

The Hallucinogenic Mushrooms: Diversity, Traditions, Use and Abuse with Special Reference to the Genus *Psilocybe*

Gastón Guzmán

Instituto de Ecología, Km 2.5 carretera antigua a Coatepec No. 351
Congregación El Haya, Apartado postal 63, Xalapa,
Veracruz 91070, Mexico

E-mail: gaston.guzman@inecol.edu.mx

Abstract

The traditions, uses and abuses, and studies of hallucinogenic mushrooms, mostly species of *Psilocybe*, are reviewed and critically analyzed. *Amanita muscaria* seems to be the oldest hallucinogenic mushroom used by man, although the first hallucinogenic substance, LSD, was isolated from ergot, *Claviceps purpurea*. *Amanita muscaria* is still used in North Eastern Siberia and by some North American Indians. In the past, some Mexican Indians, as well as Guatemalan Indians possibly used *A. muscaria*. *Psilocybe* has more than 150 hallucinogenic species throughout the world, but they are used in traditional ways only in Mexico and New Guinea. Some evidence suggests that a primitive tribe in the Sahara used *Psilocybe* in religious ceremonies centuries before Christ. New ethnomycological observations in Mexico are also described.

INTRODUCTION

After hallucinogenic mushrooms were discovered in Mexico in 1956-1958 by Mr. and Mrs. Wasson and Heim (Heim, 1956; Heim and Wasson, 1958; Wasson, 1957; Wasson and Wasson, 1957) and Singer and Smith (1958), a lot of attention has been devoted to them, and many publications have

flooded the literature (e.g. Singer, 1958a, b, 1978; Gray, 1973; Schultes, 1976; Oss and Oeric, 1976; Pollock, 1977; Ott and Bigwood, 1978; Wasson, 1980; Ammirati et al., 1985; Stamets, 1996). However, not all the fungi reported really have hallucinogenic properties, because several of them were listed by erroneous interpretation of information given by the ethnic groups originally interviewed or by the bibliography.

In spite of the above studies those of Heim (1956), Wasson and Wasson (1957), Schultes (1939) were the first to review the use of hallucinogenic mushrooms in Mexico. Schultes got two packages of sacred mushrooms from the Indians, and he also gathered more mushrooms in a third package. These three packages were deposited for identification in the Herbarium of Harvard University. Only specimens in the third package were identified as *Panaeolus campanulatus* var. *sphinctrinus* (today known as *P. sphinctrinus*). This identification was cited by Schultes in his first publication (Schultes, 1939), wherein he claimed that the Indians throughout Mexico used *P. sphinctrinus* as a sacred mushroom, which they identified as 'teonanácatl'. However Schultes made two mistakes, because *P. sphinctrinus* is not used as a sacred mushroom in any part of the country, and the name 'teonanácatl' is an Aztec term known only from literature of the 16th century (e.g. Sahagún, 1569-1582). The true identity of the 'teonanácatl' of Sahagún was an enigma for centuries. Moreover, other specialists cited the paper of Schultes (1939) as evidence that all the species of *Panaeolus* (including *Panaeolina*) are narcotic (e.g. Singer, 1949; Gray, 1973; Schultes and Hofmann, 1973; Ott and Bigwood, 1978), despite Safford's (1915) claim that 'teonanácatl' is *Lophophora williamsii*, a cactaceous plant with hallucinogenic properties used by the Indians of northern Mexico and the southern U.S.A. It is now known that Safford's interpretation was erroneous.

When Singer was at Harvard University in the 1940s, he identified the first mushroom package of Schultes obtained from the Indians. Singer identified it as *Psilocybe cubensis*. At the same time Singer checked the third package and agreed with the '*Panaeolus sphinctrinus*' identification. This information was published in his monumental work 'The Agaricales' (Singer, 1949) but only as a little note in the chapter on *Psilocybe*: "At least one species is used as a drug in Mexico (causing a temporary narcotic state of hilarity)...." Singer (1949) also wrote in his chapter on *Panaeolus*, "*Panaeolus sphinctrinus* and *P. papilionaceus* are used as intoxicating drugs in Central America together with *Psilocybe cubensis*...." These two notes of Singer were the first indication that a species of *Psilocybe* is hallucinogenic. In 1970 Guzmán (1983) restudied specimens in the second Indian package of Schultes at the Harvard University Herbarium, previously identified by Singer as *Deconica* sp., Guzmán identified those mushrooms as *P. caerulescens*, another important sacred mushroom among the Indians, which Heim

(1956) considered as *P. mazatecorum* Heim, and then (in Heim and Wasson, 1958) as *P. caeruleascens* var. *mazatecorum* (Heim) Heim. Guzmán (1959) had earlier found that the Indians in a locality of the state of Puebla called this mushroom 'teotlaquilnanácatl', but not 'teonanácatl' (both words are Aztec names; 'teotlaquilnanácatl' means 'sacred mushroom that describes or paints', and 'teonanácatl' means only 'sacred mushroom' (from nanácatl = mushroom, teo = sacred, and tlaquil = paint). Another confusion about the hallucinogenic mushrooms is whether or not the genus *Stropharia* has hallucinogenic species, because *Psilocybe cubensis* was first described as *Stropharia cubensis* from Cuba in the early 20th century; Heim used the name *Stropharia cubensis* in all his publications. However Singer (1949) for taxonomic reasons transferred the species to *Psilocybe*, a position followed since by all mycologists. No species of *Stropharia sensu stricto* have hallucinogenic properties. The other confusion on the hallucinogenic mushrooms will be discussed below.

In the present work the diversity of the hallucinogenic mushrooms in the world is described. This contribution is based on the researches of the author since 1957, mainly in the genus *Psilocybe* (e.g. Guzmán, 1959, 1983, 1995, 2005).

