

A FIELD KEY TO COMMON GENERA OF HYPOGEOUS AND GASTERIOD BASIDIOMYCETES OF NORTH AMERICA

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INTRODUCTION

To honor the tenth anniversary of the North American Truffling Society (NATS) in 1987, the author taught a course entitled "Truffles of the Pacific Northwest" at Linn-Benton Community College near Corvallis, Oregon. As part of that course he assembled and distributed a field key to hypogeous fungi, including both ascomycetes (true truffles) and basidiomycetes (false truffles), which would allow NATS members, most of whom did not have ready access to a microscope, to identify most of their collections to genus. The key was extensively used and revised. In honor of the twentieth anniversary of NATS, the present paper is a field key to hypogeous and gasteroid basidiomycetes (and one additional subdivision that may be confusing in the field).

The task of producing a field key to hypogeous fungi is a difficult one. Many of the characters that serve to distinguish genera and species require the use of a microscope. In order to use only macroscopic characters in this key, several not-so-common genera have been intentionally omitted. The key is admittedly artificial, but an attempt has been made to structure it so that omitted genera will key out to a related genus, and with the use of a microscope and appropriate literature, should be readily identifiable.

This key is not intended as a substitute for a well rounded regimen of ecological, morphological, and microscopical study. However, it is hoped that the key will allow interested persons that do not have access to a microscope to identify most common genera of hypogeous basidiomycetes.

METHODS AND MATERIALS

There are many sources describing the best ways to collect fleshy fungi (Miller 1978; Arora 1986) and there is no need to repeat this information here, except to point out that truffles are fleshy fungi too, and will become rotten and disgusting just like any mushroom if left in a plastic bag even for a few hours. Therefore collecting should be done with wax-paper bags or compartmentalized plastic fishing-tackle boxes. Although notes on the fresh condition should be taken as soon after collecting as possible, it is generally not advisable to cut into all of the sporocarps while in the field unless sufficient time can be spent to study the specimen and assess the best way to cut it to reveal the necessary structures. If you do follow that practice (admittedly, most of us can't always control our excitement), it is best to assess the fresh odor, taste, color etc. at the same time.

The following key is best used when a full range of developmental features are present in a single collection, i.e. young, mature and old specimens all collected from a relatively close proximity. Young, immature sporocarps will be difficult to identify, but may provide clues as to color, odor etc. Full utilization of the key also requires the use of a sharp knife or preferably a razor blade, hand lens and various macrochemical reagents. When the sporocarps are cut open to reveal detail in the gleba, a true vertical, median section should be used, i.e. cut vertically from the base through to the apex. This is important because the terminology of the columella, gleba, and peridium is based on a true, vertical, median view, and would otherwise be confusing. In addition, mushroom buttons (from both poisonous and nonpoisonous species) often resemble gasteroid and hypogeous fungi and the best way to tell the difference is to perform a true, vertical median section and look for the embryonic mushroom form that appears in mushroom buttons but not in hypogeous or gasteroid fungi. An incorrect, transverse section of a mushroom button will appear as concentric circles and not like any of the sporocarp or gleba types described below.

MORPHOLOGY

Many of the morphological features of the fungi treated in this key are continuous or intergrade, meaning that one sporocarp, columella or gleba type may overlap slightly or greatly with another. However, there are typically limits on the amount of intergradation for any given genus which can be recognized.

Sporocarp form

Agaricoid sporocarps generally have a stipe, a cap and either gills (lamellae) or tubes (pores) where the spores are produced. This is the typical mushroom morphology (Fig. 1). **Gasteroid** sporocarps can appear very similar, with stipe-like, cap-like and gill-like structures, or they can have some degree of enclosure of the spore producing tissue either from the cap surface or by wrinkling, contorting or chambering of the gill-like structures, or both (Figs 2, 4). **Hypogeous** sporocarps typically lack any true stipe-like structure, are more or less spherical or globose, and have little, if any exposure of the spore bearing tissue. A good analogy would be a golf-ball.

