Mycological investigations on Teonanacatl, the mexican hallucinogenic mushroom

by

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Part I & II

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Part I.
The history of Teonanacatl, field work and culture work

1. History

The use of hallucinogenic mushrooms in Mexico was reported by European and Mexican writers (11) centuries ago, and so is not news. Nor are mushrooms unique as hallucinogens. It is widely known that peyotl, Lophophora williamsii (Lem.) Coulter, a cactaceous plant likewise native to Mexico, contains a hallucinatory substance, mescaline. What is new in recent developments is the serious attempt to study the organisms responsible for these curious phenomena, an endeavor logically beginning at the biological level - i.e., with a study of the mycological aspect of the rather complex problem. With this goes an attempt to obtain more details on the ethnobotanical role of the hallucinogenic mushrooms in southern and central Mexico. A consequence, and, to a certain degree, also a motive, of all this renewed interest in the subject is the extraction in pure form of a substance or substances important in medical research, or at least data on the active principle in these fungi which might throw light on phenomena of practical concern, such as the symptoms commonly referred to as schizophrenic, or the question of the maturity factor in neuroses.

Before the first specimens had come to the botanical laboratories, there had been some doubt whether the teonanácatl of the literature, a word supposedly meaning "sacred mushroom" in the Aztec language, was actually a mushroom rather than Lophophora. The word teonanácatl is here used in the sense of Schultes (13), Heim, and in fact the majority of the authors concerned with hallucinogenic mushrooms in Mexico (3, 10, 11, 12, 18, 19) - i.e., as a general term for any hallucinogenic mushrooms used by Mexican Indians in pre-Columbian times and up to the present. While botanical interpretations of the word teonanácatl were originally based on Schultes's (13) paper, and referred to one single species of Panaeolus, we shall see subsequently that teonanácatl is not necessarily a single species, and that it is not - according to our present knowledge - probable that Panaeolus spp. are represented in the list of hallucinogenic mushrooms in Mexico.

Actually, the first correct interpretation of teonanácatl was published by this writer in 1951 (16, pp. 472, 506). This fact has not been mentioned in the current literature, although the genus Psilocybe as well as the species Psilocybe cubensis was mentioned by me in the place quoted. These indications were based on material collected by Dr. R. E. Schultes of Harvard University.

Schultes undoubtedly deposited the first botanically useful specimens of hallucinogenic mushrooms from Mexico in an American herbarium. These consisted of two collections, originally placed on one sheet in the Farlow Herbarium, but later separated by the present author (1941). One package containing Panaeolus was determined by D. H. Linder, then Curator of the Farlow Herbarium, as Panaeolus campanulatus var. sphinctrinus. If we disregard questions of nomenclature (the rules of botanical nomenclature necessitate a change in the name used by Linder, to read "Panaeolus sphinctrinus (Fr.) Quel.",) we may say that Linder's determination is correct. Heim (3) came to the same conclusion. But even though the determination is correct for these specimens, it is obvious from certain data on the label of the collection that there must have been some confusion of the Panaeolus with what later became known as Psilocybe mexicana, while on the other hand further inquiries show that Panaeolus is not one of the genera used by Mazatec Indians of the Huautla region for either religious or medical purposes.

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1. Published out of order as excess pagination through financial assistance of the National Science Foundation and the University of Michigan Herbarium.
2. The label reads in part: “Springy meadows in rainy season. Huautla de Jiménez, Oaxaca, Mexico, July 27, 1938. Stem 1-2 mm diam., 10 cm high; hemispherical but often cuspidate; gills dark brown-black, whole plant coffee brown, black when dry. Mexican name nanacate. Indian name: she to (eruption of the earth); tso-ska (loco mushroom). Said to be poisonous in overdose of 50-60, but in moderate quantity it produces hilarity and general narcotic feeling of wellbeing for an hour. Excess doses said to produce permanent insanity. ...” It is now evident that “springy meadows” are the characteristic habitat of Psilocybe mexicana, and it is this species that is “cuspidate,” never Panaeolus sphinctrinus; dark brown lamellae would be characteristic for the former, black ones for the latter. The name she to is a misspelling of xi-tjo, which is the general word for mushrooms and fails to identify the genus.
The other package, originally inserted with the first, remained unnamed in the Farlow Herbarium until this author in 1941 determined it as *Psilocybe cubensis* (Earle) Sing. (at that time still as "*Stropharia caerulescens* (Pat.) Sing. = *Stropharia cubensis* Earle"). Strangely enough, this second collection by Schultes contains a note in which the local name of the species is indicated as *kee-sho*, which in Huautla does not refer to the species represented by the dried carpophores in the package, but to *Psilocybe caerulescens* Murr., as we shall see later. The specimens and data come from the not very accessible Mazatec village Huautla, the same village where the *Panaeolus sphinctrinus* had been collected, and where, later on, by Wasson, Heim, and Singer, *Psilocybe caerulescens* was likewise found (Fig. 1). If we assume that *Psilocybe mexicana* was originally confused with *Panaeolus sphinctrinus*, and *Psilocybe caerulescens* with *Psilocybe cubensis*, by Schultes's source of information, we already have all three important hallucinogenic mushrooms of the Mazatecs, or rather traces of them, in the first two records. These psilocybes will later be treated in more detail.

![Fig. 1. Map of central and part of southern Mexico, between the 18th and 22nd parallels, showing Amecameca, Tenango, and Huautla in their respective states. 1:7,500,000.](image)

This was the status of the mycological knowledge of *teonanácatl* when in 1952 Dr. Sam I. Stein became interested in the psychiatric implications of certain reports on the action of such dark-spored agarics as *Psilocybe* and *Panaeolus* (1, 2, 6, 9, 10, 11, 12, 13, 16). He then began to prepare the organization of a research program on fungus toxicology as related to neuropsychiatric problems. One of the first steps planned was the collection of dried material and cultures of the respective species, and of botanical observations made on the spot. These were not only to help in solving the basic problem from a biological point of view, but to produce sufficient knowledge to grow fruiting bodies of these species in the United States, or to grow mycelium in sufficient quantities to satisfy the demands of further investigations. The origin of these cultures

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3. The label of this specimen reads: "Plantae Utiles Mexicanae. Oaxaca. Botanical Museum, Harvard University. Common name (Mexican) nanacate. Tribe: Mazatec. Indian name kee-sho. Habitat in freshets during rainy season. Locality Huautla de Jiménez, Oaxaca. Uses: From four to eight are eaten to produce a temporary narcotic state of hilarity. Said to be poisonous if taken in excess, causing permanent insanity. [Next follow descriptive data, illustrated by a drawing on the reverse side.] Coll. no. 349. Coll. Richard Evans Schultes, 27 July, 1938." Below Schultes's name that of Bias Pablo Reko is added (as co-collector). On a separate label, there is an annotation by Singer: "*Stropharia caerulescens* = *Psilocybe cubensis* (Earle) Sing.," and the Farlow label was made out correspondingly, although here the second and valid name was omitted. Thence resulted a later erroneous reinsertion in *Stropharia* when the herbarium material was shifted between 1949 and 1951, under W. L. White, curator.
had to be carpophores from the now classical village of Huautla de Jiménez, since obviously only a mushroom population known by previous tests and observations to be hallucinogenic should become the starting point of the production of carpophores destined to be the raw material for further experiments - particularly bio-assays and biochemical analyses - in the investigation on hallucinogens. This localization does not exclude further search for different species used in some remote valley of Mexico or Guatemala, or elsewhere.

The first author to publish data on chemical analysis and animal tests was Santesson (12), who unfortunately was handicapped by lack of thorough botanical study of the material he used, and by the application of inadequate chemical and experimental procedures. He had two samples, one "probably belonging to a Panaeolus", and the other supposed to be Armillariella mellea (although that was neither clear from the text nor at all probable). It is more likely that the material consisted of Psilocybe mexicana and Psilocybe cubensis, but it may conceivably have been a mixture of numerous elements. It was referred to as teonanácatl. Chemical reactions supposedly showed that no alkaloid was involved. According to the Fehling reaction, Santesson's material seemed to contain a glucoside as the active principle. Subcutaneous injections of 2.12 g and 1.57 g of the drug per kilogram body weight of Rana temporaria resulted in a "semi-narcosis" of the frogs, with a negative "turning test" (the classical inhibition effect of morphine on the rotation reflex of frogs).

At the time I reached Mexico - i.e., one year after Heim had accompanied the Wassons there - the former had already published three short communications (3, 4, 5) on specimens of Mexican species believed to be used in Indian ceremonies, and a preliminary article on his own observations. The name Psilocybe mexicana was then proposed for the first time, although not validly published before the second half of 1957. For what we consider to be Psilocybe caerulescens Murr., Heim proposed a new name, Psilocybe mazatecorum, and having traveled to regions further south and northwestern, he added a number of new entries on the list of species which collectively may be termed teonanácatl. Among them was Psilocybe zapotecorum Heim, from the Sierra Costera, and Psilocybe aztecorum Heim, from Popocatépetl. Fair to excellent illustrations of these species were provided by Heim for the Wassons' article (19) and in their book (20). In both of these latter publications as well as in other articles, ceremonies conducted by local curanderos (and a curandera) and experiences under the influence of hallucinogenic mushrooms were described by the Wassons and Roger Heim. No results of chemical analyses or animal tests have been published as this is written. Nevertheless, the attention given the mushrooms in the press has created - far beyond Mexico - an extraordinary interest and expectancy. Whether this attitude is justified by the research now in progress remains to be seen.

2. Field and culture work in 1957

My journey from Mexico City to the Mazatec country was undertaken in the company of two young Mexican botanists, M. A. Palacios, who worked as my assistant, and G. Guzmán H., an ardent student of agarics. There could not have been better traveling companions, or ones who better served the purpose of the trip.

We reached Huautla the first week of July and were there the guests of an Indian family. The head of the family, Isauro Nava García, an exceptionally intelligent and cooperative man who could express himself well in Spanish, and equally well spell the words of his native Mazateco, turned out to be a keen observer of fungi. He recognized easily and almost infallibly the different species of Psilocybe, knew where they could be found and when, and pointed out the interesting features of their respective habitats. He was of course completely familiar with the mushroom lore of his valley and had eaten hallucinogenic mushrooms before. Either he or his brother-in-law accompanied us in many of our collecting trips. Everything he said was checked by comparison with information obtained elsewhere. All the data obtained from him were corroborated with the exception of an opinion about the activity of a mushroom called "néhe-je néhe-je" (now known as Psilocybe candidipes), which was variously called inactive and poisonous. This, by the way, is the only species of the taxonomic group to which the hallucinogenic psilocybes belong that was not likewise reported by Wasson and Heim from the Mazatec region. On the other hand, the species said to be hallucinogenic and not belonging in the same taxonomic group as Psilocybe cubensis, mexicana, and caerulescens were not confirmed as hallucinogens by

4. After having been advised by Dr. Alexander H. Smith of the probable identity of this fungus with Murrill’s type of Psilocybe caerulescens, Heim changed the name to Psilocybe caerulescens var. mazatecorum Heim, because, as he explains, of the high variability of these fungi.
our own inquiries and observations. These unconfirmed data (3, 4, 16) refer to Conocybe siligineoides Heim, two species of Panaeolus (Panaeolus sphinctrinus and Panaeolus fimicola sensu Heim), and those psilocybes not reported to show any blue discoloration or stain (i.e., Psilocybe cordispora and Psilocybe macrocystis). I may add that there are a Psathyrella and copelandias from Santa Cruz which Guzmán, who collected them there, is inclined to think may be hallucinogenic. When we met Mr. Wasson in San Andrés near Huautla, he suggested that among these species the chances of finding real hallucinogens are rather good in Conocybe. So they are also in Panaeolus and related genera, since species of these have been shown to be poisonous or inebriating, and to be active in animal tests - e.g., Panaeolus venenosus Murr. (9), which is apparently a synonym of Panaeolus subbalteatus, and species of the same genus or related genera determined in the past as Panaeolus papilionaceus and Panaeolus "campanulatus". Unfortunately, some of these determinations (1, 2, 6) may not be accurate and may just as well refer to other related genera (Anellaria, Copelandia), or at least to other species. We must insist, however, that the phenomena which belong in the class of "cerebral mycetisms" in the terminology of Ford (2) are not fully identical - although comparable - with the hallucinatory-euphoric and lasting effect described for the psilocybes. Aside from that we feel certain that Panaeolus sphinctrinus is not used as a drug by present-day Indians in Mexico.

As for Conocybe siligineoides - which would be the only forest-inhabiting, or even xylophilous, species among those indicated by any author, it will be well to take into consideration a statement made to us by Isauro Nava. He said that there was, growing at a certain distant locality and not fruiting at the time of our visit, another hallucinogenic mushroom, as small as "pajaritos" (Psilocybe mexicana) and of the same shape and also staining blue, but differing in its habitat - wood in the forest rather than soil of meadows. Just such a species (Psilocybe yungensis) had been collected by me a year earlier in the ecologically very similar Bolivian Yungas, also a tropical-montane forest, and a similar but different one (Psilocybe pelliculosa) by Alexander H. Smith in the Pacific Coast area of the United States in coniferous forests of a temperate type. It is therefore quite possible that the missing forest-inhabiting hallucinogenic mushroom is not the species described by Heim as a Conocybe, but another representative of the section in which all the other hallucinogenic psilocybes belong.

How can such errors - if indeed errors they are - be explained? The growing demand for hallucinogenic mushrooms in the Huautla area has brought everybody, children and adults, many certainly much less expert than Isauro Nava, into the mushroom business. The younger generation of Indians tends to ridicule the use of mushrooms in ceremonies and is inadequately familiar with the characters of the mushrooms. Nevertheless, all these collect to fill the sudden demand at relatively high prices, and so inactive mushrooms are often mixed with active ones either by mistake or as conscious adulteration. I have witnessed the impurity and possible falsification of the product sold in Oaxaca, not easily discovered by anyone but a mycologist, especially if the material has been dried crudely for use between seasons. If substitution is discovered, the natural reaction of the seller is to claim that these different mushrooms are also used as hallucinogens.

As a result of the foregoing discussion, we may consider as established hallucinogens the following species of the Huautla region: (1) Psilocybe cubensis (Earle) Sing., (2) Psilocybe caerulescens Murr., and (3) Psilocybe mexicana Heim, and may add tentatively (4) Psilocybe candidipes Sing. & Smith (17).

By the end of July a further trip was organized by the National Autonomous University of Mexico, Institute of Biology, which took us by automobile to the region of Tenango del Valle (Fig. 1) southwest of Mexico City. A species of agaric is prescribed there by a "curandera" of a small village above Tenango and at times sold in the market at Tenango; it is currently collected by many local inhabitants of the region for storage, to have ready in case of illness, especially stomach troubles. The specimens come from a place called Piedras Blancas on the slopes of Cerro de Toluca. From our investigation on good specimens obtained at Piedras Blancas, and from observations on pure cultures made from them, we believe that they are an independent species, and not a variety of any known species, as suggested by Heim (4). We add therefore (5) Psilocybe muliercula Sing. & Smith (17), "mujercitas."