The known hallucinogenic fungi

More than 200 species of fungi have been reported with hallucinogenic properties (Table 1). They belong to more than 10 genera, both Basidiomycota (the majority) and Ascomycota. Table 1 shows the most important fungi reported in the literature as hallucinogenic, but *Psilocybe*, *Amanita muscaria* and *Claviceps purpurea* are the true hallucinogenics. For *Panaeolus* and *Panaeolina* see the discussion above. Species of *Conocybe*, *Copelandia*, *Gymnopilus*, *Inocybe* and *Pluteus* have hallucinogenic properties, because they have psilocybin (Schultes and Hofmann, 1979; Schultes, 1976; Stijve et al., 1985). *Conocybe siligineoides* was reported by Heim (Heim and Wasson, 1958; Wasson, 1957) only one time as an hallucinogenic mushroom by the Mazatec Indians of Mexico. It is a very rare fungus, because the author in his numerous explorations in the region, never found this mushroom or heard about it from the Indians. Species of the genera *Boletus*, *Cordyceps*, *Elaphomyces*, *Heimiella*, *Psathyrella*, *Russula*, *Lycoperdon* and *Vascellum* are not hallucinogenic mushrooms. The two puff-balls considered above, *Lycoperdon* and *Vascellum*, were reported by Heim and Wasson (Heim et al., 1967) as narcotic fungi in an Indian Mixtec town of Mexico. They reported *Lycoperdon mixtecorum* (actually *Vascellum qudenii*) and *Lycoperdon marginatum* (a synonym of *L. candidum*). Both are edible mushrooms, without any narcotic effect as Guzmán described in Ott et al. (1975). The report on *Cordyceps* (Table 1) is based on *C. capitata* and *C.*

Table 1. The hallucinogenic fungi known in the world (those with ? means doubtful hallucinogenic properties; those in boldface are used by ethnic groups in a traditional way; in some species the isolated hallucinogenic substance is presented)

Ascomycotina, Hypocreales

Claviceps purpurea (Fr.) Tul., 'ergot', LSD

? *Cordyceps capitata* (Holms.: Fr.) Link

? *C. ophioglossoides* (Ehrh.) Link

? *Elaphomyces granulatus* Fr.

Basidiomycotina, Agaricales

Amanita muscaria (L.: Fr.) Pers. ex Hooker, ibotenic acid

? *Boletus kumaeus* R. Heim

? *B. manicus* R. Heim

Conocybe cyanopus (G.K. Atk.) Kühnar, psilocybin

C. siligineoides R. Heim, psilocybin

C. smithii Watling, psilocybin

Copelandia cyanescens (Berk. & Broome) Singer, psilocybin

C. westii (Murrill) Singer & Weeks

Gymnopilus aeruginosus (Peck) Singer, psilocybin

G. braendlei (Peck) Hesler, psilocybin

G. luteoviridis Thiers, psilocybin

G. purpuratus (Cooke & Mass.) Singer, psilocybin

? *G. spectabilis* (Fr.) A.H. Smith

? *Heimiella anguiformis* (R. Heim)

Inocybe aeruginascens Babos

I. calamistrata (Fr.: Fr.) Gill.

? *Panaeolina foenicicii* (Pers.: Fr.) Maire

? *Panaeolus campanulatus* (L.: Fr.) Quél. s.l.

? *P. fimicola* (Pers.) Gill.

? *P. sphinctrinus* (Fr.) Quél.

P. subbalteatus (Berk. & Broome) Sacc., psilocybin

? *P. venenosus* Murrill

Pluteus salicinus (Pers.: Fr.) P. Kumm., psilocybin

P. nigroviridis Babos

? *Psathyrella sepulchralis* Singer, A.H. Smith & Guzmán

Psilocybe spp. (see [Tables 2 & 3](#)), psilocybin, baeocystin and others

? *Russula agglutinata* R. Heim

? *R. nondorhingi* Singer

? *R. wahgiensis* Singer

Basidiomycotina, Gasteromycetes

? *Lycoperdon marginatum* Vitt.

? *L. mixtecorum* R. Heim

? *Vascellum intermedium* A.H. Smith (all these gasteromycetous fungi are edible)

ophioglossoides, two strong fungi related to 'ergot'. *Elaphomyces*, based on *E. granulatus* and other species, are edible hypogeous fungi used by Mexican Indians in ceremonies with sacred mushrooms with *Psilocybe muliercula*. The species of *Boletus* and *Heimiella* in the Boletaceae may be toxic but not narcotic. They were reported in a confused way as neurotropic from Papua New Guinea by Heim and Wasson (1965). The species of *Russula* were also reported by Heim and Wasson (1965) and Singer (1958a, b). The case of *Psathyrella sepulchralis* [= *P. asperospora* (Clel.) Guzmán, Bandala and Montoya] was reported (Singer et al., 1958) because the Zapotec Indians in a Mexican town confused it with *Psilocybe zapotecorum*.

Claviceps purpurea is the first hallucinogenic fungus known in the history of the neurotropic fungi. Known as 'ergot', it parasitizes the tassels of rye. However, this fungus has never been used as an hallucinogenic. 'Ergot' produces poisonous sclerotia (small, hard, black horns) on the tassels. When these sclerotia are accidentally mixed in flour used to make bread, the bread becomes an important and often fatally poisonous and, when eaten, produces delirium, convulsions and hallucinations. This intoxication was common in Europe in the Middle Ages and it was known as 'Saint Antony's Fire'. In the 1940s Hofmann isolated from those sclerotia the first hallucinogenic substance known in a fungus, the lysergic acid of diethylamide, known as LSD, one of the numerous alkaloids which this fungus produces (Samorini, 2001; Schultes and Hofmann, 1973, 1979). LSD is an indole similar to the psilocybin of hallucinogenic species of *Psilocybe* (see below).

