A Study of Cultural Bias in Field Guide Determinations of Mushroom Edibility Using the Iconic Mushroom, *Amanita muscaria*, as an Example[1]

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A Study of Cultural Bias in Field Guide Determinations of Mushroom Edibility Using the Iconic Mushroom, *Amanita muscaria*, as an Example. Mushroom field guides teach identification skills as well as provide information on the edible or toxic qualities of each species of wild mushroom. As such they function as modern-day village elders for an increasingly urban, nature-ignorant population. This paper identifies underlying cultural bias in the determination of mushroom edibility in English-language field guides, using the iconic mushroom, *Amanita muscaria*, as an example. We explore a selection of ethnographic and medical texts that report the use of *A. muscaria* as a food, and we accept parboiling as a safe method of detoxifying it for the dinner table. Mushroom field guides, however, almost universally label the mushroom as poisonous. We discuss the cultural underpinnings and literary form of mushroom field guides and demonstrate that they work within a mostly closed intellectual system that ironically shares many of the same limitations of cultural bias found in traditional folk cultures, but with the pretense of being modern and scientific.

Key Words: Edibility, field guides, mushrooms, *Amanita muscaria*, mushroom edibility, mushroom field guides, field guide bias.

Introduction

Modern-day field guides teach readers how to differentiate life forms; if they are field guides to mushrooms or plants, they frequently also provide information on edibility or other uses. In other words, they function in many ways as parent, grandparent, village herbalist, or shaman for people who do not live in a village or rural area and whose direct experience of nature is limited. Given the unprecedented wealth of information available to specialists in any field, it is tempting to assume that mushroom field guides have been good teachers. But have they? Without question they have been excellent teachers of taxonomy and identification skills. Mushroom morphology is described in detail using a specialized language, and field guides have more or less kept up with changes in nomenclature and advances in scholarship (most recently, molecular studies) from Linnaeus to the present, thereby enabling careful readers to identify many mushrooms successfully. With respect to edibility, however, the mushroom field guide literature has not kept up with advances in scholarship. The field guide literature tends to lack curiosity, to be resistant to change, and even to ignore facts that contradict the prevailing cultural consensus on a mushroom's edibility, as we will show.

Flora Londinensis (1777–1798), by English naturalist William Curtis, heavily influenced the development of the field guide genre. In fact, it should be considered one of its principal English-language prototypes. In this work, the author described the natural history and distinguishing characteristics of wild plants and mushrooms growing around London. Curtis (1777–1798) observed that:

> In some Countries, Mushrooms are made much more an object of food than with us... With us they are used more as an article of luxury.

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He also pointed out that most of the mushrooms sold in English markets were cultivated, and while he offered some information on the edibility of wild mushrooms, his overall message to readers was one of prudence:

> The best advice would be to caution persons in general, to meddle with no other sort than the common field Mushrooms...

Curtis was clearly aware that he was writing for an audience more comfortable eating cultivated mushrooms than wild ones, and therefore an audience that would be reassured by his extreme caution rather than disappointed or exasperated by it.

More than a century later, in North America, the cultural underpinning for mushroom field guide authors erring on the side of extreme caution remained the same. Louis Krieger, in *The Mushroom Handbook* (1936/1967 reprint: 113) wrote:

> The wild growing kinds [of mushrooms] are not of economic importance in this country, except with certain recent immigrants, chiefly from Russia and southern Europe. The average American of "Nordic" stock either does not care for mushrooms at all, or he stands in such mortal fear of the wild kinds that nothing could tempt him to eat one of these.

Despite significant changes in culinary culture over the past two centuries, fear of mushroom poisoning still runs as a leitmotif through English-language field guides, even those that explicitly seek to encourage consumption of wild mushrooms (e.g., Fischer and Bessette 1992; Schwab 2006; Kuo 2007).

We chose the well-known mushroom *Amanita muscaria* (L.) Lam. (or *A. muscaria* sensu lato—see Oda, Tanaka, and Tsuda 2004; Geml et al. 2006) as a convenient vehicle for exploring the nature of the edibility determination in English-language mushroom field guides because it has an extensive literature both inside and outside the field of mycology. Furthermore, it is so easily identified that its "poisonous" label cannot be attributed to authors trying to protect their readership from confusing it with more dangerous species.

The Fly Agaric: *Amanita muscaria*

Amanita muscaria is one of the easiest of all mushrooms to identify—the "red one with the white spots" (Fig. 1). As Letcher (2007) points out, "Even a child with no knowledge of natural history could identify one," as there are no other terrestrial life forms in the temperate zone with a similar color pattern. *A. muscaria* is also a cultural icon. It is widely depicted in cartoons and children's books, and is the mushroom that the dwarfs dance around in Disney's 1937 animated feature, *Snow White*. While most people are familiar with its caricature in commercial art, many are unaware that such a mushroom exists in nature. But it is, in fact, a common forest species in much of the north temperate zone and is widely naturalized in the southern hemisphere as well.

Fig. 1. The iconic *Amanita muscaria* is unmistakeable. (David Arora, all rights reserved).

Most authors who write about *A. muscaria* remark on its striking appearance. The Scottish mycologist, Robert Greville (1823), called it the "most splendid chief of the agaricoid tribe," and the French naturalist Jean-Baptiste Lamarck, writing around the same time, elegantly expressed what so many feel when they come across it in the forest: "Cette espéce est remarquable par sa beauté" (Lamarck and Augustin 1815).

Amanita muscaria is known in most English-language field guides as the fly agaric or fly amanita. Steeped in milk, it has been widely used to attract flies; the flies become intoxicated by the infusion and then drown (Wasson and Wasson 1957:190; Michelot and Melendez-Howell 2003). But *A. muscaria* is also known as an inebriant. In parts of Siberia where alcohol was unknown, the recreational use of *A. muscaria* was well documented in the 18th century (e.g., von Strahlenberg 1736). Its modern use as an inebriant is also well known (Letcher 2007; Erowid 2008).

Ethnomycologist R. Gordon Wasson (1968) gained renown by focusing on its religious rather than recreational use, for example, by proposing that *A. muscaria* is the enigmatic Soma praised in ancient Vedic texts. His theories have gained currency in some circles but are still controversial (Letcher 2007). A standard dose as an inebriant is one to two caps (Greville 1823; Lincoff and Mitchel 1977); an upset stomach may or may not result. The active principle was long believed to be muscarine—isolated from *A. muscaria* in 1869 and the first mushroom toxin ever identified. Much later, however, it was demonstrated that muscarine, while found in a number of other mushrooms, occurs in such minute quantities in *A. muscaria* as to be clinically insignificant (Lincoff and Mitchel 1977; Benjamin 1995). It is ibotenic acid and muscimol (a more potent, decarboxylated version of ibotenic acid) that produce its inebriating effects (Takemoto et al. 1964; Bowden and Drysdale 1965; Eugster et al. 1965). Both of the latter compounds are water soluble and, as we will show, can easily be removed from the mushroom by parboiling it and then discarding the liquid. It should be noted that we use the term "parboil" in this paper to mean precook by boiling, as per the third definition of Rombauer et al. (2006:1054). It should also be noted that the dangerously poisonous, amanitin-containing species, e.g., *A. phalloides* Secr., cannot be detoxified by any normal cooking or processing method, and are not discussed hereafter.

Despite being common, easy to identify, and an excellent savory mushroom after parboiling (Arora 2000; Rubel 2000), and despite a long-standing, albeit scattered, tradition of being eaten as a food in the European, Russian, North American, and Japanese countrysides, *A. muscaria* is almost universally characterized by modern mushroom field guides as being poisonous (e.g., Smith and Weber 1980; Lincoff 1981; Arora 1986; McKnight 1987; Hall et al. 2003; Miller and Miller 2006), even deadly (e.g., Groves 1962; Phillips 1991).

As we will show, 19th-century investigators from various disciplines established that the mushroom could easily be detoxified by parboiling it. This understanding was widely published in the 19th-century medical and toxicological literature but was ignored and decisively rejected by English-language mushroom field guide authors of the 19th and early 20th centuries. The rejection was so thorough that knowledge of *A. muscaria*'s food use appears to have effectively been lost by the late 20th century. Contemporary field guide authors continue to emphasize (and often exaggerate) the toxicity of *A. muscaria*, seldom mention that anyone eats it, and fail to provide precise and accurate instructions on how to detoxify it. As a result, *A. muscaria* is rarely picked for the dinner table except by those who inherit a local or family tradition of eating it.

The Toxicity of *Amanita muscaria*

English-language mushroom field guides agree that *Amanita muscaria* is poisonous and should not be eaten ("This is a dangerous fungus and should be avoided"—Miller 1972:32; see also McIlvaine and Macadam 1902; Marshall 1905; Güssow and Odell 1927; Smith 1975; Arora 1979; Lincoff 1981; Fergus and Fergus 2003; etc.). In many of these cited works, the authors mention the possibility of *A. muscaria* being fatal. Some authors even classify it as deadly (Gibson 1899; Krieger 1936), and the mushroom guide belonging to the prestigious Peterson Field Guide series (McKnight 1987) marks *A. muscaria* with the universally intimidating skull-and-crossbones symbol.

Yet in researching this article, we were unable to find a single adult death in North America indisputably caused by *A. muscaria*. Recent literature typically lumps poisoning by *A. muscaria* with poisoning by the closely related but significantly more toxic *A. pantherina* (DC.) Krombh. (Lincoff and Mitchell 1977; Benjamin 1995; Michelot and Melendez-Howell 2003). Furthermore, during the 19th and 20th centuries, atropine (the active principle of deadly nightshade, *Atropa belladonna* L.) was commonly

prescribed as an antidote to *A. muscaria* poisoning in the mistaken belief that muscarine was the principal toxin. Atropine, however, may aggravate the symptoms of *A. muscaria* ingestion (Mitchel 1980). These variables complicate research into *A. muscaria* poisoning, but if *A. muscaria* has caused fatalities in North America, they have been few and far between. The only fatality cited by modern authors (Benjamin 1995:313) is that of Count de Vecchi, legate to the Italian Embassy in Washington, D.C., who allegedly died of *A. muscaria* poisoning in 1897 after dining on two dozen (!) mushrooms purchased in a local market (Prentiss 1898). Though his death has been linked repeatedly with *A. muscaria* (e.g., Jordan 1917:20), we use the word *allegedly* because it is impossible from the published accounts to reconstruct exactly what he died from; indeed, there is enough uncertainty to justify a separate article on the subject. The second most-often cited death by *A. muscaria* poisoning after that of Count de Vecchi is that of the Czar Alexis of Russia (e.g., Marshall 1905; Hard 1908)—in 1679! But authors do not agree on whether it was the Czar or the Czar's wife who was poisoned (Douglass 1917a).

