, Teton National Forest, leg. M. Moser, 10 Sept. 1997(holotype).

Comments: This species is particularly characterised by the mixture of different colors, the yellow cortina and violet universal veil. At present the relationship remains uncertain but we place it temporarily in section Callochroi.

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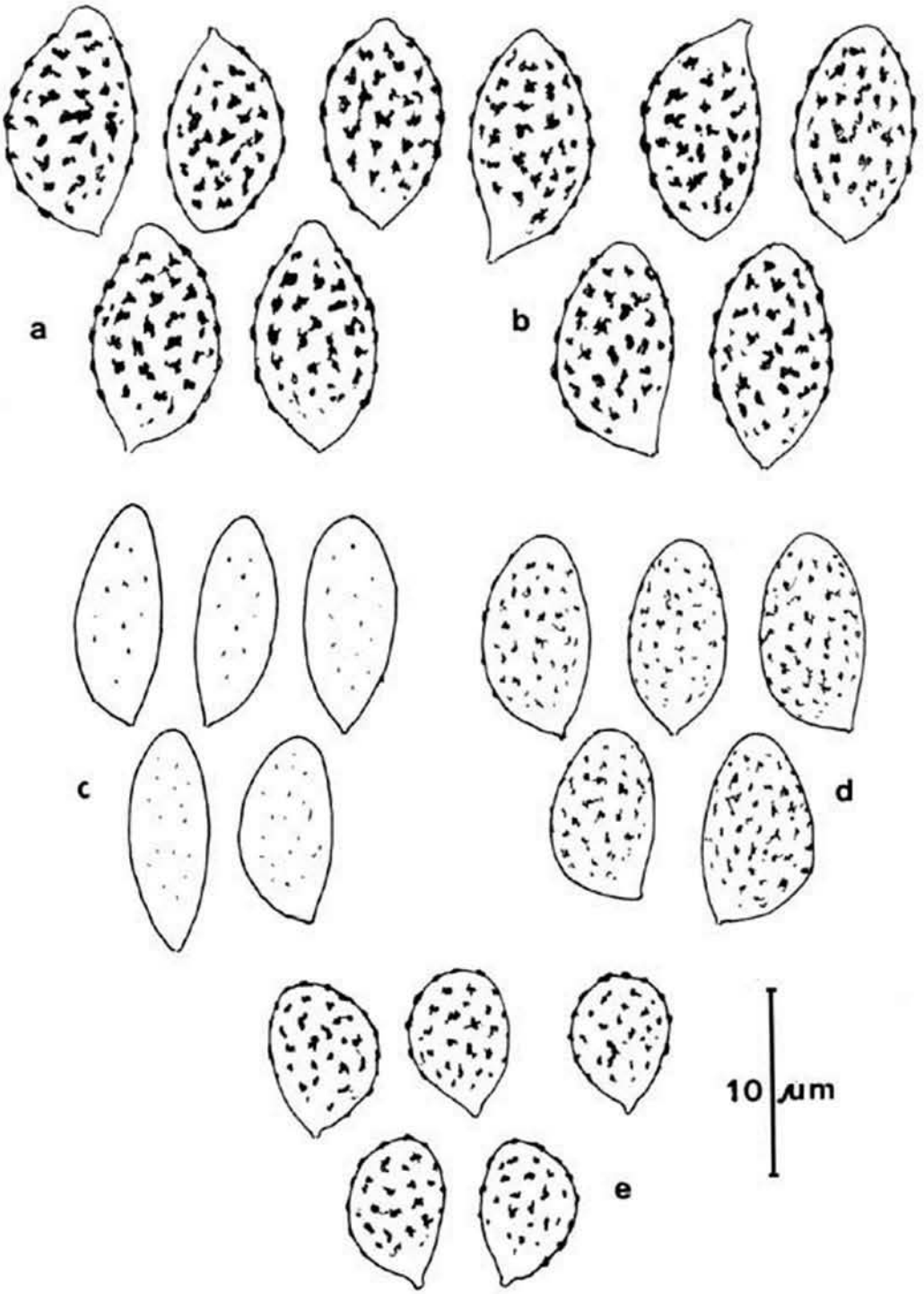

Fig.8. Basidiospores of :a. *Cortinarius calojanthinus* (97/220). b. *C.citriolens*(97/157). c.*C. pseudovariegatus* (97/296). d. *C. variosimilis* (89/493). e. *C. infractus* var. flavus (97/169). (x 2000).

