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Hunt Institute was dedicated in 1961 as the Rachel McMasters Miller Hunt Botanical Library, an international center for bibliographical research and service in the interests of botany and horticulture, as well as a center for the study of all aspects of the history of the plant sciences. By 1971 the Library's activities had so diversified that the name was changed to Hunt Institute for Botanical Documentation. Growth in collections and research projects led to the establishment of four programmatic departments: Archives, Art, Bibliography and the Library.

Natural dope said less potent

Although several potent hallucinogenic drugs are found in nature, synthetic compounds are vastly more potent, said Kendall N. Houk, professor of chemistry to a packed room at Coffee 2051 Wednesday afternoon.

Houk drew an interested crowd, judging from the number of persons who took notes during the talk.

Build a Better Mushroom." Two types of mushrooms produce hallucenogenic drugs. Houk said knowing the chemistry of the brain and making a compound that can foul it up is the way to make a better mushroom.

Houk discussed different drugs and the effects they have on the brain. One mushroom, soma, grows mostly in Siberia and produces the chemical compound muscimole. This compound affects the neurotransmitters in the brain, he said.

Mescaline is produced by the cactus, peyote, which is used by Mexican Indians in religious ceremonies, said Houk.

In discussing the synthetic hallucinogens, Houk said LSD is 4000 times more potent than mescaline, and isn't derived directly from any natural sources. LSD's hallucinogenic properties were discovered unintentionally by Albert Hoffman.

Analgesic drugs, which are not hallucinogenics, are morphine, heroin and codeine. Among the problems drugs present are tolerance and physical dependence, Houk said.

-76 state championship. But
isiana Tech won last season's
ney.

ena issued

NO CONGRESSIONAL sub-
nas have been received by our
ole," Tyler said. "We're sitting
old."
ississippi State was placed on
years probation by the NCAA
975-76 for football recruiting
gularities.
he paper said Brent, now
ving as counsel for the sub-
mittee, reportedly would be
leadoff witness and that Tyler,
d football coach and athletic
ctor at Mississippi State, was
ected to follow Clark.

teams yet. The key word here is yet.

Munick elaborated, "We will be doing most of it (team selecting) next week. That will be done by the Metropolitan Intercollegiate Basketball Association (MIBA).

"THE MIBA WILL TRY to look at the conferences and the independents and make a list of teams that probably won't be invited to the NCAA tournament."

Munick explained that every team selected for the NCA[illegible]rnament must go to that tournament so the NIT makes a l[illegible] that are good but probably won't be invited.

"Our bids will go out about one hour after the NCA[illegible]s."

Several points are used as criteria for selec[illegible] the NIT, Munick explained. "A lot of teams have [illegible] records but that's not all we're looking for. Another [illegible] is who you have beaten."

BUT ASKED IF LSU was one of [illegible] being considered, Munick wiggled out of an answer. "T[illegible] would depend on the win-loss record and who they hav[illegible] But even if they finished second in the SEC, we wouldn't [illegible]ally invite them."

However, Munic[illegible]ght off that the Tigers had beaten Kentucky and was[illegible]y two teams to do that. He also knew the Tigers record[illegible]nand.

The Fungus-Culturing Ants

The world's first gardeners have attained a skill in maintaining flourishing fungus cultures that humans might envy

Of the numerous relationships that ants have with plants, none is closer than that of the ants of the tribe Attini with their fungi. Neither partner in this mutualistic association has been recognized in nature without the other. One is dependent on the other, the ants growing the fungi as their sole food source and the fungi depending on the ants to provide properly treated substrate.

The attine ants are unique among insects in actually culturing the fungus by planting the fungal mycelium on the specially prepared substrate. In other insect-fungus relationships, such as those involving certain termites and beetles, the insects eat the fungus or feed it to their brood but have not been reported to plant the mycelium. Rather, the spores of the fungus may be carried on the insect body, or in pockets, and may grow on their excrement, but planting in the attine sense is unknown. Spores of the attine fungi never occur in the normal nest and play no role in perpetuating the fungus from one ant generation to another. The behavioral pattern of the attine ants is as much gardening as it is in the human sense. The present account emphasizes the success of these ants, both in terms of developing large gardens and of maintaining gardens under difficult circumstances through their behavioral patterns and their excretions.

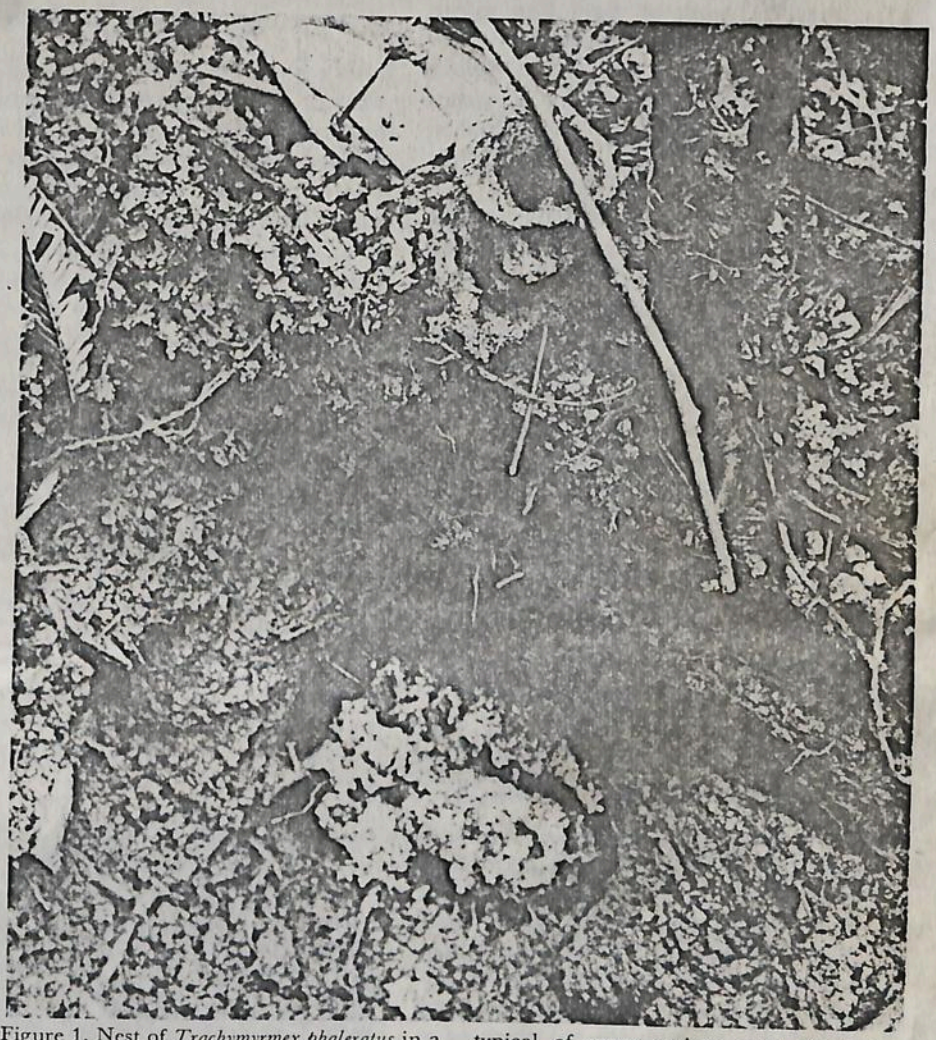

Figure 1. Nest of *Trachymyrmex phaleratus* in a Guyana rain forest, surmounted by a peculiar ear-shaped turret of clay. This type of turret entrance was noted in the first four nests of the species to be discovered (Wheeler 1925, Weber 1946). The single garden, typical of many attines, was attached to rootlets and was 60 mm high and 86 × 95 mm laterally. The area photographed was approximately 16 cm wide. The substrate was yellow-brown to black vegetal debris.

The two main divisions of the attines are the polymorphic leaf-cutting species of *Acromyrmex* and *Atta*, which cut green leaves or flowers, and the less

Neal A. Weber, Professor of Zoology, Swarthmore College, started research on the attine ants and their fungi in Trinidad on a National Research Council Fellowship in Biology immediately after completing work for the doctorate at Harvard University under William Morton Wheeler. This research, interrupted by field work in Africa, the Arctic, and the Middle East, eventually was carried on over much of the Americas. Some 135 publications deal with this field work and especially with ants. Living colonies that he has brought back from annual trips to the tropics (under USDA permit) have expanded to fill an entire laboratory, probably the only laboratory ever established for the comparative study of all types of attines. His book, Gardening Ants, The Attines, *recently published by the American Philosophical Society, Philadelphia, as their Memoirs No. 92, is a monograph that may be consulted for many other aspects of these ants and their fungi. Much of the current work was performed with the aid of National Science Foundation Grants GB-5346 and GB-31131. Address: Department of Biology, Swarthmore College, Swarthmore, PA 19081.*

The Biochemical Basis of the Fungus-Attine Ant Symbiosis

A complex symbiosis is based upon integration of the carbon and nitrogen metabolisms of the two organisms.

Michael M. Martin

The obligate symbiosis between the attine ants and the fungus which grows in their nests is a spectacular example of a mutually advantageous association of two very different types of organisms. In this article investigations which have elucidated the biochemical basis for this complex association are reviewed. It is the purpose of the article to trace the way in which a knowledge of the natural history of the attine ants permitted the formulation of questions which led to an understanding of the symbiosis in biochemical terms, and to show how this understanding has permitted the formulation of new questions of a more physiological and biological nature.

Natural History

The attine ants, commonly known as the fungus-growing ants, occur exclusively in the Western Hemisphere and are predominantly Neotropical in distribution. There is an extensive literature describing the natural history of this group (*1*, *2*). All of the species which comprise the tribe Attini culture a fungus in their nests and utilize this fungus as their primary and probably sole source of food. The substrate on which the fungus is grown varies with the genus. The simpler, more primitive genera use insect feces and insect carcasses as substrates for their cultures. The intermediate genera utilize a combination of plant debris and fragments of leaves and flowers cut from live plants. The most complex, most highly evolved, and most spectacular genera, *Acromyrmex* and *Atta*, culture their fungi almost exclusively on leaves and flowers cut from live plants. Species of these two genera are commonly known as leaf-cutting ants.

Identification of the fungus or fungi cultivated by the various attine species has been complicated by the fact that sporophores are not normally produced in the ants' nest, and their production in artificial culture has proved to be difficult. To date, only two ant fungi have been given names, after examination of their fruiting bodies (*1*). These are *Leucocoprinus* (or *Leucoagaricus*) *gongylophora*, cultivated by *Acromyrmex disciger* and possibly by *Atta*, and *Lepiota* n. sp., cultivated by the primitive attines *Cyphomyrmex costatus* and *Myrmicocrypta buenzlii*. Both are Basidiomycetes, and both are known only from attine nests.

The fungus gardens are fragile, spongelike structures consisting of many small pieces of substrate held together by the dense mycelial growth which covers them. The gardens constructed by *Atta* tend to be roughly hemispherical, with diameters ranging from 15 to 30 centimeters. A large *Atta* nest may contain hundreds of fungus gardens. The less conspicuous attines have fewer and smaller gardens. The fungus gardens are flourishing growths of a single fungus. This fungus is readily isolated in pure form by standard mycological plating procedures. When grown on standard culture media, such as potato dextrose or Sabouraud's dextrose agar, the attine fungi are seen to be rather slow-growing organisms which are readily overwhelmed by the common contaminants that complicate the lives of mycologists. However, Weber (*3*) has shown that if the ants have access to an agar culture of their fungus they can maintain it indefinitely even when it is adjacent to large areas of contamination. As soon as the ants are denied access to the fungus garden a rapid deterioration of the culture ensues, and contaminants replace the ants' fungus. Clearly, the growth of the ants' fungus in their nests is not fortuitous. The viability of the fungus depends directly upon the presence of the ants. It is this feature of the natural history of the attine ants—their ability to maintain a flourishing culture of a slow-growing fungus that cannot survive in nature independent of them—which has been the subject of research by my colleagues, Raymond Carman, John MacConnell, and Joan Martin, and me in the department of chemistry at the University of Michigan for the past few years. The behavior of the ants strongly implies a chemical basis for their success in culturing their food fungus in the face of possible competition from faster growing, more viable microorganisms present in the surrounding soil or brought into the nest on substrate or on the ants themselves (*1*).

