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Lycoperdaceae (Agaricales) on the Beartooth Plateau, Rocky Mountains, U.S.A.

Taiga Kasuya

*Laboratory of Plant Parasitic Mycology, Graduate School of Life and Environmental Sciences, University of
Tsukuba, 1-1-1, Ten-nodai, Tsukuba, Ibaraki 305-8572, Japan*

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Corresponding author: T. Kasuya, tkasuya@sakura.cc.tsukuba.ac.jp. Accepted for publication July 5, 2010.
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Abstract: Ten species of Lycoperdaceae classified into three genera, *Bovista*, *Calvatia* and *Lycoperdon* are reported from the Beartooth Plateau, Rocky Mountains, U.S.A. All are new records for this alpine area. Among them, *Lycoperdon frigidum* is a new record for the lower 48 States. Also, an alpine record of *Calvatia booniana* extends the known habitat of this fungus in North America.

Key words: Alpine fungi, Beartooth Plateau, *Bovista limosa*, *B. nigrescens*, *B. plumbea*, *Calvatia booniana*, *C. sculpta*, *Lycoperdon cretaceum*, *L. frigidum*, *L. norvegicum*, *L. turneri*, *L. utrifforme*.

Introduction: The Rocky Mountains extend along the spine of North America, continuing 5,000 km from Canada to New Mexico, U.S.A. The Beartooth Plateau is located north of Yellowstone National Park along the border of

Montana and Wyoming which is part of the Middle-Northern Rocky Mountain Floristic Zone with tree-lines at ca. 3,000 m elevation (Cripps & Horak 2008). The Beartooth plateau has rich alpine vegetation, consisting of woody *Salix*

species and *Dryas octopetala* L., grasses and various herbaceous plants. The mycota, especially the agaric species of the Beartooth Plateau is also diverse (Cripps & Horak 2008). However, so far, the diversity of Lycoperdaceae in this region is not well known.

Following Lange (1948), numerous floristic studies on arctic and alpine species of Lycoperdaceae have been published from the Eurasian continent and the adjacent area, especially from the Alps (Kreisel & Hausknecht 1998), Scandinavia (Eckblad 1955, 1971; Ulvinen 1969; Demoulin 1971), Iceland, Greenland, Svalbard (Lange 1976, 1987, 1990, 1998; Jeppson 2006) and the Himalayan mountains (Eckblad 1957, Kreisel 1969, 1976; Thind & Thind 1987). However, there have been few publications on these fungi from arctic and alpine regions of the North American continent (Bowerman & Groves 1962, Miller 1969, Miller et al. 1980). Therefore, to clarify the mycota of the Lycoperdaceae in North American alpine regions, the author investigated the species diversity on the Beartooth Plateau in August 2008 as a part of the field excursion for the International Symposium on Arctic-Alpine Mycology (ISAM VIII, August 3-10, 2008).

A total of 21 specimens of Lycoperdaceae were collected from the Beartooth Plateau and ten species were identified in the three genera: *Bovista*, *Calvatia* and *Lycoperdon*. Among them, *Lycoperdon frigidum* is a new record for the United States proper. Also, *Calvatia booniana*, a relatively common species in parts of western North America, usually grows in arid to semi-arid regions at lower elevations, is newly reported from open grassland of alpine vegetation. This article lists the recorded fungi and remarks on some noteworthy species.

Materials and Methods: The specimens examined in this study are deposited in the

mycological herbarium of the National Museum of Nature and Science, Tsukuba, Japan (TNS).

Macroscopic characters were described by observations on dried or fresh materials. For light microscope observations, free-hand sections of dried or fresh specimens were mounted in water, 3% or 5% (w/v) KOH and 30% ethanol solution on glass slides. More than forty randomly selected basidiospores were measured under a light microscope at 1000× magnification per collection. Length measurements excluded the apiculus.

The surface features of basidiospores of selected species were also observed with scanning electron microscopy (SEM). For SEM, a small portion of the gleba was dusted onto double-sided adhesive tape on a specimen holder and coated with platinum-palladium using an E-1030 Ion Sputter Coater (Hitachi, Tokyo, Japan). Spores were then examined with a S-4200 SEM (Hitachi, Tokyo, Japan) operating at 20 kV.

List of species: In the following list, all the species are enumerated in alphabetical order.

