The Psilocybin Mushroom Pandemic

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HISTORICAL ORIGINS

Since the dawn of recorded history, people have been known to employ a great variety of naturally occurring substances of vegetal origin for their intoxicating effects. One such material, *soma,* was even exalted by erudite Aryans to the level of a deity in the ancient Rig Veda Hymns of India and after more than twenty-five centuries of illusiveness was finally convincingly determined to be the fly agaric, *Amanita muscaria* (Fries ex Linnaeus) Quélet.[1] The most important psychoactive substances of this mushroom are now known to be the isoxazole derivatives ibotenic acid and muscimole.[2] Although *A. muscaria* is still employed shamanistically by various tribes in northern Siberia, no such use of this species has been documented in the New World. The fly agaric, nevertheless, seems to be intimately involved in the mythology of certain contemporary tribes of Guatemala and contiguous Chiapas, Mexico.[3]

Of the psychotropic materials utilized by ancient Nahuatl peoples of the New World, *teonanacatl* ("God's mushrooms" or, more figuratively from the etymologic derivation, "God's flesh") especially stands out in Mexican history. Although these mushrooms were offered even to strangers at the Aztec coronation festival of Montezuma II in 1502, subsequent festivals employing these sacred intoxicants were held by night out on the plains to escape the inspection of outsiders.[4] With the conquering of the Aztecs by Cortes in 1519, an official province of the Spanish Inquisition established in Mexico in 1541, and finally an *auto-da-fé* in 1574 in which priests were persecuted for religiously partaking of the mushroom sacraments, it is no wonder that the mushroom cults went into hiding, not to be rediscovered until the twentieth century.

Curious mushroom stone artifacts, usually from Guatemala but also from the Mexican states of Tabasco and Vera Cruz, have been dated between 1000 and 300 B.C. and would strongly suggest that an ancestral mushroom cult flourished in the culture of the highland Maya.[5]

The first useful herbarium specimens of *teonanacatl* were collected in the Sierra Mazateca of northeastern Oaxaca by Schultes and Reko, and one of the specimen types was identified by Linder at the Farlow Herbarium of Harvard as *Panaeolus campanulatus* Linnaeus var. *sphinctrinus* (Fries) Bresadola.[6] This mushroom, now properly retained as a distinct species, *P. sphinctrinus* (Fries) Quelét, became a significant source of controversy in scientific literature[7] and finally prompted a thorough systematic study of the genus *Panaeolus.*[8,9] Although this study confirmed the hallucinogenic potential of some species and established it *de novo* for others, it very strongly discredited the possibility of the remaining species of this genus possessing hallucinogenic constituents. The following *Panaeolus* species were found to consistently produce psilocybin (and psilocin): *ater* (Lange) Kühner and Romagnesi; *cambodginiensis* Ola'h and Heim; *cyanescens* Berkeley and Broome; *subbalteatus* Berkeley and Broome and

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tropicalis Ola'h. Other *Panaeolus* species were found to be "latent," i.e. inconsistent, producers of psilocybin (and psilocin): *africanus* Ola'h; *castaneifolius* (Murrill) Ola'h; *fimicola* (Fries) Quélet; *foenisecii* (Fries) Kühner; *microsporus* Ola'h and Cailleux and *sphinctrinus* (Fries) Quélet. The remaining species investigated were never found to contain psilocybin (or psilocin) as metabolic constituents.[8,9] A detailed consideration of the genus *Panaeolus* complete with a worldwide case review of intoxications attributed to various species within the genus will be undertaken in a subsequent communication.[10]

The other specimen type collected by Schultes and Reko in Mexico was later identified by Singer as *Stropharia cubensis* Earle. Although this agaricologist cryptically made several unfounded remarks pertaining to use of such species as intoxicants,[11] for unknown reasons he did not usefully disclose his identification until some years thereafter.[12] In the meantime, expeditions to Mexico by the Wassons and their collaborators had turned up numerous species of hallucinogenic mushrooms employed by indigenous tribes.[13-16] Although most of the species employed belong to the genus *Psilocybe* Fries *sensu* Quélet, one of the most important species was determined by Heim[13] to be *Stropharia cubensis* Earle. Psilocybin, up to 0.3% by dry weight, and traces of psilocin were later isolated from two geographically different collections of this species.[17] *S. cubensis* was also the first species determined to produce psilocybin in submerged culture.[18]

