

THE WESTERN GIANT PUFFBALL (*CALVATIA BOONIANA* A. H. SMITH) IN NORTHERN MICHIGAN

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ABSTRACT

Collections of the western giant puffball, *Calvatia booniana* A. H. Smith, are described from the Upper Peninsula of Michigan. Two collections were made by the authors in Houghton Co. in 2006 and 2007, and one collection, housed in the University of Michigan Fungus Collection, was made in Marquette Co. in 1968 by Ms. Ingrid Bartelli, and identified by Dr. Alexander H. Smith of the University of Michigan. Dr. Smith originally named the species based on collections from Idaho and Oregon, generally associated with sagebrush (*Artemisia* spp.). However, the collections from Houghton Co. were associated with white cedar (*Thuja occidentalis*). A survey of several other fungus herbaria yielded no other collection of *C. booniana* in the eastern U.S. Collections were studied macroscopically and microscopically and compared to the eastern giant puffball, *Calvatia gigantea* (Batsch ex. Pers.) Lloyd, to which it is quite similar. Because of the visibility and popularity of these mushrooms, a brief review of the history, naming and occurrence of these species is provided.

INTRODUCTION

The giant puffball is one of the most magnificent examples of massive spore production by any organism; a single specimen may produce upwards of eight trillion spores (Richter and Beardslee 2004). The fungus is a saprotrophic decayer of cellulosic plant materials (Richter and Bruhn 1989) that produces its fruiting bodies on the ground. Large white fruiting bodies, some up to two feet across, are common in late summer and fall in northern Michigan. Forever amazed by the size of these mushrooms, our forest pathology laboratory enthusiastically accepts huge specimens and receives numerous reports of basidiocarps that appear like volley balls in yards and waysides every summer and fall.

Calvatia gigantea (Batsch ex. Pers.) Lloyd (Figure 1) occurs throughout eastern North America (Miller and Miller 2006) and Europe (Breitenbach and Kranzlin 1986). This puffball has been known to science by at least nine other names throughout its history (Zeller and Smith 1964), and for many years the name *Langermannia gigantea* was applied. However, for reasons beyond the scope of this note, the name *Calvatia gigantea* has been conserved and is currently correct for this organism (Hawksworth *et al.* 1995).

In the western United States a different species of giant puffball occurs, *Calvatia booniana* A.H. Smith. The western giant puffball attains the size of *C. gi-*



FIGURE 1. *Calvatia gigantea*, the eastern giant puffball. This specimen found Sept. 23, 2007 in a grassy field in northern Marquette Co., Michigan, measuring approximately $30 \times 20 \times 20$ cm (not collected).

gantea, and is also white, however, it is distinguished by having a sculptured surface of plates and ridges not unlike the back of a tortoise (Smith 1975). It was described as a new species in 1964 by the renowned University of Michigan mycologist, Dr. Alexander H. Smith (Zeller and Smith 1964). In this treatment of the genus *Calvatia* in North America Dr. Smith writes about *C. booniana*:

“This species has been misidentified for the last fifty years as *C. gigantea*, no doubt because of its large size. Dr. Wm. Judson Boone, the first president of the College of Idaho, who was keenly interested in the central Rocky Mountain mushroom flora, had some beautiful mushroom specimens which I saw in 1935. Hence, I take pleasure in dedicating this species to him.”

Arora (1986) treats both the eastern giant puffball (*C. gigantea*) and the western giant puffball (*C. booniana*). In addition, he considers the west coast form of *C. gigantea* to be different than the *C. gigantea* found in eastern North America and Europe, as the surface of the former is scaly rather than perfectly smooth like the latter. He considers the true identity of the west coast giant puffball a “minor mystery,” and separate from *C. booniana* (Arora 1986).

The western giant puffball is considered equal in edibility to the eastern giant puffball, to which we can attest. Perhaps one of the differences between the two is the strong odor of the western giant puffball, which becomes quite foul upon

drying, and is mentioned by Lincoff (1981). Although we have also detected foul odors emitted by the eastern giant puffball with age and drying.