Amanita muscaria is the first narcotic fungus historically used by man. Primitive tribes of northeastern Siberia used and still use this mushroom in special ceremonies (Ford and Clark, 1914; Wasson and Wasson, 1957; Schultes, 1976; Schultes and Hofmann, 1979). Moreover, this mushroom is still used by North American Indians from Canada and the U.S.A. (Wasson, 1979) (this latter information strengthens the theory that man came from Asia across the Bering Strait). It is even very probable that Mexican and Guatemalan Indians used *A. muscaria* before they used species of *Psilocybe*, as discussed by Lowy (1974) and Guzmán (1990, 2001). Also, *A. muscaria*, which is common in Europe, has interesting relationships with the beginning of Christianity, as shown in a fresco found in an old church in France: a stylized *A. muscaria* is positioned between Adam and Eve as 'The Tree of Life' (Wasson and Wasson, 1957; Samorini, 2001; Gray, 1973). The hallucinogenic compound of *Amanita muscaria* is ibotenic acid, first erroneously reported as bufotenin, an indole isolated from a toad (Schultes and Hofmann, 1973). The ibotenic acid is an indole like LSD and psilocybin. However, the ingestion of *A. muscaria* produces first a gastrointestinal intoxication due to muscarine (a toxic glucoside) which this mushroom also contains. It is interesting to observe that one of first neurotropic effects

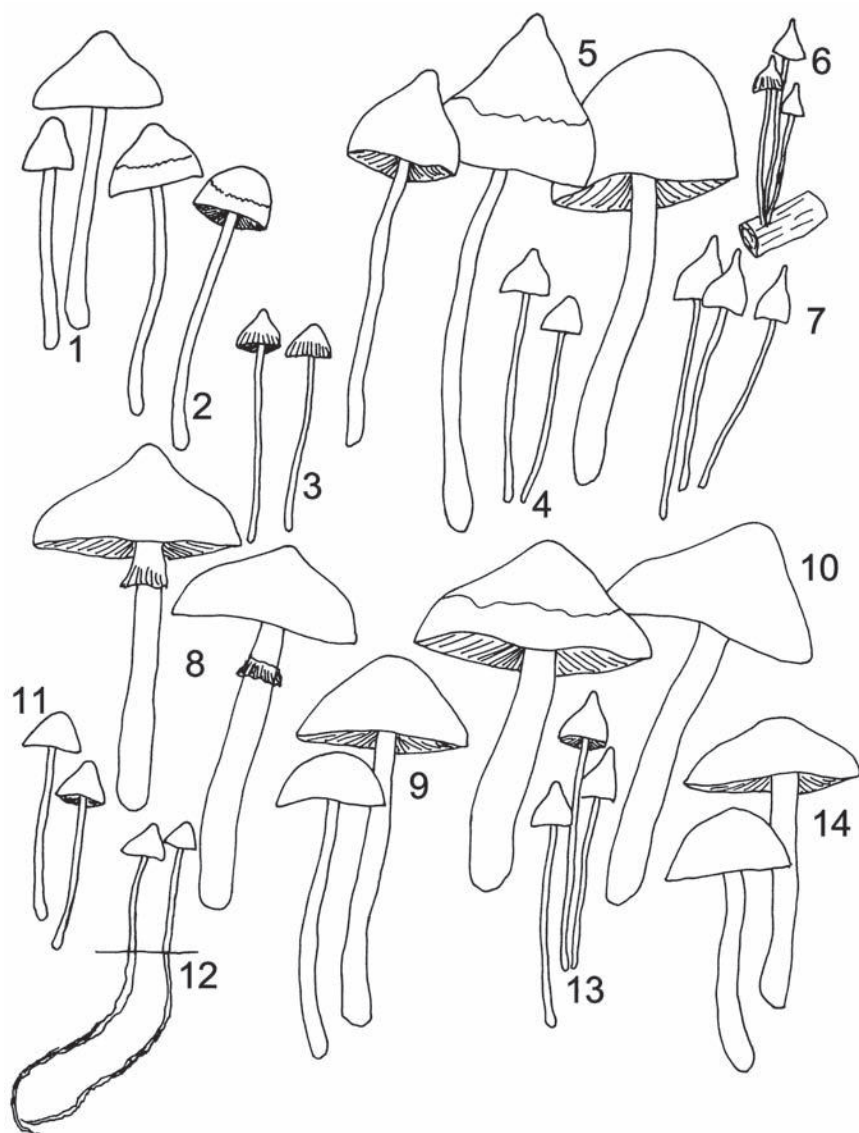
of *A. muscaria* is to see all surrounding things as gigantic, as will be discussed below which concern Mexican Indians traditions. These enlarging effects relate directly to the history of the gnomos in Europe, which supposedly began with the ingestion of *A. muscaria*. Stijve (1995) reported ibotenic acid also in other species of *Amanita*, such as *A. regalis* (Fr.) Michael and *A. pantherina* (DC.: Krombh.).

The genus *Psilocybe*

The hallucinogenic species of *Psilocybe* are the most diverse and those with the widest geographical distribution, and the most important mushrooms in the hallucinogenic fungi. Moreover, the hallucinogenic species of *Psilocybe* are the most important in ethnomycology. They probably were used in many ethnic groups in the world, but at the present only certain groups of Mexican Indians (Wasson and Wasson, 1957; Guzmán, 2001) and the Kuma in Papua New Guinea (Heim and Wasson, 1965; Heim et al., 1967) considered these mushrooms as sacred. Some important hallucinogenic species of *Psilocybe* in the world are show in Figs. 1-14. See also Tables 2 & 3.