A similar trip, a week earlier, was made to San Pedro de Nexapa near Amecameca (Fig. 1) in the Distrito Federal and at the borderline with Puebla. This trip in search of the species previously described (from purchased specimens) by Heim as Psilocybe aztecorum yielded no specimens, and we had to rely for the moment on material which did not produce cultures. The information about the use of the mushroom was, however, obtained from the informant in Nexapa interviewed by Heim, and the exact habitat of Heim's Psilocybe aztecorum was carefully studied. Since the fruiting bodies appear only later in the year, G. Guzmán
followed this exploratory trip with a second one in September, from which good specimens were collected at their natural habitat, and cultures were taken from the lamellae of these. The use made of *Psilocybe aztecorum* seems to be exactly the same as that made of *Psilocybe mulierrula*. Consequently we list (6) *Psilocybe aztecorum* Heim.

All six species enumerated have a number of important characters in common - first of all the diagnostic characters of the genus as defined by Singer (16). They are devoid of chrysocystidia, do not show a glutinous or viscid veil on the stipe, and have the stipe centrally attached. The spore print is fuscos sepia or dark purple brown (often more deep lilac when quite fresh), as is usual in the entire subfamily Stropharioideae of which *Psilocybeis* a genus. The spores are smooth and have a germ pore. Some species have rather strongly longitudinally compressed spores, although with few exceptions the compression is not strong enough to be the same as that observed in the true deconicas, and the spore size is variable from species to species (4-17 µ long). The upper layer of the pileus is a cutis, with a more or less individualized epicutis which often takes the appearance of a pellicle. A veil is present in all these species but the extent of development of the veil in adult specimens varies according to, and to a certain degree even within, the species. Some species have a persistent although never furrowed ("lamellar") thin repand annular veil. *Psilocybe candidipes* has an abundant veil development, but the annulus is narrow and not persistent. *Psilocybe caerulescens*, *Psilocybe aztecorum*, and some other species still have a well developed veil, but it is obliterated in age and never forms an annulus. In *Psilocybe mexicana*, on the other hand, is reached the extreme situation in this group, where the veil consists merely of a number of fine silky hyaline fibrils connecting the apex of the stipe with the margin of the pileus when the carpophore is young, collapsing on the stipe to form appressed scattered silky fibrils which disappear completely in age.

Aside from the generic characters indicated above, all the species that enter our list of Mexican hallucinogens have a very interesting and striking chemical character, one that is very constant in young and fresh material, but becomes lost in old and dried material, especially where the climatic conditions provide relatively high temperature. When the fruiting bodies are scratched or handled, or dried out, they stain blue or (in superposition on a yellowish pigment) green. This is apparently an enzymatic oxidation or autoxidation which may be comparable with that of *Russula sect. Nigricantinae* (where tyrosinase is the enzyme active in producing through the oxidation of tyrosine a melanin-like blue or pink and eventually blackening substance), or of the bluing boletes like *Boletus luridus* (with boletol, the pigment resulting being blue). The reaction is certainly identical with that observed in related genera of *Agaricales* like *Copelandia* and in certain species of *Pholiotina*. Some reagents such as guaiac solution accelerate this reaction in the few cases where I could make the test, but the action of guaiac is said to be nil by other authors in other cases. However, a chemical character which accompanies the bluing phenomenon is that of metol, which gives a constant strongly positive reaction with the context of the stipe in the bluing psilocybes, becoming deep purple after a few minutes (Singer 15, 16). Furthermore, it appears that the odor and taste of the whole group are sometimes distinctive: the odor of fresh carpophores is that of fresh flour or cucumber, or more rarely absent, or raphanaceous; while the taste is either hardly distinctive or more or less astringent or unpleasant. Heim (5) also indicates, among the characteristics of the hallucinogenic group, the fact that the spores show a light ochre pigmentation. It should not be denied that a very large number of *Strophariaceae* - Stropharioideae may show a light ochre color when seen under moderate magnifications in strong light or when not fully mature. However, my findings, corroborated by other observers, do not support the generalization that this particular light ochre color is characteristic for the Mexican hallucinogenic psilocybes or for the section of *Psilocybe* in which they belong.

Ecologically, however, all these species (even though not all the species which taxonomically belong with them) are adapted to conditions brought about by either cattle raising or agriculture, or else by natural but violent and profound disturbances of the equilibrium of the soil flora. Although not one of the species is carboniculous or ruderal, the specific ecology of the Mexican species has apparently much in common with the ecology of anthracophilous and ruderal agarics.

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5. Dr. A. H. Smith thinks that species with strongly lentiform rhombic spores of small size should not be generically separated from *Psilocybe*. It is possible, and even probable, that the study of a large number of species not yet analyzed will corroborate this opinion when the genus is finally monographed.
With the characteristics indicated above, the hallucinogenic mushrooms indicated vary quite naturally a taxonomic subdivision proposed by this author in 1948 (15) as the section Caerulescentes Sing., with Psilocybe cubensis as the type species. This section consisted even then of one annulate and several exannulate species. The fact that both annulate and non-annulate species enter the section now, having in common, in addition to their anatomical and chemical characters, the physiological activity referred to as "hallucinatory" (in reality a complex action) or as provoking cerebral mycetism, tends to show that the section Caerulescentes is a natural one, whatever weight conservative authors may still give the veil characters in other groups of agarics. The fact that Psilocybe cubensis is among the hallucinogenic mushrooms will thus serve as an additional argument in favor of its transfer from Stropharia to Psilocybe (Singer, 15) where its real affinities are. Why, in view of the considerable evidence in favor of its transfer, Heim (3) retains the species in Stropharia, with the cryptic remark "ils [i.e., Psilocybe cubensis and synonyms or related species] resistent cependant apparentés avec Stropharia squamosa Fr. ex Pers." is not recorded.

The type of vegetation in which hallucinogenic psilocybes occur is not uniform. The vegetation found in the Huautla region (and apparently in other areas where hallucinogenic mushrooms were observed in Oaxaca) is markedly different from that in Mexico and Puebla, further north and higher up. The Oaxaca localities, or, more properly, the Huautla region, can be characterized as transitional between tropical montane and temperate montane, the tropical montane zone being immediately adjacent in the ravines below 1500 m and the temperate montane zone in the alder forests above 2000 m altitude. The tropical montane region adjoins farther down and farther east the more truly tropical rain forests, as seen in the lower-level forests of Santa Cruz - near Jalapa, for example, where Murrill collected - and the transition zone characteristic of the localities where hallucinogenic psilocybes abound may well be likened to the South American fog- or cloud-forest. It differs, however, in at least one important point: the Mexican forests are rich in trees belonging to the order Fagales, especially in evergreen oaks, which determine the myc flora and make the presence of abundant ectotrophic mycorrhiza possible. In many places in this transitional zone or modified cloud forest limestone crops out, and a high percentage of calcium may be expected in soil samples, especially from our Psilocybe mexicana habitats. The rainy season extends over the entire summer, and the rains are extraordinarily abundant and almost continuous for weeks in certain times of the year.

The often torrential rainfall, in combination with the quality of the soil and the steepness of the mountain sides, creates a situation quite comparable to that in the upper Yungas in South America. Here as there frequent earth and stone avalanches cover the vegetation and bring the subsoil and deeper layers to the surface. This process is particularly accelerated by the methods of agriculture and will be speeded further by roadbuilding.

6. This is a species so different from both typical Strophariae like Stropharia aeruginosa and typical psilocybes like Psilocybe semilanceata (because of the combination of characters of the cystidia and the hypodermal and hymenophoral tramastructure) that it has been pointed out by Kühner (7) as anatomically closer to Hypholoma. For that reason it was transferred by Singer (16) to the genus Naematoloma (= Hypholoma sensu Kühner). Stropharia squamosa, or better Naematoloma squamosum, differs sharply from both typical stropharias and typical psilocybes in habitat requirements also, being, like so many naematolomas, a wood-inhabiting species; this ecological character of course also occurs in other genera, and in itself cannot be considered to be decisive.

7. The climate of this transitional-vegetation area where all our Huautla material came from varies between limits such as those quoted for the two extreme localities Huauchinango (Puebla) and Jalapa (Veracruz), the one being more similar to the upper limit of the Huautla zone, the other being at the lower level of the tropical montane zone. In these two comparable localities temperature records (°F) are:

<table>
<thead>
<tr>
<th>Locality</th>
<th>Lowest minimum</th>
<th>Highest maximum</th>
<th>Ave. coldest month</th>
<th>Ave. hottest month</th>
<th>Ann. ave.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Huauchinango</td>
<td>25</td>
<td>104</td>
<td>50</td>
<td>66</td>
<td>60</td>
</tr>
<tr>
<td>Jalapa</td>
<td>36</td>
<td>99</td>
<td>58</td>
<td>68</td>
<td>64</td>
</tr>
</tbody>
</table>

The observed precipitation (inches) as rain:

<table>
<thead>
<tr>
<th>Locality</th>
<th>Ave. ann. precip.</th>
<th>Ave. driest month</th>
<th>Ave. wettest month</th>
</tr>
</thead>
<tbody>
<tr>
<td>Huauchinango</td>
<td>87.4</td>
<td>1.9 (Febr.)</td>
<td>15.6 (Sept.)</td>
</tr>
<tr>
<td>Jalapa</td>
<td>62</td>
<td>1.8 (Dec.)</td>
<td>11.6 (June)</td>
</tr>
</tbody>
</table>

The data are based on Vivó and Gomez, Climatologia de México, Inst. Panamer. Geol. e Historia publ. 19, México, 1946, quoted from Miranda & Sharp (8).
The natural forest, interspersed with small pastures, fields (mostly sugar cane, some corn), and now an increasing number of coffee plantations, is partly preserved, and contains, aside from tropical and endemic elements and the species of Quercus already mentioned, some elements in common with the subtropical and temperate forests of the southeastern United States from North Carolina to Florida. Such elements among the trees are Liquidambar styraciflua, among the fungi Hygrophoropsis tapinia Sing., and among the species referable to teonanácatl, *Psilocybe caerulescens* Murr. At the same time one observes numerous species of *Marasmius* which prove the tropical relations of this region. All together, the mycoflora of this transition region is just as heterogeneous as the tree flora. As one ascends, entering the *Alnus* stands at about 2000 m, just above the transition zone, one might expect to encounter a fungous flora with even more distinctly northern links. This is not the case. The mycorrhizal partner of the alder is the same as that found at the south tip of the alder area in South America, a bolete, *Gyrodon monticola* Sing., absent from the United States and Canada.

The hallucinogenic psilocybes fruit during early (spring) rains and until fall. *Psilocybe cubensis* seems to be one of the earliest-fruiting species; I have observed fruiting in spring in Florida. But it continues producing fruiting bodies during the entire season. The habitats of all the species in the Huautla region are characteristic. *Psilocybe cubensis* is dung-inhabiting. It occurs on pastures where cattle have grazed, or among sugar cane residues, but usually where the substratum has at least been mixed with cow dung. Sugar cane mulch, but without dung, is also a habitat of *Psilocybe caerulescens*, but it grows just as often on other plant material or around living culms of *Saccharum* on the earth of the fields. The same situation can sometimes be observed of *Psilocybe mexicana*. However, *Psilocybe caerulescens* grows mainly in shaded places in plantations or shaded fields, while *Psilocybe mexicana* prefers sunny open fields and pastures. *Psilocybe caerulescens*, according to the statements of the Mazatec Indians whom we consulted, regularly inhabits the surface of old landslides, two or more years after the landslide has occurred. We found this observation correct as far as the Huautla stations are concerned, and the description of the type locality in Alabama coincides in type of soil with that seen by us. On the other hand, the open pasture land on which *Psilocybe mexicana* is found is probably mostly man-made, or at least is maintained in its present condition by the grazing of animals. *Psilocybe candidipes* grows characteristically on the cleared surface of the earth among tree leaves fallen to the ground under *Coffea* and its shade trees (especially *Inga*). According to our Indian informants, especially Isauro Nava and his neighbors and relatives, and our own observations in this region, *Psilocybe candidipes* always occurs near the habitats of *Psilocybe caerulescens* and when found serves as an indication that *Psilocybe caerulescens* is not far.

The Mazateco name for *Psilocybe mexicana* is according to Isauro Nava a word he wrote for us and that sounded like the Spanish pronunciation of *di-nizé*, and which means a bird (diminutive), supposedly, always according to Isauro, because it makes you sing happily like a bird. For *Psilocybe caerulescens* the indigenous name noted is *di-ki-sho* (or what sounded like this); it was explained that *di* stands again for the diminutive and *ki-sho* means landslide, this name being related to the habitat of the fungus. For *Psilocybe cubensis* we were given two native names, one being San Isidro, which is self-pronouncing, and the other what sounds like and was transcribed as *di-shi-tjo-le-ra-ja*, which means steer mushroom in a diminutive form. It is quite 

8. Mr. George M. Cowan, a student of the Mazateco language, was kind enough to offer the following comments: “We use what we choose to call a practical orthography in all published materials used by Mazatecs now. This is simply a phonetic alphabet adapted as far as possible to the Standard Spanish alphabet. Tone is significant in Mazateco; the numbers 1 2 3 4 represent relative pitch of the syllables; 1 represents the highest, 4 the lowest level. [The symbol !] cannot be transcribed in English orthography and is not heard by the untrained ear; it is sort of a glottal catch preceding the following sound.” The correct phonetic spelling of *di-nizé* is, according to Mr. Cowan, ‘*nti-*ni-li-se’; it is pronounced ndee nee’say; *nti* = ndee means an affectionately regarded object (referring to the mushroom) and ni-se, bird.

9. Mr. Cowan’s comments indicate that here as in the case of *Psilocybe mexicana* Isauro’s names are current abbreviated words, omitting between the *nti* and the *ki-sho*, the general term for mushrooms, *xí-tjo* (“which comes out,” presumably of the earth), so that the full name of *Psilocybe mexicana* would be *nti-* *xí-tjo-* *ni-li-se*, and for *Psilocybe caerulescens*: *nti-* *xí-tjo-* *qui-xo*, pronounced ndee-*shre-* *t(h)oe-* *kee-* *shro*, meaning dear little thing that comes out of the earth of a landslide. The *x* is a sound as if English sh and r were pronounced at the same time; j and qu are pronounced as in Spanish, *i.e.* as a more aspirated h and a k respectively. “Tsamí kishu” given by J. B. Johnson (quoted from Schultes, 13) evidently refers to this same species.

