

# On the Origin of the Genus *Psilocybe* and Its Potential Ritual Use in Ancient Africa and Europe<sup>1</sup>

TOM FROESE<sup>1</sup>, GASTÓN GUZMÁN<sup>2</sup>, AND LAURA GUZMÁN-DÁVALOS<sup>\*,3</sup>

<sup>1</sup>Instituto de Investigaciones en Matemáticas Aplicadas y en Sistemas, Universidad Nacional Autónoma de México, Apartado Postal 20-126, San Ángel, DF 01000, Mexico

<sup>2</sup>Instituto de Ecología, Apartado Postal 63, Xalapa, Ver. 91070, Mexico

<sup>3</sup>Departamento de Botánica y Zoología, Universidad de Guadalajara, Apartado Postal 1-139, Zapopan, Jal. 45101, Mexico

\*Corresponding author; e-mail: lguzman@cucba.udg.mx

---

**On the Origin of the Genus *Psilocybe* and Its Potential Ritual Use in Ancient Africa and Europe.** The role of altered states of consciousness in the production of geometric and figurative art by prehistoric cultures in Africa and Europe has been hotly debated. Helvenston and Bahn have tried to refute the most famous hypothesis, Lewis-Williams' neuropsychological model, by claiming that appropriate visual hallucinations required the ingestion of LSD, psilocybin, or mescaline, while arguing that none of these compounds were available to the cultures in question. We present here mycological arguments that tell another story. A prehistoric worldwide distribution of the mushroom genus *Psilocybe*, and therefore of psilocybin, is supported by the existence of endemic species in America, Africa, and Europe, the disjunct distribution of sister species, and the possibility of long-distance spore dispersal. It is more difficult to point to instances of actual prehistoric ritual use in Africa and Europe, but there are a growing number of suggestive findings.

**Sobre el Origen del Género *Psilocybe* y su Uso Ritual Potencial en África y Europa Antiguas.** El papel de los estados alterados de conciencia en la producción de arte geométrico y figurativo por culturas prehistóricas en África y Europa ha sido fuertemente debatido. Helvenston y Bahn han tratado de refutar la hipótesis más famosa, el modelo neuropsicológico de Lewis-Williams, al afirmar que las alucinaciones visuales apropiadas requieren la ingestión de LSD, psilocibina o mezcalina, al mismo tiempo que sostienen que ninguno de estos compuestos estaba disponible para las culturas en cuestión. Presentamos aquí argumentos micológicos que cuentan una historia diferente. La distribución prehistórica mundial del hongo del género *Psilocybe*, y por ende de la psilocibina, es apoyada por la existencia de especies endémicas en América, África y Europa, por la distribución disyunta de especies hermanas, y por la posibilidad de dispersión de esporas a larga distancia. Es más difícil señalar ejemplos de uso ritual prehistórico reales en África y en Europa, pero hay un número creciente de hallazgos sugerentes.

**Key Words:** Lewis-Williams, neuropsychological model, hallucinogens, *Psilocybe* distribution, origins of art.

---

## Introduction

One approach to understanding the origins and development of prehistoric artistic traditions involves altered states of consciousness (Froese 2013), especially in the context of shamanic rituals (Whitley 2009). Most prominently elaborated by

Lewis-Williams and his colleagues (e.g., Clottes and Lewis-Williams 1998; Lewis-Williams 2002; Lewis-Williams and Dowson 1988), one key hypothesis is that certain characteristic visual hallucinations could have been the inspiration for some prehistoric geometric and figurative motifs.

Three kinds of hallucinations have received special attention: 1) basic geometric forms, sometimes superimposed on the environment; 2) more complex geometric forms and some basic figurative imagery, which can also be superimposed; and 3) alternate realities, typically involving travel to lower subterranean and upper astral realms. All are co-

---

<sup>1</sup>Received 2 November 2015; accepted 25 April 2016; published online \_\_\_\_\_

<sup>1</sup>Received 2 November 2015; accepted 17 April 2016.

---

determined by neural, psychological, and cultural factors, ordered from more neurobiological to more psychosocial influences. For example, the stereotyped geometric patterns are likely mostly shaped by the neural architecture of the early visual system, i.e., the part of the cerebral cortex that is responsible for the processing of low-level visual features such as lines and edges (Bressloff et al. 2002). And they might also be induced by self-sustaining neural dynamics, since the spatial distribution of neural activity that maintains itself in the absence of entrainment to external sensory influences can spontaneously assume a variety of geometric forms such as spiral patterns (Froese et al. 2013). Nevertheless, explaining which of these basic hallucinatory patterns were selected for artistic reproduction also involves appeals to cultural norms (Lewis-Williams 2014). Figurative imagery and alternate realities are less physiologically constrained, and can also directly include personal memories and cultural contents.

This so-called “neuropsychological model” has been developed by Lewis-Williams and colleagues as a framework to better understand prehistoric traditions, particularly in Europe (e.g., Lewis-Williams 2002; Lewis-Williams and Pearce 2005) and southern Africa (e.g., Lewis-Williams and Chellis 2011). Given its wide-ranging ambitions, it is unsurprising that it has received extensive criticisms (e.g., Bahn 1988, 2010; Bednarik 1990; Hodgson 2006). Helvenston and Bahn (e.g., 2003, 2004, 2005, 2006) have been posing one of the most influential challenges that can be summarized in three essential steps.