Guzmán (1983) reported 91 species of hallucinogenic species of *Psilocybe* in the world versus no more than 20 species reported by Heim and Wasson (1958) and Singer and Smith (1958). The new edition of 'The Genus *Psilocybe*' in preparation by the author includes more than 150 species of hallucinogenic species of *Psilocybe* throughout the world, of which more than 55 are in Mexico; 50 in Latin America including the Caribbean, but excluding Mexico; 22 in the U.S.A. and Canada; 16 in Europe, 15 in Asia; 15 in Australia and eastern islands, and only 4 in Africa (Guzmán, 2005) (Table 2) (Fig. 15). Several species are in more than one continent, for example *P. semilanceata*, which is common in Europe and the U.S.A., is also known from Chile and Tasmania. *Psilocybe cyanescens* is known from Europe and Canada. *Psilocybe yungensis* and *P. zapotecorum* are known from Mexico and South America. With the recent study of *P. fagicola*-complex (Guzmán et al., 2005) this complex is known from Mexico, Colombia and Indonesia. *Psilocybe cubensis* and *P. subcubensis* are pan-tropical species. Table 3 shows the most common species of *Psilocybe* in the world.

The bluing reaction of fresh fruit bodies of hallucinogenic species of *Psilocybe* is the best way to distinguish them from those that lack that property. *Psilocybe coprophila*, *P. montana* and *P. argentina*, among others, have a wide world distribution but do not have neurotropic properties. However, sometimes the bluing reaction is difficult to observe, depending on the developmental stage of the fruit body, as is the case with *P. semilanceata* and *P. mexicana*. It is important to note that the bluing reaction



Figs. 1-14. Some species of *Psilocybe*. 1: *P. baeocystis*, 2: *P. aztecorum*, 3: *P. silvatica*, 4: *P. pelliculosa*, 5: *P. zapotecorum*, 6: *P. yungensis*, 7: *P. hoogshagenii*, 8: *P. cubensis*, 9: *P. caribaea*, 10: *P. caerulescens*, 11: *P. brasiliensis*, 12: *P. fagicola*, 13: *P. semilanceata*, 14: *P. cyanescens*

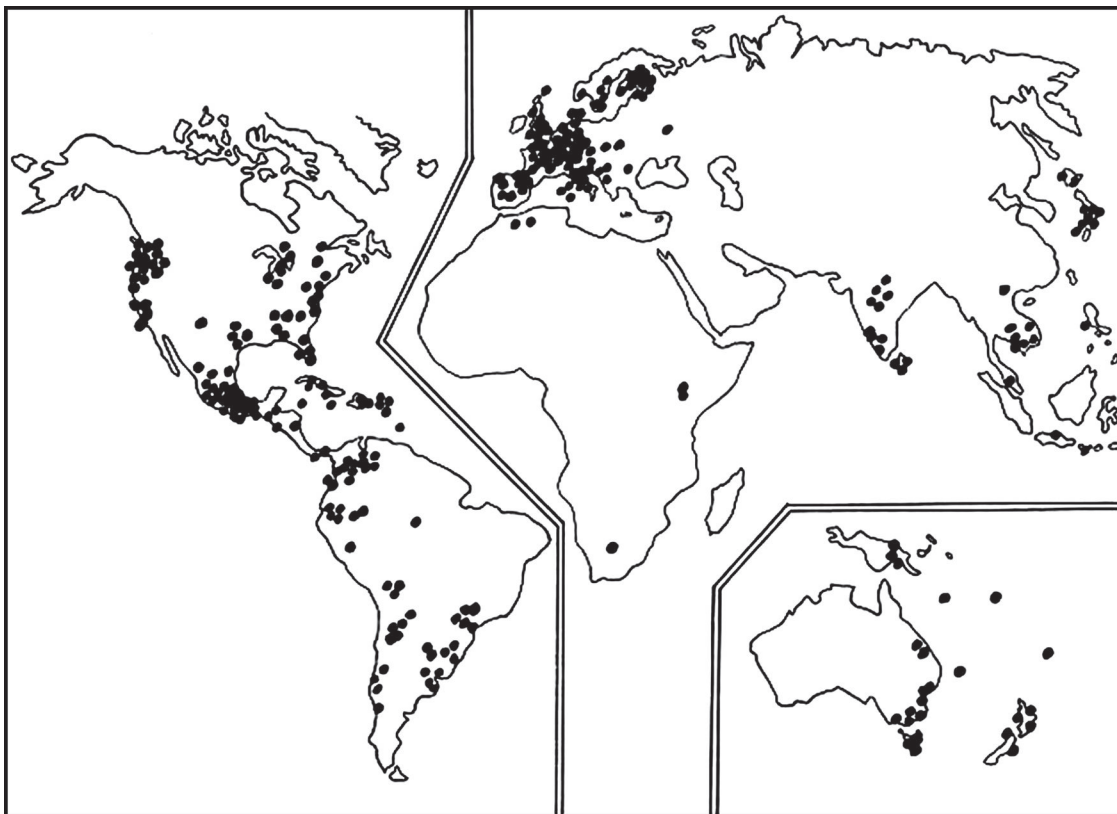


Fig. 15. World distribution of the hallucinogenic species of *Psilocybe* (each dot is one or several localities)

Table 2. Distribution of the known 150 hallucinogenic species of *Psilocybe* in the world

Mexico _____	55 species
Latin America including the Caribbean, but excluding Mexico _____	50 species
United States and Canada _____	22 species
Europe _____	16 species
Asia _____	15 species
Australia and eastern islands _____	15 species
Africa _____	4 species

The total is 177, because some species are common in several continents (e.g. *P. cubensis*, *P. cyanescens* and *P. semilanceata*).

is common in other mushrooms, edible or poisonous, for example in *Boletus satanas* (poisonous) and in *B. erythropus* (edible). Moreover some species of *Conocybe*, *Copelandia*, *Gymnopilus* and *Pluteus* turn blue, because they contain psilocybin, as described in Table 1.

