Notes on Some Puff-Balls of Indiana.

By Frank D. Kern.

Our largest fungi belong to the group popularly known as puff-balls. They receive this name because of the fact that most of them when mature and dry puff forth their spores in clouds upon the slightest disturbance. Those who are in the habit of thinking of mushrooms, toadstoods, or ordinary puff-balls as are large fungi may be somewhat surprised to learn that within our own State certain species of puff-balls frequently attain a size equal to the largest pumpkins. (See Fig. 1.) Notes concerning some of

Figure 1. CALVATIA BOVISTA
A fresh specimen measuring 40 cm. in diameter and weighing 9¾ pounds.

these larger forms may therefore not be without interest, especially since they form an important part of our fungous food products.

There have been in the United States four important workers with puff-balls, Peck, Trelease, Morgan and C. G. Lloyd. Peck's work has been largely devoted to New York forms while Trelease's studies were confined

to Wisconsin species. Morgan and Lloyd, both residents of Ohio, have covered not only their own region but have made their studies more general. Lloyd has extended his observations to various parts of the world.

No special study of Indiana species has been made. In 1893 Underwood listed twenty-three species in the Report of the Botanical Division of the Indiana State Biological Survey, published in the Proceedings of the Academy for 1893, pp. 13-67 (1894). Presumably this includes all that were known to him in the state at that time. No additions were made either by Underwood or Arthur in their supplementary lists in the Proceedings for 1896. Reddick mentions four species in a paper in the 32d Annual Report of the Department of Geology and Natural Resources of Indiana, 1907, but none of them are additions to the Underwood list. Van Hook has published two lists of Indiana fungi, one in the Proceedings of the Indiana Academy for 1910, pp. 205-212 (1911), and another in the Proceedings for 1911, pp 347-354 (1912), which include references to seven species, only two of which were not in the previous lists. This makes a total of at least twenty-five species which have been reported for the state through the Academy. For the most part these are small or moderately small forms. It is certain that this is not a complete record but no effort has been made toward an exhaustive search of the literature. Various references to Indiana species occur in the writings of Morgan, Lloyd, McIlvane, and others, and so far as known to the writer several additional species may be mentioned.

A medium-sized species (4-8 cm. in diameter) said by Lloyd to occur in Indiana, but apparently not mentioned in any of the Academy records, is *Boristella Ohiensis*. This plant was twice collected in the vicinity of Lafayette in October, 1912, once by Mr. Henry Meigs and once by Prof. C. R. Orton and the writer. In the former collection, which was only about half mature when brought in, the peridia ranged from 5-8 cm. in diameter. Lloyd especially mentions a robust specimen in the Ellis herbarium (now at the N. Y. Botanical Garden) which he says was collected by Gentry in Indiana. This specimen is about 10 cm. in diameter but according to Lloyd it rarely occurs so large. While the specimens collected by Mr. Meigs do not equal the Gentry specimen in size they appear to approach it more nearly than usual. The specimens taken by Orton and the writer are considerably weathered but appear to have been of ordinary size, 4-6 cm. in diameter. They compare very favorably with Lloyd's Figs. 5 and C, Plate 86, accompanying his Mycological Notes, No. 23 (1906). A

good illustration of the species is also to be found in Hard's Mushroom Book, p. 533, *Fig. 473*. The peridium is subglobose or depressed pyriform. The outer coat, or cortex, consists of dense, soft warts or spines which fall away after a time, exposing the smooth, shining, thin inner coat. The spores are pale cinnamon-brown, slightly oval, 3-4 x 4-5 μ, smooth, with slender hyaline pedicels 9-15 μ long. The capillitium consists of separate, branched threads, 3-6 μ in diameter, the branches gradually tapering to sharp points. Ellis and Morgan described this species in 1885 giving it the specific name of *Ohiense* but referring it to the genus *Myceneastrum*. In 1888 DeToni transferred it to *Scleroderma* in Saccardo's Sylloge Fungorum. Morgan later used it as the type of a new genus, *Boristella*, calling this plant *Boristella Ohiense*. This plant is more common southward and our locality is apparently in the extreme northern part of its distribution. Judging from the general distribution and from the Illinois and Ohio localities it would seem that this species is likely to be met with in the southern half of Indiana.