First, the neuropsychological model is simplified into a fixed three-stage sequence, which they call the “Three Stages of Trance” (TST) model, assuming that it is limited to the three types of hallucinations mentioned above, namely geometric forms, figurative imagery, and alternate realities, and that these types must always be experienced in this exact order to be appropriate for explaining the relevant prehistoric art. Second, they argue that this three-stage sequence can only be experienced following sufficient ingestion of psilocybin, mescaline, or LSD. Third, they claim there is no evidence to suggest that any of these psychoactive compounds were available during prehistoric times in the Old World. They therefore conclude that the neuropsychological model is refuted.

Helvenston and Bahn have made valuable contributions to the archaeological debate

about the origins of prehistoric art by differentiating between distinct kinds of altered states of consciousness, and thereby highlighting that only some of these lead to relevant forms of hallucination. They must also be credited for enabling a sustained debate in mainstream archaeology about the potential role of certain psychoactive substances in promoting key transformations in human prehistory, and for demanding the development of a hypothesis potentially refutable by empirical evidence. However, the refutation of Lewis-Williams’ neuropsychological model over a decade ago has had the unfortunate effect of discouraging further refinement of that model. It also threatens to prematurely undermine investigations into the potential role of altered states more generally. Thus, in order to reopen the debate and encourage renewed empirical research, it is important to highlight that all three of the refutation’s steps have weaknesses.

Briefly, to reduce the complexities of the neuropsychological model to the TST model is to set up a “straw man” argument, i.e., to create a caricature in order to more easily defeat it. To limit the methods of inducing relevant altered states of consciousness to the ingestion of those three substances is questionable, and to try to refute a hypothesis based on the absence of evidence is a logical fallacy (confusion between absence of evidence and evidence of absence). Here, we will leave aside these problems, which have already been discussed at length elsewhere (e.g., Froese 2015; Froese et al. 2014; Pearce 2004). Instead, in the following, we focus on the third and final step of the refutation, i.e., their empirical claim that psilocybin was unavailable in prehistoric Africa and Europe. We conclude that this claim is in fact unsupported by mycological arguments, meaning that even the TST model cannot be refuted on its own terms. Accordingly, we call for renewed efforts to investigate the potential role that altered states of consciousness played in human prehistory, whether induced by psilocybin or other means.

### **Role of *Psilocybe* Fungi in Archaeological Debate**

Mainstream archaeology had largely ignored the potential role of *Psilocybe* mushrooms in human prehistory until this possibility

gained prominence over a decade ago due to the critical writings on the topic by Helvenston and Bahn, who rejected this possibility on empirical grounds. We therefore summarize their attempts to base the refutation of the TST model on the absence of psilocybin, the principal psychoactive compound of *Psilocybe* mushrooms, during prehistoric times in Africa and Europe.

At first, they argued for the complete absence of the genus in the Old World. For example, Helvenston and Bahn (2003:214) failed to mention that *Psilocybe* is widespread in the wild in Europe today, writing that psilocybin is “found in hallucinogenic mushrooms growing in Mexico, Central America and South America.” Helvenston and Bahn (2004:94–95) continued to insist on the lack of naturally occurring psilocybin in contemporary Europe, claiming that “although plants containing these substances are frequently found in South America, particularly, and North America also, there is no evidence that any such plants ever grew in Europe...In our view, this fact refutes the model” (p. 95). They also extended their claims to South Africa.

Later, Helvenston and Bahn (2005:29–31) acknowledged a single *Psilocybe* species, *P. semilanceata*, in contemporary Europe. Yet, they tried to save their refutation by hypothesizing that it was introduced to Europe after sailors first made contact with the Americas. However, the evidence does not support a recent introduction to Europe. As Froese et al. (2014) pointed out in response to Helvenston, the genus *Psilocybe* actually includes around 150 hallucinogenic species worldwide (Guzmán 2009). Several species are found in Europe and nowhere else. Furthermore, apart from *Psilocybe*, there are several other genera of fungi containing psilocybin in Europe, for example *Inocybe* (Kosentka et al. 2013). Helvenston (2015a) remains unconvinced because the mere presence of psilocybin does not guarantee their psychoactive potential. She is right that we do not know much about the effects of *Inocybe*, including whether the compound is present in sufficient concentration to be effective after oral consumption. We will therefore restrict our mycological assessment to *Psilocybe* alone.

Helvenston and Bahn (2006:112–114) reiterated the presumed absence of *Psilocybe* in prehistoric Europe and South Africa, and similarly hypothesized that the presence of a local species, *P. natalensis*, is due to its recent human introduction:

Although *Psilocybe semilanceata*, a psilocybin-containing mushroom is widespread in Europe today, the earliest unequivocal evidence of this mushroom was in the twentieth century...Thus, the three stages of trance model is not applicable to understanding the meaning of Paleolithic cave art...until 1994 no psilocybine-containing plants were known in South Africa (Gartz et al. 1995:29–34), but a species known as *Psilocybe natalensis*, a psilocybin-containing mushroom was discovered...and it is said to possess strongly hallucinogenic properties. It is unlikely that this species was transported to Africa prior to the past several decades (Stamets 1996:134–5).