CERULEAN BLUE AND CHEMO-MYCOLOGICAL CONSIDERATIONS

Stropharia (Fries) Quélet and *Conocybe* Fayod

Stropharia cubensis was first described by Earle[19] after encountering it in Cuba in 1904, thus accounting for the species name. The next documented citing of this species was by Patouillard[20] in 1907 from Tonkin (now North Vietnam). He considered it to be a *Naematoloma* and designated the species *caerulescens,* noting the context bluing resulting from damage. Murrill,[21] unaware of these previous citings, described this species in 1941 as the Florida novelty *Stropharia cyanescens;* the species name again denoting the dark bluing phenomenon. Singer[22] also regarded this species as belonging to the genus *Stropharia,* but he later reclassified it as *Psilocybe cubensis* (Earle) Singer and designated it the type species of a new section *Caerulescentes* Singer.[23] This section is comprised of *Psilocybe* species assumed to be hallucinogenic by virtue of their context bluing after damage.[24] The species *cubensis* was included with these cerulescent *Psilocybes* primarily due to a lack of chrysocystidia (cystidia, i.e. large sterile cells found between the spore producing cells, possessing certain distinguishing characteristics), the context bluing and the ability to induce hallucinatory experiences.[12,24] Nevertheless, the strong development of a veil with a persistent membranous double annulus and the fact that a species of *Conocybe (C. siligineoides* Heim) was considered to be hallucinogenic were advanced by Heim with additional important morphological and other arguments for retaining the species *cubensis* in the genus *Stropharia,* perhaps as part of a section that would include other bluing *Strophariας.*[17]

Investigators later demonstrated the presence of psilocybin in bluing species of *Conocybe: C. cyanopus* (Atkinson) Kühner and *C. smithii* Watling.[25-26] This is especially significant since *Conocybe* belongs in the family *Bolbitiaceae* whereas *Stropharia* and *Psilocybe* are members of the family *Strophariaceae.* It has also been established that *Psilocybe semilanceata* (Fries ex Secretan) Kummer, generally considered the type species of the genus *Psilocybe* and previously of section *Psilocybe,*[27] often demonstrates context bluing and consistently produces psilocybin.[26,28] Thus, section *Caerulescentes* Singer *sensu* Watling is properly represented by *Psilocybe semilanceata* as the type species[26] and *Stropharia cubensis* is appropriately retained in the genus *Stropharia.* That various species of *Panaeolus* (a genus with great affinity toward the *Strophariaceae)* are now known to produce psilocybin, certainly further weakens any argument to transfer *S. cubensis* to *Psilocybe* on a biochemical basis.

By analogy to section *Caerulescentes* in *Psilocybe, Conocybes* demonstrating context bluing and/or possessing psilocybin may now be considered as belonging to a distinct section, *Cyanopes* Pollock *sectio nov.* This section includes *C. cyanopus, C. smithii* and presumably *C. siligineoides* Heim, although due to a lack of sufficient specimen material hallucinogenicity of the latter has not been chemically or psychopharmacologically determined. *Conocybe cyanopus* is considered the type species since it is best known and the first *Conocybe* in which psilocybin was detected.

Stropharia cubensis may properly be considered the type species of a section of *Stropharia,* now designated *Cyanescentes* Pollock *sectio nov.* This section includes those bluing species that in classical taxonomic arrangements would be classified in *Stropharia* (Fries) Quélet rather than *Psilocybe* (Fries) Quélet by possession of a persistent annulus. Most of these species also tend to have a viscid pellicle, a feature typically more characteristic of *Stropharia* than *Psilocybe.* It is

expected that members of the cyanescent *Stropharia* taxon have hallucinogenic capacity similar to that of the type species *S. cubensis*. While the bluing Javanese (and presumably Japanese[24]) *Stropharia aerugineomaculans* Höhnel has not yet been proven to possess hallucinogenicity, psilocybin has been isolated from a related species, *Stropharia fimetaria* Orton from Scotland.[26] The species previously described from Java by Höhnel as *Psilocybe subaeruginascens* (Höhnel in *Sitzungsberichte der K. Akademie der Wissenschaften in Wein* 123[1]:78 [1914]) belongs in this section as *Stropharia subaeruginascens* (Höhnel) Pollock *comb. nov.* Since the psychoactive Japanese species *Stropharia caerulescens* Imai (later changed to *S. venenata* Imai) might be conspecific with *S. subaeruginascens*,[24] section *Cyanescentes* admits four species at the present time: *cubensis; subaeruginascens; aerugineomaculans* and *fimetaria*. These four species are similar to *Psilocybe* in that they lack chrysocystidia, but although chrysocystidia happen to be found in other *Strophariaa*, as well as *Flammulas* and smooth spored *Pholiotas*, they are more characteristic of the genus *Naematoloma*.[30] As is the case for latent psilocybian *Panaeolus* species especially, bluing may not always be present as a biological indicator for the presence of hallucinogenic indoles in *Stropharia*. Additional species may well be added to section *Cyanescentes* after future chemotaxonomic investigations are completed.