Fungus-Culturing Behavior

Fresh leaves cut from live plants are the most commonly used substrate in the fungus gardens of *Atta* (*1*). A leaf fragment brought into the nest for incorporation into a garden is first cleaned and scraped. It is then cut into very small pieces, becoming quite pulpy and moist in the process, presumably from juices expressed from the leaf, and from saliva applied by the ants. An ant then holds the leaf particle to the tip of its abdomen and deposits a liquid fecal droplet on it. The leaf fragment is then inserted into the matrix of the fungus garden, and several tufts of mycelium are planted on it. The newly incorporated leaf fragment may receive several additional fecal applications from other ants. All attine species, regardless of their favored substrate, exhibit similar behavior. In all species the application of fecal material to the fungus garden, and to substrate prior to its incorporation into the garden, is characteristic (*1*, *3*, *4*). As Weber (*1*, *3*, *4*) has repeatedly emphasized, substances present in the fecal material and possibly also in the salivary material probably create environmental conditions favorable to the growth of

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AMBROSIA FUNGI: A TAXONOMIC REVISION, AND NUTRITIONAL STUDIES OF SOME SPECIES

LEKH R. BATRA [1]

(WITH 48 FIGURES)

General morphology of and association between ambrosia fungi and beetles were recently dealt with by Francke-Grosmann (1956, 1963), Baker (1963), and Batra (1963b, 1966). Although several new species and genera have been described recently, many ambrosia fungi still remain unnamed.

Ambrosia fungi, with their associated beetles, occupy a well-defined niche in trees of low vitality or in recently logged timber (FIGS. 1–3). They form a thin continuous palisade inside the entire tunnel system and in the larval cells of the beetles. Many species are associated only with a particular coleopterous species but in some cases this specificity may be evident only on a nutritional, rather than on a morphological, basis. In nature larvae of most species feed on a primary ambrosia fungus while adults in some cases also eat one or more auxiliary ambrosia fungi (Batra, 1966). Most ambrosia fungi are dimorphic, having (i) an ambrosial (= yeast) phase and (ii) a mycelial phase. The ambrosial phase or sprout-cell phase is invariably dominant in the tunnels throughout the active life of the insect. It can also be maintained under certain nutritional conditions in the laboratory. The conidia and sprout-cells of some species, in the absence of ambrosia beetles or on prolonged storage, germinate to give rise to the mycelial phase. Such colonies may also be induced to revert to the ambrosial phase.

Since conidiophores of many ambrosia fungi are monilioid, such fungi in the past have been referred to the form genus *Monilia* Persoon ex Fries (Mathiesen-Käärik, 1953; Verrall, 1943). Previous attempts to grow such fungi in culture were either unsuccessful (Schneider-Orelli, 1913; Neger, 1909; Batra, 1963b) or "... germination was very erratic" (Leach et al., 1940). Perhaps this was due to a misinterpretation of the morphology of reproductive structures of ambrosia fungi or be-

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FIGS 1–3. 1, 2. *Ambrosiella brunnea*. 1. Tunnels of the ambrosia beetle *Monarthrum fasciatum* in *Quercus* sp. after the brood has escaped. Approx. × 2. 2. A stem disc cut off some distance from the tunnel; dark streaks indicate location of tunnels underneath, × ½. 3. *Phialophoropsis trypodendri*. Larval cells of *Trypodendron scàrbricollis* running parallel to wood grain and the main tunnel along the radius. Approx. × 2.

cause of quick loss of viability of inoculum taken from tunnels. There are three types of apparently similar reproductive structures found in these fungi:

1. KEY TO THE GENERA OF ATTINE WORKERS

1. *a.* Gaster smooth or finely punctate..... 2
   b. Gaster tuberculate or with coarse hairs..... 9
2. *a.* Dorsal body hairs squamate or appressed..... 3
   b. Dorsal body hairs simple or lacking..... 5
3. *a.* Head with complete, divergent antennal scrobes..... *Cyphomyrmex* (fig. 31)
   b. Head with short antennal scrobes and frontal lobes..... 4
4. *a.* Head and thorax with dorsal squamate hairs on tubercles, occipital area angular..... *Myrmicocrypta* (fig. 18)..
   b. Head with dorsal appressed hairs and no tubercles, occipital area smooth and rounded, no clearly bordered antennal scrobe..... *Mycetophylax* (fig. 32)
5. *a.* Antennal scrobes complete, sub-parallel, occiput and thorax spinose or tuberculate..... *Mycetarotes* (fig. 190)
   b. Antennal scrobes less complete and frontal lobes short..... 6
6. *a.* Thorax dorsally without spines, occipital area smooth and rounded, abundant flexuous pilosity..... *Apterostigma* (figs. 19, 33)
   b. Thorax dorsally with spines or tubercles..... 7
7. *a.* Thoracic spines in the form of a circlet, frontal carinae slightly diverging and weakening posteriorly, ants monomorphic and about 2–3 mm..... *Mycocepurus* (fig. 191)
   b. Thoracic spines not in the form of a circlet... 8
8. *a.* Head cordate and without occipital spines; no thoracic spines; abundant flexuous hairs on the body, including gaster; size usually 3–5 mm..... *Sericomyrmex* (figs. 20, 34)
   b. At least the posterior occipital spines present; thorax with 3 pair spines, pilosity sparse; size 2–12 mm. or more, the maximum a soldier.... *Atta* (figs. 12, 30)
9. *a.* Antennal scrobes complete to occiput, no tuberculate dorsal hairs..... *Mycetosoritis* (fig. 192)
   b. Antennal scrobes shorter or with dorsal hairs on tubercles..... 10
10. *a.* Antennal scrobes longer, comparatively monomorphic..... *Trachymyrmex* (fig. 35)
    b. Antennal scrobes shorter, strongly polymorphic *Acromyrmex* (figs. 38, 68, 69)

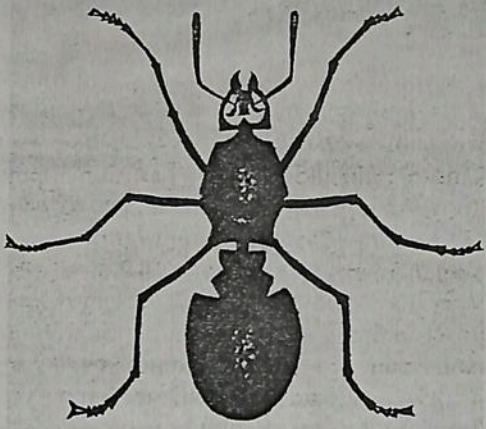
Acromyrmex subgenera:

1. Occipital lobes rounded, no supra-ocular spine or tubercle subg. *Moellerius* (fig. 37)
2. Occipital lobes angular, with supra-ocular spine or tubercle..... subg. *Acromyrmex* (fig. 38)

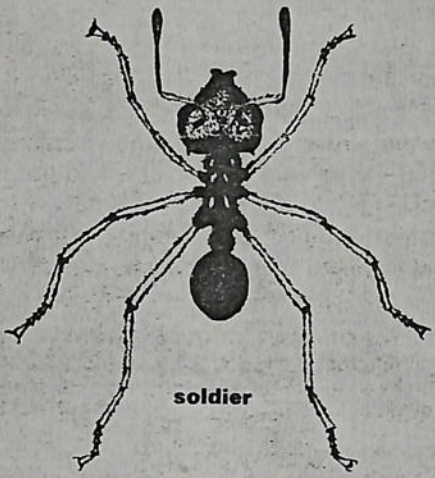
2. ATTINE SPECIES NORTH OF SOUTH AMERICA

Species	U. S.	Mexico	West Indies	Central America	Trinidad
Cyphomyrmex championi Forel				x	
Cyphomyrmex costatus Mann				x	
Cyphomyrmex dentatus Forel		x			
Cyphomyrmex flavidus Pergande		x			
Cyphomyrmex foxi André			x		
Cyphomyrmex hamulatus Weber				x	
Cyphomyrmex longiscapus Weber				x	
Cyphomyrmex rimosus Spinola	x	x	x	x	x
Cyphomyrmex rimosus subsp. *arnoldi* Aguayo			x		
Cyphomyrmex rimosus subsp. *major* Forel				x	
Cyphomyrmex rimosus subsp. *breviscapus* Weber				x	
Cyphomyrmex rimosus subsp. *flavescens* Weber				x	
Cyphomyrmex rimosus subsp. *minutus* Mayr	x	x	x	x	x
Cyphomyrmex rimosus subsp. *trinitatis* Weber				x	x
Cyphomyrmex salvini Forel				x	
Cyphomyrmex wheeleri Forel	x	x			
Mycetosoritis hartmanni Wheeler	x				
Mycetophylax conformis (Mayr)			x		x
Mycocepurus smithi Forel			x	x	x
Mycocepurus tardus Weber				x	
Myrmicocrypta buenzlii Borgmeier					x
Myrmicocrypta cucumis (Mann)				x	
Myrmicocrypta dilacerata subsp. *cornuta* Forel				x	
Myrmicocrypta ednaella Mann				x	
Myrmicocrypta godmani Forel				x	
Myrmicocrypta subnitida Forel				x	
Myrmicocrypta urichi Weber					x
Apterostigma auriculatum Wheeler				x	
Apterostigma auriculatum subsp. *icta* Weber				x	x
Apterostigma calverti Wheeler				x	
Apterostigma dentigerum Wheeler				x	
Apterostigma ierense Weber					x
Apterostigma ierense subsp. *fitzgeraldi* Weber					x
Apterostigma mayri Forel				x	x
Apterostigma robustum Emery				x	
Apterostigma tramitis Weber				x	
Apterostigma urichi Forel					x
Apterostigma collare Emery		x		x	
Apterostigma scutellare Forel		x			
Sericomyrmex amabalis Wheeler				x	
Sericomyrmex azlecus Forel		x			
Sericomyrmex urichi Forel					x
Sericomyrmex zacapanus Wheeler		x			
Trachymyrmex arizonensis Wheeler	x				
Trachymyrmex bugnioni Forel				x	x
Trachymyrmex cornetzi Forel				x	x
Trachymyrmex desertorum Wheeler	x				
Trachymyrmex intermedius Forel					x
Trachymyrmex isthmicus Santschi					x
Trachymyrmex jamaicensis (André)					x
Trachymyrmex jamaicensis (André) subsp. *antiguensis* Weber					x
Trachymyrmex jamaicensis (André) subsp. *cubaënsis* Wheeler					x
Trachymyrmex jamaicensis (André) subsp. *frontalis* Santschi					x
Trachymyrmex jamaicensis (André) subsp. *haytianus* Wheeler and Mann					x
Trachymyrmex jamicensis (André) subsp. *sharpi* Forel					x
Trachymyrmex nogalensis Byars	x				
Trachymyrmex opulenta (Mann)					x
Trachymyrmex relictus Borgmeier					x
Trachymyrmex ruthae Weber					x
Trachymyrmex saussurei Forel				x	
Trachymyrmex septentrionalis McCook	x				
Trachymyrmex squamulifer Emery					x
Trachymyrmex smithi Buren				x	
Trachymyrmex smithi subsp. *neomexicanus* Cole	x				
Trachymyrmex turrifex Wheeler	x	x			
Trachymyrmex urichi Forel					x
Trachymyrmex zeteki Weber					x
Acromyrmex (*A.*) *coronatus* Fabr. subsp. *angustata* Forel					x

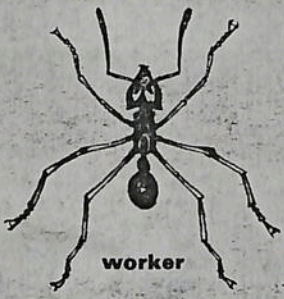
WEBER, N.W.C. A. 1972. GARDENING ANTS. THE ATTINES. AMER. PHILOS. SOC. PHILA. 1966



