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Editorial Offices
c/o Dr. J. D. Pollack
Department of Medical Microbiology
The Ohio State University
5072 Graves Hall
333 West 10th Avenue
Columbus, Ohio 43210

Business Offices
c/o Harry Knighton
4245 Redinger Road
Portsmouth, Ohio 45662

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THE MOREL
A STORY WITH A MORAL

LOUIS C. C. KRIEGER
with an Introduction by
John A. Stevenson[1]

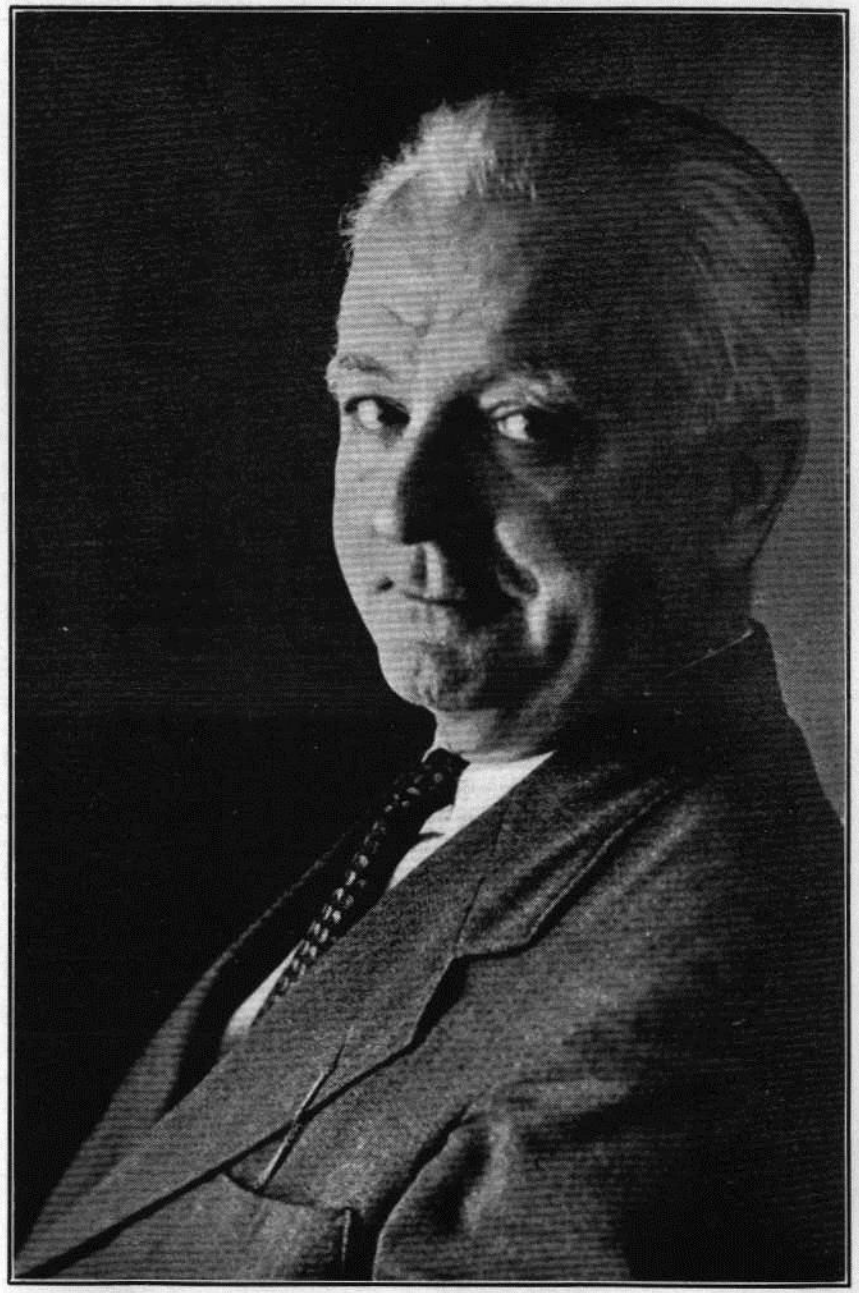
INTRODUCTION

L. C. C. Krieger (1873-1940) was the creator of the finest series of paintings of the fleshy fungi ever produced in America. The late C. G. Lloyd said of his work, "Such perfection of illustration has never been reached by anyone else in this country and in Europe only by Boudier. There may never be another as competent as he." Not only do Krieger's plates approach perfection artistically, but they are technically correct as well to the most minute detail. Mr. Krieger gained his mycological background during the years he was employed as an artist by Professor Farlow of Harvard University. Many of his paintings have been published in an extensive article in The National Geographic Magazine (1920) and in The Mushroom Handbook (1936, reprinted in 1967 by Dover Publications, Inc.).

In the spring the mushroom-lover's fancy lightly turns to - forgive us, O shade of Tennyson - thoughts of morels. The more plebian vegetables, including Mr. Jiggs' favorite, may be well enough when the luscious morel is not abroad, but let the breath of gentle Zephyrus cause grim Boreas to loosen his cold grip on the clod, and our mycophagist begins to think of cranking his "tin Lizzie" that he may hie forth in quest of the nearest orchard where the coveted fungi abound.

1. United States Department of Agriculture, Plant Science Research Division, Beltsville, Maryland 20705

Ed. Prof. Kent H. McKnight found this article in Mr. Stevenson's "Topical File" on Louis C. C. Krieger. It was written by L. C. C. K. on May 24, 1921, and we believe it has never been published. Dr. H. A. Kelly reviewing the original ms. thought it was "too fantastic." We offer it to *McIlvainea's* readers, and include a short introduction which Mr. Stevenson has recently supplied and a copy of his portrait of L. C. C. K. which was originally published in *Mycologia 33*:241, 1941.



LOUIS CHARLES CHRISTOPHER KRIEGER

You do not mean to tell me, "beloved reader," that you have contrived to survive thus far without knowing the morel? - WELL!! Perhaps you may feel disposed to make amends for your past, wellnigh unpardonable, neglect of so noble a member of the vegetable kingdom.

If this be true - and between you, me, and the doorpost, I sincerely hope it is - if this be true, I say, then make haste, summon all your available ingenuity, and follow our toadstool-hunter on one of his forays, for it is possible to profit even from a fool, and toadstool-people, if we are to believe their "safe-and-sane" brethren, are fools, unmitigated fools.

But - let me whisper in your ear - unless you proceed with the utmost caution and perspicacity, you will have some difficulty in learning just when our super-inscrutable friend sallies forth into the mushroom-bearing fields. He knows the psychological moment; you do not.

Auspicious signs of the mycophagist's prospective intentions are, the sudden and inexplicable avoidance of his best friends, and his unusually suspicious movements about the time when the first robin-redbreast pulls his wriggling breakfast from your front lawn; when the aforesaid west-wind lovingly wafts your locks about your face and glorious Orion has definitely dropped below the horizon. This time at hand, you must clutch Dame Fortune by the forelock, rise long before dawn every morning, dress for a wet outing (all this without lights, and noiselessly), and then place yourself at your rear door (open just a chink) to watch the mycophagist's, as it happens, your neighbor's garage.

At "Lizzie's" first yawns and stretches you make ready; as she pokes her nose out of the garage-door you prepare to leap; when she starts you give one mighty spring, hop on the fender and shout at the nonplussed driver that henceforth, come what may, you, too, propose to partake of that *cibus deorum,* that food of the gods, the heavenly morel, - have you qualms of conscience at carrying out so bold a proposition? Away with them; everything is fair in love, in war, and in the hunting of morels.

Caught thus, unawares, the wily fellow will doubtless, albeit grudgingly, greet you as a comrade-in-folly and welcome you on his foray, not, however, before extracting from you a solemn vow that the location of his morel patch in the old Simmons' apple orchard must not be divulged, not even under threat of the medieval thumb-screw. You swear by all "ye gods;" "Lizzie" snorts through her tin nose, and off you are for the happy hunting ground.

"Next of the Perigord truffle - which, unfortunately, is not found in our otherwise prodigally productive land - the morel, the object of our search this morning, is the most sought-after of fungous growths," confidentially whispers the man at the wheel. "No mushroom-lover," he adds, warming to your advances, "willingly betrays the whereabouts of a located patch; it is only by employing such cunning as yours that the highly desirable information is obtained. But, - I'll forgive you."

"You are extremely generous. - Tell me, how did you learn of the existence of your patch?" you continue, counting on his forgiveness.

"Old Simmons, a great uncle of mine, told me of it with his last breath: 'John,' he said, feebly, 'I have left you the orchard, but I must not die before I tell you that in this orchard grow the fattest morels you're ever likely to see on this earth;' and with that, he expired.

"Morels in the spring, and apples in the autumn; what a lucky mortal you are. Tell me, are morels ever offered for sale in our markets?"

"No. In Europe it is not unusual to see a peasant woman offering, at a fancy price, the few specimens she has succeded in finding in the vicinity of her own hamlet. Centuries ago, before the rigid laws governing forest conservation were passed, the peasants, anxious to enlarge their meager incomes, would set fire to woodlands in order to secure a great crop of morels, for, you must know, the morel has a penchant for growing on burnt-over wooded areas as well as in orchards; but, pray, do not let this bit of information kindle within you the desire to kindle someone's woodlot. At least think it over. Once the reason for your incendiarism became known, you might have a morel-hungry nation following your example, with results as deplorable as the culture of Lamb's Roast Pig."

With such conversation, both diverting and instructive, it is not long before the machine turns into a very muddy and rutty old lane at the end of which can be discerned the entrance to the Simmons orchard, the tops of the trees touched with the light of "rosy-fingered" dawn. One more jolt and a loud squeak from "Lizzie," and you two early wayfarers alight and enter mushroom fairy-land. Dew is on the grass, and in the numerous mudholes there are evidences of recent heavy rains.

"Ideal morel weather! - There should be an abundance of the little 'sponges' this spring. Last year, and the year before, they were aggravatingly few, - with this long period of rest, the 'spawn' should be in condition to send up a bumper crop."

The new owner of the orchard, walking a couple of paces ahead, just concludes with these words, when a most satisfying "Ah" hastens your step until you, too, standing by the mycophagist's side, give vent to your emotions by reiterating the same joyful exclamation.

"See what we have!! - One - two - six - ten -- fifteen, - at the first fell swoop, - and of the best kind, too. You know, there are many species of morels, - all edible, however, - and the one to which the specimens here belong is the most delicious of them all, as its scientific name, *Morchella deliciosa,* indicates. Note its bent head, a specific distinction."

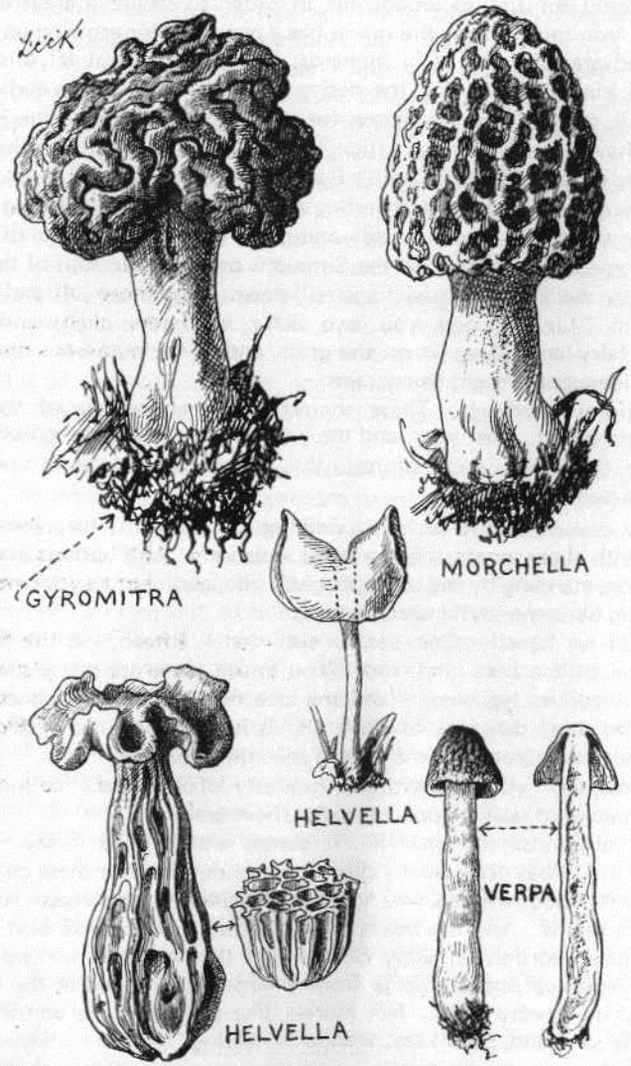
"Is it possible," you ask with the modesty of a novice, "to mistake a poisonous species of similar appearance for the morel?"

"Not at all; most fortunately! It stands alone. The closely related *Gyromitra,* which has occasionally proven poisonous, has not these characteristic pits in its head; instead, the surface is peculiarly convoluted, like that of your own brains. And the heads of 'stinkhorns' are covered with a dark-green, horribly odoriferous, slimy fluid which flies are fond of lapping up. Also these repulsive plants emerge from a large bag situated at the base of the long, white, meshy stem. No, morels, like puff-balls, are unmistakable and perfectly safe, and, need I say, wonderful eating."

An hour's hunt in the orchard fills not only the capacious basket, but both hats. With joy in your heart you return. That evening, at the mycologist's urgent invitation, you feast, while the special knowledge of this gentleman as to the haunts and habits of the delectable delicacy, imparts a feeling of security to the enjoyment of a repast which the most fastidious gourmet would welcome.

MORAL OF THIS MOREL-STORY: LEARN TO KNOW THE MOREL AND HUNDREDS OF OTHER PERFECTLY SAFE AND DELICIOUS MUSHROOMS THAT MAY BE FOUND IN, AND IN THE VICINITY OF BALTIMORE, BUT WHICH ROT WHERE THEY GROW FOR WANT OF COLLECTORS.

1406 Eutaw Place (Baltimore, Md.)



From The Mushroom Handbook, by L. C. C. Krieger, Dover Publications, Inc.

FORAYS IN THE OWYHEE DESERT

ELLEN TRUEBLOOD[1]

In planning a desert mushroom hunting field trip, the first consideration must be weather. Growth of fungi is dependent upon precipitation, humidity and temperature in addition to suitable habitat.