A few mushrooms with histories of being eaten have been shown to be quite dangerous. *Gyromitra esculenta* (Pers.) Fr., for example, is popular in northern Europe but has caused deaths when not properly prepared, in part because there is a narrow dosage threshold between serious symptoms and a complete absence of them (Benjamin 1995). Another mushroom, *Paxillus involutus* (Batsch) Fr., has a history of being eaten in Europe but can cause severe allergic reactions in people who have eaten it for years. *A. muscaria*, however, does not have such a record, and an adult who eats one or two caps, even uncooked, does not, according to the literature, risk such severe consequences. The fatal human dose for *A. muscaria* has not been determined. Benjamin (1995:309) speculated that 15 caps would be fatal, but it is unclear whether he was referring to *A. muscaria* or to the more toxic *A. pantherina.* Lincoff and Mitchel (1977) reported a man who ate 20 caps and survived, but also did not specify which species he ate. Many websites mention a fatality caused by the consumption of 20 or "two dozen" *A. muscaria* caps, but these apparently refer back to the unfortunate Count de Vecchi. What is known is that none of the hundreds, even thousands, of adults who have used *A. muscaria* as an intoxicant in North America have directly died from doing so (McDonald 1978:225), and early reports of *A. muscaria* usage as an inebriant in Siberia were not accompanied by references to fatalities.

Early Literature on the Edibility of *Amanita muscaria*

The documentation of historic *Amanita muscaria* food use is sparse, though persistent, and includes Europe, Asia, and North America. Most accounts merely mention its use as a food, but omit information on its safe detoxification. This dichotomy in the literature does not pertain only to *A. muscaria* or only to English-language field guides. See, for example, French mycologist Roget Heim's mention of the "poisonous" *Boletus satanas* Lenz being eaten by some people while failing to describe how "some people" detoxified the mushroom (Heim 1963:176).

The most explicit, widely-circulated, early account in English of *A. muscaria*'s use in the kitchen was by German physician and naturalist George Heinrich von Langsdorf, brought into the English-language literature as part of Robert Greville's influential presentation to the Wernarian Natural History Society in 1823. In Greville's (1823:344) translation: "[in Siberia it] is sometimes eaten fresh in soups and sauces, and then loses much of its intoxicating properties." While his translation might be construed to allow for the possibility of savory dishes that intoxicate slightly, it is more likely that the mushrooms were detoxified by being first parboiled, which would be consistent with the Russian method for detoxifying "poisonous" mushrooms described by Pallas (1794:76) from his visit to a region near Moscow. It is also consistent with our experience of current practice in Russia (as well as Lithuania), where many or most species of wild mushrooms are first boiled in water, drained, and then used as an ingredient in a dish.

While von Langsdorf's detailed descriptions of *A. muscaria*'s use as an inebriant in Siberia were subsequently cited (e.g., Christison 1829:653), his description of its use as a food was never cited again. But there were other mentions of kitchen use of *A. muscaria*—in, for example, Charles David Badham's (1863) book, *A treatise on the esculent funguses of England.* Its use as a food in

Russia was noted in the Annals of Horticulture (1848:423), by Cooke (1880:211), and by William Delisle Hay (1887:154), who wrote, "The plant is eaten both in North Russia and in Southern France, *but of course* [emphasis ours] after being boiled and washed." These, plus more general references to "poisonous" mushrooms being eaten in the Russian and European countrysides (e.g., Pallas 1794; Porcher 1854; Whetstone 1898:263) formed a backdrop to the more precise work on *A. muscaria* detoxification published in the 19th-century medical and toxicological literature.

During the 19th century, efforts were made to prove in a methodical way that *A. muscaria,* as well as various other "poisonous" mushrooms, could be made safe for the dinner table. A French physician, Dr. Félix Archimčde Pouchet, was especially influential in establishing the efficacy of boiling *A. muscaria* to remove its toxins, but he had a distinctly practical quest: he was looking for a way to unlock the nutrition tied up in wild mushrooms that the rural poor were not collecting because they thought them poisonous. In this quest to use "poisonous" mushrooms to help feed the poor, he was inspired by the root crop manioc (*Manihot esculenta* Crantz), described by one of his contemporaries (Taylor 1859:626) as follows:

> The root of one variety of this West Indian plant, known under the name Bitter Cassava, contains in its juice prussic [hydrocyanic] acid. It is, therefore, when recently expressed, highly poisonous, inducing coma, convulsions, and death... The vegetable principles of the plant, evaporated to dryness, form what is called *Cassava-cake*, which is not only inert, by reason [of] the poison being volatized, but highly nutritious. The starch obtained from this root is well known under the name *Tapioca*. Neither cassava nor tapioca yields any trace of prussic acid.

Pouchet (1839:323) explicitly acknowledged the example of manioc. As he put it (translated from the original French by the authors),

> Manioc forms the staple nourishment of a large number of people but has in its tissues the most violent of poisons; through skill, man extracts the poison from the nutritive part, and we think that science could do the same for mushrooms.

Pouchet's reference to manioc was a conceptual breakthrough. In suggesting that the French eat *A. muscaria,* he did not argue that it was a traditional food someplace else, like in Italy or Russia, but simply that through scientific methods he had determined it could easily be rendered safe to eat. He was also saying that mushrooms could be thought of in the same way we think of other foods that are edible, and that by analogy what he was doing to *A. muscaria* was no more extreme than detoxifying manioc.

One of Pouchet's experiments was to boil five *A. muscaria* caps per liter of water for 15 minutes. He strained out the mushrooms and fed the broth to dogs, who died, thus demonstrating that the toxins were water soluble. But he also fed dogs boiled caps without the broth, and they thrived, thus demonstrating that the caps were no longer poisonous. (Note: smaller dogs are cheaper to maintain for experimental purposes than large ones, so we can infer that five caps for one of Pouchet's dogs is equivalent to 20 or more caps for a human adult.)

Pouchet's experiments were widely described. Reese (1874:346) said in his manual on toxicology, "A third [dog] which was fed [by Pouchet] on boiled amanitas for two months actually fattened on this food." Pouchet's experiments were also cited in the standard medical references of that era, for example in *Medical Jurisprudence* (Wharton et al. 1860:569; Wharton et al. 1873:470; Wharton and Stillé 1882:675). In all of the above cases, the edibility of parboiled *A. muscaria* was accepted as fact.

While Pouchet, to demonstrate edibility, experimented on animals, another Frenchman, M. Gerard, experimented on himself, and on his family. In 1851, Gerard demonstrated that *A. muscaria*, along with a number of other "poisonous" mushrooms, could be safely eaten if parboiled (Gerard 1852). He was also widely cited in the 19th-century toxicological literature. Here is Gerard's recipe for *A. muscaria* as translated by the Southern Society for Clinical Investigation (1853: 261):

> To every five hundred grams of mushrooms cut up into a medium size, a liter of water, slightly acidulated by two or three spoonfuls of vinegar (or, if nothing else is on hand, gray salt), should be used. If [only] water alone can be obtained, this must be renewed once or twice. In this fluid the fungi are to be macerated for two entire hours, after which they are to be washed in an abundance of water. Next, they are to be put into cold water and boiled for half

an hour, after which they may be taken out, washed, dried, and used as food.

Interest in Gerard's work was so great that it was republished a decade later, again in English, under the title, "A simple means of removing the poisonous properties of suspicious mushrooms" (Gerard 1863), and it was cited in Hay's (1887) book on British mushrooms. It is worth noting Gerard's use of vinegar. This use may be traceable to Jean Jacques Paulet, a French botanist and mycologist who was credited with demonstrating in 1776 that "the mode in which... [mushrooms] were cooked" affected toxicity, and that salt and vinegar were particularly helpful in this regard (Lindley 1836:422).

The belief in the edibility of parboiled *A. muscaria* was apparently not a controversial one in the 19th-century American medical community. Dr. Francis Porcher cited most of the above sources (including Pouchet) in his report to the American Medical Association entitled *The Medical, Poisonous, and Dietetic Properties of the Cryptogamic Plants of the United States* (Porcher 1854). He also cited several sources as saying of *A. muscaria* that, "in the middle of France they had constantly been in the habit of eating them" (Porcher 1854:61). Of the ethnographic literature in general, he concluded that what was written was really true: that many poisonous mushrooms could be rendered edible through knowledgeable processing. In his own words, "There is no reason to doubt the fact that sorts *justly esteemed poisonous are really used* [author's emphasis]" (Porcher 1854:47). Porcher's work, with its imprimatur of the American Medical Association, was also cited in the aforementioned and influential *Medical Jurisprudence* (Wharton et al. 1860; Wharton et al. 1873; Wharton and Stillé 1882).

At the end of the 19th century, the noted American botanist, Charles Peck (1895:214), in an extensive passage on the use of *A. muscaria* as a food, described Americans who detoxified *A. muscaria* with vinegar and/or water. But the most detailed, objective, and accurate description of its edibility was written in 1898 by Frederick Vernon Coville, a distinguished botanist, explorer, and ethnographer, who authored 170 books and articles (but who, significantly, was not a mushroom field guide author). Coville was the first to discover the importance of soil acidity to blueberries; he also wrote books on desert plants, served as Chief Botanist for the United States Department of Agriculture and as Chairman of the National Geographic Society Research Committee, and was the first director of the United States National Arboretum. Coville published a report on *Amanita muscaria* in 1898 for the United States Department of Agriculture as part of an investigation into the death by mushroom poisoning of Count de Vecchi of Washington, D.C. In this work, entitled *Observations on Recent Cases of Mushroom Poisoning in the District of Columbia,* Coville exhibited a reasonably solid grasp of the scientific understanding of the edibility of *A. muscaria.* He went to the market where the Count had purchased the mushrooms that allegedly poisoned him and, remarkably, discovered *A. muscaria* being eaten in Washington, D.C.!