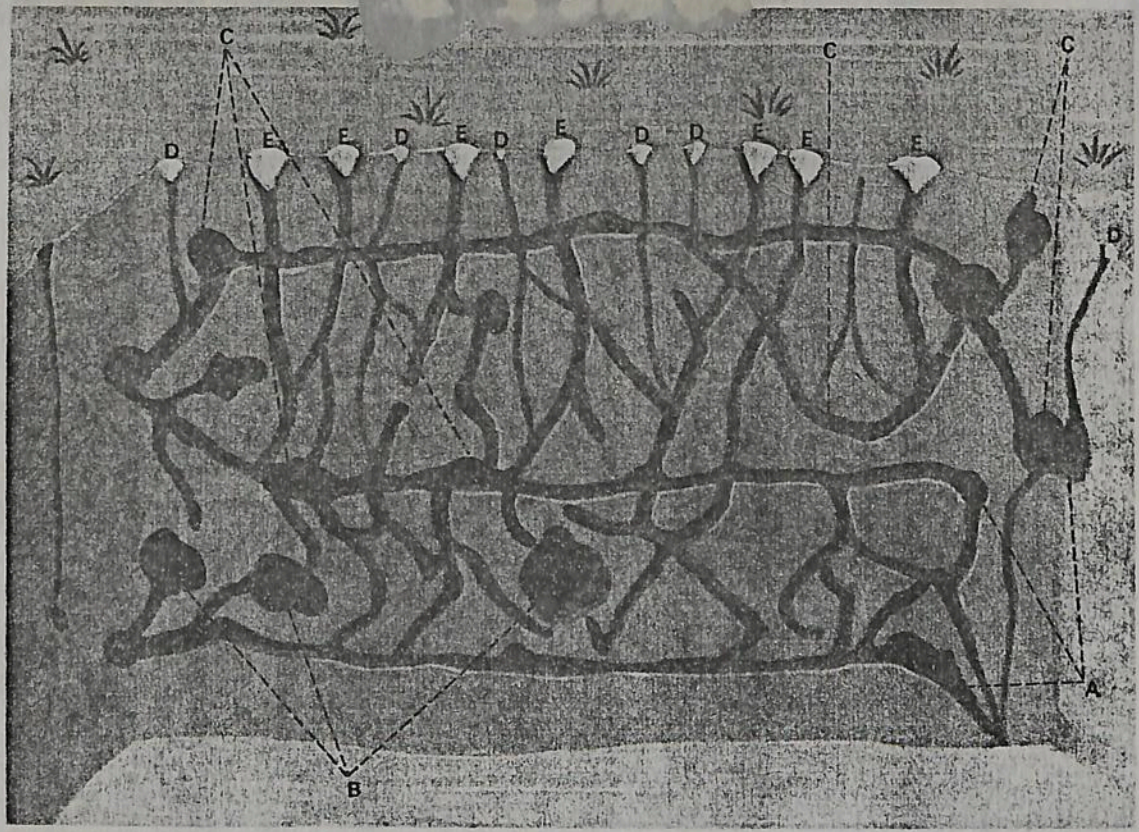
Leaf-cutting ant queen



soldier



worker



Schematic diagram of a leaf-cutting and nest. A) main galleries and defence galleries; B) fungus and brood chambers; C) working galleries; D) air holes; E) craters – entrances and exits

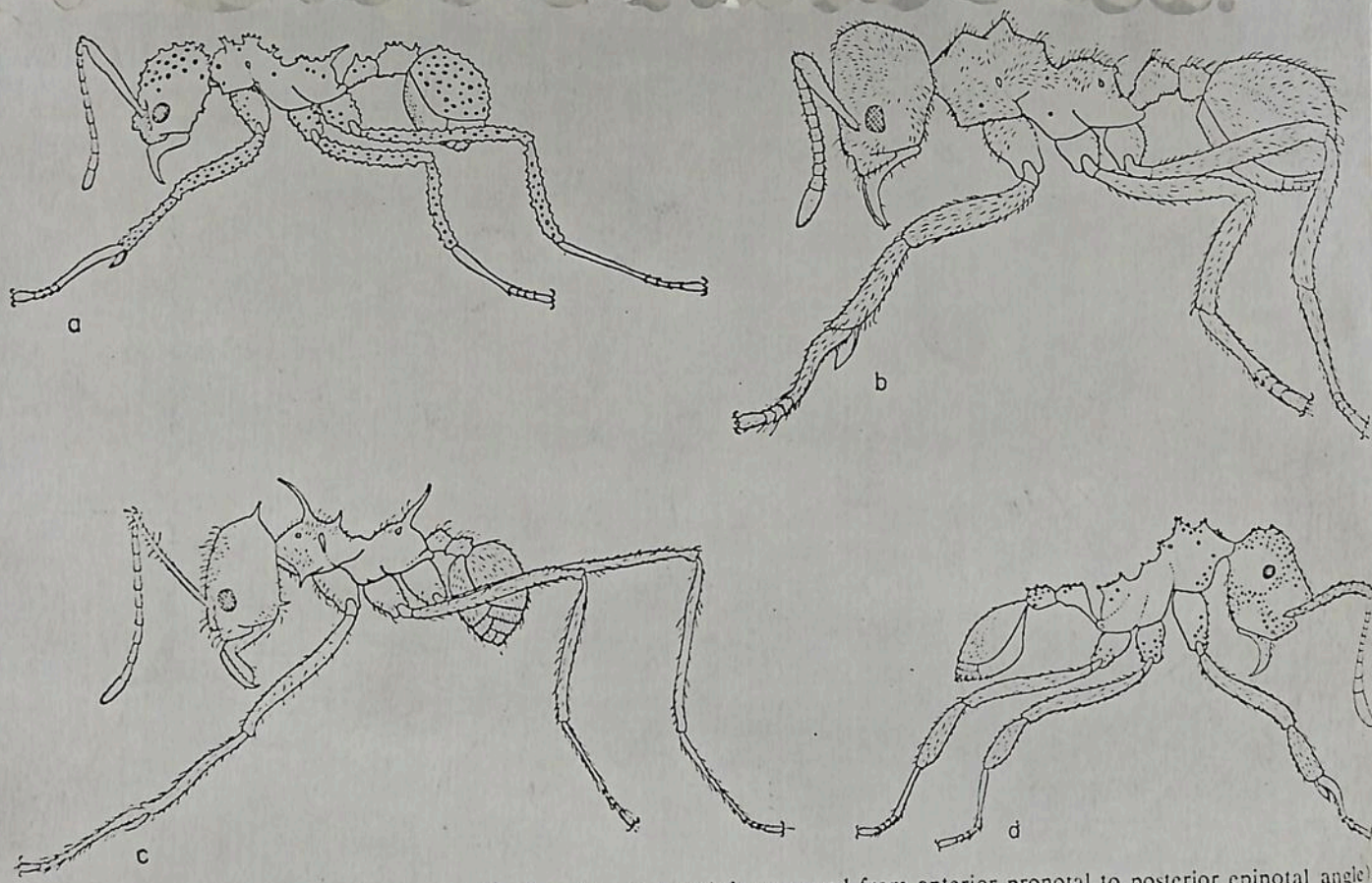


Fig. 4. Outline of representative workers in side view (thorax length is measured from anterior pronotal to posterior epinotal angle)
(*a*) *Trachymyrmex arizonensis* Wheeler; length 4.5 mm (thorax 1.6 mm). (*b*) *Sericomyrmex urichi*; length 3.5 mm (thora
1.5 mm). (*c*) *Atta cephalotes opaca*; length 7 mm (thorax 2.8 mm). (*d*) *Myrmicocrypta ednaella* Mann; length 2.3 mm (thora
0.85 mm).

Fig. 13 (facing page). Forms of ant fungi. (*a*) Fungus of *Atta colombica tonsipes* Santschi, showing inflated hyphae from an artificial culture in a flask of sterile soil. (*b*) Fungus of *Trachymyrmex jamaicensis* E. André, showing typical staphyla from a fresh fungus garden. The hyphae have been teased apart. The inflations are characteristic of the fungi of the higher attines and are 30 to 50 microns in diameter. (*c*) Fungus of *Cyphomyrmex costatus* Mann which attained the sporophore stage and has been identified as a new species of *Lepiota*. The spores are 5 by 8 microns, and the basidia are 10 microns thick. (*d*) Fungus of *Trachymyrmex septentrionalis* McCook. A fresh staphyla. (*e*) Conidial form of fungus found under certain conditions in the garden of *Trachymyrmex septentrionalis*. The ants immediately leave such gardens. (*f*) A conidiophore of the fungus found in another colony of the same ant under abnormal circumstances. (*g*) Fungus of *Atta cephalotes ithmicola* Weber, showing staphyla forming in an artificial culture on Sabouraud's dextrose agar. The thickest hypha is 39 microns in diameter.

5 AUGUST 1966

2. BODY STRUCTURE AND FUNCTION

CASTES

The fungus-growing ants possess three distinct castes: workers, females, and males (fig. 3, 12). The largest workers of *Atta* often are called "soldiers" and they appear to function primarily for colony defense. However, the workers of *Acromyrmex* and *Atta* are polymorphic, range considerably in size, and show a gradual and continuous change from the smallest to the largest workers. As the workers become larger, their heads usually become disproportionately enlarged. Since there are intermediates between any two types of workers, they cannot be separated except into arbitrary categories. The terms soldier, maxima, media and minima workers are used here to designate only approximate groups of workers. These size groups will be discussed more fully below in the section on polymorphism of workers (p. 14).

The workers are all genetic "females," but that term will be used here only for the reproductive caste or queen that lays all the eggs developing into ants in a normal colony. Some workers, perhaps most of them, lay eggs that are eaten or have eggs in their oviducts that are eventually resorbed. If a queen dies or is removed from a colony, workers may lay eggs developing into males. Workers cannot be fertilized, and there is no evidence that workers can lay eggs which develop into workers.

Explanations for the caste and worker ratios in Hymenoptera have been advanced by investigators such as Spencer (1894) and Flanders (1970).

The female caste includes virgin queens which are usually winged or alate when found in a colony and the functional queens which are wingless or dealate. Most colonies contain only a single functional queen. However, when a wingless female is found in a colony one can determine whether she is a functional queen by observing whether she lays eggs which develop into workers or by dissecting her to determine whether she has been inseminated.

The only apparent function of the male caste is to fertilize the females on the brief seasonal mating flight. Males are short-lived and, if present in a colony, they always have wings. The males do not participate in any of the work inside or outside of the colony.

FIG. 3. Castes of *Atta colombica tonsipes* (after M. M. Martin *et al.*) Panama. Winged female at right, winged male at left, queen below, workers on periphery. The smallest workers tend the brood and garden, those of medium sizes excavate soil and cut leaves and the largest sizes, culminating in the soldier, defend the colony.

STRUCTURE OF THE ADULT ANTS

The generalized attine worker is a spiny, dull reddish brown ant with a heart-shaped head and long, spindly legs (fig. 4). The mandibles are triangular with fine teeth on the cutting edges (fig. 7). Details of the mouthparts are

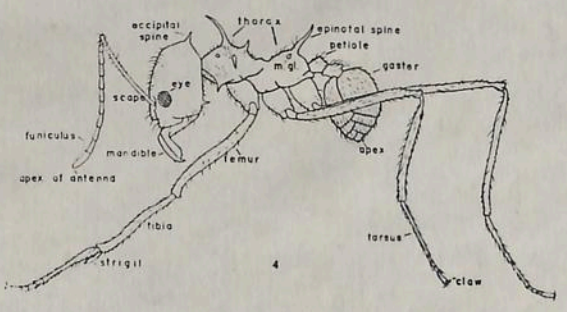


FIG. 4. An attine ant (*Atta cephalotes isthmicola*) with major parts labeled; m. gl. is the opening of the metapleural gland.

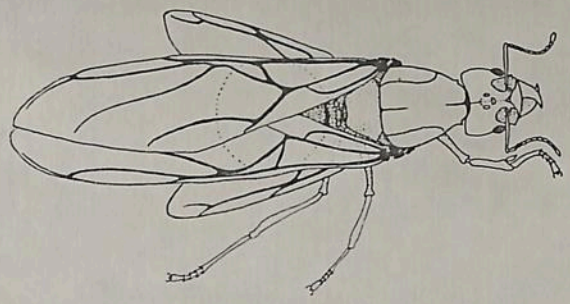


FIG. 5. Winged female of *Atta colombica tonsipes* from above. Length to wing tips 35 mm. Panama.

to be found in Gotwald (1969). The antennae are long and slender and are held forward with the tips waving about when the ant moves. The base of each antenna is concealed by a lobe of the frons (frontal lobe). The antennae of some species can be folded into antennal scrobes or grooves on the sides of the head. The compound eyes are small, convex, and situated near the middle of the head. The males and females have ocelli in addition to compound eyes. No ocelli occur in the worker caste except for a few examples in *Acromyrmex* and often in the *Atta* soldier. When a vestige occurs, it is most often the anterior one. In almost all specimens the anterior ocellus is double, indicating that ancestral insects had two pairs of ocelli of which the anterior later fused (Weber, 1947*a*). Characteristically each occipital corner

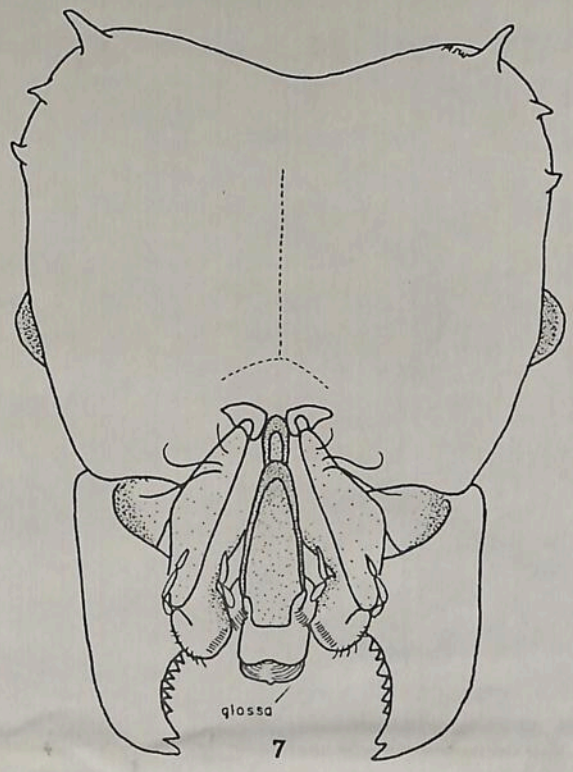


FIG. 7. Head of *Acromyrmex lundi* from behind showing mouthparts. The most central is the expanded glossa or tongue covered with a fine rasp. At the sides are accessory mouthparts, also with files and fine hairs that rasp the fungus when feeding. Only liquids pass into the body. Argentina.