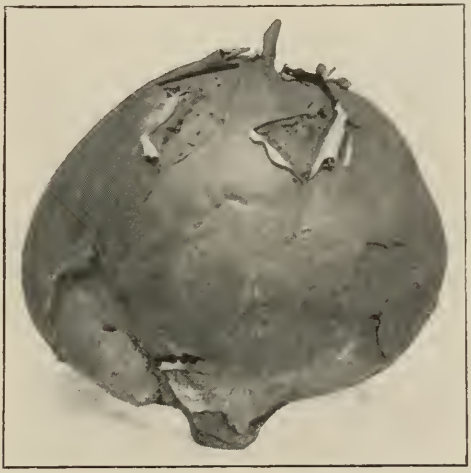

Figure 2. CALVATIA BOVISTA

A specimen which weathered for nearly a year in its place of growth. This specimen is now about 30 cm. in diameter, and weighs 4½ ounces.

A considerably larger species (10-15 cm. in diameter), *Myceneastrum spinulosum*, which has never been reported for Indiana in the Academy proceedings, or elsewhere, so far as the writer knows, was collected near

Lafayette, October 16, 1905, by Dr. J. C. Arthur. Three specimens of this collection have been preserved. This is a common puff-ball on the plains west of the Mississippi River, and occurs also in the Rocky Mountains and on the Pacific Slope. I have collected it in Colorado west of the continental divide. In 1903 Lloyd wrote that he had not seen specimens of this plant from any station farther east than Chicago, Ill. Peck, however, in his Annual Report of the N. Y. State Museum for 1901 reports it from Crown Point, N. Y. His specimens were unsatisfactory and yet he considered them to be this species. With the exception of Peck's New York locality ours seems to be at the eastern limit of distribution. The species is notable in the character of both peridium and capillitium. Peck's

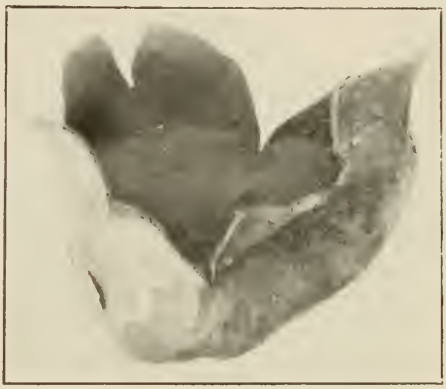

Figure 3. MYCENASTRUM SPINULOSUM
Showing the stellate splitting of the peridium and the unequal spreading of the rays. This specimen is 12 cm. in diameter.

description of the peridium as thick, firm, and gourd-like is well expressed, as is also his reference to the form of rupture as a stellate splitting from above followed by an unequal spreading and reflexing of the rays. (See Fig 3). One of the specimens in our Indiana collection was not ruptured, but the other two show the characteristic form. The peridium is hygroscopic, which often causes the rays to undergo sufficient movement to result in a movement of the whole plant. The capillitium consists of separate threads of comparatively large diameter, 10-12 μ, which are set with prominent spiny points. The spores are also large, 10-12 μ, slightly rough, and without evident pedicels. The spore-mass is a rich chocolate-