> It is well known that in some parts of Europe the fly amanita, after the removal of the poison by treatment with vinegar, is a common article of food. It was interesting to discover not long since that among some of our own people the practice prevails. Though most of the colored women of the markets look upon the species with horror, one of them recited in detail how she was in the habit of cooking it. She prepared the stem by scraping, the cap by removing the gills and peeling the upper surface. Thus dressed the mushrooms were first boiled in salt and water, and afterwards steeped in vinegar. They were then washed in clear water, cooked in gravy like ordinary mushrooms, and served with beefsteak. This is an exceedingly interesting operation from the fact that although its author was wholly ignorant of the chemistry of mushroom poisons, she had nevertheless been employing a process for the removal of these poisons which was scientifically correct. (Coville 1898: 19)

Coville's work stands as a model for writers today. While Coville was not a mushroom expert, he reviewed the scientific literature, the ethnographic literature, and did his own field work. Although he did not go on to recommend that his readers eat *A. muscaria,* he used his understanding of mushroom toxicology to explain the findings of his field research and to reconcile the two. He unambiguously concluded that "after the two treatments the mushroom is free from poisons." Thus he is notable for using the science of his day to explain why a folk method of detoxification was effective.

20th-Century Literature on the Edibility of *Amanita muscaria*

Since contemporary mushroom field guides teach that *A. muscaria* is poisonous, even potentially deadly, it is difficult to appreciate the extent to which the 19th-century toxicological literature was united behind the ethnographic literature in declaring that *A. muscaria* is edible after parboiling. Knowledge, particularly in written form, is widely assumed to progress over time as more and more bits of information are accumulated, examined, and tested. In the case of *A. muscaria*, however, 20th-century mushroom field guides have proved strangely impervious to the facts, as we will show, and knowledge of its edibility seems actually to have regressed.

Coville's work was cited in the early 20th-century medical literature (e.g., Wiley 1917:445). Furthermore, a medical doctor, Beaman Douglass (1917b:212), reported that, "The negroes of the southern states are said to have learned empirically how to prepare [*A. muscaria,* as well as *Russula emetica* (Sch.) Pers.] which they eat freely." The field guide literature, however, did not follow up on Coville (despite his excellent reputation) and the other explicit 19th-century literature on *A. muscaria* edibility. Instead, the field guide literature rejected its edibility and closed ranks around its toxicity.

In an act of omission for the apparent purpose of distorting or suppressing evidence of its edibility, Nina Marshall, in *The Mushroom Book* (1905:49–50), cited Coville but failed to say that *A. muscaria* was eaten in Washington D.C., and that there was a "scientifically correct" way to detoxify the mushroom. Instead, she labeled *A. muscaria* "poisonous," and emphasized its danger by stating, "It is known to have caused much sickness and many deaths. It caused the death of the Czar Alexis of Russia, and of the Count de Vecchi in Washington." While she did mention that *A. muscaria* is "cooked and eaten by the Russians," she prefaced that statement with the phrase "it is said" (rather than "it is known"), thus implying that it may not be true. Her respected contemporary, Prof. George F. Atkinson of Cornell University, said of *A. muscaria* in his field guide (Atkinson 1900), "... deadly as ordinarily found, [but] is undoubtedly used quite largely as food in parts of France and Russia, and it has been eaten repeatedly in certain localities in this country without harm." But Atkinson, unlike Coville, did not explain in which localities in the United States *A. muscaria* was eaten, nor how such a "deadly" mushroom could be safely prepared.

The most influential North American mushroom field guide of that era, however, was *One Thousand American Fungi* by Captain Charles McIlvaine (McIlvaine and Macadam 1902), a book that is still in print. McIlvaine was interested in the science of his day, but he proudly broke with the tradition of field guide authors simply following each other's lead, and sought to establish edibility on a sound personal and scientific basis. He tested hundreds of mushrooms on himself, including some routinely characterized as poisonous, and even had a group of designated "undertasters" (McIlvaine and Macadam 1902/1967 reprint: xv, 454).

Uncharacteristically, however, McIlvaine exaggerated the toxicity of *A. muscaria*, a mushroom that he asserted was "undoubtedly *poisonous* [author's emphasis] to a high degree" (McIlvaine and Macadam 1902/1967 reprint: 15). McIlvaine claimed to have become intoxicated from eating a hazelnut-sized piece of raw cap—an impossibility according to Phipps (2000), unless the effects were psychosomatic; that McIlvaine experienced an anxiety reaction is also suggested by the fact that he counteracted the mushroom's effects by smoking a pipe! McIlvaine emphatically rejected the use of vinegar, or any other method, for extracting poison from the mushroom on the grounds that one couldn't be sure it had all been removed. His mention of the use of vinegar (McIlvaine and Macadam 1902/1967 reprint: 15–16) implies that he was familiar with Coville's "scientifically correct" method for detoxifying *A. muscaria.* His rejection of the detoxification procedure was subsequently cited by others as a reason to reject it (e.g., Benedict 1908:94).

Why didn't McIlvaine test detoxification procedures prior to rejecting them? The answer seems to be his personal bias, for he was no stranger to conducting experiments to prove a point. McIlvaine injected etherized cats with *A. muscaria* juice, killing them. This inspired a physiologist, William Carter (1901), to conduct a bigger study of the effect of injecting a range of animals—cats, dogs, rabbits, even frogs—with *A. muscaria* juice. These experiments, unlike those of Pouchet, had no chance of demonstrating that the mushroom was edible. With the hindsight of

one hundred years, it is evident that McIlvaine and Carter presaged a 20th-century shift toward using increasingly sophisticated laboratory techniques to study toxins and toxicity while abandoning Pouchet's quest to use science as a means of learning how to safely detoxify mushrooms for the table.

The first comprehensive academic treatment of North American agarics was written by Prof. Charles Henry Kauffman (1918). Kauffman gave a detailed morphological description of *Amanita muscaria* in which he called it "deadly poisonous," saying, "It is a delightful object for the artistic eye of the nature lover but in all other respects a menace." Yet buried in the appendix of this same field guide (Kauffman 1918; 1971 reprint: 841–842) is a section called "Treatment of *Amanita muscaria* poisoning," written by Dr. O. E. Fischer, who, significantly, was not a mycologist but a medical doctor, like Porcher and Douglass. Fischer cited *A. muscaria* as being eaten as food in Saxony and Bohemia. He also cited Coville, and gave the African-American market woman's recipe for its safe preparation.

Writing ten years later, William Sturgis Thomas, president of the New York Mycological Society and author of the mushroom volume (Thomas 1928) in Putnam's Nature Field Books series, based most of his mushroom edibility information on Peck. Incredibly, however, he skipped over the information that Peck (1895) provided on the use of *A. muscaria* as food, just as Marshall had purposefully dropped Coville's authoritative information on its detoxification.

The next important field guide mention of *A. muscaria* being eaten was in *The Mushroom Handbook* (1936), by Louis Krieger. A mycological bibliographer, Krieger was conversant in English, French, and German, and his knowledge of the relevant literature was second to none. Perhaps reflecting the prevailing climate of hostility toward drugs (the notorious anti-drug movie, *Reefer Madness*, was also released in 1936), Krieger chose to exaggerate the intoxicating effects of raw *A. muscaria* by describing, apparently without basis, Siberian villages full of "intoxicated people running amok with drawn knives and false courage endanger[ing] the lives of their fellows." Regarding the edibility of *A. muscaria*, Krieger stated, "This species, though known to be deadly, is eaten without ill effects by some people." He provided no specific information on who ate *A. muscaria* nor did he give any details for safely preparing it.

But no major field guide author so fully embodies the dichotomy between the careful and scholarly treatment of mushroom taxonomy and the idiosyncratic treatment of mushroom edibility as Alexander Smith, the preeminent North American mushroom taxonomist of the 20th century. Smith authored approximately 200 articles and books over a long and distinguished career and named many new species. He dedicated his first field guide for the general public, *Mushrooms in Their Natural Habitats* (Smith 1948), to his mentor, the aforementioned Charles Kauffman, and labeled *A. muscaria* as poisonous, thus following Kauffman (1918) as well as Gibson (1899), McIlvaine and Macadam (1902), Marshall (1905), and Krieger (1936), among others, in rejecting or ignoring the 19th-century toxicological and ethnographic literature. Like Gibson (1899), Smith attributed stories of people safely eating *A. muscaria* to misidentification. He even speculated that the people were probably eating *A. frostiana* Peck, a North American species unknown in Europe and Asia.

Smith's next work for the general public was *A Mushroom Hunter's Field Guide* (1958, 1963), a book that sold 100,000 copies and was hailed as the "first modern [mushroom] field guide for amateurs" (Thiers 1987). In the first version of this book, Smith (1958:136) said this of *A. muscaria*:

> Poisonous. If someone claims to know how to cook it so that it is edible, do not argue with him, but do not eat any. Apparently there are ways of extracting the poison, but the risk is not worth the effort.

It is unclear to us what Smith's reasons were for saying not to argue the point (because it truly is edible?), or what the "effort" is that he refers to. But in the second "revised and enlarged" version of the same book, Smith (1963:177) labeled *A. muscaria* "poisonous," and then immediately went on to say,

> However, some people extract the poison and then eat the mushroom, apparently with no ill effects. They claim it is a most delicious species. The instructions, as I have heard them, are to parboil the specimens in salt water until no more yellow scum comes to the surface...

As we can find no other specific mention in the mushroom literature of "yellow scum," we conclude that Smith was in touch with credible informants who regularly ate *A. muscaria* and considered it delicious. But he provided no information about who these people were, and, unlike Coville, he didn't stand behind his own ethnographic report. Instead, he went on to tell readers that if they tried the detoxification method he had just described, that they did so at their own risk (Smith 1963:177). Smith's distrust of his own finding suggests that he was unaware of the substantial body of l9th-century literature on the subject, and furthermore, that this body of knowledge regarding *A. muscaria*'s edibility had already effectively vanished. Furthermore, Smith seems to have made no personal effort to verify the efficacy of parboiling *A. muscaria*, an indication of his and his culture's lack of interest in wild mushrooms as food. Thus he was clearly working within the same intellectual framework as the 18th-century English field guide author William Curtis, one in which the accuracy of the edibility information is not as important as that of the taxonomic information.