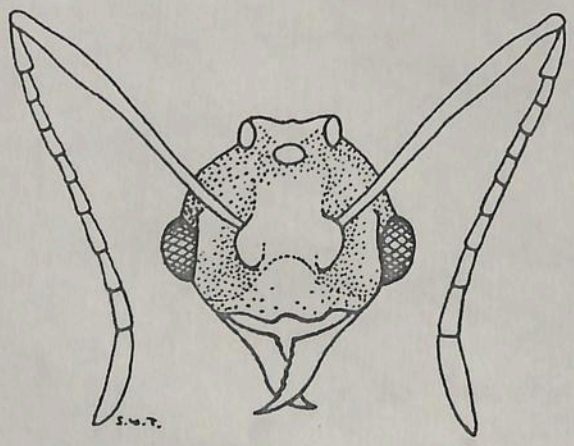


FIG. 6. Head of male of *Trachymyrmex jamaicensis* showing large eyes and ocelli, feeble mandibles, and long antennae typical of male attines. The head is compressed behind from lack of large mandibular muscles. Bahama Islands. The male has 13-segmented antennae; two of the above on each side were actually double.

bears a spine or tubercle, and usually a smaller spine arises in front of each occiput or rear of head. A prominent pair of spines occurs at the rear of the thorax or mesosoma, the epinotal spines, and they may protect the small petiole and post-petiole. The upper or basal part of the epinotum frequently has a carina, sometimes tuberculate, on each side. Its form is often obscured by hairs or spines. The rear part of the abdomen or gaster is small and ovate with an inconspicuous sting.

The males and females or queens are only slightly larger than workers of the species, except in *Atta* which has greatly enlarged reproductives (figs. 3, 12). Compared with the workers, the females are more coarsely sculptured (fig. 8) and have larger compound eyes and three ocelli in the middle of the head (fig. 9). Epinotal spines are reduced. The gaster is more nearly spherical and proportionately larger to accommodate the larger ovaries. The wings extend

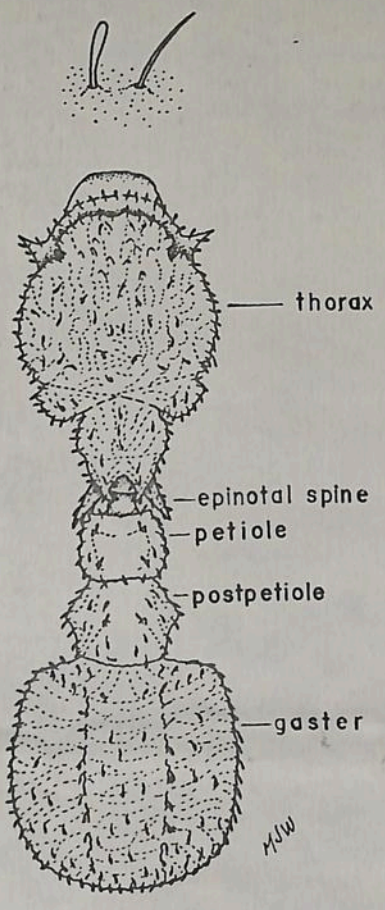


FIG. 8. Trunk of female of *Trachymyrmex zeteki* from above showing spines and hairs; two hairs are shown enlarged at top. Panama.

past the body and have usually brown membranes.

Males are consistently smaller than the females. They are black or dark brown in most cases or at least darker than the other castes. Mandibles are triangular but with reduced dentition, and more elongate than those of the females and workers. The eyes are much larger, but the heads of the males are smaller than those of the females or large workers (fig. 6). The ocelli form a protruding triangle on the frons. The thorax is proportionately smaller than that of the female but with reduced epinotal spines, sculpturing, and tubercles. Wings and legs are similar to those of the female. The genitalia are large and exserted.

The powerful adductor muscles of the mandibles fill most of the head of workers. Generally, the larger the head the more effective cutting mandibles the ant possesses. The mandibles of *Apterostigma* workers are weak and used mostly for carrying particulate fragments of substrate, and the head is not heart-shaped.

The sting is small and inconspicuous, barely extending beyond the hairs at the apex of the abdomen in some cases but twice as stout as the hairs. It is capable of slight external movement. It is difficult to separate attempts to sting from attempts to deposit liquid excrement which seem in any case synchronous acts. The gaster is bent under and forward and executes repeated thrusting movements, when the sting is against another animal in the pose of a typical stinging ant. A film of moisture on the insect or other animal that is the victim shows that the venom sac has been discharged. My khaki trousers have been conspicuously dotted by deposits from the gut and contents of the venom sac of *Acromyrmex ambiguus*. The theory that the sting has been replaced by the mandibles as a major asset in defense was advanced by Hermann *et al.* (1970).

The wings are useful for generic determinations (Weber, 1966*a*). The fore wing posterior or distal to the stigma has usually two closed cells that have been referred to by Wheeler, Forel, and Emery as the cubital and radial. Students of the honey bee and other Hymenoptera refer to them as marginal cells No. 1 and 2, respectively. These two cells tend to have a characteristic

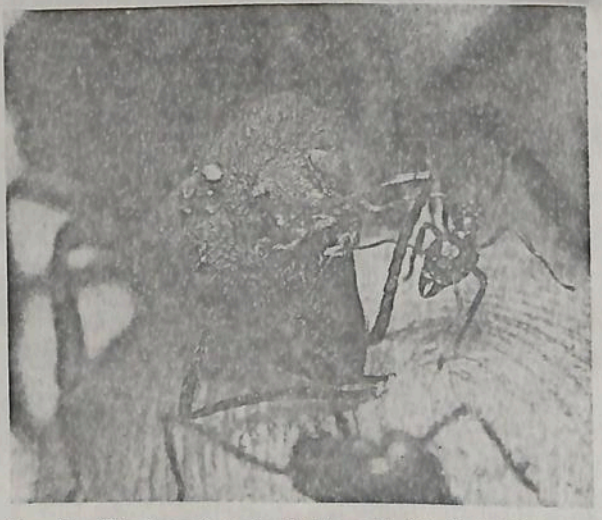


FIG. 9. The large female of *Atta cephalotes* L. held on the author's finger and with one of her attendant minima workers which refused to leave her. A female laying eggs weighed 346 milligrams alive and the minima workers weighed 0.4 mg. Trinidad.

shape in each genus and to be compact in the most primitive and elongate in the higher genera.

Integument

The integument is generally dull and roughened by spines, tubercles, and sculpturing (fig. 8) but a few workers are smooth enough to shine. Most species are hairy, and *Apterostigma* and *Sericomyrmex* are silky in appearance from the abundant flexuous hairs. Several small genera have spatulate hairs appearing as appressed silvery scales on some species. In addition to the upright hairs there is commonly a fine pubescence.

Many Attini and especially *Trachymyrmex* exhibit a variable integumentary condition known as a "bloom." This appears as a whitish granular deposit or scattered minute white areas. It gives the ant a grayish, dusty appearance to the naked eye. Under the microscope, however, the integument is seen to be immaculate and ferrugineous, with the areas of bloom occupying only a small part.

More concentrated bloom on the prosternites was seen in Trinidad in a colony of *Trachymyrmex ruthae*. The workers were a dark brown, and the silvery prosternites could be seen as the ants walked upside down on the glass ceiling of the observation nest. The contrast was striking and suggested a luminescence. Subsequently this condition of the prosternite has been seen in less striking form in many species. In *T. septentrionalis*, for example, it is of regular but variable occurrence. Young callow workers do not have it. Females exhibit the condition as workers do.

It is possible that this bloom is a crystalline wax as figured by Locke (1965) who has diagrammed the way in which it may move through the layers of the cuticle and be deposited on the outer surface.

Eyes, Antennae, and Stridulatory Apparatus

The compound eyes of attines are only moderately developed compared with those of ants in general. Like those of other insects and vertebrates, the eyes of attines are precocious in development and are the first part of the body to become pigmented in the pupa. This feature can be used to determine the age of pupae (see Life Cycle, p. 39). When the eyes are first becoming pigmented, the individual ommatidia may be distinguished as dark spots under a stereoscopic microscope. There were 168 in one eye of a female pupa of *Trachymyrmex septentrionalis*. Later these expand to form one apparent continuous dark mass. Each facet has a convex outer integumentary lens. Although the eyes appear to be adequately developed to see some images, the extent that attines use vision is unknown.

The terminal tips of the antennae appear to bear the sense organs used more than the mouthparts for detecting the suitability of substrate or fungal food. Since the apices are frequently combed by the strigil and then drawn across the moist mouthparts, they are normally clean and moist. This use of antennae, therefore, resembles the combination of the mammalian use of the tongue and nose for taste and smell.

As the ants walk about, the antennae are held outspread and are directed from side to side. Slow motion pictures show a whiplike action of the antennae and their occasional independent use. The apices are gently and carefully brought close to the object being perceived.

Attines apparently have a stridulatory organ consisting of a filelike structure on the dorsal surface of the first gastric segment and a scraper on the underside of the posterior margin of the postpetiole (fig. 8). When the gaster is moved up and down a faint stridulation or squeeking noise is produced. Haskins and Enzmann (1938) and Haskins (1939) published illustrations of the files of ants from a variety of genera.

The first thorough investigation of the stridulation of any species of ant is that by Markl (1965, 1966, 1967) for *Atta cephalotes*. No ant is apparently able to detect sounds transmitted through the air but can detect substrate vibrations. Markl reported that *Atta* workers were attracted to a vibrating glass rod and also to buried workers. The primary known function of the stridulation is as an alarm attracting other workers to dig up the buried ant making the noise.

We have used the ant stridulations as a class demonstration to students. The stridulation can be easily heard by picking up a worker by the head and holding it close to one's ear. Each of the six species of *Atta* or *Acromyrmex* we tested had a characteristic pattern distinguishable on ocillograms. The loudest was *Acromyrmex ostospinosus*, and *Atta cephalotes* produced the highest frequencies.

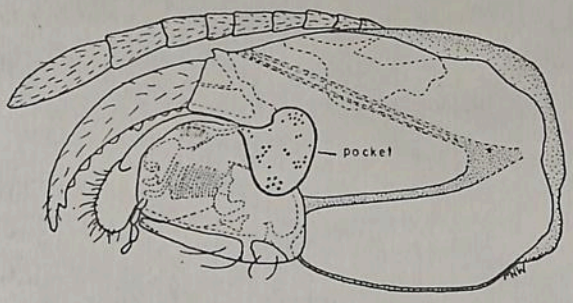


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FIG. 10. Section of head of *Trachymyrmex septentrionalis* showing infrabuccal pocket emptying into mouth above the mouthparts. The pharyngeal tube leading to the thorax is not shown. The V-shaped structure is the internal skeleton.

Infrabuccal Pocket

The infrabuccal pocket, a blind evagination below the anterior part of the pharynx at the mouth opening, is characteristic of ants but of special importance in the fungus-growing ones (fig. 10). This pocket receives the detritus from the grooming operations of the ants (e.g., Bailey, 1920). It is a consistent and impressive finding that ants throughout the world and of all kinds are literally immaculate when carefully removed from the nest in nature. It does not matter whether the nest is buried in dry and dusty soil, in wet boggy humus or in rotted wood in tropical forest, the ants are always clean externally. The ants may have a smooth and shiny integument or one covered with hairs and spines.

Important as grooming and the infrabuccal pocket are to ants in general, this activity and the structure are used by the fungus-growers for removing pathogens that might inhibit or kill the ant fungus. The attine garden is always in a moist chamber and, being of an organic nature, presents an ideal environment for many organisms besides the ant fungus. Other fungi find it entirely suitable as food.

The infrabuccal pellet may be squeezed from the head of a freshly killed ant and the contents placed on a microscope slide. Commonly the pocket contains unrecognizable and finely divided debris, angular soil particles, and spores. Two pellets from *Atta sexdens* workers of a laboratory colony, under 430 × magnification, contained two types of fungal spores and cassava starch grains.