Psilocybe (Fries) Quélet

Psilocybin, and often at least traces of psilocin, have been identified as metabolic constituents of many of the known or suspected hallucinogenic *Psilocybe* species, which may be considered as belonging to section *Caerulescentes* Singer *sensu* Watling[26] as now emended by Pollock. Since two species of the *Psilocybe* stirps *Cubensis*[24] have been properly retained in *Stropharia* while the third has now been transferred to that genus, section *Caerulescentes* accordingly must be modified to exclude species with a veil forming a distinct, persistent annulus. This emended section admits only those bluing and/or hallucinogenic species which are of the genus *Psilocybe* Fries *sensu* Quélet. Psilocybin has been detected in the following such *Psilocybe* species: *mexicana* Heim;[31,32] *semperviva* Heim and Cailleux, *aztecorum* Heim, and *zapotecorum* Heim;[17] *caerulescens* Murrill;[17,32] *wassonii* Heim[33a] and apparently *mixaeensis* Heim;[33b] *pelliculosa* (Smith) Singer and Smith;[34] *cyanescens* Wakefield;[25] *baeocystis* Singer and Smith;[25,35,36] *semilanceata* (Fries ex Secretan) Kummer;[26,28] *strictipes* Singer and Smith and *caerulipes* (Peck) Saccardo;[36] *quebecensis* Ola'h and Heim;[37] and most recently *subaeruginosa* Cleland and *collybioides* Singer and Smith.[29] Although psilocin has not been detected in all of these species, it presumably occurs under favorable conditions at least in trace amounts. Baeocystin and norbaeocystin, N-monomethyl and N-demethyl analogs of psilocybin discovered as biosynthetic indoles in *P. baeocystis*,[38] might be produced on occasion by some other species. Similar but as yet hypothetical analogs of psilocin might also occur.

Other *Psilocybes* which may presently be considered as belonging to section *Caerulescentes* because of their bluing and/or reputed hallucinogenicity are the following: *boogshagenii* Heim, *cordispora* Heim, *macrocystis* Heim, *fagicola* Heim, *acutissima* Heim; *yungensis* Singer and Smith, *aggericola* Singer and Smith, *candidipes* Singer and Smith; *isauri* Singer, *silvatica* (Peck) Singer and Smith; *fasciata* Hongo, *subcaerulipes* Hongo, *callosa* (Fries) Quélet; *kumaenorum* Heim; and finally *bolivari* Guzmán. More studies are needed on these species. Numerous additional species which are poorly known at present might also belong to section *Caerulescentes*.

THE NORTH AMERICAN NIDUS

The rediscovery of hallucinogenic mushroom use in Mexico was one of the truly great adventures in ethnobotanical anthropology. With the public made aware of this fascinating realm of human experience,[39,40] it was only a matter of time before the ancient mycological knowledge of the supernatural would have a profound impact on distant cultures. Great numbers of people flocked to the Sierra Mazateca of Oaxaca, Mexico often "braving imprisonment and fines to penetrate this mushroom paradise. . ."[41] One visitor to Mexico even attempted to portray his mushroom quest in a short novel.[42] In August 1973, my travel in Mexico revealed that Mexican officials, in their eagerness to exploit tourists, had indeed given some well known mushroom areas a bad reputation. New "mushroom towns" continue to become popular.

People also started to become cognizant of the fact that hallucinogenic mushrooms could be found outside of Mexico. As far north as British Columbia, astute persons began using locally available species. Mushrooms seized from college students in Vancouver by the Royal Canadian Mounted Police were found to contain psilocybin and were considered by Heim as appearing closest to the European species *Psilocybe semilanceata*, but they were also quite close to *P. squalidella* Peck.[43] Although existence of *P. semilanceata* in America was dubious,[43,44] it seems that the British Columbian fungal specimens were later identified by Alexander Smith as *P. semilanceata*.[26]

Mushroom use has become endemic in various parts of the United States and is particularly prevalent around the Mexican Gulf. In much of Florida especially, high temperature, humidity and frequent rains often produce bumper crops. *Stropharia cubensis* is the most well known hallucinogenic fungus from Florida[24] and would generally seem to be one of the most frequently encountered species all around the Gulf where it is popular to employ fresh mushrooms in omelets or to have tea from dried mushroom powder. The identity of a large specimen found on a hillside in Bexar County, Texas, having a four inch cap diameter and appearing to be *S. cubensis,* was examined with McClain, a mycologist, and determined to indeed be *S. cubensis.*

Psilocybe baeocystis, known from Oregon and suspected from Washington to have caused psychodysleptic intoxications,[35,45] has been attributed as the cause of death of a young child.[35] An "underground" publication, which strongly advocates the use of hallucinogenic mushrooms and even gives some overly precautious instructions pertaining to their tissue culture, warns against the use of *P. baeocystis* suggesting that the novel *baeocystis* alkaloids could have been the causative lethal agents.[46] For an as yet undetermined reason young children, in striking contrast to adults, seem to be particularly susceptible to psychotoxic effects of psilocybin mushrooms. They may develop pyrexia to 106° F and demonstrate clonic-tonic convulsions,[35,47] either of which symptoms may be life threatening. From structure-activity considerations of the effectiveness of various hydroxyindole-alkylamines in antagonizing reserpine facilitation of pentylenetetrazole induced tonic extensor seizures,[48] one might predict that baeocystin and norbaeocystin would contribute to the psychotoxicity of a species containing these tryptamine derivatives, but the prolonged clinical course observed in some intoxicated children is not characteristic of the adult pharmacology of psilocybin and certainly merits further study.

