MAGIC MUSHROOMS Around the World

A Scientific Journey Across Cultures and Time

Jochen Gartz

Translated and Edited by Claudia Taake

The Case for Challenging Research and Value Systems

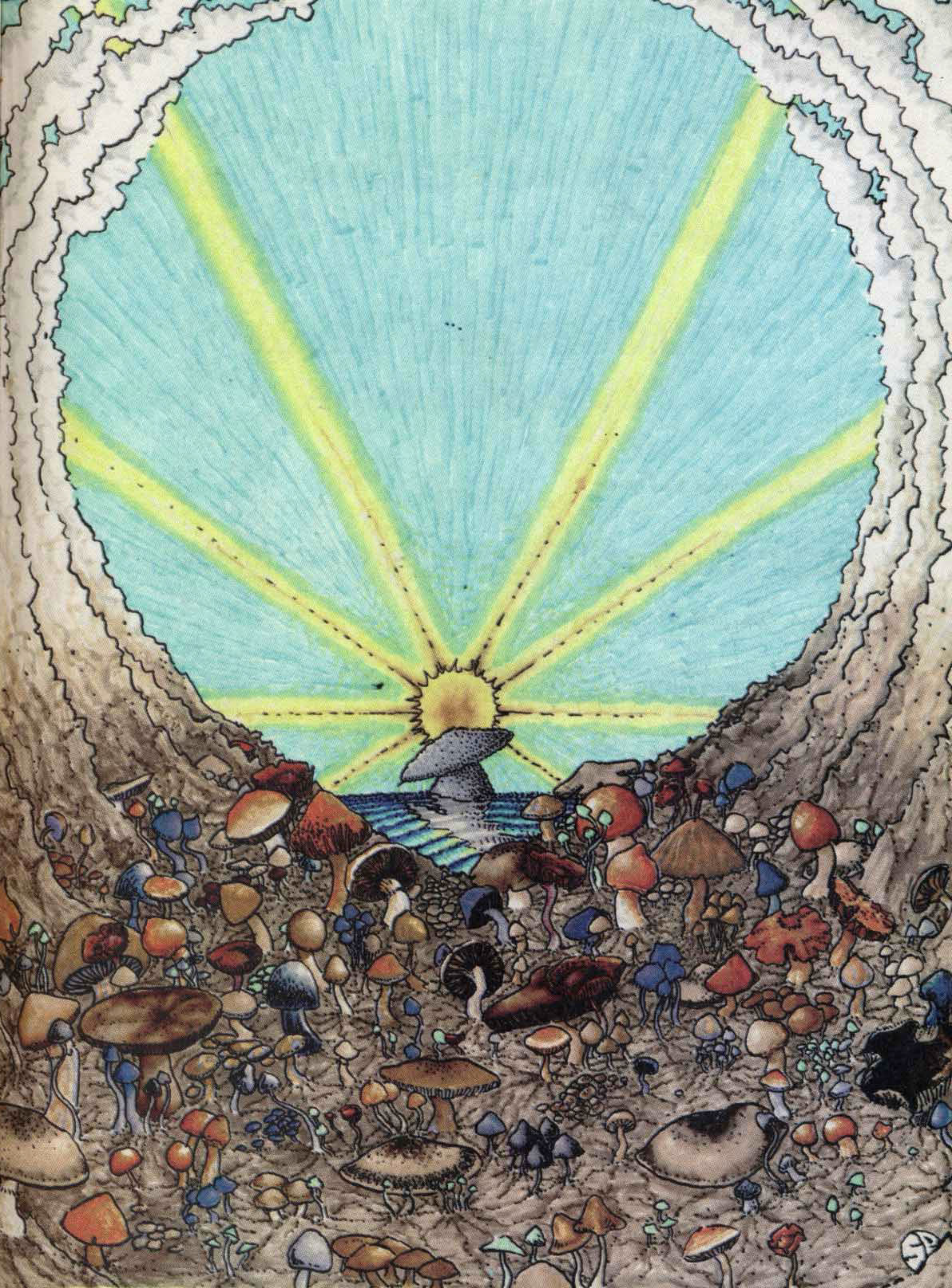

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Figure 1 - Water Color Painting of *Psilocybe semilanceata*
(Germany, 1927)

TABLE OF CONTENT *(With Active Links' Just Click On A Subject To Go To The Page)*

Figure 2 - Psilocybe cubensis from Australia

Figure 3 - Water color painting of Panaeolus subbalteatus (Germany,.1927)

Figure 4 - Fresh Panaeolus subbalteatus mushrooms.

FOREWORD

WHO WAS THE FIRST MAGICIAN?

Nobody knows precisely when the first magic mushroom emerged from the shadows of prehistory to enter the light of consciousness. Nobody knows when the first magic mushroom was eaten by a human being. Nobody knows just who the first magic mushroom eater was. In seeking answers to these questions, we can only speculate. Mycophobes, however, are quick to voice their conviction that only a fool would be reckless enough to want to attain a higher state of consciousness beyond the boundaries of everyday reality. And only a fool would attempt to do this by ingesting those odd little things that mysteriously thrive on decaying, humid soil, rotten wood and malodorous mounds of cow manure.

Historically, magic, mushrooms have been feared and hated` since antiquity: magic mushrooms were thought to be made from poisons that had dripped from serpents' fangs; they were considered to be unclean emissions of evil spirits; moreover, mushrooms were a known cause of death and disease, bloated stomachs and insanity. Beliefs such as these have survived to the present day. They persist, for example, as figures of speech, such as the slick Austrian description of a societal misfit as someone "who ate those madness-inducing mushrooms."

But, there is another, very different, magic mushroom legacy as well.

Flesh of the Gods for Devil Worshippers

The Old World: Mycenaean civilization began with a mushroom trip -Mushrooms were an ingredient in the ambrosia of Dionysus. Porphyrius, the fourth century Latin poet and contemporary of Emperor Konstantin, knew that magic mushrooms were the children of the gods.

A quasi-cannibalistic ritual, the act of eating the children of the gods unlocked one's power to experience the truly divine. But not all mushrooms enable human beings to enter the realm of divine consciousness. This magic power resides in only those fungi known as "fool's mushrooms", which were considered poisonous and believed to be the spawn of the Devil throughout the late Middle Ages and well into modern times.

The New World: The Aztecs in Mexico referred to a number of small, inconspicuous mushrooms as teonartacatl, or "flesh of the Gods." These sacred mushrooms were eaten during the course of rituals intended to contact the Gods in order to learn about the world and the realm of the divine. These magic mushroom rituals thoroughly spooked the Catholic Spaniards. The mushroom eaters, commonly thought of as Devil worshippers, were hounded by the Inquisition. Still, all good things survive the tests of time, so the cult of magic mushroom eaters did not become extinct. Like mycelia underground, the cult continued to flourish, and at the proper time in recorded history, in 1957, the fruit of the fully grown mushroom re-surfaced to draw widespread public attention. Valentine and Gordon Wasson became the heroes of the modern neo-mycophilic movement.

Back to the Old World: The revelations and insights gained from the use of psychoactive mushrooms were so magically wonderful, that our native European "fool's mushrooms" - which were gene ; considered inedible - had to be recognized as closely related to the magic mushrooms of Mexico, the flesh of the Aztec Gods. The souls of magic mushrooms in Mexico and Germany are essentially made from the same substance: psilocybin.

Jochen Gartz has made an extraordinary contribution to the field of mycology by embracing Germany's magic mushrooms and the scientific study and testing of these fungi. The research efforts upon which this book is based require nothing less than a fearless, brave and courageous consciousness, free of prejudice and mycophobia. I am convinced that a researcher's consciousness infused by the spirit of the magic mushroom is capable of far deeper scientific insights than we can ever expect from the usual ivory tower academics, isolated from reality, and who gorge themselves on our tax dollars.

I met Jochen Gartz shortly after the fall of the Berlin Wall at the third symposium of the European College for the Study of Consciousness (ECSC) in Freiburg, Germany. Our encounter was my first contact with a researcher from the former East Germany. Jochen Gartz's enthusiastic lecture was a truly consciousnessexpanding event, his words breaking down traditional borders and crossing over into new territory. The magic mushrooms spoke through him - with no trace of dogma or ideology - in the tradition of true anarchy that is the hallmark of mushroom magic. What I heard was unbelievable. Jochen spoke of a "new" psychedelic mushroom and its migration. The mycelia had spread in concentric circles outward from Leipzig, jumping all political borders. Finally, when the mycelia reached West German soil, the hated Berlin Wall crumbled. Could there possibly be a connection between the evolution of the magic mushroom and the evolution of our consciousness? Could a mushroom have contributed to the resolution of our political conflicts?

In the past, politicians, even popes, had their own jesters and magicians, who functioned as pressure release valves in the machinations of political power struggles. It is obvious that a country whose chancellor is being pelted with eggs, urgently needs a new breed of magician who are able to readjust reality. But today, no aspiring magician should go about this task without this book as a guide for the wondrous journey into the realm of magic mushrooms.

Christian Rdtsch

Figure 5 - "Anthropomorphic Beings Engaged in Mushroom Dance"
10,000-year-old rock drawing in Tassili, Sahara (Algeria)

CHAPTER 1

I BELIEVE THE TIME HAS COME FOR A COMPREHENSIVE REVIEW OF NEW FINDINGS FROM THE FIELDS OF MYCOLOGY, TAXONOMY AND NATURAL PRODUCTS CHEMISTRY

When R.G. Wasson, R. Heim and A. Hofmann began their interdisciplinary research program to study the Mexican species of mushrooms and their usage in Mexican mushroom cults, their efforts culminated in a 1958 landmark report that described the isolation, molecular structure and synthesis of the mushrooms' active ingredients: psilocybin and psilocin. Several years later, these substances were also identified in a species of mushroom in Europe, Psilocybe semilanceata, which became the first in a series of newly discovered species. Since then, psychoactive mushrooms from other genera have been reported with increasing frequency.

As part of my analytical work dedicated to the identification of naturally occurring chemicals, I had the good fortune to be part of a research team that studied alkaloids found in a variety of mushroom species. Now I believe the time has come for a comprehensive review of new findings from the fields of mycology, taxonomy and natural products chemistry.

Wasson and his successors have already provided detailed accounts pertaining to the history and study of the Mexican mushroom species, so that these materials need not be repeated in this context. However, certain aspects concerning the more recent uses of these mushrooms as well as their conditions of growth will receive more detailed attention in later chapters.

The main purpose of this book is to inspire further study of these mushrooms, particularly basic research efforts and medical applications of magic mushroom ingredients.

The extensive bibliography will help scientists and other interested mycophiles to further immerse themselves in this complex area of study.

Jochen Gartz

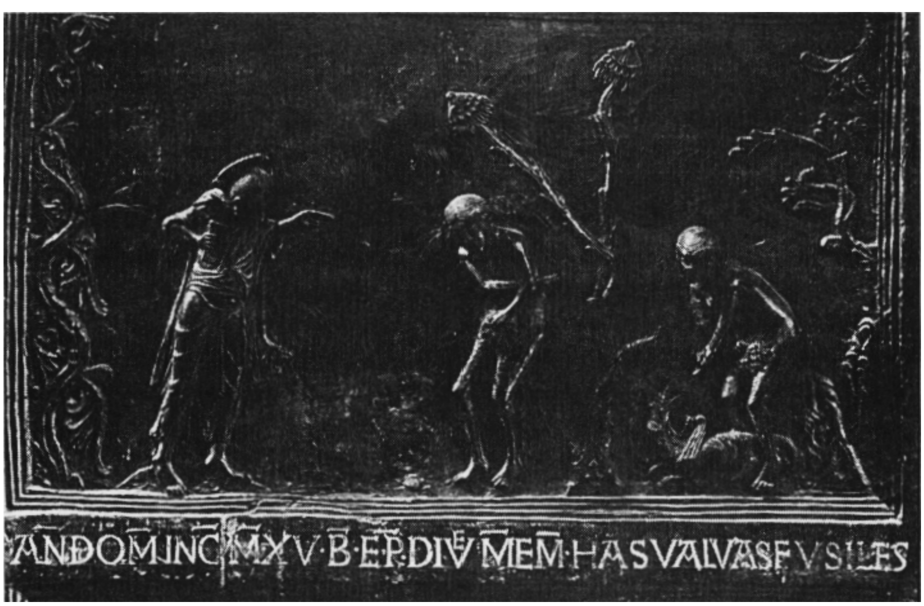


Figure 6 - Bronze doors with mushroom motif entitled "Trial and Judgment" at Hildesheim Cathedral, Germany (ca. 1020).

CHAPTER 2

REFLECTIONS ON THE HISTORY

AND SCIENTIFIC STUDY OF MAGIC MUSHROOMS

It is remarkable that cultures native to the American continent knew about a relatively large number of natural mind-altering substances compared to early cultures that evolved in Europe or Asia. Botanical evidence does not support the notion that Europe is home to fewer hallucinogenic plants than other regions. Furthermore, the growing number of recently discovered European mushroom species containing psilocybin indicate a flourishing psychotropic mycoflora in Europe similar to those found in other countries.

It is unlikely that early European cultures learned less about local plants and mushrooms through usage and experience than cultures elsewhere in the world. Most likely, early cultural knowledge of European psychoactive plants and mushrooms was lost or destroyed at some time in history, probably as early as several hundred years ago.

The discovery that the fly agaric mushroom (Amanita muscaria) was known for its psychoactive properties in Siberia invited the conclusion that this mushroom was used as a psychotropic agent in medieval Europe as well. In fact, there is very little evidence from the Middle Ages to indicate widespread knowledge of the effects of specific mushrooms on human consciousness. However, I believe that past reports on psychoactive mushrooms were causally linked to Amanita muscaria simply because this was the only known psychotropic mushroom in Europe at that time.

While the usage of Amanita muscaria among Siberian tribes has generated reports of spectacular hallucinations, European accounts of fly agaric intoxications do not generally include descriptions of such intensely hallucinatory effects.

Accordingly, the potent hallucinogenic effects of specific Psilocybes and related species are likely to have had a much more significant influence on early European cultures than the delirium-like visions induced by Amanita muscaria, a species that is also known to induce unconsciousness and severe somatic side effects. This hypothesis is corroborated by data from comprehensive field studies conducted in Mexico. I believe that historic accounts including those described below - indicate a knowledge of and familiarity with psychotropic mushrooms in Europe that is most likely derived from usage of Psilocybes and related species, rather than experience with Amanita muscaria. However, it is extremely difficult to reject or confirm this hypothesis, due to the lack of conclusive data available for analysis today.

Bwyd Ellylon: A Feast of Fairies in Celebration of the Spirit World

Tales of ritualistic mushroom usage have found their way into the realm of myths and legends. For instance, one legend describes a peculiar poisonous mushroom in Wales (British Isles) with the strange name of Bwyd Ellylon, which was considered a delicacy by fairies feasting in celebration of the spirit world. Psilocybe semilanceata is the most important psilocybin-containing mushroom in Europe and it thrives in parts of Great Britain, where the mushroom grows abundantly all across the Welsh countryside during fall season.

I would like to thank G. Samorini for pointing out that the Inquisition was unusually cruel and vicious in the Alpine valleys of Valcamonica, Valtrompia and Valtellina (located in the provinces of Brescia and Sandrio in Northern Italy). Many books chronicle countless witch burnings in that region, with particular emphasis on the witches' meetings at the "Monte del Tonale", located at an altitude of 2000 m (ca. 6,000 ft). Field research has shown that plants of the nightshade family ("witching herbs") do not grow at this altitude; even the fly agaric mushroom is rarely found there. By contrast, pastures in the area abound with Psilocybe semilanceata during the fall. Given this historical context, it would seem likely that Psilocybe semilanceata played an important role as a psychotropic agent in the region (see Figure 58, Chapter 7.4).

In light of medieval accounts describing the practice of witchcraft, it is interesting to note that a subjective sensation of flying or levitation is among the commonly reported effects of psilocybin intoxication.

Berserk Rage of Nordic Warriors

In the course of the ideological power struggle between Christianity and the remnants of pagan religions that worshipped Nature, many sources of knowledge were lost. The aggressive repression and eradication of pre-Christian customs all but destroyed the continuity of Europe's original cultural heritage, along with much historic evidence documenting early cultural practices, including the usage of plants and mushrooms for the purpose of temporary alterations of consciousness.

Some authors went so far as to blame the fly agaric mushroom for proverbial fits of "berserk rage" attributed to Nordic warriors. Many accounts detailing this phenomenon allude to a "deception of the eyes" (i.e. visual hallucinations). After the Nordic legal system banished the practice of "going berserk", it disappeared quite suddenly during the 12th century. At about the same time, Saxo Grammaticus speculated that the Berserkers may have used magical potions.

It is just as plausible, however, to suggest that the hallucinogen of choice among early Nordic cultures was Psilocybe semilanceata, a mushroom species quite common in Norway. Neither Amanita muscaria nor Psilocybe semilanceata are generally known to cause states of intense rage. However, given the historic context, it is possible that, at the time, people had already begun to internalize negatively biased distortions and the demonization of psychoactive mushrooms and their effects, in order to justify the creation of new laws intended to destroy repulsive pagan customs such as the ritual use of mind-altering plants.

It is important to note the existence of ancient Northern European rock drawings that depict various mushroom themes, along with the discovery of bronze-age vessels decorated with mushroom-related artwork. The drawings often include renditions of zoomorphic entities as well as mushrooms. Significantly, they predate any reports and speculations about the Berserkers by over 2,000 years.

These ancient images suggest the evolution of early European mushroom cults - a cultural practice that most likely vanished during the early Iron Age, as did many other customs and social practices from that era. Still, the discovery of ancient Northern European mushroom cults is a powerful piece of evidence supporting the notion that psychoactive mushroom usage has been continuous throughout history.

In addition, a traditional Swedish custom has survived to the present day, revealing an early knowledge of a certain mushroom believed to evoke "visions of spirit entities". As part of summer solstice celebrations, a poisonous mushroom species ("Baran") was cast into the bonfires. Even though nothing is known about this fungus today, the ritual burning of a poisonous mushroom was intended to weaken the powers of goblins and other evil spirits. The mushrooms were viewed as symbolic incarnations of noxious spirits. The mushrooms' ritualistic destruction by fire thus destroyed the powers of evil and mischievous spirits. The assumption that some mushrooms are physical links to the intangible powers of the spirit world may have evolved from ancient fragments of knowledge about the psychoactivity of specific types of mushrooms.