10. G. M. Cowan spells this ‘*nti-* *xí-tjo-* *le-* *nché-* *ja*’, pronounced ndee-*shre-* *t(h)oe-* *lay-* *njra-* *ha* (meaning as above: the dear little thing that comes out pertaining to the steer or ox). The pronunciation of *ch* is described as a sound similar to English j (in judge) and r (in run) if pronounced simultaneously.
obvious that San Isidro stands for an earlier heathen god who was supposed to speak through the mushroom. It is also obvious that the relation of the fungus with the steer is again that of habitat, since in the Huautla region the species grows mostly on cattle dung. *Psilocybe candidipes* is referred to as 'nchè-jè 'nchè-jè (Isauro’s spelling).\(^{11}\)

The two montane-temperate to subalpine-frigid habitats in the *pinares* (pine woods region) of the mountains nearer Mexico City mentioned above as harboring two hallucinogenic psilocybes (*Psilocybe aztecorum* and *Psilocybe muliercula*) differ from the transition forest of the Mazatec region not only climatically but likewise in the type of vegetation. The mushrooms do not, apparently, depend in any way on the detritus or the presence of living roots of the characteristic pines (*Pinus hartwegii* with *Psilocybe aztecorum*, *Pinus pseudoostrobus* with *Psilocybe muliercula*). Neither do they live on agricultural land or dung, but directly on the earth, naked earth on the banks of mountain streams with occasional salt outcroppings, following the ravines around 3000 m altitude, or else (*Psilocybe aztecorum*) among grasses and (rosaceous) herbs in openings, often on the slopes of steep ravines even higher up (between 3300 and 3700 m altitude). The subalpine pine woods are here beginning to thin out and approach the absolute timber line (at about 4000 m). The psilocybes are accompanied by those mycorrhizal Basidiomycetes which make the survival of these pines possible at such an altitude, especially *Amanita inaurata* Secr., various species of *Lactarius*, and *Suillus* aff. *brevipes* (Peck Sing. Non-mycorrhizal Basidiomycetes of this vegetation are *Pholiota helvelloides* (Fr.) Martin, *Tubaria* sp. (on *Pentstemon barbatus*), and *Laccaria* aff. *laccata* (Scop. ex Fr.) Berk. & Br. Among the Ascomycetes are *Cordyceps capitata* (Fr.) Link (on *Elaphomyces*) and *Hypomyces lactifluorum* (on *Russula delicata*), the former often collected as a remedy for various diseases but doubtfully hallucinogenic,\(^{12}\) the latter sold in the food markets. In the Piedras Blancas region on Cerro Toluca the presence of *Amanita calypratoides* Atk., a western North American species, is remarkable; the southeastern race of *Amanita muscaria*, also a hallucinogenic mushroom of a sort, and almost constantly accompanying pine mycorrhiza, is common in the neighborhood of the psilocybes, but has never been mentioned as a locally accepted drug.

While the substratum of both *Psilocybe aztecorum* and *Psilocybe muliercula* is apparently comparable to that of *Psilocybe caerulescens* (more or less unstable or shifting bare soil), the climatic conditions and the surrounding vegetation are very different in this region from the *Psilocybe* habitats in Oaxaca. There is frequent freezing in the altitudes indicated, and the precipitation is not so abundant here as in the Mazatec country. During the summer-fall rainy season, precipitation is heavy enough to maintain a relatively rich flora of large fleshy Basidiomycetes reminiscent of that further north in Mexico and in the United States. This, obviously, is possible only because of the relatively lower temperatures, even in summer, whereby evaporation is kept at a minimum.

*Psilocybe aztecorum* is known as *niños del agua* (Spanish: children of the water; this is apparently an allusion to their habitat along the ravines). *Psilocybe muliercula* from Piedras Blancas is also known as "niños," but as such it is only one of the elements referred to by the more general term niños which includes "mujercitas" and "hombrecitos" (little women and little men). Only the "mujercitas" are agarics (*Psilocybe muliercula*); the "hombrecitos" are *Cordyceps capitata* (Fr.) Link (det. Mains). There is an obvious misinterpretation of these names in the literature. Although "mujercitas" are correctly interpreted as *Psilocybe*, the term has been thought to refer to a variety of *Psilocybe mexicana*. Dr. Herrera and the author, however, found the difference in external appearance and habitat constant enough to separate the "mujercitas" from *Psilocybe mexicana*, inasmuch as in all natural habitats of the two species the spore size is consistently different. On the other hand, "hombrecitos" have been interpreted as merely smaller individuals of *Psilocybe mexicana* var., or, since hallucinatory mushrooms in Mexico are always given in pairs, the complementary individuals - in other words, part of the same drug. Our own interpretation has been reconfirmed several times, and it is also obviously the logical interpretation, since the allusion to the shape of the respective fruiting bodies is self-explanatory, and

\(^{11}\) Mr. Cowan, who had a special interview about this new species with Isauro and friends, explains that this means, as Isauro had already told us, "a signal of," in reference to the other hallucinogenic mushrooms, particularly *Psilocybe caerulescens*, which will appear here or nearby later. The correct spelling is *nché je*, pronounced in English like njre he.

\(^{12}\) It is remarkable that another species of the same family, *Cordyceps sinensis*, growing on insects, is widely used as a medicine in China, while still another species of the Hypocreaceae, *Claviceps purpurea*, ergot, is the source of several alkaloids which have only recently been studied thoroughly. In view of this, it is very probable that the Mexican medicinal hypocreaceous species would be well worth a special investigation, particularly from the biochemical point of view.

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the terms lose all descriptive significance if Heim's and Wasson's explanations are accepted.

It is interesting to note that not only are the conditions under which the respective fungi develop widely different, but the use made of the mushrooms is likewise different, in the main hallucinogen-producing states of Mexico visited by me. The Nahua Indians, according to the data obtained by us in discussions with inhabitants of San Pedro de Nexapa and Tenango del Valle as well as the mountains near these villages, do not talk about the hallucinogenic effect of the mushrooms, but volunteer information merely on their healing qualities. In these villages, the use is strictly a matter of religious healing, the business of the curandero or curandera. Permission has to be granted by God in the curandero's dream before the drug can be employed safely. On the other hand, the Mazatecs talk freely about the hallucinogenic and euphoric effects of these mushrooms, and eat them for precisely that effect. The religious healing ceremonies of the Mazatecs are also directed by curanderos, but more emphasis is given to the revelations obtained by the intoxicated persons, so that the use made of the mushroom in Huautla is at least partly divinatory rather than directly medical. Whether this corresponds to any difference in the chemicals present in the respective species, or merely to ethnological factors, cannot be stated at present. At any rate, the Mazatecs seem to have preserved more of the original Aztec lore about teonanácatl than the people living now in Aztec country, who are at least in part the direct descendants of the Aztecs. It is of course possible that the secretive and exclusive use the Nahua make of their "niños" is a result of more complete repression and conversion in the early times of the Spanish rule, when the Oaxaca Indians of the Sierras were practically left to their own devices.

![Fig. 2. Psilocybe cubensis. Stringy mycelium (upper portion of slant in tube at extreme left) and primordia. Phot. R. Singer.](image)

From all the species mentioned above, including also Panaeolus sphinctrinus, both tissue cultures and spore germinations were obtained. The tissue fragments grew well at the room temperatures of Mexico City in July, some even better at 27-29°C, and better on malt-extract agar and Kauffman’s (modified) medium than on potato-dextrose agar. These were the first pure cultures obtained directly from fruiting bodies at their classical habitats. Subcultures have been deposited at the Instituto Politécnico and the Instituto de Biologia of the University of Mexico, at the Department of Botany of the University of Michigan, The New York Botanical Garden, and the Phytopathology Laboratory of the Ministerio de Agricultura y Ganadería in Buenos Aires, all in personal care of responsible scientists for specified further research on these organisms. For the sake of comparison, isolations were also made from North American spore prints of Psilocybe caerulipes (Peck) Sacc. (northern Michigan), also belonging to the section Caerulescentes, and from Copelandia caerulescens (Berk & Br.) Sing.
Mycological investigations on teonanacatl the mexican hallucinogenic mushroom

*Panaeolus sphinctrinus, Psilocybe cubensis, Psilocybe caerulescens, Psilocybe candidipes, and Psilocybe mexicana* were checked by Dr. W. J. Robbins for antibiotic activity. None was evidenced against *Staphylococcus aureus* or *Escherichia coli*, and the action against *Mycobacterium smegma* was slight.

*Psilocybe cubensis* has been observed to form a stringy mycelium in malt-agar test tubes. Mycelium of this species, more than that of other species studied in pure culture, has a tendency, greater at lower temperatures than at higher ones, to turn blue in culture. *Psilocybe cubensis* also tends to produce most easily what might be termed white rhizomorphs in the stringy portions of the mycelium, and a large number of small fruiting bodies on the agar (Fig. 2). These carpophores or primordia do not always attain full size during later development, and often fail to mature; they tend to turn blue without being handled. The agar cultures of *Psilocybe mexicana* have a tendency to turn deep brown in contact with the mycelium (Fig. 3). On partially drying out they also frequently produce normal fruiting bodies. On the other hand, *Psilocybe caerulescens* under the conditions in which it was kept in the laboratory did not form white rhizomorphs or fruiting bodies in pure culture, and the mycelium merely colors the medium light brown (Fig. 4). In Czapek with 1% sucrose and vitamins, *Psilocybe caerulescens* produced aerial mycelium which broke down into "oidia" (mycelial fragments often referred to as arthrospores), observed for the first time by Dr. R. Ames. The mycelium of the *Panaeolus* remains pure white and fluffy without distinct discolorations, rhizomorphs, or fructifications. The same is true for other psilocybes except *Psilocybe muliercula*, which tends to form a slightly brownish aerial mycelium.

*Panaeolus sphinctrinus* (Fig. 5) and other species of *Panaeolus* grow in mushroom-house conditions as well as or better than *Agaricus bisporus* (Lange) Sing., the cultivated mushroom. The psilocybes were also grown not only under laboratory conditions in large glass containers (Fig. 6), where some produce large fleshy fructifications, but also in greenhouse conditions (Fig. 6) on compost trays, where the method used by commercial mushroom growers had to be considerably modified.
Fig. 5. *Panaeolus sphinctrinus*. Abundant carpophore production in artificial mushroom house culture, natural size. Photog. Serv. Penn. State Univ., courtesy Dr. L. R. Kneebone.
**Acknowledgments**

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It should also be stated that had it not been for the consistent initiative and the financial backing of the Bertram and Roberta Stein Neuropsychiatric Research Program, Inc., of Chicago, the present work would not have been possible, and the investigations now in progress elsewhere would have had no chance of realization. I am particularly indebted to Dr. Sam I. Stein, Executive Medical Director of the organization.

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Part II.
A taxonomic monograph of psilocybe, section caerulescentes

by

Rolf Singer and Alexander H. Smith

As has been shown by Rolf Singer in Part I of these studies, it may be accepted as probable that the majority of the hallucinogenic mushrooms of Mexico belong to the section *Caerulescentes* of the genus *Psilocybe*. It is not yet known whether all species of the section possess hallucinatory properties, but it is probable that all or at least many of them are hallucinogenic or poisonous, causing cerebral mycetism with or without other symptoms. At all events, a critical taxonomic account of the species in this section is highly desirable to facilitate a biochemical survey of the group. This contribution is a part of two major projects, first the research on hallucinogenic mushrooms carried out by the Bertram and Roberta Stein Neuropsychiatric Research Program Inc., Chicago, Illinois, and second, a monograph of the North American species of *Psilocybe* now in preparation by A. H. Smith.

We wish to express our thanks to the curators of the following institutions from which we have received material for study: Kew Herbarium (K), Dr. G. Taylor, Director, and Dr. R. W. G. Dennis, curator; Farlow Herbarium (FH), Dr. I. M. Lamb; New York Botanical Garden (NY), Dr. D. P. Rogers. Our own collections and those obtained from correspondents are on deposit at the Instituto Miguel Lillo (LIL), Tucumán, Argentina, and at the Herbarium of the University of Michigan (MICH). Valuable data were obtained for us by G. Guzmán, Mexico D.F.

The color terms used in the descriptions were taken from R. Ridgway, Color Standards and Color Nomenclature, Washington, D.C., 1912, and Maerz and Paul, A Dictionary of Color, 1st edition, McGraw-Hill, New York, 1935. Those from Ridgway are within quotation marks and those from Maerz and Paul are underlined.

In giving the measurements of spores the length is given first and the width second, but if the spore is somewhat compressed and broader than deep, the width is given following the length and the depth (i.e. breadth in side view or profile) is given last - for example, 8-11 x 6-7 x 5-6 µ. Measurements of the cystidia (including cheilocystidia) give the length first, the width of the broadest part next (usually the diameter of the basal or central enlargement), then follows the diameter of the "neck" (thinned apical portion) or the narrowed part above the mid-portion, unless the apex is described separately.

The cultural characters as far as now available are not part of the descriptions provided in this monograph since the cultures were described by Singer in Part I. Nevertheless, some of the data provide interesting and even diagnostic characteristics of certain species.

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**Psilocybe sect. Caerulescentes Sing., Sydowia 2: 37. 1948.**

Pileus white or pigmented, slightly lubricious to almost glutinous in wet weather, pellicle often separable; lamellae ascending or horizontal, usually adnate, in some species subdecurrent, in others sinuate-adnexed,
edges pallid, faces pallid to brownish, becoming purple brown from the spores; stipe slender to fairly robust, strongly purple with metol (p-methylaminophenol-sulfate), usually bluing with guaiac solution, typically bluing when wounded or blue color becoming evident on surfaces or mycelium under certain conditions of growth or in age or on drying.

Spores purple fuscous to lilac in fresh deposits or in water-mounts under the microscope, after dehydration and then mounting in KOH becoming dark yellowish brown, terete to laterally compressed and variable in shape from species to species, smooth, wall complex, apical pore distinct and typically causing the apex to appear truncate; basidia typically 4-spored, pleurocystidia present or absent but if present not as chrysocystidia (species with chrysocystidia excluded from *Psilocybe* by definition); cheilocystidia abundant and often causing the gill edge to be heteromorphous (completely sterile and sterile elements different from those of gill face), or nearly so; subhymenium and hymenopodium well developed, gill trama either regular or showing a mediostratum and lateral strata (between the mediostratum and the hymenopodia on each side); cuticle of pileus consisting of a gelatinous or subgelatinous pellicle or an almost non-gelatinous epipilicus (upper layer) and a well-differentiated hypodermium (lower layer), the epipilicus (pellicle) of narrow more or less hyaline hyphae, the hypodermium a more compact layer consisting mostly of enlarged hyphal cells but some narrow filaments also present; clamp connections consistently observed on hyphae of all types and at the base of the basidia of the species described below.