1. *Bovista limosa* Rostr., Meddr. Grønland, Biosc. 18: 52 (1894). (PLATE 1A)

Selected descriptions: Calonge (1998); Lange (1987); Sarasini (2005).

Specimen examined: TNS-F-24319 (45°01.444 N, 109°24.486 W, 2990-3020 m alt., on open grassland, Quad Creek, Carbon County, Montana, August 4 2008, coll. T. Kasuya).

This species was described from Greenland and is recognized as an arctic and alpine species (Lange 1987). It has been frequently collected from sand dunes or open grasslands of Northern Europe

and North America (Kreisel 1967). It is defined by the presence of a peristome-like operculum on the apex of basidioma (PLATE 1 A).

2. *Bovista nigrescens* Pers., Neues Mag. Bot. 1: 86 (1794). (PLATE 3 A–B)

Selected descriptions: Calonge (1998); Lange (1987); Sarasini (2005).

Specimen examined: TNS-F-24318 (45°01.444 N, 109°24.486 W, 2990–3020 m alt., on open grassland, Quad Creek, Carbon County, Montana, August 4, 2008, coll. T. Kasuya).

3. *Bovista plumbea* Pers., Ann. Bot. (Usteri) 15: 4 (1795).

Selected descriptions: Calonge (1998); Sarasini (2005).

Specimen examined: TNS-F-24320 (45°01.444 N, 109°24.486 W, 2990–3020 m alt., on open grassland, Quad Creek, Carbon County, Montana, August 8, 2008, coll. T. Kasuya).

4. *Calvatia booniana* A. H. Sm., Lloydia 27: 164 (1964). (PLATES 1 B–C & 3 C–D)

Selected descriptions: Moreno et al. (1998); Zeller & Smith (1964).

Specimen examined: TNS-F-24303 (45°00.177 N, 109°24.486 W, 3200 m alt., on open grassland, Wyoming Creek, Park County, Wyoming, August 6, 2008, coll. T. Kasuya).

Hitherto, this species has been reported from lower elevations of arid to semi-arid regions of

western North America (Zeller & Smith 1964), Spain and Iran (Moreno et al. 1998), and it has not been recognized as an arctic and alpine *Calvatia*. However, in Nepal *C. booniana* has been collected at 4,800 m elevation in the Himalayan mountains (Moreno et al. 1998). The specimen from the Beartooth Plateau is the first record of *C. booniana* from alpine vegetation in North America and this suggests that *C. booniana* has wide a distribution that extends to both lowland and alpine regions of the world. A possible arctic species, *C. polygonia* A. H. Sm. (Zeller & Smith 1964) is morphologically similar to *C. booniana*, but the latter species is easily distinguished from the former by its almost smooth basidiospores under the light microscope and a capillitium with short, spine-like branches. Under SEM, basidiospores of *C. booniana* are covered with slight ornamentation (Plate 3 C).

5. *Calvatia sculpta* (Hark.) Lloyd, Mycol. Writ. 1: 203 (1904). (PLATES 1 D & 3 E–F)

Selected descriptions: Baseia & Calonge (2008); Zeller & Smith (1964).

Specimens examined: TNS-F-24310 (44°57.932 N, 109°28.998 W, 3190–3200 m alt., on open grassland, Frozen Lake, Park County, Wyoming, August 7, 2008, coll. T. Kasuya).

There are two species of *Lycoperdaceae* having elaborately ornamented, thick pyramidal to polygonal exoperidium in North America: *Calbovista subsculpta* Morse ex M.T. Seidl. and *C. sculpta*. *Calbovista subsculpta* with almost smooth basidiospores and antler-like capillitium (Morse 1935; Seidl 1995) is more common than *C. sculpta* in the Rocky Mountains (Cripps, personal communication). However, the present fungus has slightly spiny basidiospores (PLATE 3 E–F) and long, smooth, sometimes branched capillitium. These microscopic characteristics are

in agreement with previous descriptions of *C. sculpta* (Zeller & Smith 1964). Although this species is usually on plant debris in coniferous forests of mountainous areas (Zeller & Smith 1964), it was collected from open grasslands of alpine vegetation on the Beartooth Plateau. Recently, *C. sculpta* has been recorded from Brazilian sand dunes (Baseia & Calonge 2008).

6. *Lycoperdon cretaceum* Berk., Proc. Linn. Soc. London 17(98): 15 (1878). (PLATES 1 E–F & 4 A–B)

Calvatia cretacea (Berk.) Lloyd, Mycol. Notes 46: 650 (1917).