The surest way to be disappointed with a desert mushroom hunt is to set a date regardless of weather. A long dry spell with hot weather and wind will offer nothing but a few puffballs that remain for weeks or months after fruiting.

The best fall for mushroom collecting in southwestern Idaho in many years was that of 1962 when intermittent rains continued from September through early December, when it became much colder and the temperature fell below 28 degrees. There were few periods of wind and humidity continued high.

During this period one could find gilled mushrooms and puffballs such as one seldom sees on our Owyhee desert. Even slender *Mycena* grew on willow leaves and roots at the mouth of Poison Creek Canyon south of Homedale. *Tricholoma,* another gilled mushroom but much larger, grew near the Bureau of Land Management watering trough near Poison Creek and beneath the wild rose bushes near the mouth of the canyon. It could also be found beneath sagebrush and along other desert creeks in Owyhee County.

One will find it inadvisable to call a field trip immediately following a good rain. It is better to wait a week or two for the fungi to develop from the strands of mycelium that have lain dormant awaiting moisture, suitable temperature and humidity. If possible, scan the area before taking students.

Youngsters in primary grades sometimes are more successful than adults for their shorter stature gives them a closer look beneath brush and in other habitat where fungi may be expected.

Beginners in the study of fungi find it interesting to make spore prints of agarics (gilled mushrooms). Also one needs to know the color of the spores to classify agarics. Cut off the stipe, or stem, and place the pileus, or cap, of the mushroom on a white piece of paper. Cover it with a bowl and leave it an hour or so and it will leave a spore print on the paper. Sometimes it is advisable to put newspapers or blotters beneath the white paper if your specimen is quite moist.

Puffballs have their spores enclosed in their peridium, or pouch, and are known as gasteromycetes (stomach fungi). Their spores also vary in color. Some puffballs are simple in structure and more or less globular in shape. Others have a true stipe or other adaptations.

For more complete discriptions of fungi found on the Owyhee Desert a list of helpful literature will be given at the conclusion.

In October, November and sometimes December one can find *Agaricus campestris,* the common meadow mushroom, beneath sagebrush near our desert streams. In the fall of 1962, it fruited beneath the fallen leaves of desert shrubs, principally sagebrush and bitterbrush, on flats and gently

1. 719 8th Ave. S., Napa, Idaho 83651

sloping hills. Sometimes one can find this delicious mushroom in late April, May and June. A good place to look is where sheep have bedded down for several nights, or around lambing sheds or fence rows where stock has wintered. Stockyards, barn lots and spring rains and 40 to 50 degree temperatures can bring rewarding results. However, as temperatures increase in the spring infestation by insects also increases. The earliest we have found meadow mushrooms in the spring was late March and they were completely free of larvae.

Among other gilled mushrooms one may expect to find at the base of the Owyhee Mountains is *Pleurotis,* the oyster mushroom, which grows on willow or cottonwood, poplar and other deciduous trees. Appearing quite similar but too tough to eat is *Panus* which grows on desert cottonwood trees. The oyster mushroom prefers cool, rainy weather but not hard, freezing temperatures.

Stropharia can be found near willows in June.

In moist weather or following it, *Agrocybe* and *Leucoagaricus* (formerly known as *Lepiota*) grown in decaying sagebrush. Debris from an old fire lane or where brush has been cleared from land and partly covered with dirt is a good place to hunt. It occurs in late June and early July.

Smaller gilled mushrooms of the desert include *Melanoleuca, Naucoria, Psilocybe, Rhodophyllus,* and *Clitocybe.* One species of *Psilocybe* indigenous to the north temperate zone is *P. coprophila* found on cow dung. It appears after fall rains and fruits until winter frosts. Another *Psilocybe* is a very tiny one with a pointed cap. It grows among the moss in desert canyons in January and February.

A tall mushroom with a bell-shaped pileus that grows on cow or horse manure is likely to be *Panaeolus semiovatus.* A ring or annulus will be found on its stipe. It can be found spring, summer or fall in meadows. The color of the pileus may vary from light leather to yellowish to gray.

Probably the most common group of fungi found on the desert is the puffball. The fruiting body of the gasteromycete (puffball) offers greater protection through periods of extreme heat and cold than other types.

Puffballs found in Owyhee County include *Calvatia, Lycoperdon, Bovista, Disciseda, Mycenastrum, Geastrum, Astraeus, Tulostoma, Battarraea, Secotium, Chlamydopus, Montagnea, Cyathus,* and *Crucibulum.*

Cyathus and *Crucibulum* are members of the Nidulariaceae or Bird's Nest mushrooms. Fruiting bodies of this family resemble a small nest with eggs in it. The spores are encased in the small peridioles that remind one of eggs. On the desert, January, February or March are the best times to look for them if there has been good precipitation in late fall and winter. They grow mostly on the fallen twigs of desert shrubs that lie beneath the shrubs on moss, or occasionally on larger limbs of dead brush. To find them, first look for the green moss that has been revived by moisture. Then look for these tiny nests on the twigs. Look carefully, the nests of some are 2 to 3 mms in diameter! I have found them on the desert in the fall and late spring when the precipitation was heavy, but this is not generally the case.

Montagnea is a real puzzler for the novice collector. One notices black leaves or gills around a disc. (It is usually dried and standing like a skeleton) on a ragged, fibrous stipe. Dig down and find the base of the stipe and you will discover a volva or cup. At first the entire plant was enclosed in a sac or

pouch of which the volva was a part. As the plant matured the stipe elongated carrying the gill-like plates and disc above the ground. The universal covering of its early development places it in the gasteromycetes.

Tulostoma is a common desert mushroom that looks like a puffball on a stem. It occurs both with and without a volva depending upon the species. I have found it ranging in height from 15 mms to 11 cms. It is found most often in sandy soil along creek beds or dry washes but can also be found on flats in open areas.

Secotium, a puffball with a stipe-columella running through its center and with gill-like plates is often found along creek beds or dry washes. It is important mycologically because it marks an evolutionary stage between puffballs and agarics. The lamellular plates are similar to the gills of the agarics and the columella similar to the stipe of an agaric.

Astraeus hygrometricus is interesting because of its hygroscopic rays. When it rains the rays expand, exposing the spore sac. When dry, hot weather prevails, the rays close over it. This may be demonstrated by placing the specimen on a moistened sponge and covering it with a glass or bowl. After about an hour the rays will open. Put it in the sun and they will soon reclose.

There is only one species of *Astraeus.* It may be found beneath sagebrush or bitterbrush in their leaves and duff in spring, fall or winter, depending on moisture. If you find one, scratch around in the duff for others. We found 187 under a single sagebrush one January day.

Geastrum is similar but in some species the rays are hygroscopic and not in others. In some the spore sac is pedicellate and sessile in others. It is most likely found in late fall and early winter. Frequently it is in moss near boulders.

Battarraea is occasionally found in fall and winter generally among desert shrubs along creeks or washes. Usually one finds a robust stalk with the upper half of the spore sac missing or lying shriveled on the ground. The reddish-brown spores are then exposed on the remnants of the spore sac. Its stipe is shaggy and fibrous and springs from a volva. One must dig carefully to find volva remnants at its base. *Battarraea,* like *Montagnea, Tulostoma, Chlamydopus* and others, was once encased in a peridium of which the volva is a remnant. As it matured the stipe elongated, tearing apart the upper part and pushing the spore sac above the ground--sometimes as high as 45 cms. The spore sac was an endoperidium--or one within the universal covering. In *Battarraea* the spore sac opens by circumcissle cleavage, the upper part falling away and exposing the spores on the lower half. Lower Squaw Creek is a good place to look for it.

Disciseda is easy to recognize because its disc beneath the spore case is somewhat like an acorn. It is found near desert shrubs, often in sandy soil.

Bovista is found especially where stock has browsed near springs or grassy places.

The most likely place to find the rather rare *Chlamydopus* is in desert shrubs near Coyote Wells, just before the usually dry wash breaks out of the canyon. To reach this follow State Highway 45 from Walter's Ferry Bridge east along Snake River about three miles, south until the highway turns east again, then take a dirt road south into the brush. Follow it to the main fork

of the dry creek. Leave your truck or car there and walk in the brush along either side of the wash.

Chlamydopus is found following ample fall rains and before hard freezing weather. It consists of a long stipe bearing a spore sac on its dilated apex. The exoperidium disintegrates leaving an endoperidium that has an apical pore. The stipe is larger at the apex and tapers to the base which is enclosed in a volva. It grows in sandy soil.

Chlamydopus, Montagnea and *Battarraea* are seldom mentioned in current literature because they are assumed to be rather rare. However they are found on our Owyhee Desert.

Occurring at higher elevations in Owyhee County are two puffballs of special interest to collectors of southwestern Idaho. One, *Calvatia booniana,* is a large gasteromycete named in honor of the late Dr. William Judson Boone, founder of the College of Idaho. It has been found in South Mountain and Indian Meadows country of Owyhee County and also in Boise County in June.

The other is *Calvatia owyheensis,* Smith, sp. nov., found in the Indian Meadows region and upper Reynolds Creek in mid to late June. Dr. Alexander H. Smith of the University of Michigan named both species, the latter, of course, for the county in which it was first collected.

These and others were described by Dr. Smith in his and Dr. Sanford M. Zeller's work on *Calvatia* published in Lloydia Vol. 27, No. 3, September, 1964.

A basket that can be carried on an arm is useful when collecting. Each collection should be separately wrapped in waxed paper to keep it fresh, and placed carefully in the basket with the heavier ones on the bottom. Fragile specimens should be refrigerated until notes can be made.

Each should be numbered and notes made on when and where collected, by whom, whether it was growing singly, in large numbers, scattered, habitat, etc. Then odor, taste, color, spore color, whether gilled or otherwise and anything distinctive reported. Notes are kept in a numerical file.

Mushrooms are dried over a screen such as a window screen preferably using an electric plate rather than pressed like plants. Each collection should be placed on the drier with its serial number so as not to be confused with another. After they are dried, they are placed in boxes with their number, name of collector, date and state. Add a few crystals of paradichlorobenzene to each to prevent insect infestation. These must be added each spring and fall to prevent destruction by beetles and other insects.

Desert puffballs are among the easiest fungi to preserve because many are completely dried when found. A little while on the drier will tend to kill insect larvae or eggs.

Besides Dr. Smith's and Dr. Zeller's work on *Calvatia* and other literature the beginner on fungi will find helpful include the following:

Cunningham, G. H. 1942. The Gasteromycetes of Australia and New Zealand. Dunedin, N. Z. Privately Published.

Groves, H. Walton. 1958. Mushroom Collecting for Beginners. Canada Dept. of Agriculture, Ottawa, Ontario.

Long, W. H., and Stouffer, David J. 1948. Studies in the Gasteromycetes: XVI The Geastraceae of the Southwestern United States. Mycologia *40*:547-585.

Smith, Alexander H. 1963. Mushroom Hunter's Field Guide. University of Michigan Press, Ann Arbor.

_____1949. Mushrooms in Their Natural Habitats. Sawyer's Inc., Portland, Ore.

_____1951. Puffballs and Their Allies. University of Michigan Press, Ann Arbor.

Tylutki, Edmund E. 1962. Some Edible and Poisonous Mushrooms of Idaho. Idaho Academy of Science, Moscow, Idaho.

Zeller, Sanford M. 1943. North American Species of *Galeropsis, Longia,* and *Montagnea.* Mycologia, *35*:409-421.

_____1949. Keys to the Orders, Families and Genera of the Gasteromycetes. Mycologia *41*:36-58.

. . . AND A TOUCH OF CYANIDE[1]

W. SCOTT CHILTON

Many mushrooms have the habit of growing in fairy rings. Growth begins at a single point of infection from which mycelial threads grow outward underground. Since the rate of growth in all directions is roughly equal, the shape of the subterranean mycelium is that of an ever expanding disc. In these fungi the mycelium lives for years, periodically sending up mushrooms at the periphery when conditions are right. The circle of mushrooms, which may persist for only a few weeks, is the only visible evidence of a perennial fungus. The mycelium advances at the rate of 3 to 12 inches a year. Fairy rings of ten feet or greater diameter are common in the Northwest. These colonies must be at least ten years old. One in Colorado of 300 foot diameter was estimated to be 400 years old.

Marasmius oreades, the most familiar fairy ring mushroom of Northwest lawns and meadows, has the odor of hydrocyanic acid when grown in a confined space. This colorless, toxic gas can accumulate to the threshold for detection by smell, 10 parts per million. Hydrogen cyanide, HCN, has an odor of bitter almonds. A small amount of HCN is tolerated by the body and does, indeed, contribute to the taste of almonds.

Over 20 species of mushrooms produce sufficient hydrogen cyanide (HCN) to be detected by odor under windless conditions. Most of them are *Marasmius* and *Clitocybe* species. In none of them has the concentration been enough to poison humans. While several other mushrooms, notably *Clitocybe infundibuliformis,* leak HCN at a greater rate, *Marasmius oreades* is probably the most ubiquitous of the detectable HCN mushrooms. HCN discharge by *Pholiota aurea* might also be detected by Northwest mycologists. When more sensitive chemical tests are used, a very low level of HCN may be found in many other mushrooms.

A few plants are also cyanogenic (producers of HCN), almond, lupine, and flax among them. HCN in sorgum and a few other forage crops has occasionally been implicated in deaths of grazing animals. Several bacteria produce HCN. Some millipedes defend themselves by spraying attackers with HCN and other chemicals. No role, other than a toxic one, is known for HCN in mammals.

The toxicity of HCN is caused by its interruption of the oxygen-carrying capacity of the blood in much the same way as carbon monoxide acts as a poison. HCN concentrations of 100-200 parts per million are dangerous to humans. The metal binding properties responsible for HCN toxicity also make cyanide important in silver plating mirrors and in electroplating other metals in the Northwest aircraft industry.

The fairy ring effect in *Marasmius oreades* originates either through depletion of nutrients or through progressive poisoning of areas in which *Marasmius* has fruited. HCN or its precursors are possibly among the pollution products that prevent fruiting anywhere but at the clean periphery of the mycelium. HCN may be even more deleterious to grass than it is to

1. Reprinted by permission of *Pacific Search,* March, 1972.

Marasmius itself. It may weaken the grass permitting mycelial attack on its territory. But leakage of other, longer-lived metabolites may on the other hand stimulate growth of the grass immediately ahead of the inhibition zone produced by the advancing mycelia.