There are a number of written reports about psychotropic mushrooms that date back to the late Middle Ages. While this collection of documents includes a variety of different sources from several countries, they provide remarkably similar descriptions of psychoactive mushrooms and the general nature of their effects.

Love Potions Brewed from Bolond Gomba

Clusius (1525-1609), for example, the great physician and botanist, discovered "bolond gomba" in Hungary. This mushroom was known under the German name "Narrenschwamm" ("fool's mushrooms"). It was used in rural areas, where it was processed into love potions by wise men or "javas asszony". At about the same time, this "fool's mushroom" was documented in Slovakia as well. In addition, the mushroom found its way into the verses of Polish poet Vaclav Potocki (1625-1699), who refers to its potential of "causing foolishness much like opium does ".

Similarly, in England, John Parkinson's "Theatricum Botanicum" (1640) includes details abouta 'foolish mushroom ".

The Austrian colloquial expression "He ate those madness-inducing mushrooms" refers to states of mental confusion.

Historic source materials such as these are scarce and widely scattered. Undoubtedly, they refer to psychotropic mushrooms, but lack sufficient information to permit clear identification of a specific species. However, considering the habitats and occurrence of Psilocybe semilanceata and Psilocybe bohemica, these two species are among the most likely candidates (see page 16 ff.). It is remarkable that these historic portrayals revolve around just one aspect of the mushrooms' overall effects: the occasional semi-schizophrenic reaction which can at times be quite dramatic. None of these accounts reflect a distinct appreciation of mushrooms in the tradition of the Mexican Indians ("teonanacatl" = flesh of the Gods).

Between Reverence and Fear

By contrast, in Europe we find that the symptoms of mushroom intoxication have always been compared to symptoms of mental illness. Such cross-cultural differences in value judgments can be explained in terms of two concepts introduced by R.G. Wasson and his wife: mycophilia and mycophobia. This distinction subdivides cultures with different traditional attitudes towards mushrooms into two groups. For instance, an entrenched dislike for mushrooms (mycophobia) in Britain indicates traditional beliefs vastly different from those found in Slavic countries, where mushrooms are generally cherished (mycophilia). The origins and evolution of such diverging attitudes remain lost in the shadows of history.

The development of early cultural taboos and prohibitions against psychotropic mushrooms may be the root cause of enduring mycophobic behavior. On the other hand, it is possible that, thousands of years ago, the process of harvesting mushrooms as a food source caused alarming clusters of regionally isolated cases of fatal mushroom poisonings. Such experiences may well have seeded a potent and lasting aversion towards an entire country's mycoflora.

Similarly, the mycophilia typical of ancient Mexican cultures goes hand in hand with a general social acceptance of the effects of Psilocybe mushrooms and their established ritual usages. Among Mexican Indian tribes, the effects of psilocybin have never been causally linked to any type of known mental illness. It is interesting to note that the Indians of Mexico were the only Indians in the Americas who also harvested a large number of mushroom species for food.

Unfortunately, our current socio-political climate is - strongly biased against newly discovered hallucinogens, which are often defined in terms of negatively loaded labels. Even worse, such prejudicial thinking distorts an objective, scientifically neutral approach to the study of these substances. The label "fool's mushroom" first appeared during the 1930s, along with "Mexican mushroom of insanity". In the 1950s, the Central American mushroom cults were discovered and the mushrooms themselves were renamed "Mexican magic mushrooms", in recognition of their psychotropic effects and to emphasize the significance of the mushrooms' early integration into the social fabric of the cultures that cherished them.

Later on, the relatively neutral label "hallucinogenic mushroom" came into use in the mycological literature. Other designations that gained and lost popularity over time include the somewhat derogatory term "intoxicating mushrooms" and the essentially meaningless "drug mushrooms".

Scientifically Unbiased Hallucinations?

Following his experiments with magic mushrooms in Mexico during the summer of 1960, T. Leary returned to Harvard University and began to study psilocybin as a variable in the administration of standard psychological test batteries. His initial focus was diluted when he continued to expand his experiments to include increasingly broader settings and applications. In reaction to Leary's markedly unorthodox approach, the American press began to portray psilocybin mushrooms in terms of slanderous terminology that far exceeded the negative connotations of labels such as "fool's mushrooms". Descriptions of the mushrooms' effects included claims that users expericed "death-like states".

Proponents of psilocybin research were accused of denying that the alkaloid caused "semi-permanent brain damage". This pseudo-scientific jumble of meaningless jargon was symptomatic of the sharply escalating controversy surrounding hallucinogenic substances. Increasingly, news reports on psilocybin were eclipsed by massive amounts of publicity about LSD - the most potent hallucinogen ever discovered. The subsequent frenzy of legislative attempts to control LSD resulted in ever tighter restrictions on the scientific study of not only LSD, but psilocybin as well. Mind-altering substances were no longer thought of in terms of their specific effects and properties, but rather were lumped together into a single group of dangerous chemicals. As antidrug hysteria continued to intensify, scientific and pharmacological distinctions became all but irrelevant: hallucinogens were no longer viewed as different from other classes of dangerous and physically addictive drugs, such as heroin or the opiates. This demonization of hallucinogens was successful in spite of massive research efforts that began when Sandoz Pharmaceuticals decided to distribute psilocybin to qualified scientists for experimental and psychotherapeutic purposes. By employing the method for synthesis of psilocybin developed by A. Hofmann, Sandoz Pharmaceuticals manufactured about 2 kg (ca. 4.4lbs) of pure psilocybin for scientific research purposes.

The results of pharmacological testing soon revealed psilocybin as an alkaloid that was perfectly safe for human subjects under controlled experimental conditions. Despite this evidence, the anti-drug legislative framework of the mid1960s firmly established an "official mycophobia", a misguided, yet entrenched policy that still prevails today and effectively prevents the scientific investigation of promising potential applications for psilocybin and other alkaloids. At the same time, mycological and biochemical research studies have shown that psilocybin-containing mushrooms thrive all over the world and can be found on all continents. These mushrooms are no different from any other mycoflora and must not be excluded from scientific investigation because of their alkaloid content.

In addition to overall variations in value systems across cultures, individuals tend to develop their own personal attitudes towards mushrooms in general. Oftentimes, the evolution of specific opinions about mushrooms can be traced back to childhood events, even though such early experiences seldom account for the development of prevailing biases and value systems later in life.

I recall an incident from my own childhood, which occurred when I was about five years old. I was playing in a grassy meadow, when a girl pointed to a brown mushroom and earnestly explained that it was inedible and poisonous. While I have never forgotten this encounter, I did grow up to become a devoted mushroom enthusiast. On the other hand, a different childhood event has left me with the vivid memory of discovering a landfill virtually covered with vast numbers of gilled bluing mushrooms and the sense of awe I experienced contemplating this sight. In general, the unusual characteristics of these mushrooms are most likely responsible for strong impressions formed early in life, which then may develop into various attitudes or beliefs later on.

An enduring personal interest in psychotropic mushroom species can serve to amplify or diminish mycophobic as well as mycophilic dispositions, depending on the influence of other factors. After all, judgments about the benefit or folly of deliberately altering one's state of consciousness are also colored by individual preferences, biases and opinions.

The following chapters are meant to illustrate this diversity of attitudes towards psychotropic mushrooms. Descriptions of planned and involuntary experiments with specific mushroom species offer convincing evidence that the effects of psychoactive mushrooms are open to many possible interpretations.

CHAPTER 3

THE CURRENT STATE OF KNOWLEDGE ABOUT EUROPEAN SPECIES

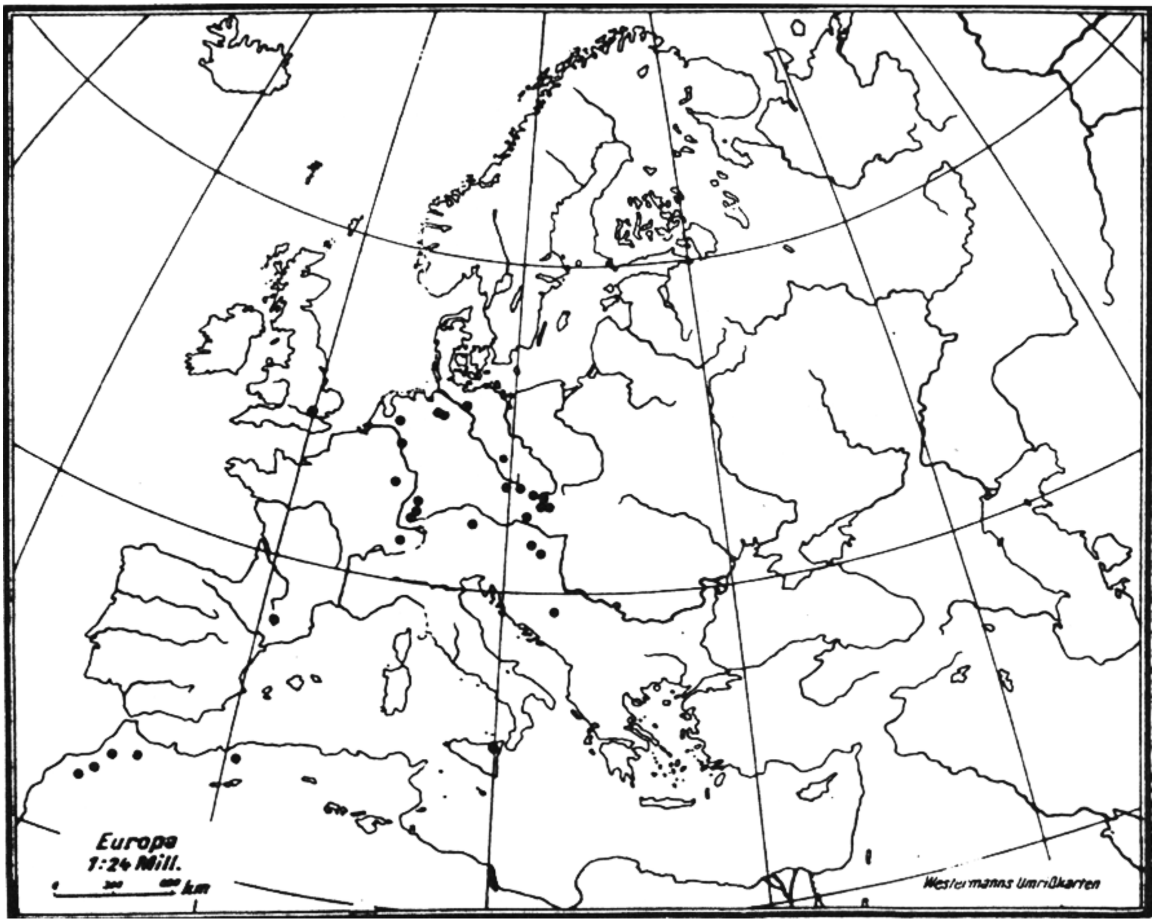


Figure 7 - Distribution pattern of ***Psilocybe cyanescens*** across Europe and North Africa (according to Krieglsteiner). Black dots indicate approximate locations where ***Psilocybe cyanescens*** was found.

Mr. E Branl, on a poisonous Species of Agaric

To the Editors of,, the Medical and Physical Journal.

Gentlemen,

IF the following account of the deleterious effects of a very common species of agaric, not hitherto generally suspected to be poisonous, appears to you likely to prove useful or interesting to the public, you will oblige me by its insertion; should its length be any obstacle to this, I beg you will omit whatever you may think superfluous.

I remain,

Gentlemen,

No.10, Arlington-Street, Yours, most obediently,

Nov. 16th, 1799. EVERARD BRANDE.

J. S. gathered early in the morning of. the third of October, in the Green Park, what he Supposed to be small mushrooms; there he stewed with the common additions in a tinned iron saucepan.* The whole did not exceed a tea saucerful, which he and four of his children ate the first thing, about eight o'clock in the morning, as they frequently had done without any bad consequence; they afterwards took their usual breakfast of tea, &c. which was finished about nine, when Edward, one of the children, (eight years old,) who had eaten a large proportion of the mushrooms, as they thought them, was attacked with fits of immoderate laughter, nor could the threats of his father-or mother restrain him. To this succeeded vertigo, and a great 'degree of stupor, from which he was roused by being called or shaken, but immediately relapsed. The pupils of his eyes were, at times, dilated to nearly the circumference of the cornea, and scarcely contracted at the approach of a strong light ; his breathing was quick, his pulse very variable, at times imperceptible, at others too frequent and small to be counted; latterly, very languid; his feet were cold, livid, and contracted, he sometimes pressed his hands on different parts of his abdomen, as if in pain, but when roused and interrogated as to it, he answered indifferently. yes, or no, as he did to every other question, evidently without any relation to what was asked. About the same time the father, aged forty, was attacked with vertigo, and complained that every thing appeared black, then wholly

* This accuracy may seem trivial, but I have met with people who supported the following symptoms might have arisen from the use of a copper vessel.

Figure 8 - Reproduction of a report from the mycological literature (1799) describing a case of ***Psilocybe semilanceata*** intoxication.

CHAPTER 3.1

PSILOCYBE SEMILANCEATA: THE CLASSIC SPECIES AMONG EUROPEAN PSYCHOTROPIC MUSHROOMS

Listen Well to this Frightful Story from St. James's Green Park....

About 200 years ago, E. Brande published an account about a remarkable case of mushroom intoxication in London. On October 3, 1799 an impoverished family picked some mushrooms in St. James's Green Park and prepared them for a meal (see Figure 8, p. 15).

Shortly after eating the mushrooms, the father and his four children developed symptoms of intoxication, such as markedly dilated pupils, spontaneous laughter and delirium. The progression of symptoms was experienced as wave-like, with cycles of increasing and fading intensity. In addition, the father's visual perception was affected so that everything around him appeared to be black - a frightening experience he believed to presage his impending death.

Even though two family members (ages 12 and 18) consumed only small amounts of the cooked mushrooms, the ensuing symptoms of intoxication were no different from those observed in family members who had eaten comparatively larger portions. After several hours, the psychic and perceptual disturbances subsided and finally disappeared, without any lingering side effects. Attempts to treat acute symptoms included administration of emetics and fortifying tonics. In the end, these potions were heralded as the crucial treatment that "cured" the family.

For the most part it is extremely difficult, if not impossible, to assemble complete and accurate details on many aspects of magic mushroom history from source materials available today. Thus, it is an instance of rare good fortune and a boon to mushroom historians that E. Brande's description of a typical psilocybin syndrome was augmented by J. Sowerby, author of "Coloured Figures of English Fungi or Mushrooms" (London, 1803). Sowerby's book included a rendition and description of the mushroom species responsible for the poisoning case described by Brande (see p. 17). Within the context of Sowerby's book, only the variety of mushrooms distinguished by their cone-shaped caps were believed to cause intoxication. Figure 9 shows a typical rendition of Psilocybe semilanceata. This mushroom species was known to Sowerby's contemporaries as "Agaricus glutinosus Curtis" and its descriptions are fully compatible with current knowledge about Psilocybe semilanceata.

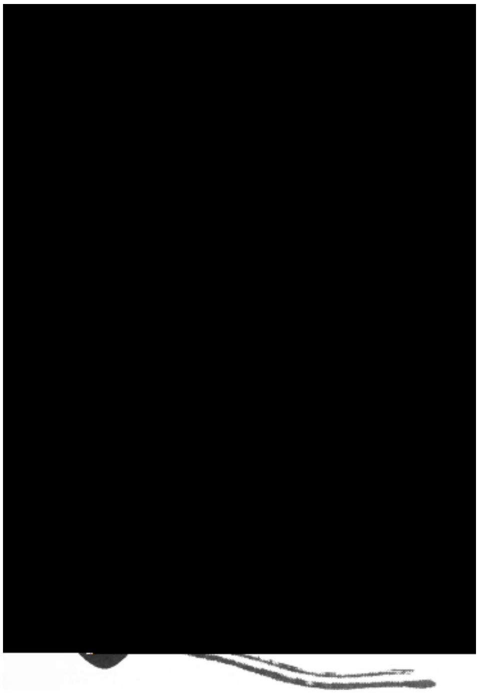
A few years later, renowned Swedish mycologist E. Fries referred to "Agaricus semilanceatus" in his book entitled "Observationes Mycologicae" (1818). Later on, the same mushroom also appeared under the names Coprinarius semilanceatus Fr. or Panaeolus semilanceatus (Fr.) Lge. Not until 1870 did Kummer and Quelet classify this mushroom as a member of the genus Psilocybe. Consequently, two valid designations may be found in the literature:

-- Psilocybe semilanceata (Fr.) Kumm. or --
-- Psilocybe semilanceata (Fr.) Quel.

Around 1900, M. C. Cooke reported two or three new instances of accidental mushroom intoxication involving children in England. Interestingly, Cooke noted that symptoms were caused only by a variety of mushroom known to turn blue (var. caerulescens). He was the first mycologist to wonder if a bluing variety of this species was poisonous, or if the bluish color was induced by external factors, causing changes in the mushroom's chemical composition so as to render them poisonous.

Early Descriptions

A close relative of Mexico's psychoactive species, Psilocybe semilanceata is a mushroom whose physical appearance resembles Psilocybe semperviva Heim & Cailleux and Psilocybe



Stalks generally single, sometimes clustered, from two to four inches in height, the thickness of a goose quill, thread shaped whitish almost solid, the tube being very small, glutinous; ring, a little below the cap, scarce perceptible.

“ Cap, from one to two inches in breadth, of a brown color; in the full. grown ones hemispherical, always convex, and more or less glutinous; wet with rain, it becomes browner and transparent,'so that it sometimes appears striated.

“ Gills numerous, single, of a brownish purple color, clouded; whole ones about twenty, horizontal, three shorter ones placed betwixt them; they throw out a powder of a brownish purple color."

With respect to the use of it, he says, « There is nothing acrimonious or disagreeable in its taste, yet its appearance will not recommend it to the lovers of mushrooms."

Figure 9- Drawing and description of ***Psilocybe semilanceata*** by J. Sowerby (London, 1803).

1733. A. semilanceatus Fries (Observ. II. pag. 178).

Synon. : Agaricus semiglobatus Sowerby (Engl. Fungi taf. 240. fig. 1-3). Hut etwas hautig, spitz kegelfdrmig, fast zugespitzt, 1 1/2 Cent. breit, 1/2 Cent. hock, feucht klebrig, fein streifig, gelb oder grunlich, zah, mit Anfangs umgeknicktem Rande und leicht trennbarer Oberhaut. Stiel zah, gebogen, 11 Cent. hock, kahl, blass. Lamellen angeheftet, aufsteigend, purpur-schwarz. Sporen ellptisch, hellbraun, 9 -16 u lang, 4 - 9 u dick.

