LONG ISLAND MYCOLOGICAL CLUB

http://limyco.org

# L.I. SPOREPRINT

VOLUME 12, NUMBER 3, AUTUMN, 2004

## MUSHROOM DAY 2004

## RESCHEDULED TO OCTOBER 10th

Mushroom Day has been moved from Oct. 17th to the 10th. Please make sure to change your Foray Schedule to reflect this.

All LIMC members are invited to join us at our annual public mushroom exhibit at Planting Fields Arboretum. **The public display will run from 1 to 4 PM, but if you wish to help, arrive around 12 noon to help in setting up the exhibit**. Mention your membership to the gate attendant to avoid the entrance fee. Bring any interesting specimens that you find for exhibition and identification .

**Following the exhibit, we will hold our annual meeting which this year will include elections (held every 3 years) for all Board members.** A quorum of 12 is necessary, so please attend to cast your vote. Two positions are vacant, that of Species Recorder, and a general board position; if interested, inform us. Likewise, should any present board member not wish to run again, please let us know.

## Communication among Fungi

*by Ed Mena*

*The last article that Ed wrote discussed some of his reasons for looking at mushrooms for interesting chemicals. He finished it by talking about the defensive chemicals that fungi synthesize and some of the uses that we have for them. This is a continuation of that article.*

What are communication molecules? The air we breathe, the water in a lake, and the soil and leaf litter, are highways through which all sorts of communication molecules course. We as humans are challenged, to say the least, at detecting all but a scant minority of these chemicals. Many species of insects use them to advertise themselves to mates. Plants attract (or repel) insects with chemicals. Various species of animals announce their presence with communication molecules. Take your pet dog for a walk and witness first hand the signs of an olfactory world from which we are excluded. The lives of millions of animals are synchronized by chemical signals. I'm sure that many of you have seen the remarkable scenes of millions of coral spawning on the same night from one of David Attenborough's shows "Life on Earth". I can't resist one more example, that of the stinkhorns, which we have the (mis)fortune to detect, as do many insects. Clearly, the chemical signal emanating from the stinkhorn has a very different meaning to you and I compared to the many species of insects encircling its tip.

We live in a sea of chemicals. I heard an analogy once that I've become very fond of. Communications chemicals can be looked at like postage stamps. You put a stamp on a letter or package to communicate something to the addressee. The stamp insures that the message will be received but says nothing about the message or the reaction of the addressee. Communication molecules also insure that a message will be transmitted; the exact meaning of the message will depend on the "sender" and "recipient". Another interesting feature of communication molecules is that once

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# PRESIDENT'S MESSAGE

Greetings from one who envies those who had plenty of rain in recent weeks! NOW maybe things will pick up for the fall forays.

I have just a few reminders for all members:

Firstly, Oct 10th at Planting Fields is our annual Mushroom Show. Please bring any decent looking specimens you have found for ID and display. Also, it would be greatly appreciated if you would come at 12 noon to help set up.( The club has purchased 2 mushroom posters as a "thank you" for the Arboretum. They have been super in allowing us to have this educational show every year.)

Secondly, at the end of the Show, there will be a brief meeting for all LIMC members to elect board representatives and voice their concerns. All officers' and board members' terms, except the President's, expire this year. **Any current officer/ board member who cannot or does not wish to be a nominee for the next three year term must let me know before elections**. The board is an important part of the club and all office holders must commit themselves to attending at least two meetings a year. We welcome any volunteers. Get involved!

Third, our Annual Luncheon is scheduled for the Sunday before Thanksgiving. I don't think we'll have a problem with snow cancellation as we did last year. Mailings will go out in ample time for this event.

Lastly, our club membership continues to grow, primarily via our website. At this time I would like to thank all members who welcome the newcomers at the forays and show them "the ropes."

Remember, there can be no club without you!

# EDITOR'S NOTE

Despite all the touting of "natural" ingredients and "organic" foods, anyone who has been following the hurricane season knows that nature is not always benign, and this is so in things both great and small. In fact, some of the smallest things, such as viruses and bacteria, are among the most deadly. Among these small but deadly organisms we can number mushrooms, which can be deceptively attractive. Every year brings a new round of mushroom poisoning among the foolhardy and uninformed; we should avoid being included among them. All it takes is a moment's inattention or lapse in wariness to fall prey to one of nature's more virulent compounds. Ed Mena's article reminds us that although these toxins were not evolved to target humans, we are nevertheless susceptible to them. I am therefore uneasy when I see careless or cavalier behavior among mushroom pickers. Even seasoned mycophiles are prone to error, and inexperienced mushroomers should confine themselves to easily recognized species that they are sure of. See my article on page 5 for some details re Russulas and Boletes.