**Summary or the stirpes**

**Stirps. Cubensis**

Spores medium to large (7.7 µ or more long) and mostly somewhat compressed, in face view obscurely to distinctly angular-ovate to angular-elliptic; veil typically membranous and the remains persisting on the stipe as a membranous annulus; aspect of carpophores not mycenoid; habitat on dung or rotten wood.

The combination of veil and spore characters is diagnostic of the stirps. The presence of a membranous annulus would cause these species to be classified in *Stropharia* in classical taxonomic arrangements, but the lack of chrysocystidia and the presence of a change to blue when injured point to close relationship with the other species of the section. The true *Strophariae* have chrysocystidia or a viscid to glutinous universal veil. Other species such as *P. aztecorum* and *P. candidipes* may at times show a narrow annulus but these have terete or only very slightly compressed spores.


**Stirps. Yungensis**

Spores very small (less than 7.7 µ long) and strongly compressed, typically angular-ovate in face view; veil floccose over the lower part of the stipe but not forming an annulus; pileus relatively high or acutely papillate; stipe thin; cap margin incurved at first (general aspect almost mycenoid but with incurved margin); habitat on forest litter and much decayed wood particles in the tropical zone; pigmentation dark, hyphae of the hypodermium heavily incrusted.

The combination of floccose veil and the uniquely small and compressed spores along with the characteristic habit determine the stirps which, so far, contains only a single species.

This stirps has as much in common with the deconicas as the preceding has with the stropharias. It differs, however, in habit and chemical characters from the species usually classified in *Deconica*. Within the section it seems to come closest to the two smaller-spored representatives of the preceding stirps, which are also characterized by relatively small carpophores.

Species included: 4. *P. yungensis*. 
Stirps. Mexicana

Spores compressed, medium sized (7-11 µ long); veil thin and poorly developed, not leaving traces on mature carpophores; pileus acute or obtuse in outline except for an apical conical papilla, with straight margin when young, or margin bent in slightly; pellicle poorly developed; stipe thin; habitat characteristically in pastures, fields, meadows, or generally outside the forest in tropical-montane vegetation or plantations.

This stirps forms a natural transition between the preceding and the following one. The spores are still compressed but are not characteristically small; the habit is mycenoid though perhaps slightly less so than in stirps Silvatica.

Species included: 5. P. mexicana.

Stirps. Silvatica

Spores not compressed, medium (6-9) to large (10-13 µ long); veil thin and not leaving traces in adult carpophores; pileus relatively high and acute, not fully expanding, with straight margin, thus habit mycenoid; pellicle present, thin to thick; habitat in forests on wood and debris, but extratropical (as far as known).


Stirps. Cyanescens

Spores varying from slightly compressed to terete, typically 9 µ or more long; veil varying from well developed (in P. aztecorum) to poorly developed, but never floccose or annulate; habit typically collybioid or nearly so; habitat terricolous or on rotten wood in forests, parks, or among scattered trees.

This combines all the large-spored exannulate species which do not have a mycenoid habit. The spores are not even obscurely angular in face view and are terete or at best only slightly compressed. It is remarkable that the habitat is rather similar in all of them and that none of them can be described as truly tropical.


Stirps. Caerulescens

Spores compressed to terete, small (less than 9 µ long); stipe typically thick (more than 3 mm at apex); veil well developed; habit collybioid to tricholomatoid but not mycenoid; habitat variable.

The species grouped here have well developed veils and rather thick stipe; they are thermophilous in the sense that they all occur in warm climates.


A fourth species which might belong here, P. zapotecorum Heim, has not been studied by us. We prefer not to place it formally in one of the stirps introduced here inasmuch as it might conceivably be closer to some other stirps, or represent a stirps of its own.

Supplement to stirps VI: 16. P. zapotecorum.

Stirps. Caerulipes

Spores 7-9(-10)µ long, terete, stipe thin (1-3 mm at apex); veil thin and cortinate; habit collybioid; habitat on rotten wood and debris in the forest and under scattered trees.

But for the small spores and thin stipe this stirps could be united with stirps Cyanescens. According to spore
size it would be close to stirps Caerulescens. But both species are either temperate or montane, and extratropical.

Species included: 17. *P. muliercula*; 18. *P. caerulipes*.

**Key to species of section Caerulescentes**

1. Annulus typically membranous and persistent ---&gt; 2
   2. Spores 11.5-17.3 µ long ---&gt; 1. *P. cubensis*
   2. Spores smaller ---&gt; 3
      3. Growing on wood; pileus viscid ---&gt; 3. *P. aerugineomaculans*
      3. Growing on dung; pileus merely moist ---&gt; 2. *P. subaeruginascens*

1. Annulus if present merely a zone of fibrils, or very fugacious ---&gt; 4
   4. Spores 5-6.5 x 4.3-5 x 3.6-4 µ, strongly compressed; pileus acute ---&gt; 4. *P. yungensis*
   4. Spores larger and only somewhat compressed or terete ---&gt; 5
      5. Pileus margin straight when young or almost so; habit more or less mycenoid ---&gt; 5
      6. Spores compressed (broader in face than in side view); growing in open areas (meadows, fields) ---&gt; 5. *P. mexicana*
      6. Spores terete; growing in woods on litter and rotten wood ---&gt; 7
         7. Spores 6-9.5 (-11.5) x 4.5-5 µ pellicle thin ---&gt; 6. *P. silvatica*
         7. Spores 9.3-11 x 5-5.5 µ (10.5-13 x 5.5-7 µ); pellicle thick and separable ---
            &gt; 7. *P. pelliculosa*

5. Pileus margin incurred when young; habit typically collybioid ---&gt; 8
   8. Spores typically less than 9 µ long ---&gt; 9
      9. Stipe 10-20 mm thick, 100-200 mm long, cortex very fibrous, hard and elastic ---&gt; 16. *P. zapotecorum*
      9. Stipe not as above ---&gt; 10
         10. Stipe white, basal half scabrous-strigose, upper half strongly floccose from veil ---&gt; 15. *P. candidipes*
         10. Not as above ---&gt; 11
            11. Veil copious and flocculose in young specimens ---&gt; 12
               12. Spores in face view 5-6 µ broad; stipe whitish when young ---&gt; 13. *P. caerulescens*
               12. Spores in face view 4-5 µ broad; stipe colored when young ---&gt; 14. *P. aggericola*
            11. Veil thin, cortinate, fugacious ---&gt; 13
               13. Pileus not viscid ---&gt; 17. *P. muliercula*
               13. Pileus viscid ---&gt; 18. *P. caerulipes*

8. Spores typically more than 9 µ long ---&gt; 14
   14. Lamellae pallid to white, or brownish only at maturity - sterile to partly sterile collections of *P. collybioides* key out here
   14. Not as above.
      15. Stipe whitish; pileus milk white or disc merely ochraceous ---&gt; 8. *P. aztecorum*
      15. Stipe or pileus or both more deeply colored ---&gt; 16
         16. Pileus chestnut color; spores slightly compressed ---&gt; 9. *P. cyanescens*
         16. Not as above ---&gt; 17
            17. Cheilocystidia 20-30 (-36) x 4-6 x 1.2-1.5 µ ---&gt; 12. *P. baecycystis*
            17. Cheilocystidia larger ---&gt; 18
               18. Odor distinctive - variable, farinaceous to raphanaceous to spermatic ---&gt; 10. *P. collybioides*
               18. Odor none; taste mild ---&gt; 19
                  19. Stipe 100-130 mm long, straight ---&gt; 11.
Pileus 16-80 mm. broad, conic campanulate with an acute papilla at first, gradually becoming convex to plane and at times with a depression around the umbo, umbo becoming more obtuse, more rarely without any umbo or papilla, viscid, glabrous or with fugacious veil remnants near margin, white with more or less fulvous center, eventually entirely fulvous brown, sometimes white to pale yellow ("cartridge buff") at margin, more "cream buff," "chamois," or "honey yellow" toward the "Isabella color" to "clay color" disc, usually staining bluish in age or when injured.

Lamellae gray, becoming deep violet gray and somewhat mottled, finally almost black, adnate to adnexed, seceding, close, narrow, becoming ventricose in mid-portion, broad in age, edges white.

Stipe 40-150 x 4-14 mm, tubular, usually somewhat thickened downward, more rarely subequal, or tapering to the base, white, staining blue ("deep Medici blue") when injured, eventually discoloring to yellow brown or reddish cinereous, often strongly sulcate at the apex, smooth otherwise, glabrous to slightly fibrillose, dry; annulus membranous but thin, smooth on both sides, white, staining blue, fragile, usually persistent.

Context white, staining blue on injury; odor none; taste farinaceous.

Spores 11.5-17.3 x 8-11.5 x 7-9 µ, dark yellow brown (in KOH) to dark olive brown (in NH₄OH), smooth, nearly elliptic in side view, ovate to broadly elliptic in face view and many obscurely angular, wall thick and complex, apex truncate from a distinct apical pore; basidia (2-, 3-, or) 4-spored, 28-35 x 10-13 µ; pleurocystidia scattered, 18-23 x 10-13 µ, ventricose and narrowed slightly near apex to an obtuse to rounded tip, thin-walled, contents (in KOH) homogeneous (not protoplasmatic); cheilocystidia numerous, 18-35 x 6-12 µ, fusoid-ventricose with obtuse to subcapitate apex, neck 4-18 µ long, 3-6.5 µ thick, enlarged tip (head) 4-5 µ, wall thin and readily collapsing; gill trama regular, mediostratum of hyaline parallel to somewhat interwoven hyphae, in well pigmented caps this layer flanked on both sides by parallel hyphae with dingy ochraceous walls (in KOH); pellicle of pileus a thin layer of narrow (c. 3.5 µ) gelatinous hyphae which are radially arranged and yellowish to hyaline in KOH; hypodermium of interwoven to more or less radial hyphae up to 26 µ in diameter, with ochraceous brown walls in KOH; clamp connections present.

Chemical characters: metol strongly positive on context of stipe ("dark naphthaline violet" or darker), other reagents negative or accelerating the bluing.

Gregarious on cow dung, more rarely on horse dung or on rich pasture soil, or on sugar cane mulch or straw or sawdust mixed with dung, usually outside the forests, fruiting from February until November or December, south of the Equator from November until April.

Material studied: U.S.A., Florida: TYPE of Stropharia cyanescens Murr. and additional collections by G. F. Weber, J. R. Watson, and W. A. Murrill, as S. cyanescens, F-19138, F-19630, F-19244, F-17932, F-17735, F-19464 (all FLAS), and R. Singer F 1802, F 1802a (FH, F); Magnesia Springs, W. A. Murrill (NY). Puerto Rico: Mayaguez and Ailonato, Bruce Fink 899 and 1955 (NY). Cuba: Santiago de las Vegas, Earle 109 both on sheets and in box, marked "tipico," TYPE of Stropharia cubensis (NY); also Earle 169, 315, 350; Candelaria, Earle 206
Mycological investigations on *teonanacatl*, the Mexican hallucinogenic mushroom


The collections enumerated above should be divided into three color varieties:

P. CUBENSIS var. CUBENSIS (the type). Here, the pigmentation of the pileus is fulvous. It develops early, and pallid pilei are hardly ever seen. The strain proved to be hallucinogenic belongs here.

P. CUBENSIS var. *cyanescens* (Murr.) comb. nov. The type of this variety is the type of *Stropharia cyanescens* Murr. It differs from the type variety in the virtual lack of pigment or its small quantity; consequently the pileus is pallid to pale isobelline. Known to occur in Florida (10).

P. CUBENSIS var. *caerulescens* (Pat.) comb. nov. The type of the variety is *Naematoloma caerulescens* Pat., type. It differs from the type variety in showing a clear yellow color at least in certain portions of the pileus. Known to occur in Indochina (11).

Illustrations: V. P. & R. G. Wasson, Mushrooms Russia and History 2: pl. 40, fig. 2. 1957; Life, May 13, 1957, p. [107] fig. at lower right. (Both the var. cubensis.)

The senior author at one time (14) thought that *Stropharia caerulescens* Imai (*S. venenata* Imai) was identical with *S. cubensis*, but we are treating it now as synonymous with a closely related but distinct species. For more detailed commentary on *S. venenata* see under *P. subaeruginascens*.

Figs. 1-8. 1-3: spores, cheilocystidia and pleurocystidia of *Psilocybe cubensis*. 4: spores of *P. subaeruginascens*. 5: spores of *P. aerugineomaculans*. 6-8: spores, cheilocystidia and pleurocystidia of *P. yungensis*. 
Psilocybe subaeruginascens Höhnel

2. **Psilocybe subaeruginascens** Höhnel, Sitzungsber. K. Akad. Wiss. Wien 123(1): 78. 1914. (Fig. 4.)


Pileus 15-25 mm broad, plano-convex, almost membranaceous, glabrous and smooth, whitish with smoke brown center, becoming slightly greenish-blue-spotted when touched.

Lamellae grayish brownish, rather distant, with paler edge, 2-3 mm broad, broadly adnate and somewhat decurrent.

Stipe 30-40 x 1.5-3 mm, cylindric, slightly thickened at base, somewhat flocculose-farinaceous above, otherwise glabrous, somewhat shining, hollow but stuffed with a loose woolly pith, white, weakly greenish blue when touched, with an annulus above the center of the stipe, annulus small, often oblique, scaly-membranous; mycelium abundant, filamentous, white, staining greenish blue or almost steel blue.

Context white, tough in the stipe, bluing; odor and taste not recorded.

Spore deposit beautifully violet-brownish.

Spores 7.7-10 (-11.5) x 7-7.8 x 6-7 µ, ovoid to subrhomboid in face view, in side view somewhat inequilateral, smooth, dingy yellow brown in KOH, apex truncate from a broad flattened germ pore; basidia 2- and 4-spored, very rarely 1-spored or 3-spored, 18-28 x 6.3-0.2 µ, typically with a median constriction; pleurocystidia 25-33 x 9-12 µ, broadly fusoid-ventricose with obtuse apex, hyaline, thin-walled, contents homogeneous; near the edge sometimes some pleurocystidia similar to cheilocystidia; cheilocystidia 20-33 x 6-9 µ, fusoid-ventricose with obtuse apex or neck narrow and cylindric, or in some the apex subcapitate, hyaline, causing the edge to appear heteromorphous; epicutis of pileus not gelatinous, apparently of closely interwoven appressed hyphae; clamp connections present.

Subcespitose on horse dung, Buitenzorg, Java, Indonesia, v. Höhnel, TYPE (FH).

This is a *Psilocybe* of the *P. coprophila* type but staining blue. The spores are more angular in face view than those of *P. coprophila* and also of smaller size.