Selected descriptions: Lange (1990); Miller et al. (1980); Sarasini (2005).

Specimens examined: TNS-F-24311 (45°01.444 N, 109°24.486 W, 2990–3020 m alt., among *Salix arctica* shrubs, Quad Creek, Carbon County, Montana, August 4, 2008, coll. T. Kasuya); TNS-F-24312 (45°00.177 N, 109°24.486 W, 3200 m alt., among *S. arctica* shrubs, Wyoming Creek, Park County, Wyoming, August 6, 2008, coll. T. Kasuya); TNS-F-24313 (44°57.932 N, 109°28.998 W, 3190–3200 m alt., on open grassland, Frozen Lake, Park County, Wyoming, August 7, 2008, coll. T. Kasuya).

Hitherto, this species has been recognized as a member of *Calvatia*, but Larsson & Jeppson (2008) put it into *Lycoperdon* based on their molecular phylogenetic study. *Lycoperdon cretaceum* appears to have a phylogenetic relationship to *L. altimontanum* Kreisel, *L. excipuliforme* (Scop.) Pers. and *L. lambinonii* Demoulin based on the phylogenetic tree (Larsson & Jeppson 2008), however, taxonomic correlation between these species has not been clarified yet. This species is one of the most common species of Lycoperdaceae in arctic and alpine regions of the world (Lange 1990). In

North America, it has frequently been reported from Alaska, Arctic Canada and alpine areas of the United States (Kobayasi et al. 1967; Miller 1969; Miller et al. 1980). It also appears to be a common Lycoperdaceae on the Beartooth Plateau. It is characterized by a thick exoperidium with large warts (PLATE 1 F) and dark brownish gleba (Lange 1976, 1990).

7. *Lycoperdon frigidum* Demoulin, Lejeunia 62: 10 (1972). (PLATES 2 A–B & 4 C–D)

Selected descriptions: Jeppson (2006); Kreisel & Hausknecht (1998); Sarasini (2005).

Specimens examined: TNS-F-24314 (45°01.444 N, 109°24.486 W, 2990–3020 m alt., among *S. arctica* and *Dryas octopetala* shrubs, Quad Creek, Carbon County, Montana, August 4, 2008, coll. T. Kasuya); TNS-F-24315 (45°00.356 N, 109°24.387 W, 3060–3100 m alt., among *S. arctica* and *Dryas* spp. shrubs, Highline Trailhead, Carbon County, Montana, August 5, 2008, coll. T. Kasuya); TNS-F-24316 (44°57.932 N, 109°28.998 W, 3190–3200 m alt., on open grassland, Frozen Lake, Park County, Wyoming, August 7, 2008, coll. T. Kasuya); TNS-F-24317 (45°01.444 N, 109°24.486 W, 2990–3020 m alt., on open grassland, Quad Creek, Carbon County, Montana, August 8, 2008, coll. H. Knudsen).

Specimens from the Beartooth Plateau have large, coarse but not dense ornamentation on basidiospores (PLATE 4 C–D) and subelastic-elastic capillitium with few pores. Those characteristics are in agreement with previous descriptions of *L. frigidum* (Demoulin 1972; Lange 1976; Kreisel & Hausknecht 1998; Jeppson 2006). This species is new to the lower United States. Hitherto, it has been known from Europe, Alaska and Arctic Canada (Demoulin 1972; Lange 1976; Kreisel & Hausknecht 1998; Jeppson 2006). It is a typical arctic and alpine species of

Lycoperdon and associated with heathland vegetation, especially with *Dryas* spp. (Jeppson 2006). This species appears to be a common fungus of Lycoperdaceae on the Beartooth Plateau.

8. *Lycoperdon norvegicum* Demoulin, Norw. J. Bot. 18: 166 (1971).

Selected descriptions: Jeppson (2006); Sarasini (2005).

Specimen examined: TNS-F-24321 (45°00.356 N, 109°24.387 W, 3060-3100 m alt., among *S. arctica* shrubs, Highline Trailhead, Carbon County, Montana, August 5, 2008, coll. T. Kasuya).