When workers of *Trachymyrmex septentrionalis* were dusted with carborundum powder (commercial 13/F having a particle size range of 0.03–0.15 mm.), the ants immediately proceeded to clean themselves using the tarsal hairs and the strigils on the fore legs. These were drawn through the mouthparts to clean them and the powder collected in the infrabuccal pocket. Two worker ants dusted in the afternoon cleaned themselves appreciably within the next hour, and overnight they deposited ten pellets. The pellets were somewhat kidney-shaped, approximately 0.16–0.17 mm. by 0.25–0.27 mm., and consisted of the characteristic steely carborundum. The same type of experiment was tried with plaster of Paris and other dusts. The ants remained where they were and cleaned themselves before entering the garden chamber.

POLYMORPHISM OF WORKERS AND DIVISION OF LABOR

Workers of some of the attines are monomorphic in that there is little range in size within the

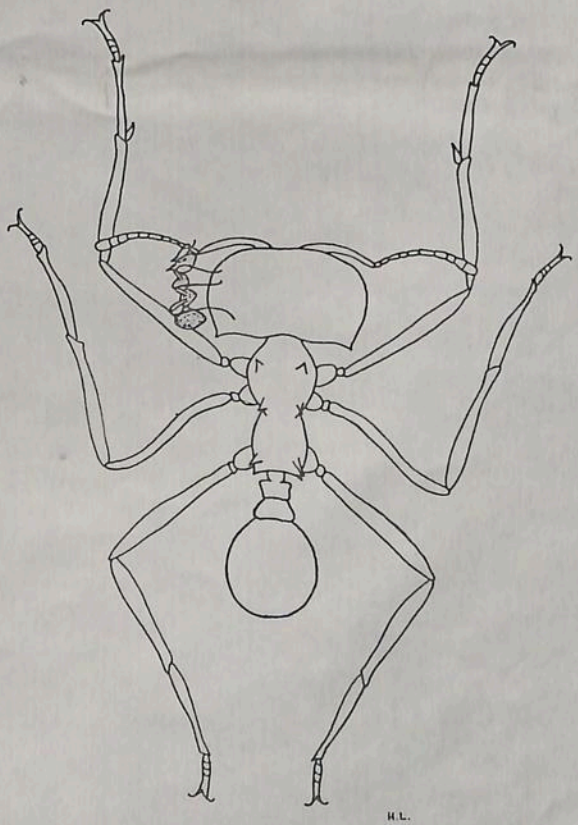

FIG. 11. Minima of *Atta cephalotes* riding on the head of a soldier. The minima commonly sponge the integument of the soldiers as they do the queen.

workers of a colony, and the largest and smallest workers are similar in shape. *Atta* and *Acromyrmex* exhibit the maximum amount of polymorphism within the tribe (figs. 11, 12)(e.g., Wilson, 1953). There is a rough correlation between the size of the workers and the tasks performed within and outside the nest. This type of correlation is usually called division of labor and is considered an advanced form of social organization that is probably evolving in the direction of increased specialization leading eventually to distinct morphological castes with specific duties.

The smallest workers of *Atta* and *Acromyrmex* are about 2 mm. long when an ant in a natural walking position is measured. Arbitrary size classes, to the nearest millimeter, which I have

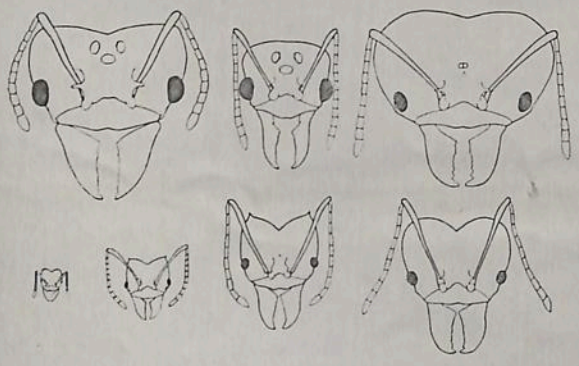

FIG. 12. Front view of heads of castes of *Atta cephalotes*, to scale. Top row, left to right, female, male, soldier (note median paired simple eye or ocellus). Bottom row, left to right, minima, two media, and maxima workers. Trinidad.

used for *Atta* are: minima, 2–3 mm.; media, 4–6 mm.; maxima, 7–9 mm.; and soldier, 10–15 mm. (fig. 13). *Acromyrmex* are somewhat smaller, with the maxima workers 7–10 mm. long (fig. 14).

Weights of a number of live attines in vials have been ascertained with a semi-micro balance. The smallest monomorphic species weighed to date is *Cyphomyrmex costatus* with an average of 0.11 mg. each for ten workers. Three males of this species averaged 0.24 mg., and three alate females averaged 0.47 m. Ten workers of *Sericomyrmex urichi* averaged 1.97 mg. with the largest worker weighing 2.62 mg., a male 2.85 mg., and a winged female 7.62 mg. Ten workers of *Trachymyrmex septentrionalis* ranged from 1.01–2.41 mg. with an average of 1.61 mg.

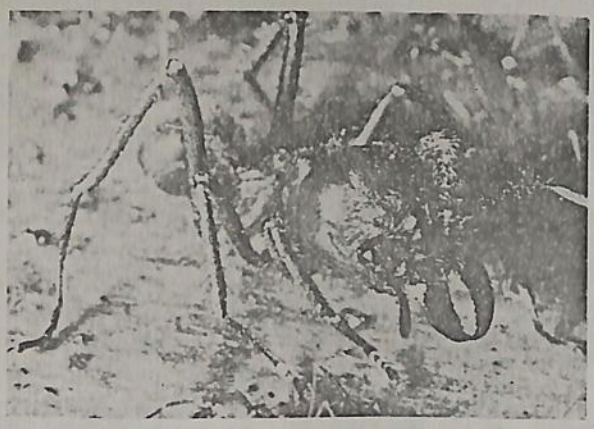

FIG. 13. Soldier of *Atta cephalotes* showing the tufts of golden hairs on each side of the front of the head and the powerful mandibles capable of cutting shoe leather. From the author's laboratory table. (Phot. C. W. Rettenmeyer.)

The polymorphic species have a far greater range in worker weights, but the minima workers of *Acromyrmex striatus*, *A. lobicornis*, *A. octospinosus*, *Atta cephalotes*, *A. cephalotes isthmicola*, *A. colombica tonsipes*, and *A. sexdens* all weighed between 0.40 and 1.0 mg., some of the *Atta* weighing least. The largest of those species of *Acromyrmex* was *octospinosus* with maxima workers weighing up to 15.59 mg., an egg-laying female 26.65 mg., and a winged female 36.44 mg.

FIG. 14. Worker of *Acromyrmex octospinsosus* attempting to bite the author's finger tip. The ant has engaged the claws of all six legs as well as the mandibles in the skin. (Phot. C. W. Rettenmeyer.)

Soldiers of *Atta cephalotes* weighed 38.39–92.00 mg., those of *isthmicola* 67–103 mg., and those of *sexdens* 22.48–63.90 mg. An ovipositing female of *A. cephalotes* weighed 346.34 mg. or about 825 times the weight of her smallest adult offspring; three of *sexdens* weighed 262, 271 and 289 mg.; *colombica* were 147–194 mg.

In all polymorphic species of attines, there is an inverse correlation between the length of the worker and their numbers in the colony. Soldiers are the least abundant but are so conspicuous that they appear to be a larger proportion of the colony. Whenever a colony of *Atta* is disturbed, the soldiers are usually attracted to the site of the disturbance. These large ants will run out of the nest entrances and attack anyone attempting to dig up the colony. The smallest ants never leave the nest, often immobilize or "freeze" when the nest is disturbed, and are very difficult to see among the garden and soil particles.

The soldiers very rarely cut or carry leaves or other objects. They sometimes go out on trails or cluster around nest entrances, but their primary function is to guard the colony against predators or objects disturbing the colony. They may "attack" and help remove an object like a fallen leaf or twig that blocks an entrance or trail.

The media workers do all the cutting and transporting of leaves and other large pieces of substrate as well as the removal of old substrate or dead ants from the nest. This group excavates the nest, helps construct the garden, and also defends the colony.

The minima workers are the most versatile group in an *Atta* colony. They will carry small fragments of substrate and dead minima workers, and are the most important group in caring for the brood and fungus garden. J. and M. Martin have shown (1970*a* and *b*) that minima workers of *Atta colombica tonsipes* have enlarged recta and deposit relatively large fecal droplets on the fungus garden.

Most of the minima workers stay within the nest, but some accompany the larger workers on the trails. These minima workers do not carry leaves but will often ride back to the nest on leaves carried by larger workers. Although it has usually been assumed that these workers are simply "hitching a ride" or "joy-riding" and detrimental to the efficiency of the foraging these riding ants appear to serve at least two functions. While the minima workers are riding they are also licking the surfaces of the leaf fragment. This may be adding enzymes favoring the growth of the fungus and certainly must clean off debris and alien organisms. This function was first implied by Stahel and Geijskes (1939) and Stahel (1943). and has been supported by my own and my students' observations. While licking the leaf, the workers probably are ingesting small amounts of food from the plant material. The licking continues when the leaf is finally deposited within the nest. In addition, perhaps it is advantageous for the minima workers to ride in with the leaves since it insures that more of these workers are present to work on the fresh material.

A column of *Atta cephalotes* that was carrying rose leaf sections to a laboratory nest was watched for two continuous hours. During this time 95 of 99 leaf pieces seen being carried had minima workers riding on them. Most pieces had a single worker but one had 7, and there were 131 minima workers on the 95 leaf fragments. Many of these ants were clearly seen to be licking the fragments.

Another function of the riding minima workers is that they fend off the parasitic phorid flies that hover over the columns of ants and nest entrances (Eibl-Eibesfeldt, 1967). Some of these flies are known to lay eggs in adult ants in which they develop as internal parasites. Others live as adults and larvae in the nests of the ants, and it is not known whether they lay eggs on the ants or leaf pieces. The minima workers rear up on their middle and hind legs and fend off the flies with the front legs, antennae, and mandibles. The soldier and media workers show similar behavior when they are not carrying leaves.

The Wonderful Secret of Reading, Pa.

Well, it's a secret no longer. Joe's mushroom restaurant is one of America's most unique dining establishments

BY SILAS SPITZER

To the casual glance of a stranger, there is nothing exciting or different about Joe's, a small, unpretentious restaurant wedged into the residential ranks of Reading, Pennsylvania. It stands on the corner of a street lined shoulder-to-shoulder with modest dwellings and blends unobtrusively with its neighbors.

Reading is an industrial town known more for its iron foundries than for elegant cuisine. Joe's is the single brilliant exception among the city's eating places. The food there, [illegible] with a high degree of professional skill. Service, provided by several pleasant young women who are not the chatterbox sort, is unhurried and serene. These are definite advantages but by no means the reason why this restaurant is a thing apart, perhaps the only one of its kind in America.

The newcomer, unless previously briefed, would never guess that the place attracts a large and devoted following, not only from Philadelphia and New York but from as far away as San Francisco and Montreal. At certain seasons of the year, cars with widely assorted license plates are parked along the curb outside. During those busy periods, tables must be reserved days ahead.

There is obviously something curiously different about Joe's to justify such celebrity. One evening not long ago, my wife, Helen, and I discovered exactly what that was and why it made dinner there such a pleasant happening.

On that early visit (we've since made several more), we were shown to a secluded corner of a long, narrow room, capacious enough for about 60 without crowding. The light-toned walls were without special adornment. There were plain gray hangings at the far end. A well in the center of the ceiling was flooded with soft rose-colored light, and there were matching lamps on the tables. We noticed a few fine pieces of antique furniture. There was nowhere to be seen a single trace of what is known in the trade as "drama." The drama, it turned out, was all in the kitchen. If you were to enter those immaculate premises, you would probably find Joe Czarnecki, a small, roundish, white-haired [illegible] fing the soup pot.

We sensed the first hint of the driving force that motivates this restaurant when our martinis arrived. Instead of an olive or a twist of lemon peel, each contained a plump, little pickled mushroom. Like the late Bernard De Voto, mentor of all martini purists, I have strict views on its composition. Juggling with the proportions, adding dashes of Scotch, Pernod or sherry or odds and ends of vegetables are all taboo. But these particular martinis, concocted by Joe's wife, Wanda Czarnecki, could not be faulted. They were as ice-cold and as crisp as any I have ever stirred for my guests or myself. And that fat little mushroom lent a faint woodsy flavor that actually pointed up the dryness of the drink.

When we looked over the menu we noted that mushrooms either dominated or played a part in about half of the twenty-odd appetizers, soups, salads, entrées and sauces on the à la carte listing. These mushrooms were not the tame, commercially cultivated kind, but poetically shaped and colored nomads that spring up at random in heavily shaded forest soil or the damp recesses of mountainside and meadow. Later we were to learn that 90 percent of them grew within a 50-mile radius of the restaurant and were collected by foraging parties consisting of the owner, his wife and customers who had become friends.