*Stropharia caerulescens* Imai (5) is placed in synonymy here although the type is unavailable at present; we base our judgment on the following original description:

Pileus 15-60 mm broad, glabrous, hygrophanous, or scarcely slightly viscid, convex to plane to subumbonate, yellowish to isabelline, more rarely whitish, margin always pallid. Lamellae pallid, then violet fuscous, adnate. Stipe 35-90 x 5-9 mm, equal, dry, almost hollow, fibrillose below the annulus, whitish, annulus almost apical, very thin membranous, more rarely fibrillose, often evanescent. Context whitish or pallid, bluing. Spores fuscous or violet fuscous, ellipsoid, 7-10.5 x 4.25-7 µ; cystidia none. Gregarious or cespitose on earth and dung, fruiting in June, July and October. Japan, Hokkaido, Ishikari province, near Asahigawa and Sapporo. [Specimens are apparently preserved at Sapporo.]

It is interesting to read in Imai’s account (5) about the physiological activity of this species. It caused ten deaths in 1929 alone, and is apparently more toxic than the related Mexican species. The symptoms are described as feeling feverish, with a subjective impression as if strong liquor had been imbibed; the limbs became somewhat paralyzed. In the hospital after an emetic had been administered and the stomach washed and eventually a laxative had been given, the patient was now in bed with intermittent constriction or trembling of muscles and finally there were hallucinations, then coma. This patient, a woman, recovered. Her son who did not eat the flesh of the mushroom but drank only the liquid of the soup in which it was cooked felt only paralysis of the limbs and a chill, followed by hallucination. All recovered eventually.

In another case, after similar symptoms were observed, coma, loss of consciousness, and talking in delirium were observed. The pupils had opened to a medium size and did not react to light. (This observation coincides with observations made in Mexico with psilocybes of this section.) For more details see Imai’s paper (5).
In a later paper (6), Imai renamed his species S. venenata Imai. The description was now slightly changed to accommodate also specimens with deeper color of the pileus, more viscid surface, and habitat on rotten wood. The conclusion is very suggestive that the forms later added to the species concept and expressed in the changes of the description at the time of the publication of S. venenata can be accounted for if it is assumed that the type form (= P. subaeruginascens) was later confused with P. aerugineomaculans. Whether this opinion is correct can be proved only if and when specimens from Japan become available.

The original description of S. caerulescens Imai is accompanied (p. 149) by a photograph which, by implication, and with certain reservations, may be cited as an illustration of P. subaeruginascens Höhnel.

**Psilocybe aerugineomaculans (Höhne)**

3. *Psilocybe aerugineomaculans* (Höhnel) comb. nov. (Fig. 5.)


Pileus 25-40 mm broad, campanulate, becoming expanded and umbonate, surface slightly viscid to the touch, disc dark blue, remainder reddish gray-cinereous (as in *Psathyrella gracilis* sensu Höhnel), margin striatulate.

Lamellae rather distant, 4-5 mm broad - *i.e.*, moderately broad - attenuate-adnate, yellowish olive, marbled as in *Panaeolus*, edges even.

Stipe 40-50 x 2 mm, not thickened at base, cylindric, hollow, white, slightly flocculose, glabrescent, shining, annulus membranous, small, entire, white; rind 0.15 mm thick when dried.

Context in the middle of the pileus thin (2 mm), membranous toward margin, somewhat cartilaginous in outer layer of stipe, soft inside, staining blue where bruised; odor and taste not recorded.

Spore deposit very deep brown, almost black.

Spores 8.5-10.5 x 7-8 x 5.5-6.5 µ, compressed, subelliptic in side view, rhombic to heart-shaped (angular ovate) in face view, with a truncate apex and a distinct germ pore, thick-walled, near bister when revived in KOH; basidía 4-spored, about 22 x 8 µ; pleurocystidia not seen in type; cheilocystidia 18-22 x 6-8 x 3.5-4 µ, fusoid-ventricose with obtuse apex, typically capped with a hyaline mucilaginous substance, the whole gill edge gelatinizing in KOH; pellicle of pileus distinct but formed by a thin layer of gelatinized epicuticular hyphae; clamp connections present.


Although the species is lignicolous, the spores remind one of the coprophilous series. The presence of a distinct gelatinous pellicle separates this species from *P. subaeruginascens*. This was clearly demonstrated from a study of the types. The type of *P. subaeruginascens* is well dried, well preserved, and consists of fruiting bodies that were in prime condition when placed on the drier. Hence, the lack of a gelatious epicutis is significant. The type of *P. aerugineomaculans* consists of two carpophores which were apparently over-age when dried and as preserved are inferior to quality to those of *P. subaeruginascens*. Under such circumstances one would expect the gelatious pellicle, if one were present originally, to be pretty well obliterated. The fact that it is still present indicates to us that when fresh material is again collected the pellicle may be found to be rather thick and well developed.

From our comments on *P. subaeruginascens*, one might expect *P. aerugineomaculans*, no less than *P. subaeruginascens*, to occur in Japan.

The macroscopical descriptions of both Javanese species are adapted from Höhnel’s notes.
Stirps Yungensis

Psilocybe yungensis Singer and Smith


Var. yungensis (Figs. 6-8, 45).

Pileus about 16 mm broad and equally high, margin at first incurved, conic with an obconic or button-like appendage at the tip, not expanding, deep rusty brown (*leaf mold*), in the marginal region between striae buffish gray (*cracker*), finely marked with long translucent striations when moist, somewhat viscid, staining deep blue (*39 H 5*) where injured.

Lamellae gray buff (*aloma*), with white edges, staining blue where wounded (*39 H 5*), very narrow, ascending and never becoming horizontal, crowded, adnate.

Stipe 55 mm long, 2 mm at apex, 3 mm at base, subequal, deep chestnut brown (*Hindu*), reaching auburn at apex, bluing less than cap and gills but such a change still evident, densely fibrillose floccose from light brownish fibrils on darker ground, becoming more fibrillose-pruinose toward apex, veil inconspicuous except for the floccos, no annulus formed.

Context concolorous with surfaces or somewhat paler both in pileus and stipe, moderately fragile in stipe; odor slightly raphanaceous.

Spore deposit dark lilac.

Spores 5-5.5 x 4.3-5 x 3.6-3.9 µ, compressed, dark olive sepia in KOH and NH₄OH, smooth, rhombic in face view and a hilar appendage visible, without suprahilar applanation or depression in side view, apical pore broad, wall thick and complex; basidia 13-18.5 x 4.7-6.2 µ, short-ellipsoid-clavate then elongating and finally ventricose in the middle 2-, 3-, or mostly 4-spored, hyaline; pleurocystidia present as an occasional cystidiole about the size of a basidium, but often with a low mucro, contents hyaline in KOH and not protoplasmatic; cheilocystidia 13-34 x 5-7.3 µ forming a sterile band along the edge, exceptionally variable: some clavate, some ventricose and with capitate to subcapitate apex, some ventricose above and constricted in the middle, others ventricose-fusoid and broadest in mid-portion, some ampullaceous, some capitulate-cylindric, some subulate-sublancoate, all hyaline, narrowest portions 2.7 µ or more; subhymenium of small irregular elements, not regularly arranged; with a brown to stramineous membranal pigment which often breaks up to incrust the walls of the cells; gill trama regular, consisting of elongate cylindric elements, pigmented like the subhymenium, with 0.8-1 µ thick walls; epicutis gradually more differentiated from the hypodermium toward the uppermost surface of the pileus, there often more or less gelatinized, with smooth hyaline filamentous elements subparallel, forming a cutis, ascending hyphal excrescences often present on these hyphae and some of these stramineous and incrusted; hypodermium of a compact layer of hyphae irregular in size and shape but generally repent and radially elongated, all strongly incrusted with ochaceous brown pigment; clamp connections present.

Chemical characters: KOH leaving a dark spot where dropped on any part of the carpophore; FeSO₄, no reaction.

In small to large groups on very rotten wood or humus containing decomposing woody material, in tropical-montane forest, fruiting in January (summer rainy season). Known only from the type locality, Cataratas de San Juan, road from La Paz to Coroico, Bolivia, 2000 m alt., 1-28-1956, *Singer B 648*, TYPE (MICH).

Var. diconica Singer and Smith, Mycologia 50: 142. 1958. (Fig. 44)

Pileus as in the preceding variety but lower, with an acute papilla rather than a knob, not quite so long-striate and somewhat darker in color (*Mohawk*, and between striae *kis kilim*).

Lamellae sordid lilac or reddish brown (between *kermanshah* and *Rembrandt*), otherwise as in var. *yungensis*. 
Stipe shorter than in the preceding variety.

Context odorless.

Spores 4.4-6.2(-7.2) x 3.8-5 x 3.3-3.8 μ, otherwise as in var. yungensis; basidia mostly 4-spored; pleurocystidia and cheilocystidia as in preceding variety; gill trama consisting of broad, often short, stramineous hyphae with thick walls; epicutis and hypodermium of pileus as in preceding variety; clamp connections present.

Chemical characters as in var. yungensis.


The two forms designated temporarily as varieties come from the same place and were gathered the same day as separate populations. Each population had its own characteristic habit and color range as described above, but under the circumstances we did not think them sufficiently distinct to separate them specifically. They were considered "probably the same" when first collected in the field.

P. yungensis is a very strongly pigmented species with typically high, little or not expanding pileus but with originally incurved margin, and with a non-annular veil remaining in floccons on the surface of the thin stipe. The spores are different from those of all other species of this section.

**Stirps Mexicana**

*Psilocybe mexicana* Heim

5. *Psilocybe mexicana* Heim, Rev. de Mycol. 22: 77. 1957. (Fig. 25-26, 43)

Pileus 5-33 mm broad, 4-15 mm high, conic-campanulate and usually with a central papilla, frequently becoming hemispheric to convex and sometimes papillate in addition, broadly conic in others, and becoming umbонат and in these the umbo sometimes crowned by a papilla, always relatively high and narrow and not fully expanded, eventually, however, often convex with an uplifted margin, glabrous, viscid but soon dry, margin at times sulcate-striate to a small apical smooth disc, disc deep ochraceous to ochraceous brown, then fulvous, marginal zone much paler, hygrophanous, fading to ochraceous over the disc, gray brown in marginal zone and pale ochre-gilvous between, all traces of silky white veil soon vanishing from the margin.

Lamellae pale gray, eventually deep sepia, close to subdistant, ascending to almost horizontal, adnate to adnexed, only moderately broad, edges whitish.

Stipe 20-80 x 1-3 mm, hollow, equal and elongate, sometimes rather distinctly attenuated at the base, ochraceous, at maturity the apex paler, central portion often fulvous, glabrous when mature; veil thin and leaving fine appressed silky fibrils on the upper third, soon evanescent.

Context in pileus paler than surface, turning blue when bruised or on drying; odor always rather strongly farinaceous; taste slightly disagreeable.

Spore deposit deep sepia to dark purple brown.

Spores (7.7-)8.8-10.5(-12) x (5.5-)6.7-7.7 x (5-)5.5-6.7 μ, compressed, in face view elliptic to rhombic and then broadest in mid-portion, subelliptic in side view, dingy yellowish brown in KOH, smooth, with thick walls, furnished with a distinct broad germ pore; basidia 20-32 x 6.3-7.7 μ, 4-spored, variable in size, typically with a median or more superior constriction; pleurocystidia none, or a few similar to cheilocystidia near the edge; cheilocystidia forming a sterile band along edge, 15.5-30.5 x (3-)3-4.9 μ, usually short pedicellate, hyaline, fusoid-ampullaceous, the neck short (rarely long), apex obtuse to acute (rarely capitate or bifurcate); subhymenium a thin layer of very irregular small elements; hymenopodium of relatively narrow filamentous axially arranged parallel hyphae, layer thin; gill trama regular, hyaline to stramineous, with voluminous (up to 19 μ in diameter) elements, hyphal walls up to 1.5 μ in diameter; epicutis a broad hyaline layer of filamentous
mostly hyaline hyphae, not strongly gelatinized but well differentiated from hypodermium, hyphae 1.7-3.5 µ in diameter; hypodermium a colored (yellowish brown) layer of hyphae 2-14 µ in diameter, with pigment in the walls (not incrusted); body of context hyaline to yellowish, many hyphae up to 20 µ in diameter and walls up to 1.5 µ thick; dermatocystidia none; clamp connections present.

On the earth or on plant fragments such as mulch from sugar cane presses, usually in open fields and springy meadows, never on dung; always solitary but often in large numbers in a limited territory; fruiting from May until October, common in the transition zone between the tropical-montane and the temperate-montane zone - i.e., between 1500 and 1800 m alt. - favoring limestone regions. Reported from Southern Mexico and Guatemala.

Illustrations: Wasson, Mushrooms Russia and History 2: pl. 40, fig. 1; Life, May 13, 1957, p. [107], fig. at lower left.


This is the only mycenoid representative of the genus occurring in Oaxaca and consequently the only mycenoid hallucinogenic mushroom used by the Mazatecs. For this reason it is sometimes confused with Panaeolus sphinctrinus which has a similar habit but is more obtuse, with blacker lamellae, and grows mostly directly on dung.

**Stirps Silvatica**

*Psilocybe silvatica* (Peck)

6. **Psilocybe silvatica** (Peck) comb. nov. (Figs. 27, 29).

Pileus 8-25 mm broad and at least half as high, obtusely conic to campanulate, margin straight at first, disc often with a papilla, glabrous, viscid, shining when dried, tawny to rather dark brown, hygrophanous, fading to pale ochraceous buff to grayish melleous or grayish brown.

Lamellae dull ferruginous brown when mature, narrow to broad, adnate, ascending to almost horizontal, close to subdistant, with a pallid edge.

Stipe 20-80 x 1-3 mm, equal or slightly thickened at the base, tubular, flexuous, pallid to brownish, apparently whitish from a superficial appressed fibrillose covering, this layer thinning out downward and more brown showing through from cortex of the stipe; veil apparently very weakly developed and all traces gone in mature specimens.

Context in pileus membranous and fragile, in stipe brownish and cartilaginous; taste farinaceous; odor also farinaceous (from crushed flesh).

Spores in deposit "benzo brown" (violaceous brown).

Spores 6-9.5(-11.5 from 2-spored basidia) x 4.5-5.5 µ, dingy yellowish brown in KOH, smooth; with a complex thick wall, terete in cross section, with a distinct apical germ pore; basidia 19-27 x 5.7-8 µ, 4-spored, rarely 2-spored; pleurocystidia none; cheilocystidia 24-45 x 4-10 µ, ventricose below and often ampullaceous with an elongated neck 1.3-2.2 µ thick, tapering to an obtuse to (rarely) subacute apex, often pedicellate, forming a sterile band on gill edge; subhymenium thin, melleous in KOH; gill trama of relatively broad hyphae with walls up to 0.8 µ thick, pale melleous in KOH and lacking pigment incrustations; epicutis of pileus a thin pellicle of gelatinized hyaline to yellowish filaments 1-2.8 µ in diameter, but pellicle not very strongly gelatinous; hypodermium of compactly arranged hyphae 3 µ or more broad and more highly pigmented than in trama proper, pigment incrusting the walls; clamp connections present.
In small groups, gregarious but not cespitose, in the woods on debris around stumps or on leafmold (mostly *Fagus grandifolia*), generally not directly on stumps or logs, fruiting in September and October. Known from New York, Ontario, and Michigan.