A mature basidioma having almost smooth, small basidiospores (2.5-3.5 µm in diameter) and whitish to pale ochraceous, connivent spines on the exoperidium was collected from the Beartooth Plateau. These morphological characteristics are in agreement with previous descriptions of *L. norvegicum* (Demoulin 1971; Jeppson 2006). This species has a boreo-continental distribution in Europe and North America (Demoulin 1971). It is not a strictly arctic and alpine species since there are a number of collections from the lowlands of central Europe (Jeppson 2006). In North America, it has been collected from sandy soil in coniferous forests of mountainous areas (Demoulin 1971), and this is the first report of *L. norvegicum* with typical North American alpine vegetation.

9. *Lycoperdon turneri* Ellis & Everh., J. Mycol. 1: 87 (1885). (PLATES 2 C—D & 5 A—B)

Calvatia turneri (Ellis & Everh.) Demoulin & M. Lange, Mycotaxon 38: 223 (1990).

Selected descriptions: Demoulin & Lange (1990); Lange (1990, 1998).

Specimens examined: TNS-F-24305 (45°01.444 N, 109°24.486 W, 2990-3020 m alt., among *S. arctica* shrubs, Quad Creek, Carbon County, Montana, August 4, 2008, coll. T. Kasuya); TNS-F-24306 (45°00.356 N, 109°24.387 W, 3060-3100 m alt., among *S. arctica* shrubs, Highline Trailhead, Carbon County, Montana, August 5, 2008, coll. T. Kasuya); TNS-F-24307 (45°00.177 N, 109°24.486 W, 3200 m alt., among *S. arctica* shrubs, Wyoming Creek, Park County, Wyoming, August 6, 2008, coll. T. Kasuya); TNS-F-24308 (45°01.444 N, 109°24.486 W, 2990-3020 m alt., among *S. arctica* shrubs, Quad Creek, Carbon County, Montana, August 4, 2008, coll. E. Ohenoja).

Previously, this species was placed in *Calvatia* (Demoulin & Lange 1990), but Larsson & Jeppson (2008) put it into *Lycoperdon* based on molecular phylogenetic study. Phylogenically, *L. turneri* shows a close relationship to *L. umbrinum* Pers. (Larsson & Jeppson 2008). *Lycoperdon turneri* is the most common species of Lycoperdaceae in arctic and alpine regions of the world (Lange 1990). Also, it appears to be the most common fungus of this family on the Beartooth Plateau judging from the number of collections. It is characterized by an exoperidium consisting of small to minute connivent spines which soon turn pale brown (Lange 1998).

10. *Lycoperdon utriforme* Bull., Annales de l'Institut agronomique de Moscou: 153 (1791). (PLATE 5 C—D)

Calvatia utriformis (Bull.) Jaap, Verh. Bot. Vereins Prov. Brandenburg 59: 37 (1918).

Handkea utriformis (Bull.) Kreisel, Nova Hedwigia 48: 288 (1989).

Selected descriptions: Kasuya (2005); Lange (1990); Sarasini (2005).

Specimen examined: TNS-F-24309 (45°01.444 N, 109°24.486 W, 2990-3020 m alt., on open grassland, Quad Creek, Carbon County, Montana, August 8, 2008, coll. H. Knudsen).

Hitherto, this species has been recognized as a member of *Calvatia*, but Larsson & Jeppson (2008) put it into *Lycoperdon* based on molecular phylogenetic study. It is placed in subgenus *Bovistella* (Morgan) Jeppson & E. Larss., which includes *L. radicum* Durieu & Mont. (*Bovistella radicata* (Durieu & Mont.) Pat.; Larsson & Jeppson 2008). This species has a worldwide distribution, but is rarely collected from alpine regions (Eckblad 1971). This is the first report of *L. utriforme* from typical alpine vegetation in North America. It is characterized by almost smooth basidiospores and a capillitium with slit-like pores (PLATE 5 C–D). Kreisel (1989) proposed a new genus *Handkea* Kreisel and recombined 11 taxa of *Lycoperdaceae* which have capillitium with slit-like pores for *Handkea*, including *L. utriforme* (*H. utriformis*). However, now *Handkea* is treated as a polyphyletic genus and is put into synonymy with *Lycoperdon* subgenus *Bovistella* (Larsson & Jeppson 2008).

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Literature cited

Baseia, I.G. and F.D. Calonge. 2008. *Calvatia sculpta*, a striking puffball occurring on Brazilian sand dunes. *Mycotaxon* 106: 269–272.

Bowerman, C.A. and J.W. Groves. 1962. Notes on fungi from Northern Canada. V. Gasteromycetes. *Canadian Journal of Botany* 40: 239–254.