**MATERIAL FOR THE WINTER, 2004 EDITION SHOULD REACH THE EDITOR BY NOVEMBER 30TH**

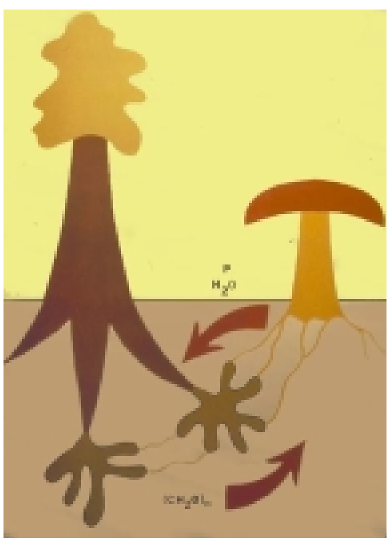
(Submissions should preferably be typed or submitted in Word or Rich Text Format on PC floppy disk or by e-mail)

# MYCORRIZHA: AN ANCIENT PARTNERSHIP

*(from "The Private Lives of Plants", Princeton U. Press, by David Attenborough)*

*SECOND OF THREE INSTALLMENTS*

The lichen partnership is the closest and most intimate between plant and fungus but it is not the only one. Some of the early algae that first made the move from the sea to the land evolved into more complex structures and became green skins and furry mats. These were the ancestors of today's liverworts and mosses. Although they were green with chlorophyll and could therefore photosynthesize, they were only able to absorb the mineral nutrients they needed for the process if their surface was wet. They had no roots, only small wiry filaments that gave them a feeble attachment to the ground. It was advantageous for them to grow tall, for then they were able to steal the light from their neighbours, but to do so they required a rigid stem. That in turn demanded better, firmer anchorage in the ground. Eventually they developed substantial outgrowths from the base of their stems that probed into the earth. These were the first true roots and they must have soon encountered the thread-like fungi in the soil.




Once again, a physical connection between the two was established and once again there were such important benefits for each party that the relationship has survived until today. Over three-quarters of all living plants still have underground fungal partners. The cables, ropes and strings, some running deep into the ground, that most of us think of as being the main roots of a tree, serve primarily as anchorage. The crucial business of collecting water and nutrients is done by a tangle of small hairy rootlets only a few inches down in the soil. That, after all, is the best place to collect liquids seeping down from the surface. It is here that the threads of the fungal partners also grow. They are physically attached to the tree's rootlets, penetrating their surface, some superficially, some deeply. They may invest the whole length of a root hair as a sheath or just be concentrated around its tip, and they extend into the soil to form a fine mesh that stretches far beyond the reach of the tree's rootlets and often connects with the fungal threads growing on the roots of neighbouring trees so that the whole forest floor is underlain by a continuous fungal mat. That this is so has been demonstrated by injecting substances with radioactive markers into one tree and then detecting their eventual appearance in the others growing nearby.

These partnerships are known as mycorrhizae, a name which means simply and accurately 'fungus-root'. Many thousands of different species of fungi take part in them. Although they depend upon their plant partners for much of their food, they live otherwise independent lives. In due season they reproduce. Some erect their fruit-bearing bodies above ground as mushrooms, toadstools and puffballs. Some trees may have several different kinds of fungal partners, but others link themselves with only one. Mycorrhizal fungi are also variable in their partnering. But some do form regular associations so fungus hunters know that a particular kind of toadstool is only to be found beneath the boughs of a certain kind of tree, such as a birch or a larch.

Some mycorrhizal fungi do not even emerge above ground to distribute their spores. They develop their fruiting bodies within the earth. These are the truffles and the false truffles. To recruit the messengers needed to distribute their spores, they use a perfume that seeps up through the soil. Human gourmets who relish the taste of truffles are seldom if ever able to detect the smell, but sows, which also like truffles, are able to do so with ease. This is hardly surprising because the scent produced by the truffle is chemically identical with that produced as a sexual signal by a boar. So properly harnessed, sows can show their human masters where these delicacies lie. These days, dogs are

***(Continued on page 4)***

## *Mycorrhiza*

*(Continued from page 3)*

more widely used. They have the most sensitive of noses and they are easily trained - and doubtless they are more easily controlled than a sexually expectant sow.