AMANITA PHALLOIDES IN CALIFORNIA

DAVID ARORA[1]

Amanita phalloides, the Death Angel of Europe, has been described as extremely rare in North America or "reported on occasion" from California, while the *A. verna* complex, the Destroying Angel, is known only east of the Rocky Mountains. This gives the impression that the deadly Amanitas are not common in California.

In early November 1973, a Santa Cruz family with this impression collected an estimated ten pounds of *A. phalloides* and two of the family died after eating several caps. I was asked to identify the mushrooms and confirmed that they were the deadly green *A. phalloides.* A week later another fatality due to the consumption of *A. phalloides* was reported from Milpitas, a small town just inland from San Francisco.

This author's observations indicate that *A. phalloides* is becoming increasingly common each year in the oak woodlands of Central California. It is possible that this species was at one time rare, but it now seems to be taking a definite foothold and is presently one of the most frequently-encountered agarics of the Santa Cruz area. This last fall we had an exceptionally large amount of early-season rain, the result being that *A. phalloides* fruited in truly enormous quantities - literally by the thousands.

Instances are well-documented of a rare species of mushroom suddenly fruiting profusely in a particular locale for one or two seasons and then disappearing again, and yet this author's observations would suggest that such may not be the case with *A. phalloides.* In the four seasons prior to this last one, *A. phalloides* was by no means uncommon. Though it did not fruit in quantities comparable to the bumper crop of last season, it would have been difficult to walk through the woods without seeing at least a few fruiting bodies. Speculatively, I feel that *A. phalloides* will continue to fruit abundantly in Central California in the years to come. In view of this and the fact that there were three fatalities in California this past season due to *A. phalloides* poisoning, it seems advisable in future mushroom field guides to include a complete description of the basidiocarp and emphasize that *A. phalloides* is regularly encountered in restricted areas of the east and west coasts; in most areas, uncommon to rare. Apparently increasing in distribution. It is definitely something to be reckoned with by collectors of these regions as well as adjacent areas.

A description of specimens on deposit in the University of California at Santa Cruz herbarium follows:

Amanita phalloides Fries

Pileus 2-8 inches broad, at first ovate or rounded, then subcampanulate to expanded, finally plane, margin decurved to slightly uplifted at maturity,

1. Box 21, University of California at Santa Cruz, Santa Cruz, California 95060.

Ed. Readers may be interested in reading the recent paper on *A. phalloides* by Drs. L. J. Tanghe and D. M. Simons in *Mycologia 65:* 99-108, 1973.

sometimes splitting, entire, not striate. Surface viscid when moist, silky when dry, glabrous or occasionally with a very thin more or less central volval patch which is white. Color when young usually some shade of brassy green or olive green but extremely variable, usually fading in age or developing pale amber tones. Usually paler at the margin. Color when dry cream to sulphur yellow with ochreous shades present, usually shining. Flesh white, firm, odor none in young specimens, but becoming quite pungent in age.

Lamellae free or adnexed by a line, medium broad, close, white, edges entire or minutely fimbriate, lamellulae abundant.

Stipe 7.5-25 cm long, 1-2.5 cm thick, central, tapering upward, stuffed becoming hollow. Color white-pallid or tinged with paler, concolorous shades of the pileus.

Annulus superior, ample, fragile, pendant, striate, membranous.

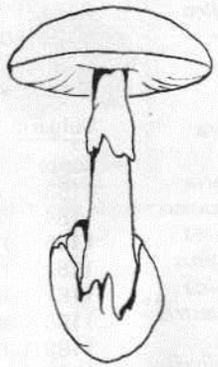
Volva mostly buried in the ground, forming a loose or appressed sack, sometimes entire but usually lobed, often irregularly torn, not circumscissile or splitting, not floccose, color white.

Spores white in mass, 6-8 X 7-10 microns, subglobose to globose, smooth, amyloid, hyaline in KOH. Basidia 10-12 X 45-55 microns, clavate to somewhat irregular in outline, predominantly four spored. Pleuro cystidia none seen, cheilocystidia 5-10 X 24-31 microns, saccate.

Gill trama divergent from a central strand, amber yellow in Melzer's solution. Pellicle thick and semi-gelatinous

Habitat under live oaks, principally *Quercus agrifolia* and *Quercus wizlizeni,* often at the edges of meadows or clearing, usually in leaf litter, solitary to scattered or densely gregarious (often in fairy rings). October through January.

Regularly encountered in restricted areas of the east and west coasts; in most areas, uncommon to rare. Apparently increasing in distribution.



MUSHROOM POSTAGE STAMPS [1]

JEANNE AND PAT PETERSON

A number of countries have issued stamps in the past twenty years using the higher fungi as their theme. We have compiled a list which includes 10 countries to date. Chronologically, Czechoslovakia 1958 and Roumania 1958 head the list, depicting most edible species. One of our usually reliable Czech correspondents would also place the Czechoslovak series at the head of the quality list, reffering to the set as "graphically perfect". Poland 1959 shows a few amanitas, edible boletes, and some other esculents. Mongolia 1964 includes some lactarii and other familiar types in addition to two boletes (*Ixocomus*). The set from San Marino 1967 depicts mostly familiar species, while that from the Congo 1970 concentrates on the genus *Termitomyces* (?). The Bhutan 1973 series was issued as a commemorative 3-D set and includes some unfamiliar types, without legend. Finland 1974 depicts popular edible mushrooms. East Germany 1974 is dedicated to the poisonous mushrooms of Europe and is of unusual beauty. We take no responsibility for the nomenclature used in the following list:

List of mushroom stamps

Czechoslovakia 1958

Scott		
882	30 h	*Lepiota procera*
883	40 h	*Boletus edulis*
884	60 h	*Boletus scaber*
885	1.40 K	*Amanita muscaria*
886	1.60 K	*Armillaria mellea*

Roumania 1958

Scott		
1225	5 b	*Lepiota procera*
1226	10 b	*Clavaria aurea*
1227	20 b	*Amanita caesaria*
1228	30 b	*Lactarius deliciosus*
1229	35 b	*Armillaria mellea*
1230	55 b	*Coprinus comatus*
1231	1 L	*Morchella conica*
1232	1.55 L	*Psalliota campestris*
1233	1.75 L	*Boletus edulis*
1234	2 L	*Cantharellus cibarius*

Poland 1959

Scott		
842	20 g	*Amanita phalloides*
843	30 g	*Boletus luteus*
844	40 g	*Boletus edulis*
845	60 g	*Lactarius deliciosus*
846	1 Z	*Cantharellus cibarius*
847	2.50 Z	*Agaricus campestris*
848	3.40 Z	*Amanita muscaria*
849	5.60 Z	*Boletus scaber*

Bulgaria 1961

Scott		
1183	2 s	*Amanita caesarea*
1184	4 s	*Psalliota silvatica*
1185	12 s	*Boletus elegans*
1186	16 s	*Boletus edulis*
1187	45 s	*Lactarius deliciosus*
1188	80 s	*Lepiota procera*
1189	1.25 L	*Pleurotus ostreatus*
1190	2 L	*Armillariella mellea*

1. Reprinted by permission of The Boston Mycological Society Bulletin, April-May 1975.

Ed. As a collector of mushroom stamps I thought to add to the Petersons' list the following new issue of edible fungi from Nationalist China 1974, their Minkus numbers, denominations and latin designation: 1113, 1.00 D, *Agaricus bisporus;* 1114, 2.50 D, *Pleurotus ostreatus*; 1115, 5.00 D, *Dictyophora indusiata*; and 1116, 8.00 D, *Flamulina velutipes.*

Mongolia 1964

Scott		
340	5 m	*Coprinus comatus*
341	10 m	*Lactarius torminosus*
342	15 m	*Psalliota campestris*
343	20 m	*Russula delica*
344	30 m	*Ixocomus granulatus*
345	50 m	*Lactarius scrobiculatus*
346	70 m	*Lactarius deliciosus*
347	1 t	*Ixocomus variegatus*

San Marino 1967

Scott		
665	5 l	*Amanita caesaria*
666	15 l	*Clitopilus prunulus*
667	20 l	*Lepiota procera*
668	40 l	*Boletus edulis*
669	50 l	*Russula paludosa*
670	170 l	*Lyophyllum Georgii*

Congo 1970

Scott		
208	5 fr	*Volvaria esculenta*
209	10 fr	*Termitomyces entomoloides*
210	15 fr	*Termitomyces microcarpus*
211	25 fr	*Termitomyces aurantiacus*
212	30 fr	*Termitomyces mammiformis*
213	50 fr	*Tremella fuciformis*

Bhutan 1973

Minkus		
544	15 ch	*Amanita caesaria*
545	25 ch	*Boletus edulis*
546	30 ch	*Amanita muscaria*
547	3 nu	*Clitocybe geotropa*
548	6 nu	*Boletus elegans*
549	7 nu	*Cantharellus lutescens*

Finland 1974

Minkus		
787	0.40 m	*Gyromitra esculenta*
788	0.60 m	*Cantharellus cibarius*
789	0.75 m	*Boletus edulis*

East Germany 1974

Minkus		
1837	5 pf	*Rhodophyllus sinuatus*
1838	10 pf	*Boletus satanas*
1839	15 pf	*Amanita pantherina*
1840	20 pf	*Amanita muscaria*
1841	25 pf	*Gyromitra esculenta*
1842	30 pf	*Inocybe patouillardii*
1843	35 pf	*Amanita phalloides*
1844	40 pf	*Clitocybe dealbata*

THE COURSE OF AN INTENTIONAL POISONING

W. SCOTT CHILTON

It has been known for over fifty years that the primary symptoms of *Amanita muscaria* poisoning (disorientation, delirium, deep sleep) are not those produced by pure muscarine (sweating, salivation, tear formation, decreased heart rate). Major toxins of *A. muscaria* which closely approximate the symptoms of poisoning by the mushroom were isolated fifteen years ago in Switzerland and then, independently, in England and Japan. Pharmacological use of major toxins, ibotenic acid and muscimol, have been patented in Belgium, Switzerland and Japan. Curiously there is even a Japanese patent for using ibotenic acid as a flavor enhancer at low levels -- like m.s.g.! Chemical modification of muscimol has led to a new synthetic pesticide currently undergoing testing in Japan -- so maybe there is something to the fly-killing properties of *A. muscaria* after all.

Many books in mycology continue to print the erroneous information that *A. muscaria* poisoning is caused by muscarine. Most recently a 1974 pamphlet of the U.S. Government's Consumer Product Safety Commission containing this misinformation has been trought to my attention. Fortunately Government credibility is restored in the Department of Agriculture's forthcoming publication on poisonous mushrooms.

The following account of an intentional ibotenic acid ingestion may help to emphasize the similarity between ibotenic acid and *A. muscaria* poisoning and the dissimilarity of muscarine poisoning to the two.

In connection with a study of the mode of action of ibotenic acid in poisoning cases, in April 1975, I drank 93 mg (1/300 oz.) of crystalline ibotenic acid dissolved in a cup of cold water at ten o'clock in the morning. Ibotenic acid has an unusual aftertaste which persists for a half an hour to an hour and may be related to its use as a flavor enhancer in much smaller doses. There were no immediate effects other than the taste sensation. My experience, based on three separate occasions is that symptom onset comes after 45 minutes to 1½ hour as described for *A. muscaria* poisoning, but that the pronounced effects are not attained until 2-3 hours by which time most of the ibotenic acid ingested has appeared in the urine.

At 11:30 I still felt normal except that I had a slight tendency to wobble in walking. Unsteadiness continued to increase until by one o'clock I felt that any sudden movement might cause my head to roll off my shoulders. By 1:30 I began noting the feeling of pressure at the base of my skull. I had a feeling of being pressed down by a great weight distributed uniformly over my body and a feeling of foreshortening of my body. By this time my penmanship had deteriorated noticeably, but thought processes and speech articulation were unaffected. About two o'clock muscular twitches began, first in the fingers then in the legs. Very mild visual spasms soon followed,

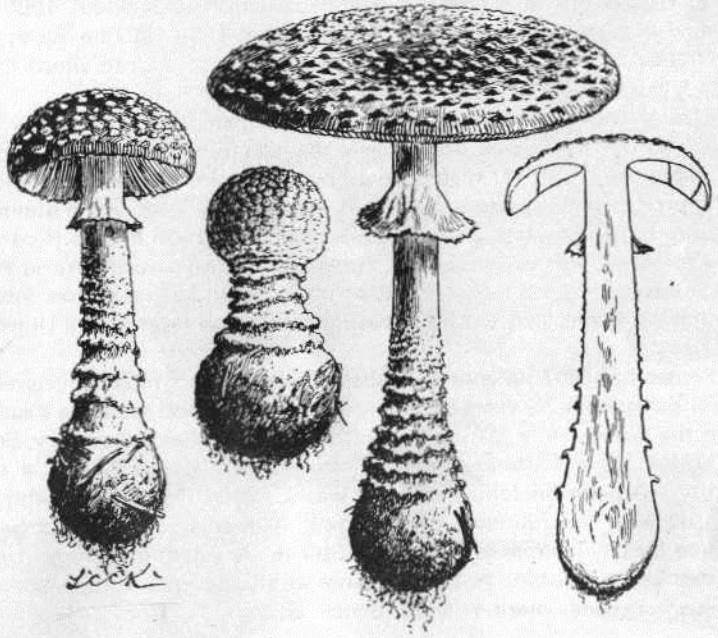
Ed. Dr. Chilton is Professor of Chemistry at the University of Washington and a recognized authority on fungal poisons. This presumably very dangerous experimentation cannot be encouraged, but, in the spirit of Charles McIlvaine "the man who ate mushrooms" and our namesake, is offered to the readers of *McIlvainea*. Dr. Chilton reported this experiment at a recent meeting of the Puget Sound Mycological Society and his findings are published here for the first time.

and my field of vision narrowed. The field of vision began to rotate slowly and sometimes to slide right, left, up or down. At no time did I hallucinate. At four o'clock I was able to read only laboriously since each word on the printed page was moving about aimlessly.