In Smith's 1975 work, *A Field Guide to Western Mushrooms,* under the description of *A. muscaria,* he reverted to labeling it poisonous and dropped the reference to detoxification (Smith 1975:167). However, as in Kauffman (1918), there is completely different information buried in the chapter on mushroom poisoning, namely, the unambiguous statement "People who know how to boil the poison out of it use it as an esculent" (Smith 1975:15). Five years later, in the revised edition of *The Mushroom Hunter's Field Guide* (Smith and Weber 1980:171–172), Smith once again changed his position, or at least his emphasis. Instead of continuing to characterize *A. muscaria* as "poisonous," he broke with his own past as well as with the entire history of mushroom field guides by labeling it as "poisonous to most people," thus implying that some people are immune to its toxins and can eat it with impunity. Smith then went on to say that "some people can eat this species and suffer no ill effects; others parboil the specimens and discard the liquid..."

While specimens of *A. muscaria* vary in the amounts of toxins they contain (Benedict 1972), and while individuals may vary in their sensitivity to the toxins, there is no literature to support the idea that anyone is immune to its toxins and could eat as many non-detoxified specimens as they wanted without becoming intoxicated or nauseous or worse. Smith cited no references for his extraordinary claim that non-detoxified *A. muscaria* is edible for some people, but the phrase "some people can eat this species and suffer no ill effects" is almost verbatim from Krieger (1936/1967 reprint: 238–239).

Despite his inconsistencies, his apparent distrust of his own findings, and his failure to use science to support (or debunk) folk detoxification techniques, Smith deserves credit for breaking with his 20th-century predecessors in publishing accounts of *A. muscaria*'s usage as food. Smith was a mushroom taxonomist, not an ethnographer, and he did not often report ethnographic uses of mushrooms in his books. He clearly did not trust the detoxification procedure he described for *A. muscaria*, and strongly recommended against employing it. Yet, in four books spanning more than 20 years he repeatedly described or alluded to this same detoxification procedure which he distrusted. Why would he do so when it would have been so much easier not to mention it being eaten and simply to agree with the 20th-century field guide consensus that *A. muscaria* was poisonous? We think his repeated references to detoxification point to food use of *A. muscaria* in North America consisting not of isolated instances, but of a tradition sufficiently developed and widespread enough that Smith anticipated some of his readers encountering it, and thus felt compelled to inform them of it.

Though Smith was a highly respected mushroom expert, his repeated references to the use of *A. muscaria* as an esculent were ignored by subsequent field guide authors (e.g., McKenny and Stuntz 1971; Miller 1972; Guild 1977; Arora 1979, 1986; Lincoff 1981; Fischer and Bessette 1992; Jordan and Wheeler 1995; Bessette et al. 1997), suggesting a broad cultural bias against taking ethnographic references to mushroom food use seriously when they contradict prevailing practices. However, we find Smith's allusions tantalizing.

In addition to the aforementioned references by Peck, and more specifically to the food use of *A. muscaria* by African-Americans in America's South, we surmise that there was, and may still be, an undocumented tradition of eating *A. muscaria* in North America. Besides Smith, who

collected mushrooms extensively in the Pacific Northwest and Midwest, Chilton (in Rumack and Salzman 1978:112) mentioned a "few people in Europe and North America" preparing *A. muscaria* for the table. He described a procedure similar to that of Coville's African-American market woman, though without the final soaking in vinegar. Lincoff and Mitchel (1977:85) mentioned unconfirmed reports from the Pacific Northwest of people who "eat the Fly Agaric as a food after peeling the cap, parboiling the peeled mushrooms, discarding the cooking water, and recooking them," but, like so many 20th-century authors, they warned against doing so. Denis Benjamin (pers. comm.) reports similar usage of *A. muscaria* in the Pacific Northwest during the 1980s, with one man telling him that his family had been eating *A. muscaria* as food for three generations.

We have also encountered people who eat *A. muscaria* as food, both in Europe and North America. One such person, a man living in the Sierra Nevada foothills of California, actually came to doubt the safety of his family's tradition of eating parboiled *A. muscaria* based on what he had read in Arora's (1986) field guide. The man asked Arora if there were any long-term ill effects from dining on parboiled *A. muscaria* because he hadn't noticed any short-term ill effects. It is difficult to imagine rural Tibetans or Mayans who had been taught by their parents how to safely prepare a particular mushroom losing confidence because of what was written in a book. But in 20th-century North America, the prestige of the written word was such that this rural man sought assurance for something that he had been doing all his life, and he ironically sought it from a field guide author who had never (at that time) eaten it as a food, and, unaware of the 19th-century understanding that it was edible, had merely repeated the 20th-century consensus that it wasn't. As a result of this encounter and further research with Alan Phipps in Sanada, Japan, where *A. muscaria* is an esteemed edible mushroom (Wasson and Wasson 1957; Arora 2000; Phipps 2000), Arora has changed his assessment of the edibility of *A. muscaria* and now considers it to be a delicious edible mushroom if parboiled. This information, however, has not yet made its way into his field guides (Arora 1986, 1991).

The only modern English-language field guide we have found that categorically states that one can make *A. muscaria* safe to eat is *The Mushroom Manual* by Lorentz Pearson (1987). Citing the Swedish field guide author Bengt Cortin, who personally tested more than 300 species of wild mushrooms including many of doubtful edibility, Pearson (1987:61) offered the following detoxification method:

> To render *Amanita muscaria* safe to eat: (1) carefully peel the cap, removing every bit of the pellis or rind...; (2) cut into relatively small bits; (3) place the bits in boiling water and boil for exactly five minutes; (4) discard the water, and boil again in fresh, boiling water for an additional five minutes; (5) discard the water and prepare the mushroom in the usual way.

Paradoxically, however, just as references to *A. muscaria* food use were buried in chapters on poisoning in Kauffman (1918) and Smith (1975), the above recipe was placed in a chapter ominously titled "The Fatal Five," thereby severely undercutting its impact. As we have already noted, other English-language field guide authors have not followed up on Smith's description of *A. muscaria's* edibility, nor on Pearson's rendition of Cortin's precise instructions.

By the end of the 20st century, mention of the use of parboiled *A. muscaria* as a food had been practically expunged from the written record. Kenneth Lampe (1979:95), in a pharmacological review of toxic mushrooms, stated, "Cooking does not markedly affect [its] activity," and Didier Michelot and Leda Maria Melendez-Howell (2003), two scientists favorably disposed towards *A. muscaria*, wrote in an otherwise well-researched paper that "Contrary to some statements, cooking does not notably lower toxicity, demonstrating that the active components are not heat sensitive." Michelot and Melendez-Howell wanted to show that the mushroom could be detoxified and then eaten for dinner, but the late 20th-century literature that they worked with no longer included the 19th-century knowledge that the toxins in *A. muscaria* are water soluble. Thus they didn't realize that "cooking" per se, i.e., the application of heat, does not detoxify *A. muscaria*, but that boiling it in water does. Their failure to match the correct cooking method to the mushroom testifies to a more general failure on the part of the literature (and especially mushroom field guides) to be more accurate and explicit in reporting the well-

established fact that *A. muscaria*'s toxins are water soluble.

Recent Food Use of *Amanita muscaria* outside North America

This work focuses on English-language field guides. A methodical survey of mushroom field guides from Europe and Asia would be instructive. As an example of what one is likely to find, the Swedish author Bengt Cortin (1942) wrote (translated by Eric Danell), "Nowadays it has been determined, that this poisonous mushroom is harmless if treated in the right way." The literature that supports that statement would be well worth knowing. An Italian author, Bruno Cetto (1994) mentioned *A. muscaria* being eaten as a food in contemporary Italy. Lucius von Frieden (1964) also mentioned it being eaten in Europe. But neither author provided concrete details, and both focused on the broader national attitude towards *A. muscaria* rather than on regional practices that deviated from the norm. Even so, the mention of *A. muscaria* use as food in parts of Italy suggests that a broader survey of field guides might uncover useful information on the practice of *A. muscaria* consumption in Europe that could then be used to focus field research where one is most likely to still be able to find people who can explain how they detoxify the mushroom, what they do with it, and how it fits into their culture and cuisine.

The best English-language report on the current use of *A. muscaria* as food in Asia, or for that matter, anywhere, is Phipps' (2000) treatise focused on the town of Sanada in Nagano Prefecture, Japan. Phipps' primary goal was to ascertain through laboratory testing whether the traditional salting method there rendered *A. muscaria* totally safe. It did. After boiling and storing the mushrooms in salt—the predominant treatment of *A. muscaria* in and around Sanada—Phipps found that there was no detectable muscimol or ibotenic acid. Phipps documented two other preparation methods: grilling and drying. The grilled caps are typically eaten by groups of men along with *sake,* while the dried caps are powdered for use as a flavor-enhancing condiment, producing the taste sensation the Japanese call *umami* (Kawai et al. 2002); according to Lincoff and Mitchel (1977), ibotenic acid and muscimol are far more powerful than the better known *umami* agent, MSG. In contrast to parboiling, Phipps found that both grilling and drying, far from detoxifying the mushroom, convert some of the ibotenic acid into the much more potent compound, muscimol (Phipps 2000:52–58). Phipps' work offers a model for combining ethnographic research with laboratory science to clarify the role of basic culinary processes—drying, grilling, roasting, frying, boiling—in eliminating or concentrating mushroom toxins.