Other animals are also coaxed by these reticent underground fungi into becoming their spore distributors. Beetle larvae burrow down to them, gorge on their substance and then pupate within them so that the adults, when they emerge, carry the spores away. Deer, mice and shrews in Europe, armadillos and opossums in South America, wallabies in Australia, all have a taste for particular truffles. The spores pass through their guts and are left with their droppings. In the great coniferous forests of the American Pacific coast, flying squirrels regularly plunder these underground treasures. The duet of interdependence now becomes a trio. The squirrel gets food from the fungus and lodging from the tree, for it habitually nests inside holes in the trunks; the conifer gets nutrients from the fungus; and the fungus gets starches and sugars from the tree, and transport for its spores from the squirrel.

This harmonious trio, here and there, may even become a quartet. But the new member introduces a dissonant note. Its ghostly pale stems rise up through the leaf litter in the darkest, gloomiest parts of the forest to a height of about ten inches. Each carries, at the tip, a white waxy flower. So lacking is it in pigment that it is sometimes called the corpse flower, but it is more generally known as the Indian pipe. Its leaves are no more than small colourless scales pressed close to the stem. Lacking chlorophyll, they are quite incapable of manufacturing food. The plant nourishes itself in a different way. Its roots reach down and fasten on to the fungal mat and from that absorbs all its nutriment. This food, of course, has not been produced by the fungus. It has come from the tree. But the Indian pipe, unlike the fungus, appears to give nothing whatever in return to either the fungus or the tree. It must be rated a parasite.

INDIAN PIPES

The contribution made by mycorrhizal fungi to their plant partners is not limited to nutrients. They are often essential for the plant's reproduction. The North American pine forests are dark places, for the thick foliage of the tall trees screens the sun from the forest floor. A young seedling cannot get enough light to photosynthesise for itself and will not grow properly in sterile soil. But if the seed falls on to ground where there is a thick mycorrhizal mat, then the developing roots link with the fungal threads and through them the infant tree gets the food it needs - food which comes, by way of the fungus, from its parent or neighbour. At this stage, it is just as much a parasite as the Indian pipe. No pine seedling will survive in these shady forests unless it germinates in the fungal nurseries and the mycorrhizal connection a young plant establishes at this time will remain with it all its life.

Fungal nursemaids are employed by many plants, but for none are they more important than orchids. Most plants provide their seeds with food stores of some kind. But not orchids. Their seeds are so small they verge on the invisible and getting them to germinate, as orchid fanciers the world over know only too well, can be extraordinarily difficult. Some spectacular specimens have fetched fantastically high prices precisely because they belong to species that are very rare in the wild and have never produced germinating seed in cultivation. The reason for their failure is that in the wild they habitually establish a partnership with a particular species of mycorrhizal fungus. No other kind will do. In cultivation, away from their native forests and in glass-house conditions, these mycorrhizae do not exist or struggle to survive. The problem was solved in the 1930's by germinating the seeds on a specially enriched jelly which supplies the seedlings with the nutrients that in their original homes their mycorrhizal fungi would have provided for them. In recent years, ways have been discovered of identifying and culturing their fungal partners so that now, theoretically, it is possible to germinate the seeds of all species of orchids.

Once the orchid has a proper start in life, the fungal connection may be abandoned. But some species retain it permanently and, like the Indian pipe, draw all their sustenance from their fungus partner which, in turn, extracts it from a tree. One of these is the bird's nest orchid. It is found in beech woods in many parts of Europe, and gets its name from the curious mass of stumpy roots that grow in all directions around its short thick central stem. These link it with a fungus that feeds on the rotting leaves on the forest floor. From the centre of this untidy bundle in June springs a stem inches high

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## Mycophagy: avoiding the cutting edge