Other *Psilocybe* species which on occasion may be deliberately employed or accidentally ingested in the United States and Canada are the following: *silvatica* reported from New York, Ontario, Michigan and Quebec; *pelliculosa* from California, Oregon, Washington and Idaho; *strictipes* from Oregon; *caerulipes* from Ontario, Michigan, Maine, New York, Ohio, Tennessee and North Carolina; *cyanescens* from Washington (although first discovered in England), and *caerulescens* from Alabama (but cited as far south as Argentina). Since *P. quebecensis* is less common and seems to fruit in colder weather than the preceding *Psilocybes,* it is unlikely to be consumed by mycophagists.

Conocybe smithii is known from Washington and Michigan. *Conocybe cyanopus (Pholiotina cyanopoda* according to Singer[27]), although originally discovered in Germany, has been collected in Colorado, New York and Washington. *Panaeolus* species are known to be employed from Maine[49,50] to Hawaii.[51]

Street psilocybin *per se,* according to definitive studies both in the United States and abroad, is said not to exist and most often to be LSD.[52-55] There seems to be only one citing of actual psilocybin tablets,[56] but no pertinent information as to sample source etc. was given. Although some street samples of magic mushrooms have turned out to be nothing more than "garden-variety mushrooms" laced with LSD, it seems that occasional genuine psilocybin mushrooms have been turning up in some west coast markets[54] and, of course, from Florida.[56]

BACK ON THE WILD PSILOCYBIN MUSHROOM TRAIL

Intoxicating "tree fungus" use may well have occurred in the westernmost Amazon basin as late as the eighteenth century by the Yurimaguas of Peru, but contemporary field work has failed to detect any remnants of such a practice.[50] Furthermore, use of hallucinogenic fungi in other areas of South America was totally unknown. It seems that about seven years ago people who had partaken of sacred mushrooms in Mexico recognized their presence in Colombia. Use became rampant throughout the country and thousands of young Colombians have enjoyed the pleasures of psychedelic *hongos* often in the peacefulness of such idyllic Andean settings as the famed commune at La Miel ("Honey").[57] Ecstatic word of the abundance of magic mushrooms in Colombia later reached the States.[58]

Since tropical ecosystems tend to be quite rich in diversity of exotic flora and no studies on the *hongos colombianos* had been undertaken, it was of considerable interest to obtain specimens for positive species identification, which in addition to macroscopic considerations requires expert microscopic examination.

In June 1974, a brief excursion to Colombia was made where we discovered an awareness of psychoactive mushrooms. Some people indicated the use of large white "table-top" fungi or of smaller fungi with somewhat globular yellow caps. Still others only selected mushrooms with tall narrow stems and brown to gray colored caps. All were said, by both Colombians and foreigners, to be associated with bovine dung and some were said to turn blue.

The most frequently encountered mushroom species

in the lofty Andes near Bogota was a dark brown *Panaeolus.* In Popayan it was learned that some people occasionally smoke dried mushrooms, usually after elaborate preparation with other agents. The idea to utilize them in such a manner may well have come from Castaneda's "humito," the smoke resulting from combustion of magic mushroom dust plus special botanical sweetening agents in a ritual pipe.[59,60] "Humito" has never been encountered by ethnobotonists, mycologists, or other investigators of ritualistic mushroom use in Mexico. Furthermore, with Castaneda's very own admission that the mushroom dust did not burn but was ingested, it seems "humito" was really a symbol or literary device to intrigue the reader. Dried samples of the mushrooms so employed at Popayan appeared to be *Stropharia cubensis.* It is said to take a larger quantity for effect and the duration of action is considered very much shorter than by the oral route. N,N-dimethyltryptamine (DMT) is known to be an intermediary metabolite of *S. cubensis* (one step away from psilocin and two from psilocybin in the major biosynthetic pathway of the compounds[61,62]) and could be a mediator of effects produced by inhalation of the mushroom smoke. I later gave the smoking method a trial but received only a headache. When taken to a mushroom site high in the Andes between Popayan and Silvia, *S. cubensis* and the *Panaeolus* seen elsewhere seemed to be present. An occasional other type was glimpsed, but due to a lack of recent rain, no species was abundant.

In the region of the *tres fronteras* i.e. where Colombia, Peru and Brazil converge on the magnificent *Rio Amazonas,* several of us bicycled to a local mushroom site after a torrential nocturnal rain (a frequent occurrence in the jungle) and found a fine crop of beautiful *Strophariας.* Although they also appeared to be *S. cubensis,* many had bright orange pigment at and near the center of the pileus (cap) which was otherwise ivory white with streaks or blotches of gray-brown discoloration. These were far more striking than the three species varieties of *S. cubensis* once designated,[25] while others fit the variety color descriptions, ranging from tawny to yellow to white. These color varieties, however, certainly do not seem to be valid taxonomic species varieties as many gradations commonly occur. A large portion of the cap of one specimen was purple, and all specimens gathered readily demonstrated context bluing.