Amanita muscaria: A Special Mushroom but Not a Special Case

The consistent labeling of *A. muscaria* as poisonous and the failure of modern field guides to acknowledge its use as food is by no means a special case. Many other mushrooms that can be made edible through *knowledgeable* processing are routinely dismissed as "poisonous" or not edible in mushroom field guides, whether out of bias, ignorance, or both. For example, *B. luridus* Schaeff., *B. erythropus* sensu auct. mult., and their close relatives are commonly eaten in China and Europe (especially Italy) but are labeled poisonous by many English-language field guides (e.g., Miller 1972; Bessette and Sundberg 1987; Bessette et al. 1997; Hall et. al 2003). *B. satanas* Lenz is eaten in Sicily after a complex cooking process (Galli 1996) but is described as poisonous by most field guides, including Italian ones (e.g., Cetto 1994; Testi 1995; Papetti et al. 1999). *B. subvelutipes* Peck is eaten in Japan (Imazeki et al. 1988) and has been safely served for years by restaurants in Massachusetts but is listed as poisonous in field guides written specifically for that area (Bessette et al. 1997; Bessette et al. 2001). *Gomphus floccosus* (Schwein.) Singer is often listed as poisonous (e.g., Miller and Miller 2006), but is commonly sold in the markets of Mexico and China. Acrid, red-capped russulas such as *Russula emetica* are widely eaten after being cooked or salted but are labeled poisonous by field guides in many languages (e.g., Hagara 1987; States 1990; Kuo 2007). Various peppery species of *Lactarius* such as *L. torminosus* (Schaeff.) Gray are condemned as poisonous by assorted English-language field guides (e.g., Glick 1979; Phillips 1981, 1991; McKenny et al. 1987; Miller and Miller 2006) but form an important part of northern European, Russian, and Siberian cuisine, as noted by

Heilmann-Clausen et al. (1998: 30) in their monograph on *Lactarius*:

> *Lactarius torminosus* is listed among the poisonous species in southern Europe, but in Finland the edibility of the species is not questioned.

Not only individual species but entire genera are routinely dismissed by field guides as poisonous or inedible or worthless (e.g., Lincoff 1981; Arora 1986; Jordan and Wheeler 1995), despite containing commercially-valuable edible species with long histories of usage. These genera include *Astraeus, Calostoma, Cortinarius, Entoloma*, *Hebeloma, Helvella, Schizophyllum, Scleroderma*, *Suillus,* and *Tremella*, to name just a few.

Criteria for Edibility Determinations of Mushrooms versus Plants

Listing *A. muscaria* as edible rather than poisonous is a completely unremarkable judgment in a culinary context, or even in the context of most books on plant identification and uses. In many cases, the processing required for traditional plant foods is far more exacting and labor-intensive than the parboiling required to make *A. muscaria* edible. For example, most bamboo shoots (e.g., *Dendrocalamus, Phyllostachys*, and *Bambusa* spp.) require boiling, in some cases with two changes of water. Researchers have determined that the traditional parboiling method for preparing the seaweed *hijiki, Hizikia fusiforme* (Harvey) Okamura, removes potentially dangerous quantities of arsenic found in the raw product (Hanaoka et al. 2001; Ichikawa et al. 2006). Lupine or wolfbean (*Lupinis albus* L.), which the authors recently purchased at a California supermarket, may require up to four *days* of soaking and water changes to make it safe for the table (Grande et al. 2004). The Canadian Food Inspection Agency (2005) recommends detoxifying fiddlehead ferns (*Matteuccia struthiopteris* L.) prior to "sauteeing, frying, or baking" by rinsing them in several changes of water, and then boiling for 15 minutes, or steaming for 12 minutes. Pokeweed (*Phytolacca americana* L.), the subject of a popular radio song in 1965 and a frequently eaten wild food in the American South and Midwest, has roots that can be fatally poisonous and shoots that are "one of the best tasting vegetables on the planet" (Brill 2002); the shoots, however, need to be boiled *three* times (and the water discarded) to render them safe to eat (Brill 2002:164–165). We have already mentioned that cassava, the source of tapioca, requires special treatment to eliminate hydrocyanic acid (Taylor 1859). Another staple, taro (*Colocasia esculenta* [L.] Schott), must be cooked 10–45 minutes depending on the variety and the part of the plant used in order to avoid experiencing "the sensation of a hundred red hot needles" in one's throat (Solomon and Solomon 1998:375).

As can be seen, this list of examples ranges from relatively obscure dietary supplements to widely-used, culturally-salient staples, and the consequences of improper preparation can be milder than for *A. muscaria,* or more severe. Yet all of these foods are consistently described in plant field guides (as well as cookbooks) as being edible, and it is either taken for granted that readers know how to prepare them (the packet of lupine we purchased had no instructions for its preparation!), or else directions for their processing are provided. Their toxicity, while acknowledged, is not used to dissuade people from eating them, but is instead treated as an inconvenience—something to be removed as one would remove dirt from a garden carrot. Jacquat and Bertossa (1990), for example, said this about the Thai plant *phak naam* (*Lasia spinosa* Thw.): "The young leaves are edible, but must be cooked or fermented to neutralize the hydrocyanic acid." While mushroom field guides are not cookbooks, and cannot be expected to carry the burden of an encyclopedic record of mushroom use, it would be easy enough for authors to say something equally terse, *useful,* and non-inflammatory about *A. muscaria*, such as, "edible if sliced thinly and parboiled in a large pot of salted water for 15 minutes, rinsed, and the water thrown out." They are, after all, the authorities that most urban people (including many scientists) consult first when they want to learn about a mushroom.

Contemporary English-language cookbook and plant field-guide authors operate in the same litigious climate as mushroom field guide authors, and all write for increasingly nature-alienated, rather than nature-immersed, audiences. But the formers' emphasis tends to be on a plant's edibility, not its toxicity, at least where there is a history of usage, while wild mushrooms appear to be held to an entirely different standard of accountability by English-language field guides.

It is tempting to attribute this double standard to the entrenched Anglo-American cultural antipathy toward wild mushrooms called "mycophobia" by the husband-wife team of Valentina Pavlovna Wasson and R. Gordon Wasson (1957), and "fungophobia" by British naturalist William Delisle Hay (1887:6), who commented,

> [All mushrooms]... are lumped together in one sweeping condemnation. They are looked upon as vegetable vermin, only made to be destroyed. No English eye can see their beauties, their office is unknown, their varieties not regarded.

While mycophobia undoubtedly limits the range of mushroom species labeled edible, a more specific Anglo-American antipathy toward boiled mushrooms has probably also had an effect on English-language authors' determinations of several species' fitness for the table, including *A. muscaria.* In Anglo-American cuisine, boiling mushrooms is an alien concept that approaches taboo status. We boil green vegetables, tubers, and eggs, not mushrooms. The last reference to boiling mushrooms that we could find in a major English-language cookbook was in Robert May's *The Accomplsht Cook* (1660). English 18th-century mushroom cookery practice was to stew, grill, bake, and fry mushrooms, but without parboiling (Glasse 1747; Briggs 1792). This is the practice that entered the American cookbook literature in the 19th century, and is the tradition that North Americans follow to this day (Randolph 1836; Lincoln 1884; Rorer 1902; Rombauer et al. 2006). An exception is Kuo (2007), an American field guide author, who is not averse to boiling the mushroom, *Lactarius deceptivus* Peck, *three* times with water changes (a northern European treatment), but nonetheless dismisses *A. muscaria* as "seriously poisonous." On the other hand, most modern field guides in other languages, even those from countries with little or no aversion to boiling mushrooms, clearly label *A. muscaria* as poisonous, with no mention of it being edible if parboiled or of its use as food by some people. Our survey of field guides in other languages, though cursory, included several from mycophilic countries such as Russia, Italy, and Japan (Hongo and Izawa 1994; Testi 1995; Papetti et al. 1999; Tat'jana 2007).

It is also significant that some mushrooms—e.g., morels (*Morchella* spp.) and honey mushrooms (*Armillaria* spp.)—are invariably labeled "edible" in English-language field guides despite being toxic raw (Benjamin 1995:278, 358). In other words, there is no consistent logical standard by which a mushroom is judged to be edible or poisonous. Instead, the initial reputation that a mushroom—or any potential food—acquires, for whatever reason, tends to hold sway through weight of precedence. Cultural assessments of a food's safety and desirability can certainly change (see Yamin-Pasternak 2008, this issue), but not easily. Thus peanuts (*Arachis hypogaea* L.) and other tree nuts are in no immediate danger of being labeled poisonous despite causing more than 100 deaths a year in the United States alone (Sampson 2002), while field guide authors list *A. muscaria* as poisonous despite its edibility being solidly established in the 19th century. Furthermore, a particularly litigious culture (such as that of contemporary America) may function as an additional brake on the dissemination of unpopular but scientifically accurate information. The net result, evident in the mushroom edibility literature, is a climate of fear-based ignorance rather than knowledge-based caution. As Douglass (1917b:207) so pungently put it, "With bigoted abstinence on the one hand, with gourmandizing and gluttony on the other and perhaps a bad cook in the kitchen even the most innocent and well-meaning mushroom will acquire a bad reputation."

Field Guides: Science or Culture?

Food choices and cuisine lie at the heart of cultural, regional, and national identity, whereas the taxonomy of nature, at least in modern urban societies, does not. This dichotomy may explain why food choices tend to be resistant to change, while scientific taxonomy embraces change as proof of modernity. The accuracy of the taxonomic and nomenclatural information is scrupulously maintained in field guides from decade to decade because modernity confers credibility. If the taxonomy and nomenclature of a field guide are out-of-date, its credibility suffers, and readers may well doubt the knowledge of the author. The edibility determinations are a significant part of almost all mushroom field guides; indeed, without the edibility information their public appeal would be greatly reduced. Yet the edibility determinations are free from the need to be modern or accurate precisely because they are culturally derived and reflect what it means to be an American or English consumer of wild

mushrooms, as opposed to a Chinese or Italian one. As but one example, when the field guide by Thomas (1928) was reissued in a new edition (Thomas 2003), the scientific nomenclature was updated, but the edibility information was not.

The disparity between field guides' treatment of mushroom morphology versus edibility can also be seen in the language. For example, *poisonous* is an intimidating word: attached to a potential foodstuff, it tends to discourage consumption. For the past 250 years, the primary meaning of "poison" has been a small amount of something that causes immense harm, even death (Oxford English Dictionary 2008), yet mushroom field guides routinely apply the label "poisonous" to a wide range of species including those that kill, those that merely upset one's stomach, and those that intoxicate. The imprecise language of mushroom edibility determinations (edible, poisonous) contrasts sharply with the highly precise terminology applied to the morphological features of mushrooms; for example, the surface ornamentation of a mushroom's stalk can be described as squamulose, scabrous, floccose, punctate, reticulate, or glandular-dotted. The difference in language further suggests that the high quality of analytical thought applied to questions of identification and morphology is not applied in the same measure to a mushroom's edibility, and is instead superseded by personal and cultural bias.