Ethnomycological studies

The traditional use of hallucinogenic mushrooms was very important in the past, as discussed above with *Amanita muscaria* and with sacred species of *Psilocybe* in Mexico (Wasson and Wasson, 1957; Wasson, 1980). In Mexico, as stated in many documents, e.g. Sahagún (1569-1582), and some codexes, as the Magliabechiano Codex (Wasson and Wasson, 1957; Gray, 1973; Wasson, 1980) the Indians considered hallucinogenic mushrooms as sacred. They identified them with several common names, such as 'teonanácatl' (Sahagún, 1569-1582), 'teotlaquilnanácatl' (Guzmán, 1959), 'apipiltzin' (= little boy of the rain) or 'siwatsintli' (= little women) (Heim and Wasson, 1958), among others. Mazatec and Zapotec Indians in Oaxaca have around one hundred common names depending on the species and region. Guzmán (1983) presented a list of more than one hundred Indians names of the hallucinogenic mushrooms in Mexico, but later (Guzmán, 1997) described about one thousand names, both in Spanish and Indian languages, from Mexico.

When the Indians use hallucinogenic mushrooms in their ceremonies, they are always supervised by an old person or a shaman of the community. Shamans were and they are very common throughout the Mexican Indian world. These shamans are women or men and are specialists in

Table 3. Some common species of neurotropic species of *Psilocybe* in the world

<i>P. argentipes</i> Yokoyama. Known only from Japan.
<i>P. aztecorum</i> R. Heim emend. Guzmán. Known only from Mexico (Fig. 2).
<i>P. baeocystis</i> Singer & A.H. Smith emend. Guzmán. Known from the U.S.A. and Canada (Fig. 1).
<i>P. barrerae</i> Cifuentes & Guzmán emend. Guzmán. Known only from Mexico.
<i>P. brasiliensis</i> Guzmán. Known only from Brazil (Fig. 11).
<i>P. caeruleoanulata</i> Singer ex Guzmán. Known from Brazil and Uruguay.
<i>P. caeruleascens</i> Murrill. Known from SE of the U.S.A., Mexico and South America (Fig. 10).
<i>P. caribaea</i> Guzmán, T.J. Baroni & Tapia. Known from the Caribbean and Mexico (Fig. 9).
<i>P. columbiana</i> Guzmán. Known only from Colombia.
* <i>P. cubensis</i> (Earle) Singer. Pantropical species (Fig. 8).
<i>P. cyanescens</i> Wakef. (a complex). Known from Europe, the U.S.A. and Canada (Fig. 14).
<i>P. cyanofibrilosa</i> Guzmán & Stamets. Known only from the U.S.A.
<i>P. fagicola</i> R. Heim & Cailleux emend. Guzmán. Known only from Mexico (Fig. 12).
<i>P. fimetaria</i> (P.D. Orton) Watling. Known in North America, Europe and Chile.
<i>P. guilartensis</i> Guzmán F., Tapia & Nieves-Riv. emend. Guzmán. Known from the Carribbea.
<i>P. hoogshagenii</i> R. Heim. Known from Mexico and South America (Fig. 7).
<i>P. keralensis</i> K.A. Thomas, Manim. & Guzmán. Known only from India.
<i>P. kumaenorum</i> R. Heim. Known only from Papua New Guinea.
<i>P. laetissima</i> Hauskn. & Singer. Known only from Europa.
<i>P. liniformans</i> Guzmán & Bas. Know only in Europe.
<i>P. mammillata</i> (Murrill) A.H. Smith. Known from the U.S.A., Jamaica, Bolivia and Mexico.
<i>P. mexicana</i> R. Heim. Known form Mexico and Guatemala.
<i>P. pelliculosa</i> (A.S. Smith) Singer & A.H. Smith. Known from North America and Europe (Fig. 4).
<i>P. plutonia</i> (Berk. & M.A. Curtis) Sacc. Known from Mexico, the Caribbean and South America.
* <i>P. semilanceata</i> (Fr.: Secr.) P. Kumm. Known from Europe, North America, Chile and Tasmania (Fig. 13).
<i>P. silvatica</i> (Peck) Singer & A.H. Smith. Known from North America and Europe (Fig. 3).

Contd.

Table 3 continued

<i>P. stuntzii</i> Guzmán & J. Ott. Known only from the U.S.A.
<i>P. subcaerulipes</i> Hongo. Known only from Japan.
<i>P. subaeruginosa</i> Clel. Known only from Australia.
<i>P. subzapotecorum</i> Guzmán. Known only from Mexico.
* <i>P. tampanensis</i> Guzmán & S.H. Pollock. Known only from Florida, U.S.A.
<i>P. venenata</i> (S. Imai) Imazeki & Hongo. Known only from Japan.
<i>P. yungensis</i> Singer & A.H. Smith. Known from Mexico and South America (Fig. 6).
<i>P. zapotecorum</i> R. Heim emend Guzmán. Known from Mexico and South America (Fig. 5).

sacred mushrooms, as well as other sacred plants. The Wassons (Wasson and Wasson, 1957; Heim and Wasson, 1958) found the shaman María Sabina in Huautla de Jiménez town; she showed them all the sacred traditions related to the mushroom ceremonies. María Sabina's knowledge of the mushrooms had such an impact on the Wassons, that they and their collaborators published a huge book with four long-playing records about it (Wasson et al., 1974). The book presented the shamanic ceremony performed in 1958 in Huautla de Jiménez, with canticles and prayers by María Sabina. After this publication on María Sabina, many books and articles were published about her, appointing her as the principal shaman on sacred mushrooms all over Mexico. However, it must be emphasized that at that time important Indian shamans with knowledge of the sacred mushrooms were common in Mexico, as the author saw in his field expeditions during that period (Fig. 17).