[doi:10.1139/b62-022](https://doi.org/10.1139/b62-022)

Calonge, F.D. 1998. Gasteromycetes, I. Lycoperdales, Nidulariales, Phallales, Sclerodermatales, Tulostomatales. *Flora Mycologica Iberica* 3: 1-271.

Cripps, C.L. and E. Horak. 2008. Checklist and ecology of the Agaricales, Russulales and Boletales in the alpine zone of the Rocky Mountains (Colorado, Montana, Wyoming) at 3000-4000 m A.S.L. *Sommerfeltia* 31: 101–121.

Demoulin, V. 1971. *Lycoperdon norvegicum* sp. nov. A new gasteromycete with boreo-continental distribution in Europe and North America. *Norwegian Journal of Botany* 18: 161–167.

Demoulin, V. 1972. Espèces nouvelles ou méconnues du genre *Lycoperdon* (Gastéromycètes). *Lejeunia* 62 : 1–28. [In French]

Demoulin V. and M. Lange. 1990. *Calvatia turneri* (Ellis et Everh.) Demoulin et M. Lange, *comb. nov.*, the correct name for *C. tatrensis* Hollós. *Mycotaxon* 38: 221–226.

Eckblad, F.E. 1955. The Gasteromycetes of Norway. The epigaeal genera. *Nytt Magasin for Botanikk* 4: 19–85.

Eckblad, F.E. 1957. Some Gasteromycetes from Tirich Mir, Chitral State, Western Pakistan. Nytt Magasin for Botanikk 5: 37–39.

Eckblad, F.E. 1971. The Gasteromycetes of Finnmark (Northernmost Norway). Astarte 4: 7–21.

Jeppson, M. 2006. The genus *Lycoperdon* in Greenland and Svalbard. Meddelelser om Grønland 56: 106–127.

Kasuya, T. 2005. Notes on Japanese Lycoperdaceae. 3. The genus *Calvatia* in the herbarium of Hiratsuka City Museum. Natural Environmental Science Research 18: 41–46.

Kobayasi, Y., N. Hiratsuka, R. Korf, K. Tubaki, K. Aoshima, M. Soneda and J. Sugiyama. 1967. Mycological studies of the Alaskan arctic. Annual Report of the Institute of Fermentation 3: 1–138.

Kreisel, H. 1967. Taxonomisch-pflanzengeographische Monographie der Gattung *Bovista*. Beihefte zur Nova Hedwigia 25: 1–244. [In German]

Kreisel, H. 1969. Gasteromyzeten aus Nepal. Khumbu Himal 6: 25–36. [In German]

Kreisel, H. 1976. Gasteromyzeten aus Nepal II. Feddes Repertorium 87: 83–107. [In German]

Kreisel, H. 1989. Studies in the *Calvatia* complex (Basidiomycetes). Nova Hedwigia 48: 281–296.

Kreisel, H. and A. Hausknecht. 1998. *Lycoperdon frigidum* und *Calvatia arctica*, neu für Österreich. Österreichischer Zeitschrift für Pilzkunde 7: 129–133.

Lange, M. 1948. The Gasteromycetes of Greenland. Meddelelser om Grønland 147: 1–32.

Lange, M. 1976. Some Gasteromycetes from North East Greenland. Kew Bulletin 31: 635–638.
[doi:10.2307/4119414](https://doi.org/10.2307/4119414)

Lange, M. 1987. Arctic Gasteromycetes. The genus *Bovista* in Greenland and Svalbard. Pp. 261–274. In: Laursen G.A., J.F. Ammirati, S.A. Redhead (eds.). Arctic and Alpine Mycology II Plenum Press, New York. Pp. 364.

Lange, M. 1990. Arctic Gasteromycetes II. *Calvatia* in Greenland, Svalbard and Iceland. Nordic Journal of Botany 9: 525–546.

Lange, M. 1998. Arctic Gasteromycetes III. Additional notes on *Bovista* and *Calvatia* from South Greenland and from Tyumen Region, Russia. Pp. 82–85. In: Mukhin, V.A., H. Knudsen (eds.). Arctic and Alpine Mycology 5. Yekaterinburg Publishers, Yekaterinburg. Pp. 171.