Their rejection of *P. natalensis* as a potential source of psilocybin in prehistoric southern Africa seems unmotivated, especially given that Gartz and colleagues (1995:29) take it to be “indigenous” to the area. To be fair, Stamets (1996:134–135) remarks that this species is “undoubtedly more widely distributed,” although he does not comment on its recent transportation to southern Africa.

Helvenston and Bahn’s skepticism can still be upheld to the extent that so far no preserved remains of prehistoric *Psilocybe* have been found in the Old World (or anywhere else for that matter). Neither do we have evolutionary analyses of known contemporary species that could pinpoint the genus’s origins. This should be a target for future research. Nevertheless, as soon as we acknowledge the existence of various wild local *Psilocybe* species in the Old World, the simplest explanation is that they evolved there. In other words, the burden of proof is on those who want to deny their endemic status and who must instead demonstrate their recent human introduction, a task that is still outstanding. Yet, Bahn (2010:79–80) writes that prehistoric sources of psilocybin “were unavailable in the Old World (including southern Africa)” such that “one can only conclude that anyone who continues henceforth to cite or apply the ‘three-stage’ model is either ignorant of the facts or has little respect for truth in scholarship.” We will now show that Helvenston and Bahn’s claims are not warranted given what we know about the origins of *Psilocybe*.

## Mycological Considerations about the Distribution and Origin of *Psilocybe*

### *PSILOCYBE* WORLDWIDE DISTRIBUTION

Currently, there are approximately 21 species of *Psilocybe* known in Asia, 15 in Australia, 22 in the USA and Canada, 55 in Mexico, 40 in Central and South America (Guzmán 2005, 2009; Guzmán and Yang 2010), and, importantly, 6 in Africa and 12 in Europe (one of them with five infraspecific taxa) as summarized in Table 1. Europe and North America (excluding Mexico) have been fairly well explored; accordingly, a dramatic increase in the number of known species is not expected. Central and South America may have many more unidentified species. Although this region is still poorly explored, it already has 40 species so far and will therefore likely have the highest diversity (Guzmán 2002:12).

Until now, Africa has the fewest species. But it is also the least studied continent from the mycological point of view. This is the case even in South Africa, where Crous et al. (2006) made an exhaustive revision, but it was incomplete in the case of the agarics. To date, just four species are known to be endemic (Table 1). Tanzania was studied by Härkönen et al. (2003) and Tibuhwa (e.g., 2012). No *Psilocybe* were found in their collections, so its presence there remains uncertain. Härkönen et al. (2003) mention that Tanzanians do not eat mushrooms with the characteristics of this genus. Indirect evidence, for example cases of neurotropic effects, could show the presence of *Psilocybe* in East Africa (Charters 1957; Cullinan et al. 1945; Vedcourt and Trump 1969). Recently, *P. congolensis* (Fig. 1) was described from Congo and a photograph of a bluing *Psilocybe*, belonging to the *P. cubensis*-complex from Uganda (Fig. 2), was published (Guzmán et al. 2014).

Several species of *Psilocybe* grow wild in Europe, and six of them, namely *P. gallaeciae*, *P. hispanica*, *P. liniformans*, *P. medullosa*, *P. puberula*, and *P. serbica* (including five infraspecific taxa), are only known to exist there and it is reasonable to assume they are endemic (Guzmán and Castro 2003; Guzmán 2012).

### ON THE PROBABLE ORIGIN OF *PSILOCYBE*

There are no specific studies about the age and place of origin of the genus *Psilocybe*. Nevertheless, there is sufficient data so that we can make educated guesses. It is known that mushrooms (Agaricomycotina) originated 380 to 960 mya

(million years ago) (Taylor et al. 2004). Based on the fossil *Archaeomarasmius*, the minimum age for Agaricales (agarics, fleshy mushrooms with gills, such as *Psilocybe*) can be established to 90 mya, in the mid-Cretaceous (Hibbett et al. 1997). However, due to their soft nature agarics are very unlikely to become fossilized, and thus they most likely originated already long before the Cretaceous. The alkaloid psilocybin in the Inocybeaceae, a family of Agaricales different from the one to which *Psilocybe* belongs, appears during the Miocene between 10 and 20 mya (Kosentka et al. 2013). It is probable that the age of appearance of psilocybin in the family of *Psilocybe* may be around that time as well.

Some *Psilocybe* species seem to have been introduced to Europe via human activity, as suggested by Borovička (2008) and Noordeloos (2010). Nevertheless, as mentioned above, others are only known to exist in Africa or Europe (Borovička 2008; Gartz et al. 1995). This strongly suggests they originally evolved there. *Psilocybe natalensis* is a South African xerophytic species very similar to *P. aztecorum* from Mexico, with basidiomata and basidiospores very much alike in both fungi. However, *P. aztecorum* grows only in grasslands in mountainous pine forests, up to 2,000 m ASL. Currently, no molecular studies have been done, so they only differ in habitat and geographic distribution (Guzmán et al. 2014). On the other hand, *P. medullosa* is morphologically almost identical and phylogenetically very related to *P. silvatica*, but with differences in its DNA sequences (EF-1 $\alpha$ , LSU, ITS); thus it seems they are different species, the first one European and the second one American (Borovička et al. 2015). These are two examples of the disjunct distribution of sister species that would indicate a prehistoric origin. Lumbsch et al. (2008:424) mention there are “two alternative explanations, vicariance versus long distance dispersal” to explain disjunct distributions, the latter implying a relatively more recent, although still ancient prehistorical, origin.