Ax Wegen, auf Grasphitzen, besonders wo Mist gelegen hat.

spitzkegeliger Kahlkopf (Psilocybe semilanceata). Kegel-glockenformig mit papilenertiger spitze Hut-o,5-1 cm breit, bis 2cm hock, lehmfarben mit oliv-grunem Stich, klebrig. Lamellen breit, oliv-lehmfarben, spater purpurbraun. Stiel schlank, glanzend. - Gedungte Wiesen, Wegrander. Stellenweise. Wertlos.

Figure 10- Two descriptions of ***Psilocybe semilanceata*** from the German-language literature. The first description (top) was written over a hundred years ago, while the second one (bottom) dates to 1962. Significantly, the more recent entry classifies the species as "essentially worthless". Also see Figure 11.

Impressive Experiences

Psilocybe bohemica is a very psychoactive species. Its effects are vividly documented in the following account of one natural scientist's experience as part of controlled clinical trials in Prague:

About 30 mg of psilocybin in mushroom tissue was prepared in hot water, with effects already noticeable ten minutes after ingestion. I grew increasingly quiet. At first, my legs began to tingle, then my underarms as well. Aside from a deeper breathing rhythm, few other somatic effects were noted. Initially there were fits of laughter caused by unusual cognitive associations; this laughter also affected the two "sober" guides. A growing hyperacuity interfered with the ability to listen to music, so that Vivaldi's "Springtime" caused painful stabs inside the brain. I compared the pain to that caused by a "sawing knife". The experimenters appeared bloated and yellow... Existing bodily characteristics, such as thinning hair stimulated a person's illusionary transformation into a monk with tonsure. Their voices also appeared reverent and, from a somewhat paranoid point of view, these gentlemen at times seemed to be working a switching station that, for some reasons, was my enemy. At the same time, I found both of them to be quite likeable. During this time period, the other female subject perceived fantastic images of moving colors and saw visions of her whole life unfolding behind closed eyes. During this period, I had the distinct impression that an electrical current was flowing through my body, which was not an uncomfortable sensation. About three hours later, the gentlemen retired to the kitchen and the nature of the experience changed quite drastically.

At first I felt as if my legs were increasingly merging into the wall, a very comfortable experience. In a state of utter clarity of consciousness, I finally felt as if I had no body at all. I said. "The most descriptive expression is the experience of a pure soul". Using words as triggers, we were able to induce shared experiences of color visions and we travelled together around the word as well the spiritual realm. She made a clearly telepathic statement about my hometown, which I could not fathom or interpret at the time, nor could I do so later on. While under the impression that the thinking process itself was something supernatural, I was filled with confidence when I realized without a doubt that death itself was but a levitation of the soul, which may or may not entail looking down upon the "normal" world. I did, however, anxiously reject her offer to see into my future and tell me about what she learned. Yet 1 knew that she was already seeing such things.

The above account vividly illustrates the cosmic-mystical aspects of the mushrooms' effects. Such effects have frequently been described following ingestion of high doses of hallucinogens, especially in cautious and protective environments ("setting") coupled with a positive, internal mood ("set") primed by careful preparation. Of course, the detailed content of such experiences varies across individuals. Pahnke's masterful study during Good Friday Services in 1962 has become a famous event in the history of research into these states of consciousness.

Three years later, a remarkable range of effects was observed in the same participant of an experiment conducted in Prague, where mycelia from Psilocybe bohemica were used. Due to an analytical error, the four participants each ingested 72 mg of psilocybin, plus some psilocin, instead of the intended dosage of 30 mg of psilocybin each:

Days before the experiment, I already began to suspect that this experience would not evolve as smoothly as it had three years ago, given the amount of personal stress I had suffered over the previous two months. However, I had faith in the expertise provided by psychiatric guidance. Prior to the experiment, I asked the psychiatrist about the possible causes underlying my seeming inability to fully experience the unfolding of visual imagery. He brushed aside my question with a short and terse reply : "Resistance", which only heightened my feelings of anxious tension.

After ingestion of the hot preparation, fifteen minutes passed until the sudden onset of its effects. I ceased to perceive the music and sank into an autistic state devoid of visions which lasted for three hours. This state was subjectively experienced as one of confusion with a partial loss of consciousness as well as the loss of a sense of time and place. This torturous period, however, did not include any rough somatic disturbances. After I woke up, I felt like a broken machine; only the compassion of the other participants, which were also suffering, helped to clear my head temporarily. My experimenter attempted to counterbalance these effects and to provide a firmly grounded focus of reality, but his efforts were unsuccessful in the long run. I felt as if I was extremely drunk, except there was none of the aggression typical of alcohol intoxication. Soon afterwards, I began to project my emotions onto the psychiatrist. I saw him undergo illusionary changes; initially he appeared to be a dominant rooster which transformed into a punk rocker. Then 1 felt that he would understand what 1 was going through, given his extensive background and experience with psycholytic therapy. So I asked him, if the two of us could retire to another room. When he consented, I began to undergo a psychic split. The sound of my voice was strange and whiny. I felt as if part of me had split off and become an observer, while the rest of my prone body had assumed the position of an infant, sucking on a finger and crying, crumbling up tissue papers at the same time. On the psychoanalytic level, an extraordinary experience began to unfold. I became conscious of all recent and past conflicts, especially those involving my parents. This part of my personality articulated and worked through the emerging conflicts. Even though one might assume this process was facilitated by the psychiatrist, this was not the case. In the semi-darkness 1 perceived him as my deceased grandfather, as a human skull and as an American football player, whose armor I recognized as a projection of my own uptight personality.

Afterwards I looked at my reflection in a large mirror and reconciled my differences with myself as the two halves of my personality merged into one. I saw a soft and tearful face and soon realized that the person I was looking at was none other than myself, that I had learned to accept myself, in spite of all my problems. At the time I also noticed that my self-disciplined behavior was overly exaggerated, a trait generally judged as unfavorable by those around me. I resolved to become more relaxed and carefree in attending to my daily routines. I believed this psychological insight to be a revelation. With my eyes closed, I saw images of translucent vessels atop a brilliantly blue surface. In the weeks and months after the experiment, those around me noticed that my behavior had changed to become more relaxed, which was mentioned spontaneously on several occasions.

The experience of an initial, painful delirium illustrates a resistance to dealing with the conflicts that invariably emerge in response to high dosages - conflicts that were resolved through an intense psycholytic catharsis (also see Chapter 9). A psychedelic experience ensued as both parts of the divided personality were merged into a whole. This is a decidedly positive outcome of a psycholytic episode with corresponding therapeutic benefits - a result that was entirely unintended (!). Personal stress prior to the experiment apparently facilitated the manifestation of deep-seated conflicts and issues that might otherwise never have been dealt with. With the exception of the attending psychiatrist, outside observers appraised this experience as a "bad trip". The subject, however, thought the experience to be enlightening and illuminating, even five years after it took place. Grof describes very similar reactions to LSD therapy. After "going through Hell", subjects proceed to re-integrate their personality at a higher level of consciousness, while experiencing visionary images of clear, bright lights and illumination.

TABLE 3

Concentrations of Psilocybin and its Derivatives in Psilocybe bohemica (% of Dried Mushrooms)

Specimen #	Weight (mg)	Psilocybin	Psilocin	Baeocystin
1	31	1.34	0.00	0.01
2	90	0.94	0.01	0.01
3	104	0.41	0.00	0.02
4	175	0.90	0.00	0.01
5	200	0.71	0.01	0.02
6	220	0.37	0.00	0.01

Distribution Patterns of Psilocybe cyanescens in the Wake of Environmental Changes

In 1973, Semerdzieva and Nerud first reported the existence and qualitative content of psilocybin in collections of Psilocybe bohemica. This research team reported psilocybin levels of up to 1.1 % in dried samples. Results from my own studies also revealed variable levels of alkaloids in different mushrooms collected at the one location near Sazava.

In spite of the intense blue staining reaction, there is very little or no psilocin in mushrooms of the European Psilocybe cyanescens complex. By chemical-taxonomic standards, European collections are very different from Psilocybe cyanescens samples collected in the Pacific Northwest of the United States. The latter are known to contain up to 1 % psilocin (dried mushrooms) as well as an equally high level of psilocybin (for a total alkaloid level of 2 %), making it one of the most potent species in North America. The study of extracts derived from these mushrooms revealed that enough psilocin was present for the oxidized compound to be visible on a thin-layer chromatography plate. This was not the case when similar analyses were performed on mushrooms collected in the former Czechoslovakia. However, mushrooms from both countries contain similarly low levels of baeocystin.

Generally we can say that this potently psychoactive and conspicuous species is in the process of expanding its habitat across Europe. Increasing use of fertilizer, the acidification of the soil in many regions and the presence in any wet forest or park of a variety of fertile substrates, such as mulch, not dependent on the presence of dung, are all factors that will likely help Psilocybe cyanescens achieve a remarkably wide area of distribution in the future.

Figure 26 - Psilocybe bohemica on twigs and compost.

CHAPTER 3.3

PANAEOLUS SUBBALTEATUS - MYCOLOGY AND MYTHS ABOUT THE PANAEOLUS MUSHROOMS

Stories about involuntary intoxications with the dark-spread dung-inhabiting mushrooms (genus *Panaeolus*) in various regions of the world have been in circulation since at least the early 19th century. In 1816, an impoverished man collected mushrooms in London's Hyde Park which he thought to be edible white mushrooms ("champignons", *Agaricus bisporus*). Soon after ingesting these mushrooms, his field of vision darkened and he saw fog while feeling lightheaded and dizzy.

Trembling, he sank into his chair. He felt all his strength draining from his body and he grew oblivious to his surroundings and no longer knew where he was. Some time later, the feelings of dizziness subsided, and his heart rate slowed down until he was finally able to fall asleep.

The symptoms were later attributed to "*Agaricus campanulatus* Linnaeus", which the man had mistaken for champignons. The same species had been responsible for a similar case of intoxication that happened about a year earlier. Both accounts are highly reminiscent of the 1799 intoxication with *Psilocybe semilanceata* from St. James Green Park (see p. 15). This would seem to be quite logical, as there are psilocybin-producing mushrooms even among the genus *Panaeolus*. However, the question which of the 15 European species actually produce the psychoactive substance is an issue that remains the subject of considerable scientific controversy. Even though I cannot offer any decisive or final evidence towards the resolution of this problem, there are some fairly conclusive results from modern biochemical analyses (see Table 4 below) of mushrooms that were clearly identified or obtained from herbariums, where certain species were known to have been deposited. Specifically, many American species within the genus *Panaeolus* do not appear to be the same as European species with the same name.

At this point, I would like to present some historic cases of *Panaeolus* intoxications.

A typical hallucinogenic experience blamed on the accidental ingestion of *Panaeolus papilionaceus* (Bull.:Fr.) Quel. occurred in Maine, USA, in 1914.

Below is an abridged version of the description of effects by a Mr. W.:

On July 10, 1914, 1 gathered a good mess of the mushrooms (*Panaeolus papilionaceus*) and had them cooked for dinner. .... They were all eaten by Mrs. Y. and myself. Peculiar symptoms were perceived in a very short time.... A little later, objects took on peculiar bright colors. A field of redtop grass seemed to be in horizontal stripes of bright red and green, and a peculiar green haze spread itself over all the landscape... Soon both of us became very hilarious, with an irresistible impulse to laugh and joke immoderately, and almost hysterically at times.... I then had a very disagreeable illusion. Innumerable human faces, of all sorts and sizes, but all hideous, seemed to fill the room and to extend off in multitudes to interminable distances, while many were close to me on all sides. They were all grimacing rapidly and horribly and undergoing contortions, all the time growing more and more hideous. Some were upside down. The faces appeared in all sorts of bright and even intensive colors - so intense that 1 could only liken them to flames of fire, in red, purple, green and yellow colors, like fireworks.... The entire experience lasted about six hours. No ill effects followed. There was no headache, nor any disturbance of the digestion.

During the winter of 1915, a species of *Panaeolus* spontaneously appeared in a mushroom greenhouse in New York. These fruiting bodies were accidentally eaten together with the champignons that were cultivated there. This error led to cases of intoxications so remarkable that Murrill described the mushroom as *Panaeolus venenosus*. Some time passed before it was discovered that this species had previously been described as *Agaricus* subbalteatus B. & Br. from England in 1861. The combination term that is in use today, Panaeolus subbalteatus (B.& Br.) Sacc. was first published in 1887.

Other cases of intoxications with similar symptoms caused by the Panaeolus species have been reported in the United States (1917), as well as from Australia (after 1940), where the species involved was described as "Panaeolus ovatus Cooke & Massee".

In 1939, these reports induced Schultes, in agreement with Linder's classification experiments, to publish as Panaeolus sphinctrinus (Fr.) Quel. the teonanacatl mushroom described in the Mexican literature from the 16th and 17th centuries.

However, Wasson, Heim and their collaborators, as well as Singer, were unable to document the usage of Panaeolus mushrooms in Mexico, in addition to their reports about the usage of psychoactive Psilocybe species from the 1950s. By 1959, even Guzman referred to this species as "the false teonanacatl". So far, he has been unable to document native usage of any Panaeolus species in Mexico. In fact, the natives of Mexico consider bluing, hallucinogenic Panaeolus mushrooms to be poisonous.

Despite the poisoning case reported in England, the early German literature does not classify Panaeolus species as poisonous (see Figure 27). The Psilocybe species were treated similarly.

Figure 27 describes the mushroom's characteristics as accurately as Figure 3 (p. 6) depicts its habitus. More recent descriptions are usually less detailed and thorough than Michael & Schulz's from 1927.

In Germany, a case of intoxication with Panaeolus mushrooms was first reported in 1957 (see Figure 28). From today's perspective, it appears that the mushroom responsible for the intoxication was most likely Panaeolus retirugis (Fr.) Gill.

About 30 to 60 minutes after ingestion of the cooked mushrooms, the woman's field of vision began to quiver increasingly. At the same time, her pupils were extremely dilated. As she began to have difficulties breathing, she suffered a full-fledged anxiety attack. All objects appeared as if obscured by curtains. After the effects had subsided, no symptoms of lasting damage could be detected.

In 1970, another poisoning case with Panaeolus subbalteatus occurred in Leipzig. Similar to the 1915 incident in New York, the mushrooms spontaneously emerged among a culture of artificially cultivated mushrooms (Stropharia rugoso-annulata Farlow, in this case) and then were eaten by mistake. The description of its effects is somewhat peculiar.

Growing on Dung, Manure and Compost

The stories about intoxications as well as the very name "dung-inhabiting" mushroom offer clues about the kinds of habitats this species prefers to grow in.

At times, they grow directly on top of dung or on pastures that have been heavily fertilized. They are also found on trash heaps, on compost or on straw substrates where mush rooms are commercially cultivated. European Panaeolus species that produce psilocybin have a special attribute that differentiates them

Psilocybe species: they very seldom develop blue stains when handled or injured.

In his description of a Scottish case of intoxication in 1977, Watling mentions marked blue colorations along the caps of stems of Panaeolus subbalteatus, which also developed in reaction to pressure. According to my observations, the formation of blue stains is very rare. Reports from the Pacific Northwest United States also state that only one in a hundred mushrooms actually turns blue.

One controversial issue in the literature concerns the toxicity of one species: Panaeolus foenisecii (Pers.:Fr.) Kuhn. This species has previously been classified as Psilocybe as well as Psathyrella, and has been described as Panaeolina in contrast to Panaeolus, because it is a species that does not grow on dung, fruits only after the hay harvest, and develops spores that are purplish-brown and abrasive. Other Panaeolus species, however, have black spore prints when placed on white paper underneath a glass vessel to prevent dehydration. But, even the spores of Panaeolus foenscecii (Pers..-Fr.) Kuhn. do not all ripen at the same time, which can cause the gills to appear mottled.

Due to the complications with taxonomic differentiation, there are certainly no reliable

192. Gezonter Düngerling. Wertlos. Panaeolus subbalteátus Berk. u. Br.

Der Hut ist flachglockig, stumpf, in der Mitte öfter etwas gebuckelt, meist 3 bis 4, manchmal auch bis 5 cm breit, hygrophan, im feuchten Zustande rotbraun, trocken blaß, bräunlich-fleischfarben, am Rande eine Zeitlang durchwässert dunkler gezont, glatt oder etwas runzelig, kahl, schleierlos, ziemlich fleischig.

Die Blätter sind erst rotbräunlich, schließlich rußig-schwarz, ziemlich gedrängt, bauchig, 7 bis 8 mm breit, dicklich, am Stiel angeheftet, später von ihm getrennt.

Die Sporen sind fast zitronenförmig, 13 bis 14 μ lang und 8 bis 9 μ breit, glatt, schwarz, undurchsichtig.

Der Stiel ist schlank, fast gleichmäßig dick, oft verbogen, 4 bis 8 cm lang und 3 bis 4, seltener bis 5 mm dick, rotbräunlich, seidig-faserig, nur oben schwach bereift, engröhrig-hohl, zerbrechlich.

Das Fleisch ist blaß, geruchlos und von mildem Geschmack.

Zeit und Standort: Der Pilz wächst von Juni bis Oktober büschelig, fast rasig, an grasigen Orten, besonders üppig auf gedüngten Äckern, kommt aber seltener vor.

192. Panaeolus subbalteatus Berk.u.Br.

The cap is broadly convex, obtuse, often with a slight umbo in the middle, usually 3-4 cm broad, sometimes up to 5 cm. Hygrophanous, reddish brown when wet, pale and brownish to flesh-colored when dry. Margins moist to watery at times, and banded with a dark brown stripe around the edges. Surface smooth or lightly wrinkled, bald, rather fleshy, no veil.

The gills are reddish brown when young, later on sooty or black, gill spacing is rather crowded and bulgy, gills are 7-8 mm wide and somewhat thick. Gills are initially attached to the stem, and detached later on.

The spores are almost lemon-shaped, 13-14u long and 8-9,u wide, smooth, black and opaque.

The stems are slender, 4-8 cm in length and uniformly thick (3-4 mm, sometimes up to 5 mm). Stems are often curvy and reddish brown in color; silky-fibrous with a slight ring at the top. Stems are narrowly tubular and break easily.

The flesh is pale and odorless with a mild taste.

Habitat and season: The mushroom grows cespitosely to gregariously from June through October in grassy areas. It particularly thrives on fertilized fields and pastures, but occurs there comparatively less often.