Stipe, stipe-columella, or columella

The columella (including stipe, stipe-columella, and columella) for the purposes of this key is considered a reduction series in the amount and location of stipe (stalk) tissue (Figs 4-11). A **stipe** is by definition found only in agaricoid sporocarps (Fig. 1), however, the **stipe-columella** found in some gasteroid fungi is indistinguishable from a stipe, and is likely to be homologous with it (Fig 4). The **stipe-columella** found in some gasteroid and hypogeous sporocarps is much reduced in extent, and no longer serves the function of elevating the sporocarp above the ground surface (Figs. 2, 8). The **columella** is yet a further reduction in the amount and location of sterile, stipe-like tissue, and is found almost exclusively in hypogeous fungi (Figs. 5-7, 9-10). Sporocarps of some hypogeous fungi lack columella tissue (Fig. 11).

To provide additional characteristics for the key, columella types have been further subdivided into several categories. A **percurrent** columella extends completely through the sporocarp as viewed in section (Figs. 4-5) and is a condition that can be either found in a stipe, stipe-columella or columella. A **dendritic** columella forms many branches from a more or less central mass of stipe-like tissue (Fig 5). A **diffuse** columella is similar to the dendritic form, but is much less evident in both branching pattern and extent (Figs 6-7). A **sterile base** can either resemble a short nonpercurrent stipe-columella (Fig 8) or a more reduced mass of stipe-like tissue at the base of a hypogeous sporocarp (Fig. 9). A **central** columella typically has a large spherical mass of sterile tissue near the center of the sporocarp from which rays of spore bearing tissue or peridioles radiate outward (Figs 10, 19). Other fungi exhibit **no columella** and possess no sterile stipe-like tissue when viewed in section (Figs 3, 11, 15, 17-19).

Gleba type

The gleba is a combination of sterile and spore-bearing tissue typically found enclosed by protective tissues in fungi such as puffballs, some gasteroid fungi, and hypogeous fungi. For simplicity, the term has been extended to gasteroid/agaricoid sporocarps, even though the spore-bearing tissue is exposed (Figs. 2, 12-13). The **lamellate** gleba can range from gill-like, nearly indistinguishable from that of agaricoid sporocarps, to wrinkled, contorted or chambered, but retaining the radial pattern of lamellae (Fig. 12). The lamellate gleba is typically exposed, at least to some extent. The **labyrinthiform** gleba may also retain a partial radial pattern but is composed of large to small chambers, typically irregularly bent and crumpled, formed by wrinkles, contortions or cross-walls of the glebal plates (Figs. 2, 4, 5-6, 8, 13-14). There may also be some degree of exposure. The **lacunate** gleba appears in section to be formed of large to small shallow holes or chambers, which are more or less identical in shape, and are typically only rarely exposed (Figs. 3, 7, 9, 11, 15). The gleba may also appear solid (not necessarily implying tough) in section because the chambers are, or appear to be, filled or stuffed with material. The **solid and rubbery** gleba is typically composed of minute chambers difficult to discern even with a hand lens, and the sporocarp is usually difficult to cut into (Fig. 16). In the **gel-filled** gleba, the chambers are filled at maturity with a gelatinous, usually highly colored material (Fig. 17). In the **liquid-filled** gleba, the mature chambers are filled with a material that is more fluid, and appears to bleed or flow from the chambers (Fig. 18). This material is usually not highly colored. A concern for correct interpretation of the gel-filled and liquid-filled gleba types is the degree of maturity of the specimen. These gleba types should also not be confused with exudation of a latex from the sterile tissue between chambers. The **peridiate** gleba (Fig. 19) is formed from distinct, separable packets of spores called peridioles that look like seeds. This is a rare type of gleba restricted to only one or two genera and is usually associated with a central columella type.

Spore color

The color of spores in the gleba is an important characteristic in

identifying hypogeous and gasteroid fungi and should be interpreted carefully. Frequently, the color observed in the freshly cut section is not the color of spores, rather it is the color of the sterile tissue comprising the glebal elements. A good example is the genus *Hydnangium*, which often appears purplish or flesh colored in section. However, close examination of the glebal chambers with a hand lens reveals that the spores are whitish and the tissue is purplish.