Dinner began that evening with wild mushroom soup, a sublime creation from which the restaurant was launched on its present course many years ago. Today it has become the most widely known and revered of all Joe's specialties. It was originally a recipe of his mother's, cooked from mushrooms growing in the lowlands of the Carpathian Mountains [illegible] soup. It is dark, velvety, with a body between thick and thin. The first spoonful is a miracle of concentrated earthy flavor, the very soul of the wild mushroom.

With the soup, we nibbled oven-warm *pirozhki*—small, flaky pastries filled with a succulent mushroom puree. All bread, cakes and pastry are baked by Mrs. Czarnecki, a smiling, motherly person who shares her husband's mycological fixation. A woman of many gifts, she runs the restaurant when Joe is busy in the kitchen, bakes with God-given lightness of hand and is a meticulous mixer of drinks.

We went on to eat baked Maryland lump crabmeat and filet mignon with a delectable *sauce duxelles*. Both dishes were transformed by the exquisite fragrance and flavor of woodland mushrooms, a taste impossible to convey in words, probably because there is no other flavor in nature exactly like it.

Among other dishes sampled on subsequent visits, our notebooks mention tiny shrimp La Maze, tenderloin *en brochette* (chunks of sizzling beef alternated on the broiler-spit with savory mushrooms), Javanese steak with fried rice and Veal Rymanow, named after the town in Poland where Joe's mother was born.

continued on page 58

Silas Spitzer is the Food Editor of Travel & Leisure.

ILLUSTRATION BY DAVID WILCOX

Supreme among the desserts is Wanda's subtle, almond cream cheesecake.

As any connoisseur will tell you, wine is the only drink worthy of wild mushrooms. Which wine mates best, however, is another and more debatable question. Joe believes that the subject calls for discussion between guest and host and for that reason does not provide the conventional wine list. His cellar reveals a studied selection, without either waste or showcasing of extravagant bottles. French and German wines predominate. There are those who prefer a lightly fragrant Rhine or flowery Moselle to the more assertive French Burgundies or Bordeaux, but the choice is large enough to accommodate all personal prejudices.

When coffee was served, we were joined by Joe and Wanda. The conversation was absorbing and midnight arrived before we knew it. This soft-spoken but forthright man was plainly no typical restaurant owner. Joe attended Bucknell and graduated with a B.A. from Albright College. Originally the premises were occupied by a tavern run by his fa[illegible] transformed the noisy place, with its crowded 77-foot bar, into the distinguished restaurant it is today.

"I love to cook and eat," he told me, "but the real fun is in the woods."

On Sundays and Mondays, when Joe's is closed, and during the vacation months of August and September, his broad-beamed jeep, specially built for rough going, takes off for the wilds, packed with family, friends and food. Treasured specimens from these periodic excursions were displayed in jars and bottles on the shelves of a sideboard behind which we were seated. Several varieties of dried mushrooms were strung in loops, like fairy necklaces. Most were unknown to us, but we recognized tawny chanterelles and crinkled, cone-shaped morels, graduated in size from a kernel of corn to a child's fist.

All mushrooms are scientifically identified and classified by the owner in his laboratory upstairs. The microscopes and other instruments are among the latest of their types. I asked him which mushrooms he cooked most often. He rattled off the Latin names: *Tricholoma equestre, Tricholoma portentosum* and *Tricholoma terreum,* to accompany meats; dried *Boletus edulis* for soups and sauces. Over the years, thousands of guests have partaken rapturously of these and other kinds, without the slightest mishap.

Joe is a member of the Mycological Society of America, and from time to time kindred spirits—mostly scientists, teachers, doctors, lawyers and literary folk—get together to hunt, talk about and feast upon wild mushrooms to the virtual exclusion of everything else.

When the pickings are good on Joe's hunting forays, the treasure, piled high in baskets, is meticulously examined by Joe before it is released for consumption. Tales of these jeep expeditions, which combine rugged physical exercise with the excitement of the treasure hunt, have spread widely among people who are students, gastronomes or simply lovers of wild mushrooms. Among these about a year ago was Mr. Craig Claiborne, at that time food editor of the *New York Times.* Intrigued by what he had heard, he arrived one day to join the hunt, impeccably dressed in a dark business suit, white shirt, necktie and highly polished shoes. Joe [illegible] and heavy boots belonging to one of their sons. After tramping most of the day in the Blue Mountain woods, they returned, muddy and scratched but laden with edible wild fungi. The guest's back ached painfully, but he was grinning and insisted he had enjoyed the time of his life. Everybody went to the kitchen and ate Wanda's Pennsylvania Dutch sausages and sauerkraut, drank floods of beer and sorted out mushrooms. The Timesman left, a friend and disciple.

Joe Czarnecki is one of the few genuinely happy men I have ever known. Unlike the overwhelming majority of humans, he has been able to weave his private passion into the texture of his business. To an astonishing degree, the restaurant reflects his character and his obsession, and all without a glimmer of flamboyance or self-consciousness. There is a quiet air of assurance about his place, the sort of low-keyed sophistication one expects to find at the Grand Véfour in Paris or the Connaught in London, but hardly on an obscure back street corner in a dreary Pennsylvania town. Year after year, patiently and with single-minded purpose, Joe has created a restaurant that affords a rare kind of pleasure to others and richly fulfills his private dream. ■

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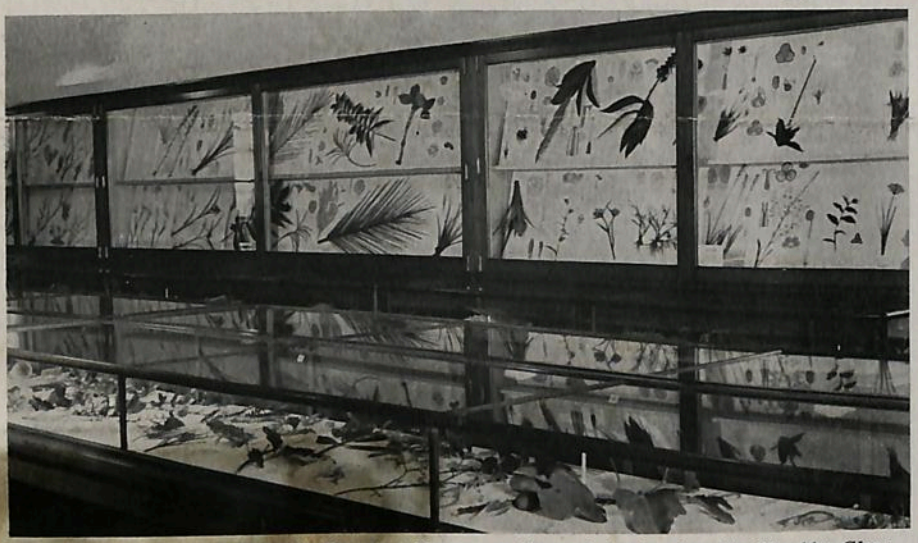
No. 2

Harvard's Ever-Blooming Garden in Glass



Closeup of several cases in the Botanical Museum at Harvard showing how the Blaschka Glass Models are exhibited

By RICHARD EVANS SCHULTES, Ph. D.*

There is a garden in Cambridge, Massachusetts, where plants are in flower throughout the year — temperature, rainfall, season notwithstanding. It is the **Ware Collection of Blaschka Glass Models of Plants** in the Botanical Museum of Harvard University. A tool for the teaching of biology as well as an exhibit of unique beauty, the "Glass Flowers," as they are familiarly called by their millions of visitors, represent in reality an "artistic marvel in the field of science and a scientific marvel in the field of art."

It is the founder and first director of the Botanical Museum, Professor George Lincoln Goodale, to whom we must give credit for establishment of the collection. Professor Goodale dreamt of an exhibit, appealing to the public yet of academic value in teaching. It must present an orderly arrangement of plant-life, to demonstrate, along with other biological phenomena, the fact of evolution. This was seventy-five years ago. Many, if not most, of the modern techniques and materials had not yet appeared on the museum scene. Dried specimens of plants were ruled out as the main basis of museum exhibits for obvious reasons. Drawings, photographs and engravings were limited, too, in their adaptability. Wax or papier-mache models, it was feared, would not provide even a minimum standard of refinement for detailed, scientific exhibits.

At this time, Harvard's Museum of Comparative Zoology, now celebrating its one hundredth anniversary, exhibited several models of marine animals done in glass. Seeing these models, Dr. Goodale was at once convinced of the unique possibilities which this medium might offer for a permanent museum display of plants. He went to Dresden to see the German artisans who had made the zoological models—Leopold Blaschka and his son Rudolph—to try to persuade them to turn their craftsmanship toward the manufacture of glass models of plants.

At first, the Blaschkas were reluctant, notwithstanding their earlier experience in making orchid models for the German orchidologist, H. G. Reichenbach—models which were destroyed by fire in Liege in 1868. They finally, however, agreed to prepare experimentally a few models for the Botanical Museum. Though seriously damaged by customs in New York, these were striking enough to convince Mrs. Elizabeth C. Ware and her daughter, Miss Mary Lee Ware, of Boston, to support financially the Blaschkas' botanical work. This support continued throughout the lifetime of both of the artisans, who worked only part-time for the Botanical Museum until 1887, after which their full time and energies went into the modelling of plants. This is how the entire production of their studio from 1887 to 1936 happens to be at Harvard to-day. On April 17, 1893, before a distinguished gathering, the collection was officially presented to the President and Fellows of Harvard College by Mrs. Ware and her daughter as a memorial to Dr. Charles Eliot Ware of the Class of 1834.

Leopold and Rudolph Blaschka worked together until the elder's death in 1895, after which Rudolph continued alone, without apprentice, until 1936, three years before his death.

The Blaschka family was steeped in the traditions of the glass-shaper's art. Leopold, born in northern Bohemia in 1822, the son of a craftsman in electrical equipment and glass, began professional life as a goldsmith and cutter of fine gems but later went to work with his father in glass. It was a transatlantic trip in 1853 that interested him in marine invertebrates, which he later began modelling in glass, establishing therewith a successful business. The zoological models may still be seen in many European museums.

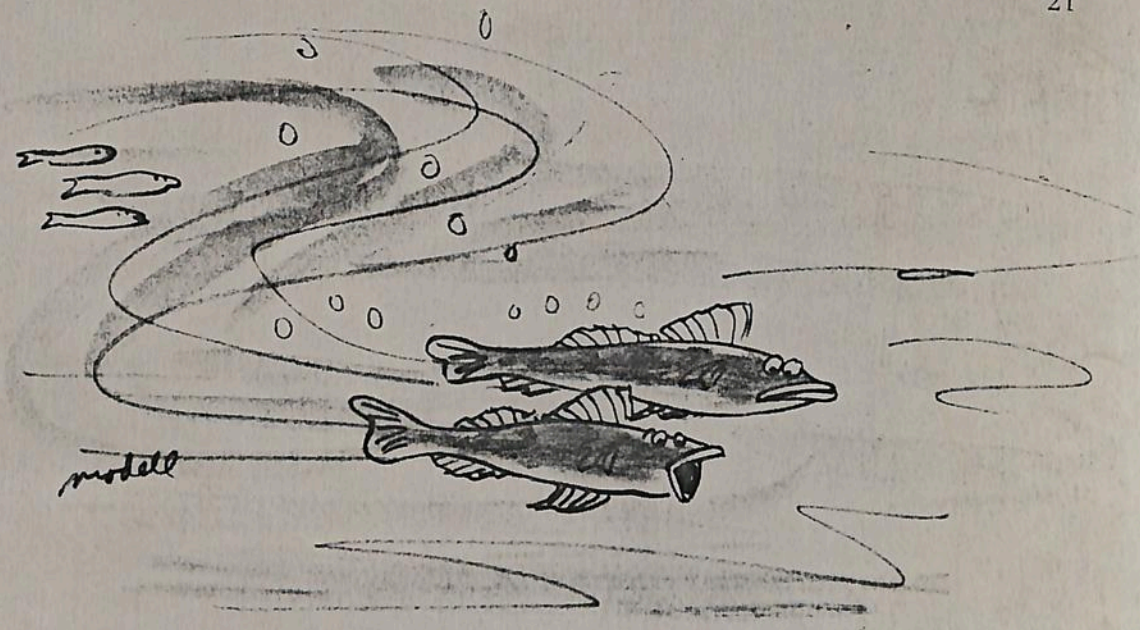
His son, born in 1857, early showed deep interest in natural history. He was given a good education in this field and became thoroughly familiar with the European flora and with Baltic and Mediterranean sea-fauna.