Figure 27 - Description of Panaeolus subbalteatus by Michael & Schulz from 1927 (with English translation below)

Eine Düngerlingvergiftung in Bremen

Von W. Neuhoff

Vergiftungen durch die schwarzsporigen Düngerlinge (*Panaeolus*) kommen anscheinend nur selten vor. Bekanntgeworden sind bisher vereinzelte Fälle aus Nordamerika und England. Die Schilderung des Krankheitsverlaufes geht im wesentlichen zurück auf Louis C. C. Krieger – »A popular guide to the higher fungi (mushrooms) of New York State«, 1935, S. 147 –, der die Symptome als ähnlich denjenigen einer Alkoholvergiftung beschreibt: Schwierigkeiten beim Stehen und Gehen, unzusammenhängendes und unangebrachtes Reden und Lachen, visionäres Schwanken oder Tanzen von Gegenständen der Umgebung. Hinzu kommen bemerkenswerte Halluzinationen prachtvoller Farbenzusammenstellungen. Äußerlich besonders auffallend sind die geröteten Augen und die Erweiterung der Pupillen.

Figure 28 - First description of a Panaeolus intoxication in Germany (1957). Symptoms are compared to those of alcohol poisoning, such as difficulties standing or walking, incoherent or inappropriate laughter and talking, and visions of objects moving or dancing. Other symptoms include remarkable hallucinations with splendid color combinations, as well as red eyes and dilated pupils.

Figure 29 - Panaeolus cyanescens in Hawaii (USA).

Figure 30 - Gymnopilus purpuratus on sawdust.

maps showing distribution patterns for the European Panaeolus species.

Taxonomic Confusion

On May 25, 1986, in the village of Heringsdorf on the Eastern German Sea Coast, I found 147 fruiting bodies of Panaeolus subbalteatus in all stages of development. They were growing on a compost heap that originally contained horse manure. Unlike the Psilocybe species, Panaeolus mushrooms can be found anytime from spring throughout the fall season. The differentiation of Panaeolus species is further hindered because they are very hygrophanous, with caps whose colors can change from whitish to grey, or from reddish brown to a very dark black-brown. Older mushrooms on the compost heap had caps that had cracked with age, and margins that had curved upwards and were covered with spore dust. Only two mushrooms had blue-stained caps, and the stems did not change color in reaction to pressure. In the American literature Panaeolus subbalteatus has been labeled "Panaeolus variabilis", because some of the stems imitate the appearances of other mushroom species and thereby contribute to the taxonomic confusion. The species is also known to grow in the immediate vicinity of Panaeolus foenisecii (Pers.:Fr.) Kiihn., creating more opportunities for mistakes, especially if the mushrooms are not closely inspected. The caps of Panaeolus subbalteatus become flat as the mushrooms age, a feature that is taxonomically significant.

The cap's long, watery marginal zone gives the mushroom its name. Only the psilocybin-producing species will be discussed in more detail below. Results from recent comprehensive analyses clearly show that Panaeolus subbalteatus is the most important psychoactive European species among the genus Panaeolus. Ola'h's world monograph about the genus Panaeolus was published in the 1960s and has caused much confusion, since he described a number of species as "latent psilocybin-producers". He proposed, for example, that Panaeolus foenisecii occasionally produces psilocybin. All Panaeolus species share one characteristic that differentiates them from all other species discussed in this book: They produce 5-substituted indole compounds, such as serotonin and its biochemical precursor, 5hydroxy-tryptophan. Serotonin is a compound widely found in animals and humans. It acts as a neurotransmitter in the brain, even though not all of serotonin's effects have been entirely understood. It should be noted, however, that both serotonin and 5-hydroxy-tryptophan are completely inactive when taken orally. When performing paper or thin-layer chromatographies, both of these substances can easily be mistaken for psilocin. It is remarkable that Ola'h's results contradict recent findings, in that his data frequently showed the existence of psilocin in Panaeolus species!

More recent studies of carefully identified mushroom material from the European Panaeolus species did not document substantial amounts of psilocin in these samples. Also, "chemical races" associated with specific species could not be established. I believe that almost all accidental intoxications can be traced to ingestion of Panaeolus subbalteatus, with the possible exception of one case caused by an imported tropical species. Very little is said in the literature about Panaeolus retirugis, its area of distribution and chemical composition. The intoxication case from Bremen, however, indicates that this species is psychoactive (see Figure 28). In 1985, I found two fruiting bodies in a pasture, whose dried weight contained 0.03 - 0.05 % psilocybin, as well as serotonin. All of the mushrooms' features, such as wrinkled, fleshcolored caps, corresponded to descriptions of Panaeolus retirugis.

Based on his analyses, Stijve concluded that the dried fruiting bodies of Panaeolus subbalteatus contain about 0.1 % psilocybin, regardless of location, as well as a tiny amount of baeocystin. Still, accounts of intoxications with consistently potent psychoactive effects would seem to provide evidence against such small amounts of alkaloids in Panaeolus subbalteatus. Indeed, dried mushrooms from the Pacific Northwest region of the United States have been reported to contain 0.16% - 0.65% psilocybin. Moreover, the first analyses of the species in North America (1959) led to the isolation of a water-soluble indole compound which is now generally thought to be baeocystin. My own analyses of mycelia and 19 fruiting bodies from the Heringsdorf location indicated levels of psilocybin that are fully compatible with the data from the United States:

TABLE 4

Ingredients Found in Mycelia and Fruiting Bodies of Panaeolus subbalteatus (% of Dried Material)

Ingredient	Mycelia	Fruiting Bodies
Psilocybin	0.07	0.08(stem)-0.70
Psilocin	0.00	0.00
Baeocystin	0.00	0.05(stem)-0.46
Serotonin	0.10	0.08-0.30
Urea	0.00	1.80-2.30(cap)

Table 4 shows that the nature and relative amounts of the substances found are different in the fruiting bodies compared to the base mycelium, which was tested here for the first time.

As far as active ingredients are concerned, levels of urea are trivial. The substance does, however, have some significance in terms of chemo-taxonomy. Among species discussed here, urea is present only in Panaeolus and Pluteus species. Urea was detected "incidentally" during thin-layer chromatography testing intended to discover the presence of indole compounds. Stijve has collected and tested samples of Panaeolus foenisecii from eight countries across three continents (namely, America, Europe and Australia), but has consistently failed to find psilocybin in addition to 5-substituted indole compounds. My own analyses of 100 mushrooms from a wide variety of locations across Germany also failed to confirm the presence of this alkaloid and its derivatives. While the local European species that are discussed here also tend to occur on other continents (Panaeolus subbalteatus, for example, grows in Hawaii), there are tropical varieties of this genus which are highly psychoactive as well. Given the best possible climate conditions, these species may fruit adventively in Europe for short periods of time.

Panaeolus cyanescens is the most well-known representative of these species (see Figure 29). Like other tropical Panaeolus and Psilocybe species, Panaeolus cyanescens exhibits a strong blue staining reaction. The large number of existing synonyms for the species, as presented by Gerhardt (see Figure 31), again indicates substantial taxonomic confusion, as well as insufficient communication and exchange of information.

Panaeolus Experiences

Sometimes it is difficult to avoid the conclusion that many prominent mycologists are only too willing to disregard existing research results in order to attach their names to definitions of "new" species. Singer lists Panaeolus cyanescens separate from Panaeolus as belonging to the genus Copelandia, along with other species. Nowadays, this classification is becoming increasingly unpopular among mycologists, and many of them do not accept it.

Panaeolus cyanescens is responsible for a number of remarkable intoxications which occurred on August 19, 1965 in Menton, located on the French Mediterranean Coast. The mushroom spontaneously appeared on compost which consisted of straw and decayed horse dung. The compost was intended to improve lawn quality. It should be noted that the horse dung came from a race track used by horses from tropical countries. Under these circum-stances, it is quite likely that the species responsible for the intoxications was imported to the location from another country. On one occasion, in the early 1970s, Panaeolus cyanescens was found at the Budapest Fairgrounds next to the pavilions from Thailand and Vietnam!

About the course of the intoxications: A woman and her two children ate a meal consisting of only about 60 g (2.1 ozs.) of the mushrooms. Within less than fifteen minutes after ingestion, she began to feel weak, followed by visual disturbances and marked dilation of the pupils. About one hour after the meal she developed dizzy spells that came and went in waves. Increasingly, all colors in her immediate surroundings coalesced into shades of green. The hallucinations were fearsome; the heads of monsters became visible and a wall opened up into an abyss. There was a succession of human figure with animal heads. The next day, everything was back to normal. The oldest child (age 14) also saw her parents' hair color turn green, had dilated pupils and watched geometric shapes appear on the wall. The youngest child (age 11) experienced cramps and lost consciousness.

In 1960, Singer and Guzman suggested that Panaeolus cyanescens might contain psilocybin, because of the intense blue staining they had observed. It wasn't until after the intoxications in Menton had been publicized, that a research team working with A. Hofmann detected 0.2% of psilocybin in the mushrooms. Considering the powerful effects, however, this concentration appears to be too low to cause such impressive reactions. Later on, Sandoz Laboratories reported the level of psilocybin in dried samples as 0.8%, along with 1.2% psilocin. The level of psilocin, however, may have been falsely elevated by the presence of serotonin and its derivates in the mushroom sample that was being tested.

According to Stijve, a mushroom sample collected by J.W. Allen in Thailand contained 0.4% - 1.05% of psilocin, with only trace amounts of psilocybin; serotonin was present in large amounts, comparable to concentrations found in all Panaeolus species.

Apparently, Panaeolus cyanescens produces more psilocin than psilocybin. Still, I was able to detect 0.4% of psilocybin in mycelia cultivated on malt agar, with no other indole compounds present.

Discussion of the Panaeolus species would remain incomplete without pointing out that those subjectively terrifying psychoses reported in 1965 cannot be attributed to a specific mushroom ingredient, but were likely precipitated by the circumstances (set and setting) surrounding the incident. The effects described by J. Allen in Hawaii after eating 20 specimens paint a different picture altogether:

With radio music playing softly in the dark, euphoria began to come on in waves. After 20 minutes, visions became so intense that I tried to close my eyes. Whenever 1 did close my eyes, my eyelids felt as if they were being sprayed from the outside. Colors were sharp and clear, but I always quickly opened my eyes again. Colors were dancing like laser beams to the rhythm of the music. The stars in the sky assembled in clusters that reached all the way into my soul. I was a little scared at the idea that the ocean water might rush up all the way into our hut. Other than that, feelings of euphoria were overwhelming. At times, I was overcome by fits of laughter. That night, I slept like "a prince ". The following morning I gathered up my belongings and had to walk back across the pasture where I had collected the mushrooms the day before. I noticed a lot of new mushrooms that had grown during the previous night's rainfall. By way of a lingering after effect I felt that the mushrooms were sending me a message: "Don't forget us, come back, if you can ".

It is important to keep in mind that more comprehensive studies on taxonomy and biochemical composition are needed in order to fully understand the Panaeolus species. Perhaps A. Weil's suggestion that Panaeolus subbalteatus from America's Pacific Northwest induces comparatively stronger somatic effects than the Psilocybe species can be investigated chemically as well as toxicologically, in order to reject or support this hypothesis.

1. Panaeolus cyanescens (Bk. & Br.) Sacc. – Syll. Fung. 5: 1123 (1887)

Bas.: *Agaricus cyanescens* Bk. & Br. – Journ. Linn. Soc. 11: 557 (1871)
Deutsche Namen: Blauender Düngerling, Falterdüngerling.
Synonyme:
Copelandia papilionacea (Bull.) Bres., non Fr. – Hedwigia 53: 51 (1913)
Campanularius anomalus Murr. – Mycologia 10: 32 (1918)
Panaeolus anomalus (Murr.) Sacc. & Trott. – Syll. Fung. 23: 323 (1925)
Campanularius westii Murr. – Lloydia 5: 154 (1942)
Panaeolus westii (Murr.) – Lloydia 5: 157 (1942)
Copelandia westii (Murr.) Sing. – Mycologia 36: 552 (1944)
Copelandia cyanescens (Bk. & Br.) Sing. – Lilloa 22: 473 (1951)
Copelandia cyanescens (Bk. & Br.) Boedijn – Sydowia 5: 222 (1951)

Dieser mittelgroße Düngerling ist durch sein blauendes Fleisch und die an den Lamellenflächen vorkommenden dickwandigen Zystiden (Metuloiden) gut gekennzeichnet. Die ziemlich breiten, glatten, deutlich abgeflachten Sporen tragen einen breiten Keimporus. Maße: 11–14(15) x 8–11 x 6,5–8 µm. Der 1–4 cm breite Hut ist weder hygrophan noch schmierig. Die Farben sind, wie bei allen Düngerlingen, sehr veränderlich und variieren von dunkelbraun bis hin zu hellgrau. Ein Velum ist nicht vorhanden.

Figure 31 - Synonyms for ***Panaeolus cyanescens*** (according to Gerhardt).

CHAPTER 3.4

INOCYBE AERUGINASCENS: FAST-SPREADING NEW ARRIVALS

On June 15, 1965, 1. Ferencz discovered fruiting bodies known as "fibrehead mushrooms" in Osca, Hungary, county of Pest. The mushrooms' characteristics did not match those of any known species of the genus *Inocybe*, as described in the literature. That same year, as well as on several occasions later on, Ferencz and other mycologists found large numbers of mushrooms of the same species growing in different locations. Eventually, in 1968, these mushrooms were described as a new species named *Inocybe aeruginascens* Babos (see Figure 33, p. 47).

Strange Distribution Patterns in Hungary and Germany

In 1985, a few mycologists who specialized in the study of the genus *Inocybe* found fibreheads with greenish discolorations in 17 locations (46 specimens) across Hungary. In her 1983 article, Babos noted that *Inocybe aeruginascens* had become the most common mushroom of the Lower Valley's sandy areas around the Hungarian capital city of Budapest. The species is known to fruit across these areas, singly or in gregarious clusters on the sandy soil of the poplar forests, or in mixed forests that include poplars. They have also been found on meadows near poplar trees. The mushrooms are loyal to the location and grow there every year, climate conditions permitting.

In 1975, Kaspar collected the Inocybe species in Berlin (K6penick District) as well. More detailed studies revealed that the mushrooms had previously been misidentified. As early as 1965, fruiting bodies of the species were found in the. arboretum at Berlin (Baumschulenweg District). The species had been noted "in passing" by other mycologists with little interest in the mushrooms. Many species (about 160) of the large European *Inocybe* genus cannot be easily differentiated from each other, and therefore attract little interest from expert mycologists. The species are part of a large group of mushrooms that are nicknamed "LBMs" (Little Brown Mushrooms) in the American literature and as such they often entail considerable taxonomic problems. Other examples of mushrooms in this group are the *Panaeolus* species as well as those of the genus *Psilocybe*.

Whenever a "new mushroom" appears spontaneously, the question of its origin has to be addressed. Herink, the Czech mycologist, maintains that he had already discovered the species during the 1930s. He reportedly deposited samples in a herbarium, but the mushrooms have never been clearly identified as *Inocybe aeruginascens* on the basis of biochemical analyses. As fruiting bodies of the *Inocybe aeruginascens* were found simultaneously in Hungary and Germany, the direction of the species' geographical migration could not be determined. It is possible that the species was initially confined to a very small area and only began to attract attention after it had migrated into new habitats. We can only speculate about the possibility of mutations that may have evolved from known species over a relatively short period of time.

Finally, during the 1980s, a few fruiting bodies were collected at locations in Holland (1980) and the Rhone Valley (Wallis Canton) of Switzerland (1984).

In 1983, the species immediately attracted the attention of biochemists and clinicians, after G. Drewitz described mysterious psychotropic intoxications caused by these mushrooms in the city and district of Potsdam, Germany, during June and July, 1980. The observed range of effects was sensational for mushrooms of the *Inocybe* genus, because many of its species induce typical muscarine poisoning symptoms. Muscarine causes parasympathetico-mimetic symptoms, such as pupil contraction (miosis), increased salivation and saliva production. Muscarine has been identified in at least 40 species of the *Inocybe* genus. The first reports about deaths following ingestion of the potent muscarine-containing *Inocybe patouillardi* Bres. date back to the early 20th century.

Identification Errors

Below is a more detailed description of the effects of *Inocybe aeruginascens*:

On June 30, 1980 a teenager collected the mushrooms near Potsdam and misidentified them as fairy ring mushrooms (*Marasmius oreades* (Bolt. & Fr.) Fr.), a species known as a choice table mushroom. At home, the teenager's father sauteed the mushrooms in margarine, and they were subsequently eaten by both of them. The son ate only about one-third of the cooked mushrooms.

About 35 to 45 minutes after the meal, both father and son began to experience initial symptoms. The son mainly reported colorful illusions and hallucinations. The woven pattern of his white handkerchief suddenly appeared as shining stripes of crimson red. With his eyes closed, he saw magically illuminated, abstract structures. He noticed his own state of foolish silliness that occurred for apparently no reason at all. Following his father's instructions, he soon found himself outside, in the pouring rain, running back to a near-by railroad embankment, still laughing and giggling, in order to gather more of the mushrooms that had poisoned him.

The father's symptoms initially included yawning and a burning sensation of the face, as well as itching at the hairline and fatigue. He then experienced increasing numbness (paraesthesia) of the left half of his face and his left arm. Later on, these symptoms spread to the right half of his body. Fully conscious, he also noticed motor disturbances that disrupted his language ability. His psyche was increasingly dominated by images of depersonalization: For the duration of the experience he felt that he "was standing beside himself as an observer", while his voice sounded very strange to him.

The second case of intoxication in Potsdam occurred on July 13, 1980:

Seventy-five minutes after ingestion of fibrehead mushrooms with greenish discolorations (*Inocvbe aeruginascens*), the woman began to experience hot flashes, nausea without vomiting, strongly dilated pupils, along with a marked sense of intoxication that she described as "mostly amusing ". Spacial illusions were experienced in combination with striking feelings of weightlessness, distances appeared to be magnified. After several hours, these symptoms gradually faded without lasting consequences; only the dilation of the pupils persisted well into the next day.

Based on these cases, Drewitz proposed that the mushrooms contain psilocybin or similar substances, a hypothesis that was later confirmed (see Tables 6 and 7, p. 49).

More cases of intoxications were reported in the years that followed and earlier cases could also be traced to this mushroom species. In each of these cases, the mushrooms were misidentified as fairy ring mushrooms.