**KEY TO HYPOGEOUS AND GASTEROID
BASIDIOMYCETES BASED ON MACROSCOPIC AND
ECOLOGICAL CHARACTERISTICS**

1. Sporocarps globose to subglobose, rarely with a stipe; usually hypogeous; gleba either: solid, hard, lacking chambers **or** composed of a uniformly thickened layer lining a single, large, hollow chamber, usually with an orifice, grooves or openings to the inside **or** nearly hollow, stuffed with cottony mycelium young but powdery in age **or** composed of infolded partitions, the partitions either single or multiple and compact, in some nearly becoming solid; texture firm, solid to plastic-like, usually very brittle. Hypogeous members of Subdivision **Ascomycotina**.....(see Trappe and Castellano 1991)
1. Sporocarps globose, subglobose or like an enclosed mushroom, often with a stipe, stipe-columella or sterile base; hypogeous to epigeous; gleba composed of numerous, small or moderately large, distinct chambers **or** lamellae-like, contorted tramal plates **or** thin to moderately thick, radiating septae or tramal plates **or** numerous, tapering, centripetally arranged peridioles **or** with combinations of chambers and contorted tramal plates; **if powdery** at maturity then young sporocarps chambered or with radiating tramal plates, the chamber walls thin, breaking down, dehiscent, **if appearing** solid, then mature chambers filled with moist, gel-like material; texture soft bread-like, firm to tough and rubbery, or cartilaginous, usually not brittle. (Hypogeous and gasteroid members of Subdivision **Basidiomycotina**).....**2**
2. Sporocarps globose, subglobose to elongated or flattened, occasionally with a thick, matted cluster of basal rhizomorphs but not possessing an obvious external stipe, stipe-columella or well formed, large sterile base; gleba usually not exposed to the surface, but if gleba exposed, then peridium entirely lacking or present in a large patch near the apex; hypogeous, subepigeous or occasionally epigeous; mostly ectomycorrhizal**3**
2. Sporocarps variously shaped but agaricoid or gasteroid, with a stipe, stipe-columella or sterile base that is evident before sectioning, often resembling a contorted mushroom, an unexpanded mushroom button, or a fully developed but unopened mushroom; with or without a small or large portion of the gleba exposed; hypogeous, subepigeous or frequently epigeous; ectomycorrhizal or saprotrophic**46**
3. Sporocarps when cut with true vertical section possessing a small or large

- columella or small sterile base in the gleba **or** densely matted cluster of rhizomorphs resembling a sterile base4
3. Sporocarps when cut with true vertical section not possessing a columella or sterile base in the gleba.....31
 4. Gleba of centripetally or radially arranged tramal plates **or** peridioles extending from central columella or sterile base **or** of chambers evident at youth but becoming powdery at maturity.....5
 4. Gleba composed of numerous, small or large chambers, occasionally requiring a hand lens to be visible9
 5. Gleba of radially arranged, tapering black peridioles.....**Pyrenogaster**
 5. Gleba of radiating tramal plates or chambers in youth but rapidly becoming powdery at maturity.....6
 6. Gleba with persistent central columella7
 6. Gleba lacking a columella8
 7. Gleba brown, dark brown or black at full development; tramal plates radiating centripetally from spherical central columella or sterile base.....**Radiigera**
 7. Gleba black at full development ; tramal plates and chambers pendant from disk of sterile tissue supported by a percurrent columella composed of thick rhizomorphs; peridium thick, leathery, dehiscing**Sedecula**
 8. Thick outer peridium tomentose, and usually splitting into well formed stellate pattern in age; gleba brown to dark brown usually contained in a leathery inner peridium.....**Astraeus**
 8. Thick outer peridium mostly not splitting into stellate pattern in age, or if so, peridium not tomentose; gleba black, powdery at maturity and not contained in an inner peridium.....**Scleroderma**
 9. Gleba darkly or brightly colored, usually in the range of brown, pink, yellow, orange, green or blue-green.....10
 9. Gleba typically white or off-white.....28
 10. Gleba gray-brown, brown, red-brown to dark brown11
 10. Gleba variously colored, occasionally olive to olive brown but not brown.....19
 11. Sporocarp lacking peridium; reaction to Melzer's reagent giving a dextrinoid reaction**Protogautieria**
 11. Sporocarp with well developed peridium entirely covering gleba; reaction to Melzer's reagent various, but usually not dextrinoid.....12
 12. Gleba of chambers filled with gel-like material**Destuntzia**
 12. Gleba of small or large chambers, containing spores but not filled at maturity with gel-like material13
 13. Columella well developed, dendritic or percurrent14
 13. Columella poorly developed or lacking; sterile base may be present....16