Halling et al. (2008) also observed a disjunction of sister taxa or morpho-taxa of bolete mushrooms on continents of both Laurasian and Gondwanan origin. They propose three hypotheses to explain this disjunction. One is the long distance dispersal through basidiospores; a second hypothesis is a post-Cretaceous migration over land bridges; and the last one is an origin before the breakup of Pangaea in the Cretaceous. What these authors state (2008:440), namely the “existence of bolete morpho-taxa on continents of both Laurasian and Gondwanan origin could be explained by an

TABLE 1. WORLD DISTRIBUTION OF AFRICAN AND EUROPEAN *PSILOCYBE* SPECIES (IN BOLD PUTATIVE ENDEMIC SPECIES; ONE ASTERISK ONLY IN AFRICA; TWO ASTERISKS ONLY IN EUROPE) (GUZMÁN 1983; GUZMÁN ET AL. 1998, 2014; GUZMÁN AND CASTRO 2003; BOROVIČKA 2008, 2011; BOROVIČKA ET AL. 2011, 2015; NOORDELOOS 2010).

Species	Distribution
* <b><i>Psilocybe aquamarina</i></b> Pegler	Africa (Kenya)
<i>P. azurescens</i> Stamets & Gartz	Western USA, introduced to Europe
* <b><i>P. congolensis</i></b> Guzmán, Nixon & Cortés-Pérez	Africa (Congo)
<i>P. cubensis</i> (Earle) Singer	Africa, America (subtropical and tropical regions), Asia (Cambodia, India, Malaysia, Nepal?, Philippines, Thailand, Vietnam), Australia
<i>P. cyanescens</i> Wakef.	North America (Canada, USA), introduced to Europe (Austria, Belgium, Czech Republic, France, Germany, Italy, Netherlands, Spain, Switzerland, Sweden, United Kingdom), Australia, Africa (probably misidentified)
<i>P. fmetaria</i> (P.D. Orton) Watling	America (Canada, USA, Chile), Europe (Czech Republic, Denmark, Finland, Great Britain, Italy, Norway, Sweden)
** <b><i>P. gallaeciae</i></b>	Europe (Spain)
** <b><i>P. hispanica</i></b>	Europe (Spain)
** <b><i>P. liniformans</i></b>	Europe (Belgium, Italy, Netherlands, Spain)
* <b><i>P. maireri</i></b> Singer	Africa (Algeria, Morocco)
** <b><i>P. medullosa</i></b> (Bres.) Borovička	Northern and central Europe (e.g., Austria, Czech Republic, Finland, France, Germany, Italy, Norway, Sweden, Switzerland, in many papers as <i>P. silvatica</i> )
* <b><i>P. natalensis</i></b> Gartz, D.A. Reid, M.T. Sm. & Eicker	Africa (South Africa)
<i>P. pelliculosa</i> (A.H. Sm.) Singer & A.H. Sm.	America (Canada, USA), cited from Europe (Finland) but maybe only American
** <b><i>P. puberula</i></b> Bas & Noordel.	Europe (Belgium, Netherlands)
<i>P. semilanceata</i> (Fr.) P. Kumm.	America (Canada, USA, Chile), Asia (India), Africa?, Australia, Europe (Austria, Belgium, Bulgaria, Czech Republic, Denmark, Estonia, Finland, France, Georgia, Germany, Great Britain, Hungary, Italy, Lithuania, Netherlands, Norway, Poland, Romania, Russia, Spain, Sweden, Switzerland, URSS), Tasmania?
** <b><i>P. serbica</i></b> var. <i>serbica</i> M.M. Moser & E. Horak	Europe (Austria, Croatia, Czech Republic, Germany, Hungary, Italy, Norway, Serbia, Slovakia)
var. <i>arcana</i> (Borov. & Hlaváček) Borov., Oborník & Noordel.	
var. <i>bohémica</i> (Šebek ex Šebek) Borov., Oborník & Noordel.	
var. <i>moravica</i> (Borov.) Borov., Oborník & Noordel.	
f. <i>sternberkiana</i> (Borov.) Borov., Oborník & Noordel.	
<i>P. silvatica</i> (Peck) Singer et A.H. Sm.	America (Canada, USA), cited from Europe, but corresponds to <i>P. medullosa</i>
<i>P. strictipes</i> Singer & A.H. Sm.	North America (Canada, USA), Europe (Czech Republic, Finland, France, Germany, Great Britain, Italy, Netherlands, Russia, Spain, Sweden)
<i>P. stuntzii</i> Guzmán et J. Ott	Western USA and Canada, introduced in Switzerland

original Pangaean distribution,” is consistent with the case of *Psilocybe* as well.