TABLE 5

Accidental Intoxications with *Inocybe aeruginascens* in Eastern Germany

Year	# of People	Location
1977	3	Hohen-Neuendorf
1980	2	Teltow
1980	1	Potsdam
1984	4	Oranienburg
1984	2	Magdeburg
1985	3	Woltersdorf
1986	7	Potsdam

In all cases, the symptoms subsided after several hours, with no lasting side effects. A psychiatrist surely would have found these situations interesting - especially the last case involving an extended family - and would most likely have welcomed the opportunity to study the psychodynamics and social interactions during the period of collective intoxication.

In 1983, Babos reported another case of unintentional ingestion of *Inocybe aeruginascens* in Budapest, which had occurred on July 1, 1970. In this case, symptoms included subjective feelings of decreasing gravity, colorful hallucinations, spacial illusions and nausea without vomiting.

Flights of the Soul

In this context, the following account is of interest; it details the experience of a mycologist who took 2.4 g of dried mushrooms in the course of a test experiment:

The mushrooms tasted like ordinary table mushrooms. While reclining in a state of relaxation about 30 minutes later, a very comfortable feeling of loss of gravity set in, with no other somatic effects. Abstract hallucinations developed slowly, in the form of bursting colors and lights. Once a state of complete loss of gravity was attained, it was followed by a very vivid sensation of the soul in flight, coupled with feelings of euphoria. When looking out the window into the dark night of a forest landscape, visions of strange patterns and formations occurred, which were deeply impressive and seemed to impart an inkling of eternity. At the end of four hours, the effects had dissipated without dysphoria or any type of somatic side effect.

A control experiment for comparison purposes was performed using 0.8 g of dried Psilocybe semilanceata. The onset of symptoms was much more sudden, including a heavy flow of tears, so that there was an initial phase of anxiety. Only in a later phase of the experience was it possible to perceive ornaments in the form of "underwater streamers", and to appreciate the aesthetically enhanced nature of these visions.

The regular pattern of. involuntary intoxications is a good indicator for the large scope of expansion of Inocybe aeruginascens into new habitats during the 1980s. For example, at the time of the initial intoxications - when the species was still restricted to a few easily quantifiable collections - the mushrooms had spread from Potsdam to the location known in 1982, and from there moved on to several other locations in the vicinity, where more than 150 mushrooms were found (see Figure 34).

Symbiosis With Trees

Starting in late May 1984, fruiting bodies of the species could be found in abundance at countless new locations across the Brandenburg region of Germany. They tend to grow near the roots of different deciduous trees (Populus, Tilia, Quercus, Betula), on lawns in parks and gardens, at the edges of trails and in the paved margin areas of tree-lined sidewalks (where they may even grow on bare, sandy soil) as well as amongst the greenery of residential areas in the suburbs and communities in and around Berlin.

Herein lies the most marked difference between Inocybe aeruginascens and other European psychotropic mushroom species: Inocybe aeruginascens grows only in areas of human development. Their prime locations are in the middle of villages and towns, where they grow locally much like other Inocybe species. They may temporarily produce mass quantities of fruiting bodies, in those locations that are typical habitats for the edible varieties of the fairy ring mushroom.

So far, the most abundant crop of fruiting bodies was observed in 1987, due to very wet weather conditions, which allowed the mushrooms to thrive. The following years were comparatively dry and the species hardly fruited at all. It wasn't until 1990 that a few mushrooms re-emerged at the classic location in Potsdam. Despite 1989 having been a bad year for mushrooms, it was the year when Inocybe aeruginascens was found for the first time at four locations in and around Rostock, a city located on the Eastern German coast, which is famous for its wet climate. Finding the mushrooms at these locations is evidence for a much wider expansion of the species. In coming years, we should expect the species to further migrate into areas with sandy soil.

The Inocybe species are mycorrhizal mushrooms, that is, in contrast to other psilocybin-containing species, they require a symbiosis with certain types of wood in order to fruit. Fruiting occurs at the time of greatest biochemical activity of the symbiotic partner trees. Following periods of extended rainfall, Inocybe aeruginascens grows in the trees' root areas from late May until October. The mushrooms are especially common in May and June, a time period during which Inocybe aeruginascens is easily differentiated from other species of fibreheads, as long as one pays close attention to locations, the characteristic greenish to bluish discoloration (e.g. if the mushrooms are stored overnight, especially in the refrigerator) and the description shown below (see Figure 32).

Beschreibung

Hut: 2—3 cm, trocken, mittelbräunlich, nach dem Rand zu radialfaserig, im Jugendstadium stumpfkegelig, dann ausgebreitet, in der Mitte gebuckelt, spitz zulaufend, Rand nicht selten etwas eingebogen, Farbe des Buckels etwas dunkler, mitunter etwas oliv- bis blaugrünlich gefärbt.

Lamellen: zuerst im Jugendstadium hell, später ton-, oliv- bis tabakbraun, normal dichtstehend.

Stiel: 3—4,5 cm, 2—5 mm Durchmesser, zur Spitze hin etwas verbreitet, seidig gestreift, nur an der Spitze bereift, Basis knollig, jung weißlich, am Standort bald, vom Stielgrund her, bis etwa zum Mittelteil außen mehr oder weniger deutlich blaugrün verfärbend, nach dem Längsschnitt durch den Fruchtkörper verfärbt sich auch das Fleisch in diesem Bereich ebenfalls blaugrün.

Sporen: 7–9 (12), 4,5–5,5 μg, glattwandig, etwas elliptisch.

Zystiden: 46–60, 21–25 μm, auffällig dickwandig und dickbauchig mit Kristallschopf.

Description

Cap: 2-3 cm broad, dry, medium brown, radially striated at the margin; cap is obutsely conic when young, widening later on, with an acutely umbonate protrusion at the center; margins are usually somewhat incurved and the color of the umbo is somewhat darker, occasionally olive to bluish green.

Gills: light-colored at first when young, later on olive to tobacco-brown or clay-colored; gill spacing is crowded.

Stem: 3-4.5 cm long by 2-5 mm thick, somewhat wider toward the top; has velvety stripes and is bulbous at the base; when young, stems are whitish in color; when left at location, the outsides of the stems soon display a pattern of more or less distinctly bluish-green discoloration, starting at the base and progressing halfway up the stem; when fruiting bodies are cut lengthwise, flesh in the exposed areas will also turn bluish-green.

Spores: 7-9(12) by 4.5-5.5 μ, surface smooth, somewhat elliptical.

Cystidia: 46-60 by 21-25 μ, walls remarkably thick and bulky with crystals.

Figure 32 - Description of ***Inocybe aeruginascens*** (Germany, 1986) with English translation at right.

FRAGMENTA BOTANICA
MUSEI HISTORICO-NATURALIS HUNGARICI

Tom. VI. 1968 Fasc. 1-4

Eine neue Inocybe-Art in Ungarn
Inocybe aeruginascens n. sp.

Von M. Babos
Botanische Abteilung des Ungarischen Naturwissenschaftlichen Museums, Budapest

In der Umgebung von Budapest ist in den letzten Jahren in den angelegten Pappelwäldern des Tieflandes, auf Sandboden, in den mit Pappeln untermischten angelegten Eichenwäldern und in den natürlichen Wacholder-Pappel-Gesellschaften recht häufig - was besonders aus den von I. FERENCZ gesammelten Exemplaren hervorgeht - eine interessante Inocybe-Art vorgekommen, die sich mit keiner aus der Literatur bekannten Art identifizieren lässt.

Typisch für sie ist das Grünwerden ihres ursprünglich weisslich-cremefarbenen Stiels. Oft ist dieser mattgrün bzw. wird es erst auf Druck; andere Exemplare sind dagegen bereits an ihren Standorten von auffallendem Oliv- bis Blaugrün. Der Hut der Inocybe ist keglig, gebuckelt, ockergelb-rostfarben-orange-rostbraun, zumeist lebhaft und weist in der Mitte auch eine oliv-blaugrünliche Tönung auf. Seine Oberfläche ist - besonders gegen den Rand - radialfaserig oder faserig-rissig.

Figure 33 - First description of ***Inocybe aeruginascens***
in the mycological literature (M. Babos, 1968).

Figure 34 - Inocybe aeruginascens fruiting bodies from Potsdam, Eastern Germany

Unlike species of thin-fleshed *Psilocybe* mushrooms that do not fruit until fall, *Inocybe aeruginascens* frequently suffers from fly larvae infestations, especially in older colonies. The resulting lesions are injured areas that turn greenish-blue. It must be noted, however, that of all species introduced here, *Inocybe aeruginascens* is most easily misidentified by laypersons, as it is of the same genus as the potentially lethal species that produce muscarine.

Drewitz's speculation that *Inocybe aeruginascens* contains psilocybin was supported by results from my own investigations in 1984. Extracts of more than 100 mushrooms collected in Hungary and Germany from 1967 to 1990 were examined. Quantitative analyses revealed that the fruiting bodies contained a fairly constant amount of psilocybin each, as well as some baeocystin. These results were first reported in February, 1985. Later that year, the presence of psilocybin in Inocybe aeruginascens was confirmed by research teams from the former West Berlin, Regensburg (Germany) and Switzerland. Known cases of intoxication seemed to indicate that the fruiting bodies contained small amounts of muscarine. But among all the samples that were tested - at all stages of development and from widely different collections - not one specimen contained even trace amounts of muscarine.

In collaboration with colleagues from Czechoslovakia, we were able to confirm that the average alkaloid content does not vary much, a finding based on analyses of extracts from several mushrooms. Moreover, the alkaloid content of fruiting bodies stored for prolonged periods declined only slightly over time:

TABLE 6

Psilocybin Content of *Inocybe aeruginascens* from Various Locations (% of Dried Samples)

Location	Year Found	Year Analyzed	Psilocybin
Potsda	1984	1984	0.38
Potsda	1983	1984	0.34
Potsda	1982	1984	0.33
Berlin	1975	1985	0.11
Hungar	1967	1985	0.22

Psilocybin levels in *Inocybe aeruginascens* are comparable to those found in *Psilocybe mexicana* Heim. Moreover, *Inocybe aeruginascens* contain traces amounts of psilocin at most. Baeocystin, on the other hand, is accumulated at levels comparable to those of psilocybin. The alkaloid content of the *Inocybe* species differs from those found in the *Psilocybe* species, which contain three to five times more psilocybin than baeocystin. The variation of alkaloid content across different samples of fruiting bodies is illustrated in Table 7, which shows the results from analyses of mushrooms collected at a location in Caputh near Potsdam on June 8, 1986 (see Figures 32 and 34).

TABLE 7

Psilocybin and Baeocystin Content in Single *Inocybe aeruginascens* Fruiting Bodies (% of Dry Weight)

Mushroom	Dry Weight (mg)	Psilocybin	Baeocystin
1	0.110	0.43	0.15
2	0.118	0.26	0.24
3	0.220	0.23	0.22
4	0.221	0.50	0.25
5	0.298	0.16	0.20

In addition, it should be noted that results from these analyses of mushroom extracts indicated the presence of a previously unknown alkaloid, which I have named aeruginascin. The molecular structure of this substance must be similar to those of psilocybin and baeocystin. It is a compound that is soluble only in polar solvents, such as water, methanol and acetic acid. The levels of concentration of aeruginascin found in the fruiting bodies is comparable to those of the other two alkaloids. The compound is characteristic of the *Inocybe* species, so that the analytical results of mushrooms extracts using thin-layer chromatography constitute a kind of fingerprint identification of *Inocybe aeruginascens*.

Of course, there is the question whether this substance contributes to the psychoactive effects of *Inocybe aeruginascens*. It is remarkable that all cases of involuntary intoxication induced a feeling of euphoria, despite a psychological state of mind likely to create extremely unfavorable internal conditions ("set") for having a "positive experience" (i.e. knowledge of being poisoned by mushrooms with unknown and potentially fatal consequences). In addition, these cases of intoxications happened in the course of pursuing normal, everyday activities, including appointments and other interferences ("setting") which should have precipitated a much more negative type of experience. Future research must focus first on the discovery of the molecular structure of aeruginascin, as well as its synthesis. Subsequent studies should investigate the potentially moodaltering influence of this substance in terms of the mushroom's psychoactive effects as a whole. Moreover, we cannot exclude the possibility that ingestion of the mushrooms may cause a slow release of alkaloids from the organic matrix, followed by their gradual resorption, a process suggested by the effects of the mycologist's test experiment described above. In the meantime, the presence of psilocybin along with baeocystin has also been confirmed in the following Inocybespecies:

Inocybe corydalina Quel.
Inocybe haemacta Berk. & Br.
Inocybe tricolor Kuhner
Inocybe coelestium Kuyper

These species, however, are not significant contributors in terms of involuntary intoxications, because, for the most part, these Inocybe species are extremely rare and grow almost exclusively in forests. Also, their psilocybin levels were lower than those found in Inocybe aeruginascens.

Among these species, Inocybe corydalina is the most common. An analysis revealed a psilocybin content of only 0.011% - 0.1%, a concentration so low, that this species would become clinically relevant only if large amounts of the mushrooms were eaten.

As part of my own experiments, I also detected psilocybin inInocybe calamistrata (Fr.:Fr.) Gill, a species whose lower stem area is blue. Other authors have not succeeded at confirming the presence of psilocybin in this species.

CHAPTER 3.5

GYMNOPILUS PURPURATUS - MAGNIFICENT MUSHROOMS FROM SOUTH AMERICA

Another controversy documented in the literature revolves around the psychoactivity of several species of the genus Gymnopilus.

More than 50 years ago, in October 1942, a remarkable case of intoxication occurred m Cleveland, Ohio, which was attributed to Pholiota spectabilis. Today, these mushrooms have been identified as Gymnopilus spectabilis (Fr.)A.H. Smith (USA). In Europe, they are also Known as Gymnopilus junonius (Fr.) Orton.

A woman had been out for a walk in the woods one afternoon and had taken a few nibbles from a mushroom that she found, feeling confident that she could distinguish the edible from the poisonous ones. As soon as she lay down, she began to experience the most glorious visions of color and sounds of music, but with no feelings of discomfort whatsoever. A friend who was with her felt that a doctor should be called immediately. When she consulted me about her symptoms, I told her that certain mushrooms are known to cause the symptoms she suffered. I added that these mushrooms were not classified as poisonous, nor did the effects last very long. called that same evening and said that the hallucinations had soon passed and that she was feeling perfectly normal again. She added that if this was the way one was supposed to die of mushroom poisoning, she was all for it.

Another case of poisoning was chronicled in Harvard, Massachusetts:

On September 9, 1966, at about 9 a.m., a 56~year-old retired mechanical engineer of Harvard, Massachusetts, picked a bunch of mushrooms clustered by the side of the road in front of his house. Under the mistaken impression that they were honey mushrooms (Armillaria mellea an edible species) he tasted the fresh flesh and found them to be slightly bitter However, he took them home, where his wife washed them and fried them in butter. He ate two or three caps around noon and within 15 minutes began to feel disconnected and "woozy" . head felt numb and his vision was blurred.

The room seemed smaller, and the walls closer than usual. Objects were shimmering, and appeared yellow with dark areas in the center. The trees and grass were a vivid green, with spots of radiant purple. These sensations were not unpleasant. Everything seemed to be unnaturally colored, resembling the image of a color TV. Even though he was unable to collect his thoughts, his mind felt sharp and clear: he asked himself questions and immediately knew the answers. By contrast, after having put down a book, he was unable to find it again. After a few hours all three of the involuntary participants had recovered and were able to give a coherent account of their experience.

In this case, the mushrooms involved were also identified as Pholiota spectabilis. This identification is questionable, however, because the species is generally described as having an extremely bitter taste. It was determined that there are significantly more species of the genus Gymnopilus in North America (73) than there are in Europe (15).

Mushrooms 24 Inches Tall!

Even though Gymnopilus junionius is one of the largest-sized species of mushrooms (with stems that have been observed to grow up to 24 inches [60 cm] tall), there are no known European cases of intoxications caused by Gymnopilus species. The extremely bitter taste typical of some Gymnopilus species is an effective deterrent to their ingestion as table mushrooms, anyway.

However, the cases of intoxication in the U.S. prompted Hatfield and his collaborators to perform phytochemical testing on some of these species. From 1968 to 1971 this group of investigators reported that eight species, including Gymnopilus junonius contained inactive styrylpyrones, such as bis-noryangonin. In the wake of yet another case of unintentional intoxication with Gymnopilus validipes in the U.S., the same research team was able to confirm that this species contained psilocybin (0.12%). They also found the alkaloid in three other species, including Gymnopilus spectabilis.

Still, similar analyses of European Gymnopilus species continued to yield negative results.

It was only through a set of strange circumstances that the presence of psilocybin and its derivatives was finally confirmed in European mushroom species of the genus Gymnopilus.

As far back as May 1887, a new species of mushroom was found growing on a tree fern trunk in the botanical gardens at Kew, England (also see p. 30, bottom right). The discovery eventually led to the publication of these mushrooms as a new species named Flammula purpurata Cooke & Massee. In this context, we must credit Mordecai Cooke (1825-1914), a mycologist of outstanding competence and expertise, who studied a vast number of mushrooms species, including Psilocybe semilanceata. He was the first to formulate a hypothesis about the nature of the bluing phenomenon and to point out its physiological significance (also see p. 16, bottom right). He discovered Inocybe haemacta as well as several Panaeolus species and classified the Flammula species mentioned above. Remarkably, one of his first publications was a book of popular folk tales entitled "The Seven Sisters of Sleep" (1860), which just happened to be an interdisciplinary investigation of narcotic plants. Did he himself, perhaps, sample one of the psychotropic mushroom species? Most likely, we will never know the answer to this question. Eventually, the Flammula species came to be recognized as being native to Australia and South America (Chile), where the mushrooms fruit on dead tree trunks during the month of May. Later on the mushroom's name was changed to Gymnopilus purpuratus (Cooke & Massee) Sing.

Mushrooms on Compost Mixture of Wood Chips and Pig Manure

In 1983, a conspicuous mushroom was observed growing on discarded bark and wood chips near a particle board factory in Ribnitz Damgarten on the Eastern German seaboard.

The mushroom was initially classified as Tricholomopsis rutilans (Schaeff.:Fr.) Sing. However, this magnificent and beautiful mushroom was found to have spore dust colored orange to rusty brown, along with a well-formed, bright yellow cortina. It also turned blue in reaction to pressure and with age. Closer study revealed that the specimen was actually of the species Gymnopilus purpuratus, a mushroom that, after a hundred years, had once again been imported into Europe. The microclimate essential for the mushroom's growth had been created by mixing liquid pig manure with the discarded wood chips. A powerful composting process results from pouring the liquid manure onto heaps that are up to 20 yards long and several yards tall. The process is designed to eliminate both types of refuse. Measurements inside the heaps revealed temperatures of about 176° Fahrenheit. Consequently, the Gymnopilus species were able to thrive on the top layers of the heaps, along with other species from Asian and South American countries with warm climates.