14. Sporocarps usually soft, fleshy, to firm but not cartilaginous or rubbery, columella or stipe-columella present**Gymnoglossum**
14. Sporocarps usually cartilaginous, tough or rubbery; columella usually diffuse, never a percurrent stipe-columella or columella.....**15**
15. Sporocarps medium to large; peridium usually thin, evanescent, white or pale brown; gleba gray brown, red brown, brown or dark brown.....**Gautieria**
15. Sporocarps usually small; peridium thick, persistent, white; gleba pink to red brown**Hysterangium**
16. Gleba strongly amyloid in Melzer's reagent.....**17**
16. Gleba not amyloid in Melzer's reagent, but may be slightly dextrinoid.....**18**
17. Brown color of gleba usually from discoloring reaction of tramal tissue and not from accumulation of spores; odor strong, oily, of maple syrup or slightly of rubber.....**Martellia** (including **Gymnomyces**)
17. Brown color of gleba usually from accumulation of spores in the glebal chambers; odor absent or different.....**Martellia**
18. Fresh sporocarps with strong, penetrating, farinaceous odor**Hymenogaster**
18. Fresh sporocarps with no or different odor**Octavianina**
19. Gleba usually some shade of green including yellow green, olive green, blue green.....**20**
19. Gleba some shade of pink, yellow, orange, or gray-blue.....**22**
20. Columella derived from a stubby sterile base, percurrent or nearly percurrent, dentritic; fleshy but not cartilaginous or gelatinous except in age.....**Truncocolumella**
20. Columella absent or simple or branched; glebal tissues cartilaginous or gelatinous.....**21**
21. Sporocarps single or loosely clustered, habitat various; cartilaginous and rubbery, the peridium often cleanly separating from the gleba, associated with a variety of tree hosts.....**Hysterangium**
21. Sporocarps, tightly clustered, encased in heavy mycelium, hyphal strands, soil and ectomycorrhizal rootlets, moderately gelatinous associated with *Eucalyptus***Chondrogaster**
22. Fresh gleba when cut exuding a latex.....**23**
22. Fresh gleba when cut not exuding a latex.....**24**
23. Gleba amyloid in Melzer's reagent.....**Zelleromyces**
23. Gleba not amyloid in Melzer's reagent; with large orange spores that are visible with a hand-lens embedded in tissue..**Endogone** (Zygomycete)
24. Gleba blue-gray at maturity**Gautieria**
24. Gleba not blue-gray at maturity, but some shade of pink, yellow or