*Hypholoma fragile* was originally reported by Peck from two localities, Star Lake and Painted Post, both in New York. As A. H. Smith (18) previously pointed out, the Painted Post collection should be regarded as the type. This latter is a *Psathyrella* and the same as *P. hymenocephala* (Peck) Smith. The Star Lake collection is *P. silvatica* (Peck) Sing. & Sm.

When A. H. Smith (17) described *P. pelliculosa* the confusion involving *H. silvaticum* had not been discovered. After working out the details of this problem he considered the apparently slight differences existing between *P. pelliculosa* and *P. silvatica* as of no taxonomic significance and reduced *P. pelliculosa* to synonymy with *P. silvatica*. It now appears from the study of all known species in this section that the slight differences disregarded earlier may have taxonomic significance and so *P. pelliculosa* is re-established here.

**Psilocybe pelliculosa (Smith)**

7. *Psilocybe pelliculosa* (Smith) comb. nov. (Figs. 28, 30, 42).


Pileus 8-15 (-30) mm broad, at least half as high as broad, obtusely conic with a straight margin when young, remaining so or becoming more broadly conic-campanulate, never fully expanding, surface glabrous, smooth, viscid from a separable gelatinous pellicle, hygrophanous, "Saccardo's umber" to "Isabella color" (dark dingy yellow-brown or more olive showing), usually fading to "pinkish buff" (dull pale alutaceous), often with greenish gray tints in age, margin translucent-striate when moist.

Lamellae dull "cinnamon brown" until darkened by the spores, adnate but eventually separating from the apex of the stipe, rather narrow to moderately broad, markedly ascending at first, less so in age, close, edges pallid.

Stipe 60-80 mm long, 1.5-2 mm thick at apex, equal above an enlarged base (base enlarged from adhering debris), pallid to grayish, appressed silky fibrillose and brownish below and reaching bister in age, pruinose above; veil absent to rudimentary.

Context thin and pliant in pileus, rather tough in stipe, turning slightly bluish or greenish where injured in pileus and stipe; odor none or slightly musty.

Spores 9.3-11 x 5-5.5 µ to 10.5-13(-14) x 5.5-7 µ (according to populations, all 4-spored), dark yellow brown in KOH, showing a distinct apical germ pore (often convex), smooth, terete, ellipsoid to subovoid; basidia 4-spored, 22-30 x 7-8 µ, hyaline; pleurocystidia none or only near gill edge and similar to cheilocystidia; cheilocystidia 22-36 x 5.5-7.5 µ, hyaline, forming a sterile band on gill edge, often pedicellate, fusiform-lanceolate with an elongated neck tapering to an acute to subacute apex, neck rarely cylindric with an obtuse apex, hyaline in KOH; subhymenium narrow and irregular, brownish in KOH; gill trama regular, pale brownish in KOH; epicutis of pileus a thick pellicle of more or less horizontal very loosely arranged strongly gelatinized wavy hyphae 0.8-5.5 µ in diameter, hyaline, walls never incrusted; hypodermium of compactly subparallel hyphae tawny from having colored walls but walls not incrusted; all hyphae with clamp connections.

Scattered to gregarious or cespitose on debris and humus in and near conifer forests from September to December. California, Oregon, Washington, Idaho.


Stirps Cyanescens

Psilocybe aztecorum Heim

8. **Psilocybe aztecorum** Heim, Rev. de Mycol. 22: 78. 1957 (Figs. 9, 31).


Pileus 15-25 mm broad, obtuse to subumbonate, expanding to broadly conic or campanulate, glabrous except for traces of the veil along margin at first, slightly viscid, hygrophanous, milk white with yellowish disc, striate over about a third of the radius when moist, pale buff faded, disc tending to become rimulose-cracked in some specimens.

Lamellae deep purple brown when mature, adnate, broad, fairly close, with pallid to whitish edges.

*Figs. 16-24.* 16: cheilocystidia of *Psilocybe baeocystis*. 17 and 20: pleurocystidia and spores of *P. candidipes*. 18, 19, 21: spores, pleurocystidia and cheilocystidia of type of *P. caerulescens*. 22-24: pleurocystidia, spores and cheilocystidia of *P. mazatecorum* (Mexican specimens so determined by Heim) = *P. caerulescens*.
Stipe 30-60 mm long, 2-4 mm thick at apex, equal or nearly so, fibrous, base at times enlarged, often flexuous, whitish, staining blue, becoming grayish on discolored portions, especially over lower part in age; veil well developed, sometimes forming a fugacious annulus.

Context white, changing to blue readily, especially in the stipe; odor farinaceous; taste astringent.

Spores 10.5-14(-16.2) x 5.3-7.7 (-8.8) µ, elongate-ellipsoid, terete, revived in KOH dark dull ochraceous brown with olive tone and a red brown line showing along the endosporium, thick-walled, germ pore broad and distinct, wall smooth; basidia hyaline to melleous-hyaline, mid-portion usually constricted, 24-31 x (5-)7.7-10(-10.5) µ, (1-, 2-, 3-) 4-spored, sterigmata 6-6.5(-7.8) µ long; pleurocystidia similar to cheilocystidia, rarely scattered, rarely a few cystidioles found, their shape reminding one of one-spored basidia; cheilocystidia abundant, causing gill edge to be heteromorphous, 24-45 x 5-8 µ, fusoid-ampullaceous with filamentous neck, neck rarely tapered sharply to a subacute apex, 6-11 µ long and about 2.5 µ in diameter; pilocystidia none; caulocystidia abundant near apex of stipe, variable in shape, 17-43 x 4-9 µ, ventricose at base and with or without a short neck; epicutis a thin pellicle consisting of narrow (1-2.2 µ) gelatinized hyphae hyaline in KOH; hypodermium poorly differentiated but hypae up to 14 µ broad, having colored (non-incrusted) walls and not gelatinized; clamp connections present.

In small groups on the earth in open pine woods (Pinus hartwegii), associated with grasses and Alchemilla procumbens. It fruits in September and is known only from around Paso de Cortés, Mexico and Puebla, between 3300 and 3700 m elevation, Mexico. G. Guzmán VA 1099, September 1957, TOPOTYPE (MICH).


In this species are combined the characters of small carpophore size, large spore size, and fairly copious veil development. It is only slightly - never abundantly - pigmented, but the fact that it turns blue when injured has been very clearly established by G. Guzmán on the material on which our description is based, and the local inhabitants likewise consider the bluing one of the mushroom's characteristic features.

**Psilocybe cyanescens** Wakefield


Pileus 20-40(-75) mm broad, convex, becoming expanded, viscid, hygrophanous, when moist chestnut color, fading yellowish or ochraceous, margin striate when moist, staining blue when touched.

Lamellae cinnamon colored becoming badio-fuscous as spores mature, adnate to adnate-decurrent, subdistant, up to 5 mm broad, edges paler.

Stipe 60-80 x 2.5-5 mm (rarely 100 x 7 mm), fairly rigid, base somewhat enlarged and often curved near the base, whitish, silky fibrillose, changing to blue when bruised or in drying; veil cortinate, snow white and thin, best seen on young fruiting bodies.

Spore print fuscous.

Spores 9-12 x 5.5-8.3 x 5-7.7(-8) µ, mostly slightly broader in face than in side view, smooth, nearly elliptic in side view, more ovate in face view, with a distinct broad apical germ pore, wall thick and complex, dingy yellow-brown in KOH and with a reddish chestnut line along the endosporium; basidia 4-spored, 16-26 x 7.2-9.3 µ, cheilocystidia 12-26 x 5-8 µ, fusoid-ventricose, with the neck 2-4 µ thick and projecting about one-third of the total length of the cheilocystidium, apex obtuse; pleurocystidia few, in form of cystidioles, 21-28 x 5.5-8.8 µ, resembling basidioles but mucronate and lacking both protoplasmatic granulation and refractive internal body when revived in KOH (hence neither basidioles nor chrysocystidia); gill trama regular, hyaline to melleous, the hypae lacking pigment incrustations and having thin to moderately thickened walls; epicutis a pellicle of long loosely arranged filaments imbedded in a gelatinous mass; beneath this a hypodermium of melleous but not conspicuously incrusted hyphae; pilocystidia none; clamp connections present.

On the earth among leaves and dead twigs in woods, perhaps occasionally on rotten wood, known only from...

The description of the field characters is translated from the original description. The data on microscopical characters were obtained by us from a study of the type.

It is not impossible that this species was introduced to Europe with exotic plant material.

**Psilocybe collybioides Singer and Smith**

10. *Psilocybe collybioides* Singer and Smith, Mycologia 50: 141. 1958. (Figs. 10-11.)

Pileus 13-40 mm broad, at first campanulate and often soon varying toward convex, at maturity convex or retaining a more or less elevated umbo, eventually tending to become flattened and irregular, surface glabrous, viscid when moist, somewhat hygrophanous, when moist usually finely translucent striate and more sordid-pallid all over, faded light ochraceous brown (13K 9) with dingy pallid center, discoloring (where touched and on drying) from the center outward and finally reaching bottle green or bayou, often with a short sulcate margin.

Lamellae pallid to pure white, in some slightly brownish at maturity, close or subclose, more or less adnate, moderately broad to broad (e.g., 2.5 mm).

Stipe 30-70 x 1.5-4.5 mm, equal to slightly thickened downward, often twisted-contorted, curved, compressed, knotty or variously irregular, stuffed becoming hollow, white at first, often becoming cinnamon-brown from the base upward, at times remaining white or fading out to white again in age, when young silky fibrillose and sometimes sub-squamulose from the veil, later appressed finely fibrillose, apex fibrillose-pruinose; veil cortinate-fibrillose, white, fugacious; basal mycelium sometimes strigose, white, and forming white rhizomorphs.

Context white to pallid or in parts cinnamon, always discolored under the cuticle and in cortex of stipe, turning green to blue (bottle green or bayou) when injured, fleshy in pileus, somewhat tough in stipe; odor slightly farinaceous becoming spermatic.

Spores generally none, or few, typical of the *Strophariaceae*, about 10 x 6.5 μ (hymenophore nearly sterile or sterile); basidia not seen; pleurocystidia in form of cystidiolose forming the hymenium, hyaline, some 24-32 x 7.3-9.5 μ, attenuate above and often with a rounded mucro, others more pseudoparaphysoid, vesiculose to broadly clavate, 14.5-23 x 9.3-13 μ; chrysocystidia none; cheilocystidia abundant, causing the gill edge to he heteromorphous, 17-23.5 x 8-9 μ, fusoid-ventricose with narrow (1.5-2 μ) extended neck and with obtuse to capitulate (and then up to 3.5 μ diameter) tip; subhymenium consisting of irregular very small elements; hymenophoral trama regular, its hyphae with about 0.5 μ thick walls, without membrane-pigment; epicutis a pellicle consisting of loosely arranged gelatinized hyphae, hyaline in KOH; hypodermium of nearly non-pigmented hyphae, or in some a slight amount of wall incrustation (melleous) present, especially in young non-contorted carpophores; clamp connections present.

On dry slopes over loose gravel near *Alnus jorullensis* var. *spachii* and on various types of organic debris (humus, grass culms, semi-decomposed alder leaves, etc.) in semi-shade, gregarious, fruiting in the summer rainy season (February), Argentina, prov. Tucumán, Pre-Andine Sierras, Tafi del Valle, 2000 m altitude, Singer T 1882, TYPE (MICH).

The above collection was designated type in order to leave open the question of the identity of the North African species whose description follows, even though the latter and the type appear to be the same. If the North African species is not the same as ours it will have to be renamed because the epithet *cyanescens* is preoccupied in *Psilocybe*. The Argentine species described above has the appearance of a *Collybia*, hence the specific epithet proposed.
Figs. 25-31. 25-26: cheilocystidia and spores of Psilocybe mexicana. 27 and 29; cheilocystidia and spores of P. silvatica. 28 and 30: cheilocystidia and spores of P. pelliculosa. 31: cheilocystidia of P. aztecorum.
Description of Maire's sterile to semi-sterile material from Algeria

The following description of *Hypholoma cyanescens* R. Maire, Bull. Soc. Mycol. Fr. 44: 51. 1928, refers to a North African species which we think probably identical with *P. collybioides*. This description is adapted from the original diagnosis. We have seen no specimens.

Pileus 15-30 mm broad, convex, then expanding, not umbonate, viscid and with a separable glutinous pellicle, hygrophanous, dingy ochraceous, faded pallescent, margin faintly striate or not striate.

Lamellae whitish becoming dingy and pallid ochraceous, finally light rufous-fuscous, close, thin, narrow (1.5-2.5 mm), arcuate, somewhat rounded behind and narrowly attached (rounded-adnexed), not intervenose, lamellulae attenuate, edges whitish pruinose.

Stipe 25-40 x 2-5 mm, subequal or slightly enlarged below, stuffed with a white silky medulla, eventually tubular, whitish, apex pruinose, innately fibrillose downward; cortina cobwebby, white, fugacious.

Context slightly fulvous, fulvous in the base of the stipe, faded pallescent, white in the stuffing of the stipe, bluing in all parts of trama on injury; odor raphanaceous; taste mild.

Spore deposit purple-brown.

Spores 10-12 x 5.5-6.5 µ, from 4-spored basidia, occasionally up to c. 20 x 7.5 µ from 2-spored basidia, ellipsoid, light fuscous brown, rather thick-walled, smooth, with a rounded to slightly attenuated apex furnished with a germ pore; basidia clavate, 4-spored, few 2-spored, 28-32 x 7-9 µ; pleurocystidia none or rare and similar to cheilocystidia; cheilocystidia 30-40 x 6-8 µ, fusiform with a subcylindric ampullaceous neck and an apex incrusted with calcium oxalate; subhymenium thin, ramose; gill trama regular, its elements 5-8 µ in diameter and rather long, interwoven.

Chemical characters: guaiac solution negative; NH₄OH negative.

Gregarious under *Cedrus atlantica*, fruiting from October until December. Algeria, Blida and La Chréa.

Description of fertile material referred to *Hypholoma cyanescens* by Malençon

The following description is translated and adapted from Malençon (8):

Pileus 15-35 mm broad, almost spheric to convex becoming campanulate to conic-campanulate, the margin finally spreading, viscid from a separable gelatinizing pellicle, naked, hygrophanous, ochraceous then amber yellow with a bister shade, finally dusky olive, bister, fading from the disc outward to yellowish white or dull stramineous (“as if it were gouachée”), in age at times disc leather color, translucent-striate half way to disc when moist, opaque when faded.