There is, of course, the question of just how the Gymnopilus species got to Europe in the first place. In the late 1970s, large amounts of feed grain were imported from Argentina. Thus, it appears likely that some mushroom spores may have stuck to the grain from where they passed unharmed through the pigs' digestive systems and went on to colonize the compost heaps.

Even though the compost heaps are plowed at least twice a year and shipped as fertilizer to surrounding fields after about two years of storage, the mushrooms continue to grow on wood piles in new locations whenever its spores have reproduced (see Figure 30, p. 40). However, in the wake of changes in economic conditions and growing ecological awareness in Eastern Germany, it is likely that this composting process will soon be discontinued so that this mushroom species may disappear in Europe once again.

The following description characterizes the Gymnopilus species that does not have a bitter taste:

Cap: 15-42 mm broad, occasionally larger sizes up to 20 cm in diameter. Flesh thin, broadly convex without an umbo. Evenly covered with pointy scales, purplish to ruby on yellow background, dry. Margin inrolled at first, incurved later, occasional blue stains.

Gills: Close, golden yellow at first, rusty yellow later on due to maturation of spores, edges concolorous with lamellae and bald.

Stem: Not hollow, 6-10 mm x 30-80 mm, very rarely up to 15 cm tall, cylindrical to slightly club-shaped, coarse fibrils, striated, lower stem area and base bruise grayish-blue to Greenish when injured and with age, found alone or in clusters of up to 22 mushrooms.

Cortina: Sulphur yellow, almost appendiculate along margin, fibrous at the apex without forming a true annulus, disappears with age.

Basidia: Approximately 35 u long, club

By 1969, Singer had noted that based on analyses performed by Cassels in Chile, the mushroom contained an indole derivative and that the species may be hallucinogenic because of the bluing reaction. By 1988, reports from Germany also confirmed the presence of psilocybin in mushroom extracts of the same species, as evidenced by the results of thin-layer chromatography testing (qualitative detection only). That same year, my own quantitative analyses of 26 mushrooms also revealed that psilocin and baeocystin were present in all fruiting bodies of the Gymnopilus species. So far, no other European species has been found to contain as much psilocin as Gymnopilus purpuratus:

TABLE 8

Alkaloid Content in Two Collections of Gymnopilus purpuratus (% of Dry Weight).

Mushroom	Psilocybin	Psilocin	Baeocystin
Sample Collected in 1988			
1	0.29	0.28	0.05
2	0.31	0.29	0.04
Sample Collected in 1987			
1	0.32	0.03	0.03
2	0.21	0.02	0.02

Table 8 illustrates the unstable nature of the psilocin molecule: during the one-year storage time until analysis in 1988, much of the sample's psilocin had already decayed.

Alkaloid concentrations were found to be higher in smaller mushrooms, as shown in Table 8. Larger mushrooms contained about 0.1 % of both psilocin and psilocybin. I am not aware of any cases of accidental intoxication nor any self experiments involving Gymnopilus purpuratus.

Intoxicating Potions of the Yurimagua Indians

In light of the discovery of psilocybin as an active ingredient in a South American Gymnopilus species, numerous historic accounts also appear in a different light.

Jesuits of the 17th and early 18th centuries who had travelled to the western Amazon (Peru) reported that the Yurimagua Indians habitually prepared a potently intoxicating potion derived from a tree-dwelling mushroom. The mushrooms appeared on fallen trees as a kind of reddish growth with a spicy taste. The potion was said to be so potent that nobody who swallowed three mouthfuls of the brew was able to resist its effects. The mushroom was considered to be Psilocybe yungensis Singer & Smith. However, since Gymnopilus species are reddish in color (see description of Gymnopilus purpuratus, above) and tend to colonize dense tree trunks, those strange tree-dwelling mushrooms were most likely a Gymnopilus species. The Psilocybe species, after all, grow almost exclusively on wood sprigs and tree bark debris. On only one exceptional occasion did we discover a specimen of Psilocybe bohemica growing on a thoroughly rotted, wet tree trunk (see p. 31, top right). Most likely, the reddishcolored tree-dwelling species was closely related to Gymnopilus purpuratus. The discovery of psilocybin in a mushroom of the Gymnopilus species marked the first time this substance had ever been found in a member of the family Cortinariaceae.

The Inocybe species who were found to contain psilocybin later on, are also members of this family. Since the alkaloid had previously been found in Psilocybe, Panaeolus and Conocybe species - which are not closely related to each other - the hypothesis postulating psilocybin's significance as an important chemo-taxonomical substance had to be abandoned.

Future research should attempt to verify the presence of psilocybin and its derivatives in other tropical and subtropical Gymnopilus species. Taxonomically, the genus has not yet been exhaustively studied, and mushroom lovers may want to watch out for occurrences of Gymnopilus purpuratus in certain European locations, such as botanical gardens or herbariums.

CHAPTER 3.6

CONOCYBE CYANOPUS - TINY MUSHROOMS OF REMARKABLE POTENCY

While studying the magic mushrooms of Mexico during the 1950s, R. Heim described a new species of the genus *Conocybe*. *Conocybe siligineodes* Heim was reported to grow up to 8 cm (3.25 in.) tall, a beautiful, reddish brown to orange-colored mushroom that thrived on rotten wood and which was used as a psychotropic species by the Indians as well. However, the species did not appear again in the literature, nor were the chemical composition or the effects of these samples published. Even after decades of field research in Mexico, Guzman was unable to find the species there. Similarly, he did not discover native usage of any kind of *Conocybe* species. Heim's description however, aroused curiosity as to the chemical composition of this species. Approximately 55 European species which existed saprophytically were relegated to a shadow existence in the older literature. Also, the differentiation of these species is very problematic at times. For the most part, the mushrooms are small and fragile, decay quickly and grow mostly in grassy and mossy areas, where they are easily overlooked.

Around 1930, J. Schaffer discovered numerous Conocybe species growing in abundance on a fertilized grassy area near Potsdam. Intrigued by the mushrooms' extra-ordinary variety of forms and colors, he was inspired to undertake the kind of taxonomic classification that is essential to pursuing mushroom research. One species that he found in Potsdam, Berlin as well as in Germany's Harz Mountains showed bluish discolorations at the base of their stems. This "Galera" species was included by Kuhner as *Conocybe cyanopoda* in his 1935 monograph about the genus *Conocybe*. Today, this species is referred to in the literature as *Conocybe cyanopus* (Atk.) Kuhn. This species with a blue base had been previously discovered in the U.S. (Ithaca, NY) in 1918 and was judged by Kuhner to be identical with the European mushrooms.

The following is an adequate description of *Conocybe cyanopus*, because its bluish discoloration is a sufficiently unique attribute to allow differentiation of this species from other European *Conocybe* species.

Cap: 0.3-2.5 cm broad, nearly hemispheric to convex, striated, ocher to dark brown without grey-green stains.

Stem: 2-4 cm long, 1-1.4 cm thick, whitish at first, equal to slightly curved at the base, silvery later on, stains bluish-green - particularly at base - in reaction to injuries or with age.

Spores: 7-10 x 4-5 um

Basidia: 4-spored, pleurocystidia absent, cheilocystidia present, 18-25x6, 5-10 ,um

Habitat: On grassy areas or moss, summer through fall.

The *Conocybe* genus is a member of the Bolbitiaceae family, which is similar to the Coprinaceae, a family of dark-spored mushrooms that includes the *Panaeolus* species.

The *Conocybe* species are very rare in Europe. The mushrooms are hardly ever found among lists of mushroom discoveries from European countries. Aside from Schaffer's discovery, the mushroom was reportedly found or described only twice (!) within the territory of the former East Germany over the last 60 years (both discoveries were made during the 1980s). However, there are only few mycologists who specialize in the study of the *Conocybe* genus, due to its lack of attractiveness.

Even though the mushroom is very rare, I was able to include one picture of *Conocybe cyanopus* in this book (see Figure 36, p. 57). 1 also had the good fortune to obtain a dried *Conocybe cyanopus* sample for chemical analysis (see Table 9, p. 56).

Psilocybin was discovered for the first time in a sample of fruiting bodies of the species *Conocybe cyanopus* which had been collected on September 4, 1961 in Seattle, WA. No psilocin however mysterious they may remain.

In 1977, Repke and his research team reported the discovery of baeocystin, as well as psilocybin in a Conocybe species from the United States and Canada. Once again, no psilocin was found in these samples. Finally in 1982/83, Norwegian researchers confirmed the existence of trace amounts of psilocin, in addition to 0.330.55% of psilocybin, an alkaloid that was also reportedly discovered in Finnish samples. Finally, Beug and Bigwood reported 0.93% of psilocybin in samples collected in the Northwestern United States. Interestingly, the second sample ever discovered in Eastern Germany was found on July 2, 1989 near Potsdam, where several fruiting bodies of the Conocybe cyanopus species were growing in a grassy area on sand. The original area, however, where Schaffer first discovered the species 60 years ago, lay within the Potsdam city limits and its exact location can no longer be determined.

The sample collected in 1989 consisted of five mushrooms that were found to have concentrations of psilocybin and baeocystin similar to levels found in Psilocybe semilanceata:

Concentrations of psilocybin were strikingly similar to those found in samples collected in the Northwestern United States.

After several days, spores from one of the fruiting bodies germinated on malt agar and, compared to other species, proceeded to grow very slowly into their permanent forms or "sclerotia" (see Figure 35, p. 57). The sclerotia showed no blue discolorations, and were found to contain 0.25 % psilocybin when dry, while no additional alkaloids were detected.

In summary, it is reasonable to assume that due to its small size and extreme rarity, Conocybe cyanopus is a species that is not a significant contributor to intoxications in Europe, nor is it likely to gain such prominence in the future. My own analyses of other, non-bluing Conocybe species, such as Conocybe tenera (Schaeff.:Fr.) Fayod and Conocybe lactea (Lge) Metrod revealed the presence of physiologically inactive ingredients only.

Samples of Conocybe species from warm countries have not yet been analyzed and may yet yield remarkable results in terms of chemical composition and alkaloid content.

TABLE 9

Selected Test Results on the Alkaloid Content of ***Conocybe cyanopus*** (% of Dry Weight)

Mushroom	Dry Weight(mg)	Psilocybin	Baeocystin
1	5	0.84	0.15
2	6	0.73	0.12
3	7	1.01	0.20
4	10	0.91	0.16
5	12	0.89	0.14

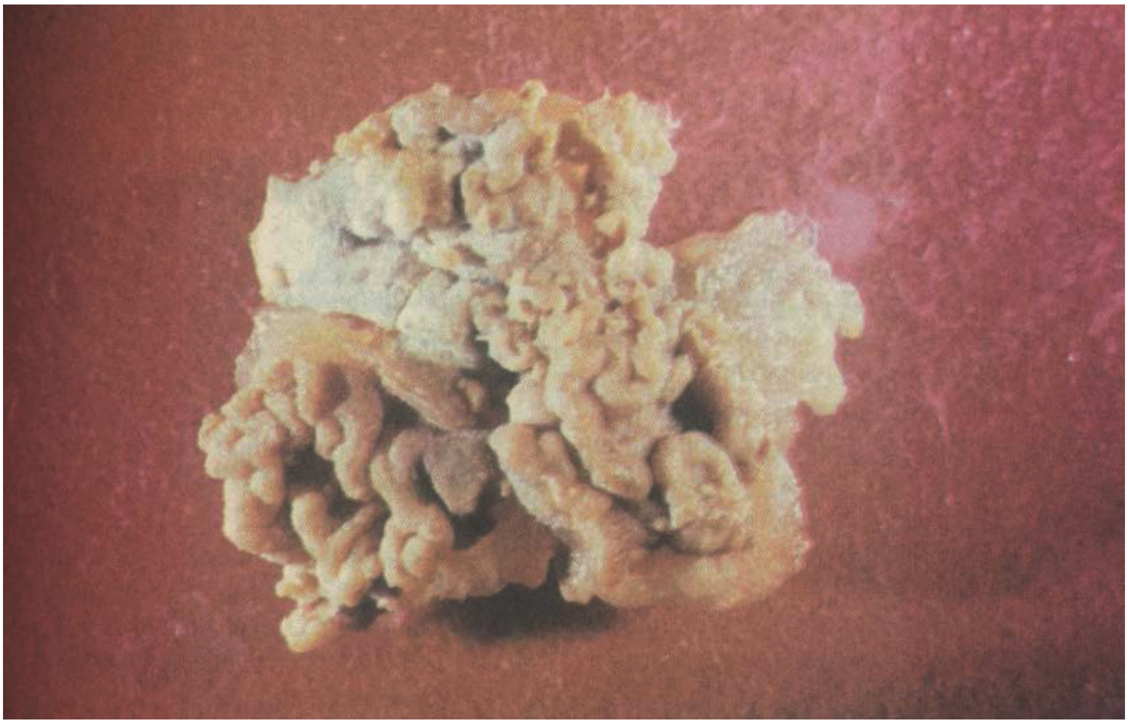


Figure 35 - Sclerotia of Conocybe cyanopus grown on malt agar.

Figure 36 - Fresh Conocybe cyanopus fruiting bodies from the Pacific Northwest (USA).

CHAPTER 3.7

PLUTEUS SALICINUS: A LITTLE-KNOWN WOOD-INHABITING SPECIES

Within the Pluteaceae family, there are about 45 European species of the genus Pluteus, some of whom also produce psilocybin.

Historically, the Pluteus species were classified as belonging to the Amanitaceae family, which also include the "death cap" and its relatives, as well as the fly agaric mushroom, both of which belong to the genus Amanita. Unlike all the other psychoactive mushrooms mentioned here in this book, the Pluteus species are classified as light-spored mushrooms, because of their rose-colored spore dust.

No accidental intoxications involving Pluteus species have been documented in the literature.

The first description providing qualitative evidence for the presence of psilocybin and psilocin was provided by Saupe in 1981, who examined extracts of Pluteus salicinus (Pers.:Fr.) Kumm. from Illinois. Surprisingly, psilocin turned out to be the alkaloid with the highest levels of concentration in the samples tested. This mushroom species had previously been described in Europe about 200 years ago. Since then, however, it has rarely been mentioned in the literature, and only briefly, if at all (see Figure 37, p. 59).

Some taxonomic methods of classification used earlier can still cause confusion today. For example, Ricken (1915) designated the mushroom as Pluteus petasatus.

By way of expanding the description from 1962 (see Figure 37), Pluteus salicinus is identified by the following characteristics:

Medium-sized mushroom with a more or less intensely bluish to bluish-green coloration. Older mushrooms are sometimes colored olive green.

Caps in some cases up to 8 cm in diameter, lighter colored around the margin, silver grey, hairy and felt-like, even hairier and felt-like towards the middle of the cap, often scaly.

Stems up to 10 cm in length, with spontaneous grey-green or grey-blue discolorations at the base, colors intensify in response to pressure.

There are also mushrooms of this species that are white in color (see Figure 38, p. 60). However, these albino fruiting bodies have stems whose bases show a slight grey-green coloration as well, as do the apex areas of their caps. Pluteus salicinus has been described as being anywhere from "very rare" to "not rare" in the wet deciduous forests of Europe. The species of the genus Pluteus are final wood-destroyers, that is, they grow saprophytically on wood that appears rotten and discolored, because it has decomposed due to the presence of other mushrooms over the course of many years. Pluteus salicinus fruits from May to October on stumps of willows, alder-trees, lime-trees, beech-trees, poplars, maple-trees and possibly on the wooden remnants of other tree species as well, The fact that this mushroom has not been the cause of any intoxications may be explained by its fruiting bodies' occurrence on tree stumps as single mushrooms or in groups of very few mushrooms. Also, compared to other wood-inhabiting mushrooms, Pluteus salicinus is not very attractive in appearance. The mushroom's habitus is well illustrated by Figure 39 (p. 60).

For unknown reasons, Kreisel described all Pluteus species as "non-poisonous" in his 1987 handbook of mushrooms, despite the fact that psilocybin (0.35 % of dried mushrooms) had already been discovered in samples of this species in 1981 (North America) and 1984 (Norway). The alkaloid was also found in mushrooms from Holland, Finland, Sweden and France. The latter tests, however, were limited to very few fruiting bodies in each case.

Whereas Stijve found an average of 0.25 % of psilocybin in dried mushrooms from 20 samples collected in Switzerland from 1984 to 1986, my own analyses of non-bluing (!) mushrooms collected in Thuringen, Germany in 1986 yielded much higher alkaloid concentrations:

TABLE 10

Psilocybin and Urea Content of
Pluteus salicinus (% of Dry Weight)

Sample#	Psilocybin		Urea	
	Cap	Stem	Cap	Stem
1	1.38	0.48	2.50	Traces
2	1.57	0.71	2.60	0.00
3	1.57	0.71	2.60	0.00
4	1.22	1.14	1.40	0.00
5	139	0.64	2.40	0.43

Additional analyses of four bluing mushrooms collected in the Dubener marshlands (Eastern Germany) in 1988, confirmed the presence of only about 0.2 - 0.7 % psilocybin in those mushrooms. This sample also contained very small amounts of baeocystin.

These results indicate that the variability m alkaloid content in Pluteus salicinus has not yet been sufficiently calibrated. Therefore, more analyses are needed. In contrast to the findings based on studies of mushrooms collected in America, it is certain that the European mushrooms produce only traces of psilocin at most.

Stijve and Bonnard were able to examine original material collected by Saupe in the United States. To their surprise, they discovered that the mushrooms were not identical to those found in Europe. They also did no longer contain any alkaloids. These findings show that mushrooms of the same name from different continents are not necessarily identical.

All other Pluteus species tested so far contained urea, a substance that can also been found in the Panaeolus species. However, the latter also produce compounds like serotonin, which do not occur in the Pluteus species. Hence, the different species are once again identifiable by their unique "fingerprints".

Other rare Pluteus species with bluish or violet discolorations are mentioned in the literature, such as a Pluteus cyanopus from Europe. However, so far, very small amounts of psilocybin (0.035% of dried mushrooms) have been found only in Pluteus nigroviridis Babos, an extremely rare species from Hungary.

Therefore, additional analyses of this fairly neglected genus are urgently needed.