orange.....	25
25. Gleba some shade of pink, associated with <i>Eucalyptus</i>	<u>Hydnangium</u>
25. Gleba some shade of yellow or orange.....	26
26. Gleba amyloid in Melzer's reagent	27
26. Gleba not amyloid in Melzer's reagent	<u>Sclerogaster</u>
27. Columella or sterile base if present poorly developed.....	<u>Martellia</u>
27. Small stipe-columella, columella or sterile base present..	<u>Gymnomyces</u>
28. Gleba amyloid in Melzer's reagent.....	29
28. Gleba not amyloid in Melzer's reagent.....	<u>Octavianina</u>
29. Fresh sporocarps exuding latex when cut.....	<u>Zelleromyces</u>
29. Fresh sporocarps not exuding latex when cut.....	30
30. Columella or sterile base if present poorly developed.....	<u>Martellia</u>
30. Small stipe-columella, columella or sterile base present..	<u>Gymnomyces</u>
31. Gleba composed of empty or gel-filled chambers, or powdery at maturity, with or without a latex.....	32
31. Gleba appearing solid or with orange spores embedded in tissue visible with a hand lens, no evidence of chambers surrounded by pale colored veins, with a latex	<u>Endogone</u> (Zygomycete)
32. Gleba with chambers filled with thick, colored gel-like material, these delineated by pale colored veins.....	33
32. Gleba composed of chambers that are not filled with a gel-like material at maturity, chambers may appear empty, filled with thin, white latex or with powdery content	34
33. Gleba composed of black gel-filled chambers surrounded by pale colored veins; usually with a strong odor of latex paint.....	<u>Melanogaster</u>
33. Gleba yellow, brown, olive, brown or red colored, if black or nearly black then the peridium is colored bright yellow; usually with no or different odor.....	<u>Alpova</u>
34. Gleba white when fresh and mature, and with a scant or profuse white latex	35
34. Gleba usually not white at maturity, with or without latex or if white then no latex is present.....	36
35. Gleba with copious latex in fresh specimens; chambers 0.5-3.0 mm broad.....	<u>Leucogaster</u>
35. Gleba with scant latex in fresh specimens, this drying rapidly into a chalky, white surface, often obscuring the chambers; chambers 0.3-0.5 mm broad.....	<u>Leucophleps</u>
36. Gleba strongly amyloid in Melzer's reagent.....	37
36. Gleba not amyloid in Melzer's reagent.....	42
37. Gleba white or off-white at maturity.....	38

37. Gleba more darkly colored at maturity.....**39**
38. Sporocarp very light in weight; with a fruity or nauseous odor; and fresh the gleba is dry**Mycolevis**
38. Sporocarp more dense; with various odors but usually not nauseous, and fresh gleba moist**Martellia**
39. Fresh sporocarps exuding a copious latex.....**Zelleromyces**
39. Fresh sporocarps moist but not exuding a copious latex**40**
40. Fresh peridium quickly turning vinaceous in KOH.....**Rhizopogon**
40. Color of fresh peridium not affected by KOH.....**41**
41. Columella or sterile base if present poorly developed; brown color of gleba usually from discoloring of tramal tissue, and not from accumulation of spores**Martellia**
41. Small stipe-columella, or columella and sterile base present.....**Gymnomyces**
42. Gleba at first composed of chambers separated by pale colored veins, but at maturity gleba powdery**Scleroderma**
42. Gleba not composed of chambers separated by pale colored veins, and is not powdery at maturity.....**43**
43. Gleba gray-brown, brown, red-brown to dark brown; usually with a strong, penetrating, farinaceous odor**Hymenogaster**
43. Gleba variously colored; with a variety of odors but not farinaceous....**44**
44. Gleba some shade of pink (like *Entoloma* spore print color) at maturity, found only in the southeastern and southwestern United States**Richoniella**
44. Gleba usually some shade of white, yellow, green or brown but **if** some shade of pink then not found in the southeast or southwest **and** gleba bruises black, blue or red.....**45**
45. Gleba white to cinnamon brown at maturity, discoloring on exposure; peridium white to pink at maturity, also discoloring upon bruising; scant latex may be present.....**Octavianina**
45. Gleba various colors, gleba infrequently discoloring on exposure; peridium various colors, frequently discoloring on bruising, latex usually lacking **but if present** then from the southeastern United States with sterile veins present in gleba.....**Rhizopogon**
46. Gleba chocolate brown, dark purple brown, smoky gray, or black at full development due to coloration of the spores in mass.....**47**
46. Gleba white, yellow, orange, green, vinaceous (pale purple brown) or olive yellow, yellow brown, red brown to rusty brown at full development due to coloration of the spores in mass**55**
47. Stipe or stipe columella tough, woody in mature specimens; found in deserts and arid grasslands and steppe**48**