This period dominated by ever-increasing disequilibrium suddenly terminated in a deep but short sleep of about twenty minutes duration. On awaking I threw up briefly and immediately sank back into heavy, drugged sleep from which I was aroused about an hour later at five o'clock by the telephone. With the greatest effort I struggled to the phone against the great weight pressing me down and against the urge to lie down on the floor and sleep. I was able to talk briefly on the phone, but then fell asleep again until seven when I stirred briefly, feeling somewhat cleared. At eight I woke up for good. Dizziness gradually disappeared, and all sensations were normal by 9:30 in the evening.

The symptoms I have described are those of a heavy intoxication. A dose as low as 53 mg is still readily detectable, the disequilibrium lasting from the second through the eighth hour. Sleep is then only a light dozing for an hour and no vomiting occurs.

Though the intoxication can be compared to alcoholic intoxication in its effect on equilibrium, it differs in two very striking points. Ibotenic acid is cleared from the body before major symptoms of intoxication come on Alcohol, on the other hand, is present in the body during intoxication, and its presence is frequently used in the legal definition of alcoholic intoxication. The other difference is that ibotenic acid has relatively little effect on speech articulation and intellectual processes while alcohol greatly degrades both.



From The Mushroom Handbook, by L. C. C. Krieger, Dover Publications, Inc.

LEXEMUEL RAY HESLER

A. J. SHARP [1]

It is with great pleasure that I am able to participate in this program honoring my long-time friend, colleague, and one-time "boss", Dr. Lexemuel Ray Hesler. I have known him since September 1929 and consider him not only an excellent mycologist, but also a great teacher, and fine gentleman.

Dr. Hesler was born February 20, 1888, on a farm near Veedersburg, Fountain County, Indiana, as the second of two sons, to Clinton F. and Laura Iris (Youngblood) Hesler. His father was of German descent; his mother's family was of Irish ancestry. He was named Lex after an aunt's beau, and his mother added (perhaps facetiously) "-emuel-" making it "Lexemuel", although he has always been familiarly known as "Lex".

His father not only was a farmer but a strong church and community leader, County Commissioner, and Representative to the Indiana State Legislature. He died in 1943 at an advanced age. His mother was in poor health much of her life due to thyroid problems, but was active in community affairs and was noted for her high spirits. She was locally noted for her production of excellent hominy which Lex (as a high school student) regularly took to the local grocery store and traded for the necessary groceries.

In 1895 he entered Shib Furr School near his home, and Veedersburg High School in 1903 from which he graduated in May 1907. He began the study of piano in 1897 (using a foot-pedal organ until about 1900) and continued the lessons until he left for college. In 1906-1907 he was organist for the New Liberty Christian Church near Veedersburg into which he was baptized, in a creek near Steam Corner.

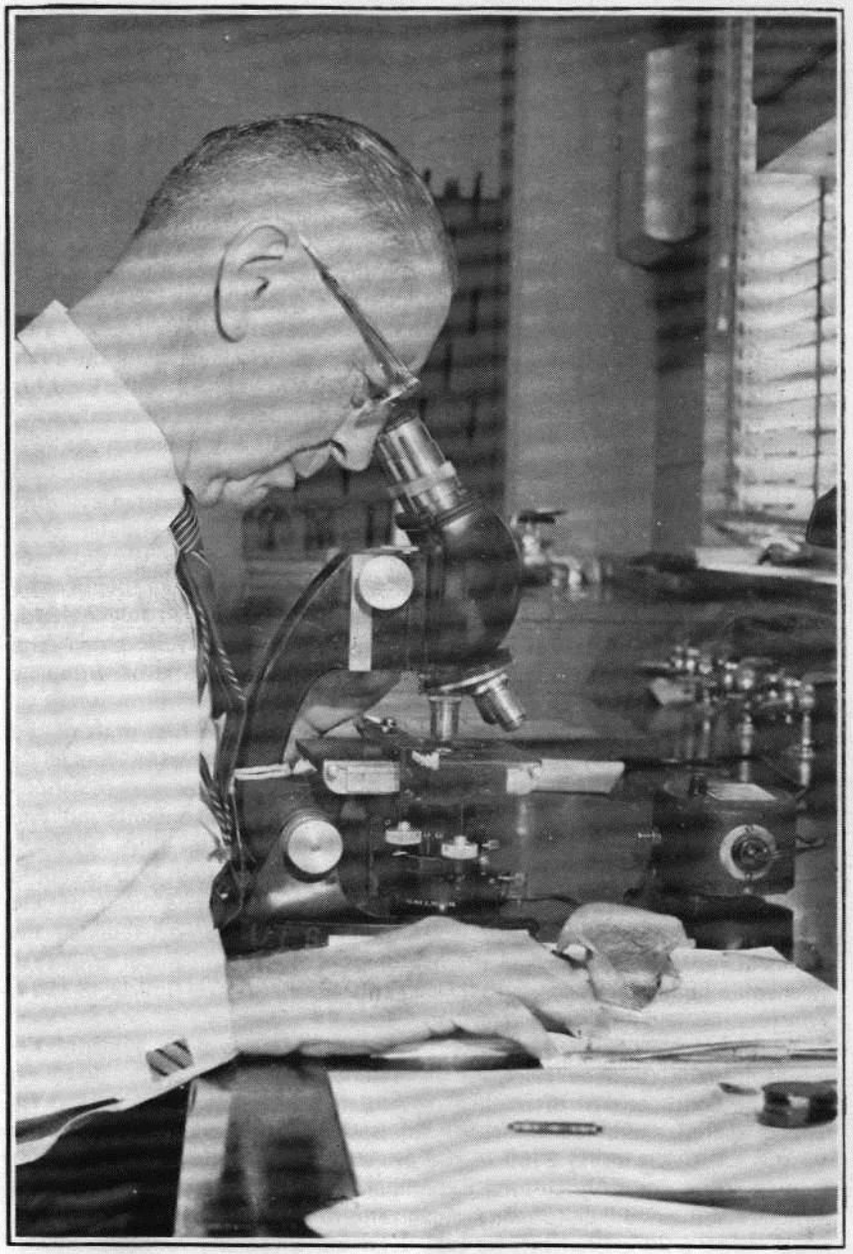
Lex early took an interest in athletics as well as music and in May 1907 as a high school senior won first place in the high jump in a tri-state (Indiana, Ohio, Kentucky) meet for high school boys at Indiana University. He joined a "semi-pro" (amateur) baseball team in western New York in the summer of 1912 and 1913 and later pitched for a baseball team in Puerto Rico while serving for The Federal Agricultural Experiment Station during World War I.

His interest in sports has continued to the present; he has seldom missed a local football game, and almost never misses a track meet at the University of Tennessee.

In September 1907 he entered Wabash College from which he received his bachelor's degree in 3½ years by taking extra courses, and spending a summer each at the Woods Hole Marine Laboratory and at a field laboratory, Sodus, New York. As a freshman he was initiated into Kappa Sigma, a social fraternity. Among his fellow students was J. (Jake) R. Schramm who later had to do with the founding of Biological Abstracts. As a junior he was appointed by Dr. Thomas as a part-time Student Assistant in Botany. He was appointed as an assistant to Dr. Schramm at Woods Hole in the summer of 1909 and studied marine algae under George T. Moore (Washington

1. Department of Botany, University of Tennessee, Knoxville, Tennessee 37916.

Ed. This biography was presented at the L. R. Hesler Foray at Tuxedo, North Carolina, Sept. 12-15, 1974, sponsored by the North American Mycological Association.



University, St. Louis) and George R. Lyman (Dartmouth College). The assistantship paid his fees; he made beds in the men's dorm for his room, and waited table for his board (evidently he was a busy boy!). The following summer he assisted Errett Wallace in his orchard disease-control program in the Cornell Field Laboratory at Sodus, New York.

In August 1910, he received a Fellowship at Cornell University underwritten by the Genesee County Fruit Growers Association, and began his graduate work in plant pathology at Cornell in January 1911. He received his A. B. degree from Wabash in June 1911, at the same time being awarded The Eastman Prize in Biology of $50 as a recognition of the high quality of his undergraduate thesis. From April to September (1911-1913) he was employed in a field laboratory at Byron, New York, where he worked on apple canker, and directed the disease and insect control for the sponsors of his fellowship which he relinquished in September 1912. He then accepted an instructorship in Plant Pathology at Cornell. In 1912 he was initiated into the social fraternity, Gamma Alpha, for graduate students; and the next year, into Sigma Xi, an honor society for research. He not only kept his interest in athletics (pitching baseball in the summers), but also in music, singing in the Ithaca, New York, Methodist Church Quartette and in the Sage Chapel Choir (the Cornell University senior choir). He also sang second bass (in 1917-1919) in the Cornell Faculty Male Quartette which often included the famous painter of birds, Louis Fuertes.

During his tours of duty at the Byron Field station he evidently did more than practice plant pathology and pitch baseball; for there he became acquainted with Esther Lillian Collins whom he married July 2, 1914, following the receipt of his Ph. D. from Cornell University in June. The following September he was promoted to Assistant Professor with the "magnificient" salary of $1,500.

In 1916, at the invitation of L. H. Bailey, he wrote the first draft of the classic, "Manual of Fruit Diseases" which was published with Whetzel as co-author by Macmillan in 1917. During the World War I he worked various periods in President Wilson's "Food Will Win the War Program" and The Plant Disease Survey.

In September 1919 he resigned from the Cornell faculty to accept a position at the University of Tennessee as professor and head of the Department of Botany. Until his retirement in 1958, he retained his professorship but relinquished his headship in 1946 to Samuel L. Meyer Meanwhile he had been appointed Dean of the Liberal Arts College in 1934, a position he held until retirement.

At the University of Tennessee, his broad interests were evident. He served as track coach in 1921, for years he was head timer at the Southern (later the Southeastern) Intercollegiate Athletic Association track meets. He helped operate Camp Callamoochee for Boys at Calderwood, Tennessee, in summer of 1923, losing $150 in the project. He served as Associate Plant Pathologist at Ohio Agricultural Experiment Station, Wooster, Ohio, several summers and as adviser to many organizations including his own fraternity. From 1924 until retirement, he served on the University Athletics Board. He, with O. E. Reinke and Ivey F. Lewis, in 1930 purchased the site and made the original plans for the Highlands, North Carolina, Biological Station,

of which he was a member and Vice President of the Board of Trustees until 1943.

The fire that destroyed the University of Tennessee biology building, Morrill Hall, in 1934 was catastrophic for him. He lost his collection of 8,000 fungi; a nearly completed manuscript on *Hygrophorus* and another on Principles of Plant Pathology, and his extensive library. However, he quickly began actively to rebuild herbarium and library. I could enumerate many more details of his activities, but I think the point has been made that Dr. Hesler was a very active man with broad interests. For his contributions to the university program, he has been honored many times - being elected to Alpha Zeta, Phi Kappa Phi, and Phi Beta Kappa. He was awarded an honorary Doctor of Laws degree by his Alma Mater, Wabash College, in 1951. In the early fifties an investigator for one of the national foundations told a friend of mine that, while evaluating the University of Tennessee, he found Dr. Hesler to be the initiator or deeply involved in nearly every constructive effort at the University.

He has published 114 items, a number of which pertain to general education, and 10 books most of them since his retirement. One of these, "Mushrooms of the Great Smokies" (1960) was awarded two prizes for excellence: (1) for clarity of writing - the Silver Pen Award, and (2) for physical appearance, an award by the Southern Library Association. Subsequently he published with Dr. A. H. Smith "North American Species of Hygrophorus", "North American Species of Crepidotus", and "North American Species of Pholiota". There also appeared "Entoloma in Southeastern North America" and "The North American Species of Pholiota".

My association with Dr. Hesler began in September 1929 when he appointed me as an Instructor in Botany. Subsequently he has been my superior until his retirement. We had a unique relationship when (1951-58) as dean he was my boss when I was head of the department, and I was his boss since he was a professor in our department.

Dr. Hesler has won deep respect from all who knew or know him. He was not loved by every student, colleague, or faculty member, but his firmness coupled with fairness, his ability to reverse himself if warranted, and his humor, a bit earthly at times is characteristic of farm boys from Indiana and Ohio, merited admiration from all. That he was known and respected internationally was shown by the attendance and patticipation of many foreign mycologists in the Symposium on Higher Basidiomycetes held at our University honoring his 80th year.

Those associated with him over a length of time came to deeply love him. A bit shy, somewhat reticent, sensitive and generous, he has had a great influence on his friends, his students, his colleagues, and the educational community.

I can honestly attest to the fact that much of my professional advancement has been due to the friendly advice and at times rather firm pressure, from Dr. Hesler.

I ask you to salute with me not only an excellent mycologist, but an outstanding scholar, and a wonderful gentleman, Dr. Lexemuel Ray Hesler.

AN INCIDENT OF MUSHROOM POISONING

ARNE BENSON [1]

In a family of seven, after eating mushrooms identified as *Amanita virosa,* a ten year old boy died, two girls, thirteen and eleven, were seriously poisoned and hospitalized nine days, and mother, father and daughter aged twelve suffered painful symptoms and possibly continuing liver damage. The younger girl, aged eight, ate no mushrooms and experienced no symptoms.

The family had been collecting and eating mushrooms for five years or more, at first under the supervision of an older family friend, more recently (three or four years) by themselves. Inadequate knowledge of mushroom species, false criteria for judging edibility and failure to realize that mushroom poisoning can be fatal are regarded as the initial causes of this tragedy.

The casual manner in which the local physicians and medical establishment responded to the parents' plea for help may have contributed to the fatality and to the persisting effects in the survivors. It is evident from the record that the local physicians first involved did not recognize that mushroom poisoning (especially when onset of symptoms is delayed) can constitute a serious medical emergency.

Removal of the boy to a larger city hospital on the fifth day after the fatal meal resulted in immediate and knowledgeable treatment, but he nevertheless died on the eighth day. The two girls were released from the local hospital three days later.

The parents are of French, French-Canadian and Polish lineage. Both disclaimed any mushroom knowledge. An older, close family friend of Italian ancestry had introduced them to mushroom collecting and eating.