We consumed mushrooms with a loaf of fresh bread and cheese we had brought along for the breakfast occasion. Soon after the mushrooms began to take effect, we went for an *au naturel* swim in a secluded lake. The setting was splendidly serene and tall exotic trees partially shaded us from the bright equatorial sun. By the time we made it back to Leticia, the intensity of intoxication induced by the fourteen tropical *hongos* I had eaten was so great that it became a major decision whether to sit in the sun or the shade. The phantasmagoria of color flashes superimposed on a panorama of solar diffraction produced by clouds blowing over the mighty Amazon was awesomely beautiful. After four and a half hours of a pleasant psychedelic experience, the tremendous exaltation passed as quickly as it had appeared, but my exhilarated mood lingered throughout the day. One mycophil had spent many years in Brazil and assured us that the use of these fungi was quite widespread there. We later met an Argentinean who had consumed similar mushrooms with milk, honey and bananas in a blender-made beverage in Iquitos, a jungle city in Peru. Thus it seems that people from many parts of South America are now enjoying these exquisitely natural delights.

The last part of the itinerary was a journey by auto from Bogota to the Archaeological Park at San Augustin, the heart of magic mushroom country according to some Colombians. Along the highway, south of Espinal and north of Neiva, the morning greeted us with a fertile field heavily bearing mushrooms of numerous species after a night of gentle rain. Among those encountered were large creamy-white "table-top" forms up to seven inches across and somewhat smaller rich yellow globular forms, both appearing to be the cyanescent *S. cubensis.* Also present were white bluing *Panaeolus,* some phenotypically identical to the thin stemmed *P. cyanescens* encountered in Hawaii in December 1972, and some with considerably thicker stems. Curiously, there were some non-bluing species resembling those of both genera. The *Panaeolus* were potent and superb as were the *Stropharia.*

Specimens were later taken to Laval University for definitive species identification. Examination of specimens, color slides, spore prints, and especially specimens obtained from spore culture enabled Ola'h[63] to determine without doubt that some of the fungi collected north of Neiva were *Stropharia cubensis* Earle. Other specimens have tentatively been identified as *Panaeolus cambodginiensis,* known only from Cambodia, but could even be a new species. The dark brown *Panaeolus* common in the Andes was determined by specimens from near Silvia to be the latent psilocybian species *sphinctrinus* (Fries) Quélet, which may account for lack of effect after a trial consumption by the author of twelve such specimens gathered in that area. *Stropharia* fruiting bodies from Silvia and the *tres*

fronteras region were not well enough preserved for positive species identification due to rather complete destruction by ants in quest of insect larvae while specimens from both locations were sun drying in the humid Amazon environment. Spore cultures from these samples unfortunately have not been as successful as from the Neiva samples.

Microscopic examination by the author of spores from *Stropharia* specimens obtained near Silvia and Leticia, however, strongly suggests that samples from both geographic locations were also *S. cubensis* rather than a phenotypically similar cyanescent *Stropharia* species.

FOCUS ON AUSTRALIA

While the powerful wave of psychedelic mushroom use was advancing through the Americas, activity began to brew in the South Pacific. As Australian botanists were investigating *Panaeolus ovatus* Cooke and Massee, once implicated as the cause of some hysteroid intoxications, they encountered a species particularly abundant in southern Queensland and later determined it to be the omnipresent *Stropharia cubensis.*[64] It seems that a visiting surfer may have recognized this species and in 1969 unseasonal heavy rains produced a bumper crop along the Gold Coast, resulting in an epidemic of voluntary cerebral mycetismus.[65] The mushrooms were so plentiful that transport businesses from southern Queensland were instituted to supply many major Australian cities. It seems that part of the mushroom surf cult utilized too much of a good thing and became entirely apathetic toward life. Although the epidemic waned, magic mushroom use became endemic throughout Australia and many insular land masses in its propinquity, resulting in a declaration by the Queensland Governor in Council on May 8, 1971, outlawing possession of *Stropharia cubensis per se* and thereby placing it under the same type of restrictions as *Cannabis sativa* Linnaeus and *Papaver somniferum* Linnaeus, the opium poppy.[29]

In 1971, Australia's Central Crime Intelligence Bureau became a center for forensic identification of hallucinogenic mushroom specimens. Samples from Tasmania, flourishing with psychoactive mushrooms, were identified as *Psilocybe collybioides,*[29] formerly known only from Argentina and presumably North Africa.[25] Although *psilocybe subaeruginosa* was known to be widely distributed in Southern Australia, *Panaeolus cyanescens* (the "Copelandia") has now been found in the Northern Territory.[29] In Hobart, Tasmania, mushrooms were dried, crushed, placed in gelatin capsules and retailed for $6 each. Furthermore, the "ready availability of this hallucinogenic material effectively reduced the illicit market for LSD to the point where few, if any LSD sales were taking place in Hobart early in 1972."[29]