Lamellae pale argillaceous becoming more lilac-beige, eventually dark purple brown, thin, not close, narrow, ascending, free to slightly adnexed, with white fimbriate edges.

Stipe 50-70 x 2-3 mm, equal to a slightly thickened base, solid becoming fistulose with a slight silky stuffing, pruinose on apex, lower down with a thickish coating of silvery to yellowish appressed fibrils; cortina silvery white, fugacious; basal mycelium cottony white, agglutinating, long white rhizomorphs present.

Context watery, with an amber color tone, lower part of stipe amber, thick in disc of pileus, thin toward margin, rather rough in stipe, changing green to blue where injured; odor and taste none.

Spore deposit blackish purple fresh, blackish in the herbarium.

Spores (11-)11.25-13(-13.5) x 5.5-7 µ, most frequently 11.2-11.8 x 5.5-6.25 µ, almond shaped, smooth, thick-walled, violet in water mounts, yellow brown in NH₄OH, apical germ pore obliterated by a hyaline callus; basidia 30-35 x 8 µ, 4-spored, cylindric or constricted, sterigmata 5 µ long; cystidioles (?) piriform, 15-17 x 7.5-8.5 µ; pleurocystidia (other than cystidioles) none or similar to cheilocystidia and near gill edge;
mycological investigations on teonanacatl the mexican hallucinogenic mushroom

often on small pieces of dead wood but also on the ground, fruiting from october until november in the Cedretum (atlanticae) and Quercetum (ilicis) above Azrou, Morocco.

in order to represent the facts as free from possible misinterpretation as we reasonably could, we have presented the data available on the collections made by each author. experience with numerous sterile forms in the genus Naematoloma in north america has shown that in these the colors invariably have more yellow in pileus, lamellae, and stipe than do those of normally fertile carpophores, but that there is no correlated variation in spore size and shape. hence, as long as these characters can be obtained from semi-sterile forms, they can be used in classifying collections. we do, however, believe that in interpreting differences in color, especially as the yellow pigments are concerned, it is best not to attempt fine distinctions between collections in situations such as this one. also we cannot regard semi-sterility in itself as necessarily being a legitimate species character.

we believe that all of the material on which the descriptions presented here are based belongs in a single species. spore characters are essentially the same, as are the characters of the cheilocystidia and lack of pleurocystidia. there may be some differences in odor and taste but in no case are the characters pronounced enough to be convincing in view of the small amounts of material tested.

since the specific epithet cyanescens cannot be transferred to Psilocybe because of the existence of P. cyanescens Wakefield, we are describing the South American material as a new species and designating a type from that region. by doing this we do not prejudice the situation as far as future studies of the african populations are concerned. if some of the slight differences noted in the descriptions presented here are found to be important, adjustments in the classification can then be made. there is the possibility that Malençon’s collections are con-specific with Miss Wakefield’s P. cyanescens.

Psilocybe strictipes Singer & Smith

11. Psilocybe strictipes Singer & Smith, Mycologia 50: 141. 1958. (Figs. 12, 15, 50.)

Pileus 20-40 mm broad, when young campanulate to convex, becoming broadly convex to plane or with an elevated wavy margin in age, glabrous, viscid from a separable pellicle, margin striatulate when moist, hygrophanous, dull yellowish brown to olive brownish (“Isabella color”), fading to cinnamon buff on disc and pallid on margin, becoming dingy over all in age, where bruised staining greenish or bluish green.

lamellae pallid becoming dark chocolate color from the spores, bluntly adnate to depressed-adnate, horizontal, narrow (4 mm in a 40 mm cap), close but not crowded, with three tiers of lamellulae.

stipe 100-130 x 2-3 mm, straight, equal or slightly flared at apex, stuffed with a pallid brownish pith, staining brownish where outer fibrils have been removed, surface pallid from appressed fibrils, often zoned near apex from broken veil, with fibrils over lower half and strigose hairs at base, staining bluish green.

context concolorous with surface in pileus, dingy brownish and cartilaginous in the cortex of the stipe; odor none; taste mild.

spore deposit purplish.

spores 9-12(-12.7) x 5.5-6.5 µ, smooth, with a distinct apical germ pore, oblong in face view, slightly inequilateral in side view, sordid tawny in KOH; basidia 25-31 x 7-9 µ, 4-spored, clavate or subcylindric with a median constriction, projecting when sporulating; hymenium dull rusty brown to pale yellowish in sections revived in KOH; pleurocystidia none or only near gill edge and similar to the cheilocystidia; cheilocystidia 26-45 x 6-12 µ, abundant, causing gill edge to be heteromorphous, hyaline, ventricose below, subulate,
attenuated gradually towards the subacute to obtuse tip; gill trama of enlarged cells pale sordid brownish to hyaline (paler than hymenium in KOH); epicutis a thick gelatinous pellicle of hyaline narrow (1.5-3.5 µ) hyphae; hypodermium of broad (3-10-18 µ), somewhat interwoven hyphae, pigmented but almost as pale as the flesh beneath, not incrusted; clamp connections readily demonstrated.

Subcespite on wood of conifers and debris in coniferous and mixed woods, fruiting in October, Oregon, U.S.A.

Material studied: Oregon: near Welches, Gruber & Smith 20248, TYPE (MICH). Other specimens from the same general region: Smith 24622, 24402 (MICH). (No. 202448, indicated as the number of the type in the original diagnosis, is erroneous.)

Figs. 32-38. 32-33: spores and cheilocystidia of *P. aggericola*. 34-35: cheilocystidia and spores of *P. muliercula*. 36-38: spores and cheilocystidia of *P. caerulipes*. 
Psilocybe baeocystis Singer and Smith

12. *Psilocybe baeocystis* Singer and Smith, Mycologia 50: 141. 1958. (Figs. 13, 16.)

Pileus 14-54 mm broad, appearing umbonate when dried but conic when fresh and with incurved margin, finally expanding to convex or plane, viscid from a thin gelatinous pellicle, olive brown to buffy brown, when dried tending toward copper brown in the center, with a faintly striate margin when moist, finally with a greenish fringe around the margin and incoming greenish where touched.

Lamellae dark cinnamon or gray, also with faint purplish tints in some, eventually nearly "heliotrope gray," adnate to uncinate, subclose, edges whitish.

Stipe 50-70 x 2-3 mm, equal to subequal, stuffed with loose fibrils, with fine white fibrils on surface, white except for apex which is yellowish; veil present but inconspicuous.

Context concolorous or paler than surface in pileus, brown in stipe; odor and taste none.

Spore deposit "heliotrope gray."

Spores (8-) 10-13.3 x 6.3-7 µ (mostly 11-12 x 6.3-7 µ), terete or nearly so, with a broad distinct germ pore, deep olive to dingy brownish olive-yellow in KOH, smooth, wall very thick and complex, with a suprahilar depression or applanation; basidiolemma 20-30 x 7-9 µ, 4-spored, hyaline to stramineous; pleurocystidia none; cheilocystidia 20-30(-36) x 4.2-5.7 µ, ampullaceous with a long thin neck (1.2-1.5 µ diameter) and subacute apex, or more often ventricose below or in middle but then pedicellate and tapered to an acute apex, hyaline, causing gill edge to be heteromorphous; subhymenium a rather broad and irregular layer of small versiform elements, slightly pigmented; hymenopodium a thin filamentous layer, regular, not as well separated as in some other species; gill trama hyaline, regular, with a slightly and indistinctly differentiated mediostratum and this flanked by parallel hyphae on either side, progressively more pigmented in the third of the trama closest to the pileus trama; epicutis a very thick hyaline gelatinous layer of narrow loosely arranged hyphae; hypodermium weakly to strongly pigmented, consisting of compactly parallel horizontal hyphae broader than those of the epicutis; clamp connections regularly present.

On decaying "peat moss" (actually apparently a mixture used instead of pure *Sphagnum*) by a green house, Eugene, Oregon, U.S.A., *F. P. Sipe*, 11-1-1945, TYPE (MICH).

This is somewhat similar to *P. strictipes* and may be confused with it, but differs in the size and shape of the cheilocystidia, which are reminiscent of those of *P. caerulipes*.

Stirps Caerulescens

13. *Psilocybe caerulescens* Murr., Mycologia 15: 20. 1923 (Figs. 18, 19, 21-24, 46, 48.)


Pileus 20-88 mm broad, at first obtusely campanulate, becoming convex with a decurved margin, at times slightly umbilicate or with a small umbo, rarely becoming irregular and almost plane or shallowly depressed in age, almost black or very deep olive-umber at first, becoming paler and olive tinge often disappearing, in age often rather pale colored (near *aztec*), umbo either darker than marginal area or at times paler, hygrophanous, fading gradually to ochraceous from disc outwards, sometimes assuming chestnut or fulvous colors in the moist areas while still fading (see illustrations by Wasson), and these at times persistent in the faded specimens, a brownish shade often pervading the disc, glabrous, smooth, slightly viscid to lubricious, short striate by translucence in smaller caps or striate half way to disc in large ones when moist, opaque when faded; veil usually fugacious on pileus, but sometimes more persistently white appendiculate.

Lamellae mostly light avellaneous gray or argillaceous, only in age reaching sepia, sinuate-adnate to bluntly adnate, close to subclose, broad, edge slightly white fringed.
Stipe 40-122 x 2-10 mm, typically equal, hollow, glassy-white to sordid although at first always with a continuous white velutinous soft covering which soon breaks up into a marbled to flocculose covering on a sordid ground color, the apex pallid fibrillose, glabrescent; basal mycelium white, occasionally developing some white rhizomorphs which at times turn blue when injured; veil thin and at first appearing cortinoid, pure white, often forming a ring for a very short time in young or nearly mature specimens, not distinctly bluing.

Context of pileus whitish to sordid or even tawny to fulvous, sometimes dark brown in upper portion of pileus, fleshy, somewhat fibrous-hard in stipe, blue when injured; odor strongly farinaceous; taste astringent.

Spore deposit deep purple fuscous, sepia.

Spores (6-)6.3-7.7 (-8) x 5-6 x 3.5-5 µ, compressed, 0.5-1 µ narrower in side than in face view, varying from subrhombic with rounded angles to ovate in face view, and from elliptic to inequilateral in side view, deep yellowish brown in KOH, smooth, with a broad germ pore, wall thick and compound as revived in KOH, showing a rusty line along the endosporium, without a suprahilar depression but at times with a small applanlation; basidia (12-) 14-21 x 4.9-7 µ, 4-spored, rarely 2-spored; pleurocystidia none except for some permanently sterile basidioles (?) or a few cells resembling the cheilocystidia; cheilocystidia 15-20(-26) x (3-)4-5.5(-6) µ, hyaline, fusoid to fusoid-ampullaceous, the apex acute to slightly enlarged, neck sometimes flexuous to filamentous and 1.5-2 µ in diameter; subhymenium a narrow layer of irregular short elements, melleous to hyaline as revived in NH\textsubscript{4}OH; hymenium hyaline, consisting of parallel filamentous hyphae; subhymenium a narrow layer of irregular short elements, accompanying the mediostratum of both sides, and the mediostratum consisting of a mixture of broad and narrow (2.5-3 µ) hyphae, walls of all cells 0.3-0.4 µ thick; epicutis well developed, consisting of thin filamentous hyphae occasionally with an upturned terminal cell, slightly gelatinized; hypodermium denser than the flesh beneath and more deeply colored; hyphae of the context of the pileus short and voluminous, cell walls c. 0.7 µ or less thick, deep ochre brown from incrusting membrane-pigment; clamp connections present.

Chemical characters: guaiac solution, bluing on white portions of context.

Gregarious to caespitose, rarely solitary on soil or on sugar cane mulch, mostly in shaded places or on rich earth which has recently been moved or altered, fruiting in summer, during the rainy season. Southern United States (Alabama) and Mexico (Oaxaca).


Illustrations: V. P. & R. G. Wasson, Mushrooms Russia and History 2: pl. 40, fig. 3 (poor); Life, May 13, 1957, p. [107], fig. at upper right.

Heim first described this fungus as a new species and then, after receiving a letter from Smith suggesting that the species was the same as \textit{P. caerulescens} Murr., he apparently changed his mind and referred to it as \textit{P. caerulescens} var. \textit{mazatecorum} but gave no immediate critical account of how var. \textit{mazatecorum} was actually different from the type variety. There may be a difference in the taste since that was indicated as mild in the type collection, but until the recent interest in hallucinogenic fungi this species remained known almost entirely from the type collection made by R. P. Burke of Montgomery, Alabama, who wrote “no characteristic taste.” It is possible that Burke did not regard a slight astringent taste as distinctive, or that in merely tasting the raw specimens he did not chew the material long enough to bring out the true flavor.

The character of the veil’s being more developed in var. \textit{mazatecorum} than in var. \textit{caerulescens}, as Heim emphasized in his Latin description, is dubious because from the description of Burke’s collection it is likely that his notes referred to mature specimens and the fact that no veil is mentioned cannot be regarded as conclusive. Hence, there seems to be no way to prove these points except by continued collecting and observing, both in the southern United States and Mexico, to determine eventually the range of variability.
Psilocybe aggericola Singer & Smith

14. *Psilocybe aggericola* Singer & Smith, Mycologia 50: 142. 1958. (Figs. 32-33.)

Pileus 20-40 mm broad when young, campanulate, then conic campanulate or convex, disc at first umbo-nate, and with a slight umbilicus in the umbo, later with a pronounced central papilla, margin incurved at first but soon straight, strongly hygrophanous and translucent-striate over outer half when moist, estriate when faded, glabrous and naked, except rarely with vestiges of the veil along the margin, colors light olive brown or brown with a darker disc (*oak, Sudan br.*: young, disc sometimes *burnt umber*, becoming khaki to *Isabella color*, with a *tortoise* colored disc) fading to a dull deep yellow tone (*9 J 6*) when young, to pale chamois (*11 F 4*) when old, tending to blacken when drying.

Lamellae narrowly and rather deeply sinuate to adnexed, close or subclose, moderately broad or rather broad and broadest towards the stipe, dingy (olive) brown (*bamboo to stag*), trama staining blue where exposed, edges white and entire.

Stipe 25-80 x 6-13 mm, later 2.5-6 mm, tapering upward or finally nearly equal, light ochraceous (*Leghorn*) above, later becoming somewhat burnt umber, dingy ochre (*maple*) downward and finally coffee-with-milk color (*Mosul*) in lower half, turning blackish in drying, with a sordid cream to pallid floccose-fibrillose covering which is very conspicuous in young material though fugacious in the upper half (persistent in the lower half) of adult stipes, bluing where injured or on handling, the base white mycelioid; veil forming a fugacious, very narrow annular belt at apex but annulus disappearing at maturity.