METHODS

Fruiting bodies of giant puffballs were collected, measured, photographed and their macroscopic characters described. In the laboratory, spores and glebal hyphae of mature fruiting bodies were mounted in 5% KOH and observed at 400X using a Nikon Optiphot® microscope. For each microscopic character (spores or capillitia), ten measurements were made of mature elements selected at random on the slide and the size range reported. Specimens were air-dried and retained in the collection of the first author at Michigan Technological University for eventual deposit in the University of Michigan Herbarium Fungus Collection. The single specimen obtained from the University of Michigan Herbarium Fungus Collection (MICH) was examined similarly to those collected by the authors.

RESULTS

Field Collections

On July 11, 2006 a large white puffball (DR06-001) was found in a yard in Hancock (Houghton Co.), Michigan (Figure 2) along a row of white cedars (*Thuja occidentalis*). The basidiocarp measured approx. $30 \times 20 \times 16$ cm, and



FIGURE 2. *Calvatia booniana*, the western giant puffball (DR06-001), found July 11, 2006 in a yard in Hancock (Houghton Co.), Michigan under a row of cedar trees, measuring approximately $30 \times 20 \times 16$ cm.

was characterized by having a surface of polygonal knobs and plates approx. 2–3 cm diam., with a thick cord-like rhizomorph attached to the base. Based on these characters we tentatively identified the specimen as the western giant puffball, *C. booniana*.

Comparisons of the mushroom collected in Hancock, Michigan to published descriptions was difficult, as it is not covered in the better-known guides for eastern North America. Lincoff (1981) illustrates and compares both the eastern and western giant puffball, and the mushroom found clearly fit the description of the western giant puffball based on size and peridium surface. Interestingly, but unlike our collections, wherever it is discussed, the western giant puffball is considered a feature of sagebrush areas (*Artemisia* spp.) of the western United States (Miller and Miller 2006, Smith and Smith-Weber 2001, Smith 1975, Zeller and Smith 1964).

If one delves further into the definitive work on the *Calvatias* in North America by Zeller and Smith (1964), comparing the description of the eastern giant puffball with the western giant puffball, one finds that there are only slight differences in the microscopic characters. The differences could easily be within the range of variability of the structures described – approximately a micrometer (μm) or less—and one would not be able to separate the two species based on spores or capillitia alone. Spores of *C. gigantea* range from $3.3\text{--}5.5 \times 3.0\text{--}5.0 \mu\text{m}$, while spores of *C. booniana* range from $3.9\text{--}6.0 \times 3.3\text{--}5.5 \mu\text{m}$. Capillitial hyphae of *C. gigantea* range from $2.2\text{--}8.8 \mu\text{m}$, compared to $3.3\text{--}8.8 \mu\text{m}$ for *C. booniana*, and both species' spores are smooth to finely spiny (Zeller and Smith 1964). The principal morphological difference between these two giant puffballs is in the appearance of the outer peridium – sculptured and plated in the western and smooth in the eastern (Zeller and Smith 1964).

We studied the spores and capillitial hyphae of the collection (DR06-001) that, based on macroscopic characters, was tentatively identified as *C. booniana*. The smooth to finely spiny spores measured $4.5\text{--}6.0 \times 3.5\text{--}5.5 \mu\text{m}$, while the diameter of capillitial hyphae measured $3.5\text{--}7.5 \mu\text{m}$. Therefore, spore shape and size, and size of capillitial hyphae are within the range of that described for *C. booniana*.

In September 2007 we went back to the yard where the western giant puffball fruited in 2006 and found eight maturing fruiting bodies of *C. booniana* (DR07-010) measuring 15 to 30 cm diam., all within approximately 3 m of each other (Figure 3). Remarkably, within a few feet of the western giant puffballs, were six fruiting bodies of the eastern giant puffball, *C. gigantea* (DR07-011) equal in size, but contrasting in appearance with their smooth peridium (Figure 4). Because we visited late in the season, the puffballs had matured and were already turning brown. The sculptured surface of the western giant puffball was broken into distinct separated plates, while the eastern giant puffball was smooth.