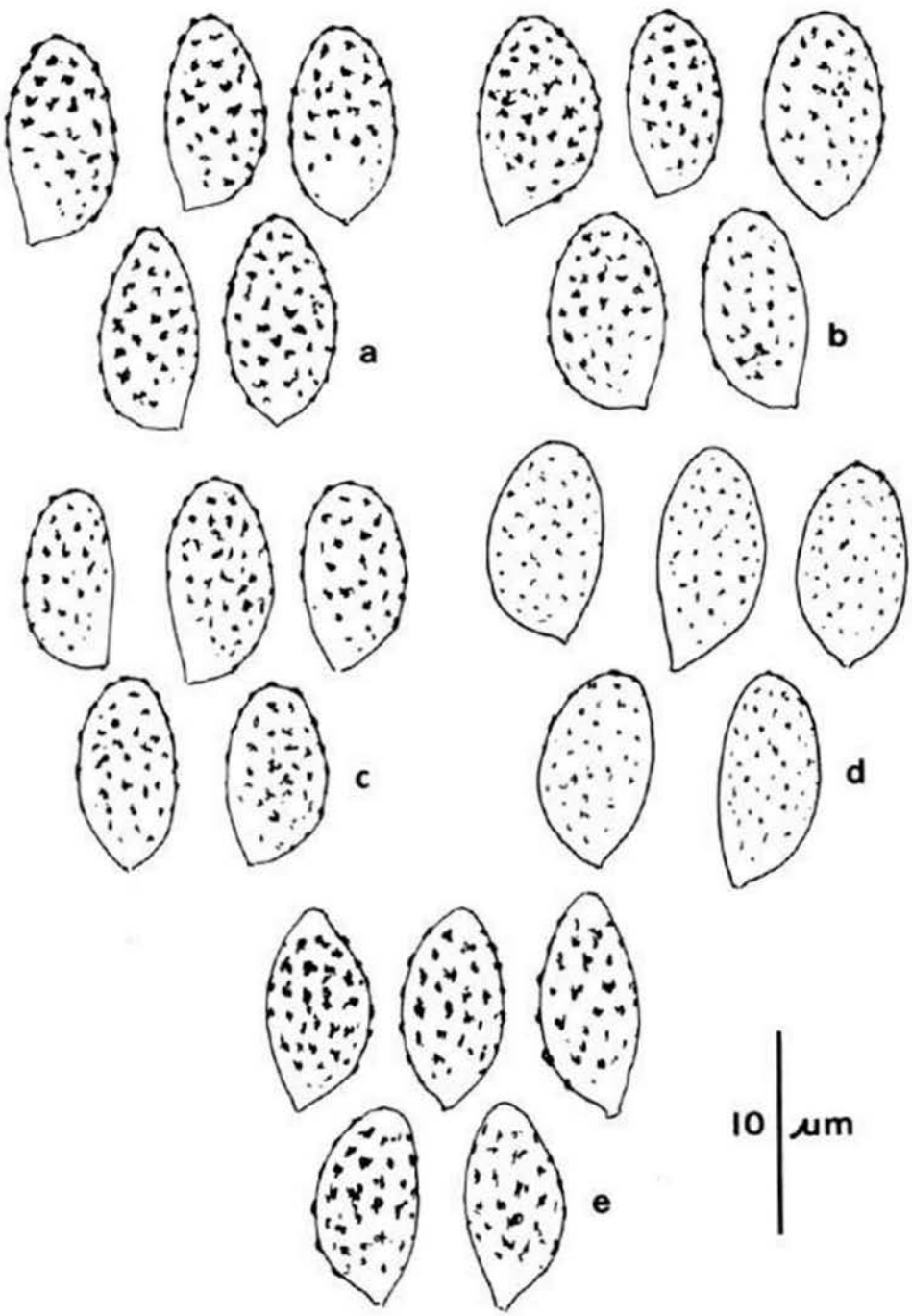

Fig. 9. Basidiospores of: a. *Cortinarius subfoetidus* var.*bubalinovelatus* (95/607). b.*C. subfoetidus* (holotype of Smith 17778). c. *C. subfoetidus* (97/458). d. *C. cephalixus* var. *aurantiobrunneus* (94/189). e. *C. sannio* (97/352) (x 2000)