The criteria used for selection appeared to be: caps white, light brown or red, large, firm, solid, flat, round or slightly concave, unstained, and lacking a membrane covering the gills. There appeared to be no knowledge of the scientific or common names of mushrooms. The fungi present in the collecting area two weeks after the fatal collection were examined with the parents with the following results:

They would accept: *Russula emetica,* and *Lactarius vellereus.*

They would reject: *Amanita brunnescens* var. *pallida* (=*Amanita aestivalis*) (annulus was collapsed on stripe and not prominent, might accept if specimen were fresher, mother stated), *Amanita virosa* (partial veil was attached to pileus margin, might accept if not for the membrane covering the gills, but probably not, mother stated), *Scleroderma* sp., *Hygrophorus* sp. (small yellow and red), *Clavaria* sp., *Amanita gemmata, Amanita rubescens, Amanita brunnescens* var. *brunnescens, Boletus* spp., *Russula virescens, Clitocybe* sp. (white), *Lactarius vellereus* (stained specimen), *Lycoperdon gemmata, Inocybe* sp., *Entoloma rhodopolium,* and all very thin stemmed species.

Observing the collecting practices of the parents, I received the distinct impression that they regarded the structural characteristics that define various species as incidental, in the same light as stains, bruises, age and physical condition. No knowledge of the existance or significance of the basal volva of *Amanita* was evident.

1. 14 Brookline Street, Nashua, New Hampshire 03060

In previous years, collections had been made during the fall, and presumably other species, e.g., *Hygrophorus* spp., would have been collected as well.

Collecting was done in mixed soft- and hardwood areas and in the extension of a grass lawn under white pine and hickory trees. Open lawn and adjacent field were not used. On occasion, the family would accept wild mushrooms picked for them by neighbors. It was estimated that the family including wild mushrooms in their meals four or five times per year.

When collecting was not overseen by the older family mentor, the mother was final judge of edibility. Collecting practices were very discriminating, with each specimen being carefully examined for suitability, but adequate knowledge was lacking.

Returning home from a car trip to Florida, the family was delighted to see the large number of mushrooms that had emerged during the previous week's wet weather. The children asked permission to collect some for dinner and the mother, seeing that the mushrooms appeared fresh and white, gave approval. Examination of the principal site thirteen days later, showed *Amanita virosa* to be the dominant species, and although the evidence is circumstantial and based upon sight identification and proximity of location, I concluded that *Amanita virosa* or a close relative was the species involved.

About twenty caps were collected. Caps varied from 3.5 to 7.0 cm diameter, with an estimated mean weight of 5 grams each (trimmed weight). Collection may have contained one red *Russula* sp. Preparation for the table consisted of trimming the stems from the caps about one half inch below the apex, slicing the caps into about one cm wide strips, sauteeing in margarine with added water and a clove of garlic. Prior to cooking, the mushrooms were again examined by the mother, and it is likely that the partial veil, which might have prompted her rejection of the lot, had by then been discarded with the stems. The garlic clove was added in the belief that it would turn black if cooked with poisonous mushrooms.

The family meal consisted of garden salad, chicken, Roquefort dressing and the mushrooms. Girls (13, 12, and 11) and parents noted a bitter taste and ate little of the mushrooms, girl (8) ate none at all, boy (10) consumed the largest quantity, having covered his mushrooms with generous amounts of dressing. The father ascribed the bitter taste to the garlic clove, which had disintegrated in cooking.

Family members reported eating the amounts noted below: father (age 35), 2-3 forkfuls; mother (age 33), 2 slices; girl (age 13), 4-5 forkfuls; girl (age 12), small amount; girl (age 11), 2-3 forkfuls; boy (age 10), about 13 caps was one estimate, 75% of the total harvested was another. I approximate that the boy ingested 65-75 grams fresh weight of presumably *Amanita virosa*; and girl (age 8), none.

Specific details of medical treatment were not available to me, consequently the ensuing events are related here in chronological order as related by the family members.

Day 1

6:00 p.m. Children collected about twenty mushrooms, which were sauted with margarine, water, garlic clove.

7:00 p.m. Family meal.

9:00 p.m. Boy (10) tired, looked "gray under the eyes."

9:30 p.m. Boy to bed.

Day 2

5:30 a.m. Boy suffering cramps, vomiting, diarrhea.

7:00 a.m. Girl (13) with cramps, vomiting.

7:30 a.m. Father and girl (12) with diarrhea.

8:00 a.m. Girl (11) vomiting.
Mother phoned family physician. Mother said, "Mushroom poisoning."

10:00 a.m. Mother exhibited some (undefined) symptoms.

1:15 p.m. Physician examined boy. Mother recalls eye, ear, nose and throat examination. Mother mentioned boy's dehydration. Physician wrote two prescriptions. Boy returned home.

Afternoon Symptoms continue, boy's most severely. Boy taken to local hospital.

7:00 p.m. Boy (10) admitted to hospital. Intravenous infusion (IV) started, presumed to be glucose in saline solution but not known. Mother reported two girls at home were very sick. Physician informed father that boy is critically ill, may die.

Day 3 Girl (13) severely ill at home. Parents report, semicomatose. Girl (11) symptoms continuing.

10:30 a.m. Girls (13 and 11) admitted to hospital and given injections "for vomiting"

Day 4 Girls (13 and 11) in same room with boy, recall boy's difficulty in urinating and nurse's attempts to increase kidney function.

Day 5 A pediatrician called for consultation.

Day 6 Boy removed to major city hospital. Thiotic acid (reported to be effective in Europe in similar cases) obtained and therapy started. Antibiotic infusion for preexisting stomach ulcer condition. Biologist requested samples of mushrooms from collecting area. He reported specimens were all *Russula* spp. Treatment reportedly started for girls (13 and 11) at local hospital.

Day 7 and 8 Haemodialysis, peritoneal dialysis, whole blood transfusions, thioctic acid for boy. Treatment for girls continued at local hospital.

Day 9 Evening. Boy died. Acute liver complications following mushroom poisoning was noted as cause.

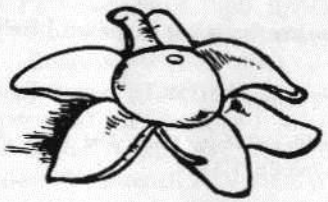
Day 12 Girls (13 and 11) released from local hospital.

Day 16 Father had cramps, diarrhea similar to previous week. Mother vomited before breakfast. Girls (12 and 13) recalled having headaches continually during the week.

Day 17 Hospital tests reported liver damage in family members. Further medical surveillance was scheduled.

It is reasonable to conclude that two factors united to bring the fatal collection to the table: (1) lack of knowledge of mushroom species and reliance upon irrelevant clues for determining edibility; (2) unsupervised collecting by children in the excitement of returning home after a long trip.

After boy's death, mother reported physician who was first called saying, "If you had said toadstool instead of mushroom, I might have understood."



ON TWO SPECIES OF FALSE MORELS (GYROMITRA) IN UTAH[1]

KENT H. MCKNIGHT[2]

The "Giant Helvella," *Gyromitra gigas* (Krombh.) Quél., is well known to collectors of spring mushrooms at high elevations in the Rocky Mountains. Although there are conflicting claims regarding its edibility, it is often collected for food. Study of dried specimens in various herbaria throughout North America and some from Europe, as well as numerous fresh collections from the United States, reveal two different species that are commonly called *Gyromitra gigas.* The second species is here referred to as *Gyromitra fastigiata* (Krombh.) Rehm. Although the two may look alike macroscopically, they are readily distinguishable on spore characterisitcs, with *G. fastigiata* having broadly fusiform spores with well-developed apiculi. *Gyromitra gigas* has more elliptic spores with little or no apiculi. The two North American species fit quite well the descriptions given by Krombholz (1832) for his two species of *Helvella.* Since there appear to be no holotypes extant, final disposition of these two entities must await their more critical study in central Europe where the one which Krombholz called *H. gigas* appears to be uncommon. Detailed descriptions follow for the two species, based on study of fresh collections as well as specimens from herbaria listed below. Differences between *G. gigas* and *G. fastigiata* and other species with which they are confused will be explored. Loans or use of facilities by the following institutions are gratefully acknowledged: Botanical Department of the National Museum, Prague (PR); Brigham Young University (BRY); Colorado State University (CS); Cornell University (CUP); Forest Disease Laboratory, U. S. Forest Service, Laurel, Md. (BFDL); Harvard University (FH); Institut für Spezielle Botanik der Eidg. Technischen Hoschschulle, Zurich (ZT); Naturhistorische Museum (W); New York Botanical Garden (NY); Oregon State University (OSC); Plant Research Institute, Canada Department of Agriculture, Ottawa (DAOM); San Francisco State College (SF); University of Michigan (MICH); University of Tennessee (TENN); and the University of Toronto (TRTC). Color names in italics follow Kelly and Judd (1955).

Gyromitra fastigiata (Krombh.) Rehm.

Fig. 1

Gyromitra fastigiata (Krombh.) Rehm. 1896. Die Pilze *in* Rabenh., L. Krypt.-Fl. Deutschl., Oster., Schw. 2nd Ed. 1:1194.

Ascocarp stipitate, shape irregular but roughly globose to ellipsoid, 3.5-9.0 cm in diameter, receptacle everted, wrinkled to convoluted and lobed, outer surface adnate with the stipe and in places intergrown with it, 0.5-2.0 mm

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2. Plant Science Research Division, Agricultural Research Service, U. S. Department of Agriculture, Beltsville, Maryland 20705.

thick, hymenium *dark grayish yellow* (2.5Y 6/5) to *strong yellowish brown* (10YR 5/6), *strong brown* (7.5YR 4/6), or *moderate brown* (7.5YR 4/5 to 6YR 3/4); excipulum white. Odor and taste not distinctive. Stipe thick and fleshy, hollow with several anastomosing channels, even or expanded downward, 1.5-5.0 X 2.5-8.0 cm, longitudinally ribbed with rounded ribs, surface white or nearly so, glabrous to minutely furfuraceous.

In section, hymenium 350-450 μ thick, subhymenium indistinct, 100-150 μ broad, consisting of textura intricata having protoplasm which stains dark in lactofuchsin and in cotton blue and including scattered oleiferous hyphae; medullary excipulum indistinctly 2-layered, the upper layer, 200-250 μ thick, of compact textura intricata, gradually becoming less compact outward, the lower, less compact layer 800-1200 μ thick, of very loose textura intricata, ectal excipulum 2-layered, the inner layer 170-200 μ thick, consisting of compact, much interwoven textura intricata, the outer layer, 75-95 μ thick, consisting of loose, radially oriented textura intricata tending to textura porrecta, hyphae 8-15 μ in diameter, terminal cells variable in shape, clavate to cylindrical or ventricose and sometimes capitate; conspicuous oleiferous hyphal segments scattered through subhymenium and medullary excipulum. Asci cylindric, contorted and tapered gradually at base, 360-415 X 14-20 μ, J-, protoplasm of young asci *strong orange yellow* (near 7.5YR 7/12) in Melzer's solution. Ascospores fusiform to narrowly elliptic, flattened in one view, hyaline, typically with one large central guttule and two smaller terminal guttules, apiculate, smooth at first but soon ornamented with a very faint to distinct, low, complete reticulum of narrow, closely spaced ridges, (21) 23.5-32.0 X 10-14 μ, apiculi truncate to broadly rounded, 1-3 μ long. Paraphyses tips cylindric to clavate, sometimes tending to be capitate, dull ochraceous brown in H_2O, fading rapidly to dull grayish yellow in KOH, darker (dull ochraceous brown) on dried specimens revived in KOH, *bright yellow* (2.5Y 8.5/6) when revived in Melzer's solution, 7-12 μ across at apex, 4.0-5.5 μ in diameter below.

Habit, Habitat, and Distribution.—Solitary to gregarious; on soil in hardwood or mixed hardwood-conifer forests, in valleys or lowlands; Atlantic Seaboard to Utah, Oregon, Idaho, and Washington.

Collections Studied.—CANADA; Ontario: Bell 17.V.1931, 7.V.1933 (TRTC), Elliott 61-53, 61-54, Groves 22.IV.1953, Horner 3.V.1953, Odell 30.V.1929, Savile and Parmelee 29.IV.1955 (DAOM). Quebec: Dupret-Lloyd 32476 (BPI), Hoare 3.V.1953, Horner 17.V.1954 (DAOM). CZECHOSLOVAKIA: Charvat IV.1943 (PR), v. Höhnel A5909 (FH). Kotlaba 10.V.1970, Landkammer 21.IV.1944, Svrcek 19.III.1961, 3.IV.1966 (PR). FINLAND: Karsten 721 (BPI and CUP). FRANCE: Patouillard 4858 (FH). SWEDEN: Lund and Nannf. Exs. 1353 (BPI and PR). Melderis 15.V.1946, 13.V.1949 (DAOM), Romell 25.V.1896 (CUP). SWITZERLAND: Horak 2.VI.1964 (ZT and BPI), J. Peter 16.VI.1965 (ZT). UNITED STATES: Idaho: Grand 17.V.1967 (TRTC), Wehmeyer 23.VI.1920 (MICH). KENTUCKY: Fink 10745 (CUP). MARYLAND: Blevins 13.VI.1935, Cash 14.IV.1935, Lakin-Lloyd 15161. McKnight 11727 (BPI), Miller 8274, 8275 (BFDL and BPI). MASSACHUSETTS: Thaxter 624 (FH). NEW YORK: Atkinson V.1901, Coppellini 21.V.1953, Korf 2628, 43900, McCaughy