There is nothing inherently wrong with teaching edibility in terms of cultural practices as long as the bias is declared. However, modern field guides tend *not* to explicitly declare their bias as Curtis (1777–1798) did when he said of *Agaricus fimetarius* L., "It is not eaten with us." Instead, field guides tend to declare a mushroom species as "poisonous" or "not edible" as if it were an objective truth (see, for example: Lincoff 1981; Bon 1987; Phillips 1991; Jordan and Wheeler 1995; Bessette et al. 1997).

The problem of cultural bias in the evaluation of mushroom edibility was recognized in the 19th century when field guides were still a new genre. The Frenchman, Dr. Pouchet (1839), noted many instances in which the absolutist language of mushroom edibility asserted as fact the inedibility of a mushroom that was either published as edible by a different "expert," or was known to be eaten someplace else:

> According to Bulliard, the *Boletus cyanescens* [*Gyroporus cyanescens* (Bull.) Quél] is poisonous, while Bosc says that it is eaten in Piémont; *Agaricus necator* [*Lactarius necator* (Bull.) Pers], considered as a violent poison by many authors, was eaten by M. Letellier without the least problem, and Buxbaum says that the Russians make a great use of it. L'Agaricus acris [*Lactarius piperatus* (L.) Pers.], is also described as poisonous by a great number of specialists, and eaten in many places, according to M. Letellier.

Little has changed since 1839, as mushroom field guides continue to disregard ethnographic and scientific evidence of edibility in favor of an intellectually closed system for assessing mushroom edibility based on personal bias, the culinary and cultural practices of the author's home country, and the information presented in preceding field guides.

Furthermore, the field guide's literary form itself deceives. All of the information about each mushroom appears to derive from one set of objective facts led by the scholarly taxonomic binomial for each species. But while the Linnaean taxonomic system is concerned with mushroom morphology and phylogeny, the edibility determination and information are there to advise *cooks*, not taxonomists. Thus, two entirely different classification systems with different goals, each resting upon a different body of knowledge and arrived at using different methods, are deceptively intermingled; the taxonomic and descriptive information predominates (typically by a ratio of more than 5:1), and the edibility information derives much of its *gravitas* from being embedded in the former. Sitting under the taxonomic umbrella, the edibility information is shaded, as it were, from the glare of objective scrutiny. In summary, mushroom field guide authors teach the science of taxonomy. They *could* teach the science of edibility, but they don't. They teach a cultural lesson, and always have.

Field Guides and the Future

Field guide bias has been an impediment to sound scholarship, as we have shown for Michelot and Melendez-Howell (2003). It may have discouraged ethnographers from seeking information on the consumption of mushrooms they assumed could not be eaten, and it most certainly has limited the number of mushroom tastes, shapes, and textures available to cooks. Therefore, we support Samuel Thayer's (2006:12) insistence that field guide authors provide citations for every

fact of edibility or toxicity not derived from personal experience. In his words,

> When the works of authors who abide by [this principle] come to supplant those of sloppy scholarship, the study of wild food plants will be taken seriously again, and the oldest and most beautiful pastime in history will rise from the ashes.

In the last century there has been a dramatic urbanization of the landscape, widespread destruction of mushroom habitat, and a radical transformation of the relationship between people and forests. Both authors have shared the company of traditional mushroom collectors on all the major continents, and, except in the most isolated villages, these people tend to collect many fewer species than their parents, and their parents collect fewer than the grandparents (see Guissou et al. 2008, this issue). As with so many practices related to forests, knowledge is being rapidly lost. But if we methodically hunt for the remnants of mushroom knowledge with the obsessive diligence we search for mushrooms hidden under forest leaves, we may still be able to preserve a broad record of human endeavor regarding wild mushroom edibility and preparation, and the role wild mushrooms have played in people's lives prior to mass urbanization. For this hunt we must use focused conferences, field work, laboratory experiments, and the many tools of the Internet to assemble and disseminate information about mushroom edibility and usage from all over the world.

We believe that concerted research will reveal that the record of mushroom usage is far richer, more intricate, and more varied than the modern literature would suggest. Bringing field guide edibility determinations in line with accurate ethnographic and toxicological scholarship would create a body of work that will both preserve culinary information that is at risk of being lost, and facilitate a new mushroom cookery based on the broadest possible definition of edibility. This might seem a daunting task, but it coincides with a renewed and growing interest in local and wild foods (Ghirardini et al. 2007) that challenges the homogenizing influences of globalization (a process occurring even with respect to wild mushrooms, as described by Sitta and Floriani 2008, this issue).

As the scope of orally-transmitted mushroom knowledge diminishes in countries where mushroom collecting has been widespread, field guides will play an increasingly important role in shaping human-mushroom relationships. They will supplant parents and village elders as the most significant and obvious sources for information on mushroom identification, ecology, and edibility; indeed, in some countries they already have. But greater influence entails heightened responsibility and a more pressing need to be accurate. For, as we have shown for *Amanita muscaria*, field guides not only reflect and reinforce cultural consensus, they forge it.

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Literature Cited

Annals of Horticulture. 1848. Annals of Horticulture and Dear-Book of Information on Practical Gardening. Charles Cox, London.

Arora, D. 1979. Mushrooms Demystified: A Comprehensive Guide to the Fleshy Fungi of the Central California Coast. Ten Speed Press, Berkeley.

———. 1986. Mushrooms Demystified: A Comprehensive Guide to the Fleshy Fungi. 2nd ed. Ten Speed Press, Berkeley.

———. 1991. All that the Rain Promises and More...: A Hip Pocket Guide to Western Mushrooms. Ten Speed Press, Berkeley.

———. 2000. Funghi dal Mondo. Bollettino del Gruppo Micologico G. Bresadola Trento 43:38–40.

Atkinson, G. F. 1900. Mushrooms, Edible, Poisonous, etc. Andrus and Church, Ithaca, New York.

Badham, C. D. 1863. A Treatise on the Esculent Funguses of England, edited by F. Currey. Lovell Reeve and Company, London.

Benedict, A. L. 1908. Golden rules of dietetics; the general principles and empiric knowledge of human nutrition; analytic tables of foodstuffs; diet lists and rules for infant feeding and for feeding in various diseases. C. V. Mosby, St. Louis.

Benedict, R. G. 1972. Mushroom Toxins Other Than Amanita. Pages 281–320 in S. Kadis, A. Ciegler, and S. J. Ajl, eds., Microbial Toxins. Vol. 8. Academic Press, New York.

Benjamin, D. R. 1995. Mushrooms: Poisons and Panaceas—A Handbook for Naturalists, Mycologists, and Physicians. W. H. Freeman, New York.

Bessette, A. E., and W. Sundberg 1987. Mushrooms: A Quick Reference Guide to Mushrooms of North America. Macmillan, New York.

———, A. R. Bessette, and D. W. Fischer. 1997. Mushrooms of Northeastern North America. Syracuse University Press, Syracuse, New York.

Bessette, A. R., A. E. Bessette, and W. J. Neill. 2001. Mushrooms of Cape Cod and the National Seashore. Syracuse University Press, Syracuse, New York.

Bon, M. 1987. The Mushrooms and Toadstools of Britain and Northwestern Europe. Hodder and Stoughton, London.

Boom, M. 2005. Re: San Francisco Chronicle Magazine article. www.tech.groups.yahoo.com/group/mssf/messages/9038 (17 March 2008).

Bowden, K., and A. C. Drysdale. 1965. A Novel Constituent of *Amanita muscaria*. Tetrahedron Letters 612:727–728.

Briggs, R. 1792. The New Art of Cookery... Being a Complete Guide to All Housekeepers, etc. W. Spotswood, Philadelphia.

Brill, S. 2002. The Wild Vegetarian Cookbook. Harvard Common Press, Boston.

Canadian Food Inspection Agency. 2005. Food Safety Measures for Fiddleheads http://www.inspection.gc.ca/english/fssa/concen/specif/fidcroe.shtml (15 July 2007).

Carter, W. S. 1901. The Physiological Action of Three Poisonous Toadstools—Amanita Muscaria, Amanita Verna or Bulbosa, and Amanita Phalloides. American Journal of Physiology 5:158–174.

Cetto, B. 1994. I Funghi dal Vero. Vol. 1. Arti Grafiche Saturna, Trento, Italy.

Christison, R. 1829. A Treatise on Poisons in Relation to Medical Jurisprudence, Physiology and the Practice of Physic. A. and C. Black, Edinburgh.

Cooke, M. C. 1880. Fungi: Their Nature and Uses. D. Appleton and Company, New York.

Cortin, B. 1942. Svampplockarens Handbok. Saxon and Lindström, Stockholm.

Coville, F. V. 1898. Observations on Recent Cases of Mushroom Poisoning in the District of Columbia. United States Department of Agriculture, Division of Botany, U.S. Government Printing Office, Washington, D.C.

Curtis, W. 1777–1798. Flora Londinensis. A non-paginated volume printed for and sold by the author; and B. White, bookseller, London.

Douglass, B. 1917a. Mushroom Poisoning. Torreya 1710:171–175.

———. 1917b. Mushroom Poisoning (cont.). Torreya 1712:207–221.

Erowid. 2008. http://www.erowid.org/plants/amanitas/amanitas.shtml (4 February 2008).

Eugster, C. H., G. F. R. Müller, and R. Good. 1965. Active Principles from *Amanita muscaria*: Ibotenic Acid and Muscazone. Tetrahedron Letters 623:1813–1815.

Fergus, C. L., and C. Fergus. 2003. Common Edible and Poisonous Mushrooms of the Northeast. Stackpole Books, Mechanicsburg, Pennsylvania.

Fischer, D. W., and A. Bessette. 1992. Edible Wild Mushrooms of North America: A Field-to-Kitchen Guide. University of Texas, Austin.

Galli, R. 1996. I Boleti. Edinatura, Milan.

Geml, J., G. A. Laursen, K. O'Neill, H. C. Nusbaum, and D. L. Taylor. 2006. Beringian Origins and Cryptic Speciation Events in the Fly Agaric (*Amanita muscaria*). Molecular Ecology 151:225–239.