Unfortunately, due to the advance of modern civilization, the traditions of hallucinogenic mushrooms are being lost. Today it is difficult to find a good shaman specialist in sacred mushrooms, but it is easy to find 'meztizos' (crossbreeds between Indian and Spanish men) who trade in the Indian traditions and the mushrooms (Guzmán, 1990, 2001). Wasson (1980) and Lowy (1974), among others, discussed the probable but now lost use of sacred mushrooms among the people of Central America. Also, Lowy (1974) described the probable sacred use of *Amanita muscaria* among Mayan Indians of Mexico and Guatemala in relation to the Thunderbolt Legend and from the study of several codexes. Guzmán (1990) discussed the probable use of *A. muscaria* among the Purepechas of Mexico, in relation to a little stone figure found at an archaeological site: it seems to be the button of an *A. muscaria*. Also, Schultes and Hofmann (1979) presented a pottery figure which represents an Indian seated below an *A. muscaria*, which this author (Guzmán, 2001) has as an evidence of the use of *A.*

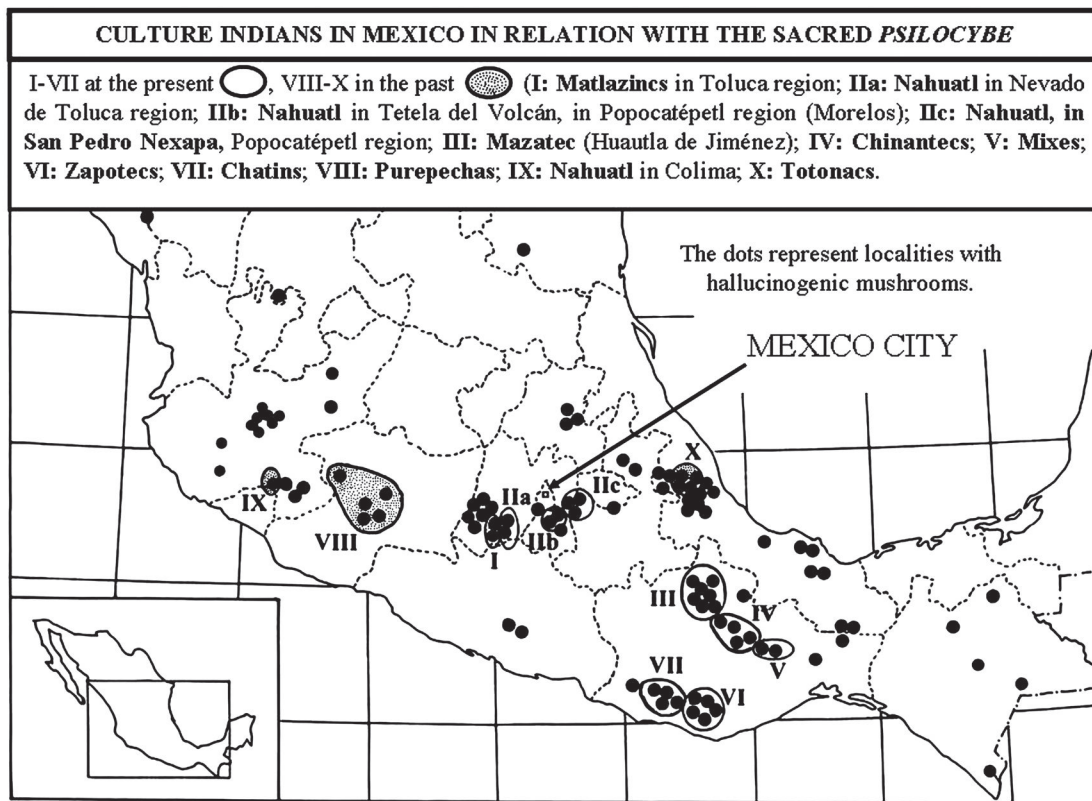


Fig. 16. Distribution of the hallucinogenic species of *Psilocybe* in Mexico, and the Indian culture related to them



Fig. 17. A typical Mexican Indian shaman in relationship with the sacred mushroom (photo by Guzmán in 1958)



Fig. 18. Pottery figure from Colima (Mexico) showing the gigantism effect after the ingestion of the hallucinogenic mushrooms. Observe the eyes and the snake on the hats of the Indians (from Schultes and Hofmann, 1979)



Fig. 19. A possible representation of Quetzalcóatl in a Colima pottery piece. Note the similarity of this with Fig. 18, where is a mushroom in the center (from del Villar, 2005)

muscaria among the Nahuatl Indians from Jalisco and Colima of Mexico in the past, as they also used the species of *Psilocybe* (see below).

At present in Mexico, six Indian cultures are related to hallucinogenic species of *Psilocybe*, as shown in Fig. 16. They are the Matlazincas and Nahuatls in central Mexico, and the Mazatecs, Chinantecs, Mixes, Zapotecs and Chatins in the State of Oaxaca. In the past it was probably the Colima Indians of Nevado de Colima, Purepechas of Michoacan and Totonacs of Veracruz who used these mushrooms. In regard to the group from Colima, the author found in Schultes and Hofmann (1979) and in del Villar (2005) and Díaz (2003) in the anthropological studies of the journal *Antropología Mexicana*, three interesting Indian pottery figures, which have a strong relationship to the traditional use of hallucinogenic species of *Psilocybe* and gigantism effects (Figs. 18-20). Fig. 18 shows four Indians surrounding a tall mushroom, which undoubtedly is a *Psilocybe* of the *Zapotecorum* group following Guzmán's classification (Guzmán, 1983). According to Schultes and Hofmann (1979), who first published the picture, these four Indians are dancing. However this interpretation is wrong, because an effect of the hallucinogenic mushrooms makes it difficult to stay standing, let alone