PSYCHOPHARMACOLOGIC ADVANCES AND SOCIO-ECONOMIC CONSIDERATIONS

Interesting studies pertaining to the psychopharmacology of hallucinogens have been completed in recent years. States of consciousness have been mapped on a meditation-perception-hallucination continuum with yoga samadhi at the extreme of trophotropic arousal and mystical rapture or ecstasy resulting from ergotropic arousal at the opposite end of the spectrum.[66] While psilocybin seems to exert psychic effects through central sympathetic excitation (ergotropic arousal), delta-9-tetrahydrocannabinol seems to produce psychophysical manifestations predominantly by parasympathetic excitation (trophotropic arousal).[67] Fischer, who in conjunction with other medical investigators has administered thousands of doses of hallucinogens to volunteers, has found psilocybin to have properties making it especially efficacious for psychoanalysis and psychotherapy and predicts this indole will be legalized for such purposes in about ten years.[68a] As a matter of practicality, it generally takes at least ten years of diligent research to obtain sufficient data for the FDA to declare a drug safe enough for public utilization. Although no statistical studies have been undertaken to compare the frequency of adverse reactions to clinical doses of psilocybin, LSD or mescaline, a very noticeable decrease was observed when psilocybin was employed rather than mescaline or LSD.[68a,b] This may reasonably be attributed in part to psilocybin's shorter duration of action, which is usually 3-6 hours whether as a synthetic clinical dose or as a naturally occurring moderate recreational dose. The ergot alkaloid LSD may be more potent and longer acting than psilocybin partly because it is a 4-substituted indole (as is psilocybin) and a phenethylamine derivative (as is mescaline).

Not only may there be some significant differences between psilocybin's central nervous system pharmacology and that of LSD or mescaline,[68b,69] but it is even predicted that there will not be cross-tolerance between psilocybin and mescaline.[68b] Although cross-tolerance between LSD and psilocybin is well known,[70] the interaction between tolerance to psilocybin and mescaline actually has not been directly investigated. The "final common pathway" hypothesis, based on similarity in clinical manifestations, nevertheless would suggest probable cross-tolerance between mescaline and

psilocybin. Psilocin would appear to be the active metabolic form of psilocybin[71] and both compounds were found to be qualitatively and quantitatively very similar in humans.[33b,72] Thus, psilocin would be expected to be at least as safe a psychotherapeutic or recreational agent as psilocybin. Furthermore, it would indeed be more difficult to abuse these psychedelic agents than to abuse other types of psychotropic materials, since tolerance to the effects of these potentially useful psychotherapeutic hallucinogens may develop within a few days of repetitious use and physical dependence definitely does not occur.

There is no evidence to date that hallucinogenic mushrooms, pure psilocybin, mescaline, or even the more potent LSD, can cause psychoses. While such agents may induce psychotomimetic states, true hallucinations are rare. Pseudohallucinations, including eidetic imagery, are far more common.[73] Although such drugs may precipitate preexisting underlying psychoses, these psychodysleptic agents cannot validly be considered causative.[70]

Although infrequent, "bad trips" may occur with psilocybin mushrooms.[65] These are usually due to panic reactions as with other hallucinogens and are best treated by supportive psychotherapy (the "talk-down method").

At one time, if pharmacologic intervention for "bad trips" or psychotomimesis from psychedelic agents were deemed necessary, a phenothiazine derivative such as chlorpromazine (Thorazine®), a major tranquilizer, would have been considered the agent of choice. Chlorpromazine was even found to partially attenuate the effects of legitimate samples of the phenethylamine megahallucinogen STP,[74] which for convenience has usually been designated as 2,5-dimethoxy-4-methylamphetamine although such designation is not consistent with correct scientific nomenclature.[75] Clinical experience suggested that "adverse reactions to atropine and related compounds may be intensified by chlorpromazine."[74] Thus, when some cases of cardiovascular shock and death were attributed to the administration of chlorpromazine to patients who had just ingested street STP, it was concluded that "there may be an atropine-like molecule present in street STP."[76] Curiously, although both LSD and psilocybin mushrooms were known to produce some atropine-like effects, chlorpromazine was still regarded as the "drug of choice" for the treatment of adverse reactions to LSD, whereas it was contraindicated for the treatment of such reactions to psilocybin mushrooms by analogy to STP.[65]