brown in color. Peck originally described this species as a *Bovista* in 1879 (Bot. Gaz. 4:170) but two years later transferred it to the genus *Myccnastrum* (Bot. Gaz. 6:240). It very evidently belongs in the group of tumblers, the mature plant becoming loosened from the place of growth. The *Bovistella* described in the foregoing paragraph normally remains attached. As to whether our American species *Myccnastrum spinulosum* is identical with any foreign species there is some diversity of opinion. Dr. L. Hollós, a Hungarian botanist, claims all forms of *Myccnastrum* to be one species, of which the oldest name is *M. Corium*, and he believes this species to be cosmopolitan. Lloyd at first disagreed but later practically accepted this disposition. Dr. Ed. Fischer, however, in Engler & Prantl, Natürlichen Pflanzenfamilien recognizes about thirteen species of *Myccnastrum*, *M. Corium* and *M. spinulossum* being considered distinct. McIlvaine in his book, One Thousand American Fungi, observes that he has no report upon the edibility of *M. spinulosum* but that it is probably good.

The largest species of all, which is also the largest species of fungus known, is commonly known as the "giant puff-ball." It passes under such a variety of scientific names that one scarcely knows which one to use. There appear to be three important specific names which have been proposed, *Bovista*, *maxima*, and *gigantea*. The latter two appear more appropriate but the first evidently has priority. These specific names with some others have been variously combined with the genera *Lycoperdon*, *Bovista*, *Globaria* and *Calvatia* so as to make a long list of synonyms. In the Academy papers already cited it has been referred to as *Calvatia gigantea*, *Lycoperdon giganteum*, *L. Bovistum*, and *Calvatia Bovista*. Without attempting to enter into a discussion of the validity of the various genera it may be said that there appear to be good reasons for separating some forms from the old genus *Lycoperdon*, and if the genus *Calvatia Fries* should be maintained, a proper name for the species under discussion would appear to be *Calvatia Bovista* (L.) Underwood (Proc. Indiana Acad. Science 1893:63). In spite of the fact that Lloyd says it is of rather rare occurrence in the United States it seems to have been frequently collected in Indiana. Published accounts indicate collections from Montgomery, Noble, and Putnam Counties. To this list is now added Tippecanoe County.[1] On October 8, 1911, Mr. George Snyder brought in a fine specimen of this fungus which he found growing on wet, peaty soil in

[1] In addition, Johnson and Fulton counties were named by persons in the audience when this paper was being read.

rather open woods about five miles east of Lafayette. The specimen was immature, not yet having begun the formation of spores, and was firm, white, and solid. (See Fig. 1.) It measured about 40 cm. in diameter and weighed 9¾ pounds. The specimen was so large that it would not go into the ovens where heat could be applied and unfortunately spoiled before we devised a method of drying it. On October 9, 1911, Mr. F. J. Pipal and the writer visited the locality where the large specimen came from and found in the immediate vicinity a whole "colony" of large puff-balls varying from 10 or 12 cm. in diameter up to the size of the one described. Several were collected and some were preserved. On September 16, 1912, nearly one year later, this locality was again visited by Mr. Pipal and the writer with the hope of finding another crop of giant puff-balls. No fresh specimens were found, but nevertheless observations were made which may be of some interest. To our great surprise a number of old specimens of the crop of the previous season were still attached in their original position, and although somewhat weathered still retained their globose form and were in an excellent state of preservation. (See Fig. 2.) That such large frail objects would withstand weathering for so long a time had not occurred to us as at all likely. One of the best of these was brought in and is now in our collection. It is now 30 cm. in diameter and weighs only 4½ oz. Judging from the size it is safe to say that this specimen must have weighed seven or eight pounds when fresh. The peridium is thin and papery and irregularly split and torn in the upper part, after the manner described by the older authors. Nees in his Systema der Pilze (1816) presents a very good illustration of this species, *Pl. 11, Fig. 124.* There can be no doubt that this plant normally remains attached to the place of growth. The capillitium is very unlike that of *Boristella* or *Mycenastrum*, consisting of long, branching, intertwined threads which are uniform in size, 4-5 μ, and smooth. The spores are globose, medium-sized, 4-5 μ, smooth.