Grauer Dachpilz (Pluteus salicinus). *Grau-rußbraun, Stielbasis etwas ins Blaugrüne.* Hut 3–6 cm, bald abgeflacht-gebuckelt, fein faserig, am Buckel fein schuppig, grau-braun. Lamellen weiß, später lachsfarben. Stiel schlank, weiß, unten etwas braunfaserig mit mehr oder weniger Stich ins Blaugrüne. – Auf Laubholzstümpfen. Recht selten.

Figure 37- Description of ***Pluteus salicinus*** from 1962 (Germany).
See page 58 for description in English.

Figure 38- *Pluteus salicinus* at a natural location (Germany).

Figure 39- Fresh *Pluteus salicinus* fruiting bodies.

CHAPTER 4

MUSHROOM IDENTIFICATION: TAXONOMIC CONFUSION AND THE POTENTIAL FOR DEADLY MISTAKES

On December 16, 1981, three teenagers hunting for psychoactive mushrooms on Whidbey Island, WA (USA) collected specimens of a Galerina species, in the mistaken belief that the mushrooms belonged to a Psilocybe species. All three of them fell ill after eating the mushrooms, but did not report their symptoms or seek medical help for another two days, afraid of being prosecuted for using psilocybin. After medical treatment, two of the teenagers made a full recovery. The third victim, however, a 16 -year-old girl, died on December 24, 1981.

As presented by Beug and Bigwood, this tragic incident underscores the dangers inherent is careless or erroneous identification of mushroom species, especially when a situation is complicated by overzealous legislative and punitive measures. The psilocybin-producing species as well as culinary mushroom varieties often share some characteristics with many other species. Casual mushroom hunters and lay-persons are especially prone to making identification errors, suffering accidental ittoxications as a result. Previous chapters included several case histories of such involuntary intoxications. To be sure, modern mycological keys are valuable tools when it comes to accuracy in deciding the family and genus of an unknown mushroom sample. It can be extremely difficult, however, to identify the specific species of questionable specimens, especially if the sample belongs to the vast category of "LBM"s, or "little brown mush-rooms". We currently know very little about the "LBM" species, since their habitats and variations in habitus have not been studied in systematic detail. Not surprisingly, reference books are often limited by incomplete descrip-tions that lack the essential criteria for differentiating one species from others that are similar or related. I vividly recall my own first attempts to identify unknown samples by relying on what appeared to be precise definitions in standard mycological reference works. I found many of the listed traits to be descriptive of a wide range of sometimes very different species. As I compared my samples with the text, I noticed a tendency to disregard some of the finer details in the literature, so that "my mushrooms" would better match the descriptions. Naturally, this approach resulted in errors. Luckily, I would quickly discover and correct my mistakes upon consultation with my mycologist friends. In my experience, competence and expertise in the area of mushroom identification are skills honed over time through extensive fieldwork, consultations with established mycological experts, and careful analyses of samples based on information found in appropriate reference books.

The literature clearly indicates that Psilocybe semilanceata is one species that, at prime locations, can be easily identified without consulting a diagnostic key. Psilocybe semilanceata is known for its uniquely distinctive appearance, so that microscopic tests are not needed to distinguish this species from other pasture-dwelling mushrooms. The situation is different, however, for Psilocybe species that thrive on wood debris, as illustrated by the tragic story at the beginning of this chapter. Besides, compared to Europe, the North American mycoflora includes a much broader and varied spectrum of mushroom species to begin with.

Warning: Amatoxins are Lethal!

The Galerina genus includes a number of poisonous mushrooms. These species are dangerous, because they contain the same deadly amatoxins as the "death cap" (Amanita phalloides) and its relatives, "death angel" and "destroying angel". Their toxins are insidious, with no symptoms evident for about 12 hours. During this latency period, the toxins can cause major irreversible internal damage, which is why many cases are fatal in spite of treatment. A common North American species is Galerina autumnalis (Peck) Singer & Smith, which grows on wood debris in parks and forests, just like several of the Psilocybe species. At first glance, Galerina autumnalis resembles Psilocybe stuntzii Guzman & Ott, and the two species may grow side by side at the same location. The *Galerina* species, however, does not turn blue. I once discovered a grassy area that was home to a cluster of Psilocybe stuntzii specimens entangled with a Galerina species. The mushrooms had grown so entwined that individual fruiting bodies could be identified only by spore analyses.

Pholiotina filaris (Fr.) Sing. (also known as Conocybe) is another North American species known to contain amatoxins. At the same time, these toxins have not been found in European samples of this species. Thus, Pholiotina filaris (Fr.) Sing. most likely does not refer to the same species on both continents. Still, at least one European Galerina species (Galerina marginata (Fr.) Kuhn.) contains the same toxins found in the "death cap" mushroom. This species also grows on decaying wood substrate and its fruiting bodies contain about one-third of the amount of amanitines found in Amanita phalloides. Incredibly, older mushroom books list Galerina marginata as an edible species.

In a previous chapter on the Panaeolus species I illustrated the potential for identification errors associated with commercial cultivation areas that are "invaded" by outside species. Due to their rapid growth, the Panaeolus species in particular will often fruit in artificial growing areas long before the cultivated species that is grown there. Chapter 3.3 details the 1970 poisoning incident involving Panaeolus subbalteatus from a cultivation area in Leipzig. In that case, the intruding species was mistaken for Stropharia rugoso-annulata Farlow (the Giant Stropharia), based on information from a mushroom book. Apparently nobody realized the glaring differences between the book's description and the actual characteristics, except for the assumption that the sample's small size meant the mushrooms simply had not grown as tall as portrayed in the book. This flawed conclusion illustrates a type of judgment error common among amateur mushroom hunters who falsely believe that they are experts. Having been shown a single sample of wild mushrooms, for example, some mycophiles become convinced they will always be able to recognize the species in the future. That is how one such mushroom hunter accidently ingested Inocybe aeruginascens specimens that he believed to be common fairy ring mushrooms. In a similar case of Inocybe aeruginascens intoxication, the mushrooms had been picked as white champignons, even though this common culinary mushroom bears no resemblance, either in size or form, to Inocybe aeruginascens. Overall, however, these unfortunate cases have also contributed to our understanding of mushroom biochemistry.

In this context, I want to emphasize once more that the hallucinogenic varieties among the Inocybes can easily be mistaken for those muscarine-producing Inocybe species that are extremely poisonous.

As part of his investigation of the Psilocybe genus, Guzman noted a common trait among the hallucinogenic species, in addition to the bluing reaction: a flour-like smell or taste. Apart from the inherent subjective nature of our sense of smell and taste, a common odor is a trait that definitely does not apply to the European species (also see Chapter 3.2).

Mycophile or Mycophobe?

There are reports from the Western United States about people with expert knowledge of Psilocybe semilanceata - devoted mushroom hunters who can identify the species with drill and accuracy. At the same time, however, these experts cannot identify easily spotted common table mushrooms, nor are they able to differentiate the Agaricus species (champignons) from other mushrooms, even when these species grow on the same pasture. Such individuals, then, are not interested in species other than Psilocybe semilanceata. In my opinion, this attitude reflects a rare combination of mycophilia and mycophobia.

A mushroom's spore dust provides important information needed to determine identity. A spore print is left by the gills when the cap is placed on black or white paper (depending on spore color). As the process takes several hours, a glass vessel must be placed over the cap to prevent drying. While useful, information obtained from spore analyses has its limitations, For instance, spores derived from mushrooms belonging to different genera may have the same color, but reveal basic differences under the microscope. There is also a high degree of similarity among spores from different Psilocybe species. Thus, the only way to prevent grave errors and potentially deadly intoxications is to rely on experienced experts for mushroom identification, a process that must include analysis of available ecological data.

CHAPTER 5

THE BLUING PHENOMENON AND METOL TESTING: REALITY VS. WISHFUL THINKING

As previously discussed in Chapters 3.1 and 3.7, the bluing reaction is characteristic of species that produce psilocybin. Still, for unknown reasons, some species or samples belonging to a genus that usually turns blue may not always change color, regardless of psilocybin content. Among the species that I have examined, Psilocybe bohemica displayed the most impressive bluing reaction. The caps of this species stain very quickly in reaction to pressure. Other species, such as Psilocybe cubensis (Earle) Sing. have stems that develop very intensely blue stains, while their caps do not exhibit the bluing reaction. By contrast, Psilocybe semilanceata, Conocybe cyanopus and Inocybe aeruginascens are species whose stems develop only slight stains m reaction to pressure and only after a relatively long time period has elapsed. With respect to time delay and intensity of the bluing reaction, Gymnopilus purpuratus is a species that falls in between these two extremes

A Rich Color Spectrum

The colors range from green to a deep blue. Psilocybe cubensis is a species in which the latter color may also take on a blackish-blue hue. 'The mechanisms underlying the color reactions in these mushrooms has not yet been studied. I have already mentioned Cooke's speculation from the early years of the 20th century about the significance of the bluing reaction in Psilocybe Smilanceata (see p. 16). In the 1950s, it was Singer and Smith who emphasized that discolorations observed in the psychotropic Psilocybe and Panaeolus species must somehow be linked directly or indirectly to the mushrooms' active ingredients. Eventually, in 1958, A. Hofmann and his collaborators reported the successful isolation of these ingredients. They were the first to observe that pure psilocin grows unstable when exposed to oxidizing agents such as air and that solutions of psilocin turn bluish-green in an alkaline range.

These results provided proof that the bluing reaction resulted from a mushroom ingredient's breakdown by oxidation. From 1960 on, Blaschko, Levine and Bocks, as well as Horita and Weber performed in-vitro studies of the biochemical reactions of psilocybin and psilocin. They concurred that only psilocin can be oxidized into a product of bluish-green color. The phosphate group prevents direct oxidation of this alkaloid (see Figure 19, p. 27). However, the typical bluing phenomenon does occur when this protective group is removed by enzymes, such as various phosphatases, which are very common in human as well as in mushroom tissue. I also observed the bluing reaction following removal of the phosphate group from baeocystin. Observations from in-vitro experiments explain why Psilocybe bohemica displays a strong bluing reaction, despite the fact that levels of psilocin in this mushroom are low or non-existent: Apparently, the enzymatic removal of the phosphate group from the psilocybin molecule occurs quite quickly. This is how psilocin is formed in reaction to injuries to the fruiting bodies. Immediately afterwards, psilocin continues to break down and disappears completely, while a number of blue-colored substances are created. In addition, some enzymes were discovered which accelerate the breakdown of psilocin. Cytochrome oxidases and laccases are examples of such enzymes. The latter has also been found in the mycelia of Psilocybe cubensis. Most likely, the enzymes are also formed in those mushrooms that display bluish discolorations in reaction to metol testing. Trace amounts of Iron" ions accelerate the bluing reaction as well. The structure of the blue-colored compounds has not yet been investigated. Apparently, they are quite unstable and involve a type of chemical bond known as chinones. Many pigments are known to have this basic structure

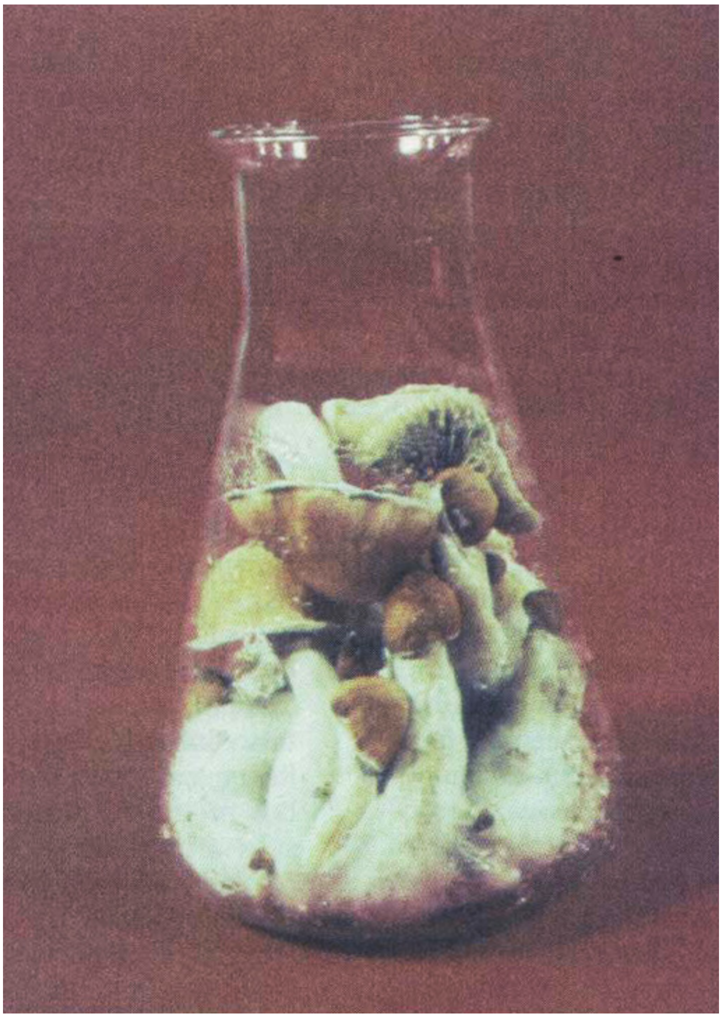


Figure 40 - Psilocybe cubensis fruiting bodies whose growth was accelerated with plant hormones.

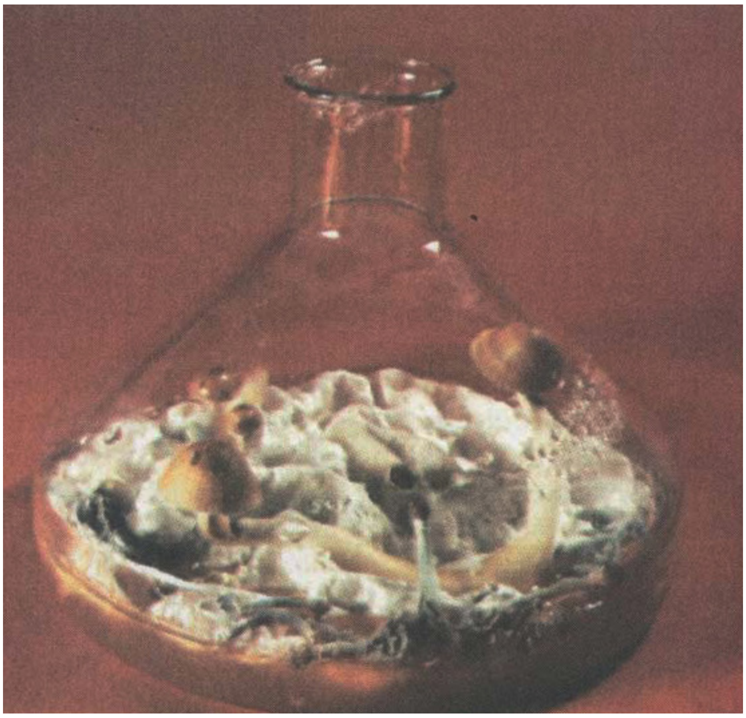


Figure 41 - Mycelial culture of Psilocybe cubensis on malt extract (3 % solution).

The Agaricales As Alkaloid Producers

Even though the blue discoloration does not occur in ali mushroom species that produce psilocybin and psilocin, we can say that, conversely, all species of the order Agaricales (gilled mushrooms) displaying this reaction are capable of producing alkaloids. Historically, this problem associated with the bluing reaction did not particularly impress early mycologists, because there were a number of boletes which turned blue in reaction to pressure and were thought to be among the most valued culinary mushrooms. Indeed, the mushrooms' color reaction is based on ingredients that are physiologically inactive. The boletes also do not display the kinds of spontaneous discolorations with age that are frequently noted in the psychotropic species.

As results of my own analyses have shown, the alkaloid concentrations in *Psilocybe semilanceata* and *Panaeolus subbalteatus* - whose fruiting bodies showed a slight degree of discoloration at most - are within the same orders of magnitude as those found in mushrooms that do not turn blue. Evidently, the pigments involved have a high degree of intensity; the tiny amounts that were produced did not measurably contribute to the destruction of the active ingredients. On the other hand, my own experiments revealed that levels of psilocin and psilocybin in very old and strongly discolored fruiting bodies and mycelia of *Psilocybe cubensis* were considerably lower in comparison to younger specimens. In 1948, Singer was the first to describe the intensification of the bluing reaction, including a change in color towards violet, in samples of *Psilocybe cubensis* which had been moistened with an aqueous solution of the photographic reagent metol (p-methylaminophenol). Ten years later he reported further examinations of some psychotropic *Psilocybe* species whose stems usually turned purple through contact with this reagent. Since 1970, various "field guides" intended to aid in the identification of North American *Psilocybes* have also described this reaction as specific to the *Psilocybe* species. For practical purposes, however, this guideline is all but useless. The metol merely reacts with the laccase enzyme (several structural types) contained in the mushrooms and it is not a reagent able to confirm the presence of psilocybin and its derivatives. Even the brown and white varieties of the commercial champignon mushroom change colors when exposed to a metol solution, just like many other mushrooms do as well.

The Limitations of Reagents

The discovery and usage of different color reagents as a means to differentiate certain species or even genera has been attempted for quite some time, with only moderate success, for the most part. Melzer's Reagent is a well-known mixture whose usage was propagated as a method for identifying the *Psilocybe* species. For this purpose, however, it turned out to be just as nonspecific and worthless as metol.

G. Drewitz discovered that the application of iron chloride to fruiting bodies of *Inocybe aeruginascens* caused a deep blue discoloration, while the muscarine-producing species of the same genus did not change color. Iron chloride is a salt that reacts with different phenoles to form intensely blue molecules. The underlying mechanism of this reaction is more realistic than the others, because psilocin will also react as a phenole. Independent of this color formation, mere trace amounts of iron ions will suffice to accelerate the oxidation of psilocin by air.

However, *Inocybe aeruginascens* is a species that produces only trace amounts of psilocin; therefore, it is very likely that the iron salt reacts with other phenoles in this mushroom species.

In summary, only those bluing reactions that are spontaneous or caused by injuries provide reliable clues as to the presence of psilocybin and its derivatives in *Agaricales*. The presence of the bluing phenomenon itself, however, reveals nothing about the type and quantity of any specific indole compound that may be present in gilled mushrooms.

CHAPTER 6

MUSHROOM CULTIVATION: CLASSIC FINDINGS AND NEW TECHNIQUES

While conducting research on the Mexican mushroom species during the 1950s, R. Heim and R. Cailleux determined the basic conditions essential to the cultivation of various mushrooms. Before providing additional details, I would like to briefly summarize the nutritional requirements and characteristics of fungal growth, to the extent that these issues are of interest here.