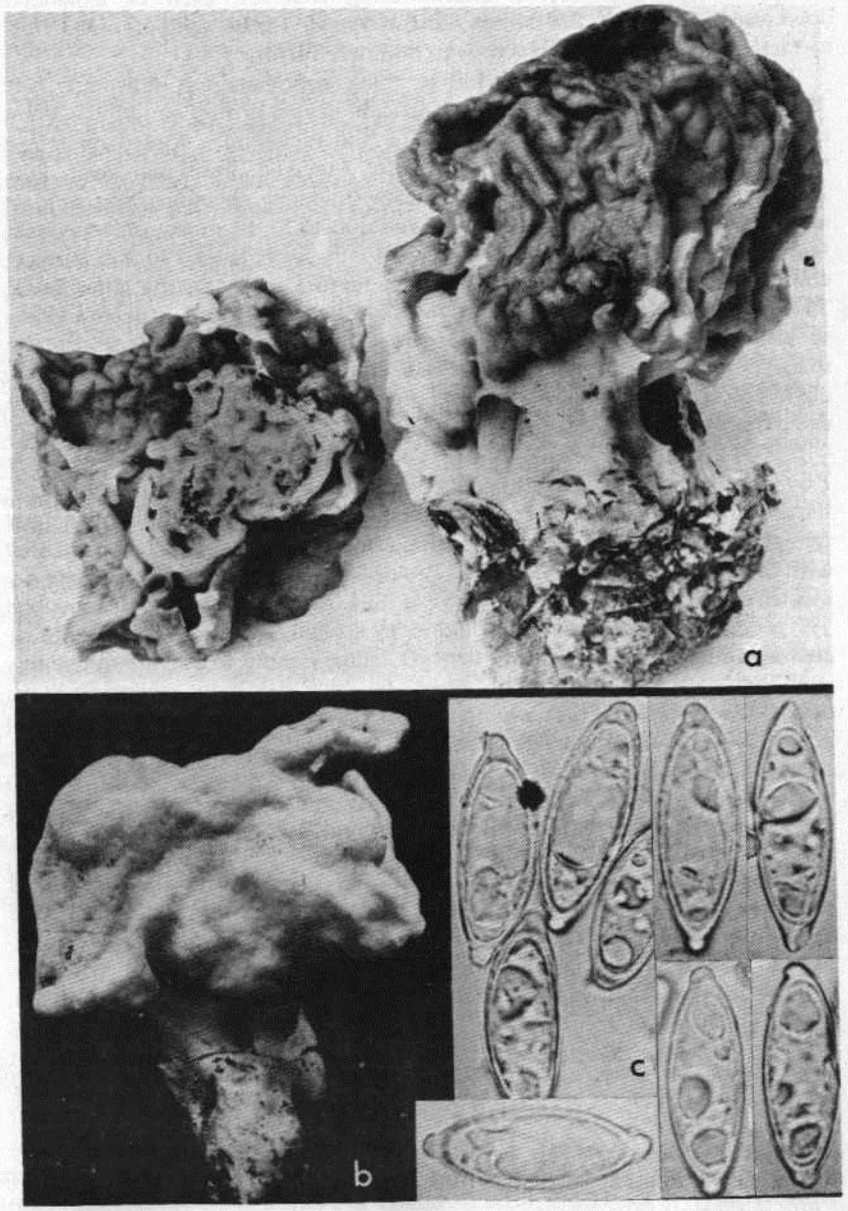

Fig. 1. *Gyromitra fastigiata*, apothecia and ascospores. a, b. apothecia, X ½. c. ascospores, X 1,000.

4.V.1905 (CUP), McKnight 10766 (BPI), Peck-CUP 5-21, Peck-CUP 5-22 Peck-CUP 5-23, Petry 537, Reddick 5.V.1907 (CUP). NORTH CAROLINA: Whetzel, et al. 5.IV.1940 (CUP). OHIO: Walters 1942 (NY). OREGON: Denison 3299 (OSC). UTAH. Rhoads 24.VI.1945 (BPI). VIRGINIA: Yechelson 29.III.1930, McKnight 10722, Schlatter 12.IV.1925 (BPI). WEST VIRGINIA: Nuttall 11.IV.1895 (CUP).

Observations.—A distinctive characteristic of the species is its broadly fusiform, 1- to 3-guttulate spores having well-developed apiculi which are truncate to broadly rounded at the apex (Fig. 1c).

Gyromitra gigas (Krombh.) Quél.

Fig. 2

Gyromitra gigas (Krombh.) Quél. 1873. Champ. Jura Vosg. 2. *In* Mém. Soc. Emul. Montbéliard Ser. II, 5:338.

Ascocarp stipitate, irregular in shape but roughly globose to ellipsoid, (1X5) 5-18 cm across, receptacle everted, strongly convolute with outer surface appressed against the stipe and sometimes inter-woven with it, 1.5-2.5 mm thick; hymenium *strong yellowish brown* (near 7.5YR 5/6) to *strong brown* (7.5YR 4/6) or *moderate brown* (7.5YR 4/4); excipulum white or nearly so. Odor and taste not distinctive. Stipe thick and fleshy, hollow with several anastomosing channels, even or expanded toward the base, 2-14 X 3-15 cm, longitudinally ribbed with rounded ribs, surface white or nearly so.

In section, hymenium 380-450 μ thick; subhymenium indistinctly differentiated from medullary excipulum, 150-200 μ broad, consisting of compact textura intricata and containing numerous oleiferous hyphae; medullary excipulum 650-750 μ thick, of textura intricata which is progressively more compact toward the subhymenium and less compact toward the ectal excipulum, hyphae 7-13 μ in diameter; ectal excipulum poorly differentiated, 150-250 μ thick, consisting of an outer layer about 80-100 μ broad, of filamentous cells (textura porrecta) and a more compact inner layer tending toward textura angularis about 100-150 μ broad, terminal cells clavate, 5.5-8.0 X 23-28 μ . The outer layer is visible only around the margin, as it soon becomes crushed and partially or wholly eroded away. Asci cylindric, contorted at the base, 350-400 X 18-24 μ, J-, young asci and immature spores *strong orange yellow* (near 7.5YR 7/12) in Melzer's solution. Ascospores hyaline, eliptic, typically flattened on one side, 1-3 guttulate, smooth or very faintly roughened with an incomplete reticulum, (21.4) 24.3-35.8 (37.5) X (9) 10.7-15.8 μ, apiculus very short and truncate or more often broadly rounded, or lacking, 0-1.1 μ long. Paraphyses 2-4 septate above the branches, terminal cell cylindric-capitate, contorted, 4-12 μ across, *pale yellow* (5Y 8.5/4) in Melzer's.

Habit, Habitat, and Distribution.—Solitary to gregarious, in early spring, on soil in conifer or mixed forests from the Rocky Mountains to the West Coast in North America, apparently rare in Europe often found around melting snowbanks and sometimes developing to considerable size under the snow.

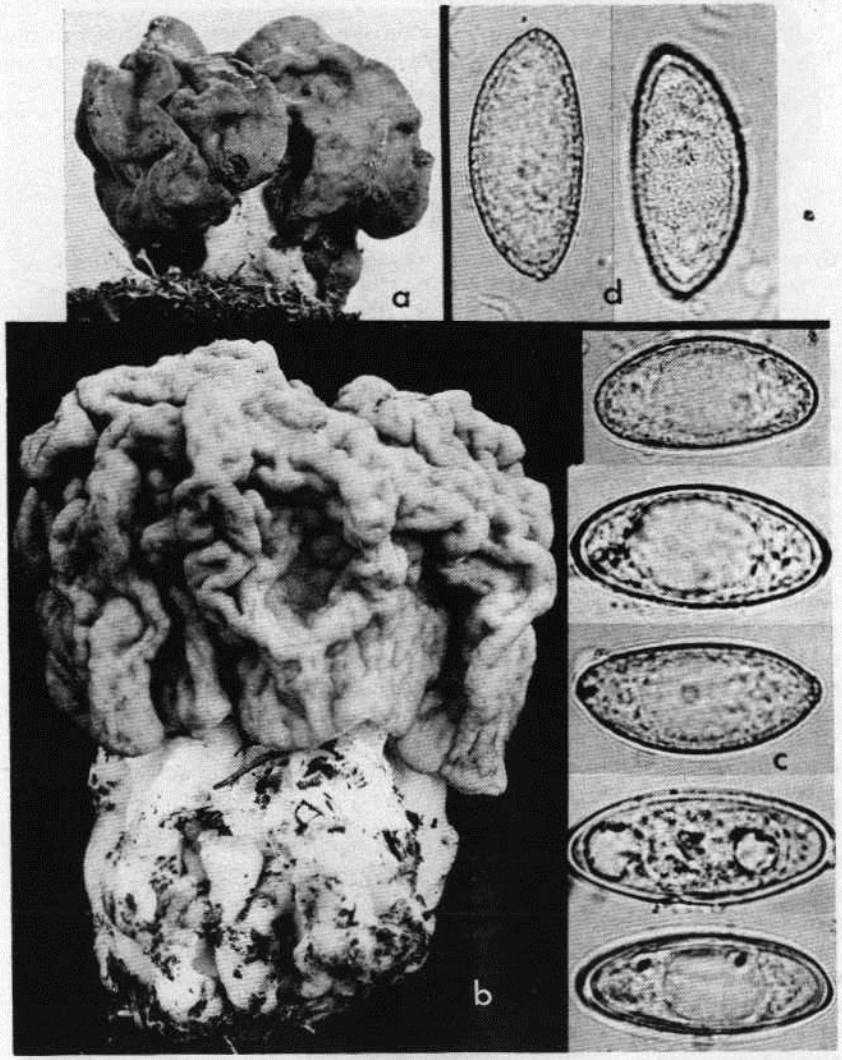

Fig. 2. *Gyromitra gigas*, apothecia and ascospores. a, b. apothecia, X ½. c. ascospores, X 1,000. d. the same ascospores at two levels of focus, X 1,000.

Collections Studied.—AUSTRIA: Melzer 30.IV.1967 (W). CANADA: BRITISH COLUMBIA: Melburn 663 (DAOM). UNITED STATES: CALIFORNIA: Breckon 425 (SF), Burdick (NY), Copeland 18.VI.1938 (BPI and FH), 10.VII.1938 (TRTC), VI.1951 (BPI and MICH), Hanks, 31.V.1964 (SF), Norman 5.V.1933 (BPI and FH), Sundberg 525, Thiers 11202, 16572, 16736, 16902, 19326, 19346, 19429, 19499, 19574, 19747, 19881, 19955, (SF). COLORADO: Overholts, 1829 (BPI and NY), Overholts, Loch Vale, 1924 (NY). IDAHO: Largent 410, Smith 65130 (SF), Wehmeyer 23.VI.1920 (MICH), Weir 8123 (BPI, CUP, and NY). MONTANA: Weir 4774 (BPI). OREGON: Denison 3423, 3679, 3686, 3691 (OSC), Shaw, Baker, Ore., Whitead, Ashland, Ore. (NY), Weir 4771 (BPI). UTAH: Dublin 2615, McKnight F258, F342, F5173, F5189, F5211, F5237, F6472 (BRY), 11784, 11845, 11864, 11866, 11867, 11900, 11903, 11915, 11960 (BPI). WYOMING: McKnight 10128, 10183, 10338, 10350, 10351, 10352 (BPI), Peterson 47-60 (BPI and CS), Solheim and Cronin 2829 (BPI and DAOM).

Observations.—Spore shape distinguishes this species readily from *G. fastigiata*. Spores of *G. fastigiata* taper more toward the ends and have elongated, narrow apiculi giving them a distinctly fusiform shape, while those of *G. gigas* have shorter, more rounded apiculi or none at all, resulting in a wider ellipsoid to oval shape. In some cases there is no evidence of an apiculus in *G. gigas,* while in others the only suggestion of an apiculus is a slightly thickened wall at one or both ends of the spore. Rarely the apiculus is truncate and depressed as in *Discina leucoxantha* Bres.; but in all cases, when present, it is much broader than in *G. fastigiata*. The habit of fruiting under or near melting snowbanks may be significant in distinguishing the two species also.

DISCUSSION

In a single publication (1832) Krombholz described five new species of *Helvella* that apparently belong in *Gyromitra* Fr. (sensu Harmaja, 1969. He distinguished between them largely on characters of gross morphology and color of the ascoscarp so that it has been very difficult for later workers to apply his names accurately to the species they find. However, with *G. gigas* and probably also with *G. fastigiata* he did give sufficient microscopic details for correct identification, but it appears that quite generally the names have been applied incorrectly.

Krombholz stated that both species were found in the vicinity of Prague in early springtime. His descriptions specify a distinct difference in spore shape, as he described the spores of *G. gigas* as "gross und volkommen oval," whereas spores of *G. fastigiata* are said to be "elliptisch-spindleformig." He did not illustrate the microscopic characters of *G. fastigiata* and his drawings of *G. gigas,* by themselves, are ambiguous since fine details of spore structure are not shown and since he shows both 1- and 2-guttulate ascospores. Most of the spores are shown with broadly rounded apices, although some are more or less pointed. It should be noted, however, that at the magnification used details of surface patterns and apiculus might not be discernible unless the original drawings were more accurate than those of Krombholz apparently were. No mention is made of an apiculus on spores of either species. However, if apiculi were included in the description of spore shape, it would

make the spores more nearly fusiform as Krombholz gives for the spore shape of *G. fastigiata,* rather than the oval shape he described for spores of *gigas.* The fact that he mentioned the 3-guttulate spores in *G. fastigiata* (and in this species only) clearly identifies it as a member of the *caroliniana-gigas* complex and refutes a possible identity with *G. esculenta* (Pers.) Fr. This, together with the brief descriptions of spore shape in the two species cited above, convinces me that the species with more definitely fusiform spores having longer apiculi should be called *fastigiata,* although it is commonly known as *gigas* both in Europe and in America. Just how the epithet *gigas* came to be associated with a species having fusiform spores with well-developed apiculi is not clear, but Krombholz's mention of brownish ascus tips and a taste of fresh almonds for *G. fastigiata* may have discouraged use of this name for the common European species. Both his description and illustrations indicate a tricuspidate-lobed receptacle which may not be consistently apparent. His reference to Flora Dancia Plate 116 (Oeder, et al., 1766-1883) and his suggestion to a close relationship to *Gyromitra infula* (Schaeff. ex Fr.) Quél. may have encouraged the idea that *G. fastigiata* was a synonym of *G. esculenta* in spite of his description of 3-guttulate spores for *G. fastigiata.* Fresh specimens referable to this species, which I have studied, have no taste and I have not seen brownish ascus tips in any of the collections studied; however, if there is a European species in this complex having these characters and a consistently fastigiate form, then perhaps the American species, which lacks them, should have a new name. Until this is confirmed, however, I prefer to use Krombholz's species names as indicated above.