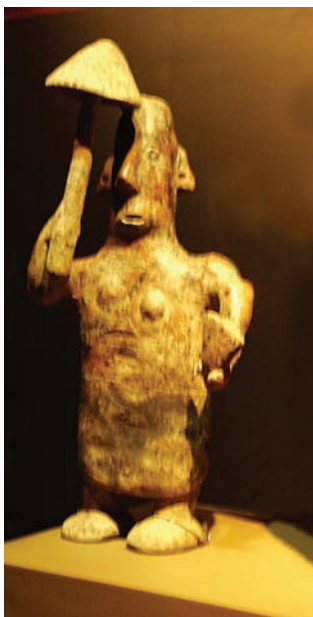


Fig. 20. An Indian woman with the effect of gigantism after eating hallucinogenic mushrooms. Note the gigantic mushroom in one of her hands and the eyes very big and out of orbit (from del Villar, 2005)

walking or dancing; the four Indians are really embracing, observing with admiration the gigantic mushroom which supposedly they ate. Other important features of this figure are the hats of the Indians, which are snakes, as are in their arms. Snakes were very important in the religion of several Indian cultures in Mexico, which considered these animals as sacred. To the Nahuatl snakes represented the god Quetzalcóatl, as was also true for the Teotihuacans, who represented this god in their pyramids. Even more interesting is Fig. 19, which resembles Fig. 18 except instead of the tall mushroom, the center contains another Indian with snakes on his head, neck and hands. This author concluded from these two figures in Colima that the cult of hallucinogenic mushrooms was related to the god Quetzalcóatl an important god among the Nahuatl Culture. Unfortunately neither an anthropological nor ethnomycological study has been devoted to these figures nor the relationships with the Quetzalcóatl god. Thus, the relationships of the sacred mushrooms with Quetzalcóatl is presented for the first time here.

Another pottery figure, also from Colima (Fig. 20) (del Villar, 2005; Díaz, 2003) shows a woman with a gigantic mushroom in her right hand, like that of Fig. 18. Thus we have here another representation of the

gigantism symptomatic of hallucinogenic mushrooms. Note the eyes of the woman: they are very big, are out of orbit, probably due to the neurotropic action of the mushrooms and to see one of them as a gigantic one. This author experienced the gigantism effects when he ate *Psilocybe cubensis* in a traditional ceremony in 1958. At the beginning of his hallucinations, this author saw gigantic black men dancing around him, but those 'men' were actually one little dog which was chasing a cat around his bed.

Traditional use of sacred mushrooms in Indian ceremonies in Mexico

It is very important to know the procedures and care followed by Mexican Indians in their nocturnal ceremonies with hallucinogenic mushrooms. Such knowledge is useful for avoiding psychological problems or possible poisoning. Indians regard hallucinogenic mushrooms as sacred and use them with respect and care; accordingly, they never encounter health problems from using them. They eat the mushrooms to find health or to talk with God or dead relatives, although these are suggestive. They relate the ceremony to the Catholic religion, and the rite is performed in front of a little altar in the house where the ceremony takes place. They pray in a confused mix of their Indian language and in Spanish. The shaman or the director of the ceremony passes the mushroom through incense before they are eaten. Indians eat the mushrooms fresh or dry, alone or with water, but never with food. Some modern modifications introduce honey or chocolate, but this is rare. During ingestion of the mushrooms they follow simple rules to prevent health problems: 1) They eat the mushrooms only at night to avoid noise and distractions, in order to concentrate on the visions. 2) They do not take meals, alcohol, medicines or drugs. 3) The dosage is more than six but not more than 12 fresh fruit bodies, twice as many if the mushrooms are dry. 4) They always take the mushrooms under the supervision of an old person or shaman, never alone. 5) They avoid travel during the ensuing seven days, resting at home under proper care, because the nervous system remains very sensitive. Indians have followed these five rules for centuries and never had health problems. It is interesting to talk with shamans who took hallucinogenic mushrooms all their life, and to observe that they are normal persons in all respects. The important conclusion about the Indian use of the hallucinogenic mushrooms is that health problems are prevented by following these five rules.

Effects of the hallucinogenic mushrooms and their application in neuropsychiatry

Hallucinogenic mushrooms do not always produce hallucinations, but they always act on the central nervous system; accordingly, a more correct term

for them is neurotropic, although there are several other names used in the bibliography, such as psychedelics, psychotropics, divines, healing, visionary and entheogens, among others (Guzmán, 1997, 2001). These mushrooms produce a dual perception between reality and the imagination. Those who eat the mushrooms do not forget who they are, but at the same time they accept another perception of themselves, and transform objects they see to visions remembered or imagined. The former are illusions and the latter are hallucinations, but in general both are initially gigantic figures with vivid colors. They hear voices from the objects they envision. All the effects vary according to the cultural background of the person, the quantity of mushrooms ingested and the surrounding circumstances. The effects of the neurotropic fungi begin approximately 30 minutes after ingestion and continue for 4-6 hours. When the effects subside, the person sleeps normally, and upon awakening is in a normal condition but remembers perfectly and will never forget the sensations experienced (Guzmán, 1990, 2001, 2003).

When this author ate neurotropic mushrooms as an experiment during a traditional Indian ceremony in an Indian house in 1958, he experienced illusions and hallucinations. He had decided to try these mushrooms, because he was finishing more than two years of field research on them. The author was gathering hallucinogenic mushrooms for a Swiss laboratory, and he doubted that the mushrooms were hallucinogenic. Following Indian counsel, he ate 12 fresh fruit bodies of *Psilocybe cubensis* gathered by him that morning. The ingestion was an interesting Indian nocturnal ceremony conducted by an old Mazatec woman, the mother of the owner of the Indian house, where this author was living, in a little Indian farm close to Huautla de Jiménez. After the ceremony this author remained talking for some minutes at a table with the only Indian there who spoke Spanish, the son of the woman who conducted the ceremony. This man had not consumed any mushrooms. The author's mind at that moment was clear, so he thought that the hallucinogenic effects were untrue. Then he decided to go to his straw sleeping mat, which was in a corner of the room where the ceremony had taken place.