Extraterrestrial or Earthly Organisms?

In terms of cultivation parameters and nutrients, the psychotropic species are no different from table mushrooms and other common gilled mushrooms. For that reason, Oss and Oeric's speculations about extra-terrestrial origins of these species clearly belong into the realm of fables. In addition, psilocybin and psilocin are substances that can be derived from tryptophan by means of discernable reactions; indeed, the amino acid tryptophan in its free form has been found in a large number of mushroom species.

The natural propagation of higher mushrooms is linked to their basidiospores, which are produced on the gills of developing fruiting bodies and which are eventually cast off. Once the spores have been dispersed - by the wind, for example - they will germinate when conditions are favorable (nutrients, temperature, moisture, lack of competing organisms) and finally, they gradually colonize available substrates. Initially, a monokaryotic mycelial thread (i.e. a mycelium with only one nucleus per cell) grows out of the spore and superficially penetrates the nutrient substrate. When two of these hyphae meet, they form a mycelium with two nuclei, or a dikaryotic mycelium ("mycelial network"). Later on, these mycelial strands go on to differentiate into sporeproducing fruiting bodies ("fruiting"). Eventually, their spores disperse and germinate once again.

During most parts of the year, the dikaryotic mycelium grows unnoticed in its natural substrate and remains purely vegetative, that is, it continues to spread and to utilize new nutritional resources without producing mushrooms, provided there is sufficient moisture and temperatures do not drop below freezing. In its dormant state, the mycelium can weather droughts and the cold temperatures of winter, only to begin to grow anew. Some species have mycelia with thick strands that are visible within the substrate (e.g. the rhizomorphs of *Psilocybe cyanescens*), while other species, such as *Psilocybe semilanceata*, develop comparatively thin strands that are hardly visible at all.

The Secret of "Overnight" Growth

Every mushroom collector knows that there are years of maximum mushroom yields. Other years, mushrooms are scarce and dry periods may pass with no apparent crops of gilled mushrooms or boletes. For the majority of mushroom species, the specific conditions required to reach the fruiting phase have not yet been determined.

The saprophytic species (including the hallucinogenic ones except the *Inocybe* species: mycorrhiza with trees) generally fruit after optimal mycelial growth has been induced by appropriate nutrient substrates, as long as the following environmental conditions are maintained:

1) Decrease of the temperature until time of optimal fruiting.
2) Increase of the humidity to 95-100%.
3) Decrease of carbon dioxide concentration through increased air circulation.
4) Exposure to light may be necessary for fruiting.

The last two items already touch upon the essential requirements for mushroom cultivation, since these conditions are always present in

Nature, but often need to be specially created for mushroom cultivation inside glass containers or enclosed rooms.

It is no coincidence that the saprophytic species almost always fruit during the fall. Plant substrates such as twigs and leaves fall to the ground during this time and they are immediately colonized by available mycelia from mushroom spores as part of the natural cycle. The concurrent drop in temperature and increase in humidity are preconditions for fruiting. The proverbial rapid growth of mushrooms "overnight" is a function of mycelia that have previously massed together into knots, followed by a differentiation process into primordia, with progressive divisions into caps and stems. The whole mushroom is then ready to develop very rapidly, given sufficient moisture and ideal temperatures. Figure 42 illustrates a comparable in-vitro fruiting process that took about a week, with mycelia from *Psilocybe cubensis* (Earle) on an agar substrate.

Cultivating High Yield Strains

Artificial cultivation is an attempt to imitate and optimize the natural conditions essential for mushroom growth, and may even result in the discovery of additional nutrient substrates on which these species cannot grow in Nature. From the outset, this method of cultivation requires a sterile environment, in order to eliminate often fast-growing organisms such as bacteria and molds. For this purpose, laminar flow hoods are used in mycological laboratories. A small sterile space is created inside these containers by installing a filtration system that removes germs from a stream of air. The sterile space is used for the performance of tasks such as isolation of strains, and the production of sterile cultures and spawn for fruiting experiments. Antibiotics such as gentamycin (0.01%) are often added to the nutrient media, especially in the early stages of this process.

Two methods are used to produce sterile cultures of fungal mycelia.

The first method mimicks the mushrooms' natural reproductive process. Spores that fell off or were removed from the gills are suspended in sterile water. With microscopic control procedures in place, the spore solution is germinated on nutrients of various compositions that have been thickened with agar. One commonly used nutrient medium contains 3-6 malt extract along with 1.5% agar. It induces spores from many different species to germinate in a matter of several days. Prior to germination, all substrates are placed in autoclaves and sterilized with steam. The simultaneous germination of a large number of spores will result in the growth of monokaryotic mycelia which spontaneously combine and go on to form dikaryotic mycelia. Alternatively, one can attempt to systematically fuse selected monokaryotic strands in order to develop vigorous strains for cultivation (criteria: rapid growth, high yield). This is a standard technique that is widely used in the cultivation of champignons (*Agaricus bisporus*).

At the same time, such cross-breeding experiments enable the grower to determine whether mushrooms from different locations belong to the same species. Using this method, I was able to establish that mycelia obtained from *Psilocybe bohemica* and from *Psilocybe cyanescens* (collected in the U.S.) can never be fused together, which means that these two mushrooms are not of the same species.

The second method of cultivation requires cutting a piece of tissue from the inside of young, unopened fruiting bodies, using a disinfected knife in a sterile environment. The piece of tissue is then placed onto nutrient agar medium. In most cases, visible mycelial growth will occur within a few days. This method has the advantage of all mycelia being genetically identical to the mushroom from which they originated, unlike mycelia grown from spore samples. Therefore, this method makes it easy for the grower to reproduce high yield strains of saprophytic species. Some wild strains obtained from various species do not fruit at all when cultivated, or else, they do so very late, with a yield of fruiting bodies that is sparse at best.

Such differences in response to attempted cultivation were also observed by R. Heim with various strains of *Psilocybe mexicana* Heim. As early as 1956, he took spore sprints from a number of fruiting bodies in Mexico. Later on, in Paris, he was able to germinate the spores and isolate mycelial cultures of five different species. In collaboration with R. Cailleux, Heim

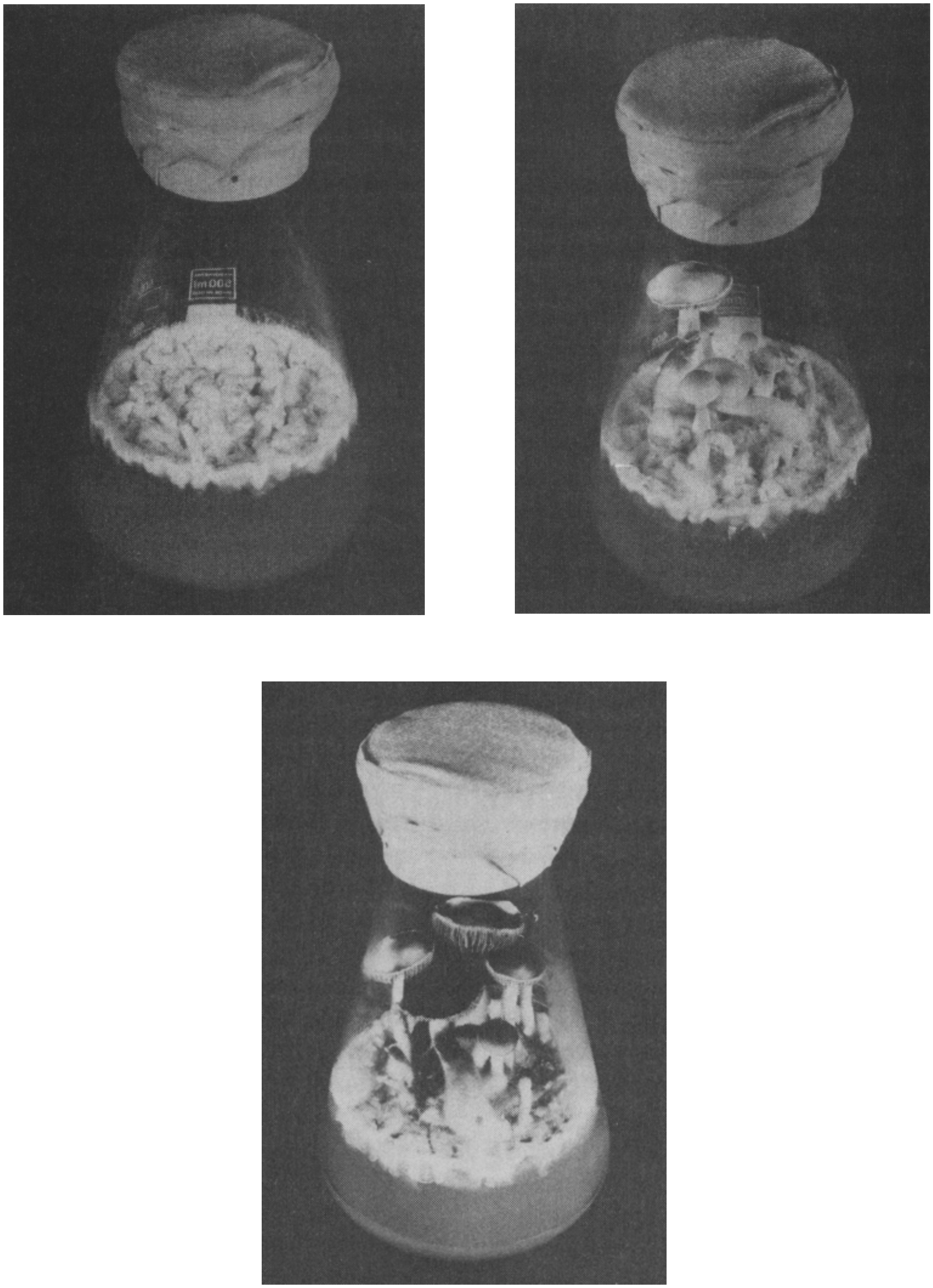


Figure 42 - One-week growth progression of ***Psilocybe cubensis*** cultivated on a malt agar (2%) substrate.

succeeded at growing fruiting bodies of the species Psilocybe mexicana, using compost substrate as a medium. This type of substrate is the most widely used nutrient soil for commercial mushroom cultivation (champignons). The fruiting bodies grown by Heim and Cailleux provided the dried material that A. Hofmann and his collaborators used to isolate psilocybin and psilocin for the first time. In Basel, it was also possible to cultivate mycelia from different species on liquid solutions of malt extract. The mycelial tissue was found to produce psilocybin without having to go through the fruiting process. This important discovery became the basis for harvesting large amounts of alkaloids. Unlike the fruiting process, which yielded five harvests over the course of several months, a species' mycelial cultures produced much larger amounts of mushroom tissue in only four weeks (see Figure 41). The cultures were grown on stationary malt extract (4-6%) with 0.2% agar added for increased viscosity.

This kind of saprophytic surface cultivation can be easily adapted for growing species which are difficult to fruit under in-vitro conditions, such as Psilocybe zapotecorum Heim, permitting cultivation of these species for alkaloid production. Even though the mycelial tissue grown from the Mexican species contained only half as much psilocybin (0.1-0.2% of dry weight) as the mushrooms did, high yields (approximately 20g/1) along with easy and rapid cultivation of mycelial tissue more than compensated for the lower psilocybin content. It is interesting to note that mycelia from the North American species of Psilocybe cyanescens will turn blue and accumulate psilocybin when grown on a medium of solid malt agar, while both of these traits disappear completely when the same strain is cultivated on the type of liquid medium described above, even if levels of nutrients are identical. The reasons for this inconsistency remain a mystery.

When mycelial cultures are kept in the dark, the mycelial forms may become partially permanent (sclerotia). Sclerotia may be hardened, are largely dark to black in color and they contain psilocybin as well. The formation of sclerotia was initially observed as part of the firstever attempt to cultivate psychotropic mushrooms on an agar medium. In 1935, H.J. Brodie reported permanent formations of bluish-green tissue while cultivating Panaeolus subbalteatus on malt agar.

Initially, he believed that his nutrient substrates had been contaminated by molds, because Panaeolus subbalteatus is a species that almost never spontaneously turns bluish-green. Figure 47 shows a distinct sclerotia formation of the species Psilocybe semilanceata. The formation of these permanent structures with Conocybe cyanopus has been described in a previous chapter (see Figure 35, p. 57).

Heim and Cailleux primarily described the fruiting of Psilocybe mexicana and Psilocybe cubensis on agar (0.05-2% malt extract) and on compost. During their experiments, Psilocybe mexicana produced the highest yields, while Psilocybe cubensis fruited quite vigorously as well. At about the same time, R. Singer had also started mycelial cultures derived from six mushroom species. Singer and his co-workers soon concentrated on Psilocybe cubensis in their efforts to induce fruiting. Soon after, in the early 1960s, R. L. Kneebone reported that this robust mushroom species, which thrives across subtropical climate zones, can also be induced to fruit on a rye-grain medium.

Counter-Cultural Expertise Gains Mainstream Acceptance

In the mid-1960s, Psilocybe cubensis became the species of choice for experiments that made use of submersed fermentation to investigate the biosynthesis of psilocybin from tryptophan and other precursors. We should note in this context that around the same time, this technique was also used to obtain mycelial pellets of the species Psilocybe baeocystis Singer & Smith, providing the material for the first-ever isolation of baeocystin from mushroom tissue.

From the 1970s on, a growing number of books were published in the United States that distributed information acquired by members of the counter-culture on the cultivation of psychotropic mushrooms. The scope of these books soon narrowed, with a primary emphasis on Psilocybe cubensis, which may be explained by the fact that, initially, only R. Heim's research results were published, thus making them available to a larger audience.

In 1971, new results were published

about the champignon's ability to fruit on a rye-grain medium, provided a cover layer was added on top. It wasn't long before these findings were applied to the cultivation of Psilocybe species.

By 1932, J. Sinden had already published a patent for a cultivation process that involved the inoculation of mushroom mycelia derived from champignons into horse dung compost (a medium widely used for cultivation purposes) but only after the mycelia had already grown to permeate a medium of sterilized grains. Since that time, this process has mainly been used in the production of table mushrooms, specifically, for manufacturing the spawn to be placed onto the compost without inducing fruiting on grain. Psilocybe cubensis fruits after about three to eight weeks on this substrate.

If a moist cover layer is added (e.g. a peat moss/lime mixture, 2:1), the yields may double. However, this process is risky, because over-saturation can render the containers non-sterile and invite contamination from bacteria and molds. Most authors prefer a mixture of rye and water that has been inoculated with mycelia from an agar culture. Still, rice, barley, wheat and other grains have also been used with varying degrees of success. Figure 52 shows that, after about five weeks, small mushrooms even grew on wet pages of a newspaper that used to be the official print medium controlled by the former East Germany's SED Party ("Sozialistische Einheitspartei Deutschlands" or "Unified Socialist Party of Germany").

Some Recent Findings

Today, Psilocybe cubensis is clearly one of the most easily cultivated mushroom species around and it can thrive on a large variety of substrates. Naturally occurring specimens are most often found growing on cow dung. Generally, the species tends to grow on dung and straw as a primary decomposer, but the mushrooms can also utilize nutrients previously converted by other organisms, such as various types of compost, among others (see Figure 53, p. 77).

Within the scope of this book, it is impossible to discuss all details pertaining to the fruiting process of psychotropic mushroom species. P. Stamets and J.S. Chilton are the authors of two outstanding books that deal with all the technical and practical aspects of mushroom cultivation. The psychotropic species are included along with information about many kinds of culinary mushrooms. Still, I would like to make special note of the fact that Psilocybe cubensis cultures benefit when horse or cow dung is added to the original nutrient mixtures, as evidenced by the mushrooms' relatively faster growth rate and the development of comparatively more robust specimens (see Figure 45, p. 71 and Figure 49, p. 74). Before adding the dung to the nutrient mixture, however, it must first be suspended in water and autoclaved, which considerably reduces the risk of contamination. Only then should the suspension be added to the rye grain substrate and sterilized once more.

In spite of numerous claims in the popular literature, most attempts by laypersons to cultivate fruiting bodies of Psilocybe cubensis on rye grain substrate are thwarted by the presence of contaminating agents such as bacteria and molds. Even though mushrooms are organisms that do not perform photosynthesis and thus are no longer thought of as plants, some mushroom species, including Psilocybe cubensis, are heliotropes, meaning they will grow toward stationary sources of light. All Psilocybe species examined to date require light to promote the biochemical process in the mycelia that will induce fruiting. Additional exposure to light is needed, if the fruiting bodies are to develop into normal shapes and produce spores.

Apart from a series of interesting physiological experiments performed by E.R. Badham during the 1980s, there are a few other noteworthy substrates for cultivation of Psilocybe cubensis fruiting bodies. For instance, we were the first to discover that a new type of plant hormone (brassinosteroids) will accelerate fruiting of the mycelia (Figure 40, p. 64). During these experiments, we were also able to completely suppress the formation of psilocybin and psilocin through high concentrations of phosphate. It is now possible to design future physiological experiments to study different hallucinogenic mushroom species under these conditions.

In recent years I have also succeeded at cultivating the European hallucinogenic mushroom species.

Figure 43 - Gymnopilus purpuratus fruiting on wet rice and saw dust.

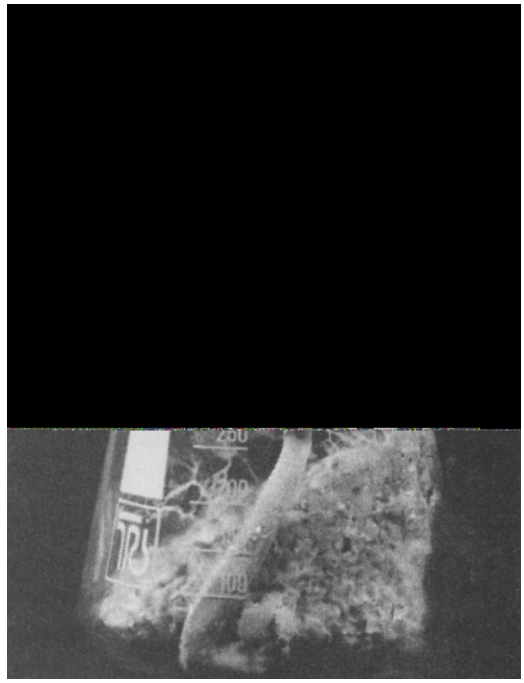


Figure 44 - Psilocybe bohemica on a rice substrate.

Figure 45 - Psilocybe cubensis fruiting bodies grown an a mixture of cow manure and rice.