47. Stipe or stipe columella fleshy, even in age; found in forests in the Rockies westward and infrequently in deserts and steppe.....**52**
48. Peridium dehiscing cleanly around the circumference of margin; gleba black, lamellate, hanging free from disk of pileus.....**49**
48. Peridium not dehiscing cleanly, rather, breaking up and weathering randomly; gleba usually powdery at maturity.....**50**
49. Stipe-columella with a persistent volva and annulus..**Gyrophragmium**
49. Stipe-columella with volva but lacking an annulus**Montagnea**
50. Resembling a large unopened *Coprinus* ("inky cap", or "shaggy-mane"); annulus absent or poorly developed**51**
50. Resembling a large, unopened *Agaricus*, often bruising red, or yellow when fresh; volva absent, annulus present.....**Longula**
51. Sporocarps large, many reaching 25 cm or so; external portion of stipe-columella prominent with a bulbous base; gleba often maturing from the base of the gleba upward**Podaxis**
51. Sporocarps typically smaller; all parts of gleba maturing simultaneously; external portion of stipe-columella poorly developed, tapering to the base.....**Phellorina**
52. Trama of gleba and stipe-columella colored pale orange to pale red, turning bright red in ETOH.....**Brauniellula**
52. Trama of gleba and stipe-columella white or very pale, not turning bright red in ETOH.....**53**
53. Sporocarp robust, fleshy**54**
53. Sporocarp slender, fragile; not necessarily associated with conifers; pileus typically acutely conical; often found on dung or other decomposing organic matter; resembling an enclosed *Stropharia* or *Psilocybe***Weraroa**
54. Hypogeous to subepigeous associated with Pinaceae; resembling an enclosed or partially enclosed *Gomphidius*; gleba sublamellate and not powdery at maturity; usually yellowish near the base of the stipe-columella.....**Gomphogaster**
54. Hypogeous to subepigeous associated with Pinaceae in the Pacific Northwest; resembling a large unopened *Agaricus* button; gleba powdery at maturity; usually bruising vinaceous near the base of the stipe-columella.....**Endoptychum**
55. Spores in mass in the chambers or tramal plates white, pale yellow or orange at full development**56**
55. Spores in mass in the chambers or tramal plates green, olive yellow, olive brown, vinaceous, yellow brown, red brown to rusty brown.....**59**
56. Color of glebal trama pink to pale red; sterile base and/or small, non-percurrent columella present, easily lost or broken; gleba not amyloid in Melzer's reagent; found only in association with *Eucalyptus*

-**Hydnangium**
56. Glebal and tramal characters not as above; may or may not be found with *Eucalyptus***57**
57. Fresh gleba and/or peridium exuding latex when cut; resembling contorted or unopened *Lactarius***Arcangeliella**
57. Neither fresh gleba or peridium exuding latex when cut.....**58**
58. Percurrent stipe-columella or columella present; gleba loculate, labyrinthiform, or sublamellate, may or may not be exposed; resembling contorted or unopened *Russula*.....**Macowanites** (including **Elasmomyces**)
58. Sterile base or at most small, columella present; gleba usually loculate or at most labyrinthiform, not exposed.....**Gymnomyces**
59. Spores in mass in the chambers or tramal plates some shade of green to olive brown or vinaceous**60**
59. Spores in mass in the chambers or tramal plates some shade of yellow brown, red brown to rusty brown.....**64**
60. Gleba vinaceous at full development from coloration of spores in mass**Truncocolumella**
60. Gleba some shade of green, olive yellow to olive brown.....**61**
61. Stipe-columella present, percurrent, simple unbranched.....**62**
61. Columella present, usually branched, if percurrent then highly branched and obviously delimited from the gleba**63**
62. Gleba tubular, pendant from substantial pileus disk.....**Gastroboletus**
62. Gleba loculate, adhering to the stipe-columella, no substantial pileus disk present**Rhopalogaster**
63. Sporocarp obpyriforme, in median section with prolonged, tapering stalk-like columella, gleba found above, in the thick portion of the sporocarp, the columella dividing the gleba into sharply delimited sectors; found in eastern and southeastern North America.....**Phallogaster**
63. Sporocarp subglobose to turbinate or slightly elongated, but usually not obpyriforme; columella typically branching from sterile base**Truncocolumella**
64. Sporocarp slender; pileus conic, parabolic to cylindric, acute to narrowly obtuse.....**65**
64. Sporocarp more robust; pileus subglobose, convex or broadly conical.....**67**
65. Pileus surface filamentous under the hand-lens.....**66**
65. Pileus surface cellular under the hand lens , at least not distinctly filamentous or with velar patches; gleba lamellate; sporocarp soon deliquescent and slimy; found in pastures or grasslands**Gastrocybe**