An alternative hypothesis can be formulated on the basis of evidence that many fungi are capable of global dispersal via airborne spores (Fröhlich-Nowojsky et al. 2012). Thus, the presence of *Psilocybe* in Africa and Europe could be more recent, coinciding with the emergence of psilocybin in

other genera of Agaricales around 10–20 mya, followed by long-distance spore dispersal to various parts of the world and by relatively rapid local speciation events. For example, there is compelling evidence that the genus *Inocybe*, which includes psilocybin-containing species (Kosentka et al. 2013), is capable of long-distance, transoceanic dispersal (Geml et al. 2012). It is therefore reasonable



Figs. 1–2. 1: *Psilocybe congolensis*; 2: *Psilocybe* complex *ubensis* from Africa (photos by Stuart C. Nixon).

to assume that the genus *Psilocybe* also has this capacity, but this still needs to be empirically demonstrated.

In conclusion, at the moment there is not sufficient data available to determine which of these two hypotheses, i.e., local distribution via an ancient supercontinent or more recent transoceanic dispersal, is the correct one. Future work could focus on arbitrating between these possibilities, for example by determining how long ago the only known endemic species from South Africa, *P. natalensis*, split off from the rest of the genus. Nevertheless, both hypotheses are in agreement that *Psilocybe* was already present in the Old World long before the emergence of modern humans.

### Ritual Use of *Psilocybe* in Africa and Europe

In response to Froese (e.g., 2015), Helvenston (2015b) has started to admit that there may be endemic species of *Psilocybe* in Africa and Europe and thus shifted the emphasis from lack of availability to lack of evidence for ritual use of *Psilocybe* in prehistoric times. This is a step in the right direction and promises a more productive debate. We therefore review current evidence suggestive of use of this genus since ancient times.

Although Africa is almost virgin with regard to the study of neurotropic mushrooms, according to Samorini (1999) it is here where the most ancient record of its relation with man can be found. He

argues that the post-Paleolithic murals on the cave walls of the Tassili n'Ajjer mountain region in Algerian section of the Sahara Desert, dated 9000–7000 B.C.E., are the oldest prehistoric evidence for the use of psychotropic mushrooms by man. In one of the paintings (Fig. 3), the humanoid figures are dancing or running and carrying mushrooms, which are connected with dotted lines to their heads, potentially indicating the influence of the mushrooms on their minds (Samorini 1999, 2001). According to Guzmán (2012), *P. mairei* could be depicted, a species endemic to Africa that was first described from Algeria (see Table 1).

With regard to a more recent but still ancient African culture, Berlant (2005) has hypothesized that the Egyptian White and Triple Crowns represent primordia (young and still closed fruit bodies) of *P. cubensis*. He bases his idea in the similar appearance of these crowns and the primordia (Figs. 4–5). He also highlights the inscription in the tomb of Pharaoh Unas: “He has eaten the Red Crown, He has swallowed the Green One [and] delights to have their magic in his belly.” With the motif of a crown we find another connection between possible representations of *Psilocybe* and human heads, perhaps alluding to their “magic” effects. Berlant (2005) also speculates that *P. cubensis* was cultivated by the Egyptians. In an ancient story, known as “King Cheops and the Magicians,” it is described that crowns were bestowed on Egypt’s rulers by deities who had hidden them in barley, which they exposed to a storm and then left in a storeroom for 14 days.



Fig. 3. Drawing of one of the paintings from Tassili n'Ajjer (Sahara Desert) showing humanoid figures dancing or running and carrying mushrooms, which are connected with dotted lines to their heads, potentially indicating the influence of the mushrooms on their minds (from Samorini 2001:56).

Berlant notes that this is consistent with modern cultivation practices, in which moist grain is employed as a substrate for incubating *Psilocybe* spores for a couple of weeks. However, so far no unequivocal references in imagery or writing have been found.

In Europe, mushrooms were depicted (Fig. 6) by prehistoric men in a mural on the wall of a rock shelter in the prehistoric archeological site Selva Pascuala in Spain, 6000–4000 B.C.E. (Akers et al. 2011). The mushrooms represented were identified by Guzmán as *P. hispanica* (Fig. 7), a common psychotropic species in that region, first described from a location not very far from this site (Guzmán 2012). The determination is based on its cap and

stem form, which can be seen in the mural, and because this species is coprophilous and is therefore ecologically related with the bulls also represented in the mural.

There is further evidence of the use of hallucinogenic mushrooms in Europe, which no longer belongs to the prehistoric period but is still dated to long before the Spanish returned from the Americas. It is an enigma what substance was used during the Eleusinian rites in ancient Greece, but it is possible that it was some kind of fungus. Wasson et al. (1978) proposed involvement of *Claviceps purpurea*. Alternatively, a species of *Psilocybe* might have been involved (Gartz 1996). This hypothesis is



Figs. 4–5. Young stages or primordia of *Psilocybe cubensis* (4) (photo by D.T. Leslie, from Guzmán 1983, fig. 770) represented in the Triple Crown (5) (from Berlant 2005:277).



**Fig. 6.** Prehistoric mural in Selva Pascuala in Spain, dated to approximately 6000–4000 B.C.E. See the line of 13 mushrooms at the right (from Akers et al. 2011:123).

supported by a relief carving from Farsala, Thessaly (Fig. 8), dated to the 5th century B.C.E., where two goddesses related to the Eleusinian rites are represented each holding mushrooms (Samorini 1999), which are agarics, but cannot be identified.