Gerard, M. 1852. On the Deprivation of the Noxious Powers of Poisonous Mushrooms. The British and Foreign Medico-chirurgical Review 10:279–280.

Gerard, M. 1863. A simple means of removing the poisonous properties of suspicious mushrooms. The Half-yearly Abstract of the Medical Sciences: being a digest of British and Continental medicine, and of the progress of medicine and the collateral sciences 37:15–16.

Ghirardini, M., M. Carli, N. Del Vecchio, A. Rovati, O. Cova, F. Valigi, G. Agnetti, M. Macconi, D. Adamo, M. Traina, F. Laudini, I. Marcheselli, N. Caruso, T. Gedda, F. Donati, A. Marzadro, P. Russi, C. Spaggiari, M. Bianco, R. Binda, E. Barattieri, A. Tognacci, M. Girardo, L. Vaschetti, P. Caprino, E. Sesti, G. Andreozzi, E. Coletto, G. Belzer, and A. Pieroni. 2007. The Importance of a Taste. A Comparative Study on Wild Food Plant Consumption in Twenty-One Local Communities in Italy. Journal of Ethnobiology and Ethnomedicine 3:1.

Gibson, W. H. 1899. Our edible toadstools and mushrooms and how to distinguish them; a

selection of thirty native food varieties, easily recognizable by their marked individualities, with simple rules for the identification of poisonous species. Harper and Brothers, New York.
Glasse, H. 1747. The Art of Cookery. 2nd ed. Printed for the Author, London.
Glick, P. 1979. The Mushroom Trail Guide. Holt, Rinehart, and Winston, New York.
Grande, A. D., R. Paradiso, S. Amico, G. Fulco, B. Fantauzza, and P. Noto. 2004. Anticholinergic Toxicity Associated with Lupin Seed Ingestion: Case Report. European Journal of Emergency Medicine 11:119–120.
Greville, R. K. 1823. Scottish Cryptogamic Flora. Edinburgh.
Groves, J. W. 1962. Edible and Poisonous Mushrooms of Canada. Canada Department of Agriculture, Ottawa.
Guild, B. 1977. The Alaskan Mushroom Hunter's Guide. Alaska Northwest Publishing, Anchorage.
Guissou, K. M. L., A. M. Lykke, P. Sankara, and S. Guinko. 2008. Declining Wild Mushroom Recognition and Usage in Burkina Faso. Economic Botany 62(3).
Güssow, H. T., and W. S. Odell. 1927. Mushrooms and Toadstools: An Account of the More Common Edible and Poisonous Fungi of Canada. Ministry of Agriculture, Ottawa.
Hagara, L. 1987. Atlas Húb. Vydavatel'stvo Osveta, Martin, Slovakia.
Hall, I. R., S. L. Stephenson, P. K. Buchanan, W. Yun, and A. L. J. Cole. 2003. Edible and Poisonous Mushrooms of the World. Timber Press, Portland.
Hanaoka, K., K. Yosida, M. Tamano, T. Kuroiwa, T. Kaise, and S. Maeda. 2001. Arsenic in the Prepared Edible Brown Alga Hijiki, *Hijikia fusiforme*. Applied Organometallic Chemistry 156:561–565.
Hard, M. E. 1908. The Mushroom: Edible and Otherwise, Its Habitat and Its Time of Growth. Mushroom Publishing Company, Columbus, Ohio.
Hay, W. D. 1887. An Elementary Text-book of British Fungi. S. Sonnenschein, Lowrey, London.
Heilmann-Clausen, J., A. Verbeken, and J. Vesterholt. 1998. The Genus *Lactarius* (Fungi of Northern Europe, Vol. 2). Danish Mycological Society, Copenhagen.
Heim, R. 1963. Les Champignons, Toxiques et Hallucinogenes. Editions N. Boubee, Paris.
Hongo, T. and M. Izawa. 1994. Mushrooms. Yama-kei, Tokyo. In Japanese.
Ichikawa, S., M. Kamoshida, K. Hanoaka, M. Hamano, T. Matitani, and T. Kaise. 2006. Decrease of Arsenic in Edible Brown Algae *Hijikia fusiforme* by the Cooking Process. Applied Organometallic Chemistry 209:585–590.
Imazeki, R., Y. Otani, and T. Hongo. 1988. Fungi of Japan. Yama-kei, Tokyo. In Japanese.
Jacquat, C., and G. Bertossa. 1990. Plants from the Markets of Thailand. Editions Duang Kamol, Bangkok, Thailand.
Jordan, E. O. 1917. Food Poisoning. University of Chicago Press, Chicago.
Jordan, P., and S. Wheeler. 1995. The Ultimate Mushroom Book. Smithmark, New York.
Kauffman, C. H. 1918. The Agaricaceae of Michigan. Michigan Geological and Biological Survey, 5:26. (Reprinted 1971 by Dover Publications, New York, as the Gilled Mushrooms [Agaricaceae] of Michigan and the Great Lakes Region.)
Kawai, M., A. Okiyama, and Y. Ueda. 2002. Taste Enhancements between Various Amino Acids and IMP. Chemical Senses 27:739–745.
Krieger, L. C. 1936. The Mushroom Handbook. Macmillan, New York. (Reprinted in 1967 by Dover Publications, New York).
Kuo, K. 2007. 100 Edible Mushrooms. University of Michigan, Ann Arbor.
Lamarck, J. B. and P. Augustin. 1815. Flore française, ou, Descriptions succinctes de toutes les plantes qui croissent naturellement en France: disposées selon une nouvelle méthode d'analyse, et précédées par un exposé des principes élémentaires de la botanique. Desray, Paris
Lampe, K. F. 1979. Toxic Fungi. Annual Review of Pharmacology and Toxicology 19:85–104.
Letcher, A. 2007. Shroom: A Cultural History of the Magic Mushroom. Ecco, New York.
Lincoff, G. 1981. The Audubon Society Field Guide to North American Mushrooms. Chanticleer Press, Knopf, New York.
———, and D. H. Mitchel. 1977. Toxic and Hallucinogenic Mushroom Poisoning: A Handbook for Physicians and Mushroom Hunters. Van Nostrand Reinhold, New York.
Lincoln, D. A. 1884. Mrs. Lincoln's Boston Cook Book. Roberts Brothers, Boston.

Lindley, J. 1836. A Natural System of Botany, or, A systematic view of the organization, natural affinities, and geographical distribution, of the whole vegetable kingdom: together with the uses of the most important species in medicine, the arts, and rural or domestic economy. Longman, Rees, Orme, Brown, Green, and Longman, London.

Marshall, N. L. 1905. The Mushroom Book. A Popular Guide to the Identification and Study of Our Commoner Fungi, with Special Emphasis on the Edible Varieties. Doubleday, Page and Company, New York.

May, R. 1660. The Accomplisht Cook, or, the Art and Mystery of Cookery. Reprinted 1994, Prospect Books, Totnes.

McDonald, A. 1978. The Abuse of Drug Terminology. In B. Rumack and E. Salzman, eds., Mushroom Poisoning: Diagnosis and Treatment. CRC Press, West Palm Beach, Florida.

McIlvaine, C. and R. K. Macadam. 1902. One Thousand American Fungi. Bowen-Merrill, Indianapolis. (Reprinted in1973 by Dover Publications, New York).

McKenny, M., and D. E. Stuntz. 1971. The Savory Wild Mushroom. University of Washington Press, Seattle.

———, D. Stuntz, and J. Ammirati. 1987. The New Savory Wild Mushroom. University of Washington, Seattle.

McKnight, K. 1987. A Field Guide to Mushrooms of North America. (The Peterson Field Guide Series: 34). Houghton Mifflin, Boston.

Michelot, D., and L. M. Melendez-Howell. 2003. *Amanita muscaria*: Chemistry, Biology, Toxicology, and Ethnomycology. Mycological Research 107:131–146.

Miller, O. K. 1972. Mushrooms of North America. Dutton, New York.

———, and H. Miller. 2006. North American Mushrooms: A Field Guide to Edible and Inedible Fungi. Falcon Guides, Guilford, Connecticut.

Millman, L., and T. Haff. 2004. Notes on the Ingestion of *Amanita muscaria*. Mushroom: The Journal of Wild Mushrooming 223:55.

Mitchel, D. H. 1980. *Amanita* Mushroom Poisoning. Annual Review of Medicine 31:51–57.

Oda T., C. Tanaka, and M. Tsuda. 2004. Molecular Phylogeny and Biogeography of the Widely Distributed *Amanita* Species, *A. muscaria* and *A. pantherina*. Mycological Research 108:885–896.

Oxford English Dictionary. 2008. (J. Simpson, Chief Editor). Oxford University Press, Oxford. (Electronic resource)

Pallas, P. S. 1794. Voyages du professeur Pallas dans plusieurs provinces de l'empire de Russie et dans l'Asie septentrionale. 2006. Elibron Classics, USA.

Papetti, C., G. Consiglio, and G. Simonini. 1999. Funghi d'Italia. Fondazione Centro Studi Micologici Dell' A.M.B. Vicenza.

Pearson, L. C. 1987. The Mushroom Manual. Naturegraph Publishers, Happy Camp, California.

Peck, C. H. 1895. Annual Report of the State Botanist 1895. University of the State of New York, Albany.

Phillips, R. 1981. Mushrooms and Other Fungi of Great Britain and Europe. Pan Books, London.

Phillips, R. 1991. Mushrooms of North America. Little, Brown and Company, Boston.

Phipps, A. 2000, Japanese Use of Beni-Tengu-Dake (*Amanita muscaria*) and the Efficacy of Traditional Detoxification Methods. Master's thesis, Biology Department, Florida International University.

Porcher, F. P. 1854. The Medicinal, Poisonous, and Dietetic Properties of the Cryptogamic Plants of the United States. Being a report made to the American Medical Association, at its sessions held in Richmond, Va., and St. Louis, Mo. Baker, Godwin and Co., New York.

Pouchet, F. A. 1839. Expériences sur L'Alimentation par les Champignons Vénéneux. Journal de chimie médicale, de pharmacie et de toxicology V. 322–328.

Prentiss, D. W. 1898. Five Cases of Mushroom-Poisoning, Three of Which Proved Fatal; Treatment of the Poisoning.. The Philadelphia Medical Journal. September 24:607–611.