The presence of an atropine-like molecule in street STP has now been discredited.[77] Mescaline, STP, LSD and psilocybin are all similar to dextro-amphetamine ([+]-alpha-methylphenethylamine) in that they each have some intrinsic sympathomimetic activity, i.e. they can produce clinical effects which may mimic those of an excited sympathetic nervous system. Belladonna alkaloids such as atropine, however, inhibit the parasympathetic nervous system. Although similar clinical manifestations, such as increased heart rate, pupilary dilation and dry mouth may result in either situation, the neuropharmacology is different. Furthermore, the toxic delirium produced by the central nervous system action of belladonna alkaloids is in striking contrast to the psychedelic experience produced by the central action of indole and phenethylamine hallucinogens. From such considerations, phenothiazines would not be expected to interact with indole or phenethylamine hallucinogens in exactly the same manner as with belladonna alkaloids. Nevertheless, chlorpromazine is no longer considered the drug of choice when pharmacologic intervention is deemed necessary in the treatment of adverse reactions to psychedelic drugs.[77] The drug of choice for psilocybin mushroom intoxications should be a minor tranquilizer such as diazepam (Valium®) or chlordiazepoxide (Librium®) since these sedative agents are safer, have more pleasant subjective effects and better allow "a search for synthesis and integration of the experience" which is "universal in any psychedelic intoxication."[77] In the rare event that after the acute episode a true psychosis is later determined to have been precipitated, phenothiazines would have their proper psychiatric indications for use. A pharmacologic agent useful for the management of belladonna hallucinosis seems to be the cholinesterase inhibitor physostigmine (Antilirium®).[78] This alkaloid is derived from the Calabar bean, which is the dried seed of a certain vine indigenous to western Africa.

Some of the problems attending enforcement of legislation declaring possession and sale of hallucinogenic mushrooms illicit have been discussed from a legal point of view by a law enforcement administrator,[29] but a consideration of such legislation from a medical, sociologic and economic view would be of far greater public value.

The major medical danger for adults who eat wild mushrooms is not the possible adverse reactions caused by hallucinogenic species of the psilocybian type but the accidental consumption of noxious types of agarics, such as some infamous deadly *Amanita* species.[79-83] There have been absolutely no reliable reports attributing psilocybian species as the cause of adult fatalities. Even lethal mycetism cases which occurred in Japan more

than four decades ago were erroneously referred by Singer and Smith[24] to the species designated *S. caerulescens* Imai. In fact, neither this nor any other hallucinogenic species were even suggested by Imai[84] to have been associated with those fatalities. Species associated with a high mortality rate, of course, are not illicit. Furthermore, there is no evidence that psilocybin mushroom gatherers have a greater frequency or incidence of serious accidental poisonings than do other groups of mushroom hunters.

When I wrote to the BNDD in 1973 to enquire whether any attempt had been made to identify the species of psilocybin mushroom samples from Florida mentioned in one of their studies,[56] I received a reply from the chief chemist that no information was available about specific instances of drug abuse but that a computer system had been developed which would hopefully be in operation by 1974 to keep records of each and every episode of drug abuse reported in the country. Although the undertaking may provide some interesting epidemiologic information, it will indeed be financially very costly to keep up with the ever increasing utilization of psychoactive substances and probably will have no major impact on the total use of these materials.

In many states there are harsh laws prohibiting the use of not only pure psilocybin and psilocin but also materials containing these compounds. Sometimes 2-10 years of imprisonment and/or fines up to $5,000 may be imposed on persons for possessing or selling such commodities. Drug abuse education programs of the past decade, sponsored primarily by the former National Institute of Mental Health (now the National Institute on Drug Abuse) unfortunately have been rather inadequate. The laws applicable to hallucinogenic mushroom use, for instance, were passed in ignorance or with misconceptions of psychopharmacologic and social factors pertaining to their use. Legislators have thereby promulgated the public delusion that such use constitutes a great ill of society. Multitudes of people, especially inquisitive open-minded young people, have learned first hand that these naturally occurring psychotropic plants are not as deleterious as legislation would suggest and happen, in fact, to be generally quite an enjoyable adjunct not only to spiritual enhancement but also to twentieth century recreation.

There is no evidence to suggest that the incidence of criminal acts committed against individuals or property by persons while under the influence of agents such as psilocybin even begins to approach those committed while under the influence of other agents such as ethyl alcohol, and the public certainly is not denied use of the latter. The occasional episodes of criminal or other deviant behavior which are reported to occur while under the influence of hallucinogenic substances tend to be interesting items for news media, and as such, the association has been inordinately amplified. When psychedelic drug use ceases to be utilized as a criminal scapegoat and is recognized for the natural worldwide transcultural phenomenon it is, public servants such as law enforcement personnel will be able to devote more time to the pursuit of real and urgent social problems such as the rising serious crime rate.

Bearing in mind that people from all walks of life recreationally employ psychedelic mushrooms and/or related materials, the economic and moral cost is quite substantial when people who would otherwise productively contribute to society are branded felons and placed in penal institutions. There are, of course, some users of hallucinogenic fungi who prefer to lead idle lives. The "hippies" in San Augustin, Colombia, for instance, sometimes in the remoteness of the beautiful environment do not bother to renew their passports and thus eventually get deported. But even in this peaceful little town these people are not considered a menace. Furthermore, there is no indication that prolonged use of such natural psychedelic agents could lead to medical symptomatology that would require taxpayers to contribute anywhere near as much as is necessary for the medical care of patients with opiate or especially alcoholic related diseases.