A later example is the bass-relief on the bronze gates of the cathedral of Hildesheim, Germany, dated to 1020, in which the first temptation of the Genesis is engraved (Gartz 1996) (Fig. 9). Although the mushroom is depicted as a big tree in allusion to the tree of knowledge, it is so accurately represented that, because of the campanulate cap with distinctive papilla and the flexuose stipe, the species can be recognized as *P. semilanceata* (Fig. 10), a mushroom very common in Europe (Guzmán 1983; Samorini 1999). The association of this species with the fall of man is consistent with the church's condemnation of ritual use of *Psilocybe* in Mexico, which is known from colonial documents (Sahagún 1955 [1530]). Yet it is odd that no explicit textual references are known from Europe before modern times, and so while these interpretations are plausible they require confirmation.

## Conclusions

Current mycological and art historical evidence supports the possibility that prehistoric cultures had access to psilocybin and therefore to precisely the three-stage sequence of altered states of



**Fig. 7.** *Psilocybe hispanica* (photo by I. Seral). For Guzmán (2012) this is the mushroom represented in Fig. 6.





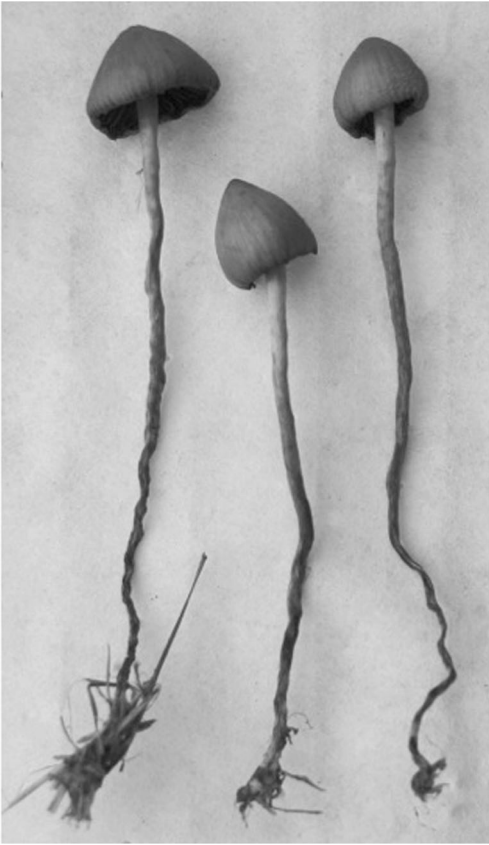
**Fig. 8.** Relief carving of two goddesses related to the Eleusinian rites, each holding a mushroom, from Farsala, Thessaly, 5th century B.C.E. (photo by T. Froese).

consciousness, which leads from geometric hallucinations to full-blown alternate realities. Given that this tentative conclusion is consistent with Lewis-Williams' neuropsychological model, and even with Helvenston and Bahn's TST model, research is

freed to explore to what extent prehistoric people actually made use of this resource, which is currently being rediscovered as a valuable drug by modern medicine (Kupferschmidt 2014). Indeed, there is a renewed opportunity to think more broadly about



**Fig. 9.** One of the reliefs on the bronze doors at Hildesheim Cathedral, in Germany, from the Middle Ages. God reprimands Adam and Eve for eating part of the tree of knowledge in the Garden of Eden. The tree is represented as *Psilocybe semilanceata* (from <https://klimtlover.files.wordpress.com/2012/10/hildesheimdoordetail2.jpg>, and Gartz 1996).



**Fig. 10.** *Psilocybe semilanceata*. Note the campanulate cap with papilla and the flexuose stipe (photo by A. Milla).

why prehistoric people may have sought out practices of mind alteration in the first place, whether or not induced by psilocybin (e.g., Froese 2015).

#### Acknowledgments

Tom Froese and Laura Guzmán-Dávalos dedicate this article to the memory of Gastón Guzmán, who sadly did not live to see its publication. Tom Froese was supported by UNAM's PAPIIT (project number IA102415).