Quélet (1873) transferred *Helvella gigas* Krombh. to the genus *Gyromitra* Fr., giving no illustrations and such incomplete description, based on macroscopic characters, that no one can be certain what species he had in mind. However, in his very brief synopsis of the genus he states, "Spore ovale, bi-ocellée." Later (1886) he listed *G. curtipes* Fr. as a synonym of *G. gigas.* Although, at the time he transferred *H. fastigiata* Krombh. to *Gyromitra,* he recognized both species, Rehm (1896) illustrated the spores of *G. gigas* with narrow, pointed apices and described them as "breit spindelförmig," which is very nearly identical with Krombholz's description of the spores of *H. fastigiata.* Thus it seems that the species concepts of Krombholz were not clearly understood from the time the two species were first included in *Gyromitra.* Since my objective here is to elucidate species concepts, the broader argument of generic limits will not be entered, except to say that *Gyromitra* appears to be the best genus for these two species. After they were transferred to *Gyromitra* Fr., later workers have quite consistently given *G. fastigiata* as a synonym of *G. gigas.*

The confusion between these and related species is very complex, as indicated by the following resumé of only a few of the many reports concerning them. Cooke (1879) illustrated the spores of *G. gigas* as broadly fusiform with distinctly pointed ends quite different from those published with Krombholz's original description and quite like those Krombholz described for *G. fastigiata,* but which he did not illustrate. According to Phillips (1893), Cooke's figure was drawn from a specimen in the Berkeley Herbarium at Kew. Velenovsky (1920-1922) described and illustrated both species but he depicted the *G. fastigiate* kind of spores for *G. gigas,* and for *G. fastigiata* he showed spores of the type found in *G. esculenta.* Lohwag

(1966) recognized that material which he collected had the fusiform spores of *G. fastigiata,* as he reproduced Krombholz's original description and illustrations of that fungus; but he was apparently persuaded by Maas Geesteranus that it was identical with *G. caroliniana* (Bosc ex Fr.) Fr. [=*Neogyromitra caroliniana* (Bosc ex Fr.) Imai], a species which actually has quite different spores. Boudier (1905) did not report *G. fastigiata;* but he described and illustrated, separately, *G. gigas* and *G. curtipes* Fr. and showed spores of the *G. fastigiata* type or both of them, while stating that *G. curtipes* may be just a young stage of *G. gigas.* Seaver (1928) likewise failed to mention *G. fastigiata* and regarded both *G. gigas* and *G. curtipes* as synonyms of *Helvella caroliniana.* Later (1942) he stated his dissatisfaction with Imai's (1938) separation of *G. gigas* and *G. caroliniana* and recommended that more field work was necessary to resolve the problem. In the latter I strongly concur. His illustrations of spores (Seaver, 1942) are not representative of either *G. gigas* or *G. fastigiata* but appear to be *G. caroliniana* or *G. costata* Schw. ex Cke. In detailing the effects of KOH on species of *Helvella,* Kanouse (1948) did not mention its distorting effect on ascospores (McKnight, 1968). She described the ascospores of *H. gigas* as smooth and indicated as preference for the illustration of Bresadola (1932) over that of Boudier (1905-1910) in interpreting the species. Both authors show strongly apiculate spores, as found in *G. fastigiata,* but Bresadola shows them without surface ornamentation.

Benedix (1969) writes of the typical *gigas apiculus* ("die durchweg typische gigas-anhängsel") with reference to the strongly apiculate-spored species which I call *fastigiata* and treats *H. fastigiata* Krombh. as a synonym of the American species, *Neogyromitra caroliniana* (Bosc ex Fr.) Imai. The latter appears to be a rare species in America, not clearly differientiated at this time from *Gyromitra costata* Schw. ex Cke. and quite widely confused with a much more common species, *Gyromitra brunnea* Underwood [=*Hellvella underwoodii* (Underw.) Seaver]. Although inadequate details are given, Smith (1963) is the only recent author, to my knowledge, who has correctly distinguished *G. brunnea* and *G. caroliniana.* The spores of these two American species are very much alike and quite different from those of Krombholz's two species being considered here. Nannfeldt (1932) considered *G. fastigiata, G. curtipes* Fr., and *G. labyrinthica* Fr. all as synonyms of *Neogyromitra gigas* (Krombh.) Imai. His description of the ascospores of *N. gigas* is more like Krombholz's *fastigiata* than *H. gigas,* and the specimens at BPI and PR in the Lundell and Nannfeldt exsiccati confirm this. Fries' original descriptions of *G. curtipes* (1866) and *G. labyrinthica* (1871) give neither illustrations nor written details of the ascospores needed to determine their possible affinity with *G. gigas* and *G. fastigiata.* On the basis of gross morphology Fries (1871) indicated a close similarity of *G. labyrinthica* with *G. esculenta* and *G. caroliniana.* He placed *labyrinthica* and *caroliniana* in a separate subgenus, *Lacunaria.* His illustrations of *G. curtipes* show a fungus very different in color from the other *Gyromitra* species and very much like a variety of *Discina olympiana* Kan. reported recently from Wyoming (McKnight, 1969) and possibly also comparable to Pilat's (1953) pallid variety of *Gyromitra infula.*

The collections reported here fall into two distinct categories as far as spore shape is concerned. These correlate very well with the descriptions given originally by Krombholz for *Helvella gigas* and *H. fastigiata* and permit

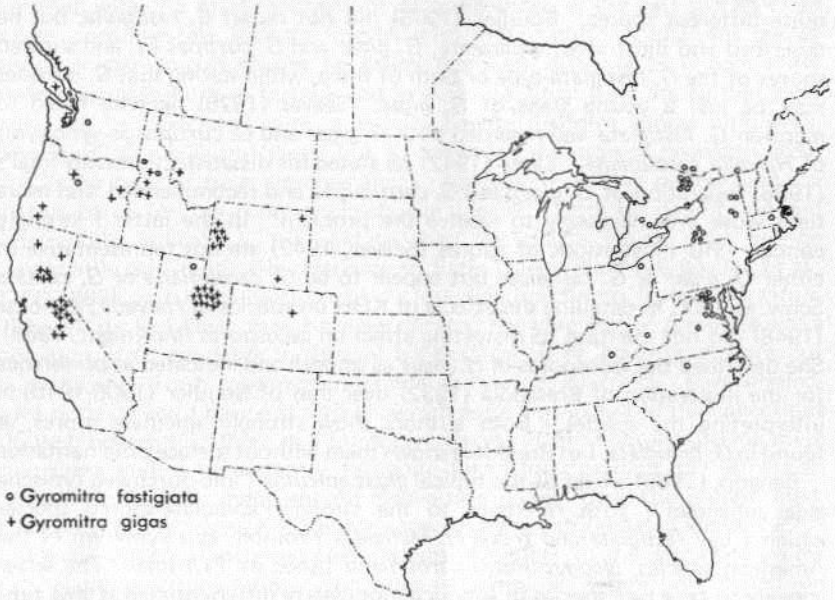

Fig. 3. Distribution of two species of *Gyromitra* in North America based on collections studied for this report.

easy separation of the two species (Figs. 1c, 2c). The fact that the two species have been regarded as one by most observers since their original descriptions by Krombholz tends to obscure the differences which actually exist between them. This is especially true with regard to gross morphology, since many collections have changed on drying so much that the dried specimens give little information about their original form. Having recognized spore differences as a practical criterion for separation of the two species, one can begin to make meaningful observations on other characters such as size, shape, color, and ecology.

These two species appear to have different ecological requirements, as indicated by their distribution in North America. On the basis of the collections cited here, *Gyromitra gigas* appears to be restricted to the mountains of the West, while *G. fastigiata* appears to be primarily an eastern species, although a few collections of it were taken in Utah, Oregon, Idaho, and Washington. It remains to be seen just how far north and south *G. gigas* extends in the western mountains and how common *G. fastigiata* is in the West and particularly in the Northwest. Snyder (1938) reports *H. caroliniana* from Tacoma, Wash., although his description is not sufficiently detailed to distinguish it from *G. fastigiata*. In an unpublished thesis, Brough (1958) refers the Tacoma collection and two other Washington collections to *Neogyromitra gigas* (Krombh.) Imai. His drawings of the spores of one of

them, presumably from near Lake Keechelus, show the long apiculus of *G. fastigiata*. The specimens could not be obtained for study. The number of European collections examined in this study is too small to reach any conclusion except the tentative suggestion that *G. fastigiata* appears to be much more common than *G. gigas*.

There may be a significant difference in the conditions which stimulate fruiting for these two species. Krombholz described *H. gigas* as fruiting in March and April and *H. fastigiata* as appearing in April. Nannfeldt (1932) stated that *G. gigas* emerges slower than *G. esculenta*, and Falck (1932) gives the fruiting for *G. esculenta* as March to May and for *G. gigas* as April to May. From their illustrations and descriptions as well as the Lundell and Nannfeldt exsiccati specimen cited above it is clear that Nannfeldt and Falck both were dealing with *G. fastigiata* as the species is used here, not *G. gigas*. This difference in time of fruiting may not be significant in itself, since all three are clearly early spring-fruiting species, but the frequent association of *G. gigas* with melting snowbanks may be important. In those areas where both *G. fastigiata* and *G. gigas* occur observations should be made on this and on details of morphology to see if other differences can be found.

Much has been written about spore ornamentation in the *G. gigas-G. caroliniana* complex. There is some confusion resulting from faulty taxonomy of the species but also some due to differences in spore ornamentation in different populations of *G. gigas* and in maturity of spores of *G. fastigiata*. Although Krombholz illustrated the spores of *H. gigas* as smooth, I admit into the species those with slightly roughened spores having spore characteristics otherwise appropriate for *G. gigas*. Actually there is much variation within the species with regard to this character and to spore size, shape, and apiculus. Since, when present, spore ornamentation seems to develop late in maturation of the spores of all the Discineae, this character must be used with caution in characterizing the species. However, spores of some specimens of *G. gigas* collected on a coverslip from maturing ascocarps have smooth spores while those of other specimens are faintly roughened (Fig. 2). In *G. fastigiata* the reticulum is more distinct and more consistently present on mature spores. In both *G. fastigiata* and *G. gigas*, in contrast to *G. caroliniana* and *G. brunnea*, the reticulum is much finer and lower and is not drawn up into spicules toward the spore apices. These differences were accurately shown by Maas Geesteranus (1965, Figs. 3 and 4) and parallel the differences in ornamentation shown by me (McKnight, 1969) for *Discina macrospora* Bup. and *Discina warnei* (Pk.) Sacc.

Although I have seen few fresh specimens of *G. fastigiata*, my notes on these and on numerous collections of *G. gigas* indicate that there may be a very subtile but significant difference in color of the fresh hymenium of the two species, *G. fastigiata* being more yellow than *G. gigas*. In both species there is a considerable color variation on a single specimen and even more between specimens and between collections. However, the various hymenium colors of both are in the large blocks of color designated "strong yellowish brown," "strong brown," and "moderate brown" by Kelly and Judd (1955). Some specimens of *G. fastigiata* were also recorded as "dark grayish yellow," and the "strong yellowish brown" is more yellow than that of *G. gigas*, as indicated by the Munsell notations reported above. Such small color differences really may not be significant at the species level, but they do seem

to be confirmed by a subtile difference in hymenium color in the two species as seen in well-dried herbarium specimens. Observations on color range of the two species fruiting in the same area could be important in establishing the significance of this character in species differentiation. Collectors in Washington, Idaho, and Utah should watch for such an opportunity.

The significance of gross morphology and ascocarp size in distinguishing these two species cannot be assessed without more field observations, particularly on *G. fastigiata*. While admitting to having seen too few fresh collections of *G. fastigiata* for a final judgment, I get the impression that differences in size and macroscopic form between it and *G. gigas* are not enough to permit distinction of fresh specimens of the two in the field without examining their spores. The "fastigate" form described originally and illustrated by Krombholz (1832) appears to be uncommon in either species, but this conclusion may be premature for *G. fastigiata*. Both species are exceedingly variable in gross form and size. The receptacle is very much convolute in some specimens with numerous small folds extending in all directions, whereas in others it is almost smooth. This character does not necessarily change with age. Although the stipe varies greatly also, it can always be characterized as thick, longitudinally ribbed or lobed, and containing mutiple channels inside throughout part or all of its length, contrasting with the typically solid stipe developed on some specimens of *Discina*. The receptacle is usually folded back against the stipe and is often intergrown with it. The entire ascocarp may be wider than it is tall, and the stipe may be almost completely hidden by the recurved receptacle. In all specimens of some populations the stipe may be very long, calling to mind Krombholz's (1832) Illustration of *Helvella tremellosa* Krombh. It may be basically cylindrical or expanded downward. The very short stipitate forms of *G. gigas* bear a close resemblance to specimens of *Discina apiculatula* McKn. which have an especially well-developed stipe, and short stipitate forms of *G. fastigiata* look superficially like *D. perlata* or *D. macrospora* Bubák. They are readily recognizable in the field, however, in spite of the fact that they sometimes grow in mixed populations as do different species of *Discina* (McKnight, 1969) and other combinations of *Gyromitra* and *Discina*. Last summer in the Uinta Mountains I found one specimen of *G. gigas* with a specimen of *Discina perlata* (Fr.) Fr. actually touching its stipe. Fruiting in such close proximity suggests that the mycelia grow intermixed in the soil. One small, solitary specimen of *G. fastigiata* collected in Maryland (McKnight 11739, BPI) had an entirely discinoid receptacle and multilacunate stipe. Further observations are needed on species in both genera to circumscribe the species accurately, after which the thorny problem of generic concepts may be resolved.

Acknowledgment

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MICROBIAL TOXINS, Vol. 8, edited by S. Kadis, A. Ciegler, and S. J. Ajl, published by Academic Press, 111 Fifth Ave., New York, New York. 400 pp., 1972 $22.00.

The first volumes of the MICROBIAL TOXINS series dealt, appropriately enough, with microbial toxins. Lack of a sufficient number of contributors to maintain an on-going series in so limited a field has apparently forced the compilers to solicit papers on non-microbial toxins. Vol. 8 is chiefly concerned with toxins of lower fungi (*Stachybotrys, Helminthosporium,* ergot, etc.) but contains two chapters which together represent the most comprehensive review of mushroom toxins to date.

Chapter 10: "The Toxic Peptides of *Amanita* Species" by Theodor Wieland and Otto Wieland deals mainly with the chemistry and toxicology of the phallotoxins and amatoxins found in *Amanita phalloides.* The Wielands themselves elucidated most of this beautiful chemistry and the reader benefits from the first-hand account.

It is a remarkable fact that *A. phalloides* provides two series of toxins completely different in their biochemical action: the phallotoxins (chiefly phalloidin) alter the permeability of the liver membranes and the amatoxins chiefly α- and β-amanitin) inhibit synthesis of ribonucleic acid. Moreover, the mushroom contains a third substance, antamanide, which completely nullifies the action of an otherwise lethal dose of phalloidin when both are administered to animals simultaneously. The authors provide a good overview of the work done on toxicology of the fascinating compounds up to early 1971. And, parenthetically, nearly every original paper in this field today has a footnote thanking Theodor Wieland for providing the samples of toxin.