Herbarium Collections

The University of Michigan Herbarium Fungus Collection (MICH) holds 290,000 specimens of fungi (see <http://herbarium.lsa.umich.edu/index2.html>), including 34 collections of *C. booniana*. The MICH collections include the type specimen from Oregon (AHS 65191), upon which the species is described, for

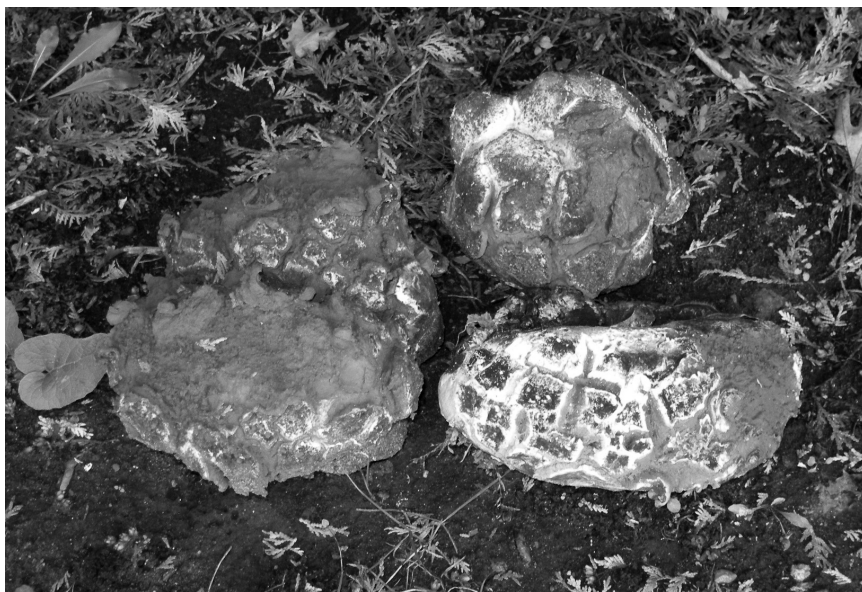


FIGURE 3. Three mature specimens of *Calvatia booniana*, the western giant puffball (DR07-010), found Sept. 27, 2007 in the yard in Hancock, Michigan where the younger specimen fruited in July 2006 (Fig. 2); eight maturing fruiting bodies were found measuring 15 to 30 cm diameter, all within the space of approximately 3 m of each other.



FIGURE 4. Mature specimens of *Calvatia gigantea*, the eastern giant puffball (DR07-011), measuring 20 to 30 cm diam., found in the same yard in Hancock, Michigan as the western giant puffball on Sept. 27, 2007.

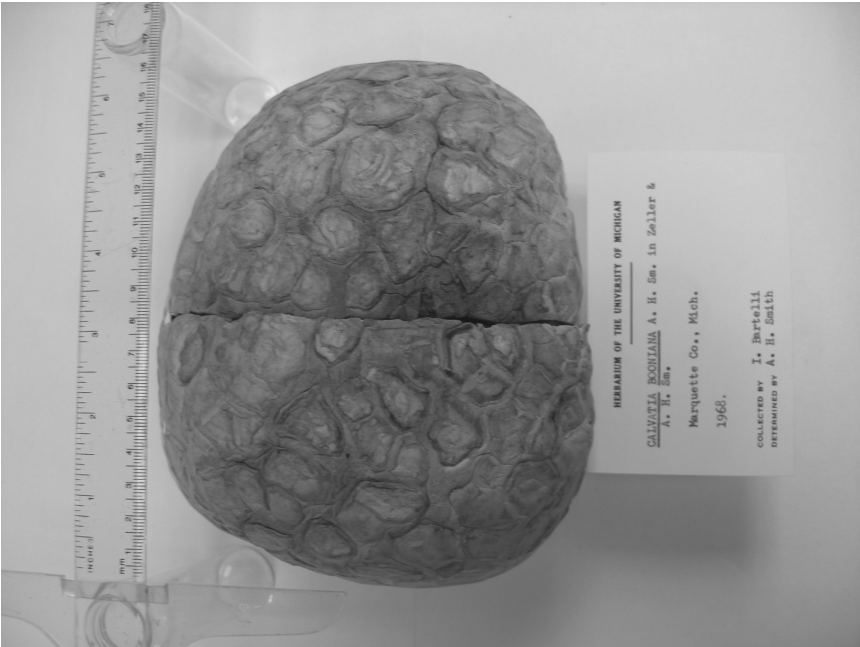


FIGURE 5. *Calvatia booniana*, the western giant puffball (IB 1968-7431) from the University of Michigan Herbarium (MICH), collected in Marquette Co., MI. 1968 (no month, date or habitat recorded); specimen measures approximately $16 \times 13 \times 11$ cm.

which there is a nice picture that matches our mature specimens well. Thirty-three of these collections are from the western U.S. (24 from Idaho, three from Arizona, two from Colorado, two from New Mexico, and one each from Oregon and Utah). However, one collection (IB 1968-7431) is from Marquette Co., Michigan, also in the Upper Peninsula, less than 100 miles east of Houghton Co. where the authors collected in 2006 and 2007.