#### Literature Cited

- Akers, B. P., J. F. Ruiz, A. Piper, and C. A. P. Ruck. 2011. A prehistoric mural in Spain depicting neurotropic *Psilocybe* mushrooms? *Economic Botany* 65:121–128.
- Bahn, P. G. 1988. Comments. *Current Anthropology* 29:217–218.
- . 2010. *Prehistoric rock art: Polemics and progress*. Cambridge University Press, New York.
- Bednarik, R. G. 1990. On neuropsychology and shamanism in rock art. *Cambridge Archaeological Journal* 31(1):77–84.
- Berlant, S. R. 2005. The entheomycological origin of Egyptian crowns and the esoteric underpinnings of Egyptian religion. *Journal of Ethnopharmacology* 102:275–288.
- Borovička, J. 2008. The wood-rotting bluing *Psilocybe* species in Central Europe—An identification key. *Czech Mycology* 60(2):173–192.
- . 2011. Lysohlávka lesní, *Psilocybe silvatica*, záhadný druh evropské mykoflóry [*Psilocybe silvatica*, a mysterious species of European mycoflora]. *Mykologický sborník* 88:4–11.
- , M. E. Noordeloos, M. Gryndler, and M. Oborník. 2011. Molecular phylogeny of *Psilocybe cyanescens* complex in Europe, with reference to the position of the secotioid *Weraroa novae-zelandiae*. *Mycological Progress* 10:149–155. doi:10.1007/s11557-010-0684-3.
- , M. Oborník, J. Stříbrný, M. E. Noordeloos, L. A. Parra Sánchez, and M. Gryndler. 2015. Phylogenetic and chemical studies in the potential psychotropic species complex of *Psilocybe atrobrunnea* with taxonomic and nomenclatural notes. *Persoonia* 34:1–9.
- Bressloff, P. C., J. D. Cowan, M. Golubitsky, P. J. Thomas, and M. C. Wiener. 2002. What geometric visual hallucinations tell us about the visual cortex. *Neural Computation* 14:473–491.
- Charters, A. D. 1957. Mushroom poisoning in Kenya. *Transactions of the Royal Society of Tropical Medicine and Hygiene* 51:265–270.
- Clottes, J. and D. Lewis-Williams. 1998. *The shamans of prehistory: Trance and magic in the painted caves*. Harry N. Abrams, New York.
- Crous, P. W., I. H. Rong, A. Wood, S. Lee, H. Glen, W. Botha, B. Slippers, W. Z. de Beer, M. J. Wingfield, and D. L. Hawksworth. 2006. How many species of fungi are there at the tip of Africa? *Studies in Mycology* 55:13–33.
- Cullinan, E. R., D. Henry, and R. W. Rayner. 1945. Fungus poisoning in Nairobi District. *The Eastern Africa Medical Journal* 22:252–255.
- Froese, T. 2013. Altered states and the prehistoric ritualization of the modern human mind. Pages 10–21 in C. Adams, A. Waldstein, D. Luke, B. Sessa, and D. King, eds., *Breaking convention:*

- Essays on psychedelic consciousness. Strange Attractor, London.
- . 2015. The ritualised mind alteration hypothesis of the origins and evolution of the symbolic human mind. *Rock Art Research* 32(1):90–97.
- , A. Woodward, and T. Ikegami. 2013. Turing instabilities in biology, culture, and consciousness? On the enactive origins of symbolic material culture. *Adaptive Behavior* 21(3):199–214.
- , ———, and ———. 2014. People in the Paleolithic could access the whole spectrum of consciousness: Response to Helvenston. *Adaptive Behavior* 22(4):282–285.
- Fröhlich-Nowoisky, J., S. M. Burrows, Z. Xie, G. Engling, P. A. Solomon, M. P. Fraser, O. L. Mayol-Bracero, P. Artaxo, D. Begerow, R. Conrad, M. O. Andreae, V. R. Després, and U. Pöschl. 2012. Biogeography in the air: Fungal diversity over land and oceans. *Biogeosciences* 9: 1125–1136.
- Gartz, J. 1996. Magic mushrooms around the world, a scientific journey across cultures and time. The case for challenging research and value systems. Claudia Taake, trans. & ed. Los Angeles, California: Lis.
- , D. A. Reid, M. T. Smith, and A. Eicker. 1995. *Psilocybe natalensis* sp. nov.—The first indigenous bluing member of the Agaricales of South Africa. *Integration: Journal for Mind Moving Plants and Kultur* 6:29–34.
- Geml, J., I. Timling, C. H. Robinson, N. Lennon, H. C. Nusbaum, C. Brochmann, M. E. Noordeloos, and D. L. Taylor. 2012. An arctic community of symbiotic fungi assembled by long-distance dispersers: Phylogenetic diversity of ectomycorrhizal basidiomycetes in Svalbard based on soil and sporocarp DNA. *Journal of Biogeography* 39:74–88.
- Guzmán, G. 1983. The genus *Psilocybe*. Cramer, Vaduz, Liechtenstein.
- . 2002. A successful coincidence: The hallucinogenic mushrooms, the genus *Psilocybe*, the traditions and the development of mycology in Mexico. Pages 9–14 in J. E. Sánchez, G. Huerta, and E. Montiel, eds., *Mushroom biology and mushroom products*. Universidad Autónoma Estado de Morelos, Cuernavaca, Mexico.
- . 2005. Species diversity of the genus *Psilocybe* (Basidiomycotina, Agaricales, Strophariaceae) in the world mycobiota, with special attention to hallucinogenic properties. *International Journal of Medicinal Mushrooms* 7(1–2):305–332.
- . 2009. The hallucinogenic mushrooms: Diversity, traditions, use and abuse with special reference to the genus *Psilocybe*. Pages 256–277 in J. K. Misra and S. K. Deshmukh, eds., *Fungi from different environments*. Science Publishers, Enfield, New Hampshire.
- . 2012. New taxonomical and ethnomycological observations on *Psilocybe* s. s. (Fungi, Basidiomycota, Agaricomycetidae, Agaricales, Strophariaceae) from Mexico, Africa and Spain. *Acta Botanica Mexicana* 100:79–106.
- and M. L. Castro. 2003. Observations on some known species of *Psilocybe* (Basidiomycotina, Agaricales, Strophariaceae) from Spain and description of a new species. *Boletín de la Sociedad Micológica de Madrid* 27:181–187.
- and Z. L. Yang. 2010. A new species of a bluing *Psilocybe* from Asia (Basidiomycota, Agaricales, Strophariaceae). *Sydowia* 62(2): 185–189.
- , J. W. Allen, and J. Gartz. 1998. A world-wide geographical distribution of the neurotropic fungi. An analysis and discussion. *Annali dei Museo civico Rovereto* 14:189–280.
- , S. C. Nixon, F. Ramírez-Guillén, and A. Cortés-Pérez. 2014. *Psilocybe* s. str. (Agaricales, Strophariaceae) in Africa with description of a new species from the Congo. *Sydowia* 66(1):43–53.
- Halling, R. E., T. W. Osmundson, and M. A. Neves. 2008. Pacific boletes: Implications for biogeographic relationships. *Mycological Research* 112:437–447.
- Härkönen, M., T. Niemelä, and L. Mwasumbi. 2003. Tanzanian mushrooms. Edible, harmful and other fungi. *Norrinia* 10:1–200.
- Helvenston, P. A. 2015a. Psilocybin-containing mushrooms, Upper Palaeolithic rock art and the neuropsychological model. *Rock Art Research* 32(1):84–89.
- . 2015b. Suppositions of psilocybin-mushroom incorporation as the main driver of human cognitive and symbolic evolution. *Rock Art Research* 32(1):97–109.
- and P. G. Bahn. 2003. Testing the "Three Stages of Trance" model. *Cambridge Archaeological Journal* 13(2):213–224.