Randolph, M. 1836. The Virginia Housewife; or, Methodical Cook. Stereotype. J. Plaskitt, Baltimore, Maryland.

Reese, J. J. 1874. A Manual of Toxicology, including the Consideration of the Nature, Properties, Effects, and Means of Detection of Poisons, more especially in their Medico-legal Relations. J. B. Lippincott and Co., Philadelphia.

Rombauer, I., M. R. Becker, and E. Becker. 2006. Joy of Cooking. Scribner, New York.

Rorer, S. T. H. 1902. Mrs. Rorer's New Cook Book: A Manual of Housekeeping. Arnold and Company, Philadelphia.

Rubel, W. 2000. http://www.williamrubel.com/mushrooms/amanita-muscaria/ (16 May 2007).

Rumack, B. H., and E. Salzman. 1978. Mushroom Poisoning: Diagnosis and Treatment. CRC Press, West Palm Beach, Florida.

Sampson, H. A. 2002. Peanut Allergy. The New England Journal of Medicine 34617:1294–1299.

Schwab, A. 2006. Mushrooming Without Fear. Merwin Unwin Books, Ludlow, U.K., and Skyhorse Publishing, New York.

Sitta, N. and M. Floriani. 2008. Nationalization and Globalization Trends in the Wild Mushroom Commerce of Italy with Emphasis on Porcini (*Boletus edulis* and Allied Species). Economic Botany 62(3).

Smith, A. H. 1948. Mushrooms in Their Natural Habitat. Hafner Press, New York.

Smith, A. H. 1958. The Mushroom Hunter's Field Guide. University of Michigan Press, Ann Arbor.

Smith, A. H. 1963. The Mushroom Hunter's Field Guide. Revised and enlarged. University of Michigan Press, Ann Arbor.

Smith, A. H. 1975. A Field Guide to Western Mushrooms. University of Michigan Press, Ann Arbor.

Smith, A. H., and N. S. Weber. 1980. The Mushroom Hunter's Field Guide. All color and enlarged. University of Michigan Press, Ann Arbor.

Solomon, C., and N. Solomon. 1998. Charmaine Solomon's Encyclopedia of Asian Food. Periplus Editions, Boston.

Southern Society for Clinical Investigation (U. S.). 1853. The American Journal of the Medical Sciences. J. B. Lippincott, Philadelphia.

States, J. S. 1990. Mushrooms and Truffles of the Southwest. University of Arizona, Tucson.

Takemoto, T., Y. Nakajima, and T. Yokobe. 1964. Isolation of a Flycidal Constituent Ibotenic Acid from *Amanita muscaria* and *A. pantherina*. Yakugaku Zasshi 84:1233–1234.

Tat'jana, I. 2007. Illustrirovannaja Enciclopediya: Sobiraem i Gotovim. Eksmo, Moscow. In Russian.

Taylor, A. S. 1859. On Poisons in Relation to Medical Jurisprudence and Medicine. 2nd American edition, from 2nd London edition. Blanchard and Lea, Philadelphia.

Testi, A. 1995. Il Libro dei Funghi D'Italia. Demetra, Colognola.

Thayer, S. 2006. The Forager's Harvest: A Guide to Identifying, Harvesting, and Preparing Edible Wild Plants. Forager's Harvest, Ogema, Wisconsin.

Thiers, H. D. 1987. Alexander H. Smith, 1904–1986. Mycologia 79:811–818.

Thomas. W. S. 1928. Field Book of Common Gilled Mushrooms, with a Key to Their Identification and Directions for Cooking Those That Are Edible. G. P. Putnam's Sons, New York.

———. 2003. Field Guide to Mushrooms: Based on Field Book of Common Mushrooms. Revised, updated, and with illustrations and photographs by Marie F. Heerkens, ed. Sterling Publications, New York.

von Frieden, L. 1964. I Funghi di Tutti I paesi. Rizzoli, Italy. Reprinted in English as Mushrooms of the World, 1969, Bobbs-Merrill, Indianapolis.

von Strahlenberg, P. J. 1736. An histori-geographical description of the north and eastern part of Europe and Asia; but more particularly of Russia, Siberia, and Great Tartary. Faithfully translated into English. London.

Wasson, R. G. 1968. SOMA: Divine Mushroom of Immortality. Harcourt Brace Jovanovich, New York.

Wasson, V. P., and R. G. Wasson. 1957. Mushrooms, Russia, and History. Pantheon Books, New York.

Wharton, F., M. Stillé, and A. Stillé. 1860. A Treatise on Medical Jurisprudence. 2nd ed. rev. Kay and Brother, Philadelphia.

———, M. Stillé, S. Ashurst, R. Amory, and W. Sinkler. 1873. Wharton and Stillé's Medical Jurisprudence. Vol. 2. Kay and Brother, Philadelphia.

——— and M. Stillé. 1882. A Treatise on Medical Jurisprudence. Kay and Brother, Philadelphia.

Whetstone, M. S. 1898. The Mushroom as Food. Annual Report of the Minnesota State Horticultural Society, XXVI: Minneapolis, Office of the Library.

Wiley, H. W. 1917. Foods and Their Adulteration; Origin, Manufacture, and Composition of Food Products; Infants' and Invalids' Foods; Detection of Common Adulterations. P. Blakiston's Sons and Co., Philadelphia.

Yamin-Pasternak, S. 2008. From Disgust to Desire: Changing Attitudes Toward Beringian Mushrooms. Economic Botany 62(3).

Appendix

How to Safely Prepare *Amanita muscaria* for the Dinner Table, and Why Bother?

The scattered historical references to the use of *Amanita muscaria* as food offer only broad guidelines for its preparation. The research done on the traditional method for detoxifying the seaweed, *hijiki, Hizikia fusiforme* (Harvey) Okamura (Hanaoka et al. 2001; Ichikawa et al. 2006) offers a model for what could be done for *A. muscaria* and other "poisonous" mushrooms with a record of being eaten. Research on the safe usage of mushrooms with water-soluble toxins, such as *A. muscaria,* could systematically examine such parameters as the boiling time, number of water changes, and quantity of water needed, the advantage of using salt and/or vinegar, if any, and the efficacy of slicing the mushrooms thinly or of presoaking them.

Until optimum methods for detoxification have been established through testing, broad guidelines based on oral tradition and the limited written record will have to suffice. Pouchet (1839) boiled *A. muscaria* for 15 minutes and Gerard (1863) for 30 minutes. Smith (1963) said the mushrooms should be boiled until "yellow scum" comes to the surface. Pearson (1987) recommended two boilings in separate batches of water for five minutes each time. Phipps (2000) reported that residents of Sanada, Japan, boiled *A. muscaria* an average of 10 minutes prior to storing them in salt, but his finding that ibotenic acid and muscimol were completely eliminated was based on specimens that had been both boiled *and* stored in salt. Both authors of this article have been serving parboiled *A. muscaria* to family and dinner guests for more than 10 years, and have arrived, through judicious experimentation, at the following recipe:

> Cut the *A. muscaria* cap and stalk into *thin* slices (no more than 3–4 mm or 1/8" thick) to hasten dissolving of the active constituents. For each 110 g* or 4 oz of mushroom, use 1 liter or quart of water with 1 teaspoon salt. Garlic and bay leaf can be added to the water for flavoring. Bring the water to a rolling boil, then add the sliced mushrooms. Begin timing the cooking once the water returns to a boil. Boil for 10–15 minutes, until the mushroom is soft, then drain and rinse.

We believe that this method of preparation renders *A. muscaria* safe, meaning adverse reactions will occur no more frequently than for most other widely-eaten foods, providing one doesn't overindulge. As Badham (1863:34) so aptly put it, people should "eat what they like but not as much of it as they like."

Once parboiled, *A. muscaria* can be used in most mushroom recipes, for example, in a mushroom gravy (Coville 1898) or as an appetizer salad dressed in a vinaigrette. It also works well as a ravioli stuffing, and provides flavor and texture as the mushroom in almost any mushroom dish. We sometimes boil *A. muscaria* caps for only five to six minutes in order to retain a touch of the red color, which looks especially beautiful when the parboiled slices are lightly simmered in a clear broth. When we do this, however, we only serve each guest one-quarter to one-third of a cap. Eating too much undercooked *A. muscaria* or using too little water or not enough salt, or not slicing it thinly enough, may be cause for inebriation (Millman and Haff 2004).

Even after long boiling, *A. muscaria* retains a pleasantly firm texture. Yet there is a popular Anglo-American misconception that boiling mushrooms makes them mushy. In reality, boiling many kinds of mushrooms in lightly-salted water has quite the opposite effect: it tightens their structure, making them firm. Rombauer et al. (2006:1055) acknowledge this when they generalize about vegetables (but not specifically mushrooms): "[boiling helps] to preserve nutrients and to firm the tissues of vegetables." Most mushrooms are actually safer and more digestible cooked, but as Benjamin (1995:143–144, 147) points out, our current cooking fashion favors raw or lightly-cooked ingredients, and young chefs, while embracing wild mushrooms, "lack the lore that should accompany this experimentation."

Properly prepared, *Amanita muscaria* is a delicious mushroom. Yet we are frequently posed the rhetorical question: Why eat *A. muscaria* when there are so many other edible mushrooms available? Or more succinctly: Why bother? The reasons to eat it are as numerous and obvious as the mushroom itself: it is big, it is beautiful, it is delicious, it is *there*, and it is one of the easiest of all wild mushrooms to identify. Safely preparing it is not difficult, and there is the added challenge and pleasure of recreating historic dishes, such as the one offered to Coville by the African-American market woman in Washington, D.C. For anyone who enjoys the occasional foray into the woods to

pick wild mushrooms for dinner, the more logical question would be: Why *not* eat it?

It also bears mentioning that amateur English and North American mushroom hunters typically do not collect a wide range of wild mushroom species. Instead they tend to mimic the limited offerings of gourmet restaurants: morels, chanterelles, porcini. An urban-based mushroom menu is thus emerging. Yet many mushroom hunters complain that these same few mushroom species they seek are becoming increasingly difficult to find because of competition (e.g., Boom 2005). *A. muscaria* is an enticing and plentiful alternative. It is thus worthwhile knowing how to prepare it safely.

* 110 g is correct, not 250 g as stated in the printed version.