The MICH herbarium collection of *C. booniana* from Marquette was made in 1968. It was deposited by Ms. Ingrid Bartelli, a respected field mycologist who collected and authored papers with Dr. Smith, and who also authored a series of pamphlets on Michigan mushrooms that were in popular use for many years. Ms. Bartelli was certainly familiar with the common eastern giant puffball, as it is illustrated in one of her pamphlets (Bartelli 1979). Furthermore, of the 31 collections of *C. gigantea* in MICH, one is deposited by her, also in 1968 from Marquette Co., but with scant collection data provided, except “near Marquette,” to indicate the city with the same name.

The MICH collection of *C. booniana* of Ms. Bartelli was requested by the authors for examination (Figure 5). The fruitbody measures approximately $16 \times 13 \times 11$ cm, somewhat smaller than the collection made in Hancock, MI in 2006; closer in size to the mature specimens found in 2007. The peridium of the specimen from MICH has the characteristic polygonal plates that are distinctive for the western giant puffball, however, the plates are not raised as on the young

specimen found in 2006, suggesting this may be a function of age. It also lacks the cord-like rhizomorph at the base which is characteristic of the species (Zeller and Smith 1964), and which is present on our collections, however, the rhizomorph may have been broken off when collected. The *C. booniana* from MICH was nearly mature, with the gleba just beginning to turn brown. Spores are smooth to minutely spiny, measuring $4.0\text{--}5.5 \times 3.5\text{--}5.5 \mu\text{m}$; diameter of capillitial hyphae measured $3.5\text{--}7.0 \mu\text{m}$. Therefore, spore shape and size and size of capillitial hyphae are within the range of that described for *C. booniana* (Zeller and Smith 1964).

The herbarium card lists Dr. A. H. Smith as the identifier of the MICH specimen of *C. booniana*. Associated with the specimen is a slip of paper with a note, presumably in the hand writing of Dr. Smith, saying, "*Calvatia booniana* Smith Marquette County Mich 1968. Brought in to Mrs. Ingrid Bartelli. *fide AHS*." However, there is no month, date, location, host or habitat information provided for the collection.

An inquiry to the curator of the Willard Sherman Turrell Herbarium Fungus Collection, at the University of Miami, Oxford, Ohio, which holds over 100,000 specimens of fungi, resulted in no specimens of *C. booniana* (Dr. Michael A. Vincent, Curator (personal communication)). A search of the Field Museum of Natural History, Chicago, IL website also resulted in no *C. booniana* collections deposited. Likewise, a search of the Cornell University, Plant Pathology Herbarium, Ithaca, NY website, which holds over 400,000 fungus specimens, also resulted in no collections of *C. booniana*. In addition, of 3,570 species of fungi recorded on the checklist of Wisconsin (Parker 2006), *C. booniana* is not listed among five species of *Calvatia*.

DISCUSSION

The difference in the outward appearance of the eastern and western giant puffballs is striking and apparently one of the most significant characters that separates these two species. Based on the published description of the shape and color of the peridium, spore size and shape, and size of capillitial hyphae, we determined that the specimens found in Hancock, Michigan are indeed *C. booniana*. The other character that separates the eastern from the western giant puffball is habitat: grassy fields and lawns for the former and sagebrush areas for the latter. Thus, it is notable to find the western giant puffball in eastern North America outside of its usual range and habitat.

It is interesting to speculate that our specimens of *C. booniana* might simply be contorted forms of *C. gigantea*, caused by some genetic aberration or infectious agent, or modified by growth under different environmental conditions. Genetic or molecular analysis may be required to determine if *C. gigantea* and *C. booniana* are truly separate species or if they are conspecific. Cultures made from fresh tissue of both the eastern and western giant puffballs were also morphologically indistinguishable. For now, however, based on the published descriptions, it must be concluded that the large, smooth puffballs that we collected

are the eastern giant puffball, *Calvatia gigantea* (Batsch ex. Pers.) Lloyd, and the sculptured fruitbodies of the same size, in the same place, is a rare occurrence of the western giant puffball, *Calvatia booniana* A. H. Smith in eastern North America.

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