While he was on his straw sleeping mat, he suddenly saw a caricature of a gigantic, colored castle with two human faces. The castle was his gasoline-lamp mushroom dryer at an opposite corner of the room. The castle smiled and said to him: "Come, come to me, don't be afraid". The author was greatly surprised and frightened, and he reached for his eyeglasses to see his mushroom dryer. Then the castle laughed loudly. He decided to turn his back on it and sleep, but sleep was impossible, because he began to see many attractive, bright colors wherever he turned, regardless of whether his eyes were open or closed. These colors gradually

transformed into gigantic black men, who danced around him, singing. In that moment the author felt very comfortable and asked the castle to please keep silent, because he was busy and happy looking at the spectacle. As discussed above in the section *Ethnomycological Studies*, these gigantic men were really a little, dark dog chasing a cat. After the above visions, he saw many others, spectacularly colored things and persons, and experimented many other cases, but the castle was there all night, saying to him, "come, come to me....". Finally he fell into a normal sleep after almost 6 hours of neurotropic effects (Guzmán, 1990).

These experiences with the hallucinogenic mushrooms, practiced by Mexican Indians for centuries, attracted the attention of chemistry laboratories. Medical and psychotherapeutic researchers were very interested to study these mushrooms or the psilocybin isolated from them to better understand neurological disorders and schizophrenia. They conducted experiments in Europe and the U.S.A. Nevertheless, overdoses of either mushrooms or psilocybin can result in convulsions or death (McCawley et al., 1962). Psilocybin in the blood inhibits serotonin, the hormone that controls the central nervous system. The absence of serotonin causes a temporal, abnormal psychotic stage with illusions and hallucinations, that disappears when the serotonin is replaced by normal biochemical processes of the body (Heim and Wasson, 1958; Singer, 1958b, 1978). However, as it will be described below, all these researches were stopped because of abuses of the use of these mushrooms by young people.

It is important to note that the effects of neurotropic mushrooms or psilocybin are produced not only by their ingestion. The hallucinations will start also after inhaling the volatiles produced by the mushrooms, as this author determined some time ago in field work. He found that psilocybin is volatilized from fresh fruit bodies. This is why the Indians said that old, dry specimens of sacred mushrooms are not good; they keep dry mushrooms no more than six months. One night in 1958 this author was trying to sleep in an Indian house in a small, closed room containing plenty of fresh hallucinogenic mushrooms, which he had gathered for a Swiss laboratory. The author started to see hallucinations when he was on his camp bed. He saw great numbers of little, colored bubbles flying in the air of the room, but he observed that these colored bubbles appeared each time a little leak dripped on his bed (it was raining outside). Each drip exploded into many colored bubbles that flew through the air. He felt nervous because he thought that the colored hallucinations he saw months ago with ingestion of the mushrooms (see above) would start. He needed to go out of the room to breathe fresh air and to shower in the rain to stop the intoxication from the air of the room. This volatility of psilocybin does not appear to have been reported in the literature before now.

Diffusion of knowledge, abuses, trade and confiscation of hallucinogenic mushrooms

The recreational use of hallucinogenic mushrooms, now so common among young people, started after the diffusion of knowledge of these mushrooms in the 1960's as discussed in the Introduction. The increase of interest in eating hallucinogenic mushrooms forced the governments of many countries to introduce legislation aimed at preventing the use, trade, culture and distribution of these mushrooms (Guzmán, 2003). The problem was with people who carelessly consumed these mushrooms, ignoring the traditional use of the mushrooms by the Indians. Many Mexican places with Indian traditions of sacred mushrooms, such as Huautla de Jiménez in Oaxaca, were invaded by foreign young people, who profaned the Indian traditions.

However, the legislation against use of hallucinogenic mushrooms passed by several governments stopped scientific and medical research on these mushrooms, with serious consequences. Also, in some parts of Mexico the Indians were restricted in their traditional use of these mushrooms. Nevertheless, at present a trade exists in Indian ceremonies with these mushrooms flowers in Huautla de Jiménez, where abuses, confiscations or adulterations are common. Governments in North America, Europe and Japan vigorously enforce their laws to stop trade with these mushrooms (e.g. Canada in the case of Heim, 1966). Consequently, it is difficult or almost impossible today to mail dried scientific specimens of *Psilocybe* for research purposes such as taxonomic study, even non-hallucinogenic taxa, because they are confiscated by customs!

Corollary

As hallucinogenic mushrooms were discovered in modern science more than 50 years ago, it might be supposed that all research on them has been completed. However, many matters of ethnomycology, anthropology, taxonomy, distribution, chemistry, physiology and medicine are still poorly known. The scant information from Africa (Morocco, Algeria and Libia) on mushroom drawings in the Sahara Desert, in relationship with *Psilocybe mairei* or also on the use of *P. kumaenorum* in Papua New Guinea, are examples of the poor knowledge that we have on these mushrooms, as are those pottery Indian figures from Colima (Mexico) discussed earlier. Concerning the taxonomy of *Psilocybe*, there are several species not well known yet, for example the *P. cyanescens* complex, and many species remain to be described, mainly from the tropics. Mexico alone has more than 50 hallucinogenic *Psilocybe* species, but only 50, 22, 16, 15, 15 and 4 species are known, respectively, from South America, North America, Europe, Asia,

Australia and eastern islands, and Africa. Much more collection is needed in such under-explored regions. It is necessary also to restore chemical and medical research on hallucinogenic mushrooms, stopped in the 60's because they were erroneously listed as drugs. This situation stemmed from the abuse of these mushrooms by young people, followed by a substantial, clandestine trade in them.

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