The models of both temperate and tropical species on display at Harvard were made in the Blaschka studio near the Royal Gardens at Pilnitz on the River Elbe. This garden was well stocked with exotic plants, which the Count placed at the Blaschkas' disposal. The Blaschkas

One of the Glass Models—a cactus in flower

*Curator, Botanical Museum
Harvard University

cisco, where I joined a company called the Opera Ring. I did the street singer in 'Threepenny Opera,' and got my first mention in a review. I came across it the other day. It was in the *Chronicle*, and I think it went like this: 'Morgan Freeman proclaims the return of the celebrated crook with an appropriate blend of awe, respect, wry humor, and barely perceptible sadness.' I started dancing lessons. I washed cars. I sold ads for a black magazine. I worked at the post office. I bummed a lot and lived on quarter-pound Baby Ruths for dinner. In the early sixties, I moved to New York for good. I worked in the garment center. Then I landed a job as a dancer with Michael Kidd in an extravaganza out at the World's Fair. In one routine, we dressed up in fur and played Eskimos. After the Fair, I couldn't find *nothin'*, and I ended up as a counterman at Nedick's in Penn Station. One night, a dancer from the show came in and I was so embarrassed I nearly got under the counter. But I got through at the time 'The Electric Company' came along. 'The Electric Company' paid me more than I'd ever been paid before, and suddenly I was making something unbelievable like seventeen thousand dollars a year. 'The Electric Company' was great the first two years. The vibes were good, we were a family, and watching Bill Cosby all the time was something else. But I'm restless and I'm afraid of the Captain Kangaroo syndrome. I quit once, but



"What surprised me was not that we're an endangered species but that we're snail darters."

• •

to his feet and stood in the middle of the room. He went into a boxer's crouch and squinted his eyes and brought them slowly down from the middle distance to regular eye level. He swayed and grabbed the mantel to steady himself, and started talking in a thick, unintelligible dialect. As he talked, his head moved like a chicken's and he shuffled and pointed a long finger at the wall. In ten seconds, he was the bum in his

"I just invented fire and pollution."

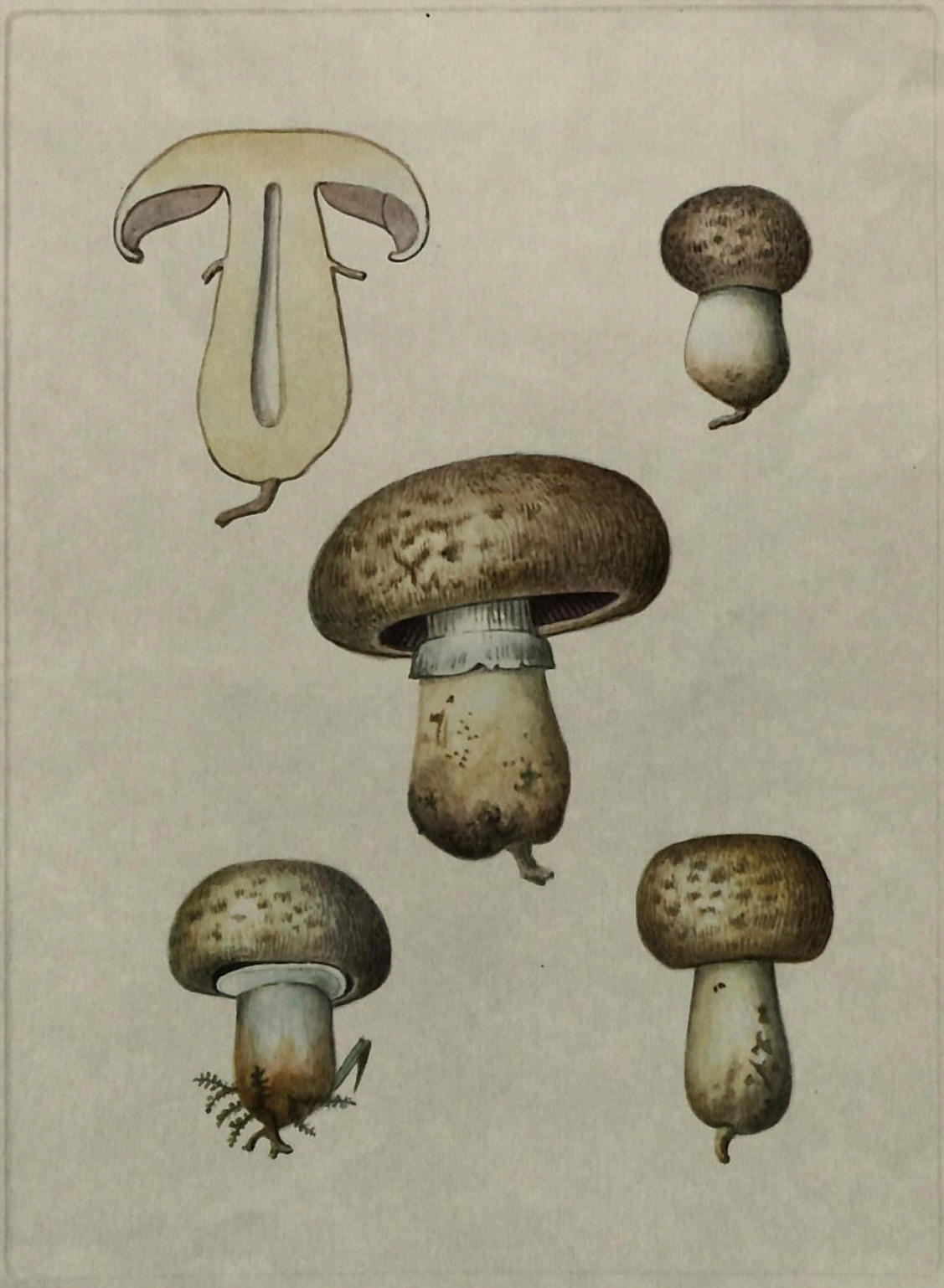
• •

NEW YORKER - 14-III-1970

***Cortinarius (myxacium) delibutus* - Fries**

Cortinarius phlegmacium croceo-caeruleus - **Fries**

Psalliota squamulifera Moller



Psalliota radicata Vittadini . Bresadola

Psalliota Langei Moller et Schaeffer

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ATLAS MYCOLOGIQUES (En Français)

Die neue Sammlung "Atlas Mycologiques" wird in 12-15 Einzelbänden alle Familien der CHAMPIGNONS behandeln.Autoren sind bekannte Mycologen.Viele neue, ganzseitige farbige Tafeln im Format 28 x 22 cm illustrieren den Text.

So will die Sammlung "Atlas Mycologiques" ein modernes Gegenstück sein zu den Werken von Boudier,Bresadola,Cooke,Konrad et Maublanc,Lange,Lucand usw.

Die Bände erscheinen in unbestimmten Abständen und zu verschiedenen Preisen. Bereits lieferbar ist Band I: "Les Psalliotes" von Henri Essette(siehe unten).Als nächste Bände sind in Arbeit "Les Bolets" mit 6o Tafeln; "Les Russules" mit 6o Tafeln; "Les Amanites" mit ca.6o Tafeln.
Subskribenten auf die gesamte Serie erhalten 2o% Preis-Nachlass.

— — —

The new collection "Atlas Mycologiques" will treat in 12 to 15 volumes all the CHAMPIGNON-families.The authors are known mycologists.A large number of coloured full-page plates in 28 x 22 cm seize will illustrate the text.

Thus,the "Atlas Mycologiques" want to be a modern counterpart to the works of Boudier,Bresadola,Cooke,Konrad et Maublanc,Lange,Lucand etc.

The different volumes will be published irregularly at different prices. Volume I: "Les Psalliotes" by Henri Essette is already available(for details please see below).Next volumes in preparation are: "Les Bolets" with 6o plates; "Les Russules" with 6o plates; "Les Amanites" with about 6o plates. Subscribers to the complete set receive a price reduction of 2o%.

— — —

Sous le titre "Atlas Mycologiques" il est compté publier toutes les familles des CHAMPIGNONS.Les auteurs sont des spécialistes mycologiques.Beaucoup de planches coloriées absolument nouvelles et en format 28 x 22 cm illustrent le texte.Ainsi la collection "Atlas Mycologiques" veut être un pendant des grandes oeuvres iconographiques des Boudier,Bresadola,Cook,Konrad et Maublanc,Lange,Lucand etc.

Les volumes sont publiés irrégulièrement à des prix diffèrents.Le volumeI: "Les Psalliotes" par Henri Essette est déjà disponible(détails ci-dessous). Le deuxième volume se réfère aux "Bolets" et contient 6o planches;après suivront "Les Russules" avec 6o planches et "Les Amanites" avec environ 6o planches.Les abonneurs à la collection complète recevront une remise de 2o%.

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Just published - Il vient de paraître - Soeben erschienen:

Atlas Mycologiques. Volume I:
Essette Henri,(Membre de la Soc.Mycologique de France)
Les Psalliotes. Paris 1964. 48 planches color.en offset d'après les aquarelles de l'Auteur.9 planches noires.
Format 28 x 22 cm.Text 136 pages.Pergament (Parchment).
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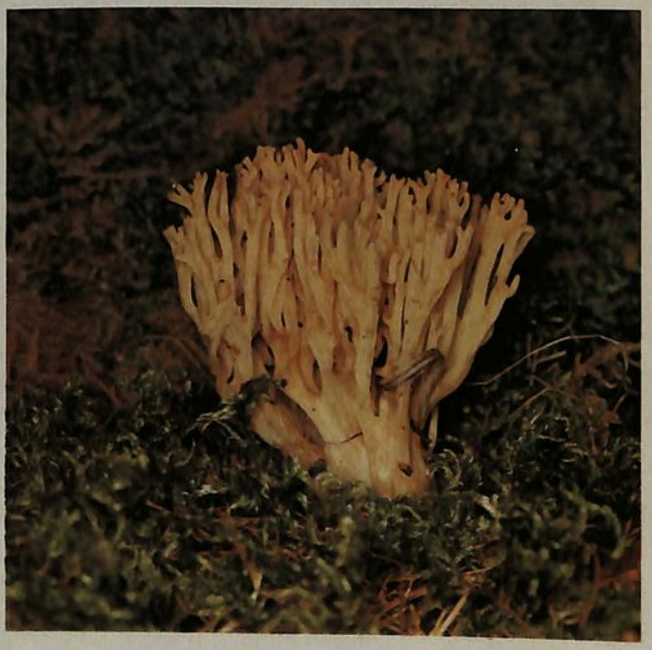


CLAVARIA AUREA

Escoba - Barba de chivo

giones del Norte; la Lactarius Deliciosus (Revellón), muy apreciada en Cataluña; la Agaricus Campester (Champiñón) y la Pleurotus Eryngii (Seta de Cardo), muy común en los campos de Castilla.

PRINCIPALES SET

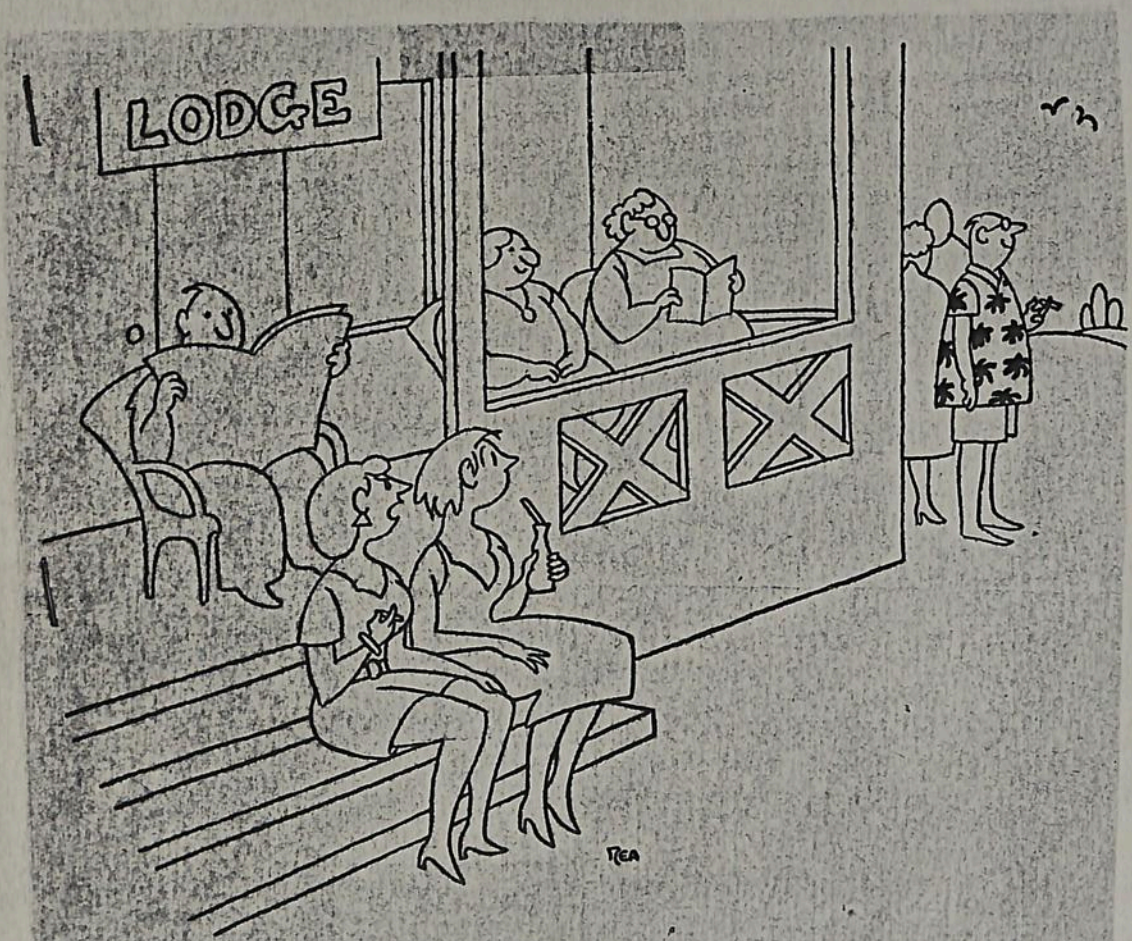
BOLETUS AEREUS
Calabaza - Ciureny - Onduak

BOLETUS EDULIS
Calabaza - Onduak

CANTHARELLUS CIBARIUS
Cantarello - Rossinyol - Cabrilla

LEPIOTA PROCERA
Matacandelas - Pantinella - Cogumella

Además de las setas que se observan en las fotografías de estas páginas deberemos mencionar, como muy comunes en España, la Tricholoma Georgii (Seta de Orduña), que se encuentra en todas las re-



"Don't ever go out in the woods to hunt rare fungi with him, because that's exactly what you'll do!"