In October, 1905, when Dr. Arthur collected the *Mycenastrum* specimens near Lafayette, several other larger forms were brought in. Two of these which average about 18 and 23 cm., respectively, in size are preserved in our collection. The characters of these specimens are unusual and considerable difficulty has been experienced in reaching a conclusion concerning their identity. The capillitium and spores agree with the giant puff-ball, as does also their large size and the manner in which the peridium ruptures. The stricture of the peridium, however, appears very different.

There are evidently three coats, or layers, to the peridium instead of the usual two. The first or outermost coat, which may be called the cortex, is more or less rough or warty; the second or intermediate coat is firm and thick, 1.5-2 mm.; the third or innermost layer is thin and membranous. The illustration (Fig. 4) brings out the features of the peridial coats. The thickness of the peridium proper suggests *Myconastrum* but the other coats and the capillitium and spores are very different. The presence of the thin papery inner peridium seems to be unique among puff-balls and so far as I have been able to learn only one

Figure 4. CALVATIA LEPIDOPHORA.
Showing the rough cortex, the thick intermediate coat, and the thin membranous inner lining which is now splitting and falling away in flakes.

species possessing this character has ever been described, viz., *Lycoperdon lepidophorum* Ellis and Ev. (Jour. Myc. 1:88. 1885). Mr. C. G. Lloyd, to whom I have sent material, agrees with me in the opinion that our specimens belong here, saying in a letter that "it is the second collection known of this very rare species. This is the first time I have ever received it, and have only previously seen the type in the Ellis collection [New York Botanical Garden]. The structure, spores, capillitium, and peculiar inner membrane covering the spores are exactly the same. The difference

in appearance of the cortex coat is due, I think, to Ellis' specimen being older than yours, and this coat having changed in drying. Your plant was evidently collected in its prime and the natural cortex coat well preserved." On account of the notable peridial characters of this species the generic standing has been uncertain. It was originally described by Ellis and Everhart as a *Lycoperdon* and was listed in Saccardo as a *Bovista*. When Mr. Lloyd published his "Genera of Gastromycetes" (Bull. Lloyd Library, Mycological Ser. No. 1) in 1902 he provided in his key for a genus *Hypoblema* separable from the genus *Calvatia* by the presence of an inner membrane such as this species possesses. On *Pl. II, Fig. 49*, he illustrates what he calls *Hypoblema pachyderma*. About a year later in his Mycological Notes (No. 14, p. 140, March, 1903) he described fully the genus *Hypoblema* saying that it was based on *Lycoperdon lepidophorum*, and referred to *Hypoblema lepidophorum* as the only species. His earlier use of the specific name *pachyderma* was founded on the assumption that it was a prior name for the same species. Further investigation, however, convinced Lloyd that Peck's *Lycoperdon pachydermum* (Bot. Gaz. **7**:54. 1882) was a distinct species, and he took up *lepidophorum* as the specific name under the genus name *Hypoblema*. Somewhat later the views concerning the validity of this genus were altered as is evidenced by a note (footnote 13, p. 14, Index Myc. Writings, vol. 2) to the effect that he would class *Hypoblema* as a subgenus under *Calvatia*. In a recent letter to the writer Mr. Lloyd has again expressed the opinion that the species should be referred to *Calvatia*. *Morgan* has already described the species as a *Calvatia*, but as he was also mistaken in thinking Peck's *L. pachydermum* was identical he used the name *Calvatia pachyderma*. This error was further perpetuated by McIlvaine (One Thousand American Fungi, p. 582) whose description clearly confuses the two plants. Believing with Mr. Lloyd that the peridial differences presented by this species can scarcely be considered sufficient for generic separation the combination **Calvatia lepidophora** is here adopted as the proper designation. The type specimens of Ellis and Everhart's *Lycoperdon lepidophorum* were collected at Huron, [South] Dakota, September, 1884, by Miss Nellie E. Crouch. As the Lafayette collection is the second known collection very little can be said about the distribution. It is evidently a very rare species. Both collections were made in the autumn. Nothing was said about the original habitat; ours was an open pasture with muck soil.

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