- and ———. 2005. Waking the trance fixed. Wasteland, Shelbyville, Kentucky.
- and ———. 2005. Waking the trance fixed. Wasteland, Shelbyville, Kentucky.
- and ———. 2006. Archaeology or mythology? The "Three Stages of Trance" model and South African rock art. *Cahiers de l'AARS* 10:111–126.
- Hibbett, D. S., D. Grimaldi, and M. J. Donoghue. 1997. Fossil mushrooms from Miocene and Cretaceous ambers and the evolution of Homobasidiomycetes. *American Journal of Botany* 84:981–991.
- Hodgson, D. 2006. Altered states of consciousness and palaeoart: An alternative neurovisual explanation. *Cambridge Archaeological Journal* 16(1):27–37.
- Kosentka, P., S. L. Sprague, M. Ryberg, J. Gartz, A. L. May, S. R. Campagna, and P. B. Matheny. 2013. Evolution of the toxins muscarine and psilocybin in a family of mushroom-forming fungi. *PLoS ONE* 8(5), e64646. doi:10.1371/journal.pone.0064646.
- Kupferschmidt, K. 2014. High hopes. *Science* 345: 18–23.
- Lewis-Williams, D. 2002. *The mind in the cave: Consciousness and the origins of art*. Thames and Hudson, London.
- 2014. Comment on: Froese et al.: "Turing instabilities in biology, culture, and consciousness." *Adaptive Behavior* 22:83–85.
- and S. Challis. 2011. *Deciphering ancient minds: The mystery of San Bushman rock art*. Thames and Hudson, New York.
- and T. A. Dowson. 1988. The signs of all times: Entoptic phenomena in Upper Paleolithic art. *Current Anthropology* 29:201–245.
- and D. Pearce. 2005. *Inside the Neolithic mind: Consciousness, cosmos and the realm of the gods*. Thames and Hudson, London.
- Lumbsch, H. T., P. K. Buchanan, T. W. May, and G. M. Mueller. 2008. Phylogeography and biogeography of fungi. *Mycological Research* 112:423–424.
- Noordeloos, M. E. 2010. *Strophariaceae s.l. Fungi Europei no. 13*. Candusso, Saronno, Italy.
- Pearce, D. 2004. "Testing" and altered states of consciousness in Upper Paleolithic art research. *Cambridge Archaeological Journal* 14:82–85.
- Sahagún, Fray Bernardino de. 1955 (1530). *Historia General de las Cosas de la Nueva España*. Acosta-Saignes, M., reimpressor. Alfa, Mexico City.
- Samorini, G. 1999. Nuevas fronteras de la etnomicología. Pages 51–80 in J. M. Fericgla, ed., *Los enteógenos y la ciencia, nuevas aportaciones científicas al estudio de las drogas*. Los Libros de la Liebre de Marzo. Colección Cogniciones, Barcelona.
- 2001. *Funghi allucinogeni, studi etnomicologici*. Telesterion, Dozza, Italy.
- Stamets, P. 1996. *Psilocybin mushrooms of the world: An identification guide*. Ten Speed, Berkeley, California.
- Taylor, J. W., J. Spatafora, K. O'Donnell, F. Lutzoni, T. James, D. S. Hibbett, D. Geiser, T. D. Bruns, and M. Blackwell. 2004. The fungi. Pages 171–194 in J. Cracraft and M. Donoghue, eds., *Assembling the tree of life*. Oxford University Press, New York.
- Tibuhwa, D. D. 2012. Folk taxonomy and use of mushrooms in communities around Ngorongoro and Serengeti National Park, Tanzania. *Journal of Ethnobiology and Ethnomedicine* 8:36. doi:10.1186/1746-4269-8-36.
- Vedcourt, B. and E. C. Trump. 1969. *Common poisonous plants of East Africa*. Collins, London.
- Wasson, R. G., A. Hofmann, and C. Ruck. 1978. *The road to Eleusis: Unveiling the secret of the mysteries*. Harcourt Brace Jovanovich, New York.
- Whitley, D. S. 2009. *Cave paintings and the human spirit: The origin of creativity and belief*. Prometheus Books, Amherst, Massachusetts.