Context rather firm at first, more fragile in age, not tough in stipe, light ochraceous (*Leghorn*) becoming coffee-with-milk color (*Mosul*), and turning blue (*Quaker blue, Arctic; finally reaching Rigi blue in dried condition*) when either pileus or stipe is bruised; odor none.

Spore deposit deep purple fuscous.

Spores 6.2-8 x 4-5.2 x 3.6-4.5 µ, usually 6.7-7.3 x 4-4.5 x 3.7-4.2 µ, somewhat but little compressed or almost terete (usually 0.3-0.4 µ broader in face than in side view), slightly inequilateral in side view, elliptic-ovate to rarely rhombic in face view, with a broad germ pore, dingy yellow brown in KOH, smooth; basidia (12.5-)14.5-20.5 x 4.2-5.5(-7) µ, 4-spored to rarely 2-spored, hyaline or nearly so, clavate to broadest below the apex, basidioles vesciculose-clavate; pleurocystidia 20-32 x 6-9 µ, originating in the subhymenium, contents homogeneous (not protoplasmatic), with a thin colorless resinous incrustation which renders them opaque, varying from clavate to fusoid or ventricose-ampullaceous or constricted in the middle, often with lateral outgrowths or apical nose-like appendages but these lacking in some preparations; cheilocystidia 20-25(-29) x (3.5-)5-5.5(-8.2) µ, usually somewhat ventricose below, upper portion lanceolate narrowed in one or two stages to an acute apex, entirely hyaline and transparent, thin-walled, non-incrusted, causing the gill edge to be heteromorphous; subhymenium when revived in NH₄OH often strongly green from a membrane-pigment, later honey yellow, consisting of a thin layer or irregularly arranged hyphal cells of various shapes; gill trama consisting of elongated subparallel hyphae of variable width and having walls 0.5-0.7 µ thick, the mediostratum not sharply differentiated from the hymenopodium and lateral stratum; epicutis of pileus a thin and not sharply differentiated layer of hyaline hyphae, the hyphae not much gelatinized, when revived in NH₄OH, freshly dried material appearing greenish but later losing all color; hypodermium composed of elements which show very variable shape but not isodiametric, brownish melleous as revived but hyphal walls not incrusted; clamp connections present.

Chemical characters: formalin on the flesh immediately brownish, not bluing; FeSO₄ on flesh, causing a bluish gray ring to appear around a brown spot.
Singly or in small cespitose groups of two or three on rich soil along dammed-up earth of the road, outside the

The opaque pleurocystidia distinguish this species from all similar ones.

**Psilocybe candidipes Singer & Smith**


Pileus 50-55 mm broad, convex with shallowly depressed disc, always obtuse at first, smooth and glabrous, slightly viscid, when moist translucent-striate over the marginal third, sordid buff to dull buff, hygrophanous, fading from the disc outward, pale buff to whitish when faded, readily staining blue when touched.

Lamellae pale avellaneous to avellaneous-gray, sinuate-adnate, rather broad, fairly close to subdistant.

Stipe about 100 mm long, 7-12 mm thick, hollow, nearly equal, readily staining blue, strongly scabrous-strigose near base, and this coating ascending up to mid-portion, increasingly white floccose upward to the annular zone left by the broken veil; veil white, soft, annular, remnants fugacious, but floccons below annular zone rather persistent, readily staining blue where injured.

Context whitish to dingy white, fleshy in pileus, fibrous-hard in the stipe; odor weakly but distinctively farinaceous.

Spores 6.7-7.7 x 3.5-3.8 µ, terete or nearly so, oblong-ellipsoid to ovoid, smooth, wall complex but relatively thin (0.7 µ), both episporium and endosporium differentiated, with a distinct apical germ pore; basidia 4-spored, 13.5-21 x 3.5-6.3 µ (mostly 4-5 µ broad), clavate, not opalescent; pleurocystidia present only as cystidioles, ventricose-submucronate to fusoid-clavate, body of cell often opalescent but neck emerging and non-opalescent, 21-24 x 5-7 µ; cheilocystidia very numerous, lanceolate-fusoid to subulate, hyaline, 18-27 x 3.5-6 µ, upper part narrowed to 1.5 µ or less in diameter, acute to subacute; subhymenium melleous to brown (browner near cap trama), consisting of very small elements often appearing cellular in sections but in reality irregular in shape; gill trama regular, hyaline, in the poorly differentiated mediostratum melleous-hyaline, hyphae not markedly enlarged; epicutis well developed, of only slightly gelatinized narrow (1.3-3.3 µ) hyphae, near surface often giving rise to a cystidiod end-cell which is not gelatinous; velar floccons of stipe everywhere consisting of very irregularly shaped cells of various sizes either inflated or filamentous and strongly interwoven, frequently cystidiod cells arising from the surface hyphae of the velar material, these c. 20 x 5 µ and ampullaceous, apex 2 µ broad; clamp connections present.

Chemical characters: Several chemical substances accelerate and augment the bluing, especially guaiac solution.

On earth, cespitose, among fallen leaves of *Coffeea* and *Inga* along irrigation ditches in plantations. Mexico, Oaxaca, Huautla de Jiménez, 1550 m altitude, R. Singer M 1514, 7-10-1957, TYPE (MICH).

The small terete spores, strong tendency to turn blue, and copious veil are an interesting set of characters in this genus. The strong development of the veil is a valid additional argument for including the stirps *Cubensis* in this genus. Weight is added to this argument by the fact that in *P. cubensis* the same kind of dermatocystidia are often found on veil and pileus. The two, of course, differ sharply in spore characters.

The young hymenium, typically hymenium just beginning to sporulate, is very interesting in view of the bluing phenomenon. The basidia and basidioles are incrusted with blue granules. The young cystidiods (obviously formed earlier in the development of the hymenium) are not. Does this mean that the early development of these cells did not include the production of the enzyme that causes the formation of the blue pigment? Also, does it prove that those cells which are destined to remain sterile are differentiated physiologically before morphological differences become evident?
Psilocybe zapotecorum Heim


Pileus 60-110 mm broad, campanulate becoming obtusely umbonate to strongly mammillate but always twisted, asymmetric, most variable in shape, margin at first white punctate with the veil remnants, (soon) glabrous, color varying from ochraceous citrine to purple-brown-black (Klingcksieck et Valette no. 45) with ochraceous-melleous tones, with dark violet stripes and gradually becoming violet black on margin, apparently hygrophanous and dingy melleous when faded.

Lamellae rather close, with sinous edges, adnexed-emarginate, not very broad, violet-purple.

Stipe 100-200 mm long, 10-20 mm broad at base, hollow, very fibrous, hard, elastic, often contorted, outer layer of cortex brownish, ochraceous toward the interior and with a central soft white bluing pith, (surface) fibrillose.

Context at first brown-rufous in cortex of stipe, yellow in central portion, entirely and quickly bluing; odor farinaceous; taste astringent.

Spore deposit brown-purple.

Spores 6-8.8 x 3.5-5 x 3-4 μ (Heim 1957), rather bright yellow revived in KOH, somewhat compressed, with a broad apical germ pore; cheilocystidia fusoid, with a filiform neck which is covered by a substance stained by dyes (such as “bleu lactique”).

On swamp soil, Yaitepec and San Agustin de Loxicha, Oaxaca, Mexico. Used as hallucinogen by the Chatino and Zapotec Indians, known as "mbey san" or "piule de barda" (according to Heim).

Illustration: *Life*, May 13, 1957, p. [107], fig. at upper left.

Material studied: None. The above incomplete description is based on fragmentary data and a Latin diagnosis furnished by Heim. Probably there are specimens at Paris.

The habitat is not particularly strange for a *Psilocybe* as far as North American members of the genus are concerned; therefore, it is rather a surprise to find that Heim considered it so. A relatively tough context of the stipe is likewise not unusual in the genus, and it may only be relatively more so in *P. zapotecorum*. Nevertheless, it is possible that this species does not belong with the preceding species. We do not wish to judge its final relationships without having had a chance to study specimens.

Stirps Caerulipes

**Psilocybe Muliercula** Singer & Smith

17. **Psilocybe muliercula** Singer & Smith, Mycologia 50: 142. 1958. (Figs. 34-35, 49.)

Pileus 20-35 mm broad or more, campanulate then convex, eventually often applanate in a zone between the umbo or papilla and the somewhat decurved marginal area, more or less umbonate, rarely papillate, fulvous brown, hygrophanous, fading out to a pale ochre tone, glabrous, not viscid, marginal area translucent-striate (up to about half way to disc) when moist, slightly sulcate at times, naked.

Lamellae fuscous-sepia, almost narrow, ascendant to subhorizontal, sinuate-adnate, often seceding, with pallid edges.
Stipe (30-) 40-100 x 2-7 mm, equal or tapering upwards, becoming hollow, sordid flesh-colored-whitish, becoming concolorous with the pileus especially below, staining blue where touched and blue stains eventually very deeply colored, smooth, more or less glabrous and naked; veil very sparse and all traces of it obliterated in mature specimens.

Context tending to turn blue when injured; odor farinaceous; taste in dried specimens not distinctive.

Spores (6-)7-8(-10) x 4.2-4.8(-5)x 3.9-4.7 µ, either terete or up to 0.3 broader in face view than in side view, elliptic to elliptic-ovate in either view, rarely subrhomboid with rounded angles in face view, sometimes ventricose-fusoid (shaped like a bolete spore) in side view, with a distinct apical germ pore, dark yellowish brown in KOH; basidium 16.5-21 x 5-5.5 µ, 4-spored; pleurocystidia none; cheilocystidia 12-23 x 3-5.5 µ, hyaline, subulate to subulate-ampullaceous, apex obtuse and sometimes subcapitate, more often subacute or acute, neck at apex 1.5-2 µ in diameter; subhymenium a thin layer, irregular, of small elements; gill trama regular, walls of hyphae up to 1.5 µ thick (thick-walled for the genus); epicutis a well developed layer of hyaline filamentous hyphae but not strongly gelatinized; hypodermium well colored by membranal pigment often incrusting the walls of the hyphae, the latter arranged into a compact layer or a cutis; hyphae of context and hypodermium with thickened (about 1.5 µ) walls; clamp connections present.

Solitary or in small clusters on earth along ravines of a pine-covered (Pinus pseudostrobus) mountain at about 3000 m elevation; fruiting in late August and September, rarely before. Known only from the slopes of Cerro Toluca (Mexico).

Material studied: Mexico, purchased at the market of Tenango del Valle (Toluca Valley), September 30, 1956, T. Herrera (MICH, MEX); September 1957, G. Guzman (MICH, MEX); purchased at Piedras Blancas, Cerro Toluca, July 30, 1957, R. Singer M 1011, TYPE (MICH). - There must be material of this at Paris since it was sent by T. Herrera to Heim, purchased at the same place and apparently identical with material earlier purchased in Tenango by the Wasson group and determined as P. mexicana var. brevispora.

This species is quite different from all other known species, particularly from P. mexicana which has larger spores and a more typically P. semilanceata-like habit.

**Psilocybe caerulipes (Peck) Sacc.**

18. *Psilocybe caerulipes* (Peck) Sacc., Syll. Fung. 5: 1051. 1887. (Figs. 36-38, 47.)


Pileus 10-35 mm broad, when young obtusely conic to convex and with an incurved margin, becoming broadly convex to plane or retaining a slight umbo, at times quite irregular, surface glabrous, viscid, soon dry and shining, closely translucent-striatulate and watery cinnamon brown to dingy "Sayal brown" fresh, hygrophanous and soon fading to dingy ochraceous buff or cinnamon buff, sordid alutaceous in age and often with greenish stains along the margin or with a greenish tinge overall.

Lamellae sordid brown when young, becoming rusty cinnamon, close or crowded, narrow, adnate or arcuate-adnate or with a decurrent tooth, edges whitish and slightly fimbriate.

Stipe 30-60 mm long, 2-3 mm thick at apex, equal or slightly enlarged downwards, stuffed with a pith but becoming tubular or hollow, the pith fairly persistent, surface pruinose at or near the apex, downward appressedly white to grayish fibrillose, usually staining greenish blue where handled, whitish to buff at first, especially above, pallid to bluish when dried, lower part often dingy brown in age; veil whitish, thin, forming an evanescent superior fibrillose zone; basal mycelium white.

Context in pileus thin and pliant, in stipe tough, in both becoming bluish when injured; odor none; taste farinaceous.

Spore deposit very dark purple brown.

Spores 7-9.8 x 4-5.3 (-5.7) x 4-5.1 µ, usually 8-8.5 x 4.4-5 µ, but those from 2-spored basidia 10-11.2(-12) x 5.7 µ, generally terete, only a small minority very slightly broader in face than in side view, ellipsoid, or elliptic in face view and inequilateral in side view, pale tawny to olive fuscous in KOH, truncate with an apical pore, smooth; basidium 15-28 x 5.2-7.5 µ, either all 4-spored, or some 2-spored, often constricted in mid-portion, hyaline in KOH; pleurocystidia none, or present only near gill edge, and then similar to cheilocystidia; cheilocystidia forming a broad sterile band at gill edge (which is heteromorphous), 18-35 x 4.2-6.7 µ, hyaline,
with homogeneous contents, narrowly fusoid-ventricose, subulate, or ampullaceous, neck 1-2.2 µ broad and, if ampullaceous, 7-20 µ long, the tip sometimes slightly thickened to almost subcapitate (1.7-2.2 µ diameter), otherwise acute to obtuse, sometimes bifurcate; subhymenium seemingly cellular, but consisting of very irregularly shaped generally rather small very elements, stramineous-melleous; hymenopodium of axial filamentous light stramineous-melleous hyphae 2-6.5 µ in diameter; gill trama not clearly differentiated in mediostratum and lateral stratum, regular, consisting of elongated hyphae 6-24 µ thick with 0.7-1.5 µ thick walls, melleous hyaline varying to pale brownish (in KOH); epicutis a gelatinous pellicle, not very broad, consisting of 2-4.5 µ thick hyaline (rare individual hyphae sometimes stramineous) filamentous hyphae which are loosely arranged; dermatocystidia none; hypodermium more irregular than epicutis, forming a cutis of compactly arranged short hyphal cells with brownish walls, but without any conspicuous incrusting pigment, hyphae 6-12 µ in diameter; this layer gradually merging below into the paler interwoven floccose trama of the pileus; clamp connections present.

Solitary or cespitose on debris of hardwood trees, especially Betula and Acer but also on their logs rotting on the ground. It fruits during the summer, more rarely in fall in the eastern and mid-western states of the U.S.A. and in Canada (Ontario), south to North Carolina.


The blue to greenish stains may be slow in developing but they usually show in a few hours.

**Literature cited**