Larsson, E. and M. Jeppson. 2008. Phylogenetic relationships among species and genera of Lycoperdaceae based on ITS and LSU sequence data from north European taxa. Mycological Research 112: 4–22.
[doi:10.1016/j.mycres.2007.10.018](https://doi.org/10.1016/j.mycres.2007.10.018)

Miller, O.K., Jr. 1969. Notes on Gasteromycetes of the Yukon Territory and adjacent Alaska. Canadian Journal of Botany 47: 247–250.
[doi:10.1139/b69-034](https://doi.org/10.1139/b69-034)

Miller, O.K., Jr., H.H. Burdsall, G.A. Laursen and J.B. Sachs. 1980. The status of *Calvatia cretacea* in arctic and alpine tundra. Canadian Journal of Botany 58: 2533–2542. [doi:10.1139/b80-295](https://doi.org/10.1139/b80-295)

Moreno, G., E. Altés and H. Kreisel. 1998. *Calvatia booniana* (Lycoperdaceae) new from Europe and Asia. Feddes Repertorium 109: 41–49.

Morse, E.E. 1935. A new puffball. Mycologia 27: 96–101. [doi:10.2307/3754047](https://doi.org/10.2307/3754047)

Sarasini, M. 2005. Gasteromiceti epigei. A.M.B. Fondazione Centro Studi Micologici, Vicenza. Pp. 406. [In Italy]

Seidl, M.T. 1995. Validation of the puffball genus *Calbovista*. Mycotaxon 54: 389–392.

Thind, K.S. and I.P.S. Thind. 1987. The Gasteromycetes of the Himalayas-VII. Indian Phytopathology 40: 451–458.

Ulvinen, T. 1969. Über einige *Bovista*- und *Lycoperdon*-Arten in Finnland. Aquilo 8: 25–41. [In Germany]

Zeller, S.M. and A.H. Smith. 1964. The genus *Calvatia* in North America. Lloydia 27: 148–186.

PLATE 1—*Lycoperdaceae* from the Beartooth Plateau. *A*—An old basidioma of *Bovista limosa* (TNS-F-24319). *B*—*C*—*Calvatia booniana* among alpine vegetation (TNS-F-24303). *D*—*Calvatia sculpta* with elaborately ornamented exoperidium (TNS-F-24310). *E*—Young basidiome of *Lycoperdon cretaceum* in natural habitat (TNS-F-24313). *F*—*Lycoperdon cretaceum* with thick exoperidium bearing large warts (TNS-F-24311). (Scales: *A* = 1 cm; *B* = 12 cm; *C* = 10 cm; *D* = 2 cm; *E*—*F* = 3 cm)

PLATE 2—*Lycoperdaceae* from the Beartooth Plateau. A—B—*Lycoperdon frigidum* (TNS-F-24314). C—D—*Lycoperdon turneri* in natural habitat (TNS-F-24306). (Scales: A—B = 5 cm; C—D = 3 cm)

PLATE 3—SEM micrographs of Lycoperdaceae from the Beartooth Plateau. *A–B—Bovista nigrescens* (TNS-F-24318). *A*—Basidiospore with a long pedicel. *B*—*Bovista*-type capillitium. *C–D—Calvatia booniana* (TNS-F-24303). *C*—Basidiospore covering with slight ornamentation. *D*—*Lycoperdon*-type, branching capillitium. *E–F*—Basidiospores of *Calvatia sculpta* (TNS-F-24310). (Scales: *A* = 3.33 μm ; *B* = 100 μm ; *C* & *E* = 2.31 μm ; *D* = 6.67 μm ; *F* = 2 μm)

PLATE 4—SEM micrographs of Lycoperdaceae from the Beartooth Plateau. A—B—Basidiospores of *Lycoperdon cretaceum* (TNS-F-24311). C—D—Basidiospores of *Lycoperdon frigidum* (TNS-F-24316). (Scales: A—B= 2.73 µm; C—D = 2.31 µm)

PLATE 5—SEM micrographs of Lycoperdaceae from the Beartooth Plateau. *A–B—Lycoperdon turneri* (TNS-F-24306). *A*—Basidiospore with ornamentation. *B*—*Lycoperdon*-type capillitium. *C–D—Lycoperdon utrifforme* (TNS-F-24309). *C*—Basidiospores with ornamentation. *D*— *Lycoperdon*-type capillitium with slit-like pores. (Scales: *A* = 1.67 μm; *B* = 6.67 μm; *C* = 2 μm; *D* = 4.29 μm)