66. Sporocarp fleshy, frail; brightly colored or drab; pileus surface often with evanescent, scattered patches or remnants of a partial veil; gleba sublamellate to chambered; often bruising blue near the base; found in arid or humid regions growing on the ground, in woods and forests, grasslands, or more rarely on woody debris**Weraroa**
66. Sporocarp dry, tough; drab or dull colored (ie. ochre, tan); pileus surface glabrous; gleba lamellate; not bruising blue; found in arid or seasonally dry regions, usually not in forests**Galeropsis**
67. Odor strong, penetrating, farinaceous; found only in association with *Eucalyptus***Setchelliogaster**
67. Odor not strong or farinaceous; found in a variety of habitats.....**68**
68. Saprophytic on twigs or logs in the springtime, often appearing as snowbanks melt, at high elevations or in mountains from the Rocky Mountains westward; reminiscent of an enclosed *Pholiota***Nivatogastrum**
68. Not saprophytic on twigs or logs; found in grassland, steppe or forests.....**69**
69. Sporocarps epigeous and nearly sessile; found in grassland or steppe habitats.....**Endoptychum**
69. Sporocarps hypogeous, subepigeous, or rarely epigeous; in conifer forests.....**70**
70. Sporocarps hypogeous, subglobose; peridium and stipe-columella bruising instantly blue; glebal plates grayish brown to dark brown from spores; sterile base or stipe-columella present, **if** stipe-columella percurrent then fragile, the external portion easily lost or broken**Chamonixia**
70. Sporocarps hypogeous, subepigeous or rarely epigeous; neither peridium nor stipe-columella bruising blue; spore-bearing surface red brown or rusty brown from spores; sturdy, percurrent stipe or stipe-columella present.....**71**
71. Sporocarps hypogeous with thick, cobwebby to cottony, unbroken or torn partial veil, spores commonly deposited on the inside surface of the veil; spore-bearing surface lamellate**Cortinarius**
71. Sporocarps hypogeous, semiepigeous or rarely epigeous, with continuous extension of the peridium protecting the gleba, occasionally separating from the stipe-columella to expose the gleba; gleba labyrinthiform or loculate, no spore deposit except in the chambers themselves.....**Thaxterogaster**

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Figures 1-3. Sporocarp types. 1. Agaricoid sporocarps, *Russula* sp. 2. Gastroid sporocarps, *Arcangeliella* sp.. 3. Hypogeous sporocarps, *Martellia* sp.

Figures 4-11. Stipe-columella or columella types. 4. Percurrent stipe-columella, *Thaxterogaster* sp. 5. Dendritic columella, *Truncocolumella* sp. 6-7. Diffuse columella. 6. *Gautieria* sp. 7. *Hymenogaster* sp. 8-9. Sterile base. 8. *Hydnangium*. 9. *Gymnomyces*. 10. Central columella, *Radiigera*. 11. No columella, *Rhizopogon*.

Figures 12-19. Gleba types. 12. Lamellate gleba, *Macowanites*. 13. Labyrinthiform gleba, *Macowanites*. 14-16. Lacunate gleba. 14. Large lacunae, *Gautieria*. 15. Small lacunae, *Rhizopogon*. 16-18. Filled or stuffed lacunae. 16. Solid or rubbery gleba, *Hysterangium*. 17. Gel-filled gleba, *Melanogaster*. 18. Liquid-filled, *Leucogaster*. 19. Peridiate gleba, *Pyrenogaster*.