*by Joel Horman*

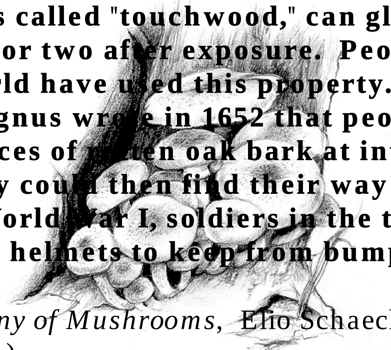
The gold standard of safe mycophagy is to consume no mushroom species which cannot be identified with certainty. More and more, however, mushroomers are resorting to rule of thumb, and departing from this principle. Many pickers believe, e.g., that a Russula is safe to eat if it passes the taste test: i.e., if it is not bitter or acrid. Others consume with abandon any Bolete that does not have red pores or pores that stain blue upon injury. Neither of these rules of thumb is valid, and believing otherwise can be dangerous. On the other hand, some individuals are risk takers and knowingly experiment by ingesting previously untried species that they believe are probably safe, perhaps because they belong to a genus whose members are mostly edible or similar reasons. That's OK if you are willing to risk some gastric distress, or possibly worse, for the thrill of the unknown. Personally, an occasional lotto ticket is the limit of my gambling.

Recently, we have encountered a very fine looking, eminently succulent-appearing Bolete that is nevertheless, toxic: *Boletus sensiblis.* Although it is not on our L.I. list, it seems to be occurring in increasing numbers, and can be confused with *Boletus bicolor*, which many of our members are fond of collecting for the table. It can be differentiated from *B. bicolor* by the **rapid blue-staining reaction of all its parts:** cap, stipe, pores and flesh. The flesh of B. bicolor stains blue only slowly, and its cap should not stain at all. There may be strains of intermediate appearance, so that any uncertainty should result in rejection of the questionable specimen. Ernst Both, the eminent boletologist, has said that bicolor is a confused taxa (pers. comm.) that requires further study. He suggests that the only set of rules one can apply to picking edible boletes consists in gathering only those that have non-staining flesh, a reticulate stipe, brown cap, and pores that are white, yellow or olive; these belong to the edulis group.

***Boletus sensiblis***

As to Russulas, all the field guides indicate that many species are of unknown edibility; this should be taken seriously and literally: it is simply not known whether they can be safely consumed. The website of the Center for Disease Control recounts a California episode in 1981 wherein a group of Laotian refugees, after applying their traditional test for poisonous mushrooms, consumed what were apparently Russulas, and suffered GI symptoms including vomiting, diarrhea, dehydration and elevated liver enzymes requiring treatment in the intensive care unit for up to seven days. According to the CDC an unidentified Russula toxin has caused both GI and parasympathetic symptoms and hallucinations. More recently, an episode of rhabdomyolysis (muscle wasting,potentially fatal) was reported in the Oct.'01 issue of the Journal of Kidney Diseases. The culprit was *Russula subnigricans*, one of the reddening Russulas, known in Japan to be deadly poisonous. All red staining or black staining Russulas should be avoided, as some field guides advise.

Mushrooming is a fascinating and enlightening pursuit in itself; edibility is a bonus that should be approached with prudence and knowledge, not casually or recklessly.



***Armillaria mellea* is bioluminescent. The greenish light, known as "foxfire," is given out not only by the mushrooms but by the mycelium within the wood. The surface layers of the such wood, which is called "touchwood," can glow fairly brightly for a week or two after exposure. People from different parts of the world have used this property. The Swedish historian Olaus Magnus wrote in 1652 that people in Scandinavia would place pieces of rotten oak bark at intervals when entering a forest. They could then find their way back following the light. During World War I, soldiers in the trenches placed touchwood on their helmets to keep from bumping into others in the dark.**

*(In the Company of Mushrooms*, Elio Schaechter, 1997, Harvard University Press.)

**WELCOME NEW MEMBERS**

**Paul Bettencourt**

**Roy Derrickson**

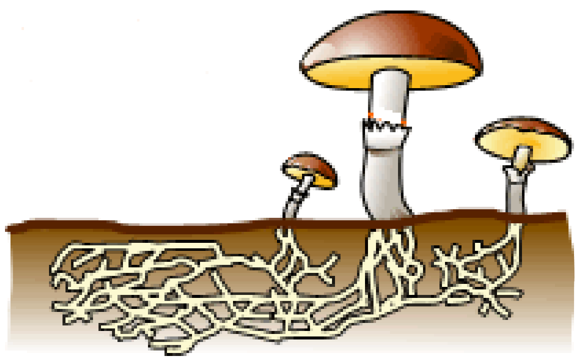
**Bernd Foerster**

**Jacqueline & Madeline Hoffstein**

**Serge Rozenbaum**

## ***Fungal Communication*** *(Cont. from page 1)*

Mother Nature found a chemical that could be used for communication purposes, she stuck with it. Similar classes of molecules are used throughout a wide phylogenic range. Communication chemicals can act to send a message from one part of an organism to another (e.g., hormones) or they can send communications to organisms of the same species (pheromones) or to different species



(stinkhorns, flowers say "come here", a skunk's smell says "go away", etc).

Since we are talking about mushrooms, what are some of the things that are likely to be mediated by communication chemicals? Let's start at the beginning. A spore responds to certain chemical cues to germinate. It may need to know if it has landed on a suitable substrate. These mycelia respond to other mycelia of the correct mating types of the same species to form diploid mycelial organisms. The growing mycelia need to be able to detect and utilize proper nutrients. Additionally, the mycorrhizal species need to colonize (or be colonized by) the appropriate type of tree root for survival and growth. The selectivity of many types of mushrooms has always amazed me. How does *Suillus granulatus* tell the difference between a pine and maple tree? How do the many other mycorrhizal species recognize their hosts? However, also consider the selectivity of the wood rot polypores. *Piptoporus betulinus* always colonizes dead birches. It is rarely found on other species of trees. What signal(s) allows this fungus to selectively grow on this wood? Many species are selective for with hardwoods or conifers. When we speak colloquially about these interactions, we make statements like, "They are attracted to dead birch trees", or" *Suillus granulatus* prefers to grow in association with pine". Statements like these seem to give decision-making qualities to organisms that consist of a very limited number of cell types. While they do make a "decision" in a manner of speaking, it is their responses to the various chemicals that they encounter, either positively, negatively, or both, that underlies this apparent decision. These chemicals interact with cell surface or intracellular receptors and induce metabolic changes in the fungus. As I mentioned above, Mother Nature is very fond of the communication systems that fungi developed a billion or so years ago. Many of them have been refined and elaborated upon as eukaryotic systems increased in complexity. Once evolution found some molecules that were good "postage stamps" and some receptors that were good "mailboxes", it stuck with them and refined them over an eon or two.

The result is that many chemicals that are used by higher organisms have their "roots" in fungal metabolism. In fact, recent phylogenetic analysis has shown that the fungal kingdom is part of the terminal radiation of the eukaryotic groups (sometimes eloquently referred to as "the great eukaryotic radiation"). This is assumed to have occurred one billion years ago when prokaryotes and eukaryotes separated (my calendar doesn't go back that far). There is evidence that fungi are more closely related to animals than to plants. The prevailing opinion is that plants diverged from the lineage that then went on to give rise to animals.

Mammals, of course, have many more pressing communication needs than fungus. In the central nervous system, at least 40 to 50 chemical transmitters have been identified. In the immune system, many types of communications proteins, the cytokines, have been discovered. These are two broad examples of mammalian communications molecules. What is also true with higher organisms is that the type of message that a molecule sends depends on the receptor that the cell has. An organism may have many different types of receptors for chemicals and the message that a cell receives depends on the receptors on that cell. For example, compounds that interact with mammalian serotonin receptors have been isolated from fungus. The introduction of Prozac has made many of us experts in neuropharmacology and we all know about serotonin's involvement in mood and depression. There are several types of serotonin receptors in our central nervous and others throughout our body. Serotonin and/or its receptor are apparently also involved in some aspect of fungal communication and may have been used as a communication molecule long before people realized that they were

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***Fungal Communication*** ***(Cont. from page 6)***

depressed. The human nervous system also has nicotinic and muscarinic receptors. *Amanita muscaria* is a particularly rich source of a variety of mammalian communication compounds. It also contains muscimol and ibotenic acid, and is a potent neurotoxin. While these chemicals act at mammalian neurotransmitter receptors, in the case of *A. muscaria,* they are probably defensive chemicals. Because of their immediate action, muscaria chemicals would probably persuade potential predators to dine somewhere else. The predators may include mammalians, insects, soil nematodes and other fungi. We should resist the egocentric notion that these chemicals are directed at our species. As I mentioned above, when nature finds a way to do something well, it usually sticks to it. Fungi synthesize chemicals that act as cytokines, compounds that mimic various peptide transmitters and gut hormones; they produce compounds that release insulin from mammalian cells. No one believes that fungi had humans in mind when these chemicals were first synthesized.

The take-home message from all of the above is that many receptors and metabolic systems used by fungi overlap with those used by more complex organisms (I'm resisting using the term "higher"). As a result, there are thousands and thousands of chemicals synthesized by fungus for their own purposes that will also affect mammalian systems, some for better, and others for worse. I'm trying to find the "better" ones.

Two other questions that I often hear are, "Exactly what do you do with these mushrooms?" and "What kind of compounds are you looking for?" I'll try to answer both of these questions in my next installment.

*(Ed Mena, Ph.D, is a researcher at the University of Conn. who has conducted studies on the venom of snails and spiders.)*

***Mycorrhiza*** ***(Continued from page 4)***

above the carpet of dead leaves. In the summer this produces five to seven flowers with yellow petals and a large pink lip. Bumble bees will visit it to gather its nectar and so be laden with its pollinia, but the plant only rarely sets seed. It reproduces itself instead with buds that develop on thread-like underground stems growing out from the main lobes.

The most extremely adapted of all these parasitic orchids grows in western Australia. It blooms underground and never emerges above the soil at all. Not surprisingly it has only been seen on very few occasions - and then largely by accident. At the start of the autumn rains, the orchid produces a tulip-shaped structure which grows upwards, lifting the surface of the earth immediately above so that cracks form, from which drifts a faint perfume. This attracts a variety of insects, including fungus gnats and termites which crawl down to the buried flowers. It is the first plant known to recruit the help of termites as pollinators. It might seem surprising that these most abundant and widespread of tropical insects are not more widely employed but termites are just as shy of light as any fungus, so the only flower that could attract them is one which has the bizarre habit of blooming below ground.

**Foray Results**

**Christie, 6-12:** Only 9 sp incl early Suillus granulatus.

**West Hills 6-19;** 10 sp., nothing exciting.

**Planting Fields 7-10:** 13 sp. incl many large *Meripilus sumstinei* and *Pluteus longistriatus*

**Bethpage 7-17:** 22 sp incl many small *C. cinnabarinus,* 5 sp Amanita

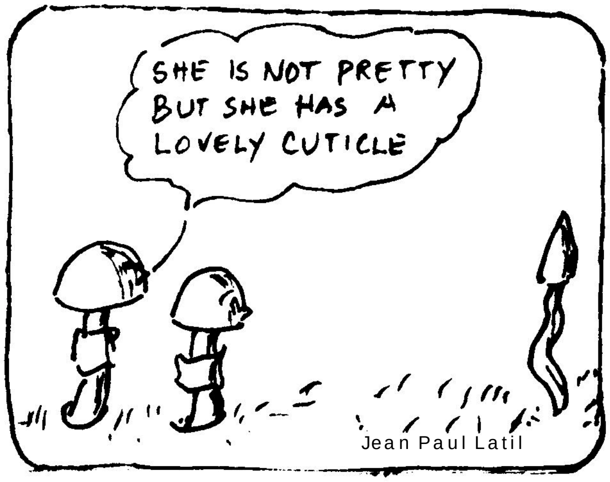
**West Hills South 7-24:** 33 sp., incl. several edibles and 3 sp not prev. recorded: *Galiella rufa* (also found prev. week by Lyle), *Russula blanda* (small, white, mild), & *Thelephora vialis.*

**Bethpage7-31 :** A surprising 50 sp., incl. 7 sp. of Bolete, many yellow and red chanterelles, as well as black trumpet. 3 new to list: *Coprinus lagopus, Ramaria formosa, Clitocybe eccentrica.* Lastly, *Cortinarius sanguinius,* uncommon here.

**Rocky Pt 8-14:** 44 sp. but only 2 of the target sp., *Lec. auranticum*, found by Boris. otherwise, 7 sp of Amanita, 5 of Boletus, 5 of Lactarius and 6 0f Russula. One new sp of toothed mushroom, *Phellodon niger var. alboniger.*

**Planting Fields 8-21:** 37 sp. incl. some *L. sulfurous* and one new sp. *Bulgaria iniquinans* ,

**Christie 8-28:** 37 sp. incl. 4 sp of Amanita, 5 Boletacae, 5 Russulacae; no appreciable quantity of edibles.




Jean Paul Latil

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***"Description demands intense observation, so intense that the veil of everyday habit falls away and what we paid no attention to, because it struck us as so ordinary, is revealed to be miraculous."***

***Czelaw Milosz, 1911-2004***

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