CONCLUDING REMARKS

The employment of psilocybian fungi, at one time completely restricted to Mexico for magico-religious purposes, has mushroomed in the twentieth century to become a worldwide transcultural phenomenon. In Mexico, native tribes still employ the sacred mushrooms in divinatory shamanistic rites.[5,85,86] Although modern industrial societies strongly tend not to foster a utopian environment favorable to constructive utilization of hallucinogenic mushrooms (as idealistically envisioned by Huxley[87]) these magic plants, nevertheless, continue to be employed for worthwhile purposes. Civilized people seem to employ the mushrooms principally as recreational euphoriants or for spiritual enhancement.

Vast medical attention traditionally has been directed to the ever-present problems of morbidity and mortality, but recently the medical panorama has been widening. A trend has been developing, especially in the United States, which emphasizes improving the general quality of life from infancy to old age. From considerations in the realm of medical hedonics, the psychopharmacology of psilocybin seems to be so

particularly efficacious that for certain age groups it promises to be invaluable in the future. In the meantime, many people who have discovered that they can indeed enrich the quality of life through the employment of hallucinogens, not surprisingly regard natural psilocybin mushrooms to be the finest. Even in Colombia, which has a reputation for being a veritable cornucopia of psychoactive substances, people who have sampled numerous exotic native preparations seem to prefer the much more palatable mushrooms.

Many mushroom species which are either utilized or capable of being utilized for their psychedelic effects have become botanically known, but discoveries of new species no doubt will continue to be made. Furthermore, reported citings of known species from new geographic locations are starting to occur quite frequently now. For instance, although positive identification is still pending, it appears that *Psilocybe caerulescens* is being found as far north as Washington[88] and that delicate Liberty Cap mushrooms employed from British Columbia to southern Oregon may be conspecific with *Psilocybe semilanceata.*[89] Probably the most important of the psilocybian species is the ubiquitous, often grandiose *Stropharia cubensis.* This prevalent species is definitely known from Cuba, Florida, Mexico (where one native name for it is San Ysidro Labrador), Puerto Rico, Trinidad, British Honduras, Bolivia, Argentina, North Vietnam, Cambodia, Thailand, Australia and now Texas and Colombia. *S. cubensis* is quite common between ca. 30° latitude above and below the equator, and its range might conceivably extend further north and south to ca. 45° latitude. The limits of distribution of this species would therefore certainly merit detailed study. It may also be noted that while *S. cubensis* does not yet seem to have been documented from Africa, typical cases of psilocybian mycetismus resulted in Kenya after consumption of fungi which had in some cases been purchased from native children.[90,91] The mushrooms responsible were identified as a yellow *Stropharia* common in the Kenya highlands. On a probability basis, the most likely species would be *S. cubensis.*

The restrictive legislation pertaining to hallucinogenic mushroom use, generally having been passed in ignorance or with misconceptions of psychopharmacologic and social factors pertaining to the use of these fungi, is in dire need of drastic revision. The sale of psychoactive mushrooms should be under reasonable controls as should any substance meant for human consumption so as to protect the consumer. One would need only to become acquainted with the wealth of ethnobotanical knowledge pertaining to natural hallucinogens to readily perceive that legislation prohibiting possession and use of these naturally occurring materials must be in fundamental violation of certain extremely basic aspects of human behavior, not to mention cherished human rights. Such legislation simply cannot be expected to prevent the multitudes of people who enjoy natural hallucinogens from continuing to do so in the future. Furthermore, with the unreliability of ever-present street markets, protection for consumers who prefer to buy genuine psilocybin mushrooms should be instituted by allowing legitimate, i.e. licensed, sources of supply to become available. Such consumer protection would be expected to diminish the present street demand for less preferable psychedelics as well.

Finally, a due word of warning is in order to indiscriminate mycophagists. Many psychedelic mushroom hunters are of the opinion that any mushroom which blues or seems to be associated with grazing is psilocybian. This simply is not the case. Certain species of *Boletus,* for example, demonstrate a bluing phenomenon but may be poisonous and certain undesirable species of *Russula* may appear to blue while in the process of turning black after damage. Furthermore, some noxious nonbluing phenotypes of psilocybian species may occasionally be found in the same habitats. The bluing *Psilocybe candidipes,* a species reported only from Mexico and associated with fallen leaves of *Coffea* and its shade trees, is said to be poisonous by some natives who enthusiastically employ other species ritualistically, but no studies have been done to confirm or discredit the claim. Old mushroom specimens of any species, aside from invariably being "wormy," may cause gastronintestinal disturbances resulting from the metabolic products of microorganisms associated with decomposition and thus should be avoided. Also, for hygienic reasons, psilocybian mushrooms should be cooked in a suitable culinary fashion prior to consumption. There is no doubt that for some mycophagists, however, fresh psilocybin mushrooms can be quite a treat to the senses.

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