Passionnante exposition de la Société Mycologique, hier, à l'hôtel de ville

Dans le cadre de l'action spectaculaire et généreuse qu'elle poursuit à travers notre département, la Société mycologique du Limousin organisait, samedi, à l'intention des amateurs et des curieux, deux sorties - promenades, à travers la région, pour aller à la recherche des champignons.

Ces deux sorties, qui avaient lieu, l'une au début de la matinée, l'autre au début de l'après-midi, avaient pour objet, bien entendu, outre le plaisir de retrouver la nature — fut-elle un peu humide — d'initier les chercheurs à la cueillette et à l'identification des bons champignons

Si samedi, c'était l'heure de la cueillette, hier, c'était l'heure de l'information et de l'exposition.

Dans la salle Jean-Pierre-Timbaud, la Société mycologique du Limousin a réuni, une fois encore, un très large public pour sa traditionnelle exposition d'automne de champignons.

L'intérêt manifesté par les Limougeauds pour cette manifestation révèle, qu'à la suite de trop nombreux accidents par empoisonnement, le besoin d'être informé sur les variétés et les dangers des champignons est ressenti par beaucoup de personnes.

En une journée, les mycologues limousins, parcourant tous les bois et taillis du département, ont réussi à ramener plus de 200 variétés de champignons. L'intérêt de l'exposition était leur tri par familles, puis par espèces, assorti de schémas et explications fort aisées à comprendre, les appelations scientifiques étant toujours traduites en langage courant.

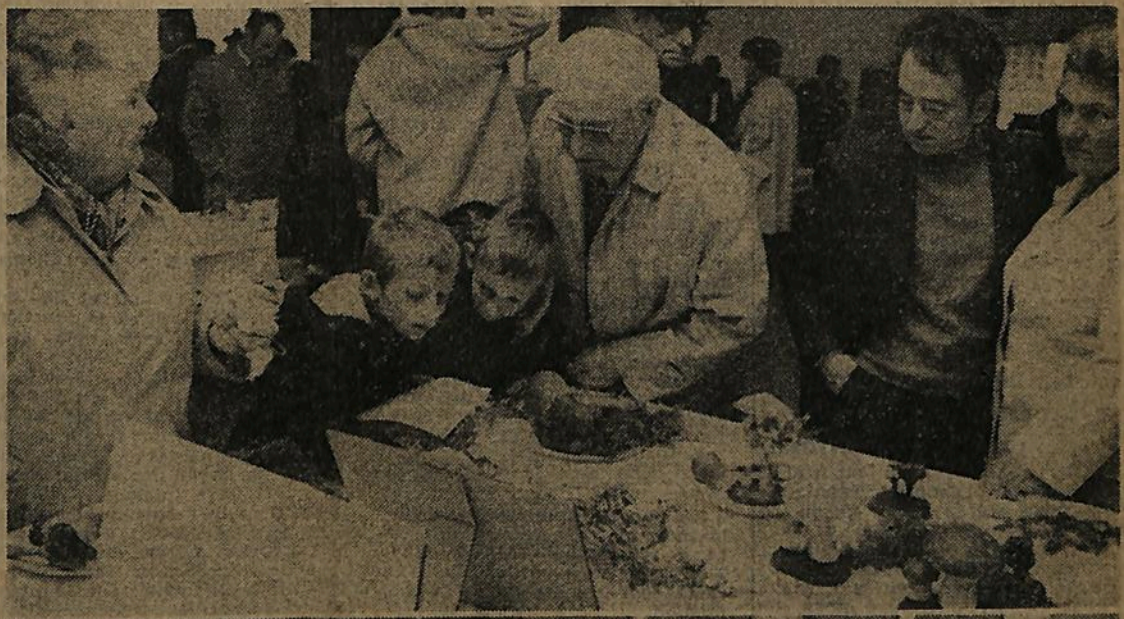
Deux cents espèces, c'est déjà beaucoup, mais cela ne représente pas la totalité des champignons qui poussent dans notre région, l'une des plus fécondes, chacun le sait, de toute la France.

On compte, en effet, près de 500 espèces en Limousin.

Comme toute information, celle relative aux dangers des champignons commence à l'école et c'est précisément dans cette perspective éducative que la Société mycologique avait préparé pour les plus jeunes, venus nombreux accompagner leurs parents, un jeu d'identification, de classement et de dessin sur les différentes espèces exposées.

Cette leçon de diagnostic, si elle a vivement intéressé les enfants, a aussi été très utile pour les plus grands.

Parmi les nombreux visiteurs de cette réalisation de la Société mycologique, nous avons remarqué M. Louis Longequeue, député-maire de Limoges.



NOS PHOTOS :

● **Les chercheurs avant leur départ pour la cueillette et une vivante leçon de sciences naturelles présentée à l'hôtel de ville, avec goût, un sens remarquable de la fidélité à la nature.**

from J. P. Chavin
Limoges, France
Dec. 1973

Quand les champignons rapportent... du champagne

Employé aux P.T.T. à Limoges mais domicilié à St-Barbant, M. Berneron avait fait le pari avec des amis de cueillir 15 kilos de champignons en une demi-heure.

L'affaire fut faite (avec 5 kg. en plus) et pour le gagnant du pari, champignon signifiera champagne puisque l'enjeu était... une caisse de champagne.

A votre bonne santé !

(Photo GALLET, Bellac.)

Cèpe phénomène en Creuse : 2 kg. 500 et 80 cm. de circonférence

Guéret. — En août, les champignons se ramassaient à « pleins paniers » et bien des amateurs ont ainsi renouvelé leurs réserves de bocaux pour cet hiver. En septembre, on n'a plus guère entendu parler de cueillettes dignes de ce nom. Le sol était trop sec.

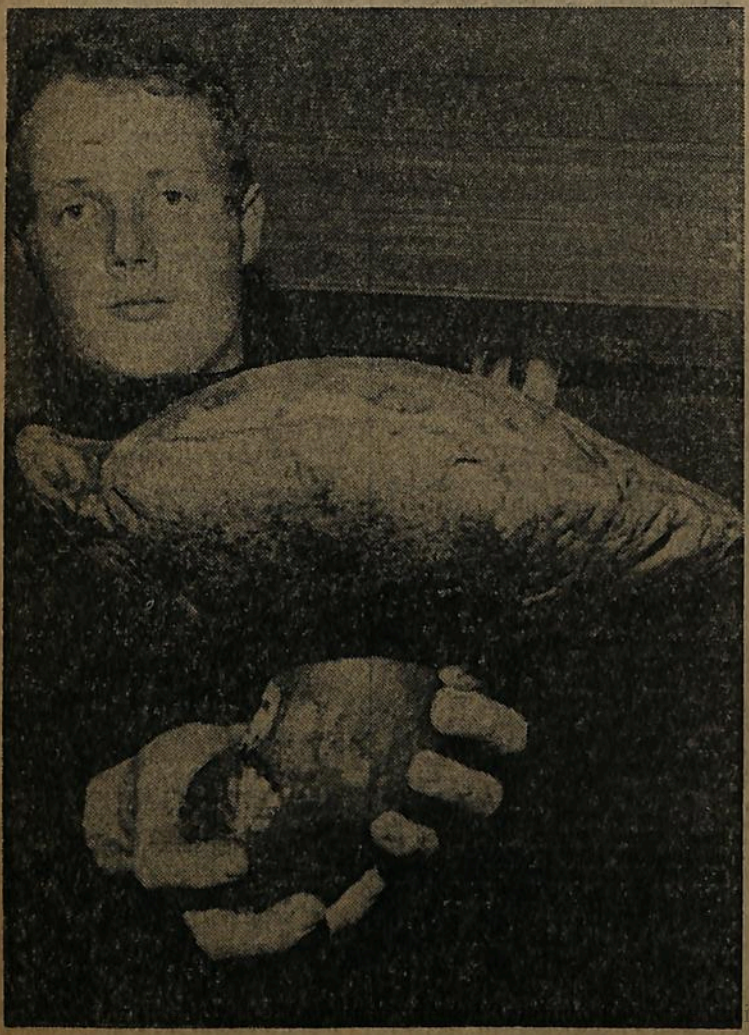
Les pluies de ce début d'automne vont sans doute relancer la saison. Une creusoise, en tout cas, ne pouvait pas ne pas apercevoir un cèpe de conte de fée.

Mme Albert, de Guéret, est perspicace et... elle vient de découvrir dans la région de Faux-la-Montagne un cèpe phénomène. Il mesure 40 cm de haut, possède un chapeau de 80 cm de circonférence et pèse 2,500 kg.

Cette robustesse s'accompagne d'une « barbe » raisonnable, ce qui a permis à l'heureuse Guérétoise de faire une belle fricassée.

Un cèpe de 3 kg. 100 ...dans le parc Bellevue !

Il reste encore quelques champignons « oubliés » pour les chercheurs parce bien bien cachés par les fougères... Mais M. Pierre-Louis Chrétien a su dénicher celui-ci dans le parc Bellevue, à Bellegarde : un cèpe de 3,100 kg. dont la tête mesure 1,05 m. de circonférence...



Toujours les champignons

Les premiers jours d'octobre 73 dans notre région, resteront sans doute longtemps encore gravés dans les mémoires. La raison en est toute simple, jamais on n'avait vu autant de champignons sortir en quelques jours. De conversations chez les commerçants en discussions devant un « zinc », on n'entend plus que ce leitmotiv : « Quelle récolte ! ». On compare les exploits des chercheurs, on discute curiosités de la nature. Et surtout, surtout, entre ail et persil, on déguste. A propos de cueillette, ne trouvez-vous pas que celle réalisée à Aureil en moins de 3 heures, par M. Pierre Jeanton, employé à la Saviem, demeurant à Poulouzat (notre photo), mérite une mention « très honorable ». Plus de 9 kilos ! Qui dit mieux ? A propos de champignons, il n'est peut-être point inutile de rappeler que samedi et dimanche prochains auront lieu à Limoges deux journées mycologiques. Elles se dérouleront de la façon suivante :

Samedi 13 : excursion-cueillette dirigée dans les environs de Limoges. Départs : 9 heures et 14 heures devant l'hôtel de ville de Limoges.

Dimanche 14 : exposition publique de champignons, salle J.-P. Timbaud. Ouverture de 9 à 13 heures et de 14 h. 30 à 19 heures.

Les Salles-Lavauguyon : L'enfant aux cèpes

Un cèpe de 90 cm. de circonférence et d'un poids de 2 kg. 500 a été trouvé par Mme Pressigout Fernand, dans une lande lui appartenant au « Meinieux » des Salles-Lavauguyon.

NOTRE PHOTO. — Le jeune Jean-Michel Pressigout est tout heureux de montrer la belle trouvaille de sa maman.

octobre 1973

Un champignon de 32 kilos !

● *Un champignon de trente-deux kilos a été trouvé par un paysan dans une forêt de chênes aux environs de Bari, dans les Pouilles. Il a un mètre dix de hauteur avec un calotte de 40 centimètres de diamètre et 25 centimètres d'épaisseur.*

Il a fallu une pioche pour le déterrer.

Vendredi 28 sept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