In cases of human poisoning by *A. phalloides* and its relatives, the amanitins cause the kidney destruction responsible for illness and death; the phallotoxins are not present in sufficient quantity in the fresh fungus to contribute to the poisoning syndrome. The first symptoms of poisoning, occurring usually some 8-14 hours after ingestion, are a sudden onset of intense abdominal pain, violent vomiting and cholera-like diarrhea, reflecting severe inflamation of the gastrointestinal tract. Remarkably, the Wielands conclude that these symptoms are caused by an unknown irritant and not by amanitin. I am not at all ready to accept this conclusion, which is apparently based solely on the observation that rats and mice do not develop gastro-intestinal symptoms when given pure amanitin, either orally or by injection. Some counterarguments are: (1) Although rats and mice are sensitive to injected amanitin, they tolerate very large oral doses without suffering any ill effect, as the Wielands point out. This tolerance may result from amanitin being destroyed by the digestive juices before it has time to be absorbed or to irritate the gastrointestinal tract. In any case I have seen no reports that rodents suffer gastrointestinal irritation when fed *A. phalloides* tissue, which would, naturally, contain the supposed irritant. Indeed, rabbits eat large amounts of *A. phalloides* without harm—the basis for the erstwhile treatment of human victims of *A. phalloides* poisoning with chopped rabbit stomachs. (2) Mushroom species containing amanitin are known from three genera, *Amanita, Lepiota* and *Galerina,* and all cause the typical delayed onset of

vomiting and diarrhea in human victims. It is highly unlikely that an unknown irritant invariably accompanies amanitin in species from three unrelated genera. (3) Reactions to a drug or toxin are often quite species-specific. For example, the fatal dose of amanitin, by injection and adjusted to a per gram basis, is some 5 times larger for rats than for mice, and mice do but rats do not suffer kidney damage. Rodents may be immune to gastro-intestinal damage, even if amanitin should escape destruction in the digestive tract, because they have a biochemical makeup different from that of humans.

There are occasional signs in the text that English is not the author's native tongue, that the manuscript was not seen by a mycologist and that the editing was sloppy. ". . . The stem [of *A. phalloides*] . . .bears at its uppermost part a large white cuff that ends in a large tuber surrounded by a leafed sheath" (p. 249) is hardly a model of clear description. Mycologists may also be startled to read that *Tricholoma equestre* "bears from the beginning faint pink, and later darker red, lamellae; it has a typical anise-like smell" (p. 250). Both the generalized structural formula for the amatoxins (p. 262) and the structure of antamanide (p. 264) are wrong. And may the coined "confluation" (p. 275) never replace the good English word "coalescence"!

Chapter 11: "Mushroom Toxins Other than Amanita" by Robert G. Benedict takes up where the Wielands leave off. It is a competent, excellent and extensive survey fo the world literature on mushroom poisoning and chemistry of the toxins. The mycophagists who believe that as long as one stays away from the Amanitas one runs no serious risk of severe poisoning may live longer if they read this work. As mentioned previously, species containing amanitin are found in *Lepiota* and *Galerina* as well as *Amanita.* A chemically unidentified toxin, orellanine, present in *Cortinarius orellanus,* kills by destroying the kidneys; symptoms may not be evident for as long as 14 days after ingestion. Gyromitrin, found in some false morels, claims a few fatalities nearly every year. *Galerina sulciceps,* toxin unidentified, may kill in as brief a time as 7 hours, deserving, Dr. Benedict suggests, the title of world's most lethal mushroom.

Dr. Benedict has been as critical of the literature as possible, but all reviewers of papers on mushroom poisoning must face the frequently unanswerable question. Was the responsible species correctly identified? The author's statement ". . .Tyler et al. (1963) obtained both chromatographic and pharmacological evidence of the toxicity of *Galerina marginata* (Batsch ex Fr.) Kühner. . ." (p. 284) appears incompatible with the comment of A. H. Smith and R. Singer (A MONOGRAPH OF THE GENUS GALERINA EARLE, Hafner Publishing Co., 1964, p. 272): "We do not dispute the claim that *G. marginata* is edible. That seems to be well established." This confusion more likely results from a different species concept among professional mycologists rather than from "mistaken" identification,however.

The text is generally free from errors. Gremlins did get in one blow, however, on page 283 read "Heterobasidiomycetes" for "Homobasidiomycetes", and vice versa.

D. M. Simons

THE COMPLETE BOOK OF MUSHROOMS, by Augusto Rinaldi and Vassili Tyndalo, translated from Italian by Italia and Alberto Mancinelli, published by Crown Publishers, 419 Park Avenue South, New York, New York. 322 pp., 1974. $14.95

Despite the ambiguous and ambitious title, that may turn the mycologist away without more investigation, this large volume contains a wealth of information for beginners and mycophagists.

The illustrations are excellent, however there is evidence that the printer did not take the needed care with his inks as the darker colors are too deep and intense. The reds and oranges are much too brilliant for American fungi. This does not seem to be the fault of the artist, Rosano Maggiora, but rather in the choice and use of inks. Line drawings are used profusely throughout the text, including an illustrated glossary within the covers. The authors lean heavily on macro-identification and therefore lean heavily on drawings as well.

The text is divided into two parts. Part I concerns itself with identification. About 400 species are treated in the text, with nearly 1,000 mentioned. The text follows the usual European style, with the descriptions accompanied by the proper plate. Similar species are discussed as well as the edible or toxic features. Almost no references are made to microscopic characters. We were surprised to find *Gyromitra esculenta* and *G. gigas* listed as edible, with certain recommendations for cooking. NAMA toxicologists will be interested in the statement that *G. esculenta* is completely harmless when dried.

Part II covers a great variety of instructions. recipes, kitchen hints, etc., for the mycophagist. In the first chapter the authors discuss methods of searching for fungi, however this seems to be aimed at avoiding the European market hunter more than aids to the American mycophagist. We were surprised and amused at some directions for placing fungi in a basket. The authors state that worms in the collections move to the stalk when the fungus is placed upside down and are thus more easily removed. A gastronomic classification of edibles is placed in five sections with first, second, third and fourth quality mushrooms listed as well as those eaten raw. There are sections on preserving, drying, pickling, etc. A table of nutrients and vitamins is included. In discussing poisonous species, a number of aged tests are debunked along with 21 drawings of toxic mushrooms. A section on poisoning symptoms includes ten additional drawings with a list of toxic fungi and first aid suggestions. Finally there is an interesting section on cultivation and its history, two keys to genera, a dictionary of scientific terms as well as an etymological history of certain terms from the original Greek to English.

Despite the European flavor of this work (it speaks with an Italian accent), its total dependence on the Friesian system of taxonomy (*Psalliota* for *Agaricus,* etc.), some odd colors for American fungi, the book is a BEST BUY. Its great volume of general information, profuse illustrations, and the obvious love and work the authors and artists have put into it, coupled with the low price of $14.95 make it a must for the mycophagist. It may well become a classic along with McIlvaine's "1,000 American Fungi." It is that kind of book.

H. Knighton

MYCOLOGY GUIDEBOOK, edited by Russell B. Stevens, published by University of Washington Press, Seattle & London. 703 pp., 40 fig., 1974. $15.00

The Mycological Society of America has become a committee working on a text aimed at improving mycological courses. This committee, headed by Dr. Stevens has produced a book that will be of great help to both the student and his teacher. The book contains so much information of value that it is almost predestined to become a mycological classic.

The book is hardbound and printed by offset from a master copy. It contains four parts. Part I discusses general information on where to collect, how to handle, laboratory care, culture techniques, making permanent slides, and a discussion of mycological color data. Part II discusses the taxonomic groups from the lowest forms through the higher fungi, where to collect these groups and handling techniques. Part III contains ecological groups with such subjects as insects & fungi, Lichens, Mycoparasites, plant pathogens, medical mycology, industrial mycology, soil fungi and ecological sites. Part IV, Fungi as Biological Tools, discusses spore release and dispersal, physiology, genetics, special materials as well as biological materials. Finally there is a list of recipes for 25 stains and reagents as well as instructions for 100 culture media.

There is a long list of contributors, literature citations, culture repositories and even a listing of available films. There is a table of contents but no index.

This book will prove of great value to the teacher of mycology and an inspiration to the serious student.

H. Knighton

IDENTIFICATION OF THE LARGER FUNGI, by Roy Watling, published by Hulton Educational Publications Ltd., Raans Road, Amersham, Bucks, Great Britain. 281 pp., 1973. About $3.00.

The book is intended for the use of students in Scotland and the British Isles, however it is so thorough and so well done that it should be of aid to students and amateurs everywhere. Dr. Watling states in the preface, quote, "Few books on fungi have ever been designed for students. This book is aimed primarily at this level, but if the interested amateur is assisted and encouraged by the same texts my hopes will have been doubly achieved".

The introduction contains such items of basic interest as to where to look, how to collect, and the examination of fungi. Microscopic examination is given an exact description with many line drawings that can be of great help to the beginner. Following this are the keys to major genera.

At this point the book departs from the usual manual style in that the student is directed as to what fungus he might expect in the woodlands; the mycorrhizal formers such as *Boletus, Cortinarius, Russula,* etc. The student is then taken to pastures and meadows for a look at such things as *Hygrocybe,* Rhodphylls, *Agaricus,* and *Lepiota.* A section is devoted to agarics of parks and lawns. The bracket-fungi and their relatives are discussed and much more! In selecting the species represented, Dr. Watling chose a typical representative of each of the major groups of fungi and also attempted to cover all of the common ecological niches.

In every plate the fungus described has its outstanding macro and micro characteristics accurately drawn with scales that will enable the student to compare his work with that of the author.

H. Knighton

THE USE OF FUNGI AS FOOD AND IN FOOD PROCESSING, Part 11, by W. D. Gray, published by CRC Press, 1890 Cranwood Parkway, Cleveland, Ohio. 112 pp., 1973. Price $9.95

It is difficult to grant the author the charity for which he pleads in the introduction. Rather than a practical guide for the beginner, or a lure for the curious Dr. Gray has arrived at a sort of hodge-podge that may confuse the novice, upset the amateur and anger the professional. The contents runs up and down hill so much that one suspects multiple authorship.

The criticism of the taxonomist to the nomenclature problems found in the introduction and Chapter I, is that the genera and specific names often seem the subject of whimsy, rather than serious attempts to bring order out of confusion. Dr. Gray would have better served his beginning readers by explaining why this situation exists. He has evidently not read the recent editions of some of the manuals he recommends. The Dover reprint of L. C. C. Krieger's THE MUSHROOM HANDBOOK, has a clear explanation of these nomenclatural problems by Dr. Robert Shaffer. A more serious ommission, in a book published in 1973, is that of Orson Miller's MUSHROOMS OF NORTH AMERICA. Whatever Dr. Gray might think of Dr. Miller's book, this very popular manual should have been included if just for the photography alone.

After the introductory emphasis on the mycologically untrained, the book launches into a more advanced level, listing features of the pileus, stipe and gills which are understood only with practice and experience. The term "veil" is limited to a marginal character while most manuals refer th this as the annulus or ring. (See THE MUSHROOM HANDBOOK). Spore colors MUST be determined on white paper. The use of black paper is obsolete.

The scientist will find the mixture of English and metric scales shocking. In the species descriptions, the pileus width is sometimes (not always) given in inches while the depth is in centimeters; stipe length may also be in inches while the width is in centimeters or meters.

The ecological significance of studies on fungi as food supports the inclusion of such a chapter and the book improves with this second chapter. It is to be hoped that this summary will stimulate more research in this area.

Wtth some confusion in nomencalture, the chapter on mushroom poisoning is a fairly accurate rendering of our present understanding of mushroom toxins, although it leans too heavily on Ford's classifications. This section with its highly technical terminology, complicated chemical formulas and medical orientation defeats the avowed purpose of introducing people to fungi. Where the beginning is sloppy, this section dealing with toxicology is too exacting.

The final chapter would have made a better beginning for the closing discussion almost fulfills Dr. Gray's intent. It is clearly the best part of the book. Seldom does one encounter any reference to mycophagy in history. The recipes offer variety and could encourage the gourmet. The table grouping mushroom dishes into types and usages is useful.

The book could be greatly improved with the emphasis on mycophagy and preparation, a simplification of the discussion on toxicology and ethnomycology and the complete ommission of chapter I - leaving the identification of fungi to the manuals.

Mrs. Allein Stanley

TROPICAL MACROFUNGI, SOME COMMON SPECIES, by M. H. Zoberi, published by Hafner Press, 866 Third Ave., New York, New York. 158 pp., 1972. Price $16.95

Mushroom books for north temperate regions have appeared in most of the major languages, and fungi producing mushrooms and other types of large fruit bodies are regularly studied although taxonomies rarely keep up with published knowledge in this area making communication between various schools difficult at best. Studies in these fungi making information about them and their edibility or poisonous characteristics available to the interested individual in the tropics are rare. This volume is significant, therefore, in that the author, a member of the Department of Biological Sciences at the University of Ife, Ile-Ife, Nigeria, has presented descriptive studies of 100 species of the larger fungi which would be observed most commonly in Nigeria and similar areas. Comments on edibility, toxicity, economic importance, and distribution are given for each species.

Following a brief introduction, techniques of collection and the type of notes most useful to be taken are described. Techniques of microscopic investigation and useful chemical tests are given. Characteristics of the classes and orders containing treated species are given and a key is presented to the several families to which these fungi are assigned.

Many of the genera are illustrated with drawings by the author's wife, Zohra Zoberi, to whom the book is dedicated. Sixteen species are presented in color from photographs. The color reproduction is of good quality.

In general, the book is well made. However, several typographical errors could have been avoided had a proof reader compared names as they appeared in indices, discussions, and in headings of figures. For anyone working on ecological projects in tropical regions, this volume could be useful as a start toward identifying fungi which occur in the region and may fruit during the course of the identification.

Wm. Bridge Cooke[1]

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ERRATA

Errata of *McIlvainea* Vol. 1, No. 2.

Page	Line	Correction
9	9	genealogy
